Part No. B-41623-B Oil Line Remover

Part No. B-43993-7/8 Wheel Bearing Collets

Part No. B-42887 Brake Caliper Piston Remover

Part No. B-45521 Steering Head Bearing Remover/Installer

Part No. B-43721 Front Fork Seal Driver

Part No. HD-39302 Steering Head Bearing Race Installer (Used with B-45521)

Part No. B-46279 7/8" Axle Wrench (Hex)

Part No. B-59000B Pro Level Oil Gauge
Part No. HD-01289 Rim Protectors

Part No. HD-33416 Universal Driver Handle

Part No. HD-45966 Fork Spring Compressing Tool

Part No. HD-33418 Universal Puller Forcing Screw

Part No. HD-41177 Fork Tube Holder

Part No. HD-B-45520 Gear Detent Assembly Aid

Part No. HD-28700 Tire Bead Expander

Part No. HD-44060 Wheel Bearing Remover/Installer
Part No. HD-99500-40 Wheel Truing and Balancing Stand

Part No. HD-33223-1 Cylinder Compression Gauge

Part No. HD-35758-B Neway Valve Seat Cutter Set

Part No. HD-35667A Cylinder Leakdown Tester

Part No. HD-96921-52A Oil Pressure Gauge

Part No. HD-34902-B Bearing Race Remover/Installer

Part No. HD-33223-1 Cylinder Compression Gauge

Part No. HD-43984 Crankshaft Locking Tool

Part No. HD-96921-52A Oil Pressure Gauge

Part No. HD-34902-B Bearing Race Remover/Installer
Part No. HD-46283 Primary Drive Locking Tool

Part No. HD-39964 Reamer Lubricant (Cool Tool)

Part No. HD-39782 Cylinder Head Support

Part No. HD-39786 Cylinder Head Holding Fixture

Part No. HD-34736B Valve Spring Compressor

Part No. B-45524 Valve Guide Installer

Part No. B-45523 Valve Guide Reamer (7mm)

Part No. B-45525 Valve Guide Hone
Part No. HD-34751 Nylon Valve Guide Brush

Part No. HD-42322 Piston Support Plate

Part No. HD-94804-57 Rocker Arm Bushing Reamer

Part No. HD-96333-51C Piston Ring Compressor

Part No. HD-33446A Cylinder Torque Plates and Torque Plate Bolts Part No. HD-33446-86

Part No. HD-95952-33B Connecting Rod Clamping Tool

Part No. HD-34623C Piston Pin Retaining Ring Installer/Remover

Part No. HD-95970-32D Piston Pin Bushing Tool
Part No. HD-94800-26A Connecting Rod Bushing Reamers and Pilots
Part No. HD-97292-61 Two Claw Puller

Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-5 and 9. Items 6 (HD-95769-69), 7 (HD-95770-69) and 8 (HD-95771-69) are optional.

Part No. HD-38515-A Clutch Spring Compressing Tool and Part No. HD-38515-91 Forcing Screw
Part No. HD-39955 Deutsch Terminal Crimp Tool

Part No. J-5586 Transmission Shaft Retaining Ring Pliers
Part No. HD-41354 Speedometer Tester
Part No. HD-41609 Amp Terminal Crimp Tool

Part No. HD-45847 Cross Plate

Part No. HD-47248 Rocker Housing Wrench

Part No. HD-47250 Intake Manifold Wrench

Part No. HD-47258 Rocker Cover Wrench

Part No. HD-45847 Cross Plate

Part No. HD-35316-C Main Drive Gear Remover/Installer and Main Drive Gear Bearing Installer

Part No. HD-38515-A Clutch Spring Compressor

Part No. HD-44750-P29 Panasonic Toughbook (touch screen) and HD-44750-P50 Panasonic Toughbook (non-touch screen)
Part No. HD-46285 Transmission Assembly Fixture

Part No. HD-47855 Main Drive Gear Needle Bearing Installer

Part No. HD-95635-46 All-Purpose Claw Puller (use with HD-95637-46A)

Part No. HD-95637-46A Wedge Attachment for Claw Puller (use with HD-95635-46)

Part No. HD-45926 Clutch Shell Bearing Remover

Part No. HD-94660-37B Mainshaft Locknut Wrench

Part No. HD-45676 Sprocket Shaft Seal Installer
Part No. B-45522 Fuel Pressure Gauge Adapter

Part No. HD-26792 Spark Tester

Part No. B-45657 Fuel Pump Puller

Part No. HD-39978 Fluke 78 Multimeter (DVOM)
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 (lock tab 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 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](image-url)
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.

Gently tug on wire to remove terminal from housing.

1. Open secondary lock.
2. Insert pick into cavity on inboard side of connector.
3. Pivot end of pick to release tang.
4. Gently tug on wire to remove terminal from housing.

Figure B-2. Release Tang and Back Out Terminals

NOTES

Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.

Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.

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

Secondary locks open (socket housings shown)

Stamped numbers on secondary locks indicate wire color locations

3-place

6-place

12-place

Pin terminal

Secondary lock

Pin housing

Socket housing

Button

Secondary lock

Socket terminal

Latch

Secondary lock

Socket housing

Button

Secondary lock

Socket terminal

Secondary lock

Socket housing

Button

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.
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.

**Pin housing:** alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, 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.

**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 inline with the groove (inline 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.

**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.
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.
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.

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.
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-12. Deutsch Crimping Procedure
Figure B-13. 2-Pin, 3-pin and 4-pin Deutsch Connectors

- **2-pin connector**
  - 1. Socket terminal
  - 2. Wire seal
  - 3. Socket housing
  - 4. External latch
  - 5. Internal seal
  - 6. Locking wedge
  - 7. Locking wedge
  - 8. Latch cover
  - 9. Pin housing
  - 10. Wire seal
  - 11. Pin terminal

- **3-pin connector**
  - 1. Socket terminal
  - 2. Wire seal
  - 3. Socket housing
  - 4. External latch
  - 5. Internal seal
  - 6. Locking wedge
  - 7. Locking wedge
  - 8. Latch cover
  - 9. Pin housing
  - 10. Wire seal
  - 11. Pin terminal

- **4-pin connector**
  - 1. Socket terminal
  - 2. Wire seal
  - 3. Socket housing
  - 4. External latch
  - 5. Internal seal
  - 6. Locking wedge
  - 7. Locking wedge
  - 8. Latch cover
  - 9. Pin housing
  - 10. Wire seal
  - 11. Pin terminal

**SOCKET SIDE**
1. Socket terminal
2. Wire seal
3. Socket housing
4. External latch
5. Internal seal
6. Locking wedge

**PIN SIDE**
7. Locking wedge
8. Latch cover
9. Pin housing
10. Wire seal
11. Pin terminal
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. For an example of this type of connector, note the MAP sensor connector [80].

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 wire-form. See Figure B-14. The manner in which the terminals are picked differs between these two types of connectors, as further described below.

![Figure B-14. Packard Connectors](image-url)
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-14. 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-14. 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-14. 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-14.
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.”
The Packard push-to-seat terminal connectors found on Softail model vehicles are listed below.

- Ignition Switch [33]
- Fuse Terminals
- MAP Sensor [80]

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. 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. 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. See Table B-1. Determine the correct dye or nest for the core crimp.

   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-15.

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. Table B-1. 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-16. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.

Table B-1. Packard Terminal Crimp Tools

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>PACKARD 115</th>
<th>PACKARD 271</th>
</tr>
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<tbody>
<tr>
<td>Part No.</td>
<td>HD-38125-8</td>
<td>HD-38125-7</td>
</tr>
<tr>
<td>Type of Crimp</td>
<td>Non-sealed terminals, butt splices</td>
<td>Non-sealed terminals</td>
</tr>
<tr>
<td>Dye/nests</td>
<td>F-G</td>
<td>A-E</td>
</tr>
</tbody>
</table>

Figure B-15. Packard Terminal Crimp Tools

Figure B-16. Inspect Core and Insulation/Seal Crimps
The following table provides a brief description of the connectors found on the Buell Lightning.

**Table B-2. Electrical Connector and Location Table**

<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>COMPONENT(S)</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[14]</td>
<td>cam position sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
</tr>
<tr>
<td>[18]</td>
<td>right rear turn signal</td>
<td>2 1-place bullet</td>
<td>under seat</td>
</tr>
<tr>
<td>[19]</td>
<td>left rear turn signal</td>
<td>2 1-place bullet</td>
<td>under seat</td>
</tr>
<tr>
<td>[22]</td>
<td>right hand controls</td>
<td>4-place Multilock</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[24]</td>
<td>left hand controls</td>
<td>4-place Multilock</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[30]</td>
<td>flasher</td>
<td>5-place Amp</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[31]</td>
<td>right front turn signal</td>
<td>2 1-place bullet</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[31]</td>
<td>left front turn signal</td>
<td>2 1-place bullet</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[33]</td>
<td>ignition switch</td>
<td>4-place Augat</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[38]</td>
<td>headlamp connector</td>
<td>4-place Amp</td>
<td>behind windsreen</td>
</tr>
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<td>[39]</td>
<td>instrument module</td>
<td>20-place Multilock</td>
<td>in front modules behind windsreen</td>
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<td>[45]</td>
<td>license plate lamp</td>
<td>2 1-place bullet</td>
<td>under seat</td>
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<td>stator</td>
<td>4-place Deutsch</td>
<td>under sprocket cover</td>
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<td>[65]</td>
<td>vehicle speed sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
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<td>[77]</td>
<td>voltage regulator</td>
<td>2-place Packard</td>
<td>under sprocket cover</td>
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<td>[83]</td>
<td>ignition coil</td>
<td>3-place Packard</td>
<td>beneath air cleaner assembly base-plate base</td>
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<tr>
<td>[84]</td>
<td>front fuel injector</td>
<td>2-place Packard</td>
<td>beneath air cleaner assembly base-plate base</td>
</tr>
<tr>
<td>[85]</td>
<td>rear fuel injector</td>
<td>2-place Packard</td>
<td>beneath air cleaner assembly base-plate base</td>
</tr>
<tr>
<td>[86]</td>
<td>fuel pump</td>
<td>4-place Multilock</td>
<td>left side of rear shock absorber</td>
</tr>
<tr>
<td>[88]</td>
<td>throttle position sensor</td>
<td>3-place Packard</td>
<td>right side of engine between cylinders</td>
</tr>
<tr>
<td>[89]</td>
<td>intake air temperature sensor</td>
<td>2-place Amp</td>
<td>in air cleaner assembly baseplate base</td>
</tr>
<tr>
<td>[90]</td>
<td>engine temperature sensor</td>
<td>1-place bullet</td>
<td>beneath air cleaner assembly base-plate base</td>
</tr>
<tr>
<td>[91A]</td>
<td>data link</td>
<td>4-place Deutsch</td>
<td>under seat, right side of vehicle</td>
</tr>
<tr>
<td>[93]</td>
<td>tail light</td>
<td>2-place spade</td>
<td>back of tail light, under seat</td>
</tr>
</tbody>
</table>

Connector numbers are listed in [brackets] in this manual.
<table>
<thead>
<tr>
<th>CONNECTOR</th>
<th>COMPONENT(S)</th>
<th>DESCRIPTION</th>
<th>LOCATION</th>
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</thead>
<tbody>
<tr>
<td>[95]</td>
<td>clutch switch</td>
<td>2-place Multilock</td>
<td>underside of clutch lever assembly</td>
</tr>
<tr>
<td>[97]</td>
<td>cooling fan</td>
<td>2-place Multilock</td>
<td>behind rear cylinder, under seat</td>
</tr>
<tr>
<td>[120]</td>
<td>oil pressure switch</td>
<td>post terminal</td>
<td>crankcase above oil filter</td>
</tr>
<tr>
<td>[121]</td>
<td>front brake switch</td>
<td>2-place Multilock</td>
<td>underside of front master cylinder assembly</td>
</tr>
<tr>
<td>[121]</td>
<td>rear brake switch</td>
<td>2-place Multilock</td>
<td>under seat</td>
</tr>
<tr>
<td>[122]</td>
<td>horn</td>
<td>spade terminals</td>
<td>behind windsreen</td>
</tr>
<tr>
<td>[128]</td>
<td>starter solenoid</td>
<td>spade terminals</td>
<td>top of starter</td>
</tr>
<tr>
<td>[131]</td>
<td>neutral switch</td>
<td>1-place bullet</td>
<td>under sprocket cover</td>
</tr>
<tr>
<td>[134]</td>
<td>bank angle sensor</td>
<td>6-place Sumitomo</td>
<td>under seat</td>
</tr>
<tr>
<td>[137]</td>
<td>oxygen sensor</td>
<td>1-place Packard</td>
<td>behind rear cylinder head</td>
</tr>
<tr>
<td>[164]</td>
<td>Interactive exhaust circuit to ECM</td>
<td>under seat</td>
<td></td>
</tr>
<tr>
<td>[161]</td>
<td>Interactive exhaust to solenoid</td>
<td>under air cleaner assembly baseplate cover</td>
<td></td>
</tr>
<tr>
<td>[178]</td>
<td>Active intake system to solenoid</td>
<td>under air cleaner assembly baseplate cover</td>
<td></td>
</tr>
<tr>
<td>[179]</td>
<td>Active intake system to ECM</td>
<td>under seat</td>
<td></td>
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## Table B-3. Wiring Diagrams

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<td>Engine management circuit</td>
<td>B-19</td>
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<tr>
<td>Lighting circuit</td>
<td>B-21</td>
</tr>
<tr>
<td>Horn and instruments circuit</td>
<td>B-23</td>
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<tr>
<td>Starting circuit</td>
<td>B-25</td>
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<tr>
<td>Charging circuits</td>
<td>B-27</td>
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<tr>
<td>Component circuits</td>
<td>B-29</td>
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</table>
2006 Buell Lightning: Electrical  B-19

2006 Lightning Models Engine Management Circuit
### Table C-1. Metric Conversions

<table>
<thead>
<tr>
<th>MILLIMETERS TO INCHES</th>
<th>INCHES TO MILLIMETERS</th>
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<tbody>
<tr>
<td>(MM X 0.03937 = INCHES)</td>
<td>(INCHES X 25.4 = MM)</td>
</tr>
<tr>
<td>mm</td>
<td>in.</td>
</tr>
<tr>
<td>.1</td>
<td>.0039</td>
</tr>
<tr>
<td>.2</td>
<td>.0078</td>
</tr>
<tr>
<td>.3</td>
<td>.0118</td>
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<tr>
<td>.4</td>
<td>.0157</td>
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<td>.6</td>
<td>.0236</td>
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<td>.7</td>
<td>.0275</td>
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<td>.8</td>
<td>.0315</td>
</tr>
<tr>
<td>.9</td>
<td>.0354</td>
</tr>
<tr>
<td>1</td>
<td>.0393</td>
</tr>
<tr>
<td>2</td>
<td>.0787</td>
</tr>
<tr>
<td>3</td>
<td>.1181</td>
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<tr>
<td>4</td>
<td>.1575</td>
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<td>7</td>
<td>.2756</td>
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<tr>
<td>8</td>
<td>.3149</td>
</tr>
<tr>
<td>12</td>
<td>.4720</td>
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<tr>
<td>15</td>
<td>.5900</td>
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<tr>
<td>17</td>
<td>.6686</td>
</tr>
<tr>
<td>18</td>
<td>.7080</td>
</tr>
<tr>
<td>22</td>
<td>.8653</td>
</tr>
<tr>
<td>23</td>
<td>.9046</td>
</tr>
<tr>
<td>24</td>
<td>.9439</td>
</tr>
</tbody>
</table>
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 2.113 = 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.)
Figure D-1. Front and Rear Brake Systems, Right Side View
Figure D-4. Evaporative Emissions Control, California Models, Top View
Figure D-5. Evaporative Emissions Control, California and 49 State Models, Left Side View

1. To induction module
2. From induction module (California)
3. From fuel tank (California)
4. From fuel tank to atmosphere (49 state)
Figure D-6. Wiring Harness, Left Side View

1. To active intake solenoid (Japan only)
2. Intake air temperature sensor (IAT)
3. Fuel pump
4. Active intake to ECM (Japan only)
1. Fuel injector (2)
2. Throttle position sensor (TPS)
3. Intake air temperature (IAT) sensor
4. Oxygen (O2) sensor

Figure D-7. Wiring Harness, Top View
Figure D-8. Wiring Harness, Right Side View

1. Speedometer sensor
2. Cable, starter to battery positive
3. Solenoid
4. Transmission vent line
5. Voltage regulator
6. Switch, oil pressure
7. Cam position sensor
Figure D-9. Oil Lines, Right Side View

1. Vent line
2. Feed oil line
3. Return oil line
4. Feed oil line from the oil pump to the oil cooler
5. Return oil line from the oil cooler to the oil filter housing
Figure D-10. Oil Lines, Bottom View

1. Vent line
2. Feed oil line
3. Return oil line
Figure D-11. Clutch Cable and Exhaust Valve Actuator (1200 only), Right Side View

- Exhaust valve actuator
- Muffler valve
Figure D-12. Clutch, Throttle, Seat Release Cables and Exhaust Valve Actuator (1200 only), Left Side View
Figure D-13. Clutch, Throttle, Seat Release Cables and Exhaust Valve Actuator, Top View

- Clutch, seat lock
- Clips into functional airbox cover
- TPS adjuster
- EVA mounted on top of functional airbox cover
ACTIVE INTAKE SYSTEM (JAPANESE MODELS ONLY)  E.1

GENERAL

Active Intake System (Japanese Models Only)
The active intake system utilizes a solenoid in the airbox which is connected to the throttle valve via a cable. The throttle valve is automatically closed by the solenoid under certain conditions to reduce engine noise.

A code 22 will set if the ECM detects that the output for the active intake control is not in agreement with the feedback circuit (minimum TP sensor voltage when actuated).

Likely causes for a code 22 are:
- Mechanical fault in the active intake solenoid, throttle valve, or cable.
- Electrical fault in the solenoid circuit.
- Electrical fault in the throttle position sensor circuit.
- When TPS reading is not between 10.4-10.9 when actuated.

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the Code 22 flow charts.
Using TEST CONNECTOR KIT (Part No. HD-41404), attach Brown pin probe and patch cord to [179] (1,2).

VERIFY SETTINGS

1. Prior to verifying the active intake system, check the throttle position sensor (TPS) zero and adjust if necessary. See 1.19 THROTTLE POSITION SENSOR (TPS).
2. Leave Digital Technician attached to vehicle.
3. In Digital Technician, go to Active Intake test screen.
4. Rotate throttle grip to wide open throttle (WOT).
   a. Check that when the throttle plate reaches WOT, TPS should read above 82°.
   b. If not, see WOT CHECK listed below.
5. While holding the throttle wide open, activate the active intake tab on Digital Technician.
   a. Verify that the TPS setting is between 10.4-10.9 degrees.
   b. If settings are not correct proceed to cable adjustment procedure.

WOT CHECK

1. Remove cosmetic intake cover assembly and functional air cleaner cover. See 2.37 INTAKE COVER ASSEMBLY  and 1.14 AIR CLEANER FILTER.
2. While holding the throttle grip to the WOT position, verify that the throttle plate is fully open.
   If the throttle plate does not fully open, see CABLE ADJUSTMENT this section.
CABLE ADJUSTMENT

1. Remove cosmetic intake cover assembly and functional air cleaner cover. See 2.37 INTAKE COVER ASSEMBLY and 1.14 AIR CLEANER FILTER.

2. See Figure E-1. Inspect for proper retraction freeplay in solenoid shaft:
   a. Open the throttle to the WOT position, push solenoid shaft (1) inward to the fully retracted position.
   b. While slowly rolling off the throttle you should be able to move the solenoid shaft slightly inward until the shaft bottoms out. This slight travel will be the retraction freeplay.
   c. If you have no travel in the shaft, adjust cable housing (4) away from the solenoid bracket (3) until freeplay is achieved.

   **NOTE**
   This freeplay is necessary for the solenoid to properly function. Freeplay should be 1/32 in. (0.79 mm) or greater.

**Figure E-1. Checking for Freeplay in the Solenoid Shaft in the Fully Retracted Position**
3. See Figure E-2. Inspect for proper extension freeplay in solenoid shaft:
   a. Open the throttle to the WOT position.
   b. Pull solenoid shaft (1) outward to the fully extended position.
   c. If you have no travel in the shaft, loosen jam nuts (2) and adjust cable housing (4) towards the solenoid bracket (3) until freeplay is achieved.

   **NOTE**
   You should be able to move the solenoid shaft slightly outward until the shaft is fully extended. This slight travel will be the freeplay which should be 1/32 in. (0.79 mm) or greater.

4. See VERIFY SETTINGS. Once freeplay has been set, it will be necessary to verify settings and adjustments again.
   If values are not between 10.4-10.9 degrees, see Throttle Stop Screw in this section.

Figure E-2. Checking for Freeplay in the Solenoid Shaft in the Fully Extended Position
**Throttle Stop Screw**

1. Remove cosmetic intake cover assembly and functional air cleaner cover. See 2.37 INTAKE COVER ASSEMBLY and 1.14 AIR CLEANER FILTER.
2. Hold throttle to wide open position and use cable strap to free hands.
   - **NOTE** It is necessary to pull velocity stack out of the way to access set screw.
3. Activate Active Intake System using DIGITAL TECHNI-CIAN.
4. Adjust stop screw, while reading the TPS on Digital Technician, until setting is between the range of 10.4 to 10.9.
   - a. If the reading is below 10.4, adjust screw clockwise.
   - b. If the reading is above 10.9, adjust screw counterclockwise.
5. Reconfirm the TPS setting. Repeat process if needed.
6. Adjust active intake cable assembly. See CABLE ADJUSTMENT.
7. Verify active intake TPS settings.
8. Install cosmetic intake cover assembly and functional air cleaner cover. See 2.37 INTAKE COVER ASSEMBLY and 1.14 AIR CLEANER FILTER.
Figure E-4. Active Intake System
Code 22 Test (Page 1 of 2)

Is the Active Intake System cable pinched or binding? Is the solenoid stuck?

- YES
  - Repair as needed.
- NO
  - Remove solenoid connector [178A] and inspect connections. Are all connections tight and free of corrosion?
    - YES
      - Clean and repair connections.
    - NO
      - Disconnect active solenoid connector [178A] at solenoid. Measure voltage at pin 2 with key ON and Run/Stop switch on. Is battery voltage present?
        - YES
          - Measure voltage at [178A] Pin Battery voltage present?
            - YES
              - Repair short to ground in G/Y wire.
            - NO
              - Measure resistance between connector [178A] pin 1 and [179B] pin 1. Continuity present?
                - YES
                  - Repair open in G/Y wire.
                - NO
                  - Measure resistance between connector [179B] pin 2 and [178A] pin 2. (W/GY wire) Continuity present?
                    - YES
                      - Repair short to voltage in G/Y wire.
                    - NO
                      - Repair open in W/GY wire.

DIAGNOSTIC NOTE
If DTC is historic, wiggle harness while performing measurements in chart to locate intermittents.
Measure resistance from active intake solenoid pin 1 to pin 2 [178B] (use HD 41404 brown pins). Continuity should be present, approximately less than 4 ohms, nominal 2.4 ohms.

3. Replace solenoid.

Connect battery voltage to [178B] pin 2 of active intake solenoid. (Use HD 41404 brown pin and patch cable). Hold throttle wide open. Observe throttle plate position. Does solenoid attempt to pull throttle almost closed?

4. NO
5. Replace solenoid.
6. YES

Hold throttle wide open. Energize active intake solenoid. Does throttle close to an angle less than 11 degrees?

7. YES
8. Replace ECM.
9. NO
10. See CABLE ADJUSTMENT in this section.
**REMOVAL**

If solenoid bracket needs to be replaced, remove the baseplate assembly, turn it over and remove the three fasteners securing the bracket to the baseplate.

1. See Figure E-5. Disconnect electrical connector (178) (1).

2. Hold solenoid shaft by flat spot provided and break cable connector (6) loose.

3. Unthread cable connector and disconnect cable from solenoid (8).

4. Loosen jam nut (5) and disconnect active cable (2) from cable bracket (4).

**NOTE**

Follow next step only is solenoid is to be replaced.

5. Loosen pinch fastener on solenoid bracket (9).

6. Remove the two fasteners at the front on the solenoid bracket (9) and slide solenoid (8) out of bracket.

**NOTE**

When removing baseplate it will be necessary to feed the electrical connector and active cable and grommets through the baseplate.

7. Remove baseplate (10). See 4.44 AIR CLEANER ASSEMBLY.

8. See Figure E-3. If the active cable needs to be replaced disconnect from cable wheel (2).

**INSTALLATION**

If solenoid bracket was removed, reinstall using the three fasteners and tighten to 48-60 in-lbs (5.4-6.7 Nm).

1. See Figure E-5. When installing baseplate assembly (10) see 4.44 AIR CLEANER ASSEMBLY.

**NOTE**

When installing the backing plate it is important to ensure that the active cable remains in the lower on the cable wheel on the throttle body. If the cable comes out the cable will not work properly and will not be able to be adjusted.

**NOTES**

- When installing baseplate be sure to feed the electrical connector (1) through hole in baseplate first and then insert active cable and then grommet.

- Follow next step only if solenoid was removed.

2. Install solenoid (8) into bracket (9) and tighten pinch fastener to 48-60 in-lbs (5.4-6.7 Nm) and bracket to solenoid fasteners to 20-24 in-lbs (2.3-2.7 Nm).

3. Install active cable (2) into bracket (4) and leave jam nut (5) loose until the setting can be verified.

4. Connect active cable (2) to solenoid shaft and tighten cable connector (6) to 20-24 in-lbs (2.3-2.7 Nm).

5. Connect electrical connector (178).

6. See CABLE ADJUSTMENT and verify active cable setting.

7. Tighten jam nuts to 48-60 in-lbs (5.4-6.7 Nm).
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<td>1.3 Maintenance Schedule</td>
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<td>1.6 Brake System Maintenance</td>
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</table>
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 1.3 MAINTENANCE SCHEDULE for details.

SAFE OPERATING MAINTENANCE

NOTES

- Do not attempt to retighten engine head bolts. Retightening can cause engine damage.
- During the initial break-in period, use only Harley-Davidson 20W50 engine oil. Failure to use the recommended oil will result in improper break-in of the engine cylinders and piston rings.

A careful check of certain equipment is necessary after periods of storage, and frequently between regular service intervals, to determine if additional maintenance is required.

Check:
1. Tires for abrasions, cuts and correct pressure.
2. Secondary drive belt condition.
3. Brakes, steering and throttle for responsiveness.
4. Brake fluid level and condition. Check hydraulic lines and fittings for leaks. Also, check brake pads and rotors for wear.
5. Cables for fraying, crimping and free operation.
6. Engine oil and transmission fluid levels.
7. Headlamp, passing lamp, tail lamp, brake lamp and turn signal operation.

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.

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 and 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.

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-ring 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.
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 STRIK-ING FACE wrench.
● Disconnect 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 mush-roomed 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; ratch-ets 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.
WARNING

Avoid spills. Slowly remove filler cap. Do not fill above bottom of filler neck insert, leaving air space for fuel expansion. Secure filler cap after refueling. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00028a)

Use a good quality unleaded gasoline (91 pump octane or higher). Pump octane is the octave number usually shown on the gas pump.

GASOLINE BLENDS

CAUTION

Do not use gasoline that contains methanol. Doing so can result in fuel system component failure, engine damage and/or equipment malfunction. (00148a)

Buell motorcycles were designed to give the best performance using unleaded gasoline. Some fuel suppliers sell gasoline/alcohol blends as a fuel. The type and amount of alcohol added to the fuel is important.

- **DO NOT USE GASOLINES CONTAINING METHANOL.** Using gasoline/methanol blends will result in starting and driveability deterioration and damage to critical fuel system components.

- **DO NOT USE RACE GAS OR OCTANE BOOSTERS.** Use of these fuels will damage the fuel system.

- **ETHANOL** is a mixture of 10% ethanol (Grain alcohol) and 90% unleaded gasoline. Gasoline/ethanol blends can be used in your motorcycle if the ethanol content does not exceed 10%.

- **REFORMULATED OR OXYGENATED GASOLINES (RFG):** “Reformulated gasoline” is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline. Your motorcycle will run normally using this type of gas.

You may find that some gasoline blends adversely affect the starting, driveability or fuel efficiency of your bike. If you experience one or more of these problems, we recommend you try a different brand of gasoline or gasoline with a higher octave rating.

ENGINE OIL

Use the proper grade of oil for the lowest temperature expected before the next oil change.

If it is necessary to add oil and Harley-Davidson oil is not available, use an oil certified for diesel engines. Acceptable diesel engine oil designations include CF-4, CG-4, CI-4 and CI-4+. The preferred viscosities for the diesel engine oils, in descending order, are 20W50, 15W40 and 10W40. At the first opportunity, see a Harley-Davidson dealer to change back to 100 percent Harley-Davidson oil.

See 1.5 ENGINE LUBRICATION SYSTEM for all service information.

WINTER LUBRICATION

Combustion in an engine produces water vapor. During starting and warm-up in cold weather, especially in freezing temperatures, the vapor condenses to water before the crankcase is hot enough to exhaust it through the breather system. If the engine is run long enough for the crankcase to become thoroughly heated, the water returns to vapor and is then exhausted.

An engine used for only short trips, and seldom allowed to thoroughly warm up, accumulates increasing amounts of water in the oil reservoir. Water mixed with oil forms a sludge that causes accelerated engine wear. In freezing temperatures, the water becomes slush or ice, which may clog oil lines and result in engine failure.

Always change the engine oil more often in winter. If the engine is used for short runs, change the oil even more frequently. The farther below freezing the temperature drops the more often the oil should be changed.
Table 1-1. Regular Service Intervals For Buell Lightning Models

<table>
<thead>
<tr>
<th>ITEM SERVICED</th>
<th>PROCEDURE</th>
<th>1000 mi</th>
<th>1600 km</th>
<th>5000 mi</th>
<th>8000 km</th>
<th>10,000 mi</th>
<th>16,000 km</th>
<th>15,000 mi</th>
<th>24,000 km</th>
<th>20,000 mi</th>
<th>32,000 km</th>
<th>25,000 mi</th>
<th>40,000 km</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil and filter</td>
<td>Replace</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil lines and brake system</td>
<td>Inspect for leaks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
</tr>
<tr>
<td>Air cleaner</td>
<td>Inspect, service as required</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Tires</td>
<td>Check pressure, inspect tread</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Transmission lubricant</td>
<td>Replace</td>
<td>X</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Clutch</td>
<td>Check adjustment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Primary chain</td>
<td>Check adjustment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rear wheel, idler and sprockets</td>
<td>Inspect</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Throttle, brake, and clutch controls, jiffy stand, active muffler cable and active intake cable ass't (if equipped)</td>
<td>Check, adjust and lubricate</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Brake fluid</td>
<td>Check levels and condition</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
<td></td>
<td></td>
<td>1, 2</td>
</tr>
<tr>
<td>Brake pads and discs</td>
<td>Inspect for wear</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Brake calipers and master cylinders</td>
<td>Inspect for leaks</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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<td>1, 3</td>
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<tr>
<td>Spark plugs</td>
<td>Replace</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Electrical equipment and switches</td>
<td>Check operation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine idle speed</td>
<td>Check adjustment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Ignition timing</td>
<td>Check</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Throttle position sensor (TPS)</td>
<td>Check</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Front fork oil</td>
<td>Replace</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Steering head bearings</td>
<td>Perform resistance test</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Oil cooler fans</td>
<td>Inspect</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Brake systems, oil lines, front forks, rear shock, exhaust system, exhaust system mounting, evaporative emission system (if applicable)</td>
<td>Inspect</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Critical fasteners</td>
<td>Check tightness</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Engine mounts and stabilizer links</td>
<td>Inspect</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Road test</td>
<td>Verify component and system functions</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. Should be performed by an authorized Harley-Davidson/Buell dealer, unless you have the proper tools, service data and are mechanically qualified.
2. Change brake fluid every two (2) years.
### Table 1-2. Quick Reference Maintenance Chart

<table>
<thead>
<tr>
<th>ITEM SERVICED</th>
<th>SPECIFICATION</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil and filter</td>
<td>Drain plug torque</td>
<td>Apply Loctite 565 Thread Sealant and reinstall plug and tighten to 29-34 ft-lbs (40-46 Nm)</td>
</tr>
<tr>
<td></td>
<td>Oil capacity</td>
<td>2.5 quarts (2.4 liters) and includes the 4.0 ounces (0.12 liter) poured into the filter</td>
</tr>
<tr>
<td></td>
<td>Filter</td>
<td>Hand tighten 1/2-3/4 turn after gasket contact</td>
</tr>
<tr>
<td></td>
<td>Black filter part number</td>
<td>63806-00Y</td>
</tr>
<tr>
<td>Primary chain tension</td>
<td>Deflection with hot engine</td>
<td>1/4-3/8 in. (6.4-9.5 mm)</td>
</tr>
<tr>
<td></td>
<td>Deflection with cold engine</td>
<td>3/8-1/2 in. (9.5-12.7 mm)</td>
</tr>
<tr>
<td></td>
<td>Chain tensioner nut torque</td>
<td>20-25 ft-lbs (27-34 Nm)</td>
</tr>
<tr>
<td></td>
<td>Primary chain inspection cover torque</td>
<td>84-108 in-lbs (10-12 Nm)</td>
</tr>
<tr>
<td>Primary chain lubricant</td>
<td>Lubricant capacity</td>
<td>FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) as required until fluid level is even with bottom of clutch diaphragm spring</td>
</tr>
<tr>
<td></td>
<td>Primary chaincase drain plug torque</td>
<td>Apply Loctite 565 Thread Sealant and reinstall plug and tighten to 14-30 ft-lbs (19-40.7 Nm)</td>
</tr>
<tr>
<td>Clutch adjustment</td>
<td>Free play at adjuster screw</td>
<td>Clockwise 1/4-1/2 turn</td>
</tr>
<tr>
<td></td>
<td>Free play at hand lever</td>
<td>1/16-1/8 in. (1.6-3.2 mm)</td>
</tr>
<tr>
<td></td>
<td>Clutch inspection cover torque</td>
<td>84-108 in-lbs (10-12 Nm)</td>
</tr>
<tr>
<td>Transmission lubricant</td>
<td>Lubricant level</td>
<td>FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) as required until fluid level is even with bottom of clutch diaphragm spring</td>
</tr>
<tr>
<td>Tire condition and pressure</td>
<td>Pressure for solo rider (All models except XB9SX)</td>
<td>Front: 36 psi (248 kPa) Rear: 38 psi (262 kPa)</td>
</tr>
<tr>
<td></td>
<td>Pressure for solo rider (XB9SX)</td>
<td>Front: 34 psi (234 kPa) Rear: 36 psi (248 kPa)</td>
</tr>
<tr>
<td></td>
<td>Pressure for rider and passenger</td>
<td>Same as Solo</td>
</tr>
<tr>
<td></td>
<td>Wear</td>
<td>Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains</td>
</tr>
<tr>
<td>Brake fluid reservoir level</td>
<td>D.O.T. 4 hydraulic brake fluid part nos.</td>
<td>99953-99A (12 oz.) 99973-05 (gal.)</td>
</tr>
<tr>
<td></td>
<td>Proper fluid level</td>
<td>1/8 in. (3.2 mm) from the top</td>
</tr>
<tr>
<td></td>
<td>Master cylinder reservoir cover torque</td>
<td>9.13 in-lbs (1.0-1.5 Nm)</td>
</tr>
<tr>
<td>Brake pad linings and discs</td>
<td>Minimum brake pad thickness</td>
<td>0.040 in. (1.0 mm) or less</td>
</tr>
<tr>
<td></td>
<td>Minimum brake disc thickness</td>
<td>0.18 in. (4.5 mm) or less</td>
</tr>
<tr>
<td>Drive belt</td>
<td>Replace drive belt and idler pulley assembly</td>
<td>At every 25,000 mi (40,000 km) service interval.</td>
</tr>
<tr>
<td>Air cleaner</td>
<td>Air cleaner cover screw torque</td>
<td>12-36 in-lbs (4-4 Nm)</td>
</tr>
</tbody>
</table>

2006 Buell Lightning: Maintenance 1-7
### Table 1-2. Quick Reference Maintenance Chart

<table>
<thead>
<tr>
<th>ITEM SERVICED</th>
<th>SPECIFICATION</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clutch and throttle cables</td>
<td>Lubricant</td>
<td>LUBIT-8 TUFOL® CHAIN AND CABLE LUBE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Part No. HD-94988-85TV)</td>
</tr>
<tr>
<td></td>
<td>Handlebar clamp screw torque</td>
<td>60-84 in-lbs (6.8-9.5 Nm)</td>
</tr>
<tr>
<td></td>
<td>Handlebar switch housing screw torque</td>
<td>25-33 in-lbs (3-4 Nm)</td>
</tr>
<tr>
<td>Spark plugs</td>
<td>Type</td>
<td>10R12A</td>
</tr>
<tr>
<td></td>
<td>Gap</td>
<td>0.035 in. (0.9 mm)</td>
</tr>
<tr>
<td></td>
<td>Torque</td>
<td>12-18 ft-lbs (16-24 Nm)</td>
</tr>
<tr>
<td>Engine idle speed</td>
<td>Idle speed</td>
<td>1050-1150 RPM</td>
</tr>
<tr>
<td>Front fork oil</td>
<td>Type: All models except XB12Scg</td>
<td>HYDRAULIC FORK OIL (TYPE E)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part No. 99884-80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.21 in. (107 mm) from the top of the fork tube</td>
</tr>
<tr>
<td>Battery</td>
<td>Lubricant</td>
<td>ELECTRICAL CONTACT LUBRICANT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part No. 99861-02 (1 oz.)</td>
</tr>
<tr>
<td></td>
<td>Battery terminal torque</td>
<td>72-96 in-lbs (8-11 Nm)</td>
</tr>
</tbody>
</table>
BATTERY MAINTENANCE

GENERAL

Buell motorcycle 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.

Inspect the battery for damage or leaks and for clean, non-corroded connections:

- At the 1000 mile (1600 km) service interval.
- At every scheduled service interval thereafter.

**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. (00063a)

**WARNING**

A warning label is attached to the top of the battery. See Figure 1-1. 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)

**WARNING**

Battery posts, terminals and related accessories contain lead and lead components, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling. (00019a)

---

**BATTERY TESTING**

**Voltmeter Test**

See Table 1-4. 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. 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 12.8V or above, perform the load test described under 7.11 BATTERY.

---

**Table 1-3. Battery Electrolyte Antidotes**

<table>
<thead>
<tr>
<th>CONTACT</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Flush with water.</td>
</tr>
<tr>
<td>Internal</td>
<td>Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Call doctor immediately.</td>
</tr>
<tr>
<td>Eyes</td>
<td>Flush with water, get immediate medical attention.</td>
</tr>
</tbody>
</table>

---

**Table 1-4. Voltmeter Test For Battery Charge**

<table>
<thead>
<tr>
<th>VOLTAGE (OCV)</th>
<th>STATE OF CHARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.7</td>
<td>100%</td>
</tr>
<tr>
<td>12.6</td>
<td>75%</td>
</tr>
<tr>
<td>12.3</td>
<td>50%</td>
</tr>
<tr>
<td>12.0</td>
<td>25%</td>
</tr>
<tr>
<td>11.8</td>
<td>0%</td>
</tr>
</tbody>
</table>

---

Figure 1-1. Battery Warning Label
BATTERIES DISCONNECTION AND REMOVAL

1. Remove seat. See 2.43 SEAT.

**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)

2. Unthread fastener and remove battery negative cable (black) from battery negative (--) terminal.
3. Pull back terminal cover boot.
4. Unthread fastener and remove battery positive cable (red) from battery positive (+) terminal.
5. Unhook strap and remove battery.

CLEANING AND INSPECTION

1. Battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause battery to self-discharge. Clean battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water). When the solution stops bubbling, rinse off the battery with clean water.
2. Clean cable connectors and battery terminals using a wire brush or sandpaper. Remove any oxidation.
3. Inspect the battery screws, clamps and cables for breakage, loose connections and corrosion. Clean clamps.
4. Check the battery posts for melting or damage caused by overtightening.
5. Inspect the battery case for discoloration, raised top or a warped or distorted case, which might indicate that the battery has been frozen, overheated or overcharged.
6. Inspect the battery case for cracks or leaks.

STORAGE

**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. (00063a)

**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 will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge. See 7.11 BATTERY.

See Figure 1-2. 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 H-D Battery Tender 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, fully charge the battery. See 7.11 BATTERY.

![Effect of Temperature on Battery Self-Discharge Rate](image)
BATTERY INSTALLATION AND CONNECTION

1. Place the fully charged battery in the mounting position, terminal side to the rear of motorcycle.
2. Hook rubber strap around body of battery.

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

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

3. Insert fastener through battery positive cable (red) into threaded hole of battery positive (+) terminal and tighten fastener to 72-96 in-lbs (8-11 Nm).
4. Install terminal cover boot.
5. Insert fastener through battery negative cable (black) into threaded hole of battery negative (-) terminal and tighten fastener to 72-96 in-lbs (8-11 Nm).
6. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.
GENERAL

Check engine oil level (hot check) at every refueling stop.

Change engine oil and filter when storing or removing the motorcycle for the season or an extended period of time.

NOTE
The colder the weather, the shorter the recommended oil change interval. A vehicle used only for short runs in cold weather must have the engine oil drained more frequently.

CHECKING ENGINE OIL LEVEL

An accurate engine oil level reading can only be obtained with the engine at normal operating temperature (hot check). The engine will require a longer warm up period in colder temperatures.

For pre-ride inspection, simply verify that there are no oil leaks from the oil filter and oil lines prior to operating the motorcycle.

- Perform a hot check of the engine oil level at each fuel stop.

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)

CAUTION
Do not overfill oil tank. Doing so can result in oil carry-over to the air cleaner leading to equipment damage and/or equipment malfunction. (00190a)

CAUTION
Do not switch lubricant brands indiscriminately because some lubricants interact chemically when mixed. Use of inferior lubricants can damage the engine. (00194a)

Ride motorcycle for approximately 10 minutes to ensure the oil is hot and the engine is at normal operating temperature.

1. The motorcycle must be on level ground, on the side-stand, with the engine off.

2. See Figure 1-3. Unscrew and remove dipstick from oil tank/swingarm filler hole. Wipe dipstick clean.
3. Insert dipstick into oil tank filler hole, screwing dipstick in completely. DO NOT OVER TIGHTEN.

NOTE
The area between the upper and lower registration marks is the operating range.

4. See Figure 1-5. Unscrew and remove dipstick and note oil level.
   a. Oil level should be within the operating range (between upper and lower registration marks) on dipstick.
   b. If oil level is below lower registration mark, add only enough oil to bring oil level between lower and upper registration marks.
Ride motorcycle for approximately 10 minutes to ensure the oil is hot and the engine is at normal operating temperature. Turn engine off.

**Draining Oil**

1. See Figure 1-4. Place a suitable container under the drain plug.

2. Using a 5/8 in. wrench, remove drain plug from under oil tank/swingarm. Wipe any accumulated debris from magnetic tip on drain plug.

**Changing Filter**

1. Remove chin fairing See 2.36 CHIN FAIRING.

2. See Figure 1-6. Remove oil filter using pliers or belt type OIL FILTER WRENCH.

3. Clean filter gasket contact surface on crankcase. Surface should be smooth and free of any debris or old gasket material.

4. Apply a thin film of clean engine oil to filter gasket.

5. Pour 4.0 ounces (0.12 liter) of clean engine oil into new filter when changing oil (until filter is approximately 1/2 full).


**WARNING**

Check that no lubricant gets on tires, wheels 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. (00047b)
Replacing Oil

1. Inspect drain plug o-ring for tears or damage. Replace if required. Wipe any foreign material from drain plug.

2. Apply Loctite 565 Thread Sealant, reinstall plug and tighten to 29-34 ft-lbs (40-46 Nm).

3. Fill oil tank through filler (dipstick) hole with recommended oil from Table 1-5. Oil tank capacity with filter change is approximately 2.5 quarts (2.4 liters) and includes the 4.0 ounces (0.12 liter) poured into the filter. Always verify proper hot oil level on dipstick. Do not over-fill.

4. Inspect o-ring on dipstick for rips or tears. Replace as required.

5. Install dipstick into oil tank/swingarm fill hole. Make sure dipstick is installed completely. DO NOT OVER TIGHTEN.

NOTE
For ease of installation, apply a light film of clean engine oil to the dipstick o-ring.

6. Remove left side oil cooler scoop. See 2.38 AIR SCOOPS.

7. Inspect oil cooler fins for debris or damage. Blow out any debris from fins with compressed air from the inside of the cooler outward.

8. Wipe up any spilled oil on muffler.

9. Start engine. Verify that oil pressure signal light on instrument support turns off after a few seconds when engine speed is 1000 RPM or above.

10. Check for oil leaks at oil filter, drain plug, hoses and oil cooler.

11. Install chin spoiler. See 2.36 CHIN FAIRING.

12. Install air scoop 2.38 AIR SCOOPS.

13. Check (hot) oil level. See CHECKING ENGINE OIL LEVEL.

Table 1-5. Recommended Oil Grades

<table>
<thead>
<tr>
<th>HARLEY-DAVIDSON TYPE</th>
<th>VISCOSITY</th>
<th>HARLEY-DAVIDSON RATING</th>
<th>LOWEST AMBIENT TEMP °F</th>
<th>COLD WEATHER STARTS BELOW 50 °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.D. Multi-Grade</td>
<td>SAE 10W40</td>
<td>HD 360</td>
<td>Below 40° (4°C)</td>
<td>Excellent</td>
</tr>
<tr>
<td>H.D. Multi-Grade</td>
<td>SAE 20W50</td>
<td>HD 360</td>
<td>Above 40° (4°C)</td>
<td>Good</td>
</tr>
<tr>
<td>H.D. Regular Heavy</td>
<td>SAE 50</td>
<td>HD 360</td>
<td>Above 60° (16°C)</td>
<td>Poor</td>
</tr>
<tr>
<td>H.D. Extra Heavy</td>
<td>SAE 60</td>
<td>HD 360</td>
<td>Above 80° (27°C)</td>
<td>Poor</td>
</tr>
</tbody>
</table>
GENERAL

Check brake fluid level and condition:
- When storing or removing the motorcycle for the season:
  - Replace D.O.T. 4 BRAKE FLUID.
  - Every 2 years:

Front brake hand lever and rear brake foot pedal must have a firm feel when brakes are applied. If not, bleed system as described.

Inspect front and rear brake lines and replace as required.
- Every 4 years:

Inspect caliper and master cylinder seals and replace as required.
- Every 2 years:

If determining probable causes of poor brake operation, refer to Table 1-6.

BLEEDING BRAKES

WARNING
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)

WARNING
Never mix D.O.T. 4 with other brake fluids (such as D.O.T. 5). Use only D.O.T. 4 brake fluid in motorcycles that specify D.O.T. 4 fluid on the reservoir cap. Mixing different types of fluid may adversely affect braking ability and lead to brake failure which could result in death or serious injury. (00239a)

WARNING
Use only fresh, uncontaminated D.O.T. 4 fluid. Cans of fluid that have been opened may have been contaminated by moisture in the air or dirt. Use of contaminated brake fluid may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

WARNING
Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

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)

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)

CAUTION
D.O.T. 4 brake fluid will damage painted and molded-in color 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. (00239a)
<table>
<thead>
<tr>
<th>CONDITION</th>
<th>CHECK FOR</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive lever/pedal travel or spongy feel.</td>
<td>Air in system. Master cylinder low on fluid.</td>
<td>Bleed brake(s). Fill master cylinder with approved brake fluid.</td>
</tr>
<tr>
<td>Brake fade.</td>
<td>Moisture in system.</td>
<td>Bleed brake(s). Replace fluid in master cylinder with approved brake fluid.</td>
</tr>
<tr>
<td>Ineffective brake – lever/pedal travel normal.</td>
<td>Distorted or glazed rotor. Distorted, glazed or contaminated brake pads.</td>
<td>Replace rotor and bushings as set. Replace pads.</td>
</tr>
</tbody>
</table>
Bleeding Front Brake

NOTE
Hydraulic brake fluid bladder-type pressure equipment can be used to fill the brake master cylinder through the bleeder valve if master cylinder reservoir cover is removed to prevent pressurization.

1. See Figure 1-7. With motorcycle in upright position, install end of plastic tubing over front caliper bleeder valve; place other end in a clean container.

CAUTION
D.O.T. 4 brake fluid will damage painted and molded in colored 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. (00239a)

2. Cover body surfaces, right handlebar switches and instrument panel to protect from spillage.

3. See Figure 1-8. Remove two fasteners from front master cylinder cover.

4. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir. Bring fluid level to within 1/8 in. (3.2 mm) of molded boss inside front master cylinder.

NOTE
Do not reuse brake fluid.

5. Slowly depress and release hand lever several times to build up hydraulic pressure, then hold brake hand lever in the depressed position.

6. While holding brake hand lever in the depressed position, open bleeder valve about 1/2-turn counterclockwise. Brake fluid will flow from bleeder valve and through tubing into clean container. When brake lever has moved 1/2 to 3/4 of its full range of travel, close bleeder valve (clockwise). Allow brake lever to return slowly to its released position.

7. Repeat steps 5-6 until all air bubbles are purged.

8. Tighten front caliper bleeder valve (metric) to 36-60 in-lbs (4-7 Nm).

9. Verify master cylinder fluid level as described in step 4.

10. Attach cover to front master cylinder reservoir and tighten fasteners to 9-13 in-lbs (1.0-1.5 Nm).

11. Remove cover from molded-in-color surfaces, right handlebar switches and instrument panel.
Bleeding Rear Brake

NOTE
Hydraulic brake fluid bladder-type pressure equipment can be used to fill the brake master cylinder through the bleeder valve if master cylinder reservoir cover is removed to prevent pressurization.

1. See Figure 1-9. With motorcycle in upright position, install end of plastic tubing over rear caliper bleeder valve; place other end in a clean container.

CAUTION
D.O.T. 4 brake fluid will damage painted and molded-in color 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. (00239a)

2. See Figure 1-10. Remove cap and gasket from rear master cylinder reservoir.

3. Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir with motorcycle upright (not on sidestand). Bring fluid level between upper and lower marks on reservoir.

NOTE
Do not reuse brake fluid.

4. Slowly depress and release brake pedal several times to build up hydraulic pressure, then hold brake pedal in the depressed position.

5. While holding brake pedal in the depressed position, open bleeder valve about 1/2-turn counterclockwise. Brake fluid will flow from bleeder valve and through tubing into clean container. When brake pedal has moved 1/2 to 3/4 of its full range of travel, close bleeder valve (clockwise). Allow brake pedal to return slowly to its released position.

6. Repeat steps 5-6 until all air bubbles are purged.

7. Tighten rear caliper bleeder valve (metric) to 36-60 in-lbs (4-7 Nm).

8. Verify master cylinder fluid level as described in step 3.

9. Install cover on master cylinder reservoir and tighten cap securely.
BRAKE PEDAL ADJUSTMENT

**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)

Before every ride, check rear brake pedal operation.

**NOTES**

- See Figure 1-11. On the very end of the threaded brake rod, are two flat sides (2). To ensure proper thread engagement with the clevis (3), the flat sides must extend below the extruded nut (1) in the clevis by at least one full thread. This is the minimum rod engagement.
- Also, there should be a minimum of 0.030 in. (0.8 mm) between brake rod end and brake pedal.

**WARNING**

Threaded rod should not be adjusted to the point of contacting brake pedal. Improper adjustment could result in death or serious injury.

1. See Figure 1-12. Inspect for minimum and maximum brake rod engagement in brake clevis (4). Adjust as required.
2. Adjust brake pedal:
   a. See Figure 1-12. Loosen locknut (3) while holding rod adjuster (2). Move locknut away from top surface of clevis (4).
   b. Turn rod adjuster to set pedal height.
   c. Return locknut (3) to fit flush against top surface of clevis and tighten to 130-173.5 in-lbs (14.7-19.6 Nm).

**NOTE**

Brake pedal has no free play adjustment.
**BRAKE PAD THICKNESS**

**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)

See Figure 1-13. Inspect brake pads for damage or excessive wear. Replace both pads as a set if friction material of either pad is worn to 0.040 in. (1.0 mm) or less. If this amount of wear occurs, wear grooves will disappear from friction material surface.

**BRAKE ROTOR THICKNESS**

**WARNING**

Check that no lubricant gets on tires, wheels 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. (00047b)

See Figure 1-14. Check brake rotors for minimum thickness:

1. Measure rotor thickness. Replace rotor if minimum thickness is less than 0.18 in. (4.5 mm). Replace drive bushings, fasteners, washers and springs whenever rotor is replaced.

2. Check rotor surface. Replace if warped or badly scored. See 2.12 FRONT BRAKE CALIPER or 2.15 REAR BRAKE CALIPER for procedure.
BRAKE PAD REPLACEMENT

Front Pad Removal

1. See Figure 1-15. Loosen pin hanger (2) but do not remove.
2. Rotate wheels so that caliper is centered between rotor mounting fasteners (1).
3. Remove lower caliper mounting fastener (4) that secures caliper to fork lower.
4. Loosen but do not remove upper caliper mounting fastener (3) that secures caliper to fork lower.
5. Remove pin hanger (2).
6. Rotate caliper counterclockwise to allow access to outer pad.
7. Remove outer pad from right side.
8. Remove inner pad from left side by pulling rearward, rotating pad 90 degrees and pulling through wheel opening.

Front Pad Installation

NOTE
Before beginning this procedure it will be necessary to remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 1/8 in. (3.2 mm) You may have to remove fluid to allow for this.

1. Push pistons in with suitable tool such as a clean paint scraper until fully seated in bores. Be careful not to damage rotor.
2. Install new inner pad from left side of motorcycle.
3. Install new outer pad from right side of motorcycle.
4. See Figure 1-15. Install pin (2) making sure it engages hole on both pads and spring clip.
5. Rotate caliper clockwise to align mounting fastener hole.
6. See Figure 1-15. Install lower caliper mounting fastener (4).
7. Apply LOCTITE 272 (red) and tighten both caliper mounting fasteners (3, 4) to 35-37 ft-lbs (48-50 Nm).
8. Tighten pin (2) to 11-14 ft-lbs (15-19 Nm).
9. Check brake fluid level.

NOTE
Avoid making hard stops for the first 100 miles (160 km) to allow new brake pads to "wear in" properly with the rotor.
Rear Pad Removal

1. See Figure 1-16. Remove rear caliper pin plug (3) and loosen pin (4).
2. Remove fastener securing p-clamp and brake line assembly to swingarm.

**NOTE**
The XB12SS model uses the rear fender to secure the brake line and not a p-clamp. It will be necessary to remove the rear fender. See 2.34 FENDERS.

3. Remove two mounting fasteners (1) securing brake caliper and carrier assembly to swingarm.
4. Lift caliper and carrier assembly up and off of rotor.
5. Remove hanger pin (4).
6. Remove inner and outer pads, being careful not to dislodge pad spring.

Rear Pad Installation

1. See Figure 1-16. Check that retainer (2) is present.
2. See Figure 1-17. Check that pad spring is present. Should pad spring become dislodged, install with widest area of spring towards piston side of caliper.

**NOTE**
Before beginning this procedure it will be necessary to remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 1/8 in. (3.2 mm) You may have to remove fluid to allow for this.

3. Push piston in with suitable tool such as a clean paint scraper until fully seated in bore.
4. Install new inner and outer brake pads
5. See Figure 1-16. Install hanger pin (4) making sure pin engages hole on both pads.
6. Install brake caliper and carrier assembly over rotor.
7. Apply LOCTITE 272 (red) and install two mounting fasteners (1) through swingarm into carrier and tighten to 24-26 ft-lbs (32.5-35 Nm).
8. Tighten hanger pin to 11-14 ft-lbs (14.9-18.9 Nm).
9. Install pin plug (3). Tighten plug to 24 in-lbs (3 Nm).
10. Install fastener securing p-clamp and brake line assembly to swingarm and tighten to 36-60 in-lbs (4.1-6.8 Nm).
11. On XB12SS models, install rear fender. See 2.34 FENDERS.
12. Check fluid level.

**NOTE**
Avoid making hard stops for the first 100 miles (160 km) to allow new brake pads to “wear in” properly with the rotor.
TIRES AND WHEELS

TIRE INFLATION

WARNING
Use only Buell approved tires. See a Buell dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00133a)

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)

Check tire pressure and tread:
- Before every ride.

Check for proper front and rear tire pressures when tires are cold. Compare pressure against Table 1-7.

Table 1-7. Tire Pressures

<table>
<thead>
<tr>
<th>TIRE</th>
<th>PRESSURE FOR SOLO RIDING</th>
<th>PRESSURE AT GVWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunlop</td>
<td>Front 36 PSI 248 kPa</td>
<td>Same as solo riding</td>
</tr>
<tr>
<td></td>
<td>Rear 38 PSI 262 kPa</td>
<td></td>
</tr>
<tr>
<td>Pirelli</td>
<td>Front 34 PSI 234 kPa</td>
<td>Same as solo riding</td>
</tr>
<tr>
<td></td>
<td>Rear 36 PSI 248 kPa</td>
<td></td>
</tr>
</tbody>
</table>

TIRE REPLACEMENT

See Figure 1-18. Treadwear indicator bars will appear on tire tread surfaces when 1/32 in. (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 treadwear indicator bars (1/32 in. [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, snaps 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.

WHEEL BEARINGS

WARNING
Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which could result in death or serious injury.

Check front and rear wheel bearings for wear:
- Every time a wheel is removed.
- When storing or removing the motorcycle for the season.

Check wheel bearings for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only.

Figure 1-18. Tire Wear Indicator—Dunlop Only

Figure 1-19. Tire Tread Pattern and Wear Bar—Pirelli Scorpion Sync
GENERAL

Transmission fluid capacity is approximately 1.0 quart (0.95 liter). For best results, drain fluid while hot.

TRANSMISSION FLUID

1. When the engine reaches normal operating temperature, turn the engine off and position motorcycle on jiffy stand, this will allow the chaincase lubricant to drain out of the transmission.

   **CAUTION**

   When draining or adding lubricant, do not allow dirt, debris or other contaminants to enter the engine.

2. See Figure 1-21. Position a suitable container under drain plug. Remove plug and drain fluid.

3. Position the motorcycle STRAIGHT UP and LEVEL. This allows additional fluid to be drained from clutch compartment and will prevent chaincase lubricant from draining out of clutch cover opening when refilled.

4. Inspect and replace the drain plug o-ring.

5. Wipe any foreign material from the magnetic drain plug and apply LOCTITE 565 THREAD SEALANT. Reinstall plug and tighten to 14-30 ft-lbs (19-41 Nm).

6. Remove three fasteners and washers from clutch inspection cover. Remove clutch inspection cover with gasket from primary cover.

   **CAUTION**

   Do not overfill the primary chaincase/transmission with lubricant. Overfilling can cause rough clutch engagement, incomplete disengagement, clutch drag and/or difficulty in finding neutral at engine idle.

7. See Figure 1-22. Add FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) quart size as required until fluid level (4) is even with bottom of clutch diaphragm spring (1).

   **NOTE**

   Each time the clutch inspection cover is removed the gasket must be replaced.

8. Install new clutch cover gasket.

9. See Figure 1-20. Install clutch inspection cover tightening three fasteners and washers to 84-108 in-lbs (10-12 Nm).

10. Clean up any fluid that may have spilled on muffler.
If clutch slips under load or drags when released, first check control cable adjustment. If cable adjustment is within specifications, adjust clutch mechanism as described below.

When necessary, lubricate cable with LUBIT® TUFOIL® CHAIN AND CABLE LUBE (Part No. HD-94988-85TV).

1. To prevent lubricant from draining out when clutch inspection cover is removed, position the motorcycle straight up and level.
2. See Figure 1-23. Slide rubber boot (1) upward to expose adjuster mechanism. Loosen jam nut (3) from adjuster (4). Turn adjuster to shorten cable housing until there is a large amount of free play at clutch hand lever.
3. See Figure 1-20. Remove three fasteners and washers from clutch inspection cover. Remove clutch inspection cover and gasket from primary cover.
4. See Figure 1-24. Remove spring (1) and lockplate (2). Using a flat tip screwdriver, turn adjusting screw (3) counterclockwise until it lightly bottoms.
5. Turn adjusting screw clockwise 1/4-1/2 turn. Install lockplate and spring on adjusting screw flats. If hex on lockplate does not align with recess in outer ramp, rotate adjusting screw clockwise until it aligns.

**NOTE**
Spring installs on outboard side of hex lockplate.
6. Squeeze clutch hand lever to maximum limit three times. This sets the ball and ramp mechanism. Pull outer cable conduit and at the same time adjust cable adjuster to provide 1/16-1/8 in. (1.6-3.2 mm) free play at clutch hand lever. Adjust as follows:
   a. See Figure 1-25. Pull ferrule (end of cable housing) away from bracket. Gap between ferrule and bracket should be 1/16-1/8 in. (1.6-3.2 mm).
   b. See Figure 1-23. Set free play by turning adjuster (4).
   c. Tighten jam nut (3) against adjuster (4).
   d. Slide boot (1) over cable adjuster mechanism.

7. Change or add transmission fluid if necessary.

NOTE
Each time the clutch inspection cover is removed the gasket must be replaced.

8. See Figure 1-20. Install clutch inspection cover and new gasket using three fasteners and washers and tighten to 84-108 in-lbs (10-12 Nm).
GENERAL

The drive belt tension on a new belt will loosen after approximately 1000 mi (1600 km). The drive belt tension is automatically adjusted by the idler pulley. Axle alignment is not adjustable.

INSPECTION

Rear Sprocket

NOTE

If gouges to rear sprocket are large enough to be harmful, they will leave a pattern on the belt face.

1. Inspect each tooth of rear sprocket for:
   a. Major tooth damage.
   b. Large coating chips larger than 1/4” (6.35 mm) missing/removed.
   c. Gouges caused by hard objects.

2. Replace rear sprocket if major tooth damage or loss of coating in an area 1/4” (6.35 mm) or larger occurs.

Drive Belt

Refer to Table 1-8. Inspect drive belt for:

- Cuts or unusual wear patterns on both sides of belt.
- Outside edge beveling. Some beveling is common, but it indicates that sprockets are misaligned.
- Outside surface for signs of stone puncture. 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 facing fabric). 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.

Idler Pulley

See Figure 1-26. Inspect idler pulley for signs of uneven wear. Excessive lateral side play of 0.020 in. (0.5 mm) or roughness indicates worn bearings. Replace idler pulley as an assembly.

CLEANING

Keep dirt, grease, oil, and debris off the belt, idler pulley and sprockets. Clean the drive belt with a mild soap and water spray solution as required. Dry thoroughly. Do not immerse belt in solution. Do not direct pressurized water on belt.
Table 1-8. Potential Limits to Belt Drive Service Life

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>ROOT CAUSE</th>
<th>REQUIRED ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive Edge Wear (mistracking)</td>
<td>Excessive Edge Wear (mistracking)</td>
<td>Excessive Edge Wear (mistracking)</td>
</tr>
<tr>
<td></td>
<td>Misalignment or bent drive structure</td>
<td>Check structure (bad bearing, bent members, etc.)</td>
</tr>
<tr>
<td></td>
<td>Bent or rough flange</td>
<td>Repair flange/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Damage due to handling (pry on, etc.)</td>
<td>Follow proper handling/installation procedure</td>
</tr>
<tr>
<td></td>
<td>Debris damage to edge of belt</td>
<td>Inspect/replace belt</td>
</tr>
<tr>
<td></td>
<td>Belt hitting obstruction</td>
<td>Check structure (bad bearing, bent members, etc.)</td>
</tr>
<tr>
<td></td>
<td>Bent or loose idler bracket</td>
<td>Replace idler assembly</td>
</tr>
<tr>
<td></td>
<td>Broken or loose guards</td>
<td>Check structure (bad bearing, bent members, etc.)</td>
</tr>
<tr>
<td>Excessive tooth wear</td>
<td>Excessive tooth wear</td>
<td>Excessive tooth wear</td>
</tr>
<tr>
<td>NOTE</td>
<td>The drive belt tension on a new belt will loosen after approximately 1000 mi (1600 km)</td>
<td>The drive belt tension on a new belt will loosen after approximately 1000 mi (1600 km)</td>
</tr>
<tr>
<td>Rough or damaged sprocket</td>
<td>Rough or damaged sprocket</td>
<td>Rough or damaged sprocket</td>
</tr>
<tr>
<td></td>
<td>Worn sprocket</td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Debris in sprocket</td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Abrasive environment</td>
<td>Inspect for damaged or missing guards</td>
</tr>
<tr>
<td>Apparent belt stretch</td>
<td>Apparent belt stretch</td>
<td>Apparent belt stretch</td>
</tr>
<tr>
<td></td>
<td>Worn sprocket</td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Debris in sprocket</td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Idler bearing failure</td>
<td>Replace idler assembly</td>
</tr>
<tr>
<td></td>
<td>Aggressive riding/hard use</td>
<td>Select idler assembly</td>
</tr>
<tr>
<td></td>
<td>Exposure to oils, solvents, harsh chemicals</td>
<td>Clean and protect drive</td>
</tr>
<tr>
<td></td>
<td>Exposure to oils, solvents, harsh chemicals</td>
<td>Clean and protect drive</td>
</tr>
<tr>
<td></td>
<td>Idler/bearing binding</td>
<td>Replace idler assembly</td>
</tr>
<tr>
<td></td>
<td>Exposure to oils, solvents, harsh chemicals</td>
<td>Clean and protect drive</td>
</tr>
<tr>
<td></td>
<td>Cut by sharp debris (not at belt edge)</td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td>Cut by sharp debris at belt edge</td>
<td>Inspect/replace belt</td>
</tr>
</tbody>
</table>
### Table 1-8. Potential Limits to Belt Drive Service Life

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>ROOT CAUSE</th>
<th>REQUIRED ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth shear/cracks</td>
<td><strong>Excessive load/shock load</strong></td>
<td>Inspect/replace belt</td>
</tr>
<tr>
<td></td>
<td><strong>Worn sprocket</strong></td>
<td>Riding practice/operator choice</td>
</tr>
<tr>
<td></td>
<td><strong>Debris damage</strong></td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace sprocket</strong></td>
<td>Clean and protect drive</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Continue to run but monitor condition frequently</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Inspect for damaged or missing guards</strong></td>
<td></td>
</tr>
<tr>
<td>Belt breakage</td>
<td><strong>Excessive load/Shock load</strong></td>
<td>Inspect/replace belt</td>
</tr>
<tr>
<td></td>
<td><strong>Riding practice/operator choice</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Damage due to handling (pry-on, etc.)</strong></td>
<td>Follow proper handling/installation procedure</td>
</tr>
<tr>
<td></td>
<td><strong>Debris in sprocket or belt</strong></td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace sprocket</strong></td>
<td>Clean and protect drive</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td>Excessive drive noise</td>
<td><strong>Worn/damaged sprocket</strong></td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Missing/damaged belt guards</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Damaged flange</strong></td>
<td>Repair flange/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Damaged idler</strong></td>
<td>Check structure (bad bearing, bent members, etc.)</td>
</tr>
<tr>
<td></td>
<td><strong>Replace idler assembly</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Damaged belt</strong></td>
<td>Follow proper handling/installation procedure</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Clean and protect drive</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Missing/damaged belt guards</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Debris stuck in belt</strong></td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace sprocket</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Missing/damaged belt guards</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Debris stuck in sprocket</strong></td>
<td>Inspect/replace sprocket</td>
</tr>
<tr>
<td></td>
<td><strong>Follow proper handling/installation procedure</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Inspect/replace belt</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Missing/damaged belt guards</strong></td>
<td></td>
</tr>
</tbody>
</table>
INSPECTION

See Figure 1-27. Measure primary chain tension through the inspection cover opening. Adjust primary chains not meeting vertical free play specifications.

1. See Figure 1-27. Remove two fasteners with captive washers and primary chain inspection cover with gasket from primary cover.

2. See Figure 1-28. Check primary chain tension by measuring vertical free play.
   a. Measure vertical free play through chain inspection cover opening.
   b. Rotate engine to move primary chain to a different position on sprockets.
   c. Measure vertical free play several times, each time with primary chain moved so that the measurement is taken with sprockets rotated to the tightest chain position.

3. The tightest measurement taken in Step 2 must be within the specifications listed in Table 1-9. If necessary, adjust as described under 1.10 PRIMARY CHAIN in ADJUSTMENT.

   NOTE
   The initial primary chain vertical free play specification used at the assembly plant is 1/4-1/2 in. (6.4-12.7 mm) with a cold engine. The 1/4 in. (6.4 mm) minimum is only allowed at the absolute tightest point in the drive, as measured with specialized factory equipment. If a chain has less than 1/4 in. (6.4 mm) vertical free play (with a cold engine), adjust free play to the "field" specification of 3/8-1/2 in. (9.5-12.7 mm). The looser specification will avoid overtightening, which might otherwise occur during adjustment using "non-factory" equipment and methods.

4. See Figure 1-27. Install primary chain inspection cover and new gasket to primary cover using two fasteners with captive washers. Tighten fasteners to 84-108 in-lbs (10-12 Nm).

Table 1-9. Primary Chain Free Play

<table>
<thead>
<tr>
<th>ENGINE TEMPERATURE</th>
<th>in.</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold</td>
<td>3/8-1/2</td>
<td>9.5-12.7</td>
</tr>
<tr>
<td>Hot (normal running temperature)</td>
<td>1/4-3/8</td>
<td>6.4-9.5</td>
</tr>
</tbody>
</table>
NOTE
If vertical free play cannot be set within the limits specified, then primary chain and/or chain adjuster are worn beyond adjustment limits. Replace parts as necessary. See 6.5 PRIMARY CHAIN.

1. See Figure 1-29. Loosen locknut (1).
2. Turn adjusting fastener (2):
   a. Clockwise (inward) to reduce free play.
   b. Counterclockwise (outward) to increase free play.
3. Tighten locknut (1) to 20-25 ft-lbs (27-34 Nm).

Figure 1-29. Chain Tension Adjusting Fastener
GENERAL

WARNING

Before evaluating and adjusting suspension settings, check the motorcycle’s tires. Be sure tires are properly inflated, balanced and have adequate tread. Inspect your tires regularly and see a Buell dealer for replacements. Riding with excessively worn, unbalanced or under-inflated tires can adversely affect stability and handling, which could result in death or serious injury. (00114a)

Make all suspension adjustments in one or two click increments. Adjusting more than one or two clicks at a time may cause you to skip the best adjustment. Test ride after each adjustment. When an adjustment makes no difference, return to the previous adjustment and try a different approach. If both preload adjustments are correct, and you have the rebound and compression damping set at the factory recommended points, the motorcycle should handle and ride properly. If you wish to fine tune these settings they can be changed according to the following procedures.

NOTE

Evaluating and changing the rebound and compression damping is a very subjective process. Many variables affect motorcycle handling under different circumstances. Approach all changes carefully and consult Table 1-10.

FINE TUNING SUSPENSION:
BUELL MODELS

The settings are the best balance of handling, ride, and stability. Suspension can be changed to accommodate rider preferences for ride quality and handling for road conditions and load changes.

NOTES

- Do not continue to repeat the steps involved with the following settings beyond those which are listed.
- Adjust suspension to the recommendation if possible, but never force adjusters beyond the mechanical stops.

WARNING

Do not exceed the motorcycle Gross Vehicle Weight Rating (GVWR). Exceeding the GVWR can affect stability and handling, which could result in death or serious injury. (00016a)

- GVWR is the sum of the weight of the motorcycle, accessories, and the maximum weight of the rider, passenger and cargo that can be safely carried.
- The GVWR is shown on the information plate, located on the frame steering head.

Ride Quality Enhancement

The stock settings are designed to offer sufficient chassis control, but some may choose to enhance ride comfort over rougher road conditions or for long rides. Adjusting the compression setting will reduce both high and low speed damping.

1. Adjust suspension for rider weight. Refer to Table 1-10, and Table 1-11.

2. Increase ride quality by reducing front and rear compression damping by turning adjuster counterclockwise 1/4-1 turn.

3. If additional ride quality is desired, reduce front preload by turning adjuster counterclockwise until an additional line is visible and also reduce rear preload 1 position.

4. If maximum ride quality is desired, decrease front and rear rebound damping by turning adjusters counterclockwise by 1/4-1/2 turn.

Enhanced Steering Quickness

The response to steering input (quickness) may be enhanced by adjusting the vehicles front/rear ride height. This adjustment effectively decreases the vehicles rake angle. This is achieved by adjusting the preload to increase front sag and reduce rear sag.

1. Adjust suspension for rider weight. Refer to Table 1-10, and Table 1-11.

2. Reduce steering effort by increasing the rear preload one position.

3. If more enhanced steering and cornering control is desired, reduce front preload by turning adjuster counterclockwise until an additional line is visible.

4. If additional enhanced steering and cornering control is desired, increase rear compression damping by turning adjuster clockwise by 1/4-1/2 turn.

5. If maximum enhanced steering and cornering control is desired, increase front rebound damping by turning adjuster clockwise 1/4 turn.

Changes in Load

Changes in the load carried requires changes in the preload setting(s). Carrying less weight than was used for setting up the suspension requires decreasing the amount of preload. Increasing the load carried requires adding more preload.
Chassis Control/Handling Enhancement

To provide more road surface feedback on smoother road conditions, increase compression and rebound settings.

1. Adjust suspension for rider weight. Refer to Table 1-10 and Table 1-11.
2. Increase chassis/handling control by increasing front and rear compression damping by turning adjuster clockwise by 1/2-1 1/2 turns.
3. If maximum chassis control/handling control is desired, increase front and rear rebound damping by turning adjuster clockwise by 1/4-1/2 turn.

Cold Weather Riding Less Than 65° F (18° C)

The viscosity of the suspension fluid increases as the temperature decreases. As the fluid viscosity increases so does the damping. It is recommended to compensate for the varying fluid viscosity by readjusting the damping adjuster positions when operating outside the normal ambient temperature range of 65-95° F (18-35° C).

1. Adjust suspension for rider weight. Refer to Table 1-10 and Table 1-11.
2. Reduce front and rear compression damping and rebound damping by turning adjuster counterclockwise 1/4-1/2 turn.

| Table 1-10. Recommended Suspension Settings for Rider Weight (XB9SX, XB12S) |
|------------------|----------------|------------------|----------------|----------------|----------------|
| RIDER AND CARGO WEIGHT | FRONT FORK | REAR SHOCK |
| LB. | KG | PRELOAD # OF LINES | COMPRESSION | REBOUND | COMPRESSION | REBOUND |
| Less than 130 | 59 | 7 | 2 | 1.75 | 1 | 2.50 | 2 |
| 130-150 | 59-68 | 6.5 | 1.75 | 1.75 | 2 | 2.25 | 1.75 |
| 150-170 | 68-77 | 6 | 1.50 | 1.625 | 3 | 2 | 1.50 |
| 170-190 | 77-86 | 5.5 | 1.50 | 1.50 | 4 | 1.75 | 1.50 |
| 190-210 | 86-95 | 5 | 1.25 | 1.50 | 5 | 1.50 | 1.25 |
| 210-230 | 95-104 | 4.5 | 1.25 | 1.50 | 6 | 1.25 | 1 |
| 230-GVWR | 104-GVWR | 4 | 1 | 1.25 | 7 | 1.25 | 1 |

* Note all compression and rebound settings are number of turns out from maximum.

| Table 1-11. Recommended Suspension Settings for Rider Weight (XB12Scg) |
|------------------|----------------|----------------|----------------|----------------|----------------|
| RIDER AND CARGO WEIGHT | FRONT FORK | REAR SHOCK |
| LB. | KG | PRELOAD # OF LINES | COMPRESSION | REBOUND | COMPRESSION | REBOUND |
| Less than 150 | 68 | 6 | 1.75 | 1.75 | 1 | 3 | 2 |
| 150-170 | 68-77 | 5.5 | 1.75 | 1.5 | 2 | 2.5 | 1.25 |
| 170-190 | 77-86 | 5 | 1.50 | 1.5 | 3 | 2.25 | 1.25 |
| 190-210 | 86-95 | 4.5 | 1.50 | 1.25 | 4 | 2 | 1 |
| 210-230 | 95-104 | 4 | 1.25 | 1.25 | 5 | 1.75 | 1 |
| 230-250 | 104-113 | 3.5 | 1.25 | 1 | 6 | 1.5 | 0.75 |
| 250-GVWR | 113-GVWR | 3 | 1 | 1 | 7 | 1.25 | 0.75 |

* Note all compression and rebound settings are number of turns out from maximum.
SUSPENSION ADJUSTMENTS

WARNING
Both forks should display the same number of alignment lines. Forks that are not properly aligned can lead to loss of control, which could result in death or serious injury. (00124a)

NOTE
All “turn settings” in Table 1-10 and Table 1-11 are “turns out from maximum.” That is, first gently turn adjustment screws fully clockwise (until they stop), then turn adjustment screws counterclockwise the amount specified.

The recommended rebound and compression damping settings for various road and riding conditions are given in Table 1-10 and Table 1-11.

Setting Front Fork Preload
1. Check number of lines (3) to be showing for your load condition. Refer to Table 1-10 and Table 1-11.
2. See Figure 1-30. Adjust preload by turning the adjuster nut (2) with a wrench.

Setting Front Fork Rebound Damping
1. See Figure 1-30. Using a screwdriver, turn the slotted dial (1) clockwise until it stops. This is the maximum rebound damping setting.
2. Then turn the dial counterclockwise the recommended amount specified in Table 1-10 and Table 1-11.

Setting Front Fork Compression Damping
1. See Figure 1-31. Using a screwdriver, turn the slotted dial clockwise until it stops. This is the maximum compression damping setting.
2. Then turn the dial counterclockwise the recommended amount specified in Table 1-10 and Table 1-11.

Table 1-12. Recommended Suspension Settings for Rider Weight (XB12Ss)

<table>
<thead>
<tr>
<th>RIDER AND CARGO WEIGHT</th>
<th>FRONT FORK</th>
<th>REAR SHOCK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRELOAD # OF LINES</td>
<td>COMPRESSION</td>
</tr>
<tr>
<td>Less than 140</td>
<td>Less than 63</td>
<td>7</td>
</tr>
<tr>
<td>140-170</td>
<td>63-77</td>
<td>7</td>
</tr>
<tr>
<td>170-200</td>
<td>77-91</td>
<td>7</td>
</tr>
<tr>
<td>200-230</td>
<td>91-104</td>
<td>7</td>
</tr>
<tr>
<td>230-250</td>
<td>104-118</td>
<td>6.50</td>
</tr>
<tr>
<td>260-290</td>
<td>118-132</td>
<td>6.50</td>
</tr>
<tr>
<td>290-GVWR</td>
<td>132-GVWR</td>
<td>6.50</td>
</tr>
</tbody>
</table>

* Note all compression and rebound settings are number of turns out from maximum.
Setting Rear Shock Preload

The factory setting is ramp number 2 position (ramp number 7 position being the tallest ramp and maximum preload). For recommended spring preload refer to Table 1-10, or Table 1-11.

1. Remove seat. See 2.43 SEAT.

2. See Figure 1-32. Change the spring preload by turning the preload adjuster at the upper part of the shock with the SHOCK SPANNER WRENCH (HD-94700-52C) or the wrench included in the tool kit.
   a. Turn adjuster to setting specified in Table 1-10, Table 1-11, or Table 1-13. Rotate adjuster clockwise to increase preload.
   b. Rotate adjuster counterclockwise to decrease preload.

   WARNING

   After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat. See 2.43 SEAT.

Setting Rear Shock Rebound Damping

1. See Figure 1-33. Using a screwdriver, turn the slotted dial clockwise until it stops. This is the maximum rebound damping setting.

2. Then turn the dial counterclockwise the recommended amount specified in Table 1-10, Table 1-11, or Table 1-13.
Setting Rear Shock Compression Damping

1. For all Lightning XB models except the Long XB12Ss, remove the seat. See 2.43 SEAT.

2. Using a screwdriver, turn the slotted dial clockwise until it stops. This is the maximum compression damping setting.

   **NOTE:**
   - See Figure 1-35. For the Lightning Long XB12Ss, the rear shock compression damping adjustor screw is accessible through the opening in the right side tail section.
   - See Figure 1-34. For all other XB models, the rear shock compression damping adjustor screw is found under the seat.

3. Then turn the dial counterclockwise the recommended amount specified in Table 1-10., Table 1-11. or Table 1-13.

   **WARNING**
   - After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. If removed, install seat. See 2.43 SEAT.
GENERAL

The steering head bearings are sealed, angular contact bearings and do not require additional lubrication.

Check steering head bearing resistance:
- At every 5000 mile (8000 km) service interval.
- When storing or removing the motorcycle for the season.

INSPECTION

NOTES
- Check that throttle cables do not bind when measuring bearing resistance.
- Steering head bearings are sealed and do not require additional lubrication.
- Steering head bearing resistance is not adjustable. Replace bearings that do not meet resistance specifications.

1. Detach clutch cable at handlebar. See 1.8 CLUTCH.
2. Place a scissor jack under jacking point and raise front wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.

WARNING

Steering must be smooth and free with no binding or interference. Do not operate motorcycle with loose, worn or damaged steering or suspension systems. Contact a Buell dealer for repairs. Loose, worn or damaged steering or suspension components can adversely affect stability and handling, which could result in death or serious injury. (00113a)

3. Check steering stem bearings for notches by turning front wheel full right and then left. Repeat if necessary.
4. Next place wheel facing straight ahead and grabbing both fork sides at the bottom move front end forward and back to check for steering head play.
5. To inspect for correct steering head resistance turn front wheel all the way to the right.
6. See Figure 1-36. Hook a spring scale into the hole in the front axle. With scale 90 degrees from fork leg, pull front wheel to center position.

DETERMINING PROPER RESISTANCE

1. Detach clutch cable at handlebar and ensure that throttle cables do not bind before measuring steering head bearing resistance.
2. Remove steering stem pinch fastener at upper triple clamp.
3. Loosen steering stem capnut and back off several turns.
4. Remove lower triple clamp pinch fasteners, two per side.
5. Tighten steering stem capnut to 38-42 ft-lbs (52-57 Nm).
6. Turn front wheel all the way to the right.
7. See Figure 1-36. Hook a spring scale into the hole in the front axle. With scale 90 degrees from fork leg, pull front wheel to center position.
8. The desired resistance is between 1-7 lbs (0.5-3.2 kg).

NOTE

If the correct specification cannot be achieved, the steering head bearings must be replaced. See 2.18 STEERING HEAD BEARINGS.

9. Once correct steering head resistance has been verified, apply LOCTITE 272 to steering stem pinch bolt, install and tighten to 23-25 ft-lbs (31.1-33.8 Nm) XB9SX only. All other models 20-22 ft-lbs (27-29.8 Nm).
10. Apply LOCTITE 272 to lower triple clamp fasteners, install and tighten to 20-22 ft-lbs (27-29.8 Nm).
11. When adjustment is complete, attach clutch cable and adjust. See 1.8 CLUTCH.
12. Remove scissor jack.
SPARK PLUGS

INSPECTION

Check spark plugs:

- Replace every 10,000 mile (16,000 km) service interval.
- Use only Harley-Davidson 10R12A spark plugs.

1. Remove left side air scoop to access front cylinder spark plug. See 2.38 AIR SCOOPS.
2. Disconnect spark plug wire from front spark plug.
3. Using a 5/8 in. box end wrench and 5/8 in. spark plug socket, remove front spark plug.
4. Remove seat. See 2.43 SEAT.
5. Remove air cleaner assembly. See 2.37 INTAKE COVER ASSEMBLY/4.44 AIR CLEANER ASSEMBLY.
6. Disconnect spark plug wire from rear spark plug (use automotive spark plug boot remover/installer if required).
7. Using a 5/8 in. wobble socket and 12 in. extension, remove rear spark plug.
8. See Figure 1-37. Compare your observations of the plug deposits with the descriptions provided below.

   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 and/or engine idling for excessive periods.

   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.

Figure 1-37. Typical Spark Plug Deposits
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)

9. If the plugs require cleaning between tune-ups and replacement plugs are not available, 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.

10. If the plugs cannot be cleaned, replace with 10R12A spark plugs.

11. Check electrode gap with a wire-type feeler gauge. Gap should be 0.035 in. (0.9 mm).

12. Apply LOCTITE ANTI-SEIZE to threads of spark plugs. Install and tighten spark plugs to 12-18 ft-lbs (16-24 Nm).

   **NOTES**
   - Start threading rear spark plug with 3/8" fuel hose being careful not to cross thread spark plug.
   - Start front spark plug with fingers.
   - An extension may be needed to push on rear spark plug boot to ensure it is seated properly.

13. Connect spark plug wires. Verify that wires are securely connected to coil and spark plugs. See 7.4 SPARK PLUG CABLES.

14. Install left side air scoop. See 2.38 AIR SCOOPS.

15. Install air cleaner assembly. See 2.37 INTAKE COVER ASSEMBLY/4.44 AIR CLEANER ASSEMBLY.

## WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

16. Install seat. See 2.43 SEAT.
REMOVAL

CAUTION
Install air filter before running engine. Failure to do so can draw debris into the engine and could result in engine damage. (00207a)

Check air cleaner filter element:
- Inspect at the 1000 mile (1600 km) service interval and at every 5000 mile (8000 km) service interval thereafter.
- Replace at every 20,000 mile (32,000 km) service interval.

NOTES
- Inspect and replace air cleaner filter element more often if the motorcycle is run in a dusty environment.
- See Figure 1-39. Do not cover or restrict the air intake screen. Certain tank bags or accessories may cover or restrict the air intake screen. This may reduce power and performance.

1. Remove seat. See 2.43 SEAT.
2. Remove four fasteners, nylon washers and intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
3. See Figure 1-40, or Figure 1-42. Remove fuel vent tube (4) from vapor valve (6) at front of air cleaner cover and groove on top of air cleaner cover (1).
4. See Figure 1-43. Unlatch six latching tabs and remove air cleaner cover from baseplate.
5. See Figure 1-44. Remove the filter element (1) from baseplate (2). Inspect and replace if necessary.

CAUTION
See Figure 1-44. Cover the velocity stack so nothing can drop into the motor.

