2006 BUELL LIGHTNING MODELS

SERVICE MANUAL

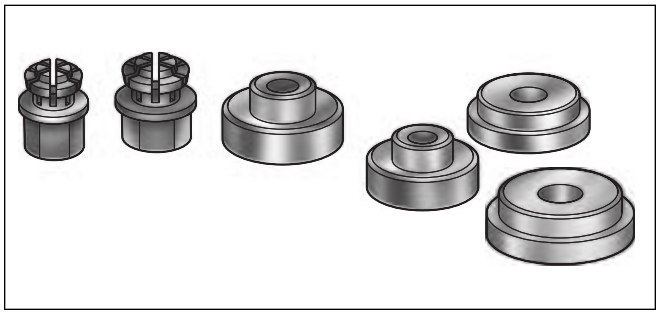
Part Number 99490-06Y

Section 1: Maintenance
Section 2: Chassis
Section 3: Engine
Section 4: Fuel System
Section 5: Starter
Section 6: Drive/Transmission
Section 7: Electrical
Appendices

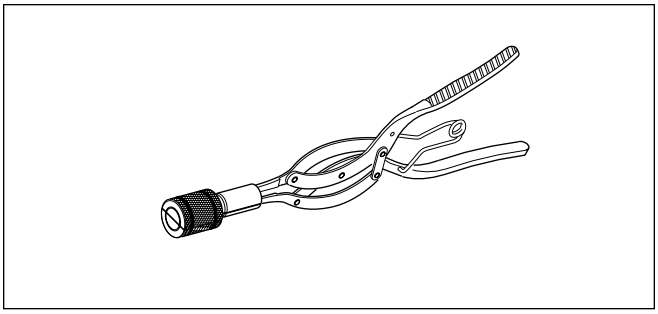
APPENDIX A–TOOLS A.1



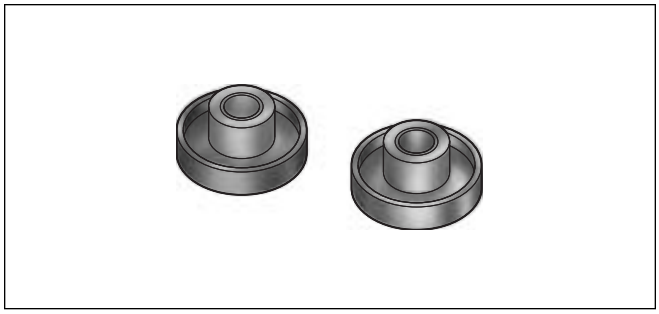
Part No. B-41623-B Oil Line Remover



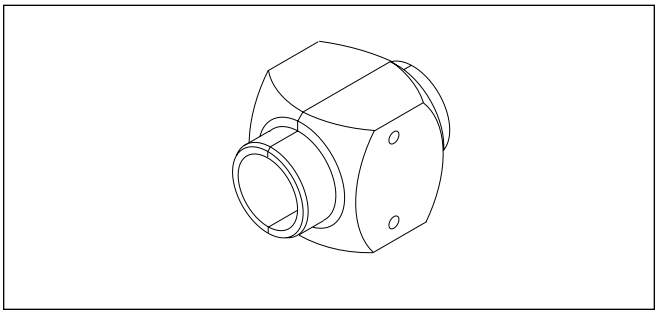
Part No. B-43993-7/-8 Wheel Bearing Collets



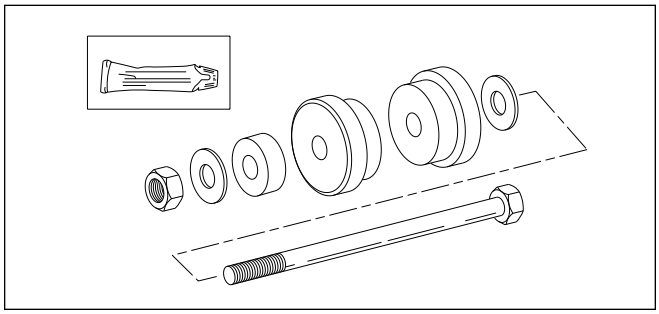
Part No. B-42887 Brake Caliper Piston Remover



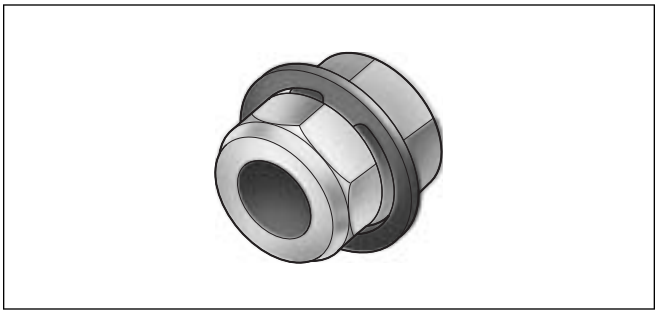
Part No. B-45521 Steering Head Bearing Remover/ Installer



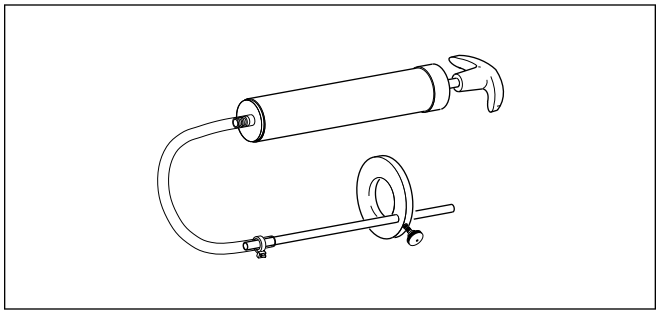
Part No. B-43721 Front Fork Seal Driver



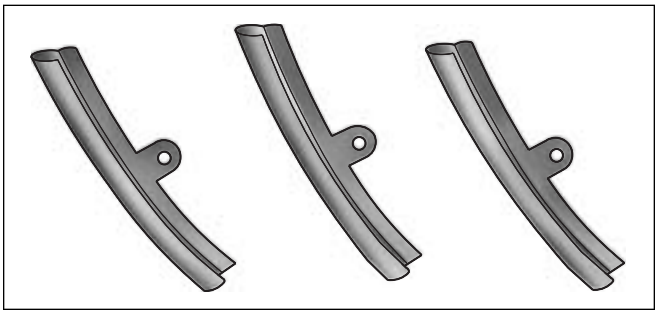
Part No. HD-39302 Steering Head Bearing Race Installer (Used with B-45521)



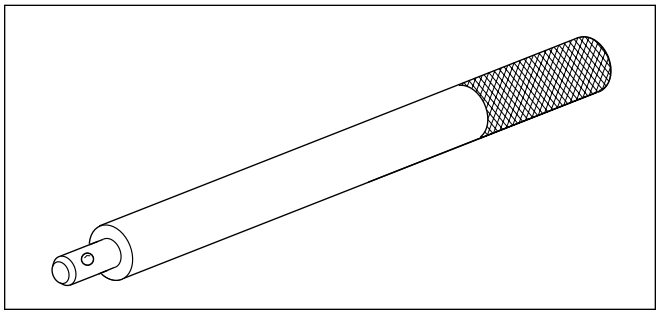
Part No. B-46279 7/8" Axle Wrench (Hex)



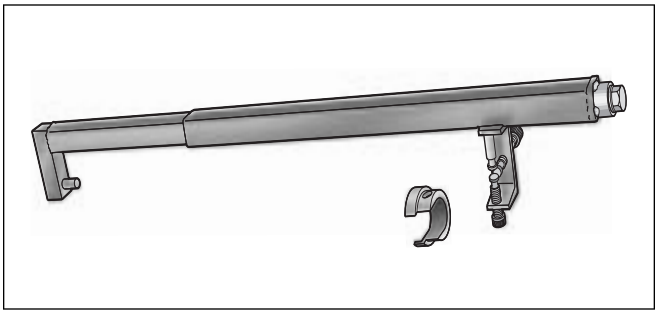
Part No. B-59000B Pro Level Oil Gauge



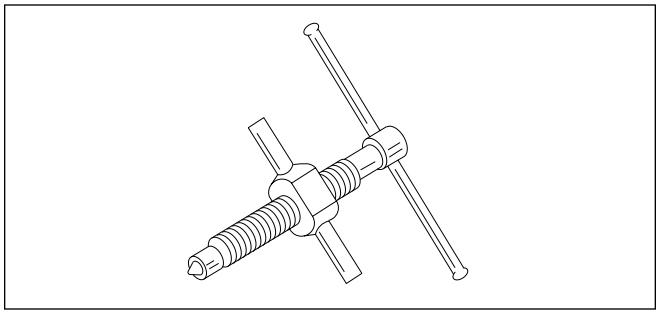
Part No. HD-01289 Rim Protectors



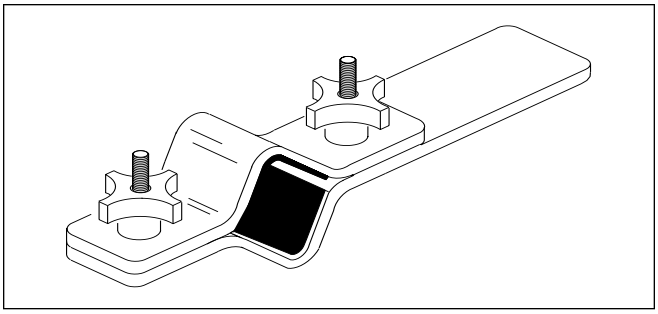
Part No. HD-33416 Universal Driver Handle



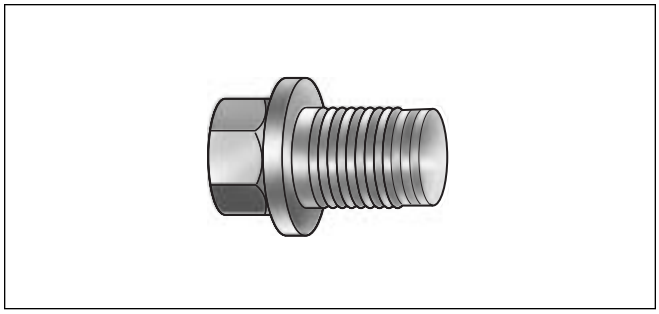
Part No. HD-45966 Fork Spring Compressing Tool



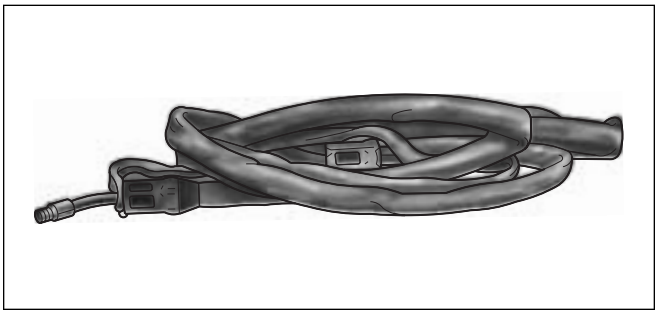
Part No. HD-33418 Universal Puller Forcing Screw



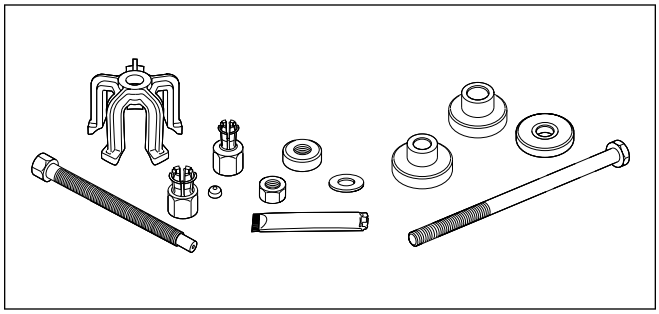
Part No. HD-41177 Fork Tube Holder



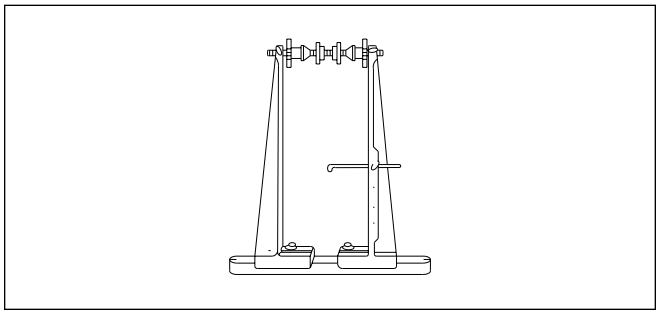
Part No. HD-B-45520 Gear Detent Assembly Aid



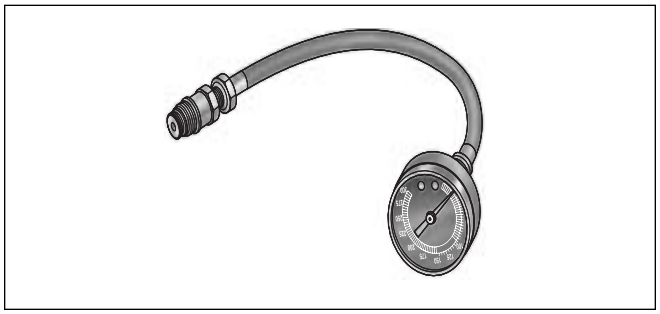
Part No. HD-28700 Tire Bead Expander



Part No. HD-44060 Wheel Bearing Remover/Installer



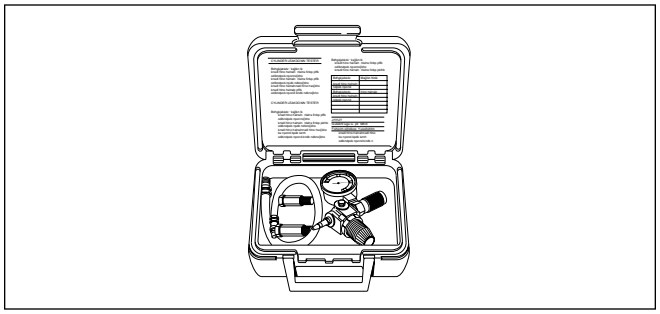
Part No. HD-99500-80 Wheel Truing and Balancing Stand



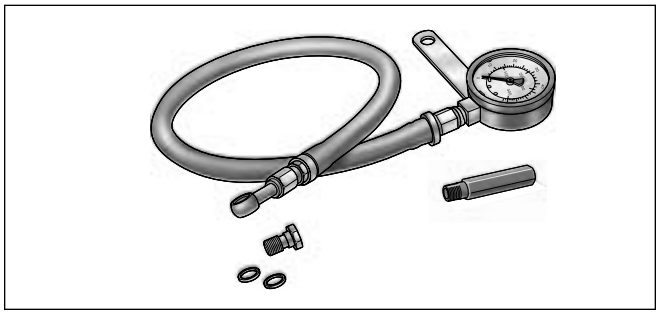
Part No. HD-33223-1 Cylinder Compression Gauge



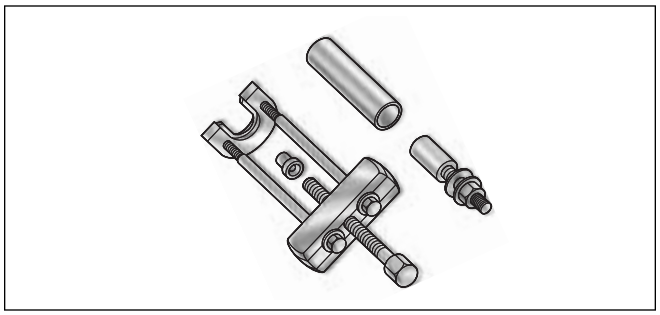
Part No. HD-35758-B Neway Valve Seat Cutter Set



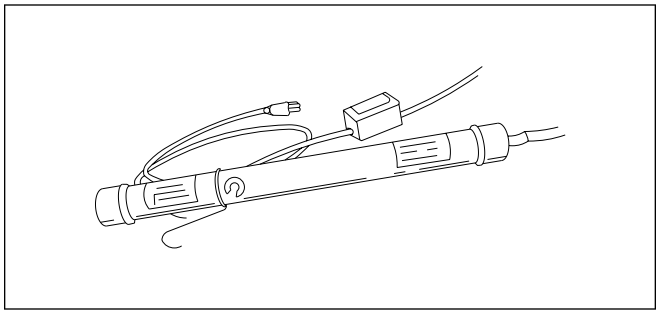
Part No. HD-35667A Cylinder Leakdown Tester



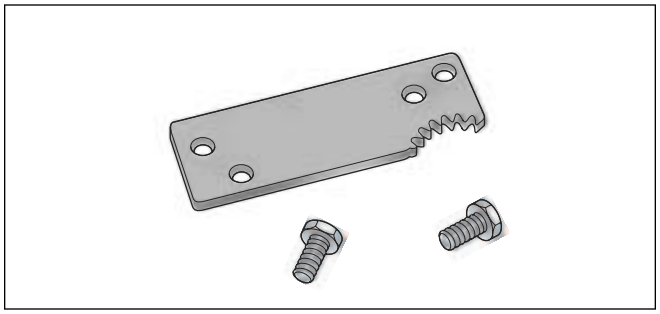
Part No. HD-96921-52A Oil Pressure Gauge



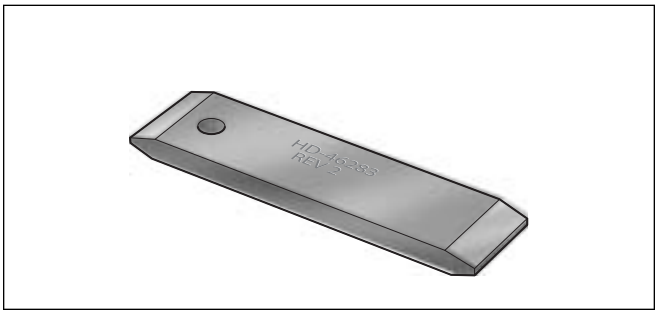
Part No. HD-34902-B Bearing Race Remover/Installer



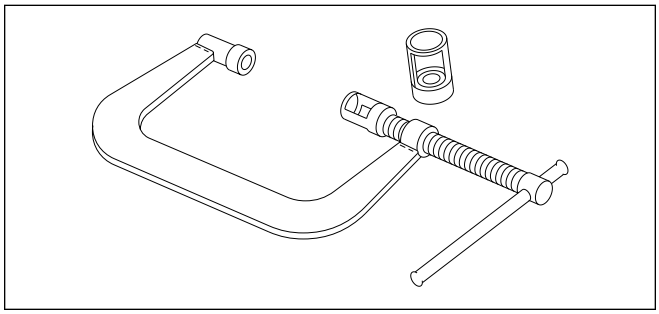
Part No. HD-35457 Black Light Leak Detector



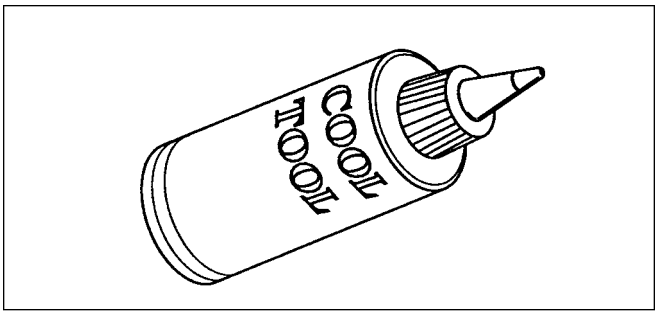
Part No. HD-43984 Crankshaft Locking Tool



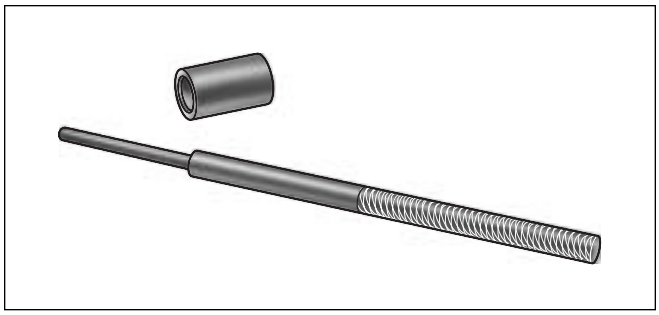
Part No. HD-46283 Primary Drive Locking Tool



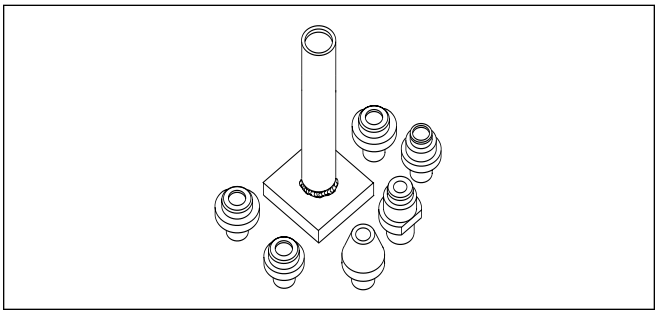
Part No. HD-34736B Valve Spring Compressor



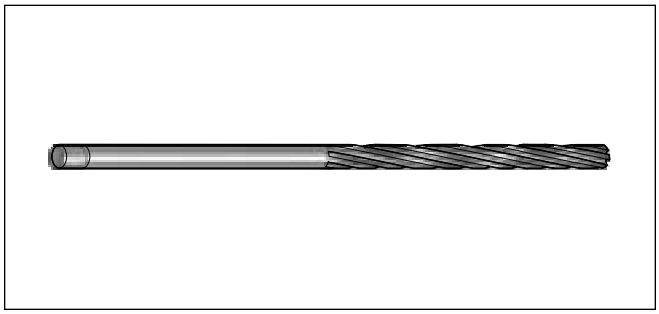
Part No. HD-39964 Reamer Lubricant (Cool Tool)



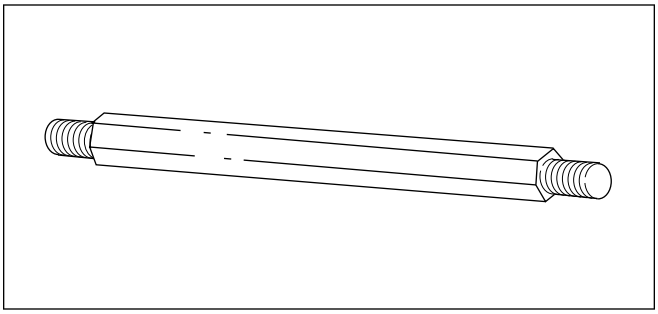
Part No. B-45524 Valve Guide Installer



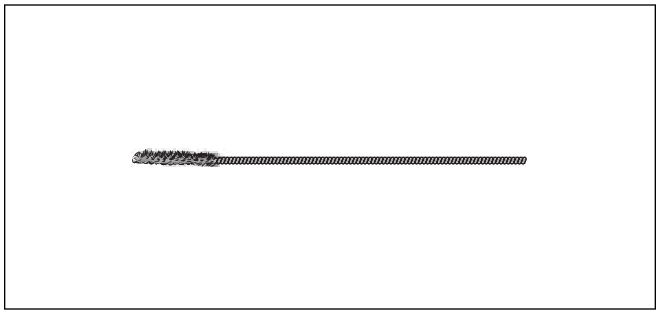
Part No. HD-39782 Cylinder Head Support



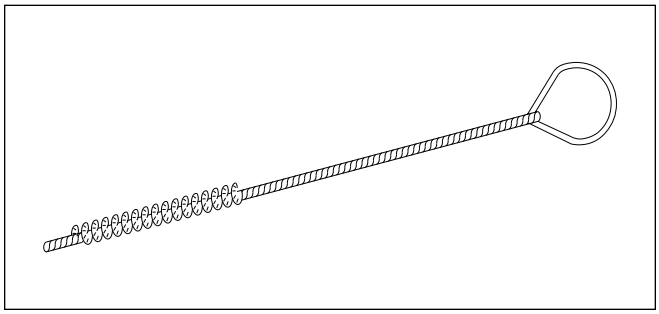
Part No. B-45523 Valve Guide Reamer (7mm)



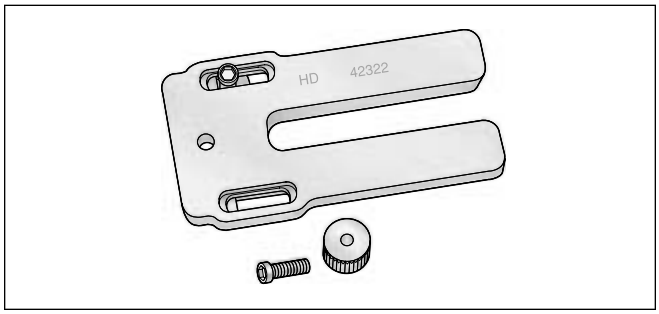
Part No. HD-39786 Cylinder Head Holding Fixture



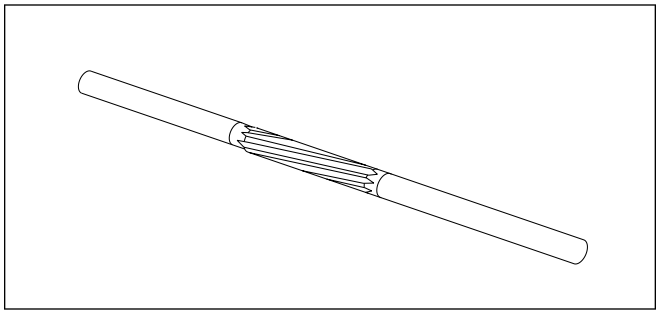
Part No. B-45525 Valve Guide Hone



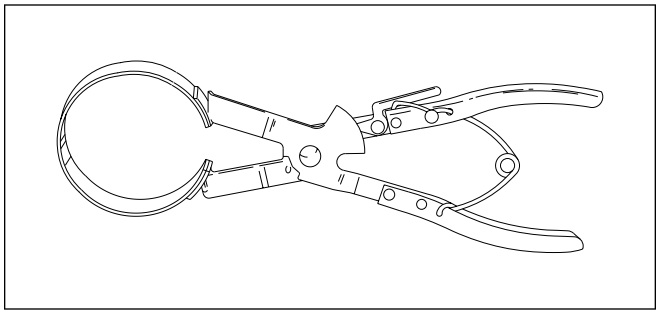
Part No. HD-34751 Nylon Valve Guide Brush



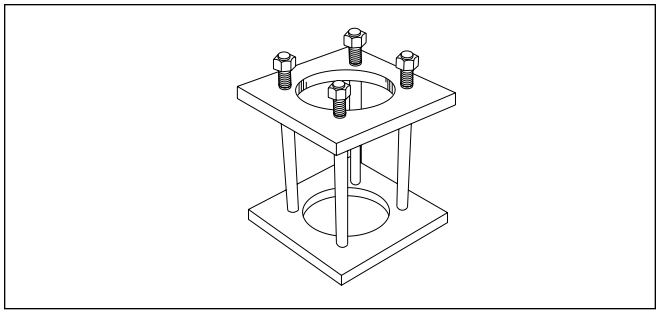
Part No. HD-42322 Piston Support Plate



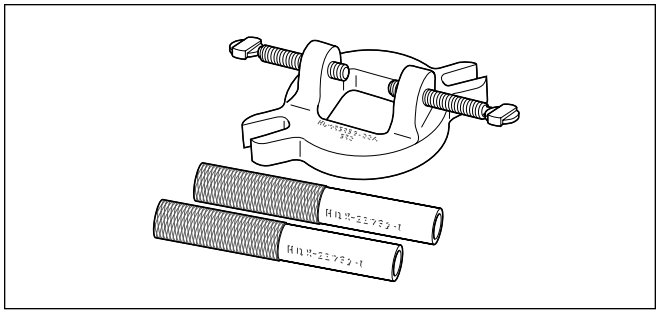
Part No. HD-94804-57 Rocker Arm Bushing Reamer



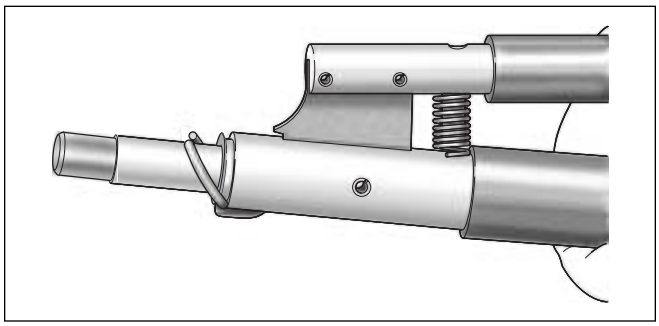
Part No. HD-96333-51C Piston Ring Compressor



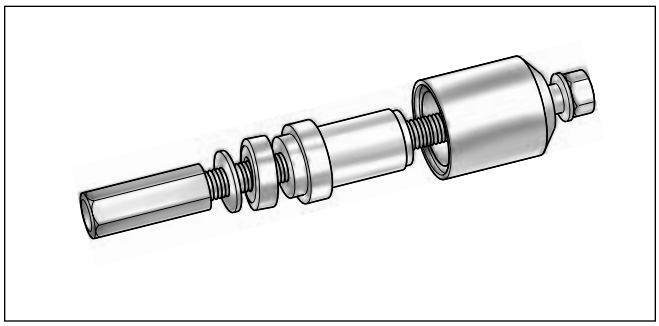
Part No. HD-33446A Cylinder Torque Plates and Torque Plate Bolts Part No. HD-33446-86



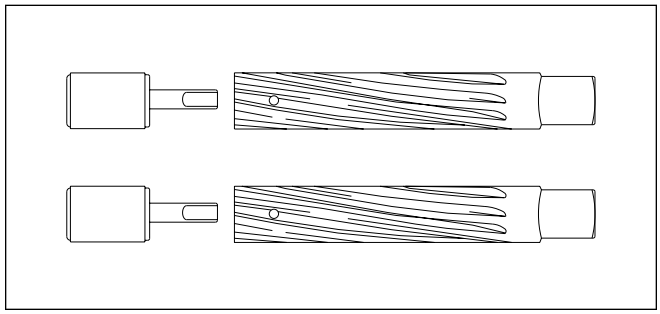
Part No. HD-95952-33B Connecting Rod Clamping Tool



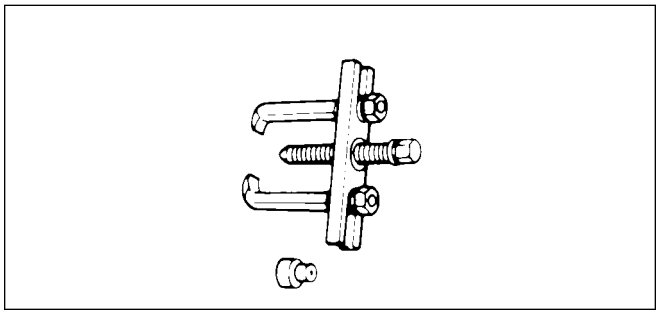
Part No. HD-34623C Piston Pin Retaining Ring Installer/Remover



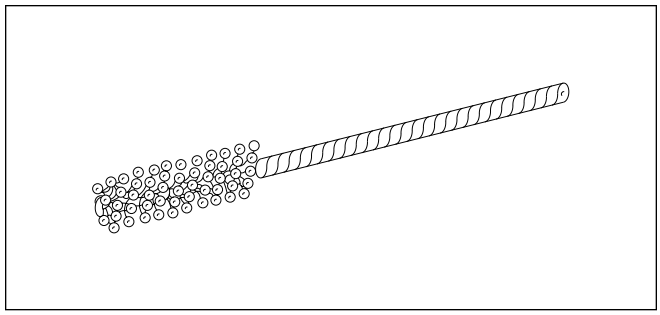
Part No. HD-95970-32D Piston Pin Bushing Tool



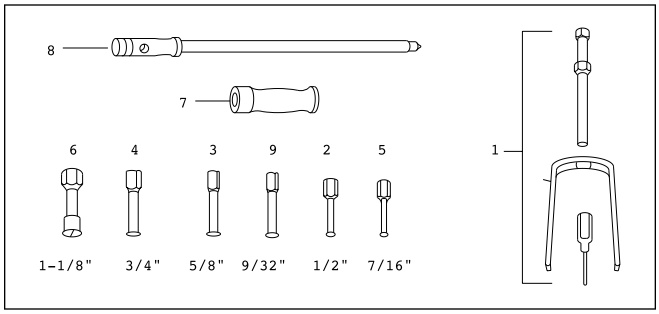
Part No. HD-94800-26A Connecting Rod Bushing Reamers and Pilots



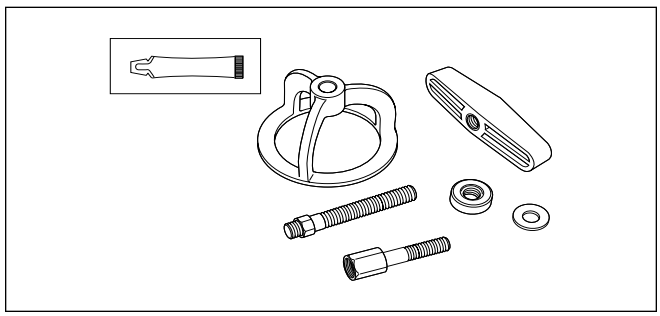
Part No. HD-97292-61 Two Claw Puller



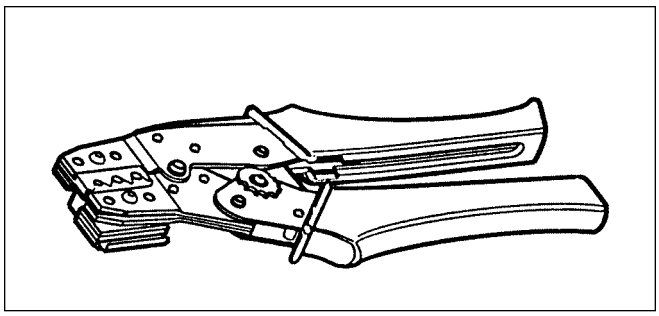
Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)



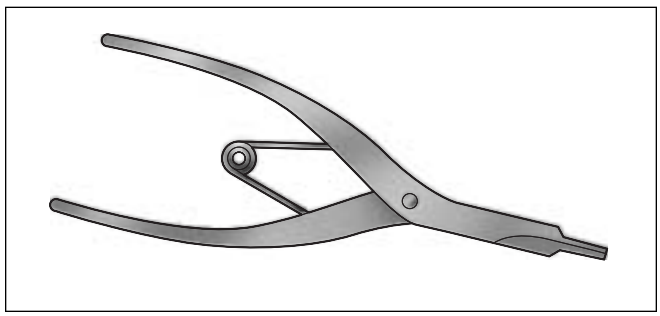
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-5 and 9. Items 6 (HD-95769-69), 7 (HD-95770-69) and 8 (HD-95771-69) are optional.



Part No. HD-38515-A Clutch Spring Compressing Tool and Part No. HD-38515-91 Forcing Screw



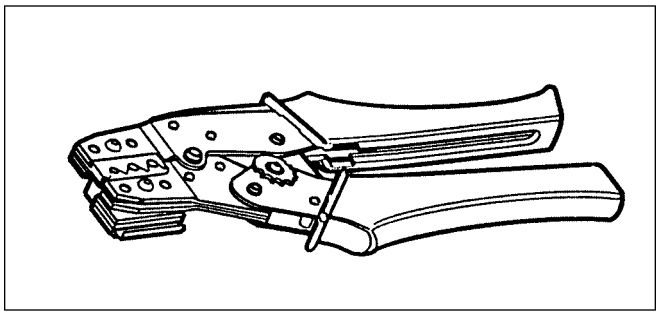
Part No. HD-39965 Deutsch Terminal Crimp Tool



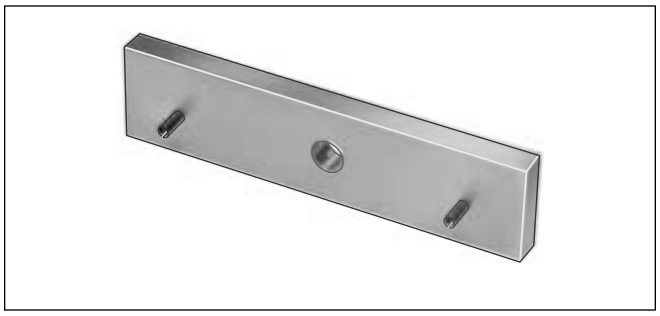
Part No. J-5586 Transmission Shaft Retaining Ring Pliers



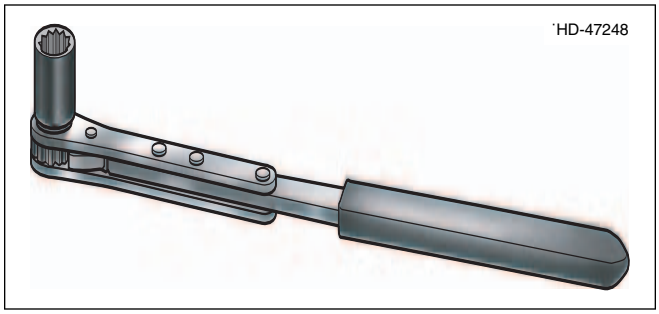
Part No. HD-41354 Speedometer Tester



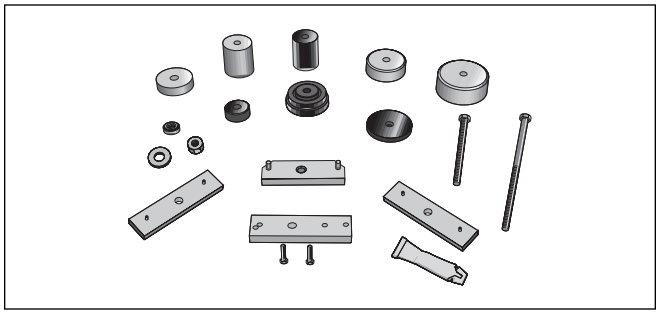
Part No. HD-41609 Amp Terminal Crimp Tool



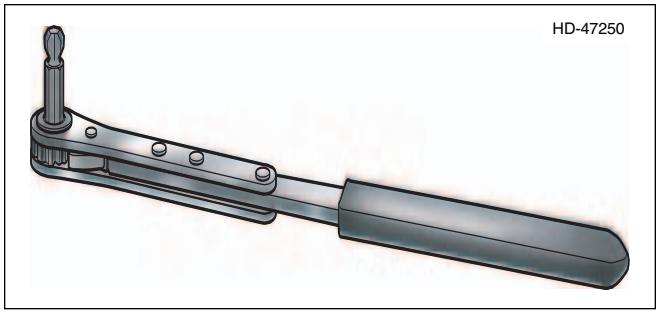
Part No. HD-45847 Cross Plate



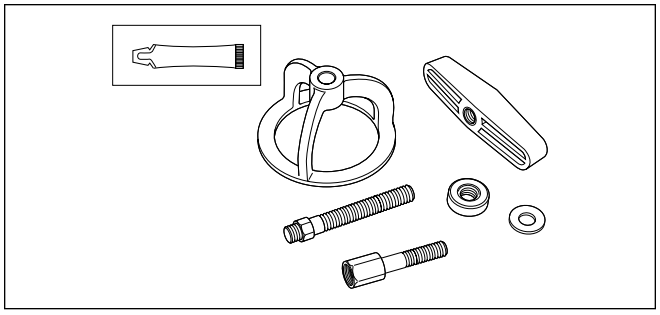
Part No. HD-47248 Rocker Housing Wrench



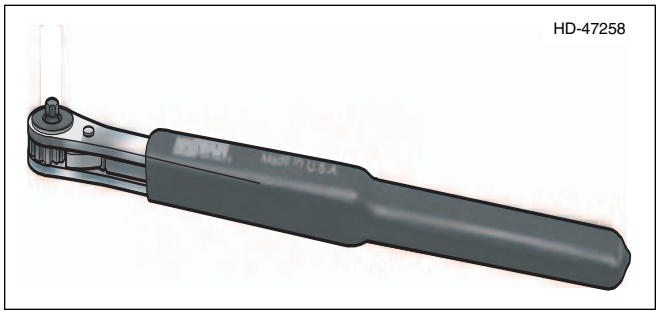
Part No. HD-35316-C Main Drive Gear Remover/Installer and Main Drive Gear Bearing Installer



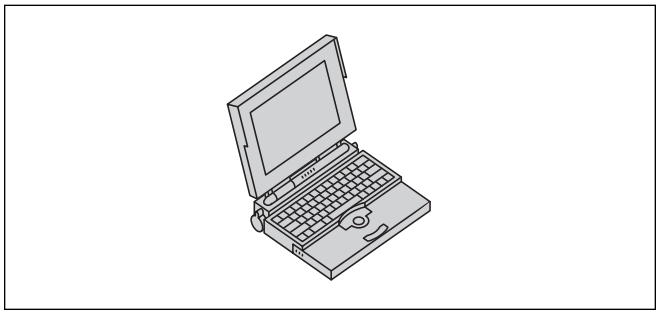
Part No. HD-47250 Intake Manifold Wrench



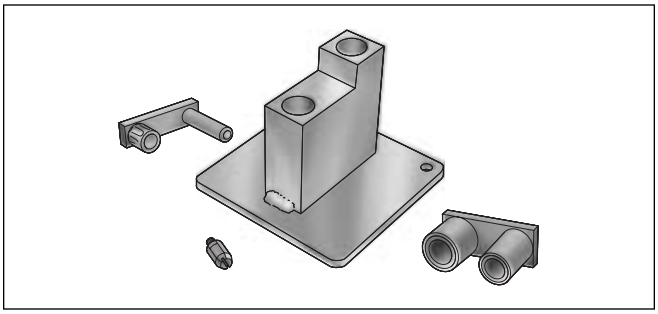
Part No. HD-38515-A Clutch Spring Compressor



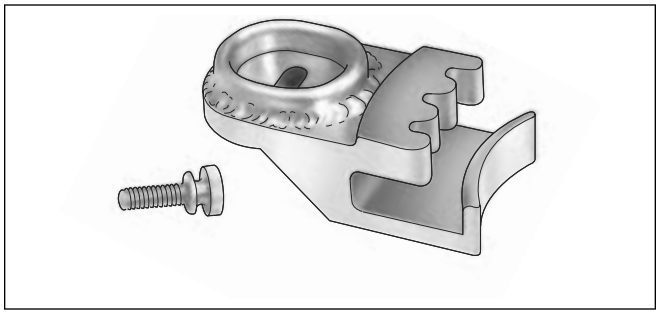
Part No. HD-47258 Rocker Cover Wrench



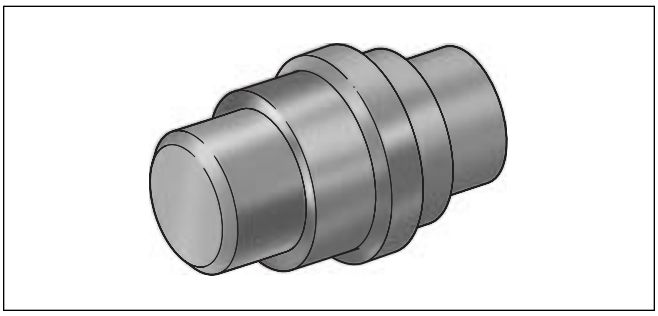
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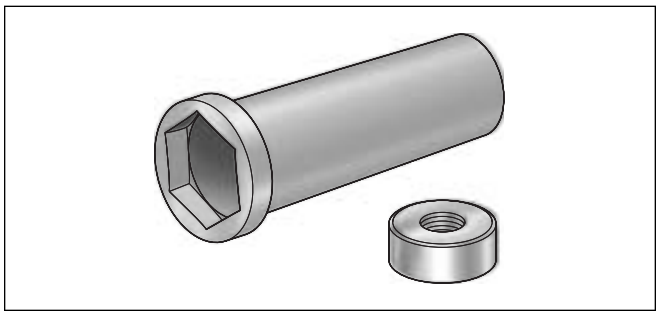
Part No. HD-46285 Transmission Assembly Fixture



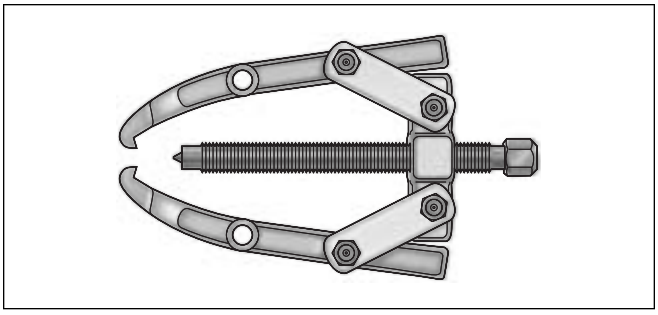
Part No. B43982 Transmission Locking Tool



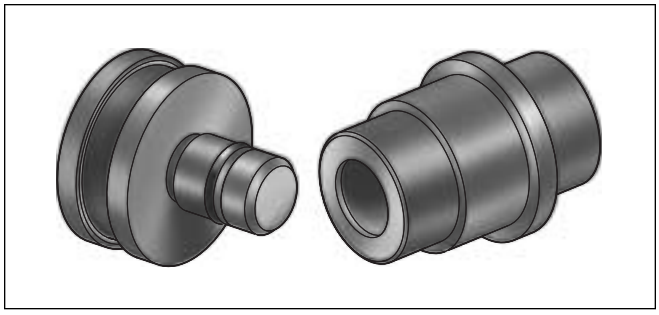
Part No. HD-47855 Main Drive Gear Needle Bearing Installer



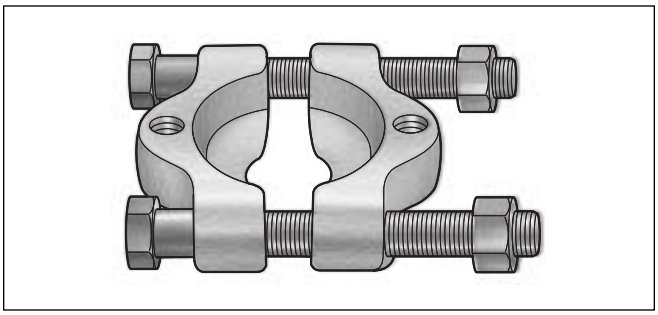
Part No. HD-94660-37B Mainshaft Locknut Wrench



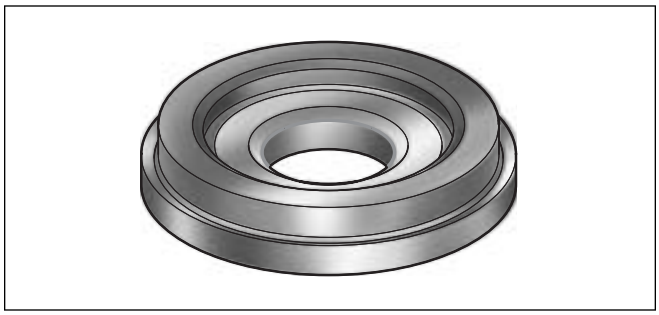
Part No. HD-95635-46 All-Purpose Claw Puller (use with HD-95637-46A)



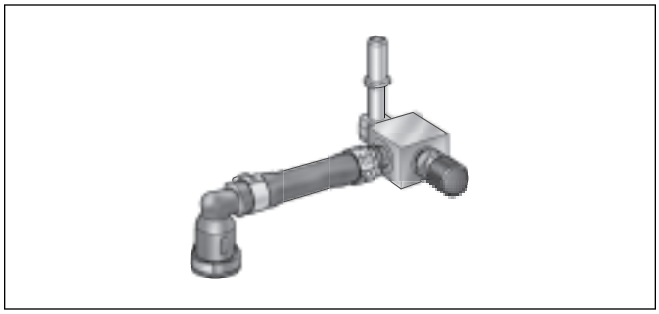
Part No. HD-45926 Clutch Shell Bearing Remover



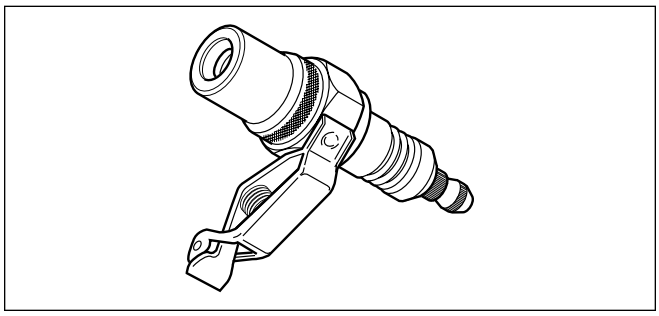
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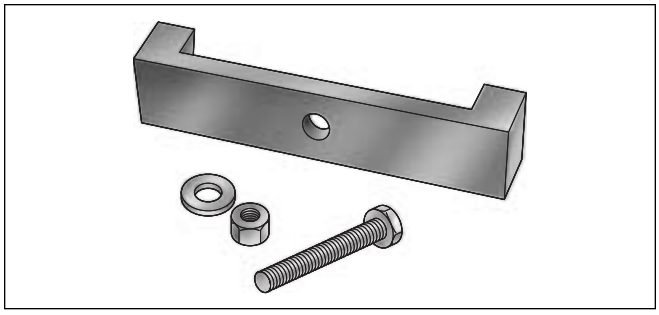
Part No. B-45676 Sprocket Shaft Seal Installer



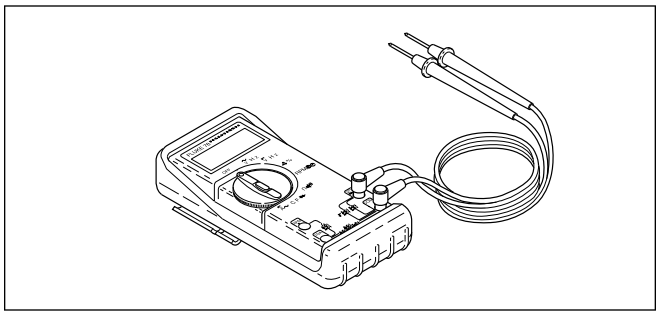
Part No. B-45522 Fuel Pressure Gauge Adapter



Part No. HD-26792 Spark Tester



Part No. B-45657 Fuel Pump Puller



Part No. HD-39978 Fluke 78 Multimeter (DVOM)F

AMP MULTILOCK ELECTRICAL CONNECTORS B.1

REMOVING SOCKET/PIN TERMINALS

1. Remove connector from the retaining device, either attachment or rosebud clip.
2. Depress the button on the socket terminal side of the connector (plug) and pull apart the pin and socket halves.
3. Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.
4. Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.
5. See Figure B-1. With the flat edge against the terminal, insert the pick tool (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A “click” is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

- *If pick tool is not available, a push pin/safety pin may be used instead.*
- *An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp 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.

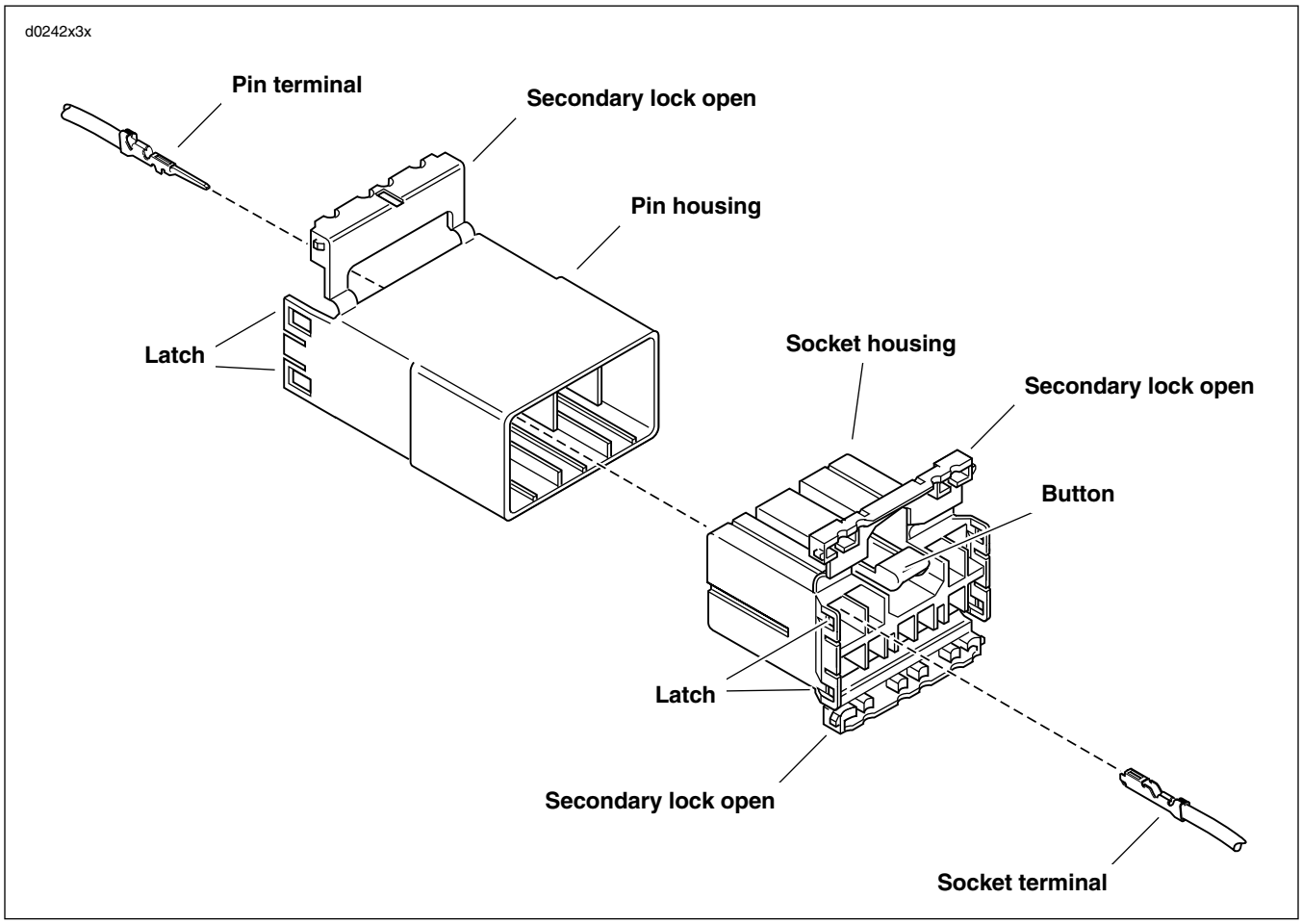


Figure B-1. 10-Place Amp Multilock Connector

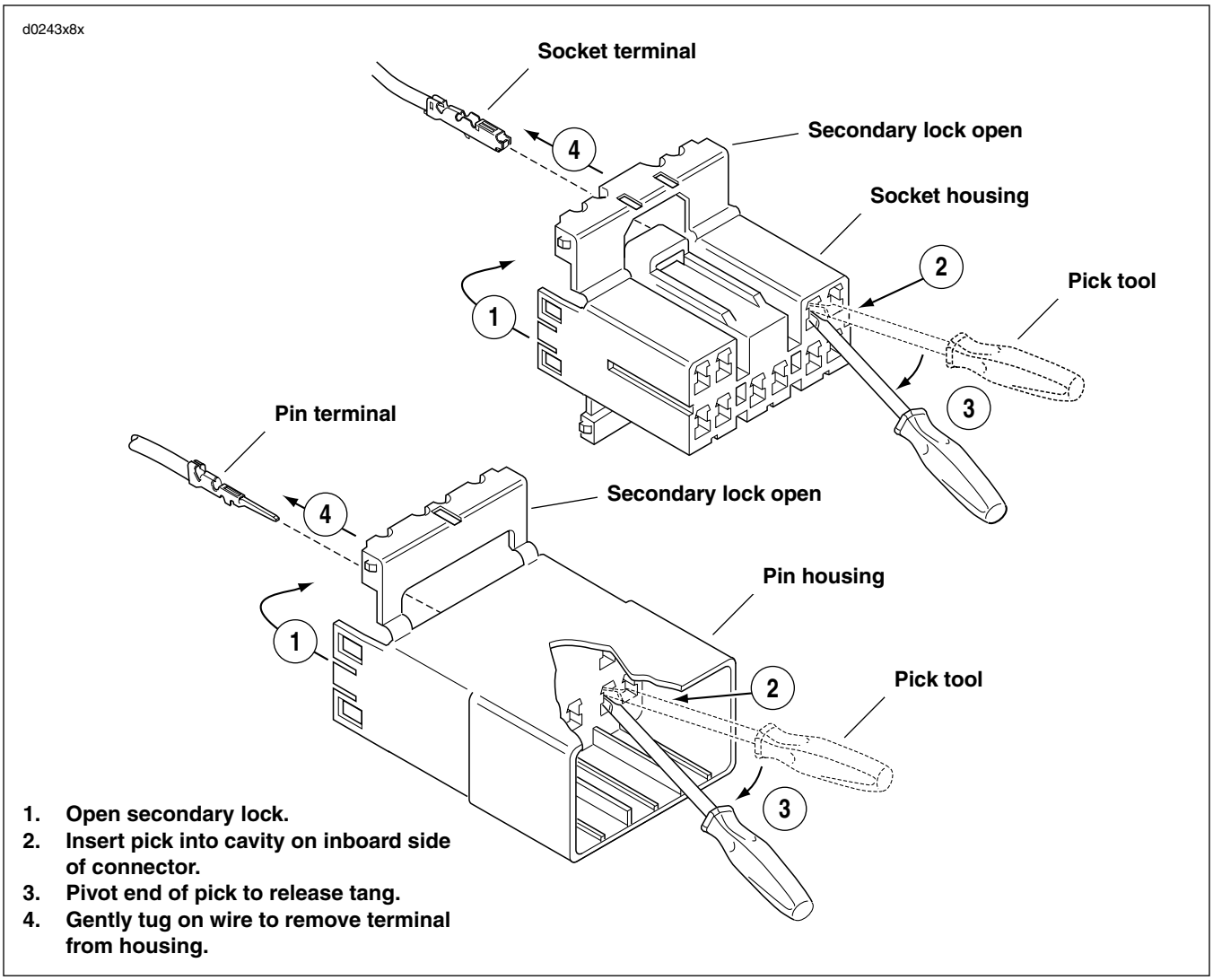


Figure B-2. Release Tang and Back Out Terminals

NOTES

- *See Figure B-3. The tang in the chamber engages the slot to lock the terminal in position.*
- *On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward.*
- *Up and down can be determined by the position of the release button (used to separate the pin and socket halves). Consider the button to always be on top of the connector.*

2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.
5. Install connector on retaining device, either attachment or rosebud clip.

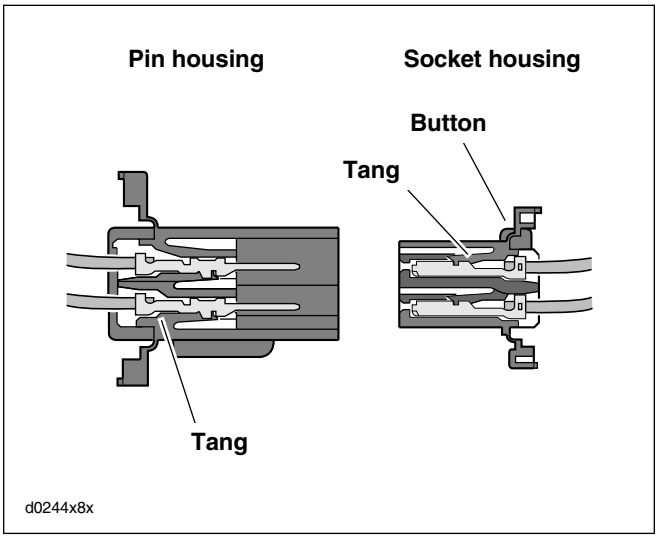


Figure B-3. Multilock Connector Cutaway View

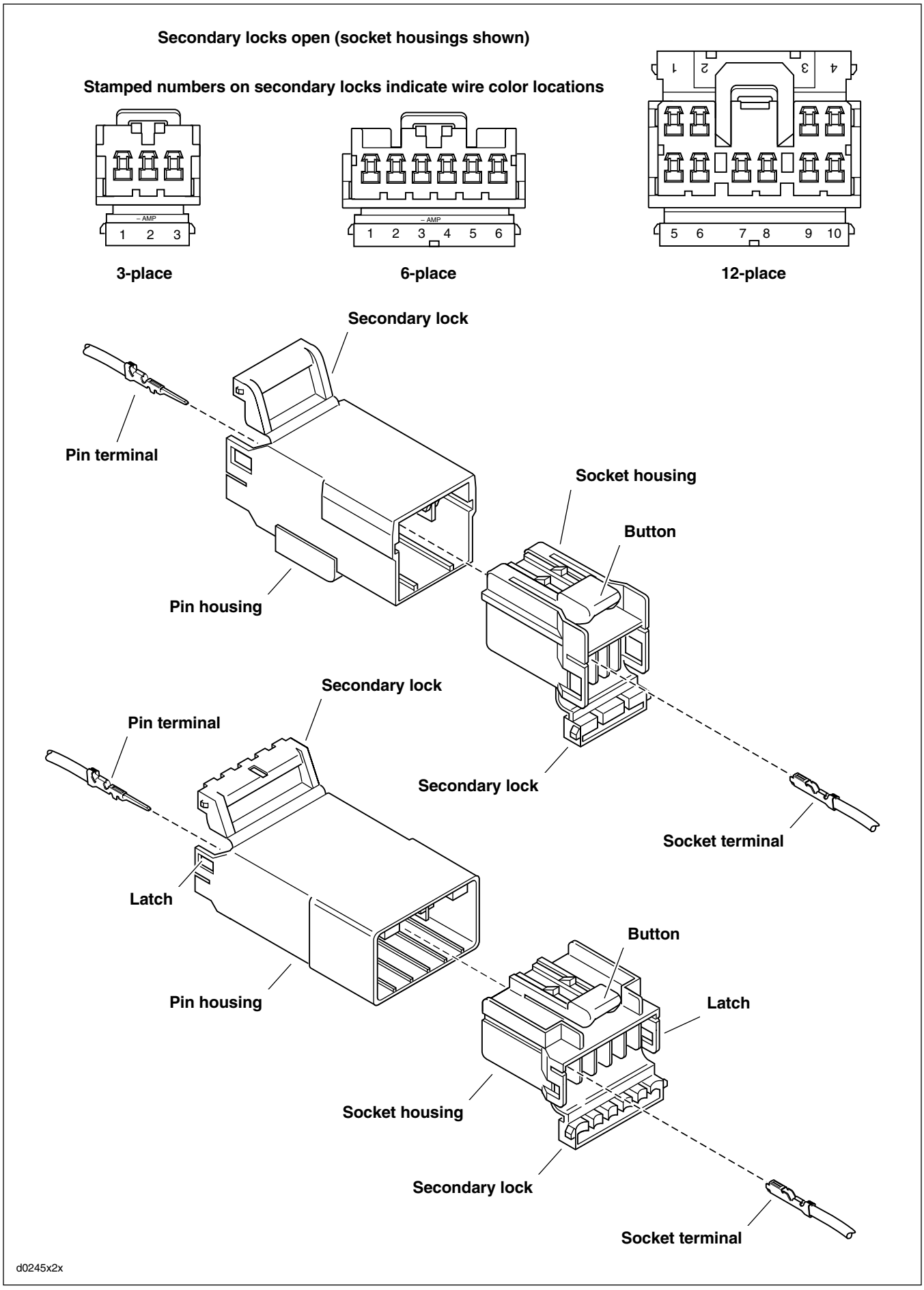


Figure B-4. 3-Place and 6-Place Amp Multilock Connectors

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool (Part No. HD-41609) to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward, insert contact (socket/pin) through locking bar, so that the closed side of the contact rests on the front nest (concave split level area of the crimp tool). See Figure B-3.
3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

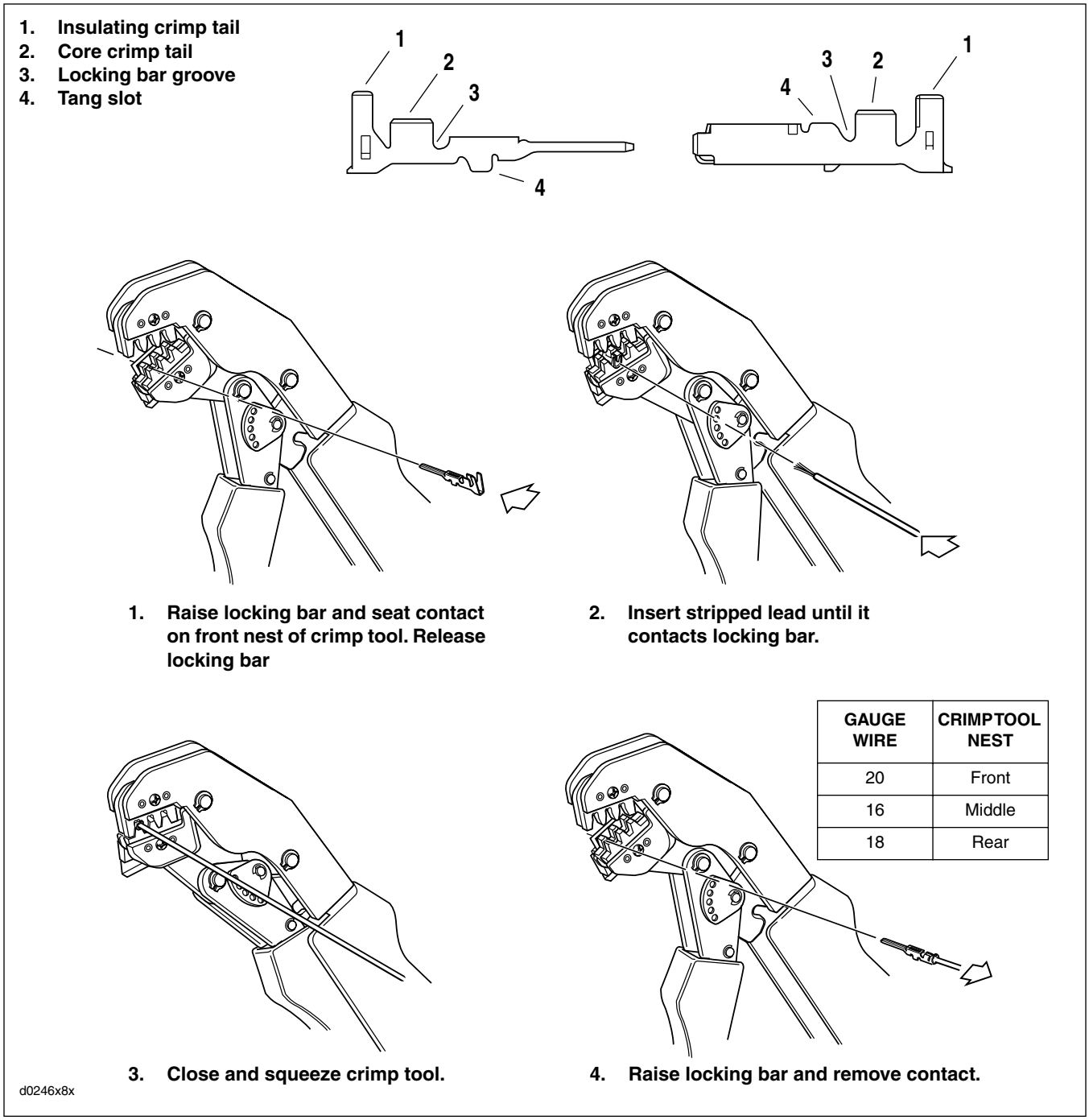


Figure B-5. Amp Multilock Crimping Procedure

DEUTSCH ELECTRICAL CONNECTORS B.2

GENERAL

Deutsch Connectors feature a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides superior pin retention.

See Figure B-8. This 12-pin connector illustrates the various parts of the Deutsch connector. The following instructions may be followed for all 2-pin through 12-pin Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal pin.

NOTE

Seal pins or plugs are installed in the wire seals of unused pin and socket locations. If removed, seal pins must be replaced to maintain the integrity of the environmental seal.

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

REMOVING/DISASSEMBLING

Attachment clips are attached to the pin housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector to disengage small end of slot on attachment clip from T-stud. Lift connector off T-stud.
2. Depress the external latch(es) on the socket housing side and use a rocking motion to separate the pin and socket halves. Two-, three-, four- and six-pin Deutsch connectors have one external latch, while eight- and twelve-pin connectors have two, both of which must be pressed simultaneously to separate the connector halves.

NOTE

With few exceptions, the socket housing can always be found on the accessory side, while the pin side of the connector is connected to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure B-7. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge 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.

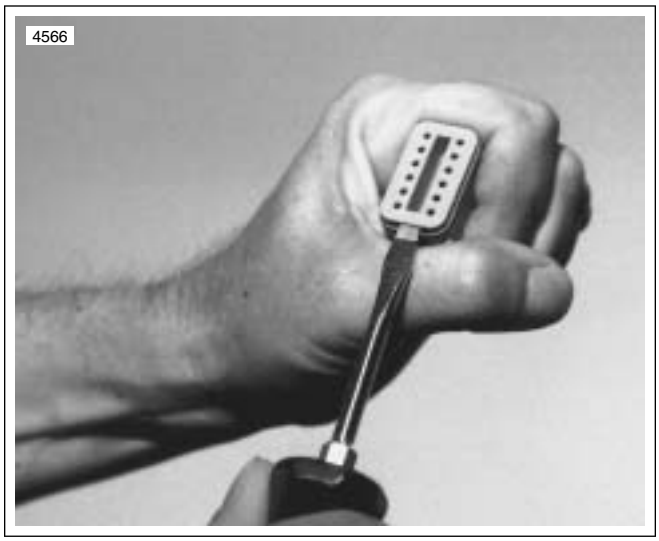


Figure B-6. Remove Secondary Locking Wedge

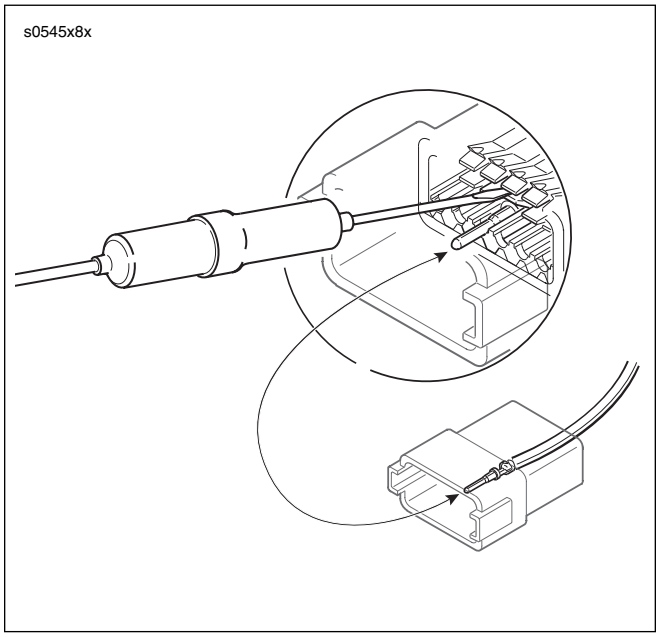


Figure B-7. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.*

Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers. Feed socket into chamber until it “clicks” in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

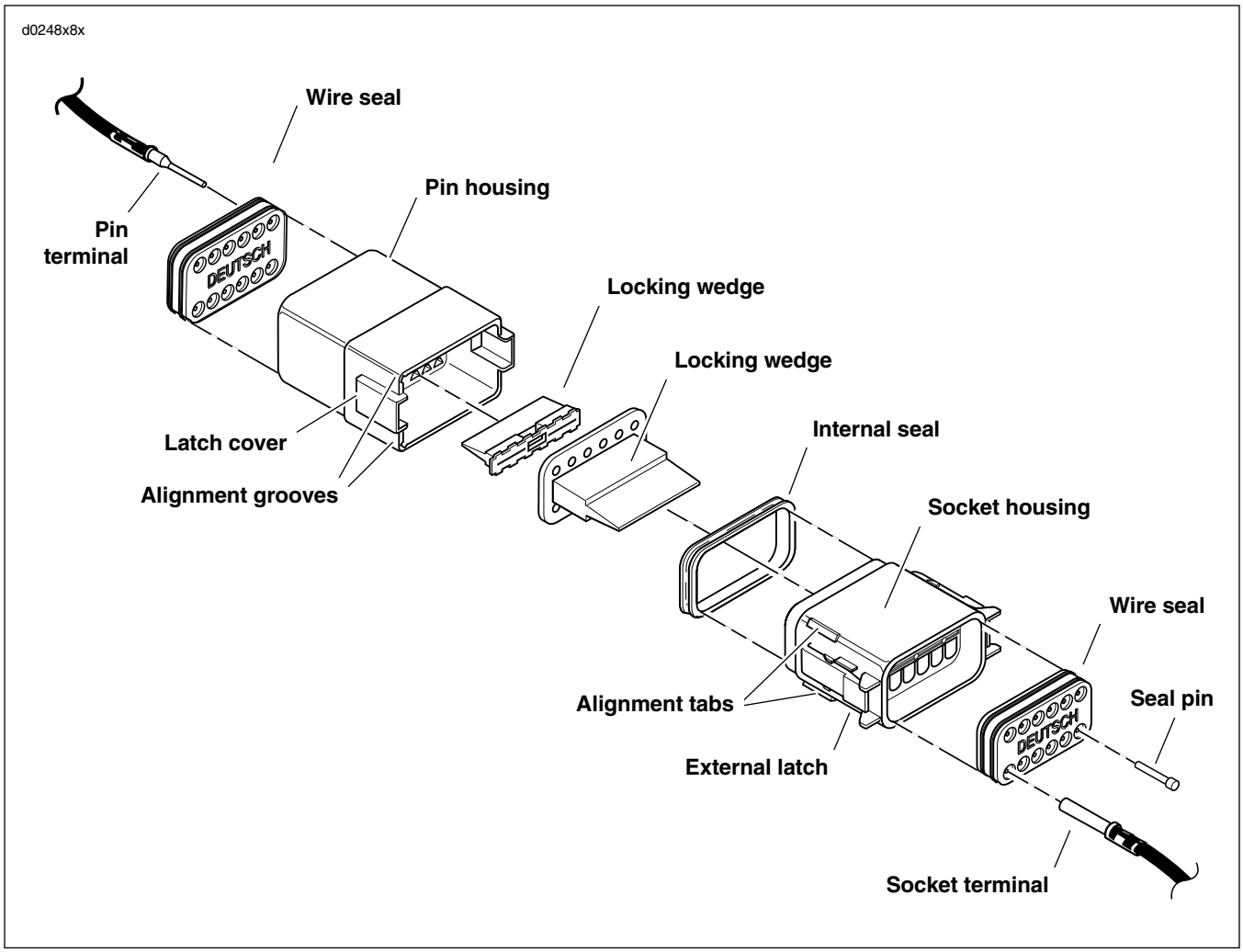


Figure B-8. 12-pin Deutsch Connector (Exploded View)

3. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure B-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire a needle nose pliers, or a suitable pick tool (Part No. HD-41475-100). See Figure B-10.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

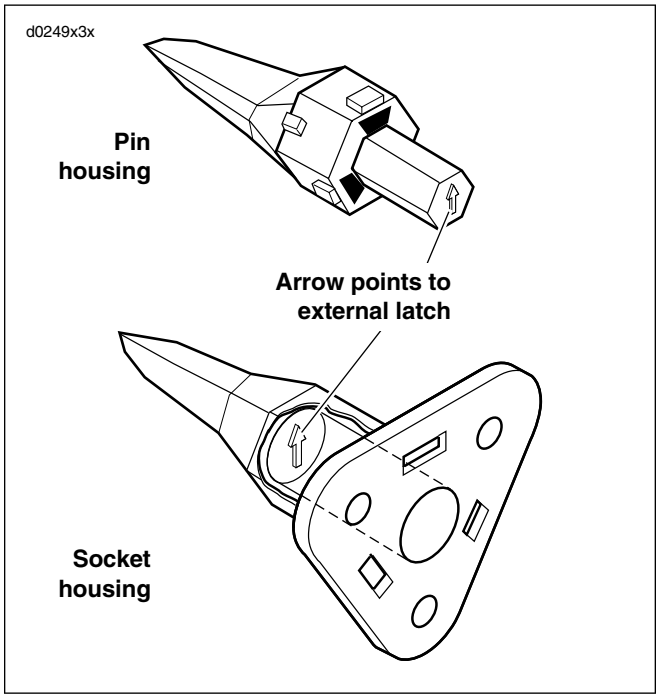


Figure B-9. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions in this section.*

3. Fit wire seal into back of pin housing. Grasp crimped pin approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered locations. Feed pin into chamber until it “clicks” in place. Verify that pin will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.
4. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place. The wedge fits in the center groove within the pin housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure B-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

ASSEMBLING/INSTALLING

1. Insert socket housing into pin housing until it snaps in place. Two-, three-, four- and six-pin Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.

   For those connectors with two external latches (8-pin and 12-pin), a different system is used to prevent improper assembly. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latches “click.” If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.

NOTE

*Deutsch connectors are color coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are black.*

If it should become necessary to replace a plug or receptacle, please note that the 8-pin and 12-pin gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and pin halves, then the black may be substituted for the gray, and vice versa. The socket and pin halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

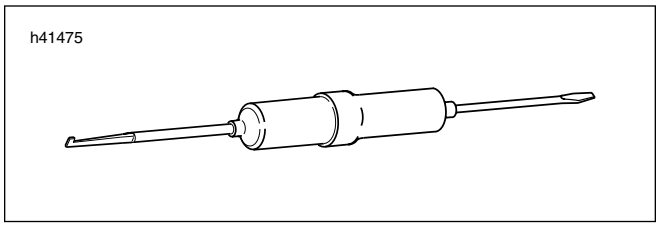


Figure B-10. Deutsch Connector Pick Tool (Part No. HD-41475-100)

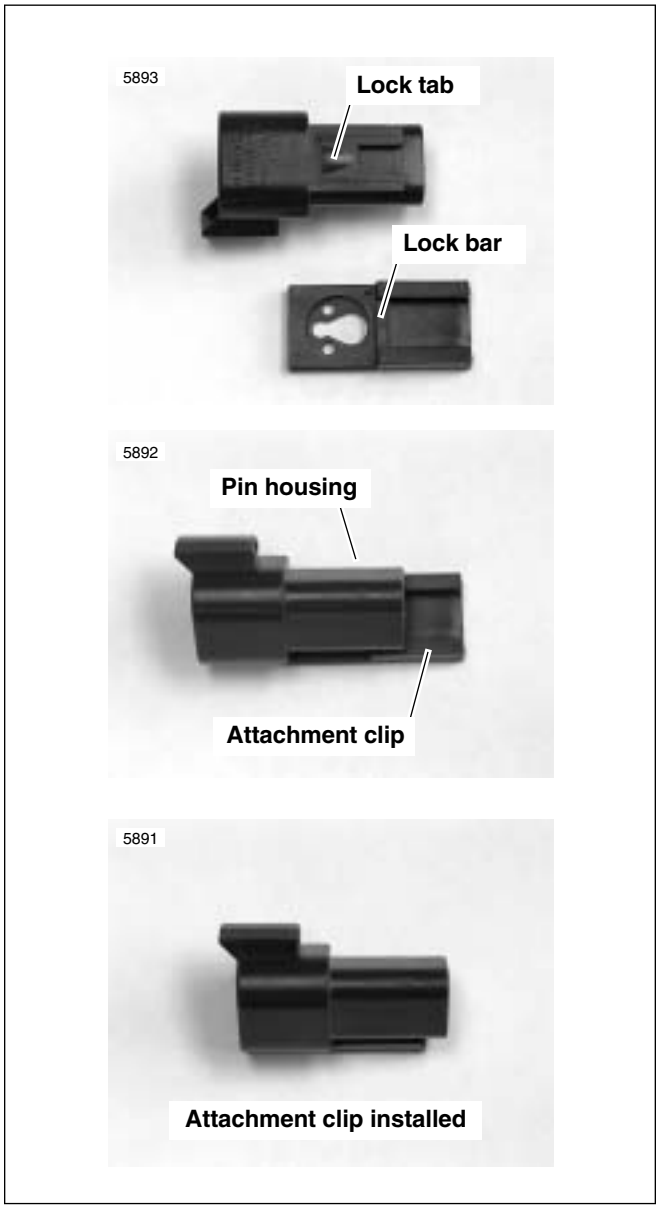
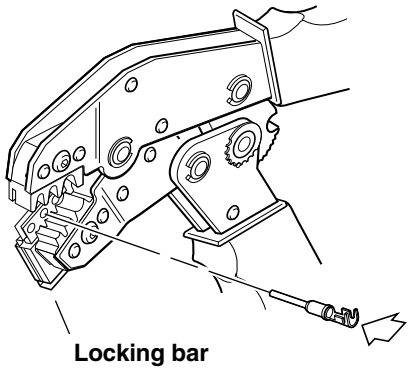


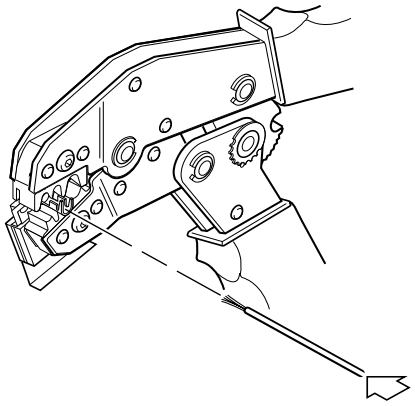
Figure B-11. Attachment Clip Installation

2. See Figure B-11. Fit the attachment clip to the pin housing, if removed. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.

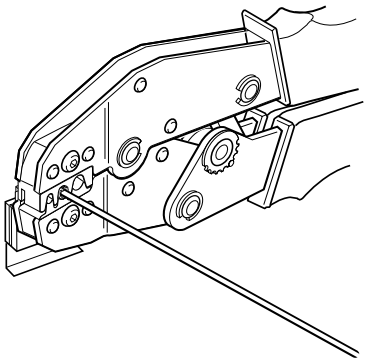
d0250x8x



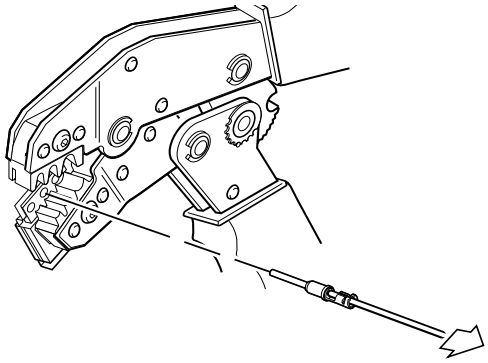
1. **Insert contact through middle hole in locking bar.**



2. **Insert stripped lead until it contacts locking bar.**



3. **Close and squeeze crimp tool**



4. **Raise locking bar and remove contact.**

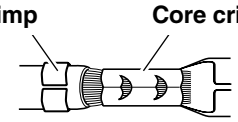


Figure B-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

1. See Figure B-12. Squeeze the handles to cycle the crimp tool to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/pin) through middle hole of locking bar.
3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

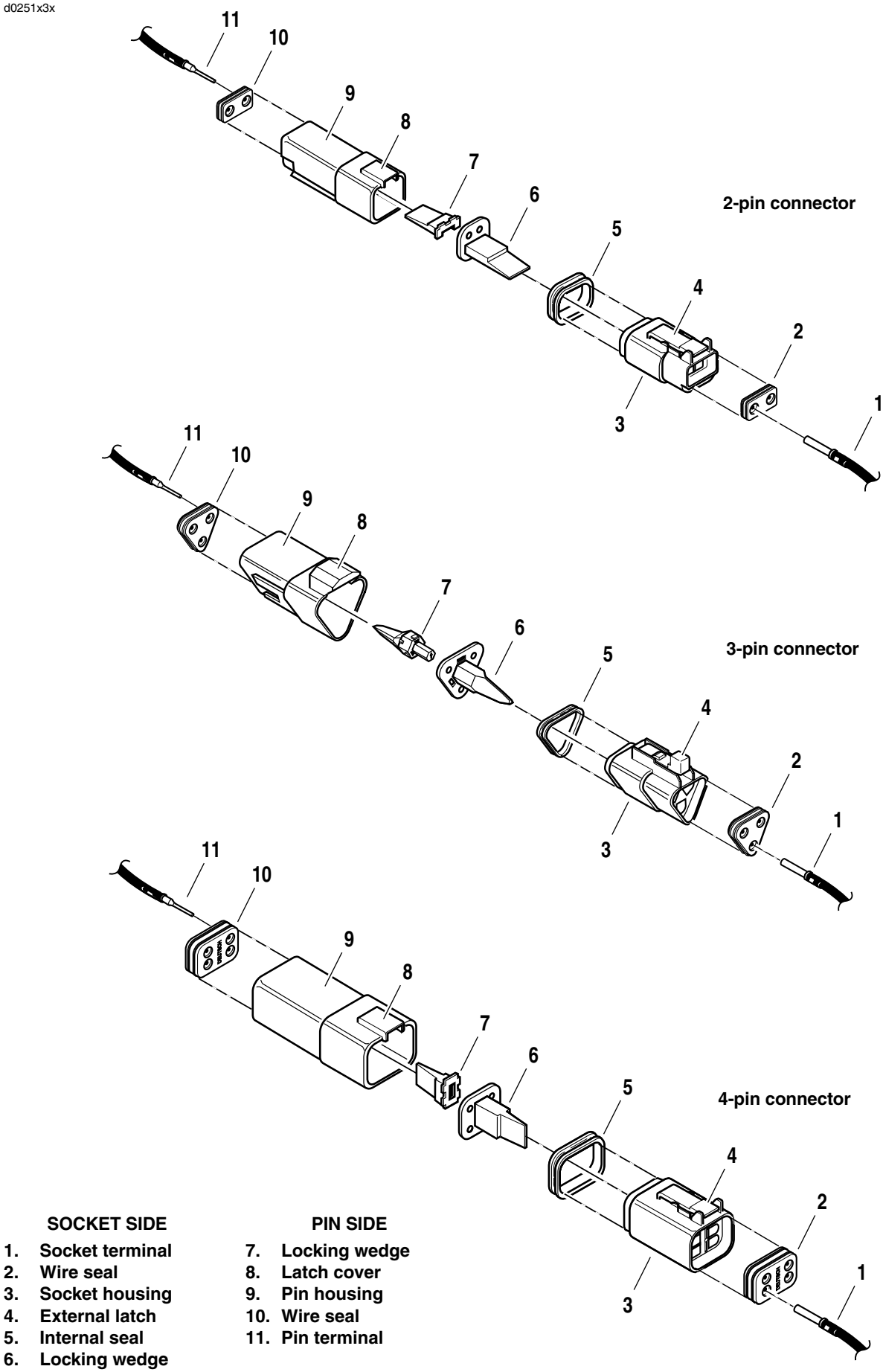


Figure B-13. 2-Pin, 3-pin and 4-pin Deutsch Connectors

PACKARD ELECTRICAL CONNECTORS B.3

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

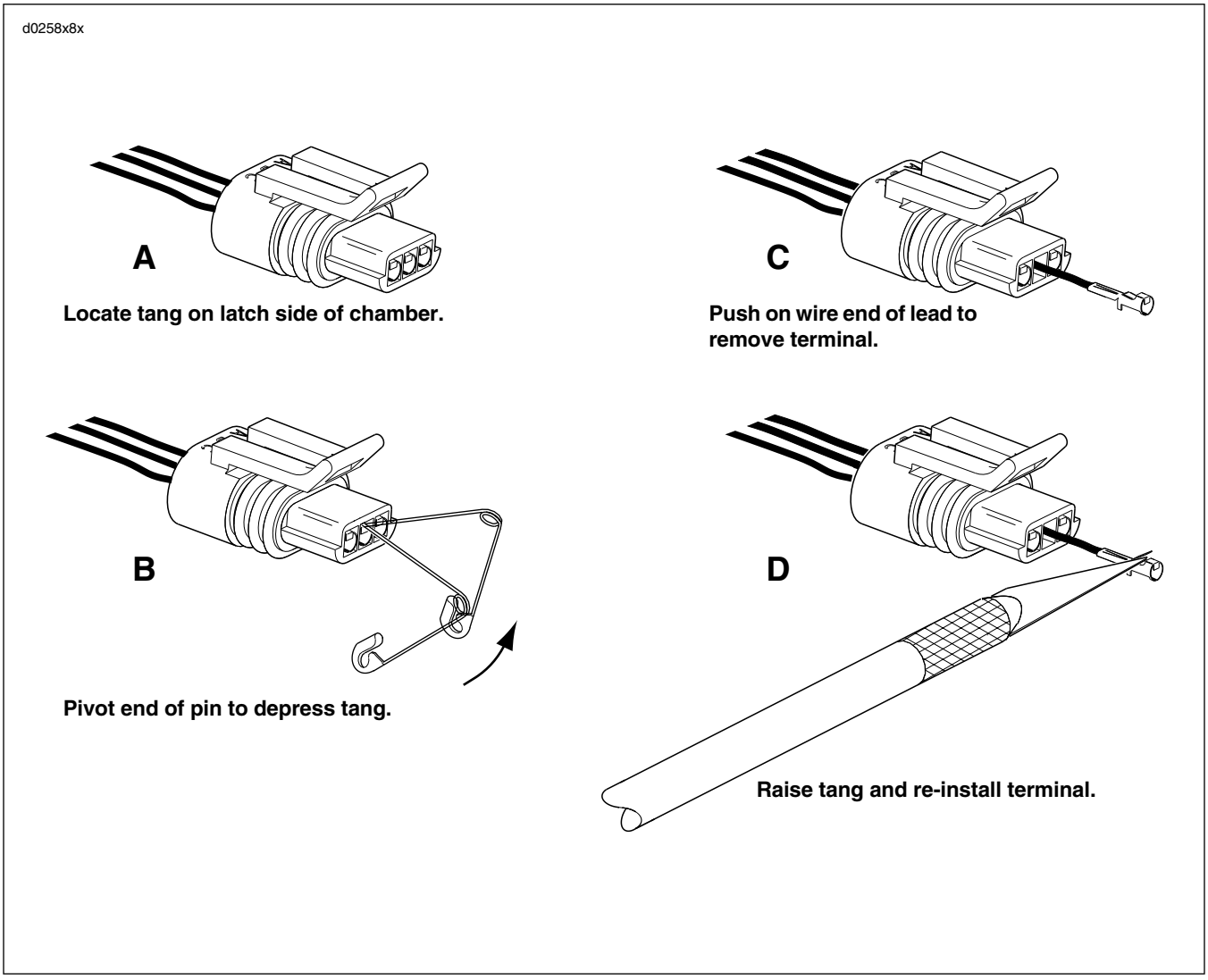


Figure B-14. Packard Connectors

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.”

PUSH-TO-SEAT TERMINALS

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.

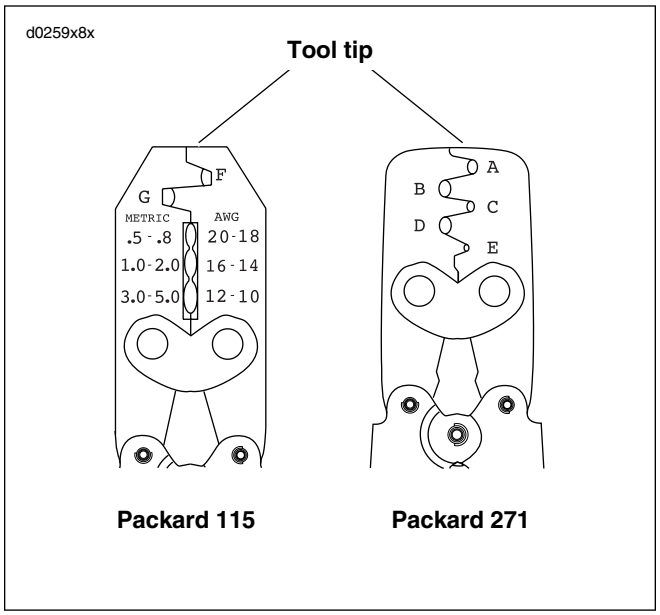


Figure B-15. Packard Terminal Crimp Tools

Table B-1. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E

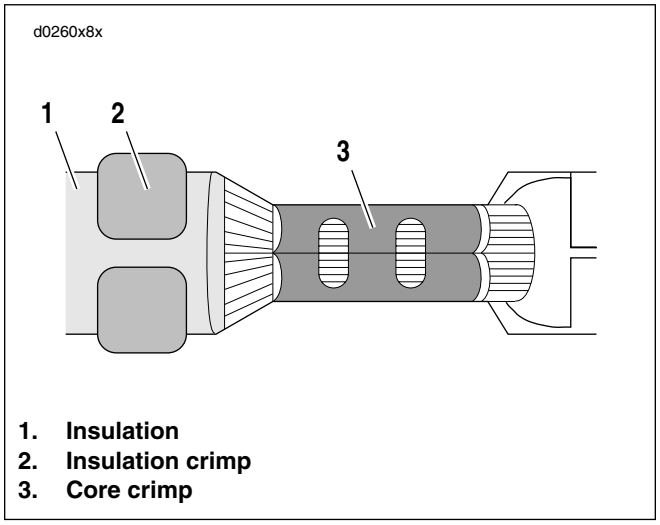


Figure B-16. Inspect Core and Insulation/Seal Crimps

ELECTRICAL CONNECTORS B.4

GENERAL

The following table provides a brief description of the connectors found on the Buell Lightning.

Connector numbers are listed in [brackets] in this manual.

Table B-2. Electrical Connector and Location Table

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

Table B-2. Electrical Connector and Location Table

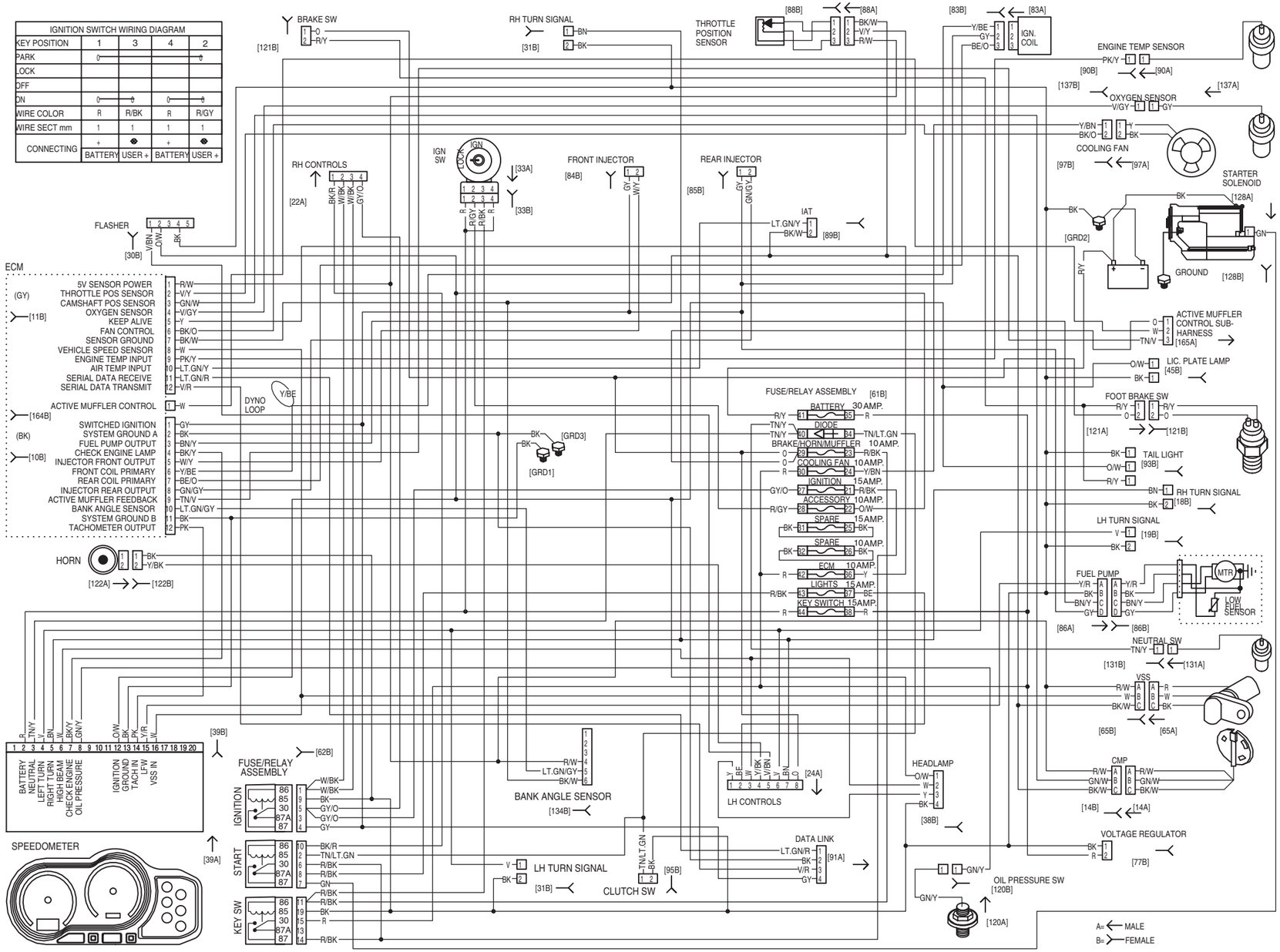
CONNECTOR	COMPONENT(S)	DESCRIPTION	LOCATION
[95]	clutch switch	2-place Multilock	underside of clutch lever assembly
[97]	cooling fan	2-place Multilock	behind rear cylinder, under seat
[120]	oil pressure switch	post terminal	crankcase above oil filter
[121]	front brake switch	2-place Multilock	underside of front master cylinder assembly
[121]	rear brake switch	2-place Multilock	under seat
[122]	horn	spade terminals	behind windscreen
[128]	starter solenoid	spade terminals	top of starter
[131]	neutral switch	1-place bullet	under sprocket cover
[134]	bank angle sensor	6-place Sumitomo	under seat
[137]	oxygen sensor	1-place Packard	behind rear cylinder head
[164]	Interactive exhaust circuit to ECM		under seat
[161]	Interactive exhaust to solenoid		under air cleaner assembly baseplate cover
[178]	Active intake system to solenoid		under air cleaner assembly baseplate cove
[179]	Active intake system to ECM		under seat

INDEX TO WIRING DIAGRAMS B.5

Table B-3. Wiring Diagrams

DIAGRAM	PAGE
Main harness	B-17
Engine management circuit	B-19
Lighting circuit	B-21
Horn and instruments circuit	B-23
Starting circuit	B-25
Charging circuits	B-27
Component circuits	B-29

bd0016aL



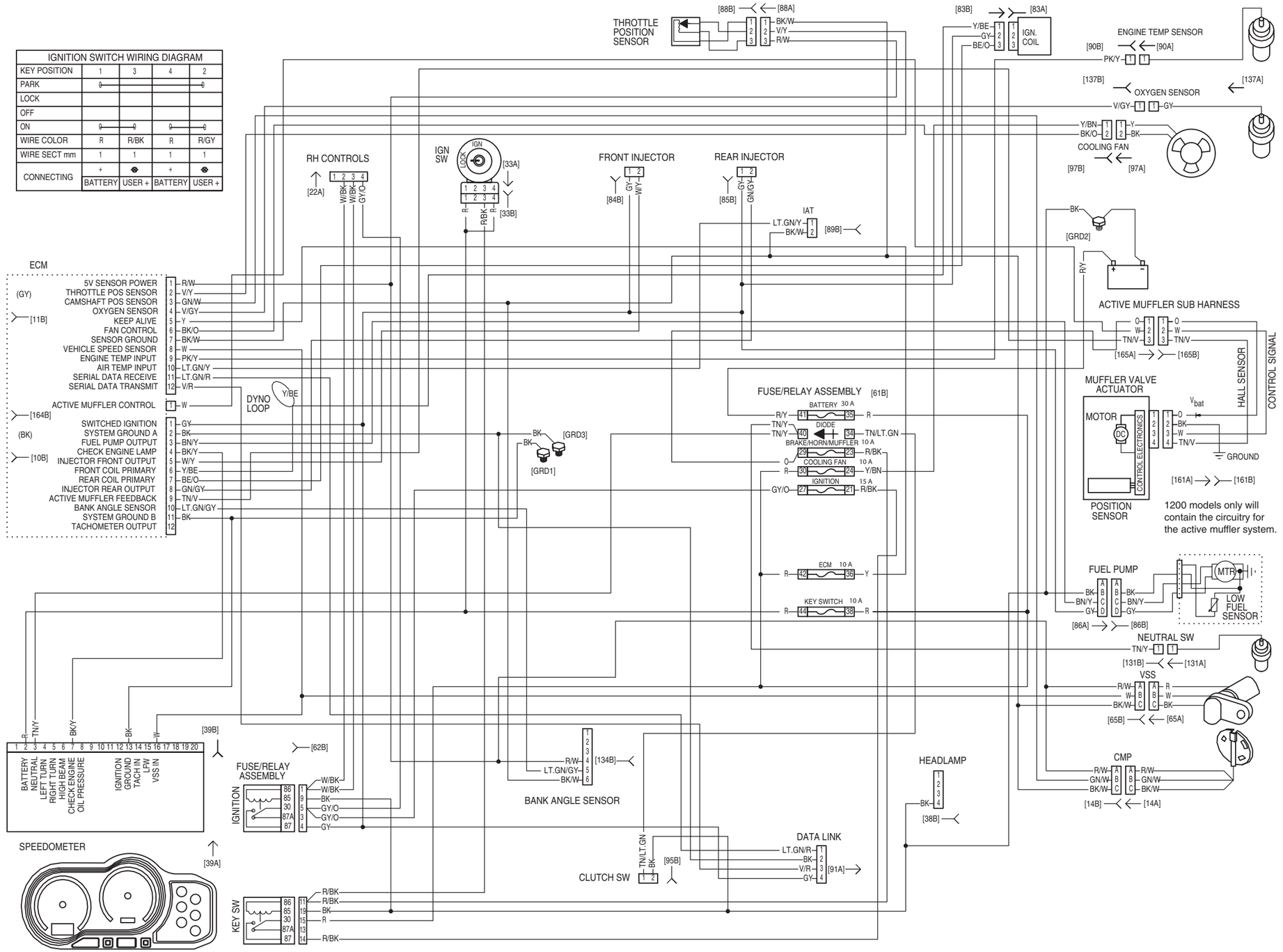
2006 Lightning Models Main Harness

2006 Lightning Models Main Harness

2006 Lightning Models Main Harness

bs0017aL

IGNITION SWITCH WIRING DIAGRAM				
KEY POSITION	1	3	4	2
PARK	●			●
LOCK				
OFF				
ON	●	●	●	●
WIRE COLOR	R	R/BK	R	R/GY
WIRE SECT mm	1	1	1	1
CONNECTING	+ BATTERY	◆ USER +	+ BATTERY	◆ USER +

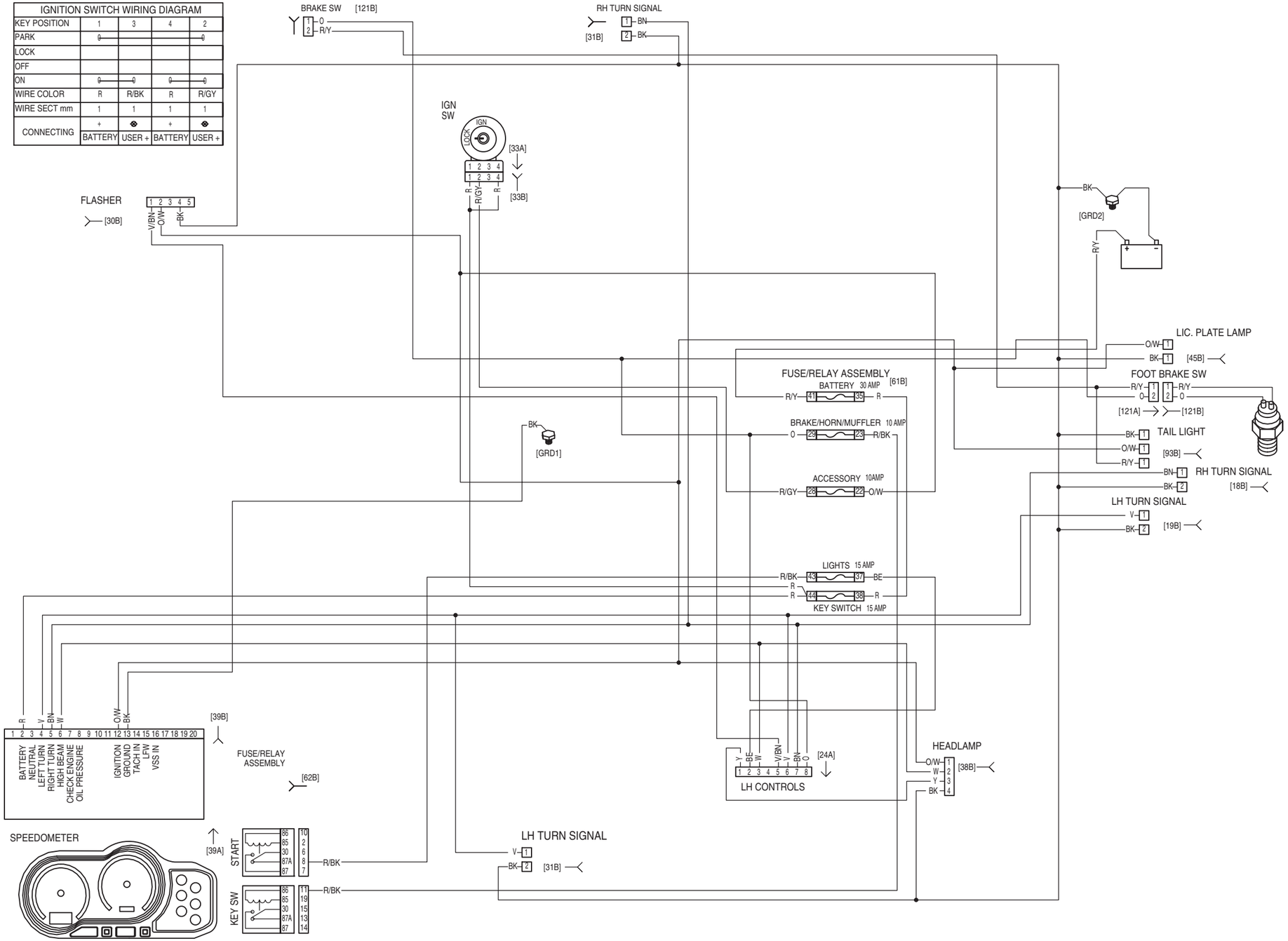


2006 Lightning Models Engine Management Circuit

2006 Lightning Models Engine Management Circuit

2006 Lightning Models Engine Management Circuit

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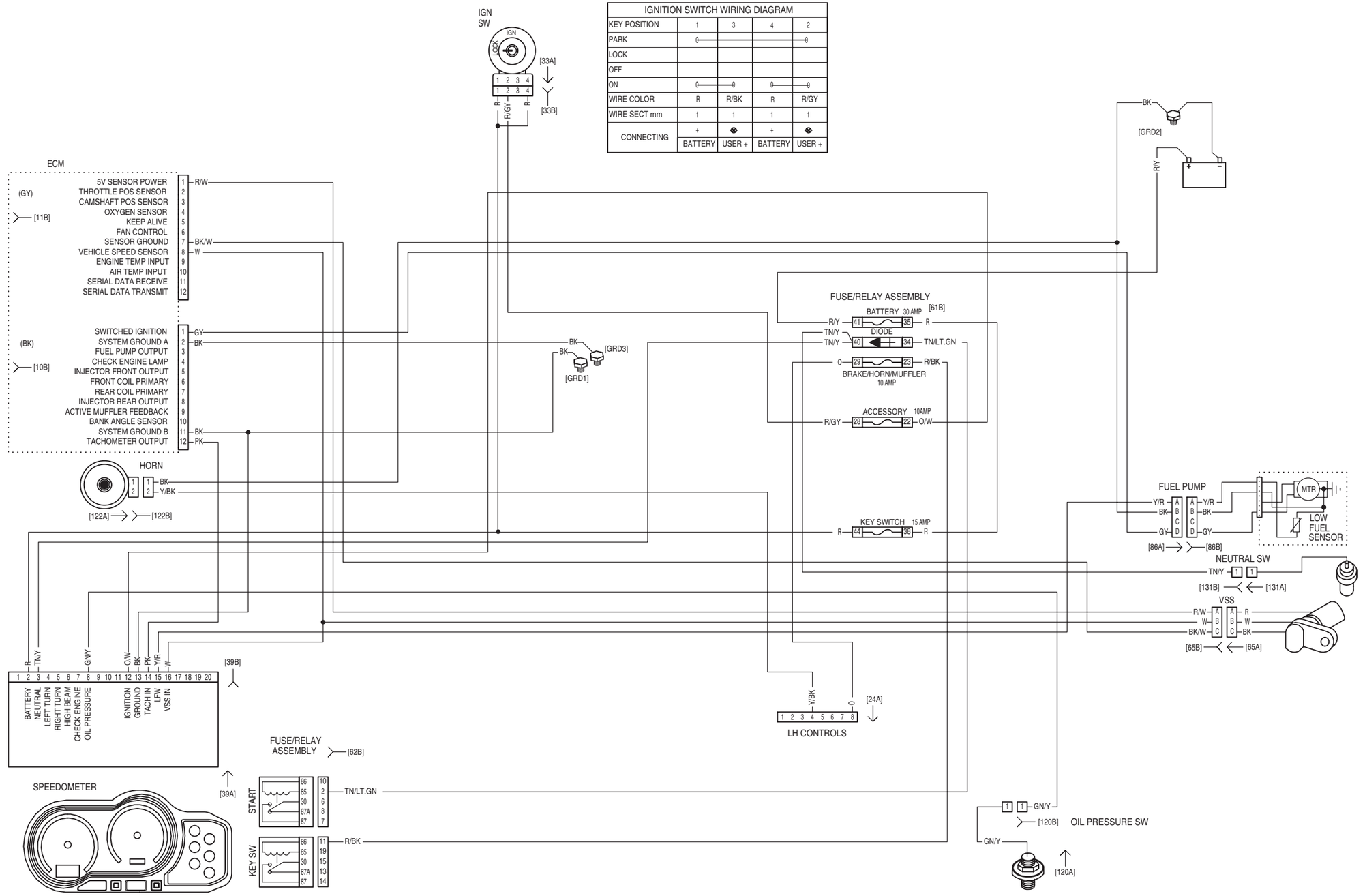
2006 Lightning Lighting Circuit

2006 Lightning Lighting Circuit

2006 Lightning Lighting Circuit

bs0019aL

IGNITION SWITCH WIRING DIAGRAM				
KEY POSITION	1	3	4	2
PARK	⊖			⊖
LOCK				
OFF				
ON	⊖	⊖	⊖	⊖
WIRE COLOR	R	R/BK	R	R/GY
WIRE SECT mm	1	1	1	1
CONNECTING	+ BATTERY	⊕ USER +	+ BATTERY	⊕ USER +



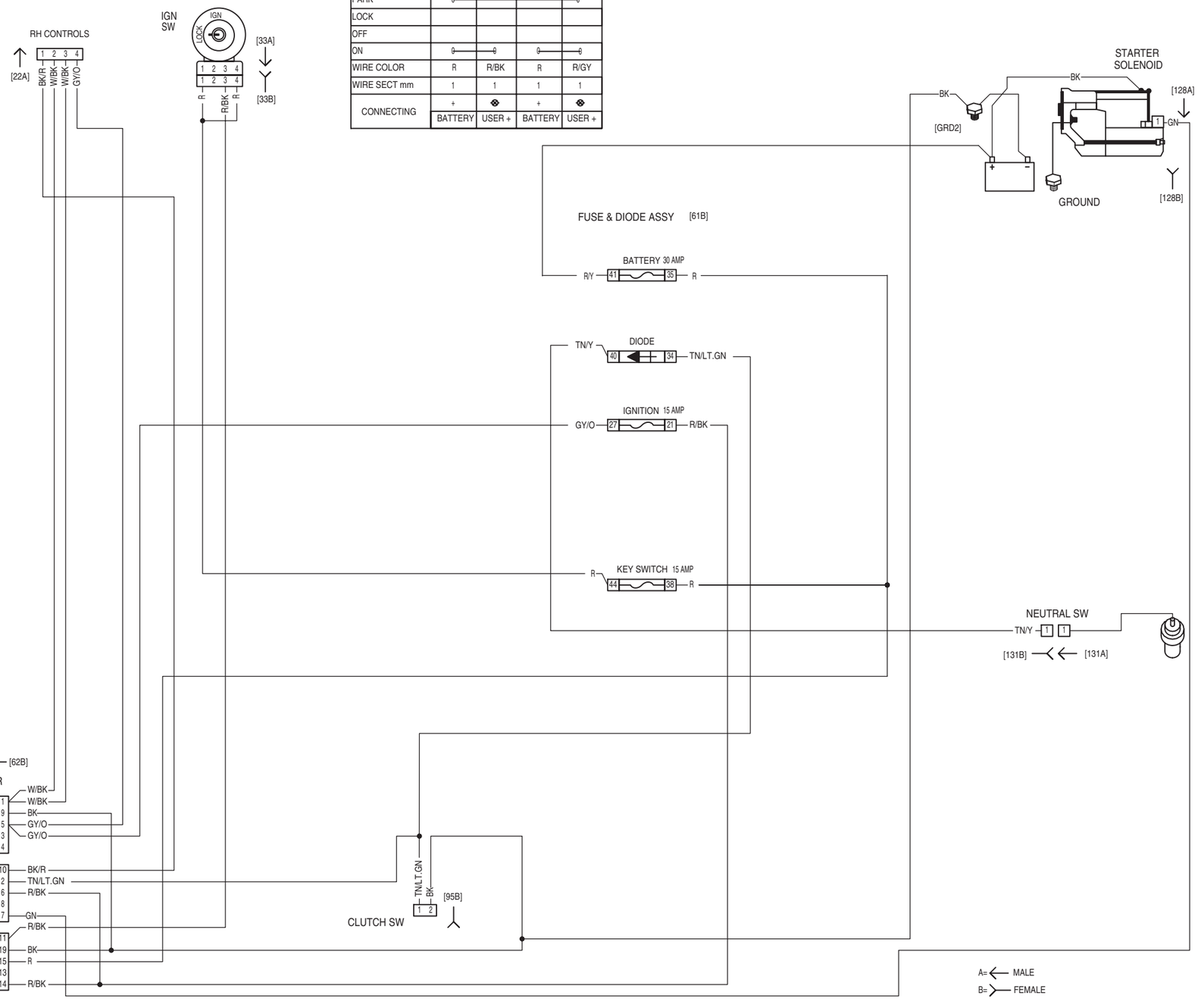
2006 Lightning Models Horn & Instruments Circuit

2006 Lightning Models Horn & Instruments Circuit

2006 Lightning Models Horn & Instruments Circuit

bd0023bL

IGNITION SWITCH WIRING DIAGRAM				
KEY POSITION	1	3	4	2
PARK	0			0
LOCK				
OFF				
ON	0	0	0	0
WIRE COLOR	R	R/BK	R	R/GY
WIRE SECT mm	1	1	1	1
CONNECTING	+	⊗	+	⊗
	BATTERY	USER +	BATTERY	USER +

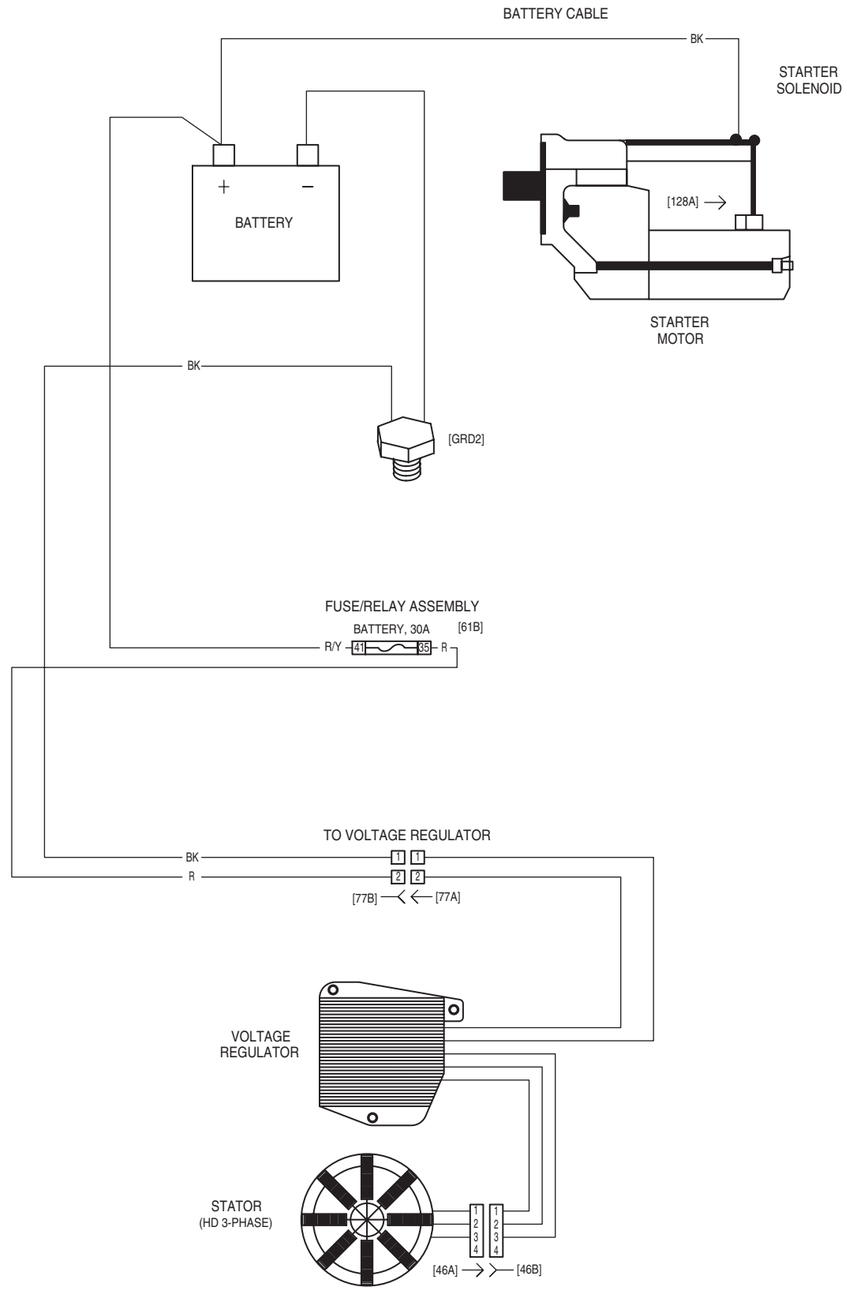


2006 Lightning Models Starting Circuit

2006 Lightning Models Starting Circuit

2006 Lightning Models Starting Circuit

bs0021xx

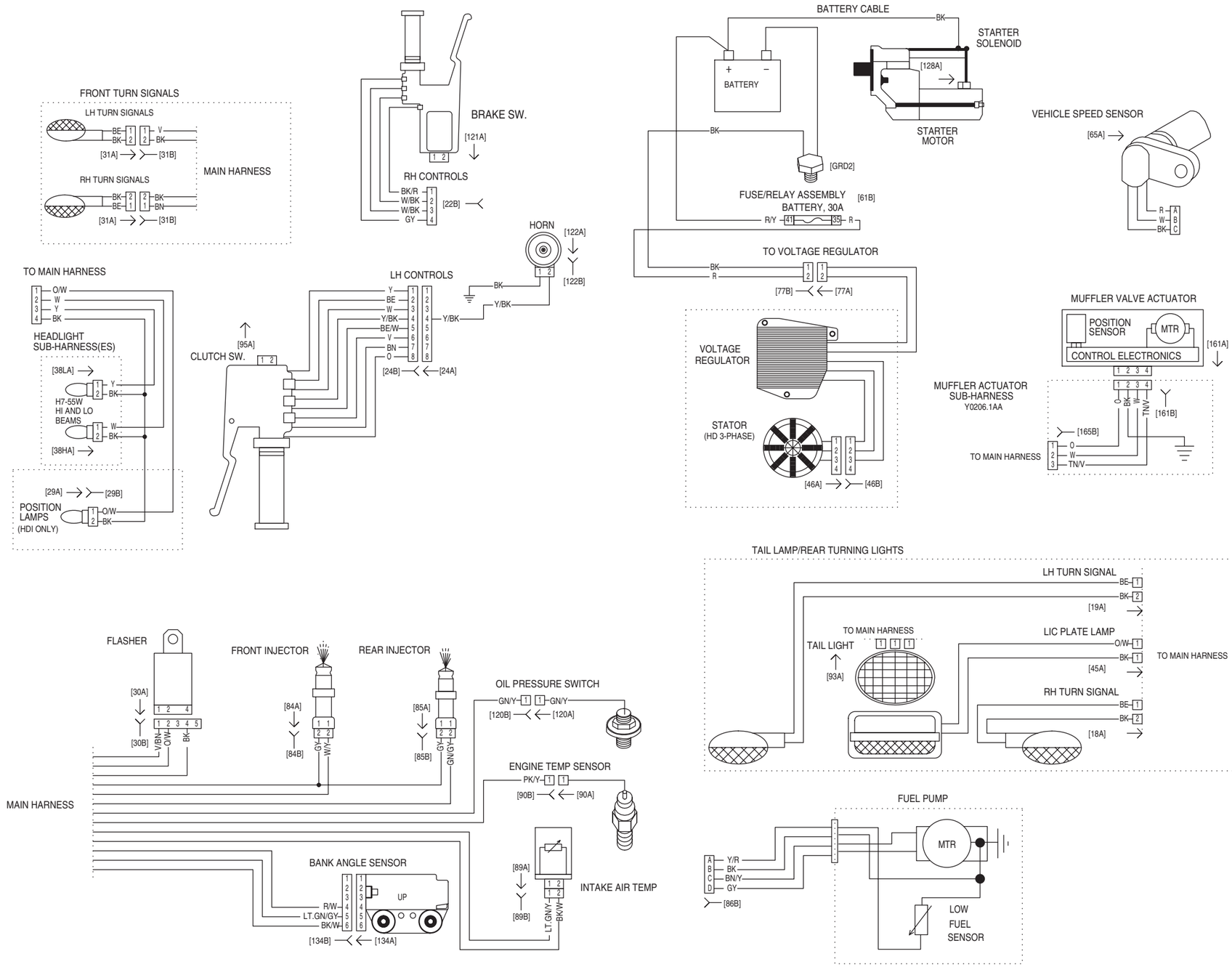


2006 Lightning Models Charging Circuit

2006 Lightning Models Charging Circuit

2006 Lightning Models Charging Circuit

bs0020aL



2006 Lightning Models Component Circuits

2006 Lightning Models Component Circuits

2006 Lightning Models Component Circuits

APPENDIX C–METRIC CONVERSIONS C.1

Table C-1. Metric Conversions

MILLIMETERS TO INCHES (MM X 0.03937 = INCHES)								INCHES TO MILLIMETERS (INCHES X 25.40 = MM)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

UNITED STATES SYSTEM

Unless otherwise specified, **all fluid volume measurements in this Service Manual are expressed in United States (U.S.) units-of-measure.** See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.113 = 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.)