CLEANING AND INSPECTION

WARNING
Do not use gasoline or solvents to clean filter element. Flammable cleaning agents can cause an intake system fire, which could result in death or serious injury. (00101a)

1. Check filter element. Hold filter element up to strong light source. The element can be considered sufficiently clean if light is uniformly visible through the element.
2. Thoroughly clean baseplate and inside of air cleaner cover.
3. See Figure 1-45. Make sure two crankcase breather hoses (1) and intake air sensor (2) are captured in baseplate behind velocity stack (3).
1. See Figure 1-44. Place filter element (1) on baseplate (2).
2. See Figure 1-40. Position air cleaner cover (1) over baseplate. Make sure air filter remains correctly positioned.
3. Install air cleaner cover by latching latch tabs to baseplate.
4. For XB12 models, verify that the actuator cable and harness are located in the grooves in the air cleaner cover.

**CAUTION**
The vent tube is now a larger outer diameter than previous and requires extra effort to install into the functional air cleaner assembly. Failure to properly install vent line will result in cosmetic damage to the inside of the translucent intake cover assembly.

5. Position fuel vent tube (3) in groove on top of air cleaner cover and connect to fuel vent valve (6). Secure vent tube to vent valve with new cable strap.

**NOTE**
If necessary, adjust interactive exhaust cable. See 1.16 INTERACTIVE EXHAUST CABLE (XB12 MODELS).

6. Install intake cover assembly with four fasteners and nylon washers. Tighten fasteners to 12–36 in-lbs (4–4 Nm).

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.
THROTTLE CABLE

WARNING

Throttle cables must not pull tight when handlebars are turned fully to left or right fork stops. Be sure wires and throttle cables are clear of fork stops at steering head so they will not be pinched when fork is turned against stops. Steering must be smooth and free with no binding or interference. Anything interfering with steering system operation may cause loss of vehicle control, which could result in death or serious injury.

NOTE

If replacing the idle adjustment cable it will be necessary to apply anti-seize to the threads before installing to the throttle body assembly.

Check throttle cable adjustment:

- Before every ride.
- At every scheduled service interval.

With engine running, turn handlebars through full range of travel. If engine speed changes during this maneuver, turn engine OFF and adjust throttle cables as follows:

1. If removing the throttle cable, remove the air cleaner cover and baseplate. See 4.44 AIR CLEANER ASSEMBLY.
2. Remove the left air scoop. See 2.38 AIR SCOOPS.
3. See Figure 1-46. Loosen cable adjuster lock (5) on each.
4. Turn adjusters (4) in direction which will shorten cable housings to minimum length.
5. Point front wheel straight ahead. Twist throttle control grip to fully open position; hold in position.
6. Turn adjuster on throttle control cable (2) until throttle cam stop touches stop plate. Tighten cable adjuster lock on throttle control cable adjuster; release throttle control grip.
7. Turn handlebars fully to right. Turn adjuster on idle control cable (3) until end of cable housing just touches the cable guide.
8. Twist and release throttle control grip a few times. Throttle plate must return to idle position each time throttle grip is released. If this is not the case, turn adjuster on idle control cable (shortening cable housing) until throttle control functions properly.
9. Tighten cable adjuster lock on idle control cable. Recheck operation of throttle control.
10. Recheck engine slow idle speed; adjust if required.
11. Install air scoop. See 2.38 AIR SCOOPS.
12. If removed, install baseplate, air cleaner, and intake cover assembly. See 4.44 AIR CLEANER ASSEMBLY.

IDLE SPEED

See Figure 1-47. Regular idle speed is 1050 - 1150 RPM. Set idle speed using idle adjuster (2). Turn adjuster clockwise to increase idle speed or counterclockwise to decrease idle speed.

NOTE

Run vehicle until engine temperature is 320 °F (160 °C) then adjust idle speed to 1050 - 1150 RPM.
ADJUSTMENT

1. Remove four fasteners, nylon washers and intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.

- The actuator cover used on models with Translucent body panels does not need to be removed in order to adjust cable.
- When the ignition/light switch is turned off with the interactive exhaust valve in motion, the valve will stop partially open which will cause an inaccurate adjustment. For a description of the inactive exhaust operation, see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

2. To close the valve in the muffler, cycle the actuator:
   a. Hold the throttle wide open.
   b. Turn the engine cut-off switch to RUN.
   c. Turn the ignition/light key switch ON.
   d. Watch the actuator cycle close/open/close.

3. See Figure 1-48. Loosen jam nut (3).

4. Using a pair of pliers, fully open the exhaust valve in the muffler by pulling the cable core by the ferule that was disconnected from the cable wheel in the previous step until resistance is felt. Be careful not to damage the cable core.

5. Mark the cable core with the marker all the way around where it comes out of the housing.

6. Release the cable core and reattach the cable to the cable wheel and bracket.

7. Tighten jam nut.

8. See Figure 1-49. Adjust interactive exhaust cable as follows:
   a. Move cable with your fingers from side to side. There should be no more than 1/8 in. (3.2 mm) side play in cable in either direction with 1/4 in. (6.4 mm) maximum overall side play.
   b. Adjust cable as needed using cable adjuster (1).

CAUTION

Do not overtighten jam nut on interactive exhaust cable.
10. Cycle the actuator to verify cable and valve operation:
   a. Hold the throttle wide open.
   b. Turn the engine cut-off switch to RUN.
   c. Turn the ignition/light key switch ON.
   d. Watch the actuator cycle close/open/close.

   **CAUTION**
   DO NOT start vehicle in this mode.

   **NOTE**
   In this mode the exhaust valve in the interactive muffler should cycle from the closed position to the wide open position and back to the closed. When the exhaust valve moves to the open position, you should see the mark on the cable core made previously. This ensures the system is working properly. If you do not see the mark, verify previous cable adjustment.

11. See Figure 1-50. Verify that the interactive exhaust cable (1) is routed behind the frame lug (2) before installing air intake cover.

   **CAUTION**
   If cable is routed in front of the frame lug it will cause the muffler valve to stay open not allowing it to work properly.

12. Install air intake cover. See 2.37 INTAKE COVER ASSEMBLY.
IGNITION TIMING

INSPECTION

Check ignition timing: after each removal of the cam position sensor.

CHECKING STATIC TIMING

CAUTION
Always wear proper eye protection when drilling. Flying debris may result in minor or moderate injury.

NOTES
● It is not necessary to remove the spark plug to determine TDC compression stroke of the front cylinder in the following procedure.
● Do not remove the timing inspection cover to check the static timing. If timing must be corrected, the inspection plate will then be removed.

1. Raise rear wheel using a lift or jacking point. Tie down motorcycle for additional support.
2. Remove timing inspection plug.
3. Place transmission in 5th gear.
4. Connect Digital Technician to data port on motorcycle and select the Static Timing procedure screen.
5. Turn on ignition and move handlebar stop switch to the run position. Listen for fuel pump cycling to confirm ignition is active.
6. Turn or gently bump the flywheel in a forward direction using the rear wheel. Position the flywheel TDC mark at the very left edge of the inspection hole.
7. If the engine is coming up on the compression stroke for the FRONT (correct) cylinder, the screen will be displaying LOW - 0 volts with timing mark at left edge of window.
8. Gently bump flywheel forward in tiny increments.
9. See Figure 1-52. If the static timing is correct, the screen will switch to HIGH - 5 volts at the precise moment the timing mark exactly centers in the inspection window.
10. If engine is coming up on the compression stroke for the REAR (incorrect) cylinder, the screen will be displaying HIGH - 5 volts as timing mark is just coming into view at left edge of window and will switch to LOW - 0 volts at same point as the timing mark continues through the window. (If this is observed, turn flywheel forward one revolution to bring engine to compression stroke for front cylinder.)

NOTES
● If timing mark check point is overshot, bump flywheel backwards till TDC mark is at left edge of inspection window and repeat test bumping flywheel in forward (normal) direction.
● Never confirm timing while bumping flywheel backwards. This will give you an incorrect reading.

11. If timing is correct, install timing inspection plug and tighten to 120-180 in-lbs (14-20 Nm). If timing is not correct, see ADJUST TIMING in this section.

Figure 1-51. Timing Plug

Figure 1-52. Correct Timing
ADJUST TIMING

1. See Figure 1-53. Remove timing plate cover.
   a. Drill rivets holding the timing plate cover.
   b. Using a hook, remove timing plate cover.
   c. Loosen timing plate fasteners.
2. See Figure 1-55. If timing is advanced (mark appears on left side of window) rotate timing plate counterclockwise.
3. Check timing. See CHECKING STATIC TIMING.
4. See Figure 1-56. If timing is retarded (mark appears on right side of window) rotate timing plate clockwise.
5. Tighten sensor plate fasteners to 15-30 in-lbs (1.7-3.4 Nm).
6. Recheck timing.
INSPECTION

WARNING
Do not modify ignition/light switch wiring to circumvent the automatic-on headlight feature. High visibility is an important consideration for motorcycle riders. Failure to have headlight on at all times could cause an accident, resulting in death or serious injury.

Check headlights for proper alignment:

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

1. In a location with low light, draw a horizontal line on a screen or wall that measures 29-31 in. (74-79 cm) above floor.

2. See Figure 1-57. Position motorcycle 25 ft (7.6 m) away from a screen or wall by measuring the distance from the front axle to the screen/wall.

3. Verify correct front and rear tire pressure. See 1.7 TIRES AND WHEELS.

4. Load vehicle with rider/passenger/cargo/accessories. Weight will compress vehicle suspension slightly.

5. Stand motorcycle upright with headlights aimed straight forward.

6. Check LOW beam (right lens) for alignment.
   a. See Figure 1-58. Turn ignition switch to IGN. Set handlebar headlamp switch to LOW beam position.
   b. Check that the correct pattern of light is a double rectangular pattern and is aligned with the horizontal line as shown in Figure 1-57.
   c. Adjust headlight alignment. See ADJUSTMENT which follows.

7. Check HIGH beam (left) for alignment.
   a. See Figure 1-58. Set handlebar headlamp switch to HIGH beam position.

   NOTE
   Low beam lamp will not stay illuminated when high beam is activated.

   b. Check that the correct pattern of light is a circular pattern and is centered on the horizontal line as shown in Figure 1-57.
   c. Adjust headlamp alignment. See ADJUSTMENT section.
Horizontal Alignment
See Figure 1-59. Loosen fasteners on right and left side of
headlight housing to adjust the horizontal alignment.

Vertical Alignment
See Figure 1-60. Loosen fastener on the bottom of headlight
housing to adjust the vertical alignment.

NOTE
Only loosen headlamp alignment fasteners enough to adjust
headlamp. Once headlights are aligned, tighten fasteners to
48-72 in-lbs (5.5-8 Nm).

Figure 1-59. Horizontal Headlamp Adjustment

Figure 1-60. Vertical Headlamp Adjustment
NOTE
If closed throttle TP degree reading is not between 5.1° - 6.2°,
TPS should be re-calibrated. See ADJUSTMENT below.

1. Connect vehicle to Digital Technician.
2. Select calibrations screen/TPS Function.
3. Select Buell TPS zero tab.
4. Select TP volts on screen.
5. See Figure 1-61. Back off idle adjustment until TP volts
stop decreasing and then continue to back out one full
turn.
6. Open and snap shut throttle control grip 2-3 times.

NOTE
This is to ensure that the throttle plate is completely closed
before beginning recalibration.

7. With ignition and run switch in the on position with
engine off and throttle in the closed position press the
TPS zero button at the bottom of the screen.
8. Select TPS zero button and perform TPS zero.

NOTE
When calibration is complete, dialogue box will appear on
Digital Tech screen with message display 'Command Sent
Successfully'; Press OK.

9. Turn idle adjustment cable screw clockwise until TPS
degrees read 5.2-5.6 degrees.
10. Run vehicle until engine temperature is at 320 °F (160°
C).
11. Set idle to 1050-1150 RPM.
GENERAL

**WARNING**
Do not store motorcycle with gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00033a)

If the motorcycle will not be operated for several months, such as during the winter season, there are several things which should be done to protect parts against corrosion, to preserve the battery and to prevent the buildup of gum and varnish in the fuel system.

1. Fill fuel tank and add a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions. Run engine until treated gasoline has had a chance to reach fuel injectors.
2. Remove battery and charge as needed to maintain the correct voltage. See 1.4 BATTERY MAINTENANCE.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs. See 1.13 SPARK PLUGS.
4. Adjust primary chain. See 1.10 PRIMARY CHAIN.
5. Check tire inflation. See 1.7 TIRES AND WHEELS. If the motorcycle will be stored for an extended period of time, securely support the motorcycle so that all weight is off the tires.

**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. (00295a)

6. Wash and polish body panels, molded-in-color and chrome plated surfaces.
7. If motorcycle is to be covered, use a material that will breathe, such as light canvas. Plastic materials that do not breathe promote the formation of condensation.

REMOVAL FROM STORAGE

**WARNING**
The clutch failing to disengage can cause loss of control, which could result in death or serious injury. Prior to starting after extended periods of storage, place transmission in gear and push vehicle back and forth several times to assure proper clutch disengagement. (00075a)

1. Charge and install battery. See 1.4 BATTERY MAINTENANCE.
2. Remove and inspect spark plugs. Replace if necessary. See 1.13 SPARK PLUGS.
3. Inspect air filter element. Replace if necessary. See 1.14 AIR CLEANER FILTER.
4. If fuel tank was drained, fill fuel tank with fresh gasoline.
5. Start the engine and run until it reaches normal operating temperature. Check fluids and refill to proper levels if required.
   a. Check engine oil level. See 1.5 ENGINE LUBRICATION SYSTEM.
   b. Check transmission fluid level. See 1.8 CLUTCH.
GENERAL

The following check list can be helpful in locating most operating troubles. Refer to the appropriate sections in this Service Manual for detailed procedures.

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over
1. Engine stop switch in OFF position.
2. Ignition key switch not ON.
3. Discharged battery or loose or corroded connections. (Solenoid chatters.)
4. Starter control relay or solenoid not functioning.
5. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
7. Starter interlock circuit malfunction.

Engine Turns Over But Does Not Start

NOTE
See 4.11 ENGINE CRANKS BUT WILL NOT START for specific tests.
1. Fuel tank empty.
2. Discharged battery, loose or broken battery terminal connections.
3. Fouled spark plugs.
4. Loose or shorting spark plug cables or connections.
5. Ignition timing badly out of adjustment.
6. Loose wire connection at coil or battery connection or plug between ignition sensor and module. See Section 4.
7. Ignition coil not functioning.
8. Ignition module not functioning.
9. Ignition sensor not functioning.
10. ATC in stuck open.
11. Spark plug cables in bad condition and shorting.

Starts Hard

1. Spark plugs in bad condition, have improper gap or are partially fouled.
2. Wires are crossed.
3. ATC in stuck open.
4. Spark plug cables in bad condition and shorting.
5. Battery nearly discharged.
6. Loose wire connection at one of the battery terminals, at coil or at plug between ignition sensor and module.
7. Throttle controls not adjusted correctly.
8. Ignition coil not functioning.
9. Engine oil too heavy (winter operation).
10. Ignition not timed properly. See dealer.
11. Vapor vent valve plugged or fuel line closed off restricting fuel flow.
12. Water or dirt in fuel system.
13. Air leak at intake manifold.
15. TP Sensor/fast idle screw not set properly. See dealer.
16. Oxygen, IAT or ET sensors damaged or malfunctioning. See dealer.

Starts But Runs Irregularly or Misses

NOTE
See 4.15 MISFIRE for specific tests.
1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Spark plug gap too close or too wide.
4. Ignition coil not functioning.
5. Ignition module not functioning.
6. Ignition sensor not functioning.
7. Battery nearly discharged.
8. Damaged wire or loose connection at battery terminals or coil.
9. Intermittent short circuit due to damaged wire insulation.
10. Water or dirt in fuel system and throttle body or filter.
11. Vapor vent valve plugged.
12. Throttle controls improperly adjusted.
13. Air leak at intake manifold or air filter.
14. Damaged intake or exhaust valve.
15. Weak or broken valve springs.
16. Incorrect valve timing.
17. Oxygen, IAT or ET sensors damaged or malfunctioning. See dealer.
18. TP Sensor not set properly. See dealer.
20. Inoperative fuel injector. See dealer.
21. Obstructed fuel tank vent valve or pinched vent tube. See dealer.
Spark Plug Fouls Repeatedly
1. Incorrect spark plug.
2. Piston rings badly worn or broken.
3. Valve stem seals worn or damaged.
4. Valve guides badly worn.
5. Sensors damaged.
6. Air intake screen covered or restricted.

Pre-Ignition or Detonation (Knocks or Pings)
1. Excessive carbon deposit on piston head or combustion chamber.
2. Incorrect heat range spark plug.
4. Ignition timing advanced.
5. Fuel octane rating too low.
6. Intake manifold vacuum leak.

Overheating
1. Insufficient oil supply or oil not circulating.
2. Clogged or damaged fins on oil cooler.
3. Cooling fan not operating properly.
4. Leaking valves.
5. Heavy carbon deposit.
6. Ignition timing retarded.

Valve Train Noise
1. Hydraulic lifter not functioning properly.
2. Bent push rod.
3. Cam, cam gears or cam bushings worn.
4. Rocker arm binding on shaft.
5. Valve sticking in guide.

Excessive Vibration
1. Engine tie bars loose, broken or improperly spaced.
2. Isolator mounting fasteners loose.
4. Primary chain badly worn or links tight as a result of insufficient lubrication.
5. Wheels not aligned and/or tires worn.
7. Wheels not balanced correctly.

Oil Does Not Return To Oil Tank
1. Oil tank empty.
2. Return pump gears damaged.
3. Oil feed pump not functioning.
4. Restricted oil lines or fittings.

Engine Uses Too Much Oil or Smokes Excessively
1. Piston rings badly worn or broken.
2. Valve stem seals worn or damaged.
3. Valve guides worn.

Engine Leaks Oil From Cases, Push Rods, Hoses
1. Loose parts.
2. Improper seal at gaskets, push rod cover, washers, etc. To aid locating leaks, use BLACK LIGHT LEAK DETECTOR (Part No. HD-35457).
3. Restricted oil return line to tank.
4. Restricted breather passage(s) to air cleaner.

Alternator Does Not Charge
1. Regulator-rectifier module not functioning.
2. Rectifier not grounded.
3. Engine ground wire loose or broken.
4. Loose or broken wires in charging circuit.
5. Stator not functioning.
6. Rotor not functioning.

Alternator Charge Rate Is Below Normal
1. Regulator-rectifier module not functioning.
2. Stator not functioning.
3. Rotor not functioning.
4. Weak battery.
5. Loose connections.

Poor Fuel Economy
1. Oxygen sensor damaged or malfunctioning (bike running rich). See dealer.
2. Air intake screen covered or restricted.
TRANSMISSION

Shifts Hard
1. Clutch dragging slightly.
2. Shifter forks (inside transmission) damaged.
3. Corners worn off shifter clutch dogs (inside transmission).

Jumps Out of Gear
1. Shifter engaging parts (inside transmission) badly worn and rounded.
2. Shifter forks bent.
3. Damaged gears.

CLUTCH

Slips
1. Clutch controls improperly adjusted.
2. Worn friction plates.

Drags or Does Not Release
1. Clutch controls improperly adjusted.
2. Clutch plates excessively warped.

Chatters
1. Friction or steel plates worn, warped or dragging.

CHASSIS

Irregular/Inadequate Brake Action
1. Master cylinder low on fluid.
2. Brake line contains air bubbles or moisture.
3. Master or wheel cylinder piston worn.
4. Brake pads covered with grease or oil.
5. Brake pads badly worn to minimum lining thickness.
6. Brake rotor badly worn or warped.
7. Brake pads dragging or excessive braking (brake fades due to heat buildup).
8. Insufficient brake pedal or hand lever free play (brake drags).

Handling Irregularities
1. Tires improperly inflated. See 1.7 TIRES AND WHEELS. Do not overinflate.
2. Loose wheel axle. Tighten front axle to 39-41 ft-lbs (53-56 Nm). Tighten rear axle to 48-52 ft-lbs (65-70 Nm).
3. Excessive wheel hub bearing play.
4. Rims and tires out-of-true side to side (lateral tire runout should not be more than 0.080 in. (2.03 mm)).
5. Rims and tires out-of-round radially (tire runout should not be more than 0.060 in. (1.5 mm)).
6. Irregular or peaked front tire tread wear.
7. Tire and wheel unbalanced or weights on wrong side of wheel. (Front wheel weights must be on the brake rotor side.)
8. Steering head bearings improperly tightened or worn. See 1.12 STEERING HEAD BEARINGS. Check for proper torque and replace worn bearings. See 2.17 FORK CLAMPS, UPPER AND LOWER.
9. Shock absorber or front forks not functioning normally due to incorrect adjustment. See 1.11 SUSPENSION DAMPING ADJUSTMENTS.
10. Heavy front end loading. Non-standard equipment on the front end (such as heavy radio receivers, extra lighting equipment or luggage) tends to cause unstable handling.
When making adjustments, remember there are two medi-ums in setting up a bike, geometry and suspension. Both components work together because suspension is a part of geometry. In order to solve handling problems, it is important to diagnose the problem’s true nature.

Chattering, sliding or an uncomfortable feeling are suspen-sion-related. Handling and a swinging fork are geometry-related, but often these unwanted characteristics can be solved by suspension adjustments. The following tables list possible suspension and operating troubles and their probable causes.

### Table 1-13. General Suspension Problems

<table>
<thead>
<tr>
<th>Troubleshooting Condition</th>
<th>Adjustment Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike wallows through turns, feels loose or vague after bumps. Wheel tends to ‘pogo’ after passing over a bump. This is noticeable by watching the bike continue to bounce as it travels over multiple bumps.</td>
<td>Increase rebound damping.</td>
</tr>
<tr>
<td>Wheel responds to bump, but doesn’t return to ground quickly after bumps. This is more pronounced over a series of bumps and is often referred to as ‘packing down.’</td>
<td>Reduce rebound damping.</td>
</tr>
<tr>
<td>The bike bottoms out or dips while cornering. Bike has excessive brake dive.</td>
<td>Increase compression damping.</td>
</tr>
<tr>
<td>Harsh ride particularly over washboard surfaces. Bumps kick through handlebars or seat. Suspension seems not to respond to bumps. This is evidenced by tire chattering (a movement with short stroke and high frequency) through corners or by jolting the rider over rough roads.</td>
<td>Reduce compression damping.</td>
</tr>
</tbody>
</table>

### Table 1-14. Rear Suspension Problems

<table>
<thead>
<tr>
<th>Troubleshooting Condition</th>
<th>Adjustment Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Pumping on the Rear” occurs when you are accelerating out of a corner. This problems occurs in two varieties. 1. The first type has a movement with a long stroke and a high frequency. 2. The second version has a movement with a short stroke and high frequency.</td>
<td>1. The shock is too soft. Increase compression damping. If the adjuster is already set to the maximum, add more preload to the spring (one turn maximum). 2. In this case the shock is too hard. Decrease compression damping.</td>
</tr>
<tr>
<td>Chattering during braking.</td>
<td>Decrease the compression damping. If the problem persists, decrease rebound damping for a faster rebound rate. Less spring preload may also help.</td>
</tr>
<tr>
<td>Lack of tire feedback.</td>
<td>The suspension is too soft. Increase compression damping.</td>
</tr>
<tr>
<td>Sliding during cornering. Sliding may occur going into the corner or accelerating out of the corner.</td>
<td>The suspension is too hard. Decrease compression damping.</td>
</tr>
</tbody>
</table>

### Table 1-15. Front Suspension Problems

<table>
<thead>
<tr>
<th>Troubleshooting Condition</th>
<th>Adjustment Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not absorbing bumps.</td>
<td>A good suspension is a balance between damping and track condition. Finding this balance requires exploring all possible compression settings.</td>
</tr>
<tr>
<td>Lack of tire feedback.</td>
<td>Increase compression damping.</td>
</tr>
<tr>
<td>Tire slides.</td>
<td>Decrease compression damping.</td>
</tr>
<tr>
<td>SUBJECT</td>
<td>PAGE NO.</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>2.1 Specifications</td>
<td>2-1</td>
</tr>
<tr>
<td>2.2 Tire Specifications</td>
<td>2-5</td>
</tr>
<tr>
<td>2.3 Vehicle Identification Number</td>
<td>2-6</td>
</tr>
<tr>
<td>2.4 Wheels</td>
<td>2-8</td>
</tr>
<tr>
<td>2.5 Front Wheel</td>
<td>2-11</td>
</tr>
<tr>
<td>2.6 Rear Wheel</td>
<td>2-18</td>
</tr>
<tr>
<td>2.7 Checking Cast Rim Runout</td>
<td>2-22</td>
</tr>
<tr>
<td>2.8 Tires</td>
<td>2-23</td>
</tr>
<tr>
<td>2.9 Brake Pedal</td>
<td>2-27</td>
</tr>
<tr>
<td>2.10 Front Brake Master Cylinder and Hand Lever</td>
<td>2-38</td>
</tr>
<tr>
<td>2.11 Front Brake Line</td>
<td>2-32</td>
</tr>
<tr>
<td>2.12 Front Brake Caliper</td>
<td>2-34</td>
</tr>
<tr>
<td>2.13 Rear Brake Master Cylinder</td>
<td>2-37</td>
</tr>
<tr>
<td>2.14 Rear Brake Line</td>
<td>2-41</td>
</tr>
<tr>
<td>2.15 Rear Brake Caliper</td>
<td>2-43</td>
</tr>
<tr>
<td>2.16 Front Fork</td>
<td>2-46</td>
</tr>
<tr>
<td>2.17 Fork Clamps, Upper and Lower</td>
<td>2-55</td>
</tr>
<tr>
<td>2.18 Steering Head Bearings</td>
<td>2-57</td>
</tr>
<tr>
<td>2.19 Swingarm and Brace</td>
<td>2-60</td>
</tr>
<tr>
<td>2.20 Front and Rear Isolator</td>
<td>2-64</td>
</tr>
<tr>
<td>2.21 Frame</td>
<td>2-65</td>
</tr>
<tr>
<td>2.22 Rear Shock Absorber</td>
<td>2-66</td>
</tr>
<tr>
<td>2.23 Throttle Control</td>
<td>2-68</td>
</tr>
<tr>
<td>2.24 Deflectors/Handlebars (XBR5X)</td>
<td>2-69</td>
</tr>
<tr>
<td>2.25 Clutch Control/Cable</td>
<td>2-70</td>
</tr>
<tr>
<td>2.26 Headlight Assembly with Grille (XBR5X)</td>
<td>2-74</td>
</tr>
<tr>
<td>2.27 Headlight Assembly and Support Bracket</td>
<td>2-75</td>
</tr>
<tr>
<td>2.28 Front Modules</td>
<td>2-78</td>
</tr>
<tr>
<td>2.29 Handlebars</td>
<td>2-80</td>
</tr>
<tr>
<td>2.30 Mirrors</td>
<td>2-82</td>
</tr>
<tr>
<td>2.31 Exhaust System</td>
<td>2-83</td>
</tr>
<tr>
<td>2.32 Footpeg, Heel Guard, and Mount</td>
<td>2-86</td>
</tr>
<tr>
<td>2.33 Sprocket Cover</td>
<td>2-88</td>
</tr>
<tr>
<td>2.34 Fenders</td>
<td>2-89</td>
</tr>
<tr>
<td>2.35 Belt Guards</td>
<td>2-90</td>
</tr>
<tr>
<td>2.36 Chin Fairing</td>
<td>2-91</td>
</tr>
<tr>
<td>2.37 Intake Cover Assembly</td>
<td>2-92</td>
</tr>
<tr>
<td>2.38 Air Scoops</td>
<td>2-93</td>
</tr>
<tr>
<td>2.39 Left Tail Section and Battery Pan</td>
<td>2-94</td>
</tr>
<tr>
<td>2.40 Center Tail Section</td>
<td>2-98</td>
</tr>
<tr>
<td>2.41 Right Tail Section</td>
<td>2-99</td>
</tr>
<tr>
<td>2.42 Windscreen</td>
<td>2-101</td>
</tr>
<tr>
<td>2.43 Seat</td>
<td>2-102</td>
</tr>
<tr>
<td>2.44 Passenger Seat Lock</td>
<td>2-103</td>
</tr>
<tr>
<td>2.45 Sidestand</td>
<td>2-105</td>
</tr>
</tbody>
</table>
Table 2-1. Dimensions

<table>
<thead>
<tr>
<th>DIMENSIONS</th>
<th>IN.</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheel base (XB12Ss)</td>
<td>54.0</td>
<td>1372</td>
</tr>
<tr>
<td>Wheel base (All other models)</td>
<td>52.0</td>
<td>1320</td>
</tr>
<tr>
<td>Seat height (XB12S)</td>
<td>30.1</td>
<td>765</td>
</tr>
<tr>
<td>Seat height (XB9SX)</td>
<td>31.4</td>
<td>798</td>
</tr>
<tr>
<td>Seat height (XB12Scg)</td>
<td>28.6</td>
<td>726</td>
</tr>
<tr>
<td>Seat height (XB12Ss)</td>
<td>30.5</td>
<td>775</td>
</tr>
<tr>
<td>Ground clearance (XB12S &amp; XB9SX)</td>
<td>3.55</td>
<td>90</td>
</tr>
<tr>
<td>Ground clearance (XB12Scg)</td>
<td>3.6</td>
<td>91.4</td>
</tr>
<tr>
<td>Ground clearance (XB12Ss)</td>
<td>5.56</td>
<td>141</td>
</tr>
<tr>
<td>Trail (XB9SX, XB12S, XB12Scg)</td>
<td>3.3</td>
<td>83</td>
</tr>
<tr>
<td>Trail (XB12Ss)</td>
<td>4.7</td>
<td>119</td>
</tr>
<tr>
<td>Rake (XB9SX, XB12S, XB12Scg)</td>
<td>21 Degrees</td>
<td></td>
</tr>
<tr>
<td>Rake (XB12Ss)</td>
<td>22 Degrees</td>
<td></td>
</tr>
</tbody>
</table>

Table 2-2. Weight Specifications (1203)

<table>
<thead>
<tr>
<th>WEIGHT-U.S. MODELS</th>
<th>LBS.</th>
<th>KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet weight (XB12S, XB12Scg)</td>
<td>462</td>
<td>210</td>
</tr>
<tr>
<td>Wet weight (XB12Ss)</td>
<td>478</td>
<td>217</td>
</tr>
<tr>
<td>GVWR (all models)</td>
<td>850</td>
<td>386</td>
</tr>
<tr>
<td>GAWR - front (all models)</td>
<td>315</td>
<td>143</td>
</tr>
<tr>
<td>GAWR - rear (all models)</td>
<td>535</td>
<td>243</td>
</tr>
<tr>
<td>Load capacity (XB12S, XB12Scg)</td>
<td>388</td>
<td>176</td>
</tr>
<tr>
<td>Load capacity (XB12Ss)</td>
<td>372</td>
<td>169</td>
</tr>
</tbody>
</table>

Table 2-3. Weight Specifications (984)

<table>
<thead>
<tr>
<th>WEIGHT-U.S. MODELS</th>
<th>LBS.</th>
<th>KG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet weight</td>
<td>452</td>
<td>205</td>
</tr>
<tr>
<td>GVWR</td>
<td>850</td>
<td>386</td>
</tr>
<tr>
<td>GAWR - front</td>
<td>315</td>
<td>143</td>
</tr>
<tr>
<td>GAWR - rear</td>
<td>535</td>
<td>243</td>
</tr>
<tr>
<td>Load capacity</td>
<td>398</td>
<td>181</td>
</tr>
</tbody>
</table>

Table 2-4. Capacities

<table>
<thead>
<tr>
<th>CAPACITIES</th>
<th>U.S.</th>
<th>LITERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel tank (inc. reserve) (XB9SX, XB12S, XB12Scg)</td>
<td>3.82 gallons</td>
<td>14.5 L</td>
</tr>
<tr>
<td>Reserve/Low fuel light at (XB9SX, XB12S, XB12Scg)</td>
<td>0.75 gallons</td>
<td>2.8 L</td>
</tr>
<tr>
<td>Fuel tank (inc. reserve) (XB12Ss)</td>
<td>4.40</td>
<td>16.7 L</td>
</tr>
<tr>
<td>Reserve/Low fuel light at (XB12Ss)</td>
<td>0.83</td>
<td>3.1 L</td>
</tr>
<tr>
<td>Oil tank (wet - for normal oil change)</td>
<td>2.5 quarts</td>
<td>2.4</td>
</tr>
<tr>
<td>Fork oil (each fork)</td>
<td>16 ounces</td>
<td>0.47</td>
</tr>
<tr>
<td>Transmission</td>
<td>1.0 quart</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Table 2-5. Tire and Positions

<table>
<thead>
<tr>
<th>TIRE AND POSITION</th>
<th>SOLO RIDING</th>
<th>GVWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>Dunlop Sportmax Radial II 120/70 ZR 17 D208FW</td>
<td>36 PSI (248 kPa)</td>
</tr>
<tr>
<td>Front</td>
<td>Pirelli Diablo SYNC (XB9SX only) 120/70 ZR 17</td>
<td>34 PSI (234 kPa)</td>
</tr>
<tr>
<td>Rear</td>
<td>Dunlop Sportmax Radial II 180/55 ZR 17 D208M</td>
<td>36 PSI (262 kPa)</td>
</tr>
<tr>
<td>Rear</td>
<td>Pirelli Diablo SYNC (XB9SX only) 180/55 ZR 17</td>
<td>36 PSI (248 kPa)</td>
</tr>
</tbody>
</table>

Table 2-6. Brake Rotor Runout

<table>
<thead>
<tr>
<th>RUNOUT</th>
<th>IN.</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front radial</td>
<td>0.0177</td>
<td>0.45</td>
</tr>
<tr>
<td>Front lateral</td>
<td>0.0248</td>
<td>0.63</td>
</tr>
<tr>
<td>Rear radial</td>
<td>0.0177</td>
<td>0.45</td>
</tr>
<tr>
<td>Rear lateral</td>
<td>0.0154</td>
<td>0.39</td>
</tr>
</tbody>
</table>

NOTE
Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding Gross Axle Weight Ratings (GAWR) are given on an information decal located on the steering head.
<table>
<thead>
<tr>
<th>ITEM</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axle (front)</td>
<td>39-41 ft-lbs</td>
<td>53-56 Nm</td>
</tr>
<tr>
<td>Axle (rear)</td>
<td>40-45 ft-lbs</td>
<td>54-61 Nm</td>
</tr>
<tr>
<td>Axle pinch fastener, rear</td>
<td>20-22 ft-lbs</td>
<td>27-30 Nm</td>
</tr>
<tr>
<td>Axle pinch fasteners, front</td>
<td>80-90 in-lbs</td>
<td>9-10 Nm</td>
</tr>
<tr>
<td>Brake hand lever housing fasteners</td>
<td>7-10 in-lbs</td>
<td>8-10 Nm</td>
</tr>
<tr>
<td>Brake lamp switch fastener, front</td>
<td>36-60 in-lbs</td>
<td>4-7 Nm</td>
</tr>
<tr>
<td>Brake line P-clamp fastener, front</td>
<td>36-60 in-lbs</td>
<td>4-7 Nm</td>
</tr>
<tr>
<td>Brake line P-clamp on inside of lighting module</td>
<td>22-24 ft-lbs</td>
<td>30-33 Nm</td>
</tr>
<tr>
<td>Brake pedal fastener</td>
<td>11-14 ft-lbs</td>
<td>15-19 Nm</td>
</tr>
<tr>
<td>Brake pin hanger set, rear</td>
<td>16-20 ft-lbs</td>
<td>22-27 Nm</td>
</tr>
<tr>
<td>Brake pin hanger set, front</td>
<td>15-19 ft-lbs</td>
<td>20-26 Nm</td>
</tr>
<tr>
<td>Brake line P-clamp</td>
<td>36-60 in-lbs</td>
<td>4-7 Nm</td>
</tr>
<tr>
<td>Caliper carrier, rear</td>
<td>36-60 in-lbs</td>
<td>4-7 Nm</td>
</tr>
<tr>
<td>Caliper fasteners, front</td>
<td>35-37 ft-lbs</td>
<td>47-50 Nm</td>
</tr>
<tr>
<td>Caliper fasteners, large</td>
<td>36-108 in-lbs</td>
<td>9.5-12.2 Nm</td>
</tr>
<tr>
<td>Caliper fasteners, small</td>
<td>84-92 in-lbs</td>
<td>9.5-10.4 Nm</td>
</tr>
<tr>
<td>Caliper inspection cover fasteners</td>
<td>84-108 in-lbs</td>
<td>9.5-12.2 Nm</td>
</tr>
<tr>
<td>Deflector fasteners</td>
<td>24-36 in-lbs</td>
<td>2.7-4 Nm</td>
</tr>
<tr>
<td>Deflector pivot shaft risers</td>
<td>43-49 in-lbs</td>
<td>4.8-5.5 Nm</td>
</tr>
<tr>
<td>Deflector, pivot shaft pin nut</td>
<td>39-48 in-lbs</td>
<td>4.4-5.4 Nm</td>
</tr>
<tr>
<td>Engine shroud air scoop</td>
<td>12-18 in-lbs</td>
<td>1-4 Nm</td>
</tr>
<tr>
<td>Exhaust header mounting nut</td>
<td>12-18 in-lbs</td>
<td>1-4 Nm</td>
</tr>
<tr>
<td>Footpeg mount fasteners, rider</td>
<td>108-132 in-lbs</td>
<td>12.2-14.9 Nm</td>
</tr>
<tr>
<td>Footpeg mount, passenger</td>
<td>25-28 ft-lbs</td>
<td>33.8-37.9 Nm</td>
</tr>
<tr>
<td>Fork cap</td>
<td>22-30 ft-lbs</td>
<td>30-40 Nm</td>
</tr>
<tr>
<td>Fork center bolt</td>
<td>22-30 ft-lbs</td>
<td>30-40 Nm</td>
</tr>
<tr>
<td>Fork clamp, lower</td>
<td>20-22 ft-lbs</td>
<td>27.2-20 Nm</td>
</tr>
<tr>
<td>Fork clamp, upper</td>
<td>23-25 ft-lbs</td>
<td>31.2-33.8 Nm</td>
</tr>
<tr>
<td>Fork damper locknut</td>
<td>36-60 in-lbs</td>
<td>4-5.4 Nm</td>
</tr>
<tr>
<td>Front fender fasteners</td>
<td>36-60 in-lbs</td>
<td>4-5.4 Nm</td>
</tr>
<tr>
<td>Front isolator bolt</td>
<td>49-51 ft-lbs</td>
<td>66-69 Nm</td>
</tr>
<tr>
<td>ITEM</td>
<td>TORQUE</td>
<td>NOTES</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td>Front isolator bracket mounting fastener</td>
<td>49.5 ft-lbs</td>
<td>66-69 Nm</td>
</tr>
<tr>
<td>Front isolator snubber, upper</td>
<td>12-36 in-lbs</td>
<td>1-4 Nm</td>
</tr>
<tr>
<td>Front isolator threaded frame insert</td>
<td>59-61 ft-lbs</td>
<td>80-82.7 Nm</td>
</tr>
<tr>
<td>Hand lever pivot fastener</td>
<td>39-48 in-lbs</td>
<td>4.4-5.4 Nm</td>
</tr>
<tr>
<td>Handlebar clamp screws</td>
<td>10-12 ft-lbs</td>
<td>14-16 Nm</td>
</tr>
<tr>
<td>Heel guard fasteners, passenger</td>
<td>48-72 in-lbs</td>
<td>5.4-8 Nm</td>
</tr>
<tr>
<td>Heel guard fasteners, rider</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm</td>
</tr>
<tr>
<td>Horn</td>
<td>72-96 in-lbs</td>
<td>8-10.8 Nm</td>
</tr>
<tr>
<td>Lower fork clamp fasteners</td>
<td>20-22 ft-lbs</td>
<td>27.1-29.8 Nm</td>
</tr>
<tr>
<td>Master cylinder banjo bolt, front</td>
<td>16-20 ft-lbs</td>
<td>22-27 Nm</td>
</tr>
<tr>
<td>Master cylinder banjo bolt, rear</td>
<td>16-20 ft-lbs</td>
<td>22-27 Nm</td>
</tr>
<tr>
<td>Master cylinder cover fasteners, front</td>
<td>9-13 in-lbs</td>
<td>1.0-1.5 Nm</td>
</tr>
<tr>
<td>Master cylinder mounting fasteners, rear</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm</td>
</tr>
<tr>
<td>Mirror adjuster</td>
<td>115-130 in-lbs</td>
<td>3-14.7 Nm</td>
</tr>
<tr>
<td>Mirror mount onto bracket</td>
<td>20-22 ft-lbs</td>
<td>27.1-29.8 Nm</td>
</tr>
<tr>
<td>Muffler mounting block fastener, rear</td>
<td>32-36 ft-lbs</td>
<td>43-49 Nm</td>
</tr>
<tr>
<td>Muffler strap fastener, front</td>
<td>108-120 in-lbs</td>
<td>12-14 Nm</td>
</tr>
<tr>
<td>Muffler strap fastener, rear</td>
<td>48-60 in-lbs</td>
<td>5-7 Nm</td>
</tr>
<tr>
<td>Negative battery cable at battery terminal</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm</td>
</tr>
<tr>
<td>Oil cooler air scoop</td>
<td>48-72 in-lbs</td>
<td>5.4-8 Nm</td>
</tr>
<tr>
<td>Oil drain plug</td>
<td>29-34 ft-lbs</td>
<td>39-46 Nm</td>
</tr>
<tr>
<td>Oil line fittings</td>
<td>108-156 in-lbs</td>
<td>12-17.6 Nm</td>
</tr>
<tr>
<td>Oil line p-clamps at swingarm</td>
<td>48-72 in-lbs</td>
<td>5.4-8 Nm</td>
</tr>
<tr>
<td>Pivot shaft pinch bolt</td>
<td>17-19 ft-lbs</td>
<td>23.26 Nm</td>
</tr>
<tr>
<td>Ram air scoop</td>
<td>12-36 in-lbs</td>
<td>1.4-4 Nm</td>
</tr>
<tr>
<td>Rear brake line p-clamp</td>
<td>36-60 in-lbs</td>
<td>4-7 Nm</td>
</tr>
<tr>
<td>Rear fender fastener</td>
<td>12-36 in-lbs</td>
<td>1.4-4.0 Nm</td>
</tr>
<tr>
<td>Rear inner fender mounting fasteners</td>
<td>12-36 in-lbs</td>
<td>1.4-4 m</td>
</tr>
<tr>
<td>Rear remote master cylinder reservoir fastener</td>
<td>48-72 in-lbs</td>
<td>11-14 Nm</td>
</tr>
<tr>
<td>Rotor mounting fasteners, front</td>
<td>25-27 ft-lbs</td>
<td>34-37 Nm</td>
</tr>
<tr>
<td>Rotor mounting fasteners, rear</td>
<td>25-27 ft-lbs</td>
<td>34-37 Nm</td>
</tr>
<tr>
<td>Shift lever pincho screw</td>
<td>48-60 in-lbs</td>
<td>5.4-6.8 Nm</td>
</tr>
<tr>
<td>Shift pedal flange head bolt</td>
<td>22-24 ft-lbs</td>
<td>30-32.5 Nm</td>
</tr>
<tr>
<td>Shock absorber, lower</td>
<td>15-17 ft-lbs</td>
<td>20.32 Nm</td>
</tr>
<tr>
<td>Shock mounting fastener, upper</td>
<td>48-52 ft-lbs</td>
<td>65-70.5 Nm</td>
</tr>
<tr>
<td>Sidestand bracket fasteners</td>
<td>25-27 ft-lbs</td>
<td>34-37 Nm</td>
</tr>
<tr>
<td>Sidestand pivot bolt</td>
<td>18-20 ft-lbs</td>
<td>24-27 Nm</td>
</tr>
<tr>
<td>Sprocket cover fastener</td>
<td>12-36 in-lbs</td>
<td>1-4 Nm</td>
</tr>
<tr>
<td>Sprocket fasteners</td>
<td>35-37 ft-lbs</td>
<td>48-50 Nm</td>
</tr>
<tr>
<td>Steering stem capnut</td>
<td>38-42 ft-lbs</td>
<td>52-57 Nm</td>
</tr>
<tr>
<td>Steering stem pinch fastener (XB9SX)</td>
<td>23-25 ft-lbs</td>
<td>31.2-33.8 Nm</td>
</tr>
<tr>
<td>ITEM</td>
<td>TORQUE</td>
<td>NOTES</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Steering stem pinch fastener</td>
<td>20-22 ft-lbs</td>
<td>27.1-29.8 Nm LOCTITE 272, page 2-55</td>
</tr>
<tr>
<td>Swingarm brace mounting fasteners</td>
<td>25-27 ft-lbs</td>
<td>34.7-37 Nm page 2-62</td>
</tr>
<tr>
<td>Swingarm pivot shaft</td>
<td>24-26 ft-lbs</td>
<td>32-35 Nm page 2-62</td>
</tr>
<tr>
<td>Switch housing fasteners, right</td>
<td>25-33 in-lbs</td>
<td>3-4 Nm page 2-67</td>
</tr>
<tr>
<td>Torca clamp</td>
<td>28-30 ft-lbs</td>
<td>38-40.6 Nm page 2-84</td>
</tr>
<tr>
<td>Valve stem nut</td>
<td>40-44 in-lbs</td>
<td>4.5-4.9 Nm page 2-24</td>
</tr>
<tr>
<td>Wear peg, rider</td>
<td>36-40 in-lbs</td>
<td>4.1-5.4 Nm LOCTITE 272 (red), page 2-85</td>
</tr>
<tr>
<td>Windscreen fasteners</td>
<td>10-12 in-lbs</td>
<td>1.1-1.4 Nm page 2-100</td>
</tr>
</tbody>
</table>
WARNING

Tires must be correctly matched to wheel rims. Use only Buell approved tires. See a Buell dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00133a)

See Figure 2-1. Tire sizes are molded on the sidewall. Rim size and contour are marked on the rim’s exterior surface.

Example: J17 x 3.5 MT DOT
- J designates the tire and rim standard.
- 17 is the normal diameter of the rim in inches, measured at the bead seat diameter.
- 3.5 is the width of the bead seat measured in inches.
- MT designates the rim type.
- DOT means that the rim meets Department of Transportation Federal Motor Vehicle Safety Standards. Refer to Table 2-7.

Figure 2-1. Rim Markings

Table 2-7. Tire Fitment-Tubeless Cast Wheels

<table>
<thead>
<tr>
<th>WHEEL SIZE &amp; POSITION</th>
<th>CONTOUR &amp; RIM SIZE</th>
<th>RIM VALVE HOLE DIAMETER</th>
<th>TIRE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 in. – Front</td>
<td>MT 3.5 x 17.0 DOT</td>
<td>0.33 in.</td>
<td>Dunlop Sportmax Radial II 120/70 ZR17 D208FW</td>
</tr>
<tr>
<td>17 in. – Rear</td>
<td>MT 5.5 x 17.0 DOT</td>
<td>0.33 in.</td>
<td>Dunlop Sportmax Radial II 180/55 ZR17 D208M</td>
</tr>
<tr>
<td>17 in. – Front</td>
<td>MT 3.5 x 17.0 DOT</td>
<td>0.33 in.</td>
<td>Pirelli Diablo SYNC 120/70 ZR17 (XB9SX only)</td>
</tr>
<tr>
<td>17 in. – Rear</td>
<td>MT 5.5 x 17.0 DOT</td>
<td>0.33 in.</td>
<td>Pirelli Diablo SYNC 180/55 ZR17 (XB9SX only)</td>
</tr>
</tbody>
</table>
VEHICLE IDENTIFICATION NUMBER (V.I.N.)

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

See Figure 2-2. 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 left side of the steering head. A Motor Identification Number is stamped on the left side crankcase near the front of the engine.

NOTE
Always give the full Vehicle Identification Number located on the steering head when ordering parts or making any inquiry about your motorcycle.

VEHICLE IDENTIFICATION: XB MODELS BUILT BEFORE MAY 2005

For XB models built before May 2005, see Figure 2-2. and Table 2-8.

VEHICLE IDENTIFICATION: XB MODELS BUILT AFTER MAY 2005

For XB models built after May 2005 see Figure 2-3. and Table 2-9.

Table 2-8. Buell 2006 XB Models V.I.N. Description (All Models Built Before May 2005)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WMI code</td>
<td>4MZ = Buell vehicles originally manufactured for sale within the United States 5MZ = Buell vehicles originally manufactured for sale outside the United States</td>
</tr>
<tr>
<td>2</td>
<td>Motorcycle type</td>
<td>KP = Blast  AX = Firebolt  KX = Lightning CityX  SX = Lightning  WX = Lightning Scg  JX = Lightning Long  DX = Ulysses</td>
</tr>
<tr>
<td>3</td>
<td>Engine type</td>
<td>12 = 984cc (World)  13 = 492cc (World)  14 = 1203cc (World)</td>
</tr>
<tr>
<td>4</td>
<td>Horsepower code</td>
<td>C = 30-35 hp  J = 86-103 hp</td>
</tr>
<tr>
<td>5</td>
<td>VIN check digit</td>
<td>Can be 0-9 or X</td>
</tr>
<tr>
<td>6</td>
<td>Model year</td>
<td>6 = 2006</td>
</tr>
<tr>
<td>7</td>
<td>Assembly plant</td>
<td>3 = East Troy, WI</td>
</tr>
<tr>
<td>8</td>
<td>Calibration</td>
<td>0 = US calibration (DOM, CAL, CAN markets)  1 = EU calibration (EUR, ENG, AUS markets)  2 = Japan calibration (JPN market)</td>
</tr>
<tr>
<td>9</td>
<td>Sequential number, by VIN configuration</td>
<td>varies</td>
</tr>
</tbody>
</table>
Figure 2-3. Typical 2006 Buell Vehicle Identification Number (All Models Built After May 2005)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>POSSIBLE VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WMI Code</td>
<td>4MZ = Buell vehicles originally manufactured for sale within the United States 5MZ = Buell vehicles originally manufactured for sale outside the United States</td>
</tr>
<tr>
<td>2</td>
<td>Motorcycle type</td>
<td>KP = Blast  AX = Firebolt  KK = Lightning CityX  SX = Lightning  WX = Lightning Stg  JX = Lightning Long  DX = Ulysses</td>
</tr>
<tr>
<td>3</td>
<td>Engine type</td>
<td>01 = 984cc (World)  02 = 492cc (World)  03 = 1203cc (World)</td>
</tr>
<tr>
<td>4</td>
<td>Market configuration</td>
<td>A = Australia  L = California  N = Canada  D = Domestic  E = England  R = Europe (HDI)  J = Japan</td>
</tr>
<tr>
<td>5</td>
<td>VIN check digit</td>
<td>Can be 0-9 or X</td>
</tr>
<tr>
<td>6</td>
<td>Model year</td>
<td>6 = 2006</td>
</tr>
<tr>
<td>7</td>
<td>Assembly plant</td>
<td>3 = East Troy, WI</td>
</tr>
<tr>
<td>8</td>
<td>Model (Manufactured after May 1, 2005)</td>
<td>0 = Blast  1 = XB9R  2 = XB9SX  3 = XB12R  4 = XB12S  5 = XB12Stc  6 = XB12Ss  7 = XB12X</td>
</tr>
<tr>
<td>9</td>
<td>Sequential number, by model</td>
<td>varies</td>
</tr>
</tbody>
</table>
GENERAL

Good handling and maximum tire mileage are directly related to the care of wheels and tires. Regularly inspect wheels and tires for damage and wear. If handling problems occur, see 1.21 TROUBLESHOOTING or Table 2-10.

See 1.7 TIRES AND WHEELS for tire pressures. Keep tires inflated to the recommended air pressure. Always balance the wheel after replacing a tire.

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)

TROUBLESHOOTING

See Figure 2-4. Check tire inflation pressure at least once each week. At the same time, inspect tire tread for punctures, cuts, breaks and other damage. Repeat the inspection before long trips.

Figure 2-4. Checking Tire Inflation Pressure
## Table 2-10. Wheel Service

<table>
<thead>
<tr>
<th>CHECK FOR</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose axles.</td>
<td>Tighten front axle. See 2.5 FRONT WHEEL.</td>
</tr>
<tr>
<td>Excessive side-play or radial (up-and-down) play in wheel hubs.</td>
<td>Replace wheel bearings.</td>
</tr>
<tr>
<td>Rims and tires out-of-true sideways; should not be more than 0.080 in.</td>
<td>Replace rims. See 2.8 TIRES/2.7 CHECKING CAST RIM RUNOUT.</td>
</tr>
<tr>
<td>(2.03 mm).</td>
<td></td>
</tr>
<tr>
<td>Rims and tires out-of-round or eccentric with hub; should not be more</td>
<td>Replace rims. See 2.8 TIRES/2.7 CHECKING CAST RIM RUNOUT.</td>
</tr>
<tr>
<td>than 0.090 in. (2.29 mm).</td>
<td></td>
</tr>
<tr>
<td>Irregular or peaked front tire wear.</td>
<td>Replace as described under 2.5 FRONT WHEEL, 2.6 REAR WHEEL, 2.7</td>
</tr>
<tr>
<td></td>
<td>CHECKING CAST RIM RUNOUT and 2.8 TIRES.</td>
</tr>
<tr>
<td>Correct tire inflation.</td>
<td>Inflate tires to correct pressure. See 1.7 TIRES AND WHEELS.</td>
</tr>
<tr>
<td>Correct tire and wheel balance.</td>
<td>Static balance may be satisfactory if dynamic balancing facilities are</td>
</tr>
<tr>
<td></td>
<td>are not available. However, dynamic balancing is strongly recommended.</td>
</tr>
<tr>
<td>Steering head bearings.</td>
<td>Check for proper torque and replace worn or damaged bearings. See 1.12</td>
</tr>
<tr>
<td></td>
<td>STEERING HEAD BEARINGS.</td>
</tr>
<tr>
<td>Damper tubes.</td>
<td>Check for leaks. See 2.16 FRONT FORK.</td>
</tr>
<tr>
<td>Shock absorbers.</td>
<td>Check damping action and mounts. See 1.11 SUSPENSION DAMPING ADJUSTMENTS</td>
</tr>
<tr>
<td>Swingarm bearings.</td>
<td>Check for proper torque and replace worn or damaged bearings. See 2.19</td>
</tr>
<tr>
<td></td>
<td>SWINGARM AND BRACE.</td>
</tr>
</tbody>
</table>
To prevent death or serious injury, use the following guidelines when installing a new tire or repairing a flat:

1. Always locate and eliminate the cause of the original tire failure.
2. Do not patch or vulcanize a tire casing. These procedures weaken the casing and increase the risk of a blowout.
3. The use of tires other than those specified can adversely affect handling which could result in death or serious injury.
4. Tires and wheels are critical items. Since the servicing of these components requires special tools and skills, Buell recommends that you see your dealer for these services.

Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the demounted tire by a Buell 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. (00118a)

Buell tires are equipped with wear bars that run horizontally across the tread. When wear bars become visible and only 1/32 in. (0.8 mm) tread depth remains, replace tire immediately. Using a worn tire can adversely affect stability and handling, which could result in death or serious injury. Use only Dunlop Harley-Davidson replacement tires. (00090a)

At regular intervals or whenever handling irregularities are noted, perform the recommended service checks. Refer to Table 2-10.

If tires must be replaced, same as original equipment tires must be used. Other tires may not fit correctly and may be hazardous to use.
REMOVAL

1. Place a scissor jack under jacking point and raise front wheel off ground. For location of jacking point see Figure 2-112.

   NOTE
   Do not operate front brake lever with front wheel removed or caliper pistons may be forced out. Reseating pistons requires caliper disassembly.

2. Remove the right side fender fasteners. See 2.34 FENDERS.

3. See Figure 2-5. Loosen front axle pinch fasteners (2) (metric) on front fork.

4. Remove axle (1).

   NOTES
   ● The front axle is left handed thread.
   ● To prevent cosmetic damage to the wheel, center caliper between spokes before removal.

5. See Figure 2-6. Raise the wheel up until the rotor clears the caliper and rotate the fork leg counterclockwise allowing wheel clearance for removal.

6. Remove wheel.

**Figure 2-5. Front Wheel Mounting**

**Figure 2-6. Front Wheel Removal**
Bearing Removal

NOTE
On single disc wheels, always remove the brake disc side bearing first.

1. See Figure 2-7. Remove wheel bearings using WHEEL BEARING REMOVER/INSTALLER KIT (Part No. B-43993-50) and WHEEL BEARING REMOVER AND INSTALLER (Part No. HD-44060).

2. Sparingly apply EXTREME PRESSURE LUBRICANT (Part No. J-23444-A) to the threads of the short forcing screw (1) to prolong service life and ensure smooth operation.

3. Assemble the short forcing screw (1), nut (2), Nice bearing (3), washer (4) and bridge (5) from the WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060).

4. See Figure 2-8. Insert the FRONT WHEEL BEARING REMOVER COLLET (Part No. B-43993-7, from kit Part No. B-43993-50) into the wheel bearing until it fully seats against the bearing.

5. Insert the ball bearing into the collet.

6. See Figure 2-9. Thread the puller assembly (1) into the collet (2).

7. Hold the collet (2), and turn the forcing screw (3) to expand the collet.

8. See Figure 2-10. Place the bridge (1) against the wheel hub.

9. Hold the forcing screw (2), and turn the nut (3) clockwise until the bearing is free of the hub.
10. See Figure 2-10. Loosen the nut (3), and back off the bridge (1). Hold the forcing screw (2) while holding the collet to remove the forcing screw from the collet.

11. See Figure 2-11. Remove the ball bearing (5) and wheel bearing (6) from the collet (4).

12. See Figure 2-12. Remove the spacer.

13. Repeat Steps 4-12 for the bearing on the other side of the wheel.

Front Rotor Removal
1. See Figure 2-18. Remove and discard rotor mounting fasteners (7).

2. Remove and inspect brake rotor (6) for wear and warping. See 2.12 FRONT BRAKE CALIPER/1.6 BRAKE SYSTEM MAINTENANCE.

3. Remove drive bushings (8) and discard.

4. Remove washers (9) and discard.

5. Remove front brake springs (4) and discard.

CLEANING AND INSPECTION

WARNING
Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which could result in death or serious injury.

1. Inspect all parts for damage or excessive wear.

NOTE
The wheel bearings are designed as sealed bearings which are not intended to be disassembled, serviced or cleaned with solvents.

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)

2. Inspect brake rotor and pads. See 1.6 BRAKE SYSTEM MAINTENANCE and 2.12 FRONT BRAKE CALIPER.
ASSEMBLY

1. See Figure 2-18. Install spacer (5).
2. Install new wheel bearings (2) into hub using suitable driver. Press on outer race only.

**NOTES**
- Press the rotor side bearings in first ensuring it is seated on the shoulder of the wheel. Followed by pressing the alternate side until it contacts the spacer.
- The Wheel Bearing Remover and Installer (B-43993-50) consists of the Front Wheel Bearing Remover Collet (B-43993-7), Rear Wheel Bearing Remover Collet (B-43993-8), Rear Wheel Bearing Installer (B-43993-9), Front Wheel Bearing Installer (B-43993-10) and Backing Plates (B-43993-11 front wheel) and (B-43993-12 rear wheel).

**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)

**Bearing Installation**

*NOTE*
On single disc wheels, always install the brake disc side bearing first.

The following procedure describes the bearing installation for the front wheel; the procedure for the rear wheel is the same.

1. See Figure 2-13. Install the Backing Plate (Part No. B-43993-12) and Forcing Screw.
2. Sparingly apply EXTREME PRESSURE LUBRICANT (Part No. J-23444-A) to the threads of the long forcing screw (1) to prolong service life and ensure smooth operation.
3. Insert a new wheel bearing (2) squarely into the hub, with the lettered side pointing out (away from the wheel).
4. Slide the FRONT BEARING INSTALLER (Part No. B-43993-9, from kit Part No. B-43993-50) (3) onto the forcing screw (1), with the smaller diameter toward the bearing bore.
5. Install a washer (4), Nice bearing (5) and nut (6) onto the forcing screw (1).
6. While holding the forcing screw (1), tighten the nut (6) until the bearing is seated firmly against the shoulder inside the bearing bore in the wheel hub.

**NOTES**
- Press the rotor side bearings in first ensuring it is seated on the shoulder of the wheel. Followed by pressing the alternate side until it contacts the spacer.
- Always install the brake side bearing first with the lettering facing out from the wheel.
7. Remove the nut, bearing, washer, FRONT BEARING INSTALLER (Part No. B-43993-9) and forcing screw.

**Figure 2-13. Install the Backing Plate (B-43993-12) and Forcing Screw**

1. Backing plate
2. Forcing screw

**Figure 2-14. Installing Wheel Bearings**

1. Long forcing screw
2. Wheel bearing
3. Front Wheel Bearing Installer (Part No. B-43993-9)
4. Washer
5. Nice bearing
6. Nut
8. See Figure 2-15. Remove the BACKING PLATE (Part No. B-43993-11) from the long forcing screw. Reinstall the Backing Plate onto the forcing screw, with the smaller diameter toward the hex head.

9. Insert the forcing screw through the wheel hub on the opposite side of the wheel.

10. See Figure 2-16. Install the spacer.

11. See Figure 2-17. Insert a new wheel bearing (1) squarely into the hub, with the lettered side pointing out (away from the wheel).

12. Slide the FRONT BEARING INSTALLER (Part No. B-43993-9) (2) onto the forcing screw (3), with the smaller diameter toward the bearing bore.

13. Install a washer (4), Nice bearing (5) and nut (6) onto the forcing screw (3).

   NOTE
   See Figure 2-16. Center the spacer while installing the wheel bearing. Failure to center the spacer could cause the bearing not to pull in straight.

14. While holding the forcing screw (3), tighten the nut (6) until the bearing contacts the spacer.

15. Remove the nut, bearing, washer, FRONT BEARING INSTALLER (Part No. B-43993-10) and forcing screw.

16. Install the wheel. See INSTALLATION under 2.5 FRONT WHEEL.
Front Rotor Installation

1. See Figure 2-18. Install new spring (4).
2. Install new washers (9).
3. Install new drive bushings (8) into rotor.

NOTE
Note the identifying mark of rotor is up and radius end of drive bushing (8) toward center of wheel.

4. Align reference dot on front rotor with the valve stem.

5. Install new rotor mounting fasteners in a criss-cross pattern around the wheel to insure proper fitting between rotor, fastener and bushing. Tighten to 25-27 ft-lbs (34-37 Nm).

NOTE
Rotor mounting fasteners must be seated into drive bushings and drive bushings must be fitted into rotor properly. Failure to comply may affect braking ability and lead to brake failure which could result in death or serious injury.
1. Raise front wheel to allow clearance for the caliper to swing under and inside the front rotor.

   **NOTE**
   To prevent cosmetic damage to the wheel, center caliper between spokes before removal.

2. See Figure 2-19. Install caliper.
   a. Align wheel so that rotor mounting fasteners straddle caliper.
   b. Rotate right front fork counterclockwise to align caliper with rotor.
   c. Lower front wheel into caliper assembly.

3. Install front axle.
   a. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle.
   b. See Figure 2-20. With pinch fasteners (metric) loose, insert threaded end of axle (1) through left side fork, wheel hub and thread into right fork.
   c. Compress the front suspension to make sure it is free and not binding.
   d. Tighten axle (1) (metric) to 39-41 ft-lbs (53-56 Nm).

   **NOTE**
   The front axle is left handed thread.

4. See Figure 2-20. Tighten the front axle pinch fasteners (2) to 20-22 ft-lbs (27-30 Nm).

5. Install right side fender fasteners. See 2.34 FENDERS.
REAR WHEEL 2.6

REMOVAL

1. Place a scissor jack under jacking point and raise rear wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.

**NOTE**
Do not operate rear brake pedal with rear wheel removed or caliper piston may be forced out. Reating piston requires caliper disassembly.

2. See Figure 2-21. Remove caliper carrier from swingarm by removing caliper carrier fasteners. See 2.15 REAR BRAKE CALIPER.

3. See Figure 2-22. Loosen rear axle pinch fastener (2).

4. Loosen rear axle (1) approximately 15 rotations to allow partial tension to be removed from rear drive system.

5. Remove idler pulley assembly by removing nuts and washers. See IDLER PULLEY REMOVAL in 6.6 DRIVE BELT SYSTEM.

6. Remove lower belt guard. See 2.35 BELT GUARDS.

7. On XB12SS models, it will be necessary to remove the rear fender. See 2.34 FENDERS.

8. Remove rear axle.

9. See 6.6 DRIVE BELT SYSTEM for proper handling. Slide drive belt out of the way and remove rear wheel.

CLEANING AND INSPECTION

**WARNING**

Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which could result in death or serious injury.

1. Inspect all parts for damage or excessive wear.

2. Inspect brake rotor. See 1.6 BRAKE SYSTEM MAINTENANCE/2.15 REAR BRAKE CALIPER.

DISASSEMBLY

1. Remove sprocket.

   a. Remove sprocket fasteners and washers. Discard fasteners.

   b. Remove sprocket from wheel.

2. Remove rear rotor.

   a. See Figure 2-23. Remove and discard rotor mounting fasteners (1).

   b. Remove and inspect brake rotor for wear and warping. See BRAKE ROTOR THICKNESS in 1.6 BRAKE SYSTEM MAINTENANCE/2.15 REAR BRAKE CALIPER.

**NOTE**

The procedure for the rear wheel bearing removal is the same as the front wheel bearing removal.

3. Remove rear wheel bearings using BUSHING AND BEARING PULLER (Part No. B43993-8) and WHEEL BEARING REMOVER AND INSTALLER (Part No. HD-44060).

4. Remove rear wheel spacer (4).
Figure 2-23. Rear Wheel Assembly

1. Rotor mounting fastener (6)
2. Brake rotor
3. Wheel bearing (2)
4. Wheel spacer
5. Wheel
6. Sprocket
7. Sprocket fastener (6)
8. Axle
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)

NOTES

- Press the rotor side bearing in first ensuring it is seated on the shoulder of the wheel. Followed by pressing the alternate side bearing until it contacts the spacer.
- See Figure 2-24. When installing rear wheel bearings it is necessary to use the FORCING SCREW (1) from the STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302).
- The Wheel Bearing Remover and Installer (B-43993-50) consists of the Front Wheel Bearing Remover Collet (B-43993-7), Rear Wheel Bearing Remover Collet (B-43993-8), Rear Wheel Bearing Installer (B-43993-9), Front Wheel Bearing Installer (B-43993-10) and Backing Plates (B-43993-11 front wheel) and (B-43993-12 rear wheel).
- The procedure for the rear wheel bearing installation is the same as front wheel bearing installation. See Bearing Installation in 2.5 FRONT WHEEL.

1. Install wheel bearing (3) on rotor side of motorcycle.
2. Install rear wheel spacer (4).
3. Install wheel bearing (3) on sprocket side of motorcycle.
4. Install sprocket:
   a. Position sprocket (6) on wheel (5) keeping lip of sprocket facing the inside.
   b. Install new sprocket fasteners (7) and washers tightening to 35-37 ft-lbs (48-50 Nm).
5. Install rear rotor (2):
   a. Position rear brake rotor (2) on wheel (5).
   b. Install brake rotor (2) with new rotor mounting fasteners (1) and tighten to 25-27 ft-lbs (34-37 Nm).
6. Install rear rotor (2):
   a. Position rear brake rotor (2) on wheel (5).
   b. Install brake rotor (2) with new rotor mounting fasteners (1) and tighten to 25-27 ft-lbs (34-37 Nm).
7. Install idler pulley. See DRIVE BELT INSTALLATION in section 6.6 DRIVE BELT SYSTEM.
   NOTE
   Never tighten rear axle with swingarm brace removed.

1. Rear wheel forcing screw
2. Front wheel forcing screw (Part No. 280856)

Figure 2-24. Forcing Screws Used for Front and Rear Wheel Bearing Installation

1. Axle
2. Pinch bolt fastener

Figure 2-26. Rear Wheel Mounting, Right Side

1. Center rear wheel in the swingarm at the same time sliding the drive belt onto the rear sprocket.
2. With wheel centered in swingarm, lower bike to align swingarm and wheel hub.
3. Apply ANTI-SEIZE LUBRICANT to hole in right side of swingarm where rear axle slides through.
4. See Figure 2-25. Coat the axle with ANTI-SEIZE LUBRICANT.
5. Slide axle through right side of swing arm and wheel hub and thread partially into swingarm on left side.
6. Install idler pulley. See DRIVE BELT INSTALLATION in section 6.6 DRIVE BELT SYSTEM.

NOTE
Never tighten rear axle with swingarm brace removed.

Figure 2-25. Anti-Seize Lubricant Location

1. Axle
2. Pinch bolt fastener

Figure 2-26. Rear Wheel Mounting, Right Side

1. Center rear wheel in the swingarm at the same time sliding the drive belt onto the rear sprocket.
2. With wheel centered in swingarm, lower bike to align swingarm and wheel hub.
3. Apply ANTI-SEIZE LUBRICANT to hole in right side of swingarm where rear axle slides through.
4. See Figure 2-25. Coat the axle with ANTI-SEIZE LUBRICANT.
5. Slide axle through right side of swing arm and wheel hub and thread partially into swingarm on left side.
6. Install idler pulley. See DRIVE BELT INSTALLATION in section 6.6 DRIVE BELT SYSTEM.

NOTE
Never tighten rear axle with swingarm brace removed.
9. Install lower belt guard. See 2.35 BELT GUARDS.
10. Install rear fender on XB12Ss models only. See 2.34 FENDERS.

11. See Figure 2-27. Install caliper carrier and tighten fastener to 24-26 ft-lbs (32-35 Nm). See 2.15 REAR BRAKE CALIPER.

NOTE
The brake pads may become cocked and will not allow the rotor to slide into the caliper. Press on the brake pad from the outside of the caliper to straighten out the pad.

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)
GENERAL

Check wheels for lateral and radial runout before installing a new tire.

Rim Lateral Runout
1. See Figure 2-28. Install truing arbor in wheel hub and place wheel in WHEEL TRUING AND BALANCING STAND (Part No. HD-99500-80).
2. Tighten arbor nuts so hub will turn on its bearings.
3. Check rim lateral runout by placing a gauge rod or dial indicator near the rim bead. Replace wheel if lateral runout exceeds specification shown in Table 2-11.

Rim Radial Runout
1. See Figure 2-29. Install truing arbor in wheel hub and place wheel in WHEEL TRUING AND BALANCING STAND (Part No. HD-99500-80).
2. Tighten arbor nuts so hub will turn on its bearings.
3. Check radial runout as shown. Replace wheel if runout exceeds specification shown in Table 2-11.

Table 2-11. Wheel Rim Runout

<table>
<thead>
<tr>
<th>RUNOUT</th>
<th>IN</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum lateral</td>
<td>0.040</td>
<td>1.02</td>
</tr>
<tr>
<td>Maximum radial</td>
<td>0.030</td>
<td>0.76</td>
</tr>
</tbody>
</table>
TIRE SPREADER (Part No. HD-21000) for inspection and repair procedures.

5. See Figure 2-31. Push lower bead into rim well on one side and insert tire tool underneath bead from opposite side. Pry bead over rim edge. Remove tire from rim.

6. Remove valve stem if it is damaged or leaks.

7. Mount tire on TIRE SPREADER (Part No. HD-21000) for inspection and repair procedures.

Figure 2-30. Loosening Beads from Rim Flange

Figure 2-31. Starting Tire Off Rim

Figure 2-32. Starting Bead on Rim

1. Remove wheel from motorcycle. See 2.5 FRONT WHEEL or 2.6 REAR WHEEL.

2. Deflate tire.

3. See Figure 2-30. Loosen both tire beads from rim flange.

Do not use excessive force when starting bead over rim. Excessive force may damage tire or rim and adversely affect handling which could result in death or serious injury.

4. If a bead breaker machine is not available, attach RIM PROTECTORS (Part No. HD-01289) to the rim. Using tire tools (not sharp instruments), start upper bead over edge of rim at valve. Repeat all around rim until first bead is over rim.

WARNING

Never repair a tire with less than 1/16 in. (1.6 mm) tread depth. Inadequate tread depth can cause an accident which could result in death or serious injury.

Buell front and rear tires are not the same. Inter-changing front and rear tires can cause tire failure, which could result in death or serious injury. (00026b)

WARNING

Never repair a tire with less than 1/16 in. (1.6 mm) tread depth. Inadequate tread depth can cause an accident which could result in death or serious injury.

Acceptable repair methods include a patch and plug combination, chemical or hot vulcanizing patches or head-type plugs. When repairing tubeless tires, use TIRE SPREADER (Part No. HD-21000) to spread the tire sidewalls.

WARNING

Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the demounted tire by your 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 1/4 in. (6.4 mm) 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 tubeless tires, use TIRE SPREADER (Part No. HD-21000) to spread the tire sidewalls.

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

Tire SPREADER (Part No. HD-21000) for inspection and repair procedures.

Figure 2-30. Loosening Beads from Rim Flange

Figure 2-31. Starting Tire Off Rim

Figure 2-32. Starting Bead on Rim

REMOVAL

1. Remove wheel from motorcycle. See 2.5 FRONT WHEEL or 2.6 REAR WHEEL.

2. Deflate tire.

3. See Figure 2-30. Loosen both tire beads from rim flange.

WARNING

Do not use excessive force when starting bead over rim. Excessive force may damage tire or rim and adversely affect handling which could result in death or serious injury.

4. If a bead breaker machine is not available, attach RIM PROTECTORS (Part No. HD-01289) to the rim. Using tire tools (not sharp instruments), start upper bead over edge of rim at valve. Repeat all around rim until first bead is over rim.
CLEANING AND INSPECTION

1. Clean inside of tire with dry rag.
2. If rim is dirty or corroded, clean with a stiff wire brush.
3. Inspect tire for wear and damage. Replace worn or damaged tires. See 1.7 TIRES AND WHEELS.

INSTALLATION

**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)

**WARNING**
- Always check both tire sidewalls for arrows indicating forward rotation. Some tires require different tire rotation depending on whether tire is used on front or rear wheel. Installing a tire with the wrong rotation could result in death or serious injury.
- Buell front and rear tires are not the same. Interchanging front and rear tires can cause tire failure, which could result in death or serious injury. (00026a)

**NOTE**
The yellow circle on the sidewall is a balance mark and should be aligned 180 degrees from the balance mark (blue dot) on inside of rim.

1. Damaged or leaking valve stems must be replaced.
2. Install and tighten fastener to 40-44 in-lbs (4.5-4.9 Nm).
3. Thoroughly lubricate rim flanges and both beads of tire with tire lubricant.

**NOTE**
Figure 2-33. Starting Bead on Rim (Typical)

4. See Figure 2-33. Starting at the valve stem, start first bead into the rim well using a bead breaker machine. If no machine is available, work bead on as far as possible by hand. Use a tire tool to pry the remaining bead over rim flange.
5. Start 180° from valve stem hole and place second bead on rim. Work bead onto rim with tire tools, working toward valve in both directions.

**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)

6. Apply air to stem to seat beads on rim. It may be necessary to use a TIRE BEAD EXPANDER (Part No. HD-28700) on the tire until beads seal on rim.
Checking Tire Lateral Runout
1. See Figure 2-34. Turn wheel on axle and measure amount of displacement from a fixed point to tire side-wall.
2. Check tire tread for tire lateral runout. Refer to Table 2-12. If tire lateral runout is more than specification, remove tire from rim.
3. Check rim bead side runout. See 2.7 CHECKING CAST RIM RUNOUT. Replace rims not meeting specifications.
4. Install tire and again check tire lateral runout.

Checking Tire Radial Runout
1. See Figure 2-35. Turn wheel on axle and measure tire radial runout.
2. Refer to Table 2-12. If tire radial runout is more than specification, remove tire from rim.
3. Check rim bead runout. See 2.7 CHECKING CAST RIM RUNOUT. Replace rims not meeting specifications.
4. Install tire and again check tire radial runout.

---

Table 2-12. Tire Runout

<table>
<thead>
<tr>
<th>RUNOUT</th>
<th>IN.</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tire radial</td>
<td>0.060</td>
<td>1.52</td>
</tr>
<tr>
<td>Tire lateral</td>
<td>0.080</td>
<td>2.03</td>
</tr>
</tbody>
</table>
Wheel Balancing

Wheel balancing is recommended to improve handling and reduce vibration, especially at high road speeds.

In most cases, static balancing using WHEEL TRUING AND BALANCING STAND (Part No. HD-99000-80) will produce satisfactory results. However, dynamic balancing, utilizing a wheel spinner, can be used to produce finer tolerances for better high-speed handling characteristics. Follow the instructions supplied with the balance machine you are using.

**NOTE**

If the rear wheel will not fit on a stock dynamic spin balance shaft, use the Carlson wheel balance shaft (Part No. AF15).

**WEIGHTS FOR CAST WHEELS**

The maximum weight permissible to accomplish balance is:

- 1.0 oz. (28 g) total weight applied to the front wheel.
- 2.0 oz. (56 g) total weight applied to the rear wheel.

Wheels should be balanced to within 1/4 oz. (7 g) at 60 MPH (97 KM/H).

See Figure 2-36. Use only WHEEL WEIGHTS (Part No. 43692-94Y) which have special self-adhesive backings. Apply WHEEL WEIGHTS to the flat surface of the wheel rim.

1. Make sure that area of application is completely clean, dry and free of oil and grease.
2. Remove paper backing from weight. For additional adhesive strength, apply three drops of LOCTITE SUPER-BONDER 420 to adhesive side of weight.

**WARNING**

Do not install balancing weights under the stand offs for the front brake rotor. Contact could push rotor out of round. Braking could result in brake failure resulting in death or serious injury.

3. On the front wheel, locate a flat surface on the right side of the wheel rim. On the rear wheel locate a flat surface. Press weight firmly in place, holding for ten seconds.
4. Allow eight hours for adhesive to cure completely before using wheel.

**NOTE**

If wheel assembly is out of specification (1 oz. front, 2 oz. rear) rotate tire on rim and rebalance until wheel is within specification.
REMOVAL

1. See Figure 2-37. Remove cotter pin (7) and discard.
2. Remove clevis pin (2).
3. Remove pedal fastener (5).
4. Remove shift brake pedal sleeve (4).
5. Remove pedal bushings (3).
6. Remove brake pedal (6).

INSTALLATION

1. See Figure 2-37. Install pedal bushings (3).
2. Install shift brake pedal sleeve (4).
3. Install brake pedal (6) using LOCTITE 272 (Red) and tighten fastener (5) to 22-24 ft-lbs (30-33 Nm).
4. Install clevis pin (2).
5. Install new cotter pin (7).
**REMOVAL**

**NOTES**
- Steps 1 is not required for removing the master cylinder assembly from the handlebars. Do not disassemble master cylinder unless problems are experienced.
- If servicing an XB9SX model, see 2.24 DEFLECTORS/HANDLEBARS (XB9SX).

**CAUTION**
DOT 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**
Direct contact of DOT 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 DOT 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

1. Drain brake fluid into a suitable container. Discard used fluid according to local laws.
   - Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   - Open bleeder valve (metric) about 1/2-turn.
   - Pump brake hand lever to drain brake fluid.
   - Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).

   **NOTE**
   Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

2. See Figure 2-38. Remove the banjo bolt (13) (metric) and two copper washers (15) to disconnect brake line (14) from master cylinder (4). Discard copper washers.

3. Unplug terminal (12) to detach brake lamp switch (11).

   **NOTES**
   - The individual parts of the brake lamp switch are not serviceable. Replace switch upon failure.
   - For XB9SX see 2.24 DEFLECTORS/HANDLEBARS (XB9SX).

4. Remove mounting clamp fasteners (5) (metric) to detach master cylinder reservoir (4) from handlebar.

---

**Figure 2-38, Front Brake Hand Lever Assembly**

1. Reservoir cover fasteners
2. Reservoir cover
3. Reservoir cover gasket
4. Master cylinder reservoir
5. Master cylinder housing fasteners (metric)
6. Piston assembly
7. Rubber boot
8. Brake hand lever
9. Pivot bolt nut (metric)
10. Brake switch fastener
11. Brake switch
12. Brake switch terminal
13. Banjo bolt (metric)
14. Brake line
15. Copper washers
16. Pivot bolt
DISASSEMBLY

Brake Hand Lever
1. See Figure 2-38. Remove pivot bolt nut (9) (metric) and pivot bolt (16) from hand lever pivot.
2. Detach front brake hand lever assembly (8) from hand lever pivot.
3. Detach front brake lamp switch (11) by removing the switch fastener (10).

Front Master Cylinder
1. See Figure 2-38. Remove master cylinder cover (2) by removing cylinder cover fasteners (1).
2. Discard excess brake fluid.
3. Remove rubber boot (7) and discard.
4. See Figure 2-39. Depress piston assembly (1) and remove internal circlip (2) and discard.
5. See Figure 2-38. Remove piston assembly (6) from front master cylinder reservoir (4) and discard.

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 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. 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.
2. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace housing if any of these conditions are found.
3. Inspect outlet port that mates with brake line fitting. As a critical sealing surface, replace housing if any scratches, dents or other damage is noted.
Front Master Cylinder

1. Obtain PISTON ASSEMBLY KIT.

2. See Figure 2-40. Assemble new piston components placing small end of spring (5) behind primary seal of piston (4).

3. Lubricate master cylinder body and piston seals with special lubricant found in the service parts kit.

4. See Figure 2-38. Insert piston assembly (6), spring first, into master cylinder reservoir (4).

5. See Figure 2-39. Secure piston assembly (1) with a new circlip (2).

6. See Figure 2-40. Install ridge on boot (1) into groove on piston (3).

Brake Hand Lever

1. See Figure 2-38. Lubricate pivot bolt (16) with LOCTITE ANTI-SEIZE.

2. Align hole in hand lever (8) with hole in hand lever pivot and install pivot bolt (16) through top of hand lever pivot and tighten nut to 39-48 in-lbs (4.4-5.4 Nm).

**WARNING**

When installing circlip to secure master cylinder, be sure the circlip snaps into place. Failure to do so can result in improper brake operation which could result in death or serious injury.
1. See Figure 2-38. Install front brake lamp switch (11).
   a. Install brake lamp switch (11) with switch fastener (10) and tighten to 7-10 in-lbs (0.8-1.0 Nm).
   b. Connect brake switch terminal (12) to brake lamp switch (11).
   c. Test switch action. Tang on switch must release when hand lever is moved.
2. Install master cylinder to handlebar by fastening clamp with fasteners. Position for rider posture and tighten to 80-90 in-lbs (9-10 Nm).

**WARNING**

Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

**WARNING**

To avoid leakage, verify that banjo washers, banjo bolt, hydraulic brake line and master cylinder bore are completely clean.

3. See Figure 2-38. Connect brake line to master cylinder using two new copper washers (15) and banjo bolt (13) (metric) and tighten to 16-20 ft-lbs (22-27 Nm).
4. See Figure 2-41. Verify brake lamp switch wires are tight.
5. See Figure 2-38. Remove two master cylinder cover screws (1), cover (2) and cover gasket (3).
6. Protect body work from brake fluid.
7. See Figure 2-42. With the master cylinder in a level position, add D.O.T. 4 BRAKE FLUID. Bring fluid level to within 1/8 in. (3.2 mm) of molded boss inside front master cylinder reservoir.

**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 proper operation of the master cylinder relief port. Actuate the brake lever with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
9. Bleed brake system. See 1.6 BRAKE SYSTEM MAINTENANCE.
10. See Figure 2-38. Attach master cylinder cover (2) and cover gasket (3). Tighten two cover fasteners (1) to 9-13 in-lbs (1.0-1.5 Nm).

**NOTE**

For XB9SX see 2.24 DEFLECTORS/HANDLEBARS (XB9SX).
REMOVAL

1. Drain brake fluid into a suitable container. Discard of used fluid according to local laws.
   a. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   b. Open bleeder valve (metric) about 1/2-turn.
   c. Pump brake hand lever to drain brake fluid.
   d. Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).
2. Remove p-clamp attaching brake line to rear of right front module. See 2.42 WINDSCREEN/2.28 FRONT MODULES.
3. See Figure 2-43. Remove p-clamp (1) detaching brake line from right side of lower fork clamp.
   
   **NOTE**
   Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

4. See Figure 2-38. Remove master cylinder banjo bolt (13) (metric) and two copper washers (15) to disconnect brake line from master cylinder (4). Discard copper washers.
5. See Figure 2-43. Remove caliper banjo bolt (5) (metric), two copper washers and wire form (3) to disconnect brake line (2) from caliper. Discard copper washers.
6. Carefully inspect the brake line for dents, cuts, chaffing or other defects. Replace the brake line if any damage is noted.

![Figure 2-43. Front Brake Line](image-url)
To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and master cylinder bore are completely clean.

1. See Figure 2-38. Connect brake line (14) to master cylinder (4) using two new copper washers (15) and a banjo bolt (13) (metric). Loosely install bolt into master cylinder.

2. Route the brake line from the master cylinder to the caliper. See 0.1 HOSE AND WIRE ROUTING for front brake line routing.

3. Install and tighten P-clamp on inside of lighting module. Tighten to 36-60 in-lbs (4-7 Nm). See 2.42 WINDSCREEN/2.28 FRONT MODULES.

4. Install brake line to caliper.
   a. See Figure 2-44. Install new copper washer, brake line (2), new copper washer and wire form (3) onto banjo bolt (5).
   b. Finger tighten banjo bolt (5) onto front caliper being careful not to pinch wire form (3) while tightening, wire form should rotate around banjo bolt freely.
   c. Twist brake line (2) into wire form (3) spiral and clock wire form against bleeder valve (4).

5. Install and tighten p-clamp with fastener (1) on lower triple clamp to 36-60 in-lbs (4-7 Nm).

6. See Figure 2-38. Tighten master cylinder banjo bolt (13) (metric) to 16-20 ft-lbs (22-27 Nm).

7. See Figure 2-44. Tighten brake caliper banjo bolt (5) (metric) to 16-20 ft-lbs (22-27 Nm).

8. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See 1.6 BRAKE SYSTEM MAINTENANCE.