HOSE AND WIRE ROUTING

b1114xasx

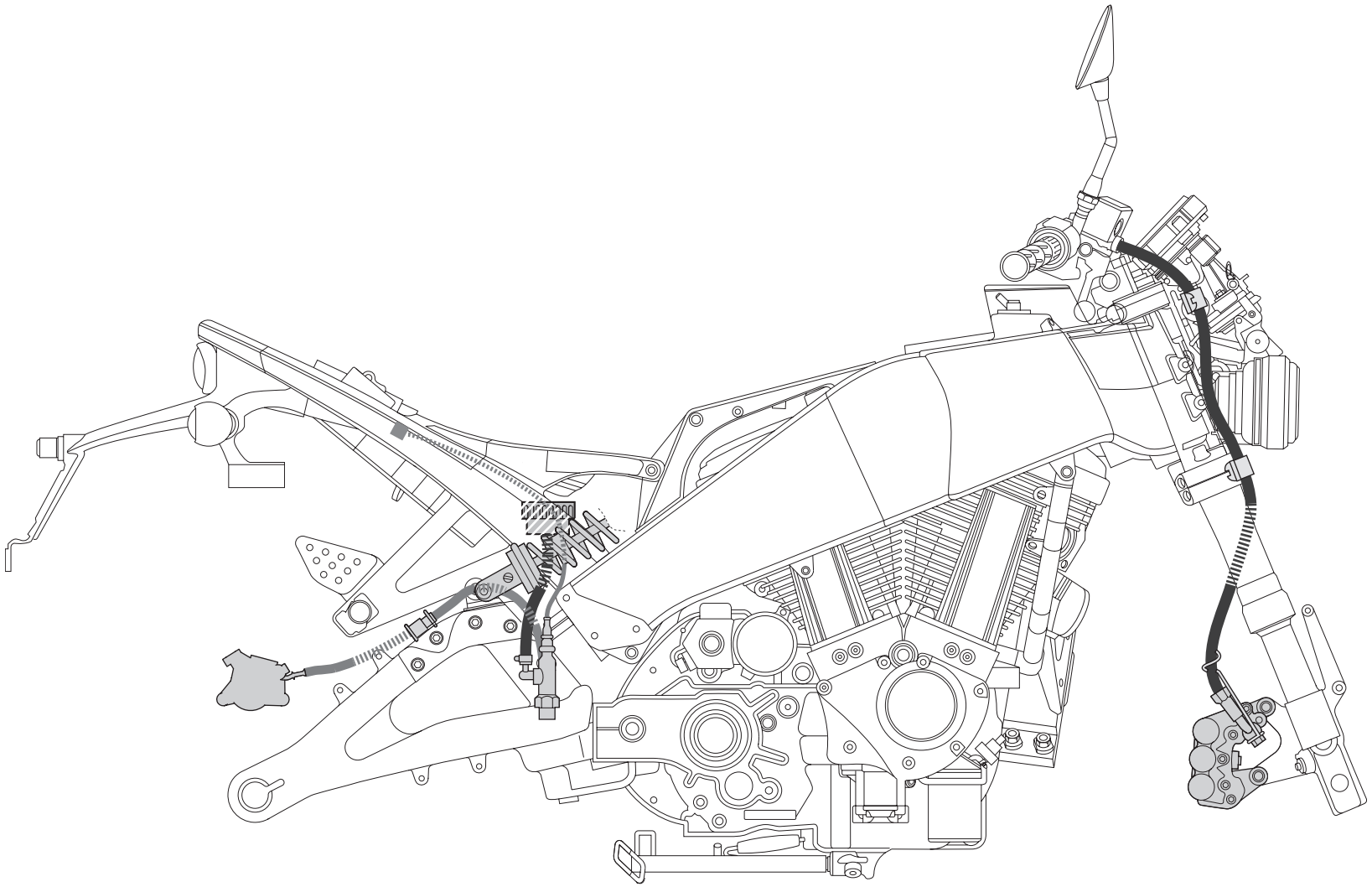


Figure D-1. Front and Rear Brake Systems, Right Side View

b1115xbsx

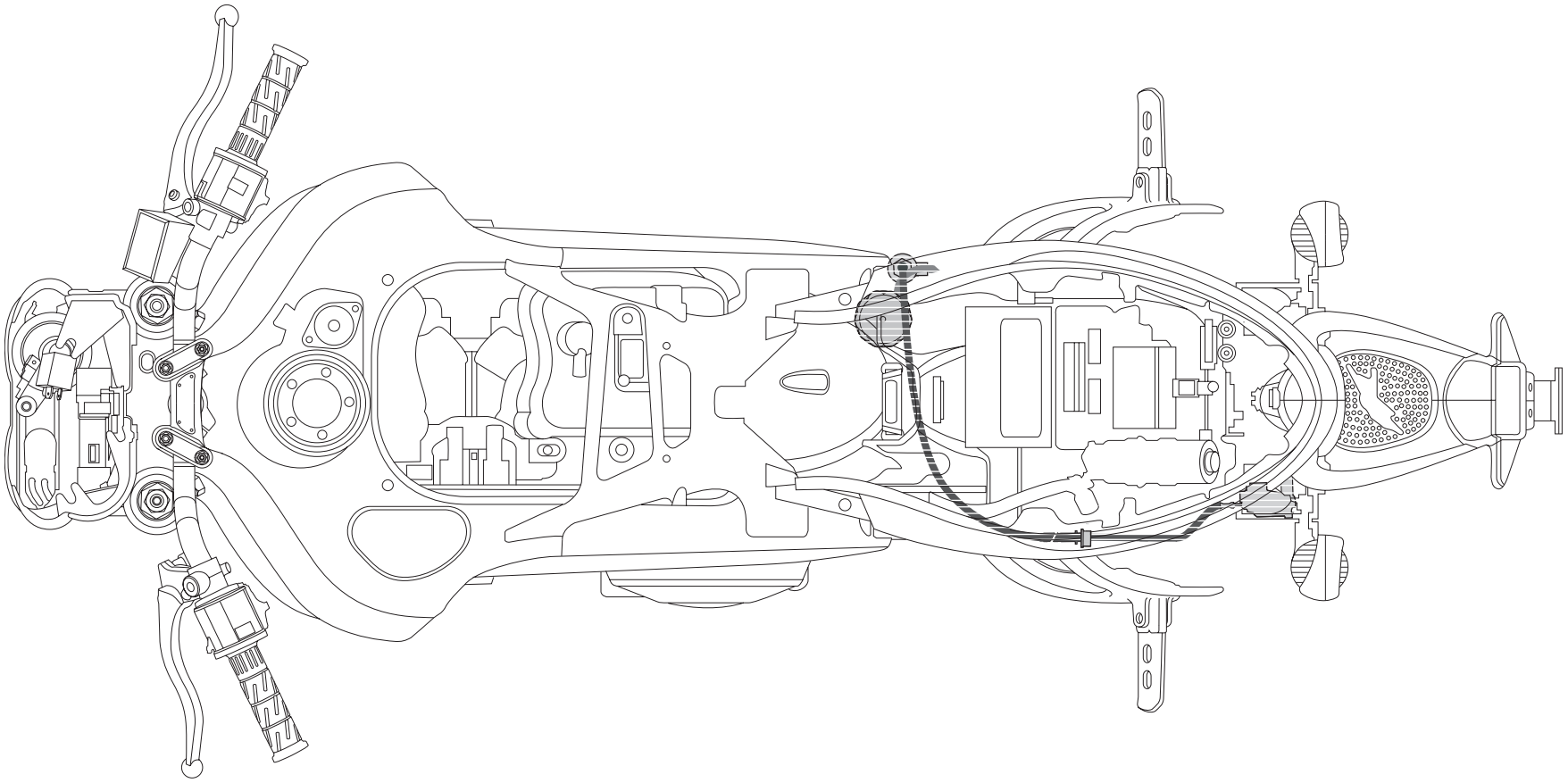


Figure D-2. Rear Brake Systems, Top View

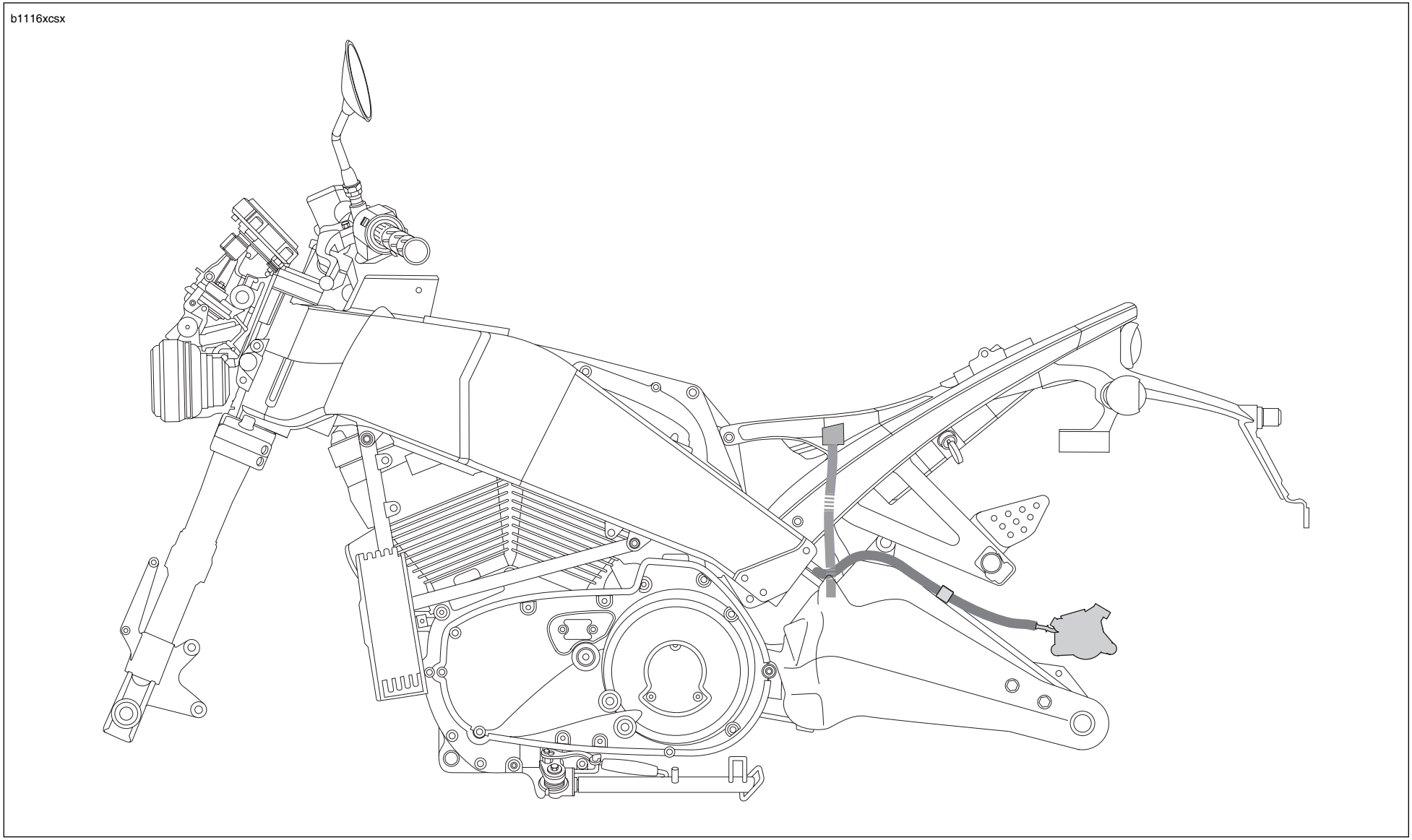


Figure D-3. Rear Brake Systems, Left Side View

b1117xasxL

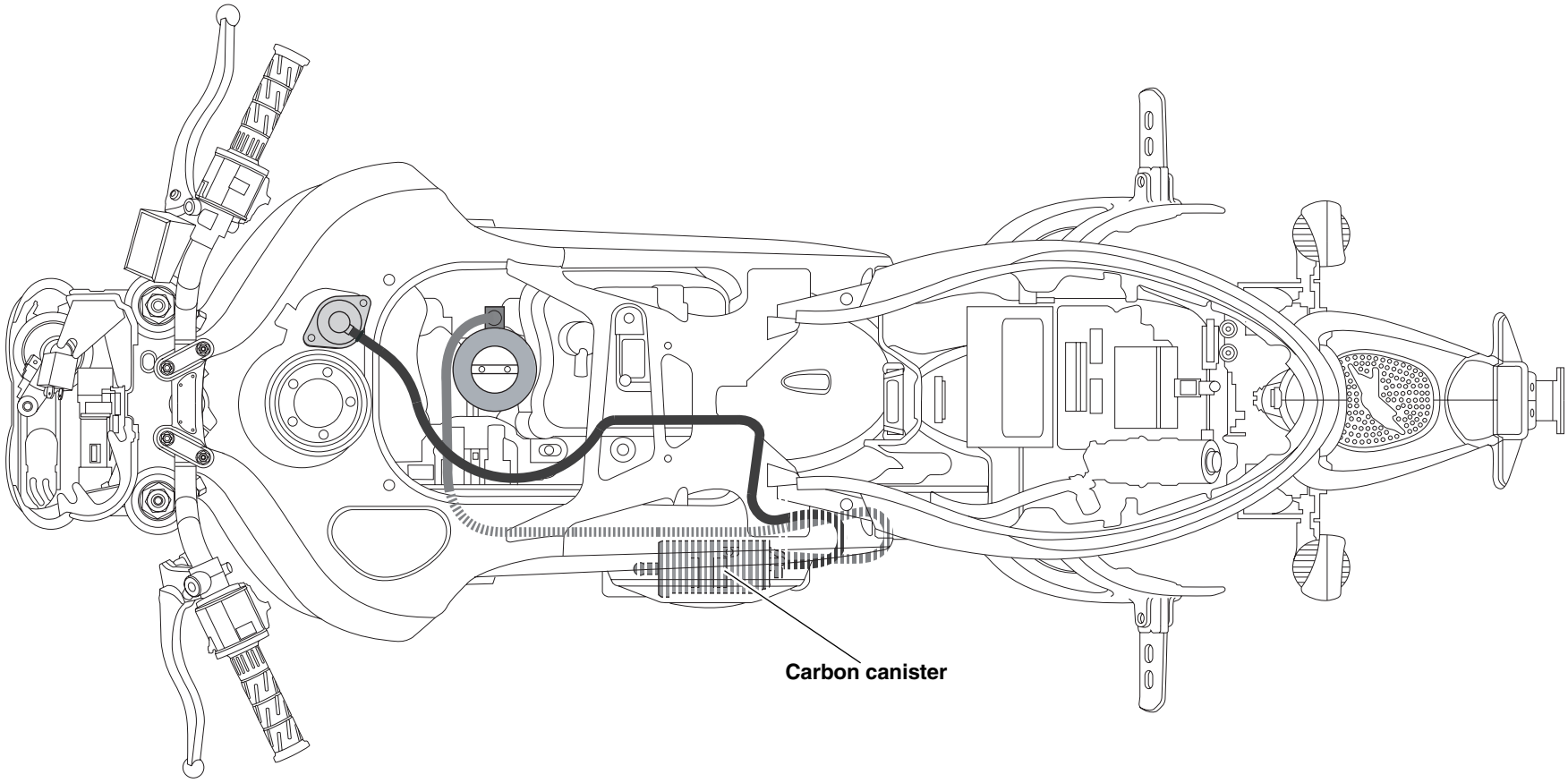
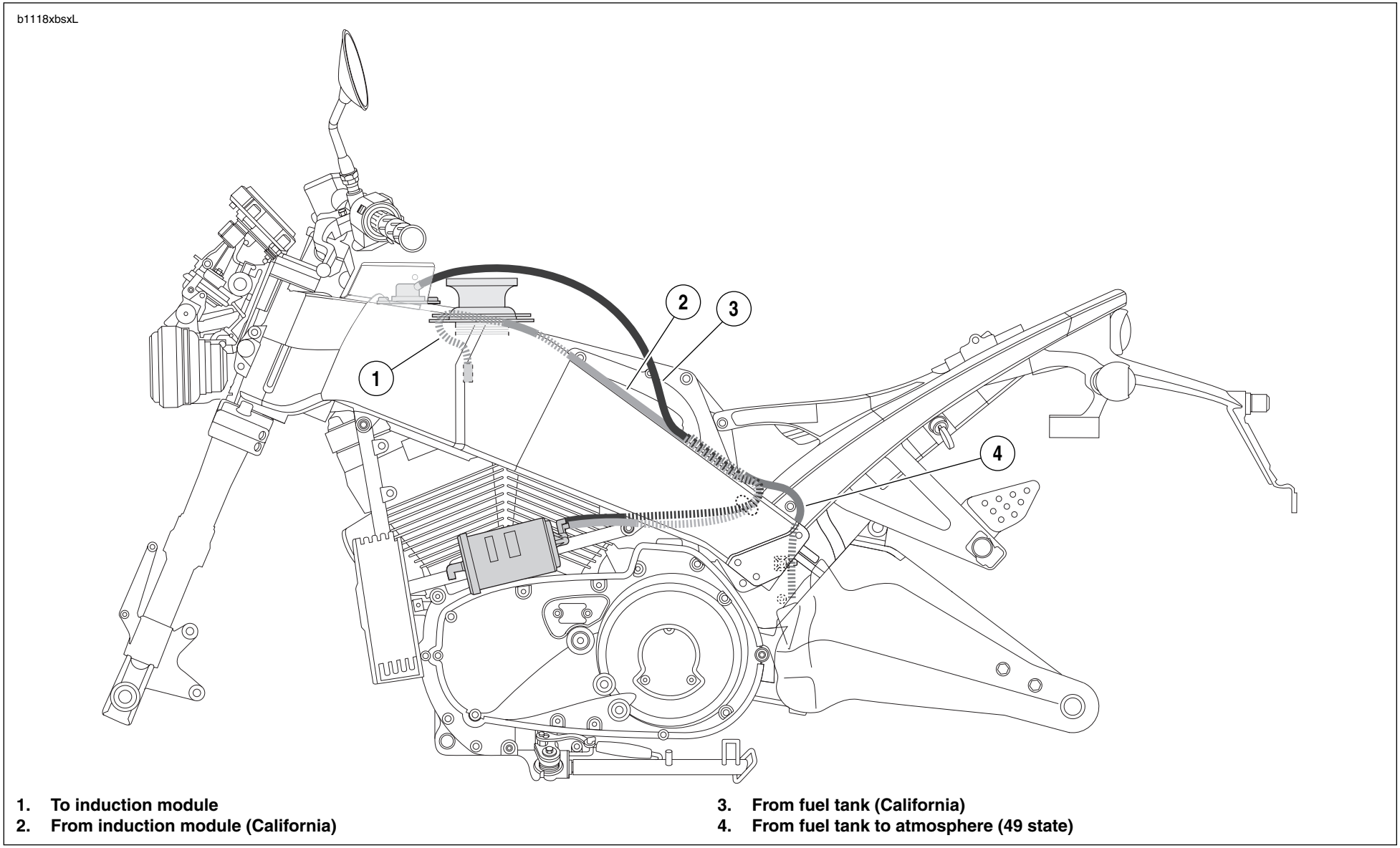


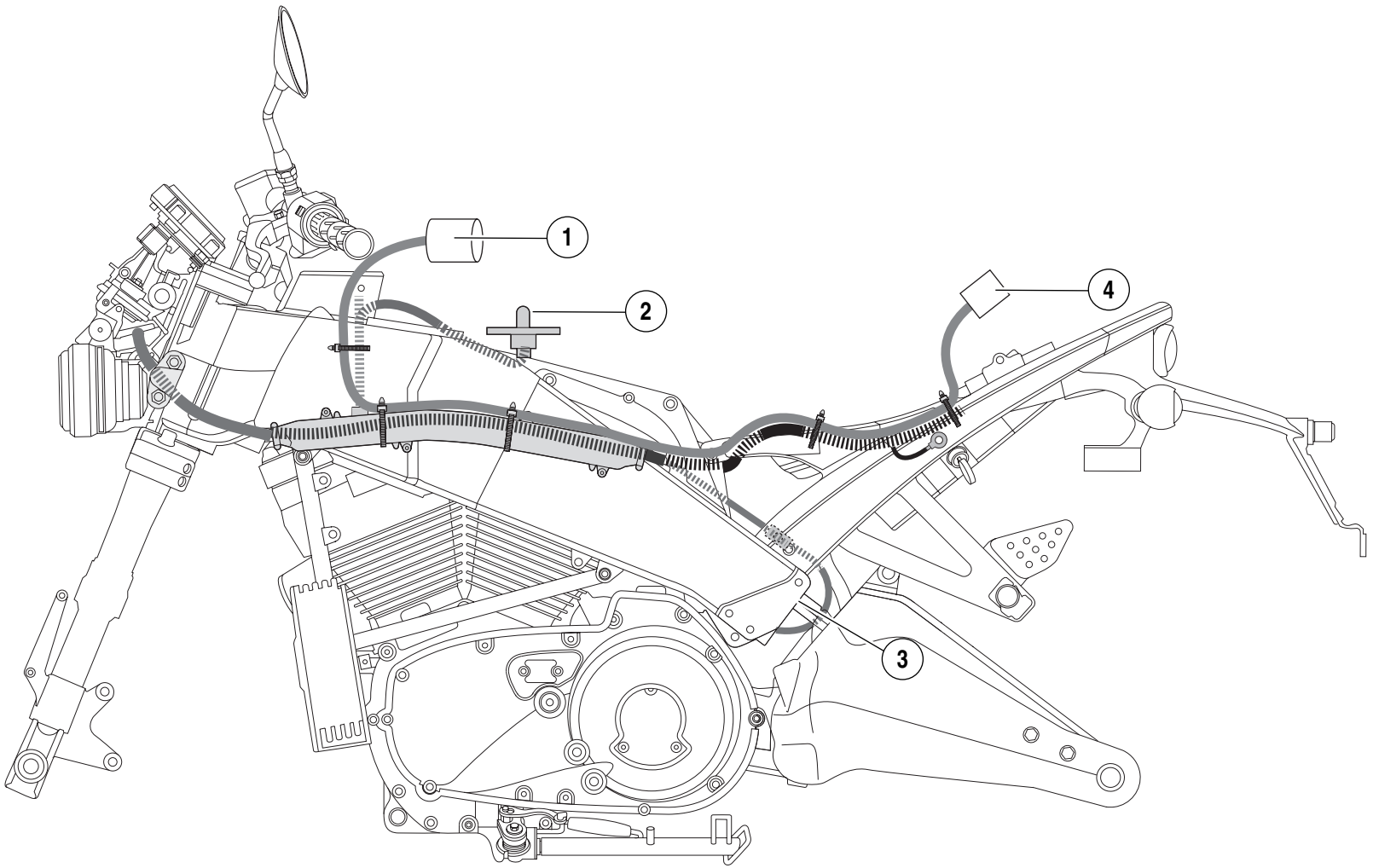
Figure D-4. Evaporative Emissions Control, California Models, Top View



1. To induction module
2. From induction module (California)
3. From fuel tank (California)
4. From fuel tank to atmosphere (49 state)

Figure D-5. Evaporative Emissions Control, California and 49 State Models, Left Side View

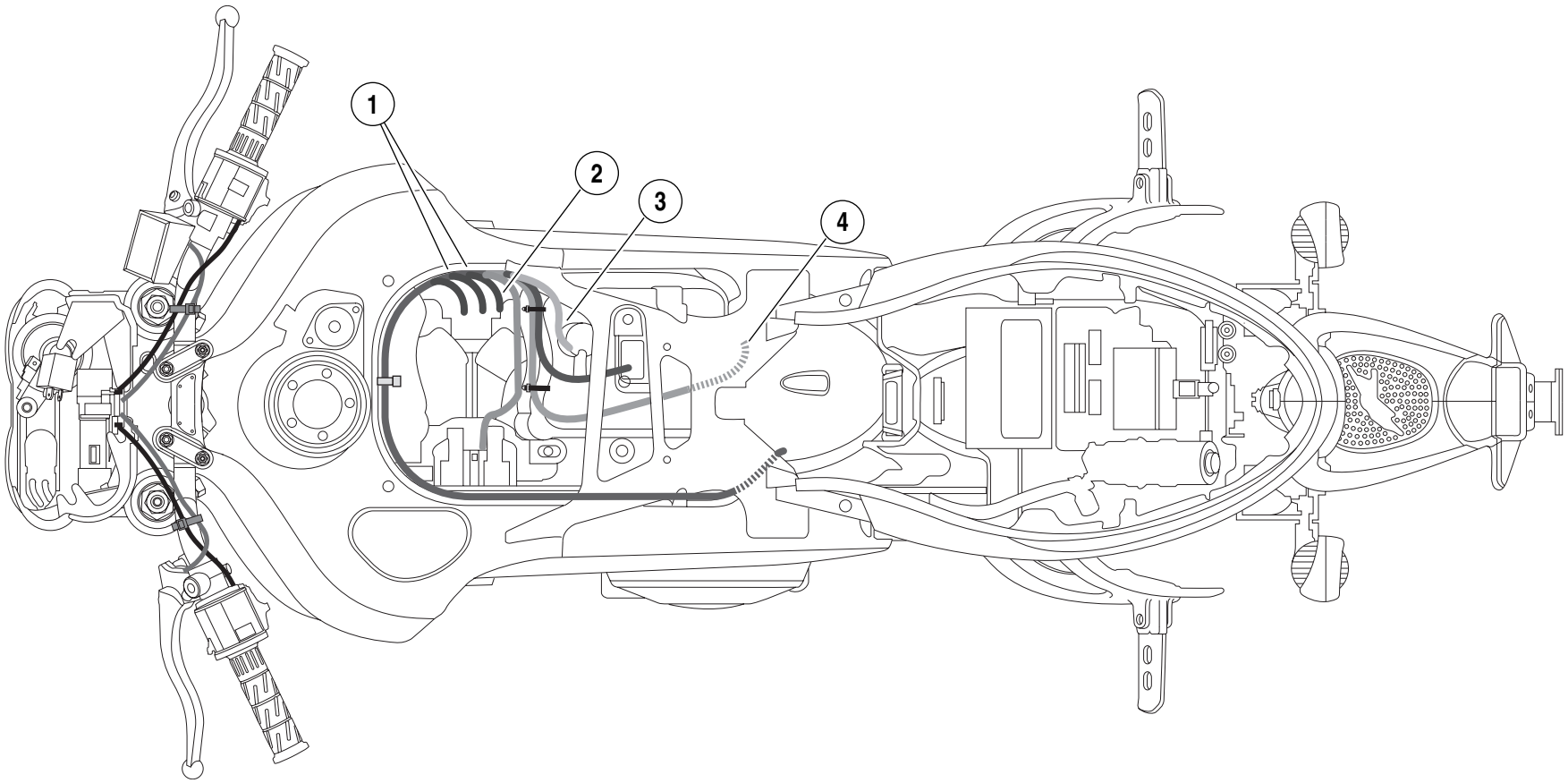
b1119xasxL



1. To active intake solenoid (Japan only)
2. Intake air temperature sensor (IAT)
3. Fuel pump
4. Active intake to ECM (Japan only)

Figure D-6. Wiring Harness, Left Side View

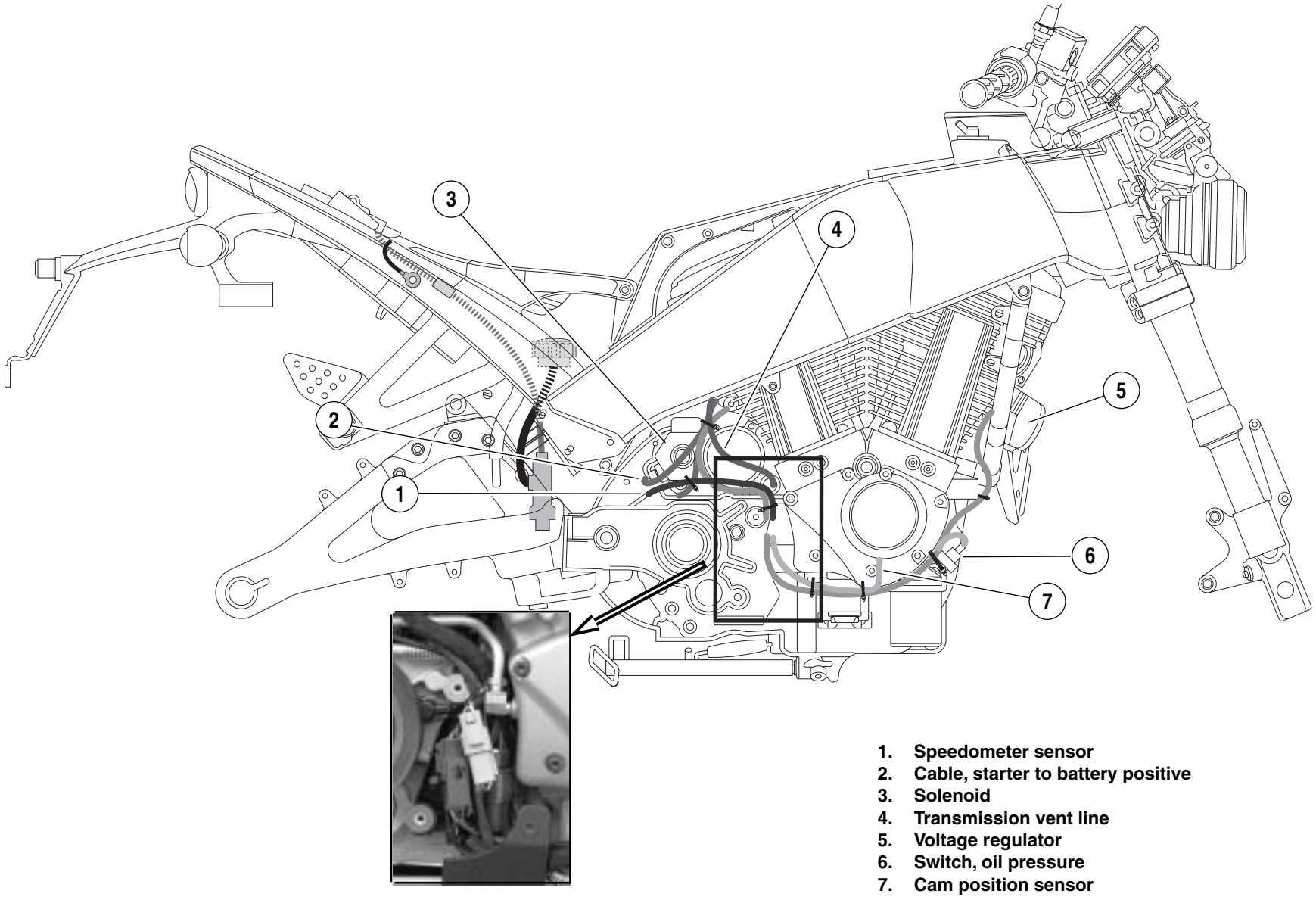
b1120xbsxL



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

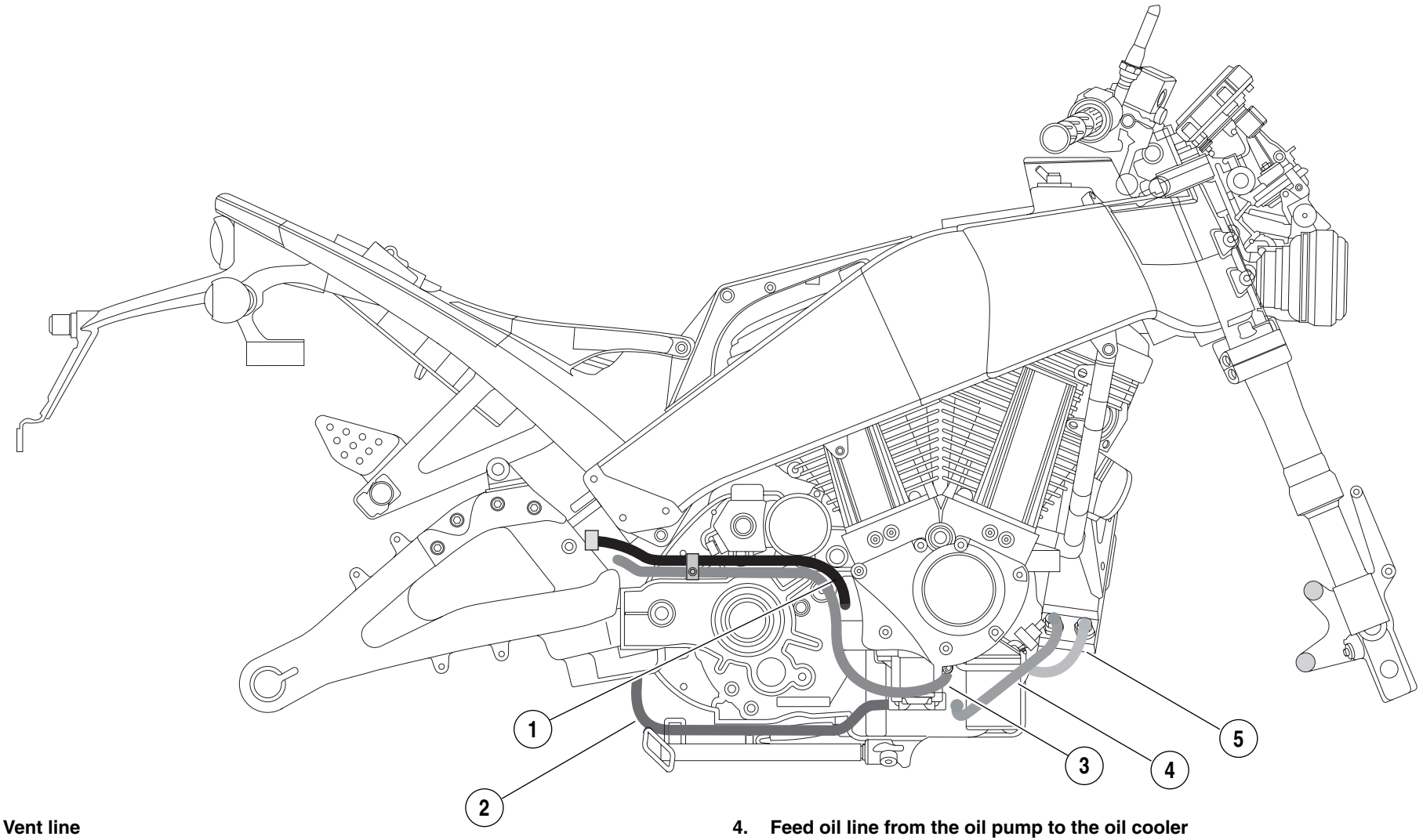
b1121xcsxL



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-8. Wiring Harness, Right Side View

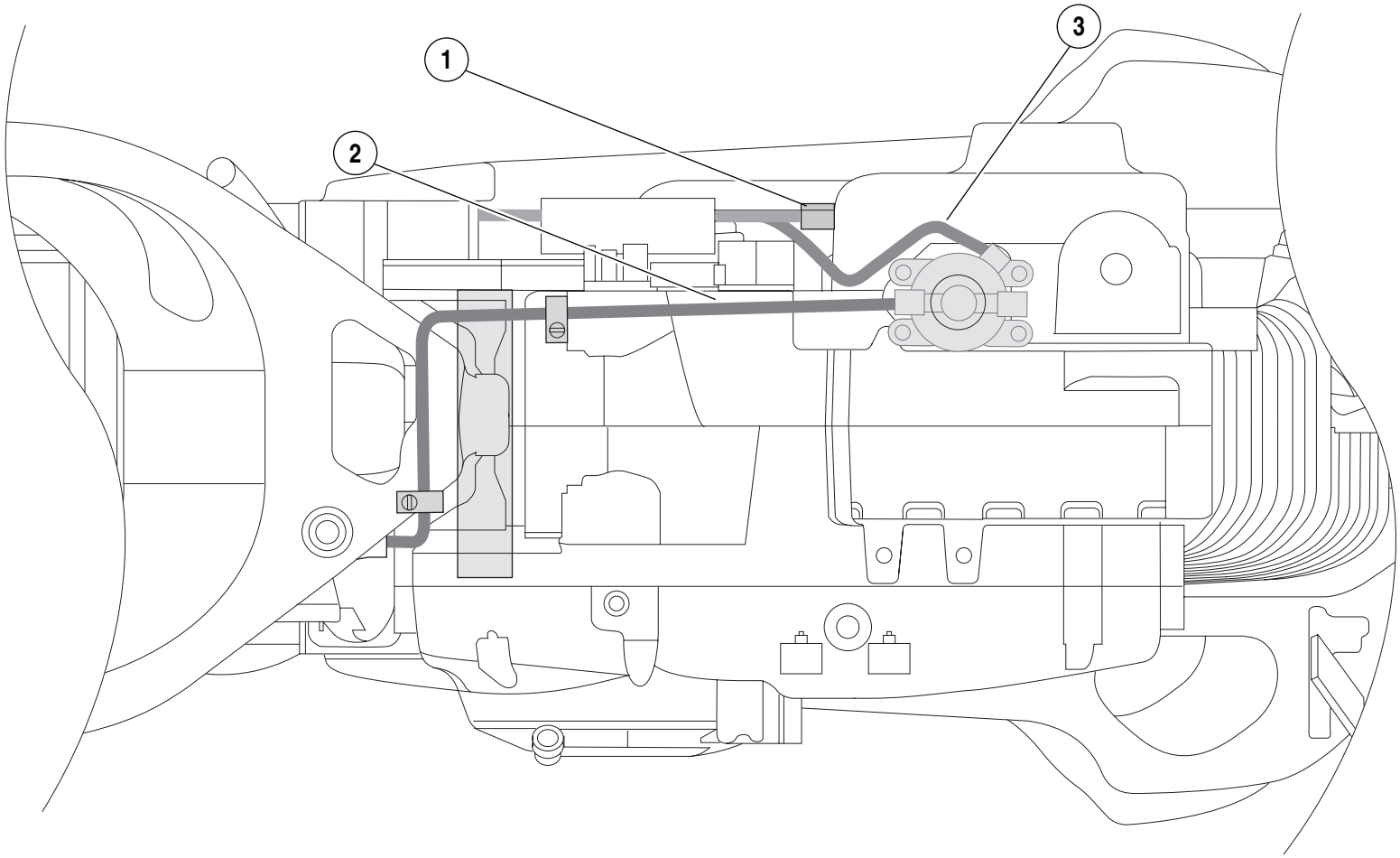
b1122xasxL



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-9. Oil Lines, Right Side View

b1123xbsxL



1. Vent line
2. Feed oil line
3. Return oil line

Figure D-10. Oil Lines, Bottom View

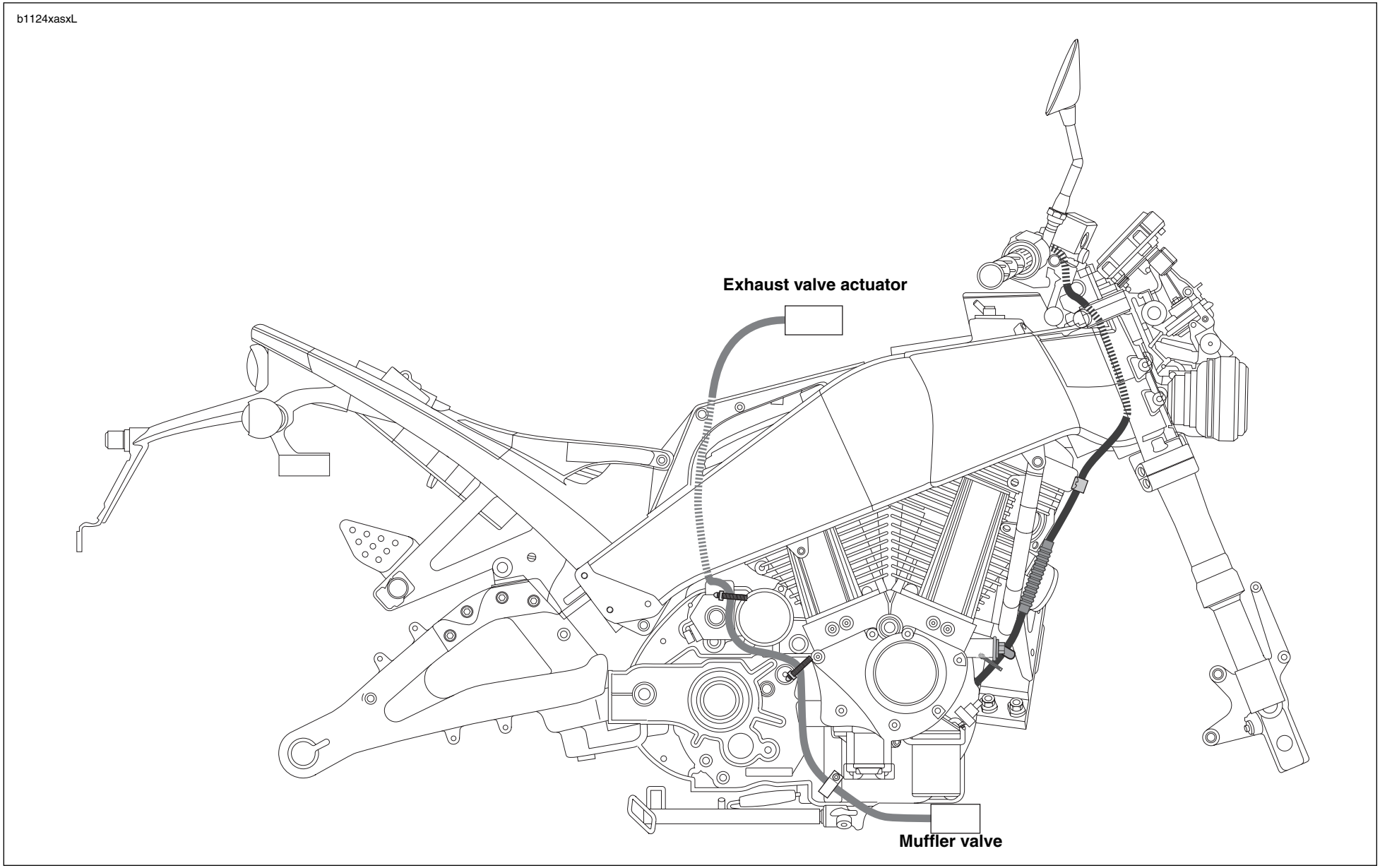


Figure D-11. Clutch Cable and Exhaust Valve Actuator (1200 only), Right Side View

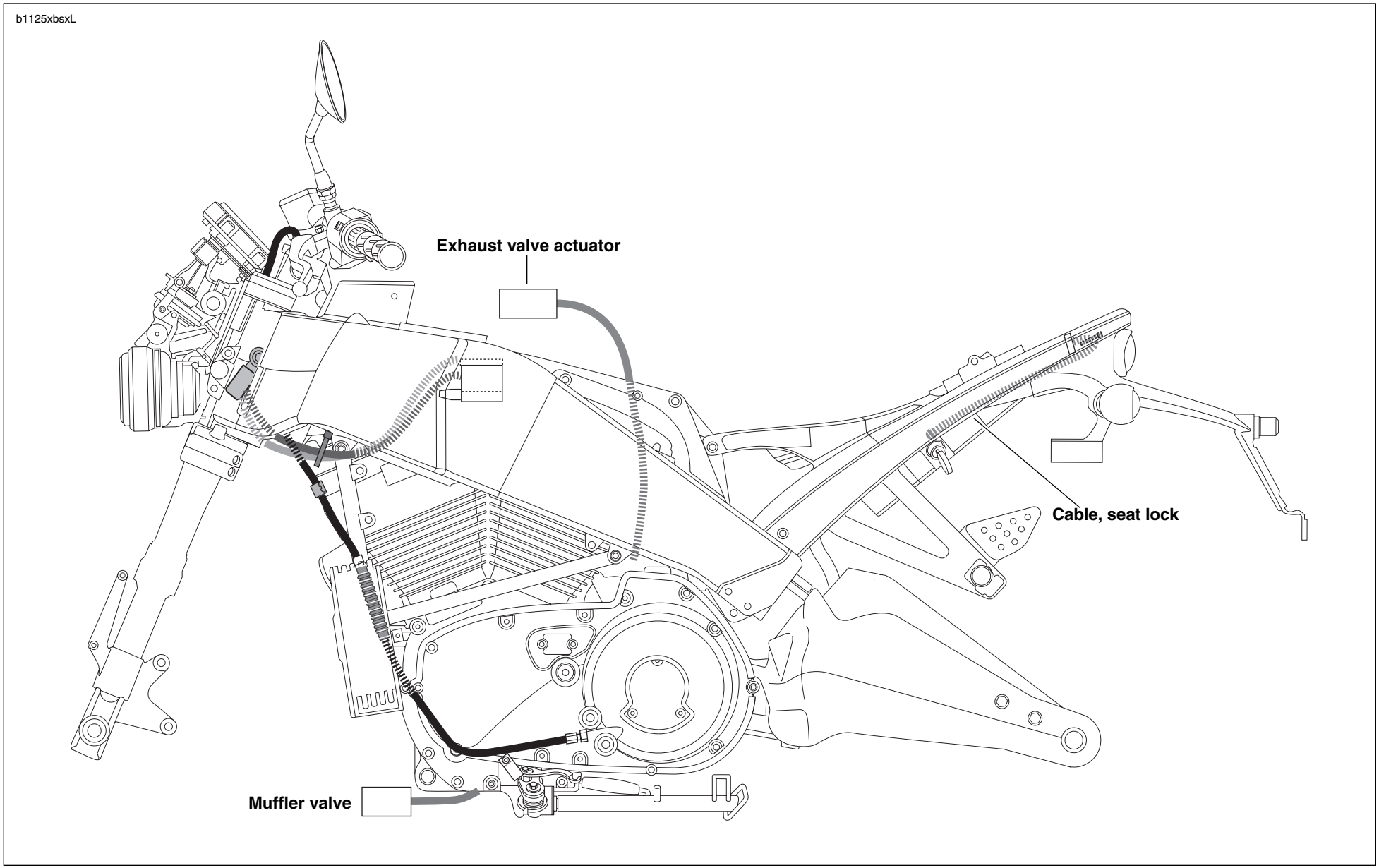


Figure D-12. Clutch, Throttle, Seat Release Cables and Exhaust Valve Actuator (1200 only), Left Side View

b1126xcsxL

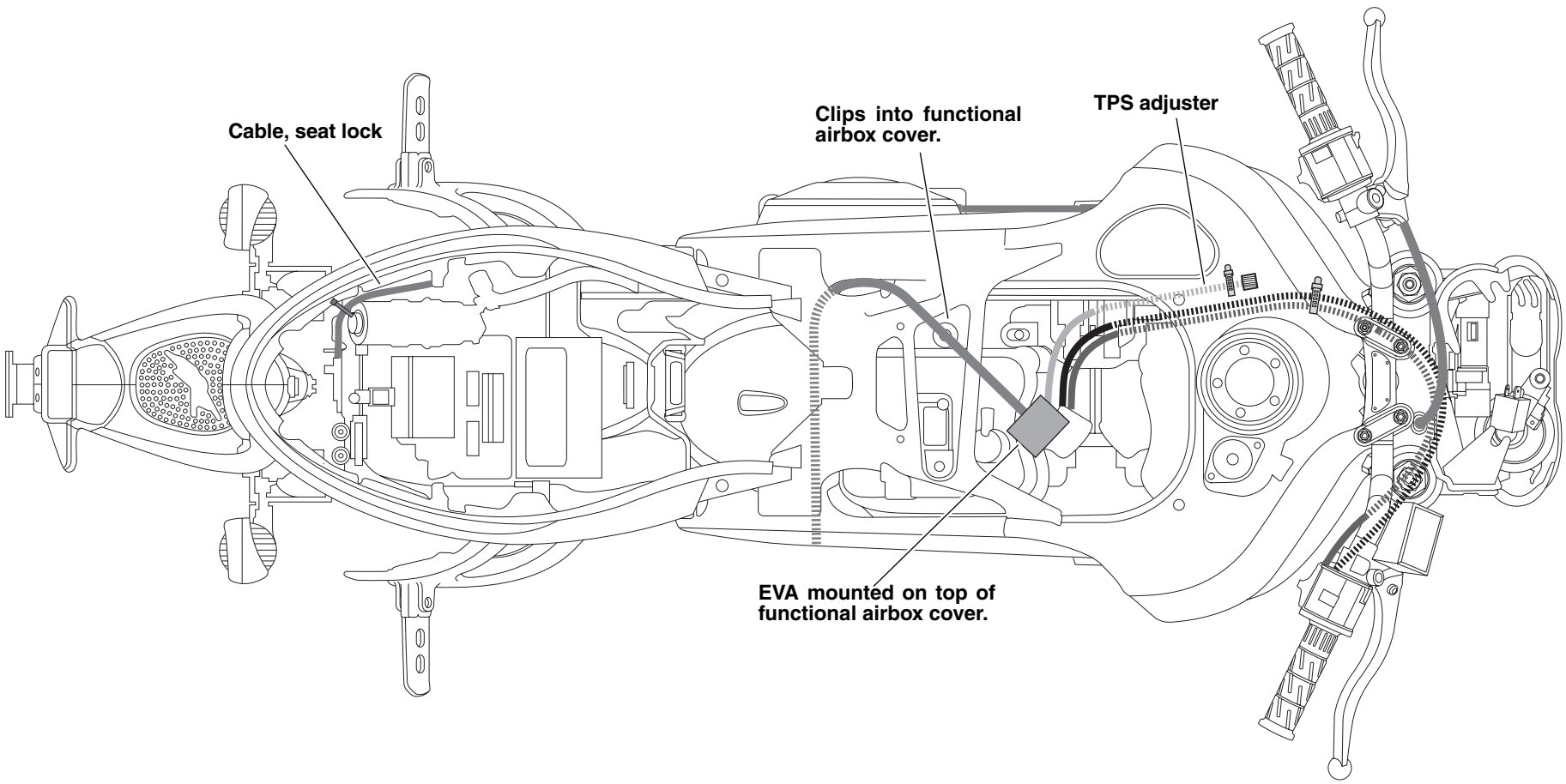


Figure D-13. Clutch, Throttle, Seat Release Cables and Exhaust Valve Actuator, Top View

NOTES

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 activated.

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.

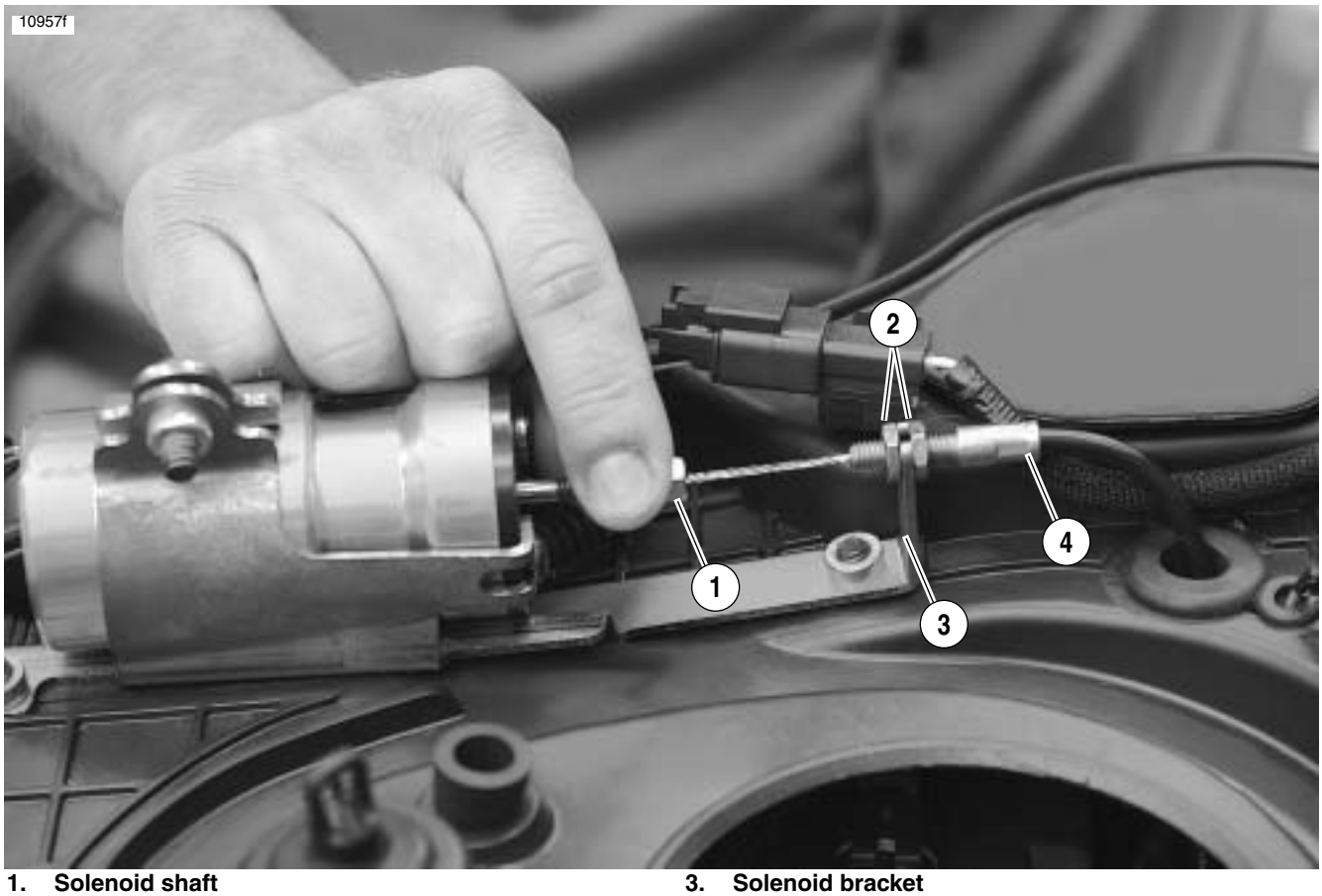
CABLE ADJUSTMENT

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.

NOTE

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

   c. If you have no travel in the shaft, adjust cable housing (4) away from the solenoid bracket (3) until freeplay is achieved.



1. **Solenoid shaft**
2. **Cable adjusting and jam nuts**
3. **Solenoid bracket**
4. **Cable housing**

Figure E-1. Checking for Freeplay in the Solenoid Shaft in the Fully Retracted Position

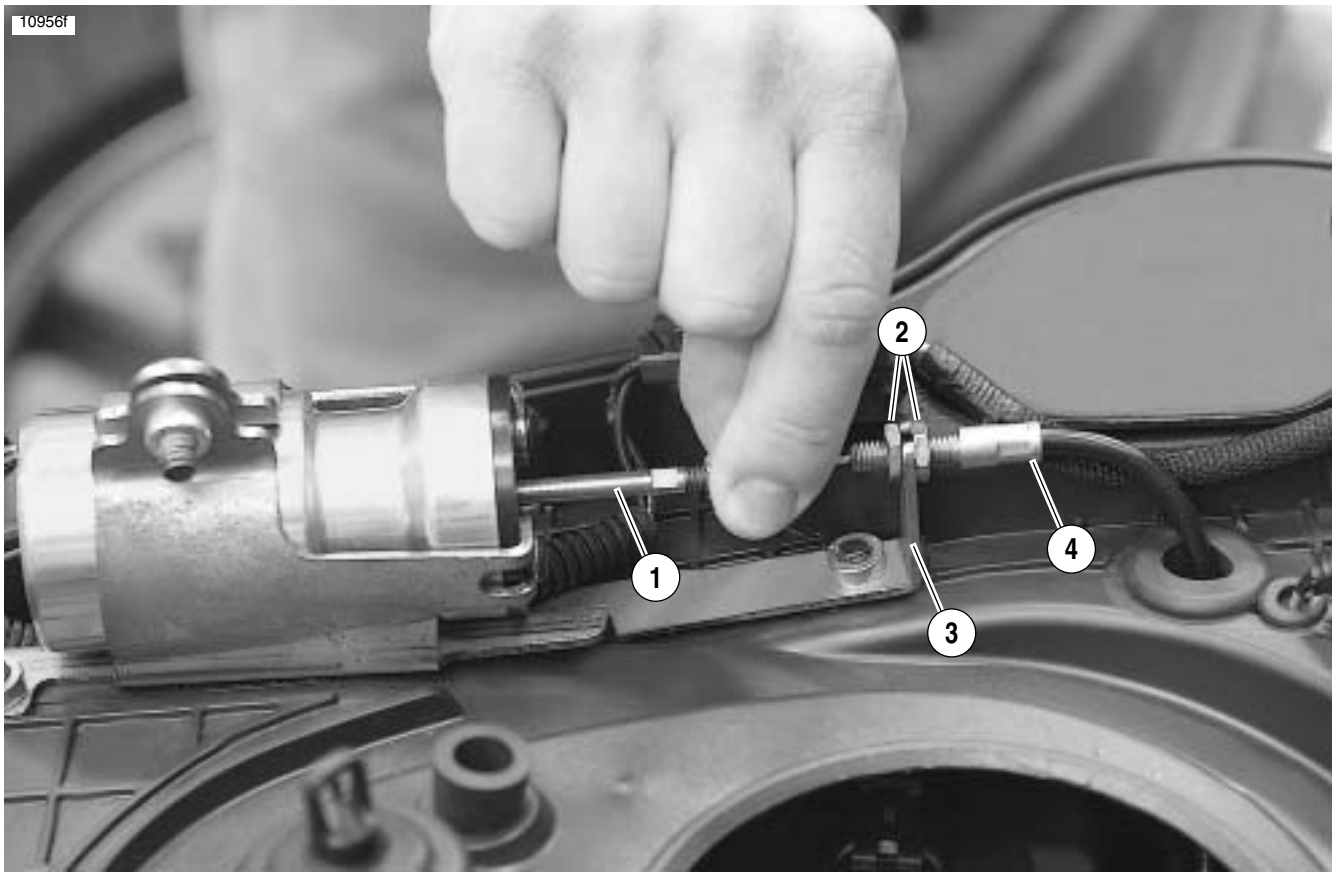
3. See Figure E-2. Inspect for proper extension freeplay in solenoid shaft:
   a. Open the throttle to the WOT position.
   b. Pull solenoid shaft (1) outward to the fully extended position.

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.

   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.
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.



1. **Solenoid shaft**
2. **Cable adjusting and jam nuts**
3. **Solenoid bracket**
4. **Cable housing**

Figure E-2. Checking for Freeplay in the Solenoid Shaft in the Fully Extended Position

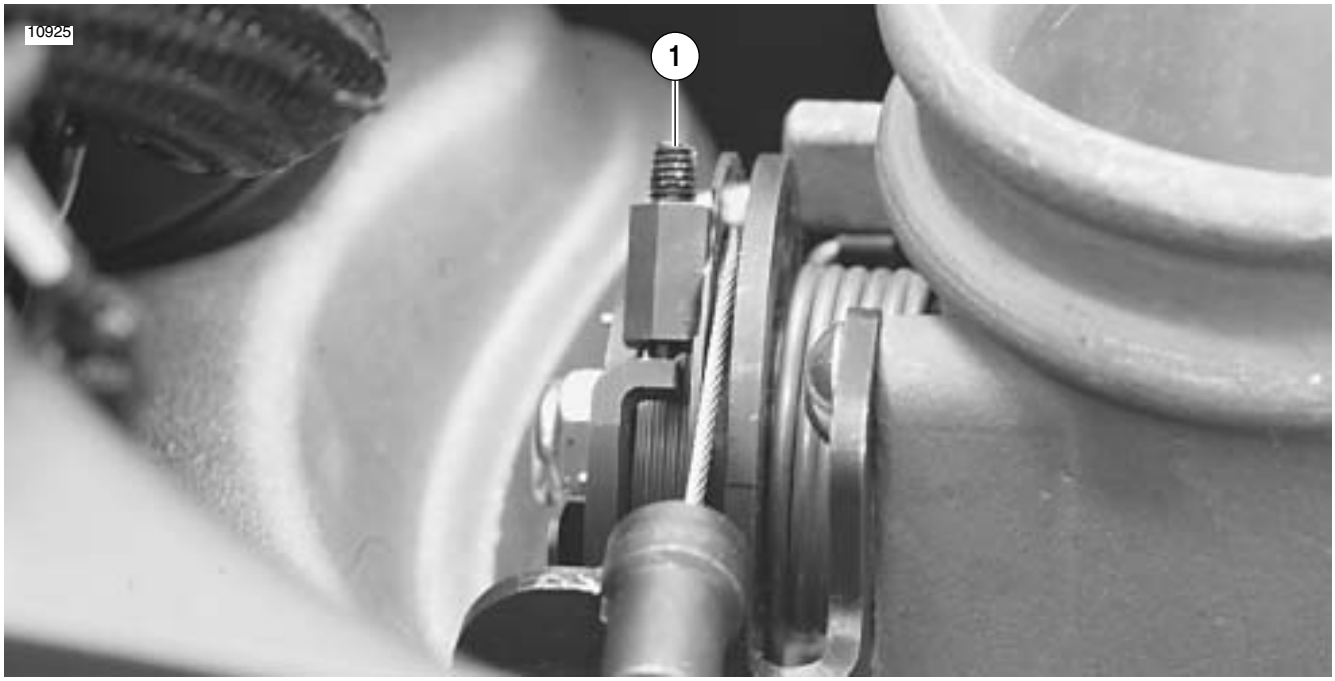
Throttle Stop Screw

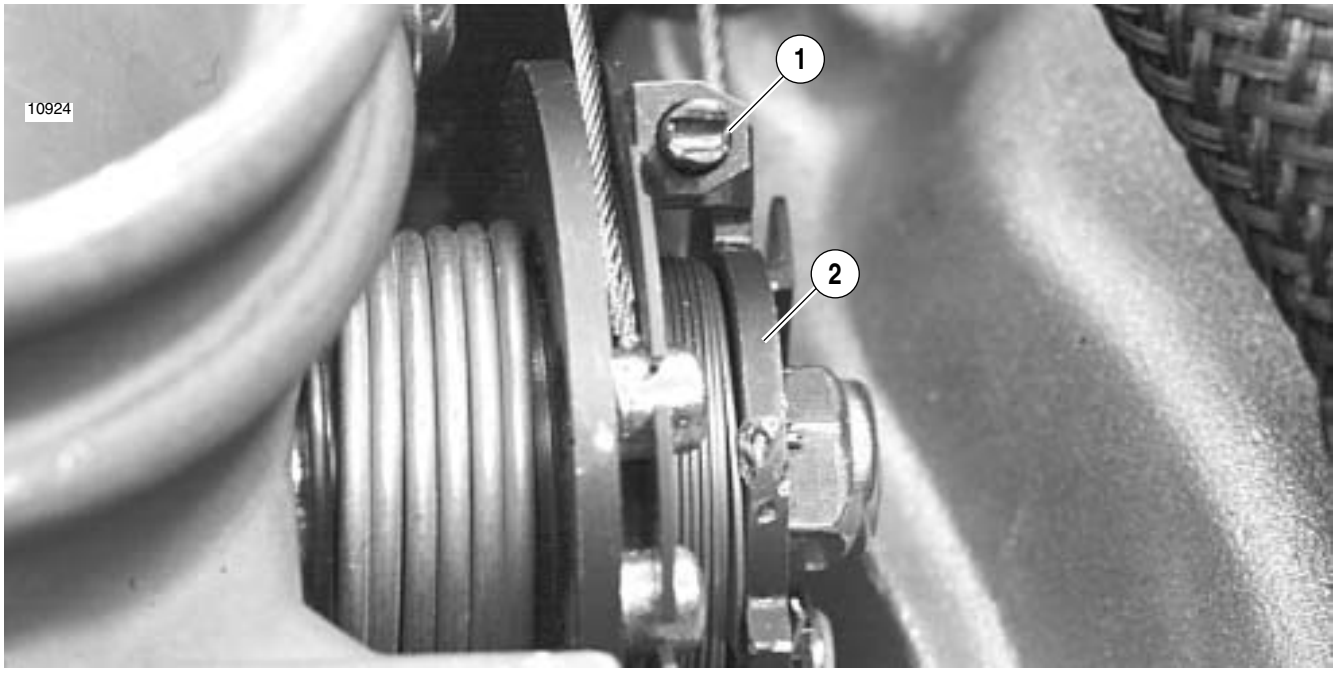
1. Remove cosmetic intake cover assembly and functional air cleaner cover. See 2.37 INTAKE COVER ASSEMBLY and 1.14 AIR CLEANER FILTER.
2. Hold throttle to wide open position and use cable strap to free hands.

NOTE

It is necessary to pull velocity stack out of the way to access set screw.

3. Activate Active Intake System using DIGITAL TECHNICIAN.
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 counter-clockwise.
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.





1. Cable stop screw **2. Active cable wheel**

Figure E-3. Active Intake Cable Stop Screw

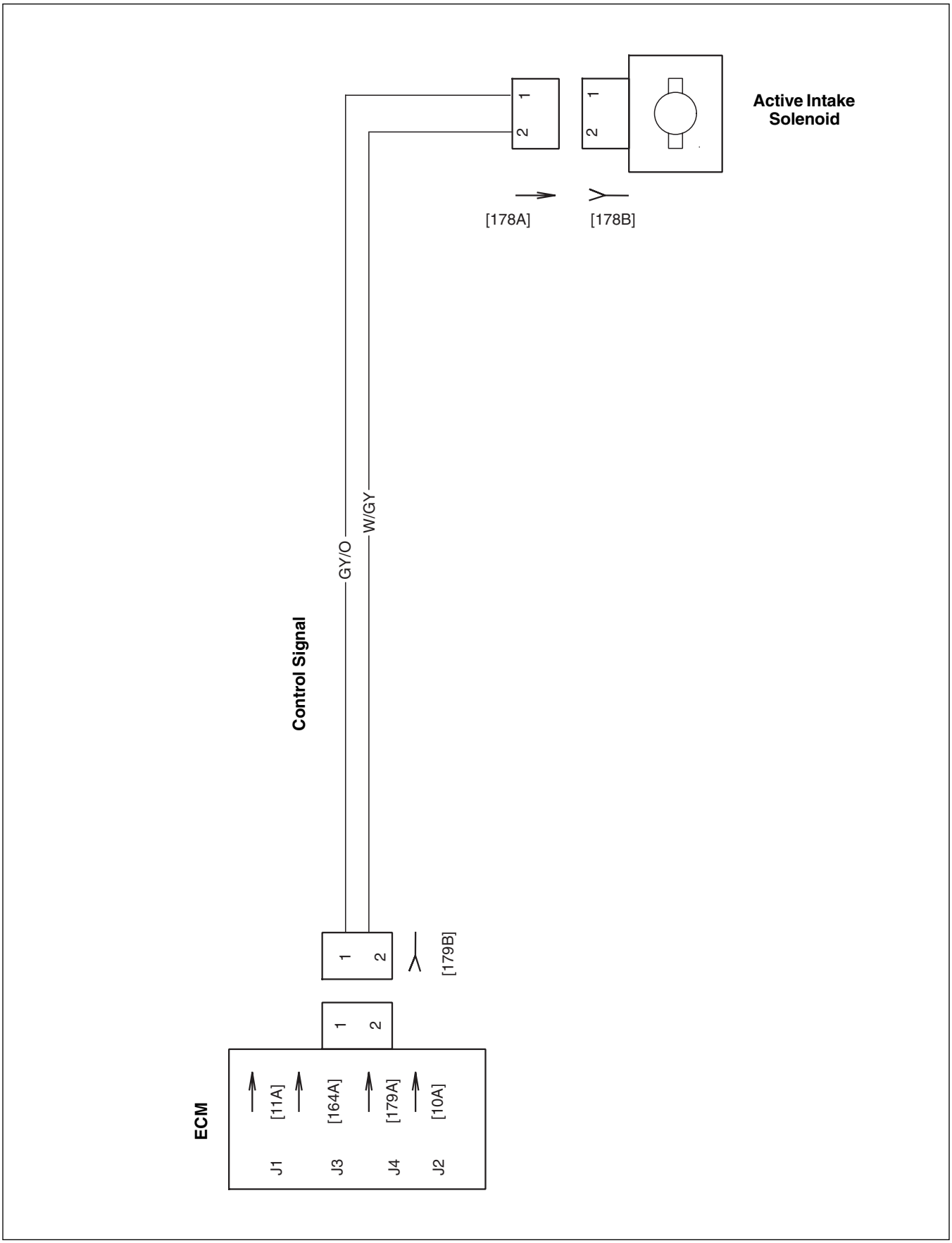
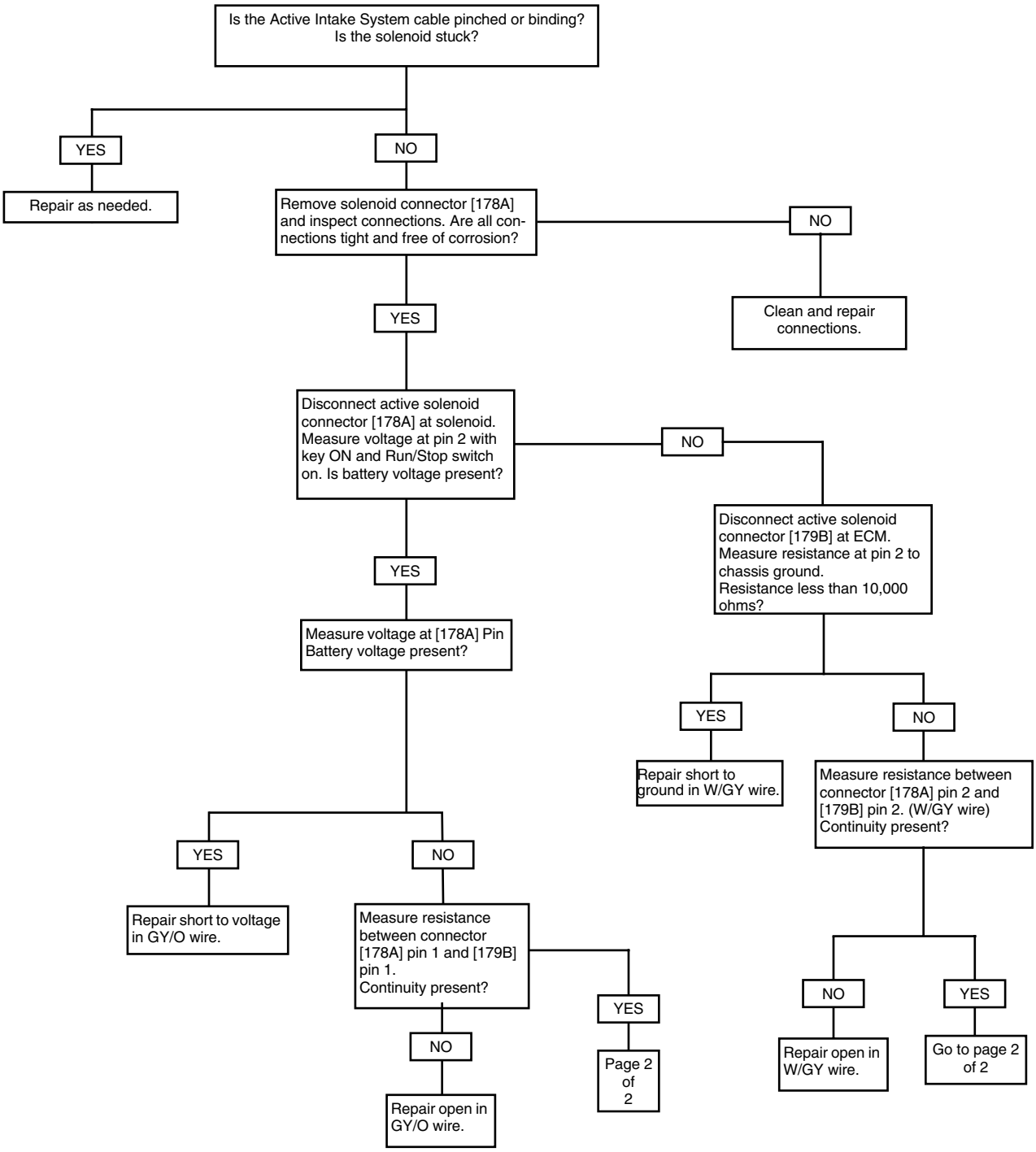


Figure E-4. Active Intake System

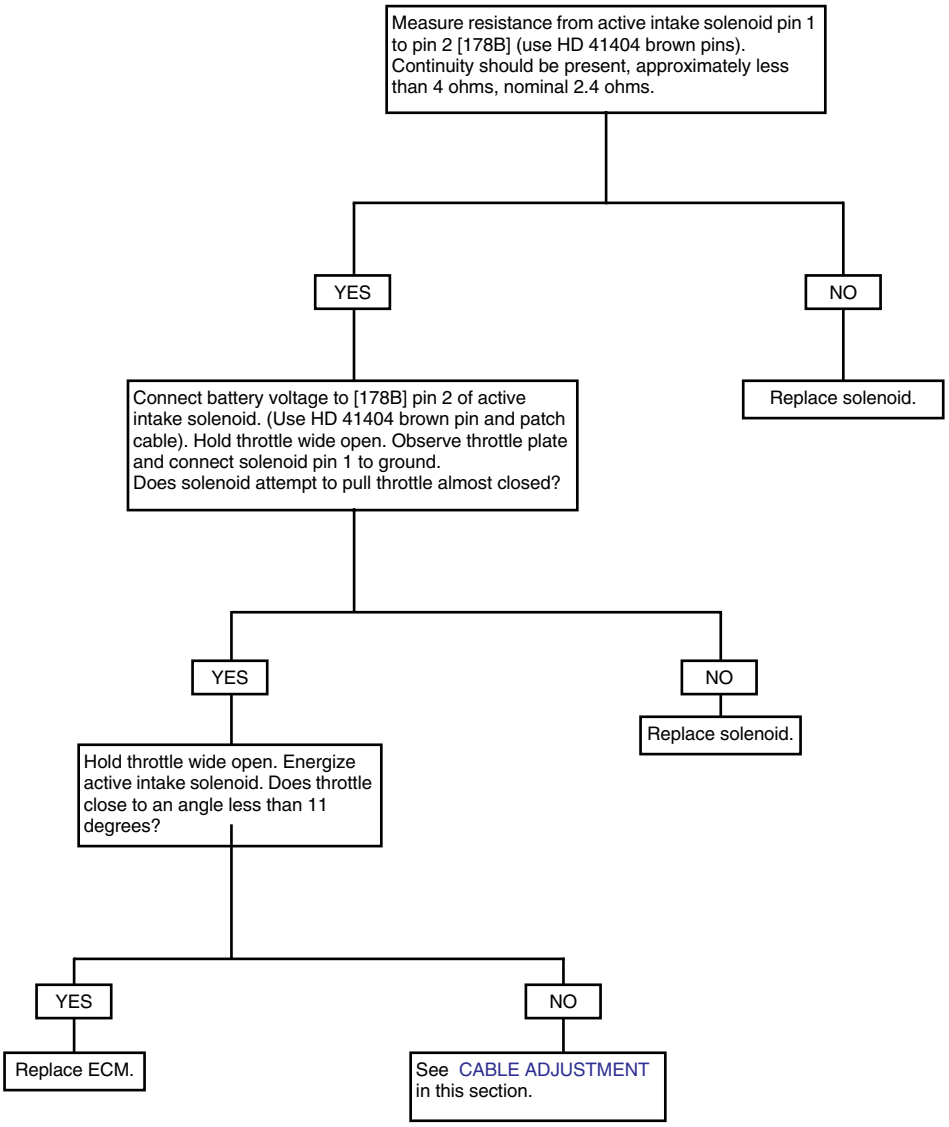
Code 22 Test (Page 1 of 2)



DIAGNOSTIC NOTE

If DTC is historic, wiggle harness while performing measurements in chart to locate intermittents.

Code 22 Test (Page 2 of 2)



REMOVAL

NOTE

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

NOTE

It 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.

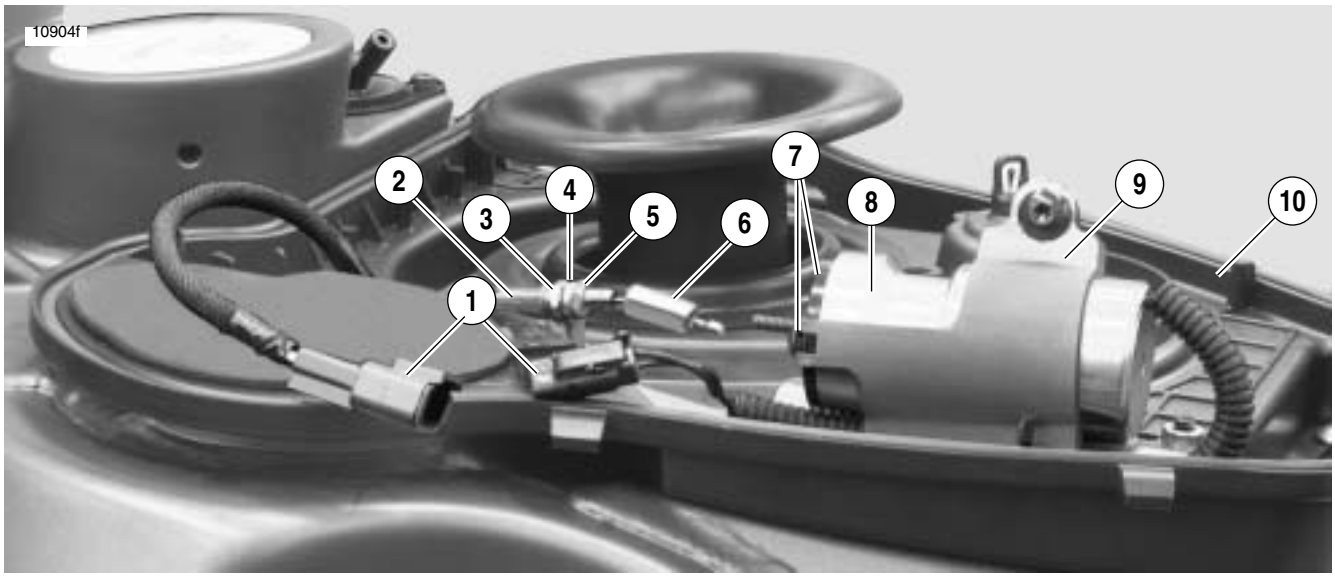
NOTE

When installing the backing plate it is important to ensure that the active cable remains in the tower 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).



1. **Electrical connector [178]**
2. **Active intake cable**
3. **Cable adjusting nut**
4. **Cable bracket**
5. **Active cable jam nut**
6. **Cable connector**
7. **Fasteners (2), bracket to solenoid**
8. **Active intake solenoid**
9. **Solenoid bracket**
10. **Air cleaner baseplate assembly**

Figure E-5. Disconnecting Active Intake System

MAINTENANCE 1

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SERVICING A NEW MOTORCYCLE

⚠WARNING

Perform the service and maintenance operations as indicated in the regular service interval table. Lack of regular maintenance at the recommended intervals can affect the safe operation of your motorcycle, which could result in death or serious injury. (00010a)

Service operations to be performed before customer delivery are specified in the applicable model year PREDELIVERY AND SETUP MANUAL.

The performance of new motorcycle initial service is required to keep warranty in force and to ensure proper emissions systems operation. See 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.

When removing hoses, wiring or tubes, always tag each part to ensure proper installation.

Cleaning

If you intend to reuse parts, follow good shop practice and thoroughly clean the parts before assembly. Keep all dirt out of parts; the unit will perform better and last longer. Seals, filters and covers are used in this vehicle to keep out environmental dirt and dust. These items must be kept in good condition to ensure satisfactory operation.

Clean and inspect all parts as they are removed. Be sure all holes and passages are clean and open. After cleaning, cover all parts with clean lint-free cloth, paper or other material. Be sure the part is clean when it is installed.

Always clean around lines or covers before they are removed. Plug, tape or cap holes and openings to keep out dirt, dust and debris.

Disassembly 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.

CLEANING

Part Protection

Before cleaning, protect rubber parts (such as hoses, boots and electrical insulation) from cleaning solutions. Use a grease-proof barrier material. Remove the rubber part if it cannot be properly protected.

Cleaning Process

Any cleaning method may be used as long as it does not result in parts damage. Thorough cleaning is necessary for proper parts inspection. Strip rusted paint areas to bare metal before repainting.

Rust or Corrosion Removal

Remove rust and corrosion with a wire brush, abrasive cloth, sand blasting, vapor blasting or rust remover. Use buffing crocus cloth on highly polished parts that are rusted.

TOOL SAFETY

Air Tools

- Always use approved eye protection equipment when performing any task using air-operated tools.
- On all power tools, use only recommended accessories with proper capacity ratings.
- Do not exceed air pressure ratings of any power tools.
- Bits should be placed against work surface before air hammers are operated.
- Disconnect the air supply line to an air hammer before attaching a bit.
- Never point an air tool at yourself or another person.
- Protect bystanders with approved eye protection.

Wrenches

- Never use an extension on a wrench handle.
- If possible, always pull on a wrench handle and adjust your stance to prevent a fall if something lets go.
- Never cock a wrench.
- Never use a hammer on any wrench other than a STRIKING FACE wrench.
- Discard any wrench with broken or battered points.
- Never use a pipe wrench to bend, raise or lift a pipe.

Pliers/Cutters/Prybars

- Plastic- or vinyl-covered pliers handles are not intended to act as insulation; don't use on live electrical circuits.
- Don't use pliers or cutters for cutting hardened wire unless they were designed for that purpose.
- Always cut at right angles.
- Don't use any prybar as a chisel, punch or hammer.

Hammers

- Never strike one hammer against a hardened object, such as another hammer.
- Always grasp a hammer handle firmly, close to the end.
- Strike the object with the full face of the hammer.
- Never work with a hammer which has a loose head.
- Discard hammer if face is chipped or mushroomed.
- Wear approved eye protection when using striking tools.
- Protect bystanders with approved eye protection.

Punches/Chisels

- Never use a punch or chisel with a chipped or mushroomed end; dress mushroomed chisels and punches with a file.
- Hold a chisel or a punch with a tool holder if possible.
- When using a chisel on a small piece, clamp the piece firmly in a vise and chip toward the stationary jaw.
- Wear approved eye protection when using these tools.
- Protect bystanders with approved eye protection.

Screwdrivers

- Don't use a screwdriver for prying, punching, chiseling, scoring or scraping.
- Use the right type of screwdriver for the job; match the tip to the fastener.
- Don't interchange POZIDRIV®, PHILLIPS® or REED AND PRINCE screwdrivers.
- Screwdriver handles are not intended to act as insulation; don't use on live electrical circuits.
- Don't use a screwdriver with rounded edges because it will slip – redress with a file.

Ratchets and Handles

- Periodically clean and lubricate ratchet mechanisms with a light grade oil. Do not replace parts individually; ratchets should be rebuilt with the entire contents of service kit.
- Never hammer or put a pipe extension on a ratchet or handle for added leverage.
- Always support the ratchet head when using socket extensions, but do not put your hand on the head or you may interfere with the action of its reversing mechanism.
- When breaking loose a fastener, apply a small amount of pressure as a test to be sure the ratchet's gear wheel is engaged with the pawl.

Sockets

- Never use hand sockets on power or impact wrenches.
- Select the right size socket for the job.
- Never cock any wrench or socket.
- Select only impact sockets for use with air or electric impact wrenches.
- Replace sockets showing cracks or wear.
- Keep sockets clean.
- Always use approved eye protection when using power or impact sockets.

Storage Units

- Don’t open more than one loaded drawer at a time. Close each drawer before opening up another.
- Close lids and lock drawers and doors before moving storage units.
- Don’t pull on a tool cabinet; push it in front of you.
- Set the brakes on the locking casters after the cabinet has been rolled to your work.

FUEL

⚠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 octane 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 octane 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, CH-4 and CI4. The preferred viscosities for the diesel engine oils, in descending order, are 20W-50, 15W-40 and 10W-40. 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.

MAINTENANCE SCHEDULE 1.3

Table 1-1. Regular Service Intervals For Buell Lightning Models

ITEM SERVICED	PROCEDURE	1000 mi 1600 km	5000 mi 8000 km	10,000 mi 16,000 km	15,000 mi 24,000 km	20,000 mi 32,000 km	25,000 mi 40,000 km	NOTES
Engine oil and filter	Replace	X	X	X	X	X	X	
Oil lines and brake system	Inspect for leaks	X	X	X	X	X	X	1
Air cleaner	Inspect, service as required	X	X	X	X		X	
	Replace					X		
Tires	Check pressure, inspect tread	X	X	X	X	X	X	
Transmission lubricant	Replace	X		X		X		
Clutch	Check adjustment	X	X	X	X	X	X	1
Primary chain	Check adjustment	X	X	X	X	X	X	1
Rear belt, idler and sprockets	Inspect	X	X	X	X	X	X	1
Throttle, brake, and clutch controls, jiffy stand, active muffler cable and active intake cable adj. (if equipped)	Check, adjust and lubricate	X	X	X	X	X	X	1
Brake fluid	Check levels and condition	X	X	X	X	X	X	1,2
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	
Brake calipers and master cylinders	Inspect for leaks			X	X	X	X	1, 3
Spark plugs	Replace			X		X		1
Electrical equipment and switches	Check operation	X	X	X	X	X	X	
Engine idle speed	Check adjustment	X	X	X	X	X	X	1
Ignition timing	Check			X		X		1
Throttle position sensor (TPS)	Zero	X		X		X		1
Front fork oil	Replace			X		X		1
Steering head bearings	Perform resistance test		X	X	X	X	X	1
Oil cooler fins	Clean	X	X	X	X	X	X	
Brake systems, oil lines, front forks, rear shock, exhaust system, exhaust system mounting, evaporative emission system (if applicable)	Inspect	X	X	X	X	X	X	1
Critical fasteners	Check tightness			X		X		1
Engine mounts and stabilizer links	Inspect			X		X		1
Road test	Verify component and system functions	X	X	X	X	X	X	

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

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque	Apply Loctite 565 Thread Sealant and reinstall plug and tighten to 29-34 ft-lbs (40-46 Nm)
	Oil capacity	2.5 quarts (2.4 liters) and includes the 4.0 ounces (0.12 liter) poured into the filter
	Filter	Hand tighten 1/2-3/4 turn after gasket contact
	Black filter part number	63806-00Y
Primary chain tension	Deflection with hot engine	1/4-3/8 in. (6.4-9.5 mm)
	Deflection with cold engine	3/8-1/2 in. (9.5-12.7 mm)
	Chain tensioner nut torque	20-25 ft-lbs (27-34 Nm)
	Primary chain inspection cover torque	84-108 **in-lbs** (10-12 Nm)
Primary chain lubricant	Lubricant capacity	FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) as required until fluid level is even with bottom of clutch diaphragm spring
	Primary chaincase drain plug torque	Apply Loctite 565 Thread Sealant and reinstall plug and tighten to 14-30 ft-lbs (19-40.7 Nm)
Clutch adjustment	Free play at adjuster screw	clockwise 1/4-1/2 turn
	Free play at hand lever	1/16-1/8 in. (1.6-3.2 mm)
	Clutch inspection cover torque	84-108 **in-lbs** (10-12 Nm)
Transmission lubricant	Lubricant level	FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05) as required until fluid level is even with bottom of clutch diaphragm spring
Tire condition and pressure	Pressure for solo rider (All models except XB9SX)	Front: 36 psi (248 kPa) Rear: 38 psi (262 kPa)
	Pressure for solo rider (XB9SX)	Front: 34 psi (234 kPa) Rear: 36 psi (248 kPa)
	Pressure for rider and passenger	Same as Solo
	Wear	Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains
Brake fluid reservoir level	D.O.T. 4 hydraulic brake fluid part nos.	99953-99A (12 oz.) 99973-05 (gal.).
	Proper fluid level	1/8 in. (3.2 mm) from the top
	Master cylinder reservoir cover torque	9-13 **in-lbs** (1.0-1.5 Nm)
Brake pad linings and discs	Minimum brake pad thickness	0.040 in. (1.0 mm) or less
	Minimum brake disc thickness	0.18 in. (4.5 mm) or less
Drive belt	Replace drive belt and idler pulley assembly:	At every 25,000 mi (40,000 km) service interval.
Air cleaner	Air cleaner cover screw torque	12-36 **in-lbs** (4-4 Nm)

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Clutch and throttle cables	Lubricant	LUBIT-8 TUFOIL® CHAIN AND CABLE LUBE (Part No. HD-94968-85TV)
	Handlebar clamp screw torque	60-84 **in-lbs** (6.8-9.5 Nm)
	Handlebar switch housing screw torque	25-33 **in-lbs** (3-4 Nm)
Spark plugs	Type	10R12A
	Gap	0.035 in. (0.9 mm)
	Torque	12-18 ft-lbs (16-24 Nm)
Engine idle speed	Idle speed	1050-1150 RPM
Front fork oil	Type: All models except XB12Scg	HYDRAULIC FORK OIL (TYPE E) Part No. 99884-80 4.21 in. (107 mm) from the top of the fork tube
Battery	Lubricant	ELECTRICAL CONTACT LUBRICANT Part No. 99861-02 (1 oz.)
	Battery terminal torque	72-96 **in-lbs** (8-11 Nm)

BATTERY MAINTENANCE 1.4

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)

Table 1-3. Battery Electrolyte Antidotes

CONTACT	SOLUTION
External	Flush with water.
Internal	Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Call doctor immediately.
Eyes	Flush with water, get immediate medical attention.

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.

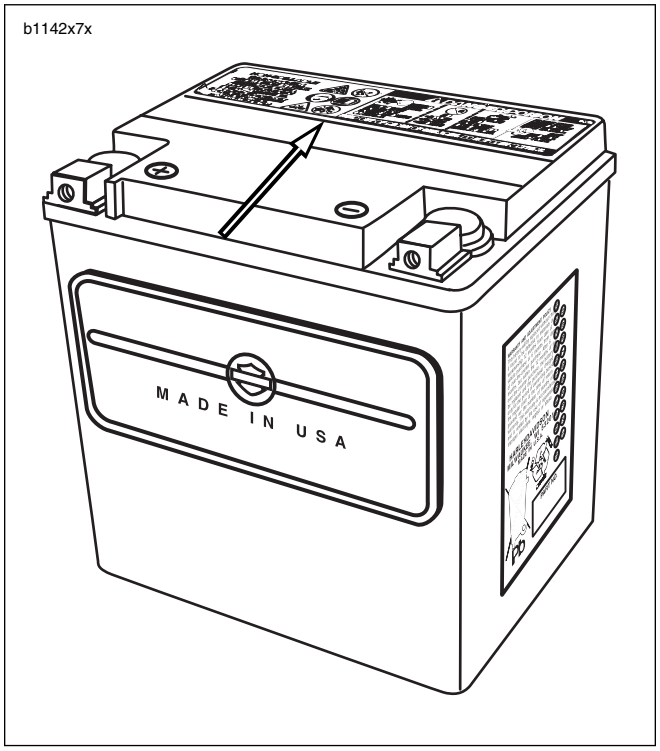


Figure 1-1. Battery Warning Label

Table 1-4. Voltmeter Test For Battery Charge

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

BATTERY 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 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.

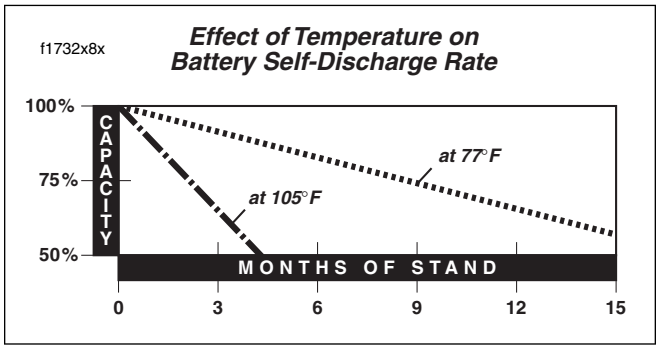


Figure 1-2. Battery Self-Discharge Rate

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 over-tighten 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. (00184a)

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.

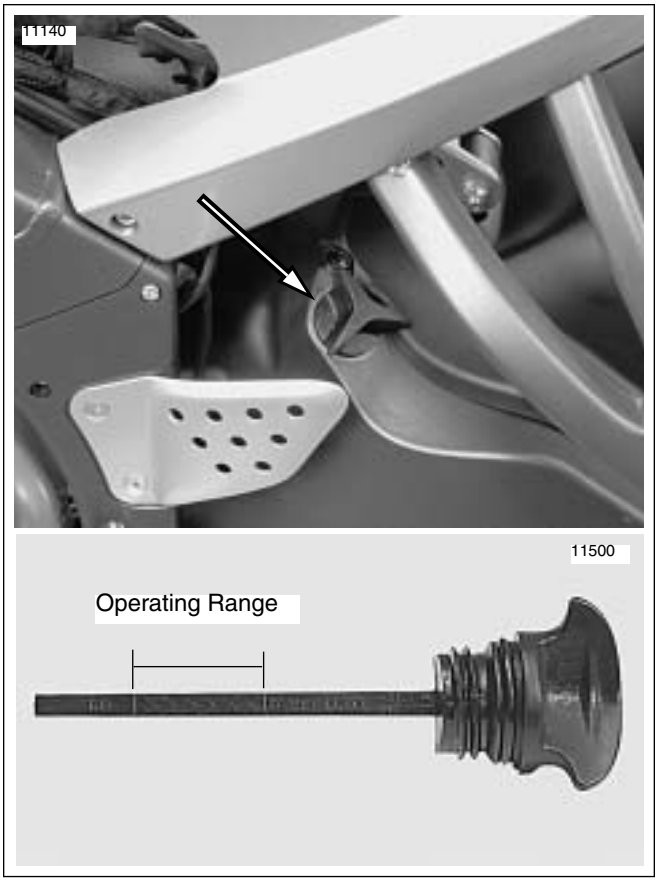


Figure 1-3. Dipstick Location/Engine Oil Level

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.

CHANGING ENGINE OIL AND FILTER

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.



Figure 1-4. Oil Tank 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.

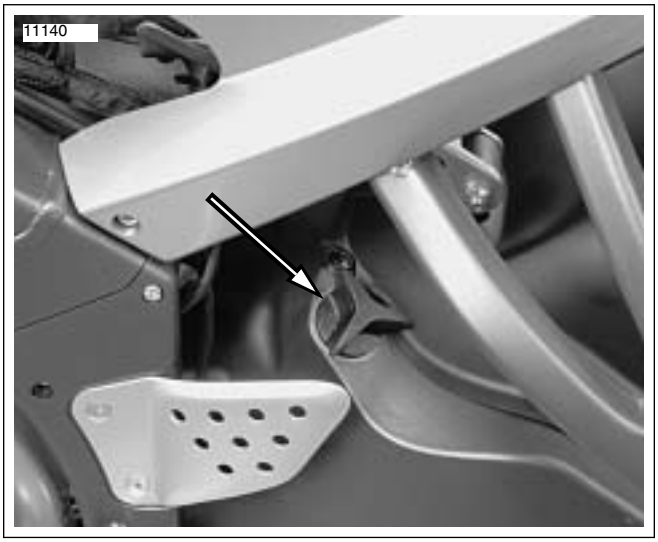


Figure 1-5. Dipstick Location

3. See Figure 1-5. Unscrew and remove dipstick from oil fill hole on top of oil tank/swingarm.

Changing Filter

1. Remove chin fairing See 2.36 CHIN FAIRING.

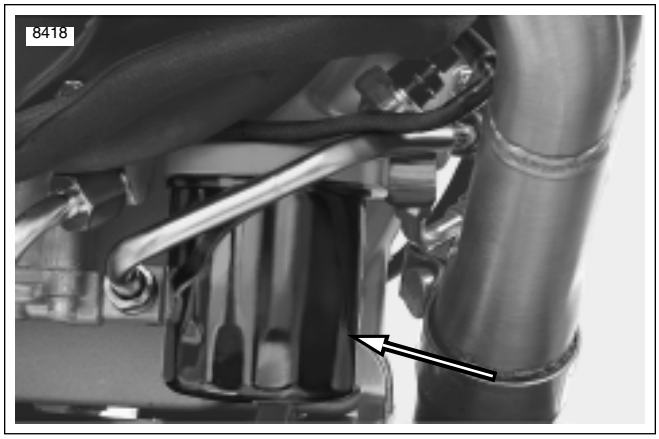


Figure 1-6. Oil Filter

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).
6. Screw filter onto adapter until filter gasket touches crankcase surface. Rotate filter another 1/2-3/4 turn by hand.

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

NOTE

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

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

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

BRAKE SYSTEM MAINTENANCE 1.6

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.

⚠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 1-6. Brake Troubleshooting

CONDITION	CHECK FOR	REMEDY
Excessive lever/pedal travel or spongy feel.	Air in system. Master cylinder low on fluid.	Bleed brake(s). Fill master cylinder with approved brake fluid.
Brake fade.	Moisture in system.	Bleed brake(s). Replace fluid in master cylinder with approved brake fluid.
Chattering sound when brake is applied.	Worn pads. Worn D shape bushings. Loose mounting bolts. Warped rotor.	Replace brake pads. Replace rotor and bushings as set. Tighten bolts. Replace rotor and bushings as set.
Ineffective brake – lever/pedal travels to limit.	Low fluid level. Piston cup not functioning.	Fill master cylinder with approved brake fluid, and bleed system. Rebuild cylinder.
Ineffective brake – lever/pedal travel normal.	Distorted or glazed rotor. Distorted, glazed or contaminated brake pads.	Replace rotor and bushings as set. Replace pads.
Brake pads drag on rotor – will not retract.	Cup in master cylinder not uncovering relief port. Rear brake pedal linkage out of adjustment.	Inspect master cylinder. Adjust linkage.

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.

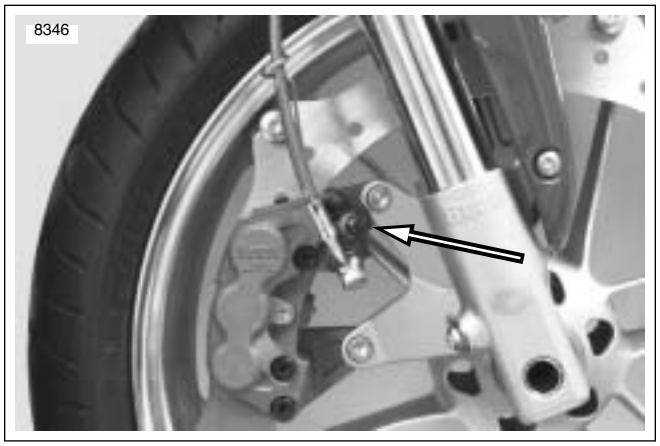


Figure 1-7. Front Caliper Bleeder Valve

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.



Figure 1-8. Front Master Cylinder Reservoir

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.

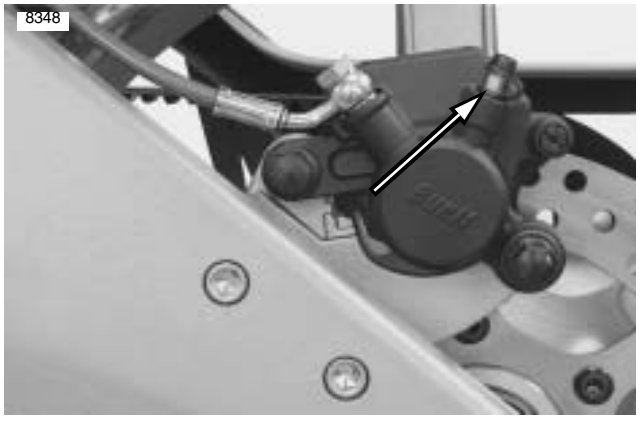


Figure 1-9. Rear Caliper Bleeder Valve

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)

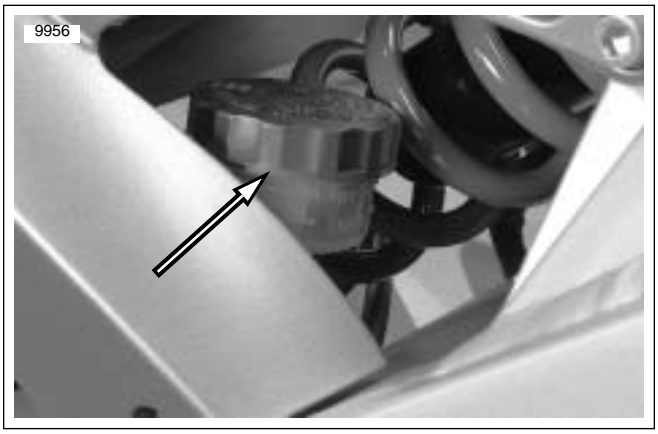


Figure 1-10. Rear Master Cylinder Reservoir

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.*

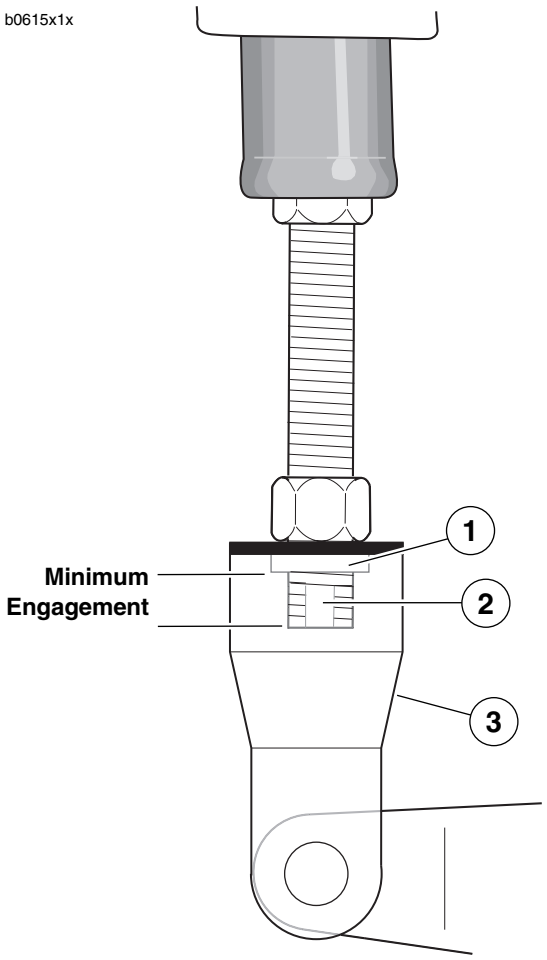
⚠WARNING

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).

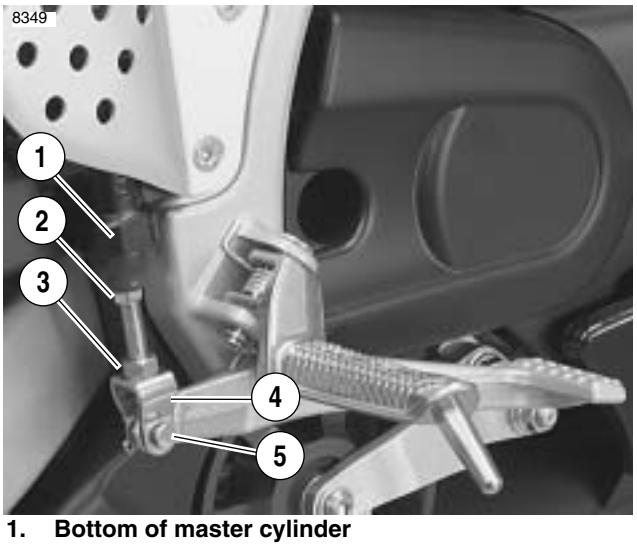
NOTE

Brake pedal has no free play adjustment.



1. **Extruded nut**
2. **Flat sides (on the end of the threaded brake rod)**
3. **Clevis**

Figure 1-11. Critical Measurements with Typical Brake Pedal



1. **Bottom of master cylinder**
2. **Rod adjuster**
3. **Locknut**
4. **Clevis**
5. **Clevis pin**

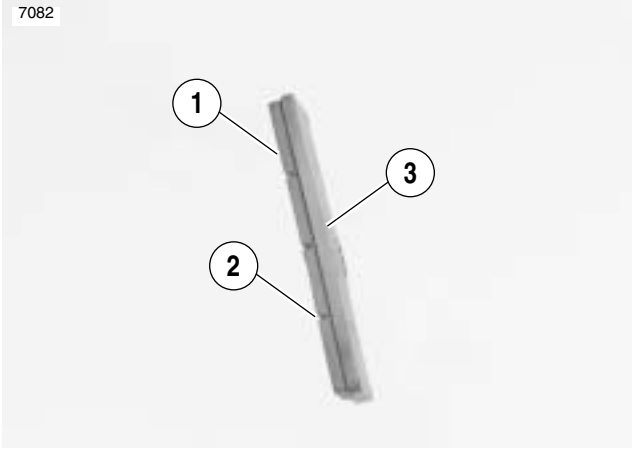
Figure 1-12. Rear Brake Pedal Pushrod Adjustment

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.



1. **Friction material**
2. **Wear groove**
3. **Backing material**

Figure 1-13. Brake Pad Thickness

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:

- At every scheduled service interval:

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.

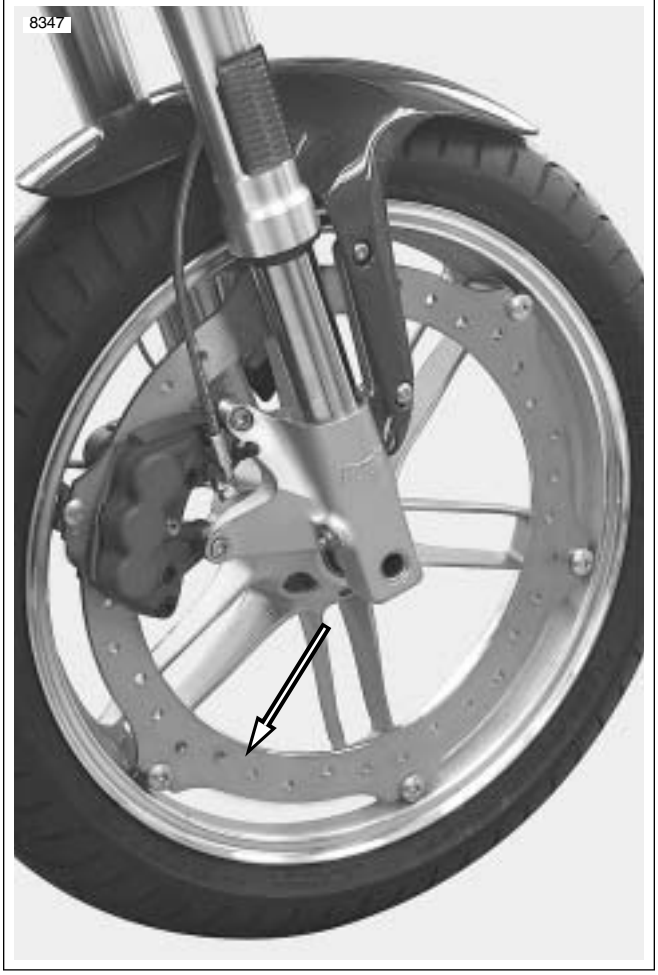
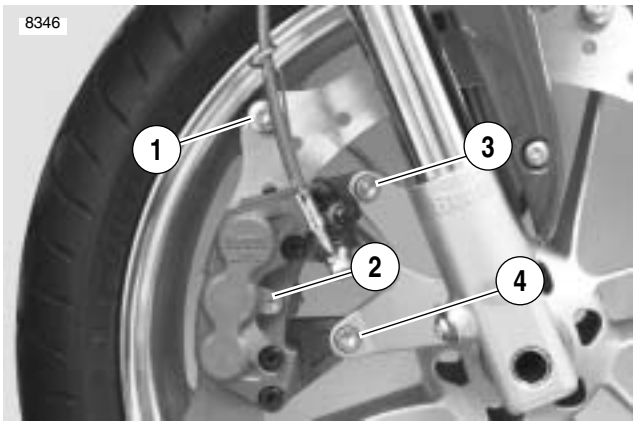


Figure 1-14. Front Brake Rotor

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.



1. **Rotor mounting fastener (6)**
2. **Front caliper pin hanger**
3. **Upper caliper mounting fastener**
4. **Lower caliper mounting fastener**

Figure 1-15. Front Brake Caliper

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.

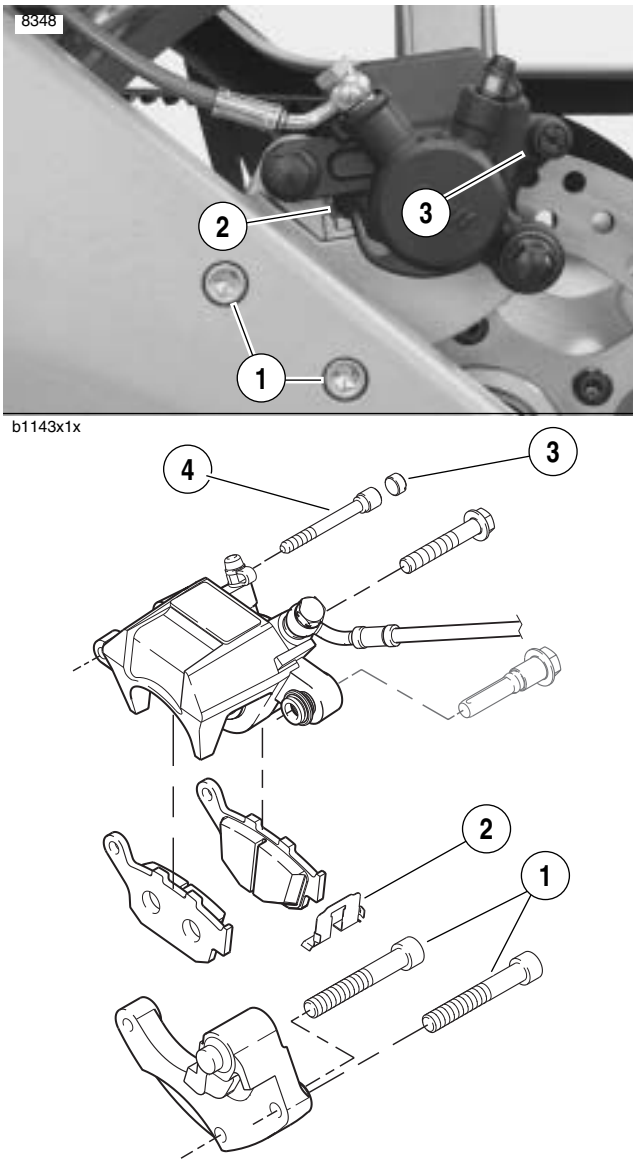
NOTE

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.*



1. **Rear caliper mounting fasteners**
2. **Retainer**
3. **Rear caliper pin plug**
4. **Rear caliper hanger pin**

Figure 1-16. Rear Brake Caliper

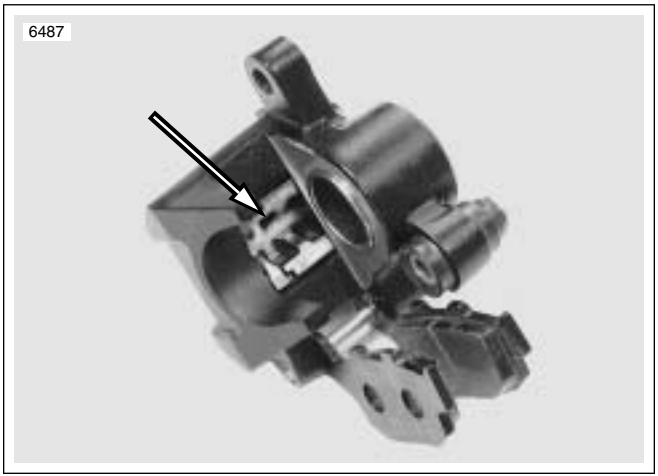


Figure 1-17. Rear Brake Pad Spring

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

TIRE		PRESSURE FOR SOLO RIDING		PRESSURE AT GVWR
Dunlop	Front	**36** PSI	**248** kPa	Same as solo riding
	Rear	**38** PSI	**262** kPa	
Pirelli	Front	**34** PSI	**234** kPa	Same as solo riding
	Rear	**36** PSI	**248** kPa	

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, snags or deep cuts.
3. A bump, bulge or split in the tire.
4. Puncture, cut or other damage to the tire that cannot be repaired.

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.

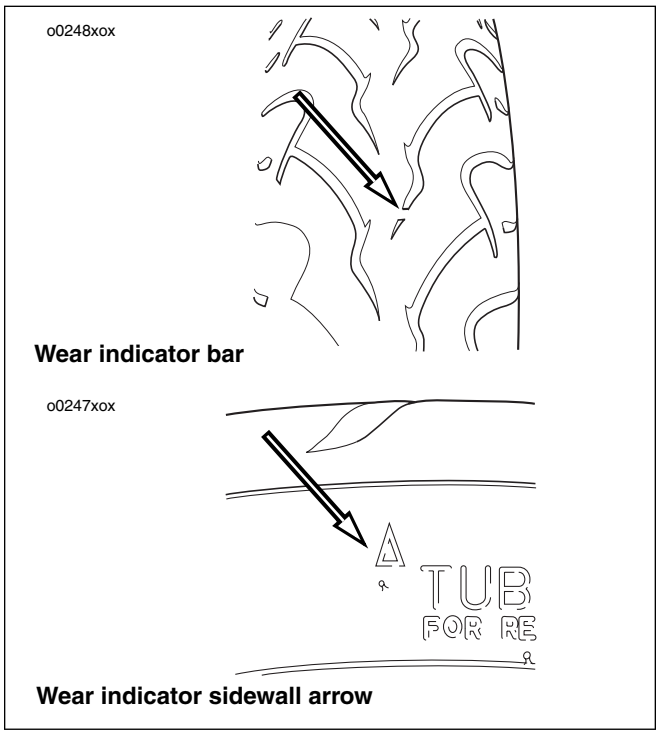


Figure 1-18. Tire Wear Indicator–Dunlop Only

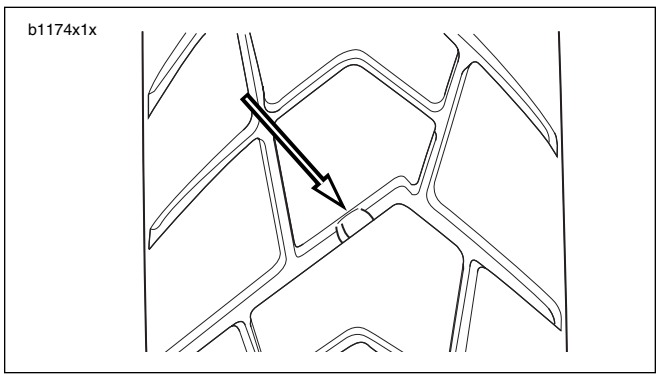


Figure 1-19. Tire Tread Pattern and Wear Bar Pirelli Scorpion Sync

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. (00198a)

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. (00199b)

NOTE

Make certain primary chaincase is filled with proper amount of lubricant with motorcycle upright. If under filled, transmission can be damaged during vehicle operation.

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.

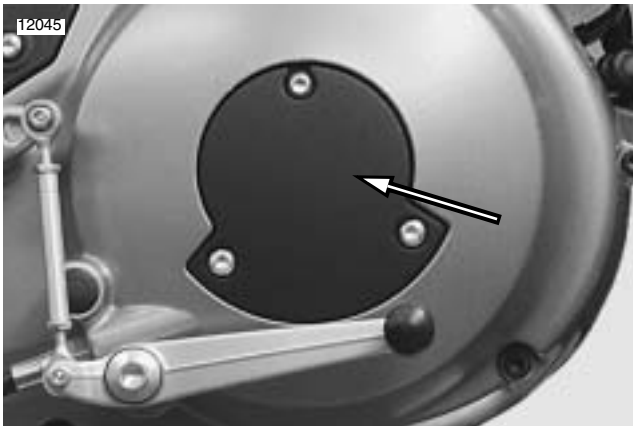


Figure 1-20. Clutch Inspection Cover

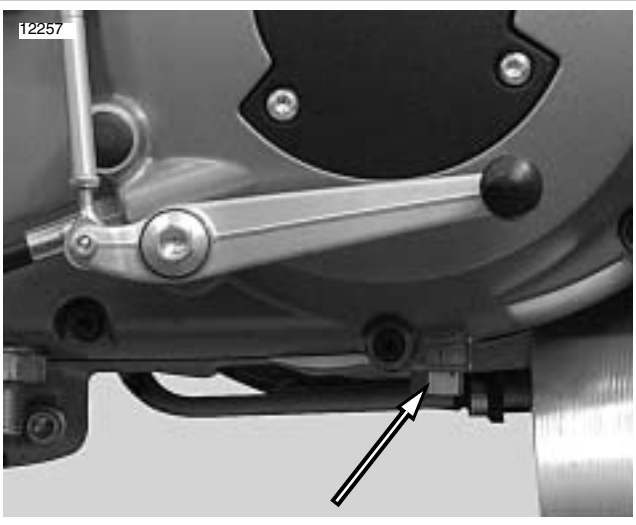
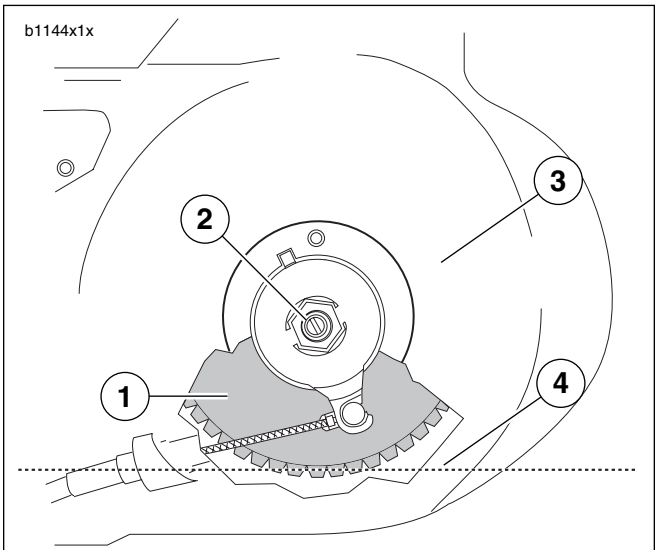


Figure 1-21. Primary Drain Plug



1. **Clutch diaphragm spring**
2. **Clutch adjusting screw**
3. **Primary cover**
4. **Correct chaincase lubricant level**

Figure 1-22. Fluid Level

ADJUSTMENT

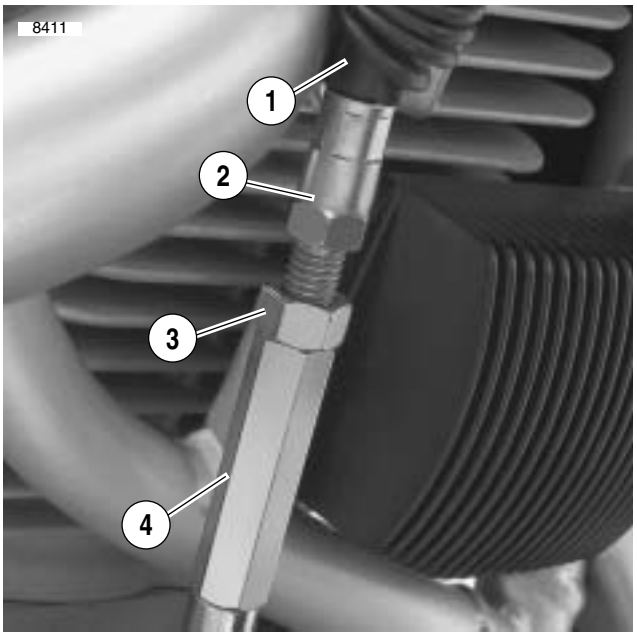
If clutch slips under load or drags when released, first check control cable adjustment. If cable adjustment is within specifications, adjust clutch mechanism as described below.

When necessary, lubricate cable with LUBIT-8 TUFOIL® CHAIN AND CABLE LUBE (Part No. HD-94968-85TV).

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.

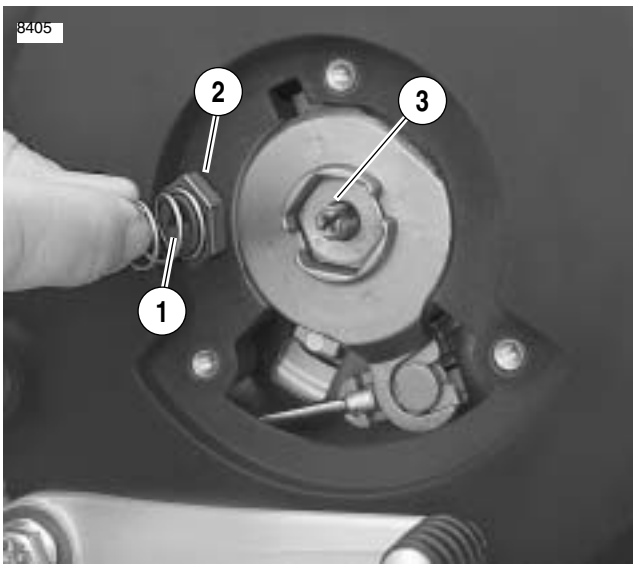
NOTE

Spring installs on outboard side of hex lockplate.



1. **Rubber boot**
2. **Cable end**
3. **Jam nut**
4. **Adjuster**

Figure 1-23. Clutch Cable Adjuster Mechanism



1. **Diaphragm spring**
2. **Lockplate**
3. **Adjusting screw**

Figure 1-24. Clutch Adjustment

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).

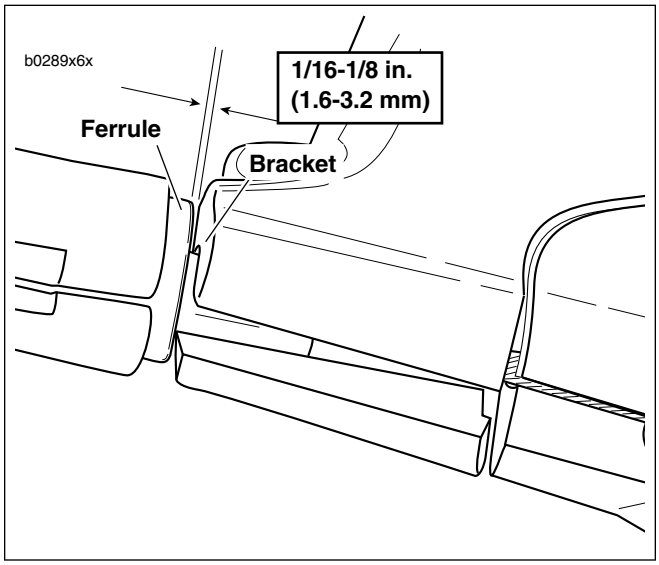


Figure 1-25. Adjusting Clutch Free Play

DRIVE BELT 1.9

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 bevelling. Some bevelling 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. See 6.6 DRIVE BELT SYSTEM.



Figure 1-26. Checking Lateral Side Play on Idler Pulley with a Dial Indicator

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

CONDITION	ROOT CAUSE	REQUIRED ACTION
Excessive Edge Wear (mistracking)	Misalignment or bent drive structure	Check structure (bad bearing, bent members, etc.)
	Bent or rough flange	Repair flange/replace sprocket
	Damage due to handling (pry on, etc.)	Follow proper handling/installation procedure
	Debris damage to edge of belt	Inspect/replace belt
		Inspect for damaged or missing guards
	Belt hitting obstruction	Check structure (bad bearing, bent members, etc.)
		Inspect for loose/missing fasteners
		Inspect for damaged or missing guards
	Bent or loose idler bracket	Replace idler assembly
		Inspect for loose/missing fasteners
	Broken or loose guards	Check structure (bad bearing, bent members, etc.)
		Inspect for loose/missing fasteners
		Inspect for damaged or missing guards
Excessive tooth wear *NOTE* *The drive belt tension on a new belt will loosen after approximately 1000 mi (1600 km)*	Rough or damaged sprocket	Inspect/replace sprocket
	Worn sprocket	Inspect/replace sprocket
	Debris in sprocket	Clean and protect drive
		Inspect for damaged or missing guards
	Abrasive environment	Eliminate or control exposure
		Inspect for damaged or missing guards
Apparent belt stretch	Worn sprocket	Inspect/replace sprocket
	Debris in sprocket	Clean and protect drive
		Inspect for damaged or missing guards
	Idler bearing failure	Replace idler assembly
	Aggressive riding/hard use	Riding practice/operator choice
	Exposure to oils, solvents, harsh chemicals	Eliminate or control exposure
		Clean and protect drive
Cracks in back of belt	Idler/bearing binding	Replace idler assembly
	Exposure to oils, solvents, harsh chemicals	Eliminate or control exposure
		Clean and protect drive
	Cut by sharp debris (not at belt edge)	Inspect/replace sprocket
		Continue to run but monitor condition frequently
	Cut by sharp debris at belt edge	Inspect/replace sprocket
		Inspect/replace belt

Table 1-8. Potential Limits to Belt Drive Service Life

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

NOTES

PRIMARY CHAIN 1.10

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).

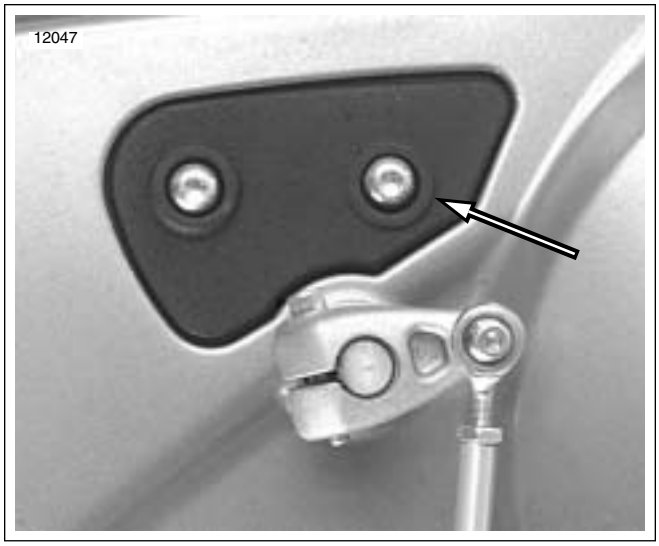


Figure 1-27. Primary Chain Inspection Cover

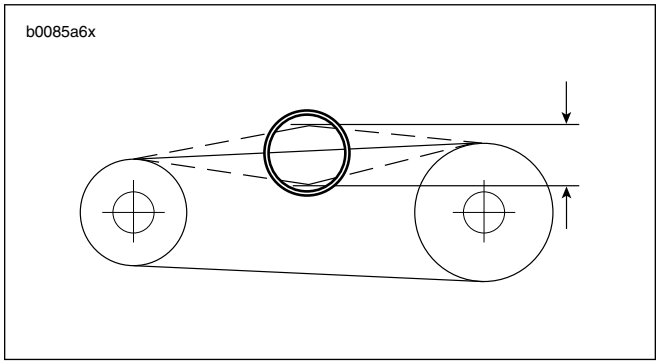


Figure 1-28. Measuring Primary Chain Free Play

Table 1-9. Primary Chain Free Play

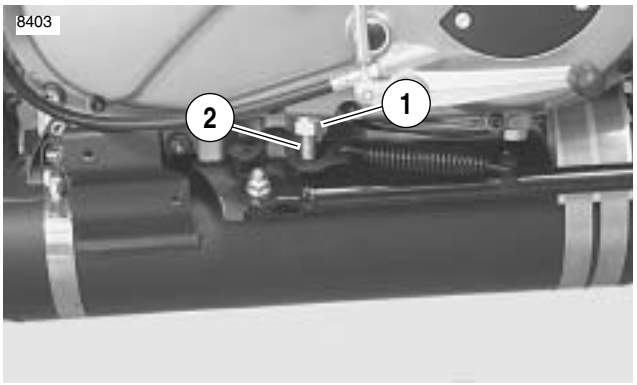
ENGINE TEMPERATURE	in.	mm
Cold	3/8-1/2	9.5-12.7
Hot (normal running temperature)	1/4-3/8	6.4-9.5

ADJUSTMENT

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).



1. Locknut
2. Adjusting Fastener

Figure 1-29. Chain Tension Adjusting Fastener

SUSPENSION DAMPING ADJUSTMENTS 1.11

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 underinflated 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 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)

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.

⚠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.

Enchanced 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.

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	PRELOAD POSITION	*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	PRELOAD POSITION	*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.							

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

RIDER AND CARGO WEIGHT		FRONT FORK			REAR SHOCK		
LB.	KG	PRELOAD # OF LINES	*COMPRESSION	*REBOUND	PRELOAD POSITION	*COMPRESSION	*REBOUND
Less than 140	Less than 63	7	2	1.75	1	2.5	2
140-170	63-77	7	1.75	1.75	2	2.25	1.75
170-200	77-91	7	1.75	1.75	3	2	1.5
200-230	91-104	7	1.75	1.625	4	1.75	1.5
230-260	104-118	6.50	1.50	1.50	5	1.50	1.25
260-290	118-132	6.50	1.50	1.50	6	1.25	1
290-GVWR	132-GVWR	6	1.25	1.5	7	1.125	1
* 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

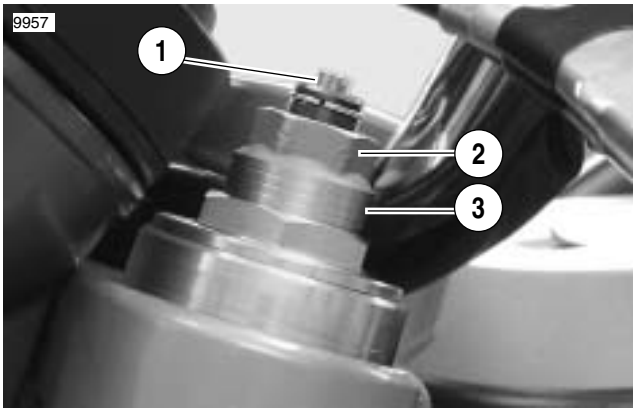
1. Check number of lines (3) to be showing for your load condition. Refer to Table 1-10. and Table 1-11.
2. See Figure 1-30. Adjust preload by turning the adjuster nut (2) with a wrench.

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.



1. **Rebound adjuster screw**
2. **Preload adjuster nut**
3. **Four lines visible (factory setting)**

Figure 1-30. Front Fork Preload And Rebound Adjuster

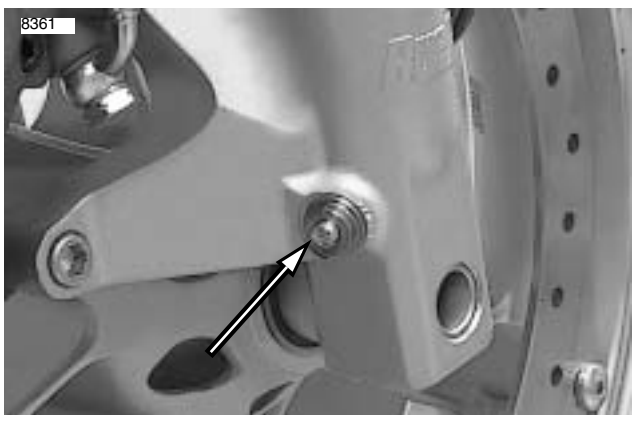


Figure 1-31. Front Fork Compression Damping Adjuster

Setting Rear Shock Preload

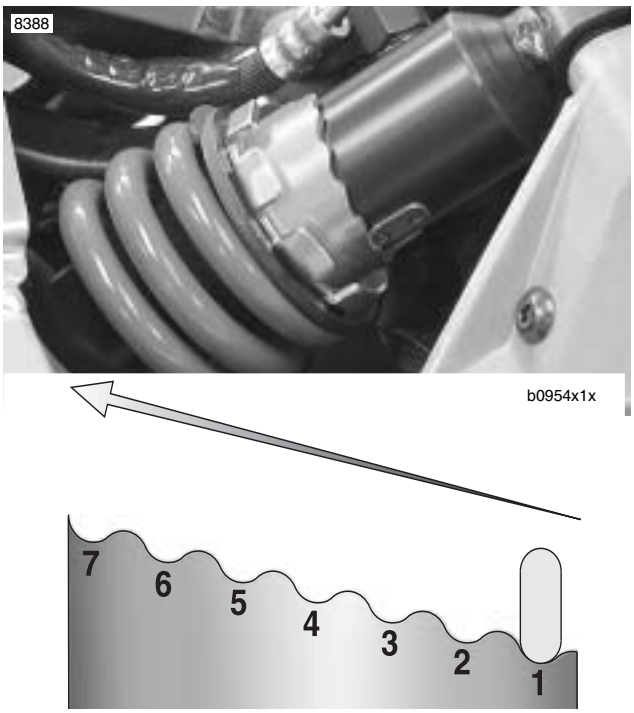
The factory setting is ramp number 2 position (ramp number 7 position being the tallest ramp and maximum preload). For recommended spring preload refer to Table 1-10. or Table 1-11.

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.



Maximum preload adjustment (ramp number 7)
Minimum preload adjustment (ramp number 1)

Figure 1-32. Rear Shock Preload Adjuster

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.

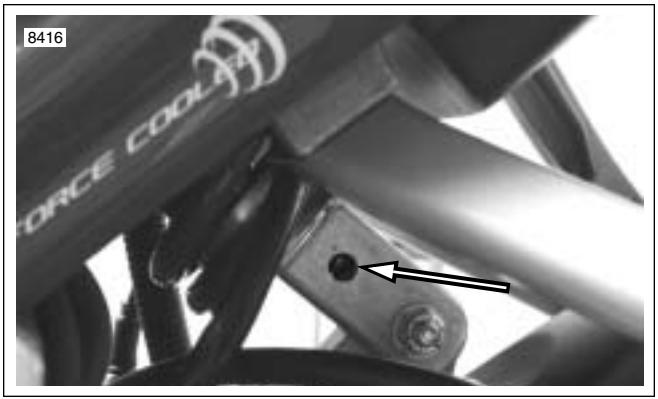


Figure 1-33. Rear Shock Rebound Adjustment

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 adjuster 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.



Figure 1-34. Rear Shock Compression Damping Adjuster (XB9SX, XB12S, XB12Scg)



Figure 1-35. Rear Shock Compression Damping Adjuster (XB12Ss)

STEERING HEAD BEARINGS 1.12

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.
   a. The desired resistance to pull front wheel to center is between 1-7 lbs (0.5-3.2 kg).
   b. If steering head resistance measurement is not within specification, see DETERMINING PROPER RESISTANCE.
7. When adjustment is complete, attach clutch cable and adjust. See 1.8 CLUTCH.

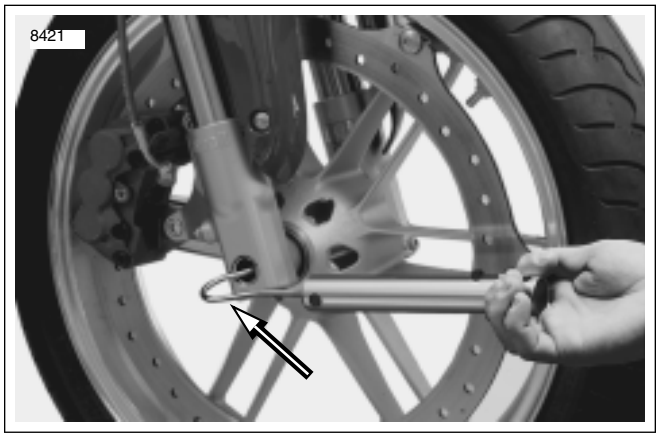


Figure 1-36. Measuring Steering Head Bearing Resistance

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 (27.1-29.8 Nm).
11. When adjustment is complete, attach clutch cable and adjust. See 1.8 CLUTCH.
12. Remove scissor jack.

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.

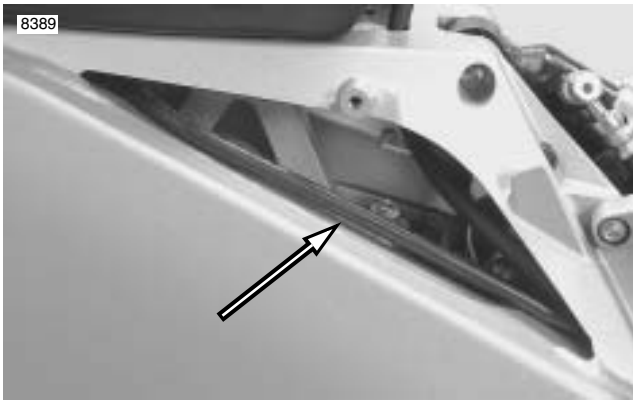


Figure 1-38. Rear Spark Plug Access

AIR CLEANER FILTER 1.14

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

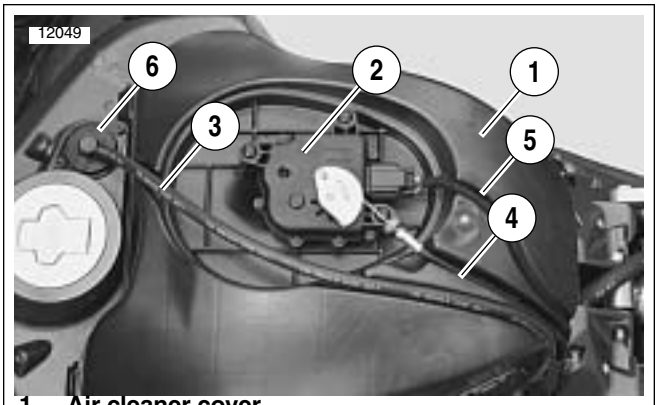
WARNING

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).



Figure 1-39. Air Intake Screen

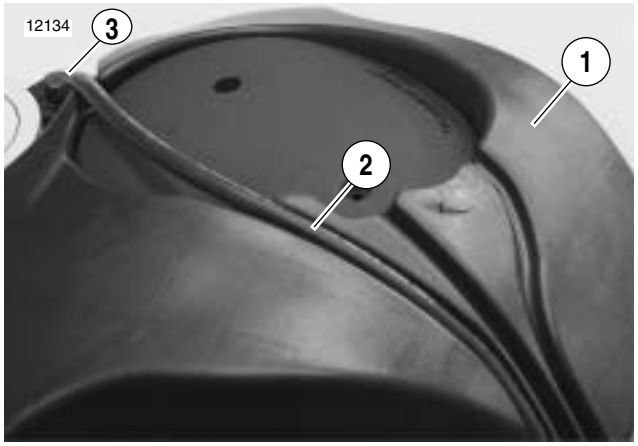


1. **Air cleaner cover**
2. **Actuator (interactive exhaust)**
3. **Fuel vent tube**
4. **Cable (interactive exhaust)**
5. **Harness (interactive exhaust)**
6. **Vapor valve**

Figure 1-40. Air cleaner cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 solid color models)



Figure 1-41. Actuator Cover for XB12 Models with translucent body panel.



1. Air cleaner cover
2. Fuel vent tube
3. Vapor valve

Figure 1-42. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB9SX "Translucid" model)

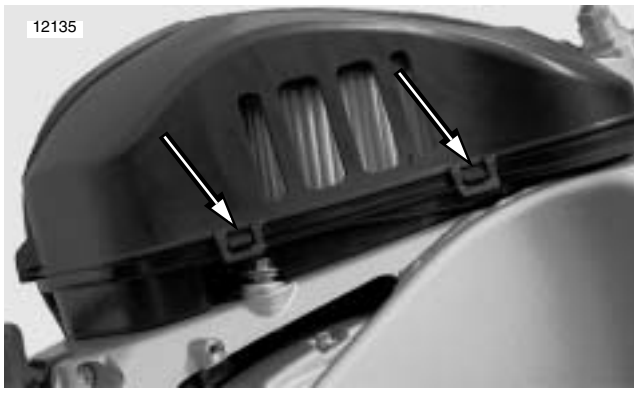
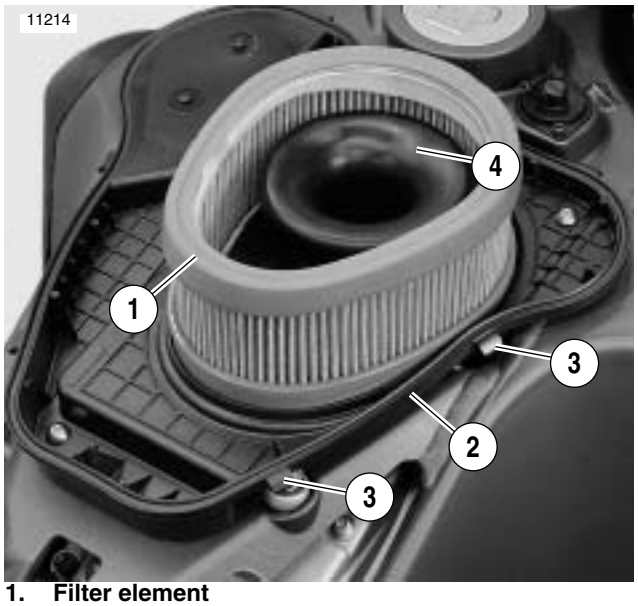


Figure 1-43. Air Cleaner Cover Latches



1. Filter element
2. Baseplate assembly
3. Air cleaner cover latch tabs
4. Velocity stack

Figure 1-44. Installed Air Cleaner Filter Element

INSTALLATION

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

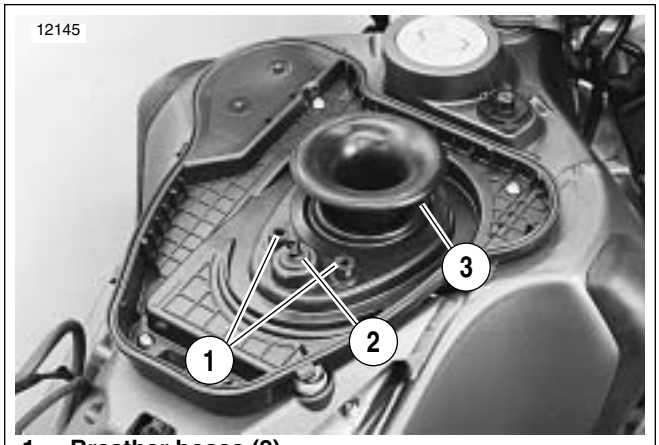
If necessary, adjust interactive exhaust cable. See 1.16 INTERACTIVE EXHAUST CABLE (XB12 MODELS).

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.



1. Breather hoses (2)
2. Intake air sensor
3. Velocity stack

Figure 1-45. Air Cleaner Base Plate Assembly

THROTTLE CABLE AND IDLE SPEED ADJUSTMENT 1.15

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

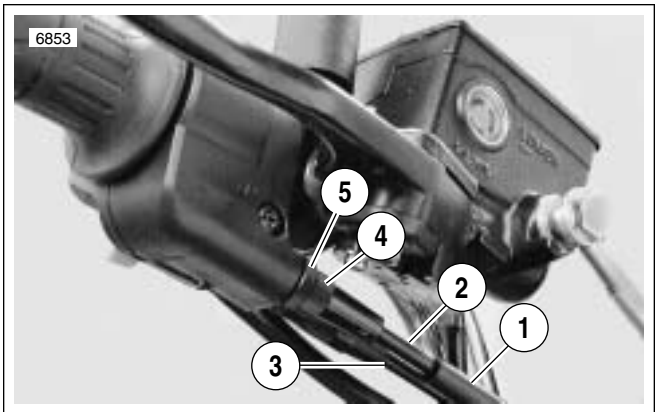
If replacing the idle adjustment cable it will be necessary to apply anti-seize to the threads before installing to the throttle body assembly.

Check throttle cable adjustment:

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

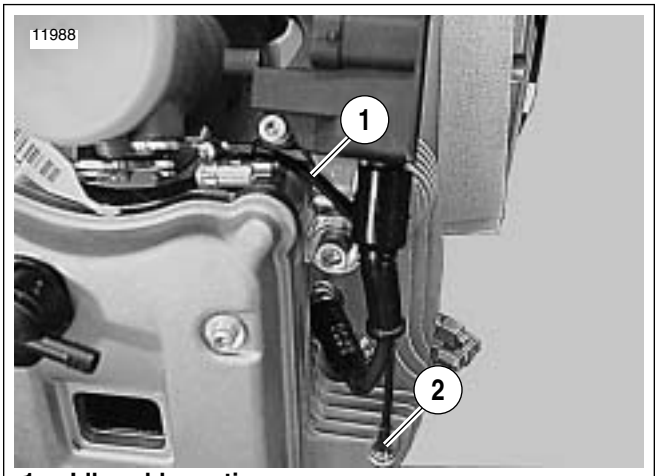
With engine running, turn handlebars through full range of travel. If engine speed changes during this maneuver, turn engine OFF and adjust throttle cables as follows:

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.



1. **Rubber boot**
2. **Throttle control cable**
3. **Idle control cable**
4. **Cable adjuster**
5. **Cable adjuster lock**

Figure 1-46. Throttle Control Cables



1. **Idle cable routing**
2. **Idle adjuster**

Figure 1-47. Idle Adjuster (scoop and frame removed for clarity)

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.

INTERACTIVE EXHAUST CABLE (XB12 MODELS) 1.16

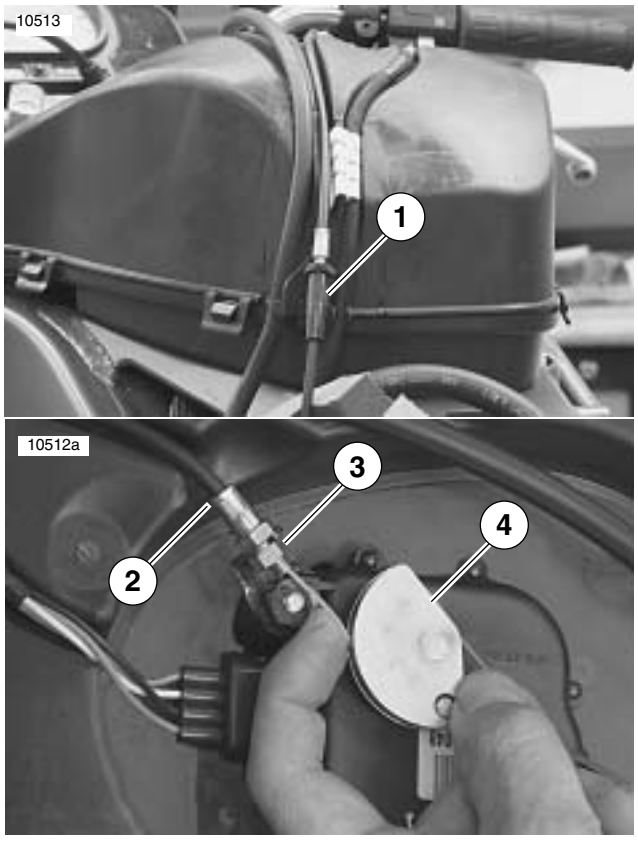
ADJUSTMENT

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

NOTES

- *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.



1. Adjuster
2. Interactive exhaust cable
3. Jam nut
4. Cable wheel

Figure 1-48. Interactive Exhaust Cable

3. See Figure 1-48. Loosen jam nut (3).
4. Remove cable (2) from bracket and cable wheel (4).

NOTE

For the next step in the procedure it will be necessary to obtain a permanent marker.

5. 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.
6. Mark the cable core with the marker all the way around where it comes out of the housing.
7. Release the cable core and reattach the cable to the cable wheel and bracket.
8. Tighten jam nut.

CAUTION

Do not overtighten jam nut on interactive exhaust cable.

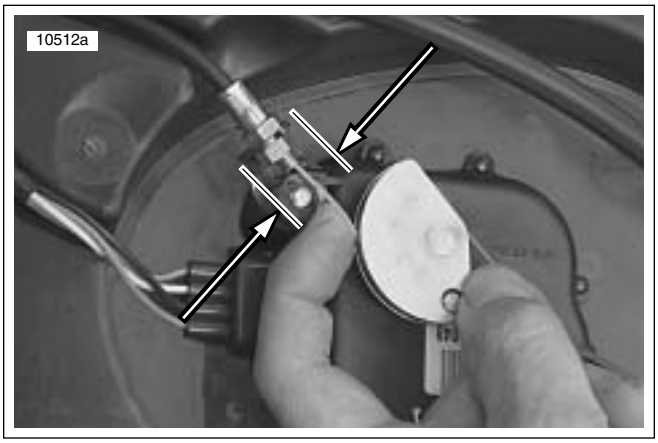
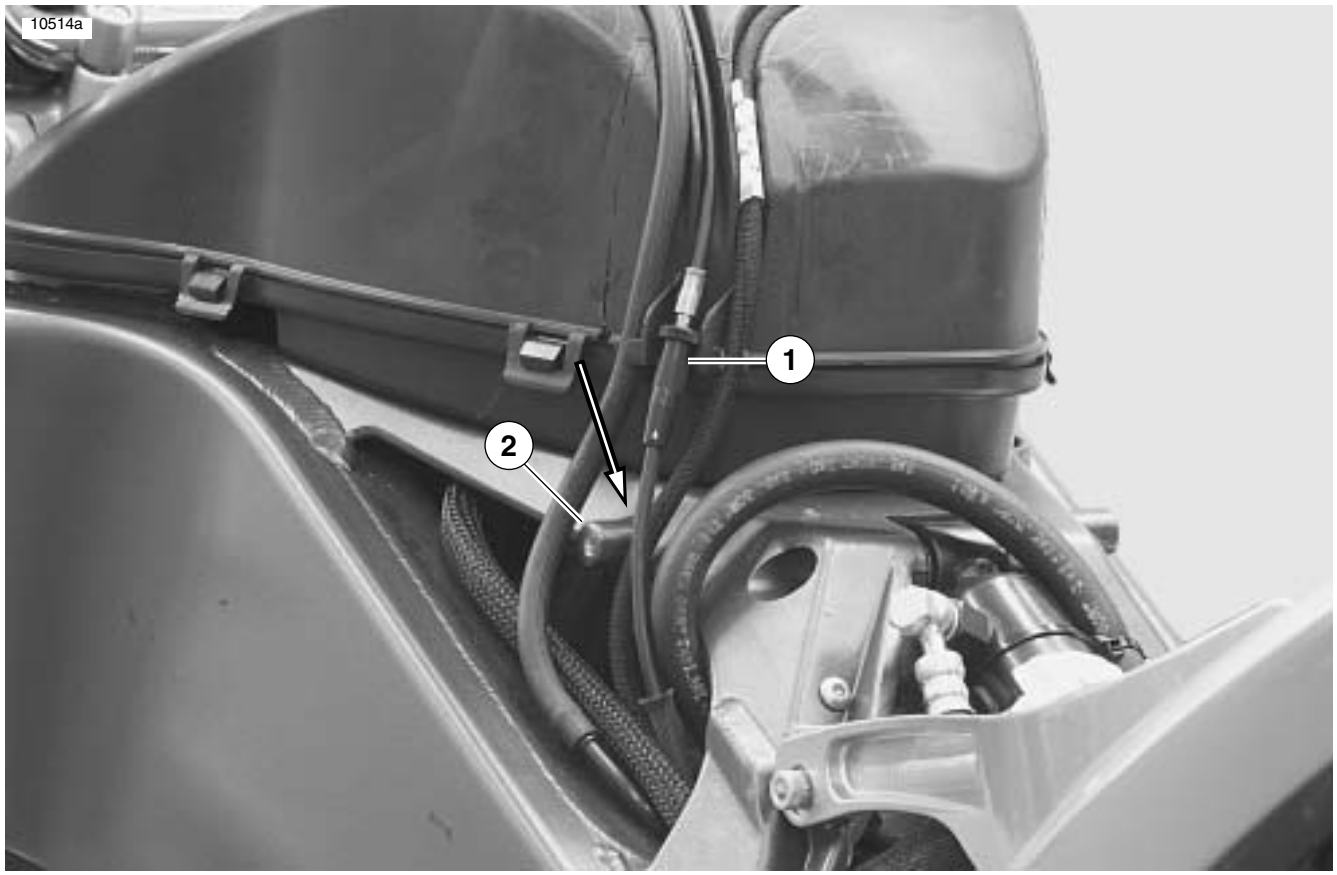


Figure 1-49. Checking For 1/8 in. (3.2 mm) Maximum Free Play In Either Direction For Proper Adjustment

9. See Figure 1-49. Adjust interactive exhaust cable as follows:
   a. See Figure 1-48. 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).



1. **Interactive exhaust cable**
2. **Frame lug**

Figure 1-50. Correct Cable Routing Behind Frame Lug

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.

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.

CAUTION

Carefully drill hole, applying minimum pressure to drill out timer plate cover rivets. Applying too much pressure will damage cam position sensor and/or timer plate and cover.

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.

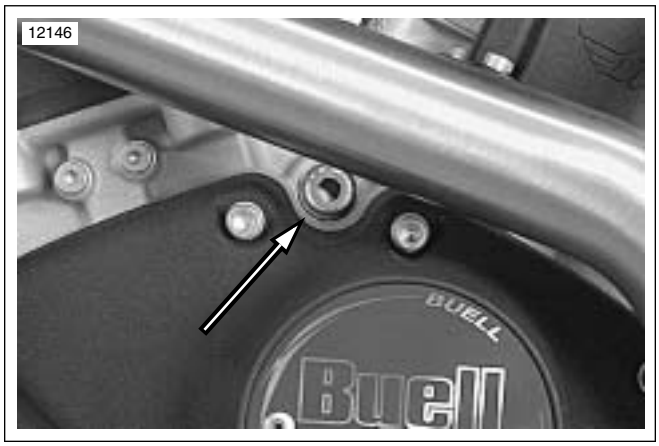


Figure 1-51. Timing Plug

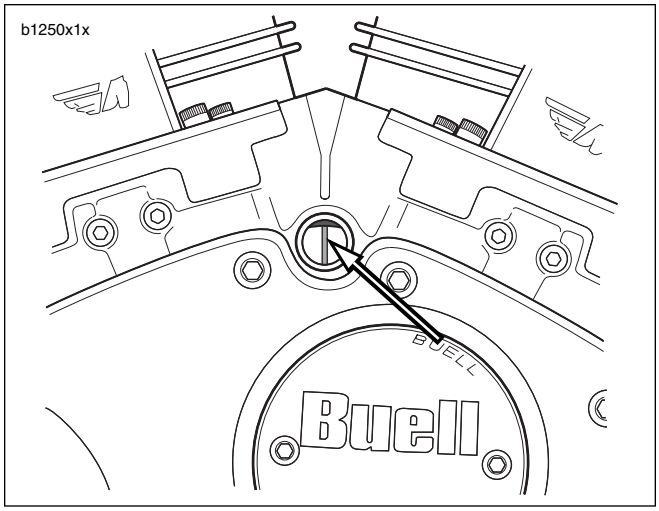


Figure 1-52. Correct Timing

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.

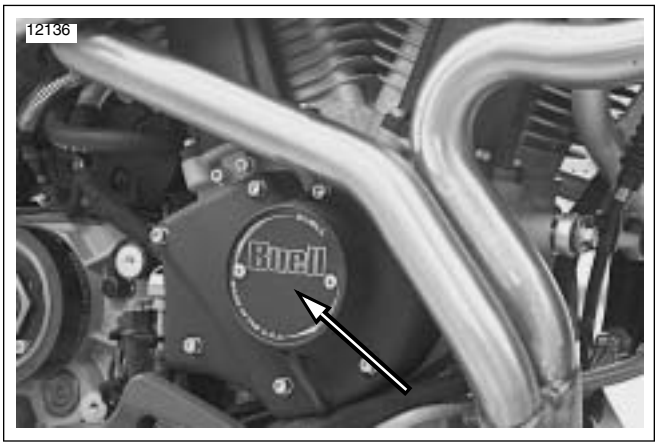


Figure 1-53. Timer Cover

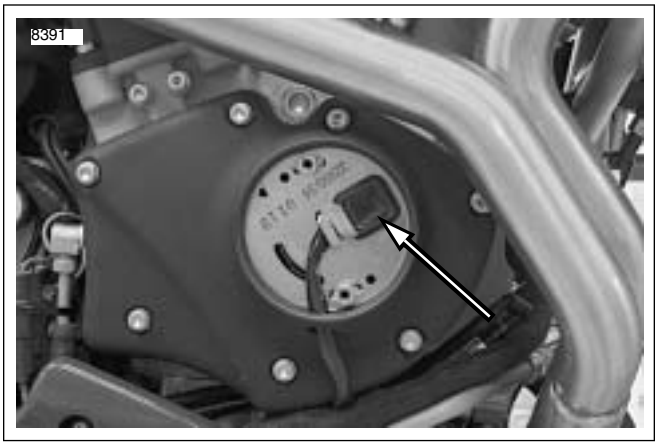


Figure 1-54. Cam Position Sensor

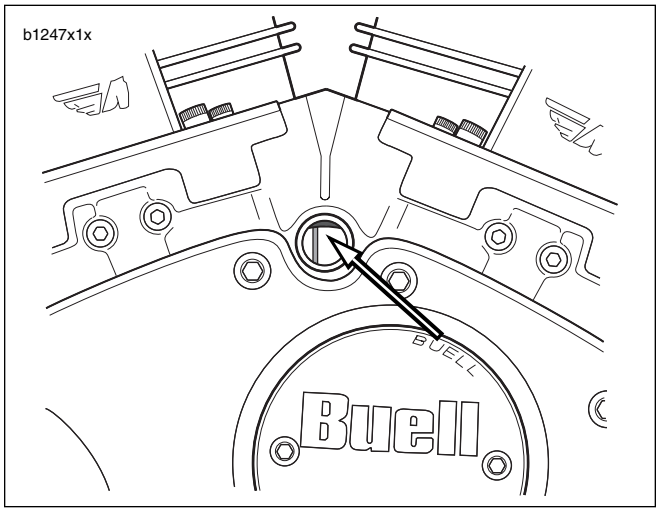


Figure 1-55. Advanced Timing

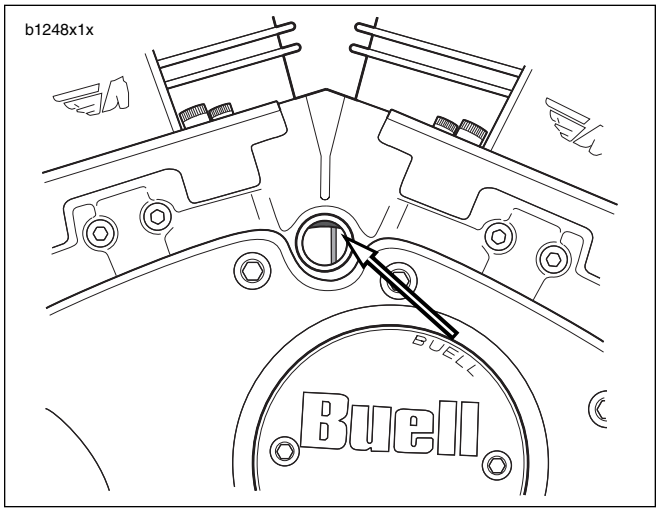


Figure 1-56. Retarded Timing

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.

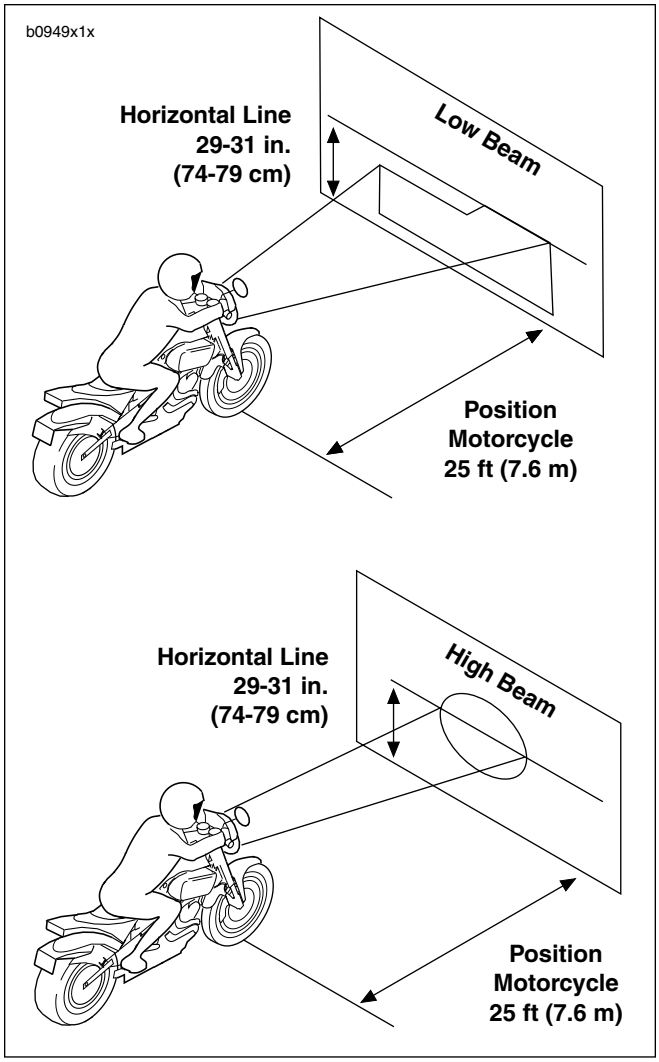
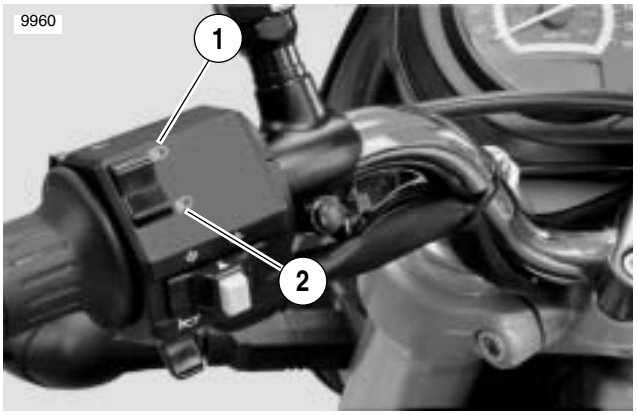


Figure 1-57. Checking Headlight Alignment



1. High beam
2. Low beam

Figure 1-58. Headlamp Switch

ADJUSTMENT

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*** *(5-8 Nm).*

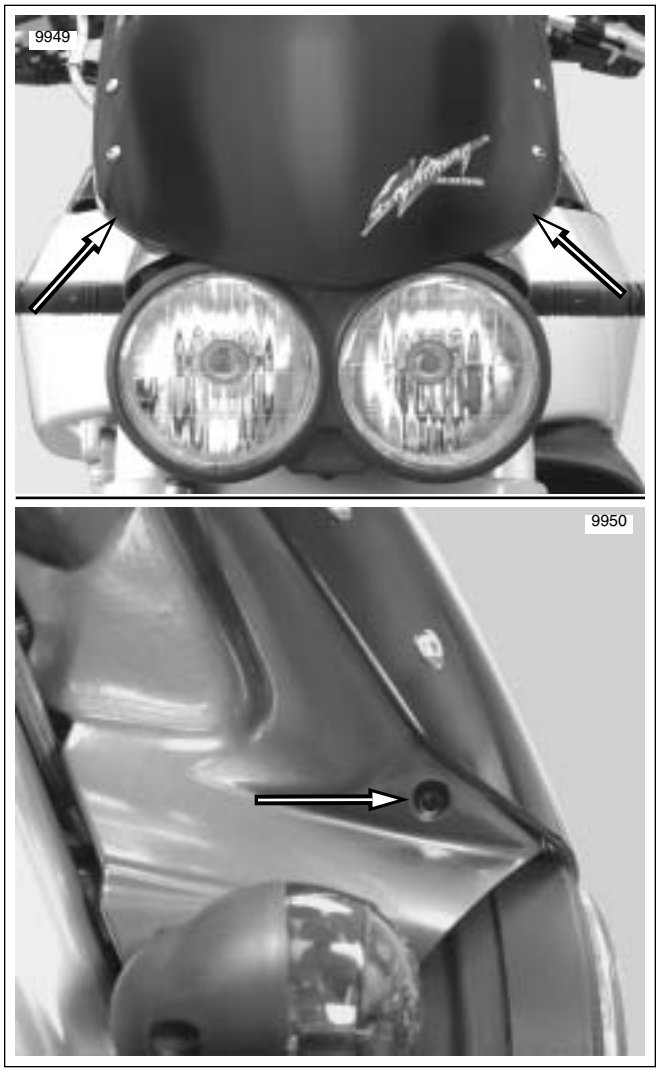


Figure 1-59. Horizontal Headlamp Adjustment

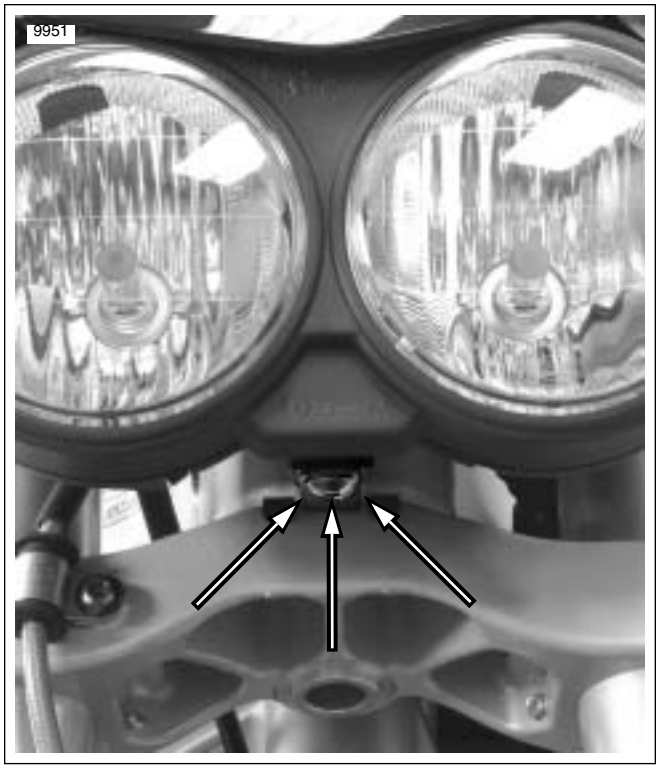


Figure 1-60. Vertical Headlamp Adjustment

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.

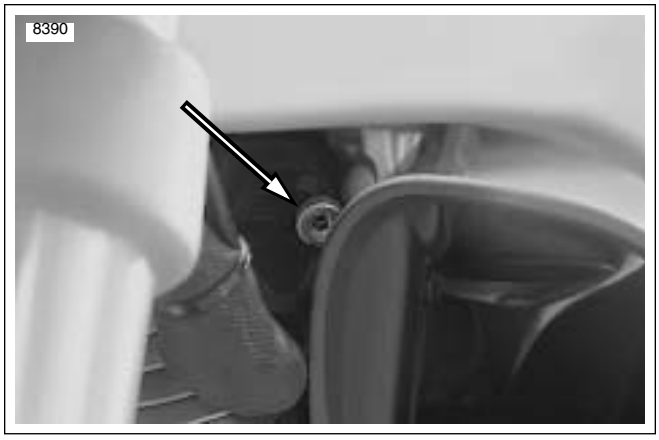


Figure 1-61. Idle Adjuster (behind left fork)

STORAGE 1.20

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. (00003a)

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. (00290a)

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.
6. Perform all of the checks in the PRE-RIDING CHECK LIST in the Owner's Manual.

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.
6. Clutch lever not pulled in. Vehicle in gear.
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. Sticking or damaged valve or valves.
11. Engine oil too heavy (winter operation).
12. Ignition circuit interlock malfunction.
13. No output from the ECM. See dealer.
14. Inadequate fuel pressure in fuel lines (possible leak). See dealer.
15. Clogged fuel filter. See dealer.
16. Clogged fuel injectors. See dealer.
17. Tripped bank angle sensor. Turn key to OFF, wait 15 seconds, and then back to IGN again to start bike.
18. TP Sensor/fast idle screw not set properly. See dealer.
19. No output from CMP sensor. See dealer.
20. Inoperative fuel pump. See dealer.

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.
14. Valves sticking.
15. TP Sensor and/or 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.
19. Fuel level too low. Add gasoline.
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.
3. Spark plugs not firing.
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.
3. Broken frame.
4. Primary chain badly worn or links tight as a result of insufficient lubrication.
5. Wheels not aligned and/or tires worn.
6. Internal engine problem.
7. Wheels not balanced correctly.

ENGINE LUBRICATION SYSTEM

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. Imperfect 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.

ELECTRICAL SYSTEM

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.

FUEL SYSTEM

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.

SUSPENSION

When making adjustments, remember there are two mediums 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 suspension-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

TROUBLESHOOTING CONDITION	ADJUSTMENT SOLUTION
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.	Increase rebound damping.
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."	Reduce rebound damping.
The bike bottoms out or dips while cornering. Bike has excessive brake dive.	Increase compression damping.
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.	Reduce compression damping.

Table 1-14. Rear Suspension Problems

TROUBLESHOOTING CONDITION	ADJUSTMENT SOLUTION
"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.	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.
Chattering during braking.	Decrease the compression damping. If the problem persists, decrease rebound damping for a faster rebound rate. Less spring preload may also help.
Lack of tire feedback.	The suspension is too soft. Increase compression damping.
Sliding during cornering. Sliding may occur going into the corner or accelerating out of the corner.	The suspension is too hard. Decrease compression damping.

Table 1-15. Front Suspension Problems

TROUBLESHOOTING CONDITION	ADJUSTMENT SOLUTION
Not absorbing bumps.	A good suspension is a balance between damping and track condition. Finding this balance requires exploring all possible compression settings.
Lack of tire feedback.	Increase compression damping.
Tire slides.	Decrease compression damping.

NOTES

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SPECIFICATIONS 2.1

Table 2-1. Dimensions

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

Table 2-2. Weight Specifications (1203)

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

Table 2-3. Weight Specifications (984)

WEIGHT-U.S. MODELS	LBS.	KG
Wet weight	452	205
GVWR	850	386
GAWR - front	315	143
GAWR - rear	535	243
Load capacity	398	181

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 2-4. Capacities

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

Table 2-5. Tire and Positions

TIRE AND POSITION	SOLO RIDING	GVWR
Front Dunlop Sportmax Radial II 120/70 ZR 17 D208FW	36 PSI (248 kPa)	Same as solo
Front Pirelli Diablo SYNC (XB9SX only) 120/70 ZR 17	34 psi (234 kPa)	
Rear Dunlop Sportmax Radial II 180/55 ZR 17 D208M	38 PSI (262 kPa)	
Rear Pirelli Diablo SYNC (XB9SX only) 180/55 ZR 17	36 psi (248 kPa)	

Table 2-6. Brake Rotor Runout

RUNOUT	IN.	MM
Front radial	0.0177	0.45
Front lateral	0.0248	0.63
Rear radial	0.0177	0.45
Rear lateral	0.0154	0.39

TORQUE VALUES

ITEM	TORQUE		NOTES
Axle (front)	39-41 ft-lbs	53-56 Nm	ANTI-SEIZE, Left handed thread, page 2-17
Axle (rear)			Follow special instructions, ANTI-SEIZE, page 2-20
Axle pinch fastener, rear	40-45 ft-lbs	54-61 Nm	page 2-20
Axle pinch fasteners, front	20-22 ft-lbs	27-30 Nm	page 2-17
Brake hand lever housing fasteners	80-90 **in-lbs**	9-10 Nm	page 2-31
Brake lamp switch fastener, front	7-10 **in-lbs**	0.8-1.0 Nm	page 2-31
Brake line p-clamp fastener, front	36-60 **in-lbs**	4-7 Nm	page 2-33
Brake line P-clamp on inside of lighting module	36-60 **in-lbs**	4-7 Nm	page 2-33
Brake pedal fastener	22-24 ft-lbs	30-33 Nm	LOCTITE 272, page 2-27
Brake pin hanger set, front	11-14 ft-lbs	15-19 Nm	page 2-35
Brake pin hanger set, rear	11-14 ft-lbs	15-20 Nm	page 2-44
Brake pin plug, rear	24 **in-lbs**	2.7 Nm	page 2-44
Caliper banjo bolt, front	16-20 ft-lbs	22-27 Nm	metric, page 2-33
Caliper banjo bolt, rear	16-20 ft-lbs	22-27 Nm	page 2-42
Caliper bleeder valves	36-60 **in-lbs**	4-7 Nm	metric, page 2-28
Caliper carrier, rear	24-26 ft-lbs	32-35 Nm	page 2-21
Caliper fasteners, front	15-19 ft-lbs	20-26 Nm	page 2-35
Caliper mounting fasteners, front	35-37 ft-lbs	47-50 Nm	page 2-35
Caliper mounting large fastener, rear	18-21 ft-lbs	24-28 Nm	page 2-45
Caliper mounting small fastener, rear	14-18 ft-lbs	19-24 Nm	page 2-45
Chin fairing fasteners	36-48 **in-lbs**	4-5 Nm	page 2-90
Clutch cable fitting to primary	36-108 **in-lbs**	4-12 Nm	page 2-71
Clutch cable p-clamp	25-27 ft-lbs	33.9-36.6 Nm	page 2-72
Clutch cable wire form	84-92 **in-lbs**	9.5-10.4 Nm	page 2-63
Clutch cable wire form	84-92 **in-lbs**	9.5-104 Nm	page 2-72
Clutch inspection cover fasteners	84-108 **in-lbs**	9.5-12.2 Nm	Tighten in a crosswise pattern, page 2-72
Deflector fasteners	24-36 **in-lbs**	2.7-4 Nm	page 2-68
Deflector pivot shaft risers	43-49 **in-lbs**	4.8-5.5 Nm	page 2-68
Deflector, pivot shaft jam nut	39-48 **in-lbs**	4.4-5.4 Nm	page 2-68
Engine shroud air scoop	12-36 **in-lbs**	1-4 Nm	page 2-92
Exhaust header mounting nut	72-96 **in-lbs**	8-11 Nm	page 2-84
Footpeg mount fasteners, rider	108-132 **in-lbs**	12.2-14.9 Nm	page 2-85
Footpeg mount, passenger	25-28 ft-lbs	33.8-37.9 Nm	LOCTITE 272, page 2-86
Fork cap	22-30 ft-lbs	30-40 Nm	page 2-52
Fork center bolt	22-30 ft-lbs	30-40 Nm	page 2-51
Fork clamp, lower	20-22 ft-lbs	27.2-20 Nm	LOCTITE 272, page 2-53
Fork clamp, upper	23-25 ft-lbs	31.2-33.8 Nm	LOCTITE 272 (red), page 2-55
Fork damper locknut	22-30 ft-lbs	30-40 Nm	page 2-51
Front fender fasteners	36-48 **in-lbs**	4-5.4 Nm	page 2-88
Front isolator bolt	49-51 ft-lbs	66-69 Nm	page 2-63

ITEM	TORQUE		NOTES
Front isolator bracket mounting fastener	49-51 ft-lbs	66-69 Nm	page 2-63
Front isolator snubber, upper	12-36 **in-lbs**	1-4 Nm	page 2-63
Front isolator threaded frame insert	59-61 ft-lbs	80-82.7 Nm	LOCTITE 222,page 2-63
Hand lever pivot fastener	39-48 **in-lbs**	4.4-5.4 Nm	page 2-30
Handlebar clamp screws	10-12 ft-lbs	14-16 Nm	tighten front screws first, page 2-79
Heel guard fasteners, passenger	48-72 **in-lbs**	5.4-8 Nm	page 2-86
Heel guard fasteners, rider	72-96 **in-lbs**	8-11 Nm	page 2-85
Horn	72-96 **in-lbs**	8-10.8 Nm	page 2-76
Lower fork clamp fasteners	20-22 ft-lbs	27.1-29.8 Nm	LOCTITE 272 (red), page 2-55
Master cylinder banjo bolt, front	16-20 ft-lbs	22-27 Nm	page 2-33
Master cylinder banjo bolt, rear	16-20 ft-lbs	22-27 Nm	page 2-42
Master cylinder cover fasteners, front	9-13 **in-lbs**	1.0-1.5 Nm	page 2-31
Master cylinder mounting fasteners, rear	72-96 **in-lbs**	8-11 Nm	page 2-40
Mirror adjuster	115-130 **in-lbs**	3-14.7 Nm	page 2-81
Mirror mount onto bracket	20-22 ft-lbs	27.1-29.8 Nm	page 2-81
Muffler mounting block fastener, rear	32-36 ft-lbs	43-49 Nm	page 2-84
Muffler strap fastener, front	108-120 **in-lbs**	12-14 Nm	page 2-84
Muffler strap fastener, rear	48-60 **in-lbs**	5-7 Nm	page 2-84
Negative battery cable at battery terminal	72-96 **in-lbs**	8-11 Nm	page 2-72
Oil cooler air scoop	48-72 **in-lbs**	5.4-8 Nm	page 2-92
Oil drain plug	29-34 ft-lbs	39-46 Nm	page 2-61
Oil line fittings	108-156 **in-lbs**	12-17.6 Nm	page 2-61
Oil line p clamps at swingarm	48-72/**in-lbs**	5.4-8/Nm	page 2-62
Pivot shaft pinch bolt	17-19 ft-lbs	23-26 Nm	page 2-62
Ram air scoop	12-36 **in-lbs**	1.4-4 Nm	page 2-92
Rear brake line p-clamp	36-60 **in-lbs**	4-7 Nm	page 2-42
Rear fender fastener	12-36 **in-lbs**	1.4-4.0 Nm	page 2-88
Rear inner fender mounting fasteners	12-36 **in-lbs**	1.4-4 m	page 2-62
Rear remote master cylinder reservoir fastener	48-72 **in-lbs**	11-14 Nm	page 2-40
Rotor mounting fasteners, front	25-27 ft-lbs	34-37 Nm	metric, Replace with new, page 2-16
Rotor mounting fasteners, rear	25-27 ft-lbs	34-37 Nm	Replace with new, page 2-20
Shift lever pinch screw	48-60 **in-lbs**	5.4-6.8 Nm	LOCTITE 272 (red), Page 2-71
Shift pedal flange head bolt	22-24 ft-lbs	30-32.5 Nm	page 2-71
Shock absorber, lower	15-17 ft-lbs	20.3-23 Nm	page 2-62
Shock mounting fastener, upper	48-52 ft-lbs	65-70.5 Nm	page 2-66
Sidestand bracket fasteners	25-27 ft-lbs	34-37 Nm	page 2-105
Sidestand pivot bolt	18-20 ft-lbs	24-27 Nm	page 2-105
Sprocket cover fastener	12-36 **in-lbs**	1-4 Nm	page 2-87
Sprocket fasteners	35-37 ft-lbs	48-50 Nm	Replace with new, page 2-20
Steering stem capnut	38-42 ft-lbs	52-57 Nm	page 2-55
Steering stem pinch fastener (XB9SX)	23-25 ft-lbs	31.2-33.8 Nm	LOCTITE 272, page 2-55

ITEM	TORQUE		NOTES
Steering stem pinch fastener	20-22 ft-lbs	27.1-29.8 Nm	LOCTITE 272, page 2-55
Steering stem pinch fastener	20-22 ft-lbs	27.1-29.8 Nm	LOCTITE 272, page 2-58
Swingarm brace mounting fasteners	25-27 ft-lbs	34-37 Nm	page 2-62
Swingarm pivot shaft	24-26 ft-lbs	32-35 Nm	page 2-62
Switch housing fasteners, right	25-33 **in-lbs**	3-4 Nm	page 2-67
Torca clamp	28-30 ft-lbs	38-40.6 Nm	page 2-84
Valve stem nut	40-44 **in-lbs**	4.5-4.9 Nm	page 2-24
Wear peg, rider	36-48 **in-lbs**	4.1-5.4 Nm	LOCTITE 272 (red), page 2-85
Windscreen fasteners	10-12 **in-lbs**	1.1-1.4 Nm	page 2-100

TIRE SPECIFICATIONS 2.2

GENERAL

⚠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.

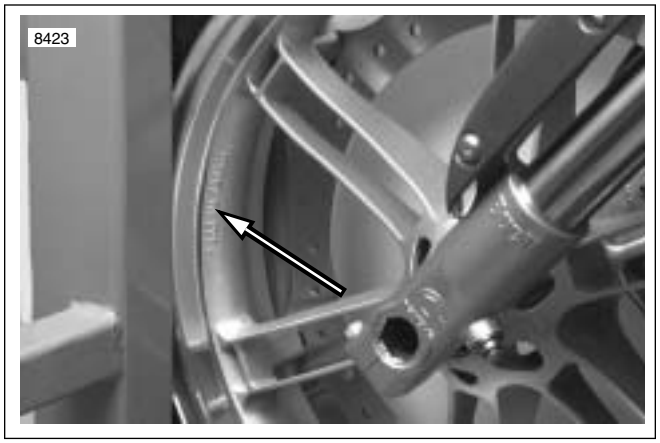


Figure 2-1. Rim Markings

Table 2-7. Tire Fitment-Tubeless Cast Wheels

WHEEL SIZE & POSITION	CONTOUR & RIM SIZE	RIM VALVE HOLE DIAMETER	TIRE SIZE
17 in. – Front	MT 3.5 x 17.0 DOT	0.33 in.	Dunlop Sportmax Radial II 120/70 ZR17 D208FW
17 in. – Rear	MT 5.5 x 17.0 DOT	0.33 in.	Dunlop Sportmax Radial II 180/55 ZR17 D208M
17 in. – Front	MT 3.5 x 17.0 DOT	0.33 in.	Pirelli Diablo SYNC 120/70 ZR17 (XB9SX only)
17 in. – Rear	MT 5.5 x 17.0 DOT	0.33 in.	Pirelli Diablo SYNC 180/55 ZR17 (XB9SX only)

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 INDENTIFICATION: XB MODELS BUILT BEFORE MAY 2005

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

VEHICLE INDENTIFICATION: XB MODELS BUILT AFTER MAY 2005

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

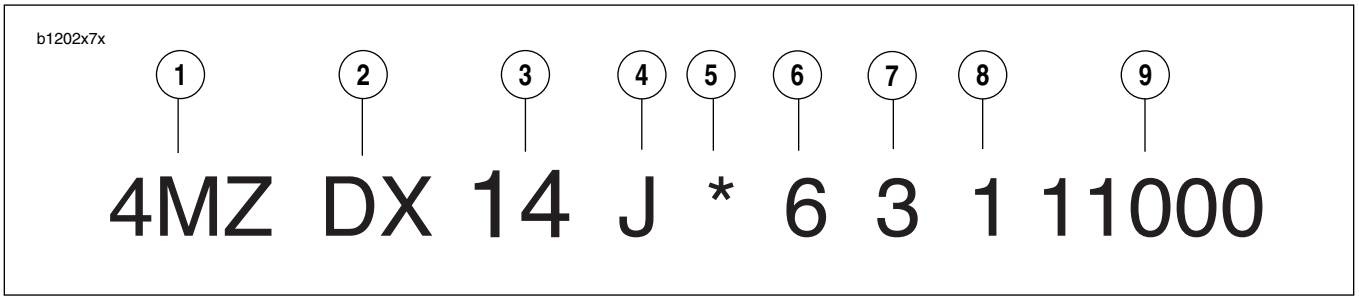


Figure 2-2. Buell Vehicle Identification Number (V.I.N.) Typical (All Models Built Before May 2005)

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

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

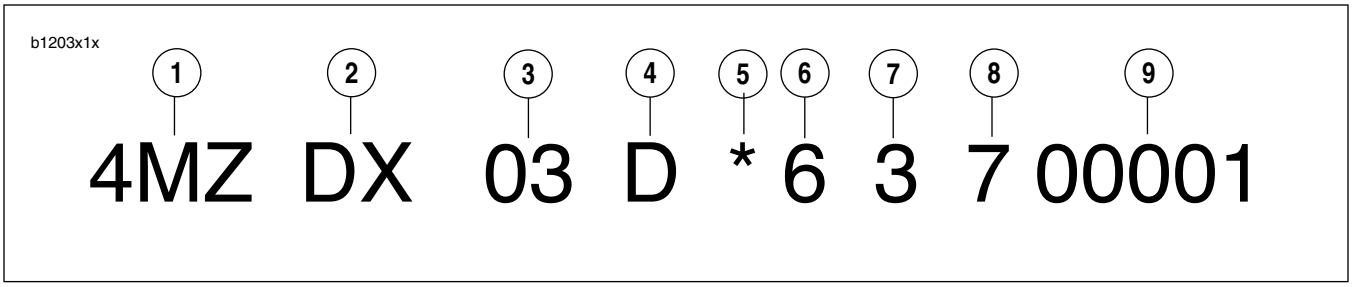


Figure 2-3. Typical 2006 Buell Vehicle Identification Number (All Models Built After May 2005)

Table 2-9. Buell 2006 XB Models V.I.N. Description (All Models Built After May 2005)

ITEM	DESCRIPTION	POSSIBLE VALUES
1	WMI Code	4MZ = Buell vehicles originally manufactured for sale **within** the United States 5MZ = Buell vehicles originally manufactured for sale **outside** the United States
2	Motorcycle type	KP = Blast AX = Firebolt KX = Lightning CityX SX = Lightning WX = Lightning Scg JX = Lightning Long DX = Ulysses
3	Engine type	01 = 984cc (World) 02 = 492cc (World) 03 = 1203cc (World)
4	Market configuration	A = Australia L = California N = Canada D = Domestic E = England R = Europe (HDI) J = Japan
5	VIN check digit	Can be 0-9 or X
6	Model year	6 = 2006
7	Assembly plant	3 = East Troy, WI
8	Model (Manufactured after May 1, 2005)	0 = Blast 1 = XB9R 2 = XB9SX 3 = XB12R 4 = XB12S 5 = XB12Scg 6 = XB12Ss 7 = XB12X
9	Sequential number, by model	varies

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.

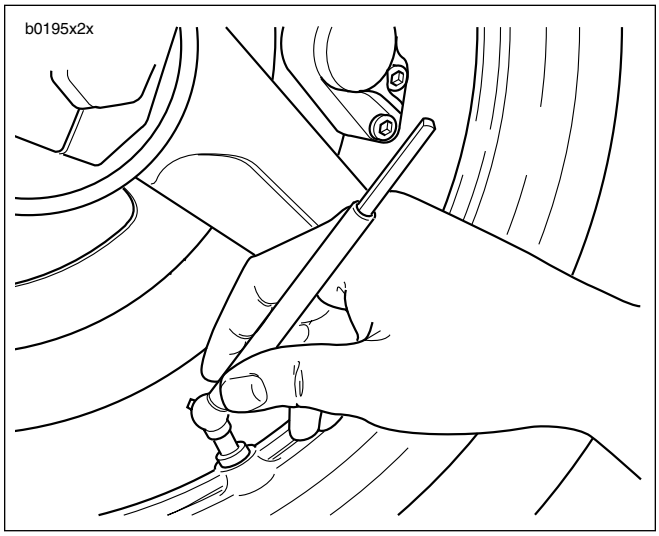


Figure 2-4. Checking Tire Inflation Pressure

Table 2-10. Wheel Service

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

⚠WARNING

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.**

⚠WARNING

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

⚠WARNING

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.

FRONT WHEEL 2.5

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

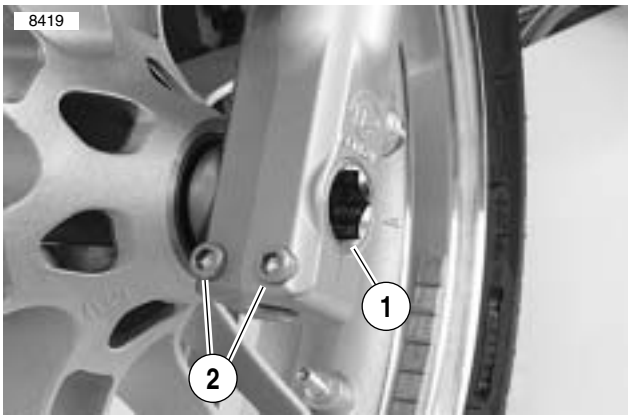
Do not operate front brake lever with front wheel removed or caliper pistons may be forced out. Reseating pistons requires caliper disassembly.

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.



1. Axle (left handed thread)
2. Front axle pinch fasteners (2) (metric)

Figure 2-5. Front Wheel Mounting



Figure 2-6. Front Wheel Removal

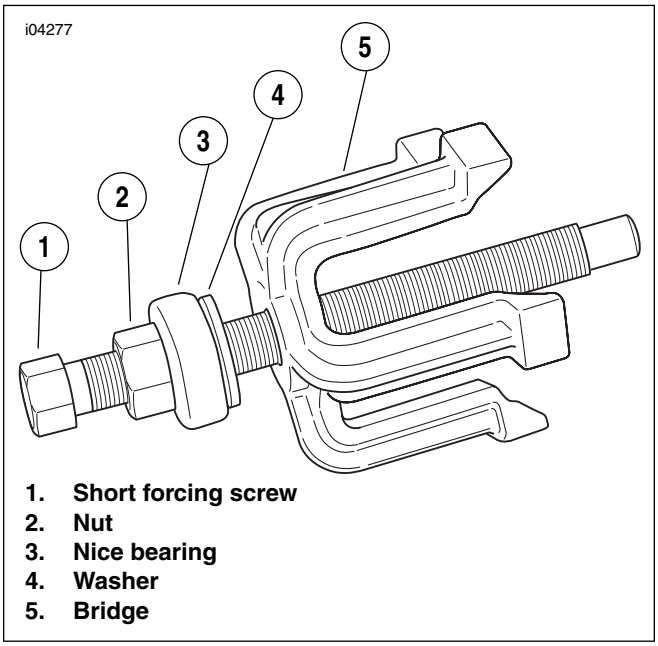
DISASSEMBLY

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.



1. **Short forcing screw**
2. **Nut**
3. **Nice bearing**
4. **Washer**
5. **Bridge**

Figure 2-7. Assemble Puller

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.

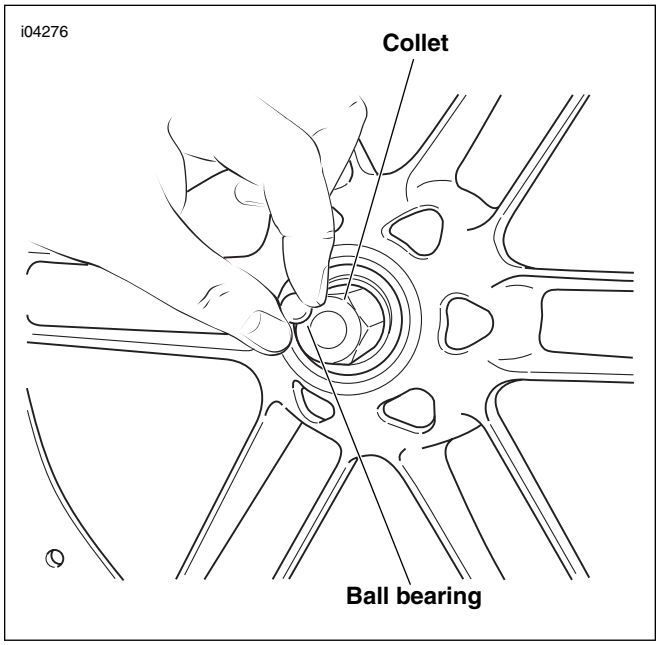
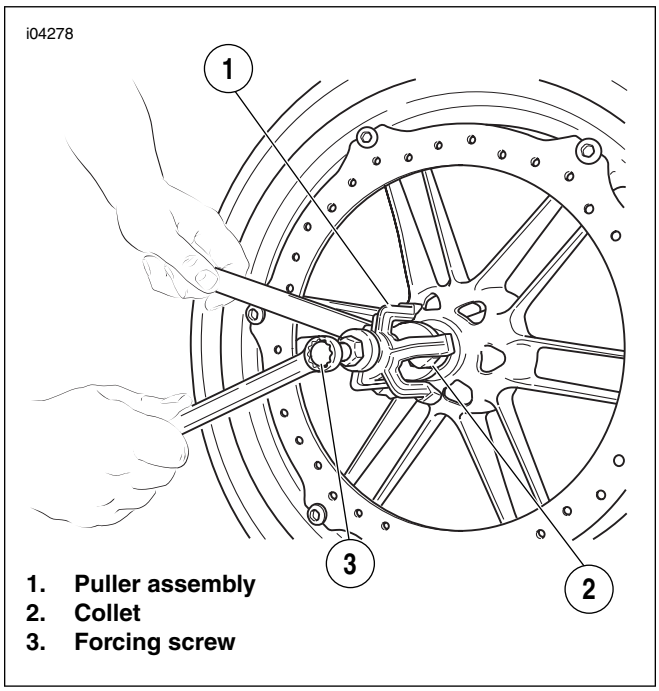


Figure 2-8. Install Collet and Ball Bearing

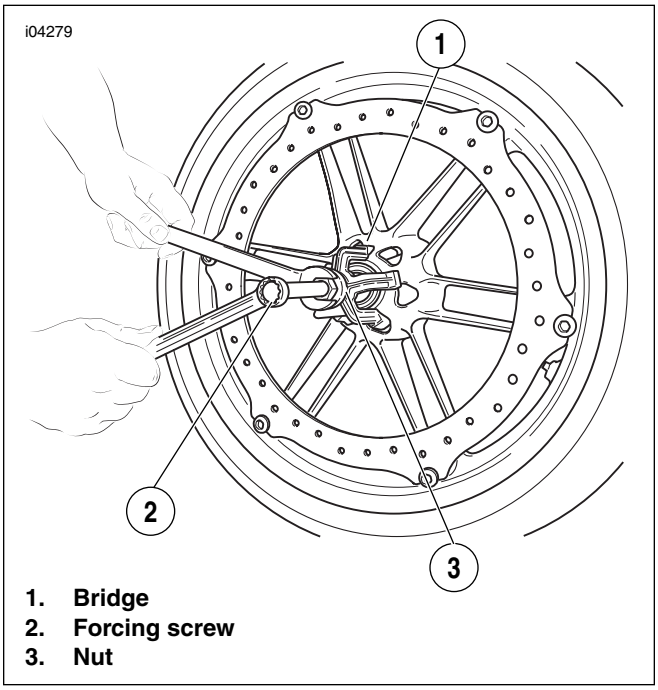
5. Insert the ball bearing into the collet.
6. See Figure 2-9. Thread the puller assembly (1) into the collet (2).
7. Hold the collet (2), and turn the forcing screw (3) to expand the collet.



1. **Puller assembly**
2. **Collet**
3. **Forcing screw**

Figure 2-9. Expand the Collet

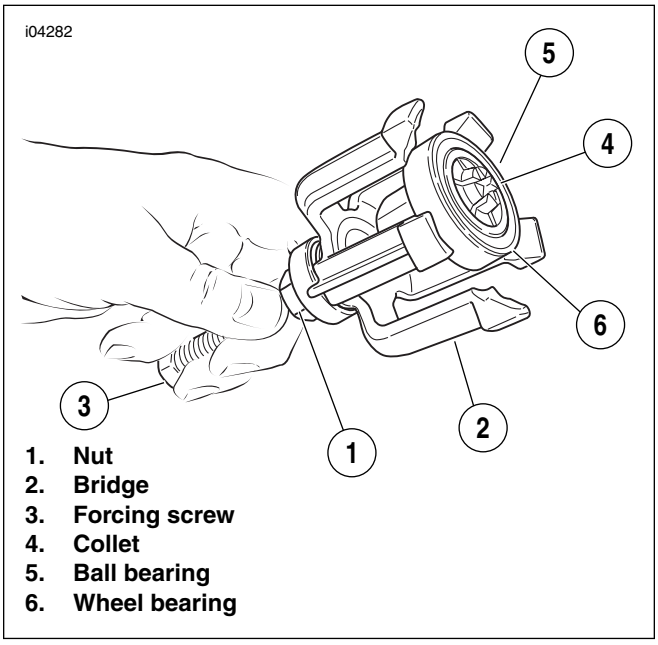
8. See Figure 2-10. Place the bridge (1) against the wheel hub.
9. Hold the forcing screw (2), and turn the nut (3) clockwise until the bearing is free of the hub.



1. **Bridge**
2. **Forcing screw**
3. **Nut**

Figure 2-10. Remove the Bearing

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).



1. **Nut**
2. **Bridge**
3. **Forcing screw**
4. **Collet**
5. **Ball bearing**
6. **Wheel bearing**

Figure 2-11. Removing Bearing from Puller

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

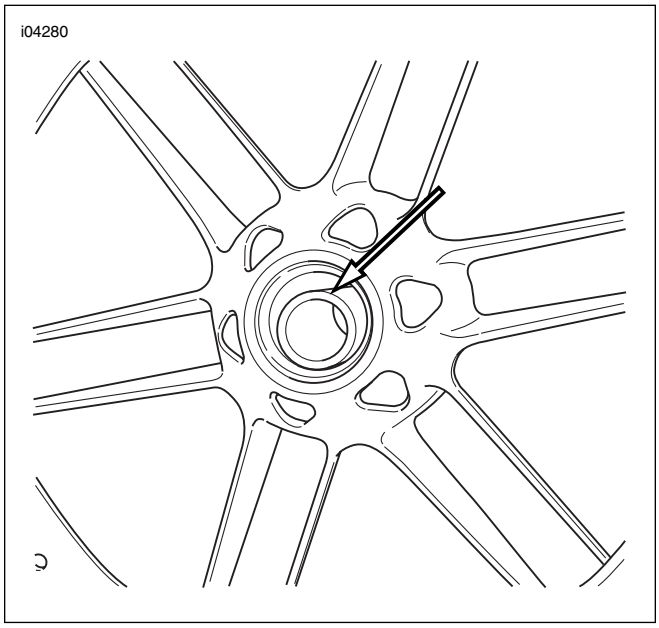


Figure 2-12. Remove the Spacer

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

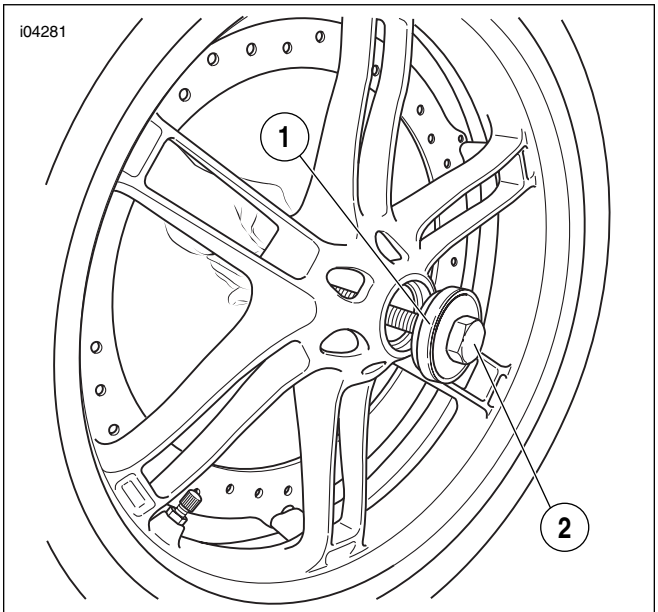
Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

Bearing Installation

NOTE

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

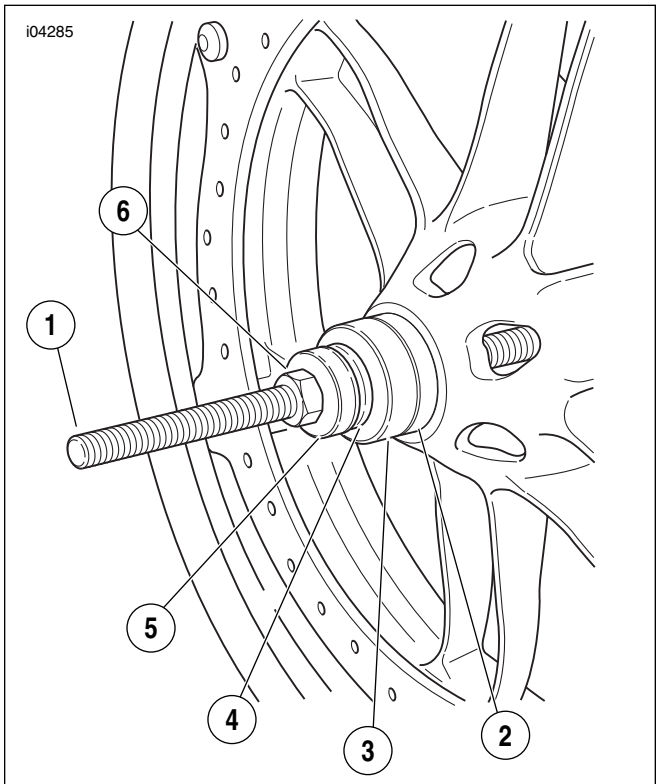
The following procedure describes the bearing installation for the front wheel; the procedure for the rear wheel is the same.



1. Backing plate
2. Forcing screw

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

1. See Figure 2-13. Install the Backing Plate (Part No. B-43993-11) onto the long forcing screw from the Wheel Bearing Installer/Remover (Part No. HD-44060), with the smaller diameter toward the wheel hub. Insert the forcing screw and backing plate into the wheel hub.



1. Long forcing screw
2. Wheel bearing
3. Front Wheel Bearing Installer (Part No. B-43993-9)
4. Washer
5. Nice bearing
6. Nut

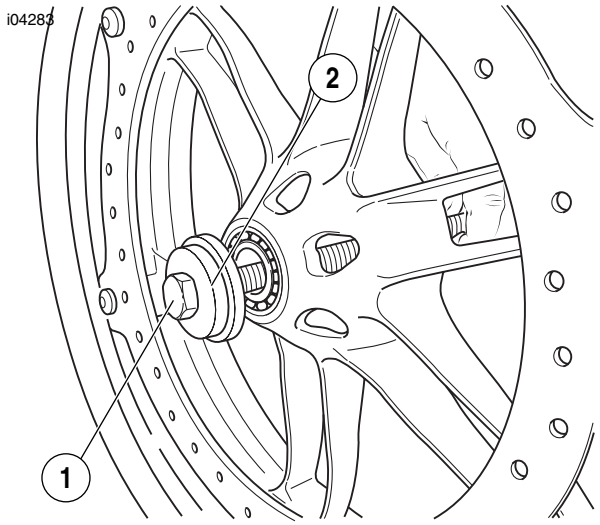
Figure 2-14. Installing Wheel Bearings

2. See Figure 2-14. 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 hub.*

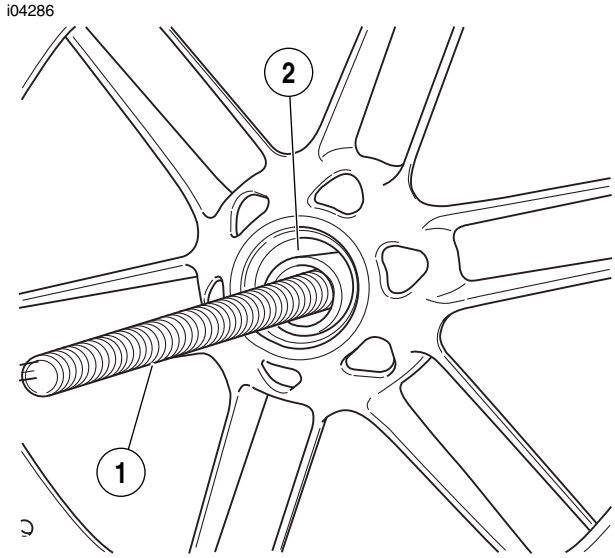
7. Remove the nut, bearing, washer, FRONT BEARING INSTALLER (Part No. B-43993-9) and forcing screw.



1. **Forcing screw**
2. **Backing Plate**

Figure 2-15. Insert Forcing Screw and Backing Plate

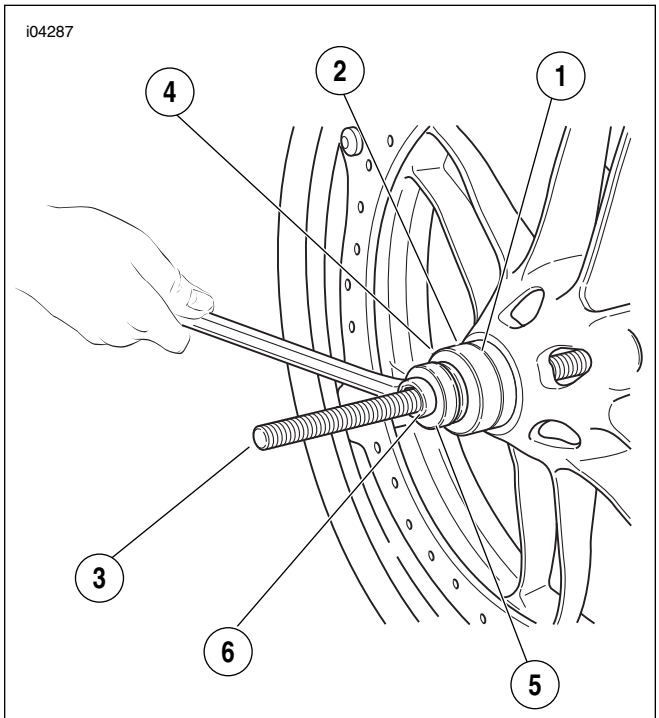
8. See Figure 2-15. Remove the BACKING PLATE (Part No. B-43993-11) from the long forcing screw. Reinstall the Backing Plate onto the forcing screw, with the smaller diameter toward the hex-head.
9. Insert the forcing screw through the wheel hub on the opposite side of the wheel.



1. **Forcing screw**
2. **Spacer**

Figure 2-16. Install the Spacer

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



1. **Wheel bearing**
2. **Front Wheel Bearing Installer (B-43993-9)**
3. **Forcing screw**
4. **Washer**
5. **Nice bearing**
6. **Nut**

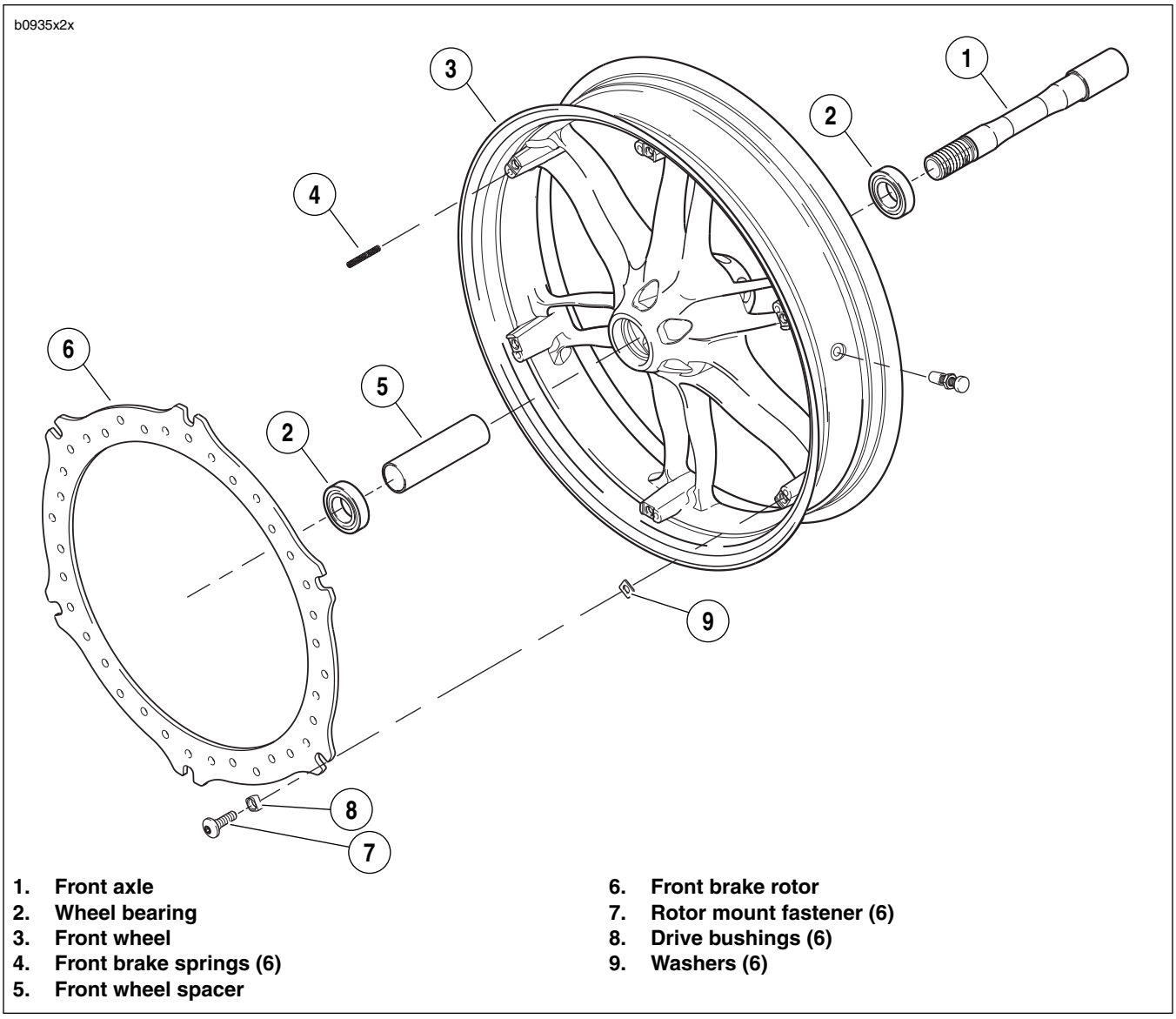
Figure 2-17. Install the Bearing

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.



1. **Front axle**
2. **Wheel bearing**
3. **Front wheel**
4. **Front brake springs (6)**
5. **Front wheel spacer**
6. **Front brake rotor**
7. **Rotor mount fastener (6)**
8. **Drive bushings (6)**
9. **Washers (6)**

Figure 2-18. Front Wheel Assembly

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.

INSTALLATION

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.

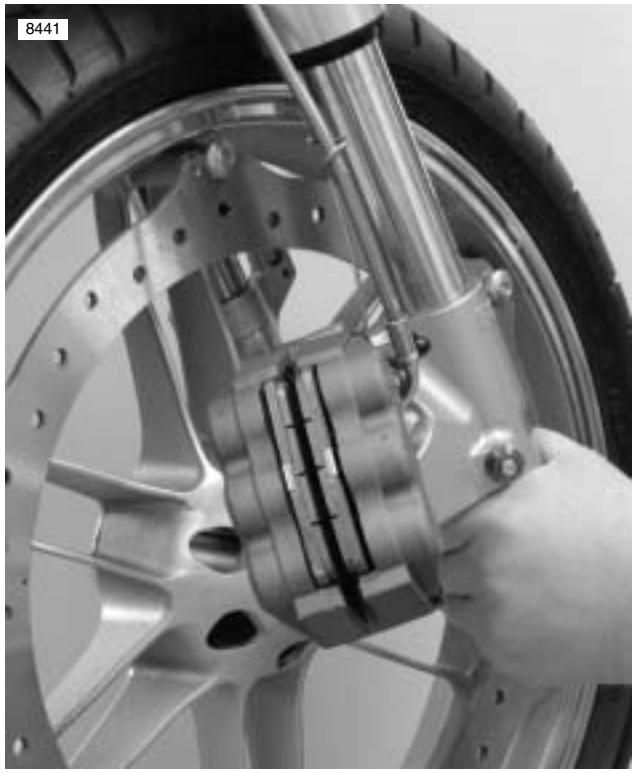
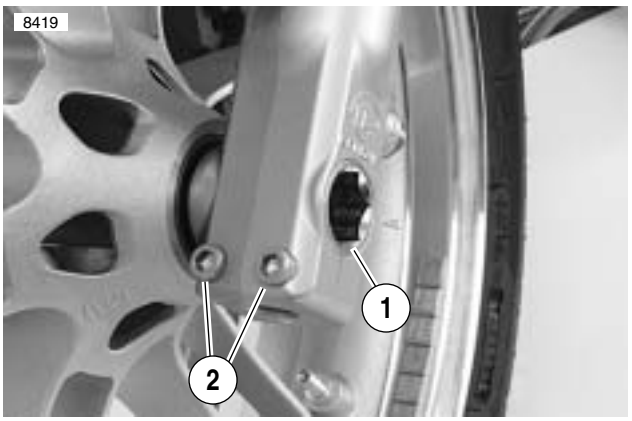


Figure 2-19. Front Wheel Installation



1. Axle (left handed thread)
2. Front axle pinch fasteners (2) (metric)

Figure 2-20. Front Wheel Mounting

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. Reseating piston requires caliper disassembly.

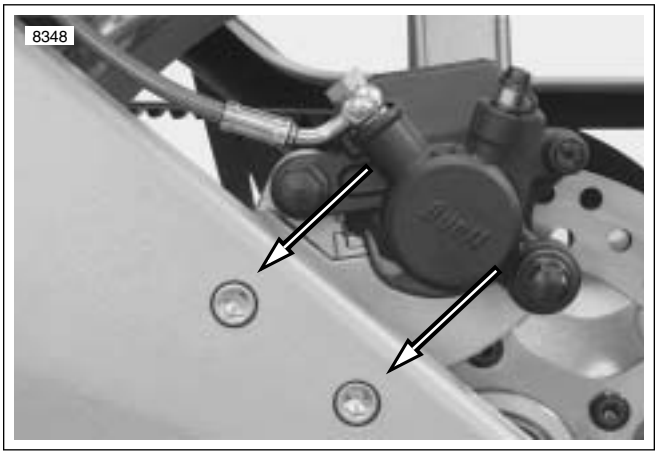
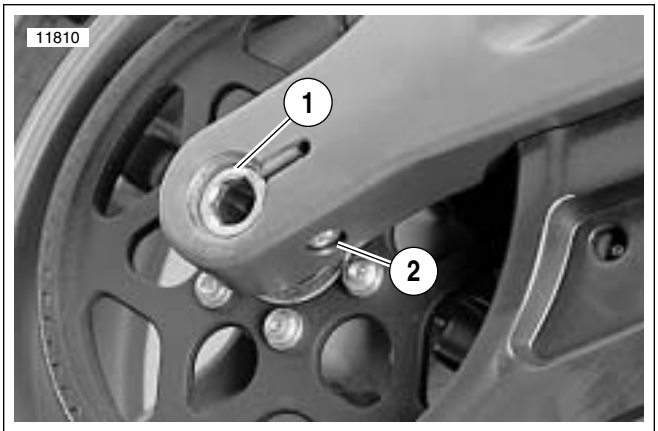


Figure 2-21. Rear Brake Caliper Carrier Fasteners

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



1. Axle
2. Pinch bolt fastener

Figure 2-22. Rear Wheel Mounting, Right Side

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.

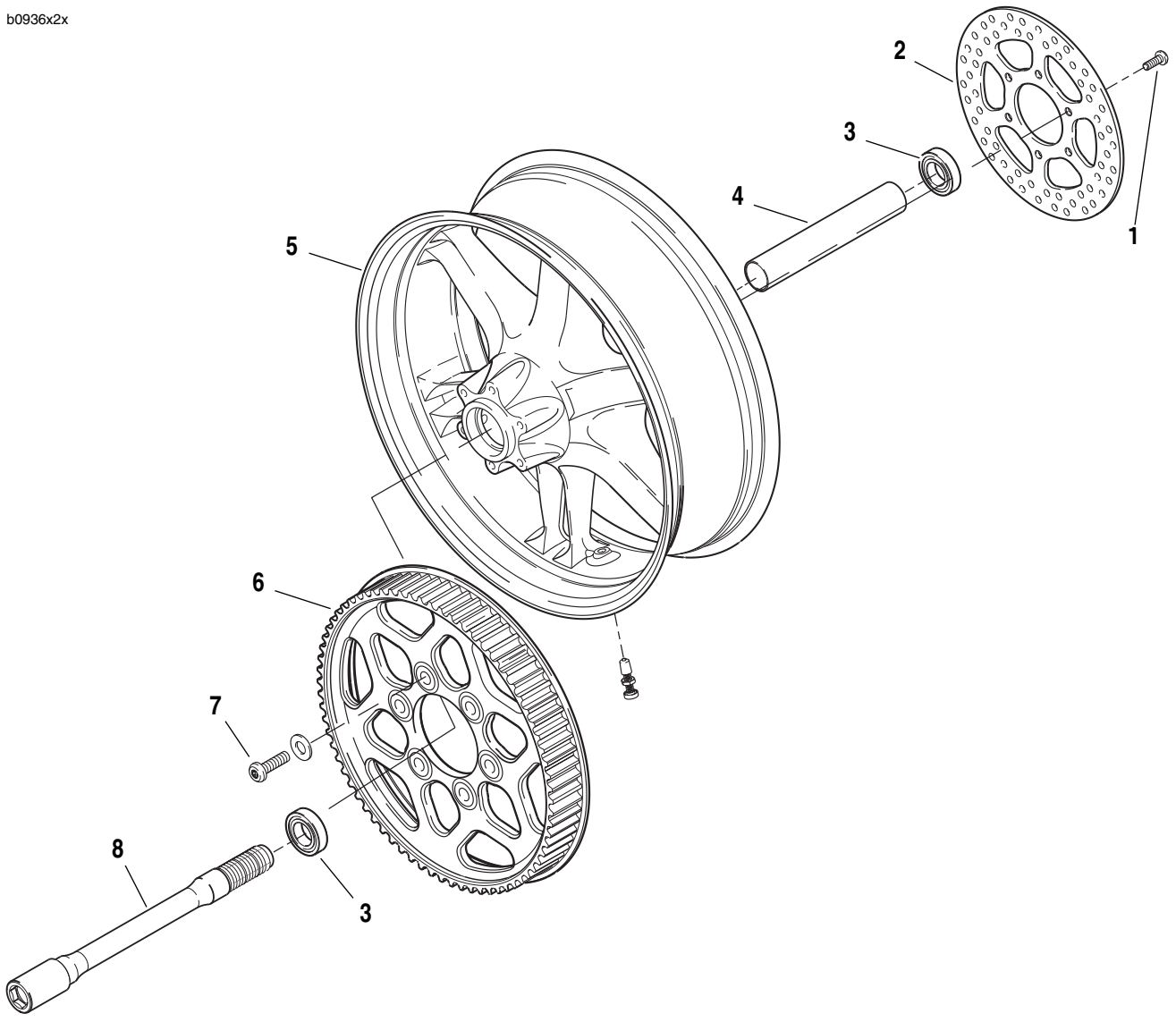
DISASSEMBLY

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).



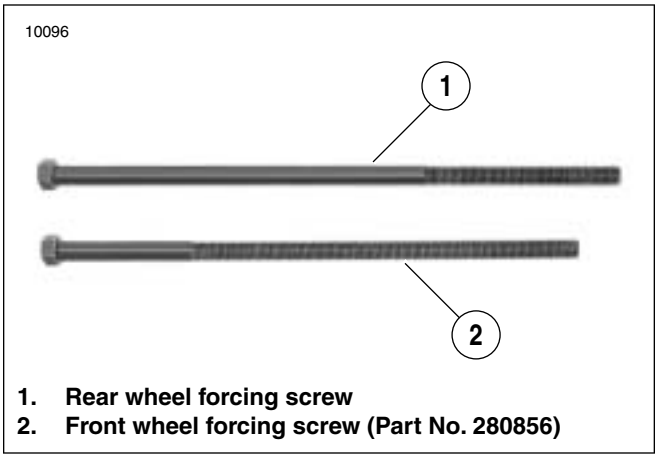
1. Rotor mounting fastener (6)
2. Brake rotor
3. Wheel bearing (2)
4. Wheel spacer
5. Wheel
6. Sprocket
7. Sprocket fastener (6)
8. Axle

Figure 2-23. Rear Wheel Assembly

ASSEMBLY

⚠WARNING

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



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

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).

INSTALLATION

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.

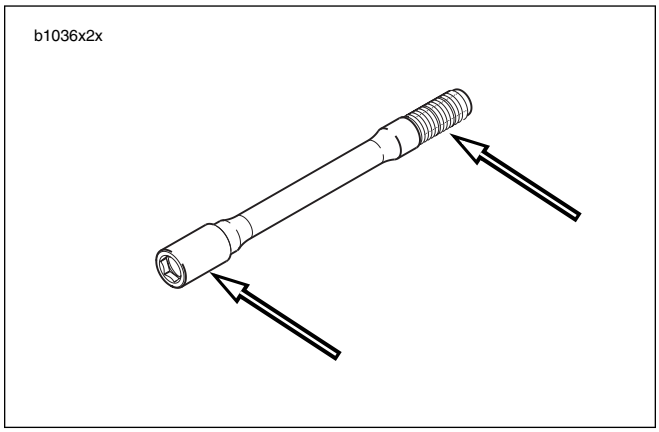
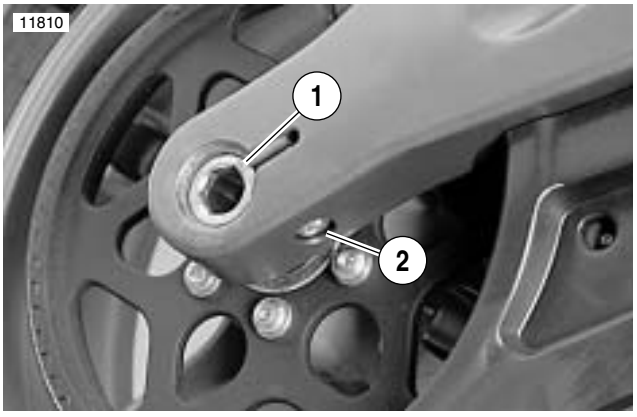


Figure 2-25. Anti-Seize Lubricant Location

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.



1. Axle
2. Pinch bolt fastener

Figure 2-26. Rear Wheel Mounting, Right Side

7. See Figure 2-26. 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).
8. Tighten pinch fastener (2) on right side of swingarm to 40-45 ft-lbs (54-61 Nm).

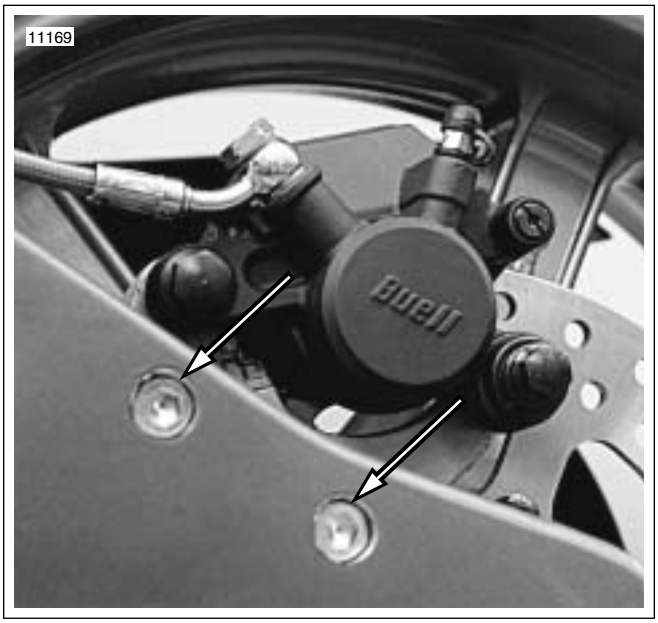


Figure 2-27. Rear Brake Caliper Carrier Fasteners

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)

CHECKING CAST RIM RUNOUT 2.7

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

RUNOUT	IN	MM
Maximum lateral	0.040	1.02
Maximum radial	0.030	0.76

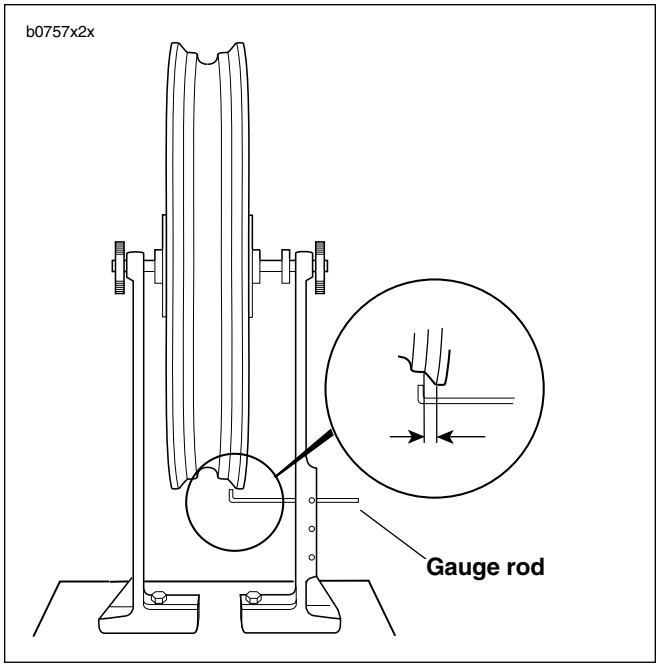


Figure 2-28. Checking Cast Rim Lateral Runout Using Wheel Truing and Balancing Stand (HD-99500-80)

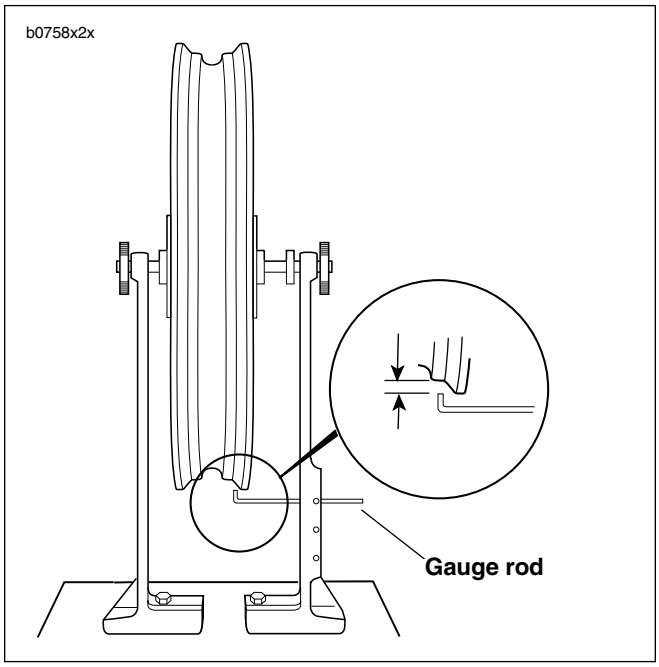


Figure 2-29. Checking Cast Rim Radial Runout Using Wheel Truing and Balancing Stand (HD-99500-80)

GENERAL

Tires should be inspected for punctures, cuts, breaks and wear at least weekly.

New tires should be stored in a horizontal tire rack. Avoid stacking new tires in a vertical stack. The weight of the stack compresses the tires and closes down the beads.

⚠WARNING

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

⚠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. Interchanging front and rear tires can cause tire failure, which could result in death or serious injury. (00026b)**

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.
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.

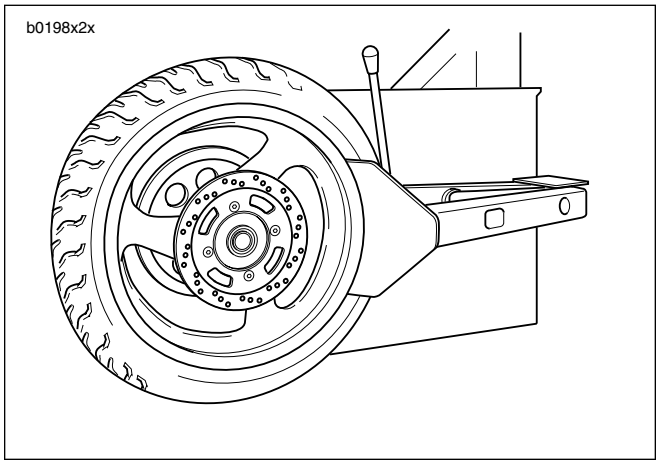


Figure 2-30. Loosening Beads from Rim Flange

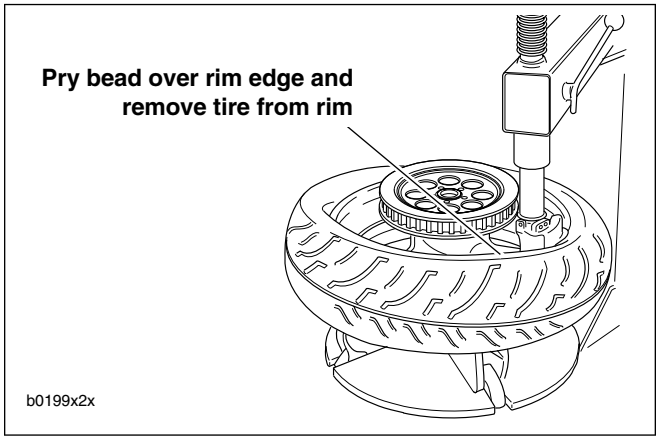


Figure 2-31. Starting Tire Off Rim

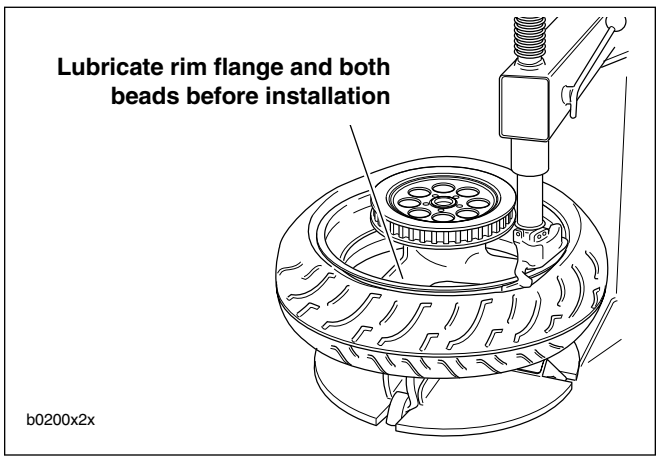


Figure 2-32. Starting Bead on Rim

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)**

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

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.

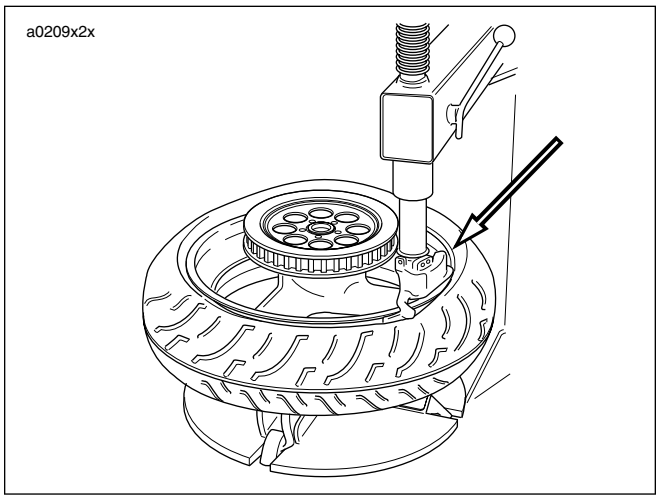


Figure 2-33. Starting Bead on Rim (Typical)

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 sidewall.
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 then 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.

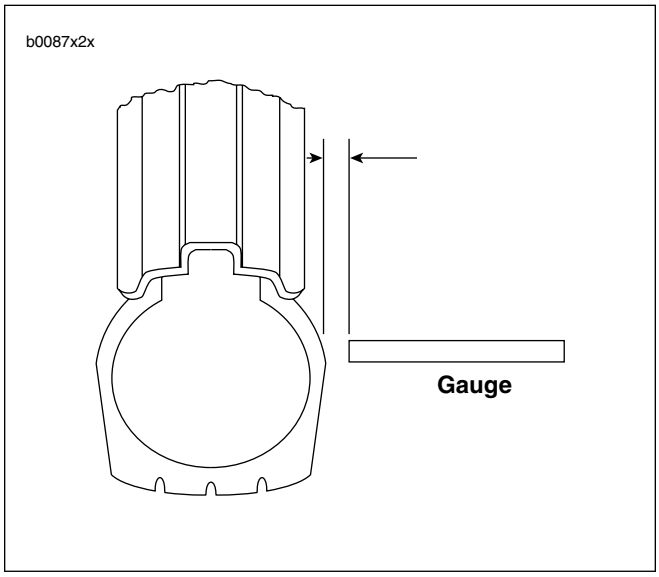


Figure 2-34. Checking Tire Lateral Runout

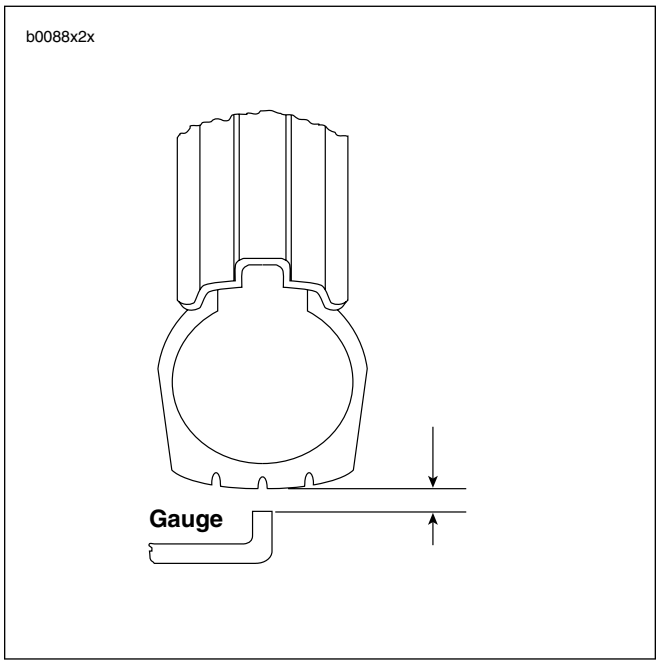


Figure 2-35. Checking Tire Radial Runout

Table 2-12. Tire Runout

RUNOUT	IN.	MM
Tire radial	0.060	1.52
Tire lateral	0.080	2.03

ADJUSTMENT

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-99500-80) 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.

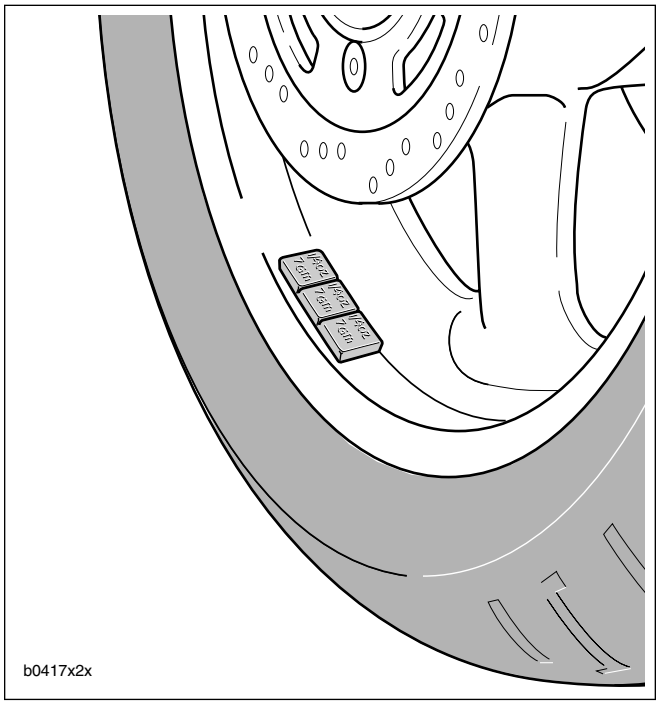


Figure 2-36. Wheel Weights

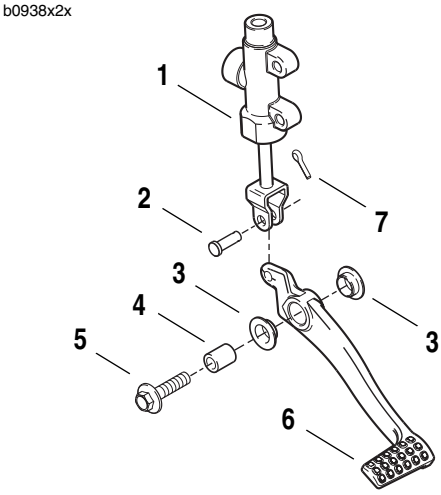
BRAKE PEDAL 2.9

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).



1. **Rear master cylinder body**
2. **Clevis pin**
3. **Pedal bushings (2)**
4. **Shift brake pedal sleeve**
5. **Brake pedal fastener**
6. **Brake pedal**
7. **Cotter pin**

Figure 2-37. Brake Pedal Assembly

FRONT BRAKE MASTER CYLINDER AND HAND LEVER 2.10

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

D.O.T. 4 brake fluid will damage painted and body panel surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239b)

⚠CAUTION

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)

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.

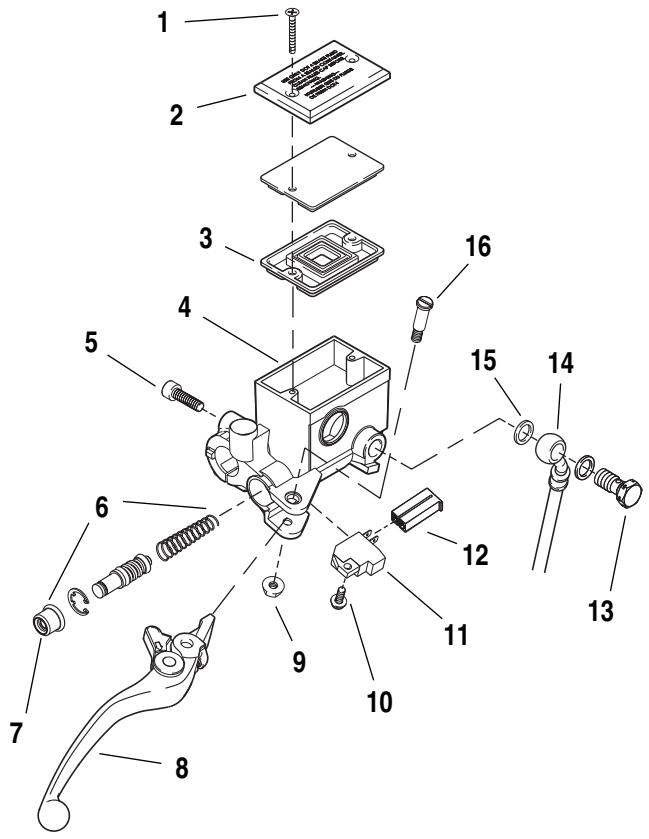
2. See Figure 2-38. Remove the banjo bolt (13) (metric) and two copper washers (15) to disconnect brake line (14) from master cylinder (4). Discard copper washers.
3. Unplug terminal (12) to detach brake lamp switch (11).

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.

b0979x2x



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**

Figure 2-38. Front Brake Hand Lever Assembly

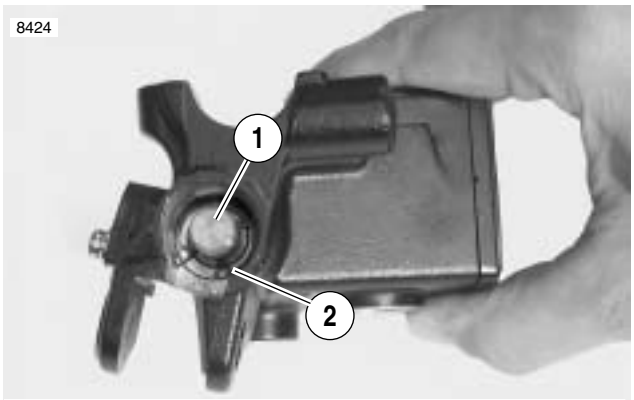
DISASSEMBLY

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.



1. Piston assembly
2. Circlip

Figure 2-39. Piston Assembly in Master Cylinder

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

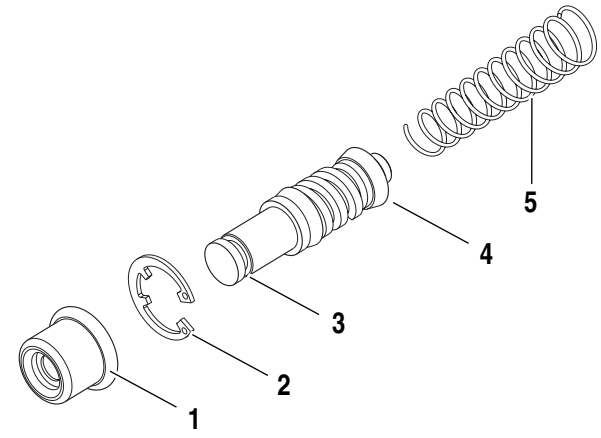
Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

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.

ASSEMBLY

Front Master Cylinder

1. Obtain PISTON ASSEMBLY KIT.



1. **Ridge on rubber boot**
2. **Circlip**
3. **Groove on piston**
4. **Primary seal of piston**
5. **Spring**

Figure 2-40. Front Master Cylinder Piston Assembly

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.

⚠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.

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).

INSTALLATION

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).

⚠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)

⚠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)

11. Turn ignition key switch to ON. Apply brake hand lever to test brake lamp operation. Turn ignition key switch to OFF.

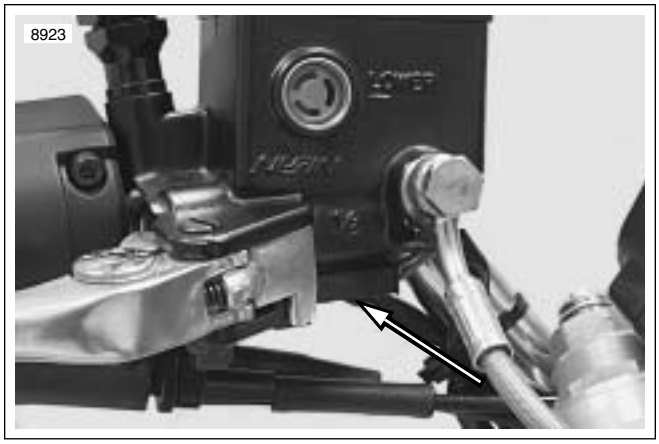


Figure 2-41. Front Brake Light Switch Connector

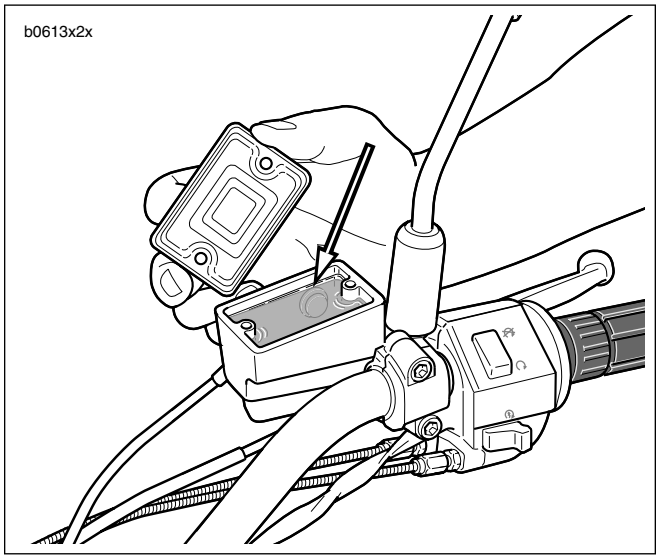


Figure 2-42. Brake Fluid Level (Standard Brake Reservoir Shown)

FRONT BRAKE LINE 2.11

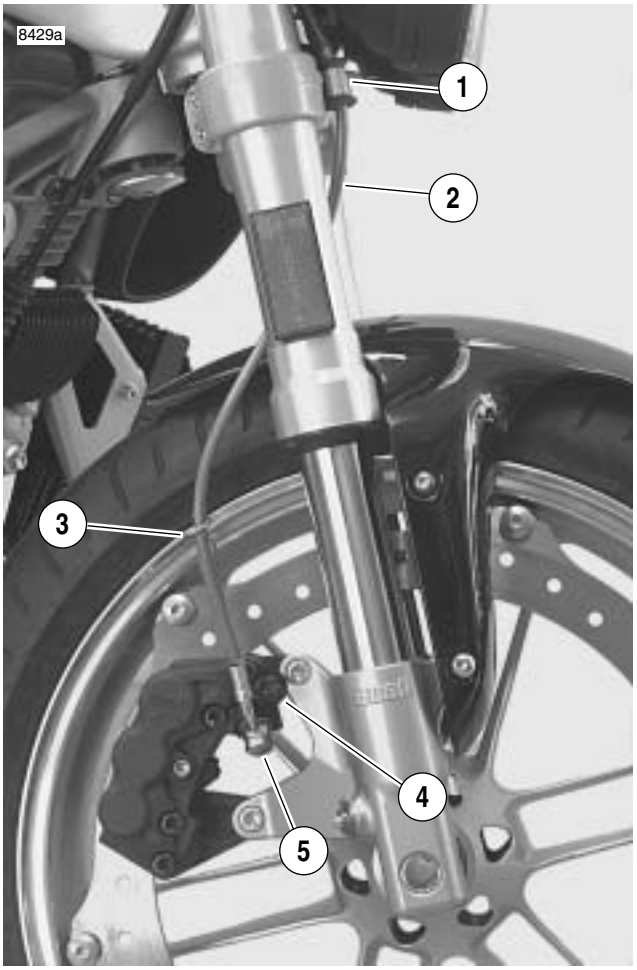
REMOVAL

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.



1. **P-clamp**
2. **Brake line**
3. **Wire form**
4. **Bleeder valve**
5. **Banjo bolt**

Figure 2-43. Front Brake Line

INSTALLATION

NOTE

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 D.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.

⚠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).

   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).

⚠WARNING

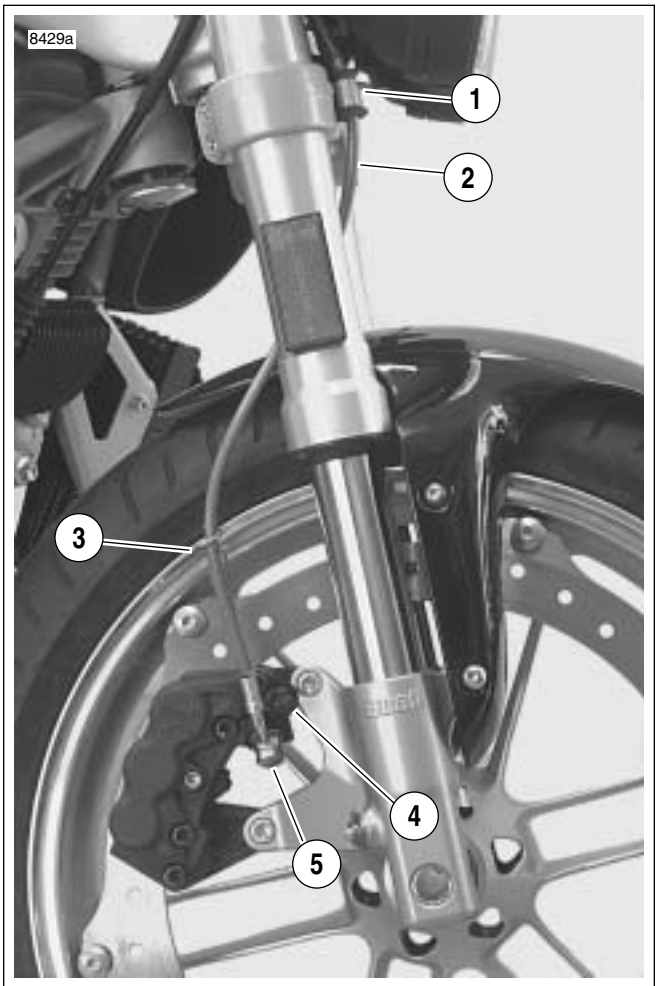
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

8. Install bleeder valve if removed. Refill master cylinder and bleed brakes. 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)

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



1. **P-clamp**
2. **Brake line**
3. **Wire form**
4. **Bleeder valve**
5. **Banjo bolt**

Figure 2-44. Front Brake Line

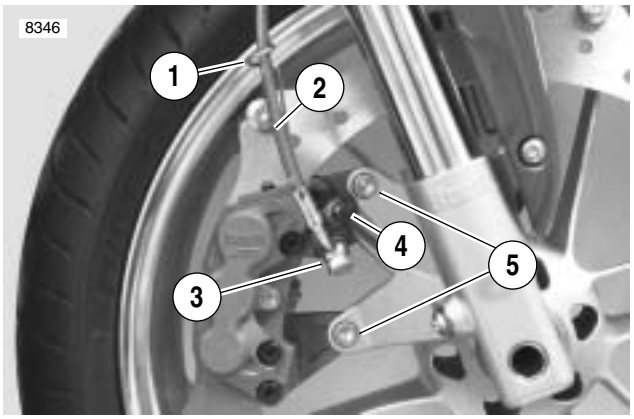
FRONT BRAKE CALIPER 2.12

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.



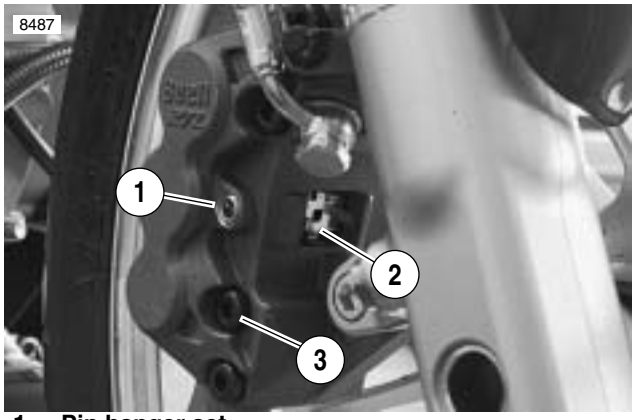
1. **Wire form**
2. **Brake line**
3. **Banjo bolt (metric)**
4. **Pin plug**
5. **Mounting fasteners (2)**

Figure 2-45. Front Brake Caliper Mounts

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).



1. **Pin hanger set**
2. **Caliper pad spring**
3. **Caliper fasteners**

Figure 2-46. Pad Spring (Typical)

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).

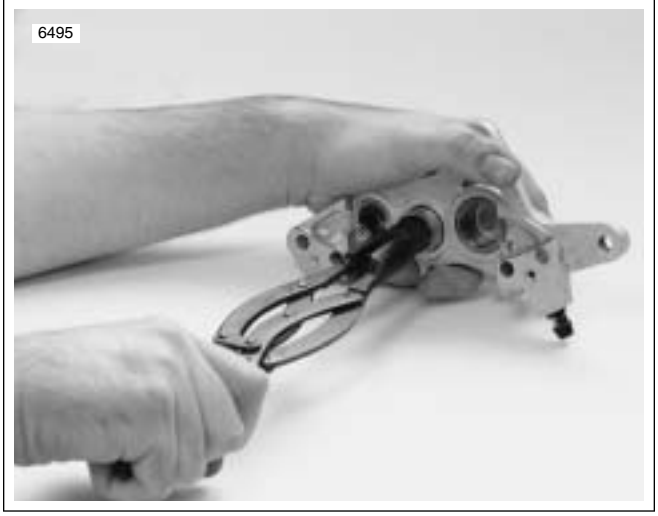


Figure 2-47. Removing Pistons (B-42887)

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.

⚠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

RUNOUT	IN.	MM
Rotor radial	0.0177	0.45
Rotor lateral	0.0248	0.63

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

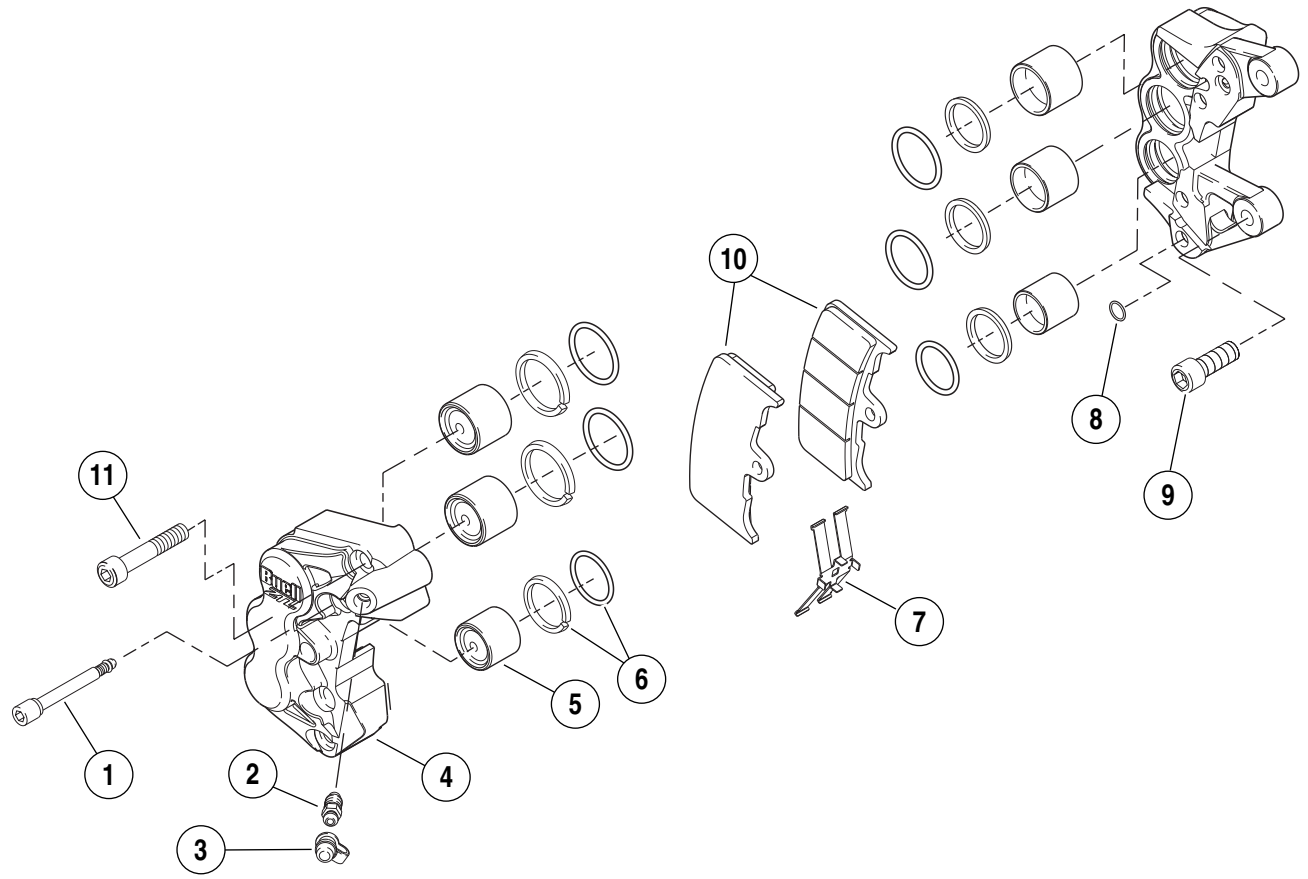
Use only new copper crush banjo washers (See Parts Catalog for Part No.) with D.O.T. 4 brake fluid. Earlier silver banjo washers are not compatible with D.O.T. 4 fluid and will not seal properly over time. Failure to comply may adversely affect braking ability and lead to brake failure which could result 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 2.13

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).

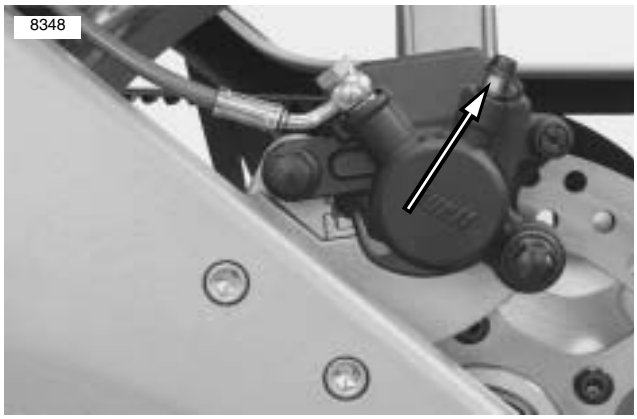
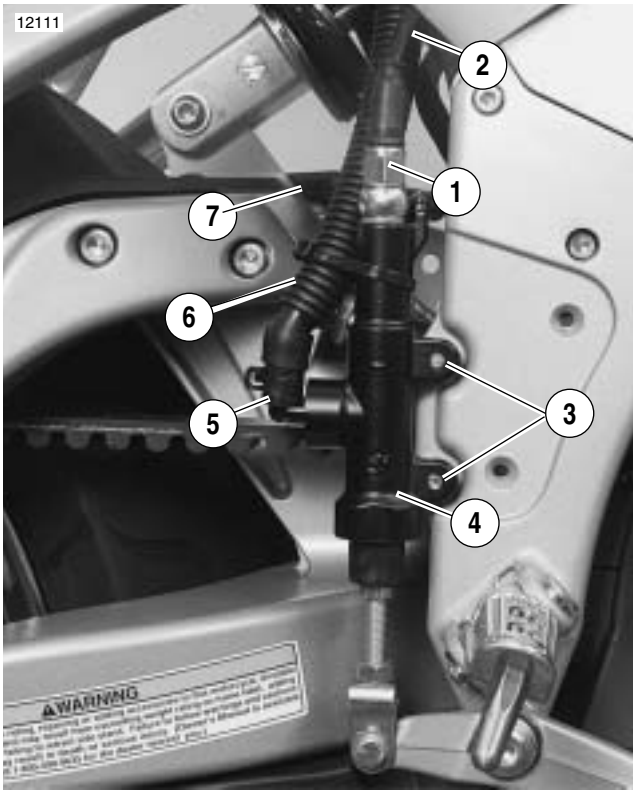


Figure 2-49. Brake Bleeder Valve, Rear Caliper

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.



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**

Figure 2-50. Rear Master Cylinder On Vehicle

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

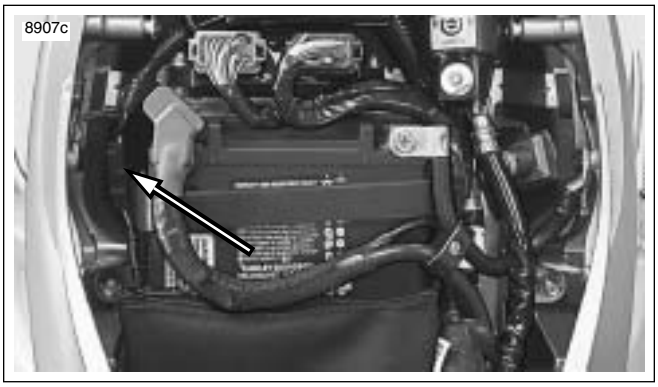
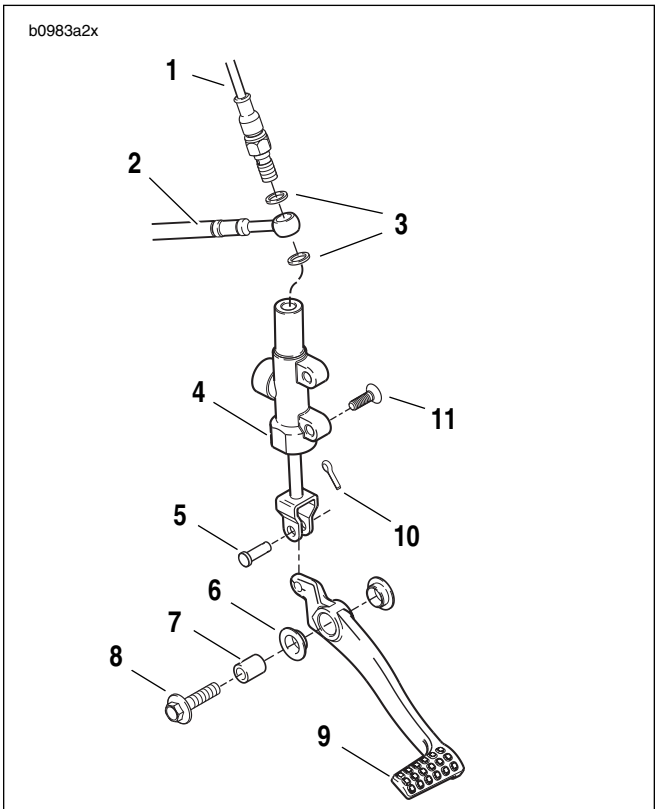


Figure 2-51. Brake Line Switch Connector (XB12S shown)

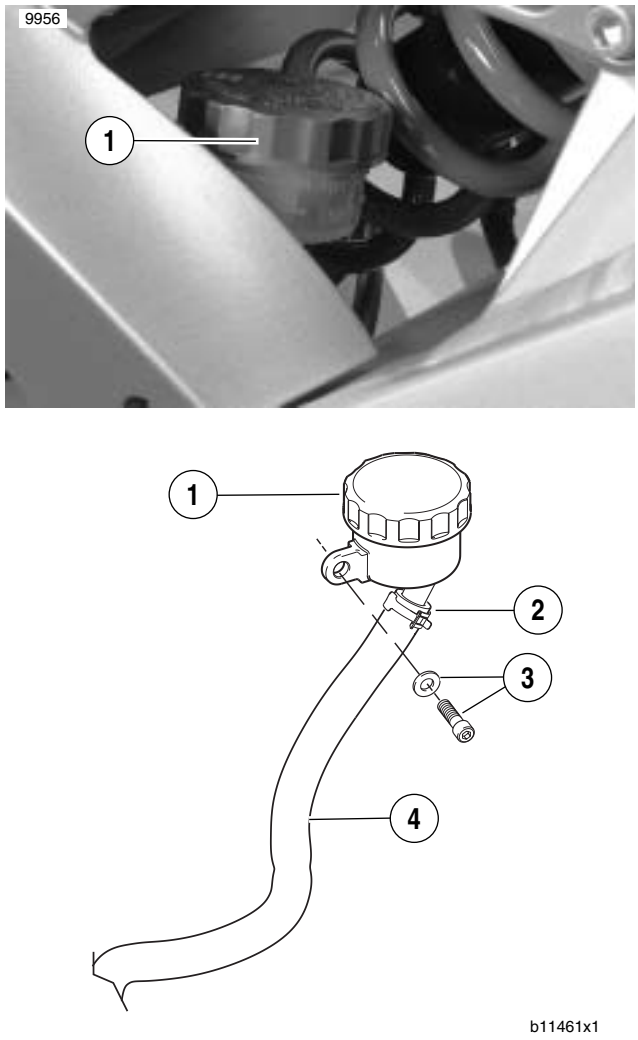
6. See Figure 2-51. Disconnect brake light connector located under the seat.



1. **Rear brake light switch assembly**
2. **Brake line**
3. **Copper washer**
4. **Rear master cylinder body**
5. **Clevis pin**
6. **Pedal bearing**
7. **Sleeve**
8. **Brake pedal fastener**
9. **Brake pedal**
10. **Cotter pin**
11. **Rear master cylinder mount screw**

Figure 2-52. Rear Master Cylinder Assembly

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 FOOTPEG, HEEL GUARD AND MOUNT.
9. See Figure 2-52. Remove fasteners (11) (metric) to detach master cylinder (4) from rider footpeg mount.



1. **Reservoir**
2. **Clamp**
3. **Fastener and washer**
4. **Remote reservoir hose**

Figure 2-53. Remote Reservoir (XB12S shown)

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

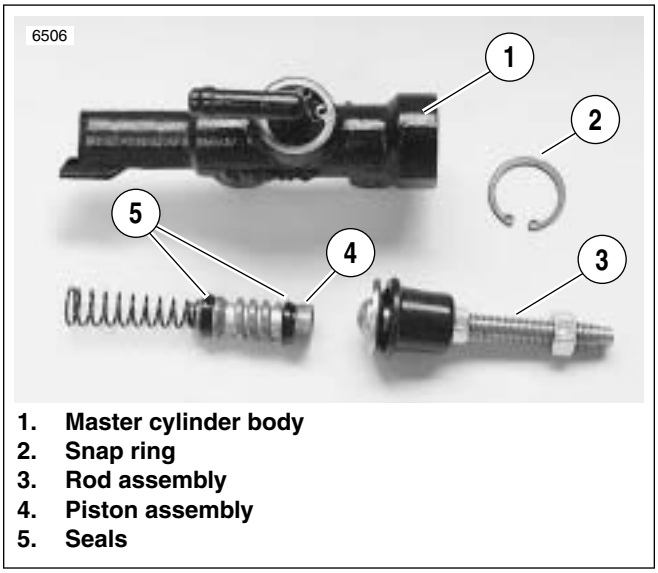
⚠WARNING

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. 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.

ASSEMBLY

1. Obtain PISTON ASSEMBLY KIT.



1. **Master cylinder body**
2. **Snap ring**
3. **Rod assembly**
4. **Piston assembly**
5. **Seals**

Figure 2-54. Master Cylinder Internal

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).

⚠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.

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 2.14

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.

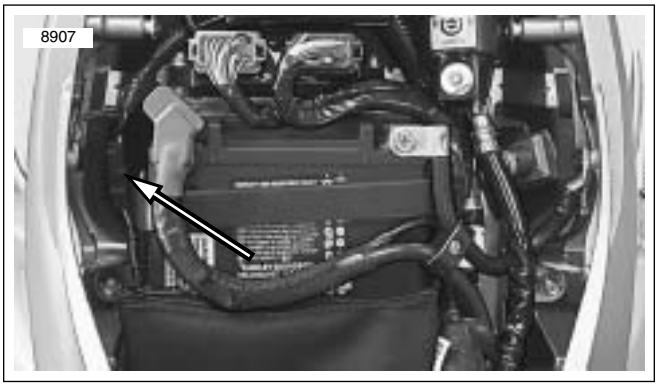
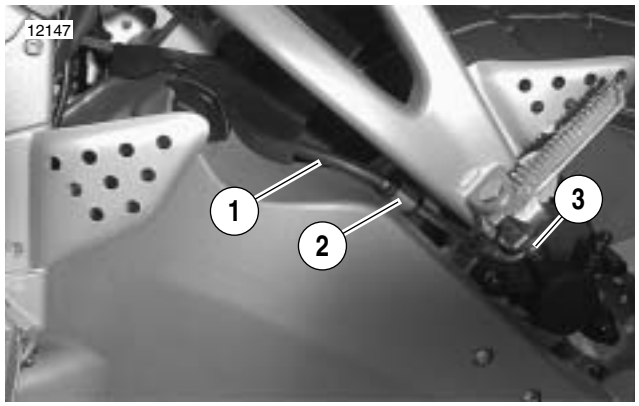


Figure 2-55. Brake Line Switch Connector (XB12S shown)

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.



1. **Brake line**
2. **P-clamp**
3. **Banjo bolt**

Figure 2-56. Rear Brake Line

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.