9. Turn ignition key switch to ON. Apply brake hand lever to test brake line operation. Turn ignition key switch to OFF.

11 WARNING

Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

CAUTION

To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and caliper bore are completely clean.

4. Install brake line to caliper.
   a. See Figure 2-44. Install new copper washer, brake line (2), new copper washer and wire form (3) onto banjo bolt (5).

11 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)

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

1. Drain brake fluid into a suitable container. Discard used fluid according to local laws.
   a. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   b. Open bleeder valve (metric) about 1/2-turn.
   c. Pump brake hand lever to drain brake fluid.
   d. Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).

   NOTE
   Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

2. See Figure 2-45. Disconnect brake line at caliper. See 2.11 FRONT BRAKE LINE.

3. Remove caliper mounting fasteners (5).

4. Slide caliper down the rotor to clear fork lower and then remove off rotor.

DISASSEMBLY

1. See Figure 2-46. Remove pin hanger set (1), brake pads and caliper pad spring (2).

2. Split caliper by removing caliper fasteners (3).

3. See Figure 2-48. Remove and discard o-rings (8).

4. See Figure 2-47. Remove pistons using a BRAKE PISTON REMOVER (Part No. B-42887).

5. See Figure 2-48. Remove and discard top and bottom piston o-rings (6).
CLEANING AND INSPECTION

1. 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. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages.

2. Carefully inspect all components. Replace any parts that appear damaged or worn. Do not hone caliper piston bore.

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 rotor and pads. See 1.6 BRAKE SYSTEM MAINTENANCE.

4. Check rotor surface. Replace if warped or badly scored. See Table 2-13.

Table 2-13. Front Rotor Runout

<table>
<thead>
<tr>
<th>RUNOUT</th>
<th>IN</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor radial</td>
<td>0.0177</td>
<td>0.45</td>
</tr>
<tr>
<td>Rotor lateral</td>
<td>0.0248</td>
<td>0.63</td>
</tr>
</tbody>
</table>

ASSEMBLY

1. See Figure 2-48. Install pistons and o-rings.
   a. Lubricate new o-rings (6), pistons (5), and caliper piston bores with D.O.T. 4 BRAKE FLUID.
   b. Install two new o-rings (6) in grooves of each piston bore.
   c. Install pistons (5) in each piston bore.

2. Install new o-rings (8) between caliper halves.

3. Clamp caliper together with caliper fasteners (11) and tighten to 15-19 ft-lbs (20-26 Nm).

INSTALLATION

1. See Figure 2-48. Install brake pads (10).

2. Install pad spring (7) and pin hanger set (1) and tighten to 11-14 ft-lbs (15-19 Nm).

3. Install caliper on caliper mount. Using LOCTITE 272 (red), tighten fasteners (9) to 35-37 ft-lbs (47-50 Nm).

WARNING
Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

4. Install brake line to caliper. See 2.11 FRONT BRAKE LINE.

5. Bleed front brakes. See BLEEDING BRAKES in 1.6 BRAKE SYSTEM MAINTENANCE.

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. Turn ignition key switch to ON. Apply brake hand lever to test brake lamp operation.
1. Pin hanger set
2. Brake bleeder
3. Bleeder cap
4. Caliper
5. Piston
6. Piston o-rings
7. Pad spring
8. Small o-ring
9. Caliper mounting fasteners
10. Brake pads
11. Caliper fasteners

Figure 2-48. Front Caliper Assembly
REAR BRAKE MASTER CYLINDER

REMOVAL

1. See Figure 2-49. Drain brake fluid into a suitable container. Discard used fluid according to local laws.
   a. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   b. Open bleeder valve (metric) about 1/2-turn.
   c. Pump brake foot pedal to drain brake fluid.
   d. Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).

2. Remove brake pedal. See 2.9 BRAKE PEDAL.
3. Remove heel guard. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

NOTE
Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

4. See Figure 2-50. Remove brake reservoir hose at master cylinder.
5. Remove seat. See 2.43 SEAT.

Figure 2-49. Brake Bleeder Valve, Rear Caliper

Figure 2-50. Rear Master Cylinder On Vehicle

1. Banjo bolt (metric) and rear brake light switch
2. Brake light switch harness
3. Fasteners (2) (metric)
4. Master cylinder body
5. Clamp
6. Remote reservoir hose
7. Brake line
6. See Figure 2-51. Disconnect brake light connector located under the seat.

7. See Figure 2-52. Remove rear brake light switch (1) (metric) and two copper crush washers (3) to detach brake line (2) from master cylinder (4). Discard copper crush washers.

8. Remove right side rider footpeg mount. See 2.32 FOOT-PEG, HEEL GUARD AND MOUNT.

9. See Figure 2-52. Remove fasteners (11) (metric) to detach master cylinder (4) from rider footpeg mount.

10. See Figure 2-53. Detach remote reservoir.
   a. Remove top clamp (2) on hose connected to master cylinder.
   b. Remove fastener and washer (3) to detach reservoir (1) from frame if necessary.
DISASSEMBLY

1. See Figure 2-54. Slide rubber boot on rod assembly (3) away from master cylinder body (1).
2. Depress rod assembly (3) and remove internal circlip (2). Discard circlip.
3. Remove piston assembly (4) from master cylinder body (1).
4. Loosen adjuster locknut on the rod assembly (3).
5. Remove the clevis from the rod assembly (3).

NOTE
Do not disassemble master cylinder unless problems are experienced. Discard all seals during the disassembly procedure. Install a complete rebuild kit upon assembly.

CLEANING AND INSPECTION

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.

1. Thoroughly clean master cylinder and all brake system components. Stand master cylinder on wooden block or towel to protect seating surfaces.
   a. Examine walls of master cylinder reservoir for scratches and grooves. Replace if damaged.
   b. Verify that vent holes on master cylinder are completely open and free of dirt or debris.
2. Inspect boot on front of master cylinder for cuts, tears or general deterioration. Replace if necessary.

WARNING
Circlip must be snapped into the groove of the master cylinder body. If the circlip is not properly installed, improper brake operation could result in death or serious injury.

ASSEMBLY

1. Obtain PISTON ASSEMBLY KIT.

2. See Figure 2-54. Assemble new piston components placing small end of spring behind primary seal of piston (4).
3. Lubricate master cylinder body (1) and piston seals (5) with D.O.T.4 BRAKE FLUID.
4. Place round side of rod assembly (3) over piston. Depress piston (4) into master cylinder body (1) and secure with a new circlip (2).

5. Tuck rubber boot on rod assembly (3) into master cylinder body (1).
INSTALLATION

1. See Figure 2-52. Install master cylinder (4) onto footpeg mount with fasteners (11). Tighten to 72-96 in-lbs (8-11 Nm).

2. Install rear brake switch (1), brake line (2) and new copper crush washers (3). Tighten to 16-20 ft-lbs (22-27 Nm).

3. Install footpeg mount to frame. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

WARNING

Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

NOTE

To avoid leakage after assembly, verify that banjo washers, banjo bolt, hydraulic brake line and bore of master cylinder are completely clean.

4. See Figure 2-53. Connect remote reservoir.
   a. If removed, attach remote reservoir (1) to frame using fastener and washer (3). Tighten to 48-72 in-lbs (5.4-8.1 Nm).
   b. Attach hose (3) to rear brake reservoir using clamp.

5. See Figure 2-51. Connect brake line switch connector under seat.

6. Install heel guard. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

7. Install rear brake pedal. See 2.9 BRAKE PEDAL.

8. Adjust rear brake pedal. See BRAKE PEDAL ADJUSTMENT in 1.6 BRAKE SYSTEM MAINTENANCE.

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. Add brake fluid and bleed brake system. See 1.6 BRAKE SYSTEM MAINTENANCE.

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)

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

10. Install seat. See 2.43 SEAT.
REAR BRAKE LINE

REMOVAL

1. Remove seat. See 2.43 SEAT.

**WARNING**

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

2. Disconnect battery by unthreading fastener removing negative cable (black) from battery first. See 1.4 BATTERY MAINTENANCE.

3. See Figure 2-55. Disconnect brake light connector from under seat in the front of the battery.

4. Remove right side heel guard. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

5. Drain brake fluid into a suitable container. Discard used fluid according to local laws.
   a. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   b. Open bleeder valve (metric) about 1/2-turn.
   c. Pump brake foot pedal to drain brake fluid.
   d. Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).

6. On XB12Ss models only, remove rear fender. See 2.34 FENDERS.

NOTE

All models except for the XB12Ss Lightning Long use a p-clamp to secure the rear brake line to the swingarm. The Lightning Long utilizes the rear fender to capture and secure the rear brake line.

7. See Figure 2-56. Remove p-clamp (2) securing brake line (1) to the left side of swingarm.

NOTE

Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

8. Remove banjo bolt (3) from rear caliper. Discard copper washers.

9. See Figure 2-57. Remove brake line switch/banjo bolt from rear master cylinder. Discard copper washer.

10. Remove brake line from motorcycle.
1. See Figure 2-57. Install brake line switch/banjo bolt with new copper washers to the master cylinder. Tighten to 16-20 ft-lbs (22-27 Nm).

Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

2. Install brake line banjo bolt and new copper washers to rear caliper. Tighten to 16-20 ft-lbs (22-27 Nm).

3. See Figure 2-56. Secure brake line (1) to left side of swingarm with p-clamp (2) and tighten to 36-60 in-lbs (4-7 Nm). See 0.1 HOSE AND WIRE ROUTING for brake line routing.

4. See Figure 2-58. Connect brake line switch connector underneath seat. See 0.1 HOSE AND WIRE ROUTING for brake line routing.

5. Install right heel guard. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

6. On XB12Ss models verify that the brake line fits the fender guide and install rear fender. See 2.34 FENDERS.

7. Bleed brakes. See BLEEDING BRAKES in 1.6 BRAKE SYSTEM MAINTENANCE.

8. Install negative battery cable and tighten to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat. See 2.43 SEAT.

10. Turn ignition key ON, depress rear brake pedal and check for proper brake light operation.

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. (00316a)

11. Test ride motorcycle and check for proper brake operation.
REAR BRAKE CALIPER 2.15

REMOVAL

NOTES

- Steps 1 and 2 are not required for detaching caliper from rotor. Drain fluid only when disassembling caliper.
- Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

1. Drain brake fluid into a suitable container. Discard used fluid according to local laws.
   - a. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   - b. Open bleeder valve (metric) about 1/2-turn.
   - c. Pump brake foot pedal to drain brake fluid.
   - d. Tighten bleeder valve to 36-60 in-lbs (4-7 Nm).

2. Remove banjo bolt connecting brake line to rear caliper. See 2.14 REAR BRAKE LINE.

DISASSEMBLY

1. See Figure 2-58. Remove pin plug (5) and pad hanger (metric) to free brake pads.

2. See Figure 2-59. Remove spring clip (1).

3. See Figure 2-60. Remove piston (3) using BRAKE CALIPER PISTON REMOVER (1) (Part No. B-42887) with adaptor (2).

   - Remove two o-rings from groove in caliper bore and discard.

Figure 2-58. Rear Brake Caliper

1. Brake line
2. Banjo bolt (metric)
3. Copper washers (2)
4. Bleeder valve (metric)
5. Pin plug
6. Small caliper fastener
7. Larger caliper fastener
8. Caliper mounting fasteners

Figure 2-59. Brake Pads

1. Clip
2. Pin plug and pad hanger (metric)
3. Brake pads (2)

Figure 2-60. Removing Rear Brake Caliper Piston

1. Brake caliper piston remover
2. Adaptor
3. Piston

2006 Buell Lightning: Chassis 2-43
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 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. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages.

2. Carefully inspect all components. Replace any parts that appear damaged or worn. Do not hone caliper piston bore.

3. Inspect brake rotor.
   a. Measure rotor thickness. Replace if minimum thickness is less than 0.18 in. (4.5 mm).
   b. Check rotor surface. Replace if warped or badly scored. Refer to Table 2-14.

NOTE

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

4. Inspect brake pads for damage or excessive wear. Replace both pads as a set if the friction material of either pad is worn to 0.04 in. (1.0 mm) or less.

WARNING

ASSEMBLY

1. See Figure 2-59. Place clip (1) inside caliper body as shown.

NOTE

To ensure proper brake pad-to-brake rotor clearance when the caliper is installed, piston must be pressed all the way into the bore whenever new brake pads are used.

2. Install pistons and o-rings.
   a. Apply a light coat of D.O.T. 4 BRAKE FLUID to o-rings, piston and caliper piston bore.
   b. Place two new o-rings inside grooves of piston bore.
   c. Install piston inside caliper body.

Table 2-14. Rear Rotor Runout

<table>
<thead>
<tr>
<th>RUNOUT</th>
<th>IN.</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotor radial</td>
<td>0.0177</td>
<td>0.45</td>
</tr>
<tr>
<td>Rotor lateral</td>
<td>0.0154</td>
<td>0.39</td>
</tr>
</tbody>
</table>

NOTE

See Figure 2-61. Retainer, brake pads

3. See Figure 2-59. Install brake pads (3) using pad hanger and pin plug (2).
   a. Install pad hanger pin (metric). Tighten to 11-14 ft-lbs (15-19 Nm).
   b. Install pin plug. Tighten to 24 in-lbs (2.7 Nm).

4. Install a new bleeder valve (metric) if necessary and tighten to 36-60 in-lbs (4.7 Nm).
1. See Figure 2-61. Install brake pad retainer (1) if removed.

2. See Figure 2-58. Install caliper assembly on caliper mount. Brake pad surfaces must face rear brake rotor.
   a. Install large caliper screw (7) (metric) tightening to 18-21 ft-lbs (24-28 Nm).
   b. Install small caliper screw (6) (metric) tightening to 14-18 ft-lbs (19-24 Nm).
   c. Install caliper carrier onto swingarm tightening caliper carrier fasteners (8) to 24-26 ft-lbs (33-35 Nm).

3. Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

   NOTE
To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and caliper bore are completely clean.

4. See Figure 2-58. Connect brake line (1) to caliper using two new copper washers (3) and banjo bolt (2) (metric). Tighten to 16-20 ft-lbs (22-27).

5. Depress rear brake pedal several times to set brake pads to proper position within caliper. Bleed brake system. See 1.6 BRAKE SYSTEM MAINTENANCE.

5. See Figure 2-62. Verify proper fluid level in reservoir.

6. 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)

   NOTE
Avoid making hard stops for the first 100 miles (160 km) to allow new brake pads to “wear in” properly with the brake rotor.
GENERAL

The XR12Scg model utilizes a 41mm fork assembly while all other models have changed to the 43mm fork assembly. The front fork consists of two telescoping outer tube/inner slider assemblies. Each assembly has an internal compression spring which supports the forward weight of the vehicle and rider. The compression spring extends and retracts to cushion the ride over rough or irregular road surfaces. An oil filled damping mechanism controls the telescoping action of each tube/slider assembly.

See 1.11 SUSPENSION DAMPING ADJUSTMENTS for more information.

REMOVAL

1. Remove front fender. See 2.34 FENDERS.
2. Remove front wheel. See 2.5 FRONT WHEEL.
3. Remove caliper mounting fasteners. See 2.12 FRONT BRAKE CALIPER.

4. See Figure 2-63. Loosen upper and lower fork clamp pinch fasteners (1, 4).

5. See Figure 2-64. Remove fork from upper fork clamp and slide the stopper ring up and over the top of the fork.
6. See Figure 2-63. Remove fork from lower fork clamp (3).
7. Repeat 4 through 6 on opposite side.

Figure 2-63. Upper and Lower Fork Clamp Assembly

Figure 2-64. Stopper Ring
NOTE
Record rider suspension settings before disassembly.

1. Remove front fork. See REMOVAL in 2.16 FRONT FORK.

2. See Figure 2-65. Clamp the FORK TUBE HOLDER TOOL (1) (Part No. HD-41177) in a vise and install the upper part of the front fork in the holding tool.

3. Remove snap ring (2).

4. See Figure 2-66. Remove preload adjuster by turning counterclockwise. After fully unthreading preload adjuster, gently pull on adjuster.

5. See Figure 2-67. Remove fork cap from outer tube.
6. See Figure 2-68. Move the fork assembly from the holding tool and compress fork in the FORK SPRING COMPRESSION TOOL.

   NOTES
   • FORK SPRING COMPRESSING TOOL (HD-45966) comes with a cup and screw that are for FLT models only and not to be used with Buell.
   • When using the FORK SPRING COMPRESSING TOOL be sure not to bind the outer fork tube on the tool.

7. See Figure 2-69. Hold damper rod assembly (3) and remove fork cap (1).

   NOTE
   Careful not to damage preload pins while holding damper rod assembly.

8. Remove preload washer (4) and slider piston (5).

9. See Figure 2-68. Expand fork and remove from FORK SPRING COMPRESSION TOOL.
Figure 2-70. Front Fork Assembly

1. Preload adjuster
2. Preload adjuster o-rings
3. Fork cap
4. Fork cap o-ring
5. Preload washer
6. Slider piston
7. Inner slider piston o-ring
8. Snap ring
9. Rebound adjuster assembly
10. Damper locknut
11. Damper rod assembly
12. Centering plate
13. Ceiling washer
14. Center bolt
15. Collar
16. Spring joint
17. Spring
18. Outer tube
19. Stopper ring
20. Reflector assembly
21. Slide bushing
22. Guide bushing
23. Seal spacer
24. Oil seal
25. Oil seal stopper ring
26. Dust seal
27. Slider fork
10. See Figure 2-70. Over drain pan, spring collar (15), remove spring (17) and drain fork oil.

11. Drain remaining fork oil by pumping the damping rod (11) approximately 8 to 10 times or until damping rod moves freely.

12. Clamp fork upside down in the FORK TUBE HOLDER TOOL (Part No. HD-41177) over drain pan allowing fork oil to drain.

**NOTE**
Be careful not to drop damping rod assembly into oil pan when removing center bolt.

13. Remove center bolt (14) to release damping rod assembly (11).

14. Remove centering plate (12) from dampering rod (11).

**WARNING**
Be careful not to scratch the slider fork or the outer tube. Improperly operating forks may lead to a loss of control which could result in death or serious injury.

15. Remove dust seal (26) to access oil seal stopper ring (25).

16. Release the oil seal stopper ring (25) out from the outer tube with a small pry tool.

17. Using a slide hammer action, remove the slider fork (27) from the outer tube (18).

18. Remove the slide bushing (21) from slider fork by prying the slide bushing at the split.

**NOTE**
Careful not to over expand slide bushing.

19. Remove guide bushing (22), seal spacer (23), oil seal (24), stopper ring (25) and dust seal (26).

**Damper Rod Disassembly**

**NOTES**

- See Figure 2-70. Disassembly of damper rod is not required unless damper locknut (10) has been moved. If damper rod needs servicing refer to the Parts Catalog for kit information.

- If damper locknut has been moved, proceed with the following disassembly and assembly procedures for setting the correct range of motion.

1. See Figure 2-70. Lightly turn the rebound adjuster screw on top of the rebound adjuster assembly (9) counter clockwise till it stops.

2. Holding the damper locknut (10), unscrew the rebound adjuster assembly (9) and remove from damper rod assembly (11).

3. Remove damper locknut (10) from damper rod assembly (11).

**CLEANING AND INSPECTION**

1. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.

2. See Figure 2-70. Check the slider fork (27) and outer tube (18) for score marks, scratches and excessive or abnormal wear. Replace if worn or damaged.

3. Check the slide bushing (21) and the guide bushing (22) for excessive wear or scratches. Replace if damaged or worn.

4. Replace the stopper ring (19) if distorted.

5. Measure spring (17) free length. Replace springs shorter than service wear limit of 10.92 in. (277.5 mm) in 41mm front fork assemblies and 14.31 in. (363.6 mm) in 43mm fork assemblies.

6. See Figure 2-71. Measure slider fork runout. Replace pipe if runout exceeds the service wear limit of 0.008 in. (0.2 mm).

**Figure 2-71. Slider fork Runout**
## Damper Rod Assembly

**Note**
Skip to fork assembly if damper rod assembly was not disassembled.

1. See Figure 2-70. Fully thread the damper rod locknut (10) on to damper rod (11) clockwise till it lightly bottoms.

**NOTE**
Set both forks to the exact same suspension settings.

2. Adjust rebound assembly for proper range of motion.
   a. Lightly turn the rebound adjuster screw on top of the rebound adjuster assembly (9) counter clockwise till it stops.
   b. Turn the rebound adjuster screw three full turns clockwise.

3. Fully thread rebound adjuster assembly (9) onto the damper rod assembly (11) until it lightly bottoms. Do not tighten.

4. Thread the damper locknut (10) until bottoms lightly on the rebound adjuster assembly. Do not tighten

5. Turning the rebound adjuster screw (9) counter clockwise three full turns or until stops.

6. See Figure 2-70. Wrap the end of the slider fork (27) and the slide bushing channel with tape to avoid damaging the oil seal lip when installing.

7. Install a new dust seal (26) and stopper ring (25) onto the slider fork (27).

8. Coat the sealing lips of the new oil seal (24) with fork oil or sealing grease and install onto the slider fork with its marked side facing the dust seal (26).

9. Remove the tape from the slider fork end.

10. Install the seal spacer (23), the guide bushing (22) and the slide bushing (21) onto the slider fork (27).

11. Coat the slide bushing (21) and the guide bushing (22) with fork oil.

**NOTE**
The outer tube can move freely up and down on the slider fork. Always hold both the slider fork and outer tube to prevent damage to bushings and seals.

---

### Fork Assembly

1. See Figure 2-70. Wrap the end of the slider fork (27) and the slide bushing channel with tape to avoid damaging the oil seal lip when installing.

2. Install a new dust seal (26) and stopper ring (25) onto the slider fork (27).

3. Coat the sealing lips of the new oil seal (24) with fork oil or sealing grease and install onto the slider fork with its marked side facing the dust seal (26).

4. Remove the tape from the slider fork end.

5. Install the seal spacer (23), the guide bushing (22) and the slide bushing (21) onto the slider fork (27).

6. Coat the slide bushing (21) and the guide bushing (22) with fork oil.

**NOTE**
The outer tube can move freely up and down on the slider fork. Always hold both the slider fork and outer tube to prevent damage to bushings and seals.

---

7. See Figure 2-70. Drive the guide bushing (22) with the seal spacer (23) and oil seal (24) into position in the outer tube using a FORK SEAL DRIVER (Part No. B-43721/41mm) and (Part No. B-42571/43mm). See Figure 2-73.

8. Install the oil seal stopper ring (25) and a new dust seal (26).

9. Place the fork in the FORK TUBE HOLDER TOOL (Part No. HD-41177) and clamp into vise horizontally.

10. See Figure 2-70. Install the centering plate (12) onto the damper assembly (11) and insert the damper assembly into the slider fork (27).

11. Replace the sealing washer (13) and center bolt (14) (metric). Tighten the center bolt to 22-30 ft-lbs (30-40 Nm).
12. Move the front fork and the FORK TUBE HOLDER TOOL in the vise from the horizontal position to the vertical.

NOTE
The recommended fork oil is hydraulic fork oil Type “E” (Part No. HD-99884-80).

13. Pour 8 oz. (236.5 cc) into the fork pipe.
14. Pump the damper rod approximately 12 to 15 times or until resistance is felt.
15. Place the damper rod in the fully bottomed position and compress fork completely.
16. Pour 8 oz. (236.5 cc) more fork oil into the slider fork.
17. See Figure 2-74. Adjust fork oil level with FRONT FORK OIL LEVEL GAUGE (Part No. B-59000A) to the specified level below the top of the fork tube. Refer to Table 2-15.

Table 2-15. Fork Oil Levels

<table>
<thead>
<tr>
<th>Model</th>
<th>Inch</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>XB9SX, XB12S, XBSs</td>
<td>4.21</td>
<td>107</td>
</tr>
<tr>
<td>XB12Scg</td>
<td>4.29</td>
<td>109</td>
</tr>
</tbody>
</table>

18. See Figure 2-70. Install spring (17) and collar (15).
19. Move fork assembly from holding tool to the FORK SPRING COMPRESSION TOOL.
20. See Figure 2-69. Install preload washer (4) and slider piston (5).
21. See Figure 2-72. Hold damper rod assembly (3) and install fork cap (1) on damper rod assembly (3) tightening to 22-30 ft-lbs (30-40 Nm).

NOTE
See Figure 2-69. Careful not to damage preload pins (2) while holding damper rod assembly (3).

22. Remove the fork assembly from the FORK SPRING COMPRESSION TOOL and install in the FORK TUBE HOLDER and install in vise.
23. See Figure 2-70. Thread fork cap (3) into fork tube (18) and tighten to 25 ft-lbs (33.89 Nm).
24. Apply fork oil or light grease to o-rings on preload adjuster and install preload adjuster (3).
25. Install snap ring (2).
1. See Figure 2-64. Install one front fork assembly into lower fork clamp.

2. Slide the stopper ring over top of fork assembly and into groove.

**WARNING**

Carefully install the fork into the upper fork clamp. Forcing the fork into the upper fork clamp could move the stopper ring out of the groove which will not allow the correct upper fork clamp load resulting in possible loss of control of the motorcycle and could result in death or serious injury.

3. Install fork assembly into upper fork clamp.

**WARNING**

Both forks should display the same number of alignment lines. Forks that are not properly aligned can lead to loss of control, which could result in death or serious injury. (00124a)

4. See Figure 2-75. Position fork with alignment lines (4) visible and reflector facing to the side and tighten the lower fork clamp.

5. Repeat step 1 through 4 on second front fork.

6. Temporarily install front axle to the fork assemblies to verify correct alignment.

7. Use LOCTITE 272 on upper fork clamp fasteners and tighten to 23-25 ft-lbs (31.2-33.8 Nm).

8. Use LOCTITE 272 on lower fork clamp fasteners and tighten to 20-22 ft-lbs (27.2-20 Nm).

9. Repeat torque sequence in steps 7 and 8.

10. Install front brake caliper onto caliper mount. See 2.12 FRONT BRAKE CALIPER.

11. Install front wheel. See 2.5 FRONT WHEEL.

12. Install front fender. See 2.34 FENDERS.

13. Check headlamp alignment. See 1.18 HEADLIGHTS.

14. Adjust front forks suspension to rider preferences. See 1.11 SUSPENSION DAMPING ADJUSTMENTS.
REMOVAL

1. Place a scissor jack under jacking point and raise front wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.
2. Remove handlebars. See 2.29 HANDLEBARS.
3. Remove front modules. See 2.28 FRONT MODULES.
4. Remove front fork assemblies. See 2.16 FRONT FORK.

5. See Figure 2-76. Remove steering stem pinch fastener (2).
6. See Figure 2-76. Hold or brace the lower fork clamp and remove steering stem capnut (1).
7. Remove the upper fork clamp (4).
8. Remove the lower fork clamp (6).
9. If steering head bearings need replacing, see 2.18 STEERING HEAD BEARINGS.

Figure 2-76. Steering Stem Assembly
INSTALLATION

1. See Figure 2-76. Install the lower fork clamp (6) into the steering stem bore and install the upper fork clamp (4).
2. Install steering stem capnut (1). Tighten but do not torque.

**WARNING**

Carefully install the fork into the upper fork clamp. Forcing the fork into the upper fork clamp could move the stopper ring out of the groove which will not allow the correct clamp load causing a possible loss of control of the motorcycle which could result in death or serious injury.

3. Install one front fork assembly into lower fork clamp (6).
4. See Figure 2-70. Slide the stopper ring (19) over top of fork assembly and into groove.
5. Install fork assembly into upper fork clamp. Tighten but do not torque lower fork clamp pinch fasteners.
6. Repeat previous two steps on second fork assembly.
7. Tighten steering stem capnut to 38-42 ft-lbs (52-57 Nm).
8. Install steering stem pinch bolt applying LOCTITE 272 (red) and tightening to 20-22 ft-lbs (27.1-29.8 Nm) for all models except for the XB9SX which should be tightened to 23-25 ft-lbs (31.2-33.8 Nm).

**WARNING**

Both forks should display the same number of alignment lines. Forks that are not properly aligned can lead to loss of control, which could result in death or serious injury.

9. See Figure 2-75. Position both forks with same number alignment lines (4) visible and reflectors facing to the sides. Do not tighten.
10. Use LOCTITE 272 (red) on upper fork clamp fasteners and tighten to 23-25 ft-lbs (31.2-33.8 Nm).
11. Use LOCTITE 272 (red) on lower fork clamp fasteners and tighten to 20-22 ft-lbs (27.1-29.8 Nm).
12. Repeat torque sequence in steps 10 and 11 to verify proper clamp load.
13. Install front modules. See 2.28 FRONT MODULES.
14. Install handlebars. See 2.29 HANDLEBARS.
STEERING HEAD BEARINGS

REMOVAL

1. Place a scissor jack under jacking point and raise front wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.

2. Remove brake lever housing. See 2.10 FRONT BRAKE MASTER CYLINDER AND HAND LEVER.

3. Remove headlight assembly and support bracket. See 2.27 HEADLIGHT ASSEMBLY AND SUPPORT BRACKET.

4. Remove front forks, lower fork clamp, brake and wheel as front-end assembly.
   a. See Figure 2-76. Loosen steering stem pinch fastener (2) and upper and lower fork clamp pinch fasteners (3, 7).
   b. Brace wheel while removing steering stem capnut fastener (1).
   c. Remove upper fork clamp (4) and front-end assembly which includes front wheel, steering stem/lower fork clamp.

5. Remove upper and lower steering head bearings (5).
   a. See Figure 2-77. Locate notches inside steering head stem bore (upper bearing removed for clarity).
   b. Place a suitable tool in the notches of the steering stem bore and remove upper and lower steering head bearings.

NOTE

Discard steering head bearings and replace with new. Steering head bearings are not reusable.

INSTALLATION

NOTES

- Steering head bearings should be installed one at a time in order to ensure proper alignment of bearing in bore.
- Use the new backing plate for wheel bearing installation (B-43993-12) on the opposite side of the frame neck. By placing the large diameter of the backing plate against the frame neck it will prevent damage to the frame.
- For easier installation of bearing, lubricate the outer bearing with engine oil prior to installing into steering stem bore.

Figure 2-77. Lower Steering Head Bearing Notches (upper bearing removed for clarity)

Figure 2-78. Steering Head Bearings Installation Tools

Steering Head Bearing Race Installer (Part No. HD-39302)

Steering Head Bearing Installer (Part No. B-45521)

Wheel Bearing Backing Plate (Part No. B-43993-12)
1. See Figure 2-78. Install new upper steering head bearing into the frame neck using STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302), the STEERING HEAD BEARING INSTALLER (Part No. B-45521) and backing plate (B-43993-12) from the wheel bearing installation kit.
   a. See Figure 2-79. Place the upper bearing squarely in the steering stem bore with the inner race lip pointing away from the steering head.
   b. See Figure 2-78. Insert the steering head bearing installation tool into the upper bearing, with the shoulder into the bearing bore.
   c. Insert the forcing screw from the steering head bearing race installer through the steering head bearing installation tool.

   **NOTE**
   For ease of steering head bearing installation, lubricate the outside of the steering head bearings.

2. See Figure 2-80. Sparingly apply EXTREME PRESSURE LUBRICANT (Part No. J-23444-A) to the threads of the forcing screw (1) from the STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302), to prolong service life and ensure smooth operation. Insert the forcing screw (1) through the STEERING HEAD BEARING INSTALLATION TOOL (Part No. B-45521) (2).
   3. Place the WHEEL BEARING BACKING PLATE with the large diameter facing the frame over the forcing screw.
   4. Install the bearing (4), washer (5) and nut (6) from the STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302) onto the forcing screw (1).
   5. Tighten the nut (6) by hand, until the bearing is started into the bore in the steering head.
6. See Figure 2-81. Hold the forcing screw while tightening the nut to draw the bearing into the steering head. Continue tightening until the bearing is fully seated.

7. Visually check to make sure the bearing is completely seated against the shoulder in the steering head.

8. Repeat this process for the lower bearing.

9. Install forks, front wheel, and lower fork clamp/steering stem as an assembly.

10. Install upper fork clamp.

11. Tighten steering stem cap nut to 38-42 ft-lbs (52-57 Nm).

12. Install steering stem pinch bolt applying LOCTITE 272 (red) and tightening to 20-22 ft-lbs (27.1-29.8 Nm) for all models except for the XB9SX which should be tightened to 23-25 ft-lbs (31.2-33.8 Nm).

13. Apply LOCTITE 272 to upper triple clamp fasteners and tighten to 23-25 ft-lbs (31.2-33.8 Nm).

14. Install front brake lever housing. See 2.10 FRONT BRAKE MASTER CYLINDER AND HAND LEVER.

15. Install front modules. See 2.28 FRONT MODULES.

16. Install brake line p-clamp to the rear of the right headlight module and tighten fastener to 36-60 in-lbs (4.7 Nm).

17. Install windscreen. See 2.42 WINDSCREEN.
GENERAL

The swingarm also serves as the oil tank. For information on the swingarm function as the oil tank, see 3.9 OIL HOSE ROUTING AND OIL RESERVOIR.

The swingarm features a removable brace on the right side to allow drive belt replacement. Sealed bearings eliminate the need for preload adjustment.

REMOVAL

Brace

NOTE

Before removing swingarm brace, always relieve belt tension first. Removing swingarm brace without releasing tension will cause swingarm brace damage.

1. Remove right side rider footpeg mount. See 2.32 FOOT-PEG, HEEL GUARD AND MOUNT.
2. See Figure 2-82. Loosen rear axle pinch fastener (2).
3. Loosen rear axle (1) approximately 15 rotations to allow partial tension to be removed from rear drive system.
4. See Figure 2-85. Remove swingarm brace mounting fasteners (10).
5. Remove swingarm brace (11).
WARNING
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect battery cables (negative (-) cable first) before proceeding. (00307a)

1. Remove seat. See 2.43 SEAT.
2. Disconnect battery by unthreading fasteners removing negative cable (black) from battery first. See 1.4 BATTERY MAINTENANCE.
3. See Figure 2-85. Remove oil drain plug (8) and drain oil from swingarm. See Draining Oil in 1.5 ENGINE LUBRICATION SYSTEM.
4. Remove drive belt. See 6.6 DRIVE BELT SYSTEM.
5. Remove rear wheel. See 2.6 REAR WHEEL.
6. Remove rear fenders. See 2.34 FENDERS.
7. Remove p-clamp securing the rear brake line to swing-arm on all models except the XB12Ss.
8. Remove p-clamps and washers that secure oil lines to swingarm.
9. Remove three oil lines from swingarm fittings. See 3.9 OIL HOSE ROUTING AND OIL RESERVOIR.
10. See Figure 2-85. Loosen pivot shaft pinch fastener (7).
11. See Figure 2-85. Loosen pivot shaft pinch fastener (7).
12. Remove pivot shaft pinch fastener (9) with a special 7/8 in. hex tool located in tool kit.
13. Remove swingarm from vehicle.

Figure 2-85. Swingarm Assembly

- Swingarm
- Dipstick
- Swingarm bushings
- Swingarm spacer
- Swingarm bearing (2)
- Engine crankcase
- Pivot shaft pinch fastener w/nut
- Oil drain plug
- Pivot shaft
- Brace fastener (4)
- Swingarm brace
- Rear axle pinch fastener
- Jiffy Tite oil line fittings (3)
DISASSEMBLY

NOTE
Carefully mark all bearing components as they are removed so that they may be returned to their original locations. Do not intermix bearing components.

Swingarm
1. See Figure 2-86. Remove oil line fittings from swingarm.

2. See Figure 2-85. Remove swingarm bearings (5) using slide hammer (SNAP-ON Part No. CJ1275 or equivalent) and 3/4 in. bearing remover and spacer.

3. Remove shock mount bushings (3) and sleeve.

4. Remove stone guard. See 2.35 BELT GUARDS.

5. See Figure 2-85. Remove swingarm bearings (5) only if replacement is required. The complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.

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. Thoroughly clean all components in solvent. Blow dry with compressed air.

2. Carefully inspect all bearing components for wear and/or corrosion. Replace complete bearing assembly if any component is damaged.

3. Check that swingarm is not bent or twisted. Replace if damaged.

ASSEMBLY

Swingarm
1. See Figure 2-85. Install new shock mount bushings (3).

2. Install new bearings (5) and spacer (4) with BEARING INSTALLER (Part No. HD-44060) by lightly seating spacer.

3. See Figure 2-86. Install oil line fittings on swingarm with new o-rings. Tighten to 108-156 in-lbs (12-17.6 Nm). See 3.10 OIL LINE FITTINGS.

4. See Figure 2-85. Install drain plug (8). Tighten to 29-34 ft-lbs (39-46 Nm).

Figure 2-86. Jiffy Tite, Quick Disconnect Oil Line Fittings

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)
Swingarm

1. See Figure 2-85. Align swingarm (1) in pivot of engine crankcase (6).
2. Install pivot shaft (10) with a special 7/8 in. hex tool located in tool kit, ANTI-SEIZE and tighten to 24-26 ft-lbs (32-35 Nm).
3. Tighten pivot shaft pinch fastener (7) to 17-19 ft-lbs (23-26 Nm).
4. See Figure 2-90. Install lower shock absorber mounting fastener and spacer from shock absorber and swingarm and tighten to 15-17 ft-lbs (20-23 Nm).
5. Install p-clamp and washer that secures rear brake line to swingarm and tighten to 36-60 in-lbs (4-7 Nm).
6. Install rear fender. See 2.34 FENDERS.
7. Install rear inner fender and tighten fasteners to 12-36 in-lbs (1.4-4Nm).

**NOTE**
On XB12Ss models it is necessary to align the rear brake line with the rear inner fender. The rear fender captures the rear brake line to help maintain the proper alignment and location.

8. Connect oil lines to swingarm fittings and install and tighten p-clamps to 48-72 in-lbs (5.4-8 Nm). See 3.9 OIL HOSE ROUTING AND OIL RESERVOIR.
9. Install stone guard. See 2.35 BELT GUARDS.
10. Install rear wheel. See 2.6 REAR WHEEL.

**NOTE**
Installing the rear wheel will include installation of the belt drive system. See 6.6 DRIVE BELT SYSTEM.
11. Fill motorcycle with recommended oil. See 1.5 ENGINE LUBRICATION SYSTEM.

Brace

1. Install the belt. See 6.6 DRIVE BELT SYSTEM.
2. See Figure 2-85. Install swingarm brace (11) with swingarm brace mounting fasteners (10) loosely. Do not tighten.
3. Tighten swingarm brace fasteners (10) to 25-27 ft-lbs (34-37 Nm).
4. Tighten rear axle. See DRIVE BELT INSTALLATION.
5. Tighten rear axle pinch fastener (12) to 40-45 ft-lbs (54-61 Nm).
6. Install right side rider footpeg mount. Tighten fasteners to 108-132 in-lbs (12-15 Nm). See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
7. Remove rear wheel support stand.
FRONT ISOLATOR

Removal

Avoid cross-threading front isolator bolt or insert. Keep weight of motorcycle off front isolator by alternately loosening front isolator bolt and raising scissor jack to support engine.

1. Place a scissor jack under jacking point for supporting engine only. For location of jacking point see Figure 2-112.
2. See Figure 2-87. Remove clutch cable wire form.
3. See Figure 2-88. Remove front isolator bolt (6).
4. Remove front isolator mount fasteners (5).
5. Remove front isolator bracket (4).
6. Remove upper snubber fastener (2) and remove upper snubber (1).

Installation

See Figure 2-88. If the threaded insert (3) is damaged and needs to be replaced, install new insert with LOCTITE 272 and tighten to 59-61 ft-lbs (80-82.7 Nm).

7. See Figure 2-88. Install upper snubber (1) tightening snubber fastener (2) to 12-36 in-lbs (1-4 Nm).
8. Loosely install front isolator bracket (4) with front isolator bolt (6).
9. See Figure 2-88. Tighten fasteners (5) to 49-51 ft-lbs (66-69 Nm).

CAUTION

Avoid cross-threading front isolator bolt or insert. Keep weight of motorcycle off front isolator by alternately tightening front isolator bolt and raising scissor jack to support engine.

10. Tighten front isolator bolt (6) to 49-51 ft-lbs (66-69 Nm).
11. See Figure 2-87. Install clutch cable wire form. Tighten fastener to 84-92 in-lbs (9.5-10.4 Nm).

REAR ISOLATOR

NOTE

It is necessary to remove engine to access rear isolator. See 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE to access the rear isolator.
REMOVAL

1. Remove fuel from frame. See DRAINING FUEL TANK in 4.39 FUEL PUMP.
2. Rotate engine. See 3.3 ENGINE ROTATION FOR SERVICE.
3. Remove exhaust header. See 2.31 EXHAUST SYSTEM.
4. Remove tail frame. See 2.39 LEFT TAIL SECTION AND BATTERY PAN.
5. Remove rear shock. See 2.22 REAR SHOCK ABSORBER.
6. Remove upper and lower fork clamps. See 2.17 FORK CLAMPS, UPPER AND LOWER.
7. Remove main wire harness. See 7.24 MAIN WIRE HARNESS.
8. Remove rear isolator fastener. See 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE.
9. See Figure 2-89. Lift and remove frame from the motorcycle.

INSTALLATION

1. Place frame over the motorcycle.
2. Install rear isolator fastener. See 3.5 ENGINE INSTALLATION.
3. Install main wire harness. See 7.24 MAIN WIRE HARNESS.
4. Install upper and lower fork clamps. See 2.17 FORK CLAMPS, UPPER AND LOWER.
5. Install rear shock. See 2.22 REAR SHOCK ABSORBER.
6. Install tail frame. See 2.39 LEFT TAIL SECTION AND BATTERY PAN.
7. Install exhaust header. See 2.31 EXHAUST SYSTEM.
8. Rotate engine. See 3.3 ENGINE ROTATION FOR SERVICE.
The rear suspension is controlled by the shock absorber. The shock allows adjustment of rear compression and rebound damping and spring preload.

The most important rear shock adjustment is the preload setting. Before making any damping adjustments, set the proper preload. See 1.11 SUSPENSION DAMPING ADJUSTMENTS.

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**Figure 2-90. Rear Shock Absorber Assembly**

1. Remote reservoir clamp fastener (XB9SX, XB12S, XB12Scg - 2) (X12Ss - 1)
2. Remote reservoir clamp
3. Remote reservoir
4. Lower shock mount nut
5. Washers (2)
6. Lower shock mount sleeve
7. Lower shock mount fastener
8. Shock reservoir body
9. Upper shock mount fastener
10. Lower shock mount
11. Shock spring retainer kit
12. Rear shock spring

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2-66 2006 Buell Lightning: Chassis
REMOVAL

1. Remove seat. See 2.43 SEAT.

**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)

2. Disconnect and remove battery. See 1.4 BATTERY MAINTENANCE.

3. Place a scissor jack under jacking point at the rear muffler and raise chassis until load has been removed from the lower shock bolt (7). See 2.31 EXHAUST SYSTEM for jacking point.

4. See Figure 2-91. Cut the cable tie (2) securing vent hose to shock housing.

5. See Figure 2-90. Remove the nut (4) and washer (5) from the lower shock bolt and raise scissor jack until the lower bolt can be removed by hand.

6. After removing both shock fasteners (7, 9) and reservoir clamp fastener (1), remove rear shock assembly and reservoir.

   For XB9SX, XB12S, and XB12Scg: The remote reservoir can be slid out of the clamp and the clamp left attached to the tail section.

   For the XB12Ss: The clamp is clipped to the remote reservoir and is removed from the tail section with the single fastener.

**NOTE**
Remove shock assembly through the top of the tail section (opening underneath rider seat).

INSTALLATION

1. Slide shock absorber through top of tail section.

2. See Figure 2-90. Install rear shock assembly in upper shock mount. Install fastener (9) and tighten to 48-52 ft-lbs (65-70.5 Nm).

3. Install lower shock mount with fasteners (4, 5, 7) and lower shock mount sleeve (6) and tighten to 15-17 ft-lbs (20.3-23 Nm).

4. Install rear shock reservoir and reservoir clamp. Tighten clamp on reservoir to 120-144 in-lbs (all models except for XB12Ss). For XB12Ss models, tighten fastener to 80-88 in-lbs (9-10 Nm).

   **NOTE**
   For XB9SX, XB12S, and XB12Scg: Verify compression dial is facing up. See Figure 2-92.

5. Secure vent hose to shock housing with cable tie.

**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)

6. Install and connect battery. See 1.4 BATTERY MAINTENANCE.

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.
REMOVAL/DISASSEMBLY

1. See Figure 2-93. Loosen cable adjuster lock (thick disc) (3) on each cable.
2. Turn adjusters (3) in direction which will shorten cable housings to minimum length.
3. Remove fasteners (1) on right switch housing and separate housing from handlebar.
4. See Figure 2-94. Remove cables (2, 3) from notches in front housing (4).
5. Remove cables (2, 3) and ferrules (6) from cable wheel (7).
6. Remove air cleaner cover and baseplate. See 4.44 AIR CLEANER ASSEMBLY.
7. Disconnect cables from throttle body manifold to remove.
8. Cut cable straps and remove cables.

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)

Clean all parts except cables in a non-flammable cleaning solvent. Blow dry with compressed air. Replace cables if frayed, kinked or bent.

ASSEMBLY/INSTALLATION

1. Route cable as shown in D.1 HOSE AND WIRE ROUTING.
2. Add cable straps as shown in the throttle cable routing in D.1 HOSE AND WIRE ROUTING.
3. Install throttle grip and position ferrules (6) into cable wheel (7).
4. Insert idle control into front switch housing.
5. Slide switch housing over throttle.
6. Insert throttle cable into front switch housing.
7. See Figure 2-93. Attach rear switch housing and position housings on right handlebar by engaging locating pin on front housing with hole in handlebar. Attach housings with two fasteners, installing longer fastener on bottom. Tighten to 25-33 in-lbs (3-4 Nm).
8. Adjust cables. See 1.15 THROTTLE CABLE AND IDLE SPEED ADJUSTMENT.
9. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
REMOVAL/DISASSEMBLY

1. Remove fasteners (2) from clutch and brake pivot shafts (3 & 6) and pivot shaft risers (4).
2. Unsnap deflectors (1) from handlebar end caps (7).
3. Lift deflectors off of the pivot shafts (3, 6) and pivot shaft risers (4).
4. Remove pivot shaft riser (4) and jam nut (5) and remove both pivot shafts (3, 6).
5. Remove front brake/clutch lever assemblies from hand lever pivot.

ASSEMBLY/INSTALLATION

1. Install brake and clutch levers with pivot shafts (3, 6). See 2.25 CLUTCH CONTROL/CABLE and 2.10 FRONT BRAKE MASTER CYLINDER AND HAND LEVER for procedure details.
2. Install jam nuts (5) and tighten to 39-48 in-lbs (4.4-5.4 Nm).
3. Install pivot shaft risers (4) and tighten to 43-49 in-lbs (4.8-5.5 Nm).
4. Spread deflectors (1) and place over the pivot shaft and riser ends.
5. Snap deflectors onto handlebar end caps (7).
6. Install deflector fasteners (2) and tighten to 24-36 in-lbs (2.7-4 Nm).
GENERAL

For clutch adjustment, see 1.8 CLUTCH.
For clutch replacement, see 6.4 CLUTCH.

REMOVAL/DISASSEMBLY

Clutch Cable

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

1. Remove seat. See 2.43 SEAT.
2. Disconnect negative battery cable. See 1.4 BATTERY MAINTENANCE.
3. Remove chin fairing. See 2.36 CHIN FAIRING.
4. See Figure 2-96. Remove wire form from front isolator.
5. Cut tie wrap from clutch cable/regulator wiring.

**NOTE**
Always disconnect front tie bar from the "V" bracket first.

6. Remove front tie bar from "V" bracket.
7. Remove front tie bar, P clamp and clutch cable from engine.
8. Remove cable strap securing clutch cable to voltage regulator wire.

9. See Figure 2-97. Slide clutch cable adjuster boot (1) up to access clutch adjuster (2).
10. Loosen clutch adjuster (2) to release tension from hand lever and clutch release mechanism.
11. See Figure 2-98. Remove clutch cable ferrule (7) from hand lever (4).

**NOTE**
See D.1 HOSE AND WIRE ROUTING in Appendix D.

12. Pull clutch cable down and out of upper triple clamp.
13. Remove three TORX screws with washers securing clutch inspection cover.
14. See Figure 2-99. Remove clutch inspection cover (2).
15. Remove complete shift assembly.
   a. Remove flange bolt (6) from primary cover.
   b. Remove engine shift lever assembly (3). Do not scratch primary cover.

16. See Figure 2-100. Remove the outer ramp and hook (1) from the cable end (3) and coupling (2). Remove cable end from slot in coupling. See 6.3 CLUTCH RELEASE MECHANISM.

17. See Figure 2-101. Unscrew the cable fitting from the primary cover. Remove clutch cable and fitting.

18. Remove and discard o-ring on the clutch cable fitting.
ASSEMBLY/INSTALLATION

Clutch Cable
1. Install new oring on the clutch cable fitting before installing.
2. Apply 565 thread sealer to fitting on clutch cable and screw the clutch cable fitting into the primary cover and tighten to 36-108 in-lbs (4-12 Nm).
3. See Figure 2-100. Install cable end into slot in coupling. Install the outer ramp and hook (1) onto the cable end (3) and coupling (2) and place assembly back into the clutch inspection area in the primary cover. See 6.3 CLUTCH RELEASE MECHANISM.
4. See Figure 2-102. Install rubber washer and engine shift lever assembly (1).
5. After applying LOCTITE 272, install flange bolt (5) and shift pedal to primary cover, and tighten to 22.24 ft-lbs (30-32.5Nm).
6. After applying LOCTITE 272 (red), tighten engine shift lever pinch screw to 48-60 in-lbs (5.4-6.8 Nm).

NOTE
See D.1 HOSE AND WIRE ROUTING in Appendix D.

7. Route clutch cable through upper triple clamp.

Figure 2-102. Installing Shift Linkage
8. See Figure 2-103. Connect clutch cable ferrule (7) to hand lever (4).
9. Adjust clutch adjusting screw. See 1.8 CLUTCH.
10. Add FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) as required until fluid level is even with bottom of clutch diaphragm spring. See TRANSMISSION FLUID under 1.8 CLUTCH.

**NOTE**
Each time the clutch inspection cover is removed the gasket must be replaced.
11. Install new clutch cover gasket.
12. See Figure 2-99. Install clutch inspection cover (4) with three TORX screws with washers. Tighten screws in a crosswise pattern to 84-106 in-lbs (9.5-12.2 Nm).

**WARNING**
Always connect front tie bar to engine mount first.
13. Install front tie bar, p-clamp and clutch cable to front engine mount and tighten fastener to 25-27 ft-lbs (33.9-36.6 Nm).
14. Connect front tie bar to "V" bracket and tighten fastener to 25-27 ft-lbs (33.9-36.6 Nm).
15. Adjust clutch cable. See 1.8 CLUTCH.
16. Install wire form and clutch cable to front isolator and tighten fastener to 84-90 in-lbs (9.5-104 Nm).
17. Install cable strap to voltage regulator wire.

**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)
18. Install chin fairing. See 2.36 CHIN FAIRING.
19. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
20. Install seat. See 2.43 SEAT.
GENERAL

See Figure 2-104. The headlight grille is offered as a standard feature on the XB9SX to provide additional protection for the headlight assemblies.

NOTE
When spreading the headlight grille during removal/installation be careful not to spread the grille too far. If this happens simply compress the grille until it fits snugly on the headlight assemblies.

REMOVAL/INSTALLATION

1. See Figure 2-104. Grab headlight grille on either side and spread to remove from headlight assemblies.

2. Spread headlight grille with hands and snap back in place over headlight assemblies.

Figure 2-104. XB9SX Headlight Grille

1. Headlight assemblies
2. Headlight grille
HEADLIGHT ASSEMBLY AND SUPPORT BRACKET  2.27

REMOVAL

1. Remove seat. See 2.43 SEAT.

**WARNING**

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

2. Disconnect battery by unthreading fastener removing negative cable (black) from battery first. See 1.4 BATTERY MAINTENANCE.

3. Remove windscreen. See 2.42 WINDSCREEN.

4. See Figure 2-105. Disconnect horn connectors [122] (11) and remove horn fastener (4) and horn (1).

**NOTE**

Horn bracket (3) should remain attached to headlight support bracket.

5. Disconnect headlight connector [38] (5).

6. Remove female connector from headlight support bracket by sliding connector upward and off of attachment clip.

7. Remove headlight assembly.
   a. Remove both upper headlight mounting fasteners (6).
   b. Remove lower fastener (not shown).
   c. Remove headlight assembly (7) from headlight support bracket (9).

8. Remove remaining two fasteners (8) securing headlight support bracket to left and right front modules (10).

9. Remove headlight support bracket (9) by sliding the left side of the bracket (on right side of vehicle) up, back and then out.

**NOTE**

The horn bracket should be attached to the headlight support bracket and should be removed as needed.

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Figure 2-105. Electrical Connectors Behind Windscreen

- 1. Horn
- 2. Horn connectors [122]
- 3. Horn bracket
- 4. Horn fastener
- 5. Headlight connector [38]
- 6. Fasteners (2), upper headlight mounting
- 7. Headlight assembly
- 8. Fasteners (3), headlight support bracket
- 9. Headlight support bracket
- 10. Left and right front modules
**DISASSEMBLY**

1. See Figure 2-106. Remove rubber boots (1) from rear of headlight housing.
2. Disconnect wiring harness (5) from headlight bulbs (3) and remove along with position bulb socket (6).
3. Remove bulb holders (2).
4. Remove headlight bulbs (3) from back of headlight housing (4).

**ASSEMBLY**

1. See Figure 2-106. Align and install headlight bulbs (3) into back of headlight housing (4).

**NOTE**

The tab on the base of the headlight bulb should rest between the two tabs located at the top of the hole on the back of the headlight assembly.

2. Install bulb holders (2).
3. Connect wiring harness (5) to headlight bulbs (3) and install rubber boots (1) and install position bulb socket (6) between the headlights. For proper alignment of rubber boots see 7.12 HEADLIGHT.
INSTALLATION

1. See Figure 2-107. Install headlight support bracket (9).

2. Apply LOCTITE 272, install fasteners (8) securing headlight support bracket to left and right front modules (10) and tighten to 48-72 in-lbs (5.4-8.1 Nm).

3. Install headlight assembly.
   a. Install headlight assembly (7) into headlight support bracket (9).
   b. Install both upper headlight fasteners (6) but do not tighten.
   c. Install lower fastener (not shown), do not tighten.

4. Attach headlight connector to headlight support bracket.

5. Connect headlight connector [38] (5).

6. Install horn (1) and tighten fastener (4) to 72-96 in-lbs (8-10.8 Nm).

7. Connect horn connectors [122] (2).

8. Adjust headlights. See 1.18 HEADLIGHTS.

9. Install windscreen. See 2.42 WINDSCREEN.

10. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-10.8 Nm). See 1.4 BATTERY MAINTENANCE.

11. Install seat. See 2.43 SEAT.
REMOVAL

1. Remove seat. See 2.43 SEAT.

WARNING
To protect against accidental start-up of vehicle and possible personal injury, disconnect the negative battery cable before proceeding. Inadequate safety precautions could cause a battery explosion, which could result in death or serious injury.

2. Disconnect battery by unthreading fastener removing negative cable (black) from battery first. See 1.4 BATTERY MAINTENANCE.

3. Remove windscreen. See 2.42 WINDSCREEN.

4. Remove headlight assembly and support bracket. See 2.27 HEADLIGHT ASSEMBLY AND SUPPORT BRACKET.

5. Disconnect and remove instrument module. See 7.19 INSTRUMENT MODULE.

6. Remove ignition switch. See 7.3 IGNITION/HEADLIGHT KEY SWITCH.

NOTE
See Figure 2-108. Once the ignition switch has been removed there will be two remaining fasteners.

7. See Figure 2-108. Remove fastener attaching p-clamp to rear side of right front module.

NOTE
See Figure 2-109. Once the clamp load has been released on the final fastener securing the right front module to the upper triple clamp, the left front module can be removed.

8. See Figure 2-108. Loosen but do not remove final fastener securing the right front module to upper triple clamp.

9. See Figure 2-109. Remove the left front module.

10. See Figure 2-108. Remove the final fastener and the right front module.

INSTALLATION

1. See Figure 2-108. Install right front module leaving single fastener loose.

2. After installing the left front module and aligning with holes in upper triple clamp, tighten previously installed single fastener to 12-14 ft-lbs (16.3-19 Nm).

3. Attach front brake line p-clamp to rear of right front module and tighten fastener to 36-60 in-lbs (4.1-6.8 Nm).

4. Install ignition switch. See 7.3 IGNITION/HEADLIGHT KEY SWITCH.

5. Install and connect instrument module. See 7.19 INSTRUMENT MODULE.

6. Install headlight assembly and support bracket. 2.27 HEADLIGHT ASSEMBLY AND SUPPORT BRACKET.

7. Install windscreen. See 2.42 WINDSCREEN.

WARNING
Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion which could result in death or serious injury.

8. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat. See 2.43 SEAT.
Figure 2-108. Right Front Module Fastener and Brake Line P-Clamp Fastener (Typical)

Figure 2-109. Fairing Support Bracket Assembly

1. Left and right front module
2. Right front module overlaps left front module
3. Right front module
4. Left front module
REMOVAL

1. Remove seat. See 2.43 SEAT.

WARNING

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

2. Disconnect battery negative cable.

3. On XB9SX models, remove deflectors. See 2.24 DEFLECTORS/HANDLEBARS (XB9SX).

4. Remove left handlebar switch housing. See 7.17 HANDLEBAR SWITCHES. Cut left handlebar grip and remove.

5. Detach clutch hand control from handlebars. See 2.25 CLUTCH CONTROL/CABLE.

6. Remove front brake master cylinder. See 2.10 FRONT BRAKE MASTER CYLINDER AND HAND LEVER.

7. Loosen screws on right handlebar switch housing, but do not detach throttle grip assembly from handlebar. See 2.23 THROTTLE CONTROL.

8. See Figure 2-110. Remove the four screws holding upper handlebar clamp.

NOTE

Right hand control assembly may now be removed from detached handlebar.

9. Remove handlebars without stretching throttle cables.

10. See Figure 2-110. Remove endcaps.

INSTALLATION

1. Slide handlebars into throttle grip assembly. Fasten right handlebar switch housing to handlebar. See 2.23 THROTTLE CONTROL.

2. See Figure 2-110. Attach handlebars.

   a. Position handlebar on lower clamp.

   b. Place the upper handlebar clamp in position and thread the four screws in place after applying Loctite 272 (Red).

   c. Tighten both front screws to 10-12 ft-lbs (14-16 Nm).

   d. Then tighten both rear screws (2) 10-12 ft-lbs (14-16 Nm).

3. Install clutch hand control. See 2.25 CLUTCH CONTROL/CABLE.

4. Install left switch housing. See 7.17 HANDLEBAR SWITCHES.

5. Check control wire routings. See D.1 HOSE AND WIRE ROUTING.

   a. Route right hand control wires between the lower clamp and fork tube and on the outside of the clutch cable.

   b. Route left hand control wires between the lower clamp and fork tube.

6. Install a new left hand grip.

7. Install front brake master cylinder. See 2.10 FRONT BRAKE MASTER CYLINDER AND HAND LEVER.

8. On XB9SX models, install end caps and deflectors. See 2.24 DEFLECTORS/HANDLEBARS (XB9SX).

9. Check steering motion range to both fork stops.

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. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

11. Install seat. See 2.43 SEAT.
Figure 2-110. Handlebar Assembly

1. Endcap (2)
2. Handlebar
3. Handlebar clamp
4. Clamp fasteners (4)
5. Left hand grip
REMOVAL
1. See Figure 2-111. Loosen adjuster nut (2) and remove mirror (1) from mount (3).
2. Loosen mount (3) and remove from bracket (4).

INSTALLATION
1. See Figure 2-111. Install mount (3) onto bracket (4) and tighten to 20-22 ft-lbs (27.1-29.8 Nm).

In a convex mirror, cars and other objects will look smaller and farther away than they actually are. Adjust mirrors to see a small portion of the rider’s shoulders in each mirror. This helps the rider establish the relative distance of vehicles to the rear of the motorcycle.

2. Install mirror (1) and while holding in position for rider vision, tighten adjuster to 115-130 in-lbs (13-14.7 Nm).

Figure 2-111. Mirrors and Mounting Hardware (Typical)
REMOVAL/DISASSEMBLY

NOTE
For details on removal of components on XB12 models with interactive exhaust systems, see REMOVAL under 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

Muffler
1. Remove chin fairing. See 2.36 CHIN FAIRING.
2. Remove front sprocket cover. See 2.33 SPROCKET COVER.
3. Remove idler pulley. See DRIVE BELT REMOVAL in 6.6 DRIVE BELT SYSTEM.
4. See Figure 2-112. Loosen front muffler mount fastener (7) but do not remove.
5. Remove front and rear muffler straps.
   a. Front: Remove front muffler strap fastener (5).
   b. Rear: Alternately loosen rear strap fasteners (1) and remove straps (2).

   NOTES
   ● The muffler may be removed for replacement without removing the exhaust header.
   ● Always replace the front muffler strap.

6. On XB12 models, remove the interactive exhaust cable from muffler.
7. See Figure 2-112. Loosen Torca clamp (1) and lower muffler.

Front Muffler Mount
1. Remove muffler.
   NOTE
   For details on removal of components on XB12 models with interactive exhaust systems, see REMOVAL under 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).
2. See Figure 2-112. Remove front muffler mount fastener (7).
3. Remove strap (4) from front muffler mount (6).
4. Remove front muffler mount bushings (8) by punching out with suitable tool.

Rear Muffler Bracket
1. Remove muffler.
2. Drain oil. See Draining Oil in 1.5 ENGINE LUBRICATION SYSTEM.
3. Remove feed oil line p-clamp and remove feed oil line from swingarm. See 3.9 OIL HOSE ROUTING AND OIL RESERVOIR and 3.10 OIL LINE FITTINGS.
4. See Figure 2-112. Remove rear muffler bracket fasteners (11).
5. Slide oil line from rear muffler bracket and remove rear muffler bracket (10).

Exhaust Header
1. Rotate engine down. See 3.3 ENGINE ROTATION FOR SERVICE.
2. Remove oxygen sensor. See 4.33 OXYGEN SENSOR.
3. See Figure 2-113. Remove exhaust header (2) by removing mounting fasteners (3).
4. Remove exhaust ring (4), retaining ring (5) and port gasket (6).
1. Rear muffler strap fastener (2)
2. Rear muffler strap (2)
3. Interactive muffler (XB12S, XB12Scg, XB12Ss)
4. Front muffler strap
5. Front muffler strap fastener
6. Front muffler mount
7. Front muffler mount fastener
8. Front muffler mount bushings
9. Interactive exhaust cable
10. Rear muffler bracket
11. Rear muffler bracket fasteners (2)

*Jacking point symbol shown on both sides of muffler.

Figure 2-112. Muffler Assembly

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Exhaust Header
1. See Figure 2-113. Install exhaust ring (4), retaining ring (5) and new port gasket (6).
2. Install exhaust header (2). Tighten mounting fasteners (3) to 72-96 in-lbs (8-11 Nm).

**NOTE**
Tighten header nuts gradually, alternating between studs to insure that exhaust rings are flush with engine.
3. Install oxygen sensor. See 4.33 OXYGEN SENSOR.
4. Rotate engine up. See 3.3 ENGINE ROTATION FOR SERVICE.

Rear Muffler Bracket
1. See Figure 2-112. Slide rear muffler bracket (10) over oil line.
2. Install rear muffler bracket fasteners (11) and tighten to 32-36 ft-lbs (43-49 Nm).
3. Install oil line to swingarm. See 3.9 OIL HOSE ROUTING AND OIL RESERVOIR and 3.10 OIL LINE FITTINGS.
4. Fill swingarm/oil tank with 2.5 quarts (3.3 liters) oil. See Draining Oil in 1.5 ENGINE LUBRICATION SYSTEM.
5. Install muffler.

Front Muffler Mount
1. See Figure 2-112. Install front muffler mount bushings (8).
2. Install new strap on front muffler mount (6).
3. Install front fastener (7) loosely. Do not tighten.
4. Install muffler.

Muffler and Straps
**NOTES**
- For details on assembly of components on XB12 models with interactive exhaust systems, see INSTALLATION under 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).
- Torca muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps and prevent the possibility of leakage, Buell recommends that muffler clamp assemblies be discarded and replaced each time they are removed.
1. Install muffler and new Torca clamp onto header.

**NOTE**
If necessary, use a fiber hammer to fit muffler on header.
2. See Figure 2-112. Loosely install new front and rear muffler straps (2, 4).

**NOTES**
- Never re-use front muffler strap. Always replace front muffler strap with a new strap when removed from system.
- It is important that the front muffler mount is tightened last in order to ensure proper alignment of the exhaust system.
- When rear muffler straps have been installed, it is important that strap fasteners do not contact idler pulley bracket.
- On the front muffler mount fastener, torque is applied to the head and not to the nut.

3. Tighten front strap fastener and alternately tighten rear muffler strap fasteners evenly till fasteners are tightened to:
   a. **Front:** Tighten around the muffler until snug.
   b. **Rear:** Tighten rear muffler strap to 48-60 in-lbs (5-7 Nm).
   c. **Front:** Tighten front muffler strap fasteners to 108-120 in-lbs (12-14 Nm). Back off fastener two full turns and then retighten to 108-120 in-lbs (12-14 Nm).
4. See Figure 2-113. Tighten the Torca clamp (1) to 28-30 ft-lbs (38-40.6 Nm).
5. Install front muffler mount fastener and tighten 16-18 ft-lbs (21.7-24.4 Nm).
6. Install idler pulley. See 5.6 DRIVE BELT SYSTEM.
7. Install front sprocket cover. See 2.33 SPROCKET COVER.
8. Install chin fairing. See 2.36 CHIN FAIRING.
FOOTPEG, HEEL GUARD AND MOUNT

RIDER

Remove Wear Peg
1. See Figure 2-114. Remove wear peg from end of footpeg assembly.

Remove Footpeg
1. See Figure 2-114. Remove clip (5).
2. Remove footpeg pin (9).
3. Remove footpeg (8).

Remove Heel Guard
1. See Figure 2-114. Remove heel guard fasteners (4).
2. Remove heel guard (3).

Remove Mount
1. See Figure 2-114. Remove footpeg mount fasteners (2).
2. Remove footpeg mount (1).

Install Mount
1. See Figure 2-114. Position footpeg mount (1).
2. Install footpeg mount with fasteners (2). Tighten to 108-132 in-lbs (12.2-14.9 Nm).

Install Heel Guard
1. See Figure 2-114. Position heel guard (3) onto footpeg mount (1).

NOTE
There is one long fastener which installs on the lower left side in order to secure the non California vent clamp.
2. Install heel guard (3) with fasteners (4). Tighten to 72-96 in-lbs (8-11 Nm).

Install Footpeg
1. See Figure 2-114. Position spring (6) in footpeg (8).
2. Position footpeg (8) on to footpeg mount (1).
3. Install footpeg pin (9).
4. Install footpeg clip (5).

Install Wear Peg
1. See Figure 2-114. Apply Loctite 272 (Red) and tighten to 36-48 in-lbs (4.1-5.4 Nm).

Figure 2-114. Rider Footpeg, Mount and Heel Guard Assembly
**Remove Footpeg**

1. See Figure 2-115. Remove clip (7).
2. Remove footpeg pin (9).
3. Remove footpeg (8), detent plate (6), ball (5) and spring (4).

**Remove Heel Guard**

1. See Figure 2-115. Remove heel guard fasteners (1).
2. Remove heel guard (2).

**Remove Mount**

**NOTE**

The portion of the right and left tail sections where the passenger footpeg supports attach is threaded at both locations. A jam nut is utilized on one of the fasteners on each side in order to help secure battery pan.

1. See Figure 2-115. Remove jam nuts (11).
2. Remove footpeg mount fasteners (10).
3. Remove footpeg mount (3).

**Install Mount**

1. See Figure 2-115. Position footpeg mount (3) onto tail section.
2. Apply LOCTITE 272 (Red) to footpeg mount fasteners (10), install and tighten to 25-28 ft-lbs (33.8-37.9 Nm).
3. Install jam nut (11) and tighten to 48-72 in-lbs (5.4-8.1 Nm).

**Install Heel Guard**

1. See Figure 2-115. Position heel guard (2) onto footpeg mounts (3).
2. Install heel guard (2).
3. Tighten heel guard fasteners to 48-72 in-lbs (5.4-8 Nm).

**Install Footpeg**

1. See Figure 2-115. Position footpeg (8), detent plate (6), ball (5), and spring (4) onto footpeg mount (3).
2. Install footpeg pin (9).
3. Install clip (7).
4. Check that footpeg clicks in the up and down position.
REMOVAL
1. See Figure 2-116. Remove rear right chin fairing fasteners.

   NOTE
   Must remove two chin fairing fasteners for sprocket cover access.

2. See Figure 2-117. Remove sprocket cover fasteners and washers (1).

INSTALLATION
1. See Figure 2-117. Position sprocket cover (2) over front sprocket.

   NOTE
   Apply LOCTITE 222 (purple) to the long fastener (1) only.

2. Install sprocket cover (2) using sprocket cover fasteners (1, 3) and tighten all fasteners and washers (1, 3) to 12-36 in-lbs (1.4 Nm).

3. Install chin fairing. See 2.36 CHIN FAIRING.
FRONT FENDER

Removal
1. See Figure 2-118. Remove fasteners and washers (2) securing the front fender (1) to front forks.
2. Carefully remove front fender (1).

Installation
1. See Figure 2-118. Align front fender (1) to fender mounts on front forks.
2. Install front fender (1) with fasteners and washers (2), apply LOCTITE 272 and tighten to 36-48 in-lbs (4-5.4 Nm).

REAR FENDER

Removal
1. See Figure 2-118.
   a. For XB9SX, XB12S, and XB12Scg: Remove fasteners (4) securing the rear fender (3) to frame.
   b. For XB12Ss: Remove fender fasteners (6).
2. Remove rear fender (XB9SX, XB12S, XB12Scg - 3) (XB12Ss - 5).

Installation
1. See Figure 2-118. Align rear fender to frame.
2. Install rear fender with fasteners (6).
   a. For XB9SX, XB12S, and XB12Scg: Tighten to 12-36 in-lbs (1.4-4.0 Nm).
   b. For XB12Ss: Tighten fender fasteners to 12-36 in-lbs (1.4-4.0 Nm).

NOTE
On XB12Ss models it is necessary to align the rear brake line with the rear inner fender. The rear fender captures the rear brake line to help maintain the proper alignment and location.
REMOVAL
1. Place a scissor jack under jacking point and raise rear wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.
2. Remove right side rider footrest support bracket.
3. Loosen rear axle pinch fastener.
4. Loosen rear axle approximately 15 rotations to allow partial tension to be removed from rear drive system.
5. See Figure 2-119. Remove lower belt guard by removing the two fasteners located on the outside of the lower belt guard.
6. Once the lower belt guard has been removed, remove the metal stone guard.
7. Remove upper belt guard (1) by removing fasteners from swingarm.

INSTALLATION
1. See Figure 2-119. Install upper belt guard (1) to swingarm brace tightening fasteners to 12-36 in-lbs (1-4 Nm).
2. Install stone guard and tighten fasteners to 12-36 in-lbs (1-4 Nm).
3. Install lower belt guard (3) and tighten fasteners (4) to 12-36 in-lbs (1-4 Nm).
4. Tighten rear axle to 48-52 ft-lbs (65-70 Nm).
5. Tighten rear axle pinch fastener to 40-45 ft-lbs (54-61 Nm).
6. Install right side rider footrest mount and tighten fasteners to 132-144 in-lbs (15-16.3 Nm).
7. Remove scissor jack from motorcycle.

Figure 2-119. Belt Guard Assembly

1. Upper belt guard
2. Upper belt guard and stone guard fasteners (2)
3. Lower belt guard
4. Lower belt guard fasteners (2)
5. Fasteners, stone guard
6. Stone guard
7. Sprocket cover
8. Sprocket cover fasteners (2 short, 1 long)
CHIN FAIRING

REMOVAL

1. Secure back tire down.
2. Turn wheel full right or left for easier access to center fasteners.
3. See Figure 2-120. Remove center section fasteners and washers (2).
4. Remove left section fasteners and washers (4).
5. Remove right section fasteners and washers (6).
6. Remove chin fairing.

**NOTE**
To separate the left, right and center sections, drill out the rivets.

INSTALLATION

**NOTE**
To join the left, right and center sections, use the rivet gun from a Marson Thread-SetterTM Tool Kit MODEL NO. MAR39200HD.

1. See Figure 2-120. Position right section (5) and install with right side fasteners and washers (6).
2. Align left section (3) and install with left side fasteners and washers (4).
3. Turn wheel full right or left for easier access to center fasteners.
4. Align center section (1) and install with center section fasteners and washers (2). Use LOCTITE 272 (red) on all fasteners tightening to 36-48 in-lbs (4-5 Nm).

Figure 2-120. Chin Fairing Assembly
REMOVAL

NOTE
The "X-Guard" on XB9SX is a non replaceable part.

1. Remove seat. See 2.43 SEAT.
2. See Figure 2-121. Remove fasteners and nylon washers (2).
3. Remove intake cover assembly (1).

INSTALLATION

1. Position intake cover assembly over top of air cleaner cover.
2. See Figure 2-121. Start the front two fasteners (2) with nylon washers.
3. Install the remaining fasteners and nylon washers (2). Tighten all fasteners to 12-36 in-lbs (1-4 Nm).

NOTE
Front screws go in at a slight angle.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat. See 2.43 SEAT.
RAM AIR SCOOP
Removal
1. See Figure 2-122. On left side of bike, locate ram air scoop (4).
2. Remove three ram air scoop fasteners (3).
3. Remove ram air scoop (4).
Installation
1. See Figure 2-122. Position ram air scoop (4).
2. Install ram air scoop (4) with three fasteners (3). Tighten to 12-36 in-lbs (1.4-4 Nm).

ENGINE SHROUD AIR SCOOP
Removal
1. See Figure 2-122. On right side of bike, locate engine shroud air scoop (6).
2. Remove three engine shroud air scoop fasteners (5).
Installation
1. See Figure 2-122. Position engine shroud air scoop (6).
2. Install engine shroud air scoop (6) with three fasteners (5). Tighten to 12-36 in-lbs (1-4 Nm).

OIL COOLER AIR SCOOP
Removal
1. See Figure 2-122. On left side of bike, locate oil cooler air scoop (2).
2. Remove two oil cooler air scoop fasteners (1).
3. Remove oil cooler air scoop (2).
Installation
1. See Figure 2-122. Position oil cooler air scoop (2).
2. Apply LOCTITE 272 (red) to oil cooler air scoop fasteners (1) and tighten to 48-72 in-lbs (5.4-8 Nm).

Figure 2-122. RAM Air Scoop, Engine Shroud, Oil Cooler
Disassembly

1. Remove seat. See 2.43 Seat.

**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.

2. See Figure 2-123. Unthread fastener and remove battery negative cable (black) from battery negative (-) terminal.

3. Pull back terminal cover boot on battery positive cable (red).

4. Unthread fastener and remove battery positive cable from battery positive (+) terminal.

5. Remove battery.

6. See Figure 2-123. Disconnect:
   - Wire harness ground (2) [GRD 2].
   - Rear brake light switch connector (5) [121].
   - ECM connectors (7) [10 & 11] and [164] (on XB12 models).
   - BAS (bank angle sensor) connector (9) [134].
   - Right turn signal connector (11) [19].
   - Left turn signal connector (10) [18].
   - License plate lamp connector (12) [45].
   - Tail light connectors (13) [93].
   - Ground terminals on right side tail section (6) [GRD 1] & [GRD 3].

7. Remove the rear shock absorber reservoir. See 2.22 Rear Shock Absorber.

8. Cut cable strap loosely attaching BAS wire harness to seat latch cable.

9. See Figure 2-123. Remove fuse block and relay center from support bracket.

10. Move rear main harness and shock absorber reservoir to right side of vehicle.

11. Remove left side passenger footrest support assembly. See 2.32 Footpeg, Heel Guard and Mount.

12. See Figure 2-123. Remove the following fasteners:
   - Left front trunk pan to left side tail section (14).
   - Left rear tail section to center tail section (15).
   - Left tail section to main frame/fuel tank assembly.
   - Left tail section to battery tray (XB12Ss models).

13. Remove left tail section from vehicle.

**Note**

In order to remove trunk pan it will be necessary to remove the following fasteners and components.

14. Remove two fasteners securing trunk pan to center tail section.

15. See Figure 2-123. Remove fastener securing right front trunk pan to right side tail section.

16. Remove right side passenger footrest support assembly. See 2.32 Footpeg, Heel Guard and Mount.

17. Slide trunk pan with battery pan, seat latch, bank angle sensor, rear shock reservoir mounting bracket and ECM out left side of vehicle.

18. Remove remaining components on trunk pan as needed.

Cleaning

**Note**

Do not use wheel care products or other compounds developed specifically for cleaning and polishing powdercoat. These cleaners could potentially damage the tail section finish.

The cast aluminum tail section has a powder coat. Because the surface is not bare polished aluminum, it must be cleaned using only mild soap and warm water. After washing, always dry the surface using a clean, soft cloth.
Figure 2-123. Main Harness and Electrical Connectors Under Seat (Typical)

1. Main harness
2. Main harness ground wire [GRD 2]
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Left turn signal connector [18]
11. Right turn signal connector [19]
12. License plate lamp connector [45]
13. Tail light connectors [93]
14. Left and right front trunk pan fasteners (2)
15. Left rear and right rear tail section fasteners (4)
NOTE
See Figure 2-124. There are two threaded plastic lugs (14) on the trunk pan that are used for manufacturing purposes only.

1. Install trunk pan assembly (11) from left side of vehicle.
2. Install fastener (8) securing right front trunk pan to right side tail section. Apply Loctite 272 to threads of left rear tail section fasteners and tighten to 102-112 in-lbs (11.5-12.7 Nm).
3. Install right side passenger footrest support assembly. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
4. Install two fasteners (12) securing trunk pan to center tail section and leave loose.
5. Install left tail section (5) onto vehicle.
   a. Install fastener (8) attaching left front trunk pan to left side tail section and tighten to 12-36 in-lbs (1.4-4 Nm).
   b. Apply LOCTITE 272 and install fasteners (4) attaching left rear tail section to center tail section and tighten to 102-112 in-lbs (11.5-12.7 Nm).
   c. Apply LOCTITE 272 and install fasteners (1) attaching left tail section to main frame/fuel tank assembly and tighten to 21-23 ft-lbs (28.5-31.2 Nm).
   d. Apply LOCTITE 272 and install fasteners securing battery tray to side castings and tighten to 48-72 in-lbs (5.4-8 Nm).
6. Tighten fasteners (12) securing trunk pan to center tail section to 48-72 in-lbs (5.4-8 Nm).
7. Install left side passenger footrest support assembly. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
8. Move rear main harness and shock absorber reservoir back to left side of vehicle.
9. See Figure 2-123. Connect:
   ● Wire harness ground (2) [GRD 2]
   ● Rear brake light switch connector (5) [121]
   ● ECM connectors (7) [10, 11] and [164] (on XB12 models).
   ● BAS (bank angle sensor) connector (9) [134].
   ● Right turn signal connector (10) [19].
   ● License plate lamp connector (12) [45]
   ● Tail light connectors (13) [59].
   ● Ground terminals on right side tail section (6) [GRD 1] & [GRD 3].
10. Attach cable strap loosely securing the BAS harness to the seat latch cable.
11. Install the rear shock absorber reservoir into bracket and tighten fastener. See 2.22 REAR SHOCK ABSORBER.

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)
12. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
13. Install seat. See 2.43 SEAT.
1. Left and right tail section fastener to main frame/fuel tank assembly (4)
2. Right tail section
3. Center tail section
4. Center tail section fastener to rear tail section (4)
5. Left tail section
6. Ground terminal fastener (2)
7. Passenger footrest support fastener with jam nut (2)
8. Front trunk pan fastener to side tail section (2)
9. Passenger footrest support fastener (no jam nut-2)
10. Seat latch assembly
11. Trunk panel assembly
12. Rear trunk pan fastener to center tail section (2)
13. Rear shock reservoir bracket
14. Plastic lugs (for manufacturing purposes only)
HOME

CENTER TAIL SECTION

DISASSEMBLY

1. Remove seat. See 2.43 SEAT.

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)

2. See Figure 2-123. Unthread fastener and remove battery negative cable (black) from battery negative (-) terminal.

3. See Figure 2-123. Disconnect:
   a. Right turn signal connector [18].
   b. Left turn signal connector [19].
   c. License plate lamp connector [45]
   d. Tail light connectors [93].

4. See Figure 2-124. Remove two fasteners (12) securing trunk pan to center tail section.

5. Remove fasteners (4) securing left and right tail sections to center tail section.

6. Remove center tail section from vehicle.

7. To further disassemble center tail section see 7.13 TAIL LAMP, 7.14 LICENSE PLATE LAMP ASSEMBLY, 7.15 TURN SIGNALS.

ASSEMBLY

1. Install center tail section between left and right tail sections.

2. Install fasteners (4) securing left and right tail sections to center tail section but do not tighten.

3. Install two fasteners (12) securing trunk pan to center tail section but do not tighten.

4. Apply Loctite 272 to threads of left and right rear tail sections fasteners (4) and tighten to 102-112 in-lbs (11.5-12.7 Nm).

5. Tighten fasteners (12) securing trunk pan to center tail section to 48-72 in-lbs (5.4-8.1 Nm).

6. See Figure 2-123. Connect:
   a. Right turn signal connector [18].
   b. Left turn signal connector [19].
   c. License plate lamp connector [45]
   d. Tail light connectors [93].

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)

7. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm).

See 1.4 BATTERY MAINTENANCE.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat. See 2.43 SEAT.
DISASSEMBLY

1. Remove seat. See 2.43 SEAT.

![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)

2. See Figure 2-125. Unthread fastener and remove battery negative cable (black) from battery negative (-) terminal.
3. Pull back terminal cover boot on battery positive cable (red).
4. Unthread fastener and remove battery positive cable from battery positive (+) terminal.
5. Remove battery.
6. Disconnect:
   a. Right side ground terminals (3) [GRD1] & [GRD 3]
   b. Rear brake light switch connector (4) [121]
7. Remove right side passenger footrest assembly. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
8. Remove master cylinder remote reservoir. See 2.13 REAR BRAKE MASTER CYLINDER.
9. See Figure 2-125. Remove right front trunk pan fastener (1).
10. Remove fastener securing battery tray to right side tail section (XB12Ss models only).
11. Remove fasteners (15) securing center tail section to right tail section.
12. See Figure 2-124. Remove fasteners (1) securing right tail section to main frame/fuel tank assembly.
13. Remove right tail section.

ASSEMBLY

1. See Figure 2-125. Install right tail section (6) onto vehicle.
   a. Install fastener (1) attaching right front trunk pan to right side tail section and tighten to 12-36 in-lbs (1.4-4 Nm).
   b. On XB12Ss models, apply LOCTITE 272 and install battery tray fasteners and tighten to 48-72 in-lbs (5.4-8.1 Nm).
   c. Apply LOCTITE 272 and install fasteners (5) attaching left rear tail section to center tail section and tighten to 102-112 in-lbs (11.5-12.7 Nm).
   d. Apply LOCTITE 272 and install fasteners attaching left tail section to main frame/fuel tank assembly and tighten to 21-23 ft-lbs (28.5-31.2 Nm).
2. Install master cylinder remote reservoir. See 2.13 REAR BRAKE MASTER CYLINDER.
3. Install right side passenger footrest support assembly. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
4. Connect:
   a. Right side ground terminals (3) [GRD1] & [GRD 3]
   b. Rear brake light switch connector (4) [121]

![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)

5. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.
6. Install seat. See 2.43 SEAT.
1. Right front trunk pan fastener
2. Passenger footrest support fastener with jam nut
3. Ground terminals [GRD1] & [GRD 3]
4. Rear brake light switch connector [121]
5. Right tail section
6. Center tail section fastener to rear tail section
NOTE

The windscreen fasteners (3) extend through the left and right front modules (2, 5) and thread into the headlight mounting bracket (1).

1. See Figure 2-126. Remove four windscreen fasteners (3).
2. Remove windscreen (4).

INSTALLATION

1. See Figure 2-126. Position windscreen (4) onto left and right front modules (2, 5).
2. Install four fasteners (3) and tighten to 10-12 in-lbs (1.1-1.4 Nm).

Figure 2-126. Front Windscreen
GENERAL

See Figure 2-127. The seat anchors in three places on the vehicle. The first is where the locating tab (4) on the seat inserts into the opening on the trunk pan (5). The second is the pair of seats hooks (3) that slide onto the shouldered fasteners (6) located in the left and right tail sections. The last is the rear seat tab (2) which fits into the slot (7) on the seat latch (8).

REMOVALS

1. See Figure 2-127. Insert ignition key into seat lock located on left side of motorcycle below seat.
2. Turn key clockwise to disengage rear seat latch.
3. Lift and remove seat (1).

INSTALLATION

1. Install seat (1) by sliding locating tab (4) on front underside of seat into opening (5) on trunk pan.
2. Align rear tab (2) with latch slot (7) at rear of motorcycle.
3. Press down firmly on rear of seat to engage seat latch (8). Pull up on rear of seat to make sure latch is engaged.
4. Remove ignition key from seat lock.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

1. Install seat (1) by sliding locating tab (4) on front underside of seat into opening (5) on trunk pan.
2. Align rear tab (2) with latch slot (7) at rear of motorcycle.
3. Press down firmly on rear of seat to engage seat latch (8). Pull up on rear of seat to make sure latch is engaged.
4. Remove ignition key from seat lock.

Figure 2-127. Seat and Attachment (Inset XB12Ss seat)
REMOVAL

1. Remove seat. See 2.43 SEAT.
2. Cut cable strap loosely securing BAS wiring harness to seat lock cable.
3. See Figure 2-128. Disconnect seat lock cable:
   a. Remove latch (9) from latch bracket (10) by removing two fasteners (6).
   b. Slide retainer (7) away from cable end (8).
   c. Remove cable end (8) and cable (5) from latch.
4. Remove seat lock:
   a. Remove seat lock retainer (3) from seat lock (1).
   b. Remove seat lock (1) from plate (2) and trunk pan (11).
   