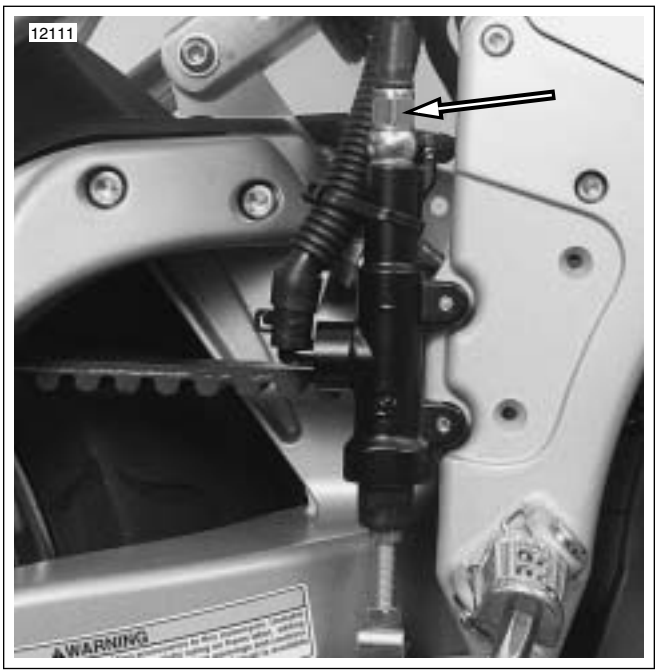


Figure 2-57. Rear Brake Line Switch/Banjo Bolt

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

INSTALLATION

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).

NOTE

Tighten the right side banjo bolt with FLARE NUT SOCKET tool (SNAP-ON Part No. FRXM14) or a crowsfoot.

⚠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.

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 D.1 HOSE AND WIRE ROUTING for brake line routing.
4. See Figure 2-58. Connect brake line switch connector underneath seat. See D.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.

⚠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)

8. Install negative battery cable and tighten 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.

⚠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)

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

⚠WARNING

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

11. Test ride motorcycle and check for proper brake operation.

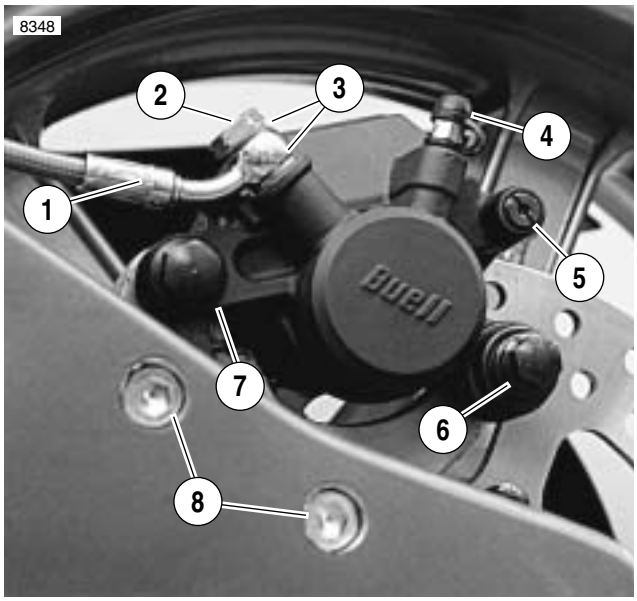
REAR BRAKE CALIPER 2.15

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.



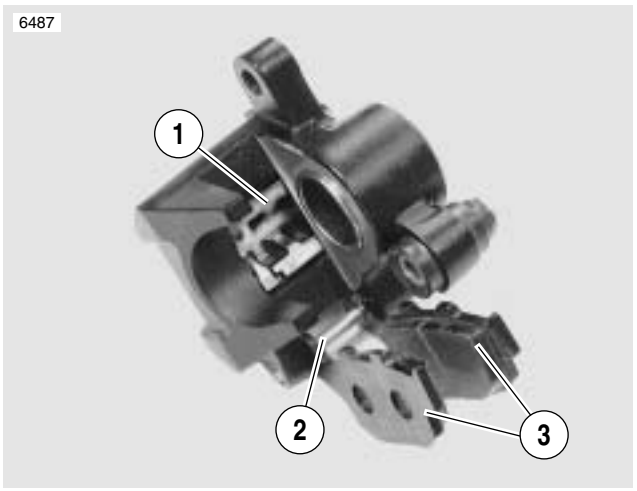
1. **Brake line**
2. **Banjo bolt (metric)**
3. **Copper washers (2)**
4. **Bleeder valve (metric)**
5. **Pin plug**
6. **Small caliper fastener**
7. **Larger caliper fastener**
8. **Caliper mounting fasteners**

Figure 2-58. Rear Brake Caliper

3. See Figure 2-58. Remove caliper mounting fasteners (6 and 7).

DISASSEMBLY

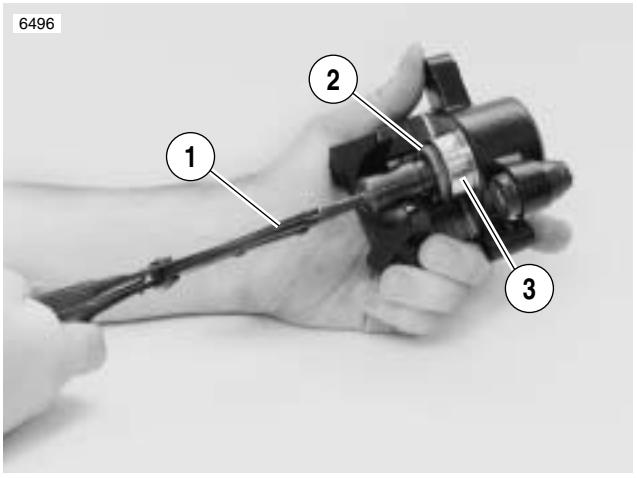
1. See Figure 2-58. Remove pin plug (5) and pad hanger (metric) to free brake pads.



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

Figure 2-59. Brake Pads

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



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

Figure 2-60. Removing Rear Brake Caliper Piston

3. See Figure 2-60. Remove piston (3) using BRAKE CALIPER PISTON REMOVER (1) (Part No. B-42887) with adaptor (2).
4. Remove two o-rings from groove in caliper bore 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.
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.

Table 2-14. Rear Rotor Runout

RUNOUT	IN.	MM
Rotor radial	0.0177	0.45
Rotor lateral	0.0154	0.39

⚠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)

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.

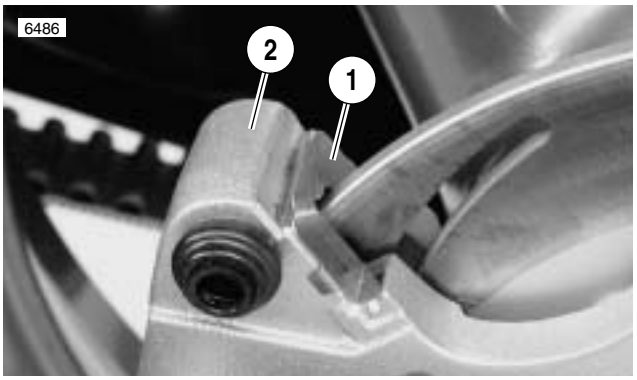
ASSEMBLY

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.



1. Retainer, brake pads
2. Rear caliper mount

Figure 2-61. Retainer, Brake Pads

NOTE

See Figure 2-61. Always make sure brake pad retainer is in place on caliper mount before installing pads and caliper.

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).

INSTALLATION

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).

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

3. 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).
4. Depress rear brake pedal several times to set brake pads to proper position within caliper. Bleed brake system. See 1.6 BRAKE SYSTEM MAINTENANCE.

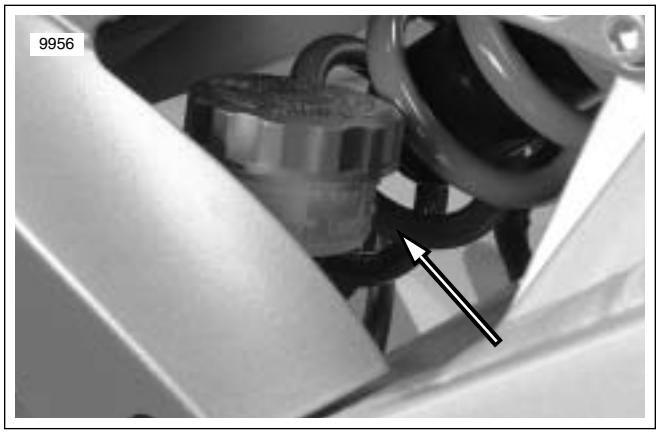


Figure 2-62. Rear Reservoir (XB12S shown)

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

⚠WARNING

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

6. Turn ignition key switch to ON. Apply brake pedal to test brake lamp operation. Turn ignition key switch to LOCK.

⚠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)

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.*

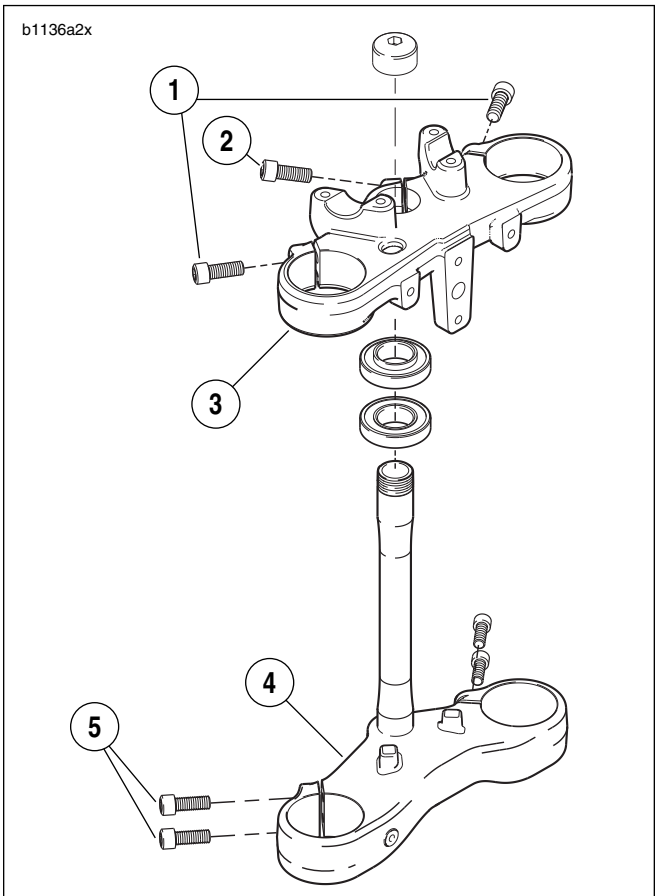
GENERAL

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.



1. **Screw, pinch fastener**
2. **Steering stem pinch fastener**
3. **Triple clamp, upper**
4. **Triple clamp assembly, lower**
5. **Screw, pinch fastener**

Figure 2-63. Upper and Lower Fork Clamp Assembly

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

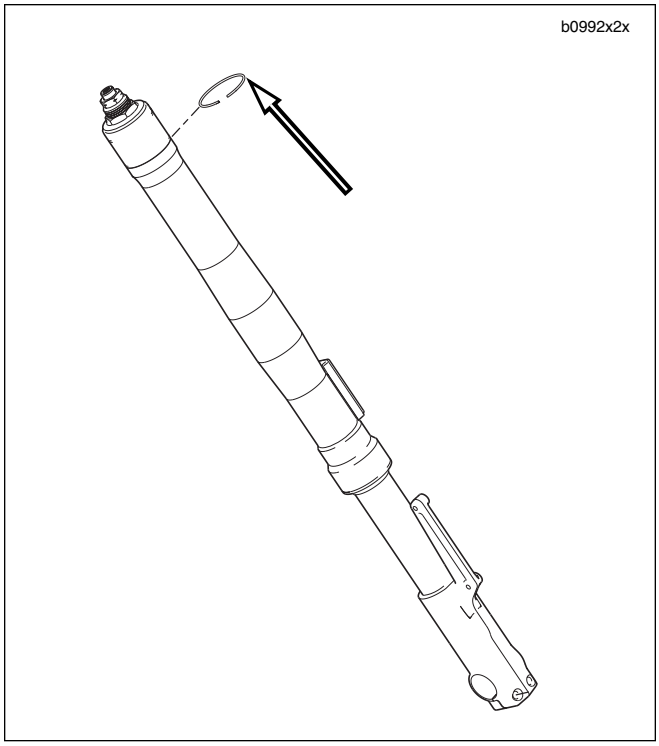


Figure 2-64. Stopper Ring

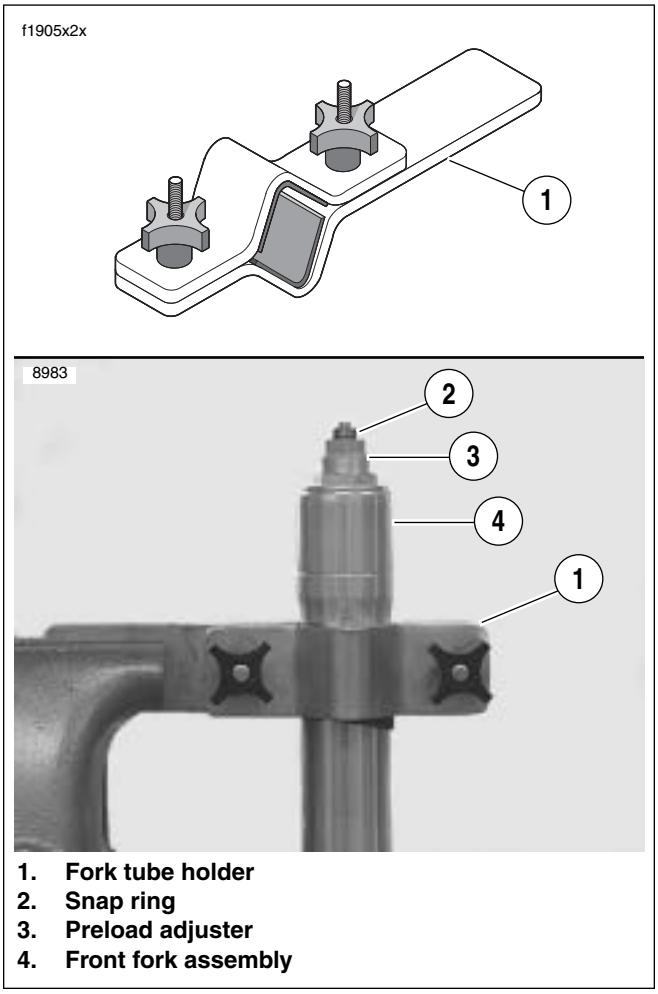
5. See Figure 2-64. Remove fork from upper fork clamp and slide the stopper ring up and over the top of the fork.
6. See Figure 2-63. Remove fork from lower fork clamp (3).
7. Repeat 4 through 6 on opposite side.

DISASSEMBLY

NOTE

Record rider suspension settings before disassembly.

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



1. **Fork tube holder**
2. **Snap ring**
3. **Preload adjuster**
4. **Front fork assembly**

Figure 2-65. Fork Tube Holder (HD-41177)

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).

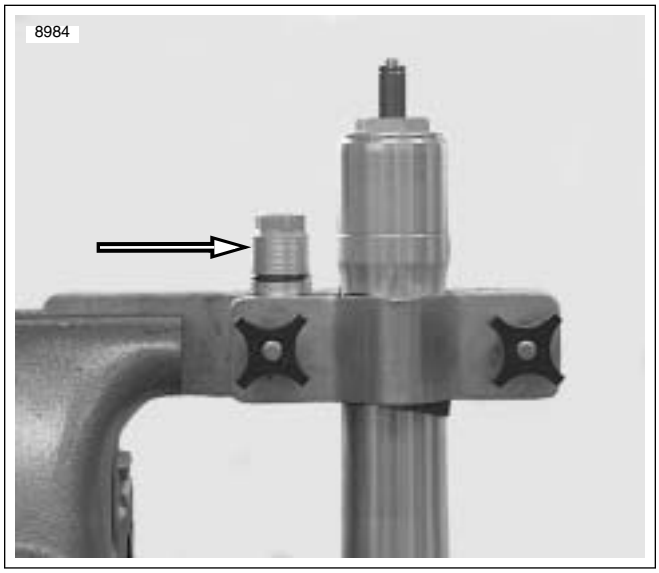


Figure 2-66. Removing Preload Adjuster

4. See Figure 2-66. Remove preload adjuster by turning counterclockwise.

NOTE

After fully unthreading preload adjuster, gently pull on adjuster.

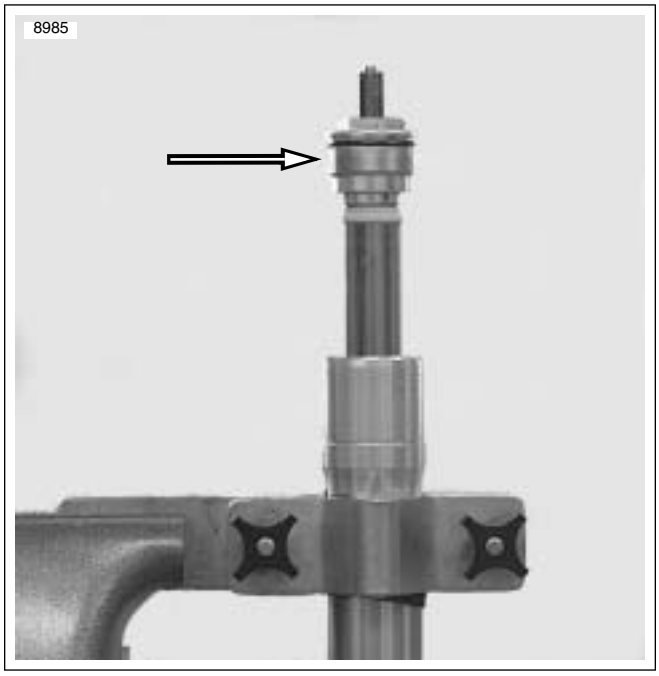


Figure 2-67. Removing Fork Cap From Outer Tube

5. See Figure 2-67. Remove fork cap from outer tube.

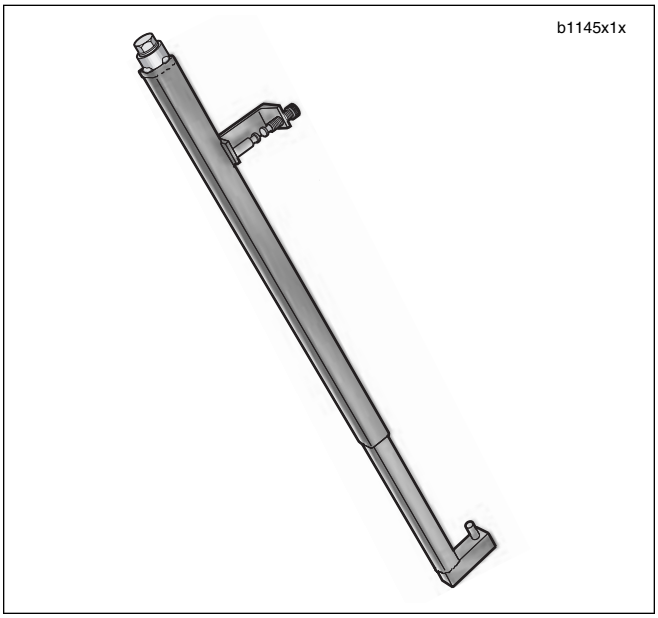
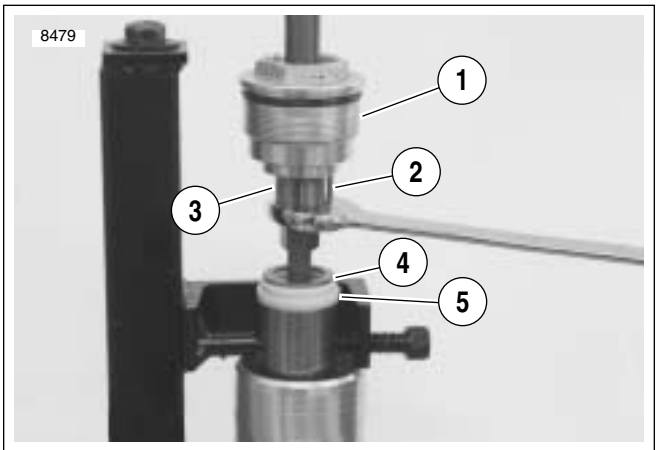


Figure 2-68. Fork Spring Compressing Tool (HD-45966)

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.*



1. **Fork cap**
2. **Preload pins**
3. **Damper rod assembly**
4. **Preload washer**
5. **Slider piston**

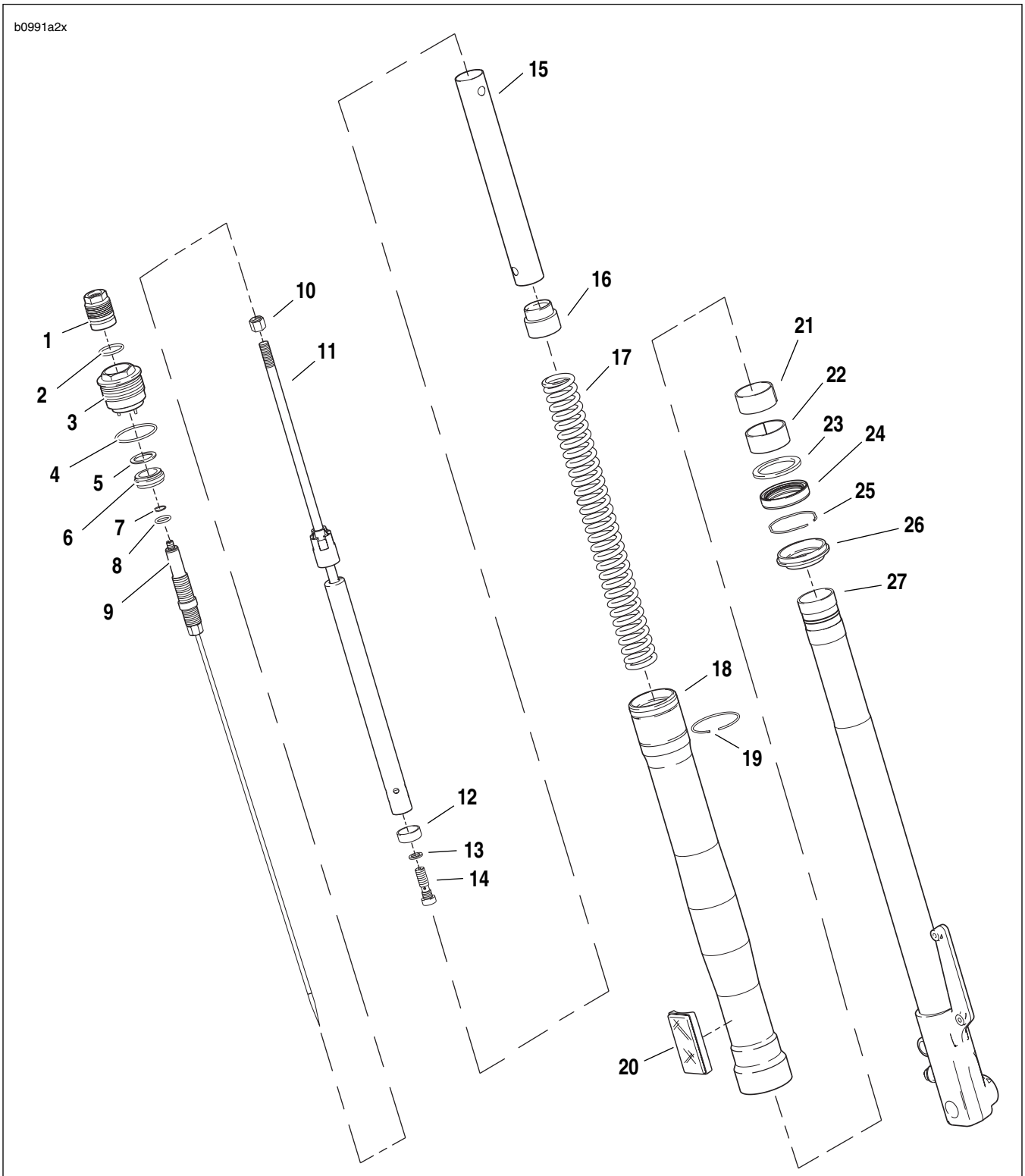
Figure 2-69. Holding Damper Rod Assembly

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.



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

Figure 2-70. Front Fork Assembly

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 dampening 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).

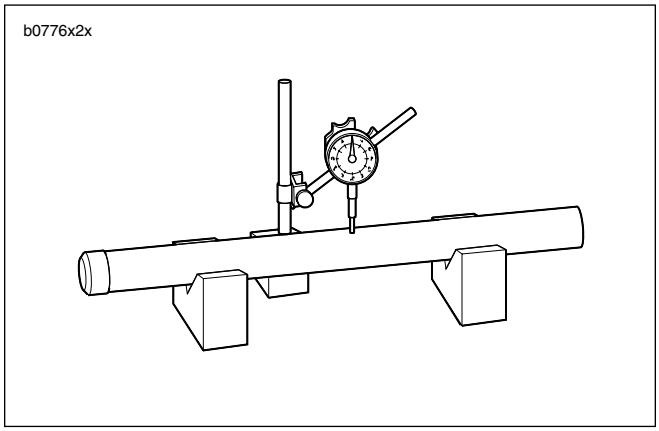


Figure 2-71. Slider fork Runout

ASSEMBLY

Damper Rod Assembly

Note

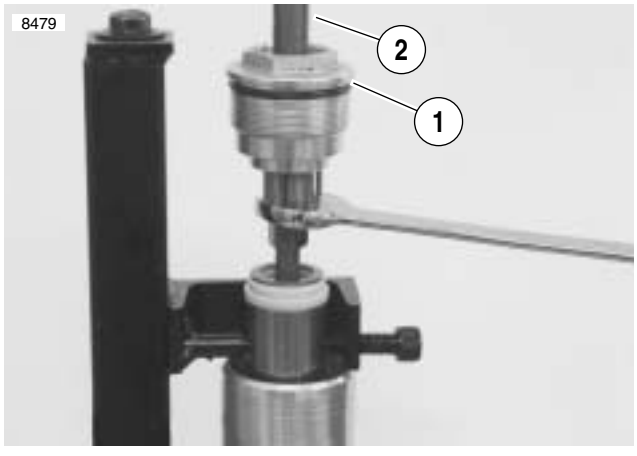
Skip to fork assembly if damper rod assembly was not disassembled.

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.



1. Fork cap assembly
2. Rebound assembly

Figure 2-72. Rebound Assembly and Fork Cap Assembly

6. See Figure 2-72. Tighten the damper locknut (10) to 22-30 ft-lbs (30-40 Nm).
7. Repeat for other fork assembly.

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.

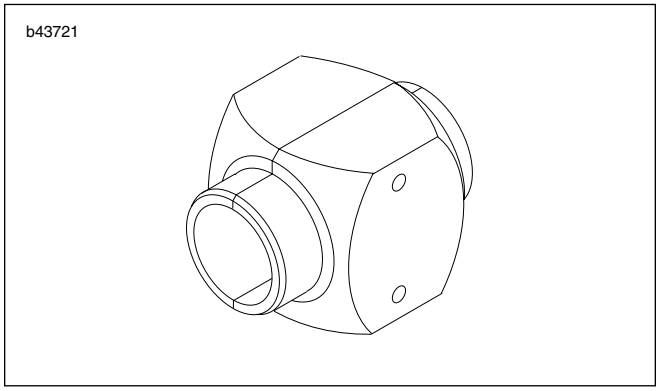


Figure 2-73. Fork Seal Driver (B-43721) 41mm
Fork Seal Driver (B-42571) 43mm

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

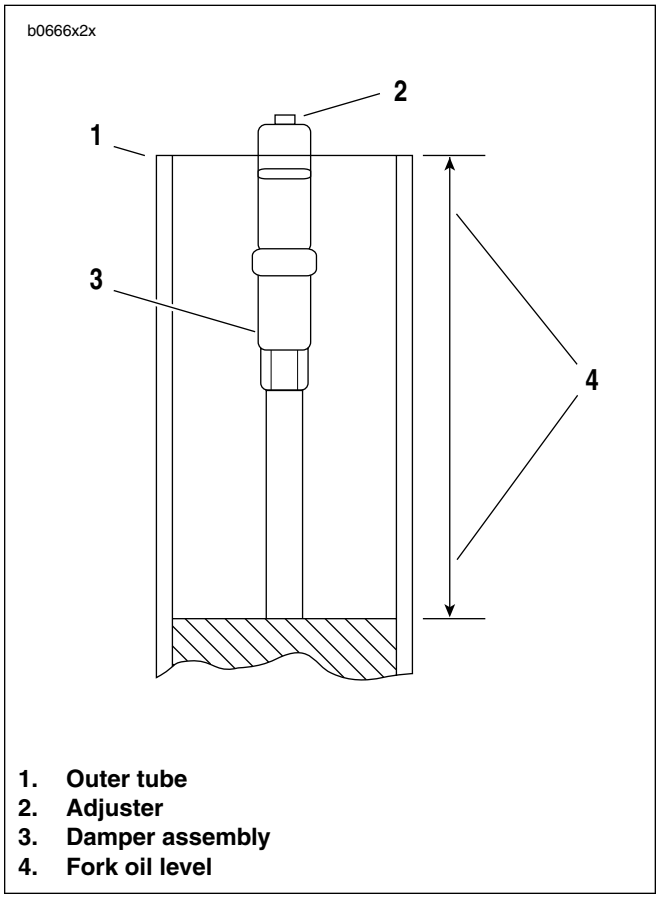
Model	Inch	MM
XB9SX, XB12S, XBSs	4.21	107
XB12Scg	4.29	109

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. Outer tube
2. Adjuster
3. Damper assembly
4. Fork oil level

Figure 2-74. Measuring Fork Oil Level

INSTALLATION

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

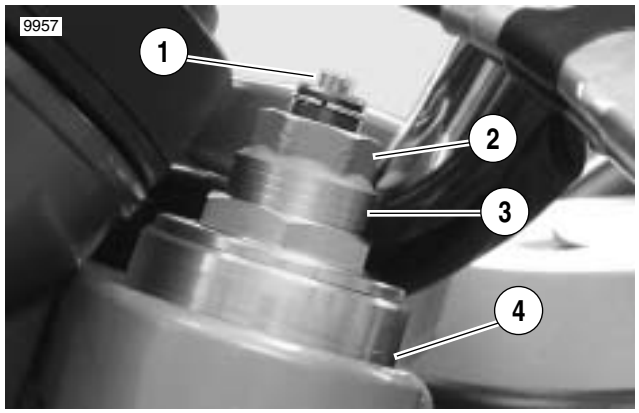
Carefully install the fork into the upper fork clamp. Forcing the fork into the upper fork clamp could move the stopper ring out of the groove which will not allow the correct upper fork clamp load resulting in possible loss of control of the motorcycle and could result in death or serious injury.

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.



1. **Rebound adjuster screw**
2. **Preload adjuster nut**
3. **Four preload alignment lines visible (factory setting)**
4. **Alignment lines**

Figure 2-75. Front Fork Preload And Rebound Adjuster

NOTES

FORK CLAMPS, UPPER AND LOWER 2.17

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.

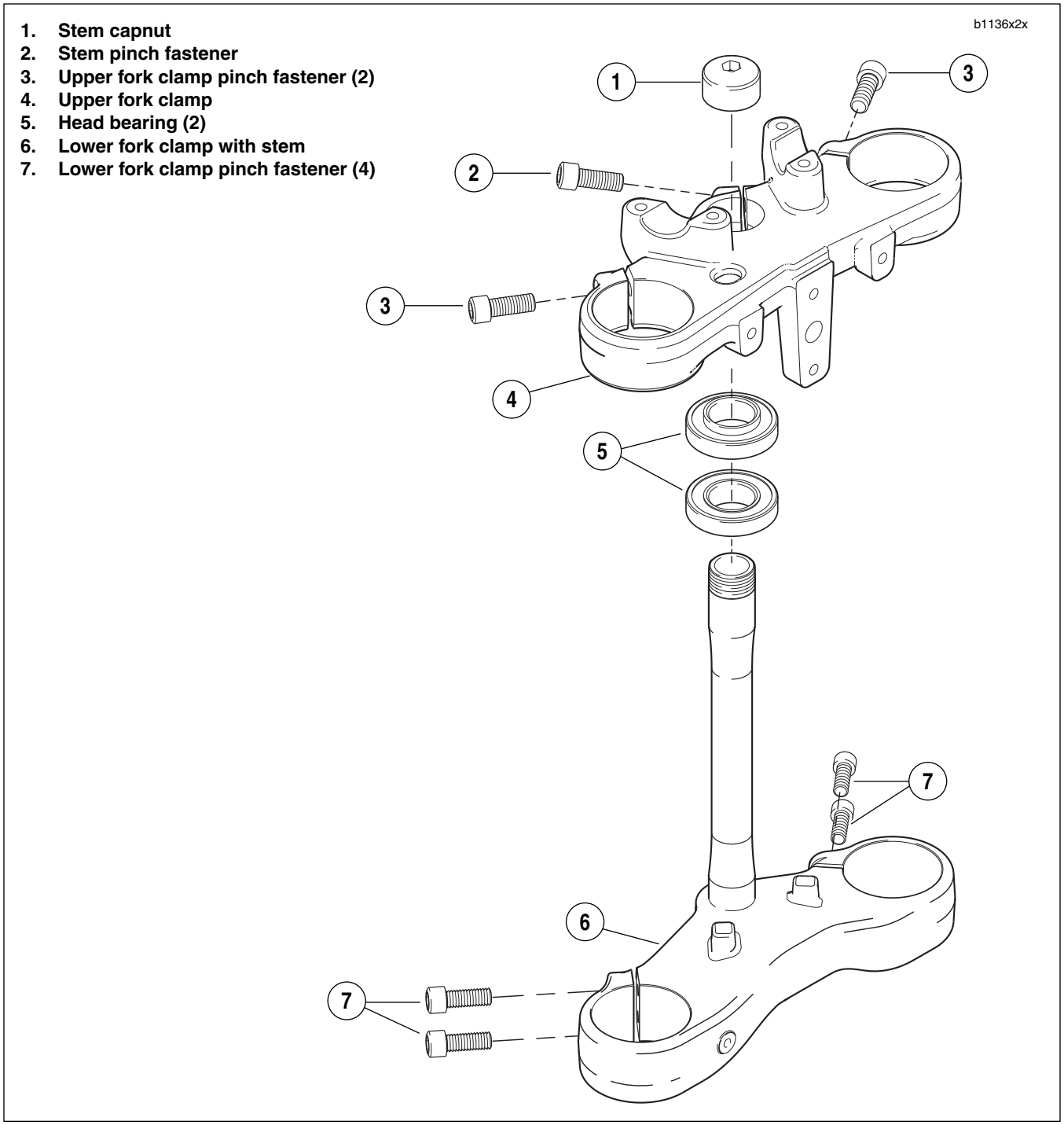


Figure 2-76. Steering Stem Assembly

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. (00124a)

NOTE

For additional information, see 2.16 FRONT FORK.

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 2.18

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.

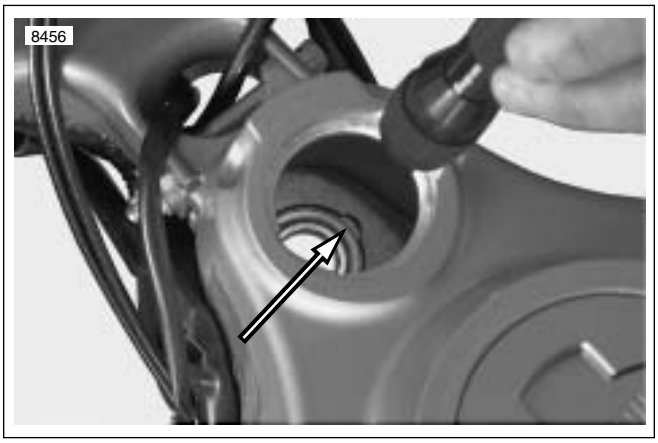


Figure 2-77. Lower Steering Head Bearing Notches (upper bearing removed for clarity)

NOTE

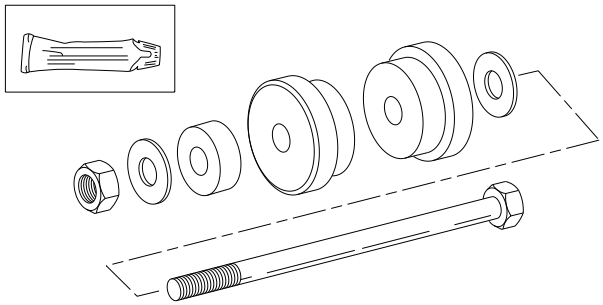
Discard steering head bearings and replace with new. Steering head bearings are not reusable.

INSTALLATION

NOTES

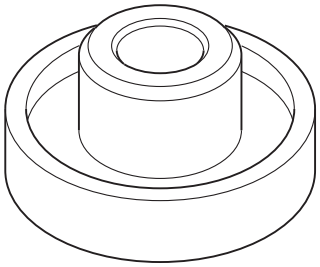
- *Steering head bearings should be installed one at a time in order to ensure proper alignment of bearing in bore.*
- *Use the new backing plate for wheel bearing installation (B-43993-12) on the opposite side of the frame neck. By placing the large diameter of the backing plate against the frame neck 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.*

h39302



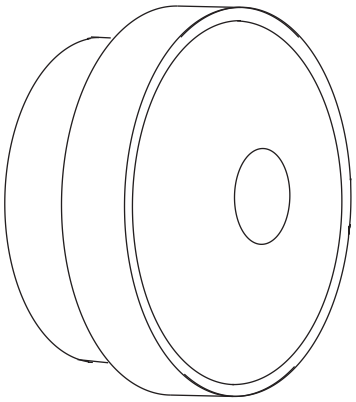
Steering Head Bearing Race Installer (Part No. HD-39302)

i04256



Steering Head Bearing Installer (Part No. B-45521)

b1172x2x



Wheel Bearing Backing Plate (Part No. B-43993-12)

Figure 2-78. Steering Head Bearings Installation Tools

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.

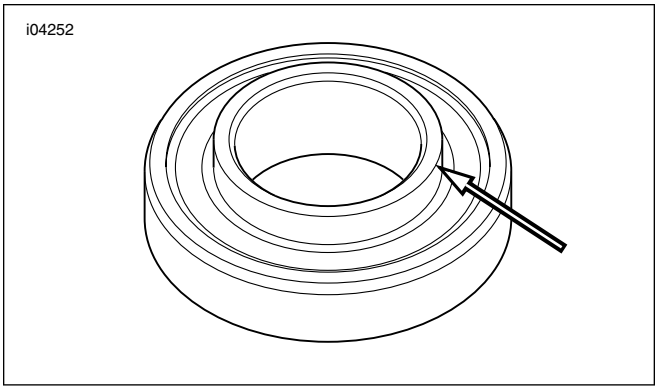
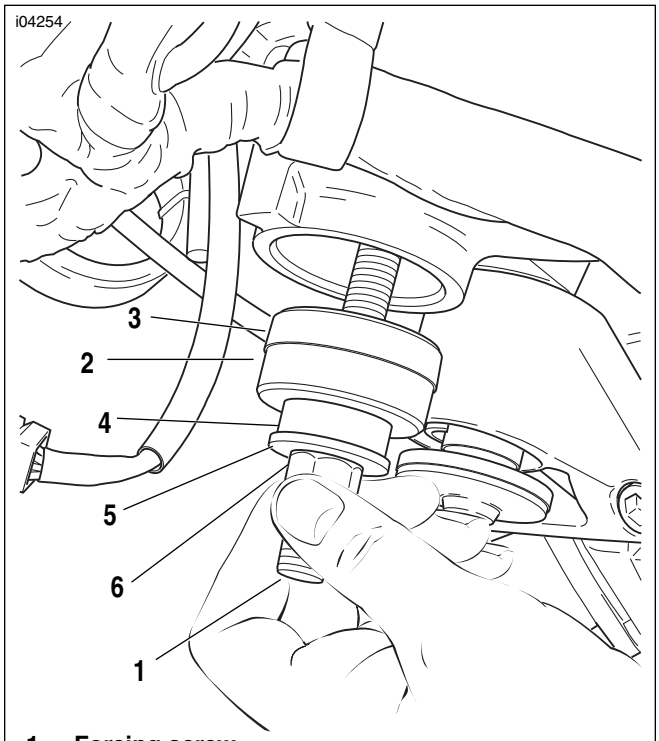


Figure 2-79. Steering Head Bearing Lip

NOTE

For ease of steering head bearing installation, lubricate the outside of the steering head bearings.



1. **Forcing screw**
2. **Steering Head Bearing Installation Tool (B-45521)**
3. **Lower bearing**
4. **Bearing**
5. **Washer**
6. **Nut**

Figure 2-80. Lower Bearing

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.

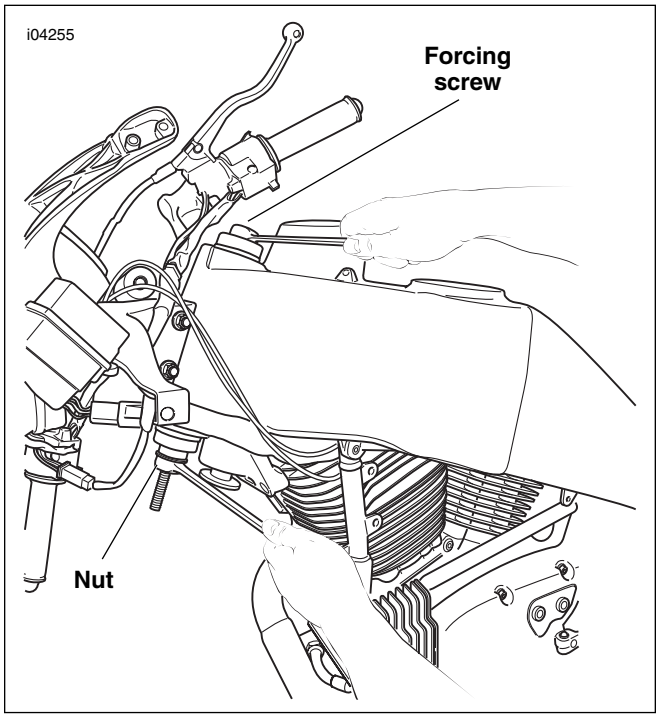


Figure 2-81. Install Bearings

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 capnut 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.

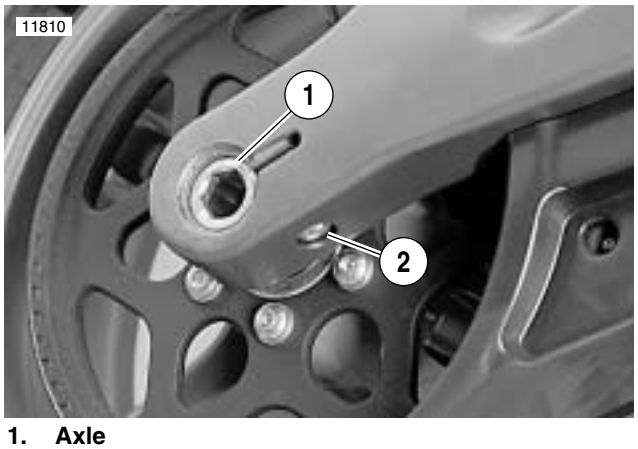
REMOVAL

Brace

NOTE

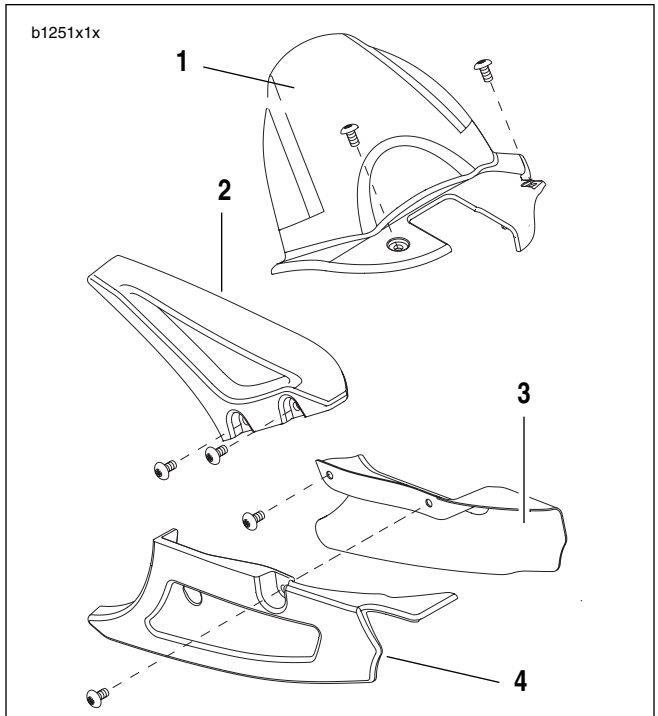
Before removing swingarm brace, always relieve belt tension first. Removing swingarm brace without releasing tension will cause swingarm brace damage.

1. Remove right side rider footpeg mount. See 2.32 FOOTPEG, 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).



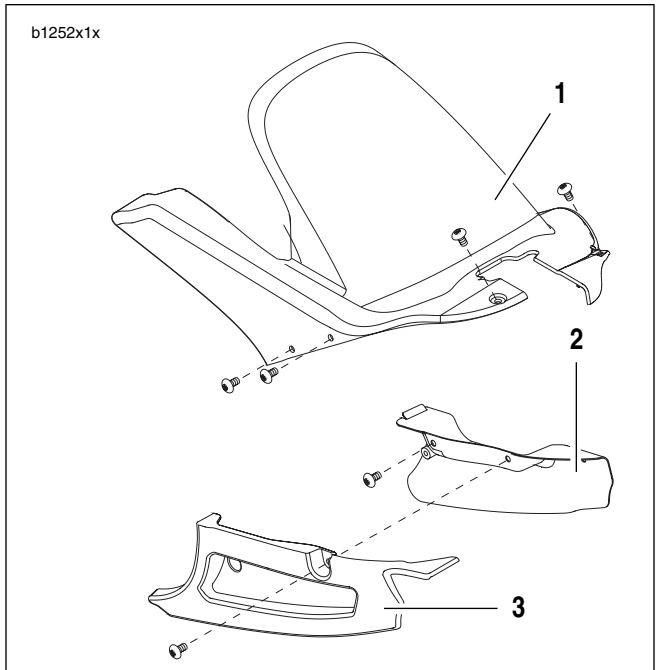
1. **Axle**
2. **Pinch bolt fastener**

Figure 2-82. Rear Wheel Mounting, Right Side (XB12Ss)



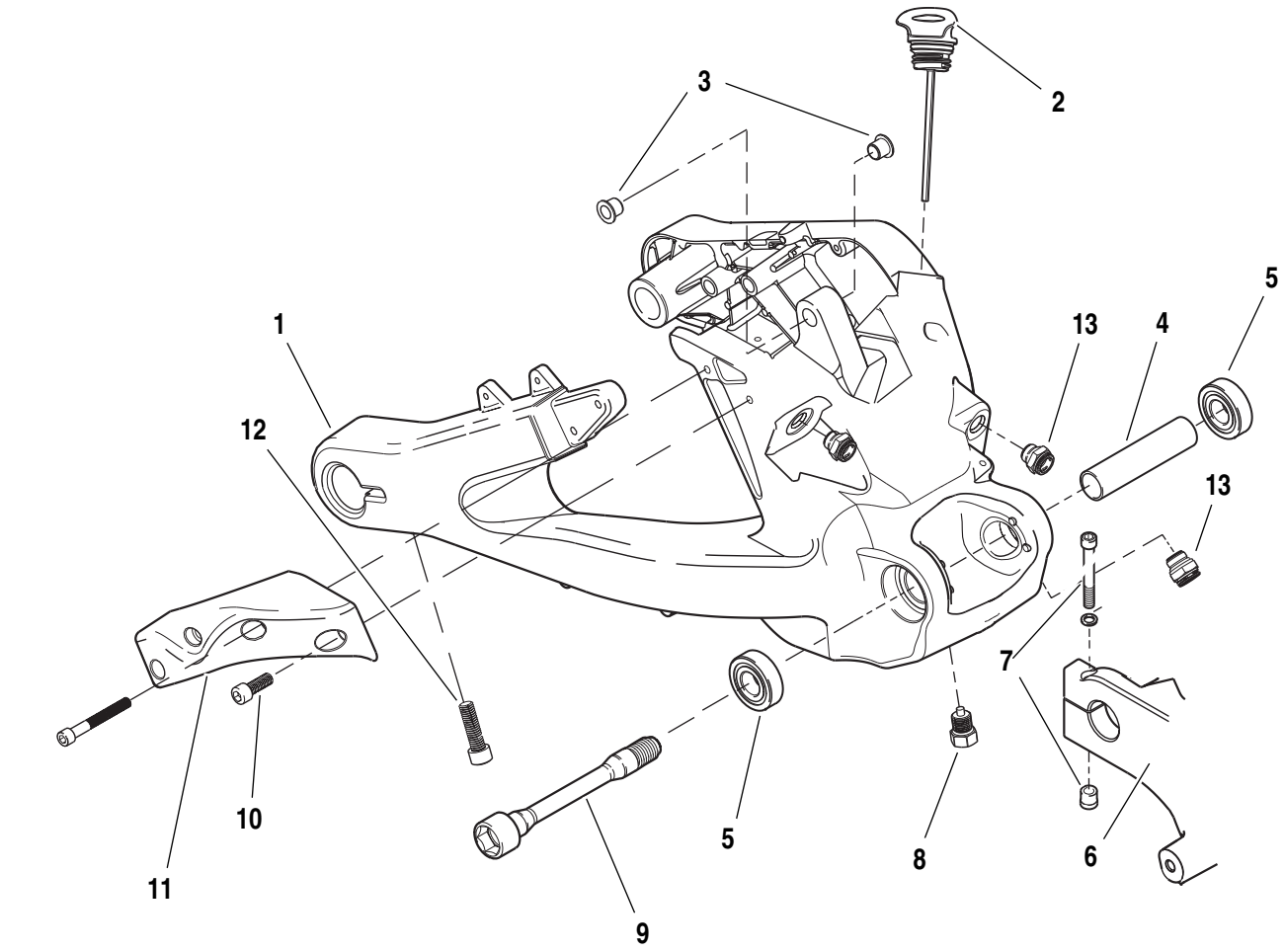
1. **Fender**
2. **Upper belt guard**
3. **Stone guard**
4. **Lower belt guard**

Figure 2-83. Belt Guard and Rear Fender Assembly (XB9SX, XB12S, XB12Scg)



1. **Rear inner fender/belt guard**
2. **Stone guard**
3. **Lower belt guard**

Figure 2-84. Belt Guard and Rear Fender Assembly (XB12Ss)



1. **Swingarm**
2. **Dipstick**
3. **Swingarm bushings**
4. **Swingarm spacer**
5. **Swingarm bearing (2)**
6. **Engine crankcase**
7. **Pivot shaft pinch fastener w/nut**
8. **Oil drain plug**
9. **Pivot shaft**
10. **Brace fastener (4)**
11. **Swingarm brace**
12. **Rear axle pinch fastener**
13. **Jiffy Tite oil line fittings (3)**

Figure 2-85. Swingarm Assembly

Swingarm

1. Remove seat. See 2.43 SEAT.

⚠WARNING

To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect battery cables (negative (-) cable first) before proceeding. (00307a)

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 swingarm 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 2-90. With vehicle supported remove lower shock absorber mounting fastener and spacer from shock absorber and swingarm.
11. See Figure 2-85. Loosen pivot shaft pinch fastener (7).
12. Remove pivot shaft (9) with a special 7/8 in. hex tool located in tool kit.
13. Remove swingarm from vehicle.

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.

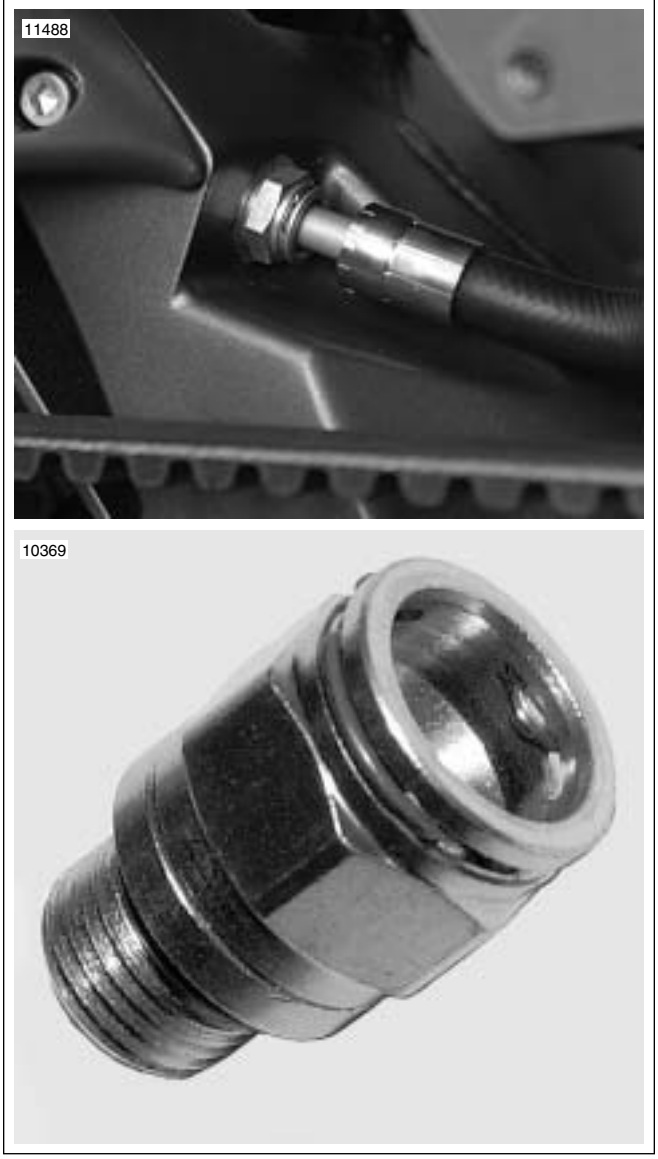


Figure 2-86. Jiffy Tite, Quick Disconnect Oil Line Fittings

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.

NOTE

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.

NOTES

- *The left side bearing must be installed first and fully seated.*
- *Swingarm bearings should be replaced as a unit. Do not intermix components. Mark all components so they may be correctly installed.*

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).

INSTALLATION

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 (20.3-23 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.

⚠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)

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 servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

⚠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.

Final Swingarm Inspection

1. Check oil level after starting motorcycle and allowing it to reach operating temperature.
2. Check rear brake operation.

FRONT AND REAR ISOLATORS 2.20

FRONT ISOLATOR

Removal

NOTE

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.

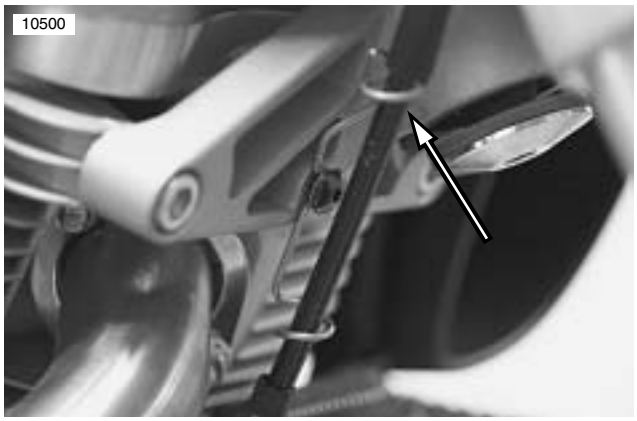


Figure 2-87. Clutch Cable Wire Form

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

NOTE

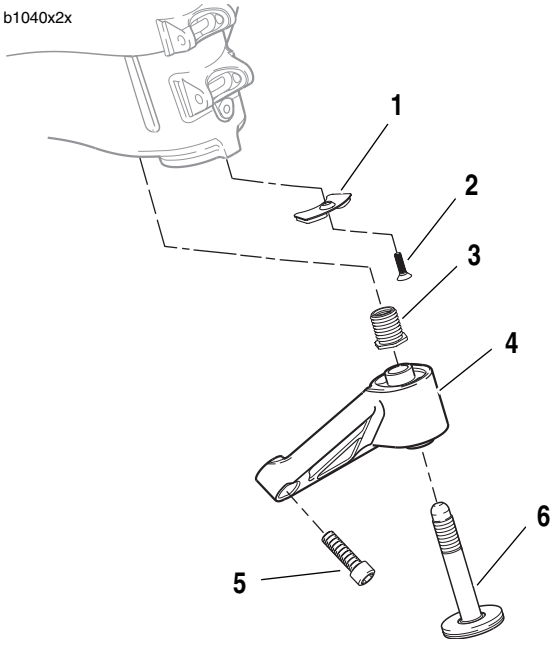
See Figure 2-88. If the threaded insert (3) is damaged and needs to be replaced, install new insert with LOCTITE 272 and tighten to 59-61 ft-lbs (80-82.7 Nm).

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).



1. **Upper snubber**
2. **Upper snubber fastener**
3. **Insert**
4. **Front isolator bracket**
5. **Front isolator bracket fastener to engine**
6. **Front isolator bolt**

Figure 2-88. Front Isolator

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.

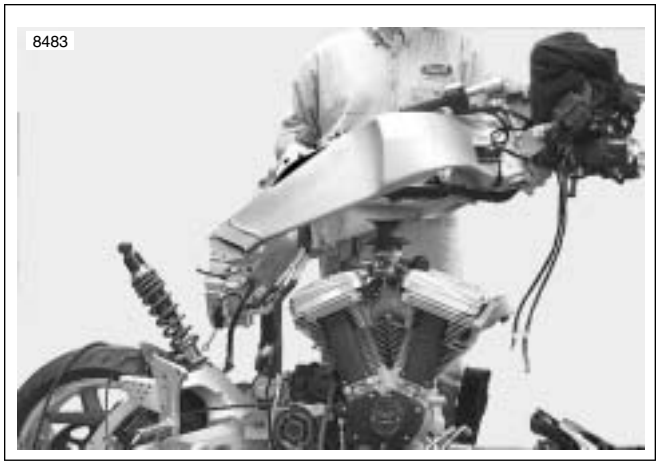


Figure 2-89. Lift Frame Off Motorcycle (Typical)

INSTALLATION

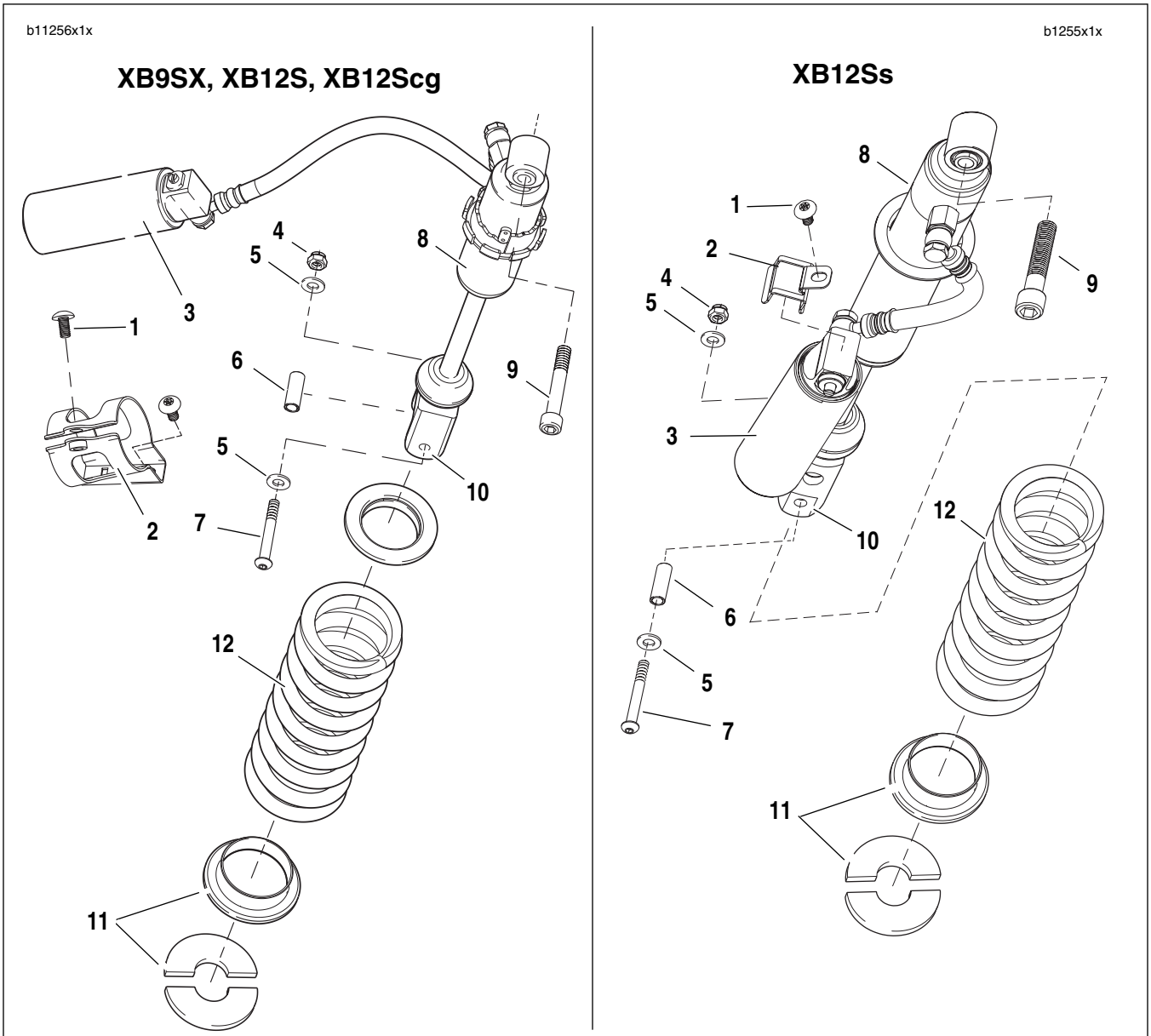
1. Place frame over the motorcycle.
2. Install rear isolator fastener. See 3.5 ENGINE INSTALLATION.
3. Install main wire harness. See 7.24 MAIN WIRE HARNESS.
4. Install upper and lower fork clamps. See 2.17 FORK CLAMPS, UPPER AND LOWER.
5. Install rear shock. See 2.22 REAR SHOCK ABSORBER.
6. Install 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.

REAR SHOCK ABSORBER 2.22

GENERAL

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.



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

Figure 2-90. Rear Shock Absorber Assembly

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).



1. **Remote reservoir clamp**
2. **Cable tie securing vent hose**

Figure 2-91. Rear Shock Absorber and Remove Reservoir (XB12Ss shown)

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.

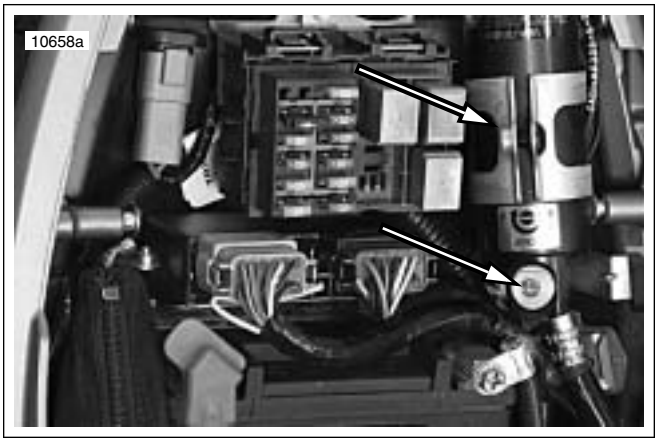


Figure 2-92. Rear Shock Absorber Remote Reservoir Clamp (XB12S shown) and Compression Dial

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

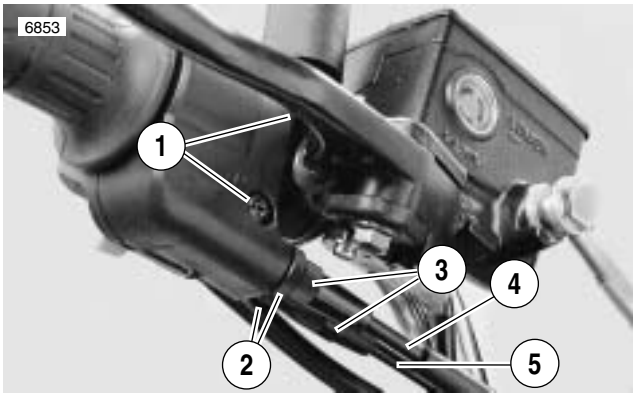
WARNING

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.

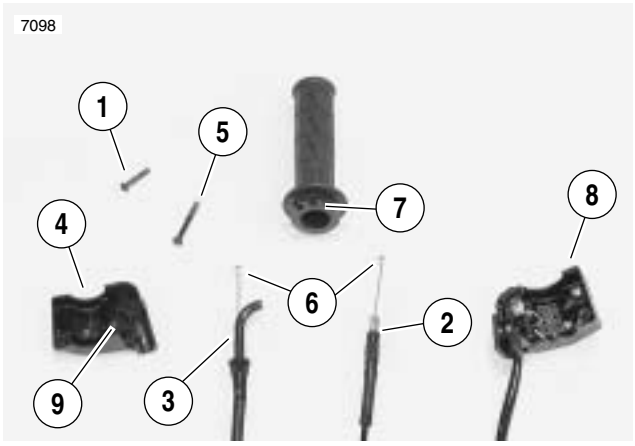
ASSEMBLY/INSTALLATION

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.



1. **Right switch housing fasteners (top fastener above brake lever)**
2. **Cable adjuster lock**
3. **Adjusters**
4. **Throttle control cable**
5. **Idle control cable**

Figure 2-93. Throttle Control Cables



1. **Screw (short, top)**
2. **Idle control cable**
3. **Throttle control cable with molded end**
4. **Front housing**
5. **Screw (long, bottom)**
6. **Ferrules**
7. **Cable wheel**
8. **Rear housing**
9. **Locating pin**

Figure 2-94. Cable Connections

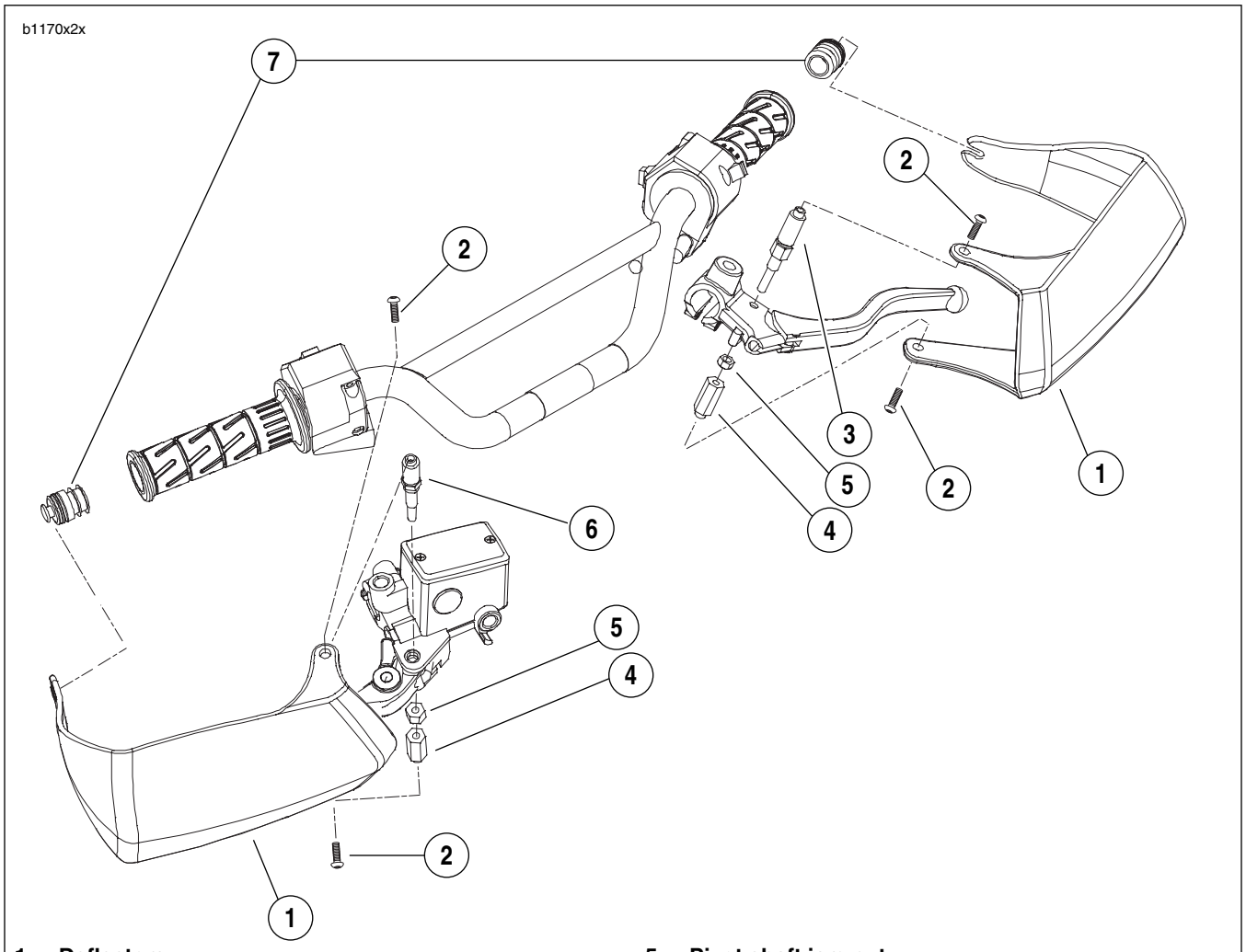
DEFLECTORS/HANDLEBARS (XB9SX) 2.24

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).



1. **Deflectors**
2. **Deflector fasteners (4)**
3. **Clutch pivot shaft**
4. **Pivot shaft riser**
5. **Pivot shaft jam nut**
6. **Brake pivot shaft**
7. **Handlebar end cap**

Figure 2-95. Deflectors

CLUTCH CONTROL/CABLE 2.25

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.



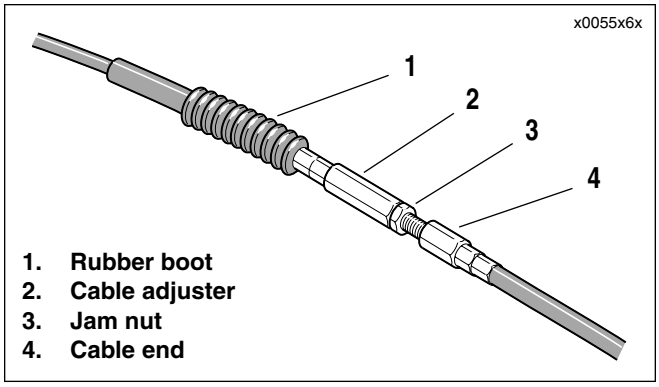
Figure 2-96. Clutch Cable Wire Form

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.



1. **Rubber boot**
2. **Cable adjuster**
3. **Jam nut**
4. **Cable end**

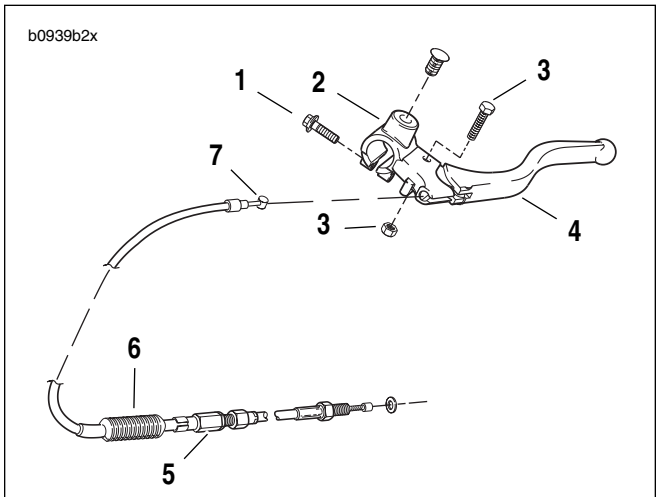
Figure 2-97. Clutch Cable Adjuster Mechanism

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

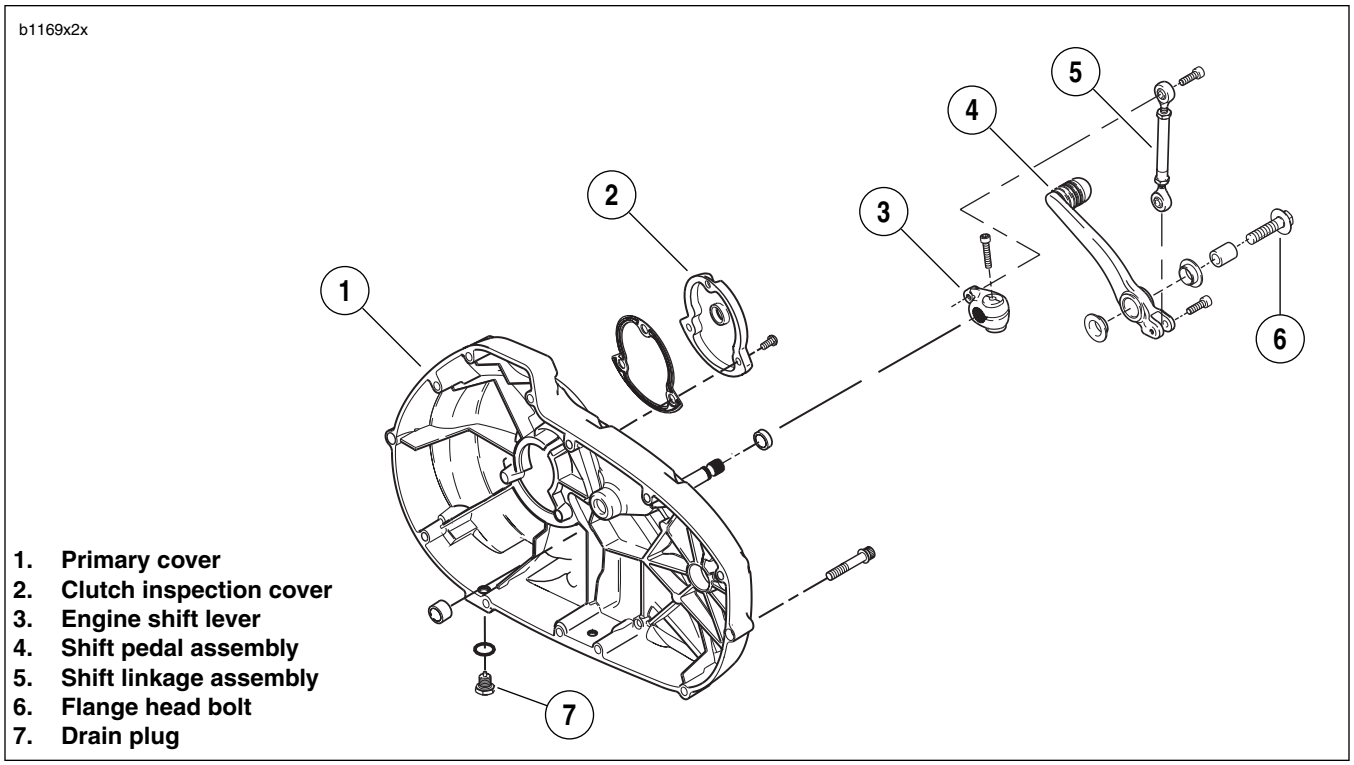
See D.1 HOSE AND WIRE ROUTING in Appendix D.

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).



1. **Hand lever clamp pinch fastener**
2. **Hand lever clamp**
3. **Hand lever pinch fastener and nut**
4. **Clutch hand lever**
5. **Clutch adjuster**
6. **Clutch cable adjuster boot**
7. **Clutch cable ferrule**

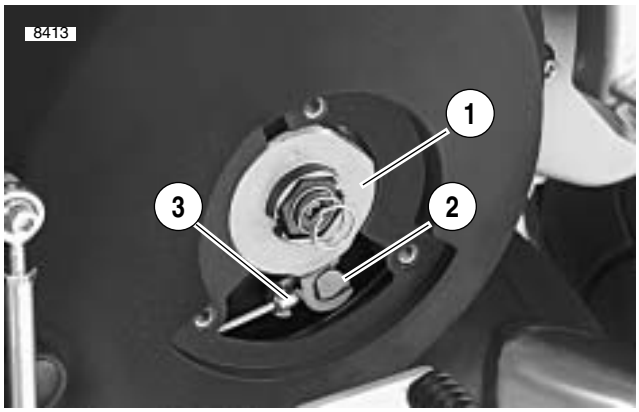
Figure 2-98. Clutch Hand Control Assembly



1. **Primary cover**
2. **Clutch inspection cover**
3. **Engine shift lever**
4. **Shift pedal assembly**
5. **Shift linkage assembly**
6. **Flange head bolt**
7. **Drain plug**

Figure 2-99. Primary Cover and Shifter Assembly

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.



1. **Outer ramp and hook**
2. **Coupling**
3. **Cable end**

Figure 2-100. Clutch Release Mechanism (Typical)

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.

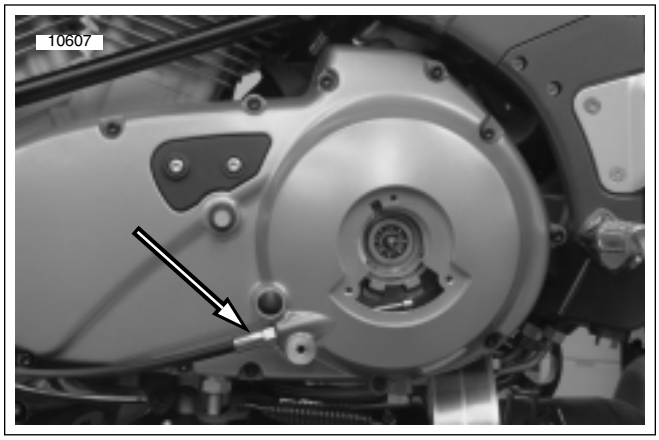


Figure 2-101. Clutch Cable and Fitting

17. See Figure 2-101. Unscrew the cable fitting from the primary cover. Remove clutch cable and fitting.
18. Remove and discard oring on the clutch cable fitting.

ASSEMBLY/INSTALLATION

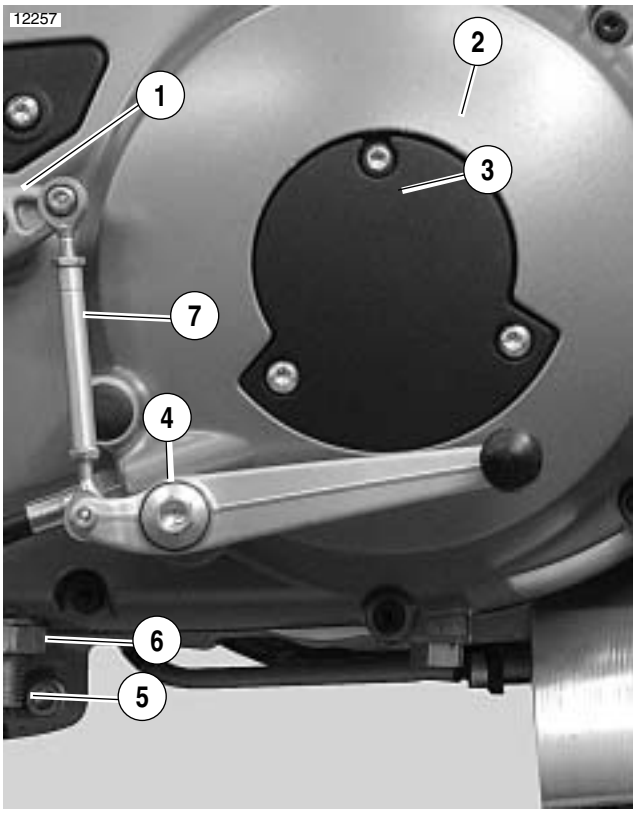
Clutch Cable

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

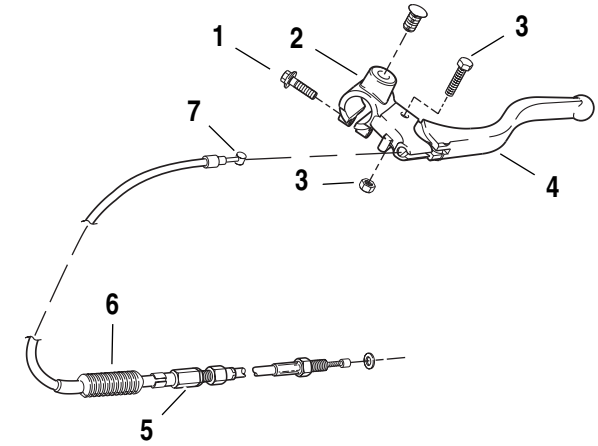
See D.1 HOSE AND WIRE ROUTING in Appendix D.

7. Route clutch cable through upper triple clamp.



1. **Engine shift lever**
2. **Primary cover**
3. **Clutch inspection cover**
4. **Flange head bolt**
5. **Chain adjuster screw**
6. **Locknut**
7. **Shift linkage assembly**

Figure 2-102. Installing Shift Linkage



1. **Hand lever clamp pinch fastener**
2. **Hand lever clamp**
3. **Hand lever pinch fastener and nut**
4. **Clutch hand lever**
5. **Clutch adjuster**
6. **Clutch cable adjuster boot**
7. **Clutch cable ferrule**

Figure 2-103. Clutch Hand Control Assembly

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 84-108 **in-lbs** (9.5-12.2 Nm).

NOTE

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 84-92 **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.

HEADLIGHT ASSEMBLY WITH GRILLE (XB9SX) 2.26

GENERAL

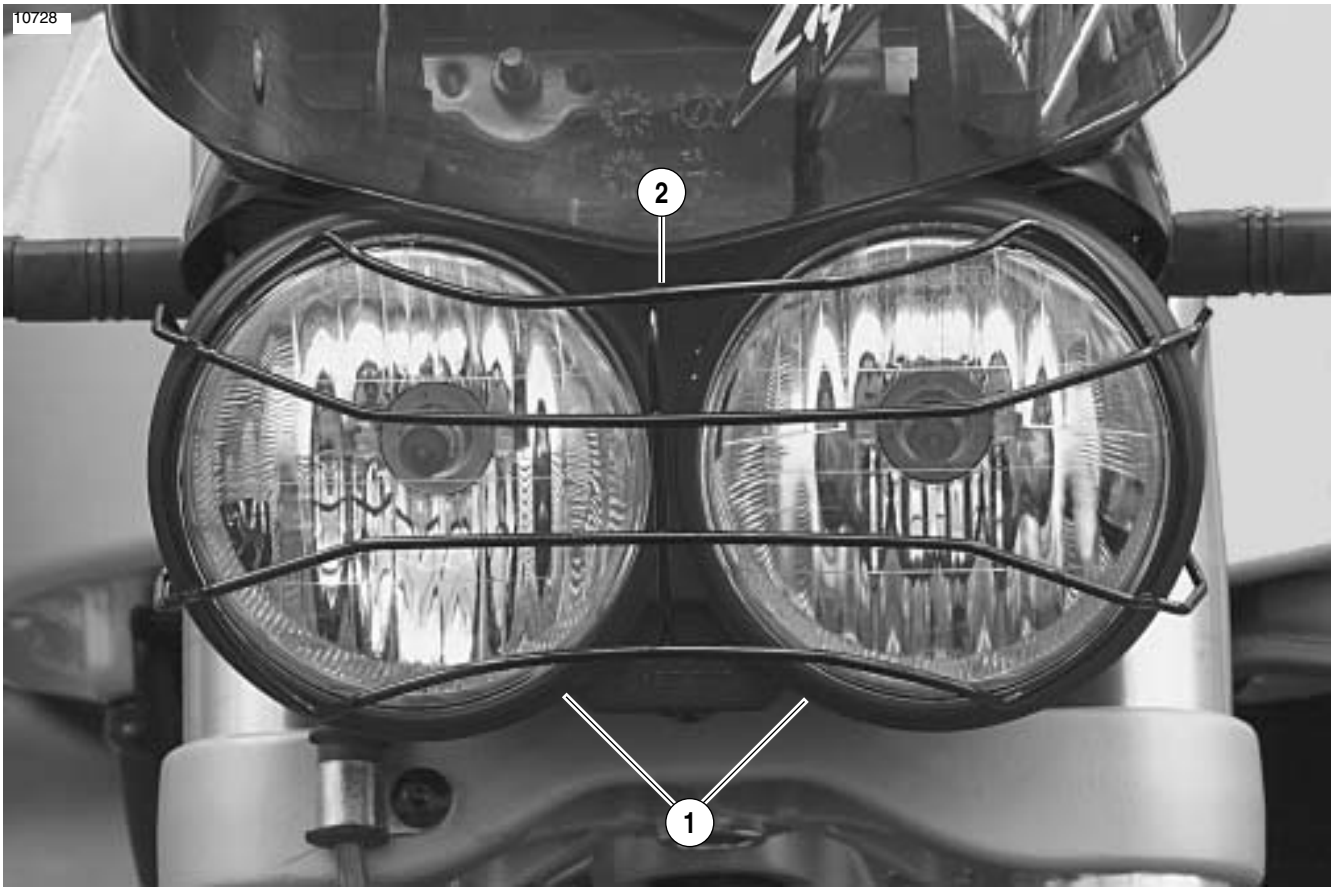
See Figure 2-104. The headlight grille is offered as a standard feature on the XB9SX to provide additional protection for the headlight assemblies.

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.



1. Headlight assemblies
2. Headlight grille

Figure 2-104. XB9SX 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).

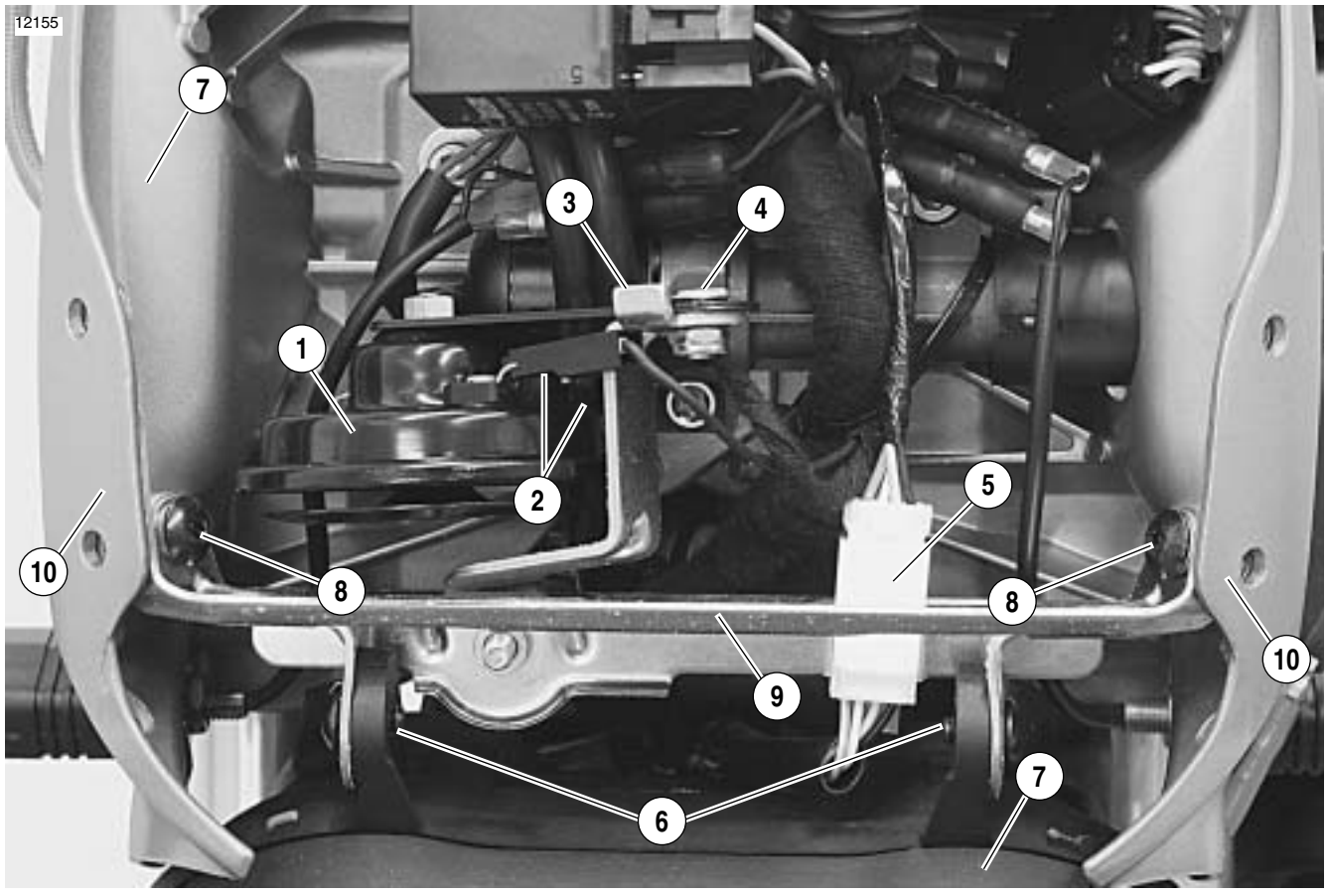
NOTE

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.



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 (2), headlight support bracket**
9. **Headlight support bracket**
10. **Left and right front modules**

Figure 2-105. Electrical Connectors Behind Windscreen

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.

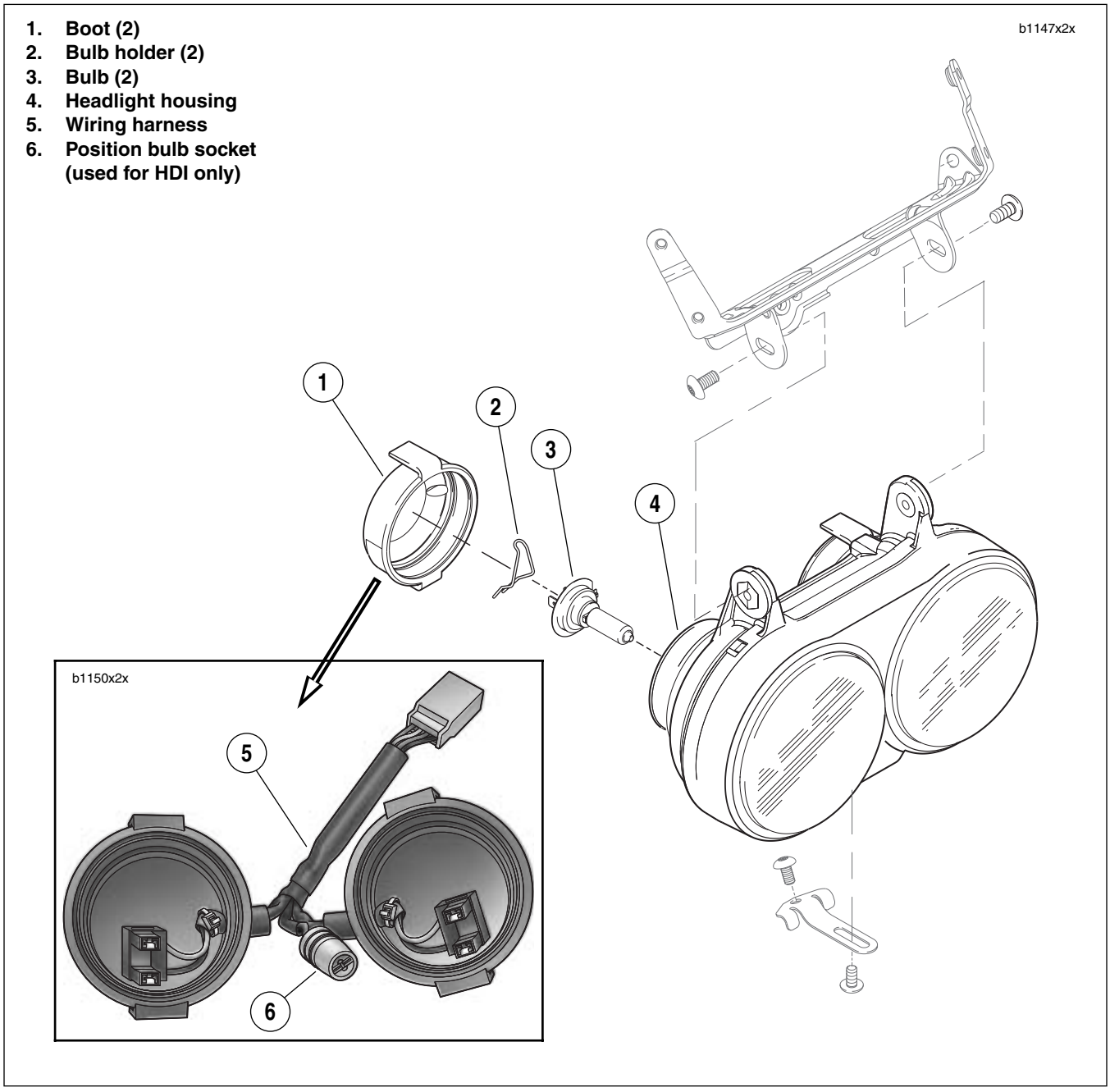


Figure 2-106. Headlight Assembly

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.

⚠WARNING

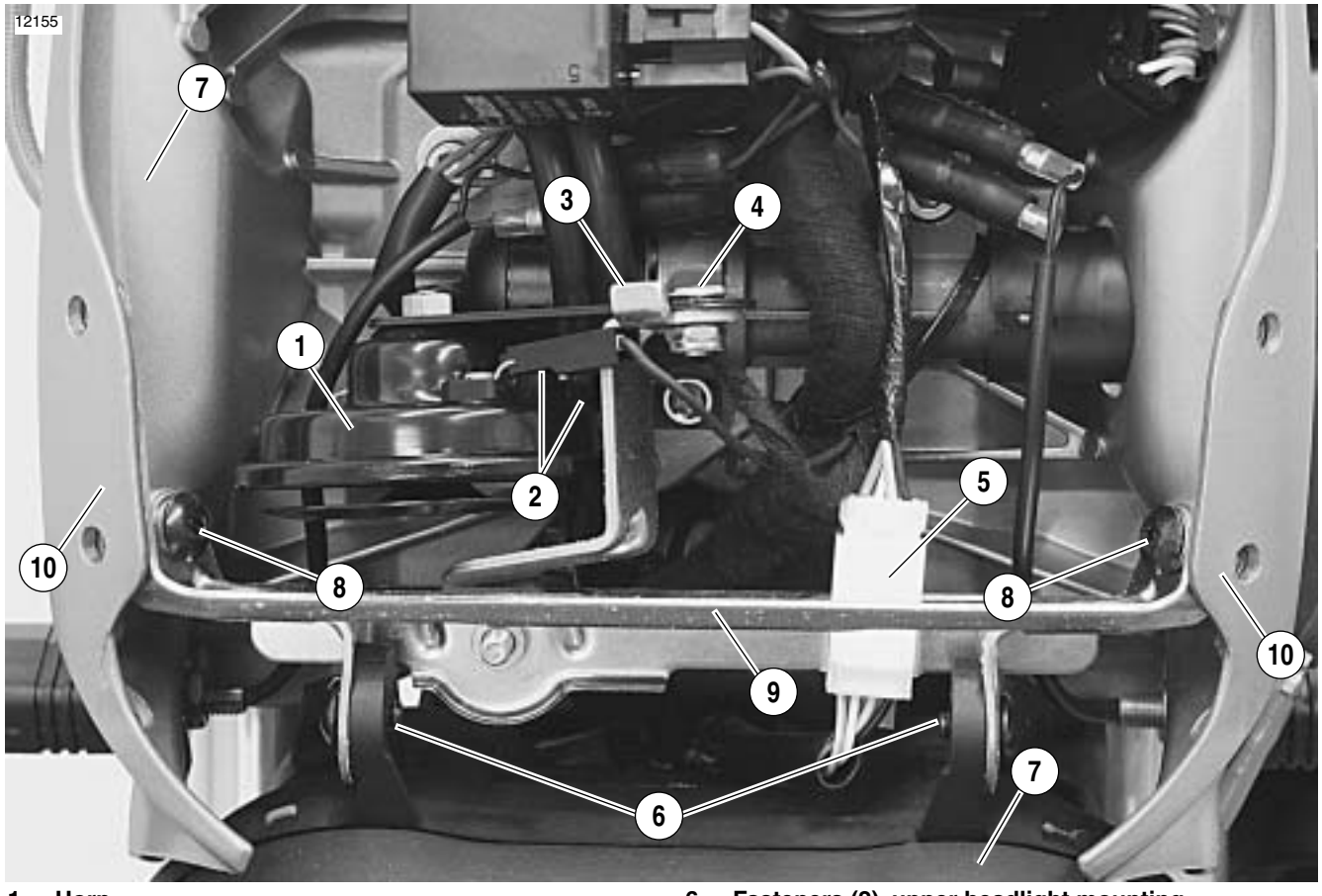
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

10. Install battery by threading positive cable (red) into threaded hole first tightening to 72-96 **in-lbs** (8-10.8 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.



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 (2), headlight support bracket**
9. **Headlight support bracket**
10. **Left and right front modules**

Figure 2-107. Electrical Connectors Behind Windscreen

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.

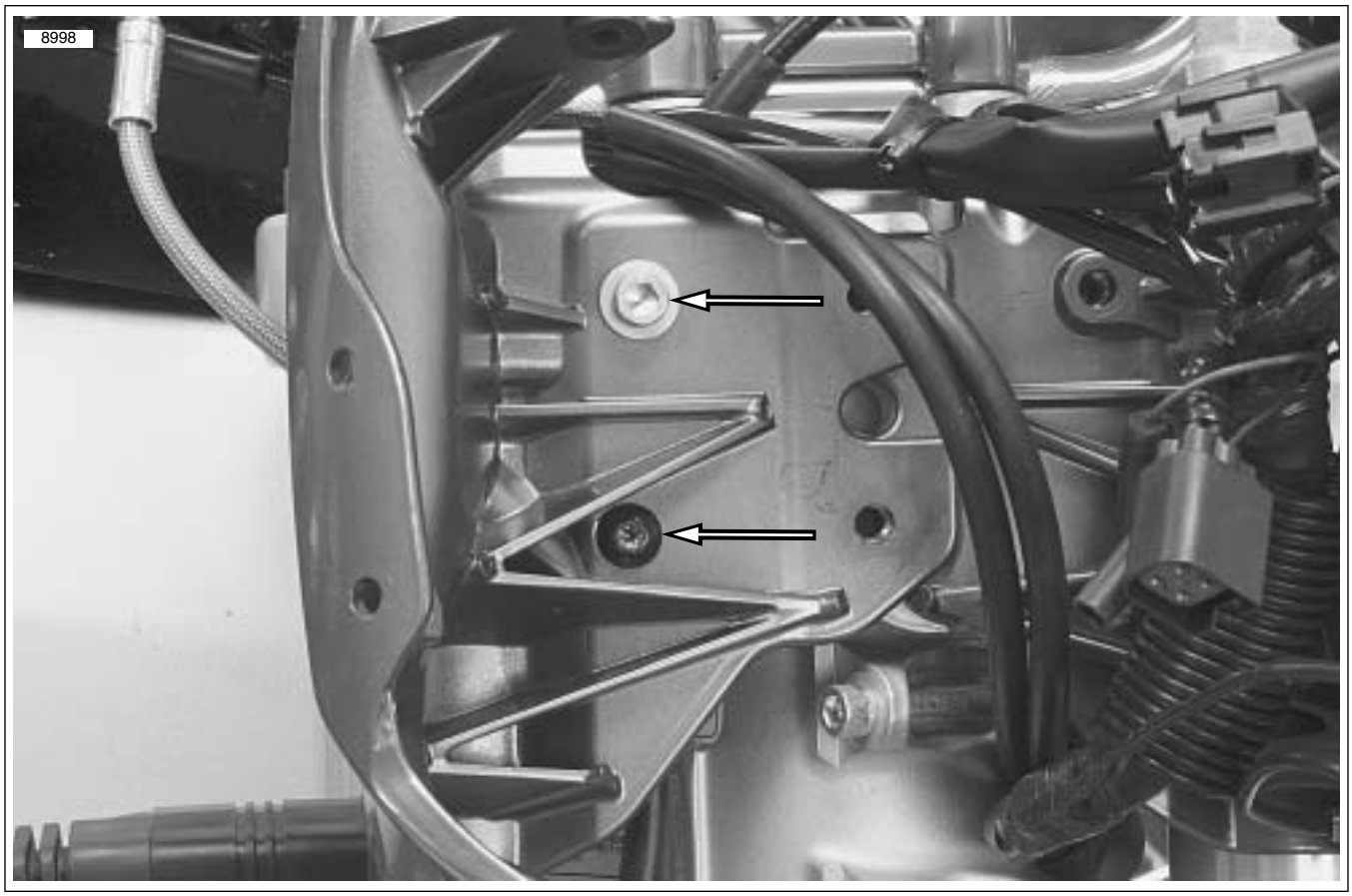
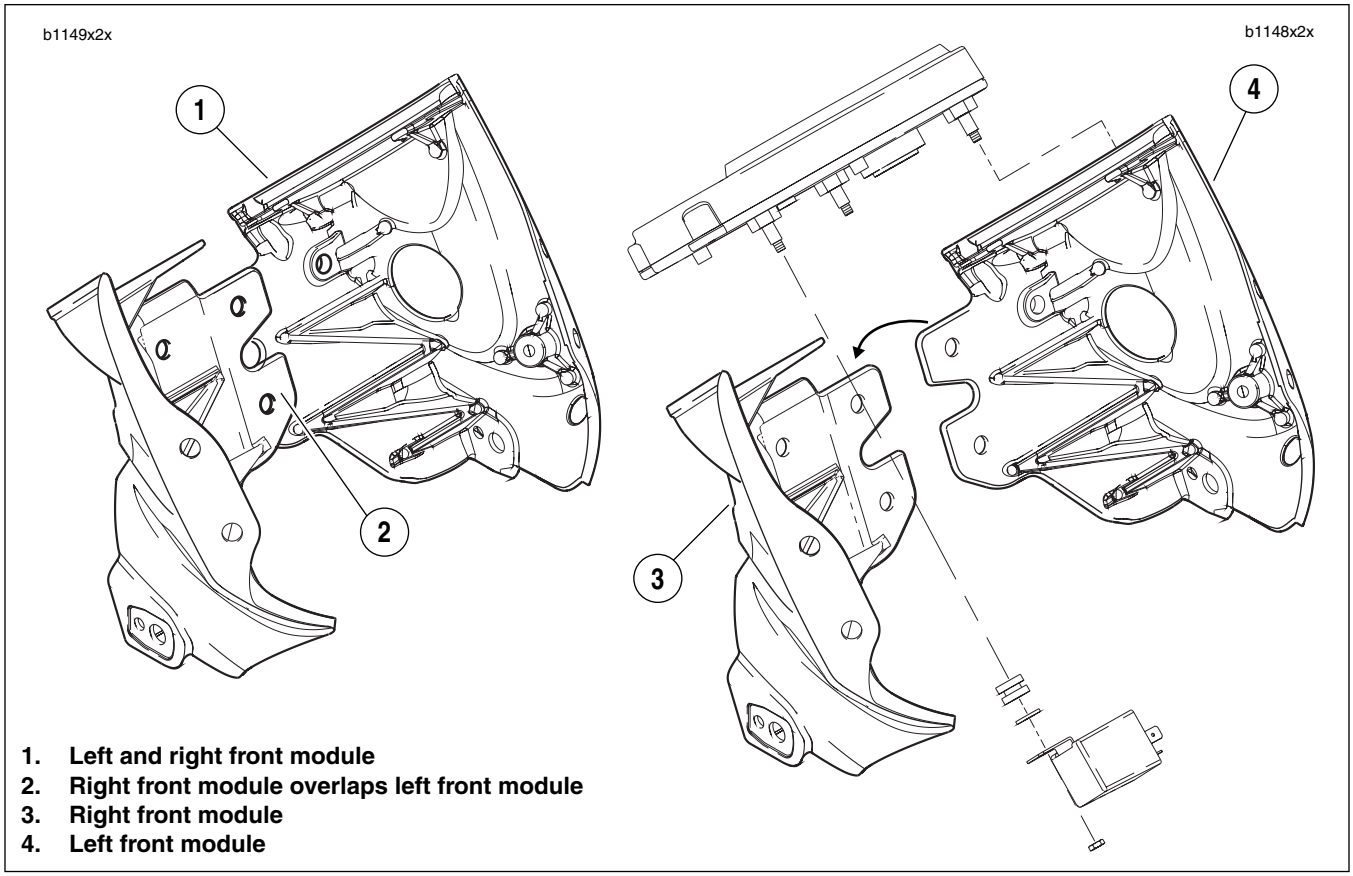


Figure 2-108. Right Front Module Fastener and Brake Line P-Clamp Fastener (Typical)



1. **Left and right front module**
2. **Right front module overlaps left front module**
3. **Right front module**
4. **Left front module**

Figure 2-109. Fairing Support Bracket Assembly

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

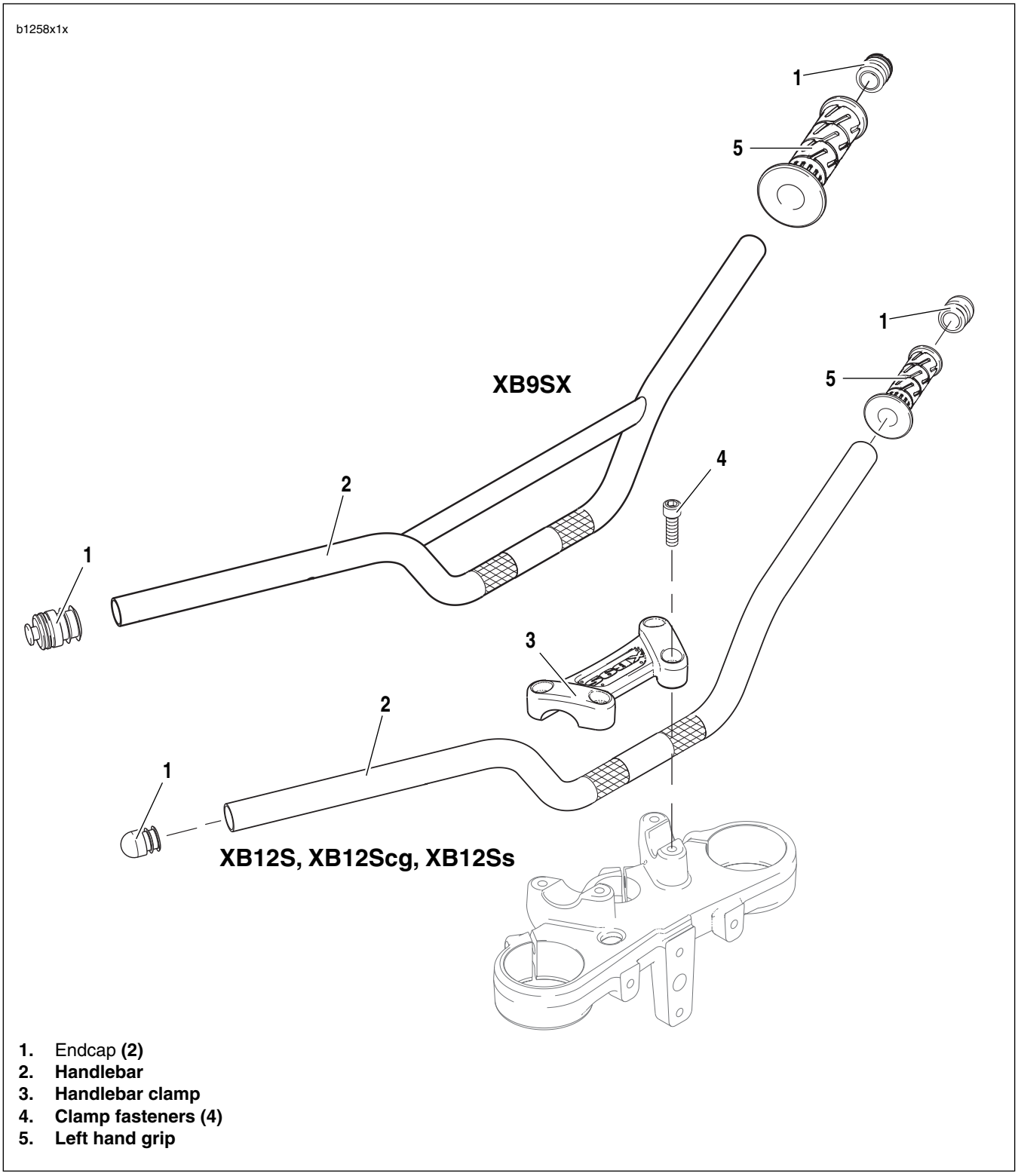
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

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.



1. Endcap **(2)**
2. **Handlebar**
3. **Handlebar clamp**
4. **Clamp fasteners (4)**
5. **Left hand grip**

Figure 2-110. Handlebar Assembly

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).

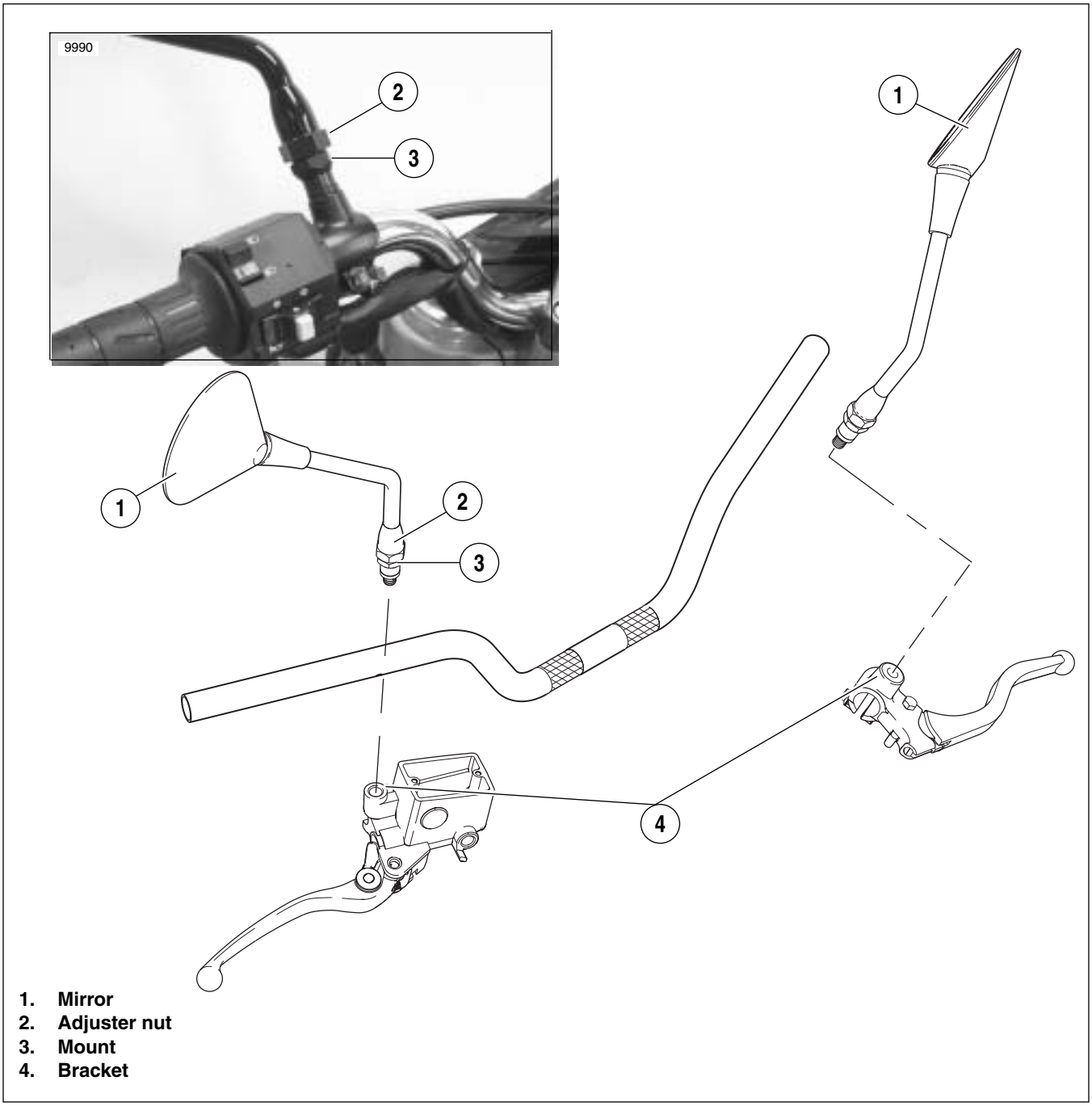
INSTALLATION

1. See Figure 2-111. Install mount (3) onto bracket (4) and tighten to 20-22 ft-lbs (27.1-29.8 Nm).

NOTE

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 riders 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).



1. **Mirror**
2. **Adjuster nut**
3. **Mount**
4. **Bracket**

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 2-113. 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).

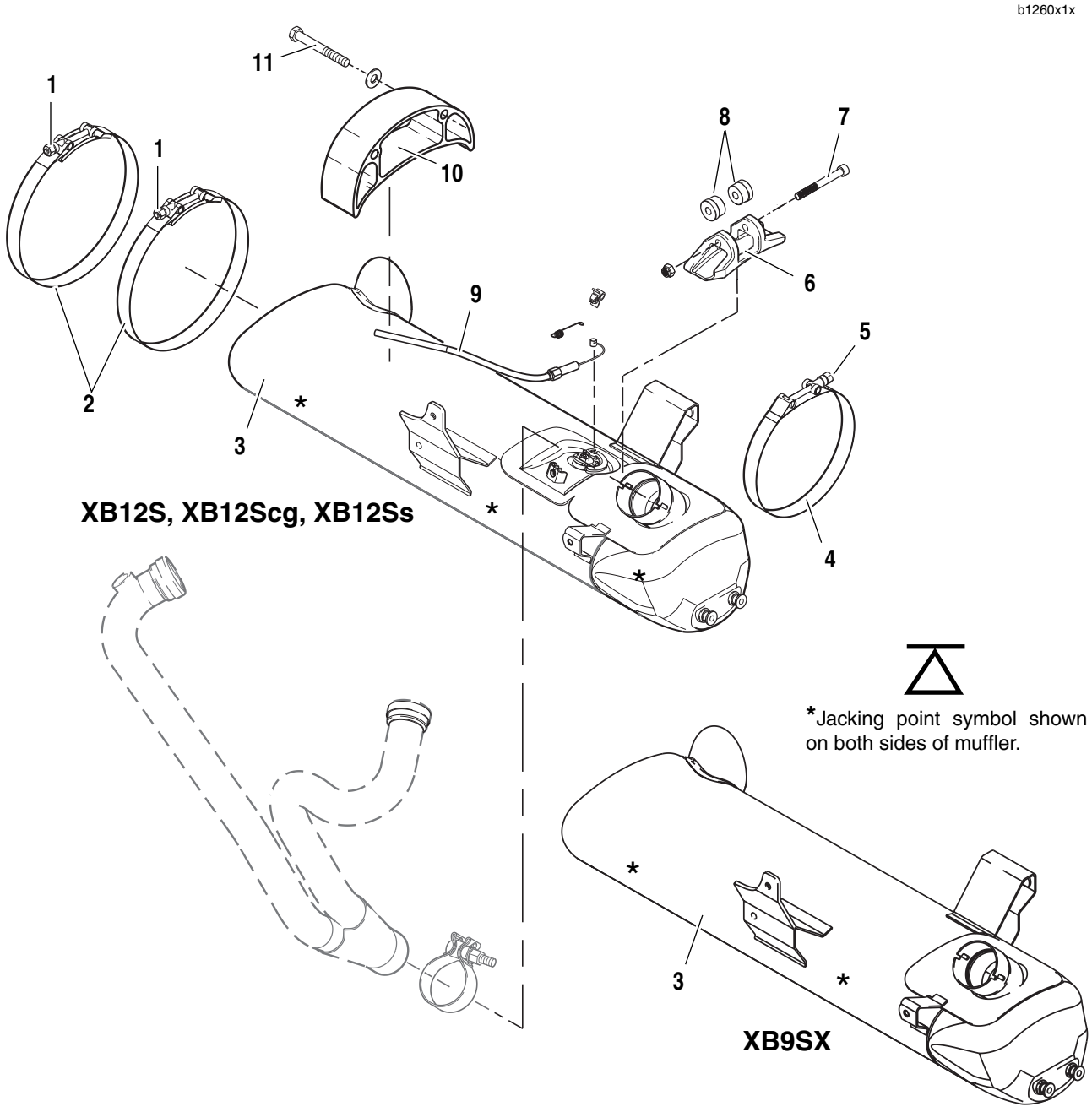
2. See Figure 2-112. Remove front muffler mount fastener (7).
3. Remove strap (4) from front muffler mount (6).
4. Remove front muffler mount bushings (8) by punching out with suitable tool.

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)**

Figure 2-112. Muffler Assembly

ASSEMBLY/INSTALLATION

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

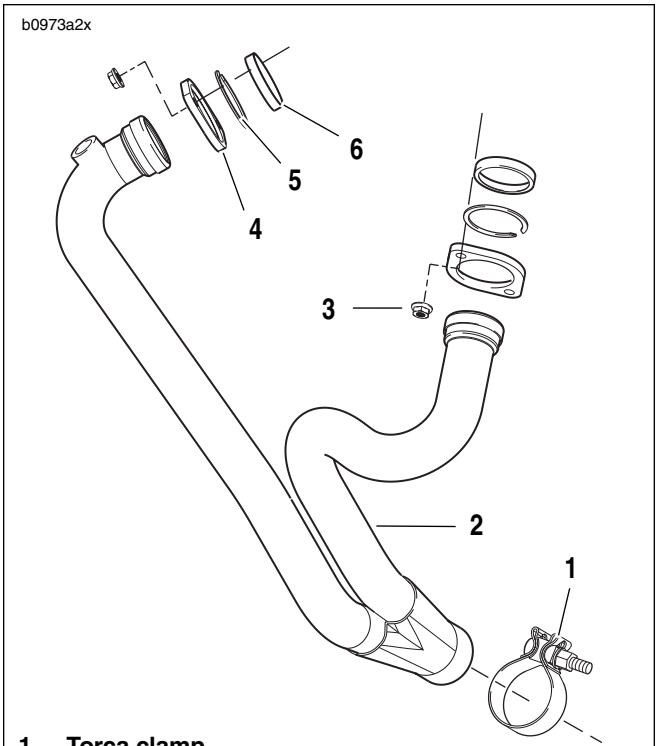
If necessary, use a fiber hammer to fit muffler on header.

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 6.6 DRIVE BELT SYSTEM.
7. Install front sprocket cover. See 2.33 SPROCKET COVER.
8. Install chin fairing. See 2.36 CHIN FAIRING.



1. **Torca clamp**
2. **Header**
3. **Header mount fastener**
4. **Exhaust ring**
5. **Exhaust retaining ring**
6. **Exhaust port gasket**

Figure 2-113. Exhaust Header

FOOTPEG, HEEL GUARD AND MOUNT 2.32

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.

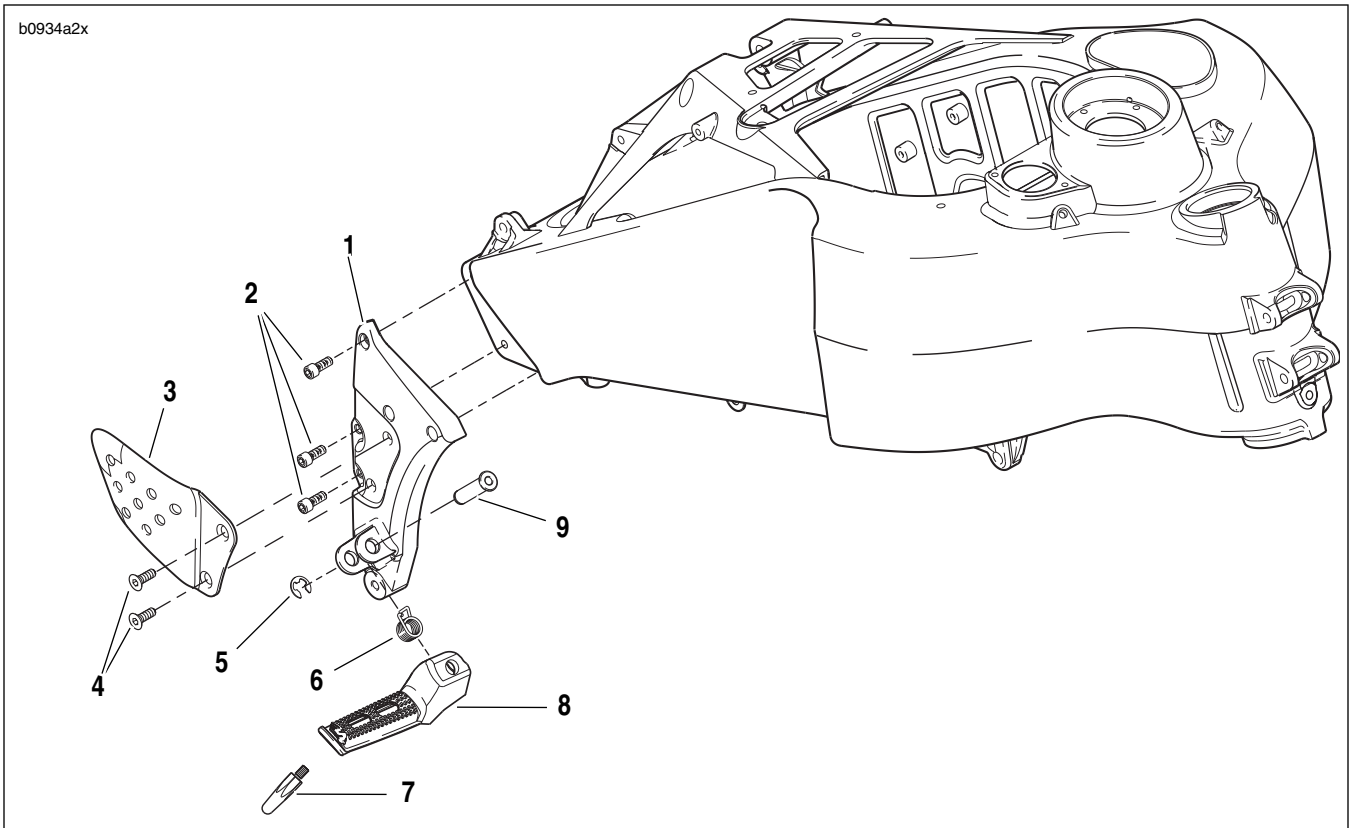
2. Install heel guard (3) with fasteners (4). Tighten to 72-96 **in-lbs** (8-11 Nm).

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).



1. **Footpeg mount**
2. **Footpeg mount fasteners**
3. **Heel guard**
4. **Heel guard fasteners**
5. **Clip, footpeg**
6. **Spring**
7. **Wear peg**
8. **Footpeg**
9. **Pin**

Figure 2-114. Rider Footpeg, Mount and Heel Guard Assembly

PASSENGER

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) on to footpeg mount (3).
2. Install footpeg pin (9).
3. Install clip (7).
4. Check that footpeg clicks in the up and down position.

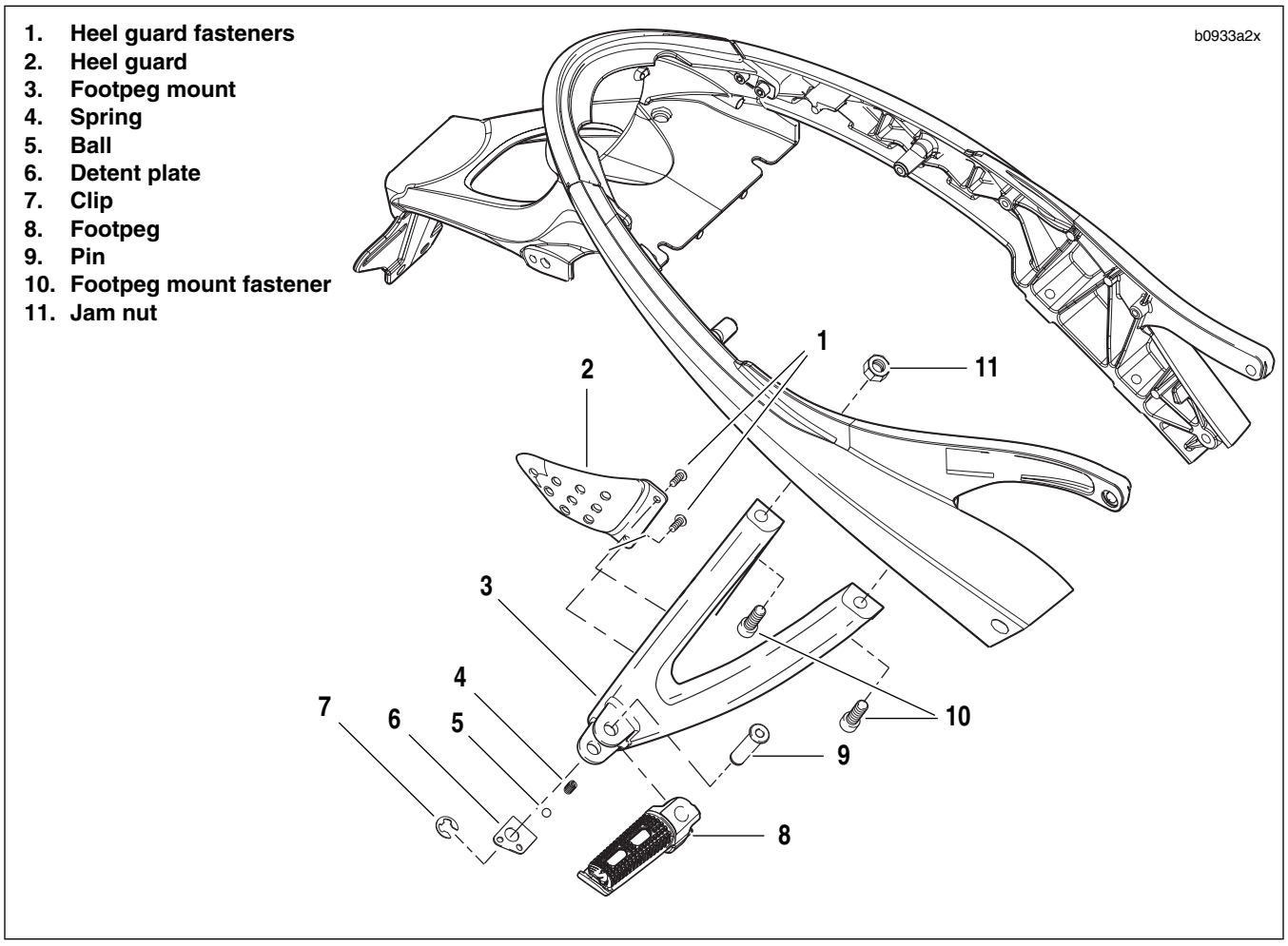


Figure 2-115. Passenger Footpeg, Mount and Heel Guard Assembly

SPROCKET COVER 2.33

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.

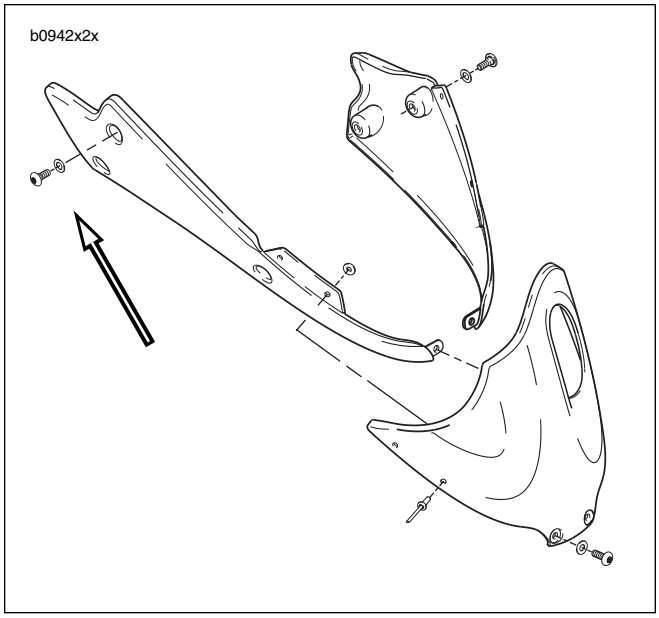
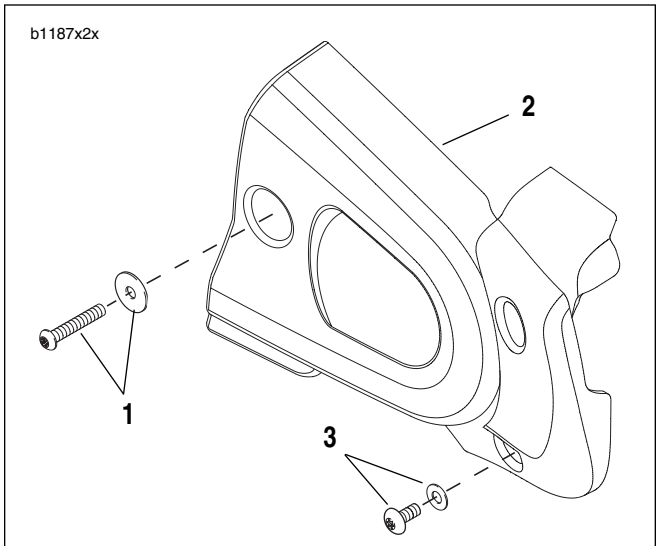


Figure 2-116. Chin Fairing Assembly, Right Rear Fasteners



1. **Long fastener and washer**
2. **Sprocket cover**
3. **Short fastener and washer (2)**

Figure 2-117. Sprocket Cover

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

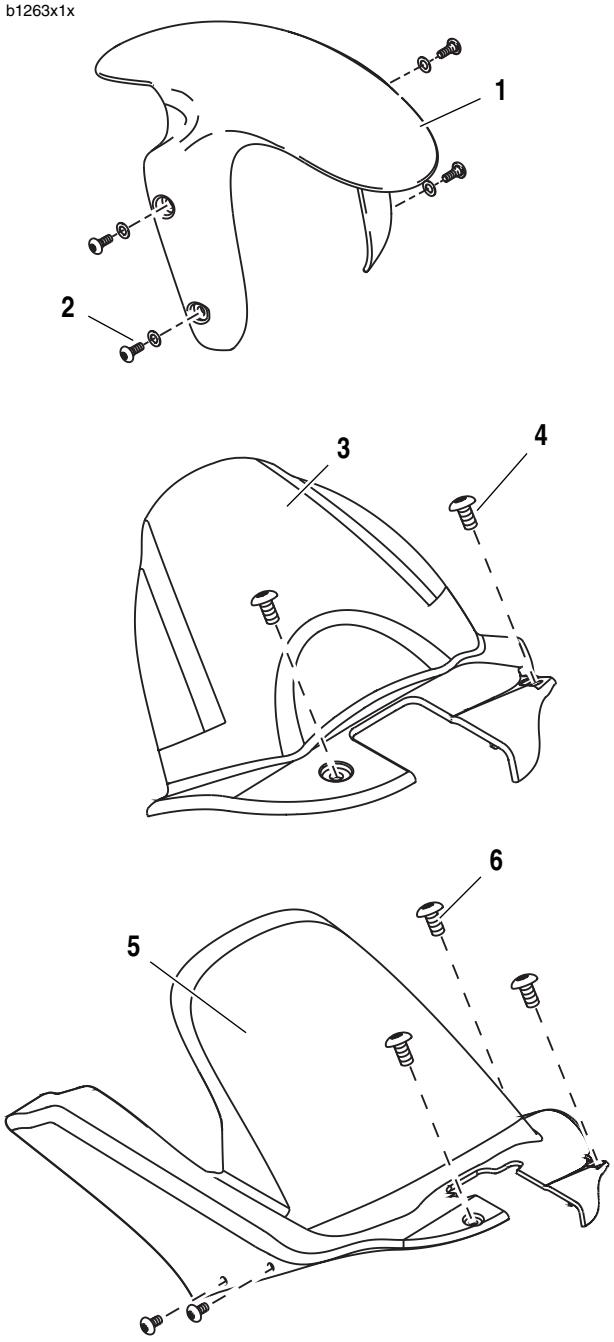
1. See Figure 2-118.
   a. **For XB9SX, XB12S, andXB12Scg:** Remove fasteners (4) securing the rear fender (3) to frame.
   b. **For XB12Ss:** Remove fender fasteners (6).
2. Remove rear fender (XB9SX, XB12S, XB12Scg - 3) (XB12Ss - 5).

Installation

1. See Figure 2-118. Align rear fender to frame.
2. Install rear fender with fasteners (6).
   a. **For XB9SX, XB12S, andXB12Scg:** 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.



1. **Front fender**
2. **Front fender fastener (4)**
3. **Rear fender (XB9SX, XB12S, XB12Scg)**
4. **Rear fender fastener (2)**
5. **Rear fender (XB12Ss)**
6. **XB12Ss rear fender fastener (5)**

Figure 2-118. Front and Rear Fender

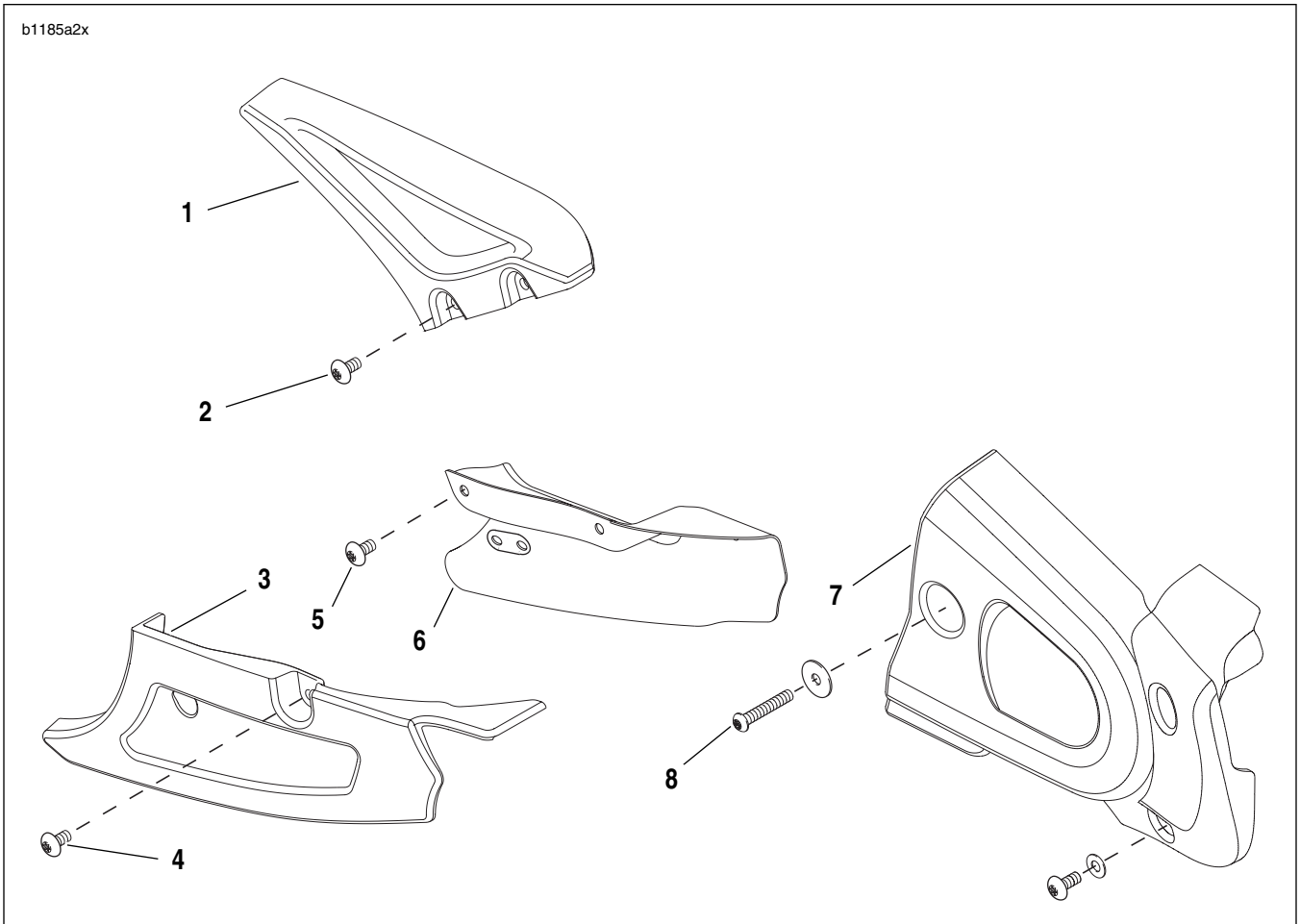
BELT GUARDS 2.35

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.



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)**

Figure 2-119. Belt Guard Assembly

CHIN FAIRING 2.36

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

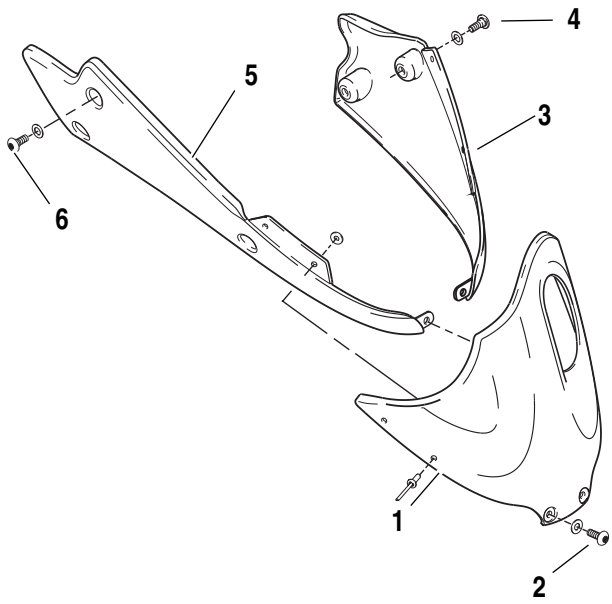
To separate the left, right and center sections, drill out the rivets.

INSTALLATION

NOTE

To join the left, right and center sections, use the rivet gun from a Marson Thread-Setter™ 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).



1. **Center section**
2. **Center section fasteners and washers**
3. **Left section**
4. **Left section fastener and washer**
5. **Right section**
6. **Right section fastener and washer**

Figure 2-120. Chin Fairing Assembly

INTAKE COVER ASSEMBLY 2.37

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).

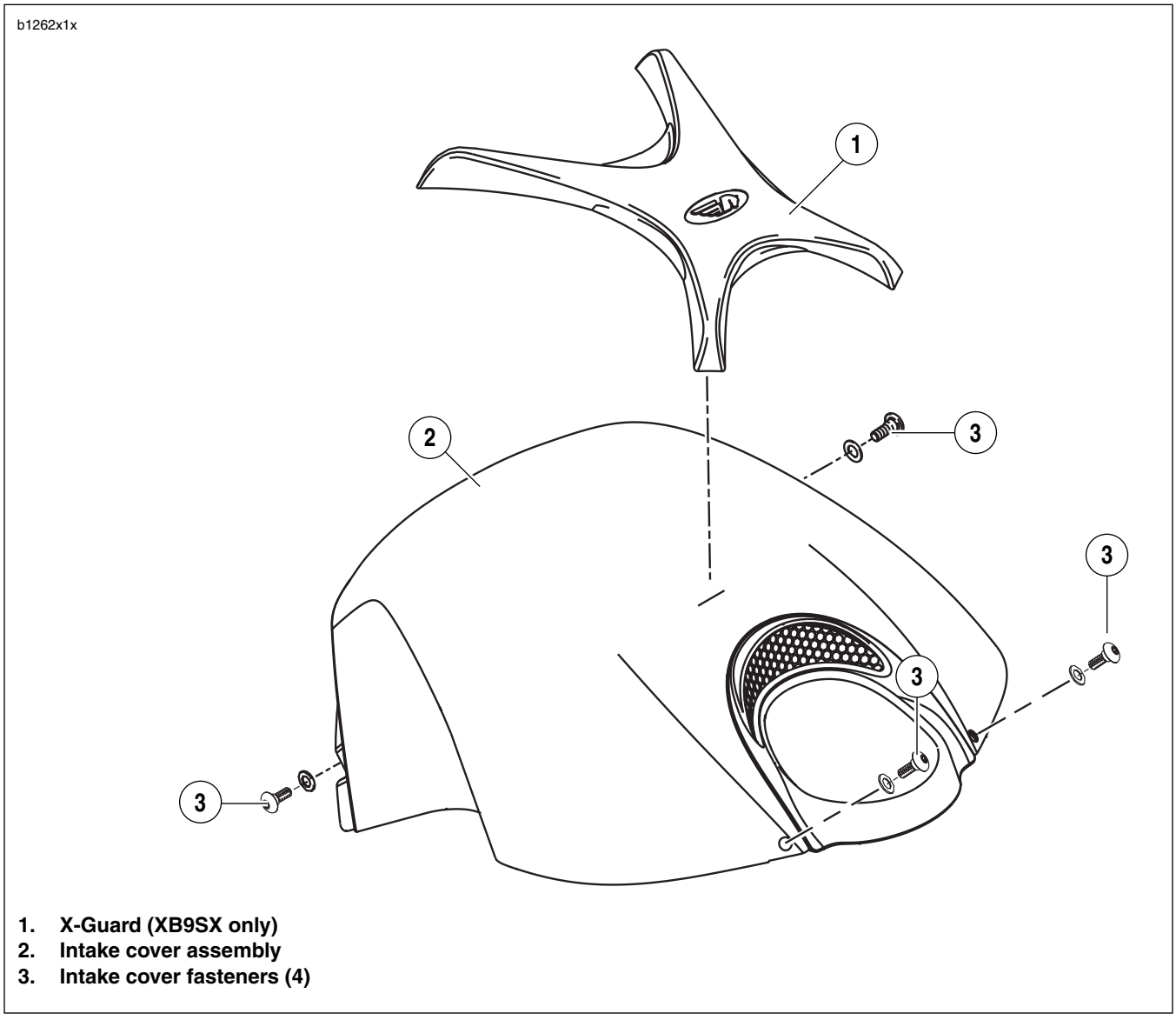
NOTE

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.



1. **X-Guard (XB9SX only)**
2. **Intake cover assembly**
3. **Intake cover fasteners (4)**

Figure 2-121. Intake Cover Assembly

AIR SCOOPS 2.38

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).
3. Remove engine shroud air scoop (6).

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).

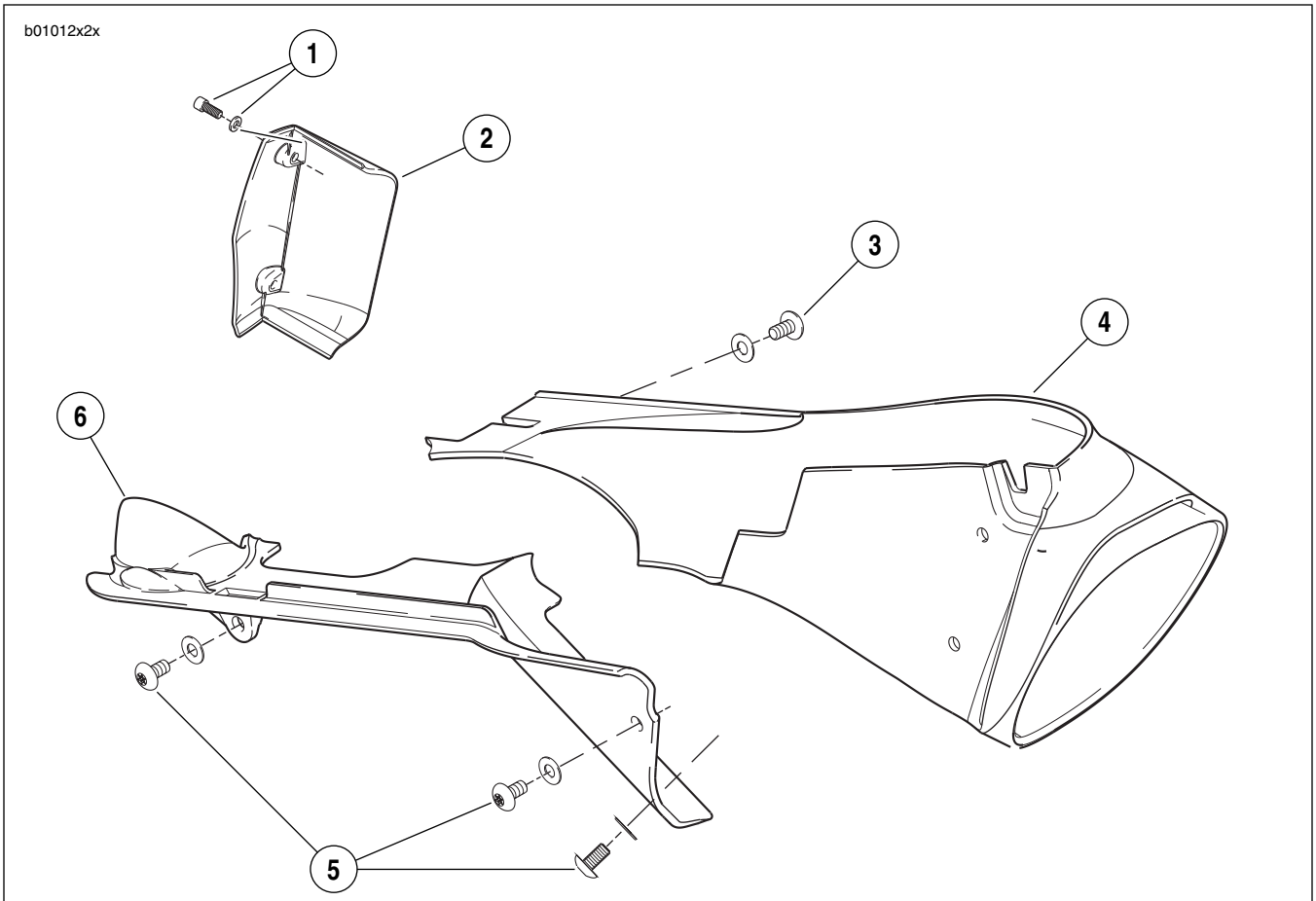
OIL COOLER AIR SCOOP

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).



1. **Oil cooler air scoop fastener and washer (2)**
2. **Oil cooler air scoop**
3. **Ram air scoop fastener and washer**
4. **Ram air scoop**
5. **Engine scoop fastener and washer (3)**
6. **Engine scoop**

Figure 2-122. RAM Air Scoop, Engine Shroud, Oil Cooler

LEFT TAIL SECTION AND BATTERY PAN 2.39

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. 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) [GRD1] & [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.

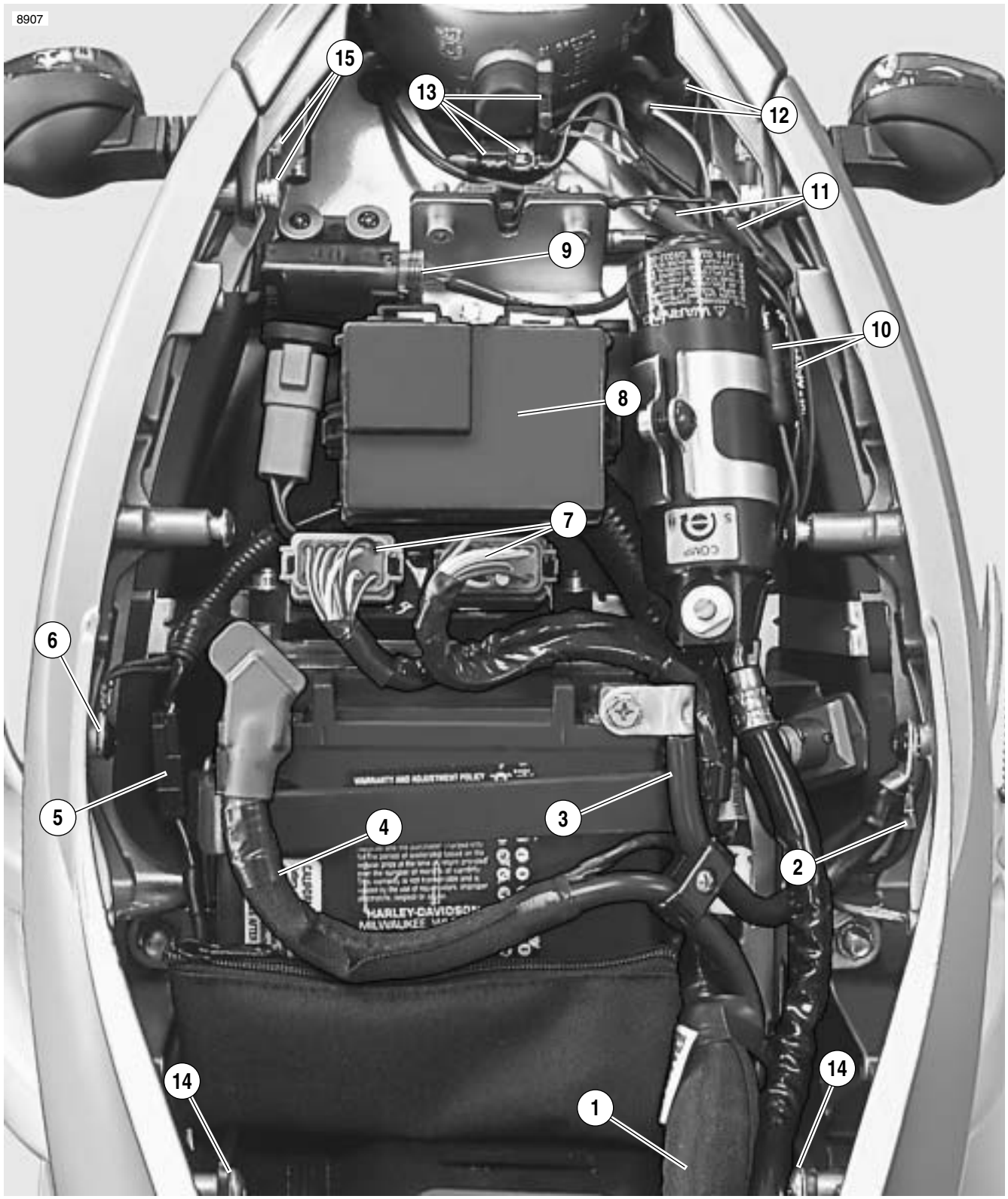
14. Remove two fasteners securing trunk pan to center tail section.
15. See Figure 2-123. Remove fastener securing right front trunk pan to right side tail section.
16. Remove right side passenger footrest support assembly. See 2.32 FOOTPEG, HEEL GUARD AND MOUNT.
17. Slide trunk pan with battery pan, 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.



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]
6. Ground terminals [GRD1] & [GRD 3]
7. ECM connectors [10] & [11]
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)

Figure 2-123. Main Harness and Electrical Connectors Under Seat (Typical)

ASSEMBLY

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 sections 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** (5.4-8.1 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 (11) [18].
   - Left turn signal connector (10) [19].
   - License plate lamp connector (12) [45]
   - Tail light connectors (13) [93].
   - 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

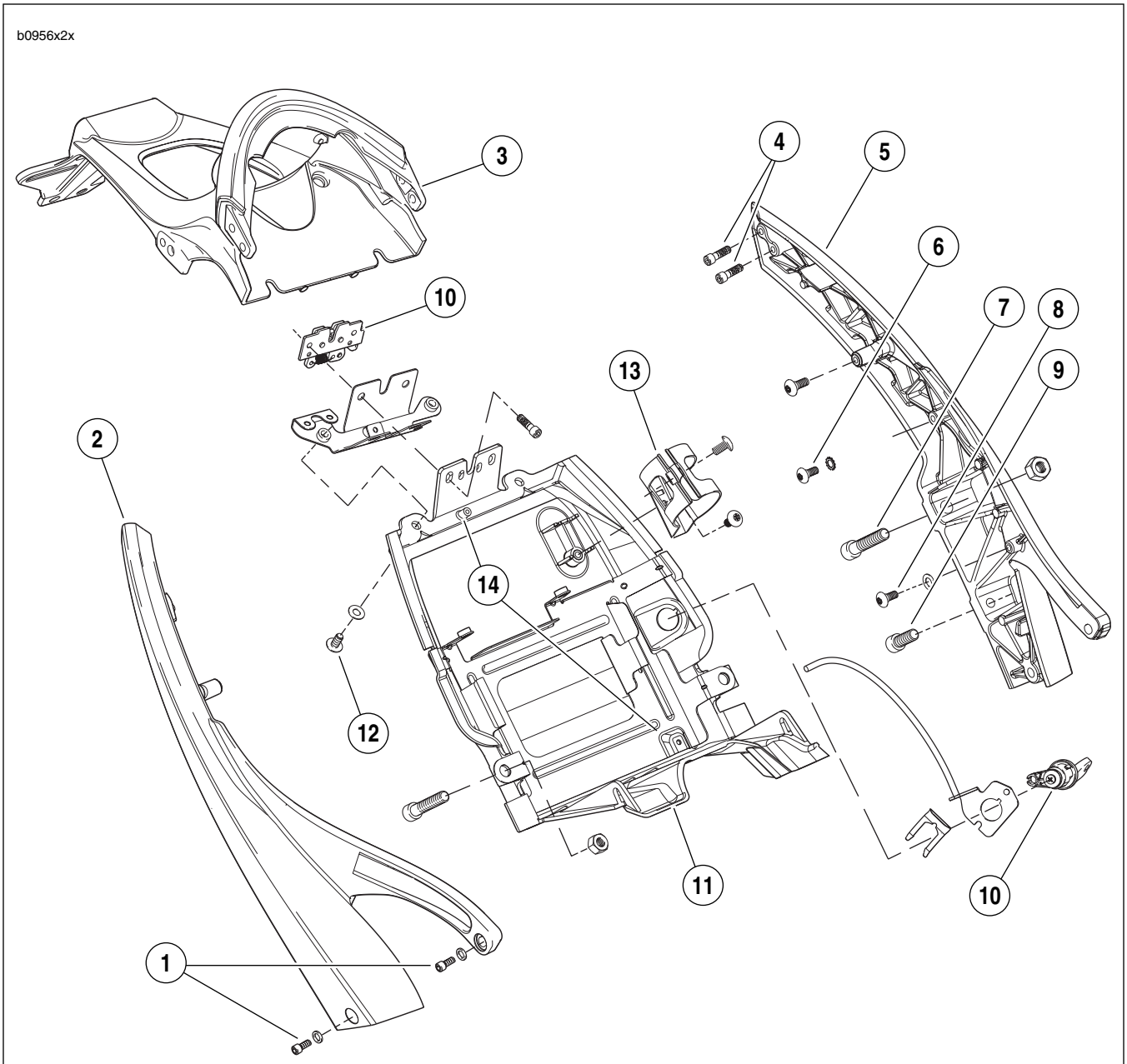
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

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 pan assembly
12. Rear trunk pan fastener to center tail section (2)
13. Rear shock reservoir bracket
14. Plastic lugs (for manufacturing purposes only)

Figure 2-124. Tail Frame and Trunk Pan Assembly

CENTER TAIL SECTION 2.40

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.

RIGHT TAIL SECTION 2.41

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.

⚠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. 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

Figure 2-125. Right Side Frame Section (Typical)

WINDSCREEN 2.42

REMOVAL

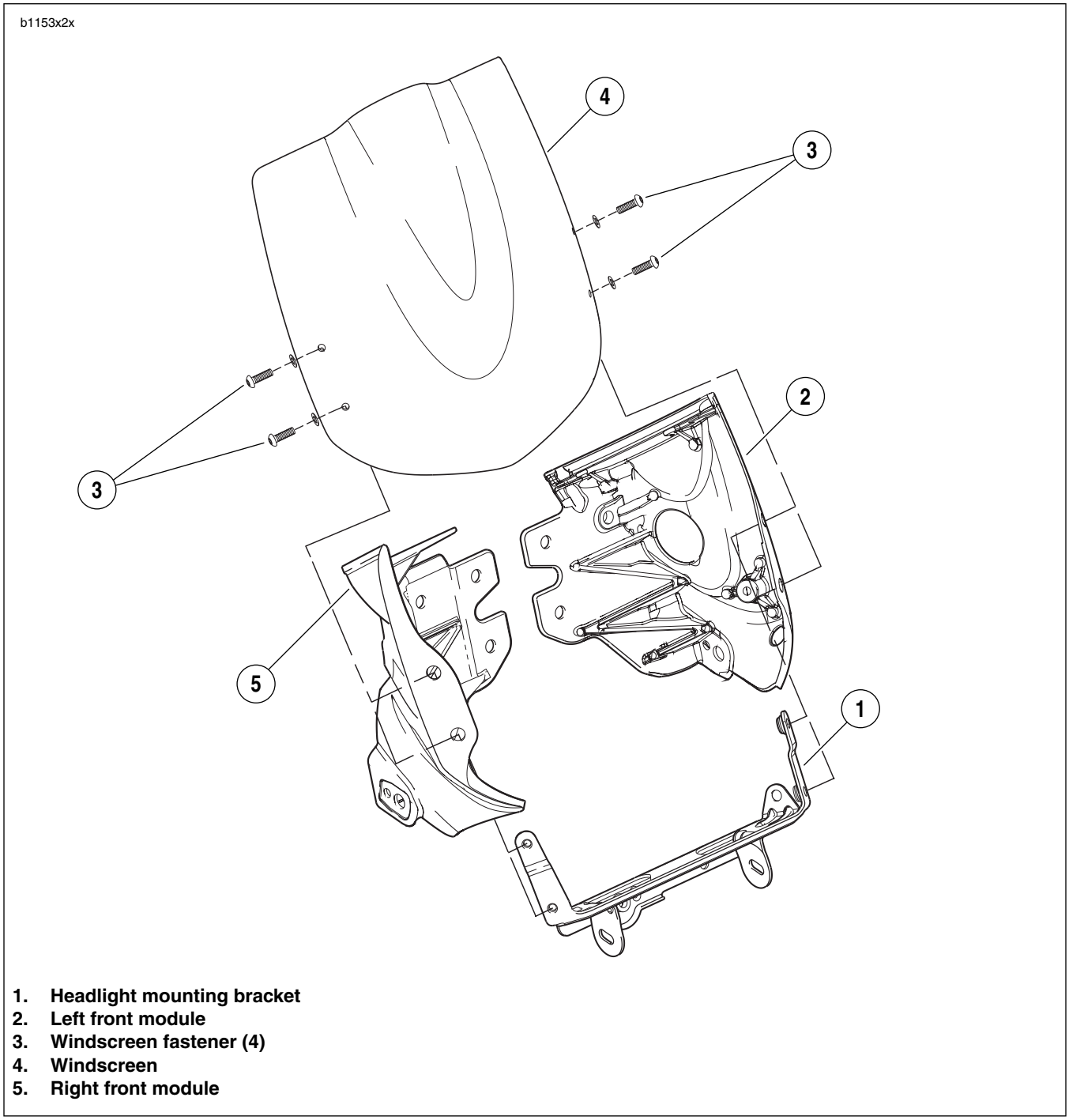
NOTE

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).



1. **Headlight mounting bracket**
2. **Left front module**
3. **Windscreen fastener (4)**
4. **Windscreen**
5. **Right front module**

Figure 2-126. Front Windscreen

SEAT 2.43

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

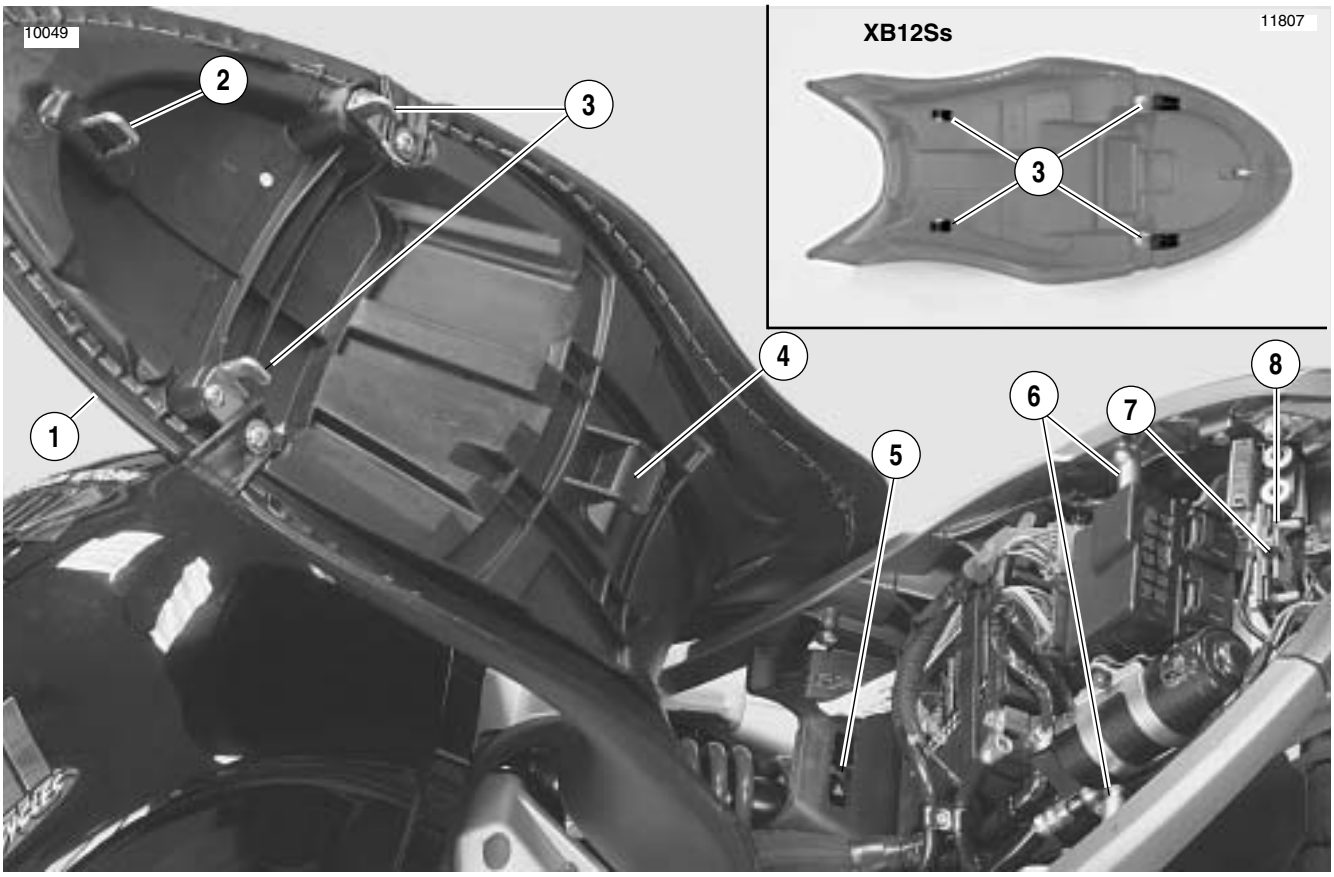
1. See Figure 2-127. Insert ignition key into seat lock located on left side of motorcycle below seat.
2. Turn key clockwise to disengage rear seat latch.
3. Lift and remove seat (1).

INSTALLATION

⚠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.



1. **Seat**
2. **Rear seat tab**
3. **Seat hooks**
4. **Locating tab**
5. **Opening in trunk pan for locating tab**
6. **Shouldered fasteners for seat hooks**
7. **Slot in seat latch**
8. **Seat latch**

Figure 2-127. Seat and Attachment (Inset XB12Ss seat)

SEAT LOCK 2.44

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

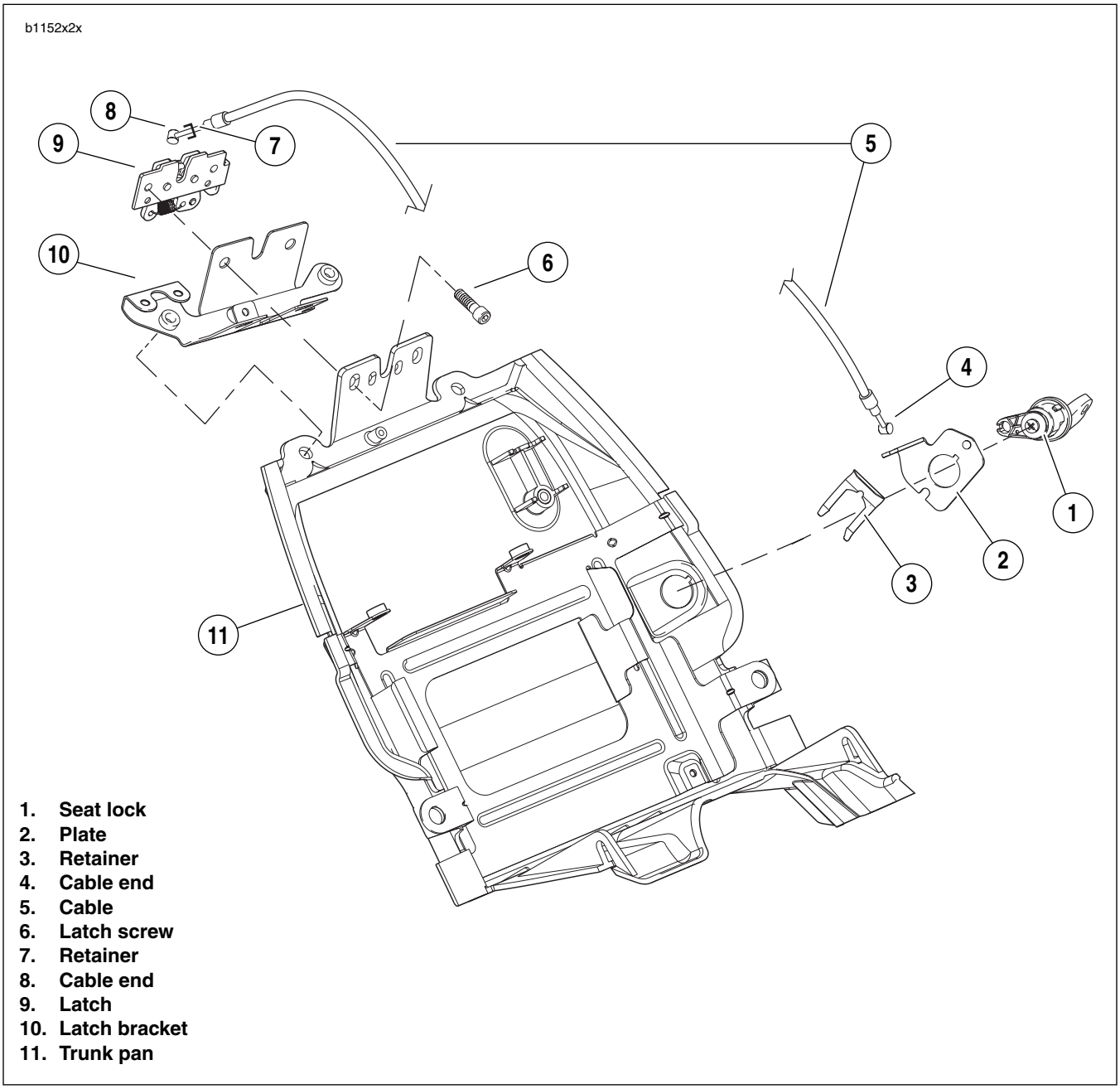
- *Once seat lock has been started through the hole in the trunk pan and plate, now is the time to connect the cable end to the seat lock.*
- *Seat lock plate must be aligned to tab on seat lock for proper installation.*

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

SIDESTAND 2.45

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.

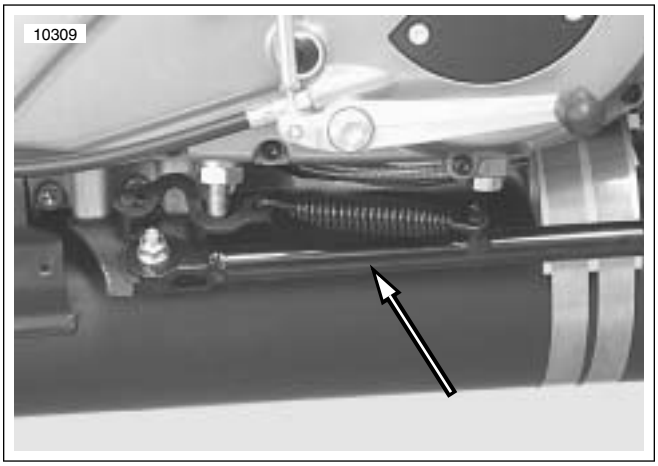


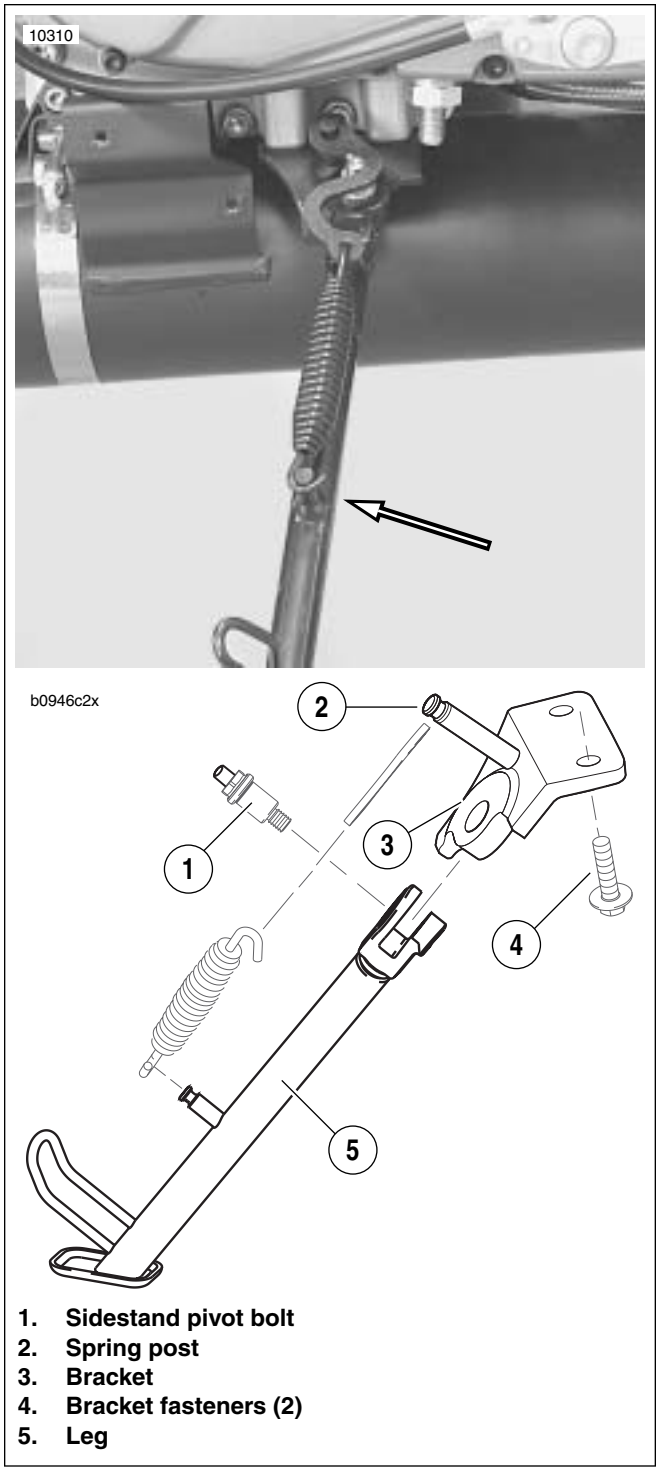
Figure 2-129. Sidestand, Retracted

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.



1. **Sidestand pivot bolt**
2. **Spring post**
3. **Bracket**
4. **Bracket fasteners (2)**
5. **Leg**

Figure 2-130. Sidestand Assembly (Extended)

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.

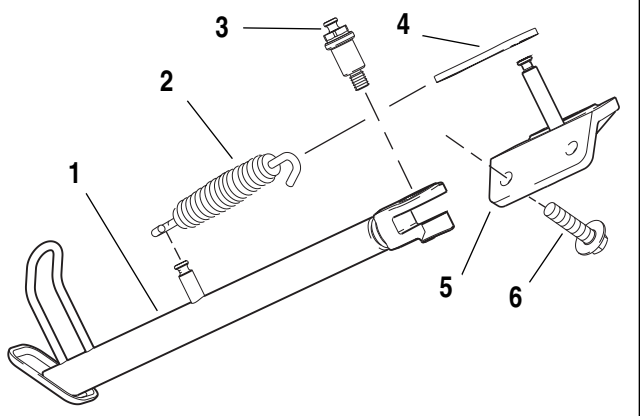
   c. See Figure 2-131. Install sidestand leg (1) and sidestand pivot bolt (3) tightening to 18-20 ft-lbs (24-27 Nm).
   d. Retract sidestand leg.
   e. Install spring extension plate (4) and sidestand spring (2) using SNAP-ON SPRING TOOL (Part No. HE-52B).

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.



1. **Leg**
2. **Spring**
3. **Sidestand pivot bolt**
4. **Extension plate**
5. **Bracket**
6. **Bracket fastener**

Figure 2-131. Sidestand Assembly

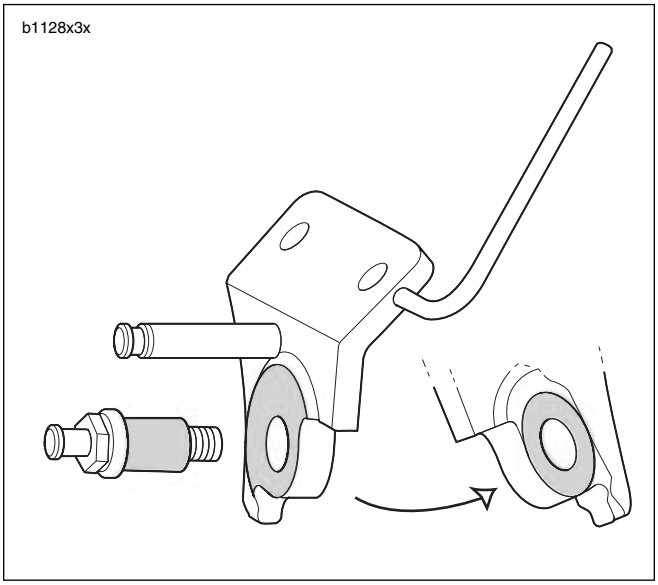


Figure 2-132. Lubricating Points (Shaded Areas)

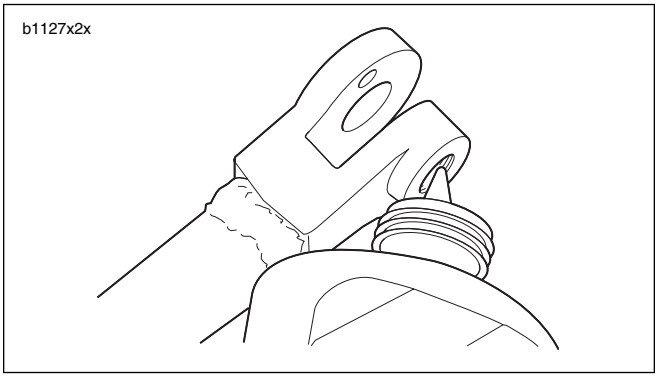


Figure 2-133. Threaded Area for Loctite Application

ENGINE 3

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SPECIFICATIONS 3.1

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

Type	2 cylinder, air cooled, four-stroke 45 Degree V-twin	
Compression ratio	10:1	
Bore (all models)	3.50 in.	88.9 mm
Stroke (XB9SX)	3.125 in.	79.38 mm
Stroke (XB12S)	3.812 in.	96.82 mm
Engine displacement (XB9SX)	60.05 cu. in.	984 cc
Engine displacement (XB12S)	73.4 cu. in.	1203cc
Oil capacity (with filter change)	2.5 quarts	2.37 liters

Table 3-2. Engine Ignition Specifications

Type	Sequential, non waste spark	
Regular idle	1050-1150 RPM	
Spark plug size	12 mm	
Spark plug type	Harley-Davidson No. 10R12A	
Spark plug gap	0.035 in.	0.8890 mm
Spark plug torque	12-18 ft-lbs	16-24 Nm

Table 3-3. Valve and Valve Seat Specifications

VALVE		NEW COMPONENTS		SERVICE WEAR LIMITS	
Fit in guide	Exhaust	0.001-0.003 in.	0.0254-0.0762 mm	0.0038 in.	0.1016 mm
	Intake	0.001-0.003 in.	0.0254-0.0762 mm	0.0038 in.	0.0889 mm
Seat width		0.040-0.062 in.	1.016-1.575 mm	0.090 in.	2.286 mm
Stem protrusion from cylinder valve pocket		2.028-2.064 in.	51.511-52.426 mm	2.082 in.	52.8828 mm

Table 3-4. Valve Spring Specifications

VALVE SPRING		NEW COMPONENTS		SERVICE WEAR LIMITS	
Free length		2.325 in.	59.1 mm	2.325. (min)	59.1 mm (min)
Intake	1.850 in. (closed)	135 lbs	61.2 kg		
	1.300 in. (open)	312 lbs	141.5 kg		
Exhaust	1.850 in. (closed)	135 lbs	61.2 kg		
	1.300 in. (open)	312 lbs	141.5 kg		

Table 3-5. Rocker Arm Specifications

ROCKER ARM	NEW COMPONENTS		SERVICE WEAR LIMITS	
Shaft fit in bushing (loose)	0.0005-0.0020 in.	0.0127-0.0508 mm	0.0035 in.	0.0889 mm
End clearance	0.003-0.013 in.	0.076-0.330 mm	0.025 in	0.635 mm
Bushing fit in rocker arm (tight)	0.004-0.002 in.	0.102-0.0559 mm		
Rocker arm shaft fit in rocker cover (loose)	0.0007-0.0022 in.	0.018-0.056 mm	0.0035 in.	0.0889 mm

Table 3-6. Piston Ring and Piston Pin Specifications

PISTON		NEW COMPONENTS		SERVICE WEAR LIMITS	
Compression ring gap (top and 2nd)		0.007-0.020 in.	0.178-0.508 mm	0.032 in.	0.813 mm
Oil control ring rail gap		0.009-0.052 in.	0.229-1.321 mm	0.065 in	1.651 mm
Compression ring side clearance	Top	0.0020-0.0045 in.	0.0508-0.1143 mm	0.0065 in.	0.1651 mm
	2nd	0.0016-0.0041 in.	0.0406-0.1041 mm	0.0065 in.	0.1651 mm
Oil control ring side clearance		0.0016-0.0076 in.	0.0406-0.1930 mm	0.0094 in.	0.2388 mm
Pin fit (loose, at room temperature)		0.00005-0.00045 in.	0.00127-0.01143 mm	0.00100 in.	0.02540 mm

Table 3-7. Cylinder Head Specifications

CYLINDER HEAD	NEW COMPONENTS		SERVICE WEAR LIMITS	
Valve guide in head (tight)	0.0033-0.0020 in.	0.0838-0.0508 mm		
Valve seat in head (tight)	0.0035-0.0010 in.	0.0889-0.0254 mm		
Head gasket surface (flatness)	0.006 in. total	0.152 mm total	0.006 in. total	0.152 mm total

Table 3-8. Cylinder Specifications

CYLINDER		NEW COMPONENTS		SERVICE WEAR LIMITS	
Taper				0.002 in.	0.051 mm
Out of round				0.003 in.	0.076 mm
Warpage (gasket surfaces)	Top			0.006 in.	0.152 mm
	Base			0.008 in.	0.203 mm
Bore diameter± 0.0002 in.	Standard	3.4978 in.	88.8441 mm	3.5008 in.	88.9203 mm

Table 3-9. Connecting Rod Specifications

CONNECTING ROD	NEW COMPONENTS		SERVICE WEAR LIMITS	
Piston pin fit (loose)	0.00145-0.00155 in.	0.03683-0.03937 mm	0.00180 in.	0.04572 mm
Side play between flywheels	0.005-0.031 in.	0.1-0.8 mm	0.036 in.	0.9 mm
Fit on crankpin (loose)	0.0004-0.0017 in.	0.0102-0.0432 mm	0.0027 in.	0.0686 mm
Connecting rod race ID	1.6245-1.6250 in.	41.2623-41.2750 mm	1.6270 in.	41.3258 mm

Table 3-10. Hydraulic Lifter Specifications

HYDRAULIC LIFTER	NEW COMPONENTS		SERVICE WEAR LIMITS	
Fit in guide	0.0008-0.0020 in.	0.0203-0.0508 mm	0.0030 in.	0.0762 mm
Roller fit	0.0006-0.0010 in.	0.0152-0.0254 mm	0.0015 in.	0.0381 mm
Roller end clearance	0.008-0.022 in.	0.203-0.559 mm	0.026 in.	0.660 mm

Table 3-11. Oil Pump Specifications

OIL PUMP		NEW COMPONENTS		SERVICE WEAR LIMITS	
Oil pressure	1000 RPM	7-12 PSI	48-83 kPa		
	2500 RPM	10-17 PSI	69-117 kPa		
Shaft to pump clearance		0.0025 in.	0.0635 mm		
Feed/scavenge inner/outer gerotor clearance		0.003 in.	0.076 mm	0.004 in.	0.102 mm

Table 3-12. Gearcase Specifications

GEARCASE	NEW COMPONENTS		SERVICE WEAR LIMITS	
Cam gear shaft in bushing (loose)	0.0007-0.0022 in.	0.0178-0.0559 mm	0.003 in.	0.076 mm
Cam gear shaft end play (min)	0.005-0.024 in.	0.127-0.610 mm	0.025 in.	0.635 mm
Intake cam gear shaft end play (min)	0.006-0.024 in.	0.152-0.610 mm	0.040 in.	1.016 mm

Table 3-13. Flywheel Specifications

FLYWHEEL		NEW COMPONENTS		SERVICE WEAR LIMITS	
Runout	**Flywheel at rim**	0.000-0.010 in.	0.000-0.254 mm	0.010 in.	0.254 mm
	Shaft at flywheel end	0.000-0.002 in.	0.000-0.051 mm	0.002 in.	0.051 mm

Table 3-14. Sprocket Shaft Bearing Specifications

SPROCKET SHAFT BEARING	NEW COMPONENTS		SERVICE WEAR LIMITS	
Bearing outer race fit in crankcase (tight)	0.006 in. Interference fit	0.2 mm		
Bearing inner race fit on shaft (tight)	0.006 in. Interference fit	0.2 mm		
Flywheel endplay in crankcase	.003-.010 in.	0.08-0.25 mm	.010 in.	0.25 mm

Table 3-15. Pinion Shaft Bearing Specifications

PINION SHAFT BEARING	NEW COMPONENTS		SERVICE WEAR LIMITS	
Pinion shaft journal diameter	1.2496-1.2500 in.	31.7398-31.7500 mm	1.2496 in. (min)	31.7398 mm (min)
Outer race diameter in right crankcase	1.5646-1.5652 in.	39.7408-39.7561 mm	1.5672 in. (max)	39.8069 mm (max)
Bearing running clearance	0.00012-0.00088 in.	0.00305-0.02235 mm		
Fit in cover bushing (loose)	0.0023-0.0043 in.	0.0584-0.1092 mm	0.0050 in.	0.1270 mm

TORQUE VALUES

ITEM	TORQUE		NOTES
Air scoop fastener at oil cooler	48-72 **in-lbs**	5.4-8 Nm	page 3-76
All tie bars	25-27 ft-lbs	33.9-36.6 Nm	page 3-14
Anti-rotation screws (lifter)	55-65 **in-lbs**	6-7 Nm	page 3-86
Clutch cable wire form fastener	84-92 **in-lbs**	9.5-10.4 Nm	page 3-15, 3-40
Crankcase 5/16 in. screws	15-19 ft-lbs	20-26 Nm	page 3-104
Cylinder head screws			Special procedure, Special pattern to tighten, page 3-59
Cylinder studs	10-20 ft-lbs	14-27 Nm	Special method to tighten, page 3-105
Exhaust header nuts	72-96 **in-lbs**	8.1-10.8 Nm	page 3-14
Feed oil line at rear of oil pump	27-29 ft-lbs	36.6-39.3 Nm	page 3-36
Front isolator bolt	49-51 ft-lbs	66-69 Nm	page 3-14
Front isolator bracket mounting fastener	49-51 ft-lbs	66.4-69.1 Nm	page 3-14, 3-33
Gearcase cover screws	80-110 **in-lbs**	9-12 Nm	Special pattern to tighten, page 3-91
Ignition coil fasteners	120-144 **in-lbs**	13.6-16.3 Nm	page 3-42
Oil cooler oil line clamp	12-36 **in-lbs**	1.3-4 Nm	page 3-38, 3-76
Oil cooler feed oil line at oil cooler	19-21 ft-lbs	26-28 Nm	page 3-38, 3-76
Oil cooler return oil line at crankcase	15-17 ft-lbs	20.3-23 Nm	page 3-38
Oil cooler return oil line at oil cooler	19-21 ft-lbs	25.8-28.5 Nm	page 3-38, 3-76
Oil filter adapter	96-144 **in-lbs**	11-16 Nm	LOCTITE 243, page 3-84
Oil line clamp at starter motor	40-50 **in-lbs**	5-5.5 Nm	page 3-36
Oil line fittings at swingarm	108-156 **in-lbs**	12-17.6 Nm	page 3-74
Oil line p-clamp fastener	48-72 **in-lbs**	5.4-8 Nm	page 3-36
Oil pressure signal light switch	50-70 **in-lbs**	6-8 Nm	page 3-84
Oil pump cover screws	70-80 **in-lbs**	8-9 Nm	TORX, page 3-83
Oil pump mounting screws	125-150 **in-lbs**	14-17 Nm	page 3-83

ITEM	TORQUE		NOTES
Pinion shaft nut	19-21 ft-lbs	26-29 Nm	page 3-90
Piston jet TORX screws	25-35 **in-lbs**	2.8-4 Nm	Loctite 222, page 3-93
Pushrod cover screw	30-40 **in-lbs**	3-5 Nm	page 3-86
Rear isolator assembly fasteners	25-27 ft-lbs	33.9-36.6 Nm	page 3-30
Rear isolator bolt	25-27 ft-lbs	33.9-36.6 Nm	page 3-33
Rear muffler bracket	32-36 ft-lbs	43.4-48.8 Nm	page 3-34
Reed valve stop fastener	5-7 **in-lbs**	0.6-0.8 Nm	page 3-79
Return oil line at top front oil pump	22-24 ft-lbs	29.8-32.5 Nm	page 3-36
Rocker box cover screws	120-156 **in-lbs**	13.6-17.6 Nm	page 3-61
Rocker box to head bolts	135-155 **in-lbs**	15-18 Nm	Small fasteners, page 3-61
Rocker box to head bolts	18-22 ft-lbs	24-30 Nm	Large fasteners, page 3-61
Rocker box to head screws	135-155 **in-lbs**	15-18 Nm	Small screw, page 3-61
Sprocket cover fastener	12-36 **in-lbs**	1-4 Nm	page 3-18, 3-43
Stabilizer bracket fastener	66-78 **in-lbs**	7.5-8.8 Nm	page 3-76
Swingarm pivot shaft pinch bolt	17-19 ft-lbs	23-25.8 Nm	page 3-31
Swingarm pivot shaft	24-26 ft-lbs	32.5-35.2 Nm	page 3-31
V bracket to main frame	120-144 **in-lbs**	13.6-16.3 Nm	page 3-14, 3-33
Vent oil line at gearcase cover	12-13 ft-lbs	16.3-17.6 Nm	page 3-36

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 COMPRESSION 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

DIAGNOSIS	TEST RESULTS
Ring trouble	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.
Valve trouble	Compression low on first stroke; does not build up much on following strokes; does not improve considerably with the addition of oil.
Head gasket leak	Same reaction as valve trouble.

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

AIR LEAK LOCATION	POSSIBLE CAUSES
Induction module intake	Intake valve leaking.
Exhaust pipe	Exhaust valve leaking.
Timing inspection hole	Piston rings leaking. Worn or broken piston. Worn cylinder.
Head gasket	Leaking gasket.

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.

ENGINE ROTATION FOR SERVICE 3.3

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

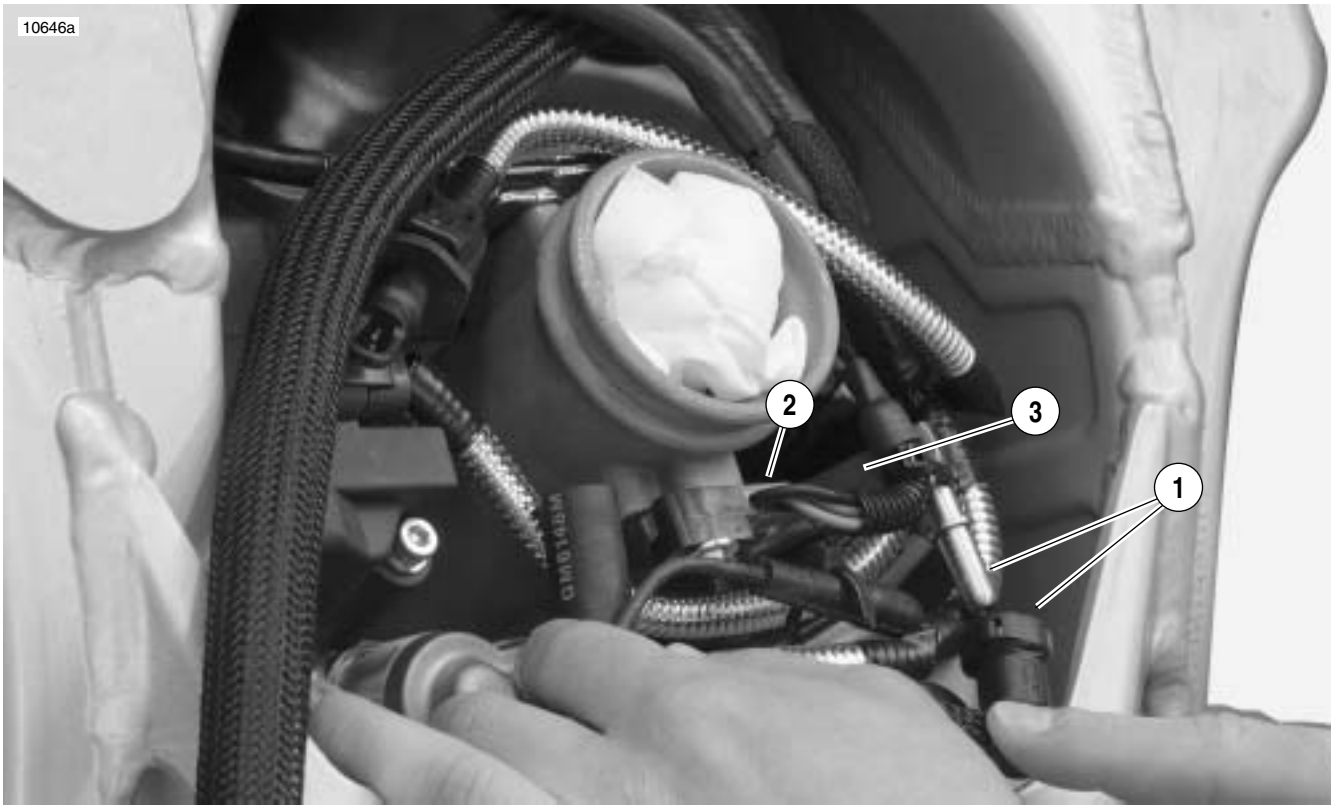
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

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

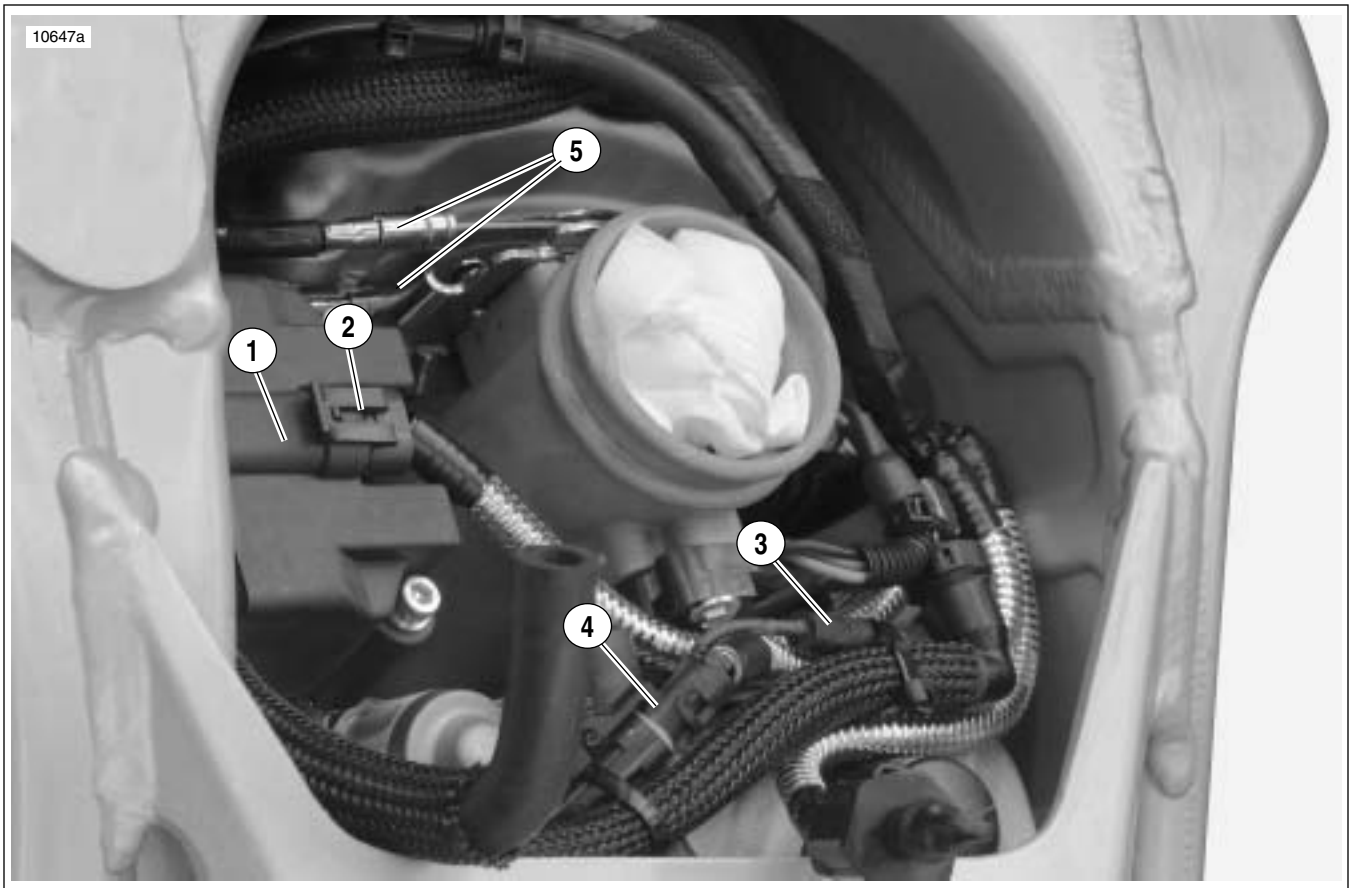
The velocity stack has a clamp ring around the throttle body.

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].



1. **Fuel line connection**
2. **Connection for throttle position sensor [88]**
3. **Connections for fuel injectors [84 & 85]**

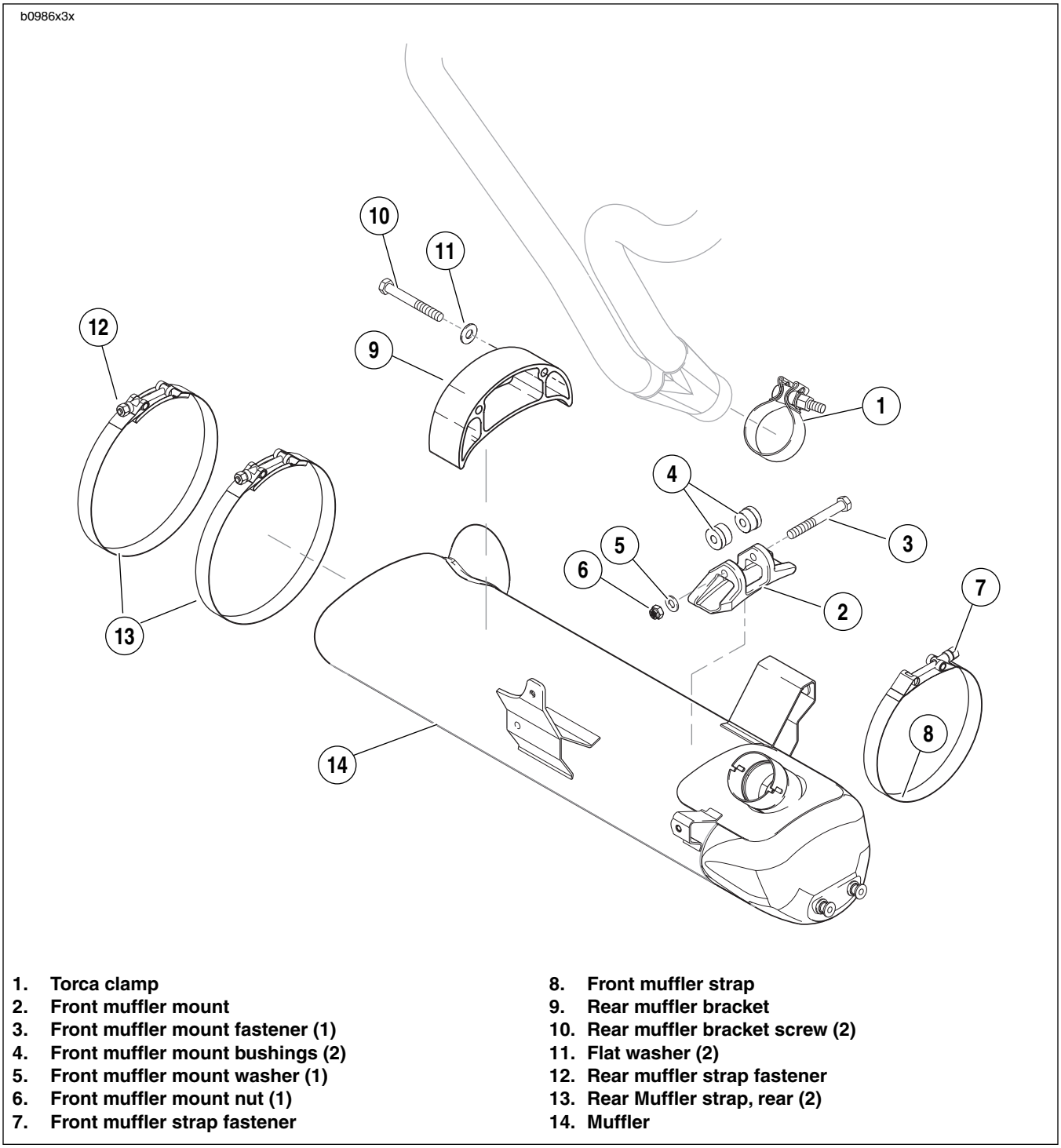
Figure 3-1. Fuel Line and DDFI Electrical Connections (Typical)



1. **Ignition coil**
2. **Coil connection [83]**
3. **Cylinder head temperature sensor connection [90]**
4. **Oxygen sensor connection [137]**
5. **Throttle cables**

Figure 3-2. Electrical Connections and Throttle Cables (Typical)

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].



1. **Torca clamp**
2. **Front muffler mount**
3. **Front muffler mount fastener (1)**
4. **Front muffler mount bushings (2)**
5. **Front muffler mount washer (1)**
6. **Front muffler mount nut (1)**
7. **Front muffler strap fastener**
8. **Front muffler strap**
9. **Rear muffler bracket**
10. **Rear muffler bracket screw (2)**
11. **Flat washer (2)**
12. **Rear muffler strap fastener**
13. **Rear Muffler strap, rear (2)**
14. **Muffler**

Figure 3-3. Muffler and Mounting System (XB9SX Model)

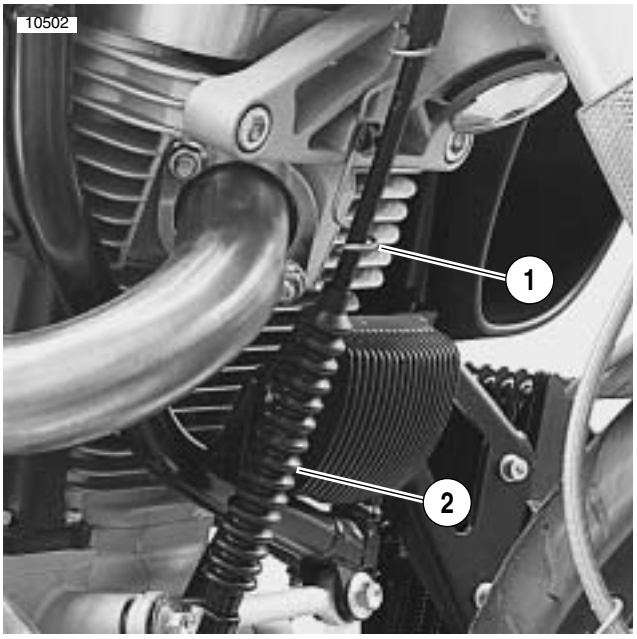
13. Disconnect and remove air scoops, right and left sides.
14. Remove transmission sprocket side cover**.**
15. Remove rear belt and idler pulley**.** See 6.6 DRIVE BELT SYSTEM.

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).

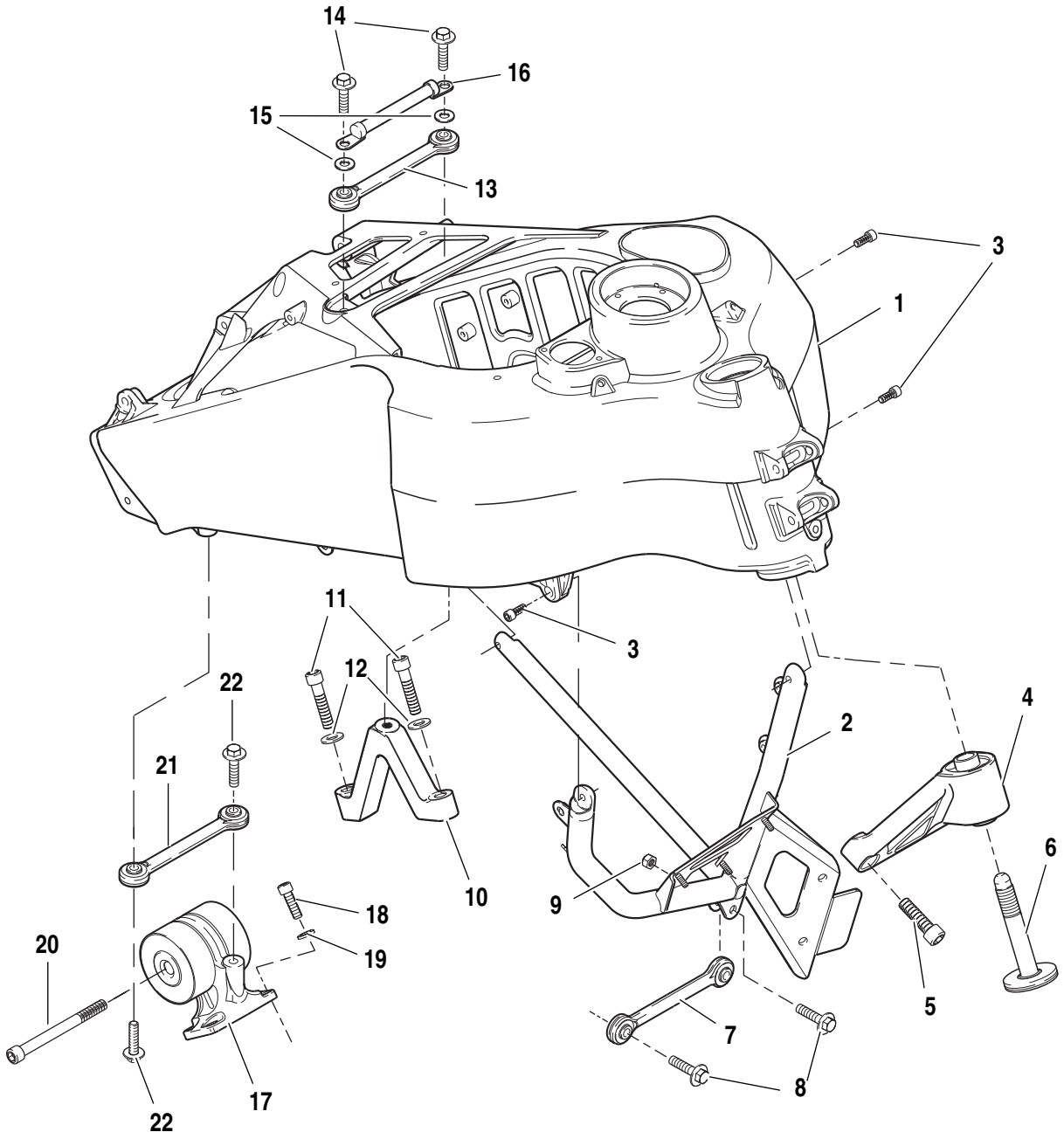
17. Remove left side rider footrest and support plate.
18. See Figure 3-4. Disconnect clutch cable.
    a. Remove wire form (1) from front isolator.
    b. Slide clutch cable adjuster boot (2) up to access clutch adjuster.
    c. Loosen clutch adjuster to release tension from hand lever.
    d. Remove clutch cable ferrule from hand lever.



1. **Wire form**
2. **Clutch cable adjuster boot**

Figure 3-4. Clutch Cable Wire form and Adjuster Boot

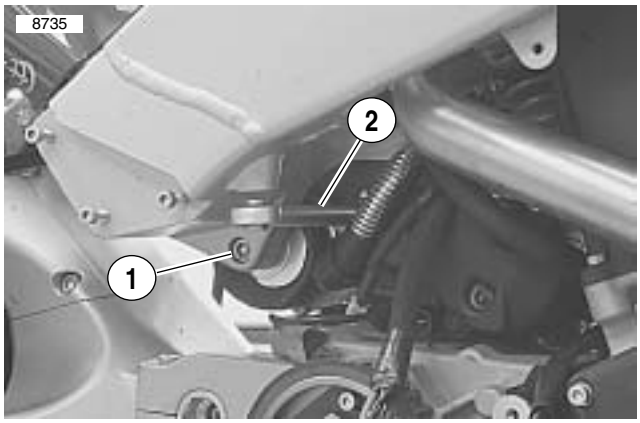
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1. Frame assembly
2. “V” bracket
3. Fasteners for “V” bracket (3)
4. Front isolator assembly
5. Fasteners (2)
6. Bolt
7. Front tie bar assembly
8. Fasteners for front tie bar assembly (2)
9. Nut for one fastener for front tie bar assembly
10. Center 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)

Figure 3-5. Engine Mounting System

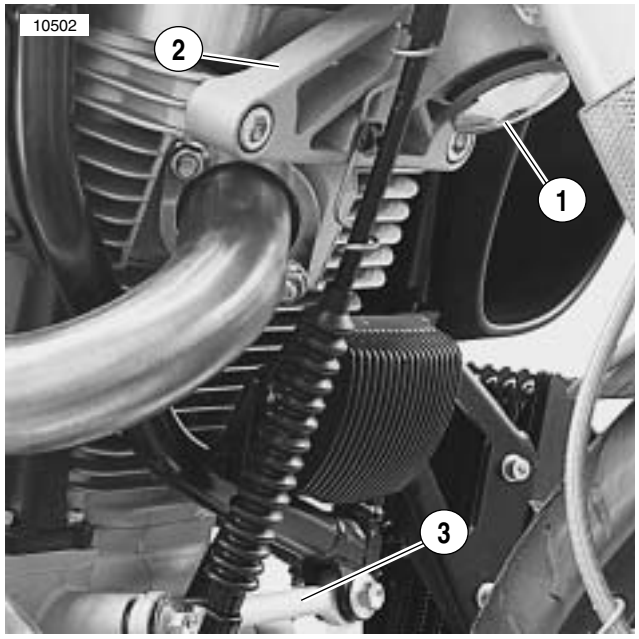
19. Support engine with wide scissors jack.
20. Unbolt “V” bracket from main frame.
21. Remove center tie bar from engine.



1. Rear isolator bolt
2. Rear tie bar

Figure 3-6. Rear Isolator Bolt and Rear Tie Bar (Typical)

22. See Figure 3-6. Remove rear tie bar from frame only.
23. Loosen rear isolator bolt. DO NOT REMOVE.



1. Front isolator bolt
2. Front isolator mount
3. Front tie bar

Figure 3-7. Front Isolator and Tie Bar Assemblies

24. See Figure 3-7. Remove front isolator bolt (1).
25. Remove front isolator mount (2) from engine.
26. Rotate engine down.

ASSEMBLY

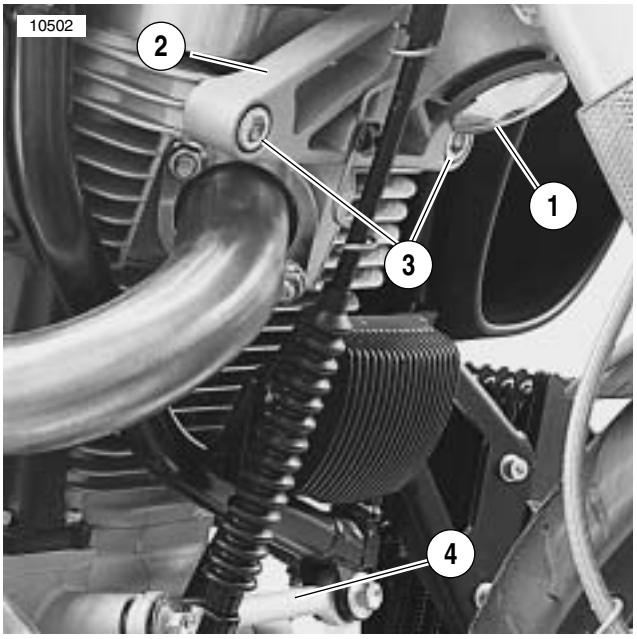
NOTES

- *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.



1. **Front isolator bolt**
2. **Front isolator mount**
3. **Front isolator mount fasteners (2)**
4. **Front tie bar**

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).
   c. Attach regulator wiring harness to bracket nylon cable straps.
9. Remove scissors jack.

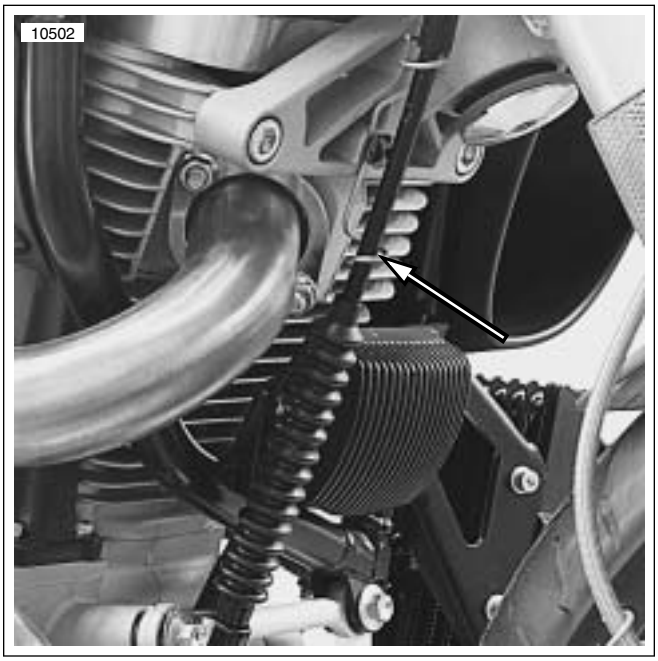
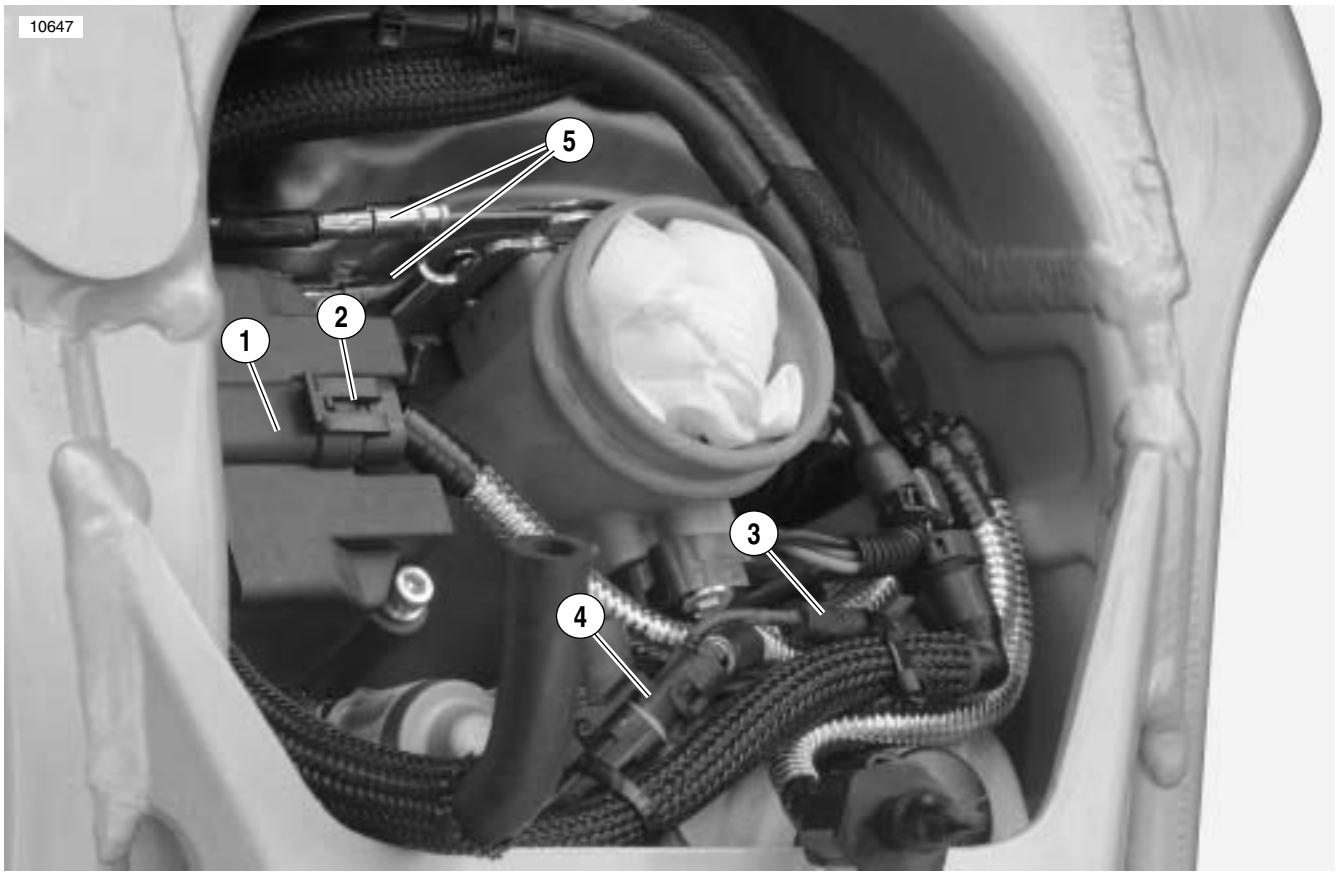


Figure 3-9. Clutch Cable Wire form

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).



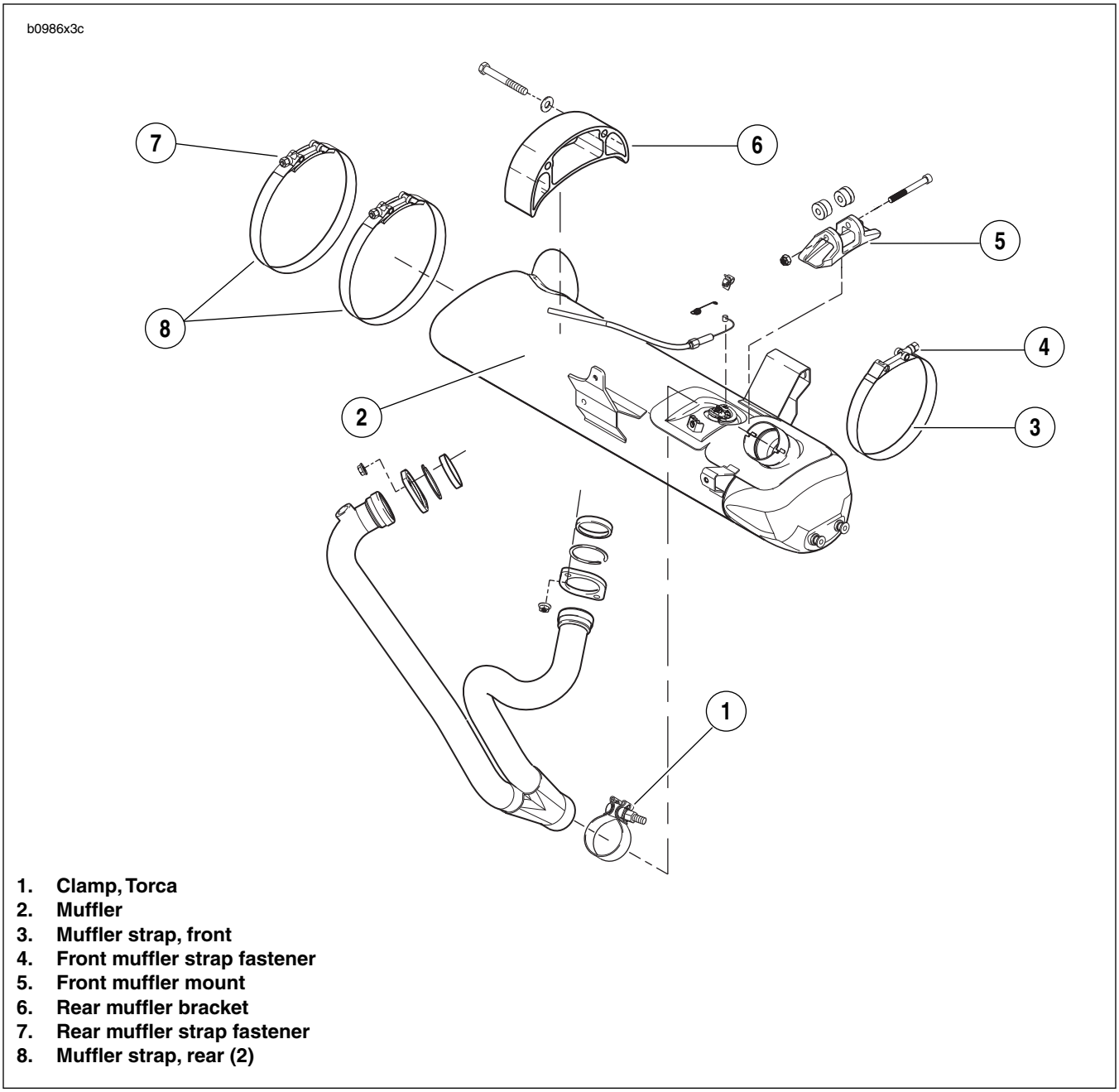
Figure 3-10. Oil Cooler Feed and Return Oil Line 1/8-1/4 in. (3.175-6.35 mm) Clearance



1. **Ignition coil**
2. **Coil connection [83]**
3. **Cylinder head temperature sensor connection [90]**
4. **Oxygen sensor connection [137]**
5. **Throttle cables**

Figure 3-11. Electrical Connections and Throttle Cables (Typical)

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).

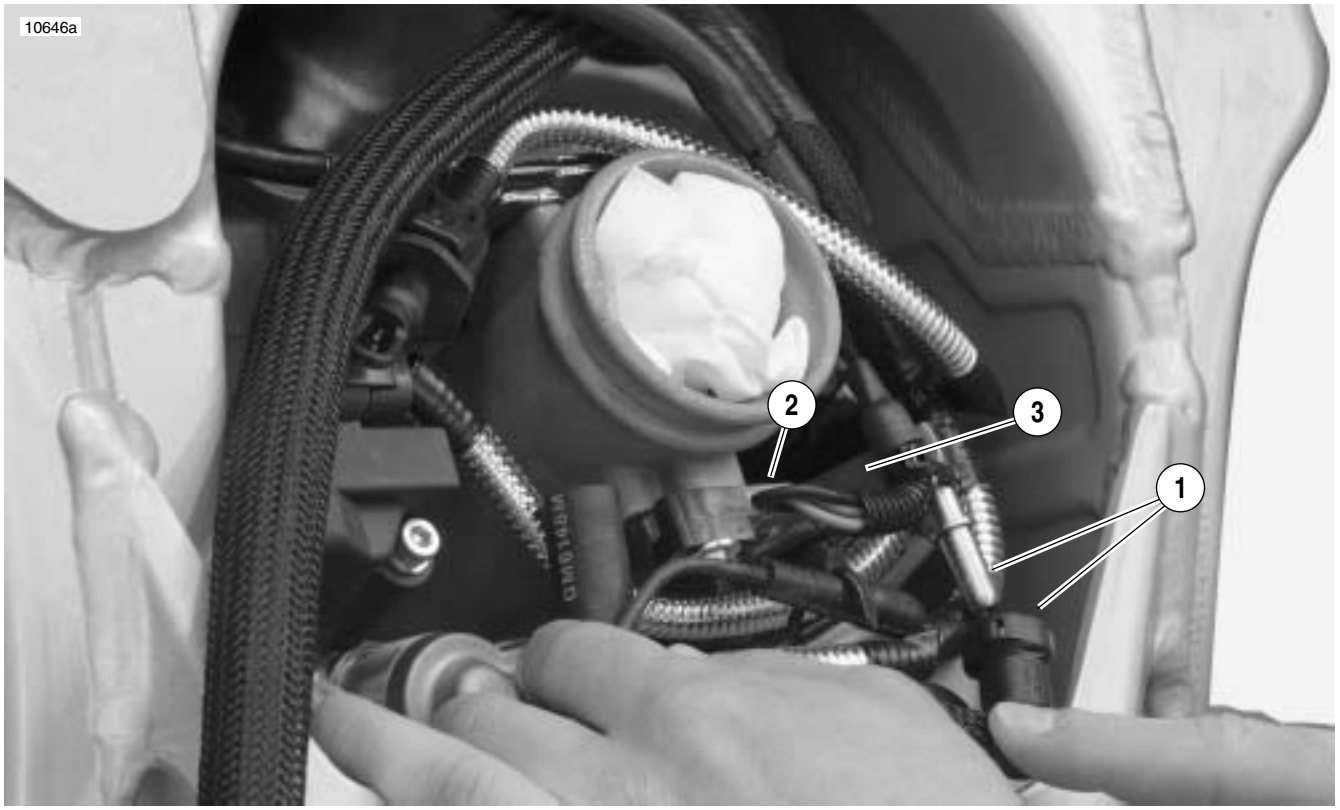


1. **Clamp, Torca**
2. **Muffler**
3. **Muffler strap, front**
4. **Front muffler strap fastener**
5. **Front muffler mount**
6. **Rear muffler bracket**
7. **Rear muffler strap fastener**
8. **Muffler strap, rear (2)**

Figure 3-12. Muffler and Mounting System (XB12 Models)

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.*



1. **Fuel line connection**
2. **Connection for throttle position sensor [88]**
3. **Connections for fuel injectors [84 & 85]**

Figure 3-13. Fuel Line and DDFI Electrical Connections (Typical)

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.

⚠WARNING

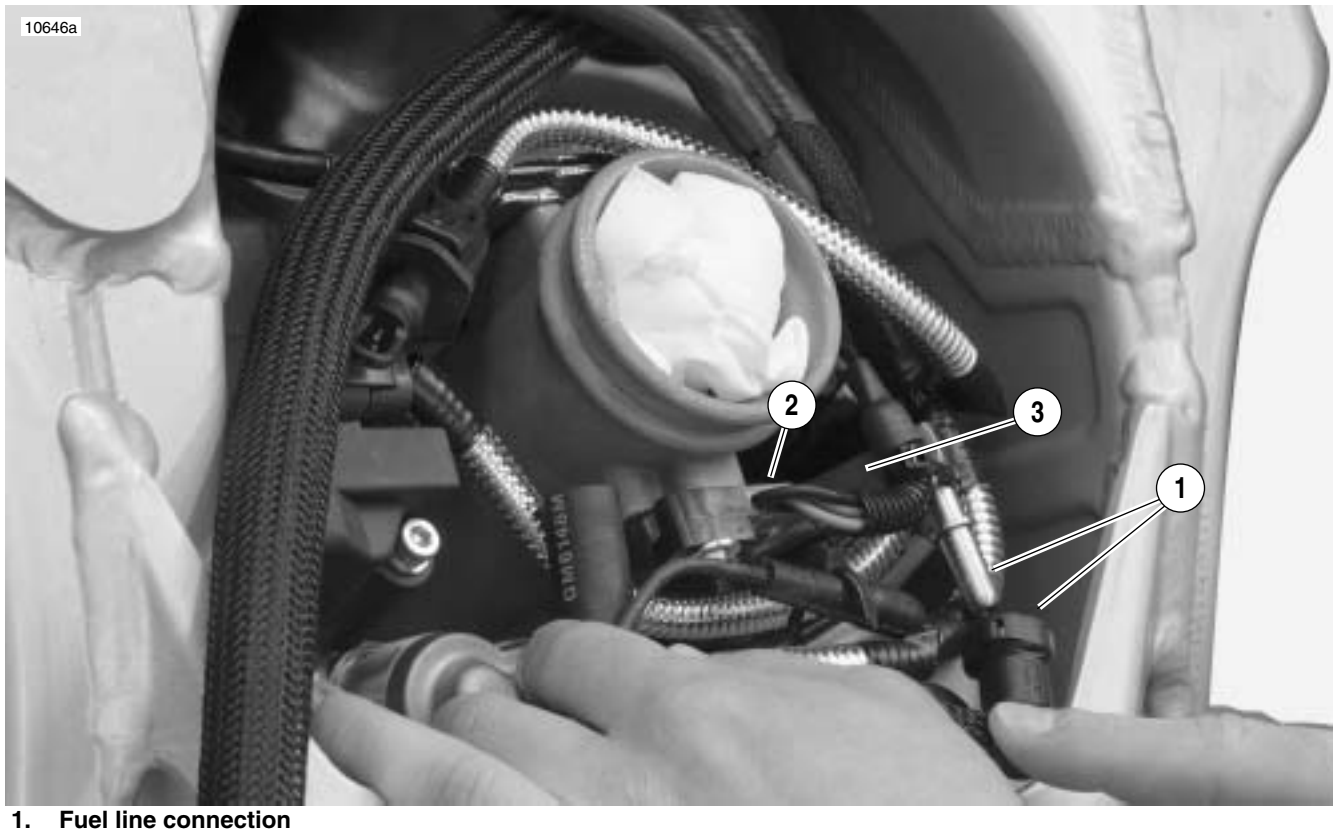
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

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

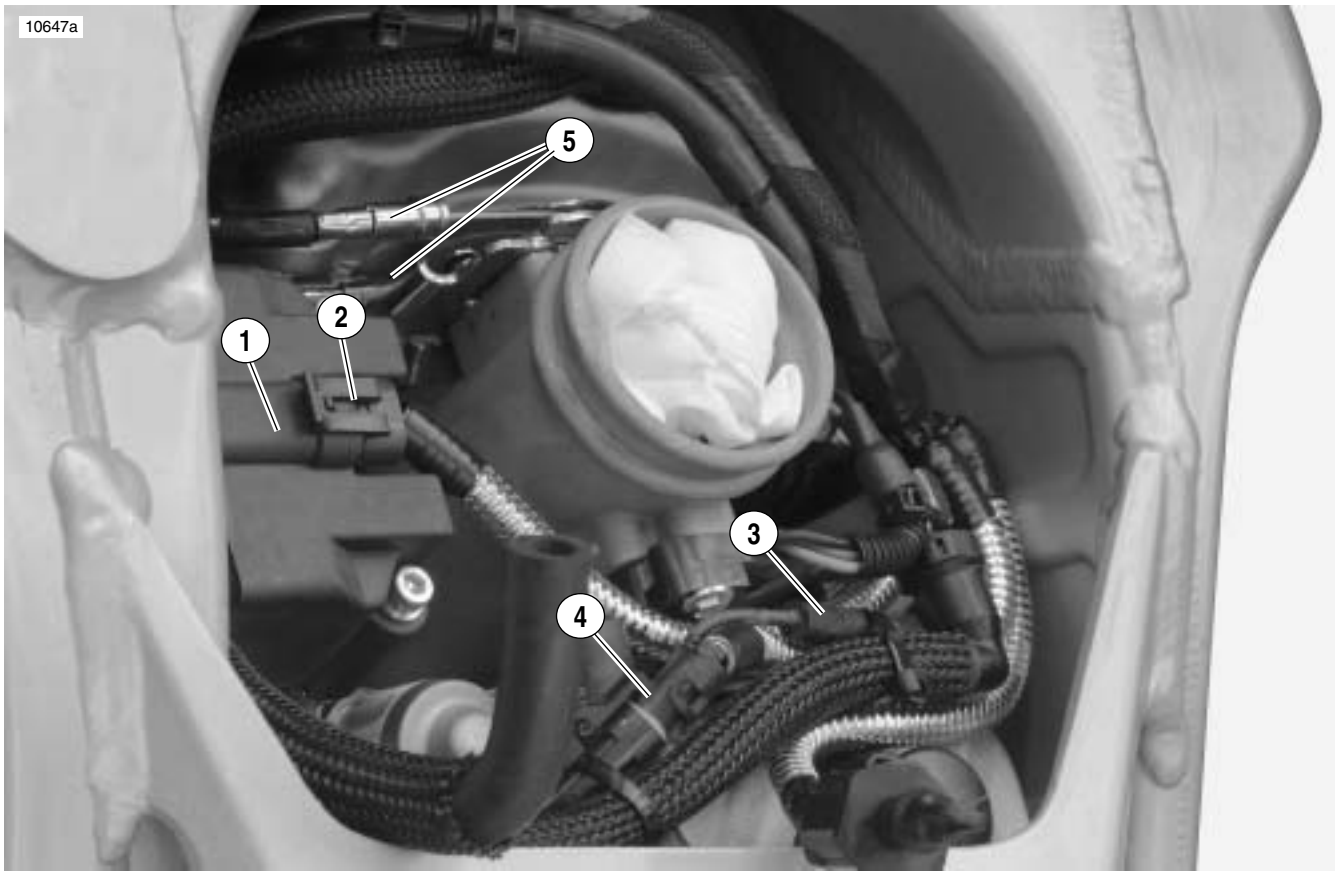
- *The XB9 and 1200 models have a clamp ring securing velocity stack to the throttle body.*
- *Install shop towel in entrance to throttle body to prevent objects from falling into the induction module.*

6. See Figure 3-14. Disconnect fuel line.
7. Disconnect throttle position sensor (2) [88].
8. Disconnect fuel injector leads (3) [84 & 85].



1. **Fuel line connection**
2. **Connection for throttle position sensor [88]**
3. **Connections for fuel injectors [84 & 85]**

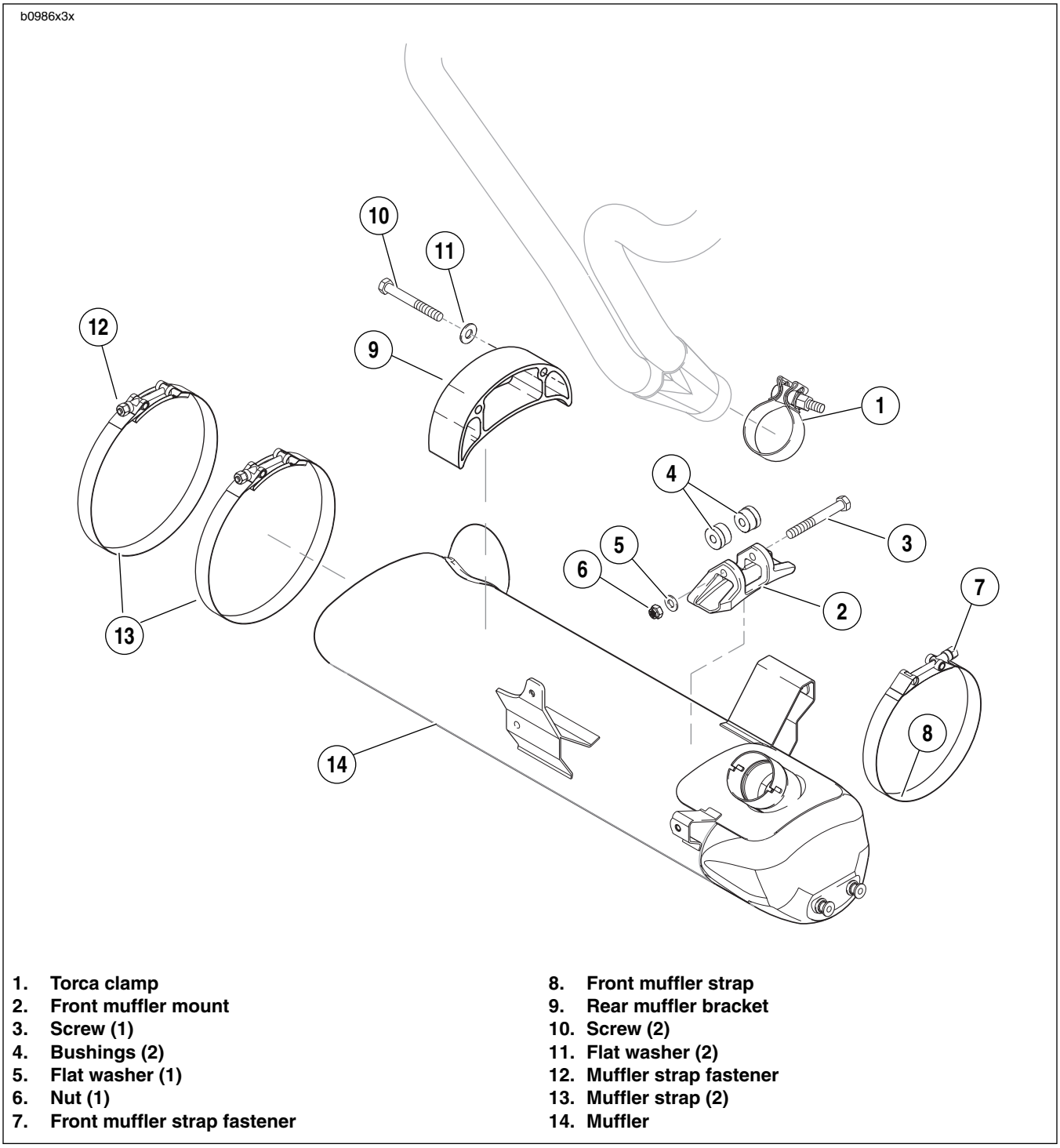
Figure 3-14. Fuel Line and DDFI Electrical Connections (Typical)



1. **Ignition coil**
2. **Coil connection [83]**
3. **Cylinder head temperature sensor connection [90]**
4. **Oxygen sensor connection [137]**
5. **Throttle cables**

Figure 3-15. Electrical Connections and Throttle Cables (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.



1. **Torca clamp**
2. **Front muffler mount**
3. **Screw (1)**
4. **Bushings (2)**
5. **Flat washer (1)**
6. **Nut (1)**
7. **Front muffler strap fastener**
8. **Front muffler strap**
9. **Rear muffler bracket**
10. **Screw (2)**
11. **Flat washer (2)**
12. **Muffler strap fastener**
13. **Muffler strap (2)**
14. **Muffler**

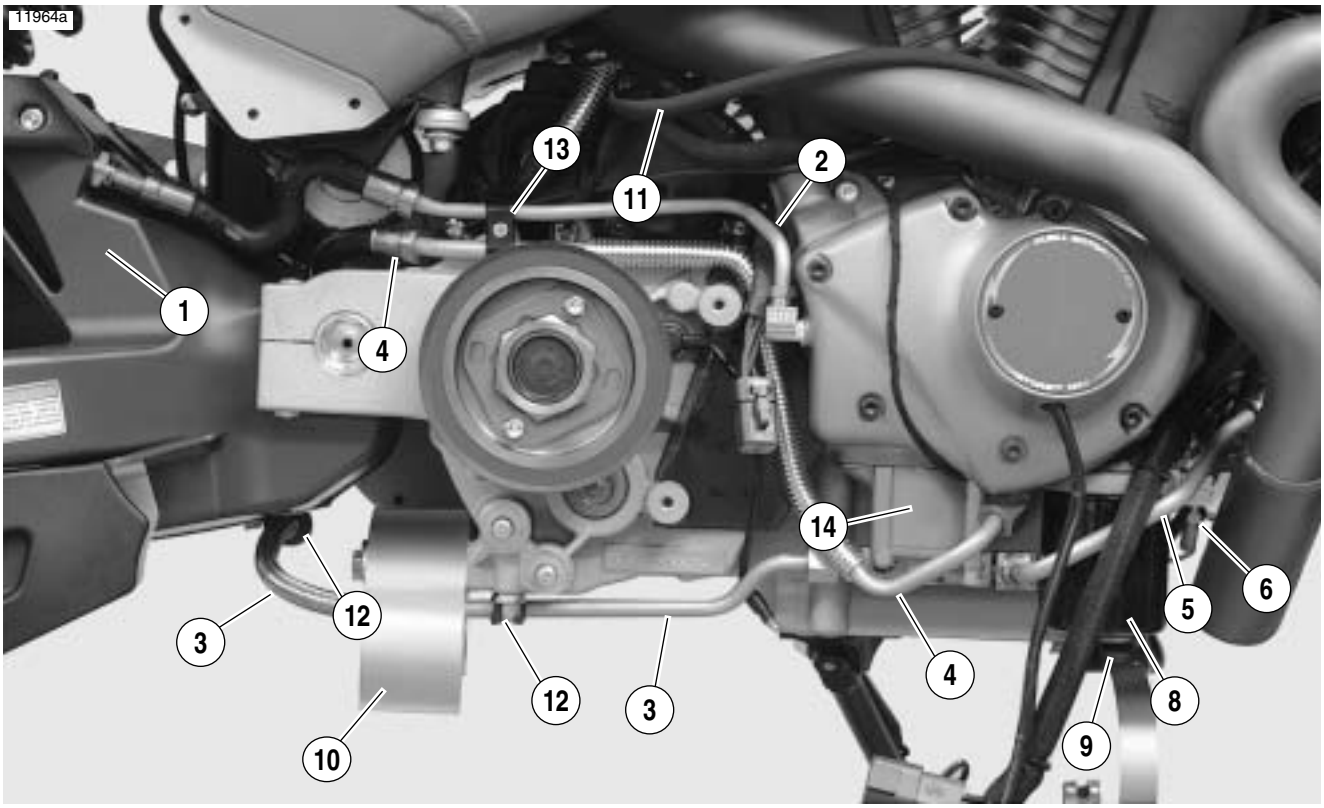
Figure 3-16. Muffler and Mounting System

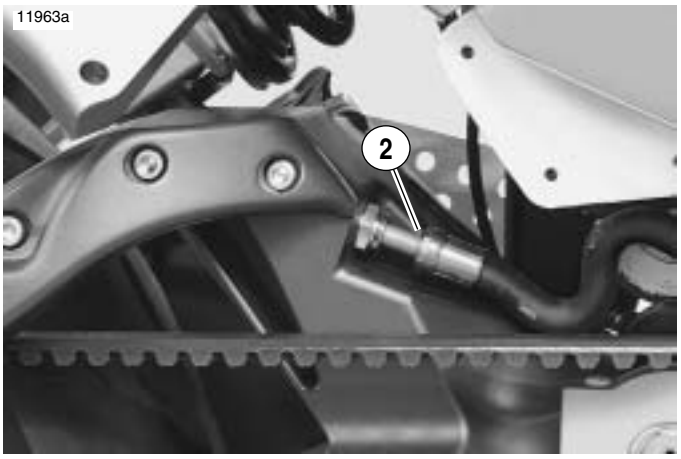
12. Disconnect and remove air scoops, right and left sides.
13. Remove complete chin fairing, bolts**.**
14. Remove transmission sprocket side cover**.**
15. Remove rear belt and idler pulley**.** See 6.6 DRIVE BELT SYSTEM.

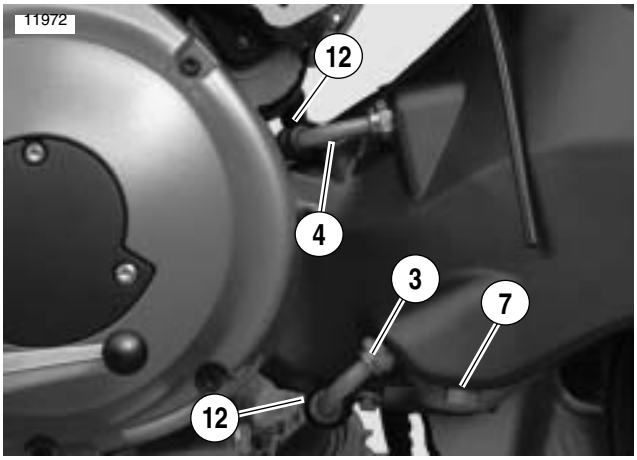
NOTE

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.







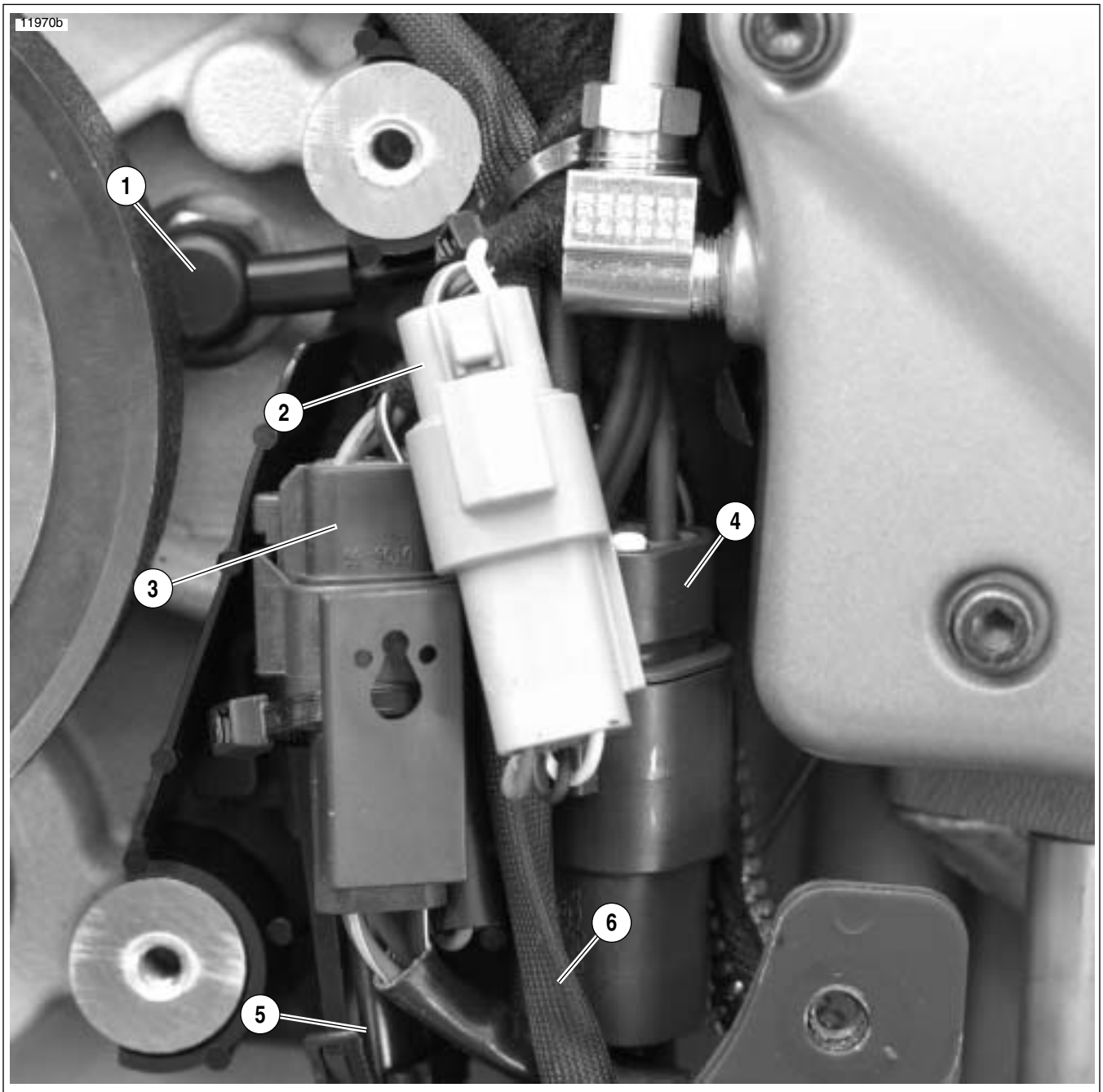
1. **Swingarm/Oil reservoir**
2. **Vent oil line**
3. **Feed oil line**
4. **Return oil line**
5. **Feed oil line from oil pump to oil cooler**
6. **Feed oil line from oil cooler to crankcase**
7. **Oil tank drain plug**
8. **Oil filter**
9. **Front muffler mount**
10. **Rear muffler bracket**
11. **Cable, interactive exhaust**
12. **P-clamp**
13. **Oil line clamp**
14. **Oil pump**

Figure 3-17. Oil Lines and Connections

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.



1. **Neutral switch [131]**
2. **Speedometer sensor connector [65]**
3. **Cam position sensor connector [14]**
4. **Alternator connector [46]**
5. **Voltage regulator connector [77]**
6. **Interactive exhaust cable**

Figure 3-18. Electrical Connectors Under Sprocket Cover

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.

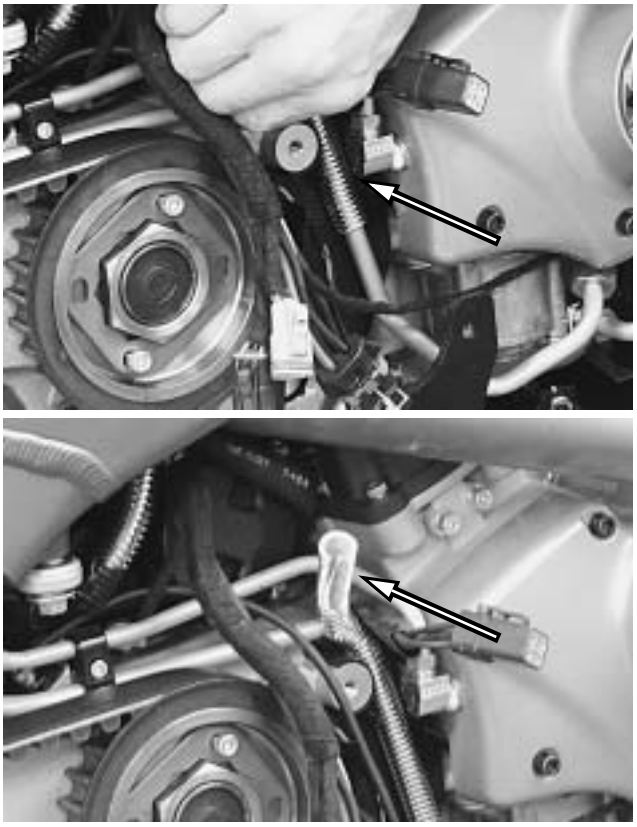
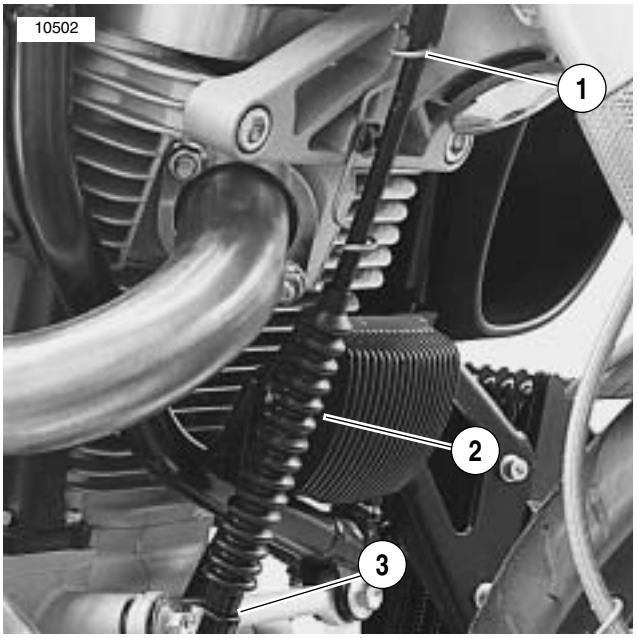
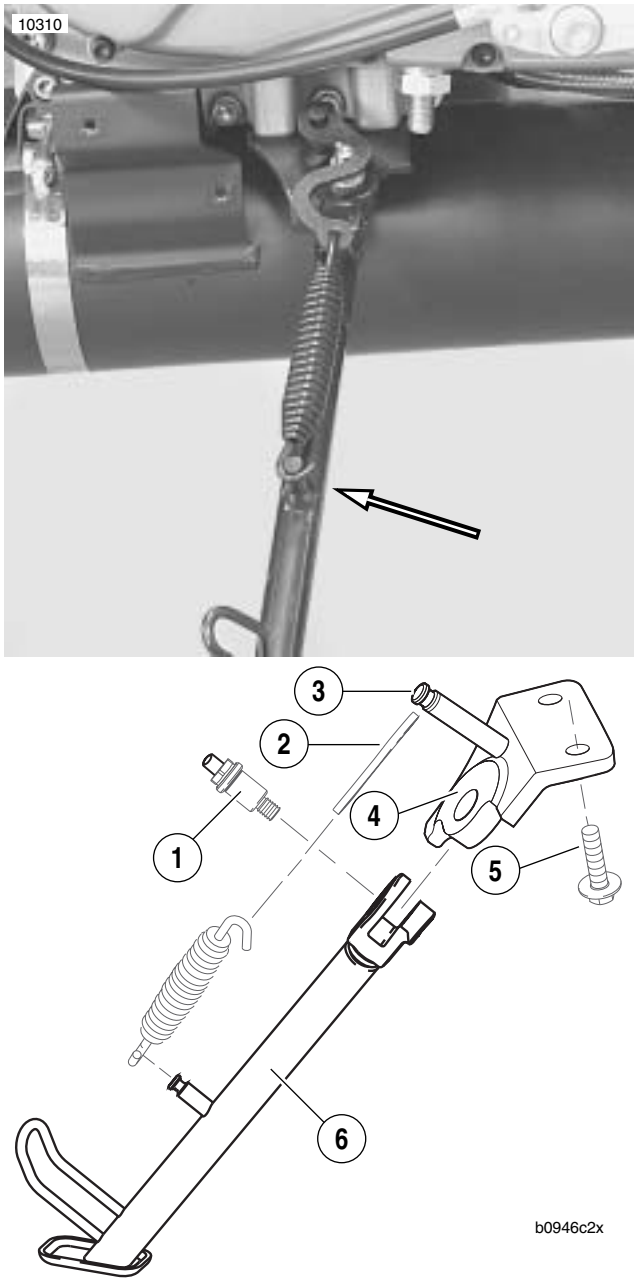


Figure 3-19. Removing Convolute Cover From Oil Line



1. **Wire form retainer**
2. **Clutch cable adjuster boot**
3. **Lower retaining clamp**

Figure 3-20. Clutch Cable Wire Form Retainer, Retaining Clamp and Adjuster Boot



1. **Pivot bolt**
2. **Spring extension plate**
3. **Spring post**
4. **Sidestand bracket**
5. **Sidestand bracket fasteners (2)**
6. **Sidestand leg**

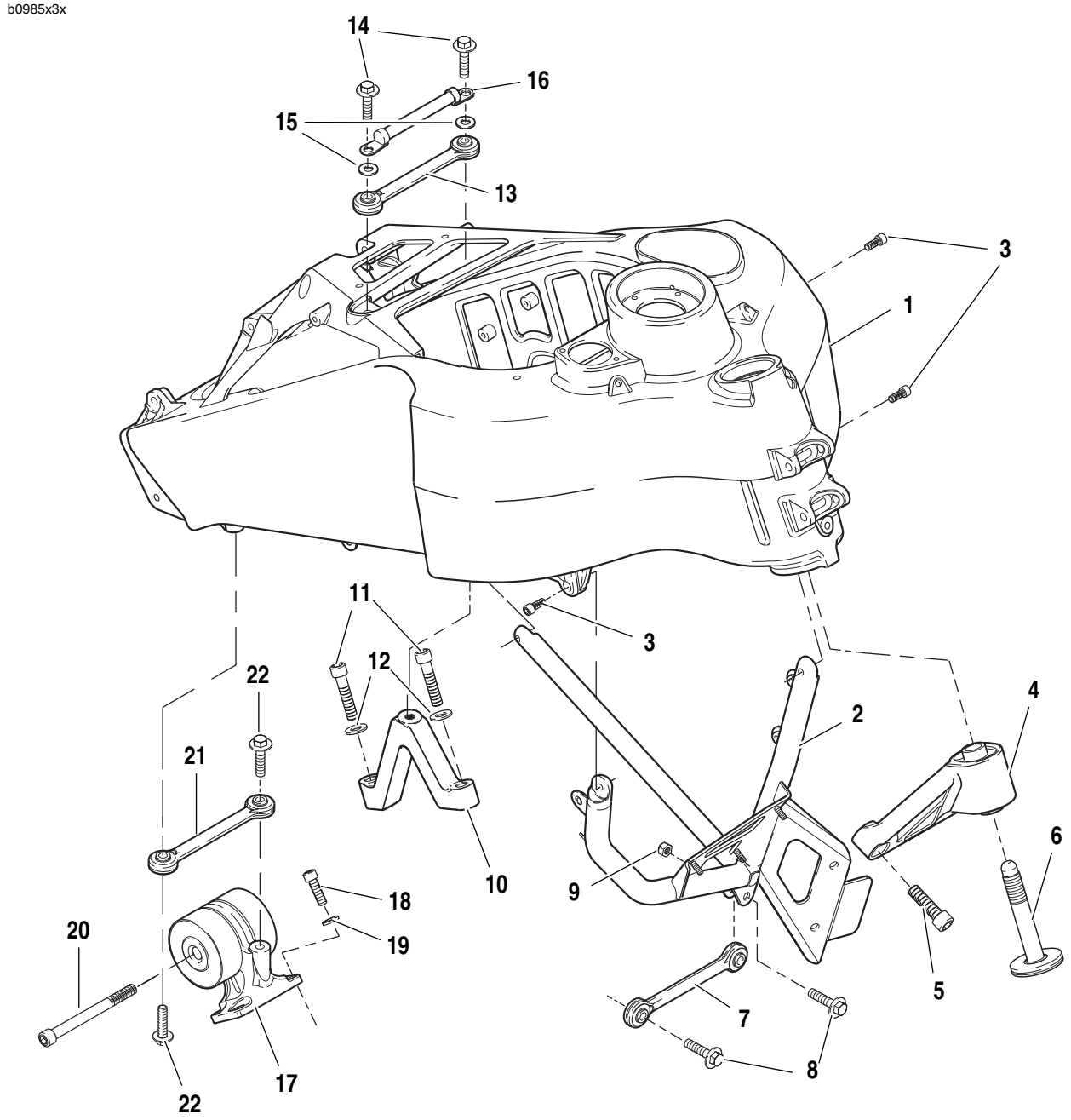
Figure 3-21. Sidestand Assembly (Extended)

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.



1. Frame assembly
2. "V" bracket
3. Fasteners for "V" bracket (3)
4. Front isolator assembly
5. Fasteners for front isolator (2)
6. Bolt
7. 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)

Figure 3-22. Engine Mounting System

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.



Figure 3-23. Supporting Vehicle for Disassembly (Typical)

31. See Figure 3-24. After rotating engine back up into frame, continue to remove:
    a. Rear isolator bolt.
    b. Swingarm pivot shaft.

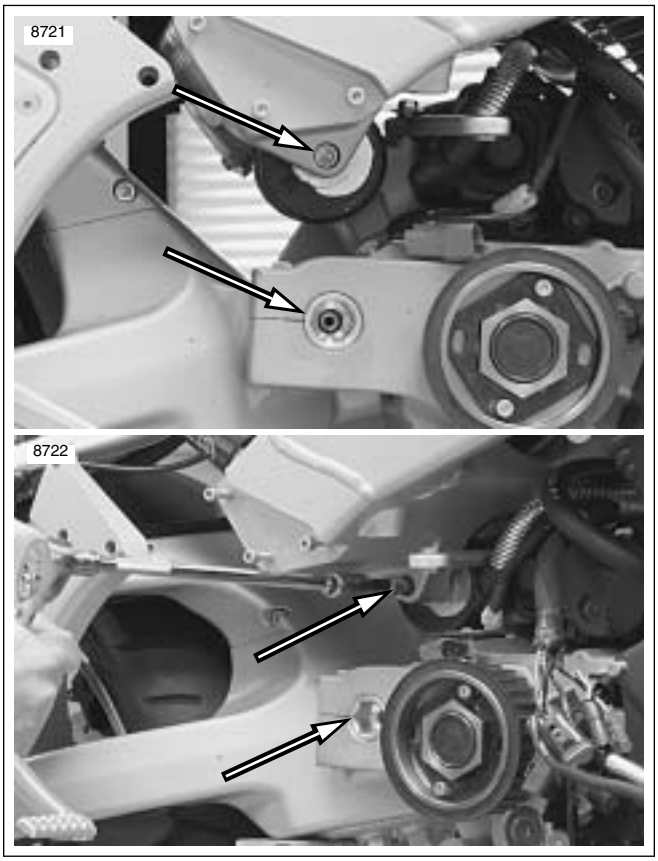


Figure 3-24. Rear Isolator Bolt and Swingarm Pivot Shaft (Typical)

32. See Figure 3-25. Support swingarm/oil tank with wooden blocks, jack, etc.



Figure 3-25. Supporting the Swingarm (Typical)

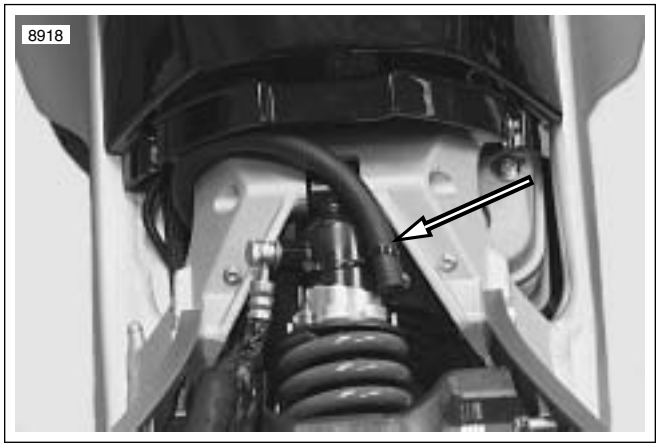


Figure 3-26. Transmission Vent Line

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.