   NOTE
   When removing seat lock (1), cable end (4) should release from seat lock.
5. Remove cable (5) from plate (2).

INSTALLATION

1. See Figure 2-128. Install cable (5) into plate (2).
2. Install the seat lock (1) into trunk pan (11) and plate (2).

   NOTES
   - Once seat lock has been started through the hole in the trunk pan and plate, now is the time to connect the cable end to the seat lock.
   - Seat lock plate must be aligned to tab on seat lock for proper installation.
3. Install seat lock retainer (3) by aligning retainer to retainer grooves on back side of seat lock (1).
4. Connect seat lock cable to latch:
   a. Install cable end (8) and cable (5) onto latch.
   b. Slide retainer (7) over pin on latch to lock cable end (8) into place.
   c. Install latch (9) to latch bracket (10) and tighten fasteners (6) to 60-72 in-lbs (6.7-8 Nm).
   d. Install cable strap to loosely secure cable to BAS wiring harness.
5. Open and close the seat lock with ignition key to verify that cable is working properly.

   WARNING
   After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
6. Install seat. See 2.43 SEAT.
1. Seat lock
2. Plate
3. Retainer
4. Cable end
5. Cable
6. Latch screw
7. Retainer
8. Cable end
9. Latch
10. Latch bracket
11. Trunk pan

Figure 2-128. Seat Lock Assembly
GENERAL

**CAUTION**

This motorcycle does NOT have a locking sidestand. Park the motorcycle on a level, firm surface. An unbalanced motorcycle can fall, which could result in death or serious injury. (00122a)

The sidestand is located on the left side of the motorcycle. The sidestand swings outward to support the motorcycle for parking.

REMOVAL

1. Remove muffler. See Muffler and Straps in 2.31 EXHAUST SYSTEM.
2. See Figure 2-130. Remove fasteners (4) securing sidestand bracket (3) to frame.
3. Remove sidestand.

![Figure 2-129. Sidestand, Retracted](image1)

DISASSEMBLY

**NOTE**

Sidestand assembly does not have to be removed from motorcycle in order to remove sidestand leg.

1. Remove two fasteners from the left side of chin fairing.
2. See Figure 2-130. Remove sidestand leg.
   a. Retract sidestand leg (5).
   b. Remove sidestand spring and spring extension plate using SNAP-ON SPRING TOOL (Part No. HE-52B).
   c. Remove sidestand pivot bolt (1).
3. Extend sidestand leg and remove.

![Figure 2-130. Sidestand Assembly (Extended)](image2)
ASSEMBLY

1. Install sidestand leg (1).
   a. See Figure 2-132. Lubricate sidestand pivot bolt (5) and mating portions on sidestand bracket (2) with WHEEL BEARING GREASE (Part No. 99855-89) as shown in Figure 2-132.
   b. See Figure 2-133. Apply LOCTITE 272 (red) to threaded area (clevis) of sidestand leg.
      NOTE
      Applying LOCTITE to threaded area of clevis on sidestand leg, instead of threads on the pivot bolt, will eliminate build-up between clevis and sidestand bracket which can interfere with the applied lubricant.
   c. See Figure 2-131. Install sidestand leg (1) and sidestand pivot bolt (3) tightening to 18-20 ft-lbs (24-27 Nm).
   d. Retract sidestand leg.
   e. Install spring extension plate (4) and sidestand spring (2) using SNAP-ON SPRING TOOL (Part No. HE-52B).
      NOTE
      Extension plate should curve away from primary chain adjustment screw to allow for clearance around adjustment screw.

INSTALLATION

1. Install sidestand to frame tightening the sidestand bracket fasteners to 25-27 ft-lbs (34-37 Nm).
2. Install muffler. See Muffler and Straps in 2.31 EXHAUST SYSTEM.
3. Inspect sidestand.
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NOTE
Service wear limits are given as a guideline for measuring components that are not new. For measurement specifications not given under SERVICE WEAR LIMITS, see NEW COMPONENTS.

Table 3-1. General Information

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<tr>
<th>Type</th>
<th>2 cylinder, air cooled, four-stroke 45 Degree V-twin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression ratio</td>
<td>10:1</td>
</tr>
<tr>
<td>Bore (all models)</td>
<td>3.50 in. 88.9 mm</td>
</tr>
<tr>
<td>Stroke (XB9SX)</td>
<td>3.125 in. 79.38 mm</td>
</tr>
<tr>
<td>Stroke (XB12S)</td>
<td>3.812 in. 96.82 mm</td>
</tr>
<tr>
<td>Engine displacement (XB9SX)</td>
<td>60.05 cu. in. 984 cc</td>
</tr>
<tr>
<td>Engine displacement (XB12S)</td>
<td>73.4 cu. in. 1203cc</td>
</tr>
<tr>
<td>Oil capacity (with filter change)</td>
<td>2.5 quarts 2.37 liters</td>
</tr>
</tbody>
</table>

Table 3-2. Engine Ignition Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Sequential, non waste spark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular idle</td>
<td>1050-1150 RPM</td>
</tr>
<tr>
<td>Spark plug size</td>
<td>12 mm</td>
</tr>
<tr>
<td>Spark plug type</td>
<td>Harley-Davidson No. 10R12A</td>
</tr>
<tr>
<td>Spark plug gap</td>
<td>0.035 in. 0.8890 mm</td>
</tr>
<tr>
<td>Spark plug torque</td>
<td>12-18 ft-lbs 16-24 Nm</td>
</tr>
</tbody>
</table>

Table 3-3. Valve and Valve Seat Specifications

<table>
<thead>
<tr>
<th>VALVE</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit in guide</td>
<td>Exhaust</td>
<td>0.001-0.003 in.</td>
</tr>
<tr>
<td></td>
<td>0.001-0.003 in.</td>
<td>0.0038 in.</td>
</tr>
<tr>
<td></td>
<td>Intake</td>
<td>0.254-0.0762 mm</td>
</tr>
<tr>
<td></td>
<td>0.0254-0.0762 mm</td>
<td>0.0038 in.</td>
</tr>
<tr>
<td></td>
<td>Seat width</td>
<td>0.040-0.062 in.</td>
</tr>
<tr>
<td></td>
<td>0.1016 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stem protrusion from</td>
<td>0.090 in.</td>
</tr>
<tr>
<td></td>
<td>cylinder valve pocket</td>
<td>2.082 in.</td>
</tr>
<tr>
<td></td>
<td>2.028-2.064 in.</td>
<td>52.8828 mm</td>
</tr>
<tr>
<td></td>
<td>51.511-52.426 mm</td>
<td></td>
</tr>
</tbody>
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Table 3-4. Valve Spring Specifications

<table>
<thead>
<tr>
<th>VALVE SPRING</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free length</td>
<td>2.325 in. 59.1 mm</td>
<td>2.325. (min) 59.1 mm (min)</td>
</tr>
<tr>
<td>Intake</td>
<td>1.850 in. (closed)</td>
<td>135 lbs 61.2 kg</td>
</tr>
<tr>
<td></td>
<td>1.300 in. (open)</td>
<td>312 lbs 141.5 kg</td>
</tr>
<tr>
<td>Exahust</td>
<td>1.850 in. (closed)</td>
<td>135 lbs 61.2 kg</td>
</tr>
<tr>
<td></td>
<td>1.300 in. (open)</td>
<td>312 lbs 141.5 kg</td>
</tr>
</tbody>
</table>
### Table 3-5. Rocker Arm Specifications

<table>
<thead>
<tr>
<th>Component Description</th>
<th>New Components</th>
<th>Service Wear Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaft fit in bushing (loose)</td>
<td>0.0005-0.0020 in.</td>
<td>0.0127-0.0508 mm</td>
</tr>
<tr>
<td>End clearance</td>
<td>0.003-0.013 in.</td>
<td>0.076-0.330 mm</td>
</tr>
<tr>
<td>Bushing fit in rocker arm (tight)</td>
<td>0.004-0.002 in.</td>
<td>0.102-0.0559 mm</td>
</tr>
<tr>
<td>Rocker arm shaft fit in rocker cover (loose)</td>
<td>0.0007-0.0022 in.</td>
<td>0.018-0.056 mm</td>
</tr>
</tbody>
</table>

### Table 3-6. Piston Ring and Piston Pin Specifications

<table>
<thead>
<tr>
<th>Component Description</th>
<th>New Components</th>
<th>Service Wear Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression ring gap (top and 2nd)</td>
<td>0.007-0.020 in.</td>
<td>0.178-0.508 mm</td>
</tr>
<tr>
<td>Oil control ring rail gap</td>
<td>0.009-0.052 in.</td>
<td>0.229-1.321 mm</td>
</tr>
<tr>
<td>Compression ring side clearance (Top)</td>
<td>0.0020-0.0045 in.</td>
<td>0.0508-0.1143 mm</td>
</tr>
<tr>
<td>Compression ring side clearance (2nd)</td>
<td>0.0016-0.0041 in.</td>
<td>0.0406-0.1041 mm</td>
</tr>
<tr>
<td>Oil control ring side clearance</td>
<td>0.0016-0.0076 in.</td>
<td>0.0406-0.1930 mm</td>
</tr>
<tr>
<td>Pin fit (loose, at room temperature)</td>
<td>0.00005-0.00045 in.</td>
<td>0.00127-0.01143 mm</td>
</tr>
</tbody>
</table>

### Table 3-7. Cylinder Head Specifications

<table>
<thead>
<tr>
<th>Component Description</th>
<th>New Components</th>
<th>Service Wear Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve guide in head (tight)</td>
<td>0.0033-0.0020 in.</td>
<td>0.0838-0.0508 mm</td>
</tr>
<tr>
<td>Valve seat in head (tight)</td>
<td>0.0035-0.0010 in.</td>
<td>0.0889-0.0254 mm</td>
</tr>
<tr>
<td>Head gasket surface (flatness)</td>
<td>0.006 in. total</td>
<td>0.152 mm total</td>
</tr>
</tbody>
</table>

### Table 3-8. Cylinder Specifications

<table>
<thead>
<tr>
<th>Component Description</th>
<th>New Components</th>
<th>Service Wear Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taper</td>
<td>0.002 in.</td>
<td>0.051 mm</td>
</tr>
<tr>
<td>Out of round</td>
<td>0.003 in.</td>
<td>0.076 mm</td>
</tr>
<tr>
<td>Warpage (gasket surfaces)</td>
<td>Top 0.006 in.</td>
<td>0.152 mm</td>
</tr>
<tr>
<td></td>
<td>Base 0.008 in.</td>
<td>0.203 mm</td>
</tr>
<tr>
<td>Bore diameter± 0.0002 in.</td>
<td>Standard 3.4978 in.</td>
<td>88.8441 mm</td>
</tr>
</tbody>
</table>

### Table 3-9. Connecting Rod Specifications

<table>
<thead>
<tr>
<th>Component Description</th>
<th>New Components</th>
<th>Service Wear Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston pin fit (loose)</td>
<td>0.00145-0.00155 in.</td>
<td>0.03683-0.03937 mm</td>
</tr>
<tr>
<td>Side play between flywheels</td>
<td>0.005-0.031 in.</td>
<td>0.1-0.8 mm</td>
</tr>
<tr>
<td>Fit on crankpin (loose)</td>
<td>0.0004-0.0017 in.</td>
<td>0.0102-0.0432 mm</td>
</tr>
<tr>
<td>Connecting rod race ID</td>
<td>1.6245-1.6250 in.</td>
<td>41.2623-41.2750 mm</td>
</tr>
</tbody>
</table>
### Table 3-10. Hydraulic Lifter Specifications

<table>
<thead>
<tr>
<th>HYDRAULIC LIFTER</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit in guide</td>
<td>0.0008-0.0020 in.</td>
<td>0.0203-0.0508 mm</td>
</tr>
<tr>
<td>Roller fit</td>
<td>0.0006-0.0010 in.</td>
<td>0.0152-0.0254 mm</td>
</tr>
<tr>
<td>Roller end clearance</td>
<td>0.008-0.022 in.</td>
<td>0.203-0.559 mm</td>
</tr>
</tbody>
</table>

### Table 3-11. Oil Pump Specifications

<table>
<thead>
<tr>
<th>OIL PUMP</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil pressure</td>
<td>1000 RPM</td>
<td>7-12 PSI</td>
</tr>
<tr>
<td></td>
<td>2500 RPM</td>
<td>10-17 PSI</td>
</tr>
<tr>
<td>Shaft to pump clearance</td>
<td>0.0025 in.</td>
<td>0.0635 mm</td>
</tr>
<tr>
<td>Feed/scavenge inner/outer georotor clearance</td>
<td>0.003 in.</td>
<td>0.076 mm</td>
</tr>
</tbody>
</table>

### Table 3-12. Gearcase Specifications

<table>
<thead>
<tr>
<th>GEARCASE</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cam gear shaft in bushing (loose)</td>
<td>0.0007-0.0022 in.</td>
<td>0.0178-0.0559 mm</td>
</tr>
<tr>
<td>Cam gear shaft end play (min)</td>
<td>0.005-0.024 in.</td>
<td>0.127-0.610 mm</td>
</tr>
<tr>
<td>Intake cam gear shaft end play (min)</td>
<td>0.006-0.024 in.</td>
<td>0.152-0.610 mm</td>
</tr>
</tbody>
</table>

### Table 3-13. Flywheel Specifications

<table>
<thead>
<tr>
<th>FLYWHEEL</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Runout</td>
<td>Flywheel at rim</td>
<td>0.000-0.010 in.</td>
</tr>
<tr>
<td></td>
<td>Shaft at flywheel end</td>
<td>0.000-0.002 in.</td>
</tr>
</tbody>
</table>

### Table 3-14. Sprocket Shaft Bearing Specifications

<table>
<thead>
<tr>
<th>SPROCKET SHAFT BEARING</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing outer race fit in crankcase (tight)</td>
<td>0.006 in. Interference fit</td>
<td>0.2 mm</td>
</tr>
<tr>
<td>Bearing inner race fit on shaft (tight)</td>
<td>0.006 in. Interference fit</td>
<td>0.2 mm</td>
</tr>
<tr>
<td>Flywheel endplay in crankcase</td>
<td>.003-.010 in.</td>
<td>0.08-0.25 mm</td>
</tr>
</tbody>
</table>
### Table 3-15. Pinion Shaft Bearing Specifications

<table>
<thead>
<tr>
<th>PINION SHAFT BEARING</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinion shaft journal diameter</td>
<td>1.2496-1.2500 in.</td>
<td>31.7398-31.7500 mm</td>
</tr>
<tr>
<td></td>
<td>1.2496 in. (min)</td>
<td>31.7398 mm (min)</td>
</tr>
<tr>
<td>Outer race diameter in right crankcase</td>
<td>1.5646-1.5652 in.</td>
<td>39.7408-39.7561 mm</td>
</tr>
<tr>
<td></td>
<td>1.5672 in. (max)</td>
<td>39.8069 mm (max)</td>
</tr>
<tr>
<td>Bearing running clearance</td>
<td>0.00012-0.00088 in.</td>
<td>0.00305-0.02235 mm</td>
</tr>
<tr>
<td>Fit in cover bushing (loose)</td>
<td>0.0023-0.0043 in.</td>
<td>0.0584-0.1092 mm</td>
</tr>
</tbody>
</table>

## TORQUE VALUES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air scoop fastener at oil cooler</td>
<td>48-72 in-lbs</td>
<td>5.4-8 Nm page 3-76</td>
</tr>
<tr>
<td>All tie bars</td>
<td>25-27 ft-lbs</td>
<td>33.9-36.6 Nm page 3-14</td>
</tr>
<tr>
<td>Anti-rotation screws (lifter)</td>
<td>55-65 in-lbs</td>
<td>6-7 Nm page 3-86</td>
</tr>
<tr>
<td>Clutch cable wire form fastener</td>
<td>84-92 in-lbs</td>
<td>9.5-10.4 Nm page 3-15, 3-40</td>
</tr>
<tr>
<td>Crankcase 5/16 in. screws</td>
<td>15-19 ft-lbs</td>
<td>20-26 Nm page 3-104</td>
</tr>
<tr>
<td>Cylinder head screws</td>
<td>10-20 ft-lbs</td>
<td>14-27 Nm Special procedure, Special pattern to tighten, page 3-59</td>
</tr>
<tr>
<td>Cylinder studs</td>
<td>72-96 in-lbs</td>
<td>8.1-10.8 Nm page 3-14</td>
</tr>
<tr>
<td>Exhaust header nuts</td>
<td>27-29 ft-lbs</td>
<td>36.6-39.3 Nm page 3-36</td>
</tr>
<tr>
<td>Front isolator bolt</td>
<td>49-51 ft-lbs</td>
<td>66-69 Nm page 3-14</td>
</tr>
<tr>
<td>Front isolator bracket mounting fastener</td>
<td>49-51 ft-lbs</td>
<td>66.4-69.1 Nm page 3-14, 3-33</td>
</tr>
<tr>
<td>Gearcase cover screws</td>
<td>80-110 in-lbs</td>
<td>9-12 Nm Special pattern to tighten, page 3-91</td>
</tr>
<tr>
<td>Ignition coil fasteners</td>
<td>120-144 in-lbs</td>
<td>13.6-16.3 Nm page 3-42</td>
</tr>
<tr>
<td>Oil cooler oil line clamp</td>
<td>12-36 in-lbs</td>
<td>1.3-4 Nm page 3-38, 3-76</td>
</tr>
<tr>
<td>Oil cooler feed oil line at oil cooler</td>
<td>19-21 ft-lbs</td>
<td>26-28 Nm page 3-38, 3-76</td>
</tr>
<tr>
<td>Oil cooler return oil line at crank-case</td>
<td>15-17 ft-lbs</td>
<td>20.3-23 Nm page 3-38</td>
</tr>
<tr>
<td>Oil cooler return oil line at oil cooler</td>
<td>19-21 ft-lbs</td>
<td>25.8-28.5 Nm page 3-38, 3-76</td>
</tr>
<tr>
<td>Oil filter adapter</td>
<td>96-144 in-lbs</td>
<td>11-16 Nm LOCTITE 243, page 3-84</td>
</tr>
<tr>
<td>Oil line clamp at starter motor</td>
<td>40-50 in-lbs</td>
<td>5-5.5 Nm page 3-36</td>
</tr>
<tr>
<td>Oil line fittings at swingarm</td>
<td>108-156 in-lbs</td>
<td>12-17.6 Nm page 3-74</td>
</tr>
<tr>
<td>Oil line p-clamp fastener</td>
<td>48-72 in-lbs</td>
<td>5.4-8 Nm page 3-36</td>
</tr>
<tr>
<td>Oil pressure signal light switch</td>
<td>50-70 in-lbs</td>
<td>6-8 Nm page 3-84</td>
</tr>
<tr>
<td>Oil pump cover screws</td>
<td>70-80 in-lbs</td>
<td>8-9 Nm TORX, page 3-83</td>
</tr>
<tr>
<td>Oil pump mounting screws</td>
<td>125-150 in-lbs</td>
<td>14-17 Nm page 3-83</td>
</tr>
<tr>
<td>ITEM</td>
<td>TORQUE</td>
<td>NOTES</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Pinion shaft nut</td>
<td>19-21 ft-lbs</td>
<td>26-29 Nm</td>
</tr>
<tr>
<td>Piston jet TORX screws</td>
<td>25-35 in-lbs</td>
<td>2.8-4 Nm</td>
</tr>
<tr>
<td>Pushrod cover screw</td>
<td>30-40 in-lbs</td>
<td>3.5 Nm</td>
</tr>
<tr>
<td>Rear isolator assembly fasteners</td>
<td>25-27 ft-lbs</td>
<td>33.9-36.6 Nm</td>
</tr>
<tr>
<td>Rear isolator bolt</td>
<td>25-27 ft-lbs</td>
<td>33.9-36.6 Nm</td>
</tr>
<tr>
<td>Rear muffler bracket</td>
<td>32-36 ft-lbs</td>
<td>43.4-48.8 Nm</td>
</tr>
<tr>
<td>Reed valve stop fastener</td>
<td>5-7 in-lbs</td>
<td>0.6-0.8 Nm</td>
</tr>
<tr>
<td>Return oil line at top front oil pump</td>
<td>22-24 ft-lbs</td>
<td>29.8-32.5 Nm</td>
</tr>
<tr>
<td>Rocker box cover screws</td>
<td>120-156 in-lbs</td>
<td>13.6-17.6 Nm</td>
</tr>
<tr>
<td>Rocker box to head bolts</td>
<td>135-155 in-lbs</td>
<td>15-18 Nm</td>
</tr>
<tr>
<td>Rocker box to head bolts</td>
<td>18-22 ft-lbs</td>
<td>24-30 Nm</td>
</tr>
<tr>
<td>Rocker box to head screws</td>
<td>135-155 in-lbs</td>
<td>15-18 Nm</td>
</tr>
<tr>
<td>Sprocket cover fastener</td>
<td>12-36 in-lbs</td>
<td>1-4 Nm</td>
</tr>
<tr>
<td>Stabilizer bracket fastener</td>
<td>66-78 in-lbs</td>
<td>7.5-8.8 Nm</td>
</tr>
<tr>
<td>Swingarm pivot shaft pinch bolt</td>
<td>17-19 ft-lbs</td>
<td>23-25.8 Nm</td>
</tr>
<tr>
<td>Swingarm pivot shaft</td>
<td>24-26 ft-lbs</td>
<td>32.5-35.2 Nm</td>
</tr>
<tr>
<td>V bracket to main frame</td>
<td>120-144 in-lbs</td>
<td>13.6-16.3 Nm</td>
</tr>
<tr>
<td>Vent oil line at gearcase cover</td>
<td>12-13 ft-lbs</td>
<td>16.3-17.6 Nm</td>
</tr>
</tbody>
</table>
Fuel

Gasoline/alcohol Blends

Buell Lightning motorcycles have been designed to obtain the best performance and efficiency using a good quality unleaded gasoline. Buell recommends using at least 91 pump octane (RON). Octane rating is usually found on the pump. Some fuel suppliers sell gasoline/alcohol blends as a fuel. The type and amount of alcohol added to the fuel is important.

- DO NOT USE GASOLINES CONTAINING METHANOL. Using gasoline/methanol blends will result in starting and driveability deterioration and damage to critical fuel system components.

- Gasolines containing ETHANOL: Gasoline/ethanol blends are mixture of 10% ethanol (Grain alcohol) and 90% unleaded gasoline. Gasoline/ethanol blends can be used in your motorcycle if the ethanol content does not exceed 10%.

- Gasolines containing ETHER: Gasoline/ether blends are a mixture of gasoline and as much as 15% ether. Gasoline/ether blends can be used in your motorcycle if the ether content does not exceed 17%.

- REFORMULATED OR OXYGENATED GASOLINES (RFG): “Reformulated gasoline” is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline, leaving fewer “tailpipe” emissions. They are also formulated to evaporate less when you are filling your tank. Reformulated gasolines use additives to “oxygenate” the gas. Your motorcycle will run normally using this type of gas. Buell recommends you use it when possible, as an aid to cleaner air in our environment.

Because of their generally higher volatility, these blends may adversely affect the starting, driveability and fuel efficiency of your motorcycle. If you experience these problems, Buell recommends that you operate your motorcycle on straight, unleaded gasoline.

Lubrication

The engine has a force-feed (pressure) type oiling system, incorporating oil feed and return pumps in one pump body, with one check valve on the oil feed side. The feed pump forces oil through the oil cooler to the engine, lubricating lower connecting rod bearings, rocker arm bushings, valve stems, valve springs, push rods and tappets. Cylinder wall, piston, piston pin, timing gears, bushings and main bearings are lubricated by oil spray thrown off connecting rods and crankshaft, and by oil draining from each rocker box through an internal drain passage in each cylinder and each tappet guide. Oil is transferred to the teeth of all the cam gears by way of the gear meshing action. The oil-scavenging section of the pump returns oil to the tank from the engine. See 3.8 LUBRICATION SYSTEM for more information.

Adjustment/Testing

General

When an engine needs repair, it is not always possible to determine definitely beforehand whether repair is possible with only cylinder head, cylinder and piston disassembled or whether complete engine disassembly is required for crankcase repair.

Most commonly, only cylinder head and cylinder repair is needed (valves, rings, piston, etc.) and it is recommended procedure to service these units first, allowing engine crankcase to remain in frame.

See 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE to strip motorcycle for removal of cylinder head, cylinder, and piston.

After disassembling “upper end” only, it may be found that crankcase repair is necessary. In this situation, remove the engine crankcase from the chassis.

NOTE
If engine is removed from chassis, do not lay engine on primary side. Placing engine on primary side will damage clutch cable end fitting. If fitting is damaged, clutch cable must be replaced.

See 1.21 TROUBLESHOOTING section. 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. However, when accompanied by blue-gray exhaust smoke and low engine compression, it indicates the piston rings need replacing. Low compression by itself, however, may indicate improperly seated valves, in addition to or in lieu of worn piston rings.

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the possible causes can be narrowed down through the process of elimination to indicate any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.
COMPRESSION TEST PROCEDURE

Combustion chamber leakage can result in unsatisfactory engine performance. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESS- SION GAUGE (Part No. HD-33223-1).

A proper compression test should be performed with the engine at normal operating temperature when possible. Proceed as follows:

NOTE
After completing the compression test(s), make sure that the throttle plate is in the closed position before starting engine. Engine will start at an extremely high RPM if throttle plate is left open.

1. Disconnect spark plug wire. Clean around plug base and remove plug.
2. Connect compression tester to cylinder.
3. With induction module throttle plate in wide open position, crank engine continuously through 5-7 full compression strokes.
4. Note gauge readings at the end of the first and last compression strokes. Record test results.
5. Compression is normal if final readings are 120 psi (827 kPa) or more.
6. Inject approximately 1/2 oz. (15 ml) of SAE 30 oil into cylinder and repeat the compression test. Readings that are considerably higher during the second test indicate worn piston rings.

Table 3-16. Compression Test Results

<table>
<thead>
<tr>
<th>DIAGNOSIS</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ring trouble</td>
<td>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.</td>
</tr>
<tr>
<td>Valve trouble</td>
<td>Compression low on first stroke; does not build up much on following strokes; does not improve considerably with the addition of oil.</td>
</tr>
<tr>
<td>Head gasket leak</td>
<td>Same reaction as valve trouble.</td>
</tr>
</tbody>
</table>

Cylinder Leakage Test

The cylinder leakage test pinpoints 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 a CYLINDER LEAKDOWN TESTER (Part No. HD-35667A) and follow the specific instructions supplied with the tester.

The following are some general instructions that apply to Buell motorcycle engines:

1. Run engine until it reaches normal operating temperature.
2. Stop engine. Clean dirt from around spark plug and remove spark plug.
3. Remove air cleaner and set induction module throttle plate in wide open position.
4. Remove timing inspection plug from crankcase.
5. The piston, in cylinder being tested, must be at top dead center of compression stroke during test.
6. To keep engine from turning over when air pressure is applied to cylinder, engage transmission in fifth gear and lock the rear brake.
7. Following the manufacturer’s instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent leakdown. Any cylinder with 12% leakdown, or more, requires further attention.
8. See Table 3-17. Listen for air leaks at induction intake, exhaust, head gasket and timing inspection hole.

NOTE
If air is escaping through valves, check push rod length.

9. Repeat procedure on rear cylinder.

NOTE
After completing the compression test(s), make sure that the throttle plate is in the closed position before starting engine. Engine will start at an extremely high RPM if throttle plate is left open.

Table 3-17. Air Leakage Test

<table>
<thead>
<tr>
<th>AIR LEAK LOCATION</th>
<th>POSSIBLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction module intake</td>
<td>Intake valve leaking.</td>
</tr>
<tr>
<td>Exhaust pipe</td>
<td>Exhaust valve leaking.</td>
</tr>
<tr>
<td>Timing inspection hole</td>
<td>Piston rings leaking. Worn or broken piston. Worn cylinder.</td>
</tr>
<tr>
<td>Head gasket</td>
<td>Leaking gasket.</td>
</tr>
</tbody>
</table>

Diagnosing Smoking Engine or High Oil Consumption

Perform COMPRESSION TEST PROCEDURE or Cylinder Leakage Test as described previously. If further testing is needed, remove suspect head(s) and inspect the following:

- Valve guide seals.
- Valve guide-to-valve stem clearance.
- Gasket surface of both head and cylinder.
GENERAL

The following process allows you to rotate engine down, pivoting on rear isolator mount, in order to service components in the top end.

NOTE

The engine does not need to be removed from chassis in order to perform top end repairs.

DISASSEMBLY

NOTES

● Before vehicle is placed on the lift it is necessary to remove the chin fairing.

● Vehicle should be placed onto the lift with front tire placed in the wheel vise in order to successfully perform this procedure.

1. Disconnect fuel pump and run vehicle until it is out of fuel. See 4.39 FUEL PUMP.

NOTES

● This step is always performed in order to purge fuel lines.

● The connection for fuel pump is just above the pump located at the rear of the fuel tank on the left side of the vehicle.

WARNING

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

2. Remove seat and disconnect battery.

3. Remove intake cover. See 2.37 INTAKE COVER ASSEMBLY.

4. Remove air filter. See 1.14 AIR CLEANER FILTER.

5. Remove air filter base plate. See 4.44 AIR CLEANER ASSEMBLY.

NOTE

The velocity stack has a clamp ring around the throttle body.

6. Remove throttle body velocity stack.

7. Cover induction module to prevent objects from falling into the intake.

8. See Figure 3-1. Disconnect fuel line.

9. Disconnect the throttle position sensor (2) [88].

10. Disconnect the fuel injector leads (3) [84 & 85].

Figure 3-1. Fuel Line and DDFI Electrical Connections (Typical)

1. Fuel line connection
2. Connection for throttle position sensor [88]
3. Connections for fuel injectors [84 & 85]
11. See Figure 3-2. Disconnect the ignition coil (2) [83] and remove.

12. Disconnect the following sensors:
   a. Temperature sensor (3) [90].
   b. Oxygen sensor (4) [137].
13. Disconnect and remove air scoops, right and left sides.
14. Remove transmission sprocket side cover.
15. Remove rear belt and idler pulley. See 6.6 DRIVE BELT SYSTEM.

NOTE
For 1200 models with interactive exhaust systems see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS) for specific details on removal of interactive components.

16. See Figure 3-3. Remove muffler: see 2.31 EXHAUST SYSTEM.
   a. Remove front muffler strap (8).
   b. Remove rear muffler straps (13).
   c. Loosen Torca clamp (1) and remove muffler (14).
   d. Loosen front muffler mount (2).

Figure 3-3. Muffler and Mounting System (XB9SX Model)
17. Remove left side rider footrest and support plate.
18. See Figure 3-4. Disconnect clutch cable.
   a. Remove wire form (1) from front isolator.
   b. Slide clutch cable adjuster boot (2) up to access clutch adjuster.
   c. Loosen clutch adjuster to release tension from hand lever.
   d. Remove clutch cable ferrule from hand lever.
1. Frame assembly
2. "V" bracket
3. Fasteners for "V" bracket (3)
4. Front isolator assembly
5. Fasteners (2)
6. Bolt
7. Front tie bar assembly
8. Fasteners for front tie bar assembly (2)
9. Nut for one fastener for front tie bar assembly
10. Center tie bar mount
11. Fasteners for center tie bar mount (2)
12. Washers for center tie bar mount (2)
13. Center tie bar assembly
14. Fasteners for center tie bar assembly (2)
15. Washers for center tie bar assembly (2)
16. Ground strap
17. Rear isolator assembly
18. Fasteners for rear isolator assembly (4)
19. Washers for rear isolator assembly (4)
20. Bolt
21. Rear tie bar assembly
22. Fasteners for rear tie bar assembly (2)
20. Unbolt “V” bracket from main frame.
21. Remove center tie bar from engine.

22. See Figure 3-6. Remove rear tie bar from frame only.
23. Loosen rear isolator bolt. DO NOT REMOVE.

24. See Figure 3-7. Remove front isolator bolt (1).
25. Remove front isolator mount (2) from engine.
NOTES

- If exhaust header was removed during service it must be torqued with the engine rotated in the down position. It is not possible to reach fasteners on the rear exhaust at the head with engine rotated in the up position.

- Tighten header nuts gradually, alternating between studs to insure that exhaust rings are flush with engine. Tighten fasteners to 72-96 in-lbs (8.1-10.8 Nm).

1. When repairs have been completed, rotate engine back up into frame.

**NOTE**

When installing and tightening front isolator bolt it is important to keep load off of isolator bolt for installation purposes. Alternate between tightening front isolator bolt and raising engine with scissors jack.

---

Figure 3-8. Front Isolator and Tie Bar Assemblies

2. See Figure 3-8. Insert front isolator bolt (1) through front isolator (2) and loosely thread into frame. Do not tighten at this point.

3. See Figure 3-8. Install isolator mounting fasteners (3) and tighten to 49-51 ft-lbs (66.4-69.1 Nm).

4. Tighten front isolator bolt to 49-51 ft-lbs (66.4-69.1 Nm).

5. Torque rear isolator bolt to 25-27 ft-lbs (33.9-36.6 Nm).

6. Install rear tie bar to frame and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

7. Install center tie bar to engine and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

8. Install front “V” bracket with oil cooler to main frame.
   a. Install “V” bracket to main frame from the left side of the vehicle and tighten to 120-144 in-lbs (13.6-16.3 Nm).

   b. See Figure 3-8. Install front tie-bar (4) to “V” bracket and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

b. See Figure 3-8. Install front tie-bar (4) to “V” bracket and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

9. Attach regulator wiring harness to bracket nylon cable straps.

9. Remove scissors jack.
10. See Figure 3-9. Pull clutch cable back up into the proper position.
   a. Connect clutch cable to handlebars and adjust to specifications. See 1.8 CLUTCH.
   b. Install wire form and tighten fastener to 84-92 in-lbs (9.5-10.4 Nm).

Figure 3-9. Clutch Cable Wire form

Figure 3-10. Oil Cooler Feed and Return Oil Line 1/8-1/4 in. (3.175-6.35 mm) Clearance
11. Connect the following sensors:
   a. Temperature sensor (3) [90].
   b. Oxygen sensor (4) [137].
12. See Figure 3-11. Install the ignition coil and connect (2) [83] and tighten fasteners to 120-144 in-lbs (13.6-16.3 Nm).

Figure 3-11. Electrical Connections and Throttle Cables (Typical)
NOTES

- Never re-use front muffler strap. Always replace front muffler strap with a new strap when removed from system.
- It is important that the front muffler mount is tightened last in order to ensure proper alignment of the exhaust system.
- When rear muffler straps have been installed, it is important that strap fasteners do not contact idler pulley bracket.
NOTE
Remove shop towel from entrance of throttle body to ensure proper operation of induction module.

13. See Figure 3-13. Connect throttle position sensor (2) [88].
14. Connect fuel injector leads (3) [84 & 85].
15. Connect fuel line.
16. Install throttle body velocity stack and replace the snap ring around the throttle body securing the velocity stack.
17. Install air filter base plate. See 4.44 AIR CLEANER ASSEMBLY.
18. Install muffler. See 2.31 EXHAUST SYSTEM.

NOTE
For 1200 model motorcycles with interactive exhaust systems see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

19. Install air cleaner assembly and intake cover and tighten fasteners to 12-36 in-lbs (1.3-4 Nm).
20. Install rear belt and idler pulley. See 6.6 DRIVE BELT SYSTEM.
21. Install left side rider footrest and support plate and tighten fasteners to 108-132 in-lbs (12.2-14.9 Nm).
22. Install sprocket cover and tighten fasteners and washers to 12-36 in-lbs (1-4 Nm).
23. Install chin fairing. See 2.36 CHIN FAIRING.
24. Install air scoops, right and left sides. See 2.38 AIR SCOOPS.

25. Connect fuel pump.

NOTE
The connection for fuel pump is just above the pump located at the rear of the fuel tank on the left side of the vehicle.

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)

26. Connect negative ground cable to battery and install seat (tighten).

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

27. Install seat. See 2.43 SEAT.
DISASSEMBLY

NOTES

● Vehicle should be placed onto the lift with rear tire in the wheel vise in order to successfully perform this procedure.

● For 1200 models with interactive exhaust systems see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

1. Disconnect fuel pump and run vehicle until it is out of fuel. See 4.39 FUEL PUMP.

   NOTES

   ● This step is always performed in order to purge fuel lines.

   ● The connection for fuel pump is just above the pump located at the rear of the fuel tank on the left side of the vehicle.

2. Drain oil tank.

3. Remove seat and disconnect battery.

4. Remove intake cover and air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.

5. Remove throttle body velocity stack.

   NOTES

   ● The XB9 and 1200 models have a clamp ring securing velocity stack to the throttle body.

   ● Install shop towel in entrance to throttle body to prevent objects from falling into the induction module.

6. See Figure 3-14. Disconnect fuel line.

7. Disconnect throttle position sensor (2) [88].

8. Disconnect fuel injector leads (3) [84 & 85].

Figure 3-14. Fuel Line and DDFI Electrical Connections (Typical)
9. See Figure 3-15. Disconnect the ignition coil connector (2) and remove.

10. Disconnect the following sensors:
    a. Temperature sensor (3) [90].
    b. Oxygen sensor (4) [137].

11. Disconnect throttle cables from induction module/throttle body.
12. Disconnect and remove air scoops, right and left sides.
13. Remove complete chin fairing, bolts.
14. Remove transmission sprocket side cover.
15. Remove rear belt and idler pulley. See 6.6 DRIVE BELT SYSTEM.

NOTE
For 1200 models with interactive exhaust system, see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

16. See Figure 3-16. Remove muffler: 2.31 EXHAUST SYSTEM.
17. See Figure 3-17. Remove oil filter.

18. Remove left and right side rider footrests and support plates. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

**NOTE**

When removing the right side rider footrest and support plate, also remove rear brake pedal assembly and remote reservoir and secure towards rear of vehicle.
19. Remove cable strap securing wire bundle to return oil line.

20. See Figure 3-18. Disconnect electrical components:
   a. Neutral switch [131].
   b. Speedometer sensor [65] (remove cable strap).
   c. Cam position sensor [14].
   d. Positive battery cable at starter.
   e. Starter solenoid [128].
   f. Oil pressure switch [120].
   g. Alternator connector [46].
   h. Voltage regulator connector [77].

21. See 3.10 OIL LINE FITTINGS. Remove all oil lines (including lines to oil cooler).

22. See Figure 3-17. Remove vent oil line (2):
   a. Disconnect vent oil line (2) at gearcase cover.
   b. Remove clamp (13) in front of starter securing vent oil line to return oil line.
   c. Disconnect vent oil line at swingarm/oil reservoir (1) and remove. See 3.10 OIL LINE FITTINGS/REMOVAL.
23. See Figure 3-17. Remove feed oil line (3).
   a. Loosen fitting at oil pump (14).
   b. Remove two p-clamps (12) from feed oil line (one on crankcase and one on swingarm/oil reservoir.
   c. Remove feed oil line (3) at oil pump (14).
   d. Disconnect feed oil line at swingarm/oil reservoir and remove. See 3.10 OIL LINE FITTINGS/REMOVAL.

24. Remove front and rear muffler brackets.

25. See Figure 3-17. Remove return oil line (4).
   a. See Figure 3-19. Remove convolute covering from return oil line.
   b. See Figure 3-17. Loosen fitting at oil pump (14).
   c. Remove p-clamp (12) at swingarm/oil reservoir (1).
   d. Disconnect oil return line (4) at swingarm/oil reservoir (1). See 3.10 OIL LINE FITTINGS/REMOVAL.
   e. Disconnect oil return line (4) at oil pump (14) and remove.

26. Disconnect and remove oil cooler oil lines. See 3.11 OIL COOLER.

27. See Figure 3-20. Disconnect clutch cable.
   a. Remove wire form retainer (1) from front isolator.
   b. Slide clutch cable adjuster boot (2) up to access clutch adjuster.
   c. Loosen clutch adjuster to release tension from hand lever.

28. Remove clutch cable ferrule from hand lever.
29. See **Figure 3-21.** Remove sidestand assembly.

**NOTE**

Anytime front tie-bar is removed, it must first be removed from the "V" bracket and then the engine. When reinstalling the tie bar, first mount to engine and then to "V" bracket in order to prevent damage to threaded area of crankcase.

30. Support engine with wide scissors jack.
NOTE
See Figure 3-23. At this point it is necessary to support main frame with overhead hoist in order to remove rear isolator bolt. Failure to do this will result in main frame dropping slightly.
31. See Figure 3-24. After rotating engine back up into frame, continue to remove:
   a. Rear isolator bolt.
   b. Swingarm pivot shaft.

32. See Figure 3-25. Support swingarm/oil tank with wooden blocks, jack, etc.

33. See Figure 3-26. Cut the cable strap holding transmission vent line and pull vent line out of frame leaving it attached to engine.

   **NOTE**
   The transmission vent line runs up the left side of the frame and exits underneath the left rear side of the intake cover assembly.

34. Lower engine with scissors lift all the way down.

35. Remove front “V” bracket with oil cooler from main frame.
   a. Remove cable strap securing the remote idle adjustment cable
   b. Remove the three cable straps holding regulator wiring harness in order to extend the harness to remove “V” bracket
   c. Remove front tie-bar from “V” bracket.
   d. Remove front tie-bar from engine.
   e. Unbolt “V” bracket from main frame.

36. See Figure 3-22. Remove center tie-bar from engine.

37. Remove rear tie bar from frame.

38. Move the engine assembly from under the main frame to the right side of the lift.

39. Remove engine.
40. Once engine has been removed from vehicle finish removing the following items as required:
   a. Shifter assembly.
   b. See Figure 3-27. Center tie bar mount.
   c. See Figure 3-28. Swingarm pivot shaft pinch bolt threaded insert.
   d. See Figure 3-29. Aluminum bushings from front exhaust mount.
   e. Timer cover.
   f. See Figure 3-30. Wire guard located under the sprocket cover.
41. See Figure 3-31. If the crankcases are being separated it will be necessary to remove rear isolator assembly by removing the forward two fasteners first and then the two rear fasteners (re-install with new fasteners).

42. See Figure 3-32. Place a block of wood between rear isolator mount on main frame and swingarm/oil tank.

43. Route a ratcheting tie down through the swingarm bearings, up over the main frame, through the top stabilizer area, back down to the ratchet mechanism and secure swingarm to main frame.

NOTE
See Figure 3-33. This allows the vehicle to remain together as a rolling chassis and to be removed from the lift and stored if necessary.

44. Remove support from under swingarm/oil tank.
45. Remove overhead support.
ASSEMBLY

Engine Prep for Re-installation

NOTE
Install components that were removed from engine as were necessary for service prior to installing engine in frame.

1. See Figure 3-34. Install rear isolator assembly by installing the two rear fasteners first and then the two forward fasteners (re-install with new fasteners). Tighten to 25-27 ft-lbs (33.9-36.6 Nm).

2. Install the following items on the engine assembly as required:
   a. Shifter assembly.
   b. See Figure 3-35. Center tie bar mount 25-27 ft-lbs (33.9-36.6 Nm).

   NOTE
   Hand thread pivot shaft into crankcase prior to installing the threaded insert. Remove pivot shaft after installing the threaded insert.

   c. See Figure 3-36. Apply LOCTITE 242 (blue) and install swingarm pivot shaft pinch bolt threaded insert.

   d. See Figure 3-37. Aluminum bushings from front exhaust mount.

   e. Wire guard under the sprocket cover.

Figure 3-34. Rear Isolator and Mounting Hardware

Figure 3-35. Center Tie Bar Mount

Figure 3-36. Threaded Insert

Figure 3-37. Front Exhaust Mount Bushings (2 piece)
Installing Engine in Frame

**NOTE**

Vehicle should be placed onto the lift with rear tire in the wheel vise in order to successfully perform this procedure.

1. See Figure 3-38. Install bottle jack and wooden block under swingarm/oil tank to the rear of the oil line fittings.
2. Remove ratcheting tie down and block of wood between rear isolator mount on main frame and swingarm/oil reservoir.

3. See Figure 3-39. With engine on a flat scissors jack, raise engine and chassis until swingarm and rear isolator mount align and pivot shaft can be installed.
4. Tighten swingarm pivot shaft to 24-26 ft-lbs (32.5-35.2 Nm).
5. Tighten swingarm pivot shaft pinch bolt to 17-19 ft-lbs (23-25.8 Nm) using LOCTITE 272 (red).
6. See Figure 3-40. Route transmission vent line up through left side of frame exiting under the left rear side of the intake cover assembly. Install cable strap to secure transmission vent line in place. Inspect vent line to verify space between vent line and rear exhaust.

7. See Figure 3-42. Using the overhead hoist to align the frame to the rear isolator, install rear isolator bolt and leave loose at this time.
1. Frame assembly
2. "V" bracket
3. Fasteners for "V" bracket (3)
4. Isolator assembly, front
5. Fasteners for front isolator (2)
6. Bolt, front isolator
7. Tie bar assembly, front
8. Fasteners for front tie bar assembly (2)
9. Nut for one fastener for front tie bar assembly
10. Mount, center tie bar
11. Fasteners for center tie bar mount (2)
12. Washers for center tie bar mount (2)
13. Tie bar assembly, center
14. Fasteners for center tie bar assembly (2)
15. Washers for center tie bar assembly (2)
16. Cable, negative battery
17. Isolator assembly, rear
18. Fasteners for rear isolator assembly (4)
19. Washers for rear isolator assembly (4)
20. Bolt, rear isolator
21. Tie bar assembly, rear
22. Fasteners for rear tie bar assembly (2)

Figure 3-43. Engine Mounting System
8. Rotate engine down and install exhaust header only and tighten fasteners to 72-96 in-lbs (8.1-10.8 Nm).

**NOTES**

- It is necessary to tighten the front head pipe first.
- Tighten header nuts gradually, alternating between studs to insure that exhaust rings are flush with engine.
- Exhaust header must be torqued with the engine rotated in the down position. It is not possible to reach fasteners on the rear exhaust at the head with engine rotated in the up position.

9. When the exhaust header has been torqued, rotate engine back up into frame.

**NOTE**

When tightening front isolator bolt it is important to keep load off of isolator bolt for installation purposes. Alternate between tightening front isolator bolt and raising engine with scissors jack.

10. See Figure 3-44. Insert front isolator bolt (3) through front isolator (1) and loosely thread into frame. Do not tighten at this point.

11. Install isolator mounting fasteners (2) and tighten to 49-51 ft-lbs (66.4-69.1 Nm).

12. Tighten front isolator bolt to 49-51 ft-lbs (66-69 Nm).

13. See Figure 3-43. Tighten rear isolator bolt to Rear 25-27 ft-lbs (33.9-36.6 Nm).

14. Install rear tie bar to frame and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

15. Install center tie bar to engine and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

16. Torque rear isolation bolt 25-27 ft-lbs (33.9-36.6 Nm).

**NOTE**

When reinstalling the tie bar, first mount to engine and then to “V” bracket in order to prevent damage to threaded area of crankcase.

17. Install front tie-bar and clutch cable lower retaining clamp to engine and tighten to 25-27 ft-lbs (33.9-36.6 Nm).

18. Install front “V” bracket with oil cooler to main frame.
   a. Install “V” bracket to main frame from the left side of the vehicle and tighten to 120-144 in-lbs (13.6-16.3 Nm).
   b. Install front tie-bar to “V” bracket and tighten to 25-27 ft-lbs (33.9-36.6 Nm).
   c. Attach regulator wiring harness to bracket with nylon cable straps.

19. Remove scissors jack.
20. See Figure 3-45. Install rear muffler bracket and torque to 32-36 ft-lbs (43.4-48.8 Nm).

21. Install front muffler mount and leave loose at this time.

● DO NOT install muffler at this time. It is necessary to install muffler mounts first in order to properly install feed oil line.

● At this point it will be necessary to install the oil lines. It is important to follow this procedure to ensure correct orientation of oil lines in order to establish the proper clearances needed between the oil lines and varied components on the vehicle.
22. See Figure 3-46. Install the feed, return and vent oil lines starting at the engine and working towards the rear of the vehicle. Leave all oil line fittings loose at the engine at this time. See 3.10 OIL LINE FITTINGS.

**NOTE**

The feed oil line (3) is routed through the right side of the rear muffler bracket (10).
Route stator and vehicle speed sensor wiring between the vent and return oil lines before connecting the vent line to the fitting at the cam cover.

23. See Figure 3-46. Install p-clamps (12) on feed oil line (3) at crankcase and swingarm/oil reservoir and tighten fastener to 48-72 in-lbs (5.4-8 Nm).

24. See Figure 3-46. Install p-clamp on return oil line at the swingarm/oil reservoir and tighten fastener to 48-72 in-lbs (5.4-8 Nm).

25. See Figure 3-46. Install oil line clamp (13) attaching vent oil line (2) to return oil line (4) in front of starter motor and tighten to 40-50 in-lbs (5-5.5 Nm).

26. See Figure 3-47. The feed oil line (2) at the rear of the oil pump should be tightened to 27-29 ft-lbs (36.6-39.3 Nm).

27. Tighten the return oil line (4) at the top front oil pump fitting to 22-24 ft-lbs (29.8-32.5 Nm).

NOTE
See Figure 3-47. Once the return oil line (4) has been installed it will be necessary to install the convolute covering (3) over the return oil line.

28. Tighten the vent oil line (1) at the gearcase cover to 12-13 ft-lbs (16.3-17.6 Nm).
29. See Figure 3-48. Loosely install the feed oil line that runs from the lower front oil pump fitting to the rear fitting on the oil cooler.

NOTE
Depending on the type of crowsfoot being used to torque the oil lines it may be necessary to remove the oil filter in order to properly torque certain oil line fittings.

Figure 3-48. Oil Cooler Feed Oil Line Orientation (Approximately 2 O’Clock) and Oil Line Clearances

30. Verify that the clutch cable and feed line have 1/8-1/4 in. (3.175-6.35 mm) clearance.

NOTE
When torquing the oil cooler feed and return lines to the oil cooler, verify that the lines do not twist while torquing.
31. See Figure 3-50. Install oil cooler oil feed line first at oil pump and tighten to 22-24 ft-lbs (29.8-32.5 Nm). Lightly coat the threads of the oil cooler fitting with clean H-D 20W50 engine oil. Wipe off any excess oil. Tighten feed oil line to 19-21 ft-lbs (25.8-28.5 Nm) at oil cooler making sure to center the oil line between the oil sending switch and the return oil line fitting on the crankcase.

**NOTE**

When installing the oil cooler return oil line it is necessary to install the end at the crankcase first.

32. Install the oil cooler return oil line at crankcase and tighten to 15-17 ft-lbs (20.3-23 Nm). Lightly coat the threads of the oil cooler fitting with clean H-D 20W50 engine oil. Wipe off any excess oil. Tighten return oil line to 19-21 ft-lbs (25.8-28.5 Nm) at oil cooler.

33. Install oil cooler line clamp. Tighten fastener to 12-36 in-lbs (1-4 Nm).

**NOTE**

See Figure 3-50. The orientation of the oil cooler return oil line where it enters the crankcase should be at approximately 6 o’clock to allow for proper alignment and clearance of other components on the vehicle.

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**Figure 3-49. Oil Cooler Oil Lines**

**Figure 3-50. Oil Cooler Feed and Return Oil Lines Location and Orientation**
34. See 7.26 SPROCKET COVER WIRING before connecting the following electrical components:
   a. Neutral switch [131].
   c. Cam position sensor [14].
   d. Alternator [46].
   e. Voltage regulator [77].
   f. Positive battery cable at starter.
   g. Starter solenoid [128].
   h. Oil pressure switch [120].
35. See Figure 3-53. Pull clutch cable back up into the proper position.
   a. Connect clutch cable to handlebars and adjust to specifications. See 1.8 CLUTCH.
   b. Install wire form retainer and tighten fastener to 84-92 in-lbs (9.5-10.4 Nm).
● Never re-use front muffler strap. Always replace front muffler strap with a new strap when removed from system.

● It is important that the front muffler mount is tightened last in order to ensure proper alignment of the exhaust system.

● When rear muffler straps have been installed, it is important that strap fasteners do not contact idler pulley bracket.

NOTE
For 1200 models with interactive exhaust system see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).
36. See Figure 3-54. Install muffler with Torca clamp but do not tighten.

37. See Figure 3-55. Connect throttle cables to induction module/throttle body. See 1.15 THROTTLE CABLE AND IDLE SPEED ADJUSTMENT.

38. Connect the following sensors:
   a. Temperature sensor [90].
   b. Oxygen sensor [137]. (Install cable wrap on harness).

39. See Figure 3-55. Install the ignition coil and spark plug wires and connect [83s]. Tighten ignition coil fasteners to 120-144 in-lbs (13.6-16.3 Nm).

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Figure 3-55. Electrical Connections and Throttle Cables (Typical)
Remove shop towel from entrance of throttle body to ensure proper operation of induction module.

40. See Figure 3-56. Connect throttle position sensor [88].
41. Connect fuel injector leads [84 & 85].
42. Connect fuel line.
43. Install throttle body velocity stack with retaining ring.

- On XB models, velocity stack attaches to the throttlebody with a wire spring clamp.
- On 1200 models, always check to ensure interactive cable is adjusted and routed properly before installing air cleaner cover. See 1.16 INTERACTIVE EXHAUST CABLE (XB12 MODELS).

44. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
45. Install intake cover assembly. Tighten fasteners to 12-36 in-lbs (1-4 Nm). See 2.37 INTAKE COVER ASSEMBLY.
46. Install oil filter and fill oil tank. See 1.5 ENGINE LUBRICATION SYSTEM.
47. Connect fuel pump.

The connection for fuel pump is just above the pump located at the rear of the fuel tank on the left side of the vehicle.

48. Install rear belt and idler pulley. See 6.6 DRIVE BELT SYSTEM.

49. Install left and right side rider footrests and support plates and torque to 108-132 in-lbs (12.20-14.91 Nm).
50. Install sprocket cover and tighten fasteners and washers to 12-36 in-lbs (1-4 Nm).
51. Install chin fairing. See 2.36 CHIN FAIRING.
52. Install air scoops, right and left sides. See 2.38 AIR SCOOPS.

**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)

53. Connect negative ground cable to battery and install seat (tighten).

**WARNING**

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

54. Install seat. See 2.43 SEAT.
REMOVAL

Before removing the cylinder head assembly, it is necessary to rotate engine down as described in 3.3 ENGINE ROTATION FOR SERVICE. The rocker arm covers and internal components must be removed before removing cylinder heads.

NOTE

All washers and fasteners used in the engine are hardened. Do not mix or replace hardened washers and fasteners with unhardened parts. Do not re-use fiber cover seals. Engine damage may result.

Figure 3-57. Rocker Arm and Push Rod Cover Assemblies
**Rocker Box Assemblies**

1. Remove spark plugs.
2. See Figure 3-57. Remove screws with washers and fiber cover seals. Discard fiber seals.
3. Remove top rocker covers.
4. Remove and discard gaskets.
5. Rotate crankshaft until both valves are closed on head being removed.
6. See Figure 3-58. Remove hardware holding lower rocker cover to cylinder head in the following order.
   a. Remove two screws and washers (1).
   b. Remove three bolts and washers (2).
   c. Loosen the four rocker arm fasteners (3) in 1/4-1/2 turn increments using a cross pattern in order to relieve valve spring pressure on the lower rocker box.
7. See Figure 3-57. Remove lower rocker cover.

**NOTES**

- Remove lower rocker box as an assembly; then disassemble as required.
- Mark rocker arm shafts for reassembly in their original positions. Valve train components must be reinstalled in their original positions to prevent accelerated wear and increased valve train noise.

8. See Figure 3-59. Remove rocker arm shafts by tapping them out using a hammer and a soft metal punch.
9. Remove rocker arms; mark them for reassembly in their original locations.
10. Mark the location and orientation (top/bottom) of each push rod. Remove push rods.
Cylinder Head Assemblies

NOTE
See Figure 3-60. Distortion to the head, cylinder and crankcase studs may result if head screws are not loosened (or tightened) gradually in the sequence shown.

1. See Figure 3-60. Loosen each head screw 1/8-turn following the sequence shown.
   a. Continue loosening in 1/8-turn increments until screws are loose. Remove head screws.
   b. Remove cylinder head, head gasket, and o-rings.
2. Discard head gasket.
3. See Figure 3-57. Remove push rod cover, gasket and valve tappets.

DISASSEMBLY

1. See Figure 3-61. Clamp VALVE SPRING COMPRESSOR TOOL (Part No. HD-34736B) in vise.
2. See Figure 3-61. Compress valve spring with VALVE SPRING COMPRESSOR.
3. See Figure 3-62. Remove valve keepers, upper collar and valve spring. Mark valve keepers for reassembly in their original locations.
4. Use a fine tooth file to remove any burrs on the valve stem at the keeper groove.
5. Mark valve to ensure that it will be reassembled in the same head. Remove valve, valve stem seal and lower collar assembly by hand. No special tools are required to remove valve stem seal and lower collar assembly.
6. Repeat the above procedure for the other valves.

Figure 3-60. Head Screw Loosening/Tightening Sequence

Figure 3-61. Valve Spring Compressor (Part No. HD-34736B)
1. Screw
2. Screw
3. Valve collar retainer
4. Upper valve spring collar
5. Valve spring
6. Valve seal and lower valve spring collar assembly
7. Valve guide intake & exhaust (2)
8. Cylinder head
9. Exhaust port stud
10. Cylinder head gasket
11. Cylinder O-ring (4)
12. Cylinder insert
13. Cylinder w/piston & rings
14. Cylinder base gasket
15. Cylinder base stud
16. Exhaust valve
17. Exhaust valve seat

Figure 3-62. Cylinder Head, Cylinder and Piston Assembly
Cylinder Heads

⚠️ 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. Bead blast or scrape carbon from head, top of cylinder and valve ports. Be careful to avoid scratching or nicking cylinder head and cylinder joint faces. Blow off loosened carbon or dirt with compressed air.


3. Wash all parts in non-flammable solvent, followed by a thorough washing with hot, soapy water. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem using a wire wheel. Never use a file or other hardened tool which could scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool.

4. See Figure 3-63. Check head gasket surface on head for flatness. Machine or replace any head which exceeds SERVICE WEAR LIMIT of 0.006 in. (0.152 mm).
Rocker Arm Assemblies

1. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.

2. Measure and record rocker arm shaft diameter.
   a. See Figure 3-64. Measure where shaft fits in lower rocker arm cover.
   b. See Figure 3-65. Measure where rocker arm bushings ride.

3. Measure and record rocker arm shaft bore diameter.
   a. See Figure 3-66. Measure bore of lower rocker cover.
   b. See Figure 3-67. Measure rocker arm bushing inner diameter.

4. Check the measurements obtained in Steps 5-6 against the SERVICE WEAR LIMITS. Repair or replace parts exceeding limits.

5. Assemble rocker arms and rocker arm shafts into lower rocker cover.

6. Check end play of rocker arm with feeler gauge.
7. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.635 mm).
Valves

1. Replace the valve if there is evidence of burning or cracking.
2. Inspect the end of the valve stem for pitting or uneven wear. Replace the valve if either of these conditions are found.
3. Inspect for burrs around the valve stem keeper groove. Remove burrs with a fine tooth file if found.

Valve Seats

**NOTE**
Valve seats are also subject to wear. Resurface valve seats whenever valves are refinished.

1. Inspect seats for cracking, chipping or burning. Replace seats if any evidence of these conditions are found.
2. See Figure 3-68. Check seats for recession by measuring valve stem protrusion.
   a. Wipe valve seats and valve faces clean.
   b. Measure valve stem protrusion.
   c. If valve stem protrudes more than 2.031 in. (51.587 mm), replace valve seat or cylinder head.

Valve Guides

1. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).
2. Scrub guides with VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water. Measure valve stem outer diameter and valve guide inner diameter. Check measurements against 3.1 SPECIFICATIONS.

Valve Springs

1. Inspect valve springs for broken or discolored coils.

**NOTE**
A single valve spring actives each valve. The inner and outer springs are combined into one tapered spring that is progressively wound.

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Spark Plug Threads

Inspect spark plug threads for damage. If threads in head are damaged, a special plug type insert can be installed using a 12 mm spark plug repair kit.

Push Rods

Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored or broken.
Replacing Rocker Arm Bushings

1. See Figure 3-70. To replace worn bushings, press or drive them from the rocker arm. If bushing is difficult to remove, turn a 9/16-18 tap into bushing. From opposite side of rocker arm, press out bushing and tap using a discarded rocker arm shaft.

2. Press replacement bushing into rocker arm, flush with arm end, and split portion of bushing towards top of arm.

3. Using remaining old bushing as a pilot, line ream new bushing with ROCKER ARM BUSHING REAMER (Part No. HD-94804-57).

4. Repeat for other end of rocker arm.
Replacing Valve Guides

Valve guide replacement, if necessary, must be done before valve seat is ground. It is the valve stem hole in valve guide that determines seat grinding location. Valve stem-to-valve guide clearances are listed in Table 3-18. If valve stems and/or guides are worn beyond limits, install new parts.

Table 3-18. Valve Stem Clearances and Service Wear Limits

<table>
<thead>
<tr>
<th>VALVE</th>
<th>CLEARANCE</th>
<th>SERVICE WEAR LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaust</td>
<td>0.001-0.003 in. (0.025-0.076 mm)</td>
<td>0.0035 in. (0.0889 mm)</td>
</tr>
<tr>
<td>Intake</td>
<td>0.001-0.003 in. (0.025-0.076 mm)</td>
<td>0.0035 in. (0.0889 mm)</td>
</tr>
</tbody>
</table>

1. To remove shoulderless guides, press or tap guides toward combustion chamber using VALVE GUIDE REMOVER/INSTALLER (Part No. B-45524).
2. Clean and measure valve guide bore in head.
3. Measure outer diameter of a new standard valve guide. The guide diameter should be 0.0020-0.0033 in. (0.0508-0.0838 mm). larger than bore in head. If clearance is not within specification, select oversize valve guide and machine valve guide O.D. as needed.
4. See Figure 3-71. Install shoulderless guides using VALVE GUIDE REMOVER/INSTALLER TOOL (Part No. B-45524). Press or drive guide until the tool touches the machined surface surrounding the guide. At this point, the correct guide height has been reached.
5. Ream guides to final size or within 0.0010 in. (0.0254 mm) of final size using VALVE GUIDE REAMER (Part No. B-45523). Use REAMER LUBRICANT (Part No. HD-39964) or liberal amounts of suitable cutting oil to prevent reamer chatter.

**NOTE**
The hone is not intended to remove material.

6. Apply the proper surface finish to the valve guide bores using the VALVE GUIDE HONE (Part No. B-45525). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60°.
7. See Figure 3-72. Thoroughly clean valve guide bores using VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water.
PROCEDURE FOR USING THE NEWAY VALVE SEAT CUTTER

Table 3-19. Neway Valve Seat Cutter

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD-35758A</td>
<td>Neway valve seat cutter</td>
</tr>
<tr>
<td>HD-39786</td>
<td>Cylinder head holding fixture</td>
</tr>
</tbody>
</table>

NOTE

- Verify correct valve stem to valve guide clearance before refacing. See Table 3-18. If new guides must be installed, complete that task before refacing valves and seats.

- 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. Secure cylinder head for service.
   a. Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786) into cylinder head spark plug hole.
   b. Clamp tool in vise and further tighten cylinder head onto the fixture to prevent any movement during operation.
   c. Place cylinder head at a 45° angle or one that offers a comfortable working position.

2. Obtain the NEWAY VALVE SEAT CUTTER SET (HD-35758A) and cut 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).

3. 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 0.080” (2.032 mm) from that number.

4. Set your dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.

5. 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.

NOTES

- 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 (Part No. HD-34751).

6. 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.

7. 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.

8. While applying a constant and consistent pressure, remove just enough material to show a complete clean-up on the 46° angle.

NOTES

- 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.

- 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.
9. 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 too 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, use the 60° cutter to raise the valve seat or move it away from the port.

   **NOTES**
   - 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.
   - Always highlight the valve seat with the permanent magic marker in order to ensure the location of the 46° valve seat.

10. If the location of the valve seat is not correct, repeat steps 8 and 9.

11. When you accomplish a complete clean-up of the 46° angle and the width is at least 0.062 in. (1.575 mm), proceed to the next step.

12. Select the proper 60° cutter and gently slide the cutter down the cutter pilot to the valve seat.

13. Remove just enough material to provide an even valve seat width of 0.040-0.062 in. (1.016-1.575 mm).

14. Remove cutter pilot and wash head thoroughly and dry completely.

15. Repeat the process on any valve seat that needs service.

16. 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.

---

![Figure 3-74. Valve and Seat Dimensions](image-url)
1. Screw
2. Screw
3. Valve collar retainer
4. Upper valve spring collar
5. Valve spring
6. Valve seal and lower valve spring collar assembly
7. Valve guide intake & exhaust (2)
8. Cylinder head
9. Exhaust port stud
10. Cylinder head gasket
11. Cylinder O-ring (4)
12. Cylinder insert
13. Cylinder w/piston & rings
14. Cylinder base gasket
15. Cylinder base stud
16. Exhaust valve
17. Exhaust valve seat

Figure 3-75. Cylinder Head, Cylinder and Piston Assembly
ASSEMBLY

1. Wash cylinder head and valves in warm, soapy water to remove all debris from cutting valve seats.
2. Scrub valve guide bores with VALVE GUIDE BRUSH (Part No. HD-34751) and hot, soapy water.

**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 dry with compressed air.
4. Apply a liberal amount of engine oil to the valve stem.
5. See Figure 3-75. Insert valve into valve guide and bottom valve on valve seat.

6. See Figure 3-76. Place a protective sleeve over the valve stem keeper groove.

**NOTE**

Failure to use a protective sleeve on the valve stem keeper groove when installing the valve stem seal and collar assembly will result in damage to the seal causing leakage around the valve stem, excessive oil consumption and valve sticking.
7. See Figure 3-78. Coat the sleeve with oil and place a new seal and lower collar assembly over the valve stem and onto valve guide.

**NOTES**

- See Figure 3-77. The valve seal is now incorporated into the lower collar and is installed by hand. NO SPECIAL TOOLS ARE REQUIRED.
- The seal is completely installed when the lower collar contacts the machined surface of the head.
- Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.

8. Install valve spring and upper collar.

9. See Figure 3-79. Compress spring with VALVE SPRING COMPRESSOR (Part No. HD-34736B).

**NOTE**

A single valve spring is used for each valve. The inner and outer springs are combined into one tapered spring that is progressively wound.

10. Insert valve keepers into upper collar, making sure they engage grooves in valve stem.

11. Release and remove from VALVE SPRING COMPRESSOR.

12. Repeat Steps 4-11 for the remaining valve.
NOTE
Push rod covers must be installed prior to installing cylinder heads.

Figure 3-80. Push Rod Locations

1. See Figure 3-81. Install push rod covers.
   a. Install new o-rings (2) on top of each push rod cover (3).
   b. Install new push rod cover gasket (5) onto bottom of each push rod cover.
   c. Install each push rod cover assembly and start the fasteners (4) securing the bottom of each cover to the crankcase.
   d. Tighten fasteners to 30-40 in-lbs (3.4-4.5 Nm).
2. Refer to Table 3-20. Identify push rod color coding, length and respective push rod positions in engine. Place intake and exhaust push rods onto seat at top of tappet.

Table 3-20. Push Rod Selection

<table>
<thead>
<tr>
<th>POSITION</th>
<th>COLOR CODES</th>
<th>LENGTH</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhaust</td>
<td>1 Band-Pink/Purple</td>
<td>10.780 in. (274.320 mm)</td>
<td>17908-02</td>
</tr>
<tr>
<td>Intake</td>
<td>1 Band-Orange/Brown</td>
<td>10.726 in. (272.948 mm)</td>
<td>17909-02</td>
</tr>
</tbody>
</table>

NOTE
After head(s) have been installed do not turn engine over until both push rods can be turned with fingers. Otherwise, damage to push rods or rocker arms may result.
**CYLINDER HEAD INSTALLATION**

**NOTE**
- Short head bolts will be installed in the 1 and 2 positions, and long head bolts in the 3 and 4 positions.
- Thoroughly clean and lubricate the threads of the cylinder head screws before installation. Friction caused by dirt and grime will result in a false torque indication.

1. Thoroughly clean and dry the gasket surfaces of cylinders and cylinder heads.

2. Install **new** o-rings over two ring dowels at the top of the cylinder. Apply a very thin film of clean H-D 20W50 engine oil to o-rings before installation.

**NOTE**
To ensure proper head gasket alignment, install new o-rings over cylinder ring dowels before installing the head gasket. Improper head gasket alignment will cause leaks.

3. Install a **new** head gasket to cylinder.

4. Carefully lower cylinder head over studs and position on dowels. Use great care so as not to disturb head gasket.

5. Lightly coat the threads and bottom face of the cylinder head bolts with clean H-D 20W50 engine oil. Wipe off any excess oil.

**NOTE**
The procedure for tightening the head screws is critical to proper distribution of pressure over gasket area. It prevents gasket leaks, stud failure, and head and cylinder distortion. Always tighten in sequence shown.

6. Start the cylinder head screws onto the cylinder studs, two short bolts on the left side of the engine, two long bolts on the right.

7. See Figure 3-82. For each cylinder head, start with screw numbered one, as shown. In increasing numerical sequence (i.e. – 1, 2, 3 and 4):
   a. Tighten bolts to 96-120 in-lbs (11-14 Nm).
   b. Tighten bolts to 13-15 ft-lbs (18-20 Nm).
   c. Loosen all screws.

8. After screws are loosened from initial torque, tighten head screws in three stages. Tighten fasteners in increasing numerical sequence (i.e. – 1, 2, 3 and 4).
   a. Tighten each screw to 96-120 in-lbs (11-14 Nm).
   b. Tighten each screw to 13-15 ft-lbs (18-20 Nm).
   c. See Figure 3-83. Mark cylinder head and head screw shoulder with a line as shown (View A).
   d. Turn all bolts an additional 85°-95°.
NOTE
When installing a particular rocker box it will be necessary to turn the engine over until both lifters are on the base circle (the lowest position) of the cams for that rocker box to be installed.
9. See Figure 3-85. Install new gaskets with the bead facing up. Place lower rocker box assembly (with rocker arms and shafts) into position. Place push rods in rocker arm sockets.

10. See Figure 3-85. Install hardware attaching lower rocker cover to cylinder head in the following order. After loosely installing all fasteners, use a cross pattern on the four large bolts that fasten the lower rocker box to head to tighten and then torque to specifications. This will bleed the tappets. Finish tightening remaining fasteners. Fastener sequences, sizes and torque specifications are listed in Table 3-21.

   a. Tighten bolts (1) to 18-22 ft-lbs (24-30 Nm).
   b. Tighten bolts (2) to 135-155 in-lbs (15-18 Nm).
   c. Tighten screws (3) to 135-155 in-lbs (15-18 Nm).

11. See Figure 3-84. Install upper rocker covers.

   a. Place a new inner gaskets on lower rocker box assemblies.
   b. Place a new lower gaskets on lower rocker cover.
   c. Install upper rocker cover using screws with washers and new fiber seals. Tighten screws to 120-156 in-lbs (13.6-17.6 Nm).

### Table 3-21. Lower Rocker Box Fasteners

<table>
<thead>
<tr>
<th>No.</th>
<th>ITEM</th>
<th>SIZE</th>
<th>TORQUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bolt w/washer</td>
<td>5/16-18 X 2-1/2</td>
<td>18-22 ft-lbs (24-30 Nm)</td>
</tr>
<tr>
<td>2</td>
<td>Bolt w/washer</td>
<td>1/4-20 X 1-1/4</td>
<td>135-155 in-lbs (15-18 Nm)</td>
</tr>
<tr>
<td>3</td>
<td>Screw w/washer</td>
<td>1/4-20 X 1-1/2</td>
<td>135-155 in-lbs (15-18 Nm)</td>
</tr>
</tbody>
</table>

**Figure 3-85. Lower Rocker Box Fasteners**
REMOVAL/DISASSEMBLY

1. Strip motorcycle as described under 3.3 ENGINE ROTATION FOR SERVICE.
2. Remove cylinder head. See 3.6 CYLINDER HEAD.
3. Clean crankcase around cylinder base to prevent dirt and debris from entering crankcase while removing cylinder.
4. See Figure 3-86. Turn engine over until piston of cylinder being removed is at bottom of its stroke.
5. Carefully raise cylinder just enough to permit placing clean towel under piston to prevent any foreign matter from falling into crankcase.

NOTE
If cylinder does not come loose, lightly tap a plastic hammer perpendicular to the cylinder fins. Never try to pry a cylinder up.


NOTE
With cylinder removed, be careful not to bend the cylinder studs. The slightest bend could cause a stress riser and lead to stud failure.

7. Install a 6 in. (152 mm) length of 1/2 in. (12.7 mm) ID plastic or rubber hose over each cylinder stud. This will protect the studs and the piston.

WARNING
Wear safety glasses or goggles when removing or installing piston pin retaining rings. Piston pin retaining rings are compressed in the ring groove and can fly out when removed from the groove, which could result in serious eye injury. (00293a)

NOTE
DO NOT re-use piston pin retaining rings. Removal may weaken retaining rings and they may break or dislodge if reinstalled resulting in engine damage.
NOTE
Handle the piston with extreme care. The alloy used in these pistons is very hard. Any scratches, gouges or other marks in the piston could score the cylinder during engine operation and cause engine damage.

8. See Figure 3-87. Remove the piston pin circlip as follows:
   a. Insert the PISTON PIN CIRCLIP REMOVER/INSTALLER (Part No. HD-34623C) into the piston pin bore until claw on tool is positioned in slot of piston (directly under circlip).
   b. Squeeze the handles of the tool together and pull from bore. In the event that the circlip should fly out, hold a shop towel over the bore during removal. Remove circlip from claw and discard.

   Figure 3-87. Removing Piston Pin Circlip

   1. Piston pin retaining ring
   2. Piston pin retaining ring installer
      (Part No. HD-34623C)

   NOTES
   ● It is not necessary to remove both piston pin circlips during piston removal. Leave the second circlip in the pin bore.
   ● Since the piston pin is a loose fit in the piston, the pin will easily slide out. The pin has tapered ends to help seat the round retaining rings.

9. See Figure 3-89. To remove piston rings spread outward until they clear grooves in piston and lift off.


### 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. Soak cylinder and piston in an aluminum-compatible cleaner/solvent until deposits are soft, then clean with a brush. Blow off loosened carbon and dirt particles and wash in solvent.

2. Clean oil passage in cylinder with compressed air.

3. Clean piston ring grooves with a piece of compression ring ground to a chisel shape.

4. Examine piston pin to see that it is not pitted or scored.

5. Check piston pin bushing to see that it is not loose in connecting rod, grooved, pitted or scored.
   a. A piston pin properly fitted to upper connecting rod bushing has a 0.00125-0.00175 in. (0.03175-0.04445 mm) clearance in bushing.
   b. See Connecting Rod Bushing section. If piston pin-to-bushing clearance exceeds 0.00200 in. (0.05080 mm), replace worn parts.

6. Clean piston pin retaining ring grooves.

7. Examine piston and cylinder for cracks, burnt spots, grooves and gouges.

8. Check connecting rod for up and down play in lower bearings. When up and down play is detected, lower bearing should be refitted. This requires removing and disassembling engine crankcase.

### Checking Gasket Surface

**NOTE**

If cylinder gasket surface does not meet flatness specifications, replace cylinder and piston. Proper tolerances will extend component life and prevent leaks.

1. See Figure 3-90. Check cylinder head gasket surface for flatness.
   a. Lay a straightedge across the surface.
   b. Try to insert a feeler gauge between the straightedge and the gasket surface.
   c. If cylinder head gasket surface is not flat within 0.006 in. (0.152 mm), replace cylinder and piston.

2. Check cylinder base gasket surface for flatness.
   a. Lay a straightedge across the surface.
   b. Try to insert a feeler gauge between the straightedge and the gasket surface.
   c. If cylinder base gasket surface is not flat within 0.008 in. (0.203 mm), replace cylinder and piston.

---

Figure 3-90. Checking Gasket Surfaces

---
Measuring Cylinder Bore

1. Remove any burrs from the cylinder gasket surfaces.
2. See Figure 3-91. Install a head gasket, base gasket and o-rings, and CYLINDER TORQUEPLATES (Part No. HD-33446B) and XL EVOLUTION TORQUE PLATE BOLTS (Part No. HD-33446-86). Tighten the bolts using the same method used when installing the cylinder head screws. See 3.6 CYLINDER HEAD.

NOTE
Torque plates, properly tightened and installed with gaskets, simulate engine operating conditions. Measurements will vary as much as 0.001 in. (0.025 mm) without torque plates.

3. See Figure 3-91. Take cylinder bore measurement in ring path, starting about 0.50 in. (12.7 mm) from top of cylinder, measuring from front to rear and then side to side. Record readings.

4. Repeat measurement at center and then at bottom of ring path. Record readings. This process will determine if cylinder is out-of-round and will also show any cylinder taper or bulge.

5. See Table 3-22. If cylinder is not scuffed or scored and is within service limit, see next section, DEGLAZING CYLINDER.

NOTE
If cylinder clearance exceeds service wear limit, cylinders and pistons should be replaced with new components. See 3.1 SPECIFICATIONS.

Table 3-22. Cylinder Bore Service Wear Limit

<table>
<thead>
<tr>
<th>STANDARD BORE</th>
<th>IN.</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>All models</td>
<td>3.5008</td>
<td>88.9203</td>
</tr>
</tbody>
</table>

Deglazing Cylinder

NOTE
Deglazing removes wear patterns, minor scuff marks and scratches without enlarging the bore diameter.

1. Lightly swab the cylinder bore with a cloth dipped in clean engine oil.

2. Obtain a 240 grit flexible ball-type deglazing tool with a bristle tip or finishing stone arrangement able to produce a 60˚ cross hatch pattern.

3. Install the deglazing tool in a slow-speed drill. The speed at which the tool rotates determines the speed at which it must be stroked up and down the bore to produce the desired cross hatch pattern.

4. Starting at the bottom of the cylinder, move the deglazing tool up and down the entire length of the cylinder bore for 10 to 12 complete strokes.

NOTES
- Stop to examine the cylinder bore and/or take measurements. A precise 60˚ cross hatch pattern in the piston travel area is the most important.
- The angular cross hatch pattern ensures an even flow of oil onto the cylinder walls and promotes longer cylinder, piston and ring life. An improper crosshatch pattern will result in insufficient oil retention and possible piston seizure and/or high oil consumption.
- Failure to remove all abrasive particles may result in premature cylinder, piston and ring wear and possible engine failure.

5. Thoroughly wash the cylinder bore with liquid dishwashing soap and warm water to remove all abrasive particles and residual grit. Continue cleaning until a clean cloth shows no evidence of dirt or debris.

6. Hot rinse the cylinder and dry with moisture free compressed air.

7. Immediately apply a thin film of clean engine oil to a clean white paper towel and thoroughly wipe the inside of the cylinder.

NOTE
After wiping the cylinder with a clean, oiled paper towel, the towel will be dark with contamination. Repeat this process using a new lightly oiled paper towel each time until the towel remains white. The cylinder is now clean.

8. With the cylinder at room temperature, check the cylinder clearance. See 3.1 SPECIFICATIONS.
Fitting Piston Rings

NOTE
See Figure 3-92. Piston rings are of two types: compression and oil control. The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward. Ring sets are available to fit standard and oversize pistons.

1. Top compression ring – Install either side up
2. Second compression ring – Install dot toward top
3. Oil control rings

Figure 3-92. Piston Rings

Figure 3-93. Measuring Ring End Gap

1. See Figure 3-93. Insert the new ring into the cylinder, square it in the bore using the top of the piston and measure the ring end gap with a feeler gauge. Do not use the ring if the end gap does not fall within the following specifications, See Table 3-23.

Table 3-23. Piston Ring End Gap

<table>
<thead>
<tr>
<th>Ring Type</th>
<th>in.</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top compression ring</td>
<td>0.010-0.020</td>
<td>0.25-0.51</td>
</tr>
<tr>
<td>2nd compression ring</td>
<td>0.014-0.024</td>
<td>0.36-0.61</td>
</tr>
<tr>
<td>Oil control ring rails</td>
<td>0.010-0.050</td>
<td>0.25-1.27</td>
</tr>
</tbody>
</table>

NOTES
- The same piston may be used if cylinder bore was not changed, unless it is scuffed or grooved. If re-using piston, replace piston rings and hone the cylinder walls with a No. 240 grit flexible hone to facilitate ring seating.
- Piston ring sets must be properly fitted to piston and cylinder: Ring sets are available to fit standard and oversize pistons.
2. See Figure 3-94. Apply engine oil to piston grooves. Use TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586) to slip compression rings over piston into their respective grooves. Be extremely careful not to over expand, twist rings or damage piston surface when installing rings.

   **NOTE**
   Install second compression ring with dot towards top.

3. See Figure 3-95. Install rings so end gaps of adjacent rings are a minimum of 90° apart. Ring gaps are not to be within 10° of the thrust face centerline.

4. See Figure 3-96. Check for proper side clearance with thickness gauge, as shown. See 3.1 SPECIFICATIONS.

   **NOTE**
   If the ring grooves are clean and the side play is still not correct, replace the rings, the piston or both.
Connecting Rod Bushing

Removal/installation

When connecting rod bushing is worn to excessive pin clearance (0.002 in. or more) (0.051 mm) it must be replaced.

1. See Figure 3-97. Secure connecting rod with CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33B).

2. See Figure 3-98. Attach PISTON PIN BUSHING TOOL (Part No. HD-95970-32D) to the connecting rod.

3. Use two box wrenches and push worn bushing from connecting rod.

4. Remove piston pin bushing tool from connecting rod.

5. Remove bushing from receiver cup.

6. See Figure 3-100. Place new bushing between connecting rod and driver.

7. Clean up and size bushing to 0.0010-0.0005 in. (0.0254-0.0127 mm) undersize using REAMER (Part No. HD-94800-26A). Sizing bushing with less than 0.00125 in. (0.03175 mm) clearance can result in a bushing loosening and/or seized pin in rod.

8. Hone bushing to final size using WRIST PIN BUSHING HONE (Part No. HD-35102). Use a liberal amount of honing oil to prevent damage to hone or bushing. Use care to prevent foreign material from falling into the crankcase.

**NOTE**

The receiver cup fits on one side of the rod while the driver fits on the opposite side as shown.

3. Use two box wrenches and push worn bushing from connecting rod.

4. Remove piston pin bushing tool from connecting rod.

5. Remove bushing from receiver cup.

**NOTE**

See Figure 3-99. The receiver cup fits on one side of the rod while the driver fits on the opposite side as shown.

6. See Figure 3-100. Place new bushing between connecting rod and driver.
ASSEMBLY/INSTALLATION

1. See Figure 3-101. Place PISTON SUPPORT PLATE (Part No. HD-42322) in position as shown.

2. Install piston assembly over connecting rod.

3. Install piston pin.

4. See Figure 3-103. Install new piston pin retaining rings (1) using PISTON PIN RETAINING RING INSTALLER (2) (Part No. HD-34623C). Place new retaining ring on tool with gap pointing up.

NOTE
Always use new retaining ring. Make sure retaining ring groove is clean and that ring seats firmly in groove. If it does not, discard the ring. Never install a used retaining ring or a new one if it has been installed and then removed for any reason. A loosely installed ring will come out of the piston groove and damage cylinder and piston beyond repair.

NOTE
Make sure the ring groove is clean. Ring must be fully seated in the groove with the gap away from the slot at the bottom.

Figure 3-101. Piston Support Plate (Part No. HD-42322)

Figure 3-102. Piston Identification

See Figure 3-102. Piston must be installed with the arrows pointing towards the front of the engine.
5. See Figure 3-104. Make sure the piston ring end gaps are properly positioned as shown.

6. See Figure 3-105. Turn engine until piston is resting on top of PISTON SUPPORT PLATE (Part No. HD-42322).

7. Lubricate cylinder wall, piston, pin and rod bushing with engine oil.

8. Remove protective sleeves from cylinder studs. Install a new cylinder base gasket. Make sure the piston does not bump the studs or crankcase.

9. See Figure 3-106. Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51C).

10. Install cylinder over piston.

11. Remove PISTON RING COMPRESSOR.

NOTE

Push rod covers must be installed prior to installing cylinder heads.

12. Assemble and install cylinder head. See 3.6 CYLINDER HEAD.

13. Install assembled engine. See 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE.
CHECKING AND ADDING OIL

Check engine oil level in oil reservoir at least once every 500 miles (800 km). Check level more frequently if engine uses more oil than normal or if vehicle is operated under harsh conditions. Check oil when engine is warmed up to operating temperature (see Hot Check).

CHANGING OIL AND FILTER

After a new engine has run its first 1000 miles (1600 km) and at 5000 miles (8000 km) intervals or annually thereafter, completely drain oil reservoir of used oil. If riding habits include severe dust conditions, operation at temperature above 80°F (26.7°C), extensive idling, speeds in excess of 65 mph (105 kph) and/or extensive two up riding or similar loads the oil should be changed at 2500 mile (4000 km) intervals. Refill with fresh oil. Always change oil filter when changing engine oil.

NOTE

See 1.5 ENGINE LUBRICATION SYSTEM for more information on checking oil level and changing oil and filter.

WINTER LUBRICATION

Normal fuel combustion in a gasoline engine produces water vapor and carbon dioxide along with other gases and particulates. When first starting and warming an engine, some of the water vapor that gets into the engine crankcase condenses to form liquid water. If the engine is driven long enough to thoroughly warm the crankcase, most of this liquid water is again vaporized and exhausted through the crankcase breather system.

A moderately driven vehicle making short runs may not be able to vacate water vapors allowing liquid water to accumulate in the oil reservoir. This is especially true if the vehicle is operated in cold weather. In freezing weather, an accumulation of water in the engine oil may become slush or ice, which can block oil lines and lead to severe engine damage. Water remaining in the engine oil for long periods of time can form an acidic sludge that is corrosive to metal engine parts and causes accelerated wear of moving components.