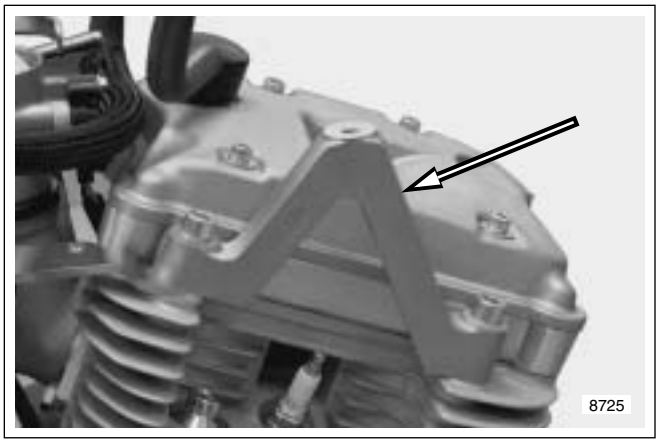


Figure 3-27. Center Tie Bar Mount

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.

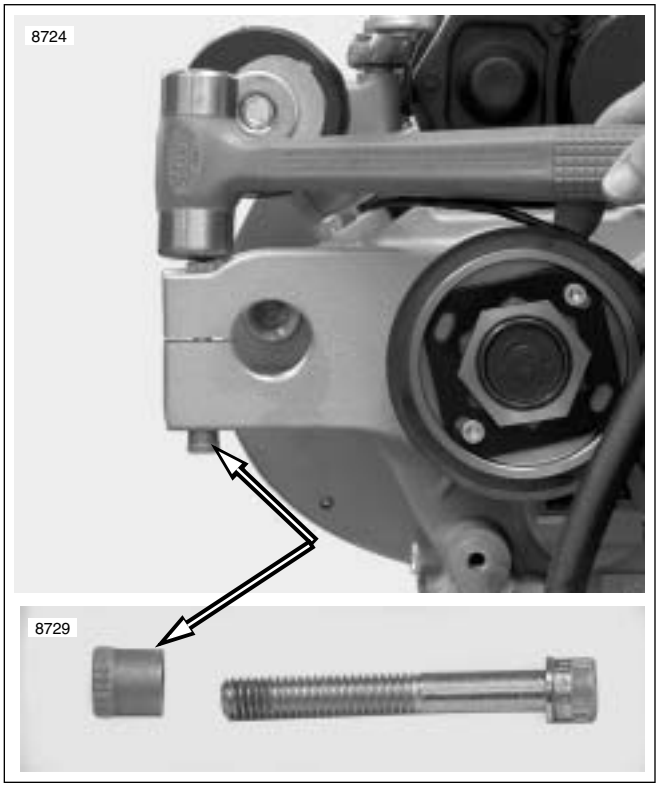


Figure 3-28. Removing Threaded Insert

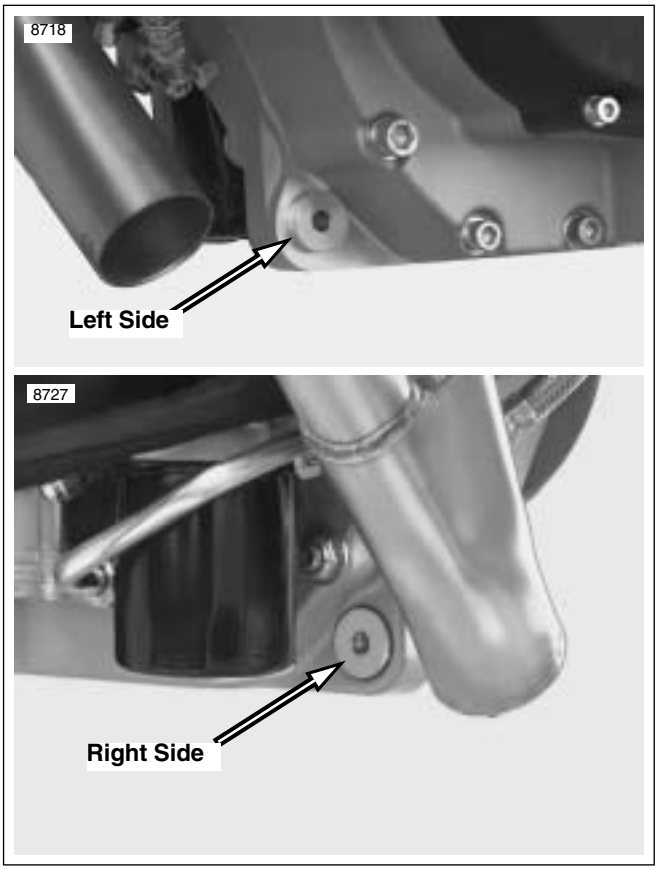


Figure 3-29. Front Exhaust Mount Bushings (2 piece)

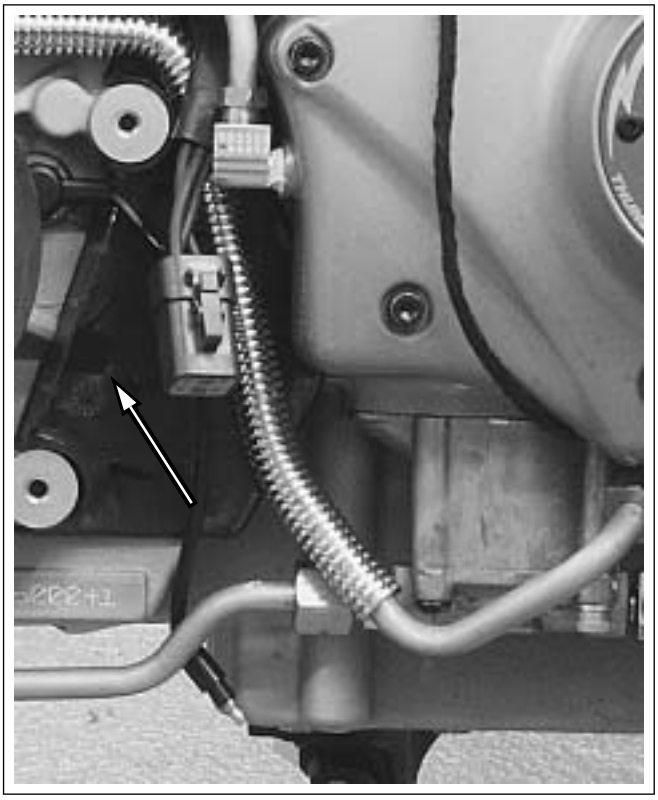


Figure 3-30. Wire Guard

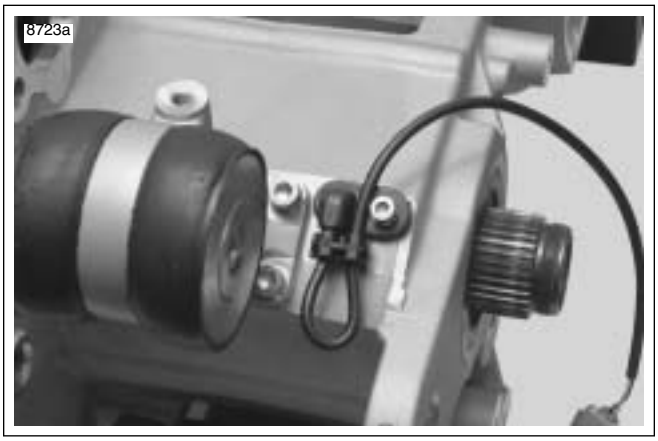


Figure 3-31. Rear Isolator and Mounting Hardware

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).



Figure 3-32. Securing Vehicle for Relocation (Typical)

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.

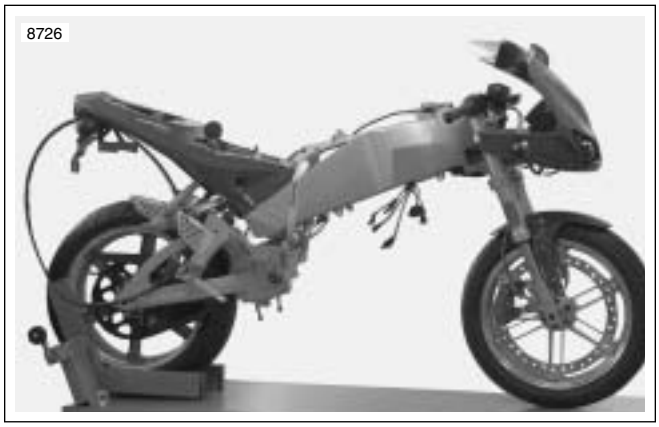


Figure 3-33. Rolling Chassis (Typical)

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.

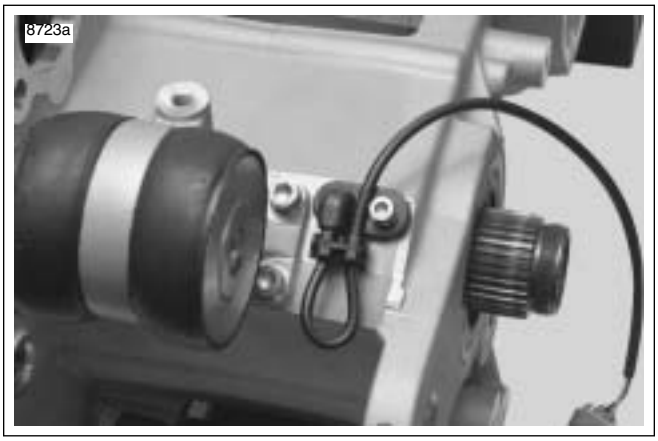


Figure 3-34. Rear Isolator and Mounting Hardware

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).

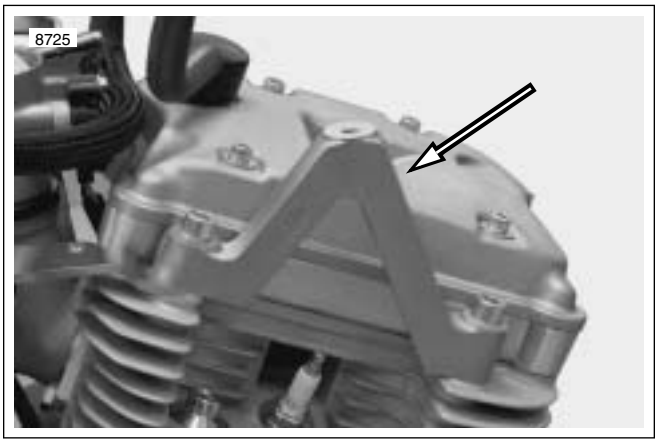


Figure 3-35. Center Tie Bar Mount

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.

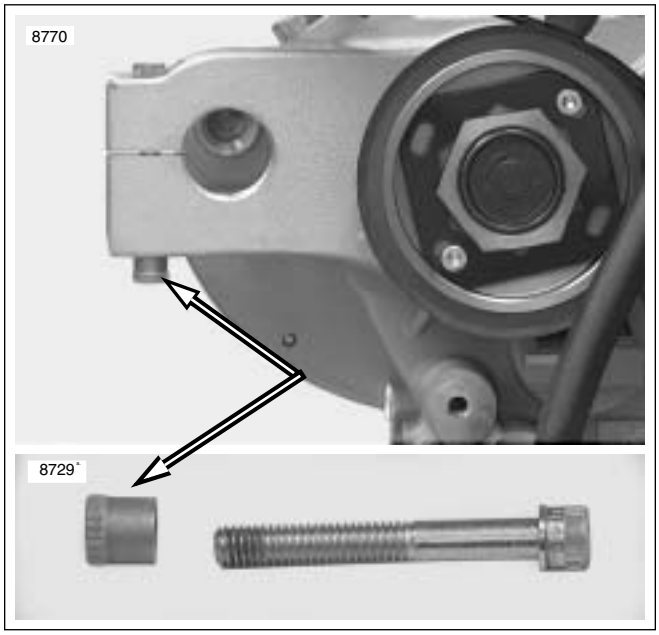


Figure 3-36. Threaded Insert

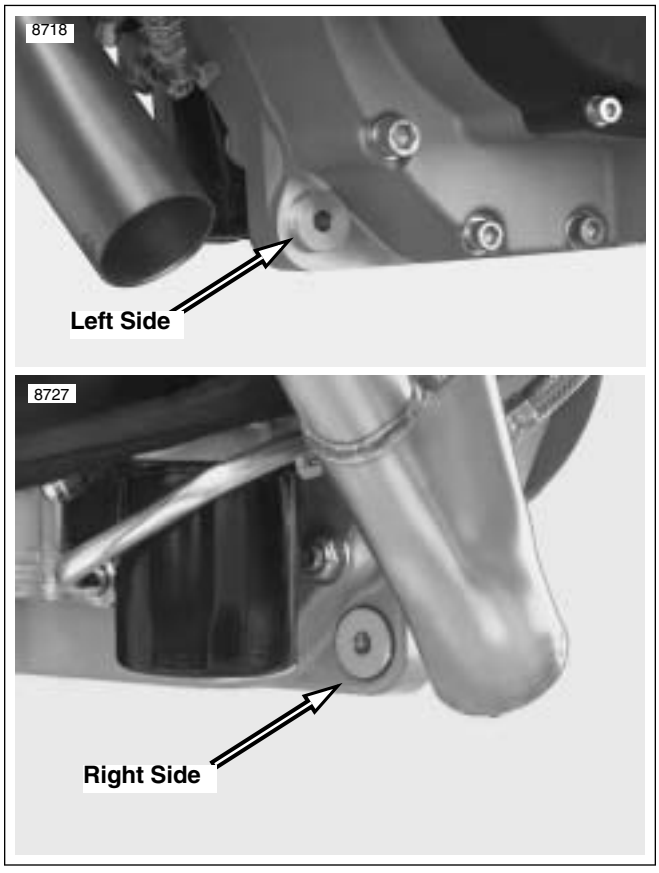


Figure 3-37. Front Exhaust Mount Bushings (2 piece)

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.



Figure 3-38. Supporting the Swingarm (Typical)

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.

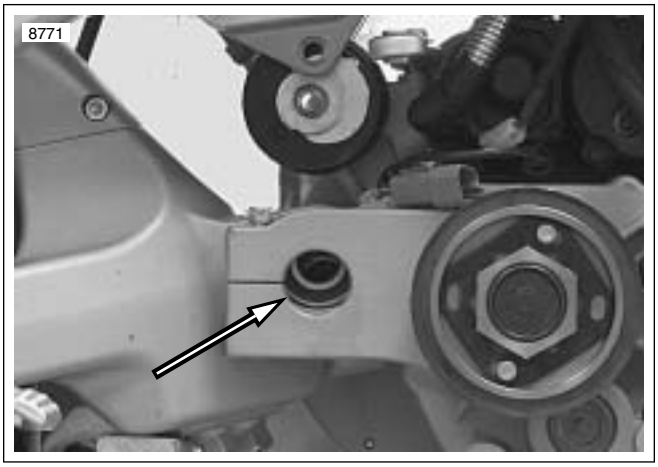


Figure 3-39. Aligning Swingarm to Crankcase for Pivot Shaft Installation (Typical)

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.

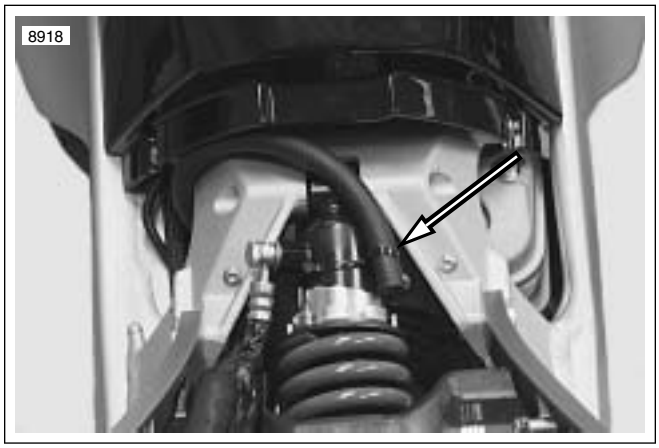


Figure 3-40. Transmission Vent Line

NOTE

See Figure 3-41. At this point it is necessary to support main frame with overhead hoist in order to install rear isolator bolt.



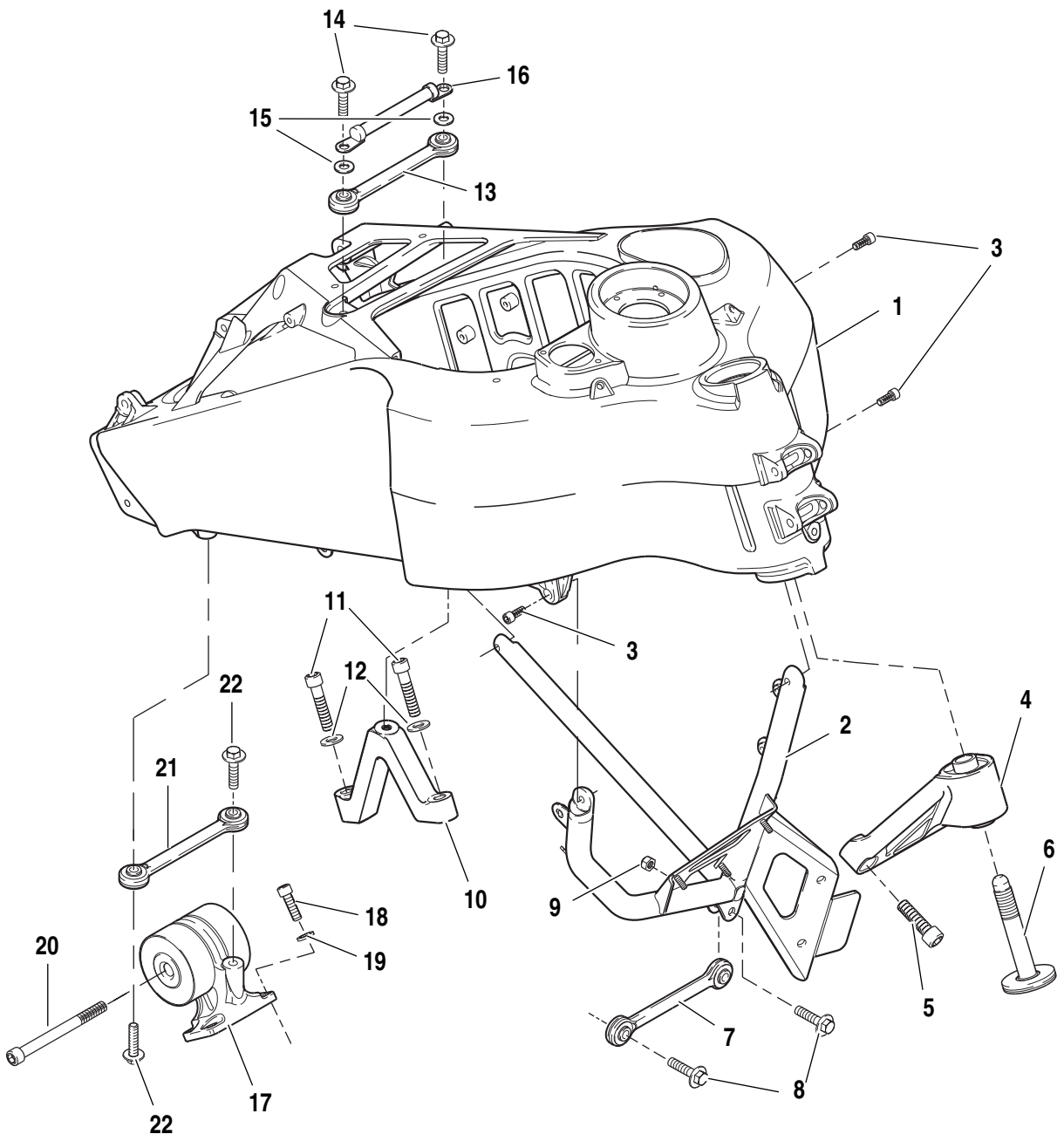
Figure 3-41. Supporting Vehicle for Assembly (Typical)



Figure 3-42. Installing Rear Isolator Bolt (Typical)

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.

b0985x3x



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).

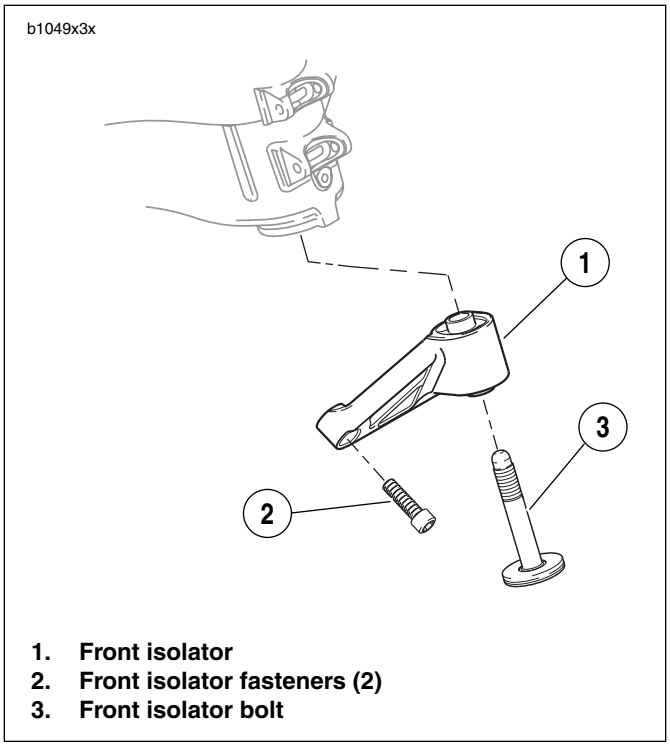
NOTES

- *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.



1. **Front isolator**
2. **Front isolator fasteners (2)**
3. **Front isolator bolt**

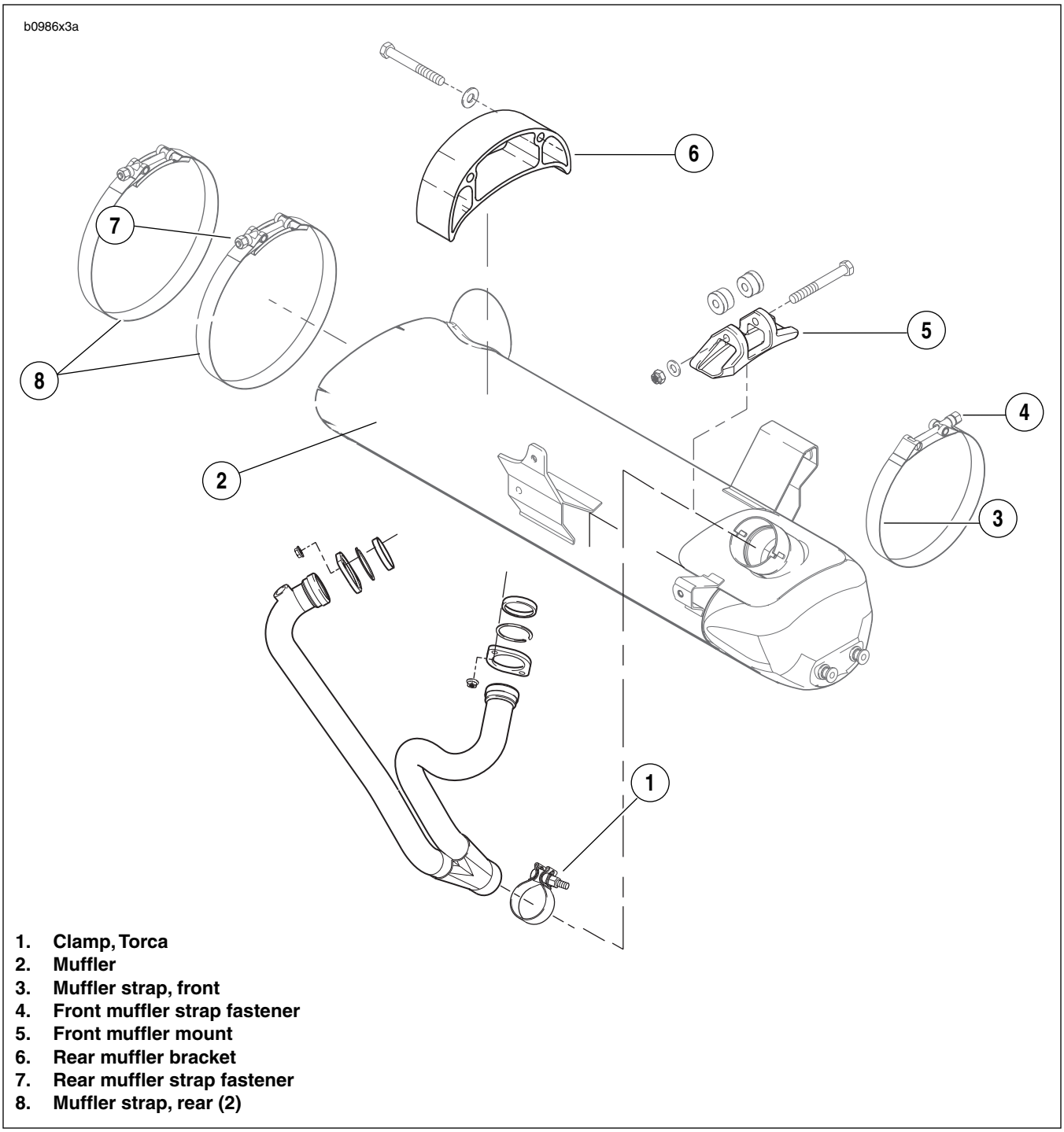
Figure 3-44. Front Isolator

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.



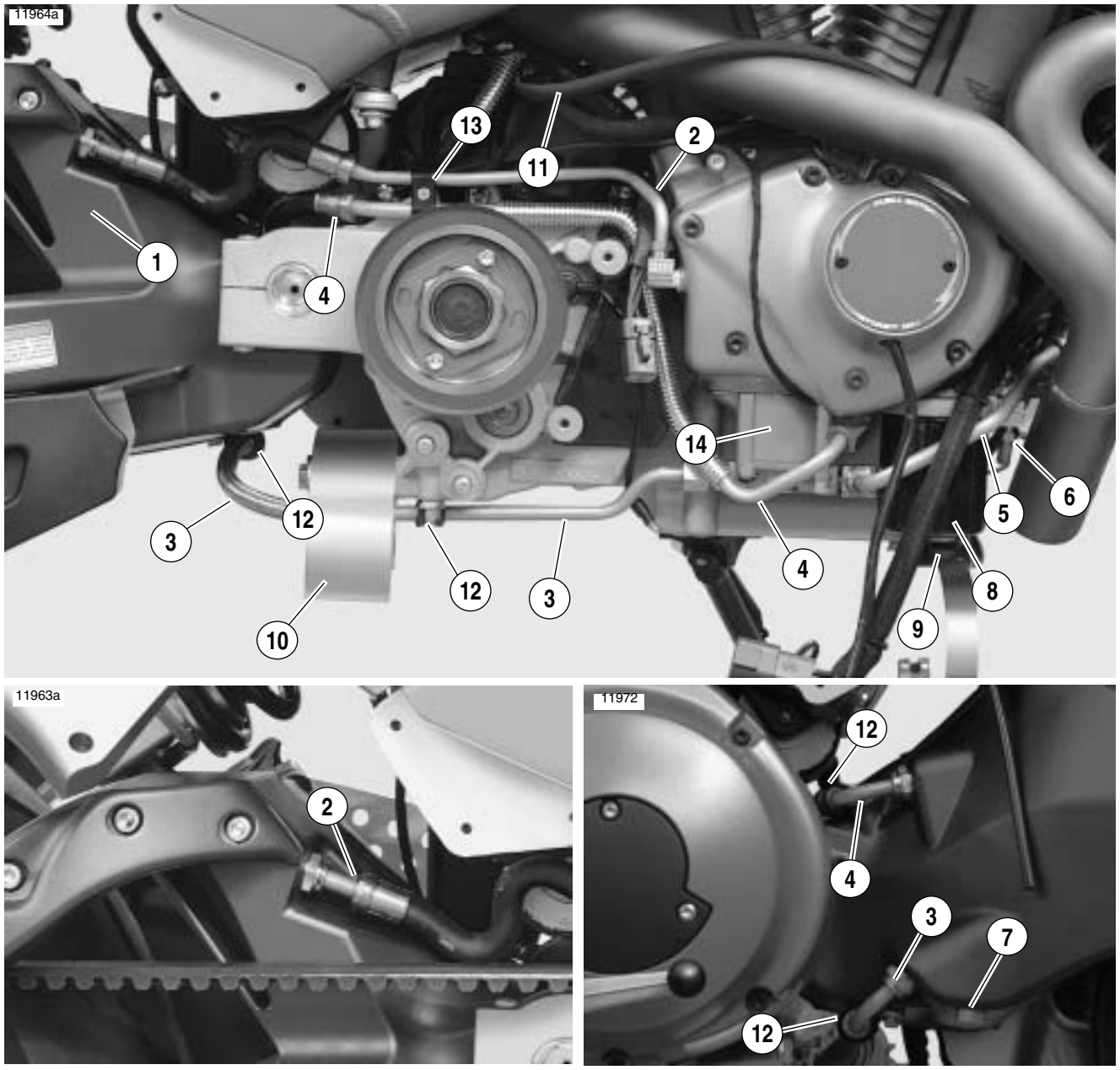
1. **Clamp, Torca**
2. **Muffler**
3. **Muffler strap, front**
4. **Front muffler strap fastener**
5. **Front muffler mount**
6. **Rear muffler bracket**
7. **Rear muffler strap fastener**
8. **Muffler strap, rear (2)**

Figure 3-45. Muffler Mounting System

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.

NOTES

- *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.*



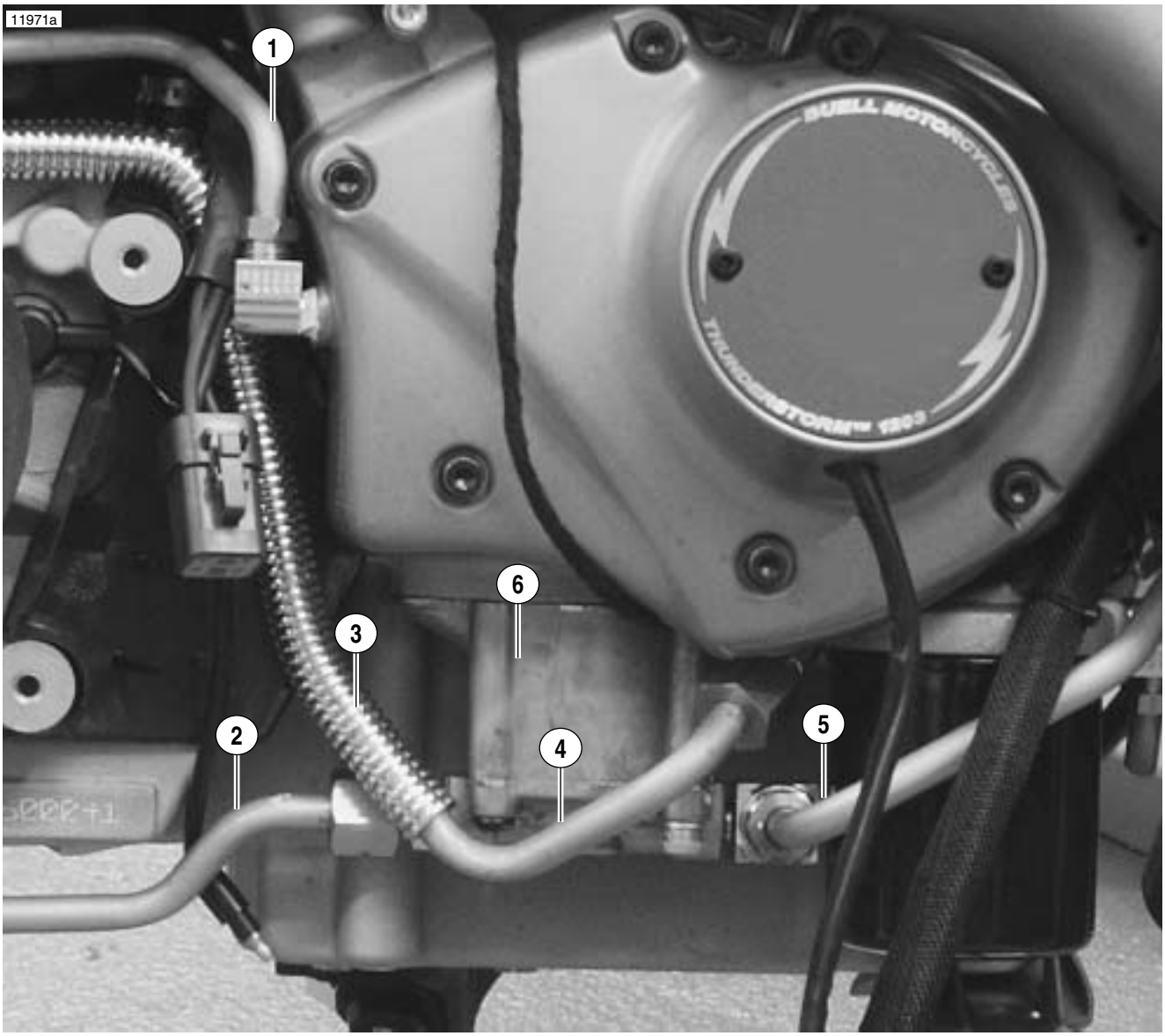
1. **Swingarm/Oil reservoir**
2. **Vent oil line**
3. **Feed oil line**
4. **Return oil line**
5. **Feed oil line from oil pump to oil cooler**
6. **Feed oil line from oil cooler to crankcase**
7. **Oil tank drain plug**
8. **Oil filter**
9. **Front muffler mount**
10. **Rear muffler bracket**
11. **Cable, interactive exhaust**
12. **P-clamp**
13. **Oil line clamp**
14. **Oil pump**

Figure 3-46. Oil Lines and Connections

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).



1. **Vent oil line orientation**
2. **Feed oil line orientation**
3. **Convolute covering for oil return line**
4. **Return oil line orientation**
5. **Feed oil line to oil cooler**
6. **Oil pump**

Figure 3-47. Orientation of Feed Oil Line, Vent Oil Line and Return Oil Line at the Oil Pump

NOTE

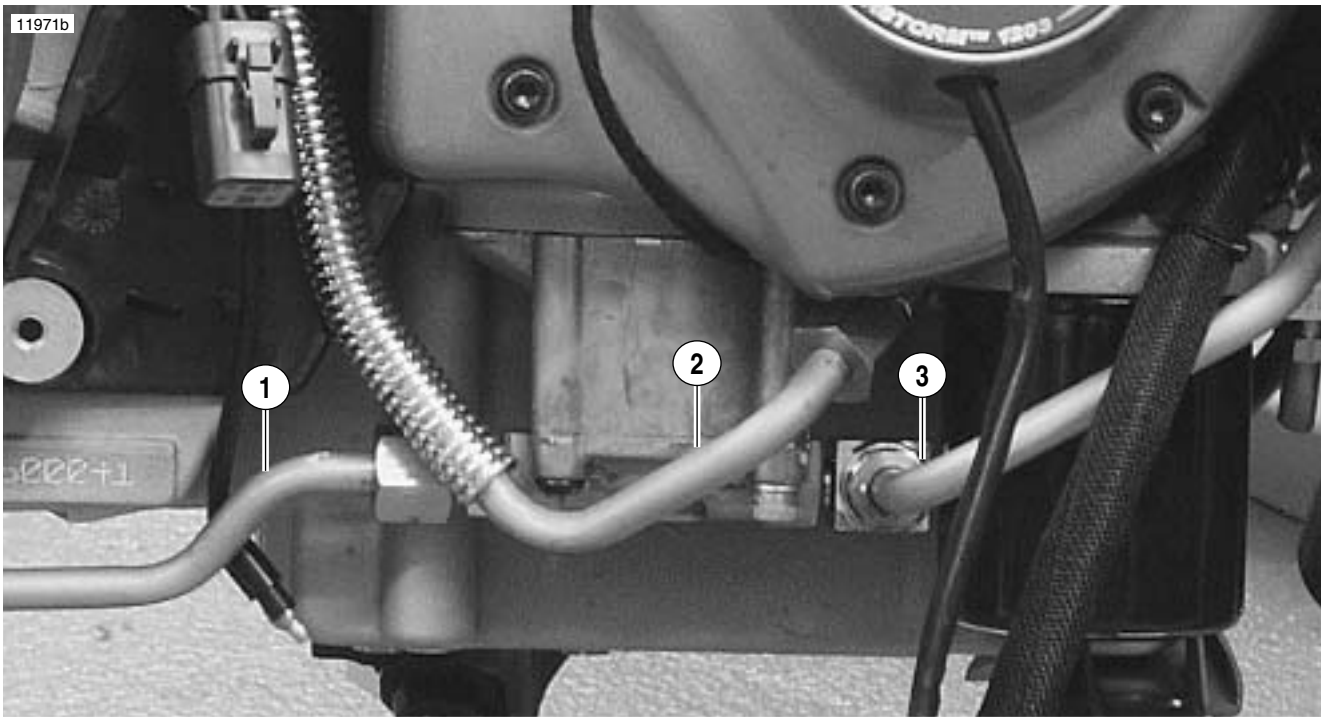
Route stator and vehicle speed sensor wiring between the vent and return oil lines before connecting the vent line to the fitting at the cam cover.

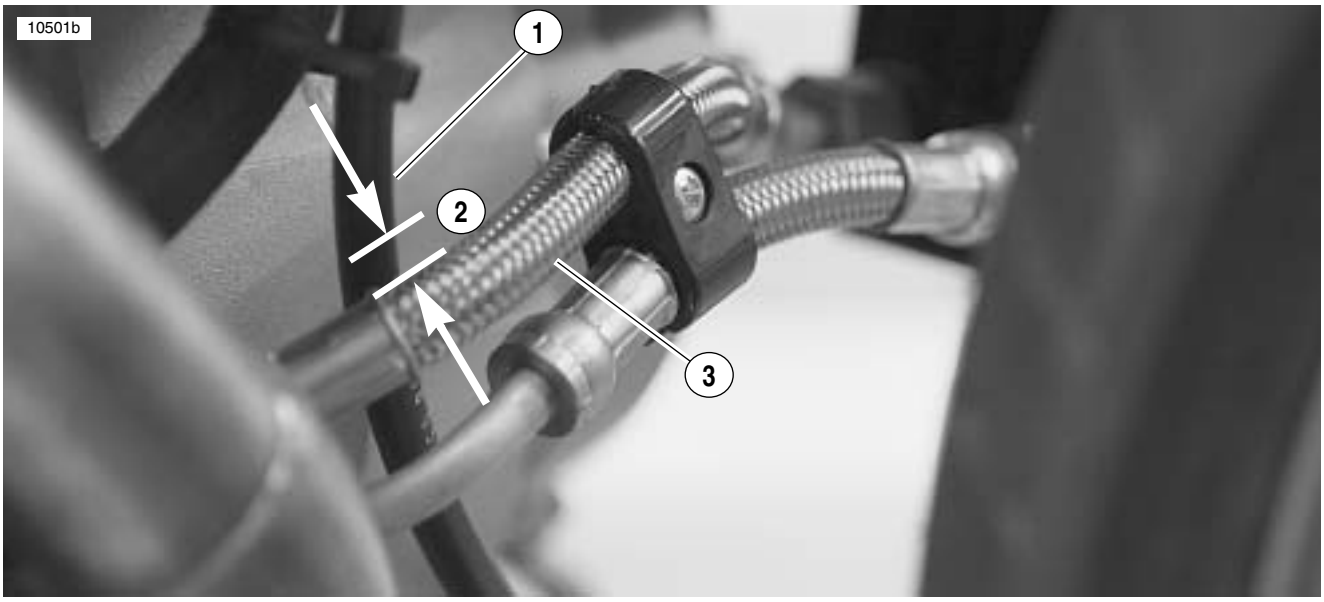
23. See Figure 3-46. Install p-clamps (12) on feed oil line (3) at crankcase and swingarm/oil reservoir and tighten fastener to 48-72 **in-lbs** (5.4-8 Nm).
24. See Figure 3-46. Install p-clamp on return oil line at the swingarm/oil reservoir and tighten fastener to 48-72 **in-lbs** (5.4-8 Nm).
25. See 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 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).





1. **Clutch cable**
2. **1/8-1/4 in. (3.175-6.35 mm) clearance**
3. **Oil line**
4. **Feed oil line**
5. **Return oil line**
6. **Feed oil line to oil cooler**

Figure 3-48. Oil Cooler Feed Oil Line Orientation (Approximately 2 O'Clock) and Oil LIne Clearances

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.

NOTE

See Figure 3-48. It is important to maintain an orientation of approximately 2 o'clock with the rigid part of the feed oil line running to the oil cooler. Also be aware of the 1/8-1/4 (3.175-6.35 mm) clearance specified between the feed oil line and the clutch cable at the front of the crankcase.

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

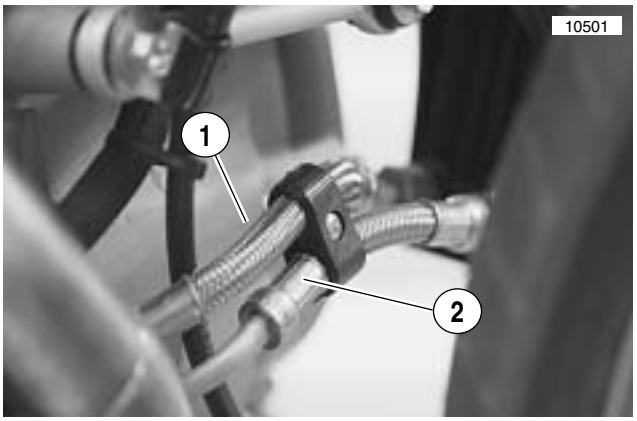
When installing the oil cooler return oil line it is necessary to install the end at the crankcase first.

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.



1. **Oil cooler feed oil line front oil pump.**
2. **Oil cooler return oil line to crankcase**

Figure 3-49. Oil Cooler Oil Lines

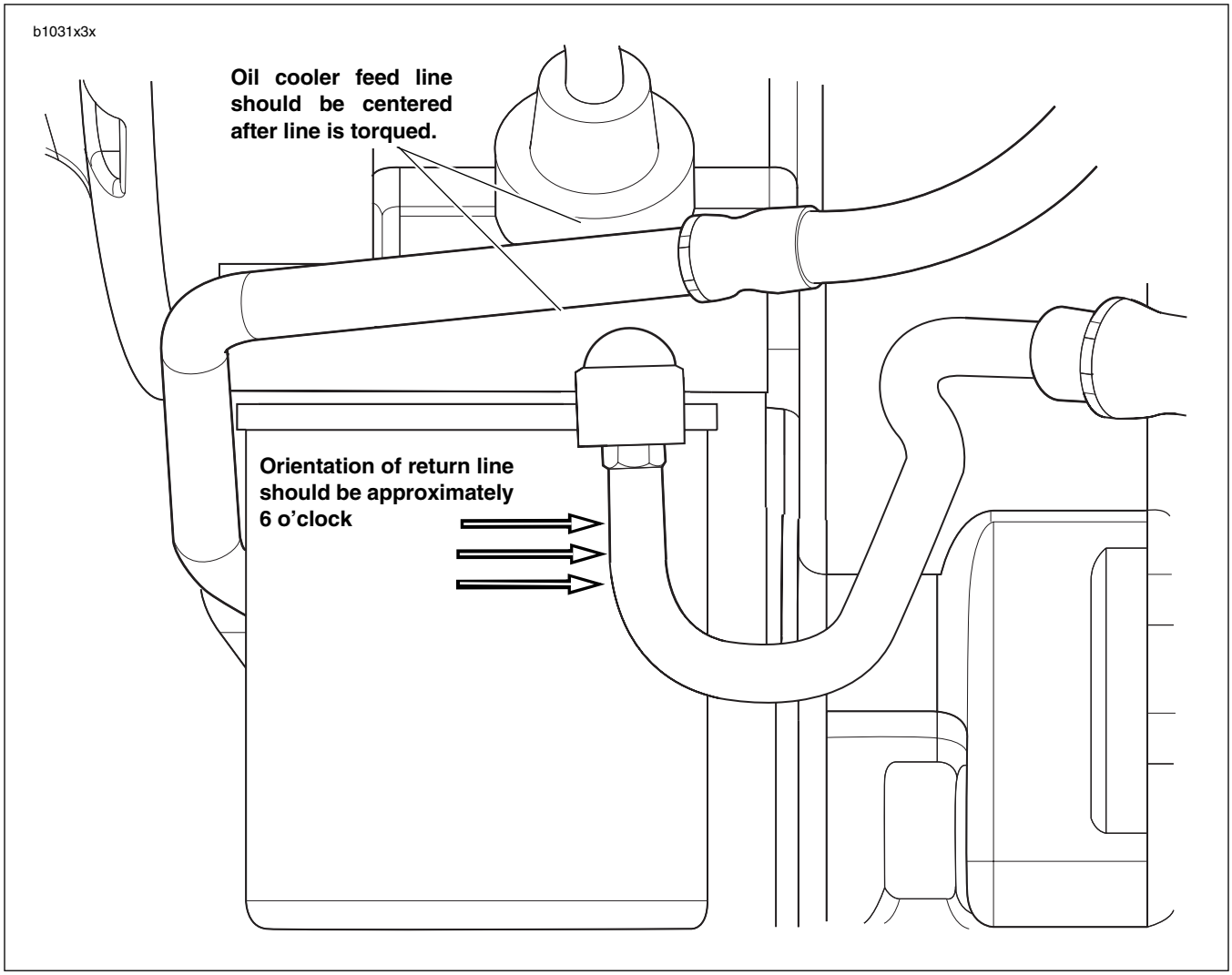
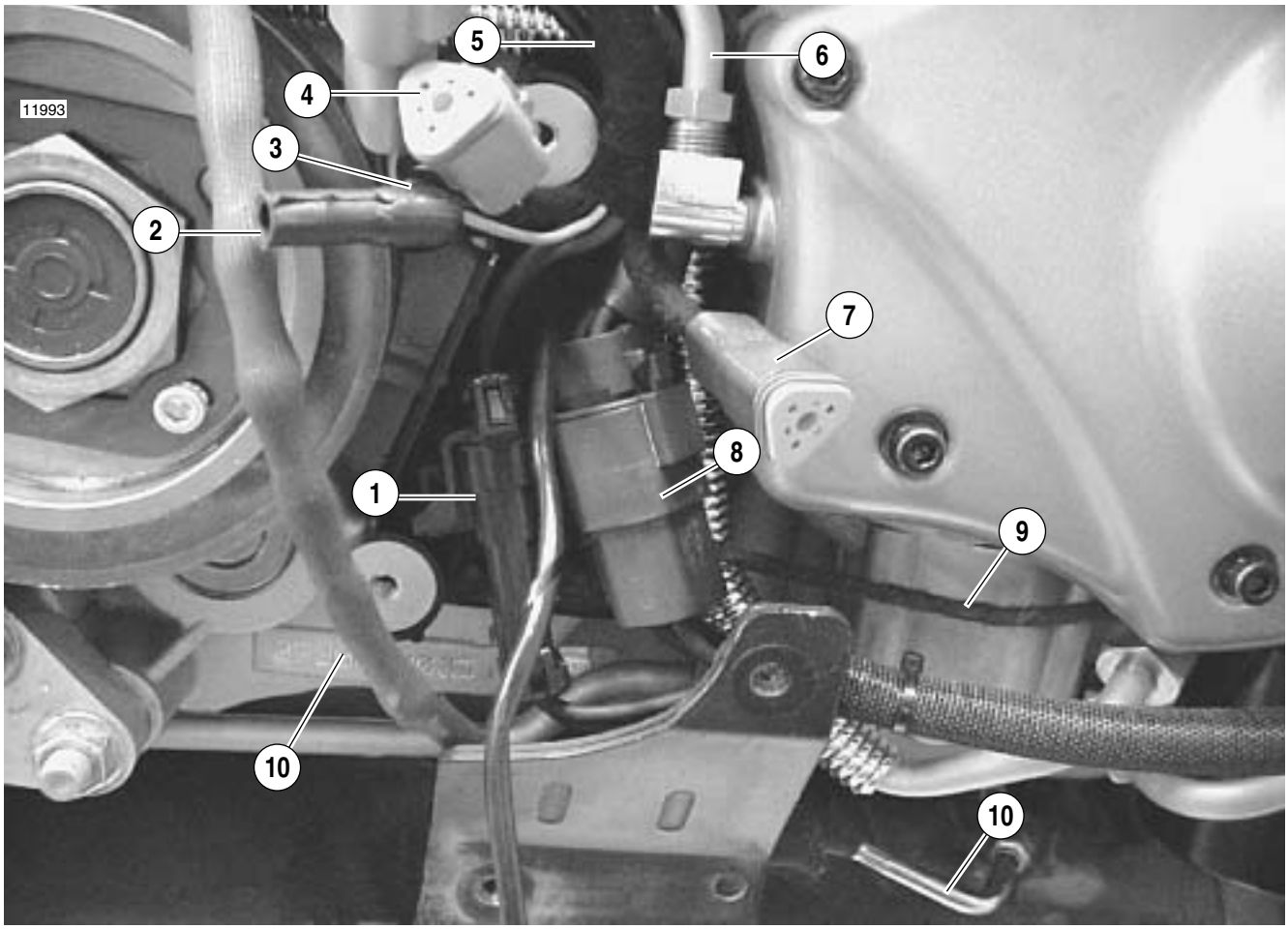


Figure 3-50. Oil Cooler Feed and Return Oil Lines Location and Orientation



1. **Voltage regulator connector [77]**
2. **Neutral switch connector [131]**
3. **Neutral switch location**
4. **Vehicle speed sensor connector [65]**
5. **Main harness**
6. **Gear cover vent line**
7. **Cam position sensor connector [14]**
8. **Stator connector [46]**
9. **Oil pressure switch wiring**
10. **Interactive exhaust cable**

Figure 7-51. Sprocket Cover Wiring and Connections

34. See 7.26 SPROCKET COVER WIRING before connecting the following electrical components:
    a. Neutral switch [131].
    b. Speedometer sensor [65] (install cable strap).
    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].

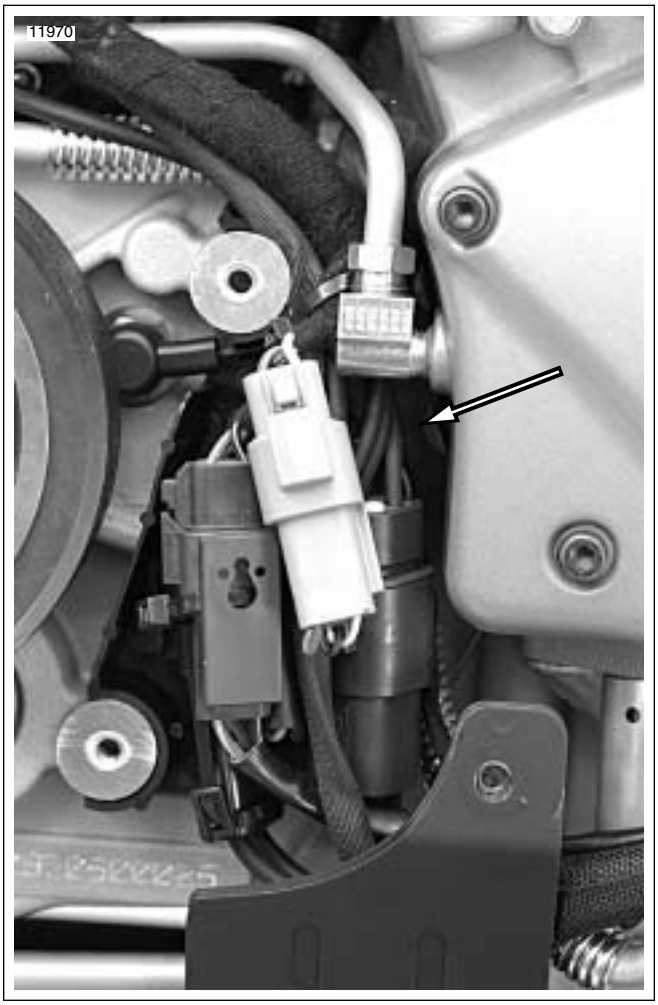


Figure 3-52. Correct Routing of Wiring Harnesses and Interactive Muffler Cable

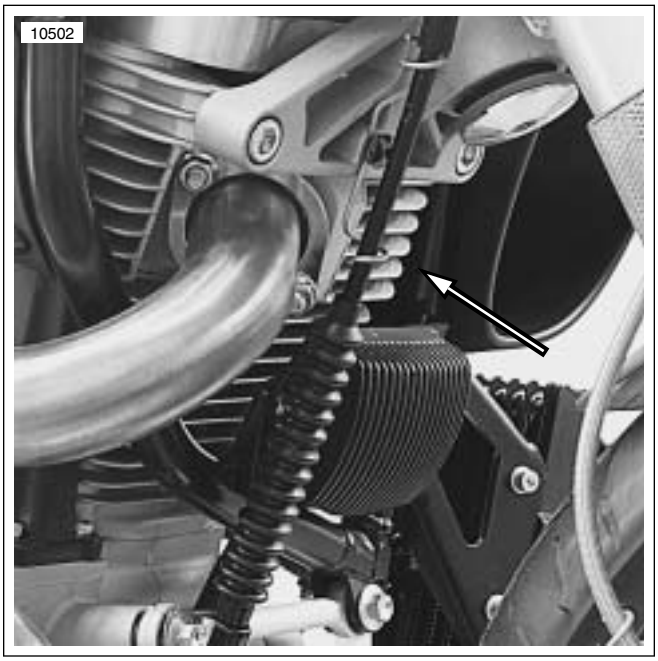
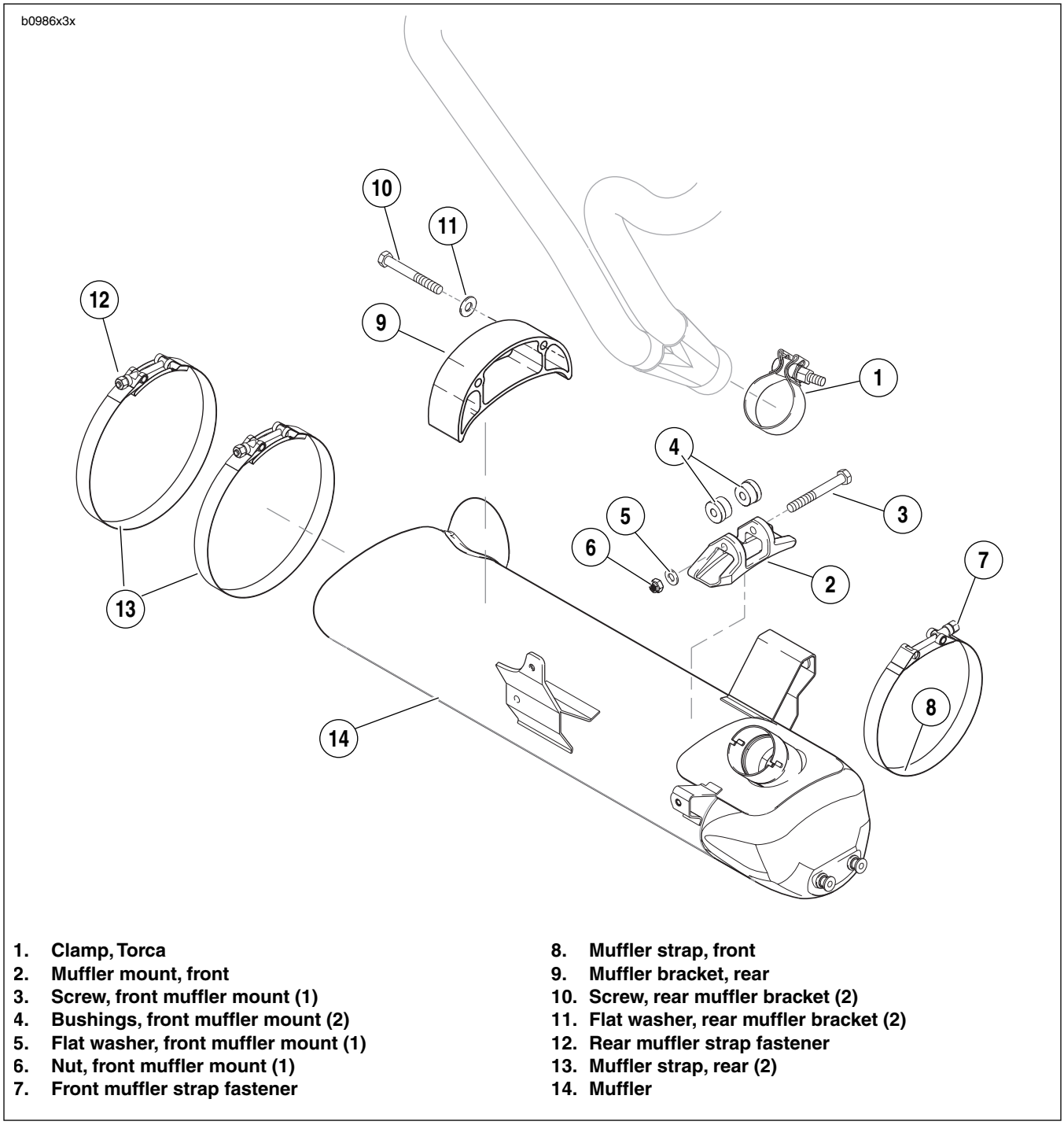


Figure 3-53. Clutch Cable Wire Form Retainer

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).



1. **Clamp, Torca**
2. **Muffler mount, front**
3. **Screw, front muffler mount (1)**
4. **Bushings, front muffler mount (2)**
5. **Flat washer, front muffler mount (1)**
6. **Nut, front muffler mount (1)**
7. **Front muffler strap fastener**
8. **Muffler strap, front**
9. **Muffler bracket, rear**
10. **Screw, rear muffler bracket (2)**
11. **Flat washer, rear muffler bracket (2)**
12. **Rear muffler strap fastener**
13. **Muffler strap, rear (2)**
14. **Muffler**

Figure 3-54. Muffler and Mounting System

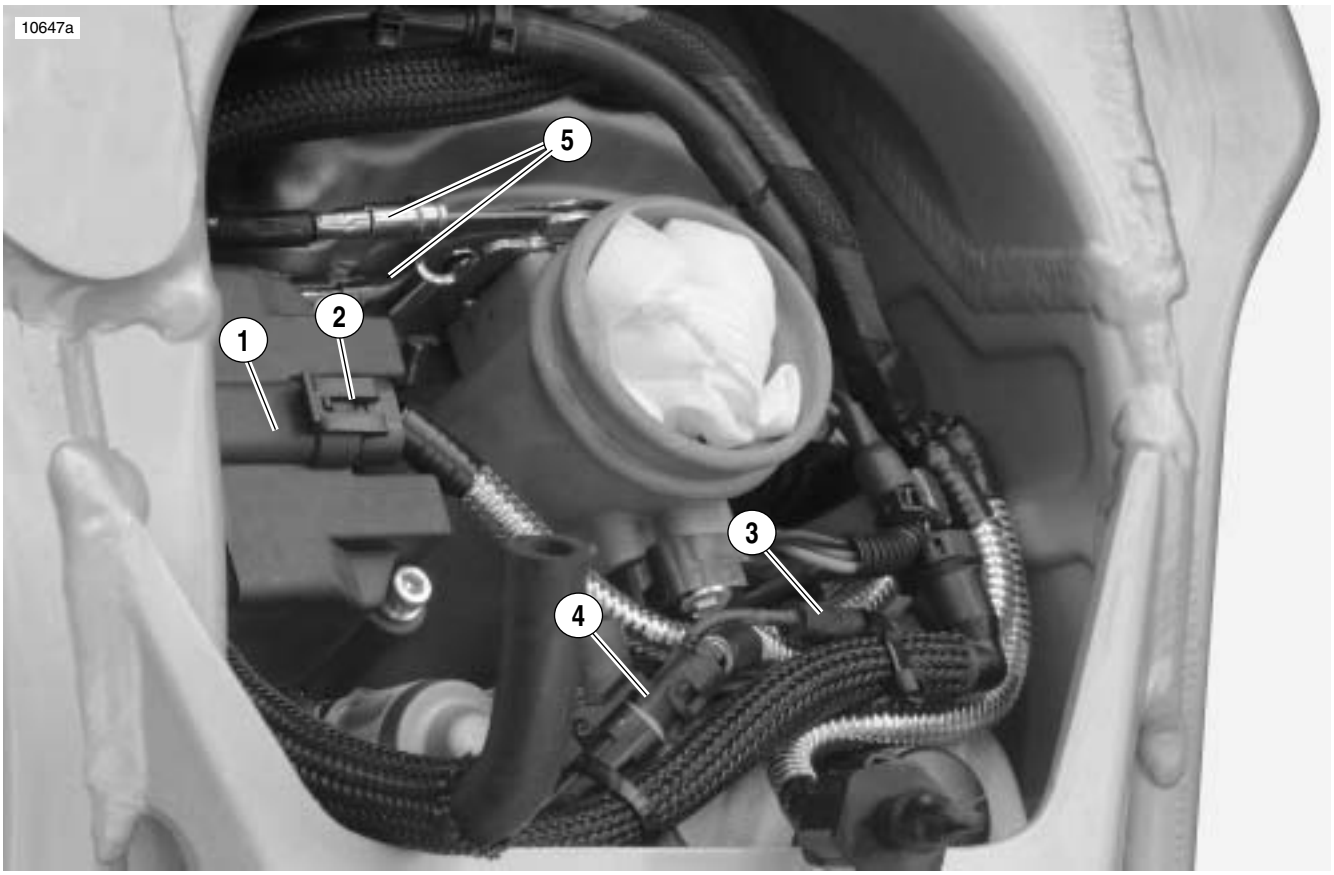
NOTES

- *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

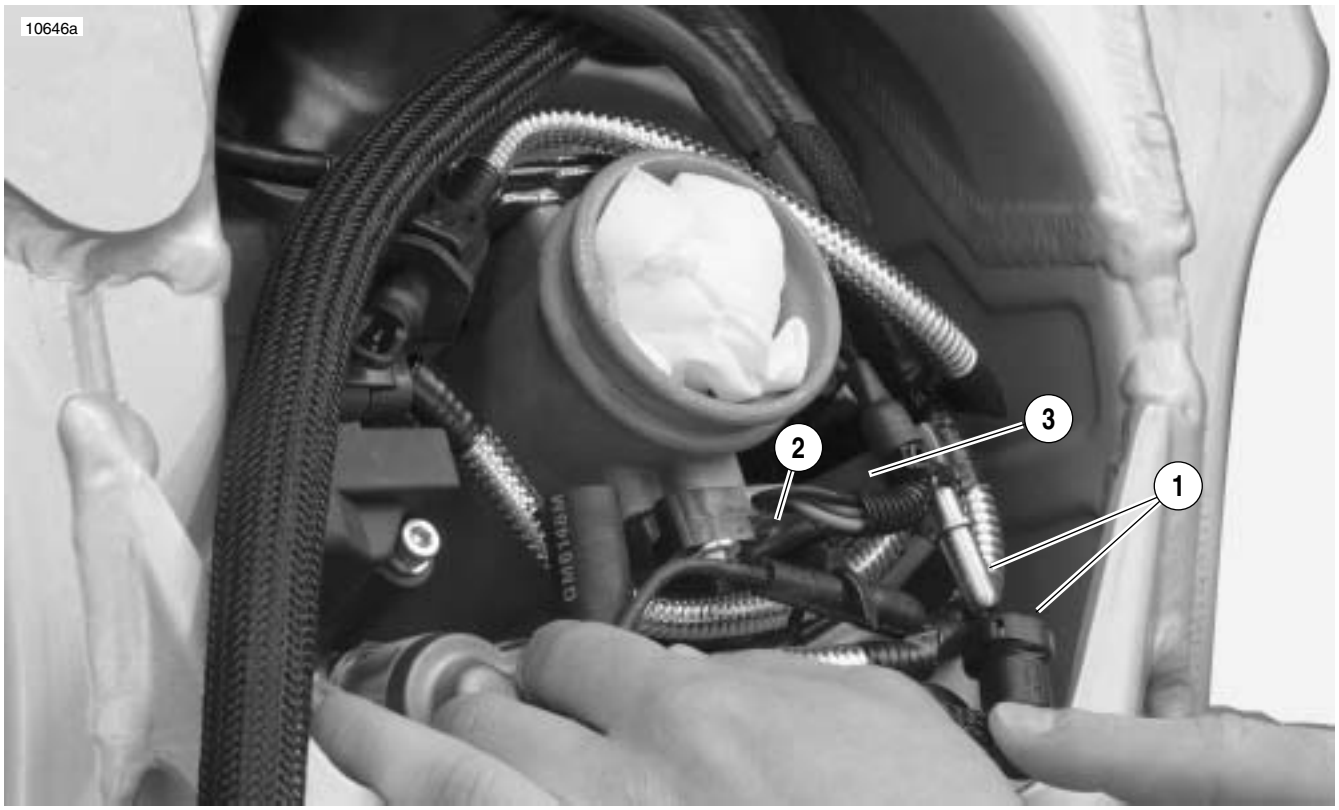
For 1200 models with interactive exhaust system see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

36. See Figure 3-54. Install muffler with Torca clamp but do not tighten: 2.31 EXHAUST SYSTEM
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).



1. **Ignition coil**
2. **Coil connection [83]**
3. **Cylinder head temperature sensor connection [90]**
4. **Oxygen sensor connection [137]**
5. **Throttle cables**

Figure 3-55. Electrical Connections and Throttle Cables (Typical)



1. **Fuel line connection**
2. **Connection for throttle position sensor [88]**
3. **Connections for fuel injectors [84 & 85]**

Figure 3-56. Fuel Line and DDFI Electrical Connections (Typical)

NOTE

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**.**

NOTES

- *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.

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.

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.

1. **Crankcase breather**
2. **Grommet**
3. **Screw (4)**
4. **Washer (4)**
5. **Gasket (4)**
6. **Rocker cover (top)**
7. **Bolt (3)**
8. **Washer (3)**
9. **Gasket (inner)**
10. **Gasket (lower)**
11. **Rocker arm shafts**
12. **Bolt (2)**
13. **washer (2)**
14. **Rocker cover (lower)**
15. **Rocker arm (2)**
16. **Bushing (rocker arm - 4)**
17. **Gasket (lower rocker cover)**
18. **Hydraulic lifter**
19. **Screw, tappet anti-rotation (2)**
20. **Gasket (push rod cover)**
21. **Push rod cover**
22. **Screw (4)**
23. **O-ring (push rod cover - 2)**
24. **Push rod**
25. **Washer (4)**
26. **Bolt (4)**

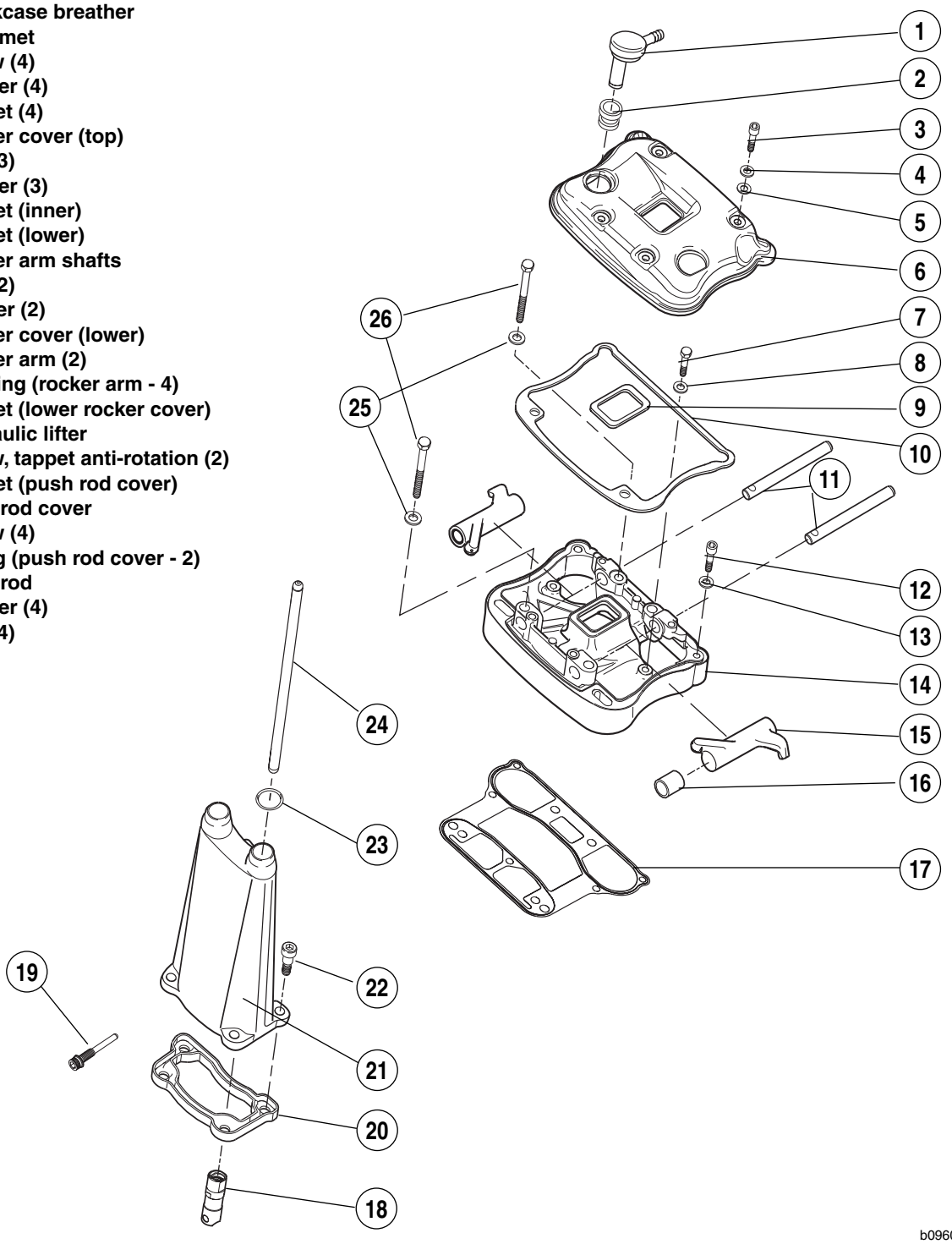


Figure 3-57. Rocker Arm and Push Rod Cover Assemblies

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.

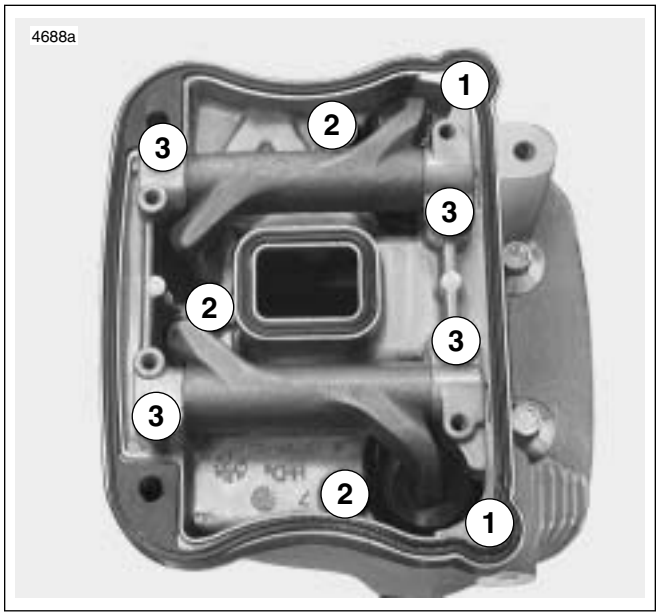


Figure 3-58. Lower Rocker Box Fasteners



Figure 3-59. Removing Rocker Arm Shafts

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.

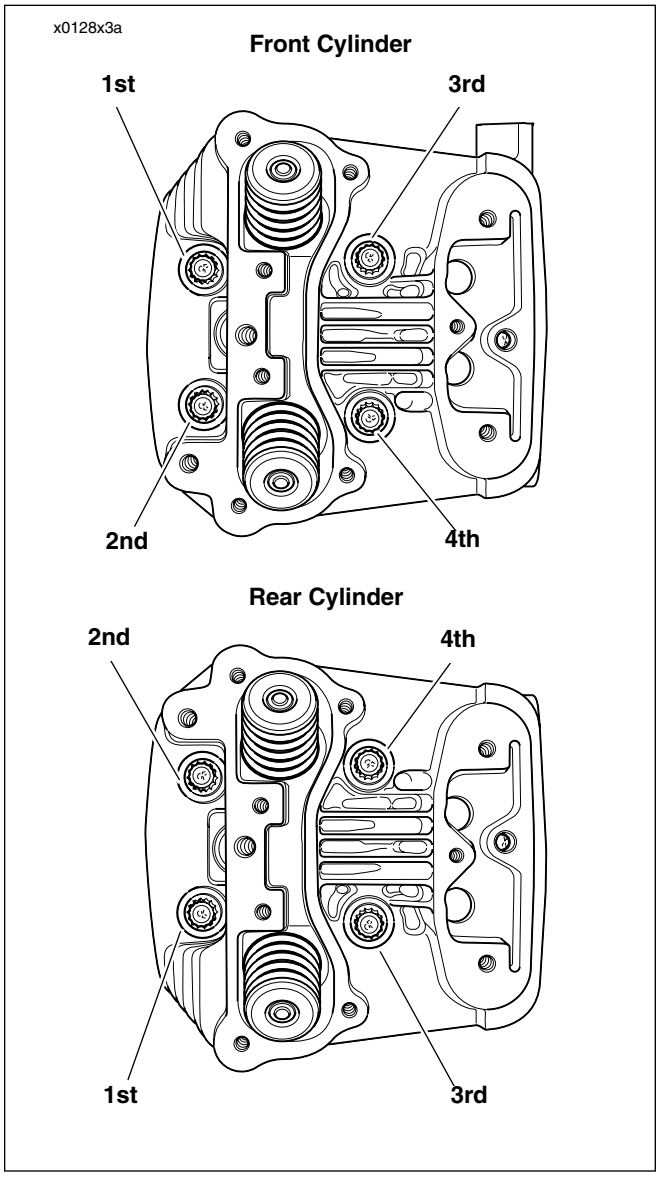


Figure 3-60. Head Screw Loosening/Tightening Sequence

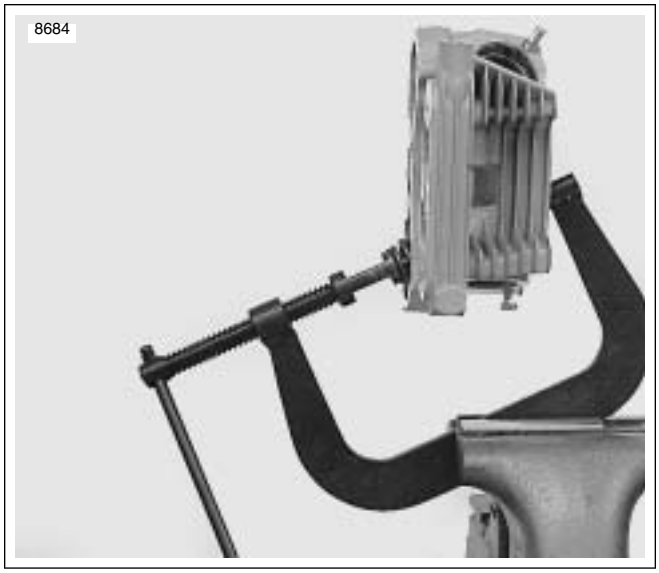
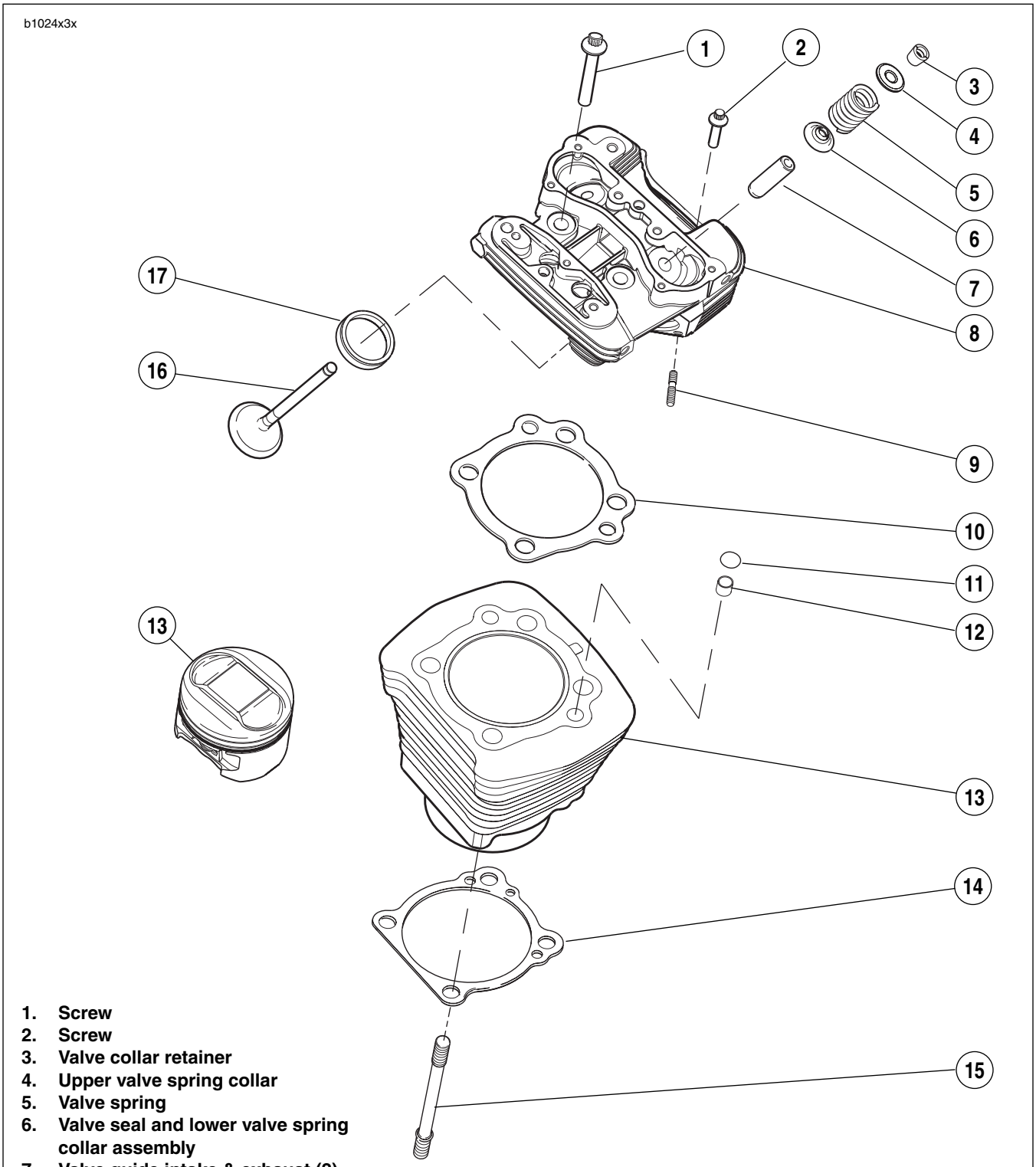


Figure 3-61. Valve Spring Compressor (Part No. HD-34736B)



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

CLEANING AND INSPECTION

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.
2. Soak cylinder head in an aluminum-compatible cleaner/solvent to loosen carbon deposits.
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.

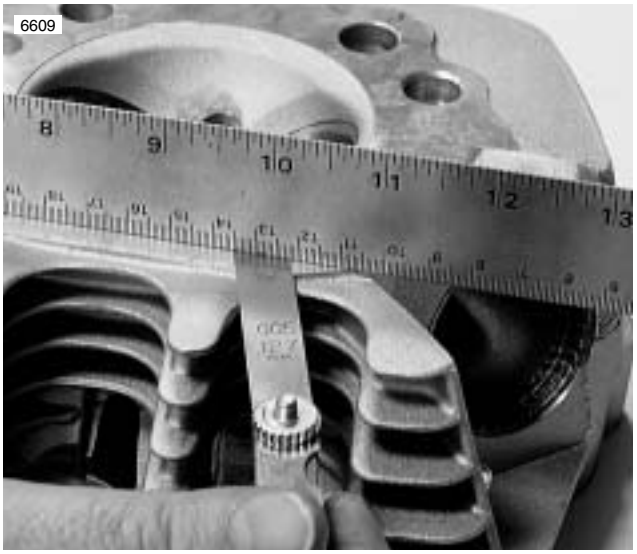


Figure 3-63. Checking Gasket Surface

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.



Figure 3-64. Measuring Rocker Arm Shaft Diameter (Rocker Cover Position)



Figure 3-65. Measuring Rocker Arm Shaft Diameter (Rocker Arm Bushing Position)

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.



Figure 3-66. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover



Figure 3-67. Measuring Rocker Arm Bushing Inner Diameter

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.



Figure 3-68. Measuring Valve Stem Protrusion

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.

NOTE

Replacing a valve seat is a complex operation requiring special equipment. If the seat is loose or is not fully seated in the head, then seat movement will prevent the proper transfer of heat from the valve. The seat surface must be flush with (or below) the head surface. See 3.1 SPECIFICATIONS for valve seat-to-cylinder head fit.

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.

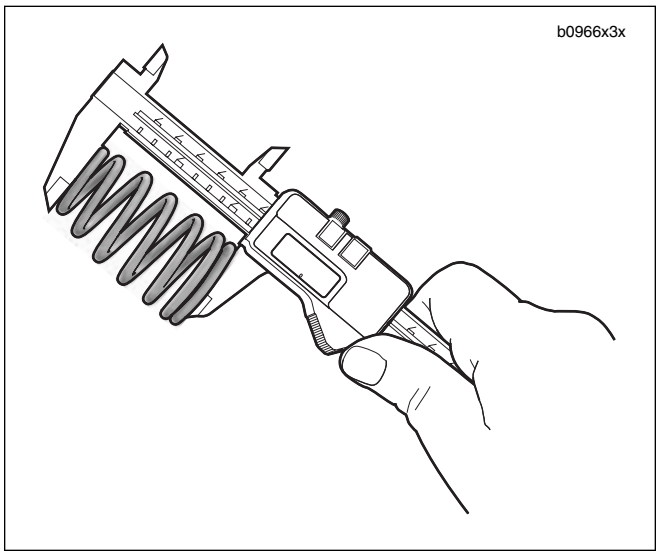


Figure 3-69. Checking Spring Free Length

2. See Figure 3-69. Check free length and compression force of each spring. Compare with 3.1 SPECIFICATIONS. If spring length is shorter than specification or if spring compression force is below specification, replace spring.

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.

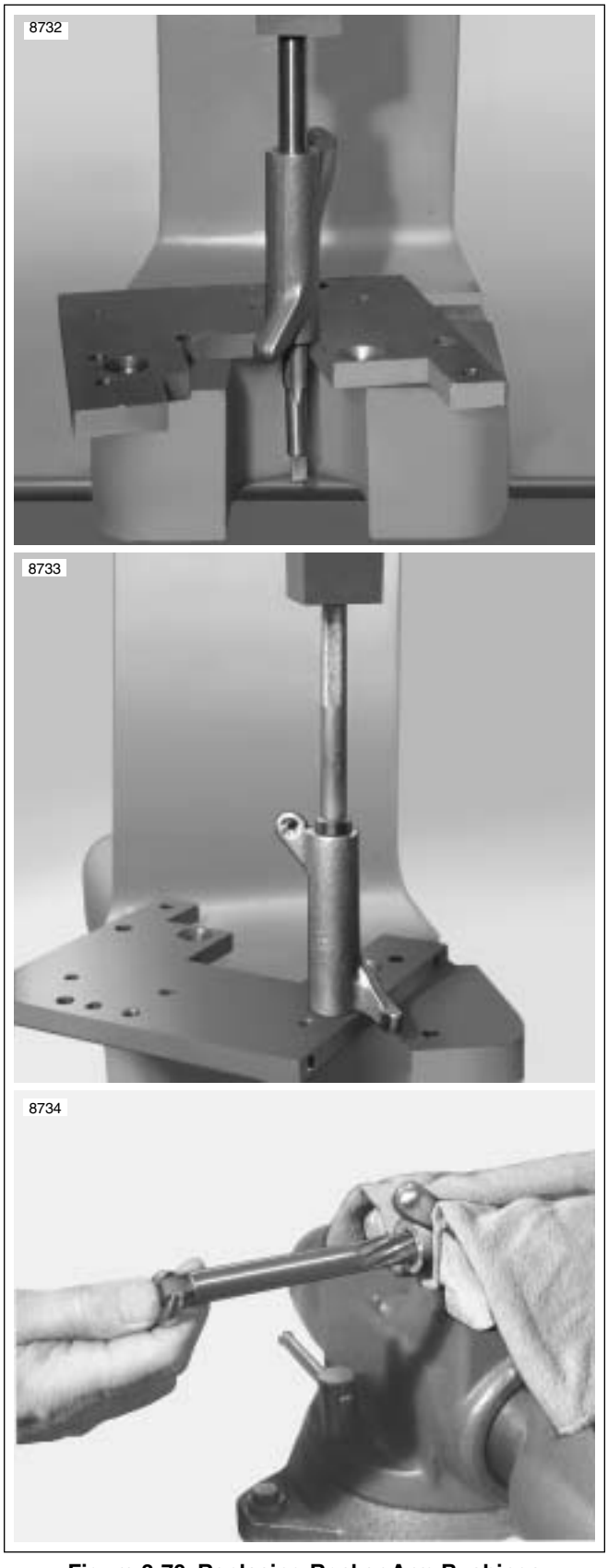


Figure 3-70. Replacing Rocker Arm Bushings

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

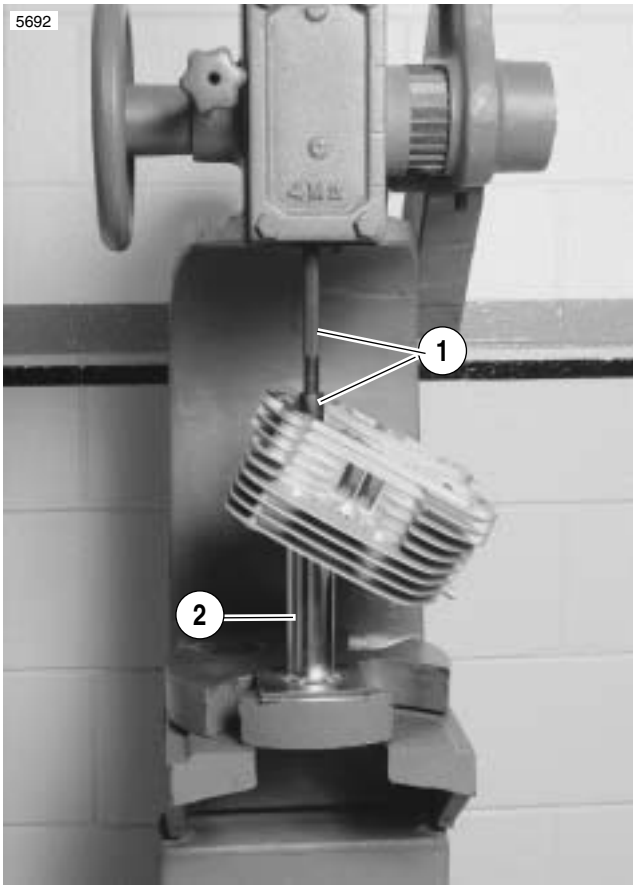
VALVE	CLEARANCE	SERVICE WEAR LIMIT
Exhaust	0.001-0.003 in. (0.025-0.076 mm)	0.0035 in. (0.0889 mm)
Intake	0.001-0.003 in. (0.025-0.076 mm)	0.0035 in. (0.0889 mm)

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

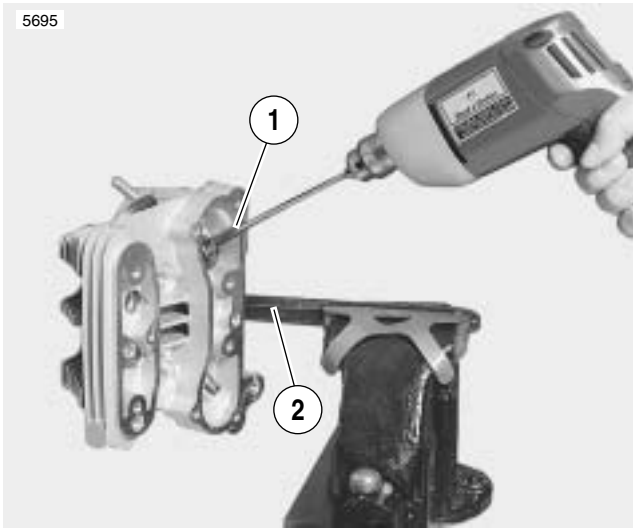
The hone is not intended to remove material.

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.



1. Valve guide remover/installer (Part No. B-45524)
2. Cylinder head stand (Part No. HD-39782)

Figure 3-71. Installing Shoulderless Valve Guide



1. Valve guide brush (Part No. HD-34751)
2. Cylinder head holding fixture (Part No. HD-39786)

Figure 3-72. Cleaning Valve Guides

PROCEDURE FOR USING THE NEWAY VALVE SEAT CUTTER

Table 3-19. Neway Valve Seat Cutter

PART NO.	SPECIALTY TOOL
HD-35758A	Neway valve seat cutter
HD-39786	Cylinder head holding fixture

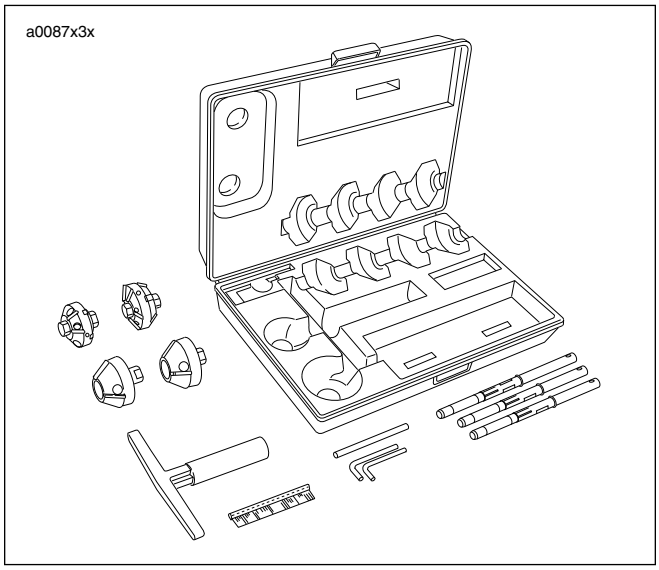


Figure 3-73. Neway Valve Seat Cutter

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 to high (towards the combustion chamber), use the 31° cutter to lower the valve seat closer to the port.
   b. If the 46° cut is too low, 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.

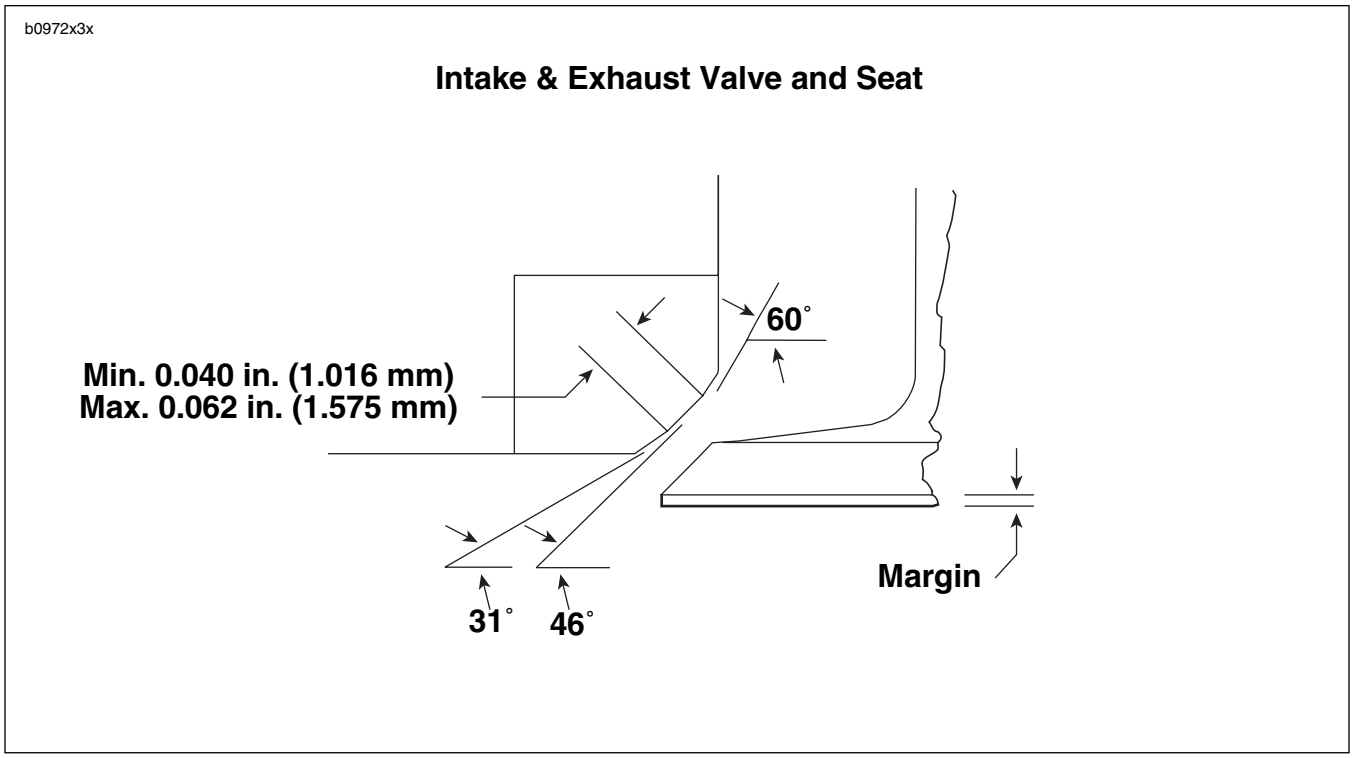
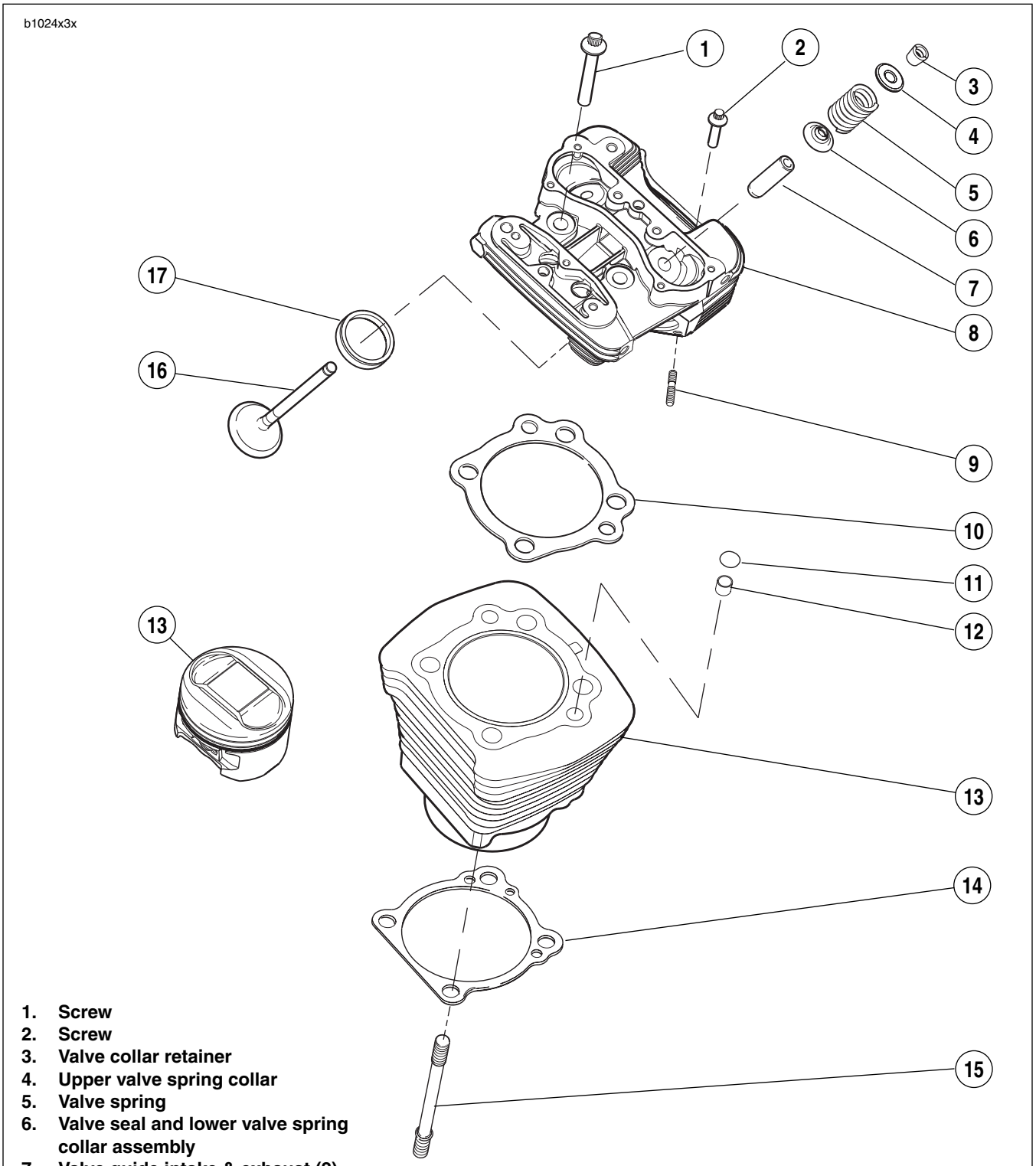


Figure 3-74. Valve and Seat Dimensions



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.

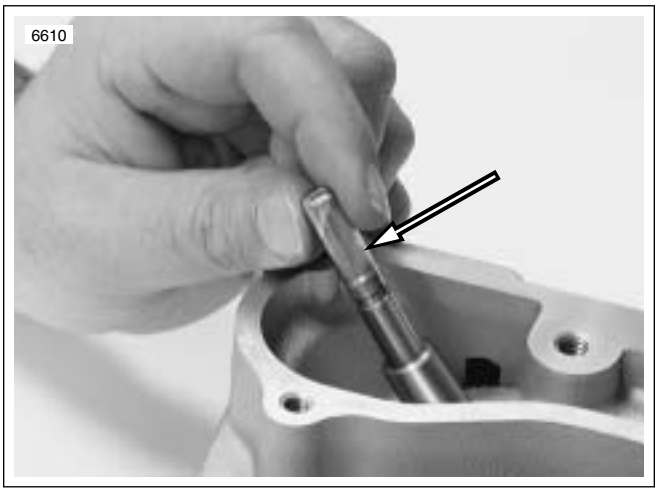


Figure 3-76. Valve Guide Seal Protector Sleeve

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.



Figure 3-77. Valve Seal and Lower Collar Assembly (seal and lower collar replaced as assembly only)



Figure 3-78. Valve Seal and Lower Collar Assembly Installation

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.*



Figure 3-79. Valve Spring Compressor (Part No. HD-34736B)

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.

PUSH ROD COVER INSTALLATION

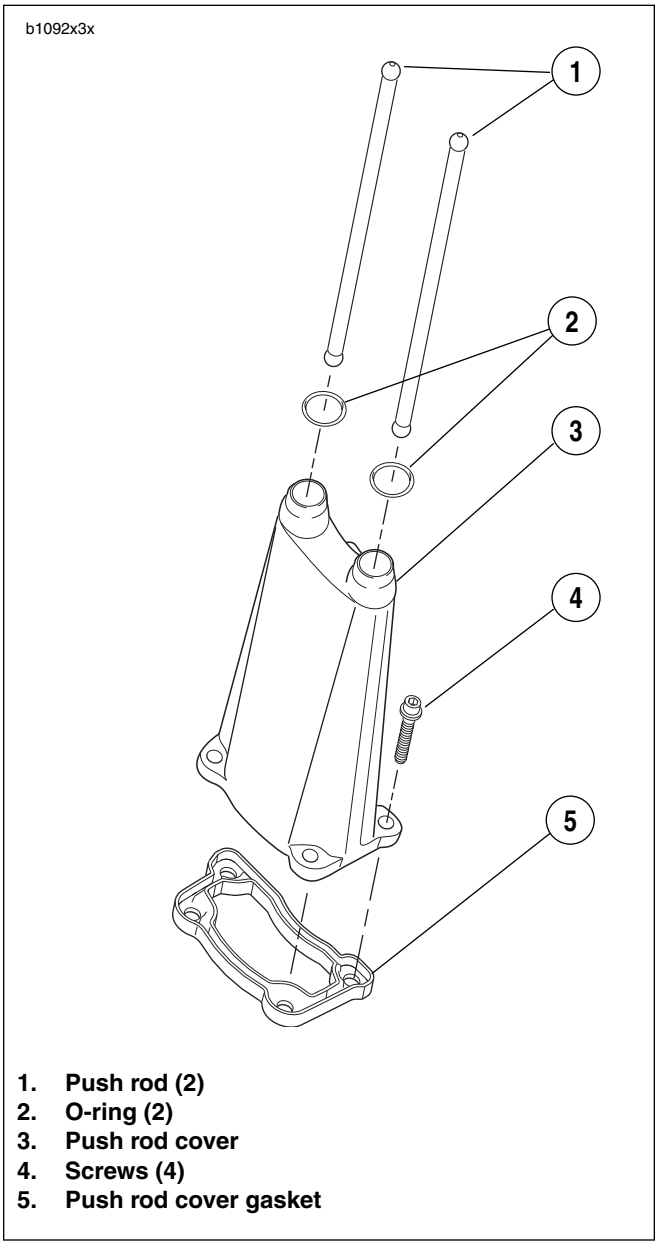
NOTE

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.



1. **Push rod (2)**
2. **O-ring (2)**
3. **Push rod cover**
4. **Screws (4)**
5. **Push rod cover gasket**

Figure 3-81. Push Rods and Push Rod Cover Assembly

Table 3-20. Push Rod Selection

POSITION	COLOR CODES	LENGTH	PART NO.
Exhaust	1 Band-Pink/Purple	10.780 in. (274.320 mm)	17908-02
Intake	1 Band-Orange/Brown	10.726 in. (272.948 mm)	17909-02

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° .

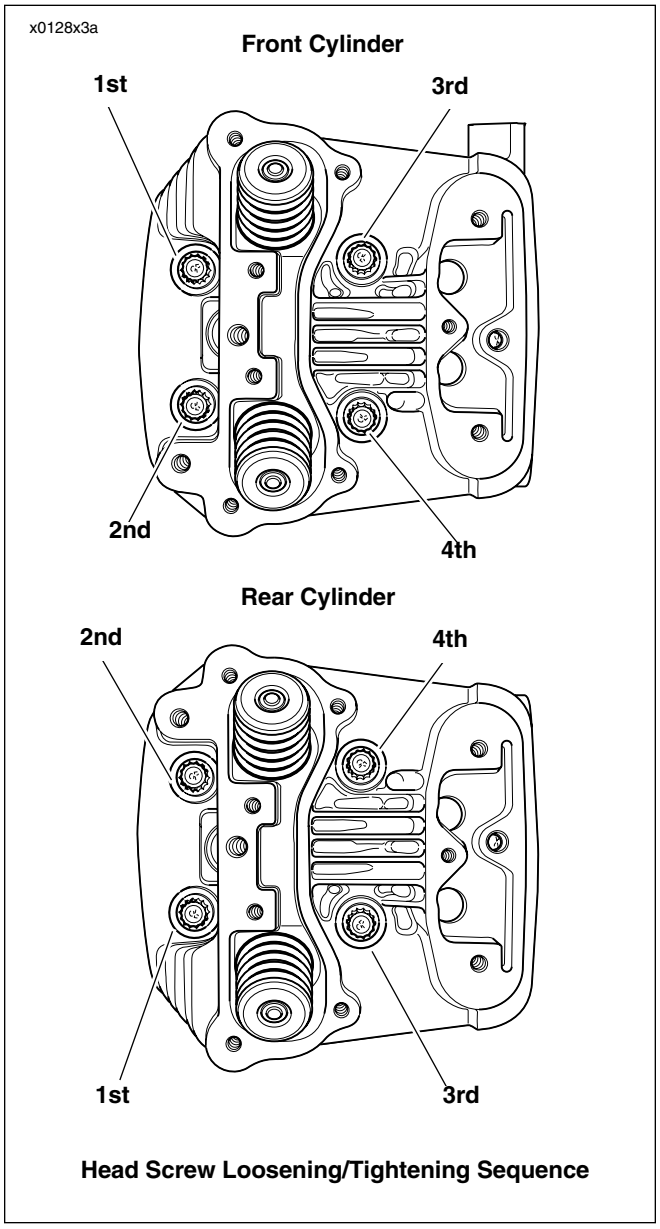


Figure 3-82. Head Screw Loosening/Tightening Sequence

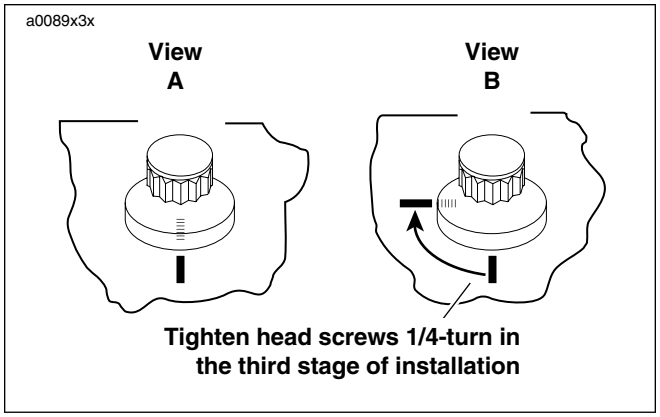


Figure 3-83. Tightening Head Screws

1. Crankcase breather
2. Grommet
3. Screw (4)
4. Washer (4)
5. Gasket (4)
6. Rocker cover (top)
7. Bolt (3)
8. Washer (3)
9. Gasket (inner)
10. Gasket (lower)
11. Rocker arm shafts
12. Bolt (2)
13. Washer (2)
14. Rocker cover (lower)
15. Rocker arm (2)
16. Bushing (rocker arm - 4)
17. Gasket (lower rocker cover)
18. Hydraulic lifter
19. Screw, tappet anti-rotation (2)
20. Gasket (push rod cover)
21. Push rod cover
22. Screw (4)
23. O-ring (push rod cover - 2)
24. Push rod
25. Washer (4)
26. Bolt (4)

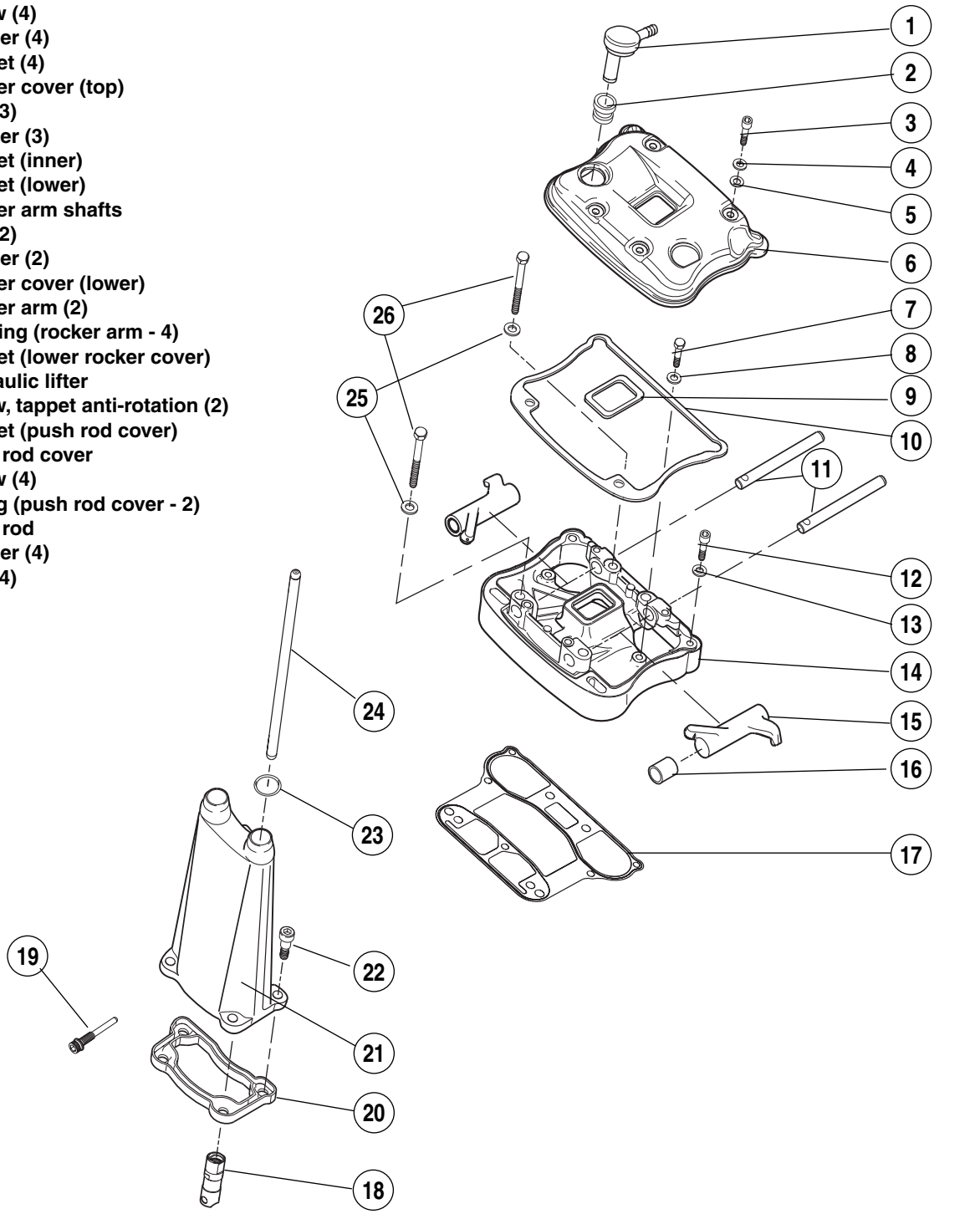


Figure 3-84. Rocker Arm and Push Rod Cover Assemblies

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.

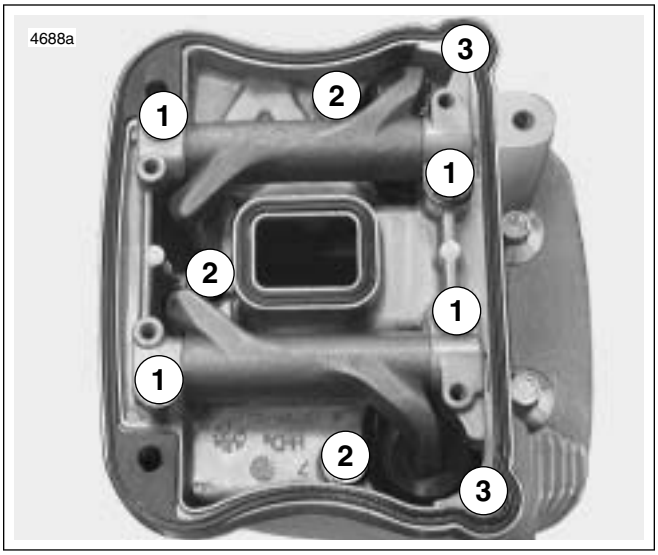


Figure 3-85. Lower Rocker Box Fasteners

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

No.	ITEM	SIZE	TORQUE
1	Bolt w/washer	5/16-18 X 2-1/2	18-22 ft-lbs (24-30 Nm)
2	Bolt w/washer	1/4-20 X 1-1/4	135-155 **in-lbs** (15.2-17.5 Nm)
3	Screw w/washer	1/4-20 X 1-1/2	135-155 **in-lbs** (15-18 Nm)

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.

6. Carefully lift cylinder over piston and cylinder studs. Do not allow piston to fall against cylinder studs. Discard cylinder base gasket.

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.

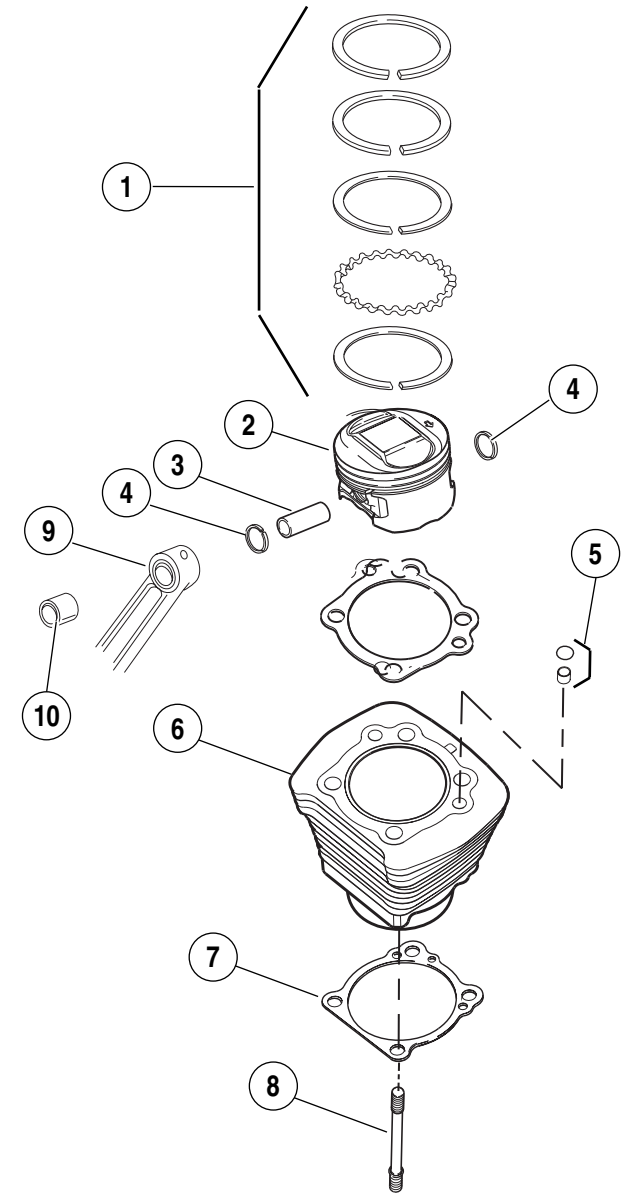
7. Install a 6 in. (152 mm) length of 1/2 in. (12.7 mm) ID plastic or rubber hose over each cylinder stud. This will protect the studs and the piston.

⚠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.

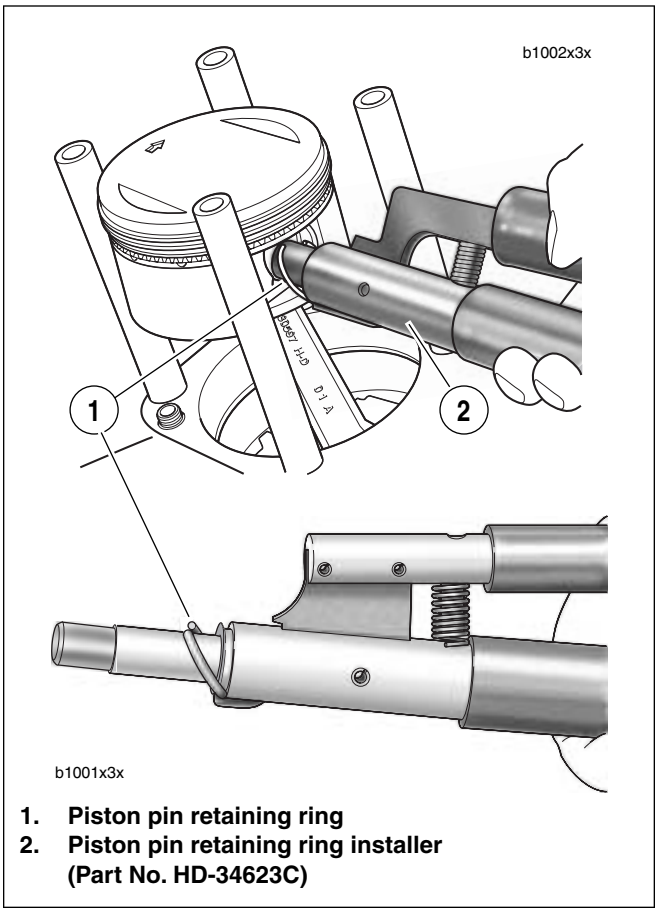


1. **Ring set**
2. **Piston**
3. **Piston pin**
4. **Retaining ring (2)**
5. **Dowel and o-ring**
6. **Cylinder**
7. **Base gasket**
8. **Cylinder stud (4)**
9. **Connecting rod**
10. **Piston pin bushing**

Figure 3-86. Cylinder and Piston

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.



1. Piston pin retaining ring
2. Piston pin retaining ring installer (Part No. HD-34623C)

Figure 3-87. Removing Piston Pin Circlip

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.

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.*

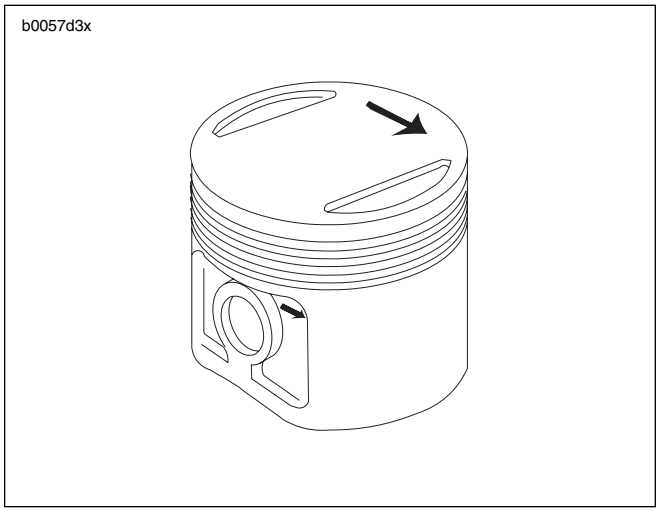


Figure 3-88. Piston Pin and Piston Identification

NOTE

See Figure 3-88. The arrows at the top of piston must always point toward the front of the engine.



Figure 3-89. Removing Piston 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.

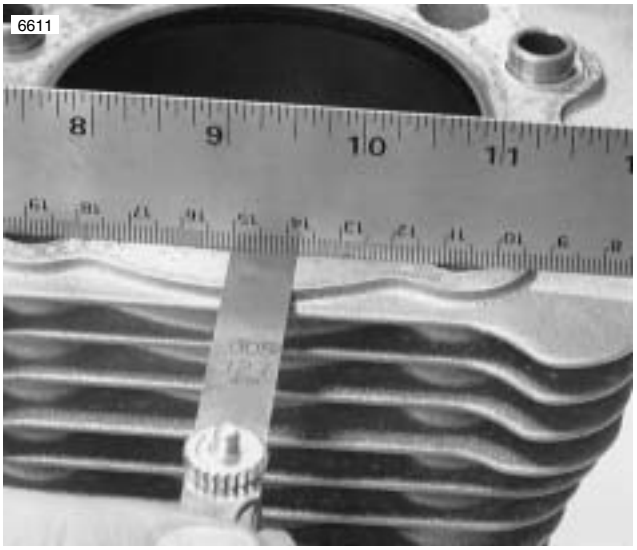


Figure 3-90. Checking Gasket Surfaces

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.

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.

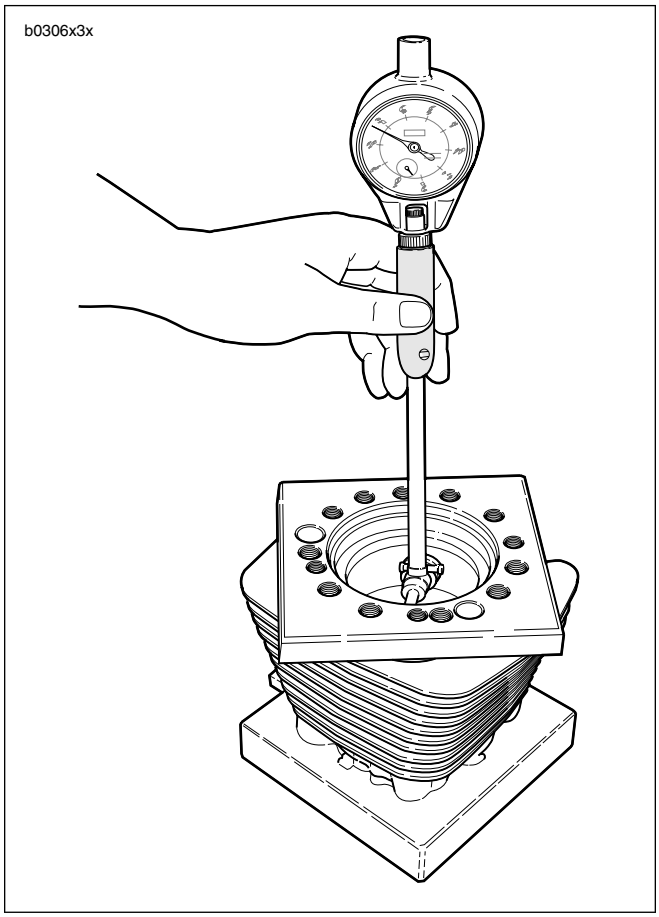


Figure 3-91. Measuring Cylinder Bore Using Torque Plates (Part No. HD-33446B)

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

STANDARD BORE	IN.	MM
All models	3.5008	88.9203

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 or 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

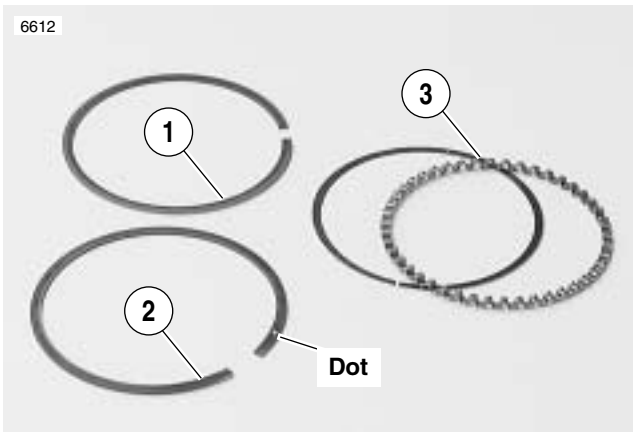
After wiping the cylinder with a clean, oiled paper towel, the towel will be dark with contamination. repeat this process using a new lightly oiled paper towel each time until the towel remains white. The cylinder is now clean.

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

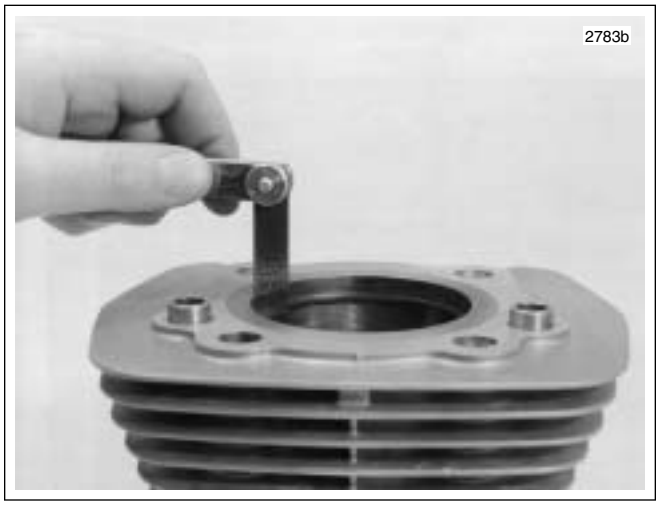


Figure 3-93. Measuring Ring End Gap

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

Ring Type	in.	mm
Top compression ring	0.010-0.020	0.25-0.51
2nd compression ring	0.014-0.024	0.36-0.61
Oil control ring rails	0.010-0.050	0.25-1.27

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.*

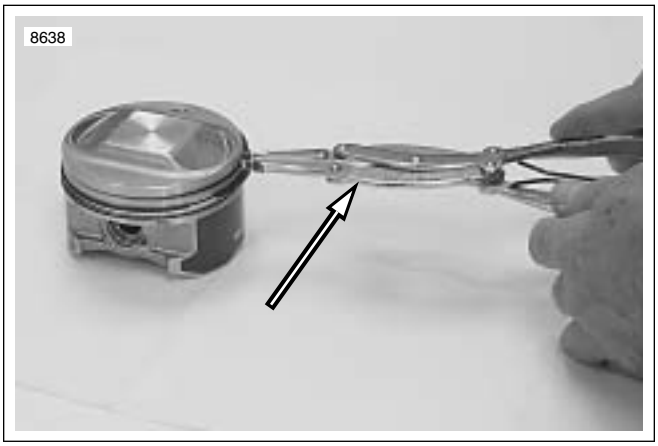


Figure 3-94. Installing Piston Rings Transmission Shaft Retaining Ring Pliers (Part No. J-5586)

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.

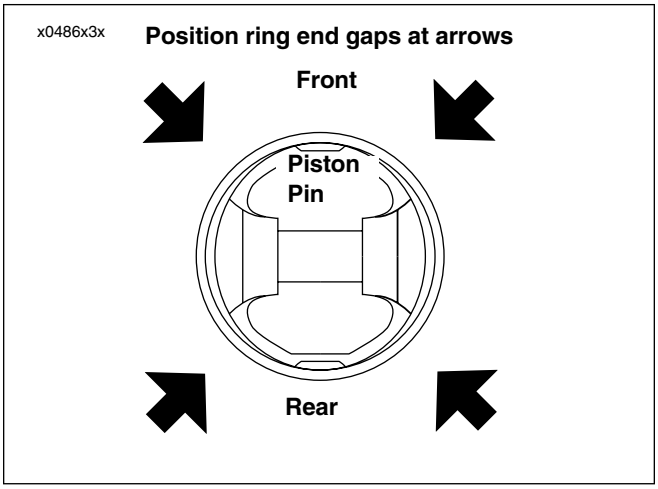


Figure 3-95. Ring End Gap Position

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.



Figure 3-96. Measuring Ring Clearance in Groove

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.

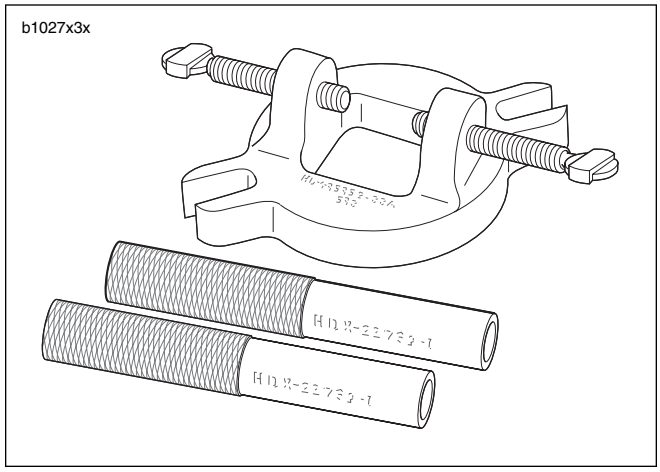
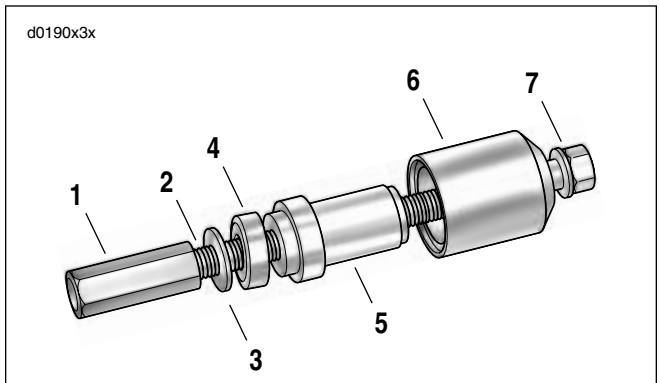


Figure 3-97. Connecting Rod Clamping Tool (Part No. HD-95952-33B)

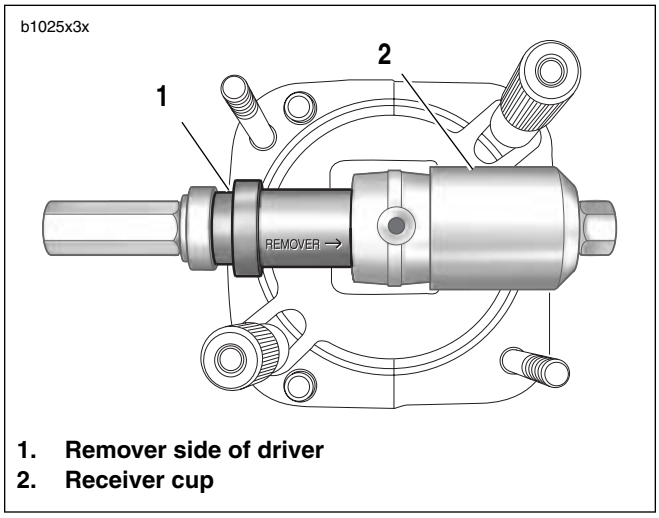
1. See Figure 3-97. Secure connecting rod with CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33B).