In winter the oil change interval should be shorter than normal. The colder the weather, the shorter the recommended oil change interval. A vehicle used only for short runs in cold weather must have the engine oil drained frequently.
GENERAL

See Figure 3-107. Engine oil runs through the swingarm which serves as the oil reservoir. From the front of the reservoir, the vent line (2) runs to the rear of the gearcase cover. The return line (4) and the feed line (3) run forward to the oil pump (14). Three rubberized clamps (12) and one plastic clamp (13) secure the lines in place.

The oil cooler feed line (5) exits the front of the oil pump and routes across the front of the engine to the oil cooler on the left front side of the crankcases. The oil cooler return line (6) then exits the oil cooler and connects to the oil filter housing on the right front side of the crankcases.

The vent line (2) connects to an elbow fitting at the rear of the gearcase cover. See 3.14 OILING SYSTEM.

Figure 3-107. Oil Lines and Connections
REMOVAL

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-41623-B</td>
<td>Oil line remover</td>
</tr>
</tbody>
</table>

1. See Figure 3-108. Close the OIL LINE REMOVER (B-41623-B) over the oil line. Match the notches in the tool flange to the U-bends in the spring clip.
2. See Figure 3-109. Rotate the tool to expand the spring clip out of the groove in the oil fitting.
3. Using finger and thumb to hold the OIL LINE REMOVER (B-41623-B) 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.
4. Pull the oil line and the tool from the fitting.
5. Repeat to remove the remaining oil lines.
6. Remove oil line fittings and plug the holes until they can be replaced.

Figure 3-108. Oil Line Remover (B-41623-B)

Figure 3-109. Oil Line Fitting with Spring Clip
INSTALLATION

1. Install oil line fittings with o-ring into swingarm and tighten to 108-156 in-lbs (12-17.6 Nm).
2. Push the correct flanged oil line into the correct fitting in the swingarm until each one clicks in place under the spring clip.
3. Lightly tug on oil line to verify that it is securely locked to fitting and the spring clip is seated in the oil line fitting groove.
4. Check oil level and add oil if required.
5. After running engine,
   a. Inspect oil fittings for oil leaks.
   b. Check oil level and add oil if required.

Figure 3-110, Flanged Oil Line
For engine oil flow through the engine, see 3.14 OILING SYSTEM.

Engine oil flows from the oil pump to the oil cooler through a supply hose. The oil circulates through the finned tubes of the cooler to dissipate heat and returns to the oil filter mount through a return hose.

**REMOVAL**

1. Cover the front chin fairing to protect finish.
   
   **NOTE**
   
   Dispose of oil in accordance with local regulations.

2. Place a container under the motorcycle to catch excess oil.

3. Remove clamp (3) from oil cooler oil lines.

4. Loosen oil cooler return line (2) at oil cooler. Do not disconnect.

5. Loosen oil cooler feed line (1) at oil cooler. Do not disconnect.

6. Remove two fasteners (10) securing the oil cooler scoop (9) and remove scoop.

   **NOTE**
   
   Place protective covering over primary cover to prevent cosmetic damage when removing and installing fastener for stabilizer bracket.

7. Remove fastener (8) securing oil cooler to stabilizer bracket.

8. Remove the fasteners (6) holding the oil cooler (5) to mounting bracket.

9. Slightly move oil cooler towards you and disconnect both oil lines from oil cooler before removing from bracket.

   **NOTE**
   
   The oil cooler should be checked for dirt and debris.

---

**Figure 3-111. Oil Cooler**

1. Oil cooler feed line
2. Oil cooler return line
3. Clamp, oil line
4. Screw with nut
5. Oil cooler
6. Screws with washers (2)
7. Stabilizer bracket
8. Screw with washer (1)
9. Oil cooler scoop
10. Screws with washers (2)
1. See Figure 3-111. Lightly coat the threads of the oil cooler fittings with clean H-D 20W50 engine oil. Wipe off any excess oil.

2. While sliding the oil cooler back onto the bracket, loosely install the feed oil line to the rear fitting on the oil cooler and return oil line to the front fitting on the oil cooler. Do not tighten.

3. After the oil cooler is in place, apply Loctite 272 to the two fasteners (6) and tighten to 120-144 in-lbs (13.6-16.3 Nm).

4. Apply Loctite 272 to the stabilizer bracket fastener (8) and tighten to 66-78 in-lbs (7.5-8.8 Nm).

5. Install oil cooler scoop and apply Loctite 272 to the two fasteners (10) and tighten to 48-72 in-lbs (5.4-8 Nm).

6. Tighten feed oil line to 19-21 ft-lbs (25.8-28.5 Nm) at oil cooler.

7. Tighten return oil line to 19-21 ft-lbs (25.8-28.5 Nm) at oil cooler.

8. See Figure 3-112. Verify that the clutch cable and feed line have a clearance of 1/8-1/4 in. (3.175-6.35 mm) between them.

9. Install oil line clamp and tighten to 12-36 in-lbs (1.3-4 Nm).
**GENERAL**

The oil pressure indicator switch is a pressure-actuated diaphragm-type switch. When oil is not circulating through the system or when oil pressure is low, spring tension holds the switch contacts closed, thereby completing the signal light circuit and causing the indicator lamp to illuminate.

**OIL PRESSURE SIGNAL LIGHT**

The oil pressure signal light turns ON when:

- Ignition switch is turned on prior to starting engine.
- Oil is not circulating through the running engine.
- Oil pressure is abnormally low in the running engine.
- Engine is idling below 1000 RPM.

The oil pressure signal light turns OFF when:

- Oil is circulating with adequate pressure through the engine running at 1000 RPM or greater.

Troubleshooting information is listed in Table 3-24.

*NOTE*

If the ignition is turned on immediately after the engine is stopped, the oil light may not turn on right away because of oil pressure retained in the filter housing.

**OIL PRESSURE**

See Figure 3-113. The oil pump is non-regulatory and delivers its entire volume of oil under pressure to the oil filter mount. When an engine is cold, the engine oil will be more viscous (i.e., thicker).

When an engine is operated at high speeds, the volume of oil circulated through the oiling system increases, resulting in higher oil pressure. As engine speed is reduced, the volume of oil pumped is also reduced, resulting in lower oil pressure.

To check oil pressure, use OIL PRESSURE GAUGE (Part No. HD-96921-52B) and OIL PRESSURE GAUGE ADAPTER (Part No. HD-96940-58B). Remove oil pressure indicator switch and insert pressure gauge fitting.

Ride motorcycle at least 20 miles (32 km) at or above 50 MPH (80 KM/H) until engine oil reaches normal operating temperature. At 2500 RPM, oil pressure will vary from 10-12 psi (69-83 kPa). At idle speed (1050-1150 RPM), oil pressure will vary from 6-8 psi (42-55 KPa).

![Figure 3-113. Oil Pressure Indicator Switch](image)

**Table 3-24. Troubleshooting Oil Pressure Signal Light**

<table>
<thead>
<tr>
<th>OIL PRESSURE SIGNAL LIGHT</th>
<th>PROBABLE CAUSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stays on at speeds above idle.</td>
<td>- Empty oil reservoir.</td>
</tr>
<tr>
<td></td>
<td>- Clogged feed line (ice and sludge, freezing temperatures).</td>
</tr>
<tr>
<td></td>
<td>- Air-bound oil line.</td>
</tr>
<tr>
<td></td>
<td>- Grounded oil switch wire.</td>
</tr>
<tr>
<td></td>
<td>- Malfunctioning signal switch.</td>
</tr>
<tr>
<td></td>
<td>- Diluted oil.</td>
</tr>
<tr>
<td></td>
<td>- Malfunctioning check valve (see 3.16 OIL FILTER MOUNT).</td>
</tr>
<tr>
<td>Flickers at idle.</td>
<td>- Incorrect idle speed. Malfunctioning or improperly installed check valve (see 3.16 OIL FILTER MOUNT).</td>
</tr>
<tr>
<td>Does not glow when ignition is turned on (prior to operating engine).</td>
<td>- Malfunctioning signal switch.</td>
</tr>
<tr>
<td></td>
<td>- Malfunction in wiring.</td>
</tr>
<tr>
<td></td>
<td>- Burned-out signal bulb.</td>
</tr>
<tr>
<td></td>
<td>- Dead battery (see NOTE).</td>
</tr>
</tbody>
</table>
GENERAL

See Figure 3-114. Pressure created in the flywheel area on piston downstroke is released through the reed valve into the gearcase. From there a mixture of crankcase air and oil mist is vented up the push rod covers to the upper rocker box.

See Figure 3-115. Air is allowed to escape the rocker boxes by exiting the positive crankcase vent (PCV) valves (4) located on top of the rocker boxes. From the PCV valves the air enters the crankcase breather hoses (2 & 3). The crankcase breather hoses route through the air cleaner base plate (1) to the air box where it is directed inside the air filter element and back into the engine.

The oil mist collects and eventually returns to the crankcase through oil passageways in the cylinder head.

Figure 3-114. Reed Valve Assembly in Gearcase

Figure 3-115. Crankcase Breathing System

1. Base plate, air box
2. Breather hose, rear
3. Breather hose, front
4. PCV valves (2)
5. Grommet
6. Rocker cover (2)
Reed Valve Replacement

NOTES
● See Figure 3-117. The reed valve (3) opens on the
downstroke to relieve crankcase pressure and closes on
the upstroke to prevent vapors returning to the crank-
case. The curved reed valve stop (2) limits the movement
of the reed valve. See 3.13 CRANKCASE BREATHING
SYSTEM.

● Whenever the gearcase cover is removed, the reed valve
should always be inspected for cracks, chips and break-
age.
1. Remove the fastener (1), the reed valve stop (2) and the
reed valve (3).

2. See Figure 3-117. To replace the assembly, align the
edges of the reed valve (3) and the reed valve stop (2) to
prevent premature failure of the reed valve.

NOTE
See Figure 3-116. It is not necessary to replace the reed
block (4) along with the reed valve. The block can only be
replaced after separating the crankcase halves.
3. With the lower part of the curve on the stop facing out,
install and tighten fastener to 5-7 in-lbs (0.6-0.8 Nm).
4. If it was necessary to replace the reed block, install the
fasteners and tighten to 25-35 in-lbs (2.8-4 Nm).

Figure 3-116. Reed Valve Assembly

1. Reed valve stop 2. Reed valve 3. Reed block

Figure 3-117. Reed Valve Stop and Reed Valve

1. Reed valve stop 2. Reed valve 3. Stop screw
GENERAL

1. Oil is gravity-fed from the oil reservoir to the gerotor-style oil pump through a feed hose. Oil enters the feed section and fills a cavity located under the feed pump.

   NOTE
   See 3.15 OIL PUMP for a complete explanation of the gerotor pump sets.

2. The feed pump transfers oil from the inlet cavity through the external steel line to the oil cooler.

3. From the oil cooler oil flows to the oil filter mount.

4. Through the filter mount cavity oil flows to the oil filter.

5. Oil enters the peripheral cavity of the oil filter, passes through the filtering medium into the central cavity of the oil filter, and flows into the filter adapter (fitting which connects filter to filter mount).

6. Adequate oil pressure in the filter mount cavity activates the oil pressure signal light switch and shuts off the oil pressure signal light.

7. Oil flowing from the filter adapter opens the check ball. The check ball opens at 4-6 psi (28-41 kPa) oil pressure.

8. With the check ball open, oil flows into the gearcase feed gallery.

9. Oil enters an intersecting passage in the gearcase cover and flow is then routed to the pinion bushing.

10. Oil enters a hole in the end of the pinion gear shaft and travels to the right flywheel where it is routed through the flywheel to the crankpin. Oil is forced through the crankpin to properly lubricate the rod bearing assembly.

11. Oil flow then continues through the gearcase cover to the main feed gallery at the top of the gearcase cover. Drilled passages in the crankcase intersect the main feed gallery and carry oil to all hydraulic lifters and piston jets.

12. Oil flows up passages in the push rods to the rocker arm shafts and bushings.

13. The valve stems are lubricated by oil supplied through drilled oil holes in the rocker arms.

14. Oil collected in the push rod areas of the cylinder heads flows down the push rod cover, through drain holes in the tappet blocks and into the gearcase. After providing lubrication to the gearcase components oil returns to the scavenge section of the oil pump through a passage located in the top of the pump. Oil is then returned to the oil tank.

15. Feed oil to the rocker area is returned to the crankcase through a passage in the head and cylinder.

16. Oil collected in the sump is splash-fed to the pistons, cylinder walls and flywheel components.

17. A pair of piston oil jets cool the bottoms of the pistons with a spray of oil.

18. Oil collected in the sump area returns to the scavenge section of the oil pump through a passage located in the rear section of the sump. Oil flow to the pump is accomplished by the scavenging effect of the pump and by the pressure created by the downward stroke of the pistons.

19. Return oil fills a cavity above the pump's return gears. The return gears pump oil back to the oil reservoir.
GENERAL

See Figure 3-118. The oil pump consists of two gerotor gear sets, feed and return, housed in one pump body. The feed set distributes oil to the engine, the scavenge set returns oil to the tank/frame reservoir.

A gerotor-type gear set has two parts — an inner and an outer gerotor. The inner gerotor has one less tooth than the outer gerotor. Both gerotors have fixed centers which are offset to each other.

In a gerotor gear set, oil is transferred from inlet to outlet as it is trapped between the rotating inner and outer gerotors.

Gravity-fed oil from the oil reservoir enters the pump through the feed line connector. It is forced by the gerotor feed set through a line to the oil filter. Return oil from the flywheel compartment is drawn back into the pump and is forced by the gerotor scavenge set back to the oil reservoir.

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be sure that all possible related malfunctions have been eliminated:

1. Make sure all oil line connections are tight and that lines are not pinched or damaged.
2. Check level and condition of oil in reservoir/swingarm. Pressure will be affected if oil is diluted. In freezing weather, proper circulation of oil can be affected if the oil feed line becomes clogged with ice or sludge.
3. Check for a grounded oil pressure switch wire or faulty switch if oil indicator light fails to go out with engine running.

---

Figure 3-118. Oil Pump

1. Mounting gasket
2. Gear shaft
3. Oil pump body
4. 90º fitting
5. O-ring
6. Thrust washer
7. Retaining ring
8. Gerotor return set
9. Separator plate
10. Gerotor feed set
11. Cover
12. 45º Fitting
13. Sems screw (2)
14. TORX screw (2)
15. Rear connector fitting
REMOVAL/DISASSEMBLY

Oil pump can be removed with engine in frame and without removing gearcase cover.

1. Remove chin fairing. See 2.36 CHIN FAIRING.
2. Drain oil reservoir. See 1.5 ENGINE LUBRICATION SYSTEM.
3. Remove and discard oil filter.
4. See Figure 3-119. Disconnect feed line connections (1, 6) on both sides of the oil pump.
5. Detach return line connection (3).
6. Carefully remove mounting screws (5) and washers only. Pump will drop with screws removed. Discard mounting gasket.
7. Remove cover TORX screws (2). Lift cover off body.
8. Remove and discard o-ring.
9. Slide both pieces of gerotor feed set, separator plate and both pieces of gerotor scaveng set off gear shaft.
10. Remove and discard retaining ring. Remove thrust washer and gear shaft.

Figure 3-119. Oil Pump Hardware

1. Feed line connection
2. Cover TORX screw (2)
3. Return line
4. Oil pump
5. Mounting screw and washer (2)
6. Feed connection to oil cooler
7. Convolute covering (for return oil line only)
CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.

2. See Figure 3-120. Inspect both gerotor sets for wear.
   a. Mesh pieces of each set together as shown.
   b. Use a feeler gauge to determine clearance.
   c. The SERVICE WEAR LIMIT between gerotors is 0.004 in. (0.102 mm). Replace gerotors as a set if clearance exceeds this dimension.
   d. Measure thickness of feed gerotors with a micrometer. Replace gerotors as a set if they are not the same thickness.

3. See Figure 3-120. Check gear shaft teeth for damage or wear. Replace if necessary.

ASSEMBLY/INSTALLATION

NOTE
Liberally coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

1. See Figure 3-118. Install gear shaft through body. Position thrust washer over end of shaft. Install new retaining ring into groove in shaft.

2. Insert inner gerotor of the gerotor scavenge set over gear shaft.

3. Place outer gerotor over inner gerotor to complete scavenge set.

4. See Figure 3-121. Install gerotor separator plate by lining up slots on perimeter with tabs inside oil pump body.

5. Install a new o-ring into groove in pump body.

6. See Figure 3-118. Place gerotor feed set over gear shaft.

7. Place cover onto pump body. Install cover TORX screws. Tighten to 70-80 in-lbs (8-9 Nm).

8. Place new mounting gasket in position.

NOTE
If fittings were removed, use TEFLON® PIPE SEALANT or HYLOMAR® on fitting threads.

9. Secure pump to crankcase with mounting screws. Tighten to 125-150 in-lbs (14-17 Nm).

10. See Figure 3-119. Attach return line connection.

11. Attach feed line connections to both sides of the oil pump.

12. Install new oil filter and fill oil reservoir with proper oil. See 1.5 ENGINE LUBRICATION SYSTEM.
GENERAL

See Figure 3-122. Oil is pressure-fed from the oil pump to the oil cooler via an external steel line. From the oil cooler, oil flows to the oil filter mount. Oil travels through the filter mount into the filter through the outer filter holes.

Adequate oil pressure activates the oil pressure indicator switch in the filter mount, which turns off the oil pressure indicator lamp.

The check ball in the filter adapter opens at 4-6 psi (28-41 kPa) oil pressure. Filtered oil leaves the filter, flowing past the check ball.

DISASSEMBLY

1. Remove chin fairing. See 2.36 CHIN FAIRING.
2. Drain oil reservoir and remove filter. See 1.5 ENGINE LUBRICATION SYSTEM.
3. See Figure 3-122. Remove filter adapter (6) from filter mount (3). Remove check ball (5) and spring (4).
4. Detach indicator lamp wire (2) from oil pressure indicator switch (1). Remove switch using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675).

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)

Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

ASSEMBLY

NOTE

Use TEF-LON PIPE SEALANT or HVLOMAR on all fittings installed to oil filter mount.

1. See Figure 3-122. Install oil pressure indicator switch (1) using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675). Tighten to 50-70 in-lbs (6-8 Nm).
2. Attach indicator lamp wire (2).

NOTE

The filter adapter has identical ends; either end may be installed into the filter mount.

3. Apply several drops of LOCTITE 243 (blue) to last few threads on that end of the filter adapter which is installed into filter mount. Do not apply LOCTITE to adapter threads on filter element side.
GENERAL

See Figure 3-123. The lifter assembly consists of a hydraulic lifter and roller. The lifter and roller, under compression force from valve spring, follow the surface of the revolving cam. The up-and-down motion produced is transmitted to the valve by the push rod and rocker arm. The lifter contains a piston (or plunger) and cylinder; it also contains a check valve, which allows the unit to fill with engine oil, thereby reducing clearance in the valve train.

When a lifter is functioning properly, the assembly operates with minimal lifter clearance. The unit automatically compensates for heat expansion to maintain a no-clearance condition.

It is normal for lifters to click when engine is started after standing for some time. Hydraulic lifters have a definite leak-down rate which permits the oil in the lifters to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain correct clearance operation. Lifters are functioning properly if they become quiet after a few minutes of engine operation.

REMOVAL

1. Clean all dirt from around crankcase. Blow loose particles from area with compressed air.
2. Pull each push rod upward through top of cylinder head. See 3.6 CYLINDER HEAD.
3. Remove cylinder head assemblies. See 3.6 CYLINDER HEAD.
4. See Figure 3-125. Remove push rod covers.
   a. Remove screws.
   b. Remove push rod covers.
   c. Remove gaskets and o-rings. Discard parts.
5. Remove valve hydraulic lifters.
   a. Remove anti-rotation screws.
   b. Remove lifters from crankcase bore using a thin-bladed screwdriver. Mark the location and orientation (front/back) of each lifter.

CLEANING AND INSPECTION


   Inside and outside micrometers used for measuring tappets and tappet guides must be calibrated to ensure accurate readings.

2. Inspect valve lifters for excessive clearance in guide. Accurately measure lifter bore inner diameter with a gauge.
   a. Clearance should be within 0.0008-0.0020 in. (0.0203-0.0508 mm).
   b. Fit a new lifter and/or replace crankcases if clearance exceeds SERVICE WEAR LIMIT of 0.0030 in. (0.076 mm).
3. Check lifter roller free play.
   a. Roller clearance on pin should be within 0.0006-0.0010 in. (0.0152-0.0254 mm).
   b. Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.0015 in. (0.0381 mm).
4. Check lifter roller end clearance.
   a. End clearance should be within 0.008-0.022 in. (0.203-0.559 mm).
   b. Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.026 in. (0.660 mm).

Figure 3-123. Lifter Assembly (Typical)
1. See Figure 3-124. Rotate engine so that both lifters from the cylinder will be installed on the base circle of the cam.

![Figure 3-124. Base Circle](image)

2. Apply a liberal amount of engine oil to each lifter assembly (especially the roller needles) for smooth initial operation.

3. See Figure 3-125. Insert lifter into bore in crankcase. Rotate lifter so that flats at upper end of lifter face the front and rear of the engine. If the lifter is installed incorrectly, anti-rotation screws cannot be inserted.

4. Secure lifters in place.
   a. Install anti-rotation screws with washers in the holes in lifter block.
   b. Tighten anti-rotation screws to 55-65 in-lbs (6-7 Nm).

5. See Figure 3-125. Install push rod cover.
   a. Place new push rod cover gasket over bottom of push rod cover.
   b. Position push rod cover onto crankcase.
   c. Install screws through holes in push rod cover into tapped holes in crankcase. Tighten screws evenly to 30-40 in-lbs (3.5 Nm).
   d. Place new o-rings on top of push rod cover.

6. Install push rods, cylinder head, lower and upper rocker covers. See 3.6 CYLINDER HEAD.

7. Repeat process for remaining cylinder head.

![Figure 3-125. Valve Lifter Service](image)
For the gearcase components to operate at their optimum, all components must be properly fitted and matched. Changing one component can affect many others. It is important to know and understand all inspection procedures and how components interact.

**GENERAL**

Read the complete gearcase section carefully before you begin any service work.

**Figure 3-126. Gearcase Cover and Cam Assembly**

1. Screw (7)  
2. Seal  
3. Fitting, oil vent line  
4. Gear Cover  
5. Gear cover gasket  
6. Bushing, outer, intake camshaft gear  
7. “E” Cam gear set  
8. Right crankcase half  
9. Dowel pin  
10. Bushing, inner, camshaft gear (4)  
11. Bushing, outer, camshaft gear (3)  
12. Key  
13. Oil pump drive gear  
14. Pinion gear  
15. Nut  
16. Bushing, gear shaft- pinion
**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. See Figure 3-126. Thoroughly clean area around gearcase cover and tappets. Blow loose dirt from crankcase with compressed air.
2. Remove any parts that will interfere with gearcase disassembly.
3. Remove push rods. See 3.6 CYLINDER HEAD.
4. Remove hydraulic lifters. See 3.17 HYDRAULIC LIFTERS.
5. Check for minimum cam gear end play. Record readings.
6. Remove cam position sensor and rotor from gearcase cover. See 4.31 CAM POSITION SENSOR AND ROTOR.
7. Place a pan under gearcase to collect oil. Remove cover screws. Carefully remove gearcase cover. Discard old gasket.
   - **NOTE**
   - If cover does not come loose on removal of screws, tap lightly with a plastic hammer. Never pry cover off.
8. See Figure 3-127. Remove cam gears (1, 2, 3 & 4).
   - **NOTE**
   - Nut is secured by LOCTITE 262 (red) on the nut threads.
9. Remove pinion nut (6). Slide pinion gear (5) and oil pump drive gear (6) off pinion shaft.
   - **NOTE**
   - See Figure 3-127. The XB9SX timing marks are located on the front intake cam assembly (2). Note the "V" marks.

---

**Figure 3-127. Cam and Pinion Gear Location and Timing Mark Indexing**

1. Front exhaust cam gear
2. Front intake cam gear
3. Rear intake cam gear
4. Rear exhaust cam gear
5. Pinion gear
6. Pinion nut
7. Timing V mark
CLEANING AND INSPECTION

1. Thoroughly clean gearcase compartment, gearcase cover and gears in solvent to remove oil and carbon deposits.

**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)

2. Blow out all cover oil passages and bushings with compressed air.

3. Clean old gasket material from gearcase and crankcase.

Cam and Pinion Gear Identification, Inspection and Selection

![Cam Identification Stamp](image)

See Figure 3-128. Cam lobes are stamped with a number (1, 2, 3 or 4) followed by a letter ("E"). The numbers identify the cam location/function and the letter ("E") indicates model year application.

<table>
<thead>
<tr>
<th>Stamp</th>
<th>Location/Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1E</td>
<td>Front Exhaust</td>
</tr>
<tr>
<td>2E</td>
<td>Front Intake</td>
</tr>
<tr>
<td>3E</td>
<td>Rear Intake</td>
</tr>
<tr>
<td>4E</td>
<td>Rear Exhaust</td>
</tr>
</tbody>
</table>

**NOTE**
Prior to changing any cam gears, check gear shaft fit within corresponding bushings. Worn bushings can cause excessive backlash.

### Bushing Inspection

1. Bushings are press fit in gearcase cover and crankcase. Inspect each bushing against its corresponding cam gear shaft or pinion gear shaft. Refer to Table 3-26.

**NOTE**
If Service Wear Limits are exceeded, replace crankcase set and/or gearcase cover as required.

#### Table 3-26. Gear Shaft Specifications

<table>
<thead>
<tr>
<th>Gear Shaft</th>
<th>Correct Clearance</th>
<th>Service Wear Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cam</td>
<td>0.0007-0.0022 in. (0.0178-0.0559 mm)</td>
<td>0.003 in. (0.076 mm)</td>
</tr>
<tr>
<td>Pinion</td>
<td>0.0023-0.0043 in. (0.0584-0.1092 mm)</td>
<td>0.0050 in. (0.1270 mm)</td>
</tr>
</tbody>
</table>
ASSEMBLY/INSTALLATION

1. See Figure 3-129. Install oil pump drive gear and pinion gear on pinion shaft.
   a. Install shaft key into pinion shaft slot.
   b. Slide oil pump drive gear over pinion shaft. Drive gear must align with shaft key.
   c. Align keyway in ID of pinion gear with shaft key.
   d. Slide pinion gear over shaft key and against oil pump drive gear.

2. See Figure 3-126. Install pinion nut.
   a. Clean threads on pinion shaft and nut.
   b. See Figure 3-130. Install CRANKSHAFT LOCKING TOOL (Part No. HD-43984) to gearcase with “Side B” facing out, over pinion shaft, with two screws.
   c. Apply several drops of LOCTITE 262 (red) to last few threads of nut.
   d. Install nut to pinion shaft. Tighten nut to 19-21 ft-lbs (26-29 Nm) plus an additional 15º to 19º rotation.

3. See Figure 3-126. Liberally apply engine oil to bushings, shafts, and gears. Install all cam gears into bushings of right crankcase half, properly aligning timing marks of cam gears and pinion gear.

NOTES

● The XB9SX uses new style timing marks on the front intake cam assembly. Please note the “V” design.

● Because of the larger diameter additional gear (which meshes with the pinion gear) on the outboard end of the cam, the front exhaust cam gear and the rear intake cam gear must be installed before the front intake cam gear is installed.

4. See Figure 3-126. Install a new seal and new dry gear cover gasket on crankcase.
5. See Figure 3-131. Install gearcase cover over all gears and onto right crankcase half. Secure cover to crankcase half with 7 socket head screws. Tighten screws evenly to 80-110 in-lbs (9-12 Nm). Use torque sequence as shown in Figure 3-131.

6. See Figure 3-132. Check cam gear end play for each cam gear as follows:
   a. Turn engine over until lobe of cam gear being checked is pointing toward its respective tappet guide hole.
   b. Gently pry the cam gear toward the gearcase cover using a flat blade screwdriver.
   c. Measure gap between bushing (in crankcase half) and cam gear shaft thrust face (shoulder) using a feeler gauge. This is cam gear end play.
   d. Compare cam gear end play measurements with the SERVICE WEAR LIMITS. Make repairs as required if end play does not meet specifications.

7. Install hydraulic lifters and push rods. See 3.17 HYDRAULIC LIFTERS.

8. Install cam position sensor and rotor in gearcase cover. See CAM POSITION SENSOR AND ROTOR section.

9. Install any components removed to gain access to gearcase (i.e. exhaust system components, air cleaner, etc.).
GENERAL

When rod bearings, pinion shaft bearing, or sprocket shaft bearing are in need of repair, the engine must be removed from the chassis; see 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE in this section. It is recommended procedure to check and make repairs to cylinder heads, cylinders, gear case and transmission at the same time (perform entire engine overhaul).

NOTE
Laying engine on primary side will damage clutch cable end fitting. If fitting is damaged, clutch cable must be replaced.

DISASSEMBLY

Crankcase Halves
1. Remove cylinder heads. See 3.6 CYLINDER HEAD.

NOTE
After removing cylinders, install plastic or rubber hose over cylinder studs. Lifting or moving crankcase by grasping studs will cause cylinder stud damage.

2. Remove cylinders and pistons. See 3.6 CYLINDER HEAD.

3. Remove oil pump. See 3.15 OIL PUMP.

4. Remove gearcase components. See 3.18 GEARCASE COVER AND CAM GEARS.

5. Remove primary cover and primary drive/clutch components. See 6.2 PRIMARY COVER.

6. Remove starter motor. See 5.7 STARTER.

Figure 3-133. Rear Isolator Assembly

7. See Figure 3-133. Remove rear isolator assembly by removing the forward two fasteners first and then the two rear fasteners (re-install with new fasteners).

8. See Figure 3-134. Remove screws securing crankcase halves together.

9. Tap crankcase with plastic mallet to loosen and separate the halves.
PISTON JETS

Removal

1. See Figure 3-135. Remove two TORX screws from each piston jet assembly to free piston jets from right crankcase.

2. Remove piston jet gaskets from right crankcase.

Installation

NOTES

- Gaskets that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure.
- Gasket is part of the piston jet assembly. Gasket not sold separately.

1. Install new piston oil jet assemblies in right crankcase.
2. Apply LOCTITE Low Strength Threadlocker 222 (purple) to threads of TORX screws.
3. With the jet pointed upward, install TORX screws to secure piston jet to crankcase. Tighten screws to 25-35 in-lbs (2.8-4.0 Nm).
Flywheel Assembly

1. See Figure 3-136. Remove the flywheel assembly from left crankcase half.

   **NOTE**
   - Flywheel assembly slides out of the sprocket shaft bearing by hand. No tools are required for this operation.
   - See Figure 3-137. If it is necessary to remove either the pinion shaft bearing or sprocket shaft bearing, proceed as follows:

2. See Figure 3-137. Pinion shaft bearing (12) will remain on flywheel pinion shaft. Remove retaining ring (13) and bearing can be slipped off pinion shaft.

---

**Figure 3-136. Removing Flywheels from Left Crankcase**

**Figure 3-137. Crankcase and Flywheel Assembly**

1. Spacer, sprocket shaft
2. Retaining ring, oil seal
3. Oil seal
4. Thrust washer
5. Crankcase half
6. Bearing
7. Bearing retaining ring
8. Inner race, sprocket shaft bearing
9. Thrust washer
10. Connecting rod and flywheel assembly
11. Inner race
12. Gear shaft bearing
13. Retaining ring
14. Outer bearing race
15. Crankshaft case
3. See Figure 3-138. Place flywheel assembly in FLY WHEEL SUPPORT FIXTURE (Part No. HD-44380). Pull sprocket shaft bearing inner race with WEDGE ATTACHMENT for CLAW PULLER (Part No. HD-95637-46A) with BEARING RACE REMOVER/INSTALLER (Part No. HD-34902B) and END CAP (Part No. HD-34902-7).

NOTE
Sprocket shaft bearing inner race does not need to be ground once it is installed on the sprocket shaft.

4. See Figure 3-139. Remove sprocket shaft oil seal retaining ring.

5. See Figure 3-137. Remove sprocket shaft oil seal (3) from crankcase using Snap-On Tool (Part No. CJ 114, Body Dent Puller).

6. Remove outer thrust washer (4) next to sprocket shaft bearing (6).

7. See Figure 3-140. Remove sprocket shaft bearing retaining ring from the inside of the left crankcase half.

8. See Figure 3-141. Using CRANKCASE BEARING REMOVER/INSTALLER with ADAPTER (Part No. B-45655, HD-42720-2 and HD-46663) press sprocket shaft bearing out of the left crankcase half.

NOTE
The bearing presses to the inside. There is a shoulder incorporated into the left crankcase half which allows the bearing to be removed in one direction only.
PINION SHAFT BEARING

General

See Figure 3-137. The right side pinion shaft bearing consists of an inner and outer race with rollers. The inner race (11) is pressed onto the pinion shaft. The outer race is a pressed into the right crankcase half (14).

NOTE
If either inner or outer race show wear, measure both races to confirm correct bearing fit.

Table 3-27. Pinion Shaft Bearing Service Wear Limits

<table>
<thead>
<tr>
<th></th>
<th>in.</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner race OD</td>
<td>1.2492</td>
<td>31.7297</td>
</tr>
<tr>
<td>Outer race ID</td>
<td>1.5672</td>
<td>39.8069</td>
</tr>
</tbody>
</table>

NOTE
Pinion shaft bearing selection at the factory, during engine build, or replacement of crankcase set or flywheel assembly is based on the largest measured outside diameter (OD) of the inner race and the smallest measured inside diameter (ID) of the outer race (crankcase bursting). A running clearance of 0.0002-0.0008 in. (0.0051-0.0203 mm) is established during crankcase set or flywheel assembly replacement and engine rebuild.

Table 3-28. Pinion Shaft Inner Race Paint Dot Specifications

<table>
<thead>
<tr>
<th>PAINT DOT COLOR</th>
<th>CLASS</th>
<th>INNER RACE OD</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>A</td>
<td>1.2498-1.2500 in. (31.7449-31.7500 mm)</td>
</tr>
<tr>
<td>Green</td>
<td>B</td>
<td>1.2496-1.2498 in. (31.7398-31.7449 mm)</td>
</tr>
</tbody>
</table>
Table 3-29. Pinion Shaft Outer Race Stamp Specifications

<table>
<thead>
<tr>
<th>OUTER RACE ID</th>
<th>CLASS NO.</th>
<th>STAMPED NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5646-1.5648 in.</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>(39.7408-39.7459 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5648-1.5650 in.</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>(39.7459-39.7510 mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5650-1.5652 in.</td>
<td>33</td>
<td>3</td>
</tr>
<tr>
<td>(39.7510-39.7561 mm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE
The different sizes of crankcase sets and flywheel assemblies will not have separate part numbers. That is, a replacement crankcase set may have a class 1, 2 or 3 pinion bearing outer race. Replacement flywheel assemblies will have either a class A or B inner race.
See Table 3-31. Select bearings using the identification information given for inner and outer races.

**Table 3-31. Pinion Shaft Bearing Selection**

<table>
<thead>
<tr>
<th>FACTORY STAMPED NUMBER</th>
<th>OUTER RACE ID</th>
<th>BEARING SIZE AS IDENTIFIED BY COLOR CODING</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 1.5672 in.</td>
<td>Service Wear Limit Exceeded – Replace Outer Race and Resize</td>
<td></td>
</tr>
<tr>
<td>1.5670-1.5672 in.</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>39.802-39.807 mm</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>1.5668-1.5670 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.797-39.802 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5664-1.5668 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.797-39.797 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5662-1.5664 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.781-39.787 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5660-1.5662 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.776-39.781 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5658-1.5660 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.771-39.776 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5656-1.5658 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.766-39.771 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5654-1.5656 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.761-39.766 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5652-1.5654 in.</td>
<td>Red Blue</td>
<td></td>
</tr>
<tr>
<td>39.756-39.761 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5650-1.5652 in.</td>
<td>Red White-Gray</td>
<td></td>
</tr>
<tr>
<td>39.751-39.756 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5648-1.5650 in.</td>
<td>Blue</td>
<td></td>
</tr>
<tr>
<td>39.746-39.751 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
<tr>
<td>1.5646-1.5648 in.</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>39.741-39.746 mm</td>
<td>White-Grey</td>
<td></td>
</tr>
</tbody>
</table>

**INNER RACE OD (In)**

<table>
<thead>
<tr>
<th>1.2460-1.2466 in.</th>
<th>1.2500-1.2502 in.</th>
<th>1.2504-1.2506 in.</th>
<th>1.2508-1.2510 in.</th>
<th>1.2512-1.2514 in.</th>
<th>1.2516-1.2518 in.</th>
</tr>
</thead>
</table>

**FACTORY COLOR CODE**

Green, White
NOTE

If either inner or outer race show wear, measure both races to confirm correct bearing fit.

1. Use a dial bore gauge to measure and record ID of outer race. Take four measurements on ID where bearing rollers ride.
   a. If the largest measurement is larger than 1.5672 in. (39.8069 mm) or the required lapping to remove wear marks would enlarge bore beyond 1.5672 in., continue at Step 5.
   b. If largest measurement is 1.5672 in. (39.8069 mm) or less, cover the cam bearings with masking tape to prevent debris from entering bearings. Assemble crankcase halves.

NOTE

The next step requires lapping the outer race. To keep sprocket shaft and pinion shaft bearings aligned the lap must be supported by an adaptor or pilot in the left crankcase half.

2. See LAPPING PINION SHAFT BEARING OUTER RACE. Lap race until all wear marks are removed.
3. Measure and record ID of race at four places.
4. Check measurements against the specifications listed in Table 3-32.
   a. If lapping increased bore ID to larger than 1.5672 in. (39.8069 mm), go to Step 5.
   b. If roundness or taper do not meet specifications, continue lapping until specifications are met.
   c. If all specifications are met, continue at Step 7 to remove and size inner race.
5. Press the outer race from the right crankcase.
6. Press new outer race into crankcase flush with inside edge of cast-in insert.

NOTE

See Figure 3-145. Dimensions are shown for fabrication of tools used in pressing the outer race into or out of crankcase.

7. The new outer race must be lapped slightly to true and align with left case bearing and to meet the following specifications in Table 3-33. See LAPPING PINION SHAFT BEARING OUTER RACE.

Table 3-32. Outer Pinion Race Service Wear Limits

<table>
<thead>
<tr>
<th>Wear Limit</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest ID measured</td>
<td>1.5672 in. (39.8069 mm)</td>
</tr>
<tr>
<td>Roundness of ID</td>
<td>within 0.0002 in. (0.0051 mm)</td>
</tr>
<tr>
<td>Taper</td>
<td>within 0.0002 in. (0.0051)</td>
</tr>
</tbody>
</table>

Table 3-33. New Component Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outer Race ID</td>
<td>1.5646 - 1.5652 in. (39.7408 - 39.7561 mm)</td>
</tr>
<tr>
<td>Roundness</td>
<td>within 0.0002 in. (0.0051 mm)</td>
</tr>
<tr>
<td>Taper</td>
<td>within 0.0002 in. (0.0051 mm)</td>
</tr>
<tr>
<td>Surface finish</td>
<td>16 RMS</td>
</tr>
</tbody>
</table>

Figure 3-145. Pinion Shaft Bearing Tools
8. See Figure 3-146. Pull inner race from pinion shaft using WEDGE ATTACHMENT for CLAW PULLER (Part No. HD-95637-46A) with BEARING RACE REMOVER/INSTALLER (Part No. HD-34902B) and END CAP (Part No. HD-34902-7). Apply heat to race to aid removal.

NOTES
● For necessary dimensions for constructing a press-on tool for the pinion bearing inner race see Figure 3-145.
● The new inner race must be ground by a competent machinist to OD dimension range for the finished lapped ID of the outer race. See Table 3-31.

9. See Figure 3-147. Press new inner race on pinion shaft as shown. When the tool bottoms against the flywheel, correct inner race location is automatically established. The finished inner race must meet the specifications in Table 3-34.

10. The following example illustrates how to determine the required inner race OD.

   a. See Table 3-31. For example purposes, suppose the smallest outer race ID measurement is 1.5651 in. (39.754 mm). This requires an inner race OD range of 1.2496-1.2504 in. (31.740-31.760 mm).
   b. Grind inner race. Measure OD at four places. Check that specifications in Step 8 are met.
   c. For example purposes, suppose the largest inner race OD measurement after grinding is 1.2499 in. (31.747 mm) OD.
   d. With a 1.5651 in. (39.754 mm) ID outer race and a 1.2499 in. (31.747 mm) OD inner race, a blue bearing is required.

Table 3-34. Pinion Inner Race Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roundness</td>
<td>within 0.0002 in. (0.0051 mm)</td>
</tr>
<tr>
<td>Taper</td>
<td>within 0.0002 in. (0.0051 mm)</td>
</tr>
<tr>
<td>Surface finish</td>
<td>16 RMS</td>
</tr>
</tbody>
</table>
Lapping Pinion Shaft Bearing Outer Race

1. Secure right and left crankcase halves with three crankcase stud bolts (top center and bottom left and right). The sprocket shaft bearing outer races and large spacer must be installed in left crankcase.

2. See Figure 3-148. Obtain CRANKCASE MAIN BEARING LAPPING TOOL (Part No. HD-96710-40B). Assemble CRANKCASE MAIN BEARING LAP (Part No. HD-96718-87) to lapping handle. Assemble guide sleeve to sprocket shaft bearing bushing. Sleeves, for use with tapered bearing, are assembled to case with bearings and small spacer collar. Finger-tighten the sleeve parts.

3. Insert lap shaft with arbor assembled through pinion bearing bushing and into guide sleeve. Tighten arbor expansion collars using a length of 0.156 in. (3.962 mm) rod as spanner until arbor begins to drag. Do not adjust arbor snug in bushing or bushing will develop a condition where hole is larger at ends than it is in the center.

4. Withdraw arbor far enough to coat lightly with 220 grit lapping compound. Do not apply a heavy coat.

5. Reposition lap in bushing and turn handle at moderate hand speed. Work lap back and forth in bushing, as it is revolved, to avoid grooving and tapering.

6. At frequent intervals, remove lap from crankcase, wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance. If necessary, flush off lap in cleaning solvent, air dry and apply fresh, light coat of fine lapping compound.

CHECKING CONNECTION ROD SIDE PLAY

1. See Figure 3-149. Check connecting rod side play with a thickness gauge as shown.

2. If side play measurement is greater than service wear limit listed below, replace flywheel/connecting rod assembly. The service wear limit is, 0.036 in. (0.8 mm).
NOTE
Lubricate all parts with Harley-Davidson 20W50 engine oil, and proceed as follows:

1. See Figure 3-151. Using CRANKCASE BEARING REMOVER/INSTALLER (Part No. B-46665, HD-42720-2 and HD-46663), install sprocket shaft bearing into left crankcase half from the inside.

NOTE
Make sure that the bearing assembly bottoms against the machined shoulder in the left crankcase half.

2. Install new bearing retaining ring in left crankcase half.

3. Install transmission. See 6.14 TRANSMISSION INSTALLATION.

Figure 3-150. Sprocket Shaft Bearing Assembly

1. Spacer, sprocket shaft
2. Retaining ring, oil seal
3. Oil seal
4. Thrust washer
5. Crankcase half
6. Bearing
7. Bearing retaining ring
4. See Figure 3-152. Attach left crankcase half to engine stand.
5. Install flywheel assembly using CRANKSHAFT GUIDE (Part No. HD-42326).

Figure 3-152. Installing Flywheel Assembly with CRANKSHAFT GUIDE (Part No. HD-42326)

6. See Figure 3-153. Install pinion shaft bearing.
   a. Lubricate pinion shaft bearing with engine oil.
   b. Slip bearing on pinion shaft.
   c. Install new retaining ring in groove of pinion shaft bearing inner race.

Figure 3-153. Pinion Shaft Bearing

---

Figure 3-151. Sprocket Shaft Bearing Installation

1. Shoulder for bearing to press against
2. Crankcase bearing remover/installer tool (Part No. B-45655, HD-42720-2 and HD-46663)
3. Bearing retaining ring
7. See Figure 3-154. Assemble crankcase halves together.
   a. Apply a thin coat of GREY HIGH-PERFORMANCE SEALANT (Part No. 99650-02) to crankcase joint faces.
   b. Slide outer race in right crankcase over pinion shaft and bearing assembly.
   c. Tighten fasteners to 15-19 ft-lbs (20-26 Nm).

   **NOTE**

   According to manufacturing, there is no torque sequence to follow when tightening crankcase fasteners.
8. See Figure 3-155. Use SPROCKET SHAFT SEAL INSTALLER (Part No. B-45676) to install sprocket shaft seal.
   a. Center seal/spacer driver over seal, so that the sleeve (smaller OD) seats between seal wall and garter spring.
   b. Sparingly apply graphite lubricant to threads of pilot shaft to ensure smooth operation.
   c. Slide sleeve over pilot until sleeve contacts the oil seal. Install handle on top of sleeve.
   d. Rotate handle clockwise until tool bottoms on crankcase lip. Remove tool from sprocket shaft.
   e. Install new retaining ring in groove in left crankcase next to oil seal.

9. See Figure 3-150. Install thrust washer (4) from the outside against the sprocket shaft bearing.

10. Install new spacer (1) in seal ID. With the thin (lipped) side facing outward, center seal/spacer assembly over bearing bore.

   NOTE
   Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

11. See Figure 3-156. Install cylinder studs.
   a. Pack clean towels into crankcase opening.
   b. Place a steel ball into a head screw.
   c. The cylinder studs have a shoulder at the lower end. Place the end of the stud without the shoulder into the head screw.
   d. Install the stud in the crankcase with the shoulder end down. Use an air gun to drive the stud until the shoulder reaches the crankcase.
   e. Remove air gun. Use a torque wrench to tighten stud to 10-20 ft-lbs (14-27 Nm).

12. Install piston and cylinder. See 3.7 CYLINDER AND PISTON.

13. Install oil pump. See 3.15 OIL PUMP.

14. Install cam gears, gearcase cover, lifter guides and lifters. See 3.18 GEARCASE COVER AND CAM GEARS.

15. Install cylinder head. See 3.6 CYLINDER HEAD.

16. Install starter. See 5.7 STARTER.

17. Install shift linkage.

18. Install all primary drive components. This includes engine sprocket, primary chain, complete clutch assembly, engine sprocket nut and mainshaft nut. See 6.4 CLUTCH.

19. Install primary cover. See 6.2 PRIMARY COVER.

   NOTE
   Be sure to refill transmission to proper level with fresh lubricant. See 1.10 PRIMARY CHAIN.

20. See 3.6 CYLINDER HEAD and perform the applicable steps.

21. To reinstall engine in frame see 3.5 ENGINE INSTALLATION.
# FUEL SYSTEM

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<td>Total (including reserve) (XB12Ss)</td>
<td>4.40</td>
<td>16.7</td>
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<td>Reserve/Low fuel indicator at (XB12Ss)</td>
<td>0.83</td>
<td>3.1</td>
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<td>Total (including reserve) (XB9SX, XB12S, XB12Scg)</td>
<td>3.82</td>
<td>14.5</td>
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<td>0.75</td>
<td>2.8</td>
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### Table 4-2. Fuel System Specifications

<table>
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<th>TYPE</th>
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<tr>
<td>Intake (XB9)</td>
<td>45 mm downdraft manifold, ram air</td>
</tr>
<tr>
<td>Intake (XB12)</td>
<td>49 mm downdraft manifold, ram air</td>
</tr>
<tr>
<td>Fuel delivery</td>
<td>DDFI fuel injection</td>
</tr>
<tr>
<td>Fuel pressure</td>
<td>49.5 PSI (338-352 kPa)</td>
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<td>Recommended fuel</td>
<td>91 Octane</td>
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<td>Air cleaner cover (Translucid XB9S)</td>
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INTRODUCTION

The Buell Dynamic Digital Fuel Injection (DDFI) System provides microprocessor-based electronic engine management for the 984cc and 1203cc high performance engines. The DDFI system has the following features:

- Independently mapped spark and fuel control.
- Engine and air temperature compensated fuel delivery.
- Engine load measurement through throttle position.
- Single point spark delivery (no waste spark).
- Sequential port indirect (manifold) fuel injection.
- Open/Closed-loop air/fuel control.
- Automatic enrichment at start-up.
- Electric cooling fan for improved thermal management.
- Engine speed and position determined using a single sensor (Cam Position Sensor).
- Full diagnostic capability compatible with the DIGITAL TECHNICIAN (Part No. HD-44750-P28/Panasonic Toughbook or Part No. HD-44750-D150/Dell Desktop).
- Returnless fuel system (excess pressure relieved in tank by Fuel Pressure Regulator Valve).
- Interactive muffler control with muffler valve position feedback for 1203cc engines only.

The DDFI system uses six sensors to monitor the operating conditions of the engine and make decisions as to spark and fuel delivery. These sensors are:

- Throttle position (TP) sensor.
- Cam position (CMP) sensor.
- Engine temperature (ET) sensor.
- Intake air temperature (IAT) sensor.
- Oxygen (O2) sensor.
- Bank Angle Sensor (BAS).

The DDFI system also analyzes how the engine performs during a ride. It then stores this information internally so it will be available for the next ride.

The 1200 models utilize an interactive exhaust system which has an electronically controlled actuator that activates a butterfly valve that controls exhaust flow in the dual-chamber muffler. The engine ECM monitors engine speed and throttle position while activating the valve. See 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

FOR MORE INFORMATION

To learn more about the Buell DDFI system, read the following topics in this section. A system diagram can be found on the next page in Figure 4-1.

Troubleshooting

- 4.3 DIAGNOSTIC INTRODUCTION.
- 4.4 CHECKING FOR TROUBLE CODES.
- 4.5 CHECK ENGINE LAMP DIAGNOSTICS.
- 4.8 INITIAL DIAGNOSTIC CHECK.
- TABLE 4-7. TROUBLE CODES AND FAULT CONDITIONS.

Fuel Injection Components

- 4.30 ELECTRONIC CONTROL MODULE.
- 4.31 CAM POSITION SENSOR AND ROTOR.
- 4.33 OXYGEN SENSOR.
- 4.34 ENGINE TEMPERATURE SENSOR.
- 4.35 BANK ANGLE SENSOR.
- 4.36 INTAKE AIR TEMPERATURE SENSOR.
- 4.37 THROTTLE POSITION SENSOR.
- 4.39 FUEL PUMP.
- 4.42 THROTTLE BODY.
- 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).
Figure 4-1. Buell Dynamic Digital Fuel Injection

Electronic Control Module (ECM)
- one 12-place black connector [10]
- one 12-place gray connector [11]
- one 1-place connector [165] (1203cc only)

ECM Fuse

VSS

Fuel Pump

Front Injector

Rear Injector

Data Link

Ignition Relay

Check Engine Lamp

Tachometer

ET Sensor

O2 Sensor

Bank Angle Sensor

Cam Sensor

Throttle Position Sensor

IAT Sensor

Interactive muffler control

To IGN relay

To cooling fan fuse

To brake/horn muffler fuse
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 bad 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 4-2. The check engine lamp indicates a fault condition exists. There may also be starting or performance problems.

RESOLVING PROBLEMS

The most sophisticated method of resolving problems involves using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).

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 check engine lamp diagnostics. See 4.5 CHECK ENGINE LAMP DIAGNOSTICS.
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.
CHECKING FOR TROUBLE CODES 4.4

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

NOTES

● All references to "Key ON" or "Ignition Switch ON" require that the ignition key be in the ON position and the engine stop switch be set to RUN.

● 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 a problem exists in the lamp circuit. See 4.9 CHECK ENGINE LAMP NOT ILLUMINATED AT KEY ON or 4.10 CHECK ENGINE LAMP ON CONTINUOUSLY for more information.

1. When the ignition switch is turned ON after being OFF for 2 seconds or more, the check engine lamp will illuminate for approximately four seconds and then turn off.

2. See Figure 4-5. 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 functional error 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.

3. See CODE TYPES for a complete description of trouble code formats.

---

Figure 4-3. Ignition Key Switch

1. OFF position
2. RUN position

Figure 4-4. Engine Stop Switch

Figure 4-5. Check Engine Lamp Operation
CODE TYPES

There are two types of trouble codes: current and historic. Certain codes are also called functional codes. Historic codes can be read using the check engine lamp diagnostics.

All trouble codes reside in the memory of the ECM until the code is cleared by DIGITAL TECHNICIAN (Part No. HD-44750) or a total of 50 trips has elapsed. A trip consists of a start and run cycle, the run cycle lasting at least 30 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.

NOTE
Trouble codes relating to the fuel injectors or the ignition coil 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 activated by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

Current
Current trouble codes are those which presently disrupt motorcycle operation. 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 fault rather than a current fault.

Historic trouble codes are stored for a length of time to assist in the diagnosis of intermittent faults. The check engine lamp will not turn on during normal operation if only historic codes are present.

It is important to note that historic trouble codes may also be present whenever the system indicates the existence of a current fault. See 4.4 CHECKING FOR TROUBLE CODES if multiple trouble codes are found.

Functional
Trouble codes 52 through 56 are considered to be functional codes. They indicate an internal problem with the ECM (trouble codes 52 through 55) or with the camshaft sensor/timing (trouble code 56).

RETRIEVING TROUBLE CODES

The fuel injection system provides two levels of diagnostics.

- The most sophisticated mode employs using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750).
- The other mode requires using the check engine lamp. See 4.5 CHECK ENGINE LAMP DIAGNOSTICS for more information.

MULTIPLE TROUBLE CODES

The throttle position, cam position and bank angle sensors are all connected to the same reference line (5v REF). If this line goes to ground or open, multiple trouble codes (codes 11 and 56) may be set.

Also, the ECM, fuel pump, fuel injectors and ignition coil all receive +12 volts from the ignition relay. If this line should go to ground the ignition fuse will open.

Always start with the trouble code having the lowest numerical value. Refer to Table 4-7.

CHECK ENGINE LAMP BLINKS

In addition to alerting the rider to trouble codes, the check engine lamp will blink during operation to warn of potentially damaging engine operating temperatures. If the key is in the on position and the check engine lamp is blinking, the engine is at a potentially damaging temperature. While this condition is in effect, the ECM will reduce engine power to assist in cooling the engine down to a safe operating temperature. The check engine lamp will blink until the engine has cooled to a safe operating temperature. This will not set a trouble code.
Retrieve Trouble Codes

Trouble codes may be retrieved without the use of the DIGITAL TECHNICIAN (Part No. HD-44750).

1. Remove protective cover from data link connector [91A]. Data link connector is located next to the fuse box under the seat.

2. To activate the diagnostic feature of the check engine lamp, proceed as follows:
   a. See Figure 4-6. Create diagnostic test wire from parts shown.
   b. See Figure 4-7. Install diagnostic test wire across Terminal 1 and Terminal 2 on the data link connector [91A].
   c. Turn the ignition/light key switch ON and wait approximately eight seconds for the check engine lamp to start flashing.

3. See Figure 4-8. All trouble codes are sent out as a series of flashes. To retrieve the first digit of the trouble code simply observe the number of times the lamp flashes.
   a. The transmission of a trouble code is always preceded by six rapid flashes (about 3 per second).
   b. This “intermission” is followed by a 2 second pause in which the lamp is off.
   c. The lamp will then flash one or more times to indicate the first digit of the trouble code. The length of time the lamp is illuminated and the length of time in which it is off are each about 1 second in duration.

4. The second digit follows:
   a. Following transmission of the first digit, there is another 2 second pause in which the lamp is off.
   b. The lamp will then flash one or more times to indicate the second digit of the trouble code. Count the number of times the lamp flashes to retrieve the second digit.

5. If more than one trouble code is sent:
   a. Following transmission of the second digit of the first code, there is a third 2 second pause in which the lamp is off.
   b. After the pause comes the intermission, which is followed by transmission of the next recorded trouble code.
   c. All subsequent codes are sent in the same manner, each separated from the next by the intermission.

6. Once all codes have been sent, the data string is repeated. When you have recorded the same trouble code twice, it is an indication that the transmission has been restarted and that all trouble codes have been retrieved.
NOTE
If the lamp flashes at a rate faster than normal, then you are observing the “Intermission” only, which means that no trouble codes are present.

7. When examining trouble codes, write down all codes on a piece of paper.
   a. If trouble codes are present, see Table 4-7. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see charts under 4.8 INITIAL DIAGNOSTIC CHECK.

8. Turn the ignition/light key switch OFF.
9. Remove diagnostic test wire and install protective cover over data link connector. Return data link to original position.

NOTE
Looking at the above transmission, we can see that the trouble code is 13. The source of the fault condition is identified as the oxygen sensor according to Table 4-7.

Figure 4-8. Check Engine Lamp Diagnostics

NOTE
The engine may be started and run when the trouble codes are received using a jumper wire on Pins 1 and 2 of the data link connector. However, if the jumper wire is removed with the engine running, the check engine lamp will continue to flash trouble codes. To stop check engine lamp from flashing codes, turn engine stop switch OFF.

CLEARING CODES

After correcting system problems, clear trouble codes. If the Digital Technician (Part No. HD-44750) is not available, perform 50 start and run cycles. To execute one run cycle:
1. Start the vehicle.
2. Let it run for at least 30 seconds.
3. Turn the engine off.
GENERAL

The BREAKOUT BOX (Part No. HD-42682) splices into 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.

INSTALLATION

1. See 4.30 ELECTRONIC CONTROL MODULE.
2. Depress latches on each side of connectors [10] (black) and [11] (gray) and detach connectors from the ECM.
3. See Figure 4-9. Attach Breakout Box (2) to black connector [10].
   a. Attach black connector from Breakout Box to corresponding black ECM connector.
   b. Attach black connector from the wiring harness to black connector on Breakout Box.
   a. Attach gray connector from Breakout Box to corresponding gray ECM connector.
   b. Attach gray connector from the wiring harness to gray connector on Breakout Box.

REMOVAL

1. See Figure 4-9. Depress latches on each side of connectors [10] (black) and [11] (gray).
2. Detach Breakout Box connectors from ECM connectors.
3. Detach Breakout Box connectors from wiring harness.
4. Reconnect harness to ECM. See 4.30 ELECTRONIC CONTROL MODULE.

Figure 4-9. ECM and Breakout Box with Connections (Typical)
WIGGLE TEST

GENERAL

NOTE
DIGITAL TECHNICIAN (Part No. HD-44750) can be used to perform wiggle test.
The wiggle test checks for the presence of intermittents in a wiring harness.

PROCEDURE

1. See Figure 4-10. Connect DVOM (Part No. H-D-39978) to wiring harness between the suspect connections. When diagnosing ECM connections, a BREAKOUT BOX (Part No. HD-42682) may be used to simplify the procedure. See 4.6 BREAKOUT BOX.
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.
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. 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 4.6 BREAKOUT BOX.

Job/Time Code Values
Dealership technicians filing out warranty claims should use the job/time code values in Digital Technician or use the ones printed in bold text underneath the appropriate repair in the service manual.

INITIAL DIAGNOSTICS

General Information
The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction.

NOTE
The engine may be started and run when the trouble codes are received using a jumper wire on Pins 1 and 2 of the data link connector. However, if the jumper wire is removed with the engine running, the check engine lamp will continue to flash trouble codes. To stop check engine lamp from flashing codes, turn engine stop switch OFF.

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the diagnostic check flow charts. See Diagnostic Check (Part 1 of 2).
1. Compare engine behavior to tables.
   a. Starts hard. Refer to Table 4-4.
   b. Hesitates, stumbles, surges, misfires and/or sluggish performance. Refer to Table 4-5.
   c. Engine exhaust emits black smoke or fouls plugs. Refer to Table 4-6.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
All diagnostic codes are listed in Table 4-7.

Table 4-4. Engine Starts Hard

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine temperature circuit</td>
<td>4.18 TROUBLE CODE 14.</td>
</tr>
<tr>
<td>Improper fuel pressure</td>
<td>4.13 FUEL PRESSURE TEST.</td>
</tr>
<tr>
<td>Spark plugs and/or wires</td>
<td>4.15 MISFIRE.</td>
</tr>
<tr>
<td>Battery discharged</td>
<td>See charging system troubleshooting in Section 7.</td>
</tr>
<tr>
<td>Cam position sensor</td>
<td>4.29 TROUBLE CODE 56.</td>
</tr>
<tr>
<td>Manifold leak</td>
<td>Spray water around induction module seals with engine idling. If RPM changes, change seals.</td>
</tr>
<tr>
<td>Ignition coil</td>
<td>4.15 MISFIRE.</td>
</tr>
<tr>
<td>Leaky injectors</td>
<td>Test fuel injectors. See 4.42 THROTTLE BODY.</td>
</tr>
<tr>
<td>Valve sticking</td>
<td>See Section 3.</td>
</tr>
</tbody>
</table>

Table 4-5. Engine Performance Problems

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine temperature circuit</td>
<td>4.18 TROUBLE CODE 14.</td>
</tr>
<tr>
<td>Improper ignition timing</td>
<td>1.17 IGNITION TIMING.</td>
</tr>
<tr>
<td>Cam position sensor circuit</td>
<td>4.29 TROUBLE CODE 56.</td>
</tr>
<tr>
<td>Spark plugs and/or wires</td>
<td>4.15 MISFIRE.</td>
</tr>
<tr>
<td>Improper fuel pressure</td>
<td>4.13 FUEL PRESSURE TEST.</td>
</tr>
<tr>
<td>Improper throttle position sensor adjustment</td>
<td>Calibrate sensor using DIGITAL TECHNICIAN (Part No. HD-44750).</td>
</tr>
<tr>
<td>Manifold leak</td>
<td>See 4.43 INTAKE LEAK TEST.</td>
</tr>
<tr>
<td>Throttle plates not opening fully</td>
<td>1.15 THROTTLE CABLE AND IDLE SPEED ADJUSTMENT.</td>
</tr>
<tr>
<td>EVAP hose disconnected from induction module (CA)</td>
<td>Connect.</td>
</tr>
</tbody>
</table>
### Table 4-5. Engine Performance Problems

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water or dirt in fuel system</td>
<td>Drain and refill with fresh fuel.</td>
</tr>
<tr>
<td>Cooling Fan Inoperative</td>
<td>4.26 TROUBLE CODE 36.</td>
</tr>
<tr>
<td>Interactive muffler control inoperative</td>
<td>4.21 TROUBLE CODE 21</td>
</tr>
</tbody>
</table>

### Table 4-6. Engine Exhaust Emits Black Smoke or Fouls Plugs

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine temperature circuit</td>
<td>4.18 TROUBLE CODE 14.</td>
</tr>
<tr>
<td>Clogged air filter</td>
<td>4.14 AIR CLEANER FILTER.</td>
</tr>
<tr>
<td>Improper throttle position sensor adjustment</td>
<td>4.37 THROTTLE POSITION SENSOR</td>
</tr>
<tr>
<td>Leaky injectors</td>
<td>Test fuel injectors. See 4.42 THROTTLE BODY.</td>
</tr>
<tr>
<td>Improper fuel pressure</td>
<td>4.13 FUEL PRESSURE TEST.</td>
</tr>
</tbody>
</table>

### Table 4-7. Trouble Codes and Fault Conditions

<table>
<thead>
<tr>
<th>CODE NO.</th>
<th>FAULT CONDITION</th>
<th>RELEVANT TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Throttle position sensor</td>
<td>4.16 TROUBLE CODE 11</td>
</tr>
<tr>
<td>13</td>
<td>Oxygen sensor</td>
<td>4.17 TROUBLE CODE 13</td>
</tr>
<tr>
<td>14</td>
<td>Engine temperature sensor</td>
<td>4.18 TROUBLE CODE 14</td>
</tr>
<tr>
<td>15</td>
<td>Intake air temperature sensor</td>
<td>4.19 TROUBLE CODE 15</td>
</tr>
<tr>
<td>16</td>
<td>Battery voltage</td>
<td>4.20 TROUBLE CODE 16</td>
</tr>
<tr>
<td>21</td>
<td>Interactive muffler control (1203's only)</td>
<td>4.21 TROUBLE CODE 21</td>
</tr>
<tr>
<td>23</td>
<td>Front fuel injector</td>
<td>4.22 TROUBLE CODES 23 AND 32</td>
</tr>
<tr>
<td>24</td>
<td>Front ignition coil</td>
<td>4.23 TROUBLE CODES 24 AND 25</td>
</tr>
<tr>
<td>25</td>
<td>Rear ignition coil</td>
<td>4.23 TROUBLE CODES 24 AND 25</td>
</tr>
<tr>
<td>32</td>
<td>Rear fuel injector</td>
<td>4.22 TROUBLE CODES 23 AND 32</td>
</tr>
<tr>
<td>33</td>
<td>Fuel pump</td>
<td>4.24 TROUBLE CODE 33</td>
</tr>
<tr>
<td>35</td>
<td>Tachometer</td>
<td>4.25 TROUBLE CODE 35</td>
</tr>
<tr>
<td>36</td>
<td>Cooling fan</td>
<td>4.26 TROUBLE CODE 36</td>
</tr>
<tr>
<td>44</td>
<td>Bank angle sensor</td>
<td>4.27 TROUBLE CODE 44</td>
</tr>
<tr>
<td>52, 53, 54, 55</td>
<td>ECM failure</td>
<td>4.28 TROUBLE CODES 52, 53, 54 AND 55</td>
</tr>
<tr>
<td>56</td>
<td>Cam sync failure</td>
<td>4.29 TROUBLE CODE 56</td>
</tr>
</tbody>
</table>
Figure 4-11. Diagnostic Check

Table 4-8. Wire Harness Connectors in Figure 4-11.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[91A]</td>
<td>data link</td>
<td>4-place Deutsch</td>
<td>under seat</td>
</tr>
</tbody>
</table>
Turn ignition/headlight key switch ON. Set engine stop switch to RUN. Do not start engine. Does check engine lamp illuminate?

- YES
  - Does light go off after four seconds?
    - YES
      - See 4.10 CHECK ENGINE LAMP ON CONTINUOUSLY.
    - NO
      - See 4.11 ENGINE CRANKS BUT WILL NOT START.
  - NO

Are any trouble codes displayed?

- YES
  - Refer to applicable trouble code flow chart. Start with lowest trouble code. All diagnostic codes are listed on page 4-13 in Table 4-7.
  - Refer to diagnostic tips in related trouble code chart (even if no code is set).
- NO
  - Go to Diagnostic Check (Part 2 of 2).
Diagnostic Check (Part 2 of 2)

Continued from Diagnostic Check (Part 1 of 2).

Remove ECM connectors [10B] (BK) and [11B] (GY). Check for continuity to ground at data link connector [91A] Terminals 1, 3 and 4. Continuity to ground?

Test the four data link connector terminals against their ECM connector pins for continuity.

<table>
<thead>
<tr>
<th>DATA LINK TERMINAL</th>
<th>ECM TERMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Wire Color</td>
</tr>
<tr>
<td>1</td>
<td>Lt./GN/R</td>
</tr>
<tr>
<td>2</td>
<td>BK</td>
</tr>
<tr>
<td>3</td>
<td>V/R</td>
</tr>
<tr>
<td>4</td>
<td>Y/G</td>
</tr>
</tbody>
</table>

Continuity present in all four circumstances?

NO

Repair short to ground.

YES

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

NO

Inspect terminals for damage or repair opens as necessary.

YES
GENERAL

If the engine stop switch is set to RUN with the engine off, and the ignition key switch is turned ON, the check engine lamp should illuminate for four seconds. See Figure 4-12. Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the ECM through the BK/Y wire. A lack of power to the ECM will cause the check engine lamp to be inoperative and also create a no start situation.

DIAGNOSTICS

Diagnostic Tips
Check for the following conditions:
- Check for open in BK/Y wire.
- Check for blown accessory fuse.
- Check for failed bulb.

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the Test 4.9 flow chart.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probe and patch cord.
2. See Figure 4-14. Inspect connector [10] (black) (3) for contamination or corrosion. If connection is good, replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

Table 4-9. ECM Connectors

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>Under seat</td>
</tr>
<tr>
<td>[91A]</td>
<td>Data link</td>
<td>4-place Deutsch</td>
<td>Under seat</td>
</tr>
</tbody>
</table>
Table 4-10. Wire Harness Connectors in Figure 4-15.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[39]</td>
<td>Instrument module</td>
<td>20-place Multilock</td>
<td>behind windscreen</td>
</tr>
</tbody>
</table>
Turn ignition key switch ON. Set engine stop switch to RUN. Does the engine start?

**YES**

Set engine stop switch to OFF. Disconnect ECM connector [10] and connect Breakout Box. Turn ignition key switch ON. Jumper Breakout Box (BK) Pin 4 to ground. Check engine lamp should be ON. Is it?

**YES**

Did check engine lamp and no start conditions occur simultaneously?

**YES**

No ECM power. Refer to 4.12 NO ECM POWER.

**NO**

Refer to 4.11 ENGINE CRANKS BUT WILL NOT START for no start condition and then return to 4.9 CHECK ENGINE LAMP NOT ILLUMINATED AT KEY ON to resolve no engine check lamp.

**NO**

Connect jumper wire from pin 7 at connector 39 to ground. Check engine lamp (BK)?

**YES**

Repair open or short to voltage on BK/Y wire between connector [39] and connector [10B].

**NO**

Disassemble instrument and inspect bulb. Bulb Failed?

**YES**

Replace instrument module. See 7.19 INSTRUMENT MODULE.

**NO**

Replace bulb.

**NO**

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
GENERAL

See Figure 4-16. If the engine stop switch is set to RUN with the engine off, and the ignition key switch is turned ON, the check engine lamp should illuminate for four seconds. Following the initial period of illumination, the lamp should go off for four seconds. It may then come back on for an eight second period (for a stored error) or remain on continuously (current error).

DIAGNOSTICS

Diagnostic Notes

See Figure 4-19. The reference numbers correlate with the circled numbers on the Test 4.10 flow chart.

1. See Figure 4-16. If the lamp goes off when the black ECM connector [10] is unplugged, the BK/Y wire is not shorted to ground.

Figure 4-16. Check Engine Lamp

Figure 4-17. Electronic Control Module, (XB12Ss)

Figure 4-18. Electronic Control Module (Typical)
Table 4-11. Wire Harness Connectors in Figure 4-19.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[39]</td>
<td>instrument module</td>
<td>20-place Multilock</td>
<td>behind windscreen</td>
</tr>
</tbody>
</table>
Turn ignition key switch OFF. Disconnect black ECM connector [10].

With ignition key switch OFF, reconnect black ECM connector [10]. With ignition key switch ON, verify that there is NOT a 4 second lamp OFF period.

- YES
  - YES
    - Check engine lamp function OK. Check for checking for trouble codes.
  - NO
    - Repair short to ground on BK/Y wire between connector [39] and connector [10].

- NO
  - Replace ECM. See 4.30 Electronic Control Module.

Check engine lamp should be OFF. Is it?

YES

YES

NO

Function OK. Check for trouble codes. See 4.4 CHECKING FOR TROUBLE CODES.
ENGINE CRANKS BUT WILL NOT START 4.11

GENERAL
If the starter will not crank engine, the problem is not ignition related. See Section 5-Electric Starter.

NOTE
The engine may be started and run when the trouble codes are received using a jumper wire on Pins 1 and 2 of the data link connector. However, if the jumper wire is removed with the engine running, the check engine lamp will continue to flash trouble codes. To stop check engine lamp from flashing codes, turn engine stop switch OFF.

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-42682) between harness and ECM. See 4.6 BREAKOUT BOX.
2. Check battery condition. Perform a voltage test and recharge if below 12.80 volts. Check battery connections and perform load test. Replace the battery if necessary.
3. Remove spark plug cable from spark plug.
   a. Visually check condition of plug.
   b. See Figure 4-20. Attach cable to SPARK PLUG TESTER (Part No. HD-26792). Clip tester to cylinder head bolt.
   c. While cranking starter, look for spark. Repeat procedure on other spark plug cable.

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)
4. Purge fuel line of high pressure gasoline. See 4.39 FUEL PUMP.
5. Access fuel injectors.
   a. Remove right side air scoop. See 2.38 AIR SCOOPS.
   b. Remove air cleaner assembly to access fuel injectors. See 4.44 AIR CLEANER ASSEMBLY.
6. See Figure 4-21. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. 34730-2C) into Breakout Box. Note that cranking the engine with test lamp in place of the ignition coil can sometimes cause a code 24 or 25. This condition is normal and does not by itself indicate a malfunction. Codes must be cleared if this condition occurs.
7. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray pin probe and patch cord.

Table 4-12. Wire Harness Connectors in Figure 4-22.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[14]</td>
<td>cam position sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
</tr>
<tr>
<td>[83]</td>
<td>ignition coil</td>
<td>3-place Amp</td>
<td>beneath air cleaner baseplate</td>
</tr>
</tbody>
</table>
Is fresh gasoline in tank?  

- YES: Check battery connections. Check battery voltage. Is voltage above 12.8 volts?  
  - YES: Does battery pass load test?  
    - YES: Install Fuel Pressure Gauge. See 4.13 Fuel Pressure Test. While cranking engine (for more than two seconds to ensure proper system operation), verify that pressure rises to 45-51 PSIG (328-352 kPa). Adequate pressure?  
      - YES: Go to Test 4.11 (Part 2 of 3).  
    - NO: No pump response or light. See 4.12 ECM Power.  
      - NO: Short pump response, light OK. See 4.27 Trouble Code 44.  
  - NO: No pump response, but light OK. See 4.13 Fuel Pressure Test.  

- NO: Fill tank with fresh gasoline.

1. Connect Breakout Box. Measure voltage between connector 16 (BK) pin 10 (+) and pin 11 (-) Voltage should be 0.25-2.7 volts (Run Mode). Is it?  

- YES: Connect Breakout Box. Measure voltage between connector 16 (BK) pin 10 (+) and pin 11 (-) Voltage should be 0.25-2.7 volts (Run Mode). Is it?  
  - NO: Refer to applicable trouble code chart. Start with lowest code.  

2. Check for trouble codes. See 4.4 Checking for Trouble Codes. Codes found?  

- YES: Refer to applicable trouble code chart. Start with lowest code.  

- NO: Check battery connections. Check battery voltage. Is voltage above 12.8 volts?  
  - YES: Does battery pass load test?  
    - YES: Install Fuel Pressure Gauge. See 4.13 Fuel Pressure Test. While cranking engine (for more than two seconds to ensure proper system operation), verify that pressure rises to 45-51 PSIG (328-352 kPa). Adequate pressure?  
      - YES: Go to Test 4.11 (Part 2 of 3).  
    - NO: No pump response or light. See 4.12 ECM Power.  
      - NO: Short pump response, light OK. See 4.27 Trouble Code 44.  

- NO: No pump response, but light OK. See 4.13 Fuel Pressure Test.  

- NO: Pump OK, but no light. See 4.9 Check Engine Lamp Not Illuminated At Key On.
Continued from Test 4.11 (Part 1 of 3).

Check spark plug condition. Replace if fouled. Check spark at both plugs while cranking. Spark present?

YES

Check for battery voltage at Terminal B of coil connector [83] using DVOM. Power present after key ON?

YES

Disconnect fuel injector connector and attach Fuel Injector Test Lamp (HD-34730-2C). Check engine. Does lamp flash?

YES

Check engine compression. See 3.2 ENGINE.

YES

Correct problems found under 4.22 TROUBLE CODES 23 AND 32.

NO

Check continuity between ignition coil Terminal A of connector [83] and Breakout Box (BK) Pin 7.

YES

Measure resistance between ignition coil Terminal C and ECM Pin 6 [10B]. Resistance should be less than 1.0 ohm. Is it?

YES

Disconnect cam position sensor connector [14]. With ignition ON, measure voltage between Terminal A (+) and Terminal C (-) of connector [14B]. Is 5 volts present?

YES

Poor connection at connector [10B], [83] or open in harness between coil and ECM. Repair open.

NO


YES

Go to Test 4.11 (Part 3 of 3).

STOP

NO

Use Breakout Box and test light for the next inspection:

Front coil: Insert tester between ECM Pin 6 (BK) and ECM pin 1 (R) of Breakout Box (OK).

Rear coil: Insert tester between ECM Pin 7 (BK) and ECM Pin 1 (R) of Breakout Box, (OK).

Does test lamp flash when engine is cranked?

YES

CHECKING IGNITION SYSTEM 4-11

NO

Open circuit wire between spark for fuel pump wire and ignition coil. Repair open.

YES

Check ignition coil connections. Connections OK?

YES

Test spark plug cable resistance. See 4.15 MISFIRE. Resistance OK?

YES

Inspect spark plug. Good?

YES

Replace spark plug cables.

NO

Replace spark plug.

NO

Replace ignition coil.

NO

Replace spark plugs.

NO

Replace ignition coil.

YES

Check for continuity between Terminal A connector [148] and ground. Continuity present?

YES

Repair open circuit.

NO

Repair short to ground.

NO

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

NO
Continued from Test 4.11 (Part 2 of 3).

Reconnect cam position sensor connector [14]. Measure voltage between Pin 3 and Pin 7 of Breakout Box (GY).

Voltage should alternate between 0 and 5 volts while cranking. Does it?

YES

Problem may be intermittent. Verify that connectors [10], [11] and [14] are reconnected. Remove Breakout Box and try to start vehicle. Does vehicle start?

YES

With engine running, wiggle cam position sensor and wires to identify any loose connection, engine misfires or stalling. Any found?

YES

Pinion gear key failure, loose rotor cup or other mechanical failure.

NO

Disconnect connector [14]. Measure resistance between Terminal B and Connector [14B] and Breakout Box (GY) Pin 3. Is resistance greater than 1.0 ohms?

YES

Disconnect cam timer cover using 1/8 in. drill bit. Crank starter. Does rotor cup rotate?

YES

Repair open connection.

NO

Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

NO

Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

NO

Mechanical failure. Inspect for loose rotor cup and sheared pinion gear key.

YES

Repair.

NO

Mechanical failure. Inspect for loose rotor cup and sheared pinion gear key.

YES

Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

NO

Mechanical failure. Inspect for loose rotor cup and sheared pinion gear key.

YES

Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

NO

Mechanical failure. Inspect for loose rotor cup and sheared pinion gear key.

YES

Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.
GENERAL

A relay controlled by the engine stop switch supplies power to the ECM. The relay requires a ground to operate. If the ground is not established, the ECM will not receive power. If the ECM does not appear to be receiving power, check the ground sources. A blown ignition fuse or ECM fuse can also disable the ECM.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.12 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
Figure 4-23. ECM Power Circuit

Table 4-13. Wire Harness Connectors in Figure 4-23.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[22]</td>
<td>right hand controls</td>
<td>4-place Multilock</td>
<td>to the right of windscreen</td>
</tr>
<tr>
<td>[95]</td>
<td>clutch switch</td>
<td>2-place Multilock</td>
<td>to the left of windscreen</td>
</tr>
</tbody>
</table>
No ECM Power

CONDITION: Key ON and transmission in neutral

1. Check ignition fuse and ECM fuse. Are fuses OK?
   - YES
   - NO

2. Attach Breakout Box (HD-42682) to ECM. Check for 12 volts on ECM connector [10] Pin 1 (+) and Pin 2 (-). Voltage present?
   - YES
   - NO

3. Check for continuity to ground on [10] Pin 2. Continuity present?
   - YES
   - NO

4. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

5. Check for 12 volts on ignition relay Terminal 30 (GY/O). Voltage present?
   - YES
   - NO

6. Replace ignition relay.
   - YES
   - NO

7. Check for 12 volts on right handlebar connector [22A] GY/O wire. Voltage present?
   - YES
   - NO

8. Repair open on GY/O wire between connector [22A] and ignition relay.
   - YES
   - NO

9. Repair open on WBK wire between connector [22A] and ignition relay.
   - YES
   - NO

10. Replace handlebar switch assembly.

   - YES
   - NO

12. Repair open on W/BK wire between connector [22A] and ignition relay.
   - YES
   - NO

13. Locate and repair open on BK wire to ground from relay.

14. Check for continuity to ground on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

15. Check ignition fuse and ECM fuse. Are fuses OK?
   - YES
   - NO

16. Replace fuse(s) as needed.
   - YES
   - NO

17. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

18. Repair open between ECM and ignition relay.
   - YES
   - NO

   - YES
   - NO

20. Replace handlebar switch assembly.

21. Check for continuity to ground on [10] Pin 2. Continuity present?
   - YES
   - NO

22. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

23. Check for 12 volts on ignition relay Terminal 86 (W/BK). Voltage present?
   - YES
   - NO

24. Repair open on GY/O wire between connector [22A] and ignition relay.
   - YES
   - NO

25. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

26. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

27. Repair open between ECM and ignition relay.
   - YES
   - NO

28. Check for 12 volts on ignition relay Terminal 30 (GY/O). Voltage present?
   - YES
   - NO

29. Replace ignition relay.
   - YES
   - NO

30. Check for 12 volts on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

31. Check for continuity to ground on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

32. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

33. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

34. Repair open between ECM and ignition relay.
   - YES
   - NO

35. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

36. Repair open on GY/O wire between ignition relay and fuse.
   - YES
   - NO

37. Replace ignition relay.
   - YES
   - NO

38. Check for 12 volts on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

39. Check for continuity to ground on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

40. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

41. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

42. Repair open between ECM and ignition relay.
   - YES
   - NO

43. Check for 12 volts on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

44. Check for continuity to ground on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

45. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
   - NO

46. Check for 12 volts on ignition relay Terminal 87 (GY). Voltage present?
   - YES
   - NO

47. Repair open between ECM and ignition relay.
   - YES
   - NO

48. Check for 12 volts on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

49. Check for continuity to ground on ignition relay Terminal 85 (BK). Continuity present?
   - YES
   - NO

50. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

2006 Buell Lightning: Fuel System 4-31
**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)

1. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.

2. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-24. Disconnect the 4-place fuel pump connector [86]. The connector is located inside the left rear portion of the fuel tank/frame.
   b. With the motorcycle in neutral, start the engine and allow vehicle to run.
   c. When the engine stalls, press the starter button for 3 seconds to remove any remaining fuel from fuel line.

**WARNING**

With fuel tank drained, gasoline can spill from bore when supply valve is loosened or removed. 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. (00277a)

3. See Figure 4-25. Depress button (2) of fuel line connector and disconnect the fuel line (3) from throttle body inlet (1).

4. See Figure 4-26. Attach FUEL PRESSURE GAUGE ADAPTER (Part No. B-45522) (2) to throttle body inlet (1).

5. Connect the fuel line (3) to fuel pressure gauge adapter.

   **NOTE**

   See Figure 4-27. Verify that fuel valve (2) and air bleed pet-cock (3) on the gauge are closed.

6. Attach FUEL PRESSURE GAUGE (Part No. HD-41182) (4) to fuel pressure gauge adapter (1).

### PART NO. SPECIALTY TOOL

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-45522</td>
<td>Fuel pressure gauge adapter</td>
</tr>
<tr>
<td>HD-41182</td>
<td>Fuel pressure gauge</td>
</tr>
</tbody>
</table>

---

**Figure 4-24. Fuel Pump Connector [86] (swingarm removed for illustration)**

**Figure 4-25. Fuel Line**

1. Throttle body inlet
2. Button
3. Fuel line
7. See Figure 4-24. Attach fuel pump connector [86] to main wiring harness.
8. See Figure 4-27. Pressurize the fuel system.
   a. Start and idle engine to pressurize the fuel system.
   b. Open fuel valve (2) on fuel pressure gauge to allow fuel to flow down the gauge hose.
   c. Position the air bleed tube (3) into proper container.
   d. Open and close the air bleed petcock (5) to purge the fuel pressure gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube.
   e. Close the air bleed petcock.
9. Open throttle and increase engine speed to 2500-3000 RPM. Note the reading on the pressure gauge.
   a. If pressure is 49.51 PSI (338-352 kPa) then system is operating within limits.
   b. If pressure is not within limits, see Test 4.13 (Part 1 of 2) flow chart after disconnecting pressure gauge.

**WARNING**

With fuel tank drained, gasoline can spill from bore when supply valve is loosened or removed. 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. (00277a)

10. See Figure 4-27. Turn engine off. Detach pressure gauge (4) from adapter (1).
   a. Open the air bleed petcock (5) to relieve fuel system pressure and purge the pressure gauge of gasoline.
   b. Remove pressure gauge from adapter.
11. Detach adapter from vehicle.
12. Connect fuel line to throttle body inlet.

**DIAGNOSTICS**

**Diagnostic Notes**

The reference numbers below correlate with the circled numbers on the Test 4.13 flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42882) to ECM. See 4.6 BREAKOUT BOX.
Table 4-14. Wire Harness Connectors in Figure 4-28.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[39]</td>
<td>Instrument module</td>
<td>20-place Multilock</td>
<td>behind windscreen</td>
</tr>
<tr>
<td>[86]</td>
<td>fuel pump</td>
<td>4-place Multilock</td>
<td>left side of rear shock absorber</td>
</tr>
</tbody>
</table>
Run fuel pressure test as described under 4.13 FUEL PRESSURE TEST. Fuel pressure should remain steady at 48-51 PSI (338-352 kPa). Does it?

No trouble found. Review symptoms.

Yes

No pressure.

Low pressure.

High pressure.

Check voltage drop between battery positive (+) and Terminal D (-) on pump side of connector [89] during first two seconds after key ON. Is voltage greater than 1 VDC?

No

Check for faulty fuel pump and replace. See 4.39 FUEL PUMP.

Yes

Check for restricted pump inlet screen. Is screen restricted?

No

Move negative (-) probe to GY wire on Terminal 87 of ignition relay. Measure voltage during first two seconds after key ON. Is voltage greater than 1 VDC?

Yes

Locate and repair poor connection between ignition relay and fuel pump.

No

Check for restricted pump inlet screen. Is screen restricted?

Yes

Locate and repair poor connection between battery and ignition relay.

No

Replace ignition relay.

Go to Test 4.13 (Part 2 of 2).

Check voltage drop between battery positive (+) and Terminal D (-) on pump side of connector [89] during first two seconds after key ON. Is voltage greater than 1 VDC?

No

Check for faulty fuel pump and replace. See 4.39 FUEL PUMP.

Yes

Move negative (-) probe to GY wire on Terminal 87 of ignition relay. Measure voltage during first two seconds after key ON. Is voltage greater than 1 VDC?

No

Move negative (-) probe to GY/O wire on Terminal 30 of ignition relay. Measure voltage during first two seconds after key ON. Is voltage greater than 1 VDC?

Yes

Locate and repair poor connection between ignition relay and fuel pump.

No

Check for faulty fuel pump and replace. See 4.39 FUEL PUMP.
Continued from Test 4.13 (Part 1 of 2): 
Check for battery voltage at GY wire Terminal D on fuel pump connector [86A]. Is battery voltage present?

1. Connect test lamp to battery positive (+) terminal. Probe GY/Y wire at [86A] during the first two seconds after key ON. Does test lamp light?
   - YES
   - NO 
   
   2. Connect Breakout Box (HD-42682) to ECM. Check continuity between [86A] Terminal C (BN/Y wire) and ECM connector [10] Terminal 3. Is continuity present?
   - YES
   - NO
   
   YES
   Replace fuel pump assembly. See 4.35 FUEL PUMP.
   
   NO
   Repair fuel pump wiring.
   
   YES
   Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   
   NO
   Locate and repair open in BN/Y wire.
   
   YES
   Replace fuel pump assembly. See 4.39 FUEL PUMP.
   
   NO
   Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   
   YES
   Locate and repair open in BN/Y wire.

Inspect fuel pump wiring. Is wiring OK?

YES

NO
IDLE SPEED CONTROL

ADJUSTMENTS

NOTE
Setting the idle below the recommended speed can result in hard starting, especially in cold ambient temperatures.

See Figure 4-29. The idle speed control cable (1) is located on the left side of the vehicle between the front cylinder head and the ram air scoop assembly (2). Idle speeds are listed in Table 4-15. A 3/16 in. allen wrench may be used to turn adjuster knob.

Table 4-15. Engine Idle Speeds

<table>
<thead>
<tr>
<th>MODEL</th>
<th>REGULAR IDLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Models</td>
<td>1050-1150</td>
</tr>
</tbody>
</table>

NOTE
Idle adjuster is located near the engine and could be extremely hot. Use suggested tool for adjusting the idle speed. Failure to comply could result in minor or moderate injury.

The idle speed should be adjusted when the engine is at normal operating temperature.

NOTE
An idle speed too low can cause poor throttle response. An idle speed too high can cause a slow return to idle.

See 1.15 THROTTLE CABLE AND IDLE SPEED ADJUSTMENT for more information on idle speed adjustment.
GENERAL

Misfire At Idle or Under Load

Misfire conditions may be caused by:

- Battery condition and connections.
- Fuel system problems. See tables under 4.8 INITIAL DIAGNOSTIC CHECK.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.15 flow charts.

WARNING

Thoroughly wipe up any spilled fuel and dispose of rags in a suitable manner. Any open spark around gasoline or other combustibles could result in fire or explosion causing death or serious injury.

1. See Figure 4-30. A SPARK TESTER (Part No. HD-26792) must be used to verify adequate secondary voltage (25,000 volts) at the spark plug.
   a. Turn ignition switch OFF.
   b. Remove spark plug cable from spark plug. Visually check plug condition.
   c. Attach cable to SPARK TESTER. Clip tester to cylinder head bolt.
   d. While cranking engine, watch for spark to jump tester gap on leads.
   e. Reinstall and repeat procedure on other spark plug cable.

2. Perform spark plug cable resistance test.
   a. Remove spark plug cable from spark plug and ignition coil. See 7.4 SPARK PLUG CABLES.
   b. Using an ohmmeter, touch probes to terminals on each end plug wire.
   c. Compare resistance values to Table 4-16. Replace cables not meeting specifications. Reinstall and repeat procedure on other spark plug cable.

Table 4-16. Spark Plug Cables

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>FRONT &amp; REAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length - in. (mm)</td>
<td>5.75 in. (146mm)</td>
</tr>
<tr>
<td>Resistance - ohms</td>
<td>1,430 - 3,360</td>
</tr>
</tbody>
</table>

3. If carbon tracking is evident, replace ignition coil and inspect spark plug wires. Wires must be clean and tight. Excessive wire resistance or faulty connections can cause coil damage. See 4.32 IGNITION 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 4.32 IGNITION COIL.

5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray pin probe and patch cord.
Table 4-17. Wire Harness Connectors in Figure 4-31.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[22]</td>
<td>right hand controls</td>
<td>4-place Multilock</td>
<td>beneath windscreen</td>
</tr>
<tr>
<td>[83]</td>
<td>ignition coil</td>
<td>3-place Packard</td>
<td>beneath air cleaner assembly baseplate</td>
</tr>
</tbody>
</table>
Is fuel contaminated?

YES

Drain and flush tank. Refill with fresh fuel.

NO

Use Spark Tester to check cables. See 4.11 ENGINE CRANKS BUT WILL NOT START. Did spark jump gap on both leads?

YES

Check for:
- Faulty, worn or cracked spark plug(s).
- Plug booting due to engine mechanical fault.
- Faulty or poor connection at plug.

NO

Check resistance of each spark plug cable that did not fire the Spark Tester.
Also, check for faulty plug wire connections and wire boots for carbon tracking

Are wires OK?

YES

Coils should be free of carbon tracking. Are they?

NO

Replace faulty wire.

YES

Replace ignition coil.

NO

Switch coil with unit known to be good. Perform spark test.
Did spark jump gap during engine cranking?

YES

Replace ignition coil.

NO

Original ignition coil is faulty. Replace.

STOP
Continued from Test 4.15 (Part 1 of 2).

Disconnect cam position sensor connector [14]. With ignition ON, measure voltage between Terminal A (+) and Terminal C (-) of connector [14B]. Is 5 volts present?

**NOTES:**

**YEs**
- Repair short to ground.
- Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

**NO**
- Check for continuity between Terminal A connector [14B] and ground. Continuity present?

**YEs**
- Repair open circuit.

**NO**
- Problem may be intermittent. Verify that connectors [10], [11] and [14] are reconnected. Remove Breakout Box and try to start vehicle. Will vehicle start?

**YEs**
- With engine running, wiggle cam position sensor and wires to identify any loose connects (engine misfires or stalls.) Any found?

**YEs**
- Pinion gear key failure, loose rotor cup or other mechanical failure.

**NO**
- Remove cam timer cover using 1/8 in. drill bit. Crank starter. Does rotor cup rotate?

**YEs**
- Repair open connection.

**NO**
- Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

**YEs**
- Disconnected cam position sensor connector [14]. Measure resistance between Terminal B and Connector [14B] and Breakout Box (GY) Pin 3. Is resistance greater than 1.0 ohm?

**NO**
- Remove cam timer cover using 1/8 in. drill bit. Crank starter. Does rotor cup rotate?

**YEs**
- Replace cam position sensor. See 4.31 CAM POSITION SENSOR AND ROTOR.

**NO**
- Mechanical failure. Inspect for loose rotor cup and sheared pinion gear key.
GENERAL

Throttle Position Sensor

See Figure 4-32. The throttle position sensor (TP sensor) is supplied 5.0 volts from the ECM (5v REF) and sends a signal back to the ECM (TP sensor signal) which varies according to throttle position. The output signal from the TP sensor varies from:

- 0.5-1.5 volts at idle (closed throttle).
- 3.9-4.9 volts at wide open throttle.

A Code 11 will set if the TP sensor signal voltage does not fall within the acceptable range.

**NOTE**

If the TP sensor is removed and/or replaced, the sensor must be calibrated using Digital Technician (Part No. HD-44750). For replacement of TP sensor see 4.37 THROTTLE POSITION SENSOR.

DIAGNOSTICS

Diagnostic Tips

TP sensor voltage should increase at a steady rate as throttle is moved from idle to wide open throttle. An open or short to ground in R/W or BK/W wires will also result in a Code 11.

Check for the following conditions:

- **Poor connection.** Inspect ECM harness connector for backed out terminals, improper mating, broken locks improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.

- **Perform 4.7 WIGGLE TEST to locate intermittents.** If connections and harness check out OK, monitor TP sensor voltage using DVOM while moving related connectors and wiring harness. If the failure is induced, the DVOM display will change.

- **TP sensor scaling.** Observe the TP sensor voltage display while opening the throttle with engine stopped and ignition switch 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 Code 11 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probe and patch cord.
Figure 4-34. Throttle Position Sensor Circuit

Table 4-18. Wire Harness Connectors in Figure 4-34.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[14]</td>
<td>cam position sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
</tr>
<tr>
<td>[88]</td>
<td>throttle position sensor</td>
<td>3-place Packard</td>
<td>right side of engine between cylinders</td>
</tr>
<tr>
<td>[134]</td>
<td>bank angle sensor</td>
<td>6-place Sumitomo</td>
<td>under seat</td>
</tr>
</tbody>
</table>
HOME

Code 11 Test (Part 1 of 2)

1. Attach ECM to Breakout Box (HD-42682). Plug DVOM into Pin 2 (+) and Pin 7 (-) of Breakout Box connector [11]. With ignition ON, gradually open throttle while observing voltage. Does voltage steadily increase with no spikes or low voltages observed from 0.5-1.5 volts at idle (closed throttle) to 3.9-4.9 volts at wide open throttle?

   YES

   Check engine lamp continuously ON and CODE 11 only code set?

   YES

   Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

   NO

   Was voltage greater than 4.9 volts?

   YES

   GO to Code 11 Test (Part 2 of 2).

   NO

   Check for intermittents by performing 4.7 WIGGLE TEST. Intermittents present?

   YES

   To identify source of intermittents, start at box marked by Bold Asterisk on right side of flow chart. Follow steps while wigging harness and monitoring DVOM.

   NO

   Replace TP sensor (4.37 THROTTLE POSITION SENSOR). Clear codes and road test. Did check engine lamp come on and set CODE 11?

   YES

   System now OK.

   NO

   Install original TP sensor and replace ECM (4.30 ELECTRONIC CONTROL MODULE). Road test again to verify.

   NO

   Reconnect TP sensor connector [88]. Measure TP sensor voltage at wide open throttle. Is voltage greater than 5.0 volts?

   YES

   Locate and repair short between V/Y wire and battery voltage.

   NO

   Locate and repair short between R/W wire and battery voltage.

   * At some point in the flow chart you may be instructed to jump directly to a 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. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
**Code 11 Test (Part 2 of 2)**

**Continued from Code 11 Test (Part 1 of 2).**

1. **Connect Breakout Box if not already connected.** Check resistance between ECM Pin 2 on connector [11] to chassis ground. Is resistance greater than 1 megaohm?
   - **YES**
   - **NO**

2. **Check continuity from Pin 2 of connector [11] to Terminal B on connector [88].** Continuity present?
   - **YES**
   - **NO**

   **RETURN TO TOP**

   **Replace TP sensor. See 4.37 THROTTLE POSITION SENSOR.**

3. **Locate and repair short to ground on V/Y wire.**
   - **YES**
   - **NO**

4. **Check continuity between connector [88] Terminal B (V/Y wire) and Pin 7 of connector [11].** Continuity present?
   - **YES**
   - **NO**

5. **Locate and repair open in V/Y wire.**
   - **YES**
   - **NO**

6. **Locate and repair open in BK/W wire.**
   - **YES**
   - **NO**

7. **Locate and repair short between R/W and BK/W wires. Reconnect [14].**
   - **YES**
   - **NO**

8. **Replace BAS.**
   - **YES**
   - **NO**

   - **YES**
   - **NO**

10. **Replace cam position sensor.**
    - **YES**
    - **NO**

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

Oxygen Sensor
See Figure 4-35. The oxygen sensor provides a signal to the ECM which indicates whether the engine is running rich or lean.
- A low voltage signal (<0.41 V) indicates the engine is running lean.
- A high voltage signal (>0.56 V) indicates the engine is running rich.

When the air/fuel mixture is ideal, approximately 14.7 parts air to 1 part fuel, the voltage will be approximately 0.48 V.

DIAGNOSTICS

Diagnostic Tips
The DVOM displays the signal from the O2 sensor in volts. This voltage will have an average value tending towards lean, rich or ideal value depending on operating temperature of the engine, engine speed and throttle position. An open/short to voltage or short to ground in the V/GY wire will cause the engine to run rich (short to ground) or lean (short to voltage) until fault is detected. Once fault is detected, vehicle will run in open loop. The engine must be running below 5000 RPM for the ECM to detect an O2 sensor failure.

Check for the following conditions:
- Poor connection. Inspect the ECM harness connector [11], fuel injector connectors [84, 85] and O2 sensor connector wiring for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Dirty/stuck open injectors. The motorcycle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there is an injector problem. This could also cause poor fuel economy and performance.
- Loose O2 sensor. See Figure 4-36. If the O2 sensor is loose engine performance may be affected. This could also show up as a slow changing O2 sensor voltage.
- Loose/leaking exhaust. This can cause a poor ground connection for sensor or allow fresh air into the exhaust system. If fresh air enters exhaust system, the O2 sensor will read a lean condition, causing the system to go rich.

Diagnostic Notes
1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
Figure 4-37. Oxygen Sensor Circuit

Table 4-19. Wire Harness Connectors in Figure 4-37.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[137]</td>
<td>oxygen sensor</td>
<td>1-place Packard</td>
<td>behind rear cylinder head</td>
</tr>
</tbody>
</table>
Home

Code 13 Test (Part 1 of 3)


Turn ignition ON and start engine. (Engine must be on and running to read O2 sensor values). Observe O2 voltage. Is it approximately 0.5 volt?

NO.

0 volts.

YES.

NO.

Greater than 1 volt.

YES.

STOP

7656

7659

7658

1

1

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 13 Test (Part 1 of 3),

Turn ignition OFF and reconnect O2 sensor. Turn ignition ON and start engine. Allow engine to reach operating temperature. With engine idling, does voltage quickly fluctuate between 0.1-0.8 volts?

**NO**
- Check for restricted fuel filter or fuel line. Restriction present?
  - YES: Replace fuel pump. See 4.39 FUEL PUMP.
  - NO: Replace fuel line or filter. Check for air leaks at induction module. Air leak present?
    - YES: Fuel injectors may be dirty. See Fuel Injectors under 4.42 THROTTLE BODY.
    - NO: Repair.

**YES**
- Perform 4.13 FUEL PRESSURE TEST. Pressure too high?
  - YES: Check continuity between Pin 4 (111) (gray) and 137 (V/GY). Continuity present?
    - YES: Replace O2 sensor. See 4.33 OXYGEN SENSOR.
    - NO: Repair open on V/GY wire.
- Perform 4.13 FUEL PRESSURE TEST. Pressure too low?
  - NO: Check for air leaks at induction module. Air leak present?
    - YES: Replace fuel line or filter.
    - NO: Repair.
  - YES: Check for restricted fuel filter or fuel line. Restriction present?
    - YES: Replace fuel pump. See 4.39 FUEL PUMP.
    - NO: Replace fuel line or filter.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 13 Test (Part 2 of 3).

Turn ignition OFF and reconnect O2 sensor. Turn ignition ON and start engine. Allow engine to reach operating temperature. Does voltage quickly fluctuate between 0.1-0.8 volts?

YES

Replace O2 sensor
(4.33 OXYGEN SENSOR). Clear codes and road test. Did check engine lamp come on and set CODE 13?

YES

Repair as necessary.

NO

Replace O2 sensor
(4.33 OXYGEN SENSOR). Clear codes and road test. Did check engine lamp come on and set CODE 13?

NO

Install original O2 sensor and replace ECM (4.30 ELECTRONIC CONTROL MODULE). Road test again to verify.

YES

System now OK.

NO

Check for intermittents by performing 4.7 WIGGLE TEST. Intermittents present?

YES

New Code 13 Test (Part 2 of 3) for "slow or no change".

NO

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

Continued from Code 13 Test (Part 2 of 3).

Turn ignition OFF and reconnect O2 sensor. Turn ignition ON and start engine. Allow engine to reach operating temperature. Does voltage quickly fluctuate between 0.1-0.8 volts?

YES

Replace O2 sensor
(4.33 OXYGEN SENSOR). Clear codes and road test. Did check engine lamp come on and set CODE 13?

YES

Repair as necessary.

NO

Replace O2 sensor
(4.33 OXYGEN SENSOR). Clear codes and road test. Did check engine lamp come on and set CODE 13?

NO

Install original O2 sensor and replace ECM (4.30 ELECTRONIC CONTROL MODULE). Road test again to verify.

YES

System now OK.

NO

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

Engine Temperature Sensor

NOTE
Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

See Figure 4-38. The ECM supplies and monitors a 0-5 volt signal to one side of the engine temperature sensor (ET sensor). The other side of the ET sensor is connected to ground through the engine.

See Table 4-20. The ET 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 supplied voltage.

- At high temperatures, the resistance of the sensor is very low. This effectively lowers the signal voltage.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to the supplied voltage of 5 volts.

The ECM monitors this voltage to compensate for various operating conditions.

DIAGNOSTICS

Diagnostic Tips

An intermittent may be caused by poor connection, rubbed through wire insulation or a wire broken inside the insulation.

Check the following conditions:


- Shifted sensor. The temperature-to-resistance values table may be used to test the ET sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 14 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probes and patch cord.

Table 4-20. Engine Temperature Sensor Specifications

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>RESISTANCE</th>
<th>TEMP °C</th>
<th>TEMP °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0</td>
<td>300</td>
<td>572</td>
</tr>
<tr>
<td>0.21</td>
<td>145</td>
<td>255</td>
<td>491</td>
</tr>
<tr>
<td>0.42</td>
<td>303</td>
<td>210</td>
<td>410</td>
</tr>
<tr>
<td>0.62</td>
<td>463</td>
<td>190</td>
<td>374</td>
</tr>
<tr>
<td>0.81</td>
<td>638</td>
<td>170</td>
<td>338</td>
</tr>
<tr>
<td>1.20</td>
<td>1042</td>
<td>150</td>
<td>302</td>
</tr>
<tr>
<td>1.59</td>
<td>1539</td>
<td>130</td>
<td>266</td>
</tr>
<tr>
<td>3.01</td>
<td>4991</td>
<td>85</td>
<td>185</td>
</tr>
<tr>
<td>4.43</td>
<td>25,647</td>
<td>40</td>
<td>104</td>
</tr>
<tr>
<td>4.63</td>
<td>41,295</td>
<td>25</td>
<td>77</td>
</tr>
<tr>
<td>4.83</td>
<td>93,759</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>4.88</td>
<td>134,200</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>4.93</td>
<td>232,414</td>
<td>-10</td>
<td>14</td>
</tr>
</tbody>
</table>

NOTE
All voltage and resistance values are approximate (+/- 20%).

Engine temperature sensor is measured between Terminal 9 of connector [11] and system ground (Terminals 2 and 11 of connector [10]).
Figure 4-39. Engine Temperature Sensor Circuit

Table 4-21. Wire Harness Connectors in Figure 4-39.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[90]</td>
<td>engine temperature sensor</td>
<td>1-place bullet</td>
<td>beneath air cleaner assembly baseplate</td>
</tr>
</tbody>
</table>
Code 14 Test (Part 1 of 2)

Disconnect ET sensor connector [90]. Measure resistance between [90] and body of ET sensor. Is resistance between 33761-74328 ohms when engine is at room temperature (68-86°F [20-30° C])?

YES

NO

YES

NO

Attach Breakout Box (HD-42682) to ECM. Using a DVM, measure the resistance between ET sensor connector and ECM Pin 9 of [11]. Is it less than 1.0 ohm?

YES

NO

Replace ET sensor. See 4.33 OXYGEN SENSOR.


YES

NO

Examine PK/Y wire in harness for open circuit and repair.

Examine harness for short to ground and repair.

STOP

Go to Code 14 Test (Part 2 of 2).

At some point in the flow chart you may be instructed to jump directly to the box marked by an 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. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 14 Test (Part 1 of 2).

Connect ECM to Breakout Box. With DVM still connected, check for intermittents by performing 4.7 WIGGLE TEST. Intermittents present?

YES

While wiggling harness to locate source of intermittents, perform the steps under Code 14 Test (Part 1 of 2) marked by Bold Asterisks. Repair as necessary.

NO


YES

Replace ET sensor (4.30 ENGINE TEMPERATURE SENSOR), clear codes and road test. Did check engine lamp come on and set only CODE 14?

YES

Install original ET sensor, replace ECM (4.30 ELECTRONIC CONTROL MODULE) and road test.

NO


YES

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.

NO

NO

Repair short to ground on PK/Y wire.
GENERAL

Intake Air Temperature Sensor

See Figure 4-40. The ECM supplies and monitors a signal at Pin 10 of [11] 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 (Pin 7 of [11]).

![Figure 4-40. IAT Sensor](image)

Refer to Table 4-22. 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 supplied voltage (Pin 10).

- At high temperatures, the resistance of the sensor is very low. This effectively lowers the signal voltage on Pin 10.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to the supplied voltage of 5 volts. The ECM monitors this voltage to compensate for various operating conditions.

DIAGNOSTICS

Diagnostic Tips

An intermittent may be caused by a poor connection, rubbed through wire insulation or a wire broken inside the insulation. Check for the following conditions:

- Poor connection. Inspect ECM harness connector for backed out terminals, improper mating, broken locks improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Perform 4.7 WIGGLE TEST to locate intermittents. If connections and harness check out OK, check intake air temperature reading while moving related connectors and wiring harness. If the failure is induced, the IAT sensor display will change.

- Shifted sensor. The temperature-to-resistance values table may be used to test the IAT sensor at various temperature levels in order to evaluate the possibility of a shifted (out-of-calibration) sensor which may result in driveability problems.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 15 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) to EFI harness only (leave ECM disconnected). See 4.6 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probes and patch cord.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probe and patch cord.

<table>
<thead>
<tr>
<th>VOLTS</th>
<th>RESISTANCE</th>
<th>TEMP °C</th>
<th>TEMP °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.49</td>
<td>1085</td>
<td>125</td>
<td>257</td>
</tr>
<tr>
<td>0.68</td>
<td>1561</td>
<td>113</td>
<td>235</td>
</tr>
<tr>
<td>0.86</td>
<td>2077</td>
<td>100</td>
<td>212</td>
</tr>
<tr>
<td>1.13</td>
<td>2920</td>
<td>90</td>
<td>194</td>
</tr>
<tr>
<td>1.40</td>
<td>3889</td>
<td>80</td>
<td>176</td>
</tr>
<tr>
<td>2.25</td>
<td>8149</td>
<td>60</td>
<td>140</td>
</tr>
<tr>
<td>3.09</td>
<td>16,178</td>
<td>40</td>
<td>104</td>
</tr>
<tr>
<td>3.52</td>
<td>23,670</td>
<td>30</td>
<td>86</td>
</tr>
<tr>
<td>3.94</td>
<td>37,170</td>
<td>20</td>
<td>88</td>
</tr>
<tr>
<td>4.24</td>
<td>55,359</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>4.53</td>
<td>96,383</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>4.68</td>
<td>146,250</td>
<td>-10</td>
<td>14</td>
</tr>
<tr>
<td>4.83</td>
<td>284,118</td>
<td>-20</td>
<td>-4</td>
</tr>
</tbody>
</table>

NOTE

All voltage and resistance values are approximate (+/- 20%). Intake air temperature sensor is measured between Terminal 10 of [11] and system ground (Terminals 2 and 11 of [10]).
Figure 4-41. Intake Air Temperature Sensor Circuit

Table 4-23. Wire Harness Connectors in Figure 4-41.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[89]</td>
<td>intake air temperature sensor</td>
<td>2-place Amp.</td>
<td>in air cleaner assembly baseplate</td>
</tr>
</tbody>
</table>

**YES**

Connect ECM to Breakout Box. Check for intermittents by performing 4.7 WIGGLE TEST. Intermittents present?

**YES**

While wiggling harness to locate source of intermittents, perform the steps under Code 15 Test (Part 2 of 2) marked by Bold Asterisks. Repair as necessary.

**NO**

Disconnect IAT sensor connector. Turn ignition switch ON. Using a DVOM, measure the voltage between ECM Pin 10 (+) and Pin 7 (-) of [11] on Breakout Box.

Is the voltage approximately 5 volts?

**YES**

NO

Less than 4.7 volts

Greater than 5.3 volts.

Replace IAT sensor (4.36 INTAKE AIR TEMPERATURE SENSOR), clear codes and road test. Did check engine lamp come on and set only CODE 15?

**YES**

System OK.

**NO**

Repair short to ground on Lt. GN/Y wire.

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

Repair short to ground on Lt. GN/Y wire.

Reseat IAT signal wire (Lt. GN/Y) for short to 12 volts and repair.

**NO**

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 15 Test (Part 1 of 2)

Disconnect IAT sensor connector [89]. Measure resistance between Pins 1 and 2 of [89] at sensor. With engine at room temperature 60-90°F (15.6-32.2°C), is resistance between 6816-3314 ohms?

YES

Using a DVOM, measure the resistance between IAT sensor connector [89] terminal 1 and ECM Pin 10 on Breakout Box. Is it less than 1.0 ohm?

YES

Replace IAT sensor. See 4.36 INTAKE AIR TEMPERATURE SENSOR.

NO

Using a DVOM, measure the resistance between IAT sensor connector [89] terminal 2 and ECM Pin 7 on Breakout Box. Is it less than 1.0 ohm?

YES

Using a DVOM, measure the resistance between ECM Pins 10 and 7 of connector [11] on Breakout Box. Is it greater than 1.0 megohm?

YES

Using a DVOM, measure the resistance between ECM Pin 10 of connector [11] on Breakout Box and ground. Is it greater than 1.0 megohm?

YES

Using a DVOM, measure the resistance between ECM Pin 10 and 7 of connector [11] on Breakout Box. Is it greater than 1.0 megohm?

YES

Using a DVOM, measure the resistance between ECM Pin 10 of connector [11] on Breakout Box and ground. Is it greater than 1.0 megohm?

YES

To locate sources of intermittent, wiggle harness while performing steps marked above by Bold Asterisk. Repair as necessary.

NO

Examine Lt. GN/Y wire and BK/W wire in harness for short between these two circuits and repair.

NO

Examine harness for short to ground and repair.

NO

Examine Lt. GN/Y wire in harness for open circuit and repair.

NO

Using a DVOM, measure the resistance between IAT sensor connector [89] terminal 2 and ECM Pin 7 on Breakout Box. Is it less than 1.0 ohm?

NO

Examine Lt. GN/Y wire in harness for open circuit and repair.

At some point in the flow chart you may be instructed to jump directly to the box marked by an 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. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

Battery Voltage

A Code 16 will set if the ECM detects battery positive voltage less than 6 volts or greater than 20 volts.

- A low voltage condition typically occurs during activation of the starter or generally indicates loose wire connections.
- A high voltage condition is usually caused by a faulty voltage regulator.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 16 flow charts.

1. The ECM is monitoring voltage at ECM connector [10] (black) Terminal 1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.

2. This checks for voltage drops in the ECM power circuit. If a significant voltage drop is not present, condition may be caused by excessive starter current draw.

Figure 4-42. Fuse Block and Electrical Relays (XB12Ss)

Figure 4-43. Fuse Block and Electrical Relays (Typical)
Figure 4-44. Battery Voltage Circuit

Table 4-24. Wire Harness Connectors in Figure 4-44.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
</tbody>
</table>
Perform charging system tests. See 7.7 CHARGING SYSTEM
Charging system OK?

YES

NO

Repair charging system

1. Remove spark plug cables from spark plugs. Attach Breakout Box (HD-42682) to ECM. Measure voltage at ECM Pin 1 (+) and Pin 11 (-) of [10] on Breakout Box while cranking engine. Is voltage above 6.2 volts?

YES

NO

Measure voltage between Battery Positive Terminal (+) and ECM Pin 1 of [10] on Breakout Box with key ON. Is voltage drop greater than 0.5 volts?

System OK.

YES

NO

2. Measure voltage drop between Battery Positive Terminal (+) and ECM Pin 1 of [10] on Breakout Box with key ON. Is voltage drop greater than 0.5 volts?

YES

Check for excessive starter current draw. See 5.6 STARTER SYSTEM TESTING.

NO

Replace ignition relay.

Measure voltage drop between Battery Positive Terminal (+) and Terminal 87 on ignition relay with key ON. Is voltage drop greater than 0.5 volts?

YES

Repair GY wire or terminals.

NO

Replace ignition relay.

Measure voltage drop between Battery Positive Terminal (+) and GY/O Terminal 30 on ignition relay with key ON. Is voltage drop greater than 0.5 volts?

YES

No

STOP

Go to Code 16 Test (Part 2 of 2).

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Code 16 Test (Part 2 of 2)

Continued from Code 16 Test (Part 1 of 2).

Measure voltage drop between Battery Positive Terminal (+) and GYO wire Terminal on ignition fuse with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal 87 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and red wire of 30 amp battery fuse with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal 87 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

YES

Replace R/BK wire or terminals.

NO

Replace GYO wire or terminals.

NO

Replace fuse or fuse terminals.

NO

Replace GYO wire or terminals.

Measure voltage drop between Battery Positive Terminal (+) and GYO wire Terminal on 15 amp ignition fuse with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and R wire Terminal 30 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and red wire of 30 amp battery fuse with key ON. Is voltage drop greater than 0.5 volt?

YES

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal 87 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

NO

Repair GYO wire or terminals.

NO

Repair R/BK wire or terminals.

YES

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal on 15 amp ignition fuse with key ON. Is voltage drop greater than 0.5 volt?

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal 87 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

NO

Repair GYO wire or terminals.

NO

Repair R/BK wire or terminals.

NO

Repair GYO wire or terminals.

YES

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal on 15 amp ignition fuse with key ON. Is voltage drop greater than 0.5 volt?

Measure voltage drop between Battery Positive Terminal (+) and R/BK wire Terminal 87 of key switch relay with key ON. Is voltage drop greater than 0.5 volt?

NO

Repair GYO wire or terminals.

NO

Repair R/BK wire or terminals.

NO

Repair GYO wire or terminals.

YES

Replace fuse or fuse terminals.

Replace key switch relay.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

The interactive exhaust system utilizes an actuator valve in the muffler which is connected to a servo motor via a cable. The valve position automatically adjusts to enhance engine performance.

Active Muffler Control (XB12 Models Only)

A Code 21 will set if the ECM detects that the output for the Interactive Muffler Control Actuator is not in agreement with the feedback circuit.
- Mechanical fault in the actuator, valve or cable.
- Electrical fault in the actuator circuit.
- Electrical fault in the actuator feedback circuit.
- Electrical fault in the brake light or horn circuits.
- Blown fuse.

See B.5 INDEX TO WIRING DIAGRAMS.

DIAGNOSTIC NOTES

The reference numbers below correlate with the circled numbers on the Code 21 flow charts.

1. Using TEST CONNECTOR KIT (Part No. HD-41404), attach red probe and patch cord to [164B].
2. Using TEST CONNECTOR KIT (Part No. HD-41404), use gray male pin probe and patch cord.

Figure 4-45. Fuses and Diodes
Figure 4-46, Interactive Exhaust Circuit
Remove air cleaner cover.

System OK. Clear codes.

Connect BREAK OUT BOX and measure voltage between pin 2 (Black) (-) and pin 9 (Black) (+). Disconnect terminal [164] from ECM. With ignition on, ground opposite end of patch cord. When grounded, voltage should be between 4-6 VDC, and 0-1 VDC when not grounded.

Check continuity between pin 9 (Black) and [161B] pin 4. Continuity present?

With the throttle in the wide open position, ignition on, Run/Stop on. Does the actuator cycle smoothly?

Locate and repair short to ground on O wire or Y/BK or R/Y wire in Brake/Horn/Muffler Circuit.

Locate and repair open on BK wire.

Locate and repair open on TN/V wire [161B].

Locate and repair short to ground on O wire or Y/BK or R/Y wire in Brake/Horn/Muffler Circuit.

Locate and repair open on O wire between fuse and [161B].

Locate and repair open on W wire.

Using pliers, gently pull on cable to interactive muffler actuator. Cable should cause interactive muffler valve to open and close freely without binding. Does it?

Disconnect cable to interactive valve. Does valve arm move freely without binding?

Replace ECM.

Replace interactive muffler cable.

Locate and repair short to voltage on TN/V wire.

Locate and repair short to ground on TN/V wire [161B].

Locate and repair open on TN/V wire [161B].

With ECM connected, measure voltage at [161B] pin 4.

Replace ECM.

Locate and repair open on TN/V wire [161B].

Locate and repair short to voltage on TN/V wire.

Replace ECM.

Replace ECM.

Replace ECM.

Replace ECM.

Replace ECM.
TROUBLE CODES 23 AND 32

GENERAL

Front Fuel Injector (Code 23)
And Rear Fuel Injector (Code 32)

See Figure 4-47. The fuel injectors (2,5) are solenoids that allow pressurized fuel into the engine intake tract. The injectors are timed to the engine cycle and are triggered sequentially.

NOTE

The injectors on the 984 and 1200 models are not interchangeable due to specific spray patterns designed for the XB engine.

The power for the injectors comes from the ignition relay. The ignition relay also provides power for fuel pump, ECM and the ignition coils. The ECM provides the path to ground to trigger the injectors.

NOTE

Ignition relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils, ECM and fuel pump.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 23/32 flow charts.

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)

1. Purge fuel line. See 4.39 FUEL PUMP.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple pin probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
4. Use FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C).

Figure 4-47. Fuel Injectors

Figure 4-48. Fuel Injector Connector
Table 4-25. Wire Harness Connectors in Figure 4-49.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[161]</td>
<td>Interactive muffler actuator</td>
<td>4-place Deutsch</td>
<td>under intake cover assembly</td>
</tr>
<tr>
<td>[164]</td>
<td>ECM</td>
<td>1-place Amp</td>
<td>under seat</td>
</tr>
<tr>
<td>[165]</td>
<td>sub-harness</td>
<td>3-place Packard</td>
<td>beneath air cleaner assembly baseplate</td>
</tr>
</tbody>
</table>
Code 23/32 Test (Part 1 of 2)

1. Is connector connected at the injector?
   - Yes
   - No

   Disconnect and attach Fuel Injector Test Lamp. Crank engine. Does lamp flash?
   - Yes
   - No

   Reconnect and install air cleaner assembly.

   - Yes
   - No

   Check Terminal 1 (GY wire) on injector connector to ground. Should be equivalent to battery voltage after key ON is it?
   - Yes
   - No

   Attach Breakout Box (HD-42682) to ECM. If CODE 23, measure resistance between ECM Pin 5 of [10] (W/Y wire) and Terminal 2 of front injector connector [84]. If CODE 32, measure resistance between ECM Pin 8 of [10] (GN/GY wire) and Terminal 2 of rear injector connector [85]. Is resistance less than 0.5 ohm?
   - Yes
   - No

   Check for loose or corroded terminals in harness. Repair as necessary.

   Replace injector. See 4.42 THROTTLE BODY.

   - Yes
   - No

   Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

4. Repair open or poor connection.

   Repair as necessary.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 23/32 Test (Part 1 of 2)

Check for 12 volts at Terminal 87 of the ignition relay. Is voltage present?

YES

Ignition relay is OK. Measure resistance between Terminal 87 of the ignition relay and Terminal 2 (W/Y for Code 23 or GN/GY for Code 32) wire at injector connector. Is resistance less than 0.5 ohm?

YES

With DVOM still attached, perform 4.7 WIGGLE TEST to locate intermittents. Repair as necessary.

NO

Check for multiple codes. See 4.4 CHECKING FOR TROUBLE CODES.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44760).
GENERAL

Front Ignition Coil (Code 24)
And Rear Ignition Coil (Code 25)

A Code 24 or 25 will set if the ignition coil rise time is out of range. This could occur if there is an open coil or loss of power to the coil. If both codes are set, it is likely a coil power failure or a coil failure.

See Figure 4-50. The coil receives power from the ignition relay at coil pin B (3) at the same time that the fuel pump and injectors are activated.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 24/25 flow charts.
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), purple pin probes and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
3. See Figure 4-36. Plug IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LAMP (Part No. 34730-2C) INTO Breakout Box. Note that cranking the engine with test lamp in place of the ignition coil can sometimes cause a code 24 or 25. This condition is normal and does not by itself indicate a malfunction. Codes must be cleared if this condition occurs.
Table 4-26. Wire Harness Connectors in Figure 4-52.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[83]</td>
<td>ignition coil</td>
<td>3-place Packard</td>
<td>beneath air cleaner assembly baseplate</td>
</tr>
</tbody>
</table>
**Code 24/25 Test**

1. **Measure voltage on Terminal B of coil. Should be equivalent to battery voltage after key is turned ON.**
   - **YES**
     - Faulty coil connection or coil. See 4.32 IGNITION COIL.
   - **NO**
     - Measure voltage on Terminal B of coil. Should be equivalent to battery voltage after key is turned ON. Is it?
       - **YES**
         - Repair or replacement as necessary.
       - **NO**
         - Perform 4.7 WIGGLE TEST. Intermittents found?
           - **YES**
             - Repair wire or connection.
           - **NO**
             - Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

2. **Use Breakout Box and test light with adapter for the next inspection.**
   - Front coil codes: Install test light and adapter between Pin 6 (BK) and ECM Pin 1 (GY).
   - Rear coil codes: install test light and adapter between Pin 7 (BK) and ECM Pin 1 (GY).

3. **Does test lamp flash when engine is cranked?**
   - **YES**
     - Measure voltage at ignition relay Terminal 4 (Pin 4 in Relay Center) after key is turned ON.
       - **YES**
         - Repair open wire or connection on GY wire.
       - **NO**
         - Check for multiple codes. See 4.4 CHECKING FOR TROUBLE CODES.
   - **NO**
     - Measure resistance at Breakout Box between ECM and coil terminals as follows:
       - Resistance should be less than 0.5 ohms. Is it?
         - **YES**
           - Repair open wire or connection.
         - **NO**
           - Perform 4.7 WIGGLE TEST. Intermittents found?
             - **YES**
               - Repair wire or connection.
             - **NO**
               - Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
GENERAL

Fuel Pump

The fuel pump assembly is shown in Figure 4-53. ECM Pin 3 provides ground to the fuel pump. Code 33 will set if:

- See Figure 4-54. BN/Y wire is shorted to 12 volts. This will also cause the ignition fuse to blow.
- BN/Y wire is shorted to ground. This will cause the fuel pump to run continuously even when the motor is not running.
- Fuel pump motor stalls or spins without providing fuel pressure.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 33 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red pin probe and patch cord.
3. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probe and patch cord.
Table 4-27. Wire Harness Connectors in Figure 4-54.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[39]</td>
<td>instrument module</td>
<td>20-place Multilock</td>
<td>behind windscreen</td>
</tr>
<tr>
<td>[86]</td>
<td>fuel pump</td>
<td>4-place Multilock</td>
<td>left side of rear shock absorber</td>
</tr>
</tbody>
</table>

Figure 4-54. Fuel Pump Circuit
Code 33 Test

1. Reach Breakout Box (HD-42682) to ECM. With DVOM, measure voltage between Pin 3 of [10] and ground after ignition switch is turned ON. Meter should read less than 2 volts and pump should run for 2-3 seconds. Does it?

   YES
   - With DVOM still connected, check for intermittents by performing 4.7 WIGGLE TEST while repeating first test of this flow chart. Intermittents present?
     - YES
     - Replace fuel pump. See 4.39 FUEL PUMP. Clear codes and road test. Did check engine lamp come on and set only CODE 33?
       - YES
       - Install original fuel pump (4.39 FUEL PUMP) and replace ECM (4.30 ELECTRONIC CONTROL MODULE).
         - System OK.
       - NO
         - Repair as necessary.
     - NO
       - Repair open.
     - NO
       - NO
   - NO
     - Repair open.

2. Does fuel pump run continuously?
   - NO
     - Locate and repair short to ground on BN/Y wire.
     - Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
   - YES
     - Check continuity of GY wire from ignition relay Terminal 87 to Pin D of [86]. Continuity present?
       - YES
       - Repair open.
       - NO
         - NO
       - NO
         - NO
   - NO
     - NO
     - NO
     - NO
     - NO

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
TROUBLE CODE 35

GENERAL

Tachometer
A Code 35 will set if the PK tachometer wire is shorted to power or ground.

DIAGNOSTICS

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the Code 35 flow chart.
1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
2. Replace instrument module. See 7.19 INSTRUMENT MODULE.

Figure 4-55. Installed Breakout Box (Typical)

Figure 4-56. ECM Connections (XB12Ss)

Figure 4-57. Instrument Module Connector (39) (Typical)
Table 4-28. Wire Harness Connectors in Figure 4-58.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[39]</td>
<td>instrument module</td>
<td>20-place Multilock</td>
<td>behind windscreen</td>
</tr>
</tbody>
</table>
Code 35 Test

1. Attach Breakout Box (HD-42682), but leave connector [10] unplugged at ECM.
2. Disconnect instrument connector [39] with ignition ON. Measure voltage across Pin 12 (+) and Pin 11 (–) in open Breakout Box connector [10].
   - Battery voltage present? YES
   - NO
   - YES
   - Locate and repair short to PK wire to voltage.
   - NO
   - Check for continuity at Breakout Box between Pin 12 and Pin 11 in connector [10].
     - Continuity present? YES
     - NO
     - YES
     - Locate and repair short on PK wire to ground.
     - NO
     - Plug in [10]. Connect voltmeter across Pin 12 and Pin 11 at Breakout Box [10].
       - Start engine and let motor idle. Is voltage approximately 4.0-6.0 volts? YES
       - NO
       - YES
       - Reconnect [39]. Locate intermittents using 4.7 WIGGLE TEST. Intermit-tents found? YES
       - NO
       - Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
       - YES
       - Replace instrument module. See 7.19 INSTRUMENT MODULE.
       - NO

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

Cooling Fan High Voltage
This code occurs when the engine is running and the ECM has commanded the fan on, and the voltage remains high at pin 6 of ECM connector [11] (gray connector).

NOTE
An engine temperature (ET) sensor signal, indicating a cylinder head temperature above 428° F (220° C), causes the ECM to command the fan on. When ignition is OFF, fan may run for approximately two and a half minutes depending on temperature of vehicle when ignition was turned off. See Figure 4-59.

Cooling Fan Low Voltage
This code will set when the ignition key is ON and the ECM does not sense voltage at pin 6 of ECM terminal 11 (gray connector).

DIAGNOSTICS

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the Code 36 flow charts.
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probes and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.

Table 4-29. Cooling Fan Specifications

<table>
<thead>
<tr>
<th></th>
<th>FAN ON</th>
<th>FAN OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key ON</td>
<td>220° C (428° F)</td>
<td>180° C (356° F)</td>
</tr>
<tr>
<td>Key OFF</td>
<td>170° C (338° F)</td>
<td>150° C (302° F)</td>
</tr>
</tbody>
</table>

This code can also set if fan blade does not spin (blocked fan blade) when fan is commanded on and battery voltage is applied to fan.

Figure 4-59. Cooling Fan
Table 4-30. Wire Harness Connectors in Figure 4-60.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[97]</td>
<td>cooling fan</td>
<td>2-place Multilock</td>
<td>behind rear cylinder</td>
</tr>
</tbody>
</table>
HOME

Code 36 Test (Part 1 of 2-fan runs continuously)

Does cooling fan run continuously?

YES

Disconnect gray connector (11) at ECM. Turn IGN switch ON. Does fan run?

YES

Repair short to ground in BK/O wire between ECM and fan.

NOTE: Fan will be engaged when cylinder head temperature exceeds 408°F (210°C).

NO

Is engine hot?

YES

Allow engine to cool. Go to BOLD asterisk on this page.

NO

Turn IGN OFF. Connect Breakout Box to ECM gray connector (11). Turn IGN ON. Measure volts at pin 9 of Breakout Box. Is voltage greater than 1.3 volts?

YES

NO

Turn IGN switch ON. Does fan run continuously?

YES

Defective ECM or ECM connection.

NO

See 4.18 TROUBLE CODE 14 (engine temperature sensor).

STOP

NO

Go to: Code 36 Test (Part 2 of 2-fan does not run).

At some point in the flow chart you may be instructed to jump directly to a 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.
Code 36 Test (Part 2 of 2-fan does not run)

1. Connect Breakout Box to ECM gray connector (leave ECM disconnected). With key ON, check for voltage at pin 6 (gray) of Breakout Box. Is battery voltage present?
   - YES - Go to step 2
   - NO - Continue with next step

2. Connect jumper wire between pin 6 (gray) of Breakout Box and ground. Does fan run?
   - YES - Go to step 3
   - NO - Disconnect fan harness (97). Remove cooling fan fuse. Check for continuity to ground between terminal 24 of fuse block and chassis ground. Continuity present?
     - YES - Repair open in circuit between fan connector [97B] Y/BN wire and fuse block. Continue with next step
     - NO - System ok.

3. With key ON, check for battery voltage at Y/BN side of fan connector. Is battery voltage present?
   - YES - Connect Breakout Box to ECM gray connector (leave ECM disconnected). With key ON, check for voltage at pin 6 (gray) of Breakout Box. Is battery voltage present?
     - YES - Replace ECM.
     - NO - Replace ECM.

4. With key ON, check for battery voltage at Y/BN side of fan connector. Is battery voltage present?
   - YES - Repair short to ground in Y/BN wire.
   - NO - Is there an obstruction preventing fan from rotating?
     - YES - Repair short to ground in Y/BN wire.
     - NO - Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Continue with next step

5. Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Continuity present?
   - YES - System ok.
   - NO - Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Resistance greater than 1 ohm?
     - YES - System ok.
     - NO - Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Resistance less than 1 ohm?
       - YES - System ok.
       - NO - Replace fan.

6. Is there an obstruction preventing fan from rotating?
   - YES - Repair fan harness at fan. Use ohmmeter to measure resistance between Y/BN terminal and BK terminal of fan connector [97A]. Resistance greater than 1 ohm?
     - YES - Replace fan.
     - NO - Replace fan.

7. Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Continuity present?
   - YES - System ok.
   - NO - Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Resistance greater than 1 ohm?
     - YES - Replace fan.
     - NO - Replace fan.

8. Repair open in circuit between pin 6 (gray) of Breakout Box and BK/O wire of fan connector [97A]. Resistance less than 1 ohm?
   - YES - System ok.
   - NO - Replace fan.
GENERAL

NOTE

See Figure 4-61. When vehicle lean angle causes weighted pendulum to enter shaded area for a period of greater than one second, ECM shuts off ignition and fuel systems.

Bank Angle Sensor

See Figure 4-63. A Code 44 occurs when the bank angle sensor voltage is outside the normal operating range of 0.25-2.7 volts. Refer to Table 4-31. This may be caused by:

- Short to ground in harness between sensor and electronic control module.
- Short to voltage in harness between sensor and electronic control module.
- Failed sensor.

If this code occurs, the engine may stop running. The engine may still be restarted and ridden to the dealership for repair.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 44 flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probes and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.

<table>
<thead>
<tr>
<th>MODE</th>
<th>VOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Run mode</td>
<td>0.25-2.7</td>
</tr>
<tr>
<td>Disable mode</td>
<td>2.8-4.8</td>
</tr>
</tbody>
</table>

Figure 4-61. Bank Angle Sensor Operation

Figure 4-62. Bank Angle Sensor (XB12Ss)

Figure 4-63. Bank Angle Sensor (Typical)
Table 4-32. Wire Harness Connectors in Figure 4-64.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10] ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
<td></td>
</tr>
<tr>
<td>[14] cam position sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
<td></td>
</tr>
<tr>
<td>[88] throttle position sensor</td>
<td>3-place Packard</td>
<td>right side of engine between cylinders</td>
<td></td>
</tr>
<tr>
<td>[134] bank angle sensor</td>
<td>6-place Sumitomo</td>
<td>under seat</td>
<td></td>
</tr>
</tbody>
</table>
Code 44 Test (Part 1 of 2)

Is bank angle sensor connected?

YES

Disconnect bank angle sensor connector [134]. Measure voltage on [134] between Socket 5 (Lt GY/GN) and Socket 6 (BK/W). What is voltage?

4.75-5.25 volts

Measure voltage between Socket 4 (R/W) and Socket 6 (BK/W). Is voltage 4-6 volts?

YES

STOP

NO

Repair short to voltage on Lt GY/GN wire.

11-13 volts

Reconnect. Clear codes and cycle ignition key. Recheck for codes.

0 volts

Go to Code 44 Test (Part 2 of 2).

No

NO

Reconnect. Clear codes and cycle ignition key. Recheck for codes.

YES

Is bank angle sensor correctly installed?

YES

STOP

NO

Repair open in R/W wire between [134] and harness.

Are ferrous metals located within 0.25 in. (6.4 mm) of sides, face or top of bank angle sensor?

YES

Install properly. See 4.35 BANK ANGLE SENSOR.

NO

Replace bank angle sensor. See 4.35 BANK ANGLE SENSOR.

STOP

Return to original configuration.
2006 Buell Lightning: Fuel System 4-87

Code 44 Test (Part 2 of 2)

Continued from Code 44 Test (Part 1 of 2).

Disconnect connectors [10] (BK) and [11] (GY) from module and plug into Breakout Box (HD-45682). Check continuity between Socket 5 (Lt GN/GY) on connector [134] and Breakout Box (BK) Pin 10. Is continuity present?

\[ \text{YES} \]

Check continuity to ground for Socket 6 (BK/W) and connector [11] Pin 7. Is continuity present?

\[ \text{NO} \]

Repair open in Lt GN/GY wire.

\[ \text{YES} \]

Check continuity to ground for Socket 5 (Lt GN/GY) and connector [134]. Is continuity present?

\[ \text{NO} \]

Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

\[ \text{YES} \]

Repair open in ground wire.

\[ \text{NO} \]

Repair short to ground on Lt GN/GY wire.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL

ECM Failure

All of the following codes indicate a failure which requires replacement of the ECM. See 4.30 ELECTRONIC CONTROL MODULE.

- Code 52 - RAM failure.
- Code 53 - ROM failure.
- Code 54 - EE PROM failure.
- Code 55 - Microprocessor failure.

Figure 4-65. ECM (XB12Ss)

Figure 4-66. ECM (Typical)
GENERAL

Cam Sync Failure
This code occurs only when the engine is running if the electronic control module either receives an intermittent (extra or missing) signal from the cam position sensor or receives an unexpected signal. The motorcycle may continue to run, not run normally or stop running altogether.

DIAGNOSTICS

Diagnostic Notes
The reference numbers below correlate with the circled numbers on the Code 56 flow charts.
1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probes and patch cord.
3. See 4.31 CAM POSITION SENSOR AND ROTOR.

Figure 4-67. Cam Position Sensor
Figure 4-68. Cam Position Sensor Circuit

Table 4-33. Wire Harness Connectors in Figure 4-68.

<table>
<thead>
<tr>
<th>NO.</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>[10]</td>
<td>ECM (black)</td>
<td>12-place Deutsch</td>
<td>under seat</td>
</tr>
<tr>
<td>[14]</td>
<td>cam position sensor</td>
<td>3-place Deutsch</td>
<td>under sprocket cover</td>
</tr>
<tr>
<td>[88]</td>
<td>throttle position sensor</td>
<td>3-place Packard</td>
<td>right side of engine between cylinders</td>
</tr>
<tr>
<td>[134]</td>
<td>bank angle sensor</td>
<td>6-place Sumitomo</td>
<td>under seat</td>
</tr>
</tbody>
</table>
HOME

Code 56 (Part 1 of 2)

1. Attach Breakout Box (HD-43682). Disconnect cam position sensor connector [14]. Turn ignition ON.

   Connect voltmeter across Terminal A (R/W wire) and Terminal C (BK/W wire) of connector [14]. Is voltage 4.75-5.25 VDC?

   YES
   NO

   STOP

   Go to Code 56 (Part 1 of 2).

2. Measure the voltage between Pin A on [14] and Pin 1 on [11]. Continuity present?

   YES
   NO

   Measure the voltage between Pin 1 and Pin 7 on [11] (GY) using Breakout Box. Is voltage 4.75-5.25 VDC?

   YES
   NO


   YES
   NO

   Measure continuity between Pin A on [14] and Pin 1 on [11]. Continuity present?

   NO

   Repair open in R/W wire between connectors [11] and [14].

   Location and repair R/W wire short to ground.

   Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
Continued from Code 56 (Part 1 of 2).

Reconnect cam position sensor connector [14]. Using Breakout Box, measure voltage between Pin 3 and Pin 7 while cranking the engine. Does voltage fluctuate between 0-5 volts?

YES

NO

Intermittent open in GNVW wire or short in GNVW, W/BK or BK.

Perform 4.7 WIGGLE TEST and repair intermittent.

YES

NO

Check for continuity on GNVW wire between Terminal B of connector [14] and Terminal 3 of connector [11]. Continuity present?

YES

NO

Repair.

Remove timing cover and cam position sensor. Observe rotor cup while cranking engine. Does rotor turn?

YES

Check rotor for damage. Is rotor loose or damaged?

YES

NO

Repair.

NO

Is rotor attached properly?

YES

NO

Remove gearcase cover and inspect for damage.

YES

Replace rotor and retort.

NO

Replace cam position sensor and clear code. Retest. Problem still exist?

YES

Replace original cam position sensor. Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.

NO

System OK.

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).
GENERAL
See Figure 4-69. The Electronic Control Module (ECM) is located under the seat.

REMOVAL
1. Remove seat. See 2.43 SEAT.

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)

2. Disconnect and remove battery. See 1.4 BATTERY MAINTENANCE.
4. For XB12 Models: Remove the interactive exhaust connector [164].
5. Remove the two fasteners to detach electronic control module from bracket.

INSTALLATION
1. Align holes in ECM with those in electrical bracket. Install two fasteners and tighten to 48-72 in-lbs (5.4-8 Nm).
3. For XB12 Models: Attach the interactive exhaust connector [164].

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. (00066a)

4. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 in-lbs (8-11 Nm). See 1.4 BATTERY MAINTENANCE.
5. Connect negative battery cable.
6. Zero TPS. See 4.37 THROTTLE POSITION SENSOR.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.

NOTE
If the ECM was replaced with a new component, it will be necessary to recalibrate Throttle Position Sensor. Throttle position sensor can only be calibrated using DIGITAL TECHNICIAN (Part No. HD-44750).
Figure 4-71. ECM Wiring (Interactive Muffler Connector [164] 1200 Models Only)

Table 4-34. Pin Table for ECM Connector [10] (Black)

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Switched ignition</td>
</tr>
<tr>
<td>2</td>
<td>System ground A (module)</td>
</tr>
<tr>
<td>3</td>
<td>Fuel pump</td>
</tr>
<tr>
<td>4</td>
<td>Check engine lamp</td>
</tr>
<tr>
<td>5</td>
<td>Injector front</td>
</tr>
<tr>
<td>6</td>
<td>Front coil primary</td>
</tr>
<tr>
<td>7</td>
<td>Rear coil primary</td>
</tr>
<tr>
<td>8</td>
<td>Injector rear</td>
</tr>
<tr>
<td>9</td>
<td>Interactive muffler control feedback</td>
</tr>
<tr>
<td>10</td>
<td>Bank angle sensor input</td>
</tr>
<tr>
<td>11</td>
<td>System ground B (coil)</td>
</tr>
<tr>
<td>12</td>
<td>Tachometer</td>
</tr>
</tbody>
</table>

Table 4-35. Pin Table for ECM Connector [11] (Gray)

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>5-volt sensor power</td>
</tr>
<tr>
<td>16</td>
<td>Throttle position sensor</td>
</tr>
<tr>
<td>17</td>
<td>Camshaft position sensor</td>
</tr>
<tr>
<td>18</td>
<td>Oxygen sensor</td>
</tr>
<tr>
<td>19</td>
<td>Memory</td>
</tr>
<tr>
<td>20</td>
<td>Fan control</td>
</tr>
<tr>
<td>21</td>
<td>Sensor ground 1</td>
</tr>
<tr>
<td>22</td>
<td>Vehicle speed sensor</td>
</tr>
<tr>
<td>23</td>
<td>Engine temperature</td>
</tr>
<tr>
<td>24</td>
<td>Intake air temperature</td>
</tr>
<tr>
<td>25</td>
<td>Serial data receive</td>
</tr>
<tr>
<td>26</td>
<td>Serial data transmit</td>
</tr>
</tbody>
</table>
REMVAL

1. Disconnect negative battery cable.
2. Remove sprocket cover. See 2.33 SPROCKET COVER.

NOTES

● Make note of cable strap positions and wire routing during disassembly.
● For more information about the wiring located underneath the sprocket cover see 7.2 SPROCKET COVER WIRING.

3. Cut cable straps holding cam position sensor wiring.
4. See Figure 4-72. Disconnect cam position sensor wiring at connector [14].
5. Note position of each cam position sensor wiring terminal in plug end of connector.
6. See Figure 4-74. Remove connector terminal pins (6). See B.2 DEUTSCH ELECTRICAL CONNECTORS under B.1 AMP MULTILOCK ELECTRICAL CONNECTORS.
7. Remove timer cover.
   a. Drill off heads of outer timer cover pop rivets (1) using a 3/8 in. drill bit.
   b. Tap remaining rivet shafts inboard through holes in timer cover (2) and inner cover (19).
   c. Remove timer cover. Remove inner cover screws (3) and inner cover (19).
   d. Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
8. See Figure 4-73. To obtain approximate ignition timing during installation, scribe alignment marks (4) across cam position sensor (3) in two places.
9. See Figure 4-74. Remove timer plate studs (4). Carefully remove cam position sensor. Remove bolt (17) and trigger rotor (16).
10. Carefully remove camshaft oil seal (15) if damaged or if there is any evidence of oil leakage past the seal.

Figure 4-72. Cam Position Sensor Connector [14]

Figure 4-73. Marking Ignition Timing
1. Pop rivet (2)
2. Timer cover
3. Screw (2)
4. Timer plate stud (2)
5. Cam position sensor connector (14)
6. Terminal pin
7. Electronic control module (ECM)
8. Connector, interactive exhaust system
9. Spark plug (2)
10. Rear spark plug cable
11. Mounting fastener
12. Ignition coil
13. Front spark plug cable
14. Engine mount
15. Seal
16. Trigger rotor
17. Trigger rotor bolt
18. Cam position sensor
19. Inner cover

Figure 4-74. Ignition Components
the active muffler system. 1200 models only will contain the circuitry for
**INSTALLATION**

1. See Figure 4-74. Coat lip of seal with a thin film of clean engine oil. With the lipped side facing inboard, install new camshaft oil seal (15) into gearcase cover, if removed. Press seal into position until flush with surface of timer bore.

2. Install trigger rotor (16).
   a. Apply LOCTITE 243 (blue) to threads of bolt (17).
   b. Position trigger rotor (16) onto end of camshaft aligning notch with camshaft slot.
   c. Install bolt to secure rotor. Tighten to 43-53 in-lbs (5-6 Nm).

3. Install cam position sensor (18) and timer plate studs (4). Rotate cam position sensor to its previously marked position to obtain approximate ignition timing.

4. Route sensor wiring leads and install cable straps. See 7.26 SPROCKET COVER WIRING.

5. See Figure 4-76. Install sensor wiring terminals into correct positions in plug end of connector [14]. R/W, GN/W and BK/W wires of plug end (from cam position sensor) must match same color wires in receptacle end of connector (from ignition module wiring harness). Install pin terminals. See B.2 DEUTSCH ELECTRICAL CONNECTORS under B.1 AMP MULTILINK ELECTRICAL CONNECTORS.

6. See Figure 4-74. Attach connector [14] (6).

7. Check ignition timing. See 1.17 IGNITION TIMING.

8. Tighten timer plate studs (4) to 15-30 in-lbs (2-3 Nm).

9. Install inner cover (2) using screws (3). Tighten to 12-20 in-lbs (1-2 Nm).

**NOTE**

Use only H-D Part No. 8699 rivets to secure outer timing cover. These rivets are specially designed so that no rivet end falls off into the timing compartment. Use of regular rivets can damage ignition system components and may allow water to enter the timing compartment.

10. Secure timer cover (2) to inner cover using new rivets (1).

11. Connect negative battery cable.
TROUBLESHOOTING

Follow the troubleshooting procedures listed under 4.8 INITIAL DIAGNOSTIC CHECK if the engine will not start, is difficult to start or runs roughly. Also check condition of spark plug cables. Insulation on cables may be cracked or damaged allowing high tension current to short to metal parts. This problem is most noticeable when cables are wet.

If poor starting/running condition persists, check resistance of ignition coil primary and secondary windings using an ohmmeter.

NOTE

The ignition coil cannot be repaired. Replace the unit if it fails.

Primary Circuit Test

1. Remove ignition coil.
2. Set ohmmeter scale to RX1.
3. See Figure 4-77. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray socket probes, place multimeter wires on primary coil windings from terminal 1 to 2, and from terminal 2 to 3.
4. Refer to Table 4-36. Check primary coil winding resistance.
   a. Normal resistance range is 0.5-0.7 ohms.
   b. See TEST RESULTS which follows if resistance is not within normal operating range.

Secondary Circuit Test

1. Remove ignition coil.
2. Set ohmmeter scale to RX1K.
3. See Figure 4-77. Place multimeter wires on secondary coil windings from terminal 2 to R, and from terminal 2 to F.
4. Refer to Table 4-36. Check secondary coil winding resistance.
   a. Normal resistance range is 5.5-7.5K ohms.
   b. See TEST RESULTS which follows if resistance is not within normal operating range.

Test Results

1. A low resistance value indicates a short in the coil winding. Replace coil.
2. A high resistance value might indicate that there is some corrosion/oxidation of the coil terminals. Clean the terminals and repeat resistance test. If resistance is still high after cleaning terminals, replace coil.
3. An infinite ohms (∞ or OL) resistance value indicates an open circuit (a break in the coil winding). Replace coil.

Ignition Coil Substitution

If a coil tester is not available, use the following test.

NOTE

Coil will function without being attached to frame.

1. Substitute a new ignition coil by attaching it to any convenient point near the old coil. Transfer connector [83] to new coil.
2. Attach new spark plug cables to coil and spark plugs.
3. Test system. If ignition trouble is eliminated by the temporary installation of a new coil, carefully inspect old coil and cables for damage. The insulation on the cables may be cracked or otherwise damaged allowing high tension current to short to metal parts. This is most noticeable in wet weather or after the motorcycle has been washed.

Table 4-36. Ignition Coil Winding Resistance

<table>
<thead>
<tr>
<th>WINDING</th>
<th>OHMMETER SCALE</th>
<th>NORMAL RESISTANCE RANGE (IN OHMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>R x 1</td>
<td>0.5-0.7</td>
</tr>
<tr>
<td>Secondary</td>
<td>R x 1K</td>
<td>5.5K-7.5K</td>
</tr>
</tbody>
</table>

Figure 4-77. Ignition Coil Circuit
**WARNING**

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

1. Disconnect negative battery cable.
2. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
3. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
4. See Figure 4-78. Disconnect the spark plug cables from the coil plug posts (1, 5).
5. Detach connector (3) [83].
6. Remove coil fasteners (2).

**INSTALLATION**

**NOTE**

To ease installation, install spark plug cables to ignition coil first.

1. Connect spark plug cables to ignition coil.
2. See Figure 4-78. Attach coil to frame with fasteners (2). Tighten to 120-144 in-lbs (13.6-16.3 Nm)
3. Attach front and rear spark plug cables to ignition coil posts.
4. Attach connector (3) [83].
5. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
6. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
7. Connect negative battery cable.
GENERAL

See Figure 4-80. The oxygen sensor (O2 Sensor), located in the rear header pipe, monitors oxygen content in the exhaust gas and converts it to a voltage reading. This voltage reading is used by the ECM to maintain the proper airfuel ratio during closed loop operation.

REMOVAL

WARNING

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

1. Disconnect negative battery cable.
2. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
3. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
4. Remove shock absorber. See 2.22 REAR SHOCK ABSORBER.
5. Remove cooling fan. See 4.38 COOLING FAN.
6. See Figure 4-81. Remove cable straps (2). Unplug 1-place connector [137] (1).
7. Remove oxygen sensor from exhaust header using Snap-on Part No. YA8875.

INSTALLATION

1. Apply LOCTITE ANTI-SEIZE LUBRICANT to threads of sensor. Make sure anti-seize is marked as safe for use with O2 sensors.
2. See Figure 4-80. Thread sensor into exhaust header. Tighten sensor to 40-45 ft-lbs (54-61 Nm).
3. Install cooling fan. See 4.38 COOLING FAN.
4. Install shock absorber. See 2.22 REAR SHOCK ABSORBER.
5. See Figure 4-81. Connect 1-place connector [137] (1) to wiring harness.
6. Install cable straps (2).
7. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
8. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
9. Connect negative battery cable.
GENERAL

See Figure 4-83. The Engine Temperature Sensor (ET Sensor), located in the rear cylinder head, monitors the engine temperature close to the combustion chamber. In addition to aiding the ECM in monitoring the operation of the engine, it is also used to warn the operator of potentially damaging temperatures by causing the CHECK ENGINE lamp to blink during operation.

REMOVAL

1. Remove seat. See 2.43 SEAT.

![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. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
4. Remove air cleaner. See 4.44 AIR CLEANER ASSEMBLY.
5. See Figure 4-84. Remove right upper tie bar fastener. Rotate tie bar to provide access to sensor.

![NOTE]

Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

6. Unplug 1-place ET Sensor connector (1) [90] above rear cylinder head.
7. Slide rubber boot up ET sensor wire.
8. Remove sensor from rear cylinder head using Snap-on socket M3503B.

INSTALLATION

![NOTE]

Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

1. See Figure 4-83. Screw sensor into rear cylinder head.

![NOTE]

In next step, make sure wire is in cutout portion (slot) of socket to prevent damage.

2. Secure sensor with Snap-on socket M3503B. Tighten ET sensor to 120-168 in-lbs (13.6-19 Nm).

![NOTE]

Orient the rubber boot so the flat on the boot is towards the left side of the motorcycle.

3. Push rubber boot down sensor wire towards cylinder head until it seats in hole on top of ET sensor.
4. See Figure 4-84. Connect ET sensor 1-place connector [90] to wiring harness.
5. Install right upper tie bar fastener. Tighten fastener to 25-27 ft-lbs (33.9-36.6 Nm).
6. Install air cleaner. See 4.44 AIR CLEANER ASSEMBLY.
7. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
8. Connect negative battery cable.

![WARNING]

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat. See 2.43 SEAT.
GENERAL

The Bank Angle Sensor (BAS), located under the seat, provides input to the ECM on vehicle lean angle. If vehicle lean angle exceeds predetermined bank angle limit, the Bank Angle Sensor will shut off power to the ignition and fuel pump.

REMOVAL

1. Remove seat. See 2.43 SEAT.

**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. See Figure 4-85. Remove screws and washers to detach sensor from seat latch bracket.
4. Unplug bank angle sensor connector [134] and remove.

INSTALLATION

1. See Figure 4-85. Install bank angle sensor connector [134].
2. Position bank angle sensor on seat latch bracket. Make sure locating post on sensor engages hole in mounting tab.
3. Install bank angle sensor to mounting tab with fasteners and new locknuts. Tighten fastener to 12-36 in-lbs (1.4-4.1 Nm).

**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. (00065a)

4. Connect negative battery cable.

**WARNING**

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat. See 2.43 SEAT.
GENERAL

See Figure 4-86. The intake air temperature sensor (IAT Sensor), located on the air cleaner baseplate, measures the air temperature allowing the ECM to calculate the density of the air entering the manifold. The IAT is a thermistor type sensor.

REMOVAL

WARNING

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

1. Disconnect negative battery cable.
2. See Figure 4-86. Remove air cleaner cover and filter. Remove fasteners securing base. See 4.44 AIR CLEANER ASSEMBLY.
3. Raise base and pull IAT sensor from sensor grommet.
4. Disconnect connector [89] from intake air temperature sensor.
5. Inspect sensor grommet for damage and replace as required.

INSTALLATION

1. Connect IAT sensor connector [89] to wiring harness.
2. Install IAT sensor into grommet on air cleaner assembly baseplate from underneath.
3. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
4. Install negative battery cable.
REMOVAL
1. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
2. See Figure 4-87. Disconnect throttle position sensor connector [88].
3. See Figure 4-88. Remove two screws and washers to detach TP sensor.

INSTALLATION
1. See Figure 4-88. Apply LOCTITE 222 (purple) to threads of fasteners.
2. Install fastener into lower mounting hole of sensor prior to installation.
3. Attach TP sensor with both fasteners and washers. Tighten to 12-14 in-lbs (1.4-1.6 Nm).
4. See Figure 4-89. Attach throttle position sensor connector [88]. Slots on female connector [88B] must fully engage tabs on male connector housing [88A].

NOTE
Throttle position sensor can only be calibrated using DIGITAL TECHNICIAN (Part No. HD-44750).
5. Calibrate throttle position sensor.
GENERAL

A computer-controlled cooling fan assists engine cooling during operation in high temperatures. Fan actuation is controlled by the ECM. Refer to Table 4-37.

Table 4-37. Cooling Fan Specifications

<table>
<thead>
<tr>
<th></th>
<th>FAN ON</th>
<th>FAN OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key ON</td>
<td>220° C (428° F)</td>
<td>180° C (356° F)</td>
</tr>
<tr>
<td>Key OFF</td>
<td>170° C (338° F)</td>
<td>150° C (302° F)</td>
</tr>
</tbody>
</table>

REMOVAL

1. Remove seat. See 2.43 SEAT.

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. Remove shock absorber. See 2.22 REAR SHOCK ABSORBER.

4. See Figure 4-90. Remove cooling fan fasteners (1).

5. Rotate fan clockwise (looking towards front of vehicle) to remove.

6. See Figure 4-91. Disconnect cooling fan connector [97].

INSTALLATION

1. See Figure 4-91. Connect cooling fan connector [97].

NOTES

- When installing cooling fan (3), be sure wiring, transmission vent hose and fuel line are routed through notch (2) in fan body.
- On California models, both fuel tank and canister vent hoses are routed through notch in fan body.

2. Install fan and rotate counterclockwise into position.

3. Install cooling fan fasteners. Tighten to 12-36 in-lbs (1.4-4.1 Nm).

4. Install shock absorber. See 2.22 REAR SHOCK ABSORBER.

5. Connect negative battery cable.

6. Install seat. See 2.43 SEAT.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
GENERAL

The fuel pump is located inside the left rear portion of the fuel tank/frame.

DRAINING FUEL TANK

**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)

1. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-92. Disconnect the 4-place fuel pump connector (1) [86]. Connector is located inside the left rear portion of the fuel tank/frame.
   b. With the motorcycle in neutral, start the engine and allow vehicle to run.
   c. When the engine stalls, press the starter button for 3 seconds to remove any remaining fuel from fuel line.

**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)

2. Remove drain plug (4) and drain fuel into appropriate container. Discard plug.
3. When fuel tank is empty, replace with new drain plug. Tighten to 84-108 in-lbs (9.5-12.2 Nm).
1. Remove rider footpeg mounts. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
2. Remove swingarm. See 2.19 SWINGARM AND BRACE.
3. Drain fuel tank. See DRAINING FUEL TANK under 4.39 FUEL PUMP.

**WARNING**

With fuel tank drained, gasoline can spill from bore when supply valve is loosened or removed. 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. (00277a)

4. See Figure 4-92. Remove fuel line from fuel supply fitting (2).
5. Remove four fuel pump fasteners (5).
6. See Figure 4-93. Assemble fuel pump puller.
   a. Thread nut (3) onto bolt (4).
   b. Slide washer (2) onto bolt.
   c. Insert bolt assembly into hole in main body (1).
7. See Figure 4-94. Place the main body of the fuel pump puller over the fuel pump assembly.
8. Thread bolt into the threaded hole in the center of the fuel pump assembly until snug.
9. Thread the nut down the shaft of the bolt until it makes contact with the main body of the fuel pump puller.
10. Place wrench onto nut and another wrench onto the bolt. Hold the bolt stationary and turn nut clockwise until fuel pump is pulled free from frame.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-45657</td>
<td>Fuel pump puller</td>
</tr>
</tbody>
</table>

![Figure 4-93. Fuel Pump Puller](image1)

![Figure 4-94. Fuel Pump Removal](image2)
Fuel Pressure Regulator Replacement

1. Remove fuel pump assembly from tank. See REMOVAL in this section.
2. See Figure 4-95. Remove the plastic retaining ring (1) securing the four plastic retainers (2) holding the fuel pressure regulator (3) in place. Spread the four clips and detach regulator (3) from regulator housing (4).
3. Remove and discard o-rings from regulator.
4. Install new o-rings on new regulator. Press new regulator into place.
5. Install plastic retaining ring (1).
6. Install fuel pump assembly. See INSTALLATION in this section.

Figure 4-95. Fuel Pressure Regulator

<table>
<thead>
<tr>
<th></th>
<th>Plastic retaining ring</th>
<th>Plastic retainers</th>
<th>Fuel pressure regulator</th>
<th>Fuel pressure regulator housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fuel pressure regulator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fuel pressure regulator housing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Low Fuel Level Sensor Replacement

1. Remove fuel pump assembly from tank. See REMOVAL in this section.
2. See Figure 4-96. Disconnect low fuel level sensor connector (10).
3. Remove screw (8) securing low fuel level sensor (7) in place.
4. Install new sensor.
5. Install screw (8) securing sensor and tighten to 18-22 in-lbs (2.0-2.5 Nm).
6. Attach low fuel level sensor wire connector (10).
7. Install fuel pump assembly. See INSTALLATION in this section.

Figure 4-96. Fuel Pump Assembly

1. Fuel supply stud
2. Fuel pump assembly
3. O-rings
4. Fuel screen
5. Fuel pump
6. Fuel pump connectors
7. Low fuel pressure regulator
8. Fastener
9. Fuel pressure regulator
10. Low fuel level sensor connector
Fuel Filter Replacement

1. Remove fuel pump assembly from tank. See REMOVAL in this section.
2. See Figure 4-97. Disconnect electrical connectors (5, 6).
3. Remove ground fastener (12) from the fuel pump and fuel filter bracket (9).
4. Remove fuel pressure regulator E-clip (7).
5. Pull regulator housing (3) and fuel pump (8) with bracket (9).
6. Remove fuel filter (2).

**NOTE**
Remove the rubber seals from each end of the original fuel filter to be used on the new fuel filter.

7. Install rubber seals on new fuel filter and install filter into pump housing (11).
8. See Figure 4-97. Install regulator housing (3) and fuel pump (8) assembly.
9. Install E-clip (7) in bottom groove on shaft.
10. Install ground fastener (12) and connect ground wires to bracket (9) and tighten to 18-22 in-lbs (2.0-2.5 Nm).
11. Connect electrical connectors (5, 6).
12. Route overflow hose (10) through guide in bracket (9).
13. Install fuel pump assembly. See INSTALLATION in this section.

**NOTE**
Fuel pump connectors are two different sizes to prevent incorrect installation.

---

**Figure 4-97. Fuel Pump Assembly (Left and Right Sides)**

1. Fuel Filter
2. Fitting
3. Pressure regulator housing
4. Low fuel level sensor
5. Fuel pump connectors
6. Low fuel level sensor connector
7. Pressure regulator E-clip
8. Fuel pump
9. Bracket, fuel pump and fuel filter
10. Overflow hose
11. Fuel pump housing
12. Ground fastener
**Fuel Screen Replacement**

1. Remove fuel pump assembly from tank. See REMOVAL in this section.
2. See Figure 4-97. Disconnect electrical connectors (5) & (6).
3. Remove ground fastener (12) from the fuel pump and fuel filter bracket (9).
4. Remove fuel pressure regulator E-clip (7).
5. Pull regulator housing (3) and fuel pump (8) with bracket (9) as an assembly.
6. See Figure 4-98. Pry fuel screen (1) from fuel pump (2).
7. Install new fuel screen on fuel pump.
8. Install regulator housing assembly (4, 5) and fuel pump (2).
9. Install E-clip (8) in bottom groove on shaft.
10. See Figure 4-97. Install ground fastener (12) and connect ground wires to bracket (9) and tighten to 18-22 lbs (2.0-2.5 Nm).

**NOTE**

Fuel pump connectors are two different sizes to prevent incorrect installation.

11. Connect fuel pump connectors (5, 6).

12. Route overflow hose (10) through guide in bracket (9).
13. Install fuel pump assembly. See INSTALLATION in this section.

**Table 4-38. Fuel Pump Specifications**

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Setting</td>
<td>49 PSI</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>13.2 volts</td>
</tr>
<tr>
<td>Fuel Delivery</td>
<td>60 LPH @ 45 PSI [310 KPa]</td>
</tr>
<tr>
<td>Current Draw</td>
<td>6.0 Amps</td>
</tr>
</tbody>
</table>

**Figure 4-98. Fuel Pump Assembly**

1. Fuel screen  6. Plastic retaining ring, pressure regulator
2. Fuel pump    7. Fuel filter
3. Low fuel level sensor  8. E-clip
5. Fuel pressure regulator  10. Fuel pump wiring harness

**Diagram**
Fuel Pump Wire Harness Replacement

1. Remove fuel pump assembly from tank. See REMOVAL in this section.
2. See Figure 4-97. Disconnect fuel pump connector (5) and low fuel level sensor connector (6).
3. See Figure 4-99. Remove terminals from fuel pump connector [86].
4. See Figure 4-97. Remove ground screw (12).

**NOTE**
Note positions of wires in connector for correct assembly.

5. Disassemble fuel pump connector [86].
   a. See Figure 4-100. Remove connector clips (3).
   b. Insert push pin/safety pin (1), into connector as shown.
   c. Bend terminal tab towards connector pin and pull wire from opposite side of connector.
   d. Repeat for all wires.
6. From outer side of fuel pump assembly, push wire harness through assembly.
7. Lubricate new o-rings with clean engine oil. From inner side of fuel pump assembly, push new wire harness into assembly.
8. See Figure 4-97. Insert new fastener (12), through ground wire terminal and secure to bracket (9). Tighten to 18-22 in-lbs (2.0-2.5 Nm).

**NOTE**
After installing terminals, pull slightly on wire to make sure it is seated. If necessary, bend tab on terminal to aid in seating wire.

10. See Figure 4-97. Connect low fuel level sensor connector (6).
11. Connect fuel pump connectors (8). Connectors are two different sizes.
12. Install fuel pump assembly. See INSTALLATION in this section.
1. See Figure 4-96. Replace o-rings (3). Lubricate new o-rings with clean engine oil.
2. Install new o-rings on fuel supply stud (2). Larger o-ring is located in groove closer to fuel pump.
3. See Figure 4-101. Insert fuel pump into frame until resistance is felt.
4. Insert four screws (5) through fuel pump and into frame.

**NOTE**
Use all four screws to draw fuel pump into frame. Using less than four screws will damage fuel pump o-rings.
5. Using crosswise pattern, draw fuel pump into frame by tightening screws. Final tighten screws to 48-51 in-lbs (5.4-5.8 Nm).

**WARNING**
Do NOT overtighten fuel fitting nuts. Overtightening fasteners may result in excessive compression of sealing components and fuel leakage which could result in death or serious injury.

6. Install fuel supply line banjo fitting (2) over fuel supply stud (3). Install new fastener. Tighten to 84-108 in-lbs (9.5-12.2 Nm).
7. Fill tank with a small amount of fuel. Check for leaks.
8. Connect fuel pump connector [86] (1) and push cable strap tab into hole in frame.

---

**Figure 4-101. Fuel Pump Location**

1. Connector [86]  
2. Fuel supply fitting  
3. Fuel supply stud  
4. Drain plug  
5. Fasteners  
6. Wire harness
GENERAL

The vent valve opens to allow gas vapor to escape the fuel tank and either vent to the atmosphere or to the charcoal canister on California Models (EVAP-equipped) and closes to prevent gasoline from leaking out of the fuel tank if the vehicle is tipped at an extreme angle.

NOTE

The fuel tank must be drained to perform this service.

REMOVAL

1. Remove seat. See 2.43 SEAT.

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. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
4. Drain fuel tank. See DRAINING FUEL TANK under 4.39 FUEL PUMP.
5. Remove fuel tank vent line from vent valve.
6. See Figure 4-102. Remove vent valve fasteners (5).
7. Remove bracket (4), vent valve (3) and o-ring (2) from fuel tank/frame (1).

INSTALLATION

1. See Figure 4-102. Install new vent valve o-ring (2).
2. Install vent valve (3) into fuel tank/frame. Vent valve nozzle should be at approximately the 7:00 position.
3. Install bracket over vent valve. Slot in bracket should line up with notch in valve.
4. Loosely install vent valve fasteners (5).
5. Tighten fasteners to 39-41 in-lbs (4.4-4.6 Nm).
6. Connect fuel tank vent line to vent valve.
7. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
8. Connect negative battery cable. Tighten battery terminal hardware to 72-96 in-lbs (8-11 Nm).

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat. See 2.43 SEAT.
REMOVAL

NOTE
The fuel tank must be drained to perform this service.
1. Drain fuel tank. See DRAINING FUEL TANK under 4.39 FUEL PUMP.
2. Remove fuel filler cap.
3. See Figure 4-103. Remove fasteners (4) securing fuel cap retaining ring (3) to fuel filler neck (1).
4. Remove fuel cap retaining ring and o-ring (2). Discard o-ring.

INSTALLATION

1. Coat new o-ring (2) with thin film of clean engine oil.
2. Place o-ring into groove in underside of fuel cap retaining ring (3).

NOTE
Be sure o-ring remains in groove of fuel cap retaining ring during installation.
3. Insert fuel cap retaining ring into fuel filler neck.
4. Install fasteners (4). Tighten to 62-71 in-lbs (7-8 Nm).
5. Install fuel filler cap.

Figure 4-103. Fuel Cap Retaining Ring
GENERAL

See Figure 4-105. The throttle body consists of the following components:
- Fuel supply fitting.
- Idle speed adjustment screw.
- Cable bracket.
- Throttle position sensor.
- Throttle lever.

REMOVAL

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)

1. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-104. Disconnect the 4-place fuel pump connector [86]. Connector is located on the left side, above the fuel pump.
   b. With the motorcycle in neutral, start the engine and allow vehicle to run.
   c. When the engine stalls, press the starter button for 3 seconds to remove any remaining fuel from fuel line.
   d. Reconnect fuel pump connector.
2. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
3. Label and detach throttle cables. See 2.23 THROTTLE CONTROL.
4. See Figure 4-106. On California models, pull EVAP hose from fitting (1).
5. Remove left and right air scoops. See 2.38 AIR SCOOPS.
6. Remove ignition coil. See 4.32 IGNITION COIL.
Figure 4-105. One Piece Throttle Body/Intake Manifold Assembly (all models)
HOME

7. Remove assembly from motorcycle.
   a. See Figure 4-107. On primary side, loosen but do not remove the two front and rear intake flange fasteners (2).
   b. Remove fastener (1) holding manifold to engine mount.
   c. See Figure 4-108. On gearcase cover side, remove both intake flange fasteners from cylinder heads.
   d. Slide the throttle body assembly through top of bike frame.

8. See Figure 4-105. Remove intake flanges (14) from manifold. Remove and discard seals (15).

REPAIR

Throttle Position Sensor
See 4.37 THROTTLE POSITION SENSOR for removal, installation and calibration information.

Fuel Injectors
1. Remove throttle body. See REMOVAL in this section.
2. Separate fuel rail assembly from throttle body.
   a. See Figure 4-109. Remove both injector clips (4).
   b. Remove fuel rail fasteners (1, 6) that hold the fuel rail to the throttle body and manifold.
   c. Separate fuel rail from injectors (2, 5) by gently rocking the fuel rail and pulling it away from the injectors.
3. Remove fuel injectors (2, 5) from manifold by gently rocking and pulling it away from the manifold.

NOTE
Front and rear fuel injectors are not interchangeable.
WARNING
Do not use any injector that has damaged or deformed o-rings. Damaged o-rings may leak gasoline. Gasoline is extremely flammable and highly explosive. Use of damaged o-rings could result in death or serious injury.

4. Inspect all injector o-rings for cuts, tears or general deterioration. Replace injector if o-rings have been damaged or have taken a definite set.

5. Apply a thin coat of clean engine oil to top and bottom injector o-rings.

NOTE
Front and rear fuel injectors are not interchangeable.

6. See Figure 4-109. Install fuel injectors.
   a. Install both injectors (2, 5) into throttle body.
   b. Press the fuel rail assembly (3) onto the top of the injectors.
   c. Apply a drop of LOCTITE 222 (purple) to threads of fuel rail fasteners (1, 6).
   d. Secure the fuel rail to the throttle body with fasteners. Tighten to 20-25 in-lbs (2.3-2.8 Nm).

7. Snap the injector clips (4) over the flange on the fuel rail outlet and into the top groove in the injector.

Testing
1. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
2. Remove air cleaner cover. See 4.44 AIR CLEANER ASSEMBLY.
3. Conduct test.
   a. Turn key ON for two seconds.
   b. Turn key OFF for two seconds.
   c. Repeat Steps A and B five consecutive times.
   d. Open throttle, replace fuel injectors if there is any evidence of raw fuel in throttle body manifold.

4. Install air cleaner cover. See 4.44 AIR CLEANER ASSEMBLY.
5. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
1. See Figure 4-110. Install front and rear intake flanges onto throttle body with the counterbore facing out. Each intake flange is labeled and the pieces are not interchangeable.

2. Place a new seal in each intake flange with the beveled side against the counterbore.

3. Install throttle body/intake manifold assembly.
   a. See Figure 4-107. Slide the assembly toward installed position. Manifold should slide over fasteners (2) on primary cover side of engine.
   b. Align holes in intake flanges with those in cylinder heads and start screws.
   c. Make sure throttle body is centered between cylinders and tighten all intake flange screws to 96-120 in-lbs (10.8-13.6 Nm).

4. Attach throttle cables. See 2.23 THROTTLE CONTROL.

5. Attach wiring.
   a. Injector cables are tagged F(front) and R(rear) for ease of assembly. Push connector halves together until latches “click.” Grooves in female connector must align with the tabs in male housing.
   b. Connect throttle position sensor by pushing the connector halves together. Slots on female connector must fully engage tabs on male connector housing.

6. Connect EVAP hose to port at bottom of throttle body (California models only).

7. Calibrate throttle position sensor if removed or replaced. See 4.37 THROTTLE POSITION SENSOR.

8. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.

9. Check throttle cable adjustment. See 2.23 THROTTLE CONTROL.
GENERAL

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.

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing 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.
- To prevent false readings, keep air cleaner cover installed when performing test.
- Do not direct propane into air scoop, false readings will result.

LEAK TESTER

Parts List

- Standard 14 oz. propane cylinder.
- HD-41417 Propane Enrichment Kit.
- 12 in. (304 mm) long 1/4 in. (6 mm) diameter copper tubing.