1. **Hex cylinder**
2. **Threaded rod**
3. **Flat washer**
4. **Nice bearing**
5. **Driver (2 way)**
6. **Receiver cup**
7. **Nut**

Figure 3-98. Connecting Rod Bushing Remover/Installer (Part No. HD-95970-32D)

2. See Figure 3-98. Attach PISTON PIN BUSHING TOOL (Part No. HD-95970-32D) to the connecting rod.



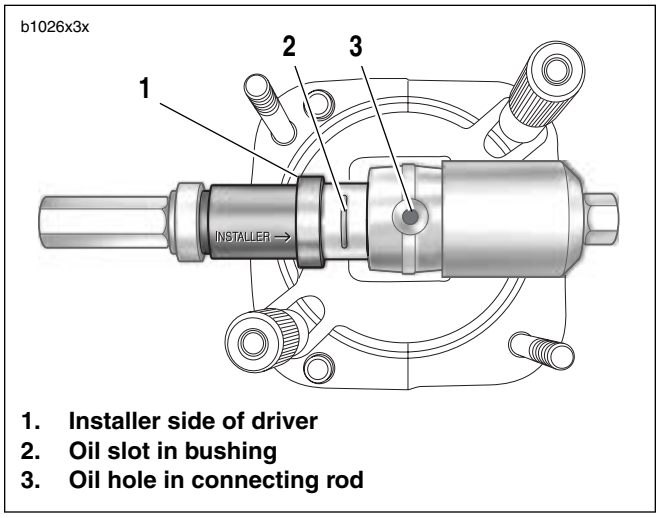
1. **Remover side of driver**
2. **Receiver cup**

Figure 3-99. Removing Wrist Pin Bushing

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.

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.



1. **Installer side of driver**
2. **Oil slot in bushing**
3. **Oil hole in connecting rod**

Figure 3-100. Installing New Wrist Pin Bushing

6. See Figure 3-100. Place **new** bushing between connecting rod and driver.

NOTE

The driver must be attached facing the opposite direction as it was for removal of the bushing.

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.

ASSEMBLY/INSTALLATION

1. See Figure 3-101. Place PISTON SUPPORT PLATE (Part No. HD-42322) in position as shown.

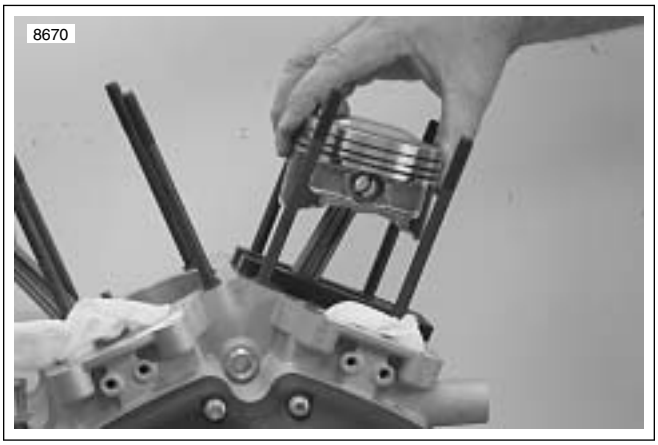


Figure 3-101. Piston Support Plate (Part No. HD-42322)

2. Install piston assembly over connecting rod.

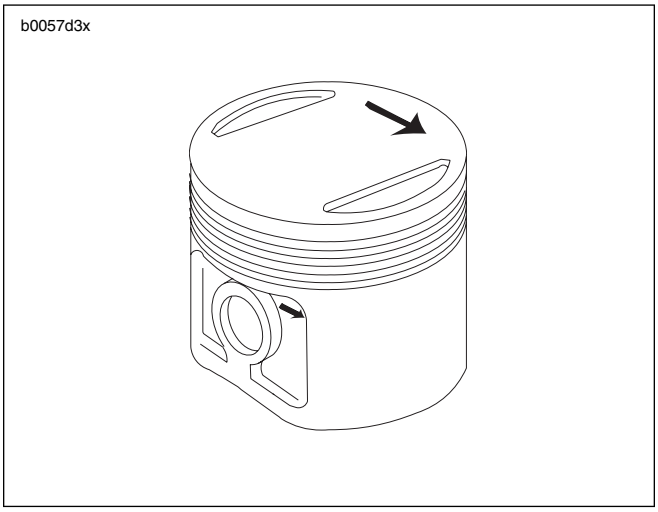


Figure 3-102. Piston Identification

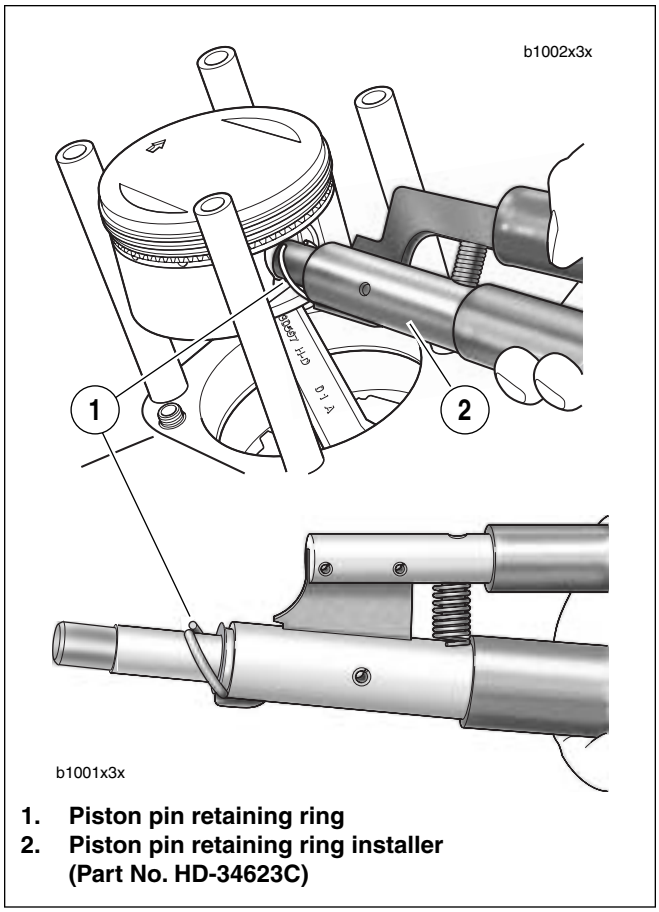
NOTE

See Figure 3-102. Piston must be installed with the arrows pointing towards the front of the engine.

3. Install piston pin.

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.



1. **Piston pin retaining ring**
2. **Piston pin retaining ring installer (Part No. HD-34623C)**

Figure 3-103. Installing Piston Pin Circlip

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

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.

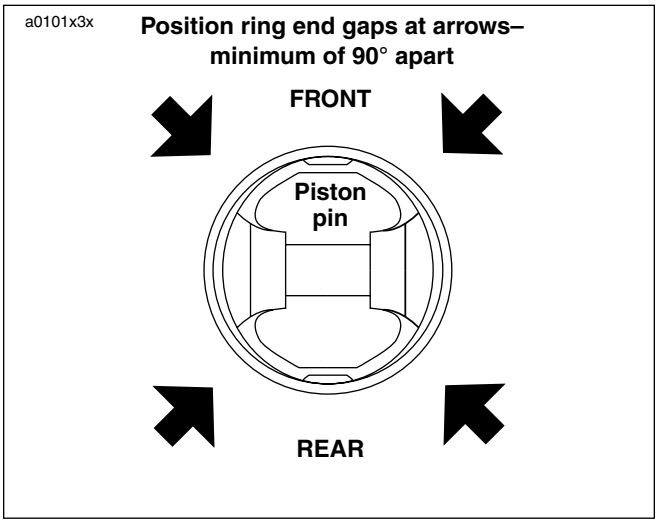


Figure 3-104. Ring End Gap Position

5. See Figure 3-104. Make sure the piston ring end gaps are properly positioned as shown.



Figure 3-105. Piston Support Plate

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.

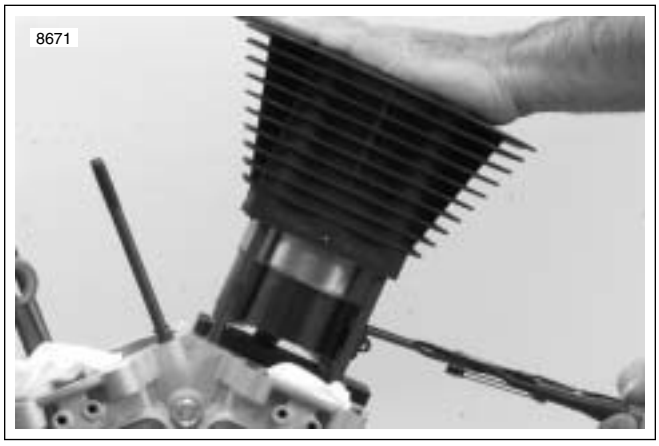


Figure 3-106. Compressing Piston Rings Using Piston Ring Compressor (Part No. HD-96333-51C)

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.

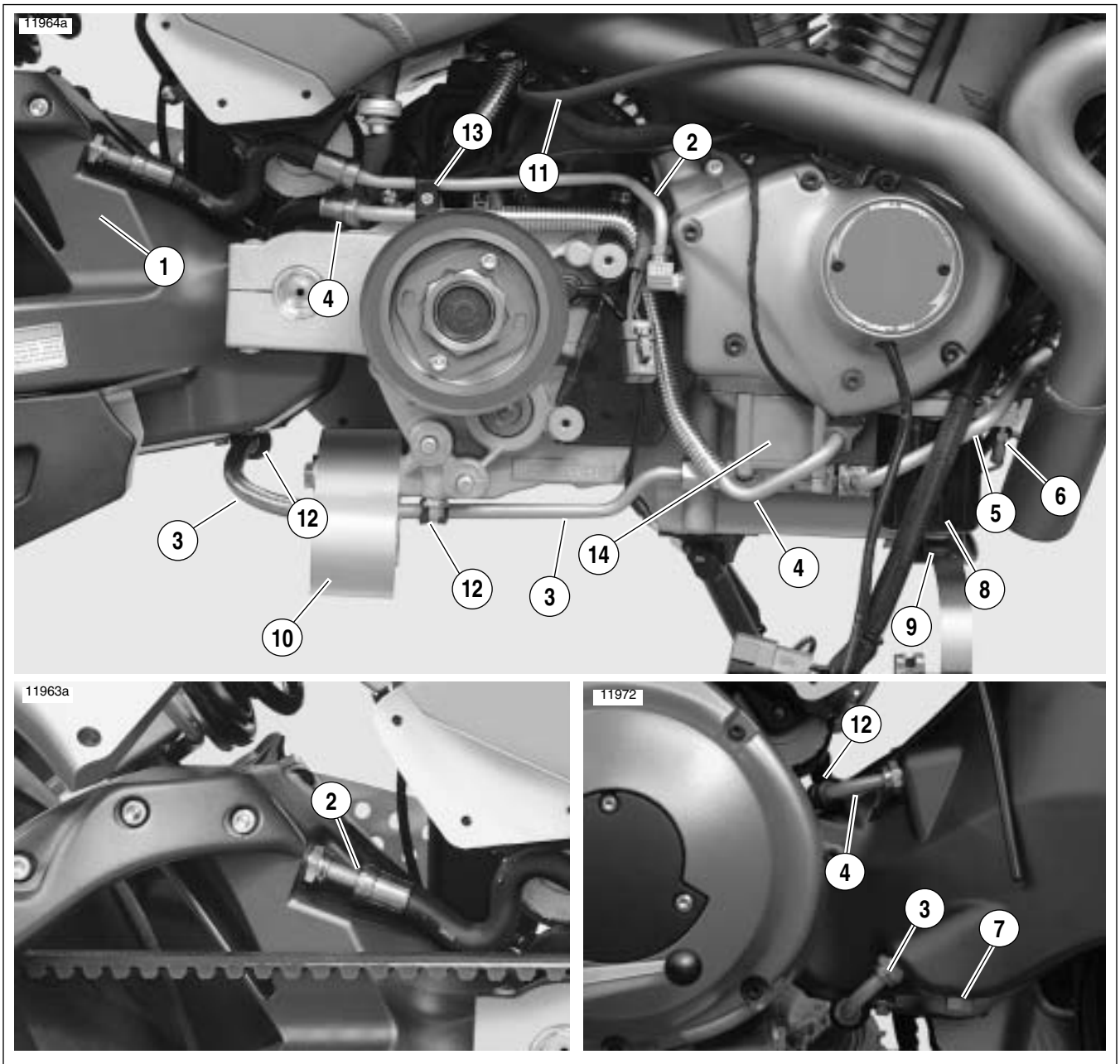
OIL HOSE ROUTING AND OIL RESERVOIR 3.9

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.



1. Swingarm/Oil reservoir
2. Vent oil line
3. Feed oil line
4. Return oil line
5. Feed oil line from oil pump to oil cooler
6. Feed oil line from oil cooler to crankcase
7. Oil tank drain plug
8. Oil Filter
9. Front muffler mount
10. Rear muffler bracket
11. Cable, interactive exhaust
12. P-clamp
13. Oil line clamp
14. Oil pump

Figure 3-107. Oil Lines and Connections

REMOVAL

PART NO.	SPECIALTY TOOL
B-41623-B	Oil line remover

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.

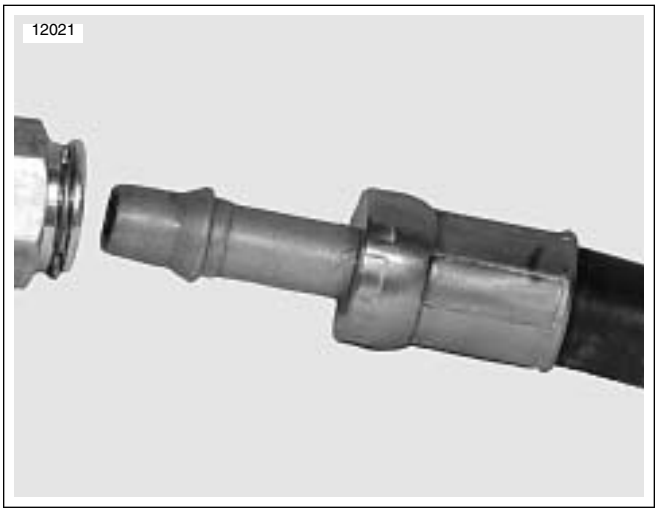
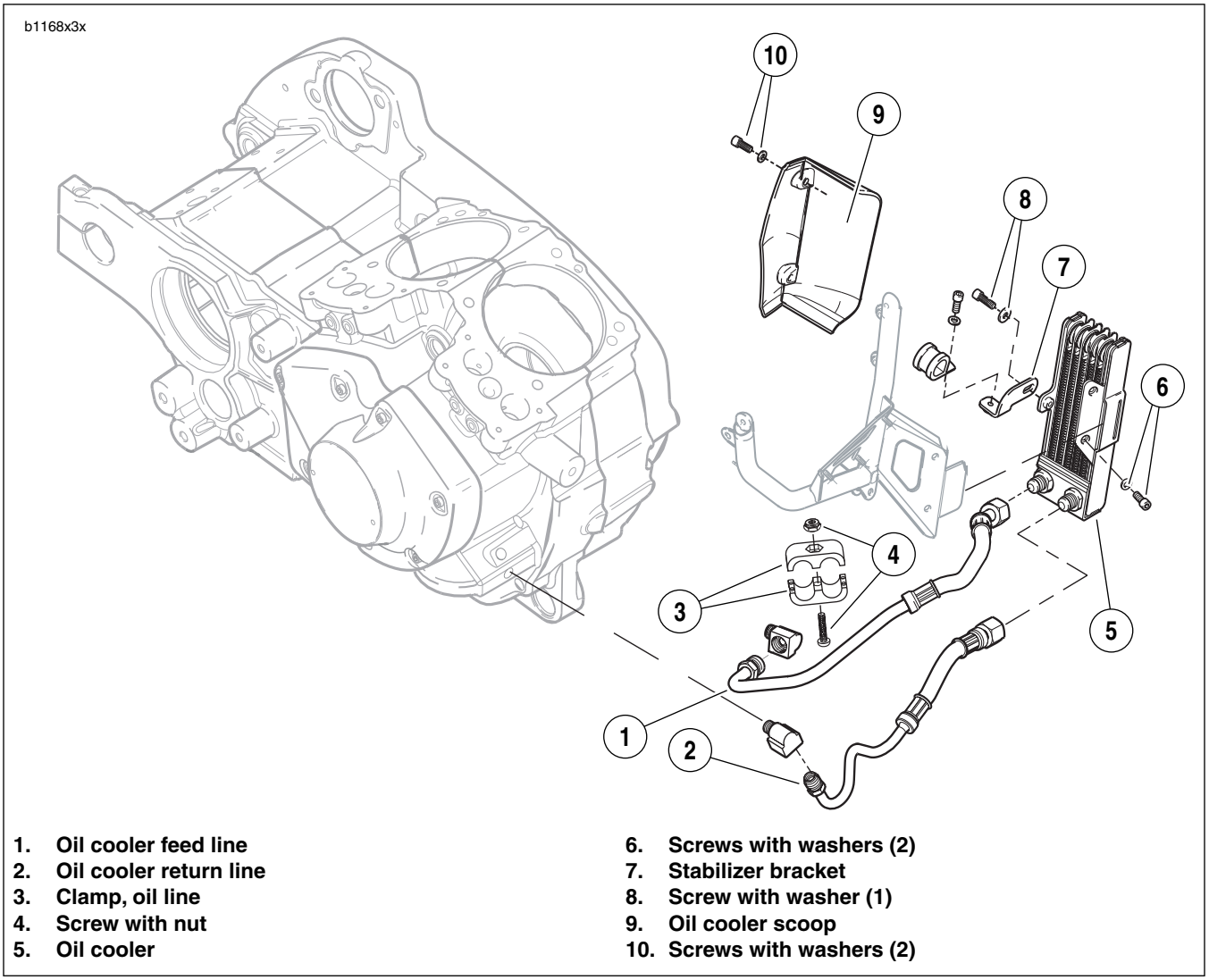


Figure 3-110. Flanged Oil Line

OIL COOLER 3.11



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)**

Figure 3-111. Oil Cooler

GENERAL

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.

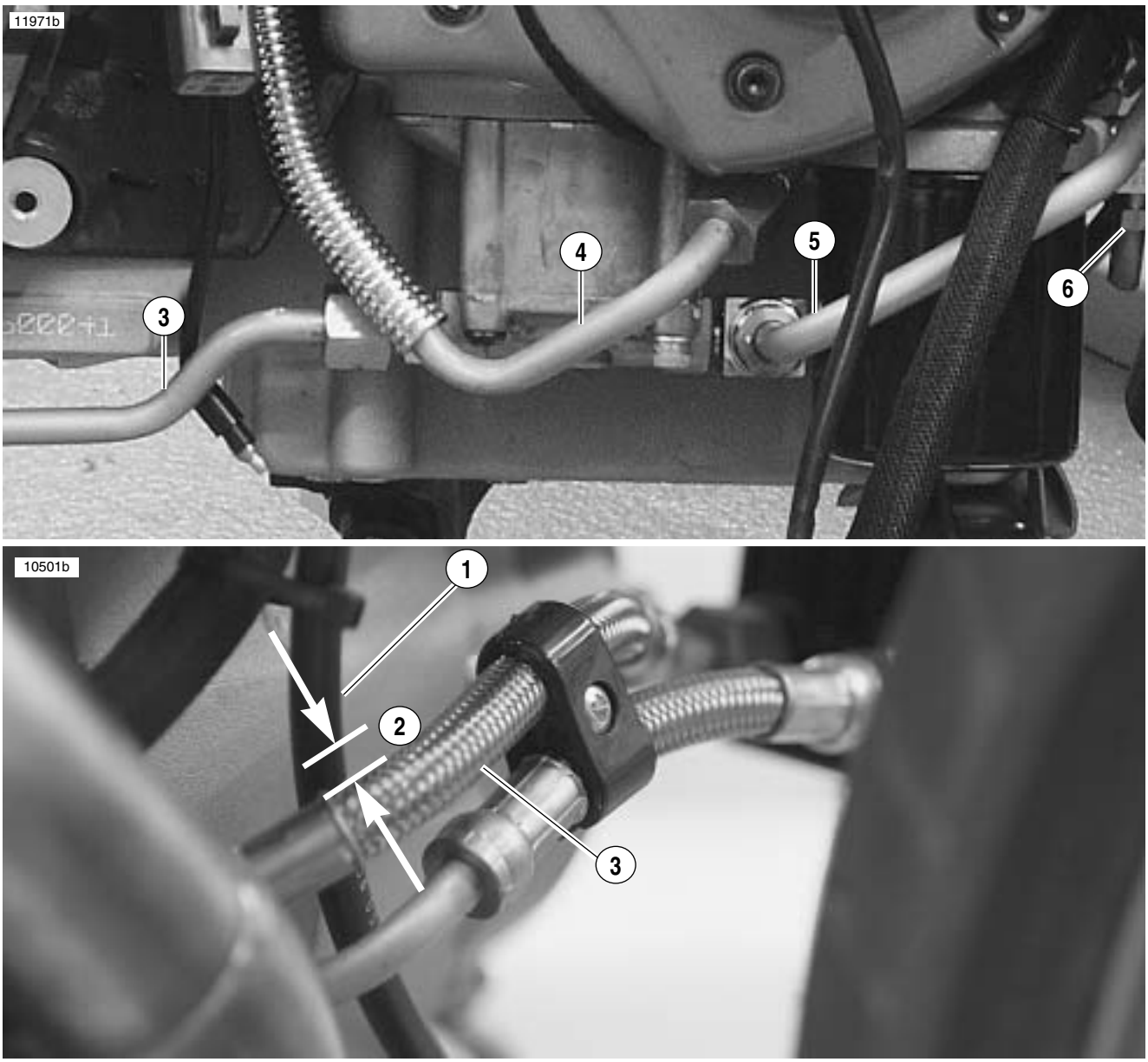
7. Remove fastener (8) securing oil cooler to stabilizer bracket.
8. Remove the fasteners (6) holding the oil cooler (5) to mounting bracket.
9. Slightly move oil cooler towards you and disconnect both oil lines from oil cooler before removing from bracket.

NOTE

The oil cooler should be checked for dirt and debris.

INSTALLATION

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).



1. **Clutch cable**
2. **1/8-1/4 in. (3.175-6.35 mm) clearance**
3. **Feed oil line**
4. **Return oil line**
5. **Feed oil line to oil cooler**
6. **Return oil line from oil cooler**

Figure 3-112. Oil Cooler Feed Oil Line Orientation (Approximately 2 O'Clock) and Oil Line Clearances

OIL PRESSURE INDICATOR SWITCH 3.12

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 back 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-96940-58). 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).

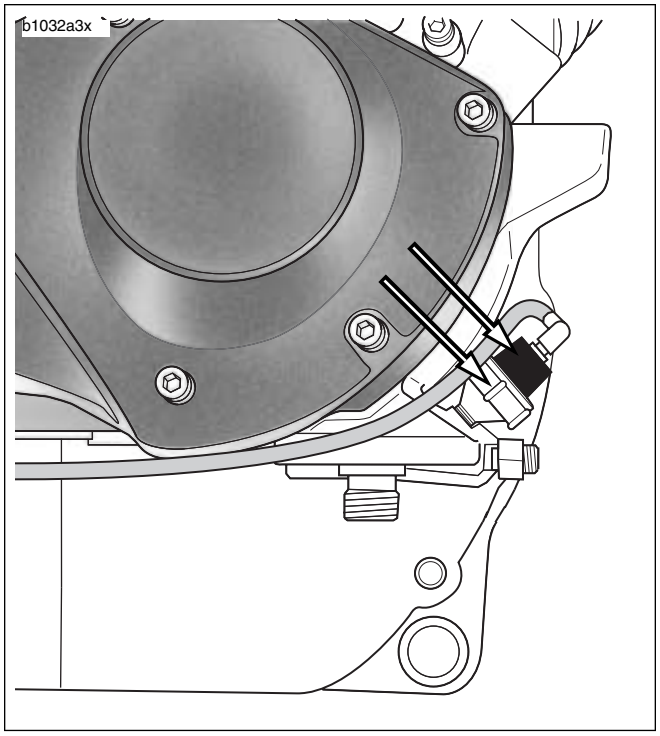


Figure 3-113. Oil Pressure Indicator Switch

Table 3-24. Troubleshooting Oil Pressure Signal Light

OIL PRESSURE SIGNAL LIGHT	PROBABLE CAUSES
Stays on at speeds above idle.	● Empty oil reservoir. ● Clogged feed line (ice and sludge, freezing temperatures). ● Air-bound oil line. ● Grounded oil switch wire. ● Malfunctioning signal switch. ● Diluted oil. ● Malfunctioning check valve (see 3.16 OIL FILTER MOUNT).
Flickers at idle.	● Incorrect idle speed. Malfunctioning or improperly installed check valve (see 3.16 OIL FILTER MOUNT).
Does not glow when ignition is turned on (prior to operating engine).	● Malfunctioning signal switch. ● Malfunction in wiring. ● Burned-out signal bulb. ● Dead battery (see NOTE).

CRANKCASE BREATHING SYSTEM 3.13

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.

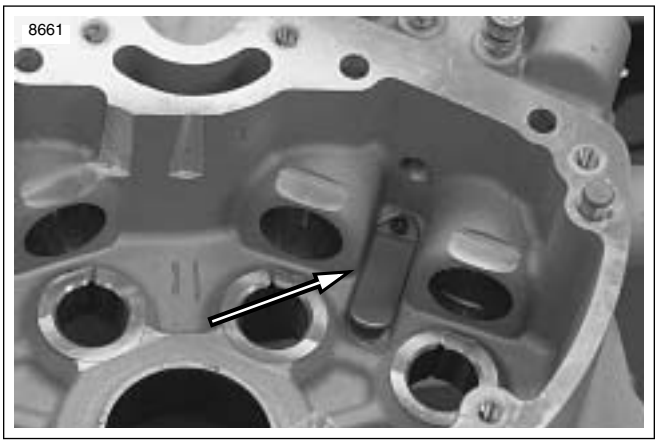
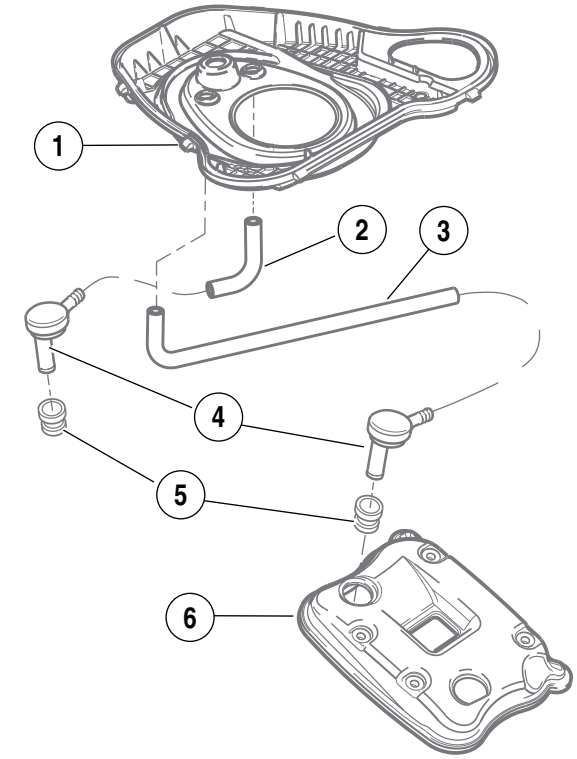


Figure 3-114. Reed Valve Assembly in Gearcase

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.



1. **Base plate, air box**
2. **Breather hose, rear**
3. **Breather hose, front**
4. **PCV valves (2)**
5. **Grommet**
6. **Rocker cover (2)**

Figure 3-115. Crankcase Breathing System

Reed Valve Replacement

NOTES

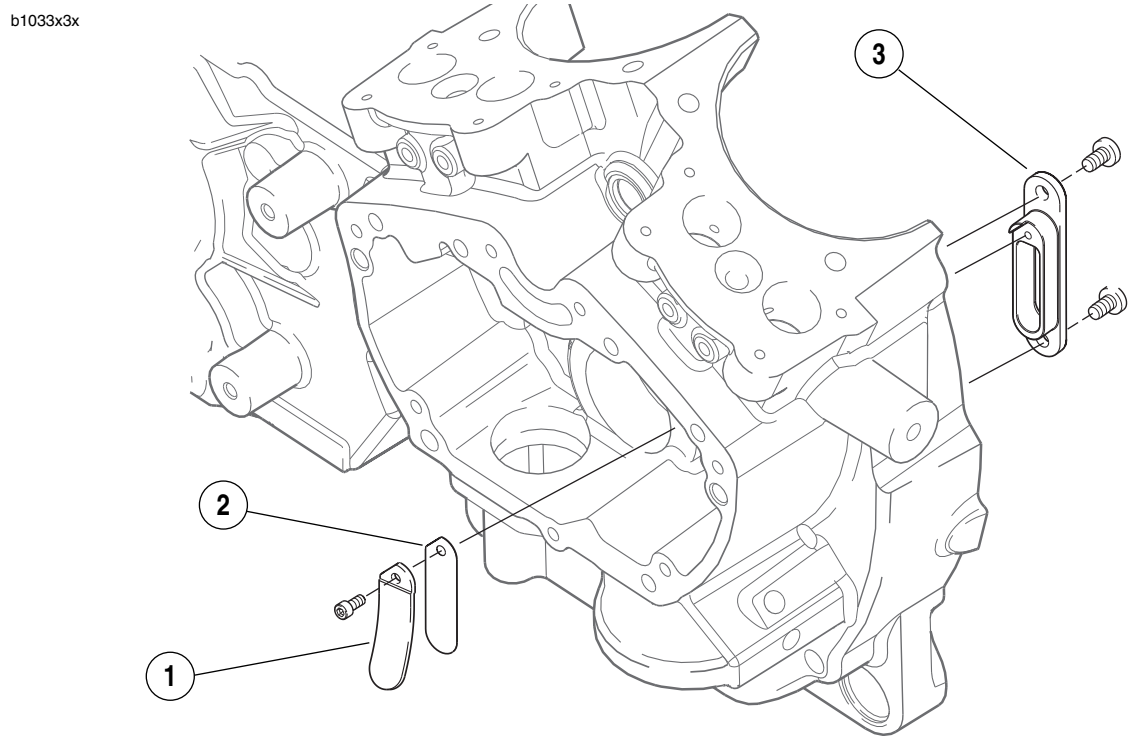
- *See Figure 3-117. The reed valve (3) opens on the downstroke to relieve crankcase pressure and closes on the upstroke to prevent vapors returning to the crankcase. The curved reed valve stop (2) limits the movement of the reed valve. See 3.13 CRANKCASE BREATHING SYSTEM.*
- *Whenever the gearcase cover is removed, the reed valve should always be inspected for cracks, chips and breakage.*

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

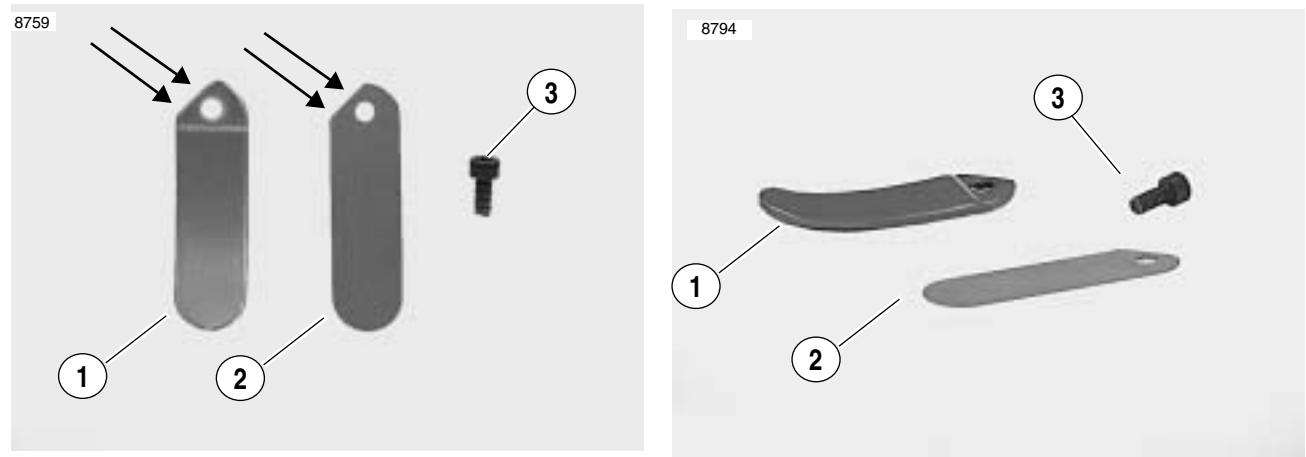
See Figure 3-116. It is not necessary to replace the reed block (4) along with the reed valve. The block can only be replaced after separating the crankcase halves.

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).



1. Reed valve stop **2. Reed valve** **3. Reed block**

Figure 3-116. Reed Valve Assembly



1. Reed valve stop **2. Reed valve** **3. Stop screw**

Figure 3-117. Reed Valve Stop and Reed Valve

OILING SYSTEM 3.14

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 crankcase feed galley.
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 galley at the top of the gearcase cover. Drilled passages in the crankcase intersect the main feed galley 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 cools 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.

OIL PUMP 3.15

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.

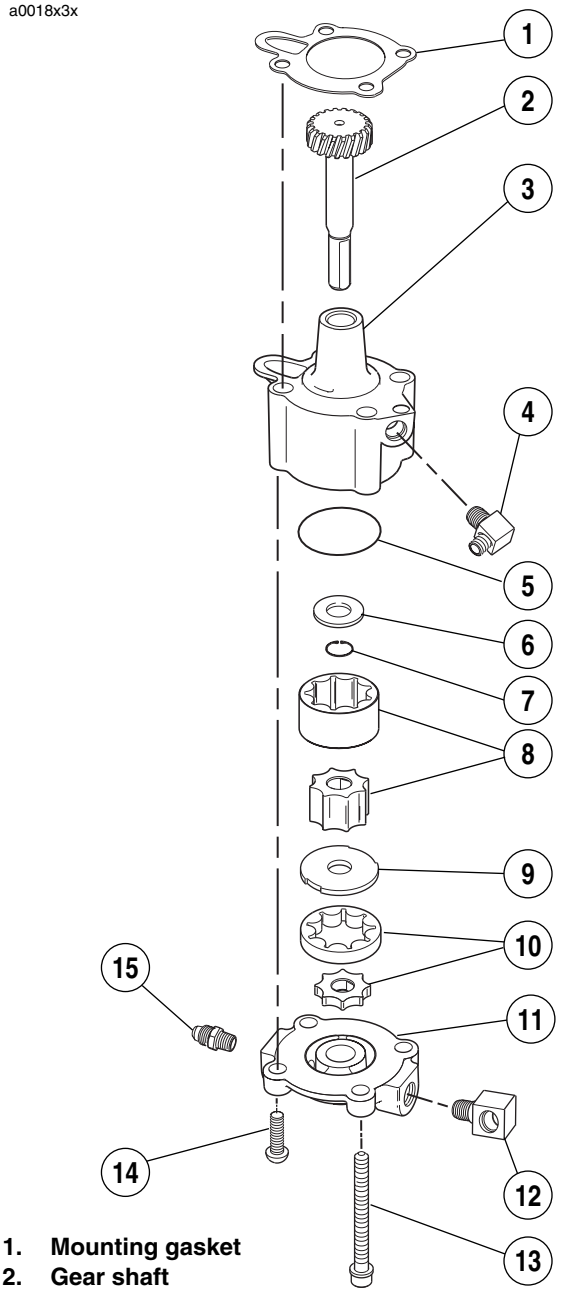
A gerotor-type gear set has two parts — an inner and an outer gerotor. The inner gerotor has one less tooth than the outer gerotor. Both gerotors have fixed centers which are offset to each other.

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.



1. **Mounting gasket**
2. **Gear shaft**
3. **Oil pump body**
4. **90° fitting**
5. **O-ring**
6. **Thrust washer**
7. **Retaining ring**
8. **Gerotor return set**
9. **Separator plate**
10. **Gerotor feed set**
11. **Cover**
12. **45° Fitting**
13. **Sems screw (2)**
14. **TORX screw (2)**
15. **Rear connector fitting**

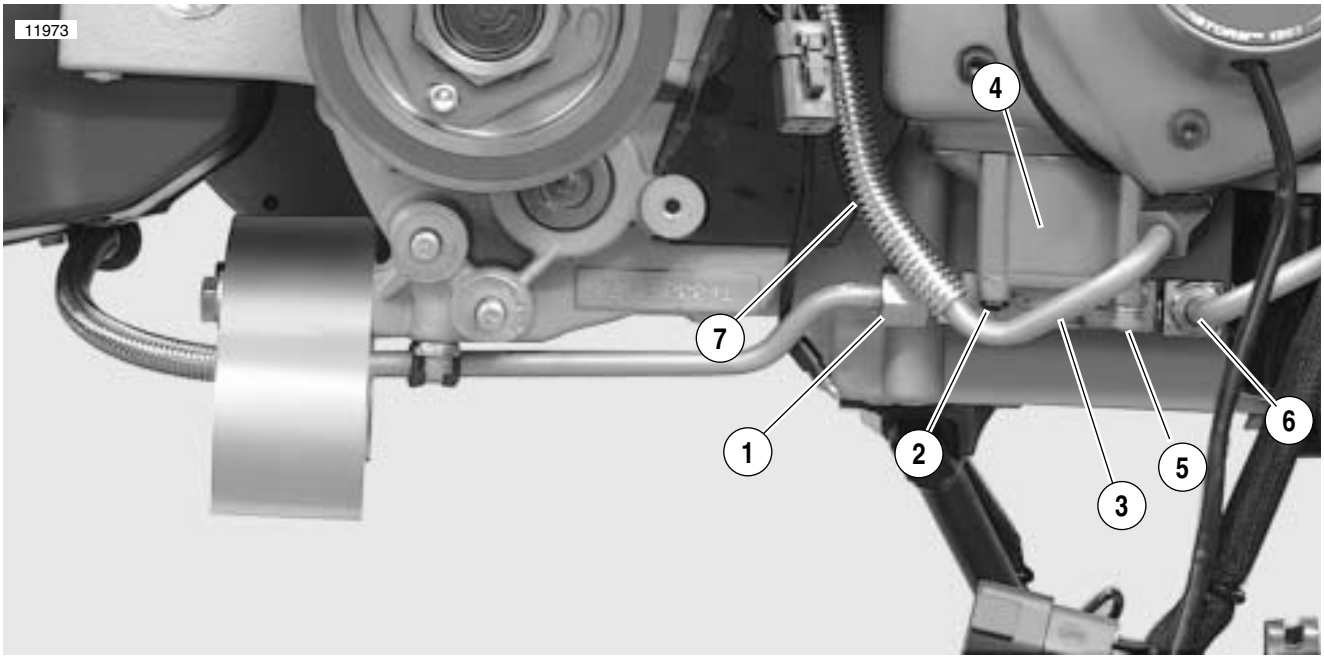
Figure 3-118. Oil Pump

REMOVAL/DISASSEMBLY

NOTE

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 scavenge set off gear shaft.
10. Remove and discard retaining ring. Remove thrust washer and gear shaft.

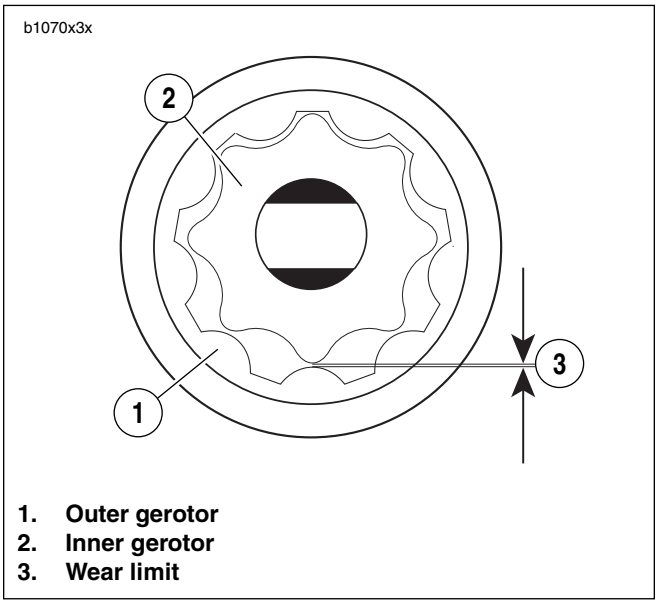


1. **Feed line connection**
2. **Cover TORX screw (2)**
3. **Return line**
4. **Oil pump**
5. **Mounting screw and washer (2)**
6. **Feed connection to oil cooler**
7. **Convolute covering (for return oil line only)**

Figure 3-119. Oil Pump Hardware

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.



1. **Outer gerotor**
2. **Inner gerotor**
3. **Wear limit**

Figure 3-120. Gerotor Wear Limits

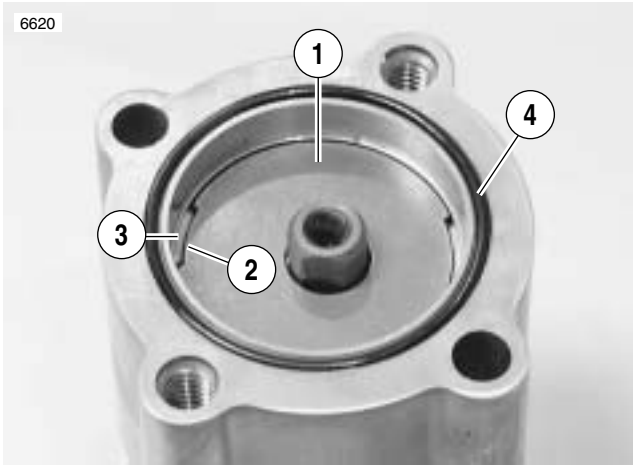
2. See Figure 3-120. Inspect both gerotor sets for wear.
   a. Mesh pieces of each set together as shown.
   b. Use a feeler gauge to determine clearance.
   c. The SERVICE WEAR LIMIT between gerotors is 0.004 in. (0.102 mm). Replace gerotors as a set if clearance exceeds this dimension.
   d. Measure 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.



1. **Gerotor separator plate**
2. **Slot on separator plate**
3. **Tab on oil pump body**
4. **O-ring**

Figure 3-121. Separator Plate Slots

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.

OIL FILTER MOUNT 3.16

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

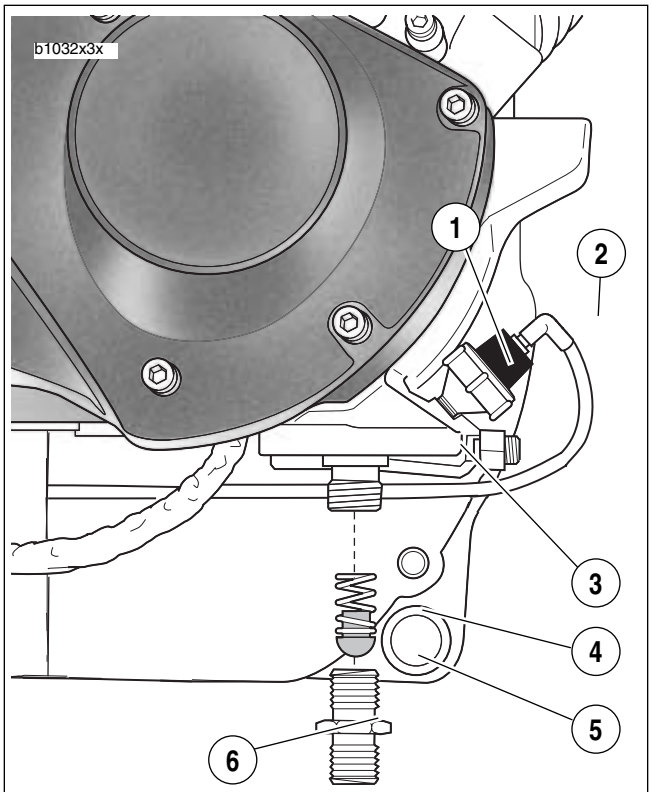
Use TEFLON PIPE SEALANT or HYLOMAR on all fittings installed to oil filter mount.

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.
4. Install filter mount components.
   a. Place spring (4) and check ball (5) into threaded hole at center of mount.
   b. Push threaded end of filter adapter (6) (with LOCTITE) against check ball to compress spring.
   c. Screw adapter into threaded hole. Tighten to 96-144 **in-lbs** (11-16 Nm).
5. Install a **new** filter and fill oil reservoir with proper oil. See 1.5 ENGINE LUBRICATION SYSTEM.
6. Install chin fairing. See 2.36 CHIN FAIRING.



1. **Oil pressure indicator switch**
2. **Indicator lamp wire**
3. **Oil filter mount (part of right crankcase half)**
4. **Spring**
5. **Check ball**
6. **Filter adapter**

Figure 3-122. Oil Filter Mount Assembly

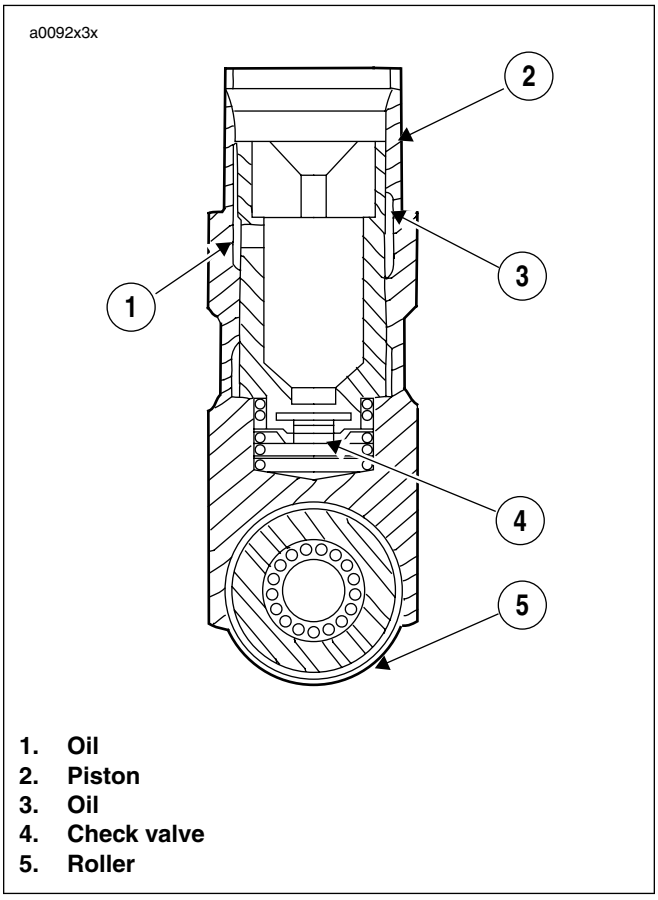
HYDRAULIC LIFTERS 3.17

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.



1. **Oil**
2. **Piston**
3. **Oil**
4. **Check valve**
5. **Roller**

Figure 3-123. Lifter Assembly (Typical)

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

⚠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 roller/lifter assembly, thoroughly in solvent. Blow dry with compressed air.

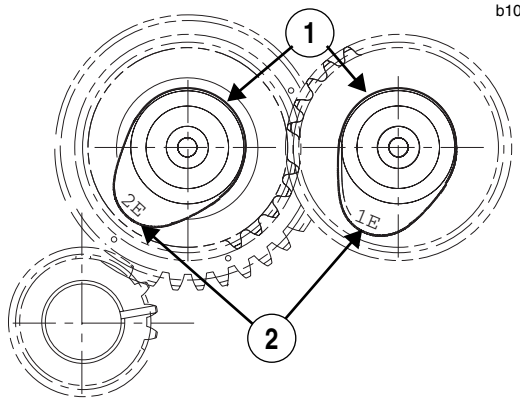
NOTE

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).
5. Soak lifters in clean engine oil. Keep covered until assembly.

INSTALLATION

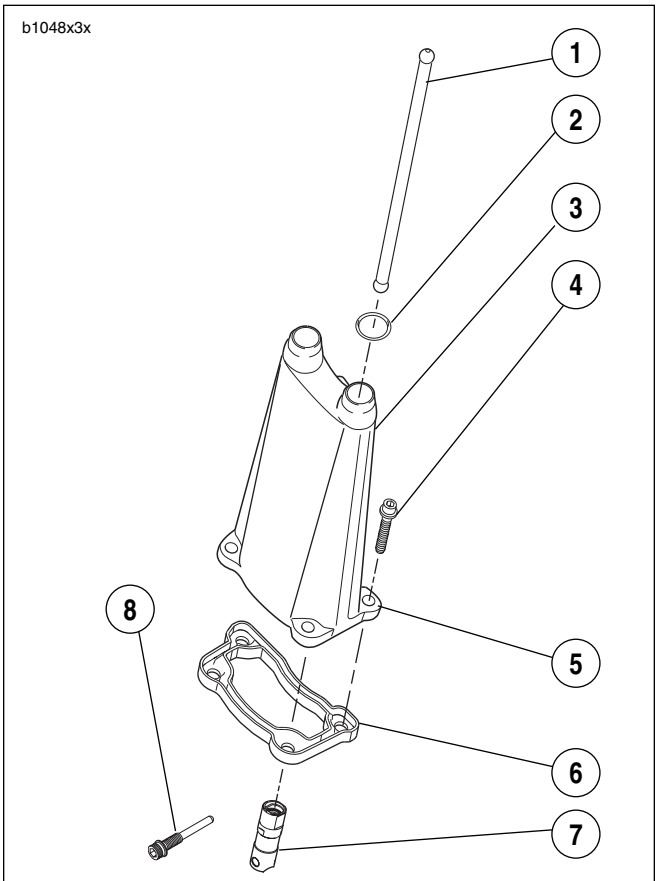
1. See Figure 3-124. Rotate engine so that both lifters from the cylinder will be installed on the base circle of the cam.



1. Base circle (lowest position)
2. Cam lobe (maximum lift)

Figure 3-124. Base Circle

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.



1. Push rod (exhaust)
2. O-ring
3. Push rod cover
4. Screws (4)
5. Push rod cover
6. Push rod cover gasket
7. Hydraulic lifter (tappet)
8. Anti-rotation screw

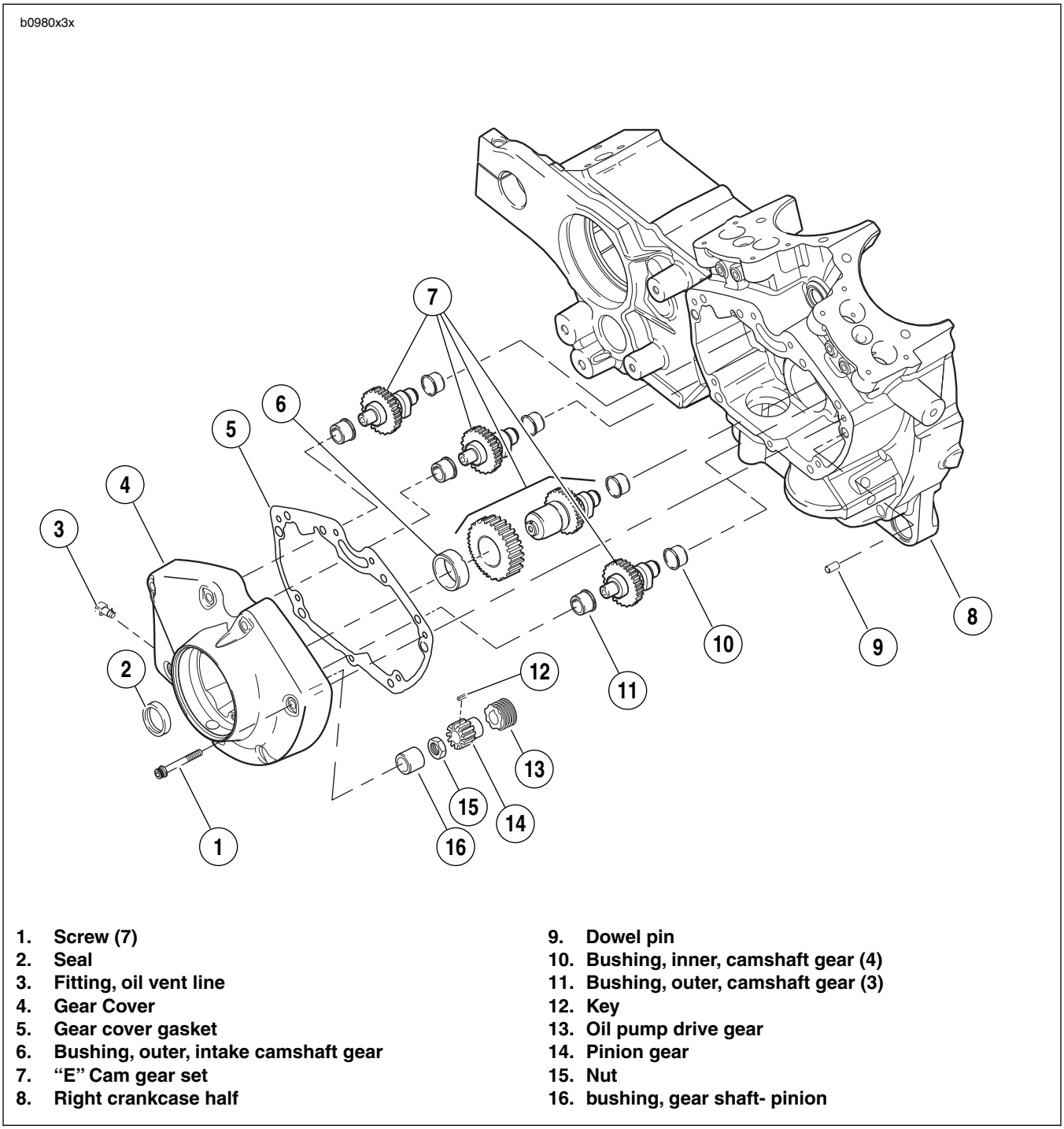
Figure 3-125. Valve Lifter Service

GEARCASE COVER AND CAM GEARS 3.18

GENERAL

Read the complete gearcase section carefully before you begin any service work.

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.



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

Figure 3-126. Gearcase Cover and Cam Assembly

REMOVAL/DISASSEMBLY

⚠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).

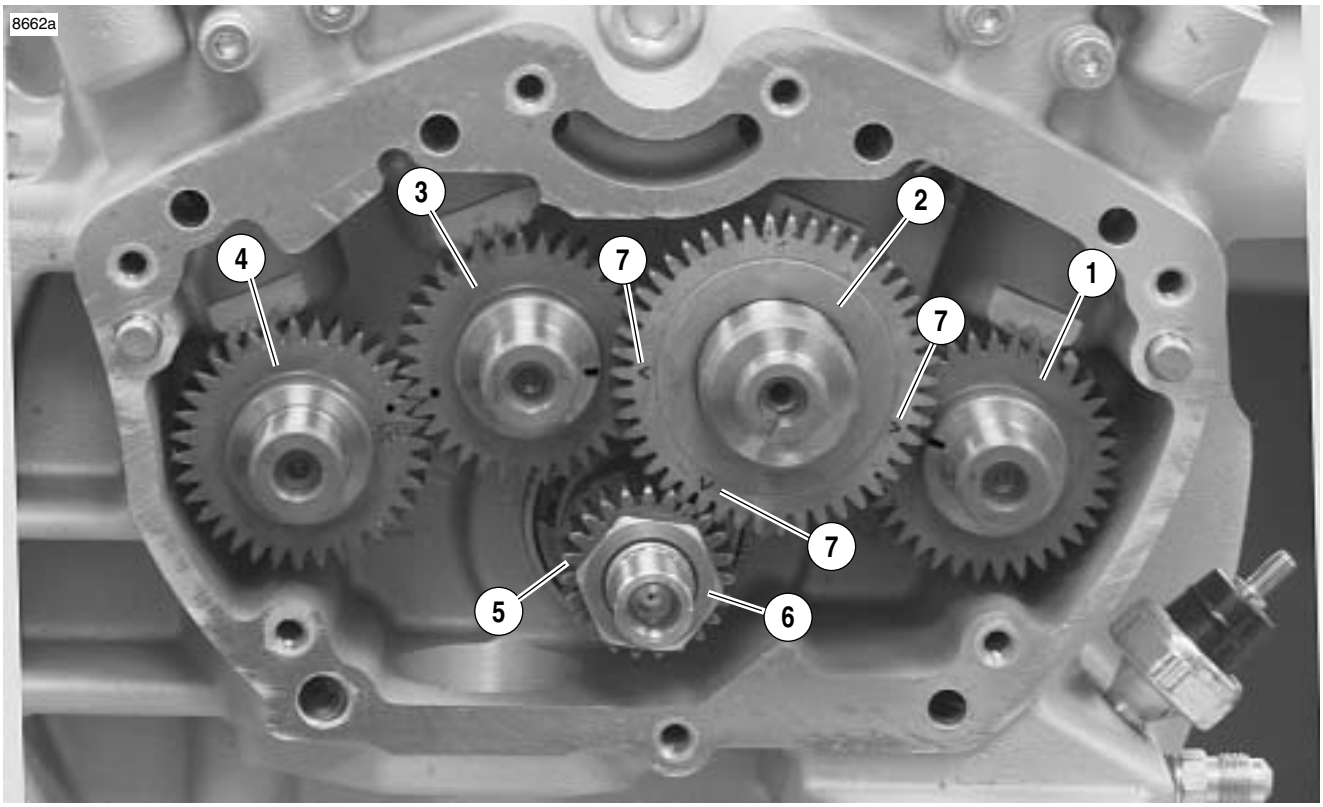
NOTE

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.



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**

Figure 3-127. Cam and Pinion Gear Location and Timing Mark Indexing

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

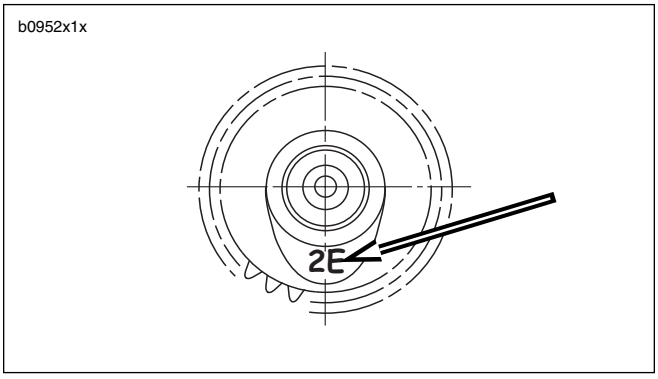


Figure 3-128. Cam Identification Stamp

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 3-25. Cam Identification

Stamp	Location/Function
1E	Front Exhaust
2E	Front Intake
3E	Rear Intake
4E	Rear Exhaust

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

GEAR SHAFT	CORRECT CLEARANCE	SERVICE WEAR LIMIT
Cam	0.0007-0.0022 in. (0.0178-0.0559 mm)	0.003 in. (0.076 mm)
Pinion	0.0023-0.0043 in. (0.0584-0.1092 mm)	0.0050 in. (0.1270 mm)

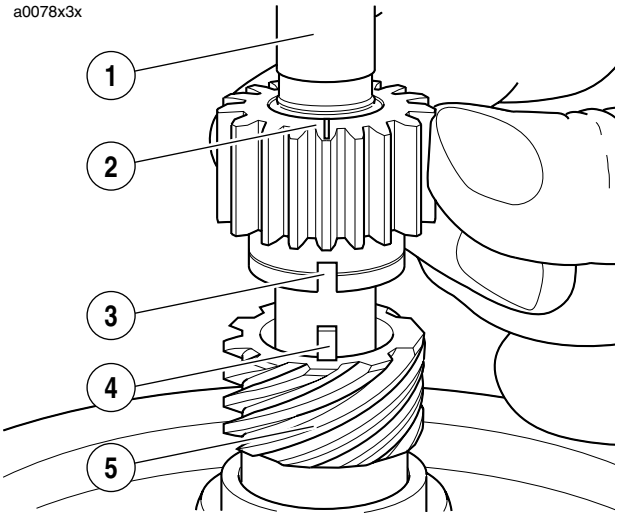
ASSEMBLY/INSTALLATION

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.



1. Pinion shaft
2. Timing Mark on pinion gear
3. Keyway
4. Shaft key
5. Oil pump drive gear

Figure 3-129. Aligning Pinion Gear



Figure 3-130. Crankshaft Locking Tool (Part No. HD-43984)

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.).

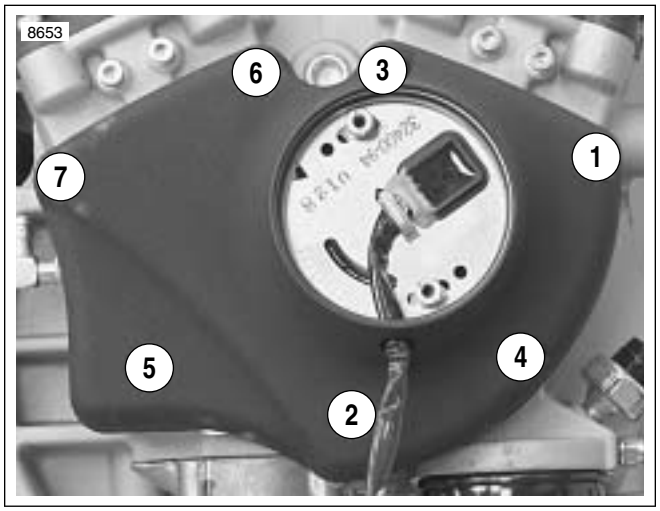


Figure 3-131. Gearcase Cover Mounting Screw Torque Sequence



Figure 3-132. Checking Cam Gear End Play

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.

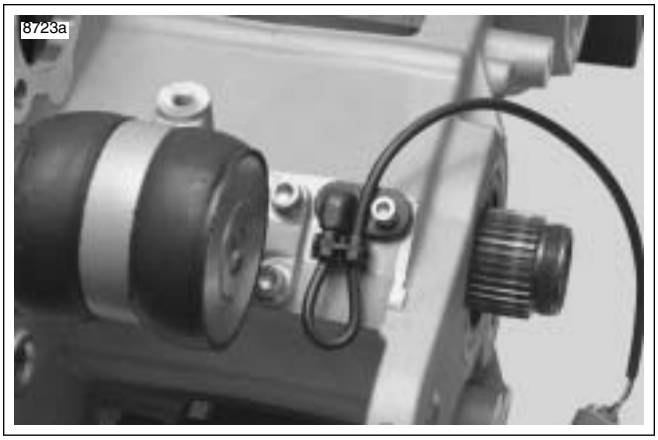


Figure 3-133. Rear Isolator Assembly

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.

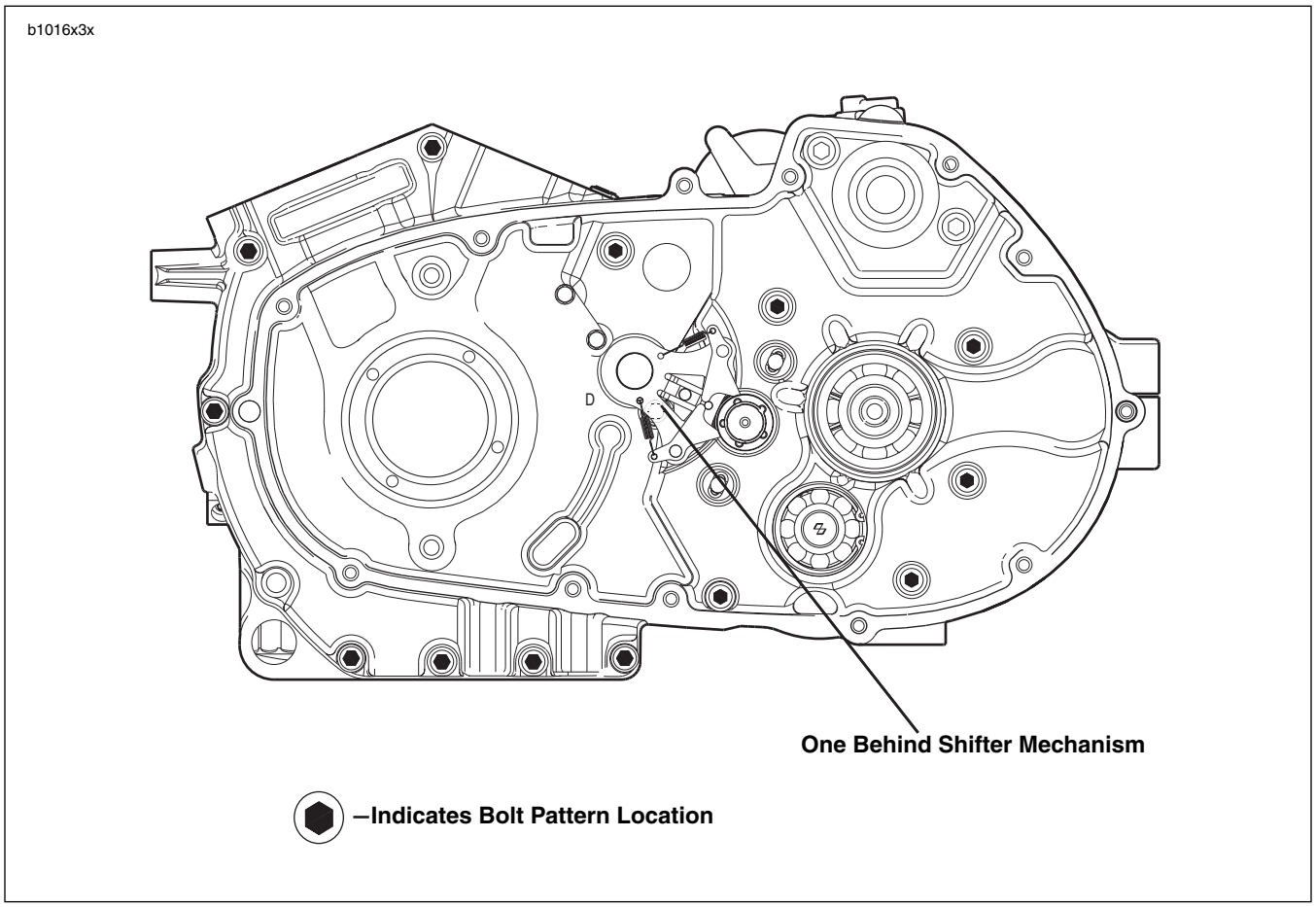


Figure 3-134. Crankcase Fasteners

PISTON JETS

Removal

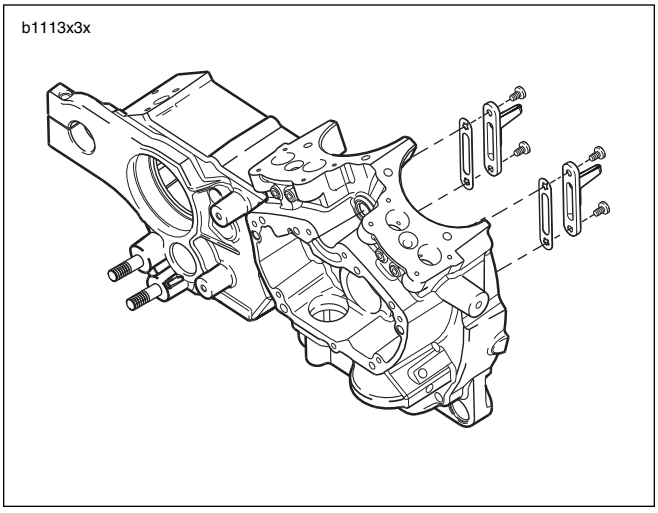


Figure 3-135. Piston Oil Jet Assemblies

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.

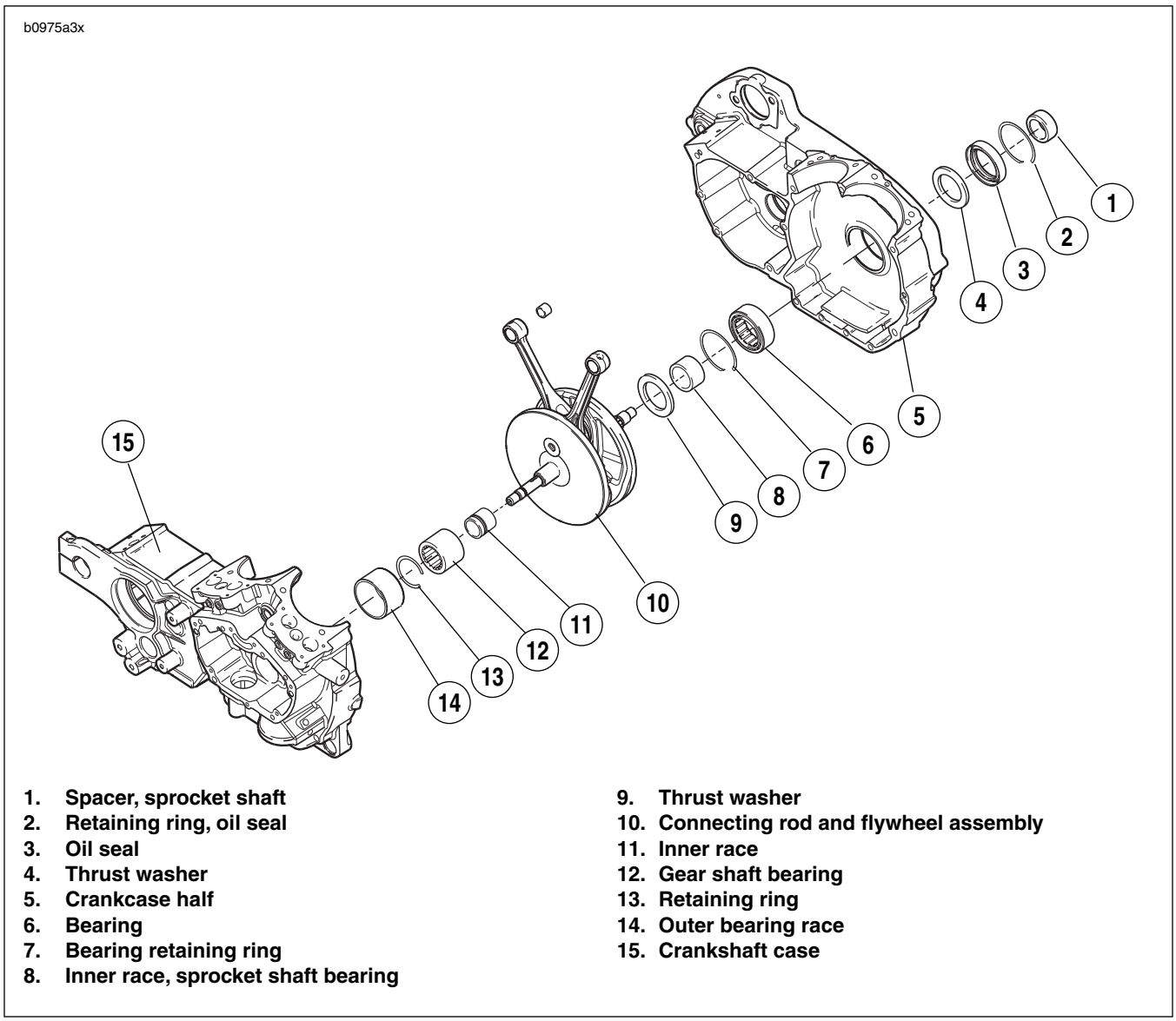
NOTE

- *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



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**

Figure 3-137. Crankcase and Flywheel Assembly

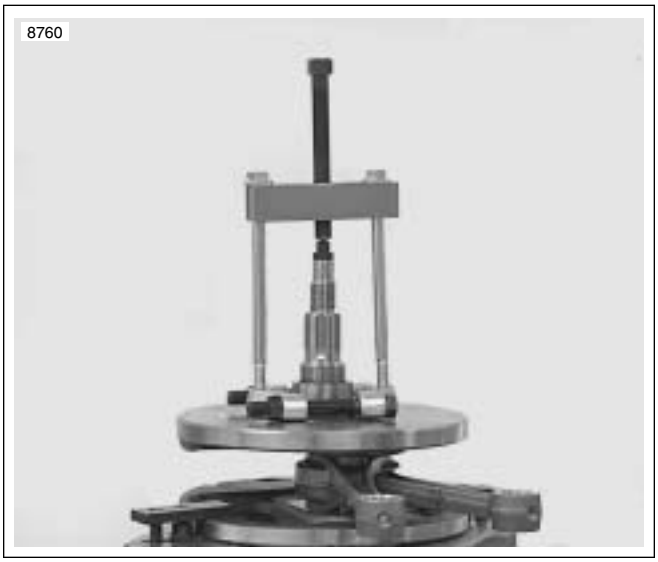


Figure 3-138. Removing Sprocket Shaft Inner Bearing Race

3. See Figure 3-138. Place flywheel assembly in FLYWHEEL SUPPORT FIXTURE (Part No. HD-44385). 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.

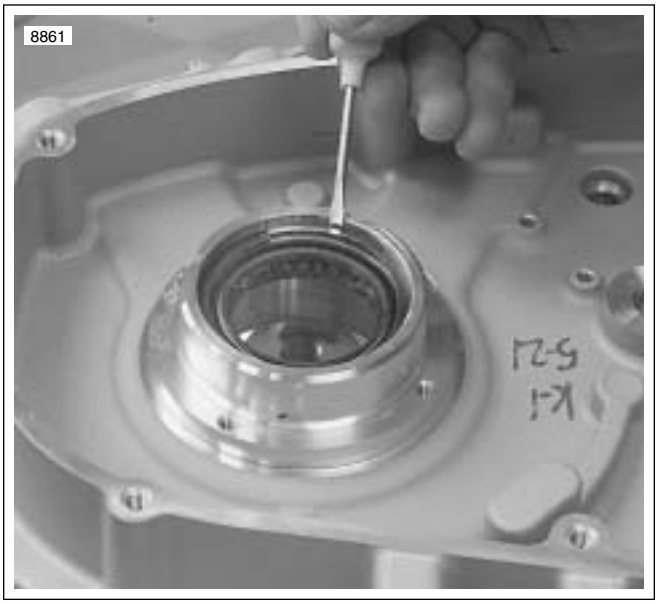


Figure 3-139. Sprocket Shaft Seal Retaining Ring

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).



Figure 3-140. Removing Sprocket Shaft Bearing Retaining Ring

7. See Figure 3-140. Remove sprocket shaft bearing retaining ring from the inside of the left crankcase half.

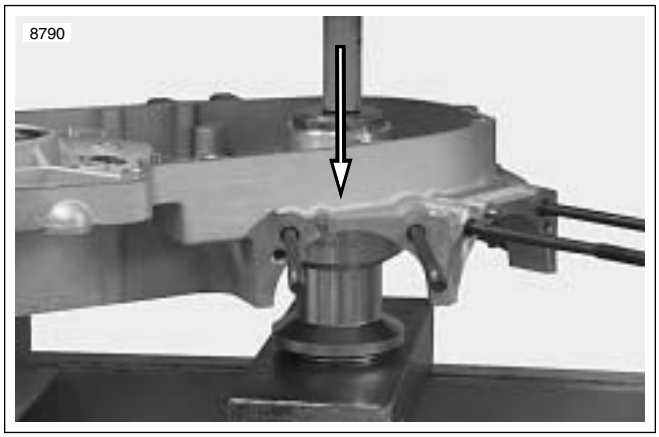


Figure 3-141. Direction of Bearing Removal From Left Crankcase

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

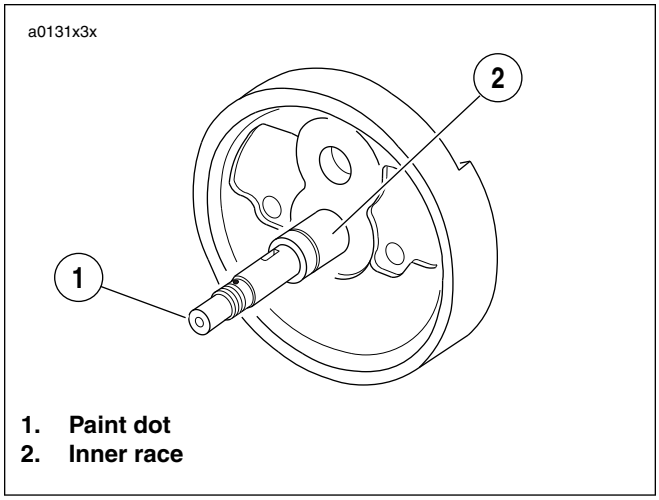
If either inner or outer race show wear, measure both races to confirm correct bearing fit.

Table 3-27. Pinion Shaft Bearing Service Wear Limits

	in.	mm
Inner race OD	1.2492	31.7297
Outer race ID	1.5672	39.8069

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 bushing). 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.

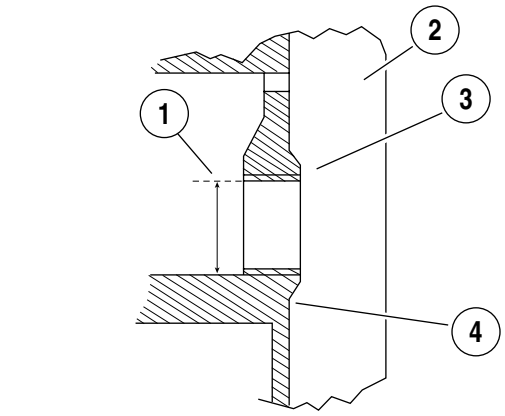


1. **Paint dot**
2. **Inner race**

Figure 3-142. Pinion Shaft Inner Race

Table 3-28. Pinion Shaft Inner Race Paint Dot Specifications

PAINT DOT COLOR	CLASS	INNER RACE OD
White	A	1.2498-1.2500 in. (31.7449-31.7500 mm)
Green	B	1.2496-1.2498 in. (31.7398-31.7449 mm)



1. **Inside diameter (ID)**
2. **Outer race**
3. **Right crankcase half**
4. **Stamped class no.**

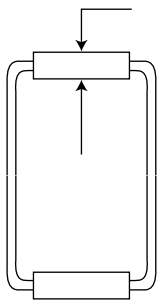
Figure 3-143. Pinion Shaft Outer Race

Table 3-29. Pinion Shaft Outer Race Stamp Specifications

OUTER RACE ID	CLASS NO.	STAMPED NO.
1.5646-1.5648 in. (39.7408-39.7459 mm)	1	1
1.5648-1.5650 in. (39.7459-39.7510 mm)	2	2
1.5650-1.5652 in. (39.7510-39.7561 mm)	3	3

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.



Roller OD cannot be measured to required accuracy with micrometer.

Refer to Table 3-31.

Figure 3-144. Bearing Roller OD

Table 3-30. Pinion Bearing Roller Specifications

ROLLER OD	COLOR*
Largest	Red
	Blue
	White (grey)
Smallest	Green

Selection

See Table 3-31. Select bearings using the identification information given for inner and outer races.

Table 3-31. Pinion Shaft Bearing Selection

FACTORY STAMPED NUMBER	OUTER RACE ID	BEARING SIZE AS IDENTIFIED BY COLOR CODING										
	over 1.5672 in. 39.807 mm	Service Wear Limit Exceeded – Replace Outer Race and Resize										
	1.5670-1.5672 in. 39.802-39.807 mm											Red
	1.5668-1.5670 in. 39.797-39.802 mm										Red	Blue
	1.5666-1.5668 in. 39.792-39.797 mm									Red	Blue	White-Gray
	1.5664-1.5666 in. 39.787-39.792 mm								Red	Blue	White-Gray	Green
	1.5662-1.5664 in. 39.781-39-787 mm							Red	Blue	White-Gray	Green	
	1.5660-1.5662 in. 39.776-39.781 mm						Red	Blue	White-Gray	Green		
	1.5658-1.5660 in. 39.771-39.776 mm					Red	Blue	White-Gray	Green			
	1.5656-1.5658 in. 39.766-39.771 mm				Red	Blue	White-Gray	Green				
	1.5654-1.5656 in. 39.761-39.766 mm			Red	Blue	White-Gray	Green					
	1.5652-1.5654 in. 39.756-39.761 mm		Red	Blue	White-Gray	Green						
3	**1.5650-1.5652 in. 39.751-39.756 mm**	**Red**	**Blue**	White-Gray	Green							
2	**1.5648-1.5650 in. 39.746-39.751 mm**	**Blue**	**White-Gray**	Green								
1	**1.5646-1.5648 in. 39.741-39.746 mm**	**White-Gray**	**Green**									
INNER RACE OD (In)		**1.2496-1.2498 in.**	**1.2498-1.2500 in.**	1.2500 - 1.2502 in.	1.2502 - 1.2504 in.	1.2504-1.2506 in.	1.2506 - 1.2508 in.	1.2508 - 1.2510 in.	1.2510 - 1.2512 in.	1.2512 - 1.2514 in.	1.2514 - 1.2516 in.	1.2516 - 1.2518 in.
		31.740 31.745 mm	31.745 31.750 mm	31.750 - 31.755 mm	31.755 - 31.760 mm	31.760-31.765 mm	31.765 - 31.770 mm	31.770 - 31.755 mm	31.775 - 31.780 mm	31.780 - 31.786 mm	31.786 - 31.791 mm	3.791-31.796 mm
FACTORY COLOR CODE		**Green**	**White**									

Replacement

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.

Table 3-32. Outer Pinion Race Service Wear Limits

Largest ID measured	1.5672 in. (39.8069 mm)
Roundness of ID	within 0.0002 in. (0.0051 mm)
Taper	within 0.0002 in. (0.0051)

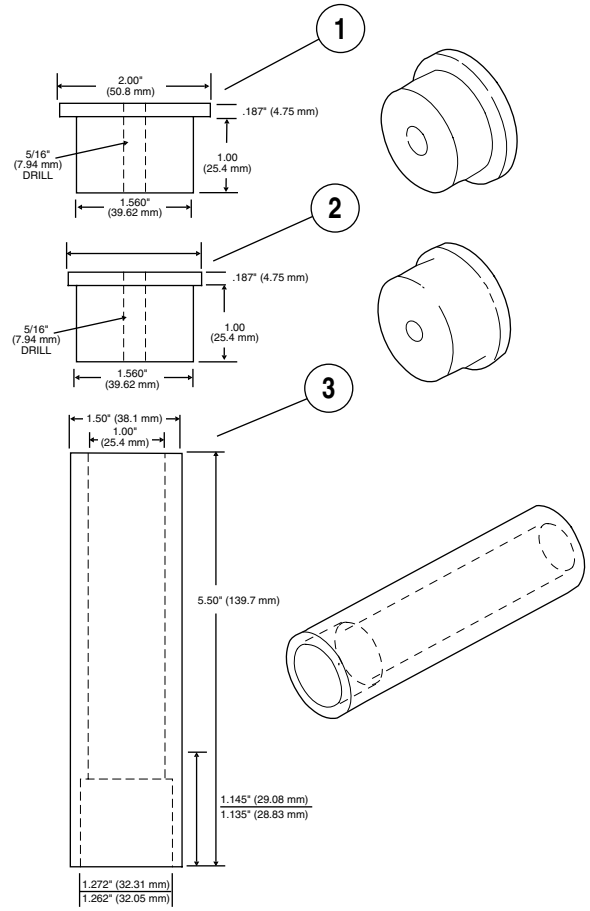
   a. If lapping increased bore ID to larger than 1.5672 in. (39.8069 mm), go to Step 5.
   b. If roundness or taper do not meet specifications, continue lapping until specifications are met.
   c. If all specifications are met, continue at Step 7 to remove and size inner race.

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.



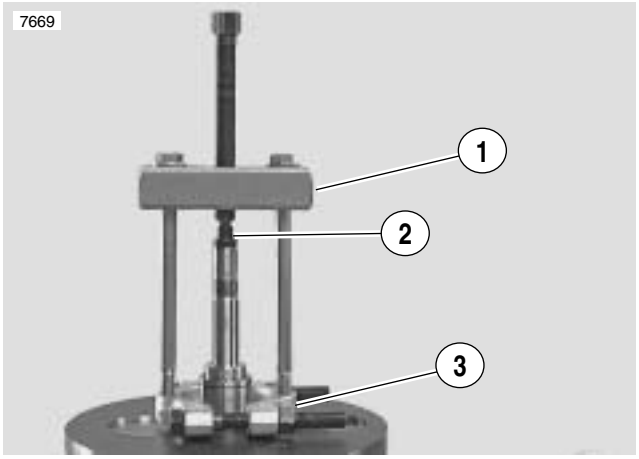
1. **Pinion outer race installer**
2. **Pinion outer race remover**
3. **Pinion inner race installer**

Figure 3-145. Pinion Shaft Bearing Tools

Table 3-33. New Component Specifications

Outer Race ID	1.5646 - 1.5652 in. (39.7408 - 39.7561 mm)
Roundness	within 0.0002 in. (0.0051 mm)
Taper	within 0.0002 in. (0.0051 mm)
Surface finish	16 RMS

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.



1. **Bearing race remover/installer (Part No. HD-34902B)**
2. **End cap (Part No. HD-34902-7**
3. **Wedge attachment for claw puller (Part No. HD-95637-46A)**

Figure 3-146. Removing Pinion Bearing Inner Race

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.

Table 3-34. Pinion Inner Race Specifications

Roundness	within 0.0002 in. (0.0051 mm)
Taper	within 0.0002 in. (0.0051 mm)
Surface finish	16 RMS

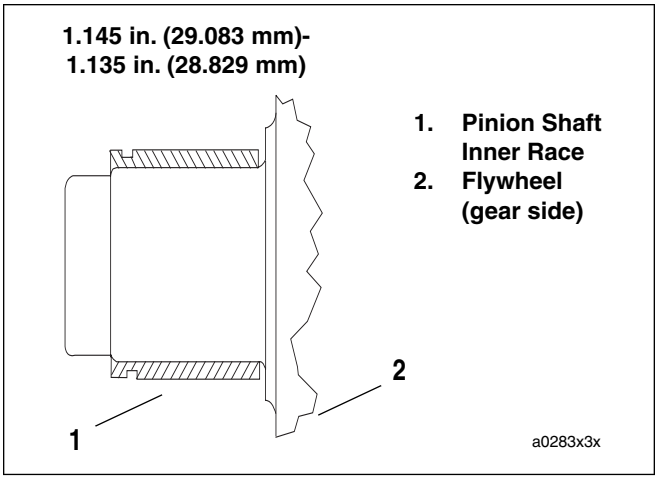


Figure 3-147. Inner Race Location

NOTES

- *Have machinist grind inner race to center or middle of required OD range in Table 3-31. This will prevent grinding outer race undersize and gives a more easily achieved tolerance range.*
- *If you are unable to perform this operation, Harley-Davidson Motor Company provides a flywheel refurbishing program as outlined in Tech Tip #38.*
- *Always use the smallest outer race ID measurement and the largest OD inner race measurement when selecting bearings.*

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.

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.

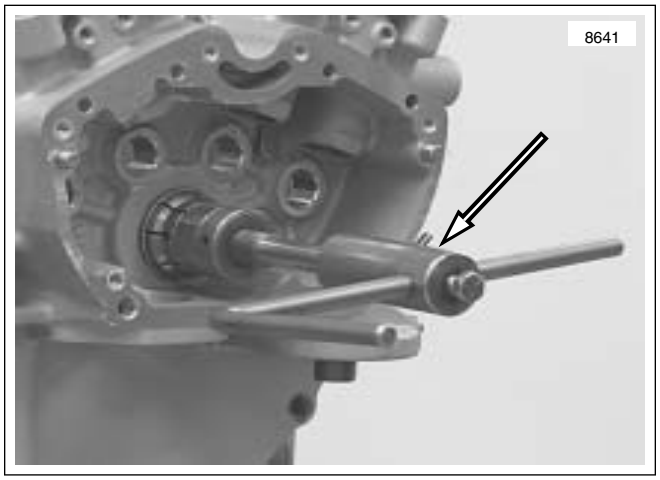


Figure 3-148. Lapping Pinion Shaft Bearing Outer Race with Crankcase Main Bearing Lapping Tool (Part No. HD-96710-40B)

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).

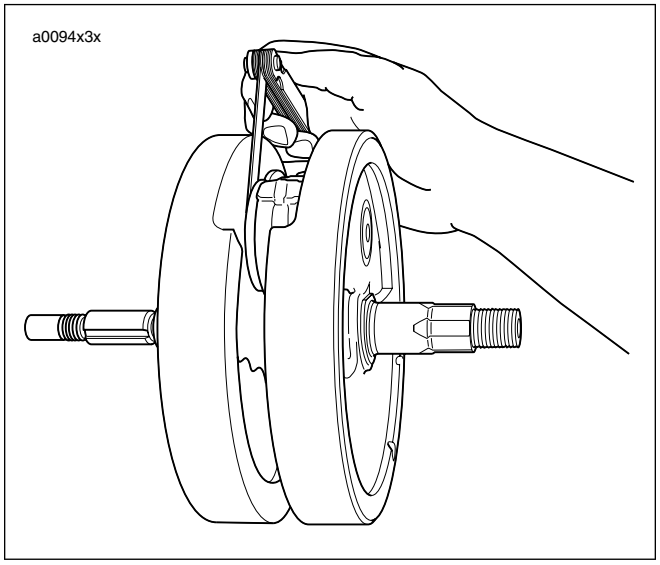


Figure 3-149. Checking Connecting Rod Side Play

ASSEMBLY

Crankcase Halves

NOTE

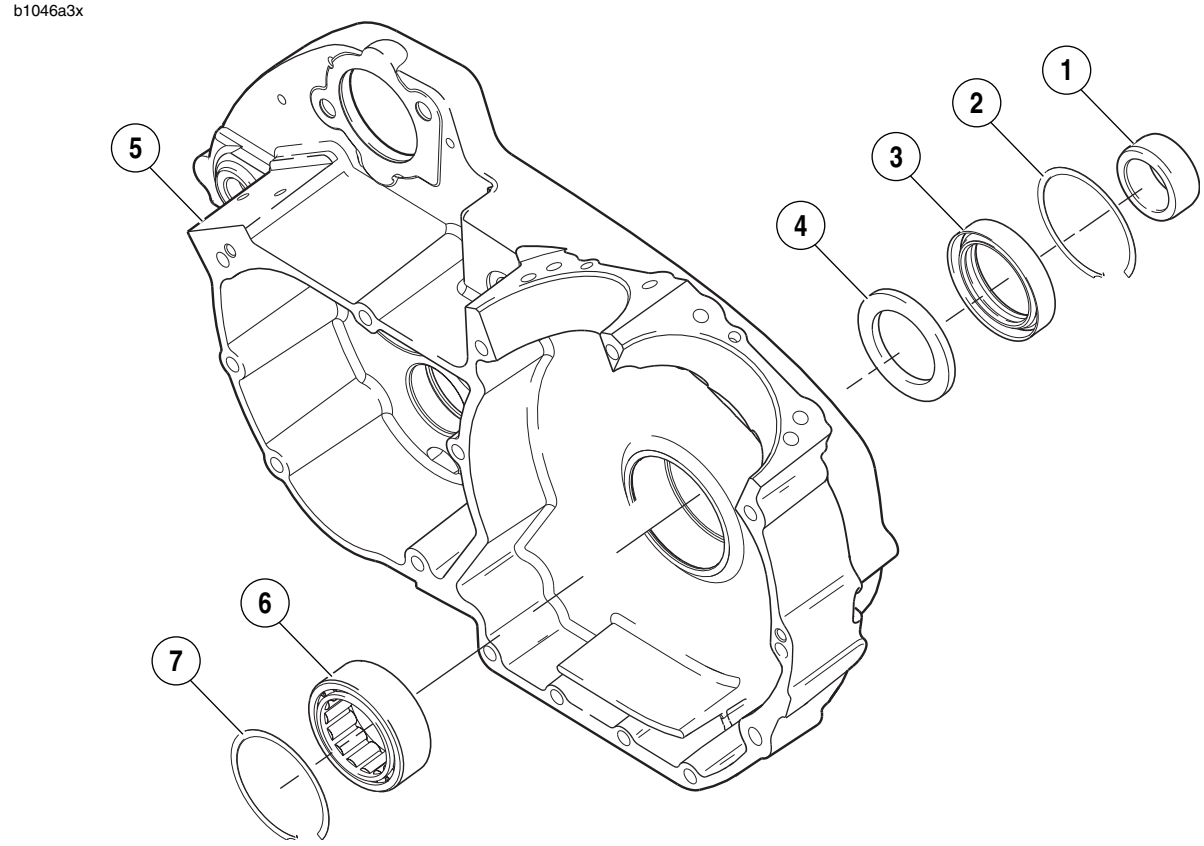
Lubricate all parts with Harley-Davidson 20W50 engine oil, and proceed as follows:

1. See Figure 3-151. Using CRANKCASE BEARING REMOVER/INSTALLER (Part No. B-45655, HD-42720-2 and HD-46663), install sprocket shaft bearing into left crankcase half from the inside.

NOTE

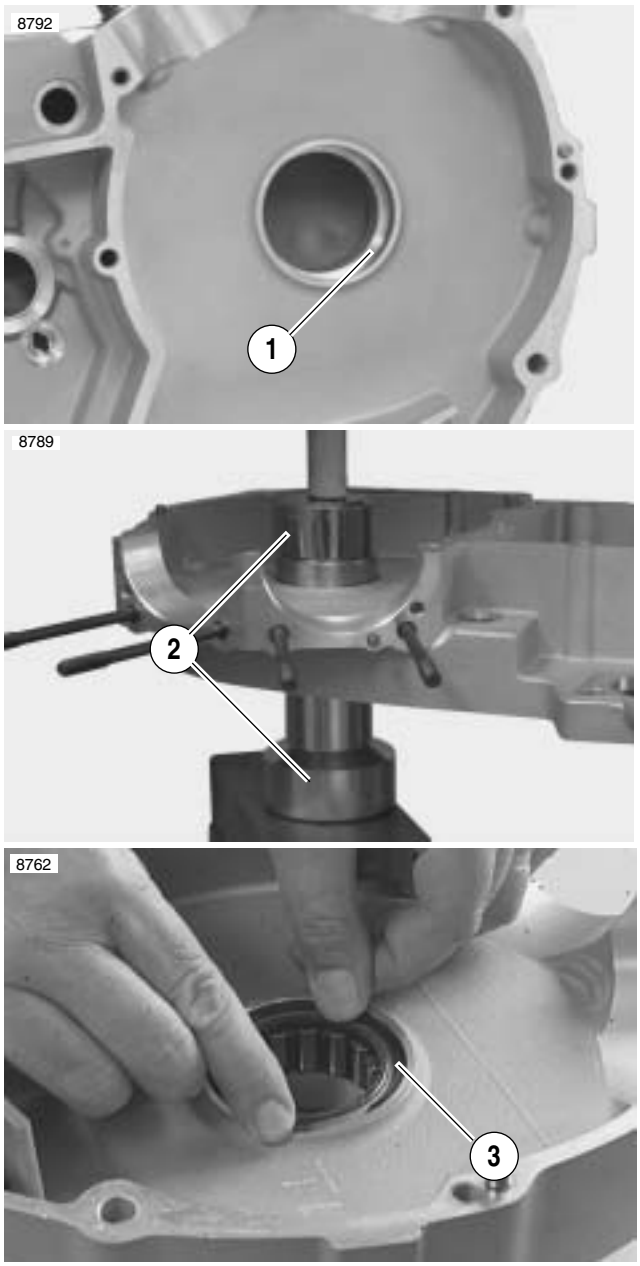
Make sure that the bearing assembly bottoms against the machined shoulder in the left crankcase half.

2. Install **new** bearing retaining ring in left crankcase half.
3. Install transmission. See 6.14 TRANSMISSION INSTALLATION.



1. **Spacer, sprocket shaft**
2. **Retaining ring, oil seal**
3. **Oil seal**
4. **Thrust washer**
5. **Crankcase half**
6. **Bearing**
7. **Bearing retaining ring**

Figure 3-150. Sprocket Shaft Bearing Assembly



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**

Figure 3-151. Sprocket Shaft Bearing Installation

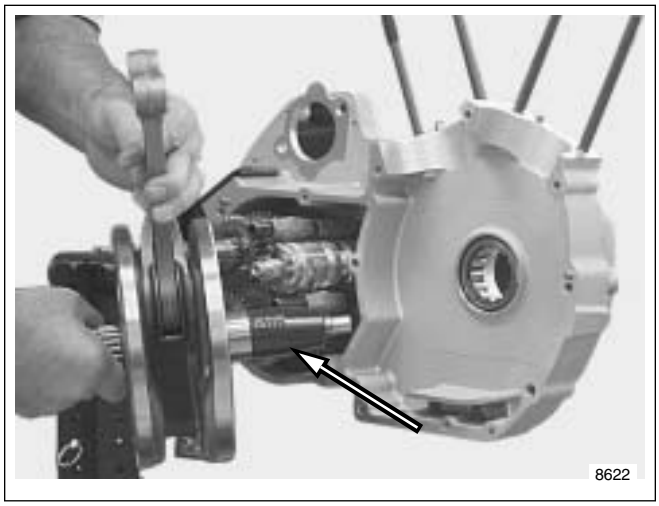


Figure 3-152. Installing Flywheel Assembly with CRANKSHAFT GUIDE (Part No. HD-42326)

4. See Figure 3-152. Attach left crankcase half to engine stand.
5. Install flywheel assembly using CRANKSHAFT GUIDE (Part No. HD-42326).

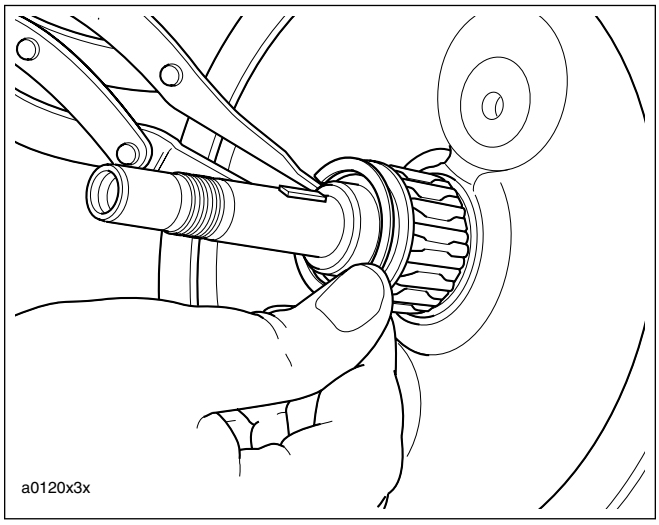


Figure 3-153. Pinion Shaft Bearing

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.

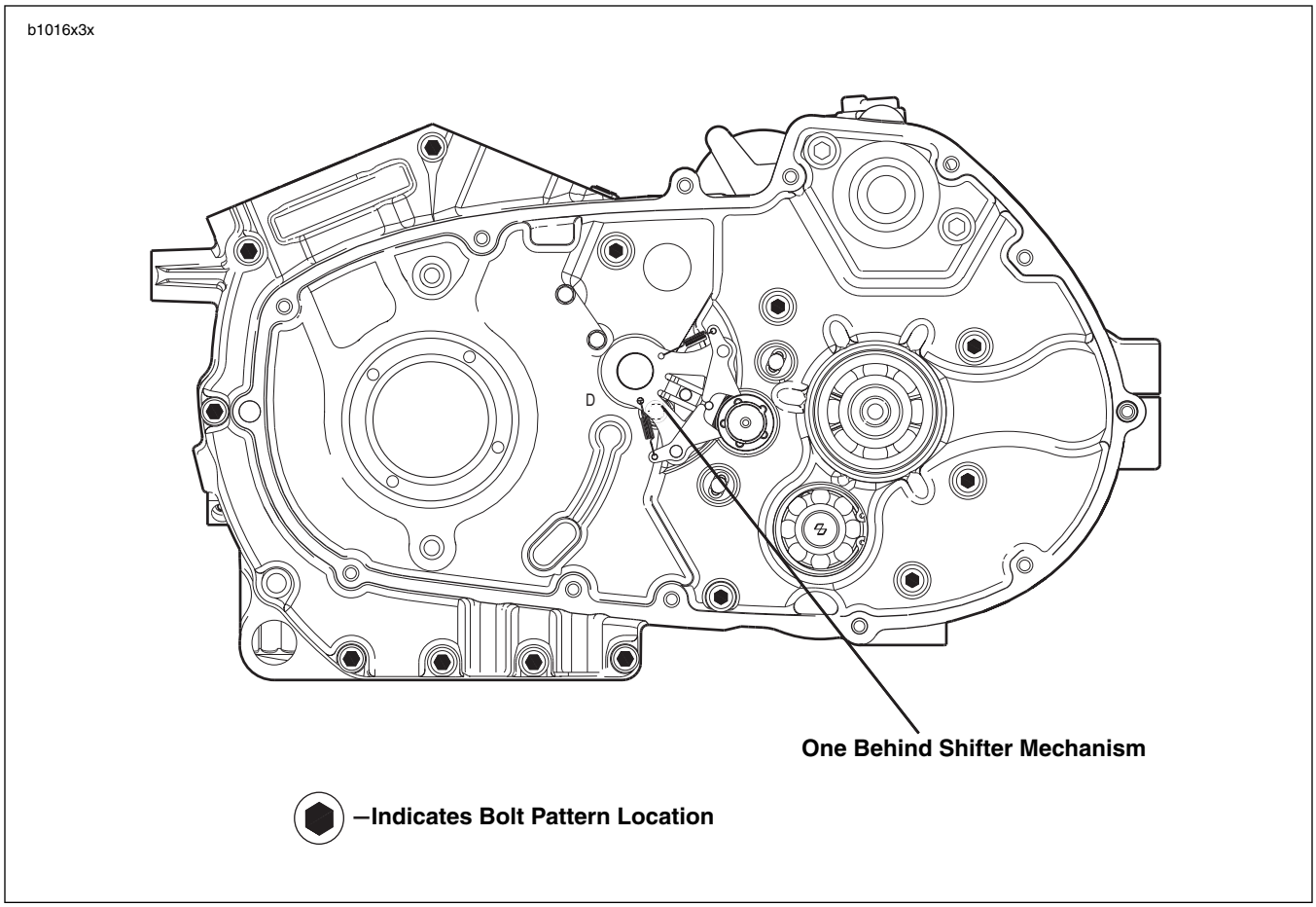


Figure 3-154. Crankcase Fasteners

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.

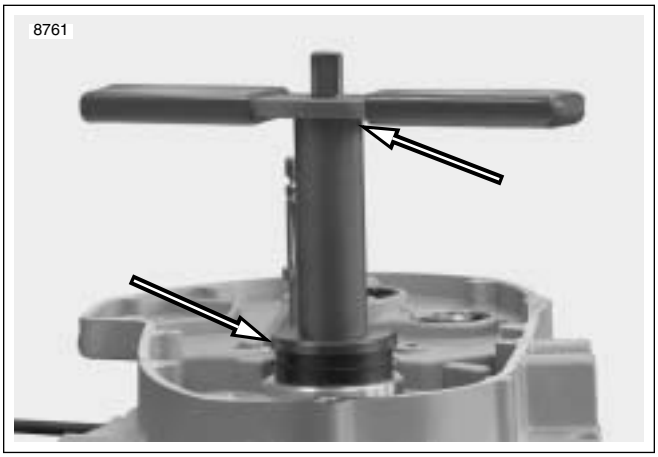
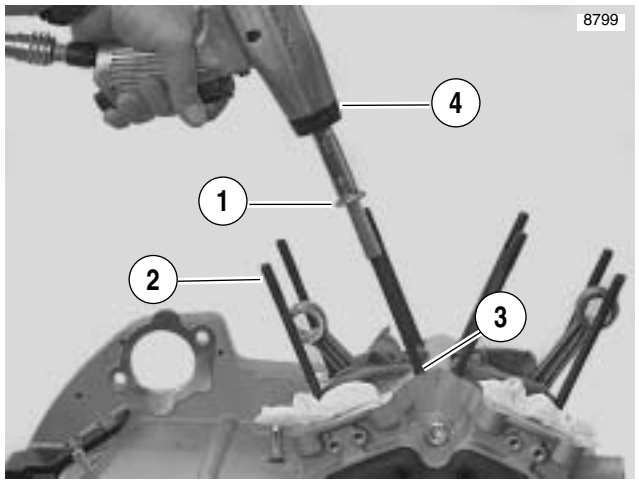


Figure 3-155. Sprocket Shaft Seal/Spacer Installer (Part No. HD-42579 and B-45676)

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.



1. **Head Screw with ball inside**
2. **Cylinder stud**
3. **Shoulder on cylinder stud**
4. **Air gun**

Figure 3-156. Cylinder Studs

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.

NOTES

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SPECIFICATIONS 4.1

Table 4-1. Fuel Tank Specifications

FUEL TANK CAPACITY	GALLONS	LITERS
Total (including reserve) (XB12Ss)	4.40	16.7
Reserve/Low fuel indicator at (XB12Ss)	0.83	3.1
Total (including reserve) (XB9SX, XB12S, XB12Scg)	3.82	14.5
Reserve/Low fuel indicator at (XB9SX, XB12S, XB12Scg)	0.75	2.8

Table 4-2. Fuel System Specifications

FUEL SYSTEM	TYPE
Intake (XB9)	45 mm downdraft manifold, ram air
Intake (XB12)	49 mm downdraft manifold, ram air
Fuel delivery	DDFI fuel injection
Fuel pressure	49-51PSI (338-352 kPa)
Recommended fuel	91 Octane

Table 4-3. Idle Speed Specifications

ADJUSTMENT	RPM
Normal idle speed	1050 -1150 RPM

Torque Values

ITEM	TORQUE		NOTES
Air cleaner back plate fasteners	84-120 **in-lbs**	9.5-13.6 Nm	page 4-126
Air cleaner cover (Translucid XB9S)	8-12 **in-lbs**	0.9-1.3 Nm	page 4-124
Bank angle sensor mounting fastener	12-36 **in-lbs**	1.4-4.1 Nm	page 4-103
Battery terminal hardware	72-96 **in-lbs**	8-11 Nm	page 4-115
Cooling fan fasteners	12-36 **in-lbs**	1.4-4.1 Nm	page 4-106
Engine temperature sensor	120-168 **in-lbs**	13.6-19 Nm	page 4-102
Fuel cap retaining ring fasteners	62-71 **in-lbs**	7-8 Nm	page 4-116
Fuel pump drain plug	84-108 **in-lbs**	9.5-12.2 Nm	page 4-107
Fuel pump harness fastener	18-22 **in-lbs**	2.0-2.5 Nm	page 4-113
Fuel pump screws	48-51 **in-lbs**	5.4-5.8 Nm	page 4-114
Fuel pump wire harness fastener	18-22 **in-lbs**	2.0-2.5 Nm	page 4-113
Fuel rail fasteners	20-25 **in-lbs**	2.3-2.8 Nm	LOCTITE 222 (purple), page 4-120
Fuel supply line banjo fitting-late model	84-108 **in-lbs**	9.5-12.2 Nm	page 4-114
Fuel tank vent valve fasteners	39-41 **in-lbs**	4.4-4.6 Nm	page 4-115
Ignition coil mounting screws	120-144 **in-lbs**	13.6-16.3 Nm	page 4-100
Ignition rotor mounting bolt	43-53 **in-lbs**	5-6 Nm	LOCTITE 243 (blue), page 4-98
Inner timer cover screws	12-20 **in-lbs**	1.3-2.3 Nm	page 4-98
Intake flange screws	96-120 **in-lbs**	10.8-13.6 Nm	page 4-121
Oxygen sensor	40-45 ft-lbs	54-61 Nm	LOCTITE ANTI-SEIZE, page 4-101
Throttle position sensor	16-20 **in-lbs**	1.8-2.3 Nm	LOCTITE 222 (purple), page 4-105
Timer plate studs	15-30 **in-lbs**	2-3 Nm	page 4-98
Upper tie bar	25-27 ft-lbs	33.9-36.6 Nm	page 4-102

NOTES

DYNAMIC DIGITAL FUEL INJECTION (DDFI) 4.2

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).

GENERAL

The Buell DDFI operates both as an open and closed loop system which allows it to adjust for all possible operating conditions. During open loop operation, the system utilizes programmed fuel and spark maps in the ECM which provide ease of cold starting and maximum power at wide open throttle (WOT). The adaptive fuel value which is “learned” during closed loop operation is applied during open loop operation to adjust fuel and spark maps for optimum performance.

During closed loop operation, the system relies on input from the O2 sensor to provide for the most efficient, stoichiometric air fuel mixture (14.7:1) which results in reduced emissions, good fuel economy and power. In order for the system to enter closed loop operation, the following conditions must be met:

- O2 Sensor at operating temperature (Engine at normal operating temperature).
- Operation below 4000 RPM or lower with engine under, steady or light load conditions.

By using both open and closed loop systems, engine performance is continuously tuned to compensate for changing conditions and provide maximum performance.

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).

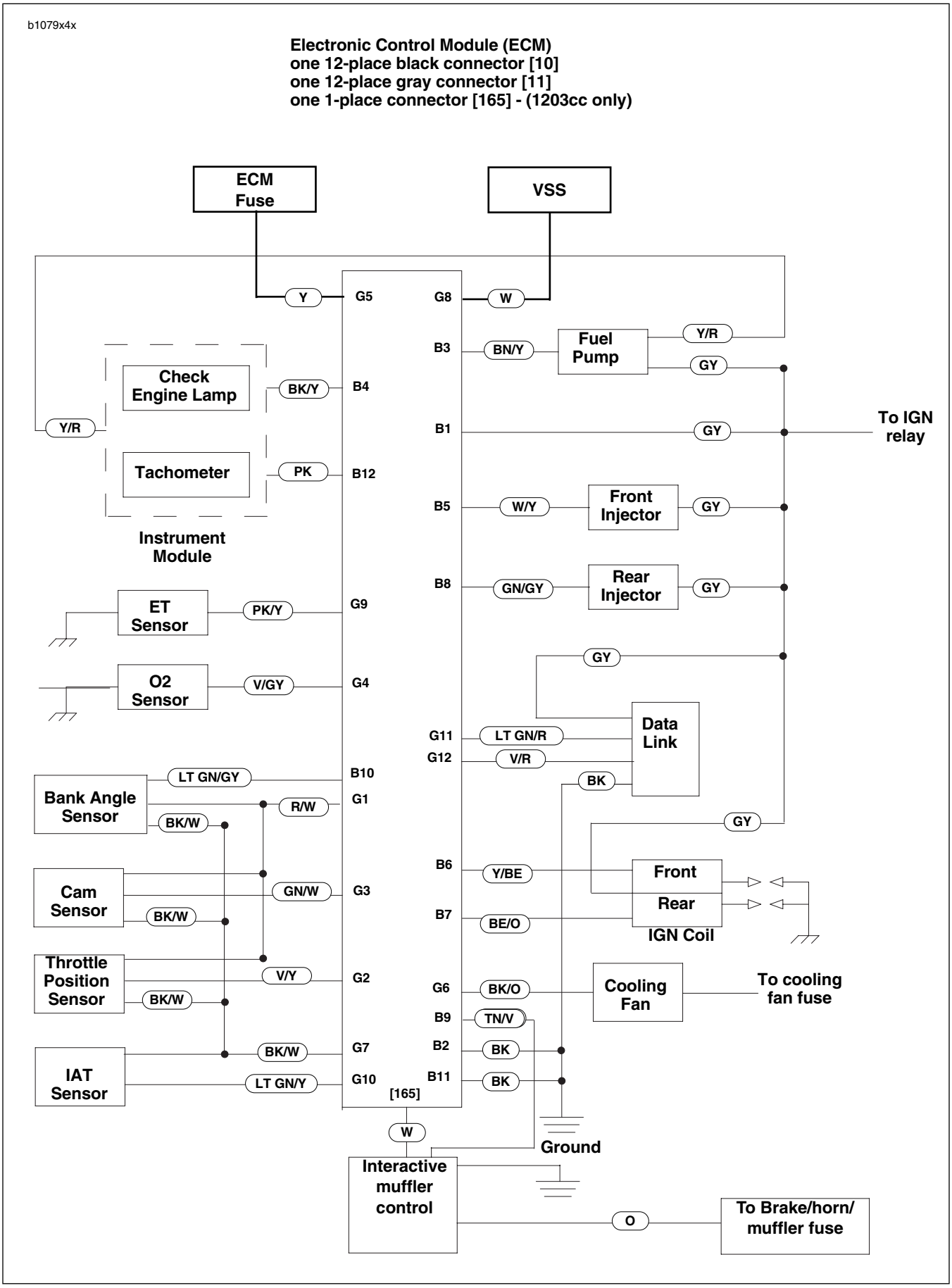


Figure 4-1. Buell Dynamic Digital Fuel Injection

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.



1. **Low fuel lamp**
2. **Check engine lamp**

Figure 4-2. Check Engine Lamp (XB12 Shown)

RESOLVING PROBLEMS

NOTE

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.

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.

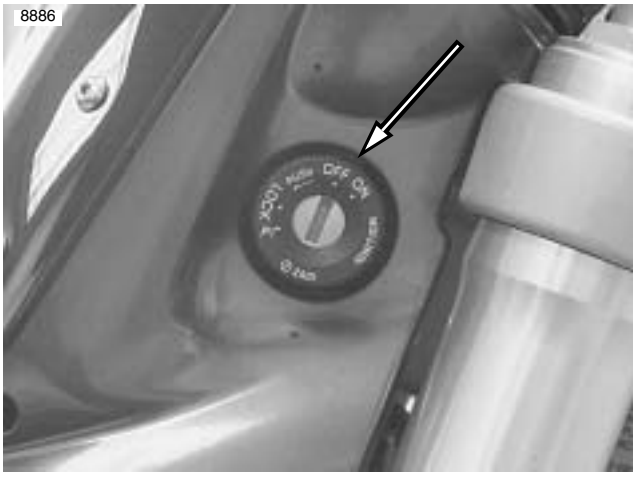
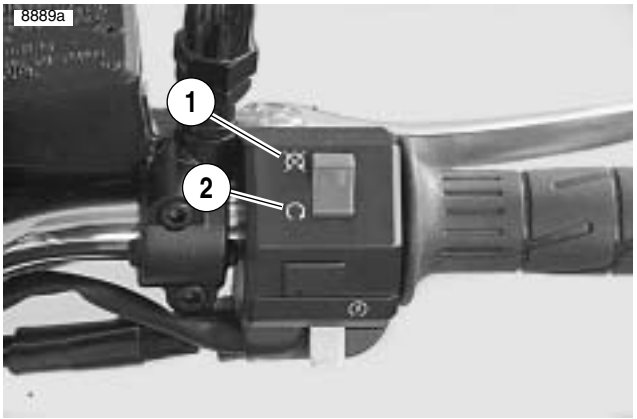


Figure 4-3. Ignition Key Switch



1. **OFF position**
2. **RUN position**

Figure 4-4. Engine Stop Switch

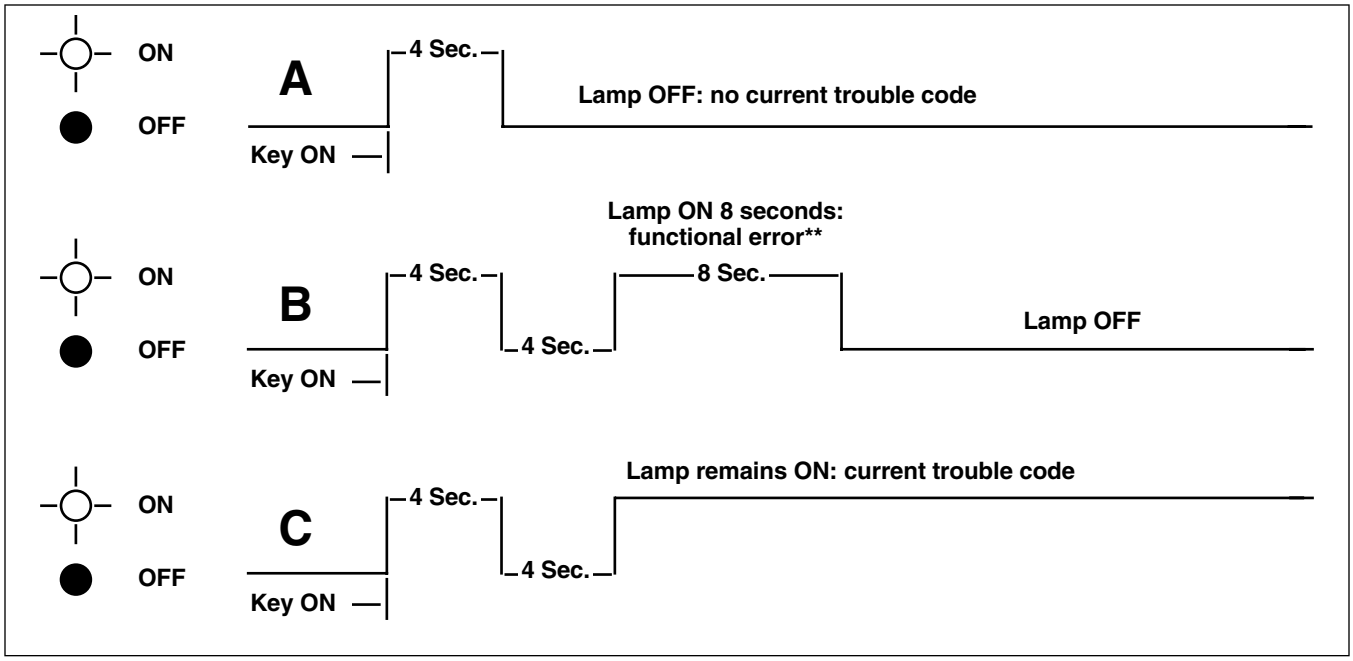


Figure 4-5. Check Engine Lamp Operation

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 elasped. 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.

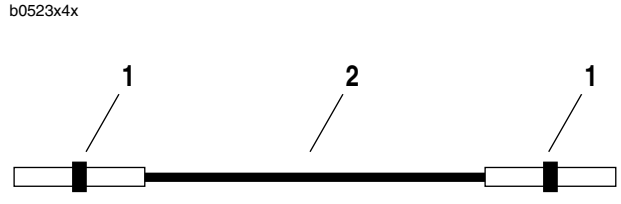
CHECK ENGINE LAMP BLINKS

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.

RETRIEVING TROUBLE CODES

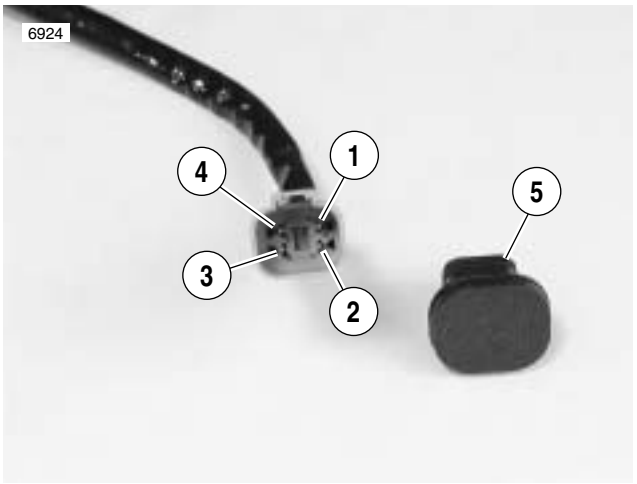
Trouble codes may be retrieved without the use of the DIGITAL TECHNICIAN (Part No. HD-44750).

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.



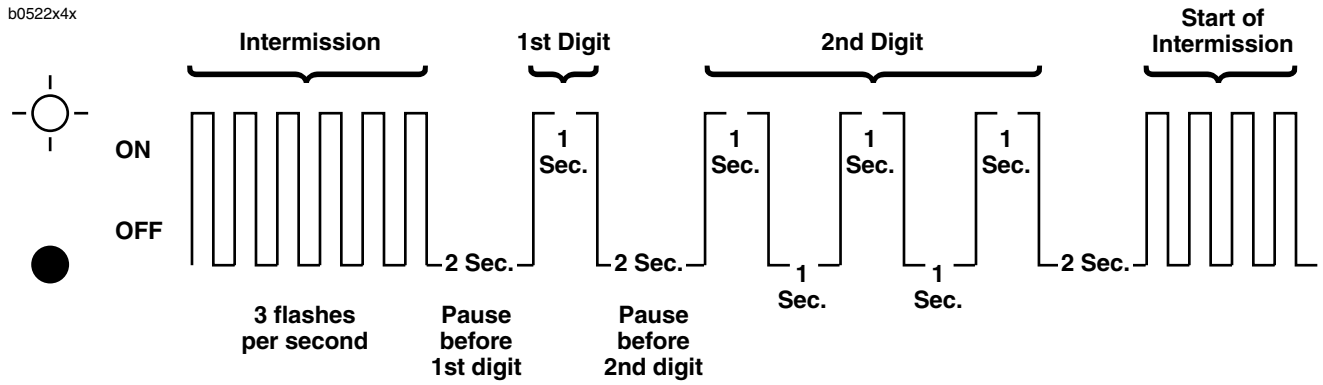
1. **Part Number 72191-94 (2)**
2. **2.0 in. (51 mm) 18 Gauge Wire**

Figure 4-6. Diagnostic Test Wire



1. **Terminal 1: Receive Data Line (Lt GN/R)**
2. **Terminal 2: Ground (BK)**
3. **Terminal 3: Transmit Data Line (V/R)**
4. **Terminal 4: Power (GY)**
5. **Protective Cap**

Figure 4-7. Installing Diagnostic Test Wire



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

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

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.

BREAKOUT BOX 4.6

GENERAL

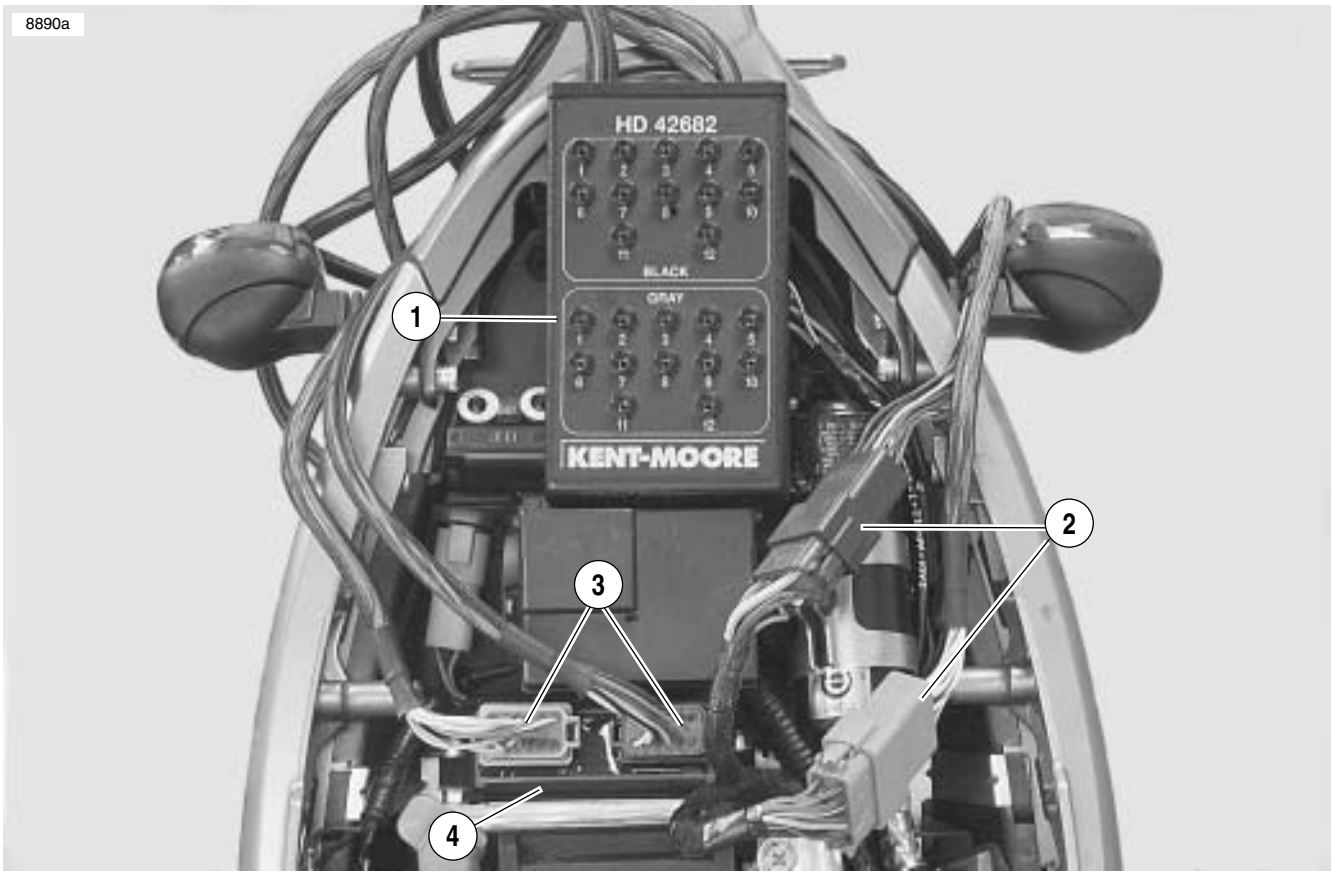
The BREAKOUT BOX (Part No. HD-42682) splices into the main harness. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

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.
4. Attach Breakout Box to gray connector [11].
   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.



1. **Breakout box**
2. **Breakout box grey and black connections at main harness**
3. **Breakout box grey and black connections at ECM**
4. **ECM**

Figure 4-9. ECM and Breakout Box with Connections (Typical)

WIGGLE TEST 4.7

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.

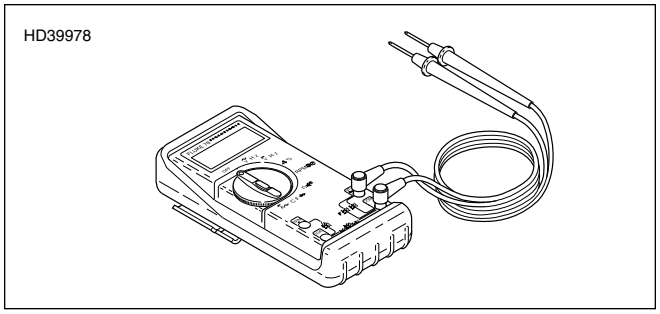


Figure 4-10. Fluke 78 Multimeter (DVOM) (Part No. HD-39978)

INITIAL DIAGNOSTIC CHECK 4.8

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.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Dealership technicians filing 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

CAUSE	SOLUTION
Engine temperature circuit	4.18 TROUBLE CODE 14.
Improper fuel pressure	4.13 FUEL PRESSURE TEST.
Spark plugs and/or wires	4.15 MISFIRE.
Battery discharged	See charging system troubleshooting in Section 7.
Cam position sensor	4.29 TROUBLE CODE 56.
Manifold leak	Spray water around induction module seals with engine idling. If RPM changes, change seals.
Ignition coil	4.15 MISFIRE.
Leaky injectors	Test fuel injectors. See 4.42 THROTTLE BODY.
Valve sticking	See Section 3.

Table 4-5. Engine Performance Problems

CAUSE	SOLUTION
Engine temperature circuit	4.18 TROUBLE CODE 14.
Improper ignition timing	1.17 IGNITION TIMING.
Cam position sensor circuit	4.29 TROUBLE CODE 56.
Spark plugs and/or wires	4.15 MISFIRE.
Improper fuel pressure	4.13 FUEL PRESSURE TEST.
Improper throttle position sensor adjustment	Calibrate sensor using DIGITAL TECHNICIAN (Part No. HD-44750).
Manifold leak	See 4.43 INTAKE LEAK TEST.
Throttle plates not opening fully	1.15 THROTTLE CABLE AND IDLE SPEED ADJUSTMENT.
EVAP hose disconnected from induction module (CA)	Connect.

Table 4-5. Engine Performance Problems

CAUSE	SOLUTION
Water or dirt in fuel system	Drain and refill with fresh fuel.
Cooling Fan Inoperative	4.26 TROUBLE CODE 36.
Interactive muffler control Inoperative	4.21 TROUBLE CODE 21

Table 4-6. Engine Exhaust Emits Black Smoke or Fouls Plugs

CAUSE	SOLUTION
Engine temperature circuit	4.18 TROUBLE CODE 14.
Clogged air filter	1.14 AIR CLEANER FILTER.
Improper throttle position sensor adjustment	Calibrate sensor. See 4.37 THROTTLE POSITION SENSOR.
Leaky injectors	Test fuel injectors. See 4.42 THROTTLE BODY.
Improper fuel pressure	4.13 FUEL PRESSURE TEST.