Tester Assembly

1. Cut rubber hose from kit to 18 in. (457 mm) in length.
2. See Figure 4-111. Flatten one end of copper tube to form a nozzle.
3. Insert round side of copper tube into end of tubing.

Figure 4-111. Nozzle

Figure 4-112. Leak Tester
INTAKE LEAK TEST

**DANGER**
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.

**DANGER**
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.

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing 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.

1. Start engine.
2. Warm engine to operating temperature.
3. See Figure 4-112. Turn knob (5) counterclockwise to open propane bottle (6).

**NOTE**
Do not direct propane stream toward front of engine. If propane enters air scoop a false reading will be obtained.

4. See Figure 4-113. Aim nozzle toward possible sources of leak such as fuel injectors and intake tract.
5. See Figure 4-112. Push valve (4) to release propane. Tone of engine will change when propane enters source of leak.

Figure 4-113. Checking for Intake Leak
Removal

1. Remove intake cover assembly. 2.37 INLET COVER ASSEMBLY.

Notes

● For XB12 models, see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

● For the XB9SX model with "Translucid" body work, an additional cover is found in the actuator cavity. Remove the two screws to remove the cover. To install, tighten the screws to 8-12 in-lbs (0.9-1.3 Nm).

2. See Figure 4-114. Remove fuel vent tube (2) from fuel cell vent (3) and groove on top of air cleaner cover (1).

3. Unlatch six lock tabs and remove air cleaner cover from baseplate.

4. Remove the filter element from baseplate. Inspect and replace if necessary.

5. See Figure 4-117. Remove air cleaner baseplate-baseplate.
   a. Remove four fasteners (1) and raise baseplate (4).
   b. Disconnect longer breather hose (5) from baseplate (pull out from bottom).
   c. Disconnect shorter breather hose from PVC valve located on top of rear cylinder.
   d. Disconnect IAT sensor connector (89) from bottom of baseplate.
   e. Lift baseplate off of frame, carefully disengaging baseplate from rubber sealing ring (7) on airflow stack (6).
   f. Remove baseplate from motorcycle.

Inspection

1. Inspect air cleaner assembly. Check for dirt, torn filter material and general condition. Replace if necessary.

2. Inspect inside of backing plate and cover. Remove any dirt or debris.

3. Inspect condition of velocity stack and velocity stack sealing ring. If torn or damaged, replace.

4. Inspect IAT sensor and replace if faulty. See 4.36 INTAKE AIR TEMPERATURE SENSOR.

5. Inspect breather hoses, intake air temperature sensor grommet and air cleaner cover seal (3). Replace as necessary.
1. See Figure 4-117. Hold baseplate above mounting posi-
tion.
2. Insert IAT sensor into grommet on baseplate from under-
side. See 4.36 INTAKE AIR TEMPERATURE SENSOR.

NOTES
● A small amount of soapy water applied to the inside
diameter of grommet will make breather hose installation
easier.
● In next step, be sure breather hoses do not extend past
intake air temperature sensor tower. If hoses extend past
tower, damage to sensor may occur.
3. Insert longer breather hose into right baseplate grommet
from underside.
4. Attach shorter breather hose onto crankcase breather
located on top of rear cylinder.
5. Carefully lower baseplate into mounting position. Ensure
rubber sealing ring on velocity stack completely engages
baseplate. Baseplate should be sandwiched between
upper and lower rubber sealing rings.
6. See Figure 4-119. Install baseplate (7) to frame with four fasteners and washers (5). Tighten fasteners to 84-120 in-lbs (9.5-13.6 Nm).
7. Position air cleaner filter on baseplate.
8. Install air cleaner cover to baseplate and latch six latches to secure.
9. Route vent hose through groove on air cleaner cover to vent valve.

**NOTE**
For XB12 models see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

10. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

11. Install seat. See 2.43 SEAT.
Figure 4-119. Air Cleaner Assembly (XB12 Models) with Interactive Exhaust Components

1. Screw (XB12 actuator cover, for "Translucid" models) (2)
2. Flat washer (not shown)
3. Actuator, interactive exhaust
4. Harness, interactive exhaust
5. Cable bracket
6. Interactive exhaust cable
7. Cover, air cleaner
8. Filter element
9. Air cleaner cover seal
10. Shoulder screw (4)
11. Baseplate assembly
12. Breather hoses, front and rear
13. Grommet
14. Activator cover (XB12 "Translucid" cover)
GENERAL

Buell 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 vent valve and stored in the carbon canister. If the vehicle is tipped at an abnormal angle, the vent valve closes to prevent liquid gasoline from leaking out of the fuel tank through the fuel tank vent hose.
- When the engine is running, manifold venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the carbon canister through the canister vent hose. These vapors pass through the throttle body manifold and are burned as part of normal combustion in the engine.

TROUBLESHOOTING

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)

The system has been designed to operate with a minimum of maintenance. Check that all hoses are properly routed and connected and are not pinched or kinked.

REMOVAL

Vent Valve

1. Remove vent valve. See 4.40 FUEL TANK VENT VALVE.
2. If necessary, label fuel tank vent hose at canister fitting and remove.

Canister

1. See Figure 4-120. Label and disconnect the fuel tank vent hose (2) and canister vent hose (3) from the canister.
2. Slide canister towards rear of vehicle to disengage from mounting plate.
VENT VALVE

WARNING

Verify that the fuel tank vent hose does not contact hot exhaust or engine parts. The hose contains flammable vapors that can be ignited if damaged, which could result in death or serious injury.

NOTE

For XB12 models, see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

1. Install vent valve. See 4.40 FUEL TANK VENT VALVE.
2. See Figure 4-120. Attach fuel tank vent hose (2) to canister if disconnected.

CANISTER

NOTE

In next step, be sure canister hose barbs are facing rear of vehicle at approximately the 1 o’clock position.

1. See Figure 4-122. Slide canister into position on canister mounting plate and push towards front of vehicle.

WARNING

Always make sure fuel hoses are seated against the component they connect to and that hose clamps are properly tightened and positioned on straight section of fitting and not on the fitting barb. Failure to comply may result in fuel leakage which could result in death or serious injury.

NOTE

The barb is the largeroutside diameter portion (bump) on the fuel fitting.

2. See Figure 4-120. Connect two hoses to the canister.
   Make sure to push hoses all the way on to carbon canister fittings.
HOSE ROUTING

Both fuel tank and canister vent hoses are routed through notch in fan body.

NOTE
For information on vent hose routing, see D.1 HOSE AND WIRE ROUTING.

WARNING
Always make sure fuel hoses are seated against the component they connect to and that hose clamps are properly tightened and positioned on straight section of fitting and not on the fitting barb. Failure to comply may result in fuel leakage which could result in death or serious injury.

Figure 4-123. Emissions Hose Attachment, California Models Only
<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>PAGE NO.</th>
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</thead>
<tbody>
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<td>5-1</td>
</tr>
<tr>
<td>5.2 Electric Starter System</td>
<td>5-2</td>
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<td>5.3 Starting System Diagnosis</td>
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<td>5.4 Starter Activation Circuits</td>
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<td>5.5 Diagnostics/Troubleshooting</td>
<td>5-9</td>
</tr>
<tr>
<td>5.6 Starter System Testing</td>
<td>5-11</td>
</tr>
<tr>
<td>5.7 Starter</td>
<td>5-12</td>
</tr>
<tr>
<td>5.8 Starter Solenoid</td>
<td>5-21</td>
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### Table 5-1. Starter Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free speed</td>
<td>3000 RPM (min.)</td>
<td>@ 11.5 V</td>
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<tr>
<td>Free current</td>
<td>90 Amp (max.)</td>
<td>@ 11.5 V</td>
</tr>
<tr>
<td>Stall current</td>
<td>400 Amp (max.)</td>
<td>@ 2.4 V</td>
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<tr>
<td>Stall torque</td>
<td>8 ft-lbs (11 Nm)</td>
<td>(min.) @ 2.4 V</td>
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### Table 5-2. Service Wear Specifications

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<th>SERVICE WEAR LIMITS</th>
<th>IN.</th>
<th>MM</th>
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<tbody>
<tr>
<td>Brush length (min.)</td>
<td>0.433</td>
<td>11.0</td>
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<tr>
<td>Commutator diameter (min.)</td>
<td>1.141</td>
<td>28.981</td>
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### TORQUE VALUES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery terminal fasteners</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm</td>
</tr>
<tr>
<td>Starter battery positive cable nut</td>
<td>60-85 in-lbs</td>
<td>7-10 Nm</td>
</tr>
<tr>
<td>Starter mounting bolts</td>
<td>13-20 ft-lbs</td>
<td>18-27 Nm</td>
</tr>
</tbody>
</table>
GENERAL

The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear and a clutch gear in the drive housing. The idler gear is supported by rollers. The clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagram at the end of Section 7, ELECTRICAL.

Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

Starter Interlock

See 7.5 STARTER INTERLOCK for operation and troubleshooting information.

OPERATION

See Figure 5-1. When the starter switch is pushed, the starter relay is activated and battery current flows into the pull-in winding (10) and the hold-in winding (11), to ground.

The magnetic forces of the pull-in and hold-in windings in the solenoid push the plunger (7) causing it to shift to the left. This action engages the pinion gear (1) with the clutch ring gear (13). At the same time, the main solenoid contacts (8) are closed, so battery current flows directly through the field windings (3) to the armature (4) and to ground. Simulta-

neously, the pull-in winding (10) is shorted.

The current continues flowing through the hold-in winding (11) keeping the main solenoid contacts (8) closed. At this point, the starter begins to crank the engine.

After the engine has started, the pinion gear (1) turns freely on the pinion shaft through the action of the overrunning clutch (12). The overrunning clutch prevents the clutch ring gear (13) (which is now rotating under power from the engine) from turning the armature (4) too fast.

When the starter switch is released, the current of the hold-in winding (11) is fed through the main solenoid contacts (8) and the direction of the current in the pull-in winding (10) is reversed. The solenoid plunger (7) is returned to its original position by the return spring, which causes the pinion gear (1) to disengage from the clutch ring gear (13).
Figure 5-1. Starter Operation

- Pinion gear
- Idler gear
- Field winding
- Armature
- Brush
- Ball bearing
- Solenoid plunger
- Main solenoid contacts
- Battery
- Pull-in winding
- Hold-in winding
- Overrunning clutch
- Clutch ring gear

Starting circuit-see wiring diagram
DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the starter system flow charts.

1. See VOLTAGE DROPS under 5.5 DIAGNOSTICS/TROUBLESHOOTING.

2. Remove starter motor and connect jumper wires as described in FREE RUNNING CURRENT DRAW TEST under 5.7 STARTER.

3. Take measurement with connector mated.

4. See DIAGNOSTICS in 7.5 STARTER INTERLOCK.

5. See STARTER CURRENT DRAW TEST under 5.6 STARTER SYSTEM TESTING.

6. See FREE RUNNING CURRENT DRAW TEST under 5.6 STARTER SYSTEM TESTING.

Starter Test 1

Check battery using visual inspection, voltage test and load test.

Check connections at battery and starter components. Is system operational?

1. Motor terminal
2. Battery terminal
3. Relay terminal

![Figure 5-2. Starter Terminals](image)

1. Motor terminal
2. Battery terminal
3. Relay terminal

Disconnect solenoid-relay terminal from solenoid. Is 12V present on GN wire with starter button not pressed?

Is 12V present on starter relay Terminal 85 with starter button not pressed?

Replace solenoid.

Replace starter relay.

OR

OR

OR

OR

Relay clicks. See Starter Test 3: Relay Clicks.

Solenoid clicks. See Starter Test 2: Solenoid Clicks.

Nothing clicks. See Starter Test 4: Nothing Clicks.

Check for audible clicking noise.

STARTER RUNS ON.

STARTER SPINS, BUT DOES NOT ENGAGE.

STARTER STALLS OR SPINS TOO SLOWLY.

STARTER STALLS OR SPINS TOO SLOWLY.

STARTER STALLS OR SPINS TOO SLOWLY.

OR

OR

OR

Nothing click. See Starter Test 4: Nothing Clicks.
Starter Test 2: Solenoid Clicks

1. Perform voltage drop tests from battery positive to starter motor terminal. Crank engine. Voltage greater than 1 volt?
   - YES
   - NO

   1. Perform voltage drop tests from battery positive to starter terminal. Crank engine. Voltage greater than 1 volt?
      - YES
      - NO

      1. Perform voltage drop tests from battery negative and starter studs or bolts. Voltage greater than 1 volt?
         - YES
         - NO

         STOP

         Go to Starter Test 3: Relay Clicks. Begin with box marked with bold asterisk.

         YES
         NO

Starter Test 3: Relay Clicks

2. Does starter motor turn if jumped?
   - YES
   - NO

   2. Test for voltage at solenoid relay terminal on starter. Is 12V present when starter button is pressed?
      - YES
      - NO

      2. Test starter motor for opens, shorts or grounds. Replace or repair starter motor.
         - YES
         - NO

         YES
         NO

         Replace starter relay.

         NO

         Repair open on 5/16 wire leading Terminal 30 on starter relay.

         YES
         NO

         Repair open on R/BK wire feeding Terminal 30 on starter relay.

         NO

         Repair open on GN wire between relay and solenoid.

         YES

      2. Test for voltage to relay. Is 12V present on relay terminal 30?
         - YES
         - NO

         YES

         Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?
         - YES
         - NO

         2. Test starter motor for opens, shorts or grounds. Replace or repair starter motor.
            - YES
            - NO

            YES
            NO

            Repair open on 5/16 wire between relay and solenoid.

            NO

            Replace starter relay.

            YES

            Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

            NO

            Repair open on R/BK wire leading Terminal 30 on starter relay.

            YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?

           NO

           Repair open on R/BK wire leading Terminal 30 on starter relay.

           YES

           Test for voltage to relay. Is 12V present on relay terminal 30?

           NO

           Repair open on GN wire between relay and solenoid.

           YES

           Replace starter relay.

           NO

           Repair open on 5/16 wire between relay and solenoid.

           YES

           Test for voltage from relay to 12V present on relay Terminal 87 when starter button is pressed?
Starter Test 4: Nothing Clicks

1. Check for battery voltage at starter relay Terminal 85 from starter button. Battery voltage present?
   - YES
   - NO

   2. Check for ground at relay Terminal 85. Ground present?
      - YES
      - NO

      3. Substitute good starter relay or test relay.
         - YES
         - NO

      4. Repair wiring from starter button to relay.
         - YES
         - NO

   3. Check for battery voltage from starter button (BK/R wire at connector [22]). Battery voltage present with starter button pressed?
      - YES
      - NO

5831

   5832

   5816

5828

5816 5831

Inspect starter interlock circuit or correct relay ground.

Replace light runner switchgear.

Repair wiring to starter button.
Starter Test 5: Starter Spins But Does Not Engage

Remove starter. Disassemble drive housing assembly. Inspect for damage to armature gear or idler gear. Damage present?

YES
Replace damaged idler gear and armature.

NO
Starter clutch failure. Replace starter clutch.

Starter Test 6: Starter Stalls or Spins Too Slowly

1. Perform voltage drop tests from battery positive to starter battery terminal. Crank engine. Voltage greater than 1 volt?

YES
Perform voltage drop tests from battery positive to starter stud or bolt. Voltage greater than 1 volt?

NO
Repair connection between battery and starter.

YES
Perform voltage drop tests between battery negative and starter studs or bolts. Clean ground connections.

NO
Perform starter motor current draw test (on vehicle).

YES
Test starter motor for opens, shorts or grounds. Replace or repair starter motor.

NO
Perform starter motor free draw bench test.

YES
Check for engine, primary and/or crankshaft bind.

NO
Repair or replace solenoid (contacts).

NO
Perform voltage drop tests from battery positive to starter motor terminal. Crank engine. Voltage greater than 1 volt?

YES
Repair connection between battery and starter.

NO
Perform voltage drop tests between battery negative and starter studs or bolts. Remove spark plugs while in 5th gear. Rotate rear wheel.

YES
Test starter motor for opens, shorts or grounds. Replace or repair starter motor.

NO
Use appropriate code
STARTER ACTIVATION CIRCUITS

Figure 5-3. Typical Circuity. Refer to wiring diagrams for more information.
GENERAL

Follow the 5.3 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, fuses 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 5-3. 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 (1).
2. See ITEM B in Figure 5-3. 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 5-3. An open circuit should read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.
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.
   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 5-3. 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 5-4. Electric Starting System Circuit
“ON-MOTORCYCLE” TESTS

Starter Relay Test

NOTE
Starter relay test also applies to ignition and key switch relays.
1. See Figure 5-5. Locate starter relay. The relay is attached to the relay block under the seat.
2. To test relay, proceed to Step 3. If installing a new starter relay, remove old relay. Install new relay into relay block.
3. See Figure 5-6. Obtain a 12 volt battery and a continuity tester or ohmmeter.
   a. Pull relay from relay block.
   b. Connect positive battery lead to the 1 terminal.
   c. Connect negative battery lead to the 2 terminal to energize relay.
   d. Check for continuity between the 3 and 5 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.

Starter Current Draw Test

NOTES
● Engine temperature should be stable and at room temperature.
● Battery should be fully charged.
See Figure 5-7. Check starter current draw with an induction ammeter before disconnecting battery. Proceed as follows:
1. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.
2. Clamp induction ammeter over positive battery cable next to starter.
3. With ignition key switch ON, turn engine over by pressing starter switch 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 140-180 amperes.
   b. If starter current draw exceeds 180 amperes, then the problem may be in the starter or starter drive. Remove starter for further tests. See 5.7 STARTER.
REMOVAL

1. Remove seat. See 2.43 SEAT.

**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)

2. Disconnect battery. See 1.4 BATTERY MAINTENANCE.
3. Remove primary cover. See 6.2 PRIMARY COVER.
4. Remove sprocket cover. See 2.33 SPROCKET COVER.

**NOTE**

A ball hex driver may be required to gain access to the starter mounting bolts.

5. See Figure 5-8. Remove two starter mounting bolts and washers (1).
6. See Figure 5-9. Remove fastener with washer (1) (metric).
   a. Remove protective boot.
   b. Remove positive battery cable (2) ring terminal.
   c. Detach solenoid wire (3).
7. Remove starter and gasket from the gearcase cover side.

Figure 5-8. Starter Mounting

Figure 5-9. Starter Wires
(protective boot not shown)
TESTING ASSEMBLED STARTER

Free Running Current Draw Test
1. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. See Figure 5-10. Attach one heavy jumper cable (6 gauge minimum).
   a. To the starter mounting flange (1).
   b. To the negative (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
   a. To the positive (+) terminal of the battery (2).
   b. To an inductive ammeter (3). Continue on to the battery terminal (4) on the starter solenoid.
4. Connect a smaller jumper cable (14 gauge minimum).
   a. To the positive (+) terminal of the battery (2).
   b. To the solenoid relay terminal (5).
5. Check ammeter reading.
   a. Ammeter should show 90 amps maximum.
   b. If reading is higher, disassemble starter for inspection. See 5.7 STARTER.
   c. If starter current draw on vehicle was over 200 amps and this test was within specification, there may be a problem with engine or primary drive.

Starter Solenoid

NOTES
● Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in Figure 5-11.
● Each test should be performed for only 3-5 seconds to prevent damage to solenoid.
● The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. Conduct all three tests one after the other in the sequence given without interruption.

Solenoid Pull-in Test
1. See Figure 5-11. Using a 12 volt battery, connect three separate test leads as follows:
   a. Solenoid housing to negative battery post.
   b. Solenoid motor terminal to negative battery post.
   c. Solenoid relay terminal to positive battery post.
2. Observe starter pinion.
   a. If starter pinion pulls in strongly, solenoid is working properly.
   b. If starter pinion does not pull in, replace the solenoid.
Solenoid Hold-in Test

1. See Figure 5-12. With test leads still connected in the manner specified in the previous SOLENOID PULL-IN TEST, disconnect solenoid motor terminal/battery negative test lead (B) at negative battery post only; reconnect loose end of this test lead to positive battery post instead.

2. Observe starter pinion.
   a. If starter pinion remains in pull-in position, solenoid is working properly.
   b. If starter pinion does not remain in pull-in position, replace the solenoid.

Solenoid Return Test

1. See Figure 5-13. With test leads still connected in the manner specified at the end of the previous SOLENOID HOLD-IN TEST, disconnect solenoid relay terminal/positive battery post test lead (C) at either end.

2. Observe starter pinion.
   a. If starter pinion returns to its original position, solenoid is working properly.
   b. If starter pinion does not return to its original position, replace the solenoid.
1. See Figure 5-14. Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).
2. See Figure 5-15. Remove both thru-bolts (1, 3).
3. Remove both end cover screws with o-rings (2) and end cover (4).
4. See Figure 5-16. Use a wire hook to pull upward on brush springs (3), and lift brushes out of holder (2). Remove brush holder.
5. Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm).

**NOTE**
Brushes not available separately. Purchase a new field frame (1) and brush holder (2) to replace brushes.

6. Remove armature (4) and field frame (1).
7. Place armature in lathe or truing stand and check commutator runout and diameter.
   a. Commutators with more than 0.016 in. (0.406 mm) of runout should be replaced or machined on a lathe.
   b. Replace commutators when diameter is less than 1.141 in. (28.981 mm)
   c. Check armature bearings. Replace if necessary.

**NOTES**
- Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.
- See Figure 5-17. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.

8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.203 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.794 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.
Mica must not be left with a thin edge next to segments.

Mica must be cut away clean between segments.

Figure 5-17. Underrutting Mica Separators
9. See Figure 5-18. Check for SHORTED ARMATURE with a growler.
   a. Place armature on growler.
   b. Hold a thin steel strip (hacksaw blade) against armature core and slowly turn armature.
   c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace shorted armatures.

10. See Figure 5-19. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
    a. Touch one probe to any commutator segment.
    b. Touch the other probe to the armature core.
    c. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace grounded armatures.

11. See Figure 5-20. Check for OPEN ARMATURE with an ohmmeter or continuity tester.
    a. Check for continuity between all commutator segments.
    b. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.
12. See Figure 5-21. Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester.
   a. Touch one probe to the frame.
   b. Touch the other probe to each of the brushes attached to the field coil.
   c. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field coil(s) are grounded and the field frame must be replaced.

13. See Figure 5-22. Check for OPEN FIELD COILS with an ohmmeter or continuity tester.
   a. Touch one probe to the field wire.
   b. Touch the other probe to each of the brushes attached to the field coil(s).
   c. There should be continuity (0 ohms). If there is no continuity at either brush, then the field coil(s) are open and the field frame must be replaced.

14. See Figure 5-23. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.
   a. Touch one probe to holder plate.
   b. Touch the other probe to each of the positive (insulated) brush holders.
   c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.

15. See Figure 5-24. Remove two drive housing mounting screws (6). Remove drive housing from solenoid housing.

16. Remove drive, idler gear, idler gear bearing, and o-ring from drive housing (o-ring is located in drive housing groove).
ASSEMBLY

1. See Figure 5-24. Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.

2. See Figure 5-27. When installing drive assembly components, open end of idler bearing cage (15) faces toward solenoid.

3. When installing drive housing (10) to solenoid housing (11), use new o-ring (16). Be sure to install return spring (17) and ball (18).

4. Lubricate armature bearings (8) with high temperature grease, such as LUBRIPLATE 110. Install armature (6) and field frame (7) to solenoid housing (11).

5. Install brushes and brush holder (4).

6. Install o-rings (23). Attach end cover (3) with end cover screws and o-rings (2).

7. Install thru-bolts (1).

8. Attach field wire (22) to solenoid housing (11) with field wire nut and washer (24) (metric). Replace rubber boot.

INSTALLATION

1. Install starter and starter gasket from the gearcase cover side.

2. See Figure 5-25. Connect wiring to starter.
   a. Connect solenoid wire (3).
   b. Attach positive battery cable (2) ring terminal to stud with fastener and washer.
   c. Install nut and washer (1) (metric). Tighten nut to 60-85 in-lbs (7-10 Nm).
   d. Replace protective boot.

3. See Figure 5-26. Install both starter mounting bolts and washers. Tighten to 13-20 ft-lbs (18-27 Nm).

4. Install sprocket cover. See 2.33 SPROCKET COVER.

5. Install primary cover. See 6.2 PRIMARY COVER.

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)

6. Install positive battery cable (red) to positive terminal of battery. Tighten to 72-96 in-lbs (8-11 Nm).

7. Connect negative battery cable. Tighten to 72-96 in-lbs (8-11 Nm).

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat. See 2.43 SEAT.
1. Thru-bolt (2)  
2. End cover screw and o-ring (2)  
3. End cover  
4. Brush holder  
5. Brush spring (4)  
6. Armature  
7. Field frame  
8. Armature bearing (2)  
9. Drive housing mounting bolt  
10. Drive housing  
11. Solenoid housing  
12. Drive assembly/Overrunning clutch  
13. Idler gear  
14. Idler gear roller (5)  
15. Idler gear Bearing cage  
16. O-ring  
17. Return spring  
18. Ball  
19. Gasket  
20. Washer (2)  
21. Mounting bolt (2)  
22. Field wire  
23. O-ring (2)  
24. Field wire nut  
with washer (metric)
GENERAL

NOTE
See Figure 5-28. Do not tighten nut (7) without removing items (1) through (5). Movement will cause damage to the contact.

The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See Figure 5-28. Remove screws (1) and clip (2).
2. Remove cover (3) and gasket (4). Discard gasket.
3. Remove plunger (5) from solenoid housing (6).

ASSEMBLY

1. See Figure 5-28. Replace wire connection hardware as necessary.
2. Install plunger (5) in solenoid housing (6).
3. Install new gasket (4) onto cover (3).
4. Position cover with gasket onto solenoid housing. Install clip (2) and screws (1).

Figure 5-28. Starter Solenoid
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<table>
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<tr>
<th>ITEM</th>
<th>NEW COMPONENTS (XB9)</th>
<th>NEW COMPONENTS (XB12)</th>
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<tbody>
<tr>
<td>Engine sprocket – number of teeth</td>
<td>34</td>
<td>38</td>
</tr>
<tr>
<td>Clutch sprocket – number of teeth</td>
<td>57</td>
<td>57</td>
</tr>
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Table 6-2. Final Drive (Transmission-to-rear Wheel)

<table>
<thead>
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<th>ITEM</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission sprocket – number of teeth</td>
<td>27</td>
<td>Inspect at 5,000 mi (8,000 km)</td>
</tr>
<tr>
<td>Rear wheel sprocket – number of teeth</td>
<td>65</td>
<td>Inspect at 5,000 mi (8,000 km)</td>
</tr>
<tr>
<td>Secondary drive belt – number of teeth (XB9Sx, XB12S, XB12Sxg)</td>
<td>128</td>
<td>Inspect at 5,000 mi (8,000 km)</td>
</tr>
<tr>
<td>Secondary drive belt – number of teeth (XB12Sx)</td>
<td>135</td>
<td>Inspect at 5,000 mi (8,000 km)</td>
</tr>
</tbody>
</table>

Table 6-3. Transmission

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NEW COMPONENTS (XB9)</th>
<th>NEW COMPONENTS (XB12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary drive / transmission lubricant capacity (approximately)</td>
<td>Approximately 32 fl. oz. (946 ml)</td>
<td></td>
</tr>
<tr>
<td>Overall gear ratios</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First gear (low)</td>
<td>10.688</td>
<td>9.563</td>
</tr>
<tr>
<td>Second gear</td>
<td>7.635</td>
<td>6.831</td>
</tr>
<tr>
<td>Third gear</td>
<td>5.678</td>
<td>5.080</td>
</tr>
<tr>
<td>Fourth gear</td>
<td>4.706</td>
<td>4.211</td>
</tr>
<tr>
<td>Fifth gear (high)</td>
<td>4.036</td>
<td>3.611</td>
</tr>
</tbody>
</table>

Table 6-4. Wet Clutch Multiple Disc-clutch Plate Thickness

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction plate (fiber) (in.)</td>
<td>0.0866 ± 0.0031 in. (2.200 ± 0.079 mm)</td>
<td>N/A</td>
</tr>
<tr>
<td>Steel plate</td>
<td>0.0629 ± 0.0020 in. (1.598 ± 0.051 mm)</td>
<td>N/A</td>
</tr>
<tr>
<td>Clutch pack (in.)</td>
<td>N/A</td>
<td>0.661 in. (16.789 mm) (minimum)</td>
</tr>
</tbody>
</table>
### Table 6-5. Wet Clutch Multiple Disc-maximum Allowable Warpage

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NEW COMPONENTS</th>
<th>SERVICE WEAR LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction plate (fiber)</td>
<td>N/A</td>
<td>0.0059 in. (0.150 mm)</td>
</tr>
<tr>
<td>Steel plate</td>
<td>N/A</td>
<td>0.0059 in. (0.150 mm)</td>
</tr>
</tbody>
</table>

### TORQUE VALUES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axle pinch fastener, rear</td>
<td>40-45 ft-lbs</td>
<td>54-61 Nm</td>
</tr>
<tr>
<td>Axle, rear</td>
<td>Special procedure, ANTI-SEIZE, page 6-24, 6-55</td>
<td></td>
</tr>
<tr>
<td>Chin fairing fasteners</td>
<td>36-48 in-lbs</td>
<td>4.5 Nm</td>
</tr>
<tr>
<td>Clutch inspection cover fasteners</td>
<td>84-108 in-lbs</td>
<td>9.5-12.2 Nm</td>
</tr>
<tr>
<td>Clutch mainshaft nut</td>
<td>70-80 ft-lbs</td>
<td>94.9-108.5 Nm</td>
</tr>
<tr>
<td>Countershaft retaining screw</td>
<td>33-37 ft-lbs</td>
<td>44.8-50 Nm</td>
</tr>
<tr>
<td>Crankcase 5/16 in. fasteners</td>
<td>15-19 ft-lbs</td>
<td>20.3-25 Nm</td>
</tr>
<tr>
<td>Engine sprocket nut</td>
<td>240-260 ft-lbs</td>
<td>325.4-352.5 Nm</td>
</tr>
<tr>
<td>Idler pulley wheel fastener</td>
<td>20-23 ft-lbs</td>
<td>27.1-31.2 Nm</td>
</tr>
<tr>
<td>Magnetic drain plug</td>
<td>14-30 ft-lbs</td>
<td>19-40.7 Nm</td>
</tr>
<tr>
<td>Negative battery cable at battery terminal</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm</td>
</tr>
<tr>
<td>Neutral indicator switch</td>
<td>60-84 in-lbs</td>
<td>6.7-9.5 Nm</td>
</tr>
<tr>
<td>Primary cover fasteners</td>
<td>100-120 in-lbs</td>
<td>11.3-13.5 Nm</td>
</tr>
<tr>
<td>Rear axle</td>
<td>Special procedure, ANTI-SEIZE, page 6-24</td>
<td></td>
</tr>
<tr>
<td>Shift lever pinch screw</td>
<td>48-60 in-lbs</td>
<td>5.4-6.8 Nm</td>
</tr>
<tr>
<td>Shift linkage fasteners</td>
<td>36-60 in-lbs</td>
<td>4-6.8 Nm</td>
</tr>
<tr>
<td>Shift pedal flange head bolt</td>
<td>22-24 ft-lbs</td>
<td>30-32.5 Nm</td>
</tr>
<tr>
<td>Transmission sprocket nut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission sprocket screws</td>
<td>90-110 in-lbs</td>
<td>10.2-12.4 Nm</td>
</tr>
</tbody>
</table>
REMOVAL

1. Remove seat. See 2.43 SEAT.

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 from battery.
3. Remove chin fairing. See 2.36 CHIN FAIRING.

4. See Figure 6-1. Place a drain pan under the engine/pri-
mary area. Remove drain plug (4) and drain lubricant from primary drive.
5. Remove engine shift lever assembly (1) and rubber washer. Do not scratch primary cover.
6. Remove flange bolt (5) from primary cover.

NOTE

It is recommended that the shifter shaft seal be replaced whenever the primary cover is removed.

7. Add free play to clutch cable. See ADJUSTMENT under 1.8 CLUTCH.
8. See Figure 6-1. Loosen locknut (7). Turn chain adjuster screw (6) counterclockwise to remove tension on primary chain.
9. Remove three TORX screws with washers and clutch inspection cover.
10. See Figure 6-1. Remove clutch inspection cover (3).
11. See Figure 6-2. Remove the outer ramp and hook (1) from the cable end (3) and coupling (2). Remove cable end from slot in coupling. See 6.3 CLUTCH RELEASE MECHANISM.
12. Remove screws which secure primary cover. Remove cover and gasket.
14. Remove and discard shifter lever oil seal.
15. Clean all parts in a non-volatile cleaning solution or sol-
vent.

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)

16. Blow parts dry with low pressure compressed air.
Figure 6-3. Primary Cover, Primary Chain Adjuster and Shifter Assembly

1. Gasket
2. Shifter bushing
3. Primary cover
4. Gasket
5. Cover
6. Sems screw(5)
7. Inspection cover gasket
8. Inspection cover
9. Lever
10. Screw
11. Rubber shift lever pad
12. Linkage assembly
13. Shifter linkage assembly bolt
14. Flange head bolt
15. Shift-brake lever sleeve
16. Pedal bearing (2)
17. Bolt
18. Shifter lever
19. Oil seal
20. Sems screw (14)
21. Adjuster assembly
22. Chain adjustment nut
23. O-ring
24. Drain plug
PRIMARY CHAIN ADJUSTER REPLACEMENT

1. See Figure 6-4. Remove locknut (3) from adjuster screw (2). Turn adjuster screw out of threaded boss in primary cover (4).
2. Remove chain adjuster as an assembly.

3. See Figure 6-4. Inspect primary chain adjuster shoe (1). If badly worn or damaged, it must be replaced.
4. Replace adjuster shoe as an assembly.
5. Position adjuster inside primary cover (4) with closed side of shoe against cover. Thread adjuster screw (2) all the way into tapped boss at bottom of primary cover.
6. At outside of cover, thread locknut (3) onto adjuster screw with nylon sealing surface toward cover. A 1/4-inch allen wrench may be inserted into end of adjuster screw to hold it while threading lock nut.

INSTALLATION

1. Remove foreign material from magnetic drain plug. Apply LOCTITE 565 thread sealant and install plug and tighten to 14-30 ft-lbs (19-40.7 Nm).
2. Wipe gasket surface clean. Install new gasket on primary cover.
3. Install primary cover and gasket onto left crankcase half using mounting bolts.
4. See Figure 6-5. Tighten fasteners to 100-120 in-lbs (11.3-13.5 Nm) in sequence shown.
5. See Figure 6-3. Install new shifter lever oil seal.
6. See Figure 6-6. Fit coupling (2) over cable end (1) with rounded side inboard and the ramp connector button out-board. With retaining ring side of ramp assembly facing inward, place hook of ramp (3) around coupling button and rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover.
7. Thread nut on adjustment screw until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjustment screw counterclockwise.
8. Adjust clutch. See ADJUSTMENT under 1.8 CLUTCH.
9. Adjust primary chain tension. See 1.10 PRIMARY CHAIN.
10. Fill transmission to proper level with fresh lubricant. See 1.8 CLUTCH.

11. See Figure 6-7. Install clutch inspection cover (4) with new gasket and three TORX screws with washers. Tighten screws in a crosswise pattern to 84-108 in-lbs (9.5-12.2 Nm).

12. See Figure 6-8. Install rubber washer and engine shift lever assembly (1).

13. After applying LOCTITE 272, install flange bolt (5) and shift pedal to primary cover, and tighten to 22-24 ft-lbs (30-32.5Nm).

14. After applying LOCTITE 272 (red), tighten engine shift lever pinch screw to 48-60 in-lbs (5.4-6.8 Nm).

15. If the shift linkage assembly (8) was removed for any reason, apply Loctite 272 to fasteners and tighten to 36-60 in-lbs (4-6.8Nm). Adjust to rider comfort.

16. Install left footpeg support bracket. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

17. Install chin fairing. See 2.36 CHIN FAIRING.

18. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

19. Install seat. See 2.43 SEAT.

**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)

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
DISASSEMBLY

NOTE
For clutch adjustment procedure, see 1.8 CLUTCH.

1. Remove seat. See 2.43 SEAT.

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

1. Disconnect negative battery cable.
2. Slide rubber boot on clutch cable adjuster upward to expose adjuster mechanism. Loosen jam nut from adjuster. Turn adjuster to shorten cable housing until there is a large amount of free play at clutch hand lever. See 1.8 CLUTCH.
3. See Figure 6-9. Remove three TORX screws with washers and clutch inspection cover.
4. Slide spring (4) with attached screw lockplate (5) from flats of adjusting screw.
5. Turn adjusting screw clockwise to release ramp and coupling mechanism (7). As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (6) from end of adjusting screw.
6. Remove hook of ramp from cable end coupling (10). Remove cable end from slot in coupling.
7. Remove and discard retaining ring from ramp assembly to separate inner and outer halves. Remove three balls from ramp sockets.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in cleaning solvent.
2. See Figure 6-9. Inspect three balls of release mechanism and ball socket surfaces of inner and outer ramps for wear, pitting, surface breakdown and other damage. Replace parts as necessary.
3. Check hub fit of inner and outer ramps. Replace ramps if excessively worn.
4. Check clutch cable for frayed or worn ends. Replace cable if damaged or worn.
5. Change or add transmission fluid if necessary. See 1.8 CLUTCH.
ASSEMBLY

1. See Figure 6-10. Assemble inner and outer ramps.
   a. Apply multi-purpose grease to balls and ramps.
   b. Insert balls in sockets of outer ramp.
   c. Install inner ramp on hub of outer ramp with tang 180° from hook of outer ramp.
   d. Install new retaining ring in groove of outer ramp hub.

2. See Figure 6-11. Install ramp assembly.
   a. Fit coupling over cable end with rounded side inboard, the ramp connector button outboard.
   b. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button.
   c. Rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover.

   a. Thread nut on adjusting screw until slot of screw is accessible with a screwdriver.
   b. Turn adjusting screw counterclockwise until resistance is felt.
   c. Adjust clutch release mechanism. See 6.3 CLUTCH RELEASE MECHANISM.
   d. Fit nut hex into recess of outer ramp.
   e. Install clutch adjusting lockplate and spring.

4. Install clutch inspection cover and new gasket with three TORX screws with washers. Tighten in a crosswise pattern to 84-108 in-lbs (9.5-12.2 Nm).

5. Adjust clutch cable. See 1.8 CLUTCH.

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. (00066a)

6. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

CAUTION
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.

6-8 2006 Buell Lightning: Drive/Transmission
GENERAL

The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping and shifting gears.

See Figure 6-12. The clutch is a wet, multiple-disc clutch with steel plates and fiber (friction) plates stacked alternately in the clutch shell. The pack consists of seven fiber plates, seven steel plates, one narrow fiber plate, one damper plate and one damper spring seal. The fiber plates (clutch driving plates) are keyed to the clutch shell, which is driven by the engine through the primary chain. The steel plates (clutch driven plates) are keyed to the clutch hub, which drives the rear wheel through the transmission and secondary drive belt.

When the clutch is engaged (clutch lever released), the diaphragm spring applies strong force against the pressure plate. The pressure plate then presses the clutch plates together causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell is transmitted through the clutch plates to the clutch hub. As long as the transmission is set in a forward gear, power from the engine will be transmitted to the rear wheel.

When the clutch is disengaged (clutch lever pulled to left handbar grip), the pressure plate is pulled outward (by clutch cable action) against the diaphragm spring, thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates together. The fiber plates are now free to rotate at a different relative speed than that of the steel plates (i.e. slip-page between the clutch plates occurs). The result is that the rotational force of the clutch shell is no longer fully transmitted through the “unlocked” clutch plates to the clutch hub. The engine is free to rotate at a different speed than the rear wheel.

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>CAUSE (CHECK IN FOLLOWING ORDER)</th>
<th>REMEDY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clutch slips.</td>
<td>Incorrect clutch release adjustment.</td>
<td>Check and adjust clutch release mechanism.</td>
</tr>
<tr>
<td></td>
<td>Worn clutch plates.</td>
<td>Check service wear limits. Replace plates.</td>
</tr>
<tr>
<td>Clutch drags.</td>
<td>Incorrect clutch release adjustment.</td>
<td>Check and adjust clutch release mechanism.</td>
</tr>
<tr>
<td></td>
<td>Worn clutch release ramps or balls.</td>
<td>Replace release ramps and/or balls.</td>
</tr>
<tr>
<td></td>
<td>Warped clutch steel plates.</td>
<td>Replace clutch steel plates.</td>
</tr>
<tr>
<td></td>
<td>Blade worn or damaged clutch gear splines.</td>
<td>Replace clutch gear or hub as required.</td>
</tr>
<tr>
<td></td>
<td>Overfilled primary.</td>
<td>Drain lubricant to correct level.</td>
</tr>
</tbody>
</table>
1. Spring
2. Lockplate
3. Nut
4. Outer ramp
5. Coupling
6. Ball (3)
7. Inner ramp
8. Retaining ring
9. Retaining ring
10. Spring seat
11. Diaphragm spring (separate spring for XB9 & XB12)
12. Retaining ring
13. Release plate
14. Retaining ring
15. Bearing
16. Adjusting screw
17. Pressure plate
18. Friction plate, paper (7)
19. Steel plate (7)
20. Friction plate, narrow
21. Damper spring
22. Damper spring seat
23. Mainshaft nut
24. Washer
25. Clutch hub
26. Inner thrust washer
27. Needle bearing inner race
28. Needle bearing
29. Clutch shell and sprocket
30. Outer thrust washer

Figure 6-12. Clutch Assembly
WARNING
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

1. Remove negative battery cable from battery.
2. Drain the transmission fluid. See 1.8 CLUTCH under 1.8 CLUTCH.
3. Remove primary cover. See 6.2 PRIMARY COVER.

WARNING
Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL (Part No. HD-38515-A), CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) and proper eye protection. Otherwise, the highly compressed diaphragm spring could fly out with great force which could result in death or serious injury.

4. See Figure 6-13. Attach tools to compress clutch diaphragm spring.
   a. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) onto the clutch adjusting screw.
   b. Place the bridge of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring.
   c. Install bearing and washer.
   d. Thread the tool handle onto end of forcing screw.

5. See Figure 6-14. Remove pressure plate assembly.
   a. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning.
   b. Turn compressing tool handle clockwise until tool relieves pressure on retaining ring and spring seat. Remove and discard retaining ring.
   c. Unseat spring seat from the groove in clutch hub prongs.
   d. Remove pressure plate assembly.
   e. Remove the clutch pack from the shell/hub assembly.

NOTE
See Figure 6-14. Turn compressing tool handle only the amount required to release spring seat and remove snap ring. Excessive compression of diaphragm spring could damage clutch pressure plate.
ADJUSTING SCREW DISASSEMBLY/ASSEMBLY

1. See Figure 6-15. Remove adjusting screw assembly.
   a. Remove large retaining ring.
   b. Remove adjusting screw assembly from pressure plate.
2. If necessary, disassemble adjusting screw assembly.
   a. Remove and discard small retaining ring (6).
   b. Separate the adjusting screw (8) from the bearing (7) and release plate (5).
   c. Remove bearing (7) from release plate (5).
3. Replace components as required and reassemble adjusting screw assembly in reverse order.
4. Install adjusting screw assembly into pressure plate.
   a. See Figure 6-37. Align two tabs on perimeter of release plate with corresponding recesses (3) in pressure plate.
   b. Secure the adjusting screw assembly with new retaining ring.

Figure 6-15. Adjusting Screw Assembly

Figure 6-16. Adjusting Screw Assembly
CLUTCH PACK CLEANING AND INSPECTION

1. Separate the pack into the following components:
   a. Seven fiber plates.
   b. Seven steel plates.
   c. One narrow fiber plate.
   d. One damper spring.
   e. One damper spring seat.

   **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)

2. Wash all parts, except fiber (friction) plates and bearing in the clutch hub/shell, in cleaning solvent. Blow dry with compressed air.

3. Examine the clutch components as follows:
   a. Check all clutch plates for wear and discoloration.
   b. Inspect each steel (drive) plate for grooves.
   c. Place each steel plate on a flat surface. Using a feeler gauge, check for flatness in several places. Replace any plates that are damaged or are warped more than 0.006 in. (0.15 mm).

4. Inspect the damper spring for cracks or distortion. Install a new spring if either condition exists.

5. See Figure 6-17. Check fiber plates for thickness.
   a. Wipe the lubricant from the eight fiber plates (7 regular and 1 narrow) and stack them on top of each other.
   b. Measure the thickness of the eight stacked fiber plates with a dial caliper or micrometer. The minimum thickness must be 0.661 in. (16.789 mm).
   c. If the thickness is less than specified, discard the fiber plates and steel plates. Install a new set of both friction and steel plates.

6. See Figure 6-18. Inspect primary chain sprocket and the starter ring gear on the clutch shell. If either sprocket or ring gear are badly worn or damaged, replace the clutch shell. See 6.5 PRIMARY CHAIN.

7. Inspect slots that mate with the clutch plates on both clutch shell and hub. If slots are worn or damaged, replace shell and/or hub. See 6.5 PRIMARY CHAIN.
HOME

ASSEMBLY AND INSTALLATION

1. Submerge and soak all friction and steel plates in FOR-MULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT for at least five minutes.
2. See Figure 6-19. Install the narrow friction plate on the clutch hub engaging tabs on plate with slots in clutch shell.
3. See Figure 6-20. Install damper spring seat (5) on clutch hub so that it seats inboard of narrow friction plate (4).
4. Install damper spring (1) on clutch hub with the concave side up (facing opposite damper spring seat).
5. Install a steel plate and then a friction plate on the clutch hub. Install six remaining sets in the same manner, alternating between steel plates and friction plates.
6. Place pressure plate, diaphragm spring, adjusting screw assembly with new retaining ring and spring seat onto clutch pack.
   a. See Figure 6-21. Align square openings of pressure plate and diaphragm spring so that the assembly can be installed over prongs on clutch hub.
   b. Position spring seat with its larger outer diameter side toward diaphragm spring.
   NOTE
   See Figure 6-14. Turn compressing tool handle only the amount required to install spring seat and snap ring. Excessive compression of diaphragm spring could damage clutch pressure plate.
   c. See Figure 6-22. Install SPRING COMPRESSING TOOL (Part No. HD-38515-A) onto clutch hub against diaphragm spring.
   d. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning.
   e. Turn compressing tool handle clockwise until diaphragm spring compresses just enough to install new retaining ring into the groove in clutch hub prongs.
   f. With retaining ring fully seated in groove of clutch hub, carefully loosen and remove compression tool.

NOTE
When the compressing tool is removed, the diaphragm spring will move outward forcing the spring seat up into the inside of the retaining ring. The spring seat provides an operating surface for the diaphragm spring at the same time preventing the retaining ring from coming out during operation.

Figure 6-19. Friction Plates

Figure 6-20. Clutch Pack Stack-Up (Cut-Away View)

Figure 6-21. Spring Seat Installation

Figure 6-22. Diaphragm Spring Installation
1. Install primary cover. See 6.2 PRIMARY COVER.
2. Adjust Clutch. See 1.8 CLUTCH.
3. Fill with FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT. See 1.8 CLUTCH.

**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 to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

**WARNING**

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat. See 2.43 SEAT.

---

**Figure 6-22. Pressure Plate Assembly**

1. Tool handle
2. Washer
3. Bearing
4. Bridge
5. Forcing screw
6. Diaphragm spring
7. Snap ring
8. Pressure plate
9. Spring seat

---

**Figure 6-23. Clutch Adjusting Screw Assembly and Retaining Ring**

1. Adjusting screw assembly
2. Retaining ring
3. Tab recesses
GENERAL

Since the primary chain runs in lubricant, little service will be required other than checking lubricant level and chain tension. If, through hard usage, the primary chain does become worn and cannot be adjusted to within specifications, it must be replaced. See 1.10 PRIMARY CHAIN.

An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both areas.

REMOVAL

WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00046a)

1. Remove negative battery cable from battery.
2. Drain the transmission fluid. See 1.8 CLUTCH under 1.8 CLUTCH.
3. Remove primary cover. See 6.2 PRIMARY COVER.

4. Loosen engine sprocket.
   a. See Figure 6-24. Install SPROCKET LOCKING LINK (Part No. HD-38362).
   b. Remove the engine sprocket nut.
   c. Loosen but do not remove engine sprocket. If necessary, use the slotted portion of TWO CLAW PULLER (Part No. HD-97292-61) and two bolts to loosen the engine sprocket.
5. See Figure 6-16. Remove adjusting screw assembly.
   a. Remove large retaining ring.
   b. Remove adjusting screw assembly from pressure plate.

6. See Figure 6-25. Remove mainshaft nut and washer.
7. Remove the clutch, clutch shell/hub, primary chain and engine sprocket as a unit.
1. Separate primary chain, engine sprocket and clutch shell/hub assembly.
2. Inspect engine sprocket for damage or excessive wear. Replace as required.
3. Attach tools to compress clutch diaphragm spring and remove pressure plate assembly. See 6.4 CLUTCH.

   NOTE
   The clutch hub and clutch shell are no longer pressed together. There are no retaining rings securing the clutch hub to the clutch shell. Once the pressure plate assembly has been removed the clutch hub will slide out of the clutch shell.

4. Remove clutch pack. Disassemble, clean and inspect clutch pack. See CLUTCH PACK CLEANING AND INSPECTION under 6.4 CLUTCH.
5. Disassemble adjusting screw assembly and inspect bearing, release plate, and adjusting screw. See ADJUSTING SCREW DISASSEMBLY/ASSEMBLY under 6.4 CLUTCH.
6. Remove clutch hub from clutch shell. Inspect primary chain sprocket and the starter ring gear on the clutch shell.
7. Inspect slots that mate with the clutch plates on both clutch shell and hub.
8. See Figure 6-26. Inspect the clutch shell compensating spring set.

   NOTE
   As you proceed around the back of the clutch shell, the compensating springs go from being loaded to unloaded so it is possible for the clutch springs to rattle during inspection. This condition is normal.
9. See Figure 6-27. Inspect clutch shell needle bearing for smoothness. Rotate the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced. See CLUTCH SHELL BEARING REPLACEMENT.
10. See Figure 6-28. Inspect clutch shell bearing inner race on the back side of the clutch hub for pitting and wear. If the inner race shows any of these signs the complete hub assembly must be replaced.
11. Replace damaged parts as necessary.
CLUTCH SHELL BEARING REPLACEMENT

The clutch shell uses a caged needle bearing that corresponds to an inner race installed on the clutch hub.

1. See Figure 6-30. Place clutch shell on support blocks with sprocket side facing up.

NOTE

The CLUTCH SHELL BEARING REMOVER/INSTALLER (Part No. B-45926) is clearly marked for removal and installation purposes.

2. See Figure 6-30. Insert removal end of tool into bearing assembly and remove bearing from clutch shell.

3. See Figure 6-31. Remove bearing guide from end of CLUTCH SHELL BEARING REMOVER/INSTALLER (Part No. B-45926).

4. Place new needle bearing onto installer end of tool and insert the bearing guide to prevent the bearing from falling off during installation and to align bearing with clutch shell.

5. See Figure 6-32. Place clutch shell on support blocks with sprocket side facing up.

6. Press bearing into clutch shell until tool bottoms on the shell. This will be the correct installed height.
Prior to installing engine sprocket nut and the clutch hub nut, the threads on the sprocket shaft, sprocket nut, mainshaft and clutch hub nut must be thoroughly cleaned to remove any oil that might contaminate and interfere with the locking agent.

1. See Figure 6-33. Assemble clutch hub (1) and shell (3) by sliding inboard end of clutch hub into shell bearing (2) by hand. No tools are required.

2. Submerge and soak all friction and steel plates in FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT for at least five minutes and assemble clutch pack in sequence in the clutch hub. See ASSEMBLY AND INSTALLATION under 6.4 CLUTCH.

3. Verify that outer thrust washer (4) is installed on transmission shaft.

4. Install the engine sprocket, clutch assembly and primary chain as a unit into primary chaincase.

5. See Figure 6-34. Install the engine sprocket nut.
   a. Install SPROCKET LOCKING LINK (Part No. HD-38362).
   b. Apply two or three drops of LOCTITE 262 (red) onto threads of sprocket shaft.
   c. Install engine sprocket nut. Tighten to 240-260 ft-lbs (325.4-352.5 Nm).
6. See Figure 6-35. Install mainshaft washer (2) and nut (1).
   a. Apply two or three drops of LOCTITE 262 (red) onto threads on end of mainshaft.
   b. Place washer (2) on mainshaft with the word "out" facing away from clutch hub.
   c. Install nut (left-hand threads) (1). Tighten to 70-80 ft-lbs (94.9-108.5 Nm).
7. Remove SPROCKET LOCKING LINK.
8. Install the pressure plate assembly. See 6.4 CLUTCH.
9. Install adjusting screw assembly into pressure plate.
   a. See Figure 6-37. Align two tabs on perimeter of release plate with corresponding recesses (3) in pressure plate.
   b. Secure the adjusting screw assembly with new retaining ring.
10. Install primary cover. See 6.2 PRIMARY COVER.
11. Adjust Clutch. See 1.8 CLUTCH.
12. Add FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT. See TRANSMISSION FLUID under 1.8 CLUTCH.

**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)

13. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

14. Install seat. See 2.43 SEAT.
GENERAL

There is no drive belt adjustment required. The system utilizes a fixed idler pulley that maintains the desired tension throughout suspension travel and life of the belt.

INSPECTION AND CLEANING

See 1.9 DRIVE BELT.

NOTE

Mishandling drive belt will result in premature failure. For maximum strength, integrity and longevity, avoid over bending (A and B), twisting (C), crimping, pinching or kinking (D), and prying (E).

Figure 6-38. Proper Drive Belt Handling
DRIVE BELT REMOVAL

1. Place a scissor jack under jacking point and raise rear wheel off ground. For location of jacking point see 2.31 EXHAUST SYSTEM.
2. Remove right side rider footpeg support bracket. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.

NOTE
The right rear chin fairing fasteners must be removed to access the front sprocket cover.

3. Remove right rear chin fairing fasteners. See 2.36 CHIN FAIRING.
4. For XB125s Models: Remove rear fender. See 2.34 FENDERS.
5. Remove belt guards. See 2.35 BELT GUARDS.

6. See Figure 6-40. Remove front sprocket cover (5) by removing fasteners. See 2.33 SPROCKET COVER.

7. See Figure 6-41. Loosen rear axle pinch fastener (2).
8. Loosen rear axle (1) approximately 15 rotations to allow partial tension to be removed from rear drive system.
9. Remove idler pulley assembly by removing nuts and washers. See IDLER PULLEY REMOVAL in 6.6 DRIVE BELT SYSTEM.
10. Remove swingarm brace. See 2.19 SWINGARM AND BRACE.

NOTE
When removing or installing belt, do not bend or twist belt, partially slide belt onto sprocket and "roll" wheel or belt damage will occur.

11. Slide belt from sprocket and remove.
DRIVE BELT INSTALLATION

NOTE
When removing or installing belt, do not bend or twist belt, partially slide belt onto sprocket and "roll" wheel or belt damage will occur.
1. Slide belt onto sprocket.
2. Install swingarm brace and tighten fasteners to 25-27 ft-lbs (34-37 Nm). See 2.19 SWINGARM AND BRACE.

NOTE
See Figure 6-42. Occasionally the drive belt is not fully seated in rear sprocket making it difficult to install the idler pulley. It will be necessary to follow the outlined procedure in order to easily install idler pulley.
3. Grasp top and bottom of drive belt and squeeze together until belt teeth are fully seated in rear sprocket.
4. While keeping tension on lower belt, install idler pulley assembly lightening washers and nuts to 33-35 ft-lbs (45-47 Nm).
5. See Figure 6-41. Tighten rear axle (1) to 23-27 ft-lbs (31.2-36.6 Nm), back off two full turns and then retighten to 48-52 ft-lbs (65.1-70.5 Nm).
6. Tighten rear axle pinch fastener (2) to 40-45 ft-lbs (54-61 Nm).
7. See Figure 6-40. Install front sprocket cover. See 2.33 SPROCKET COVER.
8. Install chin fairing. See 2.36 CHIN FAIRING.
9. Install right side rider footpeg mount. See 2.32 FOOT-PEG, HEEL GUARD AND MOUNT.
10. Install lower belt guard. See 2.35 BELT GUARDS.
11. Install rear fender. See 2.34 FENDERS.
12. Remove scissor jack from motorcycle.
IDLER PULLEY REMOVAL

1. See Figure 6-43. Loosen rear axle pinch fastener (2).
2. Unthread axle approximately 15 rotations to release tension from drive belt.
3. Remove chin fairing fasteners. See 2.36 CHIN FAIRING.
4. Remove front sprocket cover. See 2.33 SPROCKET COVER.
5. See Figure 6-44. Remove idler pulley bracket nuts and washers (5) from studs (3).
6. Slide idler pulley bracket (4) off studs (3).
7. See Figure 6-44. Inspect pulley by spinning wheel (1) and checking for wheel bearing wear. See INSPECTION under 1.9 DRIVE BELT.
8. If pulley wheel needs replacement, remove fastener (6), washer and nut (2) from idler pulley bracket (4) and discard wheel. Replace with new pulley wheel (1).

NOTE
The pulley wheel bearings cannot be replaced separately.

IDLER PULLEY INSTALLATION

1. See Figure 6-44. Install new or existing pulley wheel (1), if removed, and tighten washer and nut (2) wheel fastener (6) to 20-23 ft-lbs (27.1-31.2 Nm).
2. Slide idler pulley bracket (4), washer and nuts (5) on to studs (3) and tighten to 33-35 ft-lbs (45-47 Nm). See DRIVE BELT INSTALLATION.
3. Install front sprocket cover. See 2.33 SPROCKET COVER.
4. Install chin fairing fasteners and tighten to 36-48 in-lbs (4-5 Nm). See 2.36 CHIN FAIRING.

NOTE
Never tighten rear axle with swingarm brace removed.

5. See Figure 6-43. Install and tighten rear axle (1) to 23-27 ft-lbs (31.2-36.6 Nm), back off two full turns and then retighten to 48-52 ft-lbs (65.1-70.5 Nm). See 6.6 DRIVE BELT SYSTEM.
6. Tighten rear axle pinch fastener (2) to 40-45 ft-lbs (54-61 Nm).
The transmission is foot-operated by the gear shifter lever, which transmits the force through a gear shifter shaft. The shifter shaft actuates a pawl and a shifter fork drum. The shifter fork drum moves shifter forks, which slide a series of shifter dogs on the mainshaft and countershaft, into and out of mesh with the other gears.

Figure 6-45. Transmission Power Flow
GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. Servicing of transmission components requires removing the engine and disassembling (splitting) the crankcase.

RIGHT CRANKCASE REMOVAL

1. Remove transmission sprocket. See 6.16 TRANSMISSION SPROCKET.
2. Remove engine from chassis. See 3.4 STRIPPING MOTORCYCLE FOR ENGINE SERVICE.
4. Disassemble top end. See 3.6 CYLINDER HEAD.
5. Disassemble gearcase. See 3.18 GEARCASE COVER AND CAM GEARS.
6. Remove primary cover. See 6.2 PRIMARY COVER.
7. Remove clutch assembly, primary chain and engine sprocket. See 6.5 PRIMARY CHAIN.
8. See Figure 6-46. Place transmission in 1st gear. Remove hex fastener.
9. See Figure 6-47. Place transmission in neutral. Remove neutral switch to ensure shifter drum detent is visible indicating transmission is in correct location.
10. See Figure 6-48. With transmission still in neutral, scribe a line on the end of the shifter drum at the 12 o’clock position for later reference.
11. See Figure 6-49. Remove shifter shaft assembly.

12. See Figure 6-50. Depress ratchet arms (3) in order to clear the shifter drum and remove shifter shaft assembly from left crankcase half.

13. Remove starter. See 5.7 STARTER.

14. See Figure 6-51. Remove rear isolator assembly by removing the forward two fasteners first and then the two rear fasteners (re-install with new fasteners).
15. See Figure 6-52. Remove crankcase bolt set (14 fasteners).

**NOTE**

Flywheel assembly slides out of the left main bearing by hand. No tools are required for this operation.

16. See Figure 6-53. Separate crankcase halves.

17. See Figure 6-54. Remove the flywheel assembly from left crankcase half.
TRANSMISSION DISASSEMBLY

GENERAL

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-43985-1</td>
<td>Transmission remover</td>
</tr>
<tr>
<td>J-5586</td>
<td>Retaining ring pliers</td>
</tr>
</tbody>
</table>

TRANSMISSION REMOVAL FROM LEFT CRANKCASE

NOTE
See Figure 6-55. Shifter design allows for one common part number for both countershaft shifter forks. As the transmission runs, each shifter fork develops a certain wear pattern with its mating parts. For this reason, it is important that each shifter fork be reinstalled in its original location.

1. See Figure 6-56. Remove shifter fork shafts by inserting a small flat punch in the slots and tapping on the end of each shaft until it falls free.

NOTE
Carefully tap on alternate sides of the shaft using the provided slots.

2. See Figure 6-57. Remove shifter drum (1) and shifter forks (2). Mark each shifter fork as it is removed, so it can be reinstalled in the same location.

Figure 6-55. Shifter Forks, Drum and Shafts

Figure 6-56. Slots For Removing Shifter Fork Shafts

Figure 6-57. Transmission Assembly

1. Shifter drum
2. Shifter fork (3)
3. Mainshaft
4. Mainshaft 2nd gear
5. Countershaft
1. Spring, detent
2. Detent spring sleeve assembly
3. Screw, detent assembly
4. Shaft, shifter forks (2)
5. Fork assembly, shifter (2nd-3rd)
6. Fork assembly, shifter (1st)
7. Shifter cam assembly
8. Fork assembly, shifter (4th-5th)
9. Pin, shifter stop
10. Spring, shifter return
11. Spring, extension
12. Shifter lever assembly
13. Oil seal
14. Rubber washer
15. Lever, engine
16. Bolt, engine lever
17. Bearing, shift lever assembly (2)
18. Shift lever
19. Bolt, linkage assembly
20. Sleeve, shift/brake lever
21. Bolt, shift lever
22. Pad, rubber, shift lever
23. Linkage assembly, shifter
24. Bolt, linkage assembly

Figure 6-58. Shifter Mechanism
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. See Figure 6-59. Remove left crankcase half and transmission assembly (4) from engine stand.
   a. Place crankcase half (3) and transmission assembly (4) on arbor press (1) and support transmission assembly on parallel supports (5).
   b. Press transmission assembly using TRANSMISSION REMOVER (2) (Part No. B-43895-1) to remove transmission assembly from crankcase half.
   c. Remove crankcase from press.

Figure 6-59. Removing Transmission Assembly from Left Case Half
Figure 6-60. Transmission Assembly

1. Oil seal
2. Retaining ring
3. Ball bearing
4. O-ring
5. Oil seal
6. Needle bearing (2)
7. Mainshaft 5th gear
8. Mainshaft 1st gear
9. Retaining ring (4)
10. Thrust washer (4)
11. Mainshaft 4th gear
12. Split bearing (4)
13. Mainshaft
14. Mainshaft 3rd gear*
15. Mainshaft 2nd gear*
16. Mainshaft bearing
17. Retaining ring
18. Closed end bearing
19. Countershaft 5th gear**
20. Countershaft
21. Countershaft 1st gear
22. Dog ring
23. Countershaft 4th gear
24. Countershaft 3rd gear
25. Dog ring
26. Thrust washer
27. Countershaft 2nd gear
28. Spacer
29. Countershaft bearing
30. Retaining ring
31. Countershaft retaining screw

* Mainshaft 2nd and 3rd gears are integral to the shaft.
** Countershaft 5th gear is integral to the shaft.
## MAINSHAFT/COUNTERSHAFT

### NOTES

- As the transmission runs, each part develops a certain wear pattern and a kind of “set” with its mating parts. For this reason, it is important that each component be reinstalled in its original location and facing its original direction.

- See Figure 6-61. As each component is removed, place it on a clean surface in the exact order of removal.

- All thrust washers are one common part number. This transmission requires no shimming.

### 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)

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See Figure 6-62. Remove 1st gear (1).

2. Use RETAINING RING PLIERS (Part No. J-5586) to expand and remove retaining ring (2). Discard retaining ring.

3. Slide thrust washer (3) off end of mainshaft.

4. Remove 4th gear (4) and split bearing (5). Discard bearing.

### 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. Clean all parts in cleaning solvent and blow dry with compressed air.

2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.

3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, cracked, battered, chipped or dimpled.

---

### MAINSHAFT DISASSEMBLY

### NOTES

- Mainshaft 2nd and 3rd gears are integral to the shaft.

- Mainshaft 1st gear is directional. Mark gear when removed for correct installation.

- Once the transmission assembly has been pressed out of the left crankcase half, the mainshaft and countershaft assemblies can be serviced separately.

---

*Mainshaft 2nd and 3rd gears are integral to the shaft.*
COUNTERSHAFT DISASSEMBLY

NOTES

- Countershaft 5th gear is integral to the shaft.
- Once the transmission assembly has been pressed out of the left crankcase half, the mainshaft and countershaft assemblies can be serviced separately.
- All thrust washers are one common part number. This transmission requires no shimming.
- Use correct retaining ring pliers with correct tips. Verify that tips are not excessively worn or damaged.

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 6-63. Remove spacer (19) and 2nd gear (18) from the end of the of the countershaft (2). Remove and discard split bearing (17).
2. Remove spacer (16).

NOTE

When removing the dog ring (15), it is important to mark the direction of the ring on the shaft as parts establish wear patterns.

3. Remove dog ring (15).

5. Remove thrust washer (13), 3rd gear (12), and split bearing (11). Discard bearing.
6. Remove thrust washer (10).
7. Expand, remove and discard retaining ring (9).
8. Remove 4th gear (8) and dog ring (7).
9. Expand, remove and discard retaining ring (6).
10. Remove thrust washer (5), 1st gear (4) and split bearing (3). Discard bearing.

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. Clean all parts (except bearings) in cleaning solvent and blow dry with compressed air.
2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.
3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, cracked, battered, chipped or dimpled.

Figure 6-63. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly
GENERAL

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>J-5586</td>
<td>Retaining ring pliers</td>
</tr>
</tbody>
</table>

MAINSHAFT 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)

NOTES
- Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.
- During assembly, the split bearings and the internal bores of the gears must be lubricated with Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. See Figure 6-64. Install new split bearing (5) in 4th gear position on mainshaft.
2. Install 4th gear (4) and thrust washer (3).
4. Install 1st gear (1).

![Figure 6-64. Transmission Mainshaft Assembly/Reassembly](image_url)

1. Mainshaft 1st gear
2. Retaining ring
3. Thrust washer
4. Mainshaft 4th gear
5. Split bearing
6. Mainshaft
7. Mainshaft 3rd gear
8. Mainshaft 2nd gear

* Mainshaft 2nd and 3rd gears are integral to the shaft.
COUNTERSHAFT 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)

NOTES

- Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

- During assembly, the split bearings and the internal bores of the gears must be lubricated with Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. See Figure 6-65. Install new split bearing (3) in 1st gear position on mainshaft.

2. Install 1st gear (4) and thrust washer (5).


4. Install dog ring (7) onto 4th gear (8). Now install dog ring and gear assembly onto countershaft.

5. Expand and install new retaining ring (9).

6. Install thrust washer (10).

7. Install new split bearing (11) in 3rd gear position on mainshaft.

8. Install 3rd gear (12) and thrust washer (13).

9. Expand and install new retaining ring (14).

10. Install dog ring (15). Make sure to install with dog ring facing same direction as when it was removed.

11. Install spacer (16).

12. Install new split bearing (17) in 2nd gear position on shaft.

13. Install 2nd gear (18) and spacer (19).

NOTE

At this point both mainshaft and countershaft sub-assemblies are ready to be pressed into the left crankcase half.

![Figure 6-65. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly](image)

* Countershaft 5th gear is integral to the shaft.
See Figure 6-66. When removing the main drive gear (3), the gear is pressed out against the resistance of the ball bearing (8) inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing must also be replaced.

### GENERAL

<table>
<thead>
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<th>PART NO.</th>
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<tr>
<td>HD-35316-C</td>
<td>Main drive gear remover and installer</td>
</tr>
<tr>
<td>B-45847</td>
<td>Cross plate</td>
</tr>
<tr>
<td>HD-47855</td>
<td>Inner/outer main drive gear needle bearing installation tool</td>
</tr>
<tr>
<td>HD-95637-46A</td>
<td>Bearing race puller</td>
</tr>
<tr>
<td>HD-47856</td>
<td>Seal driver</td>
</tr>
</tbody>
</table>

**Figure 6-66. Transmission Assembly-Right Crankcase Half**

1. Retaining ring
2. Bearing (Inner)
3. Fifth gear mainshaft
4. Bearing (Outer)
5. O-ring
6. Oil seal
7. Right crankcase half
8. Ball bearing with spacer
9. Retaining ring
10. Oil seal
11. Bearing, (closed end) countershaft
12. Bushing, shifter drum
1. Split crankcases in half. See 6.8 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL.
2. Remove transmission as an assembly. See 6.9 TRANSMISSION DISASSEMBLY.

3. See Figure 6-67. From inside case tap out seal at end of mainshaft 5th gear. Discard seal.

4. See Figure 6-68. Place cross plate on crankcase as shown.

5. See Figure 6-69. Assemble MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-A) with CROSS PLATE (Part No. B-45847).
6. Insert bolt (2) through cross plate (1) and 5th gear (3).

   NOTE
   When removing the main drive gear, the gear is pressed out against the resistance of the bearing inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing will also have to be replaced.

7. At outside of case, place driver (4) and thrust washer (5) over end of bolt (2). Install and tighten nut (6) until 5th gear (3) is free.
Main Drive Gear Bearing

**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**

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

1. See Figure 6-66. At outside of case remove and discard oil seal (10). Remove and discard main drive gear bearing retaining ring (8).
2. See Figure 6-68. From inside crankcase, position BEARING DRIVER (Part No. HD-035316-9) (2) over main drive gear bearing.
3. Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through bearing driver and bearing.
4. See Figure 6-70. At outside of case, slide RECEIVER CUP (Part No. HD-35316-11) (3) onto bolt and over bearing. Install NICE BEARING (4), FLAT WASHER (5) and NUT (6) over end of bolt.

**NOTE**

Support bearing remover assembly as you remove bearing in the following step. Entire assembly will fall out of crankcase when bearing comes free.

5. Tighten nut until main drive gear bearing is free.
6. Discard main drive gear bearing.

---

**DISASSEMBLY**

1. See Figure 6-67. Remove and discard retaining ring (5).
2. Drive out needle bearings (2) from inside bore of main drive gear (1) using appropriate bearing and bushing puller. Discard bearings. Do not reuse bearings after removal.
3. Remove o-ring from outside of main drive gear and discard. Do not reuse o-ring after removal.

**NOTE**

When the main drive gear is removed, a portion of the bearing inner race remains attached to the main drive gear. This inner race must be removed before the main drive gear can be re-installed.

4. See Figure 6-71. Attach BEARING RACE PULLER (Part No. 95637-46A) (3) to inner race (2) on main drive gear (1).
5. Place main drive gear with bearing race puller assembly onto press bed as shown in the photo.

**NOTE**

Provide a soft surface to catch the main drive gear when it falls free in the next step.


---

**Figure 6-70. Removing Main Drive Gear Bearing (Typical)**

1. 8 in. Bolt (Part No. HD-35316-4A)
2. Bearing driver (Part No. HD-35316-9)
3. Receiver cup (Part No. HD-35316-11)
4. Nice bearing
5. Flat washer
6. Nut

---

**Figure 6-71. Removing Inner Bearing Race From Main Drive Gear**

1. Main drive gear
2. Inner bearing race (not visible in this photo)
3. Bearing race puller (Part no. HD-95637-46A)
4. Press ram
1. Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL (Part No. HD-47855) for assembly. Assemble parts. The installation tool will automatically bottom on the gear when the correct depth is reached.

2. See Figure 6-72. Place main drive gear (4) on press bed with gear end facing up.

3. Place needle bearing (3) squarely into end of drive gear. Insert installation tool (2) with end stamped “INNER” facing needle bearing.

4. Press in the inner bearing until the installation tool bottoms on the main drive gear. The surface of the needle bearing will be at a depth of 0.0175 - 0.0200 in. (4.5 - 5.0 mm) from the face of the shifter dogs on the main drive gear.

5. Install new retaining ring.

6. See Figure 6-73. Place main drive gear (4) on press bed with gear end facing down.

7. Place needle bearing (3) squarely into end of drive gear. Insert installation tool (2) with end stamped “OUTER” facing needle bearing.

8. Press in the outer bearing until the installation tool bottoms on the main drive gear. The surface of the needle bearing will be at a depth of 0.315 in. (8.001 mm) from the end of the main drive gear.
Main Drive Gear Ball Bearing

1. See Figure 6-74. Place CROSS PLATE (Part No. B-45847) (1) on right crankcase as shown. Position cross plate so that roll pins (2) fit into crankcase mating screw holes and bolt hole (3) in cross plate is centered over crankcase bearing bore (4).

2. See Figure 6-75. Insert 8 IN. BOLT (Part No. HD-35316-4A) (2) through cross plate (1) and main drive gear bearing bore.

3. At outside of case, place main drive gear ball bearing (3), BEARING DRIVER (Part No. HD-35316-8) (4), NICE BEARING (5), FLAT WASHER (6) and NUT (7) over end of bolt.

CAUTION
Do not continue to tighten nut after ball bearing bottoms against lip in crankcase bearing bore. Tightening nut too much can break lip in bearing bore casting.

4. Tighten nut until main drive gear ball bearing bottoms against lip cast into crankcase bearing bore.

5. Remove main drive gear bearing installer tool.

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
Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

6. See Figure 6-66. At outside of case install new beveled retaining ring (9) in groove inside bearing bore with beveled side facing outside of case.

7. Lubricate main drive gear ball bearing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05).
Main Drive Gear

1. See Figure 6-76. Lubricate both main drive gear needle bearing assemblies and the mating surface of the main-shaft with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (Part No. 99857-97).

2. See Figure 6-67. Install o-ring (5) into groove in main drive gear. Lubricate o-ring with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05).

   NOTE
   See Figure 6-67. Make sure to install new o-ring (5) onto main drive gear before installing main drive gear into crankcase.

3. See Figure 6-75. Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through WASHER (Part No. HD-35316-7) (2) and main drive gear (3). From inside of case insert bolt with washer and main drive gear through inner race of main drive gear bearing.

4. At outside of case, place INSTALLER CUP (Part No. HD-35316-12) (4), NICE BEARING (5), FLAT WASHER (6) and NUT (7) over end of bolt. Tighten nut until main drive gear bottoms against main drive gear bearing.

5. Remove MAIN DRIVE GEAR REMOVER AND INSTALLER set.

6. See Figure 6-67. Tap in new oil seal (6) at threaded end of main drive gear to a depth of 0.060-0.030 in. (1.524-0.762 mm).
Main Drive Gear Seal

1. See Figure 6-78. From outside of crankcase, install PILOT (Part No. HD-47856-2) over end of main drive gear bearing inner race.

2. Coat lips of new main drive gear seal with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05).

   NOTE
   ADAPTER (Part No. HD-47856-4) and main drive gear have left-hand threads.

3. See Figure 6-79. Place seal over pilot and position seal squarely in end of crankcase bore.

4. See Figure 6-80. THREAD ADAPTER (Part No. HD-47856-4) onto end of main drive gear several turns. Do NOT tighten. Doing so could make it difficult to remove adapter after seal has been installed.

5. See Figure 6-81. Slide INSTALLER (Part No. HD-47856-1) over ADAPTER until cupped end of installer is flat against seal.
6. See Figure 6-82. Thread NUT (Part No. HD-47856-5) onto end of adapter, until it tightens against installer.

7. See Figure 6-83. Place CROWFOOT WRENCH (Part No. HD-47856-7) (1) with 1/2 inch breaker bar (2) on large nut. Place an adjustable wrench (3) on flats of hex head cast into end of adapter.

8. Holding smaller wrench, tighten nut with larger wrench until outer face of seal is flush with outer edge of crankcase bore.

   **NOTE**
   It is acceptable to recess seal to about 0.030 in. (0.762 mm) below outer edge of bore. Seal will be controlled by tool.

9. Remove nut, installer, adapter and pilot.
GENERAL

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD-95760-69A</td>
<td>Bushing and bearing puller</td>
</tr>
<tr>
<td>HD-95765-69A</td>
<td>1/2 in. collet</td>
</tr>
</tbody>
</table>

REMOVAL

1. Split crankcases. See 6.8 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL.

Countershaft Needle Bearing

1. See Figure 6-84. From inside transmission case use a suitable BEARING DRIVER/PULLER to remove countershaft bearing (11) from crankcase bore.

Shifter Drum Bushing

1. The shifter drum bushing (12) is a press fit in the right crankcase half. Inspect the bushing against the corresponding end of the shifter drum for proper fit and wear.
2. If bushing is to be replaced, use BUSHING AND BEARING PULLER (Part No. HD-95760-69A) with 1/2 IN. COLLET (Part No. HD-95765-69A) to remove bushing from crankcase bore.

INSTALLATION

Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. (31.75 mm) in diameter.
2. See Figure 6-84. From the outside of the case place the needle bearing (11) open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven flush or 0.030 in. (0.762 mm) below the outside surface of the case.
3. Lubricate bearing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT.

Shifter Drum Bushing

1. See Figure 6-84. Using SNAP-ON BUSHING DRIVER SET (Part No. A-157C) with a 1/2 inch adapter (Part No. A157-8), install new bushing (12).
2. lubricate bushing with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAIN-CASE LUBRICANT (Part No. 99851-05).

Figure 6-84. Transmission Assembly-Right Crankcase Half

1. Retaining ring  
2. Bearing (Inner)  
3. Fifth gear mainshaft  
4. Bearing (Outer)  
5. O-ring  
6. Oil seal  
7. Right crankcase half  
8. Ball bearing with spacer  
9. Retaining ring  
10. Oil seal  
11. Needle bearing, (closed end) countershaft  
12. Bushing, shifter drum
REMOVAL

Mainshaft and Countershaft Bearings

1. Split crankcases in half. See 6.8 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL.
2. Remove shifter forks and drum. See 6.10 TRANSMISSION ASSEMBLY under 6.9 TRANSMISSION DISASSEMBLY.
3. Remove countershaft and mainshaft. See 6.9 TRANSMISSION DISASSEMBLY.
4. Inspect the mainshaft and countershaft ball bearings for pitting, scoring, discoloration or other damage.
5. See Figure 6-85. If bearing replacement is required, remove retaining rings (1, 2) using snap ring pliers (Snap-On Part No. PR-36). Press out bearings (3, 4) from the inside of the crankcase.

Shift Drum Bushing

Inspect the shifter drum bushing for pitting, scoring, discoloration or excessive wear. If bushing requires replacement press bushing out of crankcase from either side.

INSTALLATION

Mainshaft and Countershaft Bearings

1. Place crankcase on press with inside surface of crankcase downward.
2. Lay bearing squarely over bore with printed side of bearing upward. Place a pressing tool (slightly smaller than outside diameter of bearing) against outer race. Press bearing into bore until bearing bottoms against shoulder.
3. Install new retaining ring with beveled side facing away from bearing.

Shift Drum Bushing

1. Place crankcase on press with outside surface of crankcase downward.
2. See Figure 6-86. Lay bushing squarely over bore. Using a pressing tool larger than diameter of bushing, press bushing into bore until bushing contacts shoulder in left crankcase half. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against crankcase when bushing is flush with top surface.
INSTALLATION

NOTES

After re-installing the transmission assembly, verify that all parts have been properly installed. See:

- 6.11 MAIN DRIVE GEAR
- 6.10 TRANSMISSION ASSEMBLY
- 6.13 TRANSMISSION LEFT CASE BEARINGS
- 6.12 TRANSMISSION RIGHT CASE BEARINGS

- Make sure crankcase does not begin to tilt when pressed onto transmission assembly. It may be necessary to place press ram on transmission installer closer to main-shaft to keep the crankcase level.

- When removing crankcase and transmission assembly from fixture, make sure mainshaft 1st gear does not fall off shaft. Gear could be damaged if it strikes a hard surface.

1. See Figure 6-87. Place transmission assembly onto TRANSMISSION REMOVER/INSTALLER FIXTURE (Part No. B-43985-2) on arbor press.
2. Install COUNTERSHAFT GUIDE ADAPTER (Part No. B-43985-4).

Figure 6-87. Transmission Assembly in Fixture (Typical)

1. Arbor press
2. Guide tool (Part No. B-43985-4)
3. Transmission assembly
4. Transmission Remover/Installer fixture (Part No. HD-46285)

Figure 6-88. Pressing Transmission Into Left Crankcase (Typical)

3. See Figure 6-88. Place left case half over transmission assembly and install TRANSMISSION INSTALLER (Part No. B-43985-3) into crankcase.
4. Press crankcase onto transmission assembly into until it bottoms out.
5. Remove COUNTERSHAFT GUIDE ADAPTER (Part No. B-43985-4).
6. Remove transmission assembly and left crankcase half from fixture.
7. Re-install transmission assembly and left crankcase half in engine stand.
NOTES

● See Figure 6-89. Shifter design allows for one common part number for both countershaft shifter forks. As the transmission runs, each shifter fork develops a certain wear pattern with its mating parts. For this reason, it is important that each shifter fork be reinstalled in its original location.

Always lubricate the shaft bore in each shifting fork with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) before assembly.

1. Place 2nd/3rd gear shifter fork onto dog ring between countershaft 2nd and 3rd gears.
2. Install shifter drum into left case half with previously scribed line at 12 o’clock position. This will place shifter drum in neutral position.

NOTE

See Figure 6-90. Install shifter fork shafts in the left case half by lightly tapping on the end of the shaft with a brass or hard plastic hammer until shaft is seated in bore.

3. Place 1st gear shifter fork onto dog ring between countershaft 1st and 4th gear gears. Install shifter fork shaft through two installed shifter forks and into left crankcase half.
4. Install 4th/5th gear shifter fork onto sliding gear with dogs located on mainshaft. Install remaining shifter fork shaft through last installed shifter fork and into left crankcase half.

NOTE

See Figure 6-90. Install shifter fork shafts in the left case half by lightly tapping on the end with a brass hammer until seated in bore.
1. See Figure 6-91. Install the flywheel assembly into the left crankcase half using CRANKSHAFT GUIDE TOOL Part No. HD-42326.

**NOTE**
The Gear Detent Assembly Aid is used to move the gear detent lever clear of the shifter drum for assembly purposes.

![Figure 6-91. Installing Flywheel Assembly Using Crankshaft Guide Tool (Part No. HD-42326)](image)

2. See Figure 6-92. Retract detent assembly in right case half and install GEAR DETENT ASSEMBLY AID (Part No. B-45520) until it has bottomed in right case half.

3. Place Transmission in the 1st gear position.

4. Lubricate main drive gear needle bearing assemblies, the mating surface of the mainshaft and countershaft with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (Part No. 99857-97).

5. See Figure 6-93. Assemble crankcase halves together.
   a. Apply a thin coat of GRAY HIGH-PERFORMANCE SEALANT (Part No. 99650-02) to crankcase joint faces.
   b. Apply several drops of LOCTITE 262 (red) to last few threads.
   c. See Figure 6-94. Tighten 5/16-in. fasteners to 15-19 ft-lbs (20.3-25 Nm).
   d. Remove GEAR DETENT ASSEMBLY AID and install neutral indicator switch and washer. Tighten to 60-84 in-lbs (6.7-9.5 Nm). See Figure 6-93. Assemble crankcase halves together.

![Figure 6-93. Crankcase Halves](image)
Figure 6-94. Crankcase Fasteners

- Indicates Bolt Pattern Location

One Behind Shifter Mechanism
INSTALLATION

1. See Figure 6-95. Correctly install shifter return spring onto the reverse side of the shifter shaft assembly before placing shaft in left crankcase half.

![Figure 6-95. Shifter Shaft Return Spring (Correctly Installed)](image)

**NOTE**

See Figure 6-96. The shifter shaft return spring can be installed incorrectly and then assembled in the left crankcase half. Failure to install the spring properly will result in improper shifting.

![Figure 6-96. Shifter Shaft Return Spring (Incorrectly Installed)](image)
2. See Figure 6-98. Depress ratchet arms and insert shaft assembly into the bushing in the left case half and release. Ratchet arms should now be inside the end plate of the shifter drum contacting the shifter drum pins.

3. See Figure 6-99. Apply several drops of LOCTITE 262 (red) to last few threads of countershaft retaining screw. Thread screw into end of shaft.

4. Place transmission in gear and tighten screw (1) to 33-37 ft-lbs (44.8-50 Nm).

5. Install transmission sprocket. See 6.16 TRANSMISSION SPROCKET.

6. Continue assembling engine. See appropriate sections of 3.19 CRANKCASE and 3.6 CYLINDER HEAD/3.7 CYLINDER AND PISTON.

7. Install primary chain and engine sprocket, clutch assembly and primary cover. See 6.5 PRIMARY CHAIN.

8. Install engine in chassis. See 3.5 ENGINE INSTALLATION.
REMOVAL

NOTE
Use spacer and fastener from B-45659 to install sprocket locking tool.

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>SPECIALTY TOOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-45659</td>
<td>Transmission sprocket locking tool</td>
</tr>
<tr>
<td>HD-94660-37B</td>
<td>Mainshaft locknut wrench</td>
</tr>
</tbody>
</table>

1. Loosen rear axle pinch fastener. See IDLER PULLEY REMOVALS 6.6 DRIVE BELT SYSTEM.
2. Unthread axle approximately 15 threads to release tension from drive belt.
3. Remove front sprocket cover. See 2.33 SPROCKET COVER.
4. See Figure 6-100. Remove both bracket nuts with washers (5) attaching idler pulley bracket (4) to studs (3).
5. Slide idler pulley assembly off studs.
6. Inspect pulley by spinning wheel (1) and checking for excessive wheel bearing wear.
7. If pulley wheel needs replacement, remove fastener (6) and nut (2) from idler pulley bracket (4) and discard. Replace with new pulley wheel (1).

NOTE
The pulley wheel bearings can not be replaced separately. A new pulley wheel must be installed.

Figure 6-100. Idler Pulley Assembly

8. See Figure 6-101. Place transmission in first gear. Remove two socket head screws (1) and lockplate (2).

NOTES
● Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft.
● Use the P3/Blast SPROCKET HOLDING TOOL (Part No. B-43982) with the spacer and fastener from the Firebolt SPROCKET LOCKING TOOL (Part No. B-45659) to hold the sprocket.

9. Place transmission in neutral. See Figure 6-102. Install the P3/Blast SPROCKET HOLDING TOOL to hold the sprocket.
10. Remove transmission sprocket nut (3) from main drive gear (5) using MAINSHAFT LOCKNUT WRENCH (Part No. HD-94660-37B or HD-46288) and a breaker bar.
11. Remove secondary drive belt from transmission sprocket. Remove transmission sprocket (4) from main drive gear (5).

Figure 6-101. Transmission Sprocket

Figure 6-102. Removing Transmission Sprocket Locknut
1. See Figure 6-101. Install transmission sprocket (4) with secondary drive belt onto main drive gear (5).

2. Place transmission in neutral.

3. Apply a few drops of LOCTITE 262 (red) to the left-hand threads of transmission sprocket nut (3) and lightly coat the washer-faced side with clean H-D 20W50 engine oil. Wipe off any excess oil.

4. Position nut with washer-faced side facing transmission sprocket. Turn the nut counterclockwise to install it onto main drive gear.

**NOTE**

Use the P3/Blast SPROCKET HOLDING TOOL (Part No. B-43982) with the spacer and fastener from the 2003 Firebolt SPROCKET LOCKING TOOL (B-45659) to hold the sprocket.

5. See Figure 6-103. Install SPROCKET HOLDING TOOL (Part No. B-43982) as shown.

6. Using MAINSHAFT LOCKNUT WRENCH (Part No. HD-94660-37B) and a torque wrench, tighten sprocket nut to 50 ft-lbs (67.8 Nm) INITIAL TORQUE ONLY.

7. See Figure 6-104. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.

8. Tighten the transmission sprocket nut an additional 30°-40°.

**NOTE**

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs. Do not loosen sprocket nut while attempting to align the screw holes. The lock plate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened to 45° as specified above. Tightening too much or too little may cause the nut to come loose during vehicle operation. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened until screw holes align. NEVER LOOSEN nut to align the screw holes.

9. See Figure 6-101. Install lockplate over nut so that two of lock plate's four drilled holes (diagonally opposite) align with sprocket's two tapped holes.

10. See Figure 6-101. Install two socket head screws through aligned holes of lock plate and into tapped holes of sprocket. Tighten to 90-110 in-lbs (10.2-12.4 Nm).

**NOTE**

See Figure 6-101. The original equipment socket head screws (1) have thread-locking compound applied to them. Since this compound remains effective for about three removal/installation cycles, the original screws may be reused up to three times. After the third removal/installation cycle, replace both screws with new screws identical to the original.

11. Install idler pulley. See IDLER PULLEY INSTALLATION under 6.6 DRIVE BELT SYSTEM.
NOTE
Never tighten rear axle with swingarm brace removed.

NOTE
If axle was removed for any reason, apply anti-seize to holes in swingarm and on axle prior to installing.

12. See Figure 6-105. Tighten rear axle (1) to 23-27 ft-lbs (31.2-36.6 Nm), back off two full turns and then retighten to 48-52 ft-lbs (65.1-70.5 Nm).

13. Tighten pinch fastener (2) on right side of swingarm to 40-45 ft-lbs (54-61 Nm).
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<td>7.20 Speedometer Performance Check</td>
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<td>7.21 Horn</td>
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<td>7.22 Neutral Indicator Switch</td>
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Table 7-1. Battery Specifications

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<tr>
<td>Size</td>
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<td>Type</td>
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Table 7-2. Spark Plug Specifications

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<td>Torque</td>
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Table 7-3. Alternator Specifications

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<td>AC voltage output</td>
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<tr>
<td>Stator coil resistance</td>
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Table 7-4. Regulator Specifications

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<tr>
<td>Voltage output @ 3600 RPM</td>
<td>14.4-14.6 VDC@ 75° F (24° C)</td>
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<tr>
<td>Amperes @ 3600 RPM</td>
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Table 7-5. Ignition Coil Specifications

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<tr>
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<td>Secondary winding</td>
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Table 7-6. Electrical System Specifications

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<td>Ignition fuse</td>
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<td>Light fuse</td>
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<td>Accessory fuse</td>
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<td>Brake/horn/active muffler fuse (1200 models only)</td>
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<td>ECM fuse</td>
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Table 7-7. Bulb Chart

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<th>BULBS REQUIRED</th>
<th>WATTS</th>
<th>AMPS</th>
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<td>Bulb (H3)</td>
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<td>Marker lamps</td>
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<td>Turn signal lamp (front and rear 1 bulb each)</td>
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<tr>
<td></td>
<td>License plate illumination lamp (European models only)</td>
<td>1</td>
<td>5</td>
<td>0.37 53436-97</td>
</tr>
<tr>
<td></td>
<td>License plate illumination lamp</td>
<td>1</td>
<td>5</td>
<td>0.37 Y05148.B.C</td>
</tr>
</tbody>
</table>

2006 Buell Lightning: Electrical 7-1
### Table 7-7. Bulb Chart

<table>
<thead>
<tr>
<th>ITEM</th>
<th>BULBS REQUIRED</th>
<th>WATTS</th>
<th>AMPS</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn signal indicator</td>
<td>1</td>
<td>1.12</td>
<td>0.08</td>
<td>Y0163.02A8</td>
</tr>
<tr>
<td>Check engine</td>
<td>1</td>
<td>1.12</td>
<td>0.08</td>
<td>Y0163.02A8</td>
</tr>
<tr>
<td>High beam</td>
<td>1</td>
<td>0.7</td>
<td>0.05</td>
<td>Y0162.02A8</td>
</tr>
<tr>
<td>Oil indicator</td>
<td>1</td>
<td>1.12</td>
<td>0.08</td>
<td>Y0163.02A8</td>
</tr>
<tr>
<td>Neutral</td>
<td>1</td>
<td>1.12</td>
<td>0.08</td>
<td>Y0163.02A8</td>
</tr>
<tr>
<td>Backlight</td>
<td>2</td>
<td>1.12</td>
<td>0.08</td>
<td>Y0163.02A8</td>
</tr>
<tr>
<td>Low fuel</td>
<td>1</td>
<td>0.7</td>
<td>0.05</td>
<td>Y0162.02A8</td>
</tr>
</tbody>
</table>
|                                            |                |       |      | Replace instrument cluster if low fuel warning lamp fails.

### TORQUE VALUES

<table>
<thead>
<tr>
<th>ITEM</th>
<th>TORQUE</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuator ground wire</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm page 7-76</td>
</tr>
<tr>
<td>Battery (+) to starter fastener</td>
<td>60-85 in-lbs</td>
<td>7.10 Nm page 7-34</td>
</tr>
<tr>
<td>Battery terminal fasteners</td>
<td>72-96 in-lbs</td>
<td>8-11 Nm page 7-74</td>
</tr>
<tr>
<td>Clutch switch fasteners</td>
<td>7.10 in-lbs</td>
<td>0.8-1.12 Nm page 7-16</td>
</tr>
<tr>
<td>Handlebar control housing screws (left side)</td>
<td>25-33 in-lbs</td>
<td>3-4 Nm page 7-53</td>
</tr>
<tr>
<td>Handlebar control housing screws (right side)</td>
<td>25-33 in-lbs</td>
<td>3-4 Nm Longer screw on bottom, page 7-52</td>
</tr>
<tr>
<td>Horn fastener</td>
<td>72.96 in-lbs</td>
<td>8-11 Nm page 7-62</td>
</tr>
<tr>
<td>Ignition switch body fastener</td>
<td>12-36 in-lbs</td>
<td>1.4-4.0 Nm page 7-8</td>
</tr>
<tr>
<td>Ignition switch fastener</td>
<td>18-20 ft-lbs</td>
<td>24.4-27.1 Nm LOCTITE (red), 272, page 7-9</td>
</tr>
<tr>
<td>Instrument module fastener</td>
<td>12-36 in-lbs</td>
<td>1.4-4.0 Nm page 7-56</td>
</tr>
<tr>
<td>Interactive exhaust actuator fasteners</td>
<td>36-40 in-lbs</td>
<td>4.0-4.5 Nm page 7-76</td>
</tr>
<tr>
<td>Main battery ground</td>
<td>48-72 in-lbs</td>
<td>5.4-8.1 Nm page 7-34</td>
</tr>
<tr>
<td>Neutral indicator switch</td>
<td>36-60 in-lbs</td>
<td>4-6.8 Nm LOCTITE 243 (blue), page 7-64</td>
</tr>
<tr>
<td>Retainer plate fasteners</td>
<td>56 in-lbs</td>
<td>6.3 Nm page 7-31</td>
</tr>
<tr>
<td>Rotor mounting fasteners</td>
<td>90-110 in-lbs</td>
<td>10-12 Nm LOCTITE THREADLOCKER 243, page 7-31</td>
</tr>
<tr>
<td>Spark plugs</td>
<td>11-18 ft-lbs</td>
<td>15-24 Nm page 7-1</td>
</tr>
<tr>
<td>Stator TORX mounting screws</td>
<td>30-40 in-lbs</td>
<td>3-4 Nm T-27 TORX with retaining compound, replace with new after each removal, page 7-31</td>
</tr>
<tr>
<td>Tail lamp lens and tail light</td>
<td>6-7 in-lbs</td>
<td>0.7-0.8 Nm page 7-45</td>
</tr>
<tr>
<td>Turn signal fastener (rear)</td>
<td>25-28 in-lbs</td>
<td>2.8-3.2 Nm page 7-49</td>
</tr>
<tr>
<td>Turn signal fasteners (front)</td>
<td>25-28 in-lbs</td>
<td>2.8-3.2 Nm page 7-49</td>
</tr>
<tr>
<td>Turn signal flasher fastener</td>
<td>30-40 in-lbs</td>
<td>3-4 Nm page 7-50</td>
</tr>
<tr>
<td>Voltage regulator mounting screws</td>
<td>36-60 in-lbs</td>
<td>4.1-6.8 Nm Use new fasteners, page 7-32</td>
</tr>
</tbody>
</table>
GENERAL

The vehicle uses a breakerless inductive-discharge ignition system. The system has both a primary and secondary circuit. The primary circuit consists of the battery, main fuse, ignition switch, primary coil windings, computerized ignition timer and associated wiring. The secondary circuit consists of the secondary coil, spark plugs and associated wiring. See Figure 7-1.

DIGITAL TECHNICIAN (Part No. HD-44750) can access the information received by and stored in the electronic control module.

The electronic control module (ECM) is located under the seat. The module has three primary functions. First, it computes the spark advance for proper ignition timing based on sensor input. Second, it controls the independent, primary windings of the spark coil and is thus able to provide sequential and independent firing of the spark plugs (non waste spark). Third, it calculates the correct air/fuel ratio based on input from the sensors.

The electronic control module contains all the solid-state components used in the ignition system. The dwell time for the ignition coil is also calculated by the ECM-microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to keep battery drain to a minimum and to adequately charge the coil 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 and oil. The module is not repairable. Replace the unit if it fails.

The ECM uses six different sensors to monitor rider demands and changing engine conditions. These sensors are:

- Throttle Position (TP) Sensor
- Cam Position (CMP) Sensor
- Intake Air Temperature (IAT) Sensor
- Engine Temperature (ET) Sensor
- Oxygen (O2) Sensor
- Bank Angle Sensor (BAS)
- Interactive Muffler Valve Position Sensor (1200 models) (Built-in to the actuator)

The ECM uses the information provided by the throttle position and cam position sensors to calculate how much air is entering the engine. The throttle position sensor monitors the amount of air entering the engine by how far the throttle is open, whether it is open or closing and how fast it is opening or closing. The IAT sensor measures the temperature of the air entering the engine, providing the rest of the information necessary to determine the density of the air entering the engine. The ECM also monitors the cam position sensor to determine the exact position of both cylinders in the combustion cycle and the engine speed.

The ET sensor provides the ECM the current engine temperature. Proper fuel and spark delivery are dependent on the temperature of the engine. The ECM will provide a richer fuel mixture on start up and a higher degree of spark advance. As the vehicle warms up to operating temperature the fuel mixture will lean and the spark advance will decrease.

On the 1200 models, an interactive exhaust system utilizes an actuator valve in the muffler which is connected to a servo motor via a cable. The valve position automatically adjusts to enhance engine performance.

Cooling fan actuation is controlled by the ECM. With key ON, the fan turns on when engine cylinder head temperature reaches 220° C (428° F) and shuts off when temperature reaches 180° C (356° F). With key OFF, the fan turns on when engine temperature reaches 170° C (338° F) and shuts off when temperature reaches 150° C (302° F).

The information provided by the O2 sensor allows the ECM to ensure a proper air/fuel mixture by monitoring the final combustion efficiency in the exhaust system. This ensures optimum engine performance at any altitude or barometric pressure. The O2 sensor input to the ECM is required to ensure a stoichiometric (14.7:1) air/fuel ratio during closed loop operation.

The Bank Angle Sensor (BAS) provides input to the ECM on whether the vehicle lean is greater than predetermined bank angle limit. As long as lean angle does not exceed limit, fuel supply and ignition operation are unaffected. If the vehicle exceeds the predetermined bank angle limit, the BAS will interrupt the operation of the ignition system and fuel supply. To reset system, return vehicle to the upright position and switch key OFF.

The ECM-controlled ignition coil fires each spark plug independently on the compression stroke of each cylinder (no waste spark). The spark plug in the front cylinder fires at the end of that cylinder’s compression stroke, thereby igniting the air/fuel mixture. The same sequence occurs at the end of the rear cylinder’s compression stroke (thereby igniting the air/fuel mixture in the rear cylinder).

The rotor and cam position sensor are located in the gearcase cover on the right side of the motorcycle. The Cam position sensor consists of a Hall-effect device, magnet and plate. The plate is mounted over a rotating cup (“rotor cup”). The rotor cup is mounted on the camshaft and operates at one-half crankshaft speed. As the rotor cup turns inside the gearcase, six symmetrical teeth on the rotor cup sequentially break the magnetic field between the magnet and the Hall-effect device. The edges of these teeth are cut to correspond to specific positions of the camshaft during the engine cycle such as TDC for the front cylinder. The output of the cam position sensor is used by the ECM to not only determine engine position, but also to calculate engine speed. This method of measuring camshaft position provides accurate information on engine position down to zero engine speed.

For more information on the sensors used in conjunction with the ECM see Section 4 Fuel System. See the wiring diagrams in the Appendix for additional information on ignition system circuits.

TROUBLESHOOTING

See Section 4 Fuel System for troubleshooting information.
Figure 7-1. Ignition Components

1. Pop rivet (2)
2. Timer cover
3. Screw (2)
4. Timer plate stud (2)
5. Cam position sensor connector (14)
6. Terminal pin
7. Electronic control module (ECM)
8. Connector, interactive exhaust system
9. Spark plug (2)
10. Rear spark plug cable
11. Mounting fastener
12. Ignition coil
13. Front spark plug cable
14. Engine mount
15. Seal
16. Trigger rotor
17. Trigger rotor bolt
18. Cam position sensor
19. Inner cover
WARNING

DO NOT modify the ignition/headlight switch wiring to circumvent the automatic-on headlight feature. Visibility is a major concern for motorcyclists. Failure to have proper headlight operation could result in death or serious injury.

Switch positions are explained in Table 7-8.

CAUTION

Turn the ignition switch to the OFF position and remove the key before locking the motorcycle. Leaving the key in the P position will keep the instrument lights on and result in a discharged battery. (00155a)

NOTE

The key locks the ignition system and is removable in both the LOCK and P positions. The P position is located counter-clockwise from the LOCK position and allows the rider to remove the key while leaving the lights on. When the key is placed in the P position, several indicator markers are or can be activated. Refer to Table 7-9.

Table 7-8. Ignition Key Switch Positions

<table>
<thead>
<tr>
<th>LABEL</th>
<th>IGN.</th>
<th>LAMPS</th>
<th>REMOVE KEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>Off</td>
<td>Off</td>
<td>Yes</td>
</tr>
<tr>
<td>P</td>
<td>Off</td>
<td>See note &amp; Table 7-9.</td>
<td>Yes</td>
</tr>
<tr>
<td>ON</td>
<td>On</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>LOCK</td>
<td>Off</td>
<td>Off</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 7-9. Indicator Markers

<table>
<thead>
<tr>
<th>ITEM</th>
<th>P</th>
<th>ON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headlight position marker (European models only)</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Headlight high beam</td>
<td>Off</td>
<td>Can be activated</td>
</tr>
<tr>
<td>Headlight low beam</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>Instrument module illumination lamps</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Stop lamp</td>
<td>Off</td>
<td>Can be activated</td>
</tr>
<tr>
<td>Front and rear turn signals</td>
<td>Can be activated</td>
<td></td>
</tr>
<tr>
<td>Horn</td>
<td>Cannot be activated</td>
<td>Can be activated</td>
</tr>
</tbody>
</table>
REMOVAL

1. Remove seat. See 2.43 SEAT.

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. Remove windscreen.

4. See Figure 7-3. Disconnect:
   - Turn signal flasher [30]
   - Turn signals [31]
   - Left [24] and right [22] handlebar wiring harnesses
   - Instrument cluster [39]
   - Horn [122]

5. Remove horn (12) from horn mount (10).

6. Cut cable strap (7) that loosely holds main wiring harness (8) to the ignition switch (6) and disconnect ignition switch connector [33].

Figure 7-3. Electrical Connectors Behind Windscreen

1. Turn signal flasher connector [30]
2. Instrument cluster connector [39]
3. Left handlebar connector [24]
4. Right handlebar connector [22] (Behind No. #1)
5. Turn signal connectors [31]
6. Ignition switch
7. Cable strap
8. Main harness
9. Horn fastener
10. Horn mount
11. Horn connector [122]
12. Horn
7. See Figure 7-4. Use Snap-on Tamper-Resistant T45 Torx driver (Part No. FTXR45E) to remove the two tamper-resistant Torx fasteners (2) securing ignition switch to upper fork clamp.

8. Remove the final ignition switch fastener (1) along with spacer located behind the ignition switch.

9. While holding the throttle cables (3) to your left (the right side of the vehicle), pull the ignition switch (4) toward you and roll the assembly away from you until the fork stop pin (5) is pointing down.

10. Slide the ignition switch assembly out to your left (the right side of the vehicle).

Figure 7-4. Ignition Switch (Typical)

1. Socket head fastener (1), with spacer behind switch
2. Tamper-resistant Torx fasteners (2)
3. Throttle cables
4. Ignition switch as positioned on vehicle
5. Fork stop pin (retracted)
DISASSEMBLY

1. See Figure 7-5. Remove ignition switch housing (4) from ignition switch (5) by prying tabs on side of housing
2. Remove ignition switch body fasteners (1). Separate ignition switch body (2) from ignition switch (5).

ASSEMBLY

**NOTE**

See Figure 7-5. In next step, be sure wide slot in ignition switch housing (4) is installed over wide boss on ignition switch (5).

1. Push ignition switch housing (4) on to ignition switch (5).

**NOTE**

In next step, do not force ignition switch (5) into ignition switch body (2). If ignition switch does not easily slide into ignition switch body, rotate slot in ignition switch body with screwdriver until proper installation can be achieved.

2. Mate ignition switch to ignition switch body.
3. Install ignition switch body fasteners (1). Tighten to 12-36 in-lbs (1.4-4.0 Nm).
Installation

Note

When installing the ignition switch it is important to have the fork lock pin pointing down while sliding the switch into place.

1. See Figure 7-4. While holding the throttle cables (3) to your left (the right side of the vehicle), slide the ignition switch assembly in to your right (the left side of the vehicle).

2. Install the ignition switch (4) with the fork stop pin (5) pointing down and, once in place, roll the assembly toward you and insert the fork stop pin into the upper triple clamp.

3. Attach ignition switch assembly to upper triple clamp using ignition switch fasteners (1, 2). Use LOCTITE 272 (Red) on fasteners. Tighten to 12-14 ft-lbs (16.3-19 Nm).

4. See Figure 7-7. Connect ignition switch connector [33] to wiring harness.

5. Install horn connectors [122] and install horn assembly tightening fastener to 72-96 in-lbs (8-11 Nm).

6. See Figure 7-6. Connect:
   a. Instrument cluster [39]
   b. Left [24] and right [22] handlebar wiring harnesses
   c. Turn signals [31]
   d. Turn signal flasher [30]

7. Loosely install cable strap around the main wiring harness and the ignition switch.

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. (00065a)

8. Install negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

WARNING

DO NOT modify the ignition/headlight switch wiring to circumvent the automatic-on headlight feature. Visibility is a major concern for motorcyclists. Failure to have proper headlight operation could result in death or serious injury.

9. Check ignition switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

10. Install seat. See 2.43 SEAT.

11. Install windscren and tighten fasteners to 10-12 in-lbs (1.1-1.4 Nm).
GENERAL

Resistor-type high-tension spark plug cables have a carbon-impregnated fabric core, instead of solid wire, for radio noise suppression and improved reliability of electronic components. Use the exact replacement cable for best results.

REMOVAL

WARNING

Never disconnect a spark plug cable with the engine running. If you disconnect a spark plug cable with the engine running, you may receive a potentially fatal electric shock from the ignition system which could result in death or serious injury.

NOTE

When disconnecting each spark plug cable from its spark plug terminal, always grasp and pull on the rubber boot at the end of the cable assembly (as close as possible to the spark plug terminal). Do not pull on the cable portion itself. Pulling on the cable will damage the cable’s carbon core.

1. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
2. Remove air scoop left side.
3. See Figure 7-8. Disconnect spark plug cables from ignition coil and spark plug terminals. Inspect cables for damage.

Figure 7-8. Spark Plug Cable Location

1. Front spark plug cable
2. Rear spark plug cable
INSPECTION

1. Inspect spark plug cables. Replace cables that are worn or damaged.
   a. Check for cracks or loose terminals.
   b. Check for loose fit on ignition coil and spark plugs.
2. Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.

   NOTE
   Both cables are the same length.
3. See Figure 7-9. Check spark plug cable resistance with an ohmmeter. Replace cables not meeting resistance specifications.

Table 7-10. Spark Plug Cables

<table>
<thead>
<tr>
<th>SPECIFICATION</th>
<th>FRONT &amp; REAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length - in. (mm)</td>
<td>5.70 ± 0.25 (145)</td>
</tr>
<tr>
<td>Resistance - Ohms</td>
<td>1,350-3,465</td>
</tr>
</tbody>
</table>

INSTALLATION

NOTES

● To ease installation, install spark plug cables to ignition coil first and apply ELECTRICAL CONTACT GREASE (Part No. 99861-90) to the inside of spark plug boot.

● See Figure 7-10. When assembling the spark plug boots onto the spark plugs, make sure the boot is slid all the way down over the spark plug insulator. The gap should not exceed 1/8 in. (3.2 mm).

● For spark plug information see 1.13 SPARK PLUGS.
1. Connect spark plug cables to ignition coil and spark plugs. Fasten boots/caps securely. Tight connections provide the necessary moisture-proof environment for the ignition coil and spark plug terminals.
2. Install air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
GENERAL

The starter interlock system is designed to prevent unintended start-up.

Two circuits make up the starter interlock system.

Starter Circuit

The starter circuit prevents the motorcycle from being started unless a ground has been established at the starter relay. This ground may come from one of two sources.

- By placing the motorcycle in neutral and grounding through the neutral switch.
- By disengaging the clutch and grounding through the clutch lever switch.

Once the starter circuit is grounded and the starter button pushed, the starter relay can be energized. The energized relay then permits the starter motor to crank the engine.

Table 7-11. Starter Interlock Troubleshooting

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CHECK FOR</th>
<th>CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric starter will not crank.</td>
<td>Battery problems.</td>
<td>See 7.11 BATTERY.</td>
</tr>
<tr>
<td>Inappropriate gear selected.</td>
<td>Inappropriate gear selected.</td>
<td>Place vehicle in neutral.</td>
</tr>
<tr>
<td>Clutch lever not disengaged.</td>
<td>Clutch lever not disengaged.</td>
<td>Pull in clutch lever.</td>
</tr>
<tr>
<td>Starter relay problems.</td>
<td>Starter relay problems.</td>
<td>Listen for starter relay “click”. If click is not heard, perform starter relay tests.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Follow starter troubleshooting in Section 5.</td>
</tr>
</tbody>
</table>
DIAGNOSTICS

The reference numbers below correlate with the circled numbers in the 7.5 STARTER INTERLOCK flow charts.
1. Check diode polarity as shown in Figure 7-11.
2. Check diode with an ohmmeter as shown in Figure 7-12.

Figure 7-11. Diode Polarity

Figure 7-12. Ohmmeter Diode Test

Figure 7-13. Diode Wiring
Starter Test (Part 1 of 2)

CONDITION: Key ON, transmission in neutral and clutch engaged

1. Depress starter button. Does Starter work?
   - YES
   - NO

   - YES
   - NO

3. Repair open on TN/LT.GN wire between diode and start relay.
   - YES
   - NO

4. Check for ground on TN/LT.GN wire of Diode. Ground present?
   - YES
   - NO

5. Repair open on TN/Y wire between neutral switch and Diode.
   - YES
   - NO

6. Replace neutral switch.

7. Check for ground on TN/LT.GN wire of Diode.
   - YES
   - NO

8. Neutral interlock OK.
   - YES
   - NO

9. Check for ground on TN/Y wire on Diode. Ground present?
   - YES
   - NO

10. Replace diode.

    - YES
    - NO

12. Remove sprocket cover. Check for ground at neutral switch terminal. Ground present?
    - YES
    - NO

13. Replace neutral switch.
Starter Test (Part 2 of 2)
CONDITION: Key ON, transmission in gear and clutch disengaged

- Depress starter button. Does Starter work?
  - NO
  - YES

  - Check for ground on TN/LTGN wire of clutch switch connector [95]. Ground present?
    - YES
      - System OK
    - NO
      - Repair open on TN/LTGN wire between connector [95] and starter relay.

  - Check for ground on BK wire of connector [95]. Ground present?
    - YES
      - System OK
    - NO
      - Repair open on BK wire between connector [95] and ground.

- Replace clutch switch.
Clutch Switch

See Figure 7-14. The clutch switch attaches to the clutch control lever bracket. The switch completes a path to ground for the ignition relay and the starter relay when the clutch is disengaged. Test the switch as follows:

1. Unplug the 2-place clutch switch connector [95].
2. Test the switch using an ohmmeter.
   a. With clutch engaged (1) (switch open), the switch should show \( \infty \) ohms (infinite ohms).
   b. With clutch disengaged (2) (switch closed), the switch should show 0 ohms or little resistance.
3. Replace the assembly with a new switch if necessary. See 2.25 CLUTCH CONTROL/CABLE.
4. Tighten fasteners to 7-10 in-lbs (0.8-1.12 Nm).

**Figure 7-14. Clutch Switch**
Ignition Relay
The ignition relay is located under the seat. Test the relay as follows:
1. See Figure 7-15. Locate ignition relay (2) within relay block.
2. To test relay, proceed to Step 3. If installing a new starter relay, remove old relay. Install new relay into relay block.
3. See Figure 7-17. Obtain a 12 volt battery and a continuity tester or ohmmeter.
   a. Pull relay from relay block.
   b. Connect positive battery lead to the 86 terminal.
   c. Connect negative battery lead to the 85 terminal to energize relay.
   d. 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. Replace the relay with a new relay if necessary.

Key Switch Relay
See Figure 7-15. The key switch relay (1) is under the seat. See Ignition Relay under 7.5 STARTER INTERLOCK for testing procedure.

Battery Fuse
A 30 Amp battery fuse links the ignition key switch and the battery. The 30 Amp battery fuse is located under the rider’s seat. See 7.23 BATTERY FUSE AND FUSES for more information.
Diodes

See Figure 7-18. The diode is located in the fuse block under the seat.
1. See Figure 7-20. Locate diode within fuse block.
2. Test diode using Starter Test flow charts under DIAGNOSTICS.
3. Replace the diode by pulling it straight out. Ensure it is installed in the correct direction.

Figure 7-18. Fuse Block (contains diode)

Figure 7-19. Fuse Block (XB12Ss) (contains diode)

Figure 7-20. Fuse Blocks

<table>
<thead>
<tr>
<th>11 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty</td>
</tr>
<tr>
<td>Diode</td>
</tr>
<tr>
<td>Access</td>
</tr>
<tr>
<td>Battery</td>
</tr>
<tr>
<td>Fan</td>
</tr>
<tr>
<td>ECM</td>
</tr>
<tr>
<td>Lights</td>
</tr>
<tr>
<td>Spare</td>
</tr>
<tr>
<td>Key Sw</td>
</tr>
<tr>
<td>Spare</td>
</tr>
</tbody>
</table>

Figure 7-20. Fuse Blocks
INTERACTIVE EXHAUST SYSTEM (XB12 MODELS)  7.6

GENERAL

NOTE
The interactive exhaust system is standard equipment on the XB12 models only.

See Figure 7-21. An electronically controlled actuator opens or closes a butterfly valve (1) that controls exhaust flow in a multi-chamber muffler.

The ECM monitors engine speed and throttle position while alternating flow paths between the chambers to adjust back-pressure optimizing torque and horsepower for the riding condition.

For example:

1. At low RPM with a wide-open throttle, the valve (1) is opened to reduce back-pressure so the engine can gain RPM quickly. The exhaust enters (2) the muffler and flows (3) through the open valve (1) into chamber C (7) and then exits (8).

2. In the mid-range, the valve is closed to increase acceleration torque. The exhaust flows (4) through chamber A, around to chamber B and then through chamber C and exits.

3. At high RPM, the valve opens again to maximize horsepower. The exhaust enters (2) the muffler and flows (3) through the open valve (1) into chamber C (7) and then exits (8).

Figure 7-21. Interactive Exhaust System Muffler
Figure 7-22. Air Cleaner Assembly (XB12 Models) with Interactive Exhaust Components

1. Screw (XB12 “Translucid” cover) (2)
2. Flat washer (not shown)
3. Actuator, interactive exhaust
4. Harness, interactive exhaust
5. Cable bracket
6. Interactive exhaust cable
7. Cover, air cleaner
8. Filter element
9. Air cleaner cover seal
10. Shoulder screw (4)
11. Base plate assembly
12. Breather hoses, front and rear
13. Grommet
14. Activator cover (XB12 “Translucid” cover)
REMOVAL

1. Remove seat. See 2.43 SEAT.

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. Remove chin fairing. See 2.36 CHIN FAIRING.
4. Remove front sprocket cover. See 2.33 SPROCKET COVER.
5. Remove intake cover assembly. See 4.44 AIR CLEANER ASSEMBLY.

6. See Figure 7-23. Remove fuel vent tube (3) from fuel cell vent and groove on top of air cleaner cover (2).

7. Disconnect harness connector [161B] from actuator (5).
8. Add freeplay to interactive exhaust cable (6), loosen jam nut and remove cable from bracket on actuator (5).
9. Remove interactive exhaust cable from cable wheel on actuator.
10. Remove actuator.
11. Remove tree fastener securing interactive exhaust cable to inside of muffler bracket on right side.

NOTE

It is necessary to remove interactive exhaust cable from muffler with muffler only partially removed.

12. Loosen jam nut and remove interactive exhaust cable from bracket on muffler.
13. Remove interactive exhaust cable from cable wheel on muffler.

NOTE

To replace interactive cable on vehicle it will be necessary to use hose assembly (Part No. HS0020.02A8) to aid in removal and installation.

14. Remove interactive cable from vehicle.
   a. Slip end of hose over upper end of cable and attach with tape.
   b. Gently pull cable assembly down and out.
   c. Remove hose from interactive cable assembly.
15. Remove muffler. See 2.31 EXHAUST SYSTEM.

Figure 7-23. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 solid color models)
NOTES

- Never reuse front muffler strap. Always replace front muffler strap with a new strap when removed from system.
- It is necessary to install interactive exhaust cable to muffler with muffler only partially installed.

1. Install muffler. See 2.31 EXHAUST SYSTEM.
2. Install interactive cable onto vehicle.
   a. Slip end of hose over upper end of cable and attach with tape.
   b. See Figure 7-24. Gently pull cable assembly up through the wire harness strap and guide at the left rear corner of the frame/fuel tank assembly.

3. Install actuator and tighten fasteners to 36-40 in-lbs (40.1-41.5 Nm).
4. Attach interactive exhaust cable to cable wheel on actuator.
5. Connect interactive exhaust harness to actuator [161B].
6. Route fuel vent line and install.
7. Attach interactive exhaust cable to bracket and cable wheel on actuator and adjust. See 1.16 INTERACTIVE EXHAUST CABLE (XB12 MODELS).
8. Install intake cover assembly. See.

9. Install negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

10. Install seat. See 2.43 SEAT.

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)

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
GENERAL

The charging system consists of the alternator and regulator. Charging system circuits are shown in Figure 7-27.

NOTE

Never install accessory wiring between battery post and battery cable. Installing wire between battery post and battery cable could cause damage to electrical system.

When installing electrical accessories, install longer battery post fasteners. Install wiring between battery cable and fastener.

Alternator

The alternator consists of two main components:

- The rotor which mounts to the engine sprocket shaft.
- The stator which bolts to the engine crankcase.

Voltage Regulator

See Figure 7-25. The voltage regulator is a series regulator with shunt control. The voltage regulator combines the functions of rectifying (converting AC voltage to DC) and regulating (controlling voltage output).

TROUBLESHOOTING

When the charging system fails to charge or does not charge at a satisfactory rate, check the following:

Battery

Check for a weak or dead battery. See 7.11 BATTERY. Battery must be fully charged in order to perform any electrical tests.

Wiring

Check for corroded or loose connections in the charging circuit. See Figure 7-27.

Voltage Regulator Inspection

See Figure 7-26. The plug connector to stator must be clean and tight.
Test 7.7 (Part 1 of 2)
SYMPTOM: BATTERY BECOMES DISCHARGED

Test battery. Charge or replace as required. See 7.11 BATTERY.

PASS

Perform Milliampere Draw Test (If applicable).

PASS

Perform Total Current Draw Test. Record measurement.

PASS

STOP

Go to Test 7.7 (Part 2 of 2).

FAIL

Correct as required.

FAIL

Isolate damaged component or wiring.

FAIL

Isolate damaged wiring or excessive accessories.

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 7.7 (Part 2 of 2)
SYMPTOM: BATTERY BECOMES DISCHARGED

From Test 7.7 (Part 1 of 2).
Perform Current and Voltage Output Test. Record measurement and compare with Total Current Draw Test before proceeding.

PASS

Perform Voltage Output Test.

FAIL

Perform Stator Check.

PASS

Perform AC Output Check.

FAIL

Replace stator.

PASS

Replace regulator.

FAIL

Inspect rotor.

PASS

Replace stator.

FAIL

Damaged or slipping rotor.

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 7-27. Charging System Circuit
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.

1. See Figure 7-28. Connect ammeter between negative battery terminal and battery. With this arrangement, you will also pick up any regulator drain.

2. With ignition key switch turned to OFF and all lights and accessories off, observe amperage reading.
   a. Maximum reading should be 2.0 milliamperes.
   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.

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 7-29. To check for this condition, place load tester induction pickup or current probe pickup over battery negative cable.

2. Disconnect stator wiring from voltage regulator wiring at the connector [46] under front sprocket cover See 7.26 SPROCKET COVER WIRING. Start the motorcycle and run the engine at 3000 RPM.

3. With ignition and all continuously running lights and accessories turned on (headlight 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

1. Connect load tester.
   a. Connect negative and positive leads to battery terminals.
   b. See Figure 7-30. Place load tester induction pickup over positive regulator cable.

   **NOTE**
   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 34-38 amps. Make note of measurement for use in **TOTAL CURRENT DRAW TEST**.

   **NOTE**
   Rider’s habits may require output test at lower RPM.

Voltage Output Test

1. See Figure 7-30. After removing the load, read the load tester voltage meter.
   a. If voltage to the battery is not more than 15 VDC, voltage output is within specifications. Investigate other possible problems. See **TROUBLESHOOTING** in this section.
   b. If voltage is higher, regulator is not functioning properly.

Stator Check

1. Turn ignition key switch to OFF.
2. See Figure 7-31. Connect an ohmmeter.
   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 and ground.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 7-32. 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 the stator sockets should be 0.1-0.3 ohms.
   b. If the resistance is lower, 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 7-33. Test AC output.
   b. Connect an AC voltmeter across stator sockets 1-2.
   c. Run the engine at 2000 RPM. The AC output should be 32-40 volts AC. (approximately 16-20 volts per 1000 RPM).
   d. Repeat test across stator sockets 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/rectifier. Replace as required.

3. Check the output again as described under CURRENT AND VOLTAGE OUTPUT TEST on page 7-28.

Figure 7-32. Check for Stator Resistance

Figure 7-33. Check Stator AC Voltage Output
### REMOVAL/DISASSEMBLY

#### WARNING

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

1. Disconnect negative battery cable.
2. Remove primary cover. See 6.2 PRIMARY COVER.
3. Remove clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See 6.5 PRIMARY CHAIN.
4. Remove/disassemble rotor and/or stator, as required. Refer to the following procedures.

#### Rotor

1. See Figure 7-34. Remove the eight fasteners which secure alternator rotor to engine sprocket.
2. See Figure 7-35. Position blocking under rotor. Press sprocket free of rotor.

**NOTE**
Resistance to sprocket/rotor disassembly is due in part to the magnetic force of the permanent rotor magnets.

#### Stator

1. See Figure 7-36. Disconnect stator wiring (4) from voltage regulator wiring at connector (5) [46] under sprocket cover. See 7.26 SPROCKET COVER WIRING.
2. Remove cable straps holding stator wire to wire harness.

**NOTE**
Stator TORX screws contain a thread locking compound. Do not reuse existing screws. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners could result in alternator damage.

3. Remove and discard the four TORX screws (1) which secure stator (2) to left crankcase half.
4. Remove retainer plate fasteners.
5. Remove stator wiring grommet (3) from left crankcase half.
6. Withdraw stator wiring (4) from grommet hole in left crankcase half. Remove stator.

---

**Figure 7-34. Rotor Assembly**

**Figure 7-35. Removing Rotor From Sprocket**

**Figure 7-36. Stator Assembly**
CAUTION

Do not strike or drop alternator rotor or damage to magnet adhesive may occur. Magnet adhesive damage can result in rotor failure.

1. Clean rotor with a petroleum-base solvent. Remove all foreign material from rotor magnets. Replace rotor if rotor magnets are cracked or loose.
2. Clean stator by wiping with a clean cloth.
3. Examine stator leads for cracked or damaged insulation.

NOTE
The rotor and stator can be replaced individually if either is damaged.

ASSEMBLY/INSTALLATION

Depending on whether the rotor, the stator, or both the rotor and stator were removed/disassembled, perform the applicable procedures which follow:

1. See Figure 7-36. Feed stator wiring (4) with attached grommet (3) into open grommet hole in left crankcase half.
2. Apply a light coating of clean engine oil or chaincase lubricant to grommet. Install grommet into hole in left crankcase half.

NOTE
Stator TORX screws contain a thread locking compound. Do not reuse existing screws. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners could result in alternator damage.

3. Position stator (2) on left crankcase half. Secure stator using four new TORX screws (1). Tighten TORX screws to 30-40 in-lbs (3-4 Nm).
4. Install retainer plate and tighten fasteners to 56 in-lbs (6.3 Nm).
5. Route stator wiring (4) behind rear cylinder and in front of transmission breather hose. See 7.26 SPROCKET COVER WIRING for remaining wire routing information.

6. See Figure 7-37. Attach rotor to sprocket.
   a. Position rotor (3) on sprocket (1). Align holes in sprocket with holes in rotor.
   b. Insert the new eight mounting fasteners through rotor and start fasteners into tapped holes in sprocket.
   c. Position a section of pipe (2) with an inside diameter larger than the sprocket mounting hub over center of rotor. Press rotor onto sprocket. Tighten fasteners to 90-110 in-lbs (10-12 Nm).
7. Install clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See 6.5 PRIMARY CHAIN.
8. Install primary cover. See 6.2 PRIMARY COVER.
9. Connect negative battery cable.
10. Test charging system. See 7.7 CHARGING SYSTEM.
GENERAL

The voltage regulator is mounted to the front of the crankcase. The voltage regulator is not repairable. Replace the unit if it fails.

REMOVAL

1. Remove seat. See 2.43 SEAT.

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 from battery.

NOTE

When disconnecting the alternator stator wiring, pull apart the connector by firmly grasping both connector halves. Do not pull on leads or damage to the wires and/or terminals may result.

3. See Figure 7-39. Disconnect stator connector [46] (1) and voltage regulator connector [77] (2) located under sprocket cover. See 7.26 SPROCKET COVER WIRING.

4. Remove fasteners (5) and voltage regulator (4) from bracket (3).

INSTALLATION

1. See Figure 7-39. Attach new voltage regulator (4) to bracket (3). Tighten new fasteners (5) to 36-60 in-lbs (4.1-6.8 Nm).

2. Connect stator connector [46] (1) and voltage regulator connector [77] (2) located under sprocket cover. See 7.26 SPROCKET COVER WIRING.

3. Connect negative battery cable to battery terminal.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat. See 2.43 SEAT.

5. Test charging system. See 7.7 CHARGING SYSTEM.
REMOVAL

**WARNING**

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

**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)

1. See Figure 7-40. Disconnect negative and positive cables from battery, negative cable first.
   a. Remove fastener holding negative cable to negative terminal.
   b. Remove fastener holding positive cable to positive battery terminal.

2. See Figure 7-42. Remove fastener to detach negative battery cable from frame.

3. See Figure 7-40. Remove protective rubber boot from starter fastener. Remove fastener with washer to detach positive battery cable from starter.

4. Cut 14 gauge Red/Yellow wire approximately 6 in. (152.4 mm) above the point where it enters the main harness bundle.

   **NOTE**

   *This is to allow a splice to be made for the new positive cable to be installed.*

INSTALLATION

1. Clean cable connectors and battery terminals using a wire brush or sandpaper to remove any oxidation.

**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)
2. Connect cables to frame and starter.
   a. See Figure 7-43. First, connect positive cable to starter using fastener with washer. Tighten fastener to 60-85 in-lbs (7-10 Nm).
   b. See Figure 7-42. Attach negative cable to frame. Tighten to 48-72 in-lbs (5.4-8.1 Nm).
3. Apply light coat of petroleum jelly or corrosion-retardant material to both battery terminals.
4. Connect cables to battery.
   a. See Figure 7-40. Positive battery cable runs from starter to positive battery terminal.
   b. Splice 14 gauge Red/Yellow wire coming from positive battery cable into main harness bundle.
   c. Connect positive cable to positive (+) battery terminal using fastener.
   d. Connect negative cable to negative (-) battery terminal using fastener.
   e. Tighten terminal fasteners to 72-96 in-lbs (8-11 Nm).
GENERAL

All Buell 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.

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. (00063a)

WARNING

Figure 7-44. 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)

Table 7-12. Battery Electrolyte Antidotes

<table>
<thead>
<tr>
<th>CONTACT</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>External</td>
<td>Flush with water.</td>
</tr>
<tr>
<td>Internal</td>
<td>Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Call doctor immediately.</td>
</tr>
<tr>
<td>Eyes</td>
<td>Flush with water, get immediate medical attention.</td>
</tr>
</tbody>
</table>

Figure 7-45. Battery Warning Label

NON-SPILLABLE
This is a ready filled, activated SEALED BATTERY. NEVER remove strip. Refer to owner’s manual or instruction sheet for charging procedure.

DANGER/POISON

EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY. SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.

KEEP OUT OF REACH OF CHILDREN. DO NOT OPEN BATTERY.
BATTERY TESTING

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

Refer to Table 7-13. 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. 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 12.8V or above, perform the load test.

Table 7-13. Voltmeter Test For Battery Charge

<table>
<thead>
<tr>
<th>VOLTAGE (OCV)</th>
<th>STATE OF CHARGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.7</td>
<td>100%</td>
</tr>
<tr>
<td>12.6</td>
<td>75%</td>
</tr>
<tr>
<td>12.3</td>
<td>50%</td>
</tr>
<tr>
<td>12.0</td>
<td>25%</td>
</tr>
<tr>
<td>11.8</td>
<td>0%</td>
</tr>
</tbody>
</table>

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 7-46. 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 7-46. Battery Test Results–Printout
Load Test

The load test measures battery performance under full current load and is the best indicator of battery condition. To load test the battery, proceed as follows:

**NOTE**

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

1. Always fully charge the battery before testing or test readings will be incorrect. See BATTERY INSTALLATION AND CONNECTION. Load testing a discharged battery can also result in permanent battery damage.

2. 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. 

3. Connect tester leads to battery posts and place induction pickup over negative (black) cable. See Figure 7-47.

**NOTE**

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

4. See Table 7-14. 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).

5. Install the battery on the motorcycle. See BATTERY INSTALLATION AND CONNECTION.

---

### Table 7-14. Battery Load Test

<table>
<thead>
<tr>
<th>COLD CRANKING AMPERAGE (CCA)</th>
<th>100%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buell Lightning</td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

**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.

1. Remove seat. See 2.43 SEAT.

**WARNING**

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

2. Unthread fastener and remove battery negative cable (black) from battery negative (-) terminal.

3. Unthread fastener and remove battery positive cable (red) from battery positive (+) terminal.

4. Unhook battery strap from frame.

5. Remove battery.

---

### CLEANING AND INSPECTION

1. Battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause battery to self-discharge. Clean battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water). When the solution stops bubbling, rinse off the battery with clean water.

2. Clean cable connectors and battery terminals using a wire brush or sandpaper. Remove any oxidation.

3. Inspect the battery screws and cables for breakage, loose connections and corrosion. Clean clamps.

4. Check the battery posts for melting or damage caused by overtightening.

5. Inspect the battery for discoloration, raised top or a warped or distorted case, which might indicate that the battery has been frozen, overheated or overcharged.

6. Inspect the battery case for cracks or leaks.
BATTERY CHARGING

Safety Precautions

Never charge a battery without first reviewing the instructions for the charger being used. 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.

Charging Battery

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.

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)

1. Perform a voltmeter test to determine the state of charge. See BATTERY TESTING. If battery needs to be charged, proceed to step 2.

CAUTION

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

2. Remove the battery from the motorcycle. See DISCONNECTION AND REMOVAL. Place the 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)

WARNING

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

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

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.

5. Step away from the battery and turn on the charger. See the charging instructions in Table 7-15.

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)

6. After the battery is fully charged, disconnect the black battery charger lead to the negative (–) terminal of the battery.
7. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
8. Mark the charging date on the battery.
9. Perform a load test to determine the condition of the battery. See BATTERY TESTING.
Table 7-15. Battery Charging Rates/Times (Approximate)

<table>
<thead>
<tr>
<th>Battery Amp-Hour</th>
<th>State of Charge</th>
<th>3 Amp Charger</th>
<th>6 Amp Charger</th>
<th>10 Amp Charger</th>
<th>20 Amp Charger</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Voltage Reading</td>
<td>% of Charge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>12.7 V</td>
<td>100%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12.6 V</td>
<td>75%</td>
<td>1 hour, 10 minutes</td>
<td>34 minutes</td>
<td>20 minutes</td>
</tr>
<tr>
<td></td>
<td>12.3 V</td>
<td>50%</td>
<td>2 hours, 20 minutes</td>
<td>1 hour, 10 minutes</td>
<td>40 minutes</td>
</tr>
<tr>
<td></td>
<td>12.0 V</td>
<td>25%</td>
<td>3 hours, 20 minutes</td>
<td>1 hour, 40 minutes</td>
<td>1 hour</td>
</tr>
<tr>
<td></td>
<td>11.8 V</td>
<td>0%</td>
<td>4 hours, 30 minutes</td>
<td>2 hours, 14 minutes</td>
<td>1 hour, 20 minutes</td>
</tr>
</tbody>
</table>

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.

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 for more than 30 minutes.
BATTERY CABLE ROUTING

Positive battery cable runs from starter post to positive battery terminal. Negative battery cable runs from frame to negative battery terminal. See Figure 7-49.

BATTERY INSTALLATION AND CONNECTION

1. Place the fully charged battery into the battery box, terminal side up.

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect the cables to the correct battery terminals. Failure to do so could result in damage to the motorcycle electrical system. (00215a)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>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)</td>
</tr>
</tbody>
</table>

2. Insert fastener through battery positive cable (red) into threaded hole of battery positive (+) terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

3. Insert fastener through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

4. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.

5. Install battery strap.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)</td>
</tr>
</tbody>
</table>

6. Install seat. See 2.43 SEAT.
**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. (00063a)

**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 will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge. See BATTERY CHARGING.

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. See Figure 7-50.

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 H-D Battery Tender Automatic Battery Charger (P/N 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 BATTERY CHARGING.

---

![Figure 7-50. Battery Self-Discharge Rate](image-url)
GENERAL

Dual headlights are equipped with replaceable bulbs.

- High beam headlight is located on the left side of vehicle and turns on and off with headlight switch.
- Low beam headlight is located on the right side of vehicle.
- Adjustment of individual headlight projection is accomplished by adjusting the entire headlight assembly.

NOTE
Low beam does not remain on when high beam is activated. Only one headlight remains on at any given time unless the passing lamp switch is depressed while low beam is activated causing the high beam to temporarily flash.

Figure 7-51. Headlight Assembly/Rear View

1. Headlight
2. Bulb holder (2)
3. High beam connection [38] (left side) with ground
4. Low beam connection [38] (right side) with ground
5. Headlight bulbs
HEADLIGHT BULBS

Removal
1. Remove seat. See 2.43 SEAT.

NOTE
On XB9SX models it will be necessary to remove headlight grille and reinstall once defective bulbs have been replaced.

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.

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

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)

3. See Figure 7-51. Remove rubber boot from headlight housing.

4. Unplug headlight bulb connectors (3) and/or (4).

5. Release bulb holder (2) from headlight housing clips.

6. Pull bulb housing from headlight housing.

Installation

NOTE
Not using the specified bulb may cause charging system problems.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

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)

CAUTION
If the rubber boots are not installed correctly the wiring harnesses can contact the edge of the forward frame mount. The wiring harness guides must be installed at a 20 degree angle.

1. See Figure 7-51. Align tabs on bulb (5) with tabs on headlight (1). Insert bulb.

2. Close the bulb holder (2).

3. Connect the headlight bulb connector.

NOTE
If the rubber boots are not installed correctly the wiring harnesses can contact the edge of the forward frame mount. The wiring harness guides must be installed at a 20 degree angle.

4. See Figure 7-53. Install rubber boot.

5. Connect negative battery cable.

a. When installing the rubber boots on the back of the headlight housing be sure to align the harness guides or spigots with the casting marks on the headlight housing.

b. When the spigots are aligned with the casting marks the wiring harness will be at approximately 20 degrees.

6. See Figure 7-52. Check headlight for proper operation. If operation fails, reread procedure and verify that all steps were performed.

a. Turn ignition key switch to ON.

b. Check headlight LOW (3) and HIGH beam (2) settings.

c. Set headlight to LOW beam. Press passing lamp switch (1). Headlight should flash HIGH beam for as long as the switch is pressed.

d. Turn ignition key switch to OFF.

7. Align headlight. See 1.18 HEADLIGHTS.

8. Install seat. See 2.43 SEAT.
Figure 7-53. Headlight Housing 20 Degree Alignment Marks for Rubber Boot Wiring Harness Guides or Spigots
**REMOVAL/DISASSEMBLY**

1. See Figure 7-54. Remove two screws (2) to detach tail lamp lens (4) and tail lamp (5). If replacing bulb (3), turn counterclockwise and remove.
2. Remove seat. See 2.43 SEAT.
3. Disconnect three connectors [93] from tail lamp harness (6).

**ASSEMBLY/INSTALLATION**

1. See Figure 7-54. Attach the three tail lamp harness connectors [93] (7).
2. If removed, install tail lamp bulb (3).
   a. Turn bulb clockwise to install.
   b. Install tail lamp lens (4) and tail lamp (5) with two fasteners (2). Tighten to 6-7 in-lbs (0.7-0.8 Nm).
3. Check tail lamp for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Check for tail lamp illumination.
   e. Turn ignition key switch to OFF.

**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)

4. Install seat. See 2.43 SEAT.

---

**Figure 7-54. Tail Lamp Assembly**

1. Center tail section
2. Screws (2)
3. Bulb
4. Lens
5. Tail lamp
6. Tail lamp wiring harness
7. Tail lamp boot
REMOVAL/DISASSEMBLY

1. Remove seat. See 2.43 SEAT.
2. See Figure 7-55. Disconnect the two connectors [45] from license plate lamp harness (2).
3. Remove two jam nuts and washers (1) to detach license plate lamp from center tail section (3).
4. Pull the lamp assembly away from center tail section pulling the harness out between the tail screen and the center tail section.

NOTE
See Figure 7-56. If replacing bulb only, remove both lamp lens screws (3), remove lamp lens (5) and remove bulb (4). Replace bulb and install lens and tighten screws.

ASSEMBLY/INSTALLATION

1. See Figure 7-55. Install license plate lamp assembly.
   a. Insert license plate lamp wiring harness (2) through hole at rear of center tail section (3) and route between the tail section and the tail screen (4).
   b. Attach lamp assembly to tail section using washers and jam nuts (1) and tighten to 12-36 in-lbs (1.4-4.1 Nm).
   c. Attach the two connectors [45] from license plate lamp harness (2) to main harness.
2. Check lamp for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Check for license plate lamp illumination.
   c. Turn ignition key switch to OFF.

WARNING
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat. See 2.43 SEAT.
REMOVAL

NOTE
To ensure correct installation, make note of wire routing and cable strap locations before removing turn signals.

Bulbs
Remove screw on back of housing to access turn signal bulbs.

Front
1. Remove windscrean. See 2.42 WINDSCREEN.
2. See Figure 7-57. Disconnect bullet connectors on turn signal wires.
3. See Figure 7-58. Remove jam nut and lockwasher (2) from inside of front module (3).
4. Pull bullet connectors and wiring through hole in front module (3) and remove turn signal (1).

Figure 7-57. Front Turn Signal Connections

Figure 7-58. Front Turn Signals
Rear

1. Remove seat See 2.43 SEAT.
2. See Figure 7-59. Disconnect bullet connectors [18] & [19] on turn signal wires.
3. See Figure 7-60. Remove fastener and lockwasher (4).

   NOTE
   In next step, reflector bracket (3) will be removed with turn signal (1).
4. Remove turn signal from center tail section (5).

Figure 7-59. Rear Turn Signal Connections

Figure 7-60. Rear Turn Signals

1. Turn signal (2)
2. Turn signal bulb
3. Reflector bracket
4. Jam nut and lockwasher (2)
5. Center tail section
6. Bungee hooks
**Installation**

**Front**
1. See Figure 7-58. Insert bullet connectors and wiring through hole in front module.
2. Install turn signal using lockwasher and jam nut. Tighten fastener to 25-28 in-lbs (2.8-3.2 Nm).

![Figure 7-61. Front Turn Signal Connections](image)

3. Attach bullet connectors on turn signal wires as shown in Figure 7-62.

**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)

4. Check turn signals for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Activate left turn signals using switch on left handlebar. Front and rear left turn signals must flash.
   c. Activate right turn signals using switch on left handlebar. Front and rear right turn signals must flash.
   d. Turn ignition key switch to OFF.
5. Install windscreer. See 2.42 WINDSCREEN.

**Rear**
1. See Figure 7-62. Insert bullet connectors through center tail section.
2. Install reflector bracket.

**NOTE**
Be sure tab on turn signal fits into hole in reflector bracket and tab on reflector bracket fits into hole in enter tail section.

3. See Figure 7-60. Attach turn signal using lockwasher and fastener (4). Tighten fastener to 25-28 in-lbs (2.8-3.2 Nm).

![Figure 7-62. Rear Turn Signal Connections](image)

4. Attach bullet connectors on turn signal wires as shown in Figure 7-62.

**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)

5. Check turn signals for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Activate left turn signals using switch on left handlebar. Front and rear left turn signals must flash.
   c. Activate right turn signals using switch on left handlebar. Front and rear right turn signals must flash.
   d. Turn ignition key switch to OFF.

**WARNING**
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat. See 2.43 SEAT.
REMOVAL

NOTE
The turn signal flasher is not repairable. Replace flasher upon failure.

1. Remove windscreen. See 2.42 WINDSCREEN.
2. Remove fastener securing turn signal flasher to front module.
3. See Figure 7-63. Detach 3-place connector [30] from flasher body.

INSTALLATION

1. See Figure 7-63. Attach 3-place connector [30] to flasher.
2. Install turn signal to front module. Tighten fastener to 12-36 in-lbs (1.4-4.1 Nm).

⚠️ 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)

3. Check turn signals for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. See Figure 7-64. Activate left turn signals using switch on left handlebar. Front and rear left turn signals must flash.
   c. Activate right turn signals using switch on left handlebar. Front and rear right turn signals must flash.
   d. Turn ignition key switch to OFF.
4. Install windscreen. See 2.42 WINDSCREEN.
NOTE
The individual handlebar switches are not repairable. Replace switch assembly upon switch failure.

Right Side
1. Remove throttle cables. See 2.23 THROTTLE CONTROL.
3. Detach brake switch connector [121].

Left Side
1. Remove left switch housing mounting fasteners.
2. Unplug the clutch switch [95].
INSTALLATION

Right Side

1. Attach throttle cables to hand control. See 2.23 THROTTLE CONTROL.

2. Install right switch housing.
   a. Position housing on right handlebar by engaging alignment pin on front housing with hole in handlebar.
   b. Attach switch housing with two mounting fasteners and tighten to 25-33 in-lbs (3-4 Nm).

3. Attach brake switch connector [121].

4. Attach right handlebar switch connector [22] to wire harness. See D.1 HOSE AND WIRE ROUTING for wire routing information.

**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)

5. Check handlebar switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Set ENGINE STOP SWITCH to RUN.
   c. Start motorcycle.
   d. Turn ignition key switch to OFF.

6. Turn ignition key switch to OFF.

Figure 7-67. Right Handlebar Switch Connection

---

**Figure 7-67. Right Handlebar Switch Connection**
**Left Side**

1. Install left switch housing.
   a. Position housing on left handlebar by engaging alignment pin on front housing with hole in handlebar.
   b. Attach switch housing with three mounting fasteners and tighten to 25-33 **in-lbs** (3-4 Nm).

2. Connect clutch switch [95].


**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)

4. Check handlebar switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to ON.
   b. Check headlight LOW and HIGH beam settings.
   c. Set headlight to LOW beam. Press passing lamp switch. Headlight should flash HIGH beam for as long as the switch is pressed.
   d. Check left and right turn signals.
   e. Activate horn by pressing horn switch.

![Figure 7-68. Left Handlebar Switch Connection](image-url)
VEHICLE SPEED SENSOR

REMOVAL

1. See Figure 7-69. Remove fastener (1) to detach vehicle speed sensor (2) from crankcase.
2. Remove cable strap.
3. Disconnect 3-place Deutsch connector [65] under sprocket cover. See 7.26 SPROCKET COVER WIRING.

INSTALLATION

1. See Figure 7-69. Lubricate o-ring with engine oil and install fastener (1) to attach vehicle speed sensor (2) to crankcase.
2. Connect vehicle speed sensor connector [65] to wiring harness. See 7.26 SPROCKET COVER WIRING.
3. Install cable strap.

Figure 7-69. Speedometer Sensor

Figure 7-70. Vehicle Speed Sensor Wiring
GENERAL

Replace the instrument module if the unit is not working properly. However, before replacing a component, check that the problem is not caused by a loose wire connection.

NOTE
Replacement bulbs are now available for indicator lights, check engine light and backlights.

REMOVAL

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

1. Remove seat. See 2.43 SEAT.
2. Disconnect negative battery cable.
3. Remove windscreen. See 2.42 WINDSCREEN.
4. See Figure 7-70. Disconnect instrument module connector [39].
5. See Figure 7-75. Remove fasteners (5) and washers (4).
6. Pull instrument module (2) from front support module (1).

Bulb Replacement

1. Once the instrument module has been removed from the vehicle place face down on a work surface.
2. Remove the nine fasteners securing the back of the module housing to the display and remove back cover.

NOTE
Do not turn display over. Speedometer and tachometer will fall out possibly causing damage to instruments.

1. Light grey/taller bulb-Y0162.02A8
2. Dark grey/shorter bulb-Y0163.02A8

NOTE
See Figure 7-73. Bulbs are identified both by color and length.

4. Select correct replacement bulb and install into back of instrument cluster.
5. Reinstall back cover and insert and tighten the nine fasteners originally removed.
1. See Figure 7-75. Place instrument module (2) into position in front support module (1).

2. Install washers (4) and fasteners (5). Tighten fasteners to 12-36 in-lbs (1.4-4.1 Nm).

3. See Figure 7-75. Connect instrument module connector [39].

4. Install windscreen. See 2.42 WINDSCREEN.

5. Install negative battery cable.

**WARNING**

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat. See 2.43 SEAT.

![Figure 7-74. Instrument Module Connector [39]](image)

---

**Figure 7-75. Instrument Module**

1. Front support module, left and right
2. Instrument module
3. Grommet (3)
4. Washer (2)
5. Fastener (3)
6. Instrument module connector [39]
GENERAL

See Figure 7-76. Use the SPEEDOMETER TESTER (Part No. HD-41354) for speedometer diagnostics. These diagnostics may include:

- Checking speedometer operation.
- Testing speedometer needle sweeping action.

The tester generates a simulated speedometer sensor signal. This signal aids in determining whether speedometer replacement is necessary. It can also be used to simulate running engine conditions for ignition system troubleshooting.

NOTES

- Use the following procedures in conjunction with the manual supplied with the speedometer tester.
- Test results may be inaccurate if tester battery is low.

TESTING

NOTE

The SPEEDOMETER TESTER (Part No. HD-41354) cannot be used to verify the calibration of a speedometer and it will not verify the speedometer's function to support legal proceedings. Its purpose is to verify speedometer function when performing service diagnosis or repair. It can also assist in determining if speedometer replacement is necessary.

Speedometer Operation Test

NOTE

For information on the correct routing of vehicle speed sensor wiring see 7.26 SPROCKET COVER WIRING.

1. See Figure 7-77. Locate the 3-place vehicle speed sensor connector [65] under the sprocket cover. See 2.33 SPROCKET COVER.

2. Place speedometer tester power switch in the ON position. Place signal switch in the OUT position.

3. Turn vehicle ignition switch ON.


   a. Press ENTER on the tester keypad.
   b. Enter a frequency from Table 7-16. Note that different markets use different frequencies.
   c. Verify that speedometer display reads the corresponding speed. To change the test frequency, press CLEAR to cancel and enter the new frequency. Press ENTER to begin and reverify.

NOTE

The speedometer should be accurate within 0-5 MPH (0-8 KPH).

Table 7-16. Speedometer Test Frequency in Hertz (Hz)

<table>
<thead>
<tr>
<th>MARKET</th>
<th>SPEED</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>20 MPH</td>
<td>531</td>
</tr>
<tr>
<td></td>
<td>40 MPH</td>
<td>1062</td>
</tr>
<tr>
<td></td>
<td>60 MPH</td>
<td>1593</td>
</tr>
<tr>
<td></td>
<td>80 MPH</td>
<td>2124</td>
</tr>
</tbody>
</table>
### Speedometer Needle Sweep Test

**NOTE**

**Speedometer needle sweep test works on the speedometer only. Use the diagnostics available with DIGITAL TECHNI- CIAN (Part No. HD-44750) to test a tachometer.**

The tester’s sweep function moves the speedometer needle through the full range of movement. This allows for testing the smoothness of operation and checking for hesitancy or a stuck needle.

1. See Figure 7-77. Disconnect vehicle speed sensor connector [65]. Attach speedometer tester connector to vehicle speed sensor connector.
2. Place speedometer tester power switch in the ON position. Place signal switch in the OUT position.
3. Turn vehicle ignition switch ON.
4. Begin test by pressing 0 on the tester keypad, then pressing ENTER. The tester will scan for two seconds, then the tester will put out a 1 Hz signal.
5. Select a test range.
   a. Press 2 to select LO range (1-20 Hz).
   b. Press 5 to select CEN range (21-999 Hz).
   c. Press 8 to select HI range (1000-20,000 Hz).
6. After selecting a range, use the corresponding arrow keys to accelerate through the range. As you move through the speed range, check for smooth needle movement.
   a. If testing LO range, press 1 or 3.
   b. If testing CEN range, press 4 or 6.
   c. If testing HI range, press 7 or 9.

### Speedometer Sensor Test

If the speedometer is inoperative, but backlighting and odometer work, the speedometer sensor may not be working.

See Figure 7-78. Fabricate a test harness using the following parts. This harness can also be used to test the tachometer.

- Two Deutsch 3-place socket housings (Part No. 72113-94BK) and six socket terminals (Part No. 72191-94).
- Deutsch 3-place pin housing (Part No. 72103-94BK) and three pin terminals (Part No. 72080-99Y).
- Six lengths of 18 gauge wire, each 6.0 in. (15 cm) long.
- Test for voltage to sensor by checking for 4-6 VDC on red/white wire in connector [65].
- Then check for continuity to ground on black wire in connector [65].
1. Install the test harness between the vehicle speed sensor connector halves [65].
2. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
3. Place speedometer tester power switch in the ON position. Place signal switch in the IN position.
4. Plug the speedometer tester into the test harness. Turn vehicle ignition switch ON.
5. Press ENTER on the tester keypad.
6. Rotate the motorcycle’s rear wheel.
   a. If reading on speedometer tester changes as wheel is rotated, speedometer sensor is OK.
   b. If reading does not change, vehicle speed sensor is suspect. Install a known, good vehicle speed sensor and test again.

![Figure 7-78. Test Harness](image)
Speedometer Test: Chart 1
ODOMETER, TRIP ODOMETER AND RESET SWITCH TESTING

Turn ignition ON. Does odometer display consist of correct numbers?

- YES
  - Press trip mode switch. Does display toggle between trip and odometer modes?
    - YES
      - Verify trip display consists of correct numbers. Are correct numbers displayed?
        - YES
          - Press reset for 5 seconds. Does trip odometer reset to zero?
            - YES
              - Stop
            - NO
              - Replace instrument module.
        - NO
          - Replace instrument module.
    - NO
      - Replace instrument module.
  - NO
    - Replace instrument module.

Go to Speedometer Test: Chart 2A.
Problem #2: Speedometer inoperative, reading high/low, or needle sticking/intermittent/erratic.
Check Accessory Fuse. Fuse OK? No, replace Fuse. Yes, Turn ignition ON. Is speedometer backlighting on?

YES

Hook up speedometer tester. See TESTING. Verify that tester battery is OK.

NO

If speedometer backlighting is not on, check for 9-12 VDC on O/W wire at terminal on back of speedometer. Voltage present?

YES

Perform speed sweep function and specified inputs with tester and observe output speed and odometer/trip odometer change on speedometer. Does speedometer appear to function normally and follow sweeping frequency input?

NO

Check 3-pin vehicle speed sensor connector and wires for damage. Connector or wire damage found?

YES

Program steady input frequency on tester and observe output speed on speedometer while moving/shaking vehicle harness connections. Output erratic?

NO

Check for continuity to ground on BK wire at terminal on back of instrument module. Continuity present?

YES

Replace instrument module.

NO

Locate and repair open in O/W wire.

DIAGNOSTIC NOTES

- Low battery voltage on speedometer tester may cause inaccurate test results. Make sure speedometer tester battery is fully charged.
- If necessary, remove vehicle speed sensor and check for accumulation of debris. If debris is not present, replace sensor. If debris is present, clean sensor and repeat test. Replace if necessary.
INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER

Continued from Speedometer Test: Chart 2A.
Check for 4-6 VDC on R/W wire in vehicle speed sensor connector [65B]. Voltage present?

- **YES**
  - Check for continuity to ground on BK wire in connector [65B]. Continuity present?
    - **YES**
      - Check for voltage on W wire in connector [65B]. While connected, meter should read 4-6 VDC when gear tooth absent and 0-1 VDC when gear tooth present. Does it?
        - **YES**
          - Replace instrument module.
        - **NO**
          - Check for open/grounded wires. Wires OK?
            - **YES**
              - Replace instrument module.
            - **NO**
              - Repair wires.
    - **NO**
      - Check for open/grounded wires. Wires OK?
        - **YES**
          - Replace instrument module.
        - **NO**
          - Repair wires.

- **NO**
  - Check for open/grounded wires. Wires OK?
    - **YES**
      - Replace instrument module.
    - **NO**
      - Repair wires.

Check instrument module power (O/W wire) and ground terminal (BK wire) voltage at back of instrument module. Test voltage while shaking harness. Does voltage fluctuate?

- **YES**
  - Repair as necessary.
- **NO**
  - Check speedometer speed sensor. Clean or replace sensor as required. Retest. Problem solved?
    - **YES**
      - System OK.
    - **NO**
      - Replace instrument module.
REMOVAL

1. Remove seat. See 2.43 SEAT.

**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. See Figure 7-79. Remove fastener (3).
4. Remove horn (1) from fairing support bracket (4).
5. See Figure 7-80. Detach Y/BK power wire and BK ground wire from terminal clips on horn.

INSTALLATION

1. See Figure 7-80. Connect Y/BK power wire and BK ground wire to terminal clips on horn.
2. See Figure 7-79. Attach horn (1) to fairing support bracket (4) using fastener (3). Tighten to 72-96 in-lbs (8.1-10.8 Nm).
3. Check horn operation. If horn does not sound or fails to function satisfactorily, see TROUBLESHOOTING.
   a. Turn ignition key switch ON.
   b. Press horn switch to activate horn.
   c. Turn ignition key switch OFF.
4. Install negative battery cable.

**WARNING**

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat. See 2.43 SEAT.

---

Figure 7-79. Horn Assembly

Figure 7-80. Horn Wiring
1. If the horn does not sound or fails to function satisfactorily, check for the following conditions:
   a. Discharged battery.
   b. Loose, frayed or damaged wiring leading to horn terminal.

2. If battery has a satisfactory charge and wiring appears to be in good condition, test horn grounds and switch using voltmeter.
   a. See Figure 7-80. Remove Y/BK power and BK ground wires from terminal clips.
   b. Connect voltmeter positive (+) lead to Y/BK wire.
   c. Connect voltmeter negative (–) lead to ground.
   d. Turn ignition key switch ON.

3. See Figure 7-81. Depress horn switch and observe voltmeter reading.
   a. If battery voltage is present, horn or horn grounding is faulty. If horn is faulty, replace unit as an assembly. The horn is not repairable.
   b. If battery voltage is not present, either horn switch or wiring to horn is faulty. If horn switch is faulty, replace left handlebar switch. See 7.17 HANDLE-BAR SWITCHES.
GENERAL

See Figure 7-82. The neutral indicator switch (2) is threaded into the transmission portion of the right crankcase half. It is immediately forward of the transmission sprocket (1). The sprocket cover must be removed to test the switch.

A pin on the shifter drum contacts the neutral indicator switch plunger, completing the neutral indicator circuit. The switch is not repairable. Replace the switch if it malfunctions.

TESTING

1. Remove sprocket cover. See 2.33 SPROCKET COVER.
2. See Figure 7-82. Disconnect wire lead from neutral indicator switch (2).
3. Turn ignition key switch to ON. Touch the neutral indicator wire lead to a suitable ground.
   a. If indicator lamp lights, then problem is at indicator switch. Replace switch.
   b. If indicator lamp does not light, then problem is elsewhere in circuit. Check for loose connections, burned out indicator lamps or faulty wiring.
   c. After testing and repair, connect wire lead to indicator switch.
4. Install sprocket cover. See 2.33 SPROCKET COVER.

REMOVAL/INSTALLATION

1. Verify that the ignition key switch is turned to OFF.
2. Remove sprocket cover. See 2.33 SPROCKET COVER.

NOTE
If replacing neutral indicator switch wiring, see 7.26 SPROCKET COVER WIRING for correct wire routing.

3. See Figure 7-83. Remove wire lead (1) from neutral indicator switch (2).
4. Remove neutral indicator switch and washer (3).
5. Install new neutral indicator switch.
   a. Apply a light coating of LOCTITE 243 (blue) to new neutral indicator switch (2) threads.
   b. Install washer (3) over neutral indicator switch (2) threads.
   c. Install switch in crankcase. Tighten switch to 36-60 in-lbs (4-6.8 Nm).
   d. Connect wire lead (1) to switch.
6. Install sprocket cover. See 2.33 SPROCKET COVER.
GENERAL

Buell motorcycles feature two components which protect the electrical system.

Fuses
The covered fuse block is under the seat.
See Figure 7-84. The lights, key switch and ignition fuses are rated at 15 amps. The ECM, cooling fan, brake/horn and accessory fuses are rated at 10 amps.
Always investigate the cause of blown fuses before replacing them.

Battery Fuse
See Figure 7-85. The 30 amp battery fuse is located under the seat.
To disable the motorcycle’s ignition system, pull the battery fuse up and out of the fuse block.
GENERAL

The main wire harness runs from the front of the motorcycle to the tail section.
Always replace plastic tree fasteners when replacing main wire harness. Remove tree fasteners carefully, do not leave any of fastener in frame.

REMOVAL

NOTES

● To ensure correct installation, make note of wire routing and cable strap locations before removing main wire harness.

● Main wire harness is removed from rear of vehicle through fan section of frame.

1. Remove seat. See 2.43 SEAT.
2. Remove air cleaner cover. See 4.44 AIR CLEANER ASSEMBLY.
3. Remove sprocket cover. See 2.33 SPROCKET COVER.

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. Unthread fastener and remove battery negative cable (black) from battery negative (–) terminal.
5. Pull back terminal cover boot on battery positive cable (red).
6. Unthread fastener and remove battery positive cable from battery positive (+) terminal.
7. Remove battery.

8. See Figure 7-86. Disconnect positive battery cable from starter.
9. See Figure 7-87. Disconnect:
   ● Wire harness ground [GRD 2].
   ● Rear brake light switch connector [121].
   ● BAS (bank angle sensor) connector [134].
   ● Right turn signal connector [18].
   ● Left turn signal connector [19].
   ● License plate lamp connector [45].
   ● Tail light connectors [93].
   ● Ground terminals on right side tail section [GRD 1] & [GRD 3].
   ● See Figure 7-87. Interactive exhaust connector [165B], (under main wiring harness) (1200 models only)
10. Remove fuse block and relay center from support bracket.
11. Remove the rear shock absorber assembly and reservoir. See 2.22 REAR SHOCK ABSORBER.
12. Remove fan. See 4.38 COOLING FAN.
Figure 7-87. Main Harness and Electrical Connectors Under Seat (Typical)

1. Main harness
2. Main harness ground (high voltage ground wire)
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
6. Ground terminals (low voltage ground wires)
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Right turn signal connector [10]
11. Left turn signal connector [19]
12. License plate lamp connector [45]
13. Tail light connectors [93]
14. Interactive exhaust connector [165B], (1200 models only)
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<td>BAS (bank angle sensor) connector [134]</td>
</tr>
<tr>
<td>10</td>
<td>Interactive exhaust connector [165B]</td>
</tr>
</tbody>
</table>

**Figure 7-88. Main Harness and Electrical Connectors Under Seat (XB12Ss)**
1. Turn signal flasher connector [30]
2. Instrument cluster connector [39]
3. Right handlebar connector [22]
4. Left handlebar connector [24]
5. Turn signal connectors [31]
6. Ignition switch
7. Cable strap
8. Main harness
9. Horn fastener
10. Horn mount
11. Horn connector [122]
12. Horn

13. Remove windscreen. See 2.42 WINDSCREEN.
14. See Figure 7-89. Disconnect:
   - Turn signal flasher connector [30].
   - Instrument module connector [39].
   - Left switch housing connector [24] and right switch housing connector [22].
   - Turn signal connectors [31].
   - Headlight connector [38].
   - Horn connectors [122].
   - Clutch switch [95] from left switch housing.
   - Front brake switch [121] from right switch housing.
15. Cut and remove cable strap (6) securing main harness to ignition switch.
16. Disconnect wiring located under sprocket cover. See 7.26 SPROCKET COVER WIRING.
17. Remove connector from oil pressure switch [120]. Oil pressure switch is located on front of engine. See 3.12 OIL PRESSURE INDICATOR SWITCH.
18. Disconnect intake air temperature sensor [89]. See 4.36 INTAKE AIR TEMPERATURE SENSOR.
19. Disconnect throttle position sensor [88]. See 4.37 THROTTLE POSITION SENSOR.
20. Disconnect fuel line at fuel rail.
21. Remove spark plug wires.
22. Remove any remaining cable straps and clamps securing wire harness and remove harness from front of vehicle.
23. Pull the main harness out through the rear of the frame/fuel tank assembly between the trunk pan and the rear tire.

**NOTE**

*Using scissors jack, raise vehicle higher to gain more clearance between the trunk pan and tire.*
24. Remove all push pins.

---

**Figure 7-89. Electrical Connectors Behind Windscreen**
NOTES

- See Figure 7-93. Always align harness when installing in the frame and tail section. Align the harness so both ECM wire bundles, the dyno loop and the main ground all face upward so when they are installed the harness will not be twisted.

- For more information on wire harness and hose routing, see D.1 HOSE AND WIRE ROUTING.

1. Install the new harness from the rear of the vehicle working towards the front.
2. Feed front and center portion of harness between the trunk pan and tire through opening at rear of frame/fuel tank assembly.
3. Place connectors in general location of installation.
4. Secure plastic harness holder to left inside portion of frame using new plastic tree fasteners.
5. On 1200 models be sure to route the interactive exhaust cable behind the harness strap with main harness.

NOTE
Fuel line is installed under engine connector portion of wire harness.

6. See Figure 7-90. Install clamp over portion of harness that leads to engine connectors. Install clamp as shown using new plastic tree fastener.

7. See Figure 7-91. Route portion of main wire harness that contains the positive battery cable (3), sprocket cover wiring (4) and transmission vent hose (2) through corner mounting strap and guide (1) at rear of frame. Install new plastic tree fasteners.
8. See Figure 7-92. Connect:
   ● Front brake switch [121] from right switch housing.
   ● Clutch switch [95] from left switch housing.
   ● Horn connectors [122].
   ● Headlight connector, [38].
   ● Turn signal connectors [31].
   ● Left switch housing connector [24] and right switch housing connector [22].
   ● Instrument module connector [39].
   ● Turn signal flasher connector [30].
9. Install cable strap (7) loosely around main harness (8) and ignition switch.
10. Connect throttle position sensor [88]. See 4.37 THROTTLE POSITION SENSOR.
11. Connect intake air temperature sensor [89]. See 4.36 INTAKE AIR TEMPERATURE SENSOR.
12. Install spark plug wires.
13. Install connector on oil pressure switch [120]. See 3.12 OIL PRESSURE INDICATOR SWITCH.
14. Install sprocket cover wiring. See 7.26 SPROCKET COVER WIRING.
15. Connect fan connector [97].
16. Install fan and tighten fasteners to 12-36 in-lbs (1.4-4.1 Nm). See 4.38 COOLING FAN.
17. Install rear shock absorber assembly. See 2.22 REAR SHOCK ABSORBER.
18. Pull rear section of main harness up over trunk pan towards the rear of the vehicle and place connectors in general location of installation.
19. Install fuse block and relay center on support bracket.
20. See Figure 7-93. Connect:
   ● Ground terminals on right side tail section [GRD 1] & [GRD 3].
   ● Tail light connectors [93].
   ● Left turn signal connector [19].
   ● Right turn signal connector [18].
   ● BAS (bank angle sensor) connector [134].
   ● ECM connectors [10, 11].
   ● Rear brake light switch connector [121].
   ● Wire harness ground [GRD 2].
21. Install starter side of positive battery cable to starter.
1. Main harness
2. Main harness ground (high voltage ground wire)
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
6. Ground terminals (low voltage ground wires)
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Right turn signal connector [18]
11. Left turn signal connector [19]
12. License plate lamp connector [45]
13. Tail light connectors [93]

Figure 7-93. Main Harness and Electrical Connectors Under Seat (Typical)
Figure 7-94. Main Harness and Electrical Connectors Under Seat (XB12Ss)

1. Main harness
2. Main harness ground (high voltage ground wire)
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
6. Ground terminals (low voltage ground wires)
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Interactive exhaust connector [165B]
22. See Figure 7-95. Install cable straps:
   a. Front cable strap (3) secures voltage regulator and oil pressure switch wiring.
   b. Middle cable strap (2) secures voltage regulator, oil pressure switch and cam position sensor wiring.
   c. Rear cable strap (1) secures conduit to voltage regulator wiring.

23. Verify that front forks can be turned from full left to full right lock without wire harness binding or pinching.

24. Install positive battery cable (red) to positive terminal of battery. Tighten to 72-96 in-lbs (8-11 Nm).

25. Connect negative battery cable. Tighten to 72-96 in-lbs (8-11 Nm).

26. Verify operation of all electrical components.

27. Install windscreen. See 2.42 WINDSCREEN.

28. Install seat. See 2.43 SEAT.

**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)

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)
REMOVAL

1. Remove seat. See 2.43 SEAT.
2. Remove four fasteners, nylon washers and intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
3. See Figure 7-96. Remove negative battery cable (3) from battery. See 7.11 BATTERY.
4. Remove the cooling fan. See 4.38 COOLING FAN.
5. Remove the fuel block from the battery tray to access the actuator ground actuator harness connector [165].
6. Remove the exhaust actuator ground (4).
7. See Figure 7-96. Separate exhaust actuator harness connector [165] at main harness.
8. Pull actuator harness through frame.
10. See Figure 7-97. If removing actuator:
   a. Add free play to interactive exhaust cable (4), loosen jam nut and remove cable from bracket. See 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).
   b. Remove interactive exhaust cable from cable wheel.
   c. Remove actuator.

Figure 7-96. Harness and Cable Routing (XB12 Models)

Figure 7-97. Exhaust Actuator (XB12 Models)
INSTALLATION

1. Install the actuator on the airbox cover. Tighten the fasteners to 36-40 in-lbs (4.0-4.5 Nm).

2. See Figure 7-98. Attach controls:
   a. Attach interactive exhaust cable (2) to cable wheel (1) on actuator.
   b. Install cable in bracket and tighten jam nut.
   c. Install fuel tank vent hose.
   d. Adjust cable. See 1.16 INTERACTIVE EXHAUST CABLE (XB12 MODELS).
   e. Mate actuator connector[161B] to actuator.

3. Route harness along channel in airbox under frame and over main wiring harness.

   NOTE
   If cable is routed in front of the frame lug it will cause the muffler valve to stay open not allowing it to work properly.

4. See Figure 7-99. Verify that the interactive exhaust cable (3) is routed behind the frame lug (1) before installing air intake cover.

5. Mate exhaust actuator harness connector halves [165].

6. Install ground bolt through actuator ground wire. Tighten to 72-96 in-lbs (8-11 Nm).

   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)

7. Install cooling fan. See 4.38 COOLING FAN.

8. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 in-lbs (8-11 Nm).

9. Install intake cover. Tighten fasteners to 12-36 in-lbs (1.4-4.0 Nm).

   WARNING
   After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

10. Install seat.
Connectors for the stator [46], voltage regulator [77], vehicle speed sensor [65], cam position sensor [14] and neutral switch [131] are located under the sprocket cover.

Figure 7-100. Sprocket Cover Wiring and Connections
REMOVAL

1. Remove sprocket cover. See 2.33 SPROCKET COVER.
2. See Figure 7-100. Disconnect appropriate connector(s).

INSTALLATION

NOTES

See Figure 7-101. Convolute covering the return oil line should have the seam rotated to the back side of the oil line away from wiring.

1. Route the vehicle speed sensor wiring behind the starter trigger wire and secure in place with a cable strap.
2. See Figure 7-100. Route oil pressure switch wiring (9) from main harness (5), to oil pressure switch located on front of engine and connect to the oil pressure switch.

NOTES

● Stator connector wiring is installed over oil pressure switch wiring.
● See Figure 7-100. Make sure the stator wire bundle is behind the oil breather fitting (6).

3. See Figure 7-100. Place the larger black and red wires in the harness up against the front of the upper sprocket cover boss behind the vent line fitting in the cam cover and connect the (2-pin) voltage regulator (1).

Figure 7-101. Convoluted Covering for Oil Return Line

1. Reflective convolute covering with seam
2. Covering in place on bottom of return line
3. Covering in place on top of return line
4. Sprocket cover boss
4. See Figure 7-102. Position the voltage regulator connector as it is shown, with the connector latch to the back and above the bottom sprocket cover boss.

**NOTE**
*Make sure that the voltage regulator connector is all the way back against the plastic wire guard.*

5. The main harness bundle needs to be pressed into place between the front sprocket cover mounting boss and the oil return line.

6. The vehicle speed sensor wires (3-pin grey) are routed behind the oil breather line fitting on the cam cover.

7. See Figure 7-103. At the oil pressure switch, use a cable strap to encircle the voltage regulator wire bundle and the oil pressure switch wire, and secure to the base of the oil pressure switch itself.

8. Then move back and cable strap that bundle with the cam position sensor wires. Orient the cam sensor wires on top and the oil pressure switch wire inside of it.

9. Connect the neutral safety switch (single bullet), and the cam position sensor (3-pin black).

10. See Figure 7-104. Using a cable strap, secure the loop the neutral safety wire makes to the cam position connector under the attachment clip on the connector.
11. See Figure 7-105. Position the cam position sensor wire bundle and the voltage regulator wire bundle inboard, then push the wire bundle up against the return oil line and cable strap them to the return oil line.

12. See Figure 7-106. Capture the main wire harness bundle, the vehicle speed sensor lead, the stator bundle, and the muffler actuator cable (if applicable) to the oil return line with a cable strap.

13. See Figure 7-107. Connect the vehicle speed sensor last.

**NOTES**

- The vehicle speed sensor is positioned high in the bundle in order for the front sprocket cover to conform to the additional components.

- See Figure 7-108. Make sure main harness (2) is routed around sprocket cover boss (1).

14. Install sprocket cover. See 2.33 SPROCKET COVER.
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