Table 4-7. Trouble Codes and Fault Conditions

CODE NO.	FAULT CONDITION	RELEVANT TOPIC
11	Throttle position sensor	4.16 TROUBLE CODE 11
13	Oxygen sensor	4.17 TROUBLE CODE 13
14	Engine temperature sensor	4.18 TROUBLE CODE 14
15	Intake air temperature sensor	4.19 TROUBLE CODE 15
16	Battery voltage	4.20 TROUBLE CODE 16
21	Interactive muffler control (1203's only)	4.21 TROUBLE CODE 21
23	Front fuel injector	4.22 TROUBLE CODES 23 AND 32
24	Front ignition coil	4.23 TROUBLE CODES 24 AND 25
25	Rear ignition coil	4.23 TROUBLE CODES 24 AND 25
32	Rear fuel injector	4.22 TROUBLE CODES 23 AND 32
33	Fuel pump	4.24 TROUBLE CODE 33
35	Tachometer	4.25 TROUBLE CODE 35
36	Cooling fan	4.26 TROUBLE CODE 36
44	Bank angle sensor	4.27 TROUBLE CODE 44
52, 53, 54, 55	ECM failure	4.28 TROUBLE CODES 52, 53, 54 AND 55
56	Cam sync failure	4.29 TROUBLE CODE 56

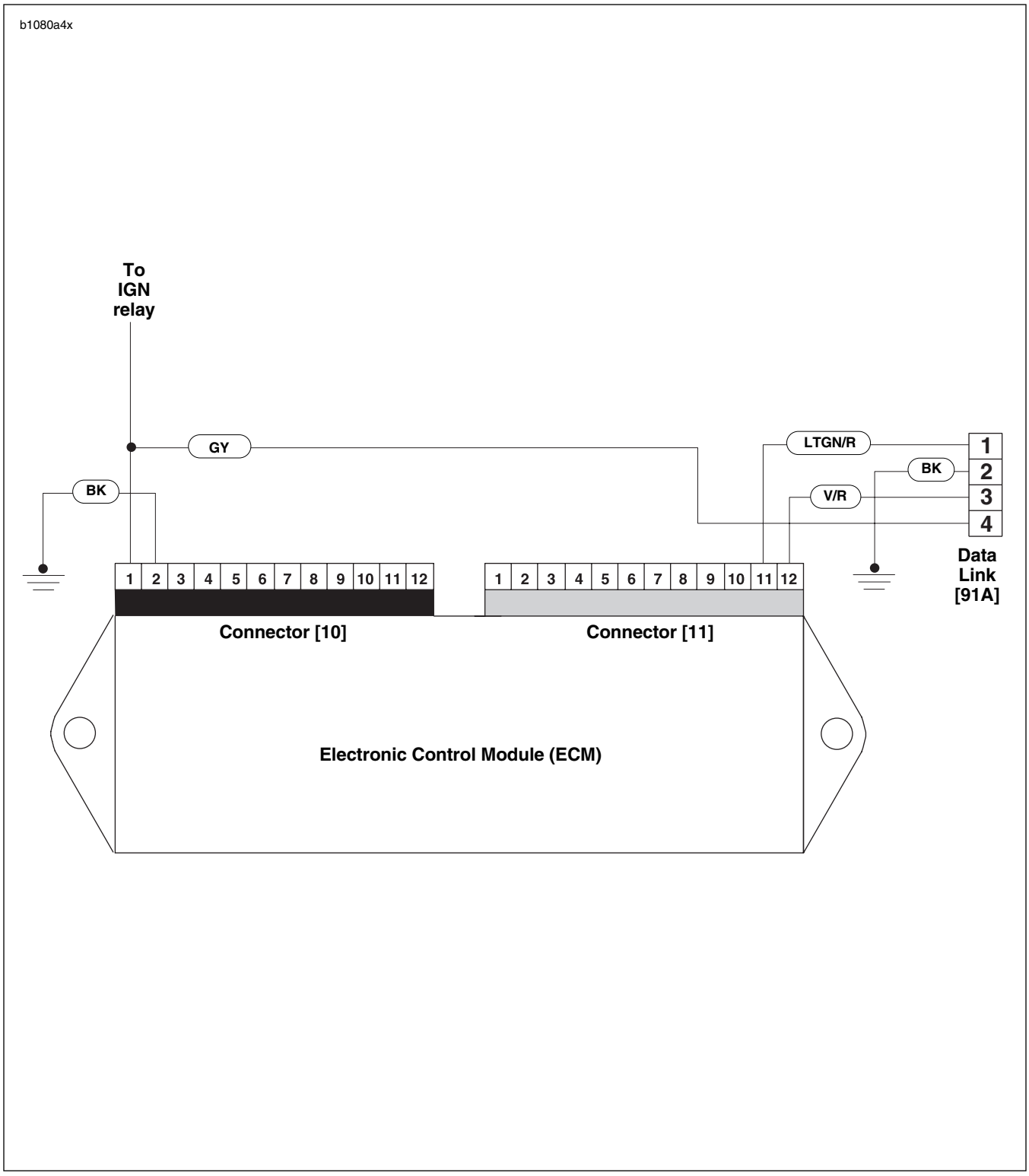
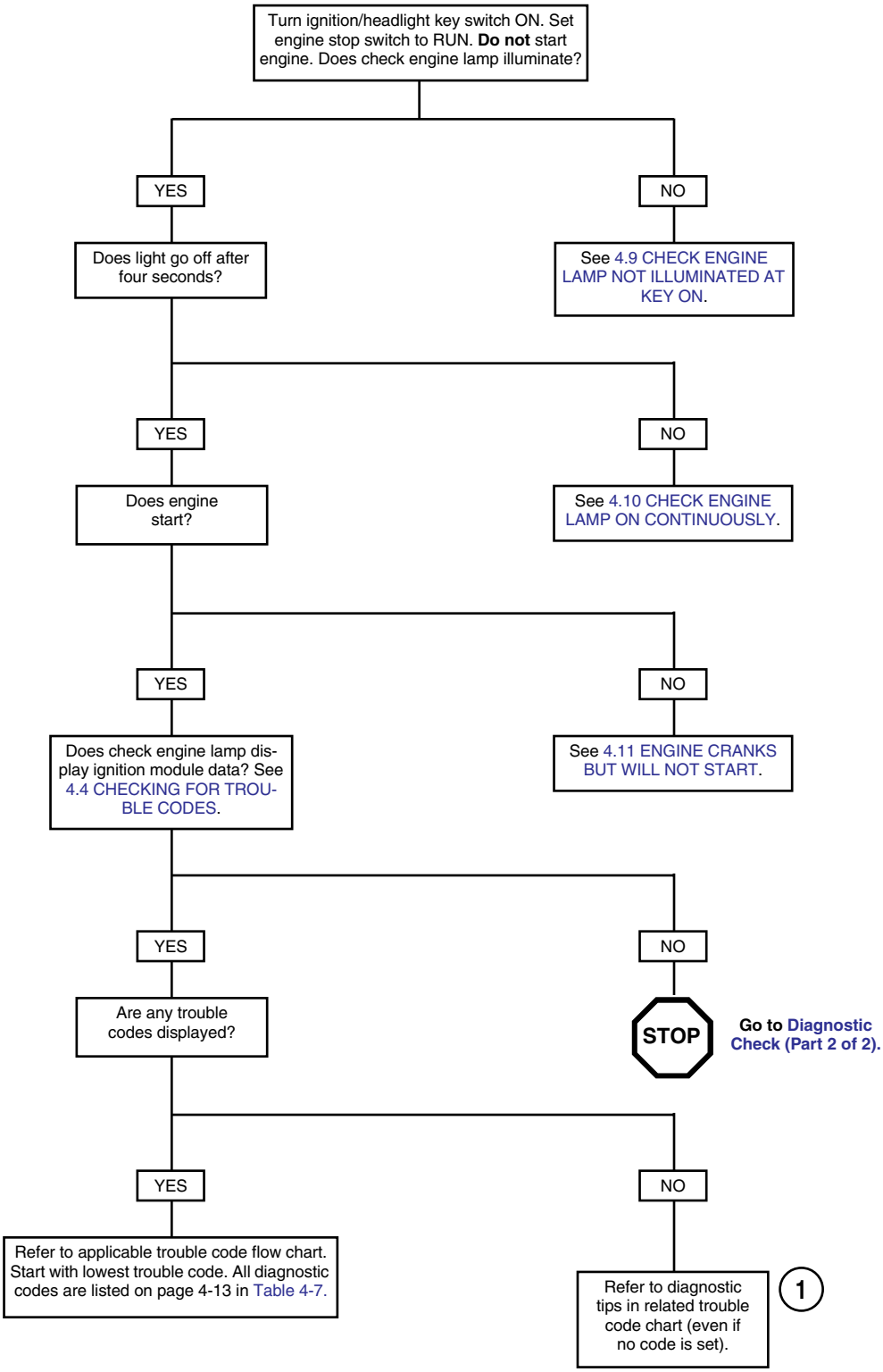


Figure 4-11. Diagnostic Check

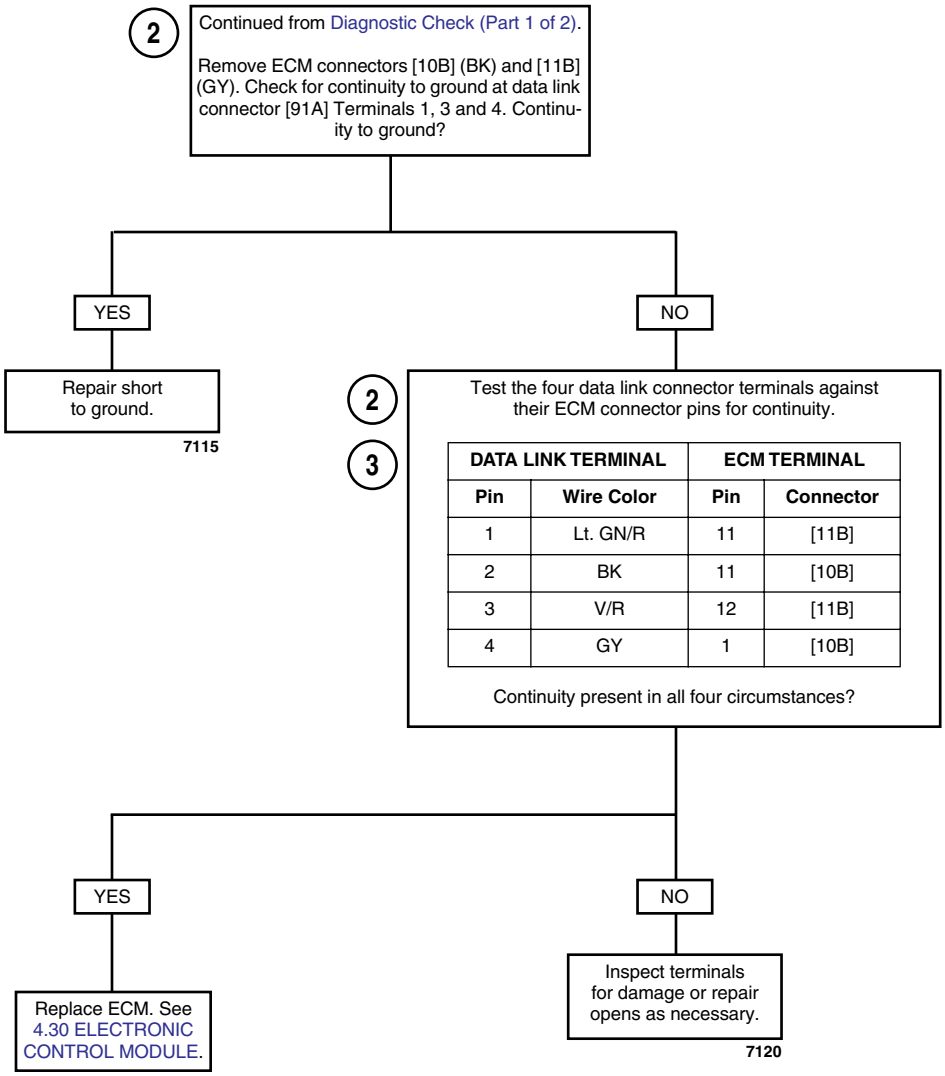
Table 4-8. Wire Harness Connectors in Figure 4-11.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[11]	ECM (gray)	12-place Deutsch	under seat
[91A]	data link	4-place Deutsch	under seat

Diagnostic Check (Part 1 of 2)



Diagnostic Check (Part 2 of 2)



CHECK ENGINE LAMP NOT ILLUMINATED AT KEY ON 4.9

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.
3. Check continuity between instrument connector [39] Pin 7 and ECM connector [10] (black) (3), pin 4.



1. **Low fuel lamp**
2. **Check engine lamp**

Figure 4-12. Check Engine Lamp

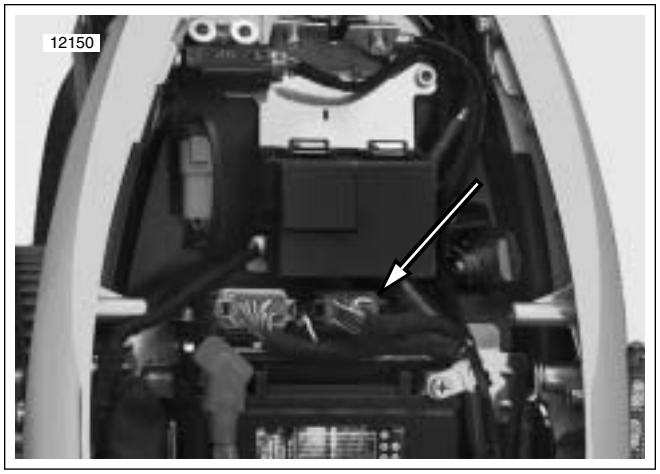
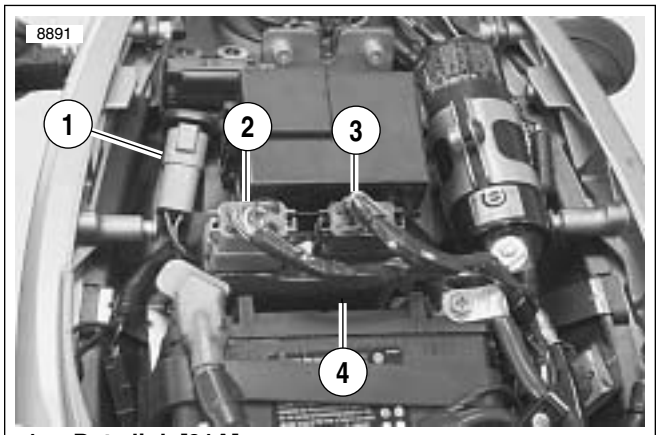


Figure 4-13. Electronic Control Module, (XB12Ss)



1. **Data link [91A]**
2. **ECM connector [11] (gray)**
3. **ECM connector [10] (black)**
4. **Electronic control module (ECM)**

Figure 4-14. Electronic Control Module (Typical)

Table 4-9. ECM Connectors

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	Under seat
[11]	ECM (gray)	12-place Deutsch	Under seat
[91A]	Data link	4-place Deutsch	Under seat

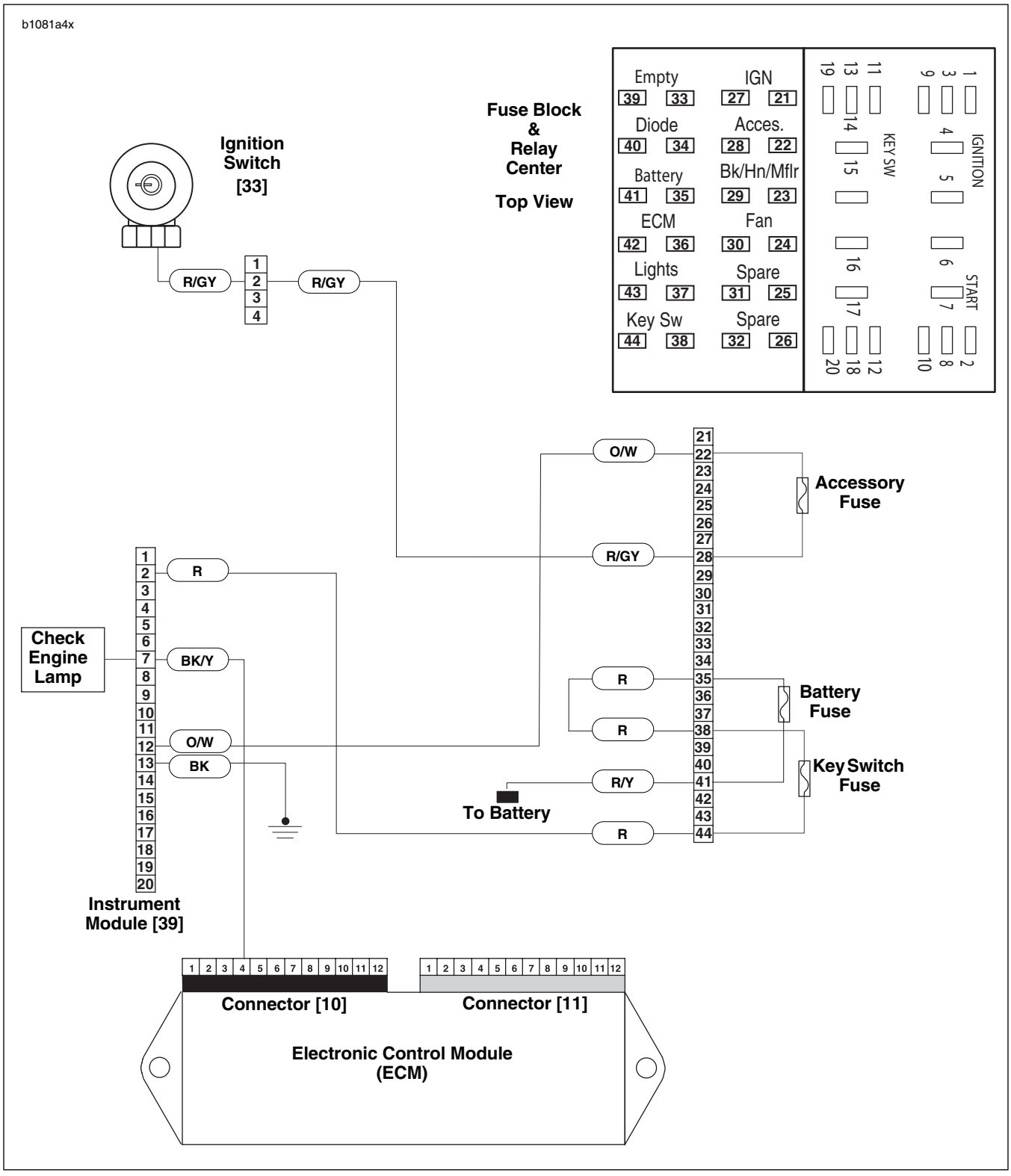
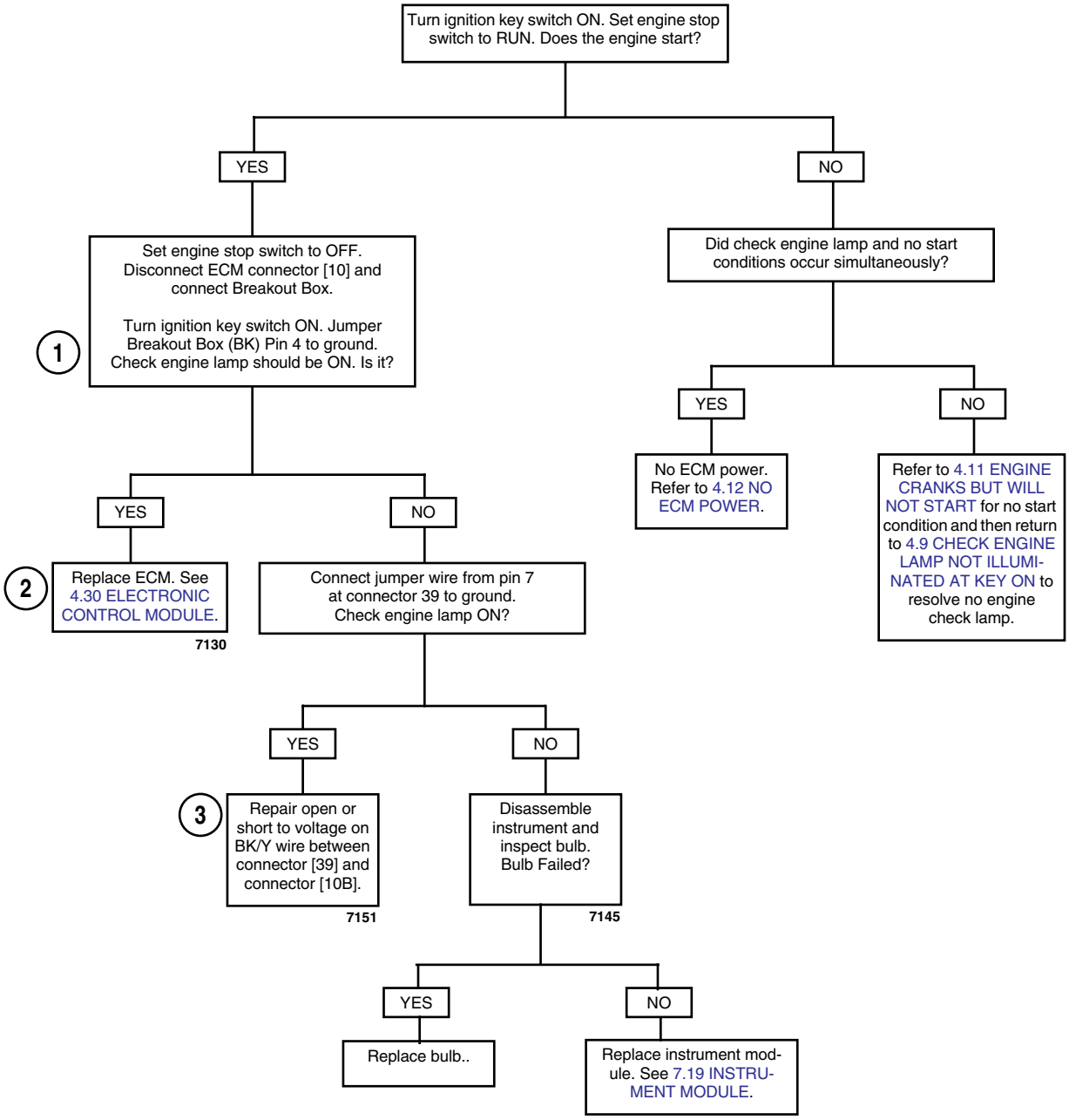


Figure 4-15. Check Engine Lamp Circuit

Table 4-10. Wire Harness Connectors in Figure 4-15.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[39]	instrument module	20-place Multilock	behind windscreen

Test 4.9


Turn ignition key switch ON. Set engine stop switch to RUN. Does the engine start?
YES
NO
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?
1
Did check engine lamp and no start conditions occur simultaneously?
YES
NO
No ECM power. Refer to 4.12 NO ECM POWER.
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.
YES
NO
2
Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
7130
Connect jumper wire from pin 7 at connector 39 to ground. Check engine lamp ON?
YES
NO
3
Repair open or short to voltage on BK/Y wire between connector [39] and connector [10B].
7151
Disassemble instrument and inspect bulb. Bulb Failed?
7145
YES
NO
Replace bulb..
Replace instrument module. See 7.19 INSTRUMENT MODULE.

CHECK ENGINE LAMP ON CONTINUOUSLY 4.10

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)

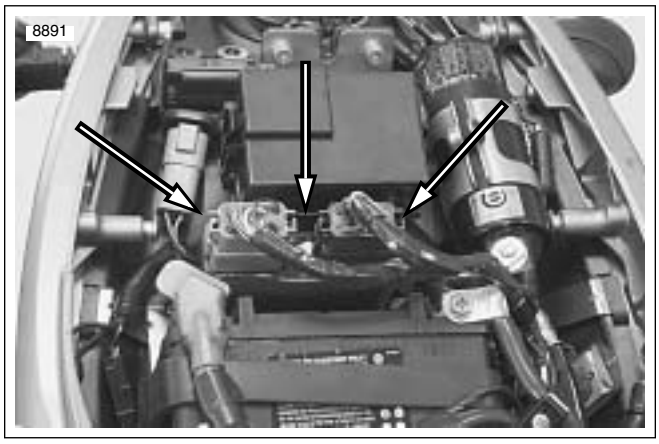


Figure 4-18. Electronic Control Module (Typical)

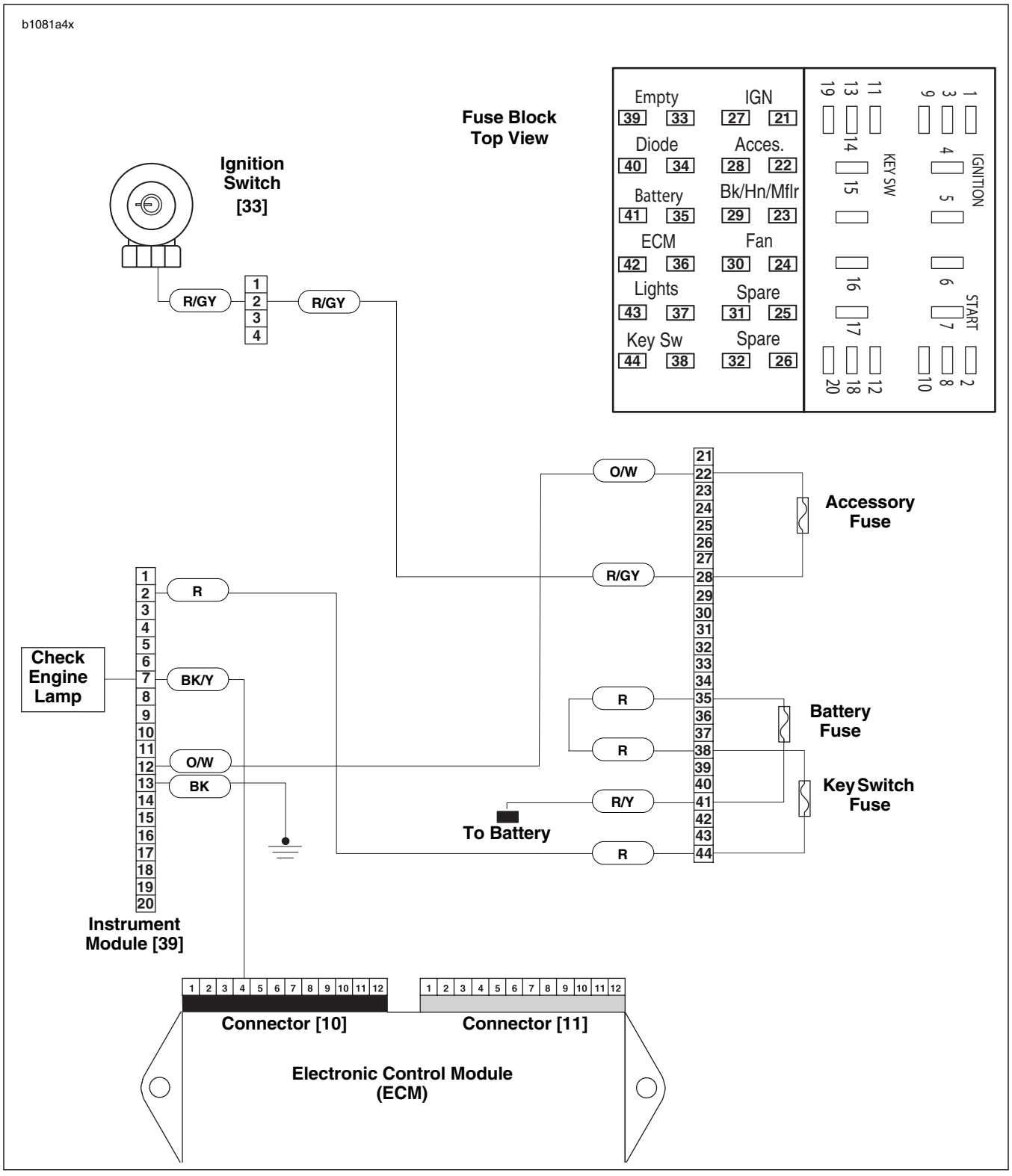
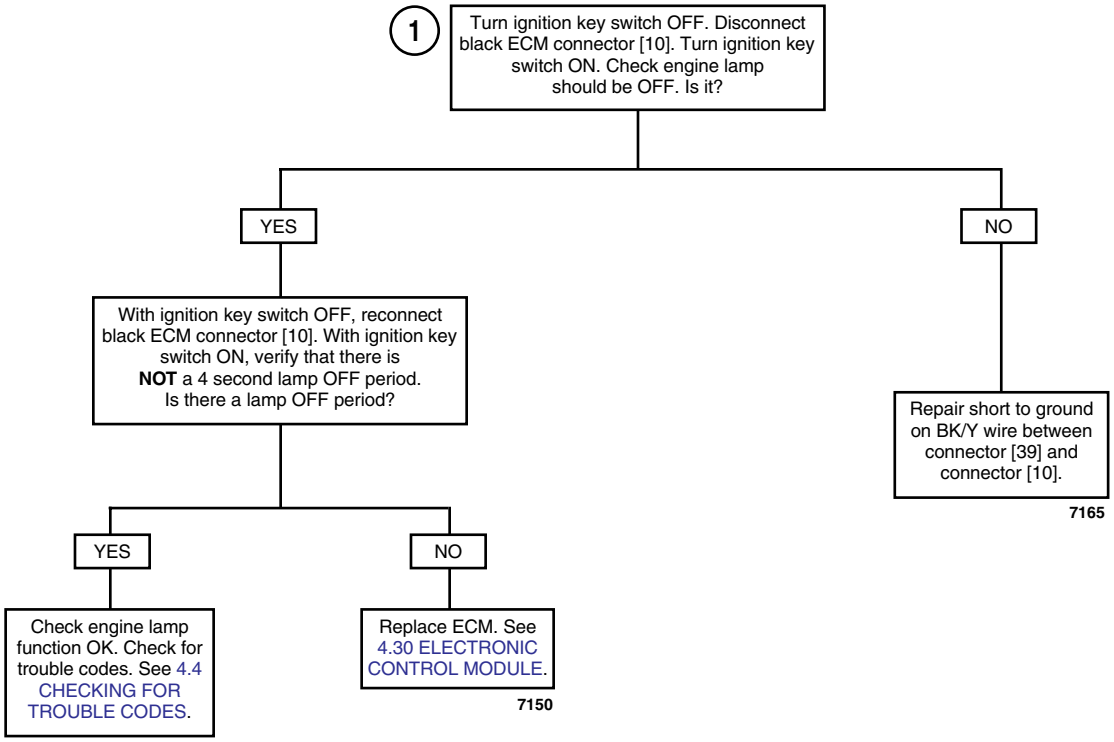


Figure 4-19. Check Engine Lamp Circuit

Table 4-11. Wire Harness Connectors in Figure 4-19.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[39]	instrument module	20-place Multilock	behind windscreen

Test 4.10


1
Turn ignition key switch OFF. Disconnect black ECM connector [10]. Turn ignition key switch ON. Check engine lamp should be OFF. Is it?
YES
NO
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. Is there a lamp OFF period?
Repair short to ground on BK/Y wire between connector [39] and connector [10].
7165
YES
NO
Check engine lamp function OK. Check for trouble codes. See 4.4 CHECKING FOR TROUBLE CODES.
Replace ECM. See 4.30 ELECTRONIC CONTROL MODULE.
7150

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.

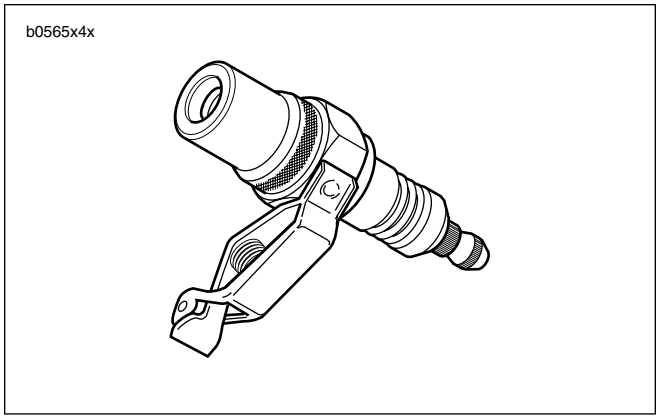


Figure 4-20. Spark Plug Tester (Part No. HD-26792)



Figure 4-21. Ignition Coil Circuit Test

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.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[11]	ECM (gray)	12-place Deutsch	under seat
[14]	cam position sensor	3-place Deutsch	under sprocket cover
[83]	ignition coil	3-place Amp	beneath air cleaner baseplate

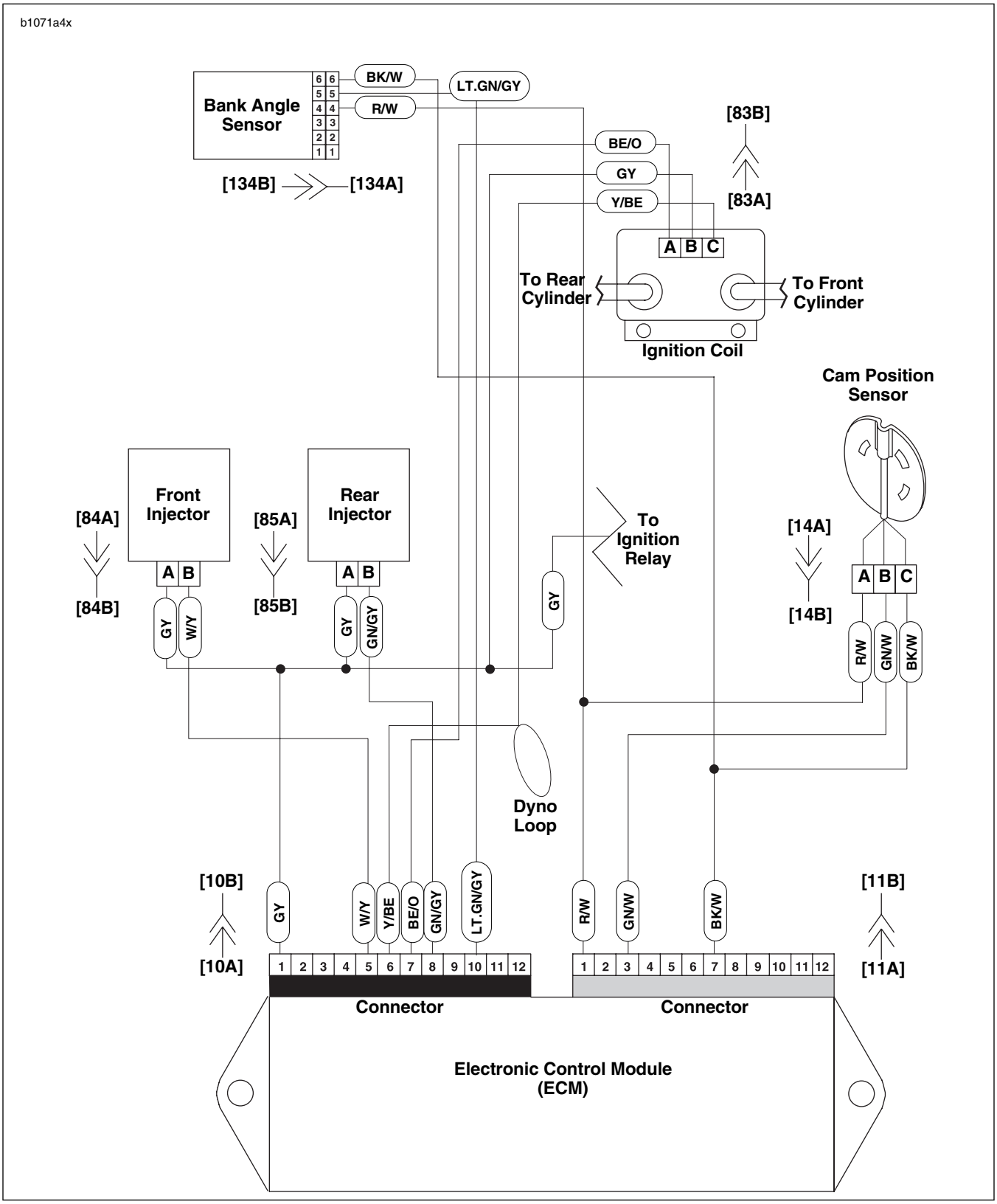
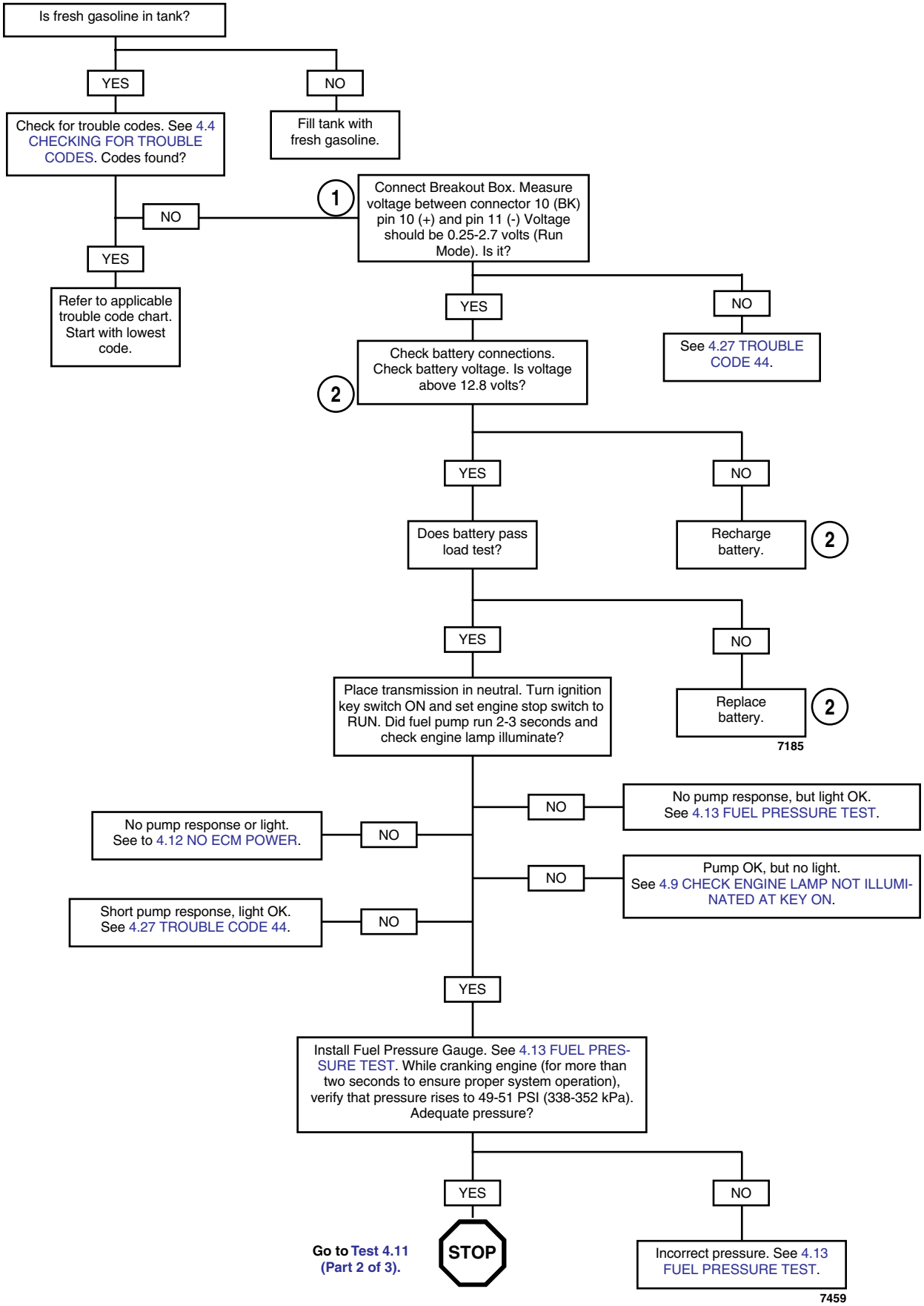
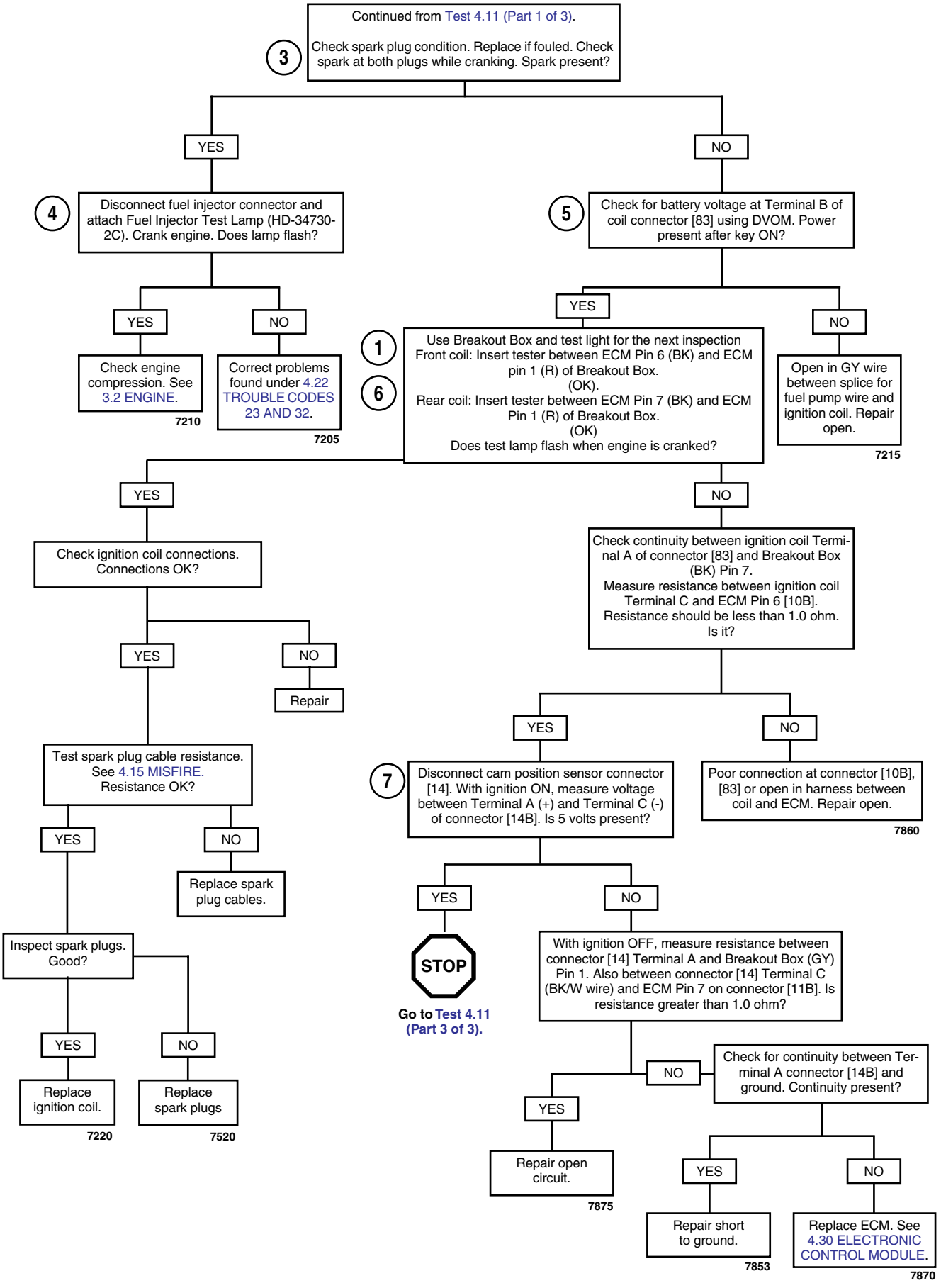


Figure 4-22. Ignition Circuit

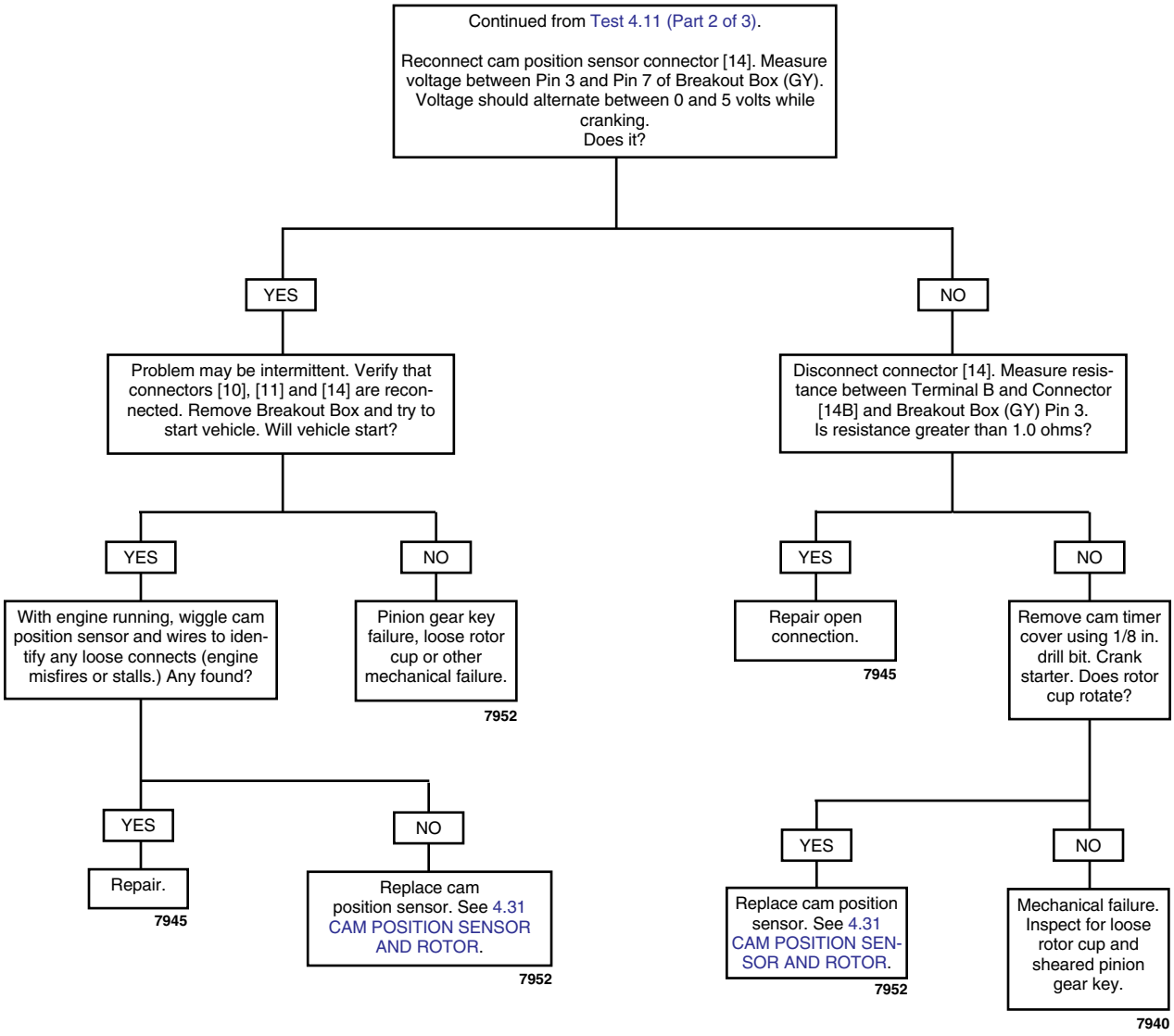
Test 4.11 (Part 1 of 3)



Test 4.11 (Part 2 of 3)



Test 4.11 (Part 3 of 3)



NO ECM POWER 4.12

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.

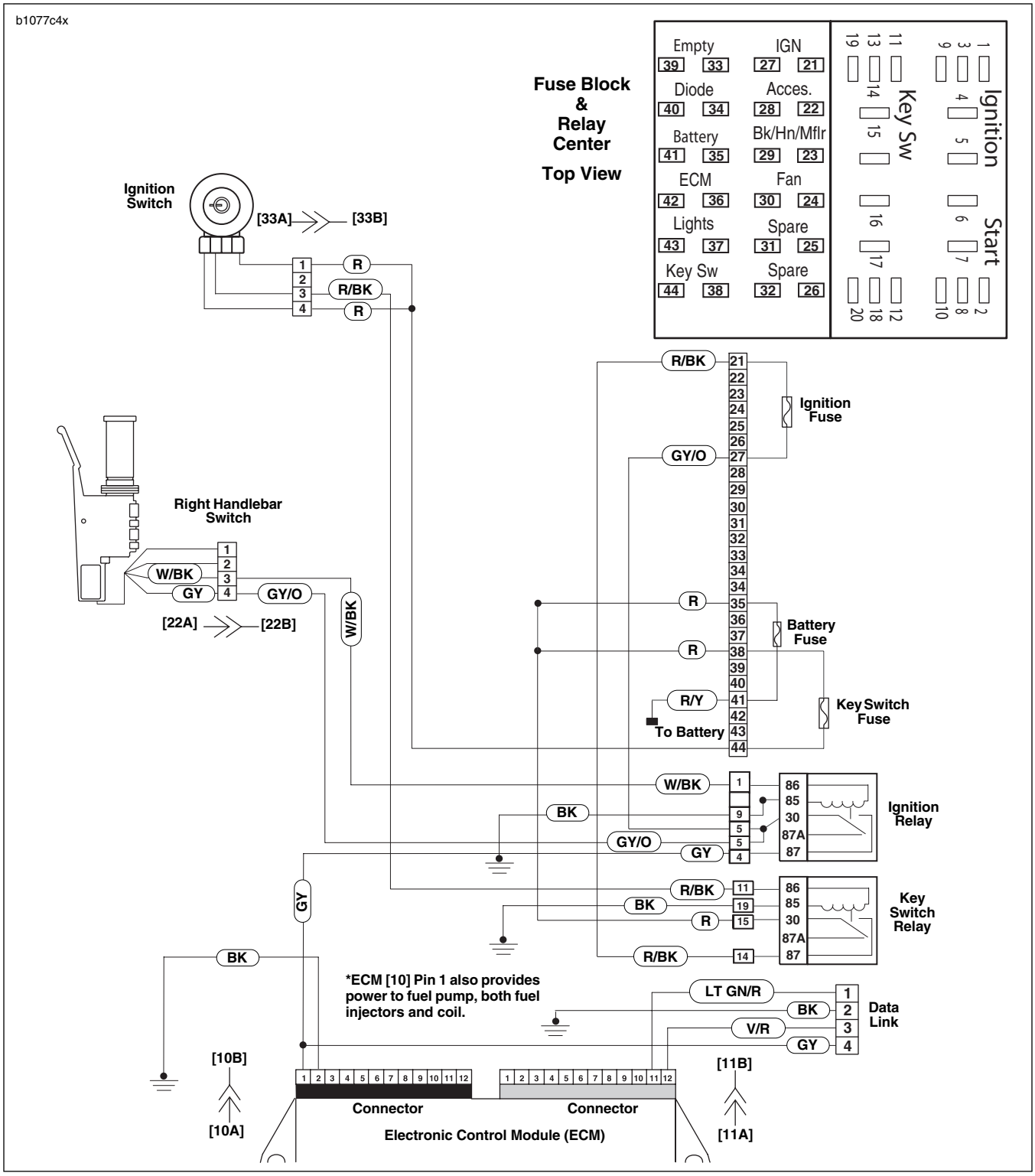


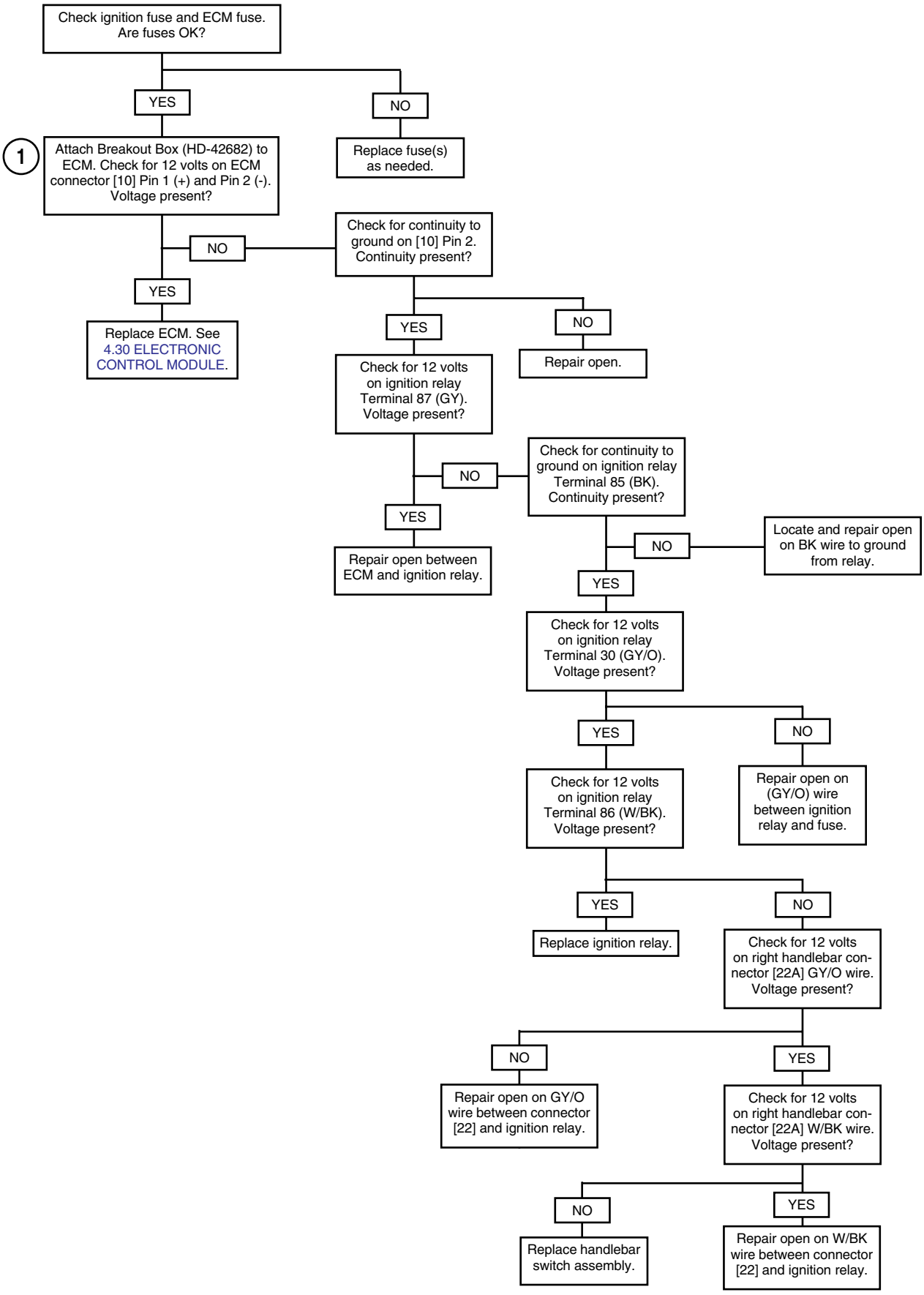
Figure 4-23. ECM Power Circuit

Table 4-13. Wire Harness Connectors in Figure 4-23.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[22]	right hand controls	4-place Multilock	to the right of windscreen
[95]	clutch switch	2-place Multilock	to the left of windscreen

No ECM Power

CONDITION: Key ON and transmission in neutral



INSPECTION

PART NO.	SPECIALTY TOOL
B-45522	Fuel pressure gauge adapter
HD-41182	Fuel pressure gauge

⚠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.

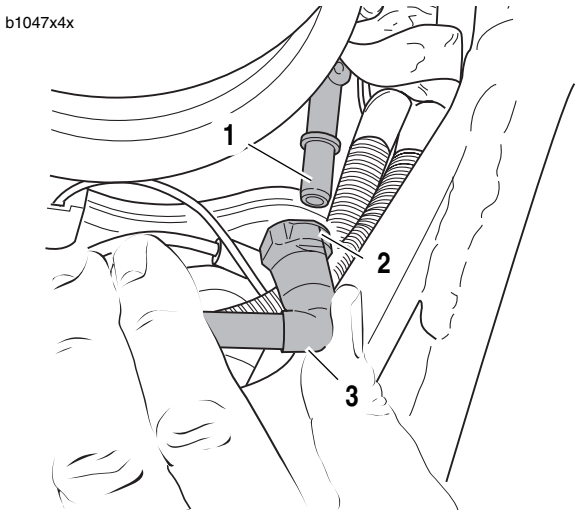
NOTE

See Figure 4-27. Verify that fuel valve (2) and air bleed petcock (5) on the gauge are closed.

6. Attach FUEL PRESSURE GAUGE (Part No. HD-41182) (4) to fuel pressure gauge adapter (1).



Figure 4-24. Fuel Pump Connector [86] (swingarm removed for illustration)



1. **Throttle body inlet**
2. **Button**
3. **Fuel line**

Figure 4-25. 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)

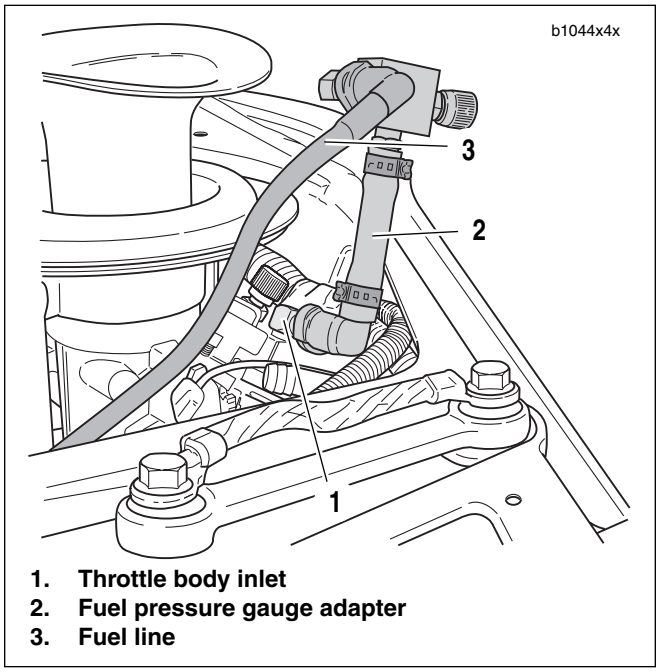
10. See Figure 4-27. Turn engine off. Detach pressure gauge (4) from adapter (1).
    a. Open the air bleed petcock (5) to relieve fuel system pressure and purge the pressure gauge of gasoline.
    b. Remove pressure gauge from adapter.
11. Detach adapter from vehicle.
12. Connect fuel line to throttle body inlet.

DIAGNOSTICS

Diagnostic Notes

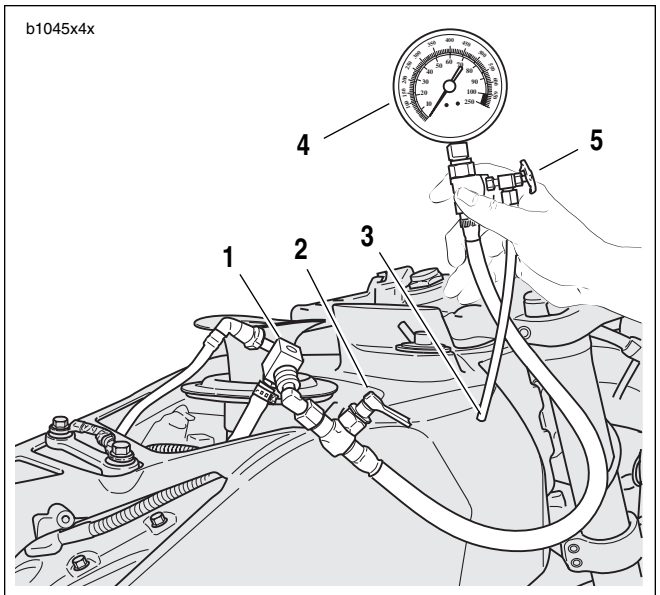
The reference numbers below correlate with the circled numbers on the Test 4.13 flow charts.

1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probe and patch cord.
2. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.



1. **Throttle body inlet**
2. **Fuel pressure gauge adapter**
3. **Fuel line**

Figure 4-26. Fuel Pressure Gauge Adapter



1. **Fuel pressure gauge adapter (B-45522)**
2. **Fuel valve (closed position)**
3. **Air bleed tube**
4. **Fuel pressure gauge (HD-41182)**
5. **Air bleed petcock**

Figure 4-27. Fuel Pressure Gauge (Part No. HD-41182)

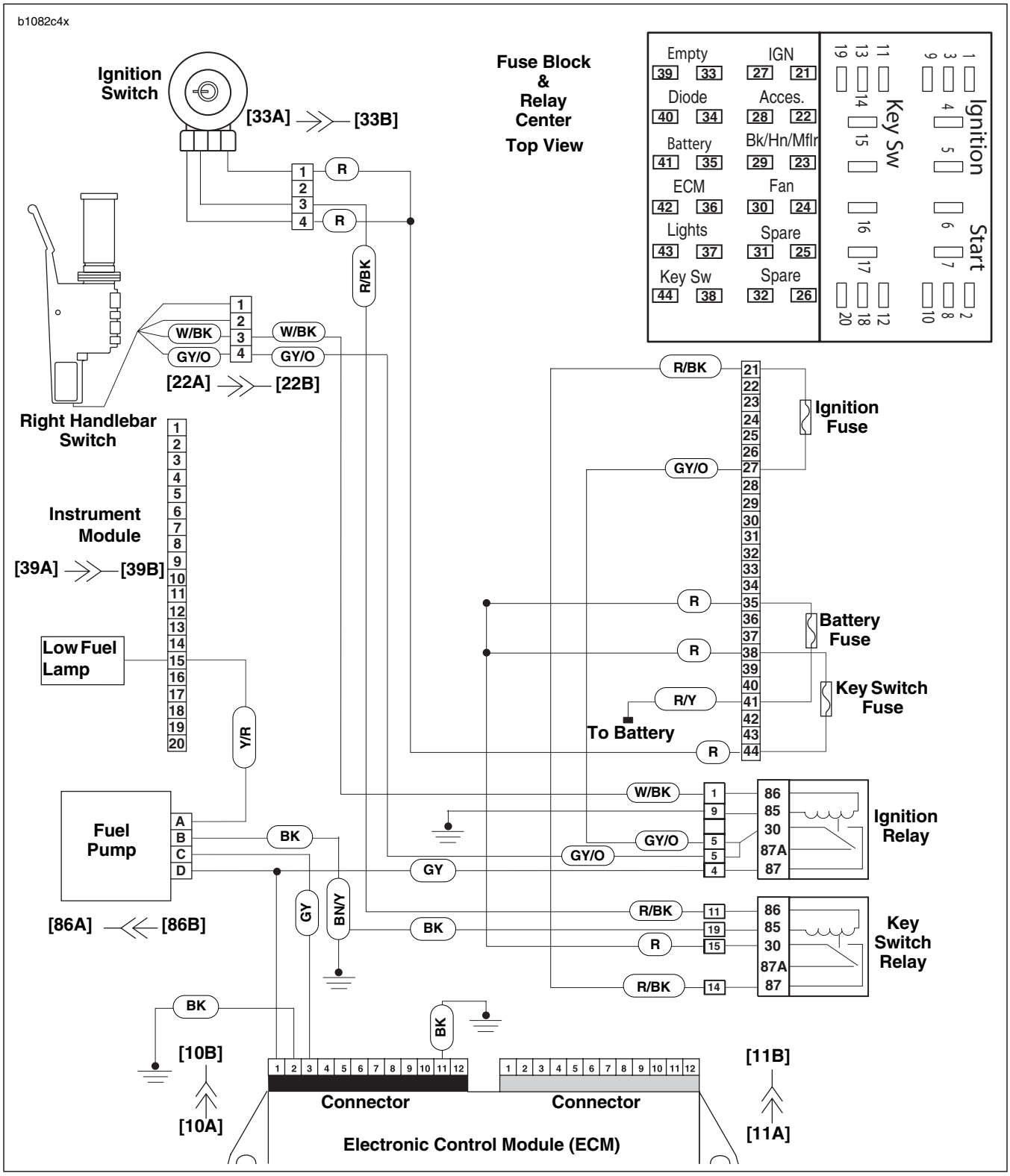
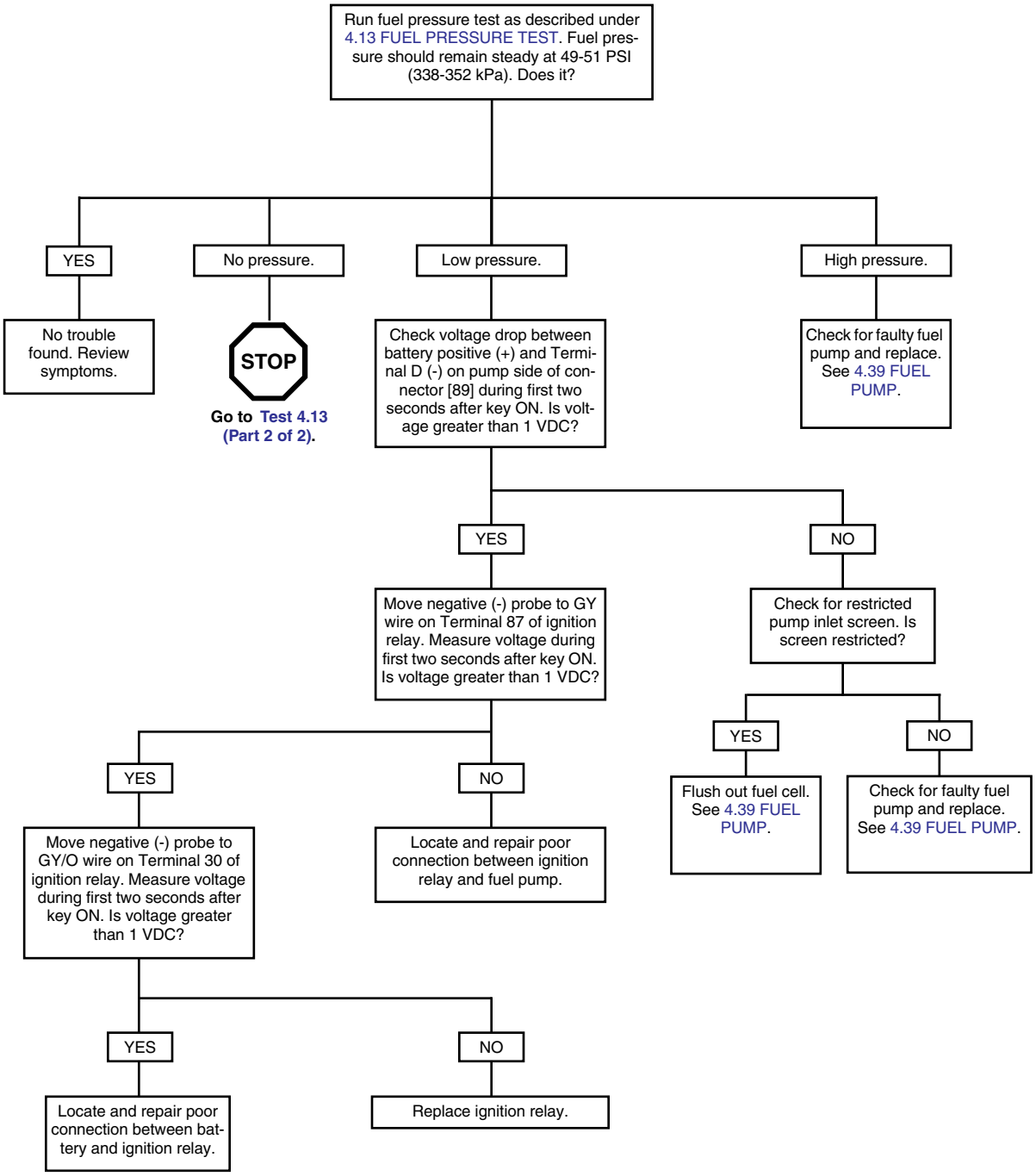


Figure 4-28. Fuel Pump Circuit

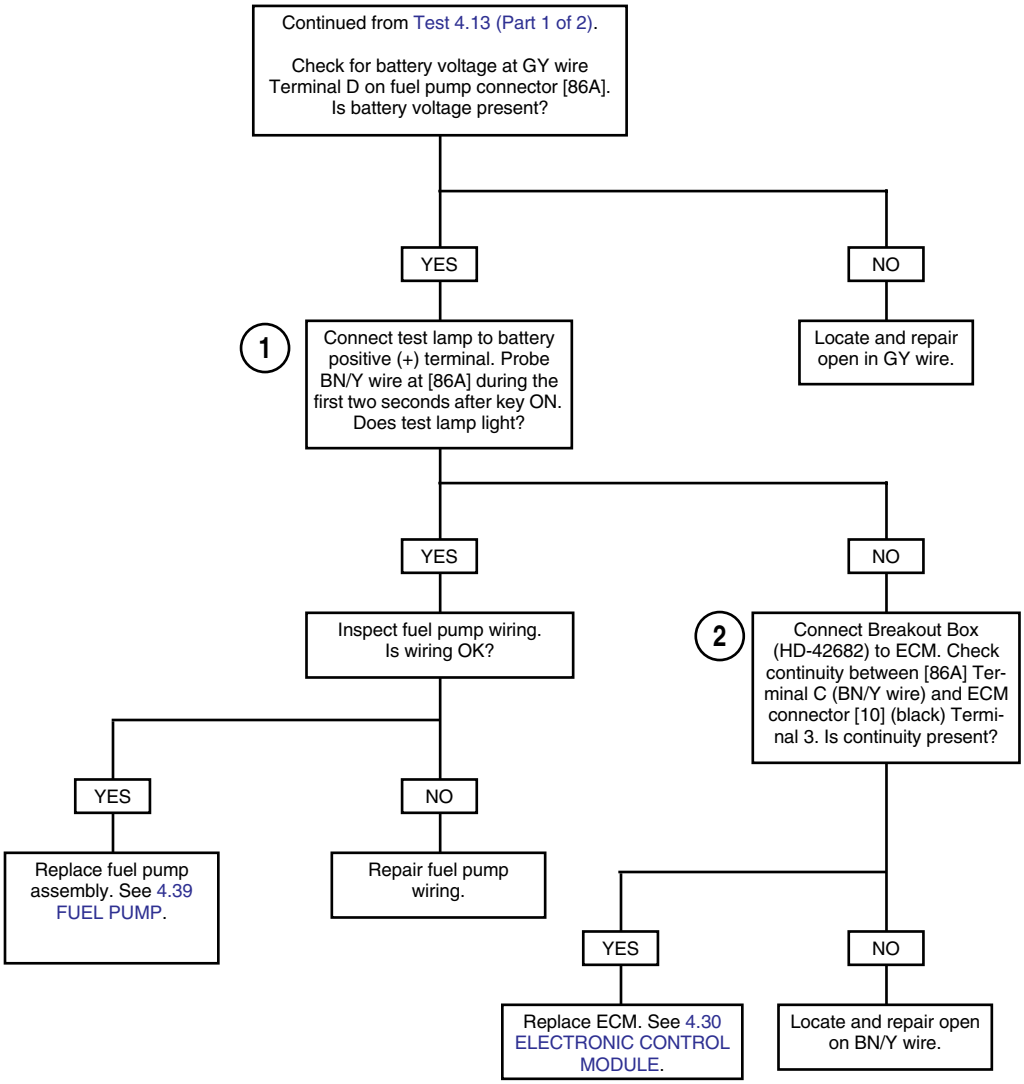
Table 4-14. Wire Harness Connectors in Figure 4-28.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[39]	instrument module	20-place Multilock	behind windscreen
[86]	fuel pump	4-place Multilock	left side of rear shock absorber

Test 4.13 (Part 1 of 2)



Test 4.13 (Part 2 of 2)



IDLE SPEED CONTROL 4.14

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

MODEL	REGULAR IDLE
All Models	1050-1150

NOTE

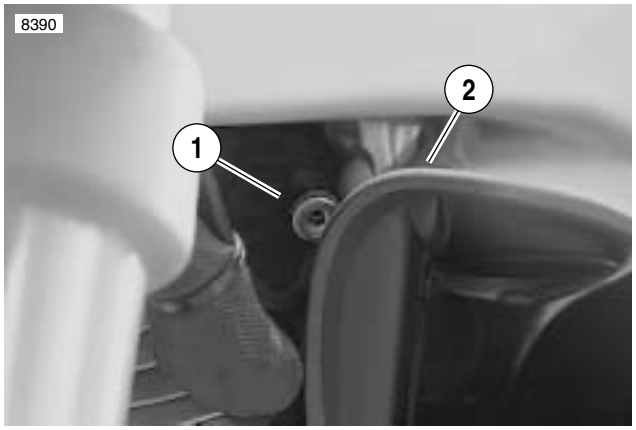
Idle adjuster is located near the engine and could be extremely hot. Use suggested tool for adjusting the idle speed. Failure to comply could result in minor or moderate injury.

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.



1. Idle speed control cable
2. Ram air scoop

Figure 4-29. Idle Adjustment Cable

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.

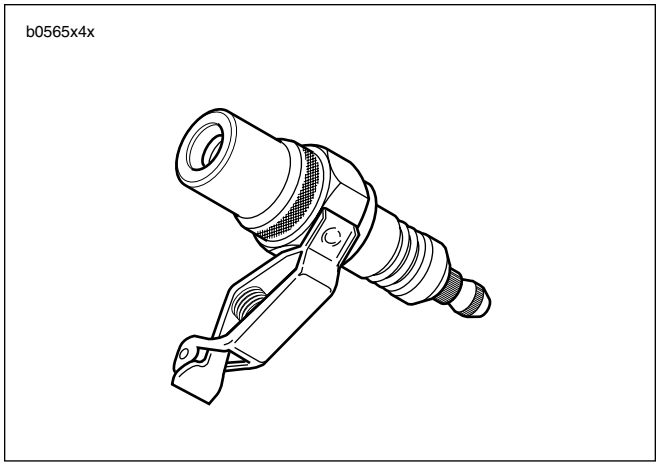


Figure 4-30. Spark Tester (Part No, HD-26792)

Table 4-16. Spark Plug Cables

SPECIFICATION	FRONT & REAR
Length - in. (mm)	5.75 in. (146mm)
Resistance - ohms	1,430 - 3,360

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.

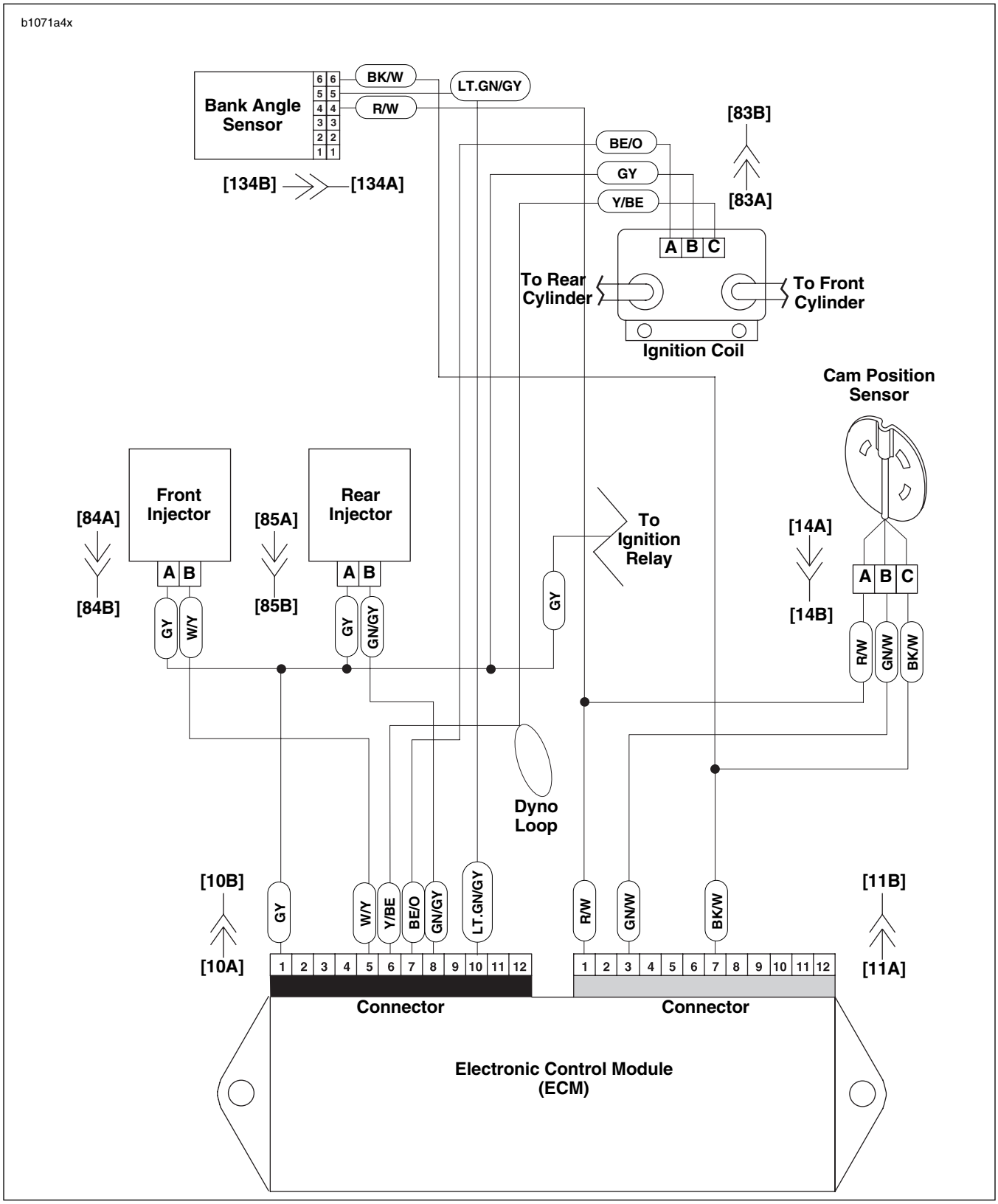
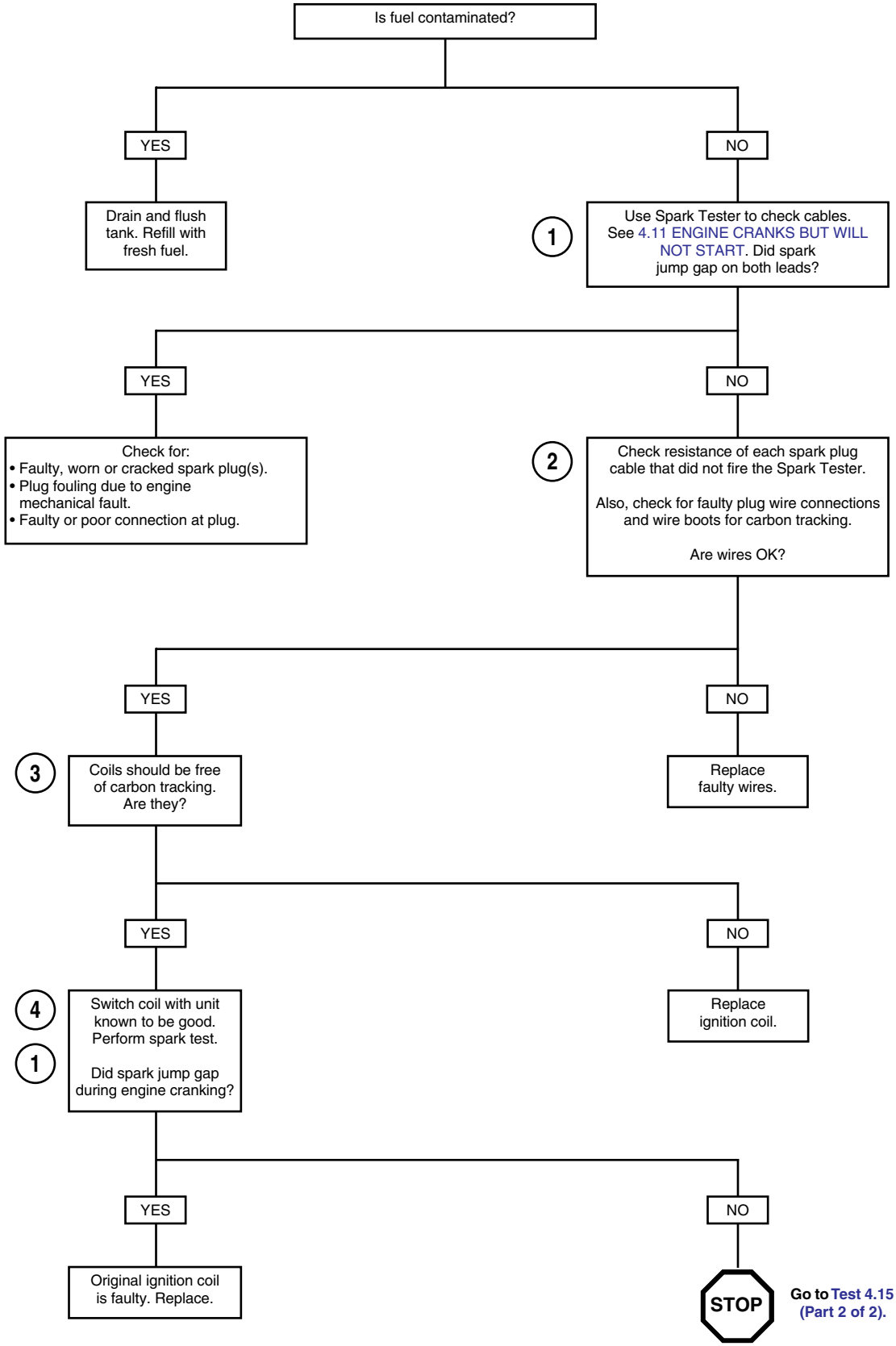


Figure 4-31. Ignition Coil Circuit

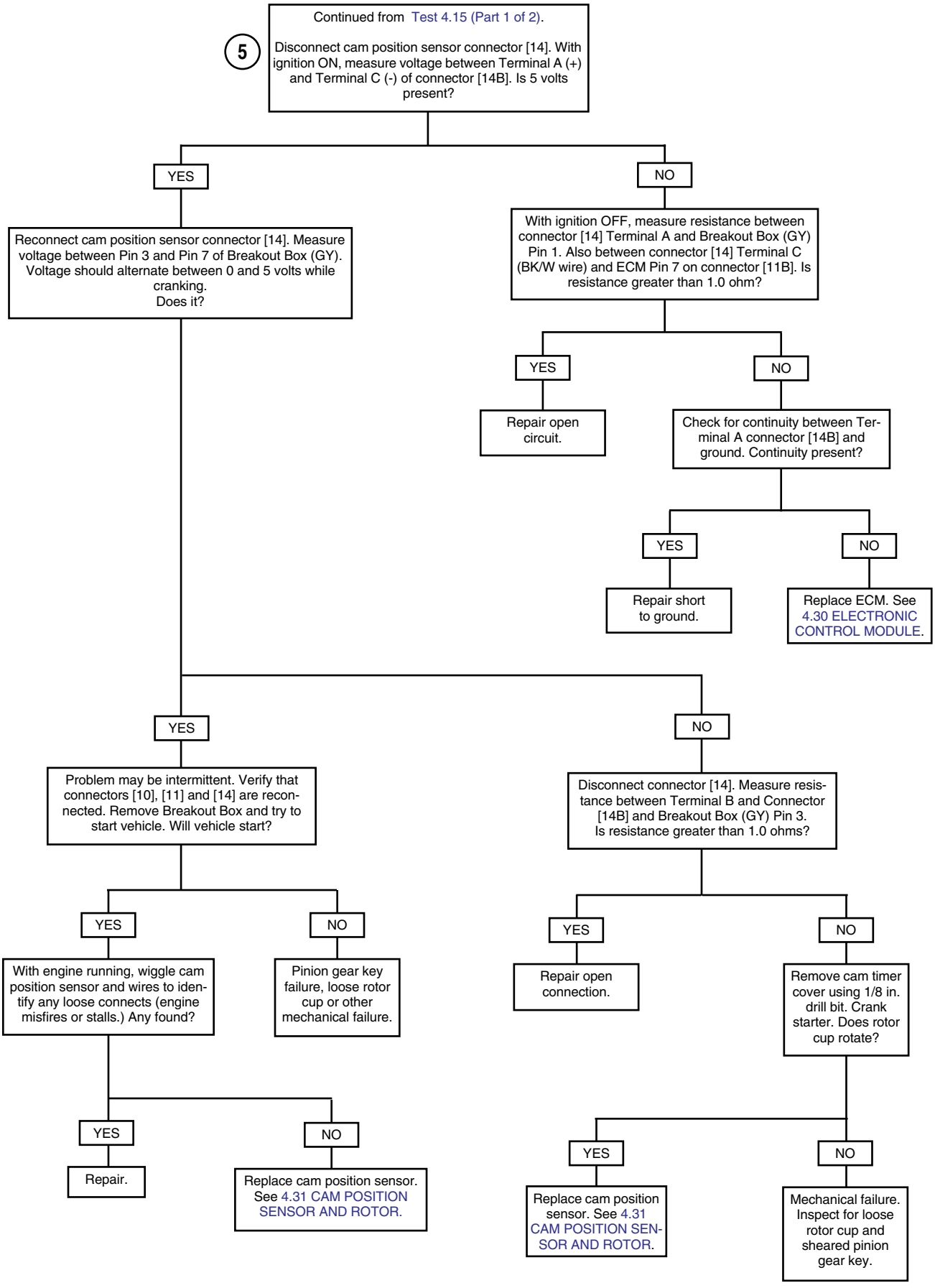
Table 4-17. Wire Harness Connectors in Figure 4-31.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[22]	right hand controls	4-place Multilock	beneath windscreen
[83]	ignition coil	3-place Packard	beneath air cleaner assembly baseplate

Test 4.15 (Part 1 of 2)



Test 4.15 (Part 2 of 2)



NOTES

GENERAL

Throttle Position Sensor

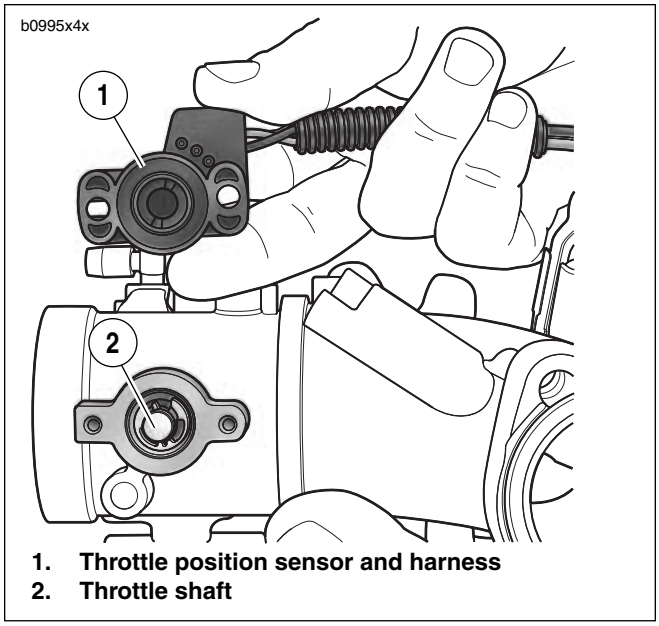
See Figure 4-32. The throttle position sensor (TP sensor) is supplied 5.0 volts from the ECM (5v REF) and sends a signal back to the ECM (TP sensor signal) which varies according to throttle position. The output signal from the TP sensor varies from:

- 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.



1. **Throttle position sensor and harness**
2. **Throttle shaft**

Figure 4-32. TP Sensor Assembly

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.

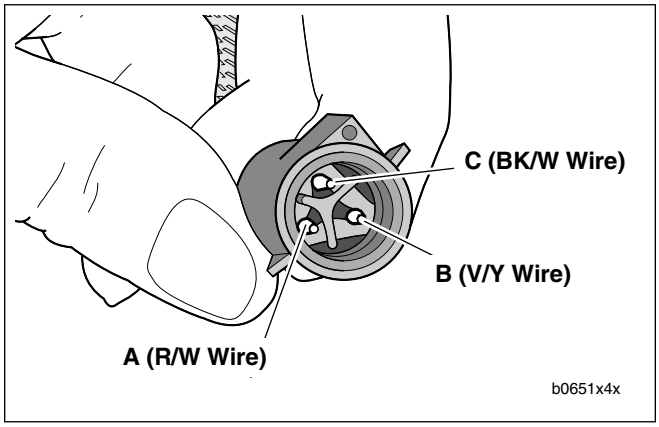


Figure 4-33. TP Sensor Terminals [88A]

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.

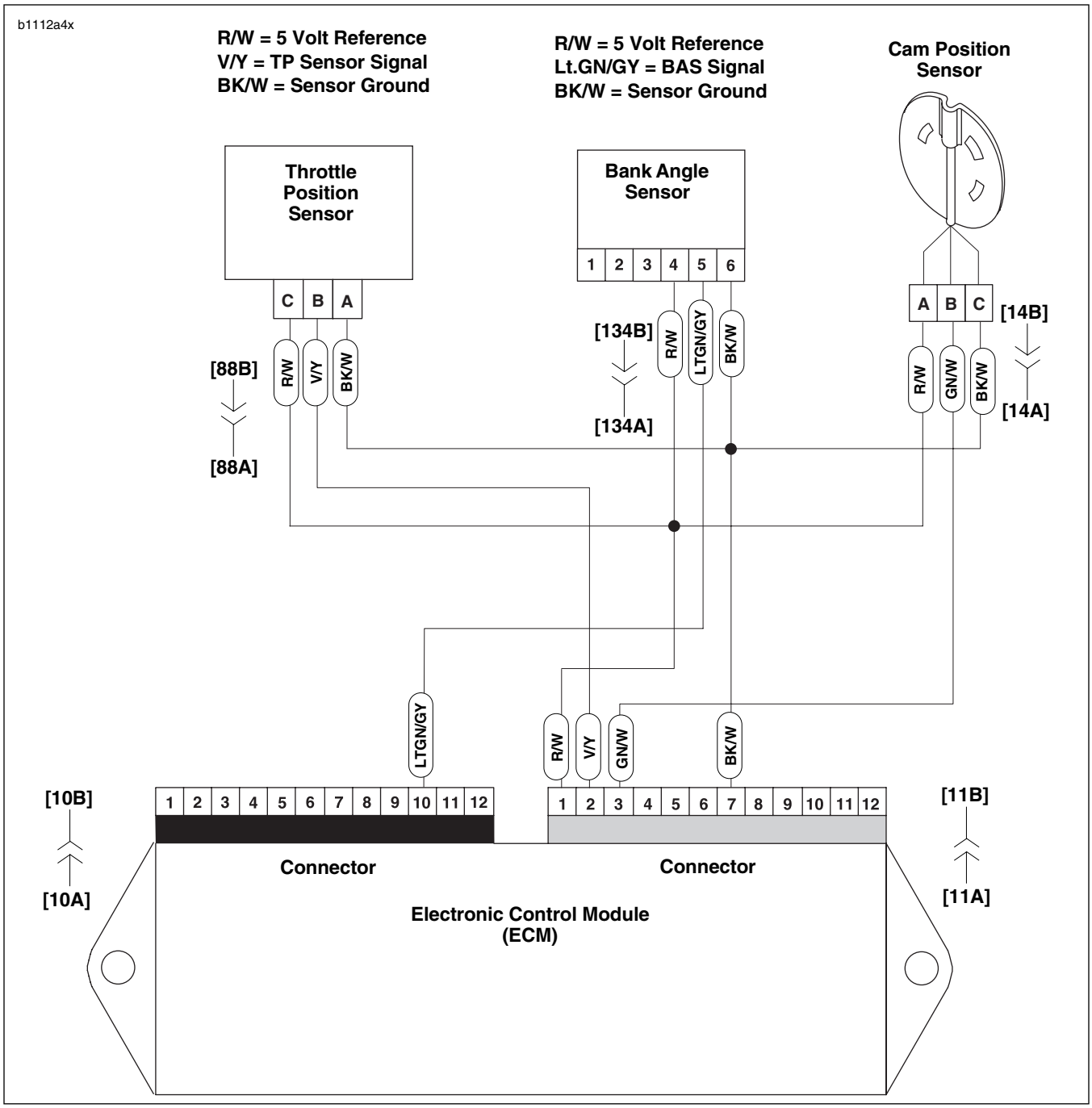
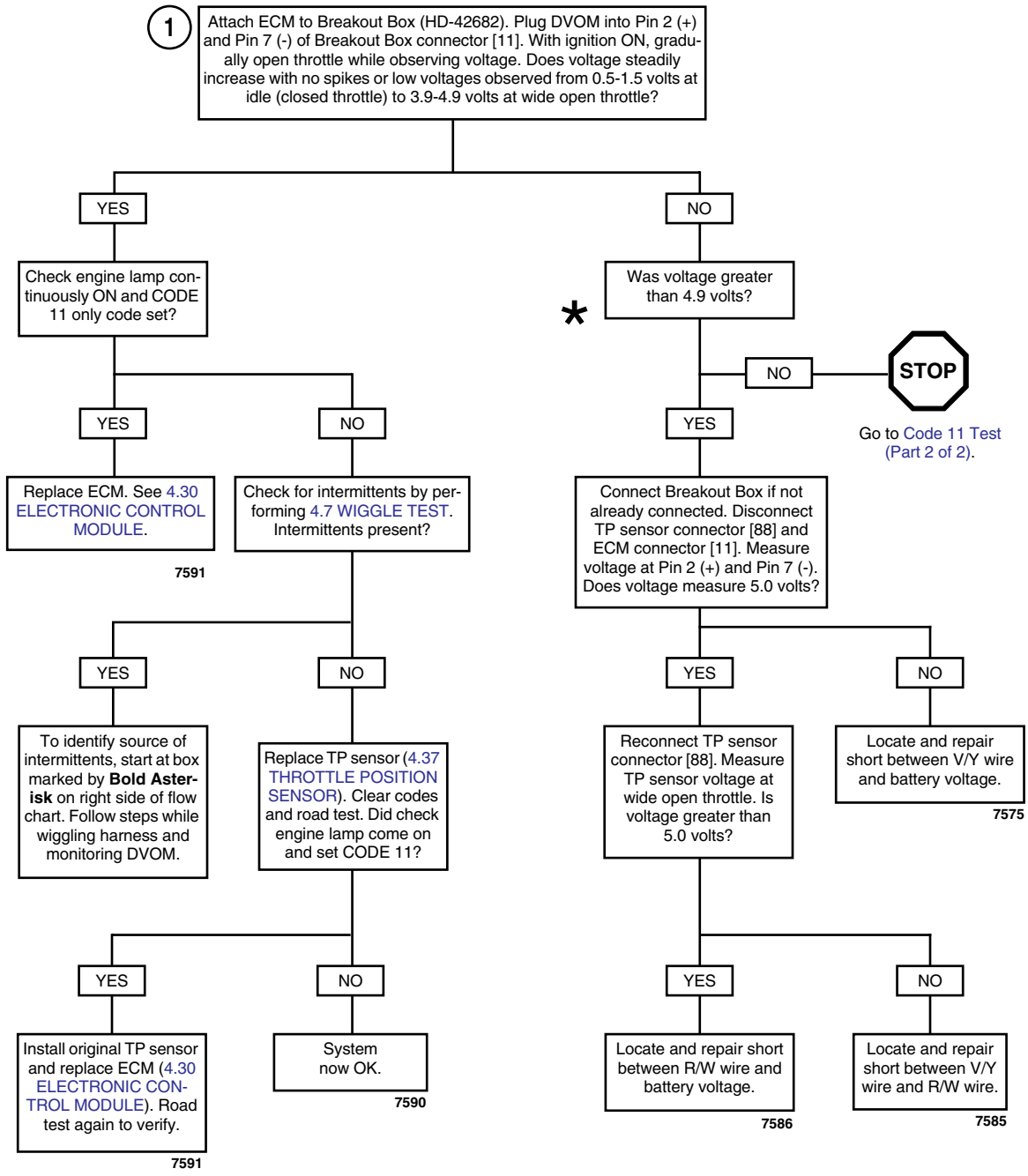


Figure 4-34. Throttle Position Sensor Circuit

Table 4-18. Wire Harness Connectors in Figure 4-34.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[11]	ECM (gray)	12-place Deutsch	under seat
[14]	cam position sensor	3-place Deutsch	under sprocket cover
[88]	throttle position sensor	3-place Packard	right side of engine between cylinders
[134]	bank angle sensor	6-place Sumitomo	under seat

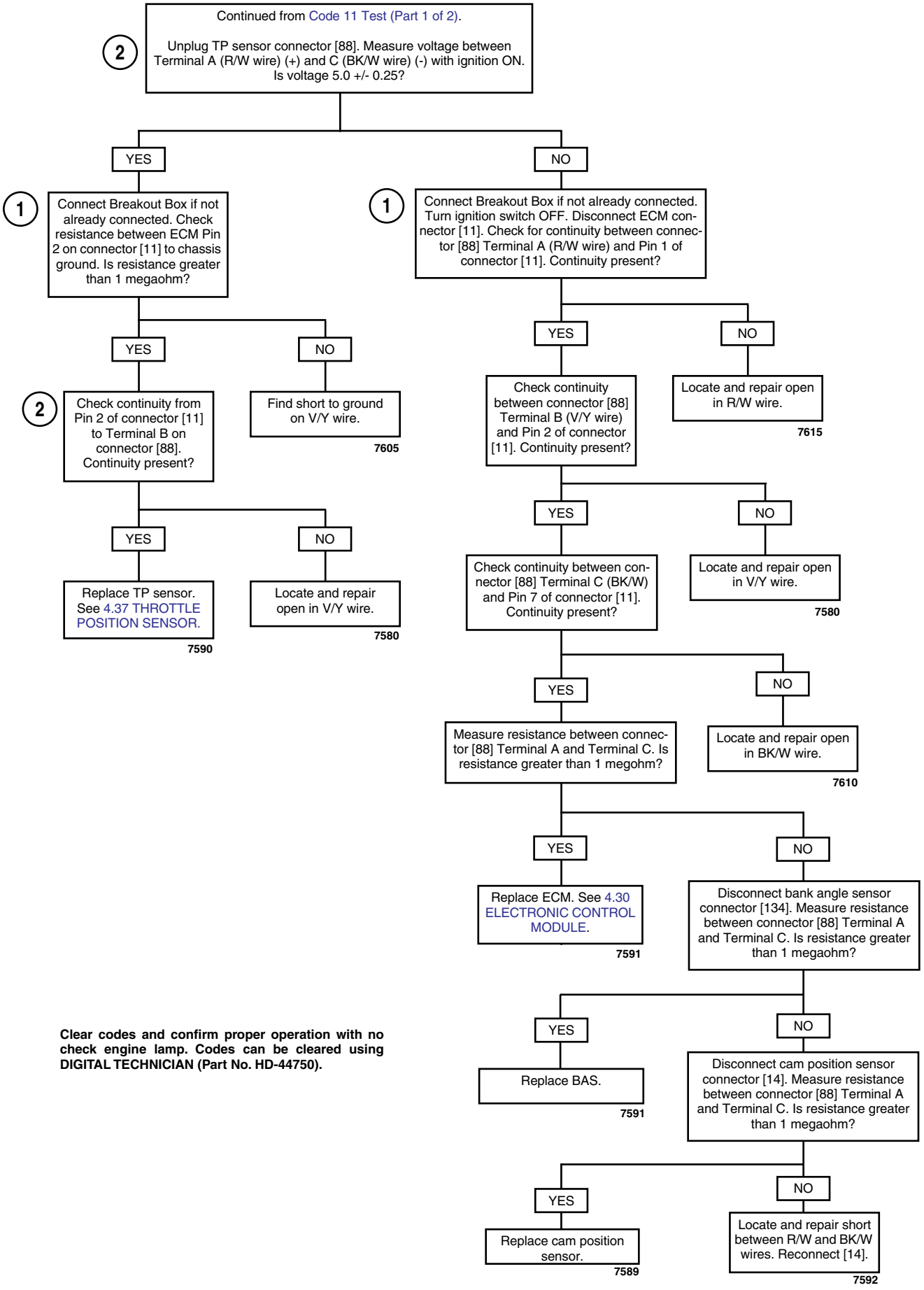
Code 11 Test (Part 1 of 2)



* **At some point in the flow chart you may be instructed to jump directly to a the box with the bold asterisk. Disregard the asterisk (but not the instruction box) if your normal progression through the chart brings you to this location.**

Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

Code 11 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).

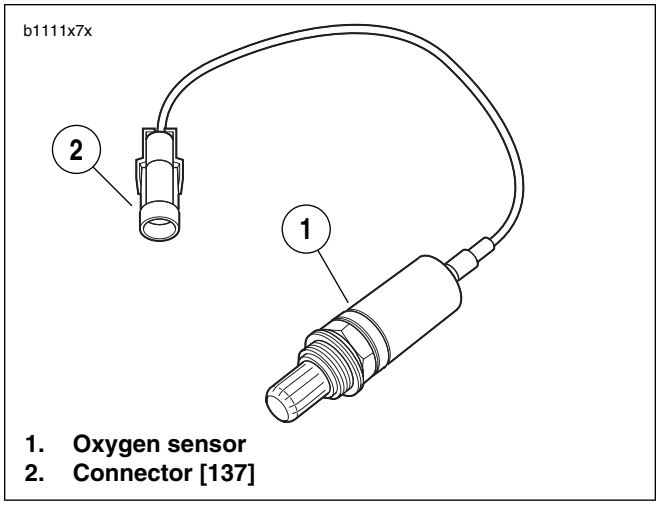
GENERAL

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.



1. Oxygen sensor
2. Connector [137]

Figure 4-35. Oxygen Sensor

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.

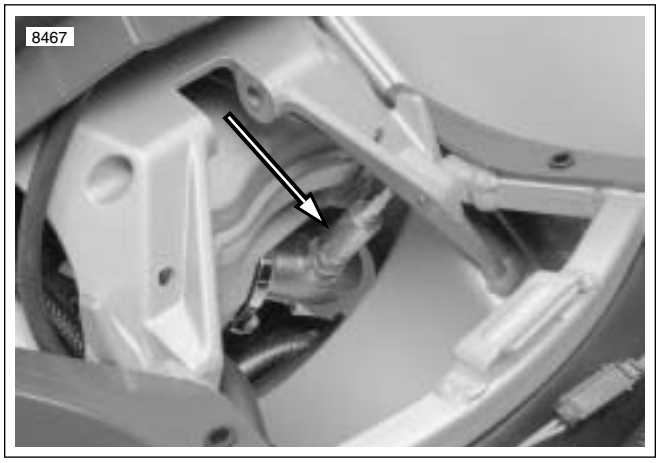


Figure 4-36. Oxygen Sensor (shock absorber removed)

Diagnostic Notes

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.6 BREAKOUT BOX.

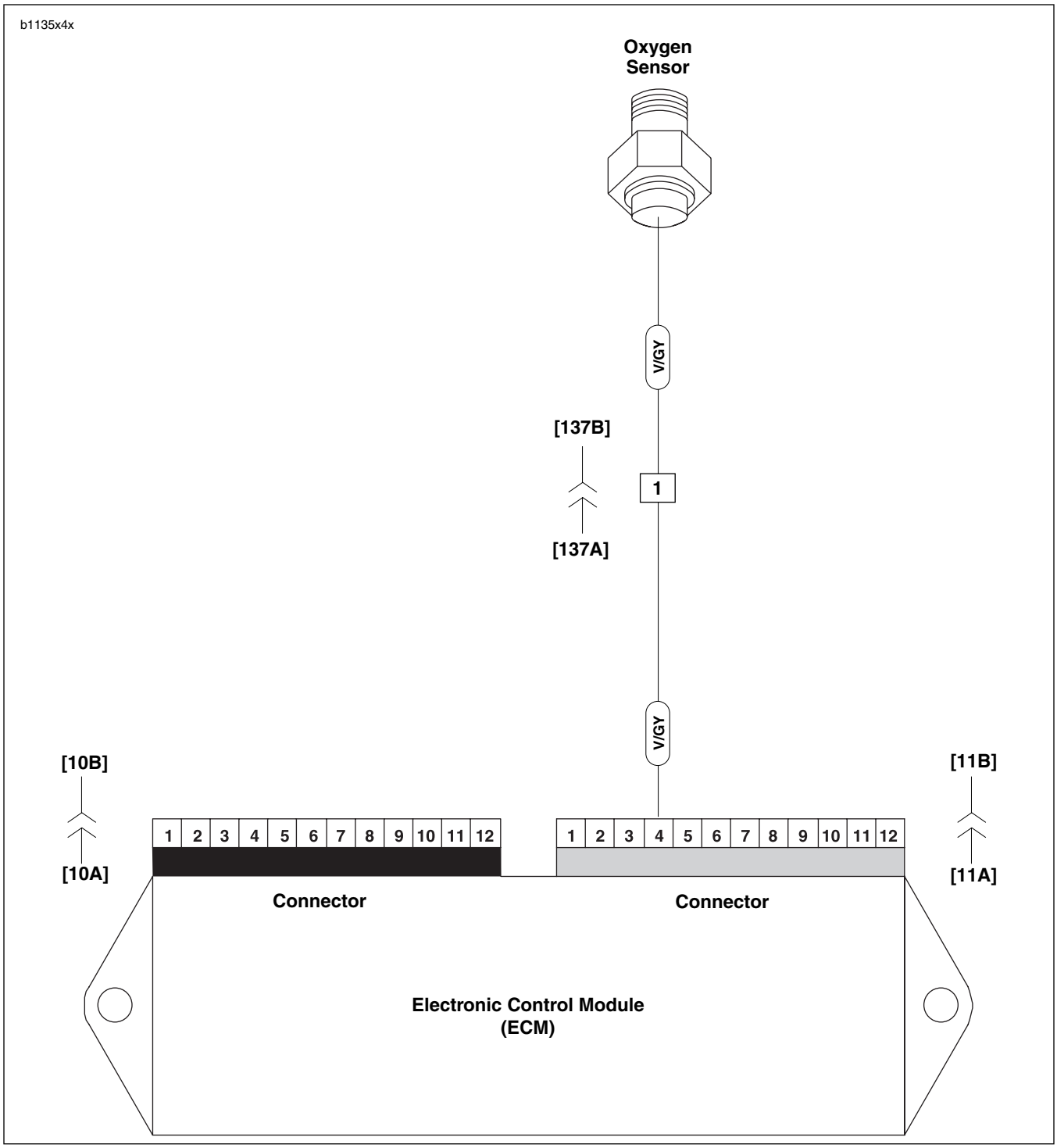
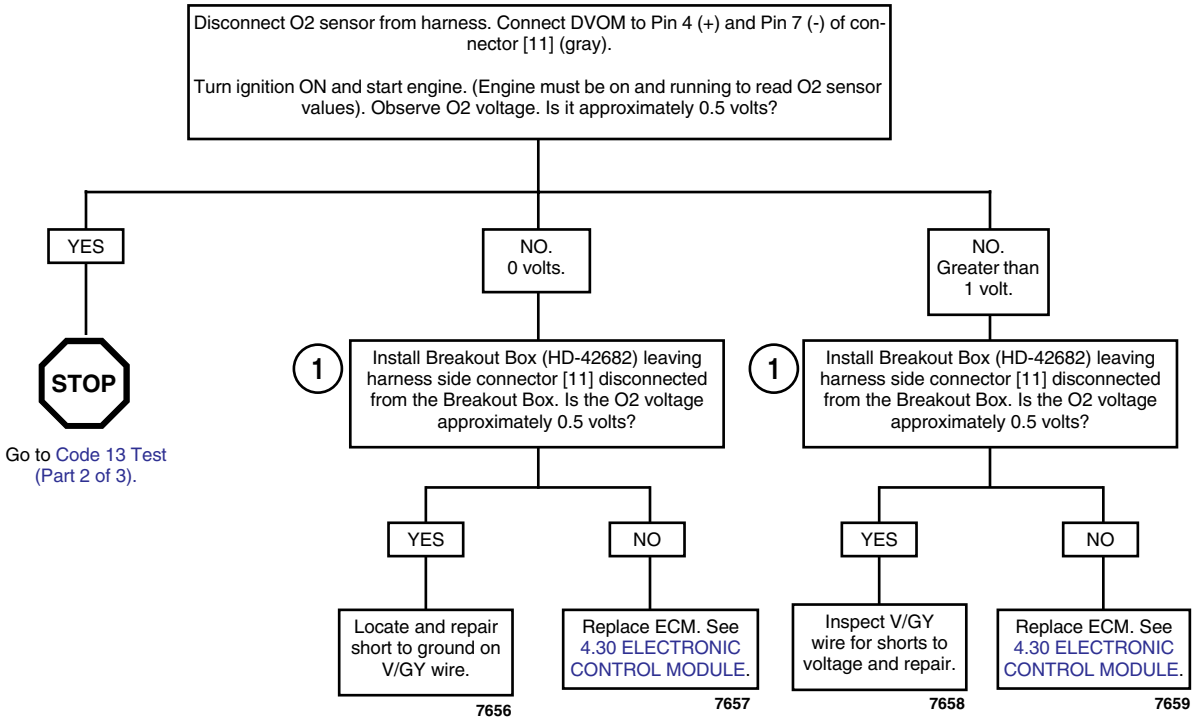


Figure 4-37. Oxygen Sensor Circuit

Table 4-19. Wire Harness Connectors in Figure 4-37.

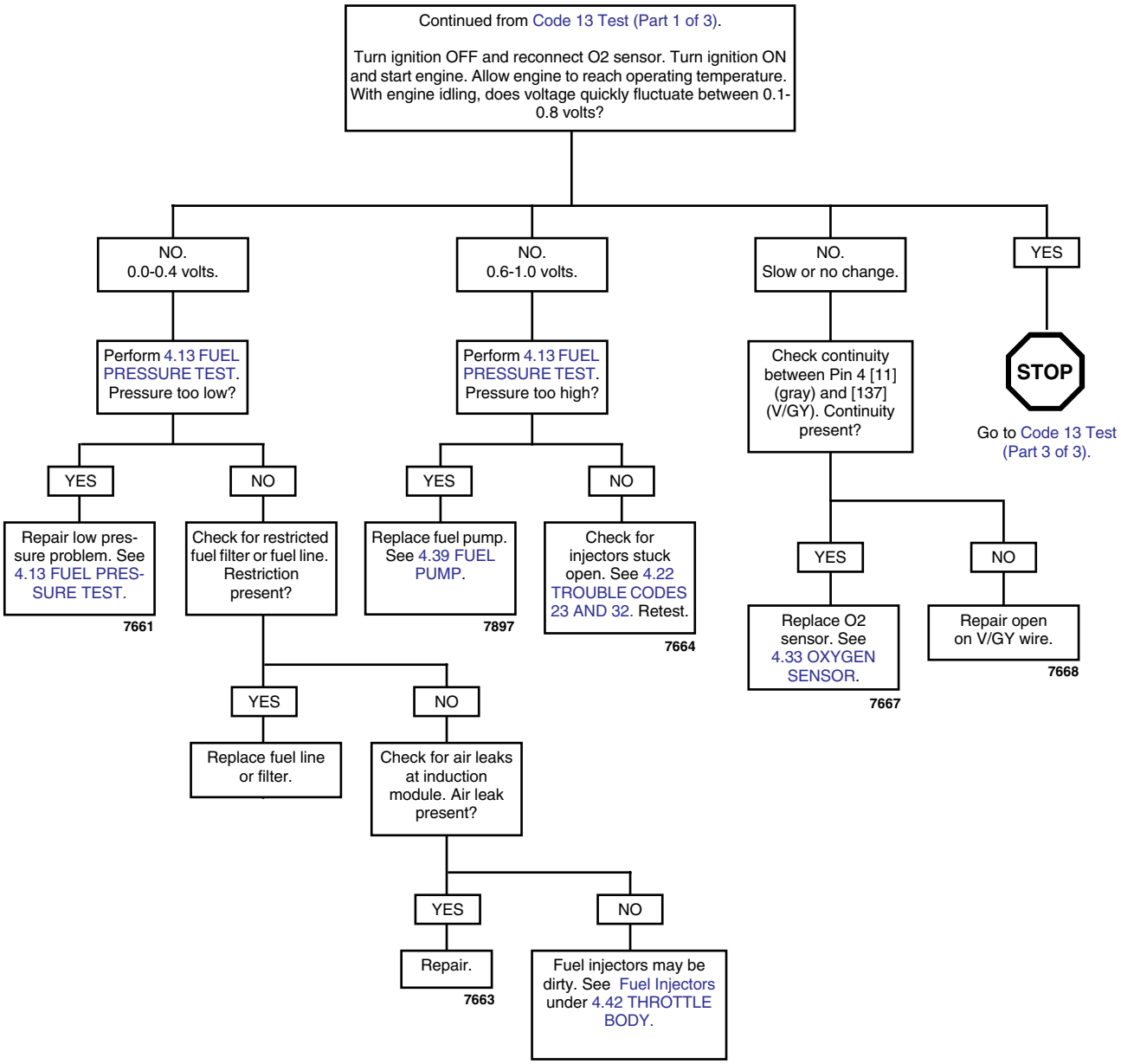
NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under seat
[137]	oxygen sensor	1-place Packard	behind rear cylinder head

Code 13 Test (Part 1 of 3)



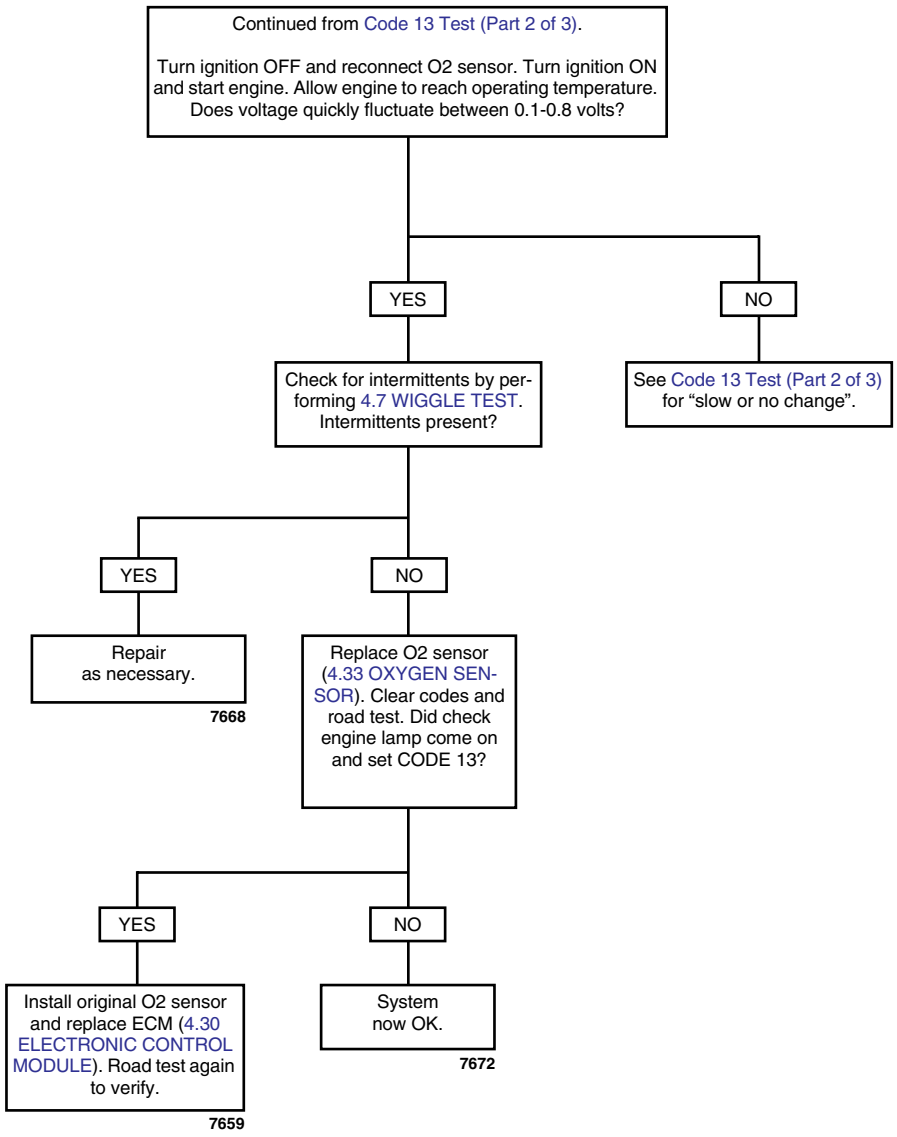
Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

Code 13 Test (Part 2 of 3)



Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

Code 13 Test (Part 3 of 3)



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:

- **Poor connection.** Inspect ECM harness connector [11] for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **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.

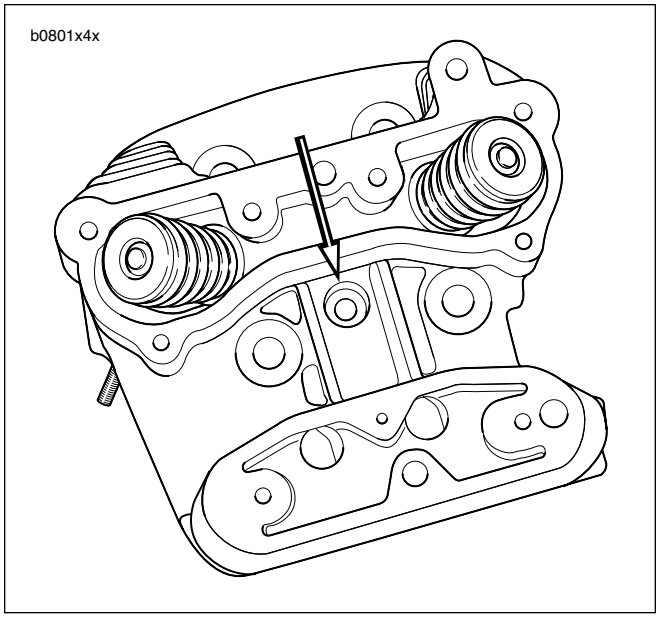


Figure 4-38. Location of Engine Temperature Sensor in Rear Cylinder Head

Table 4-20. Engine Temperature Sensor Specifications

VOLTS	RESISTANCE	TEMP °C	TEMP °F
0.00	0	300	572
0.21	145	255	491
0.42	303	210	410
0.62	463	190	374
0.81	638	170	338
1.20	1042	150	302
1.59	1539	130	266
3.01	4991	85	185
4.43	25,647	40	104
4.63	41,295	25	77
4.83	93,759	10	50
4.88	134,200	0	32
4.93	232,414	-10	14

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]).

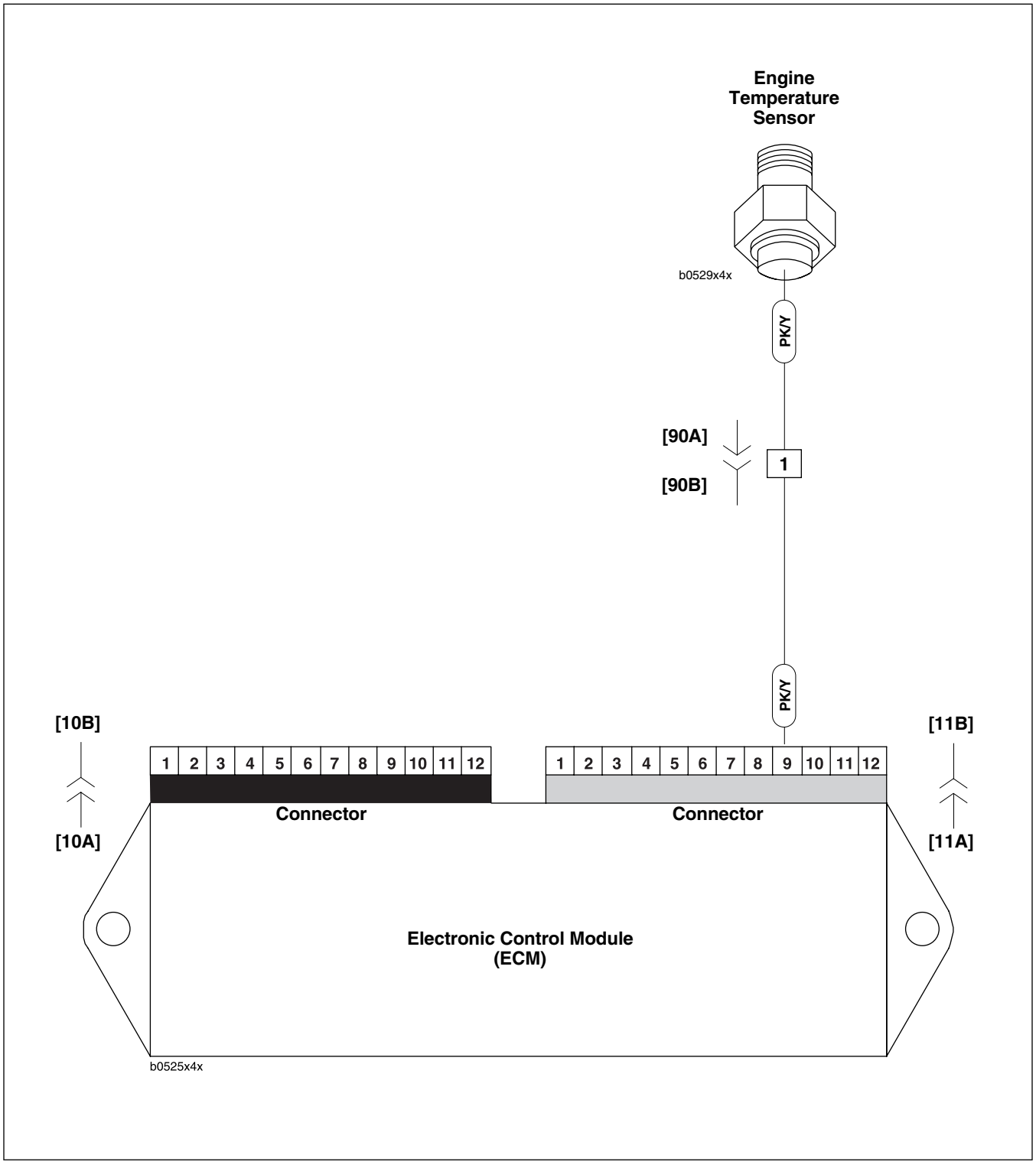
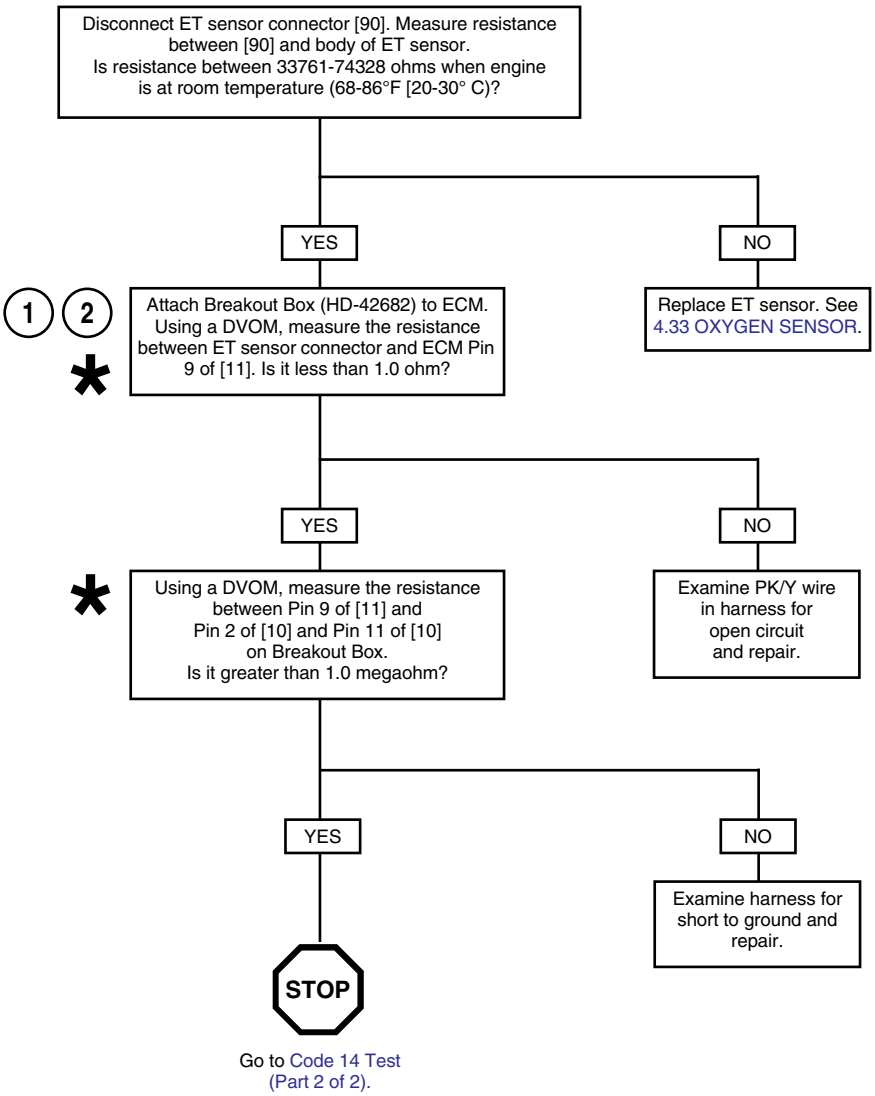


Figure 4-39. Engine Temperature Sensor Circuit

Table 4-21. Wire Harness Connectors in Figure 4-39.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under seat
[90]	engine temperature sensor	1-place bullet	beneath air cleaner assembly baseplate

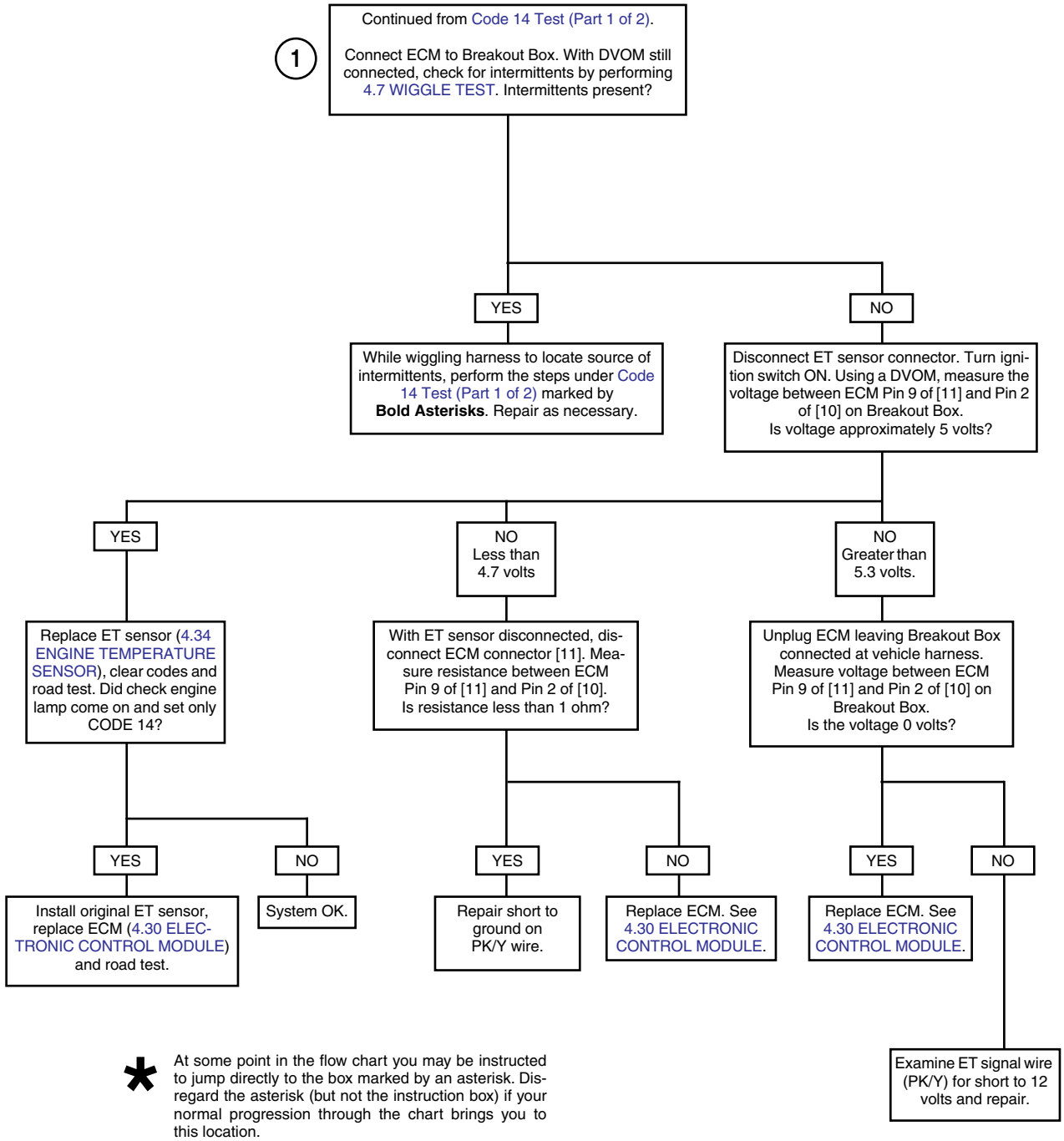
Code 14 Test (Part 1 of 2)



* 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).

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).

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]).

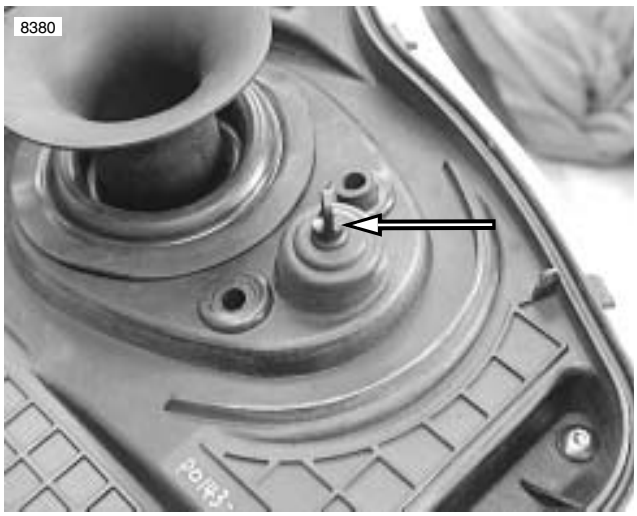


Figure 4-40. IAT Sensor

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 4-22. Intake Air Temperature Sensor Specifications

VOLTS	RESISTANCE	TEMP °C	TEMP °F
0.49	1086	125	257
0.68	1561	113	235
0.86	2077	100	212
1.13	2920	90	194
1.40	3889	80	176
2.25	8149	60	140
3.09	16,178	40	104
3.52	23,670	30	86
3.94	37,170	20	68
4.24	55,359	10	50
4.53	96,383	0	32
4.68	146,250	-10	14
4.83	284,118	-20	-4

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]).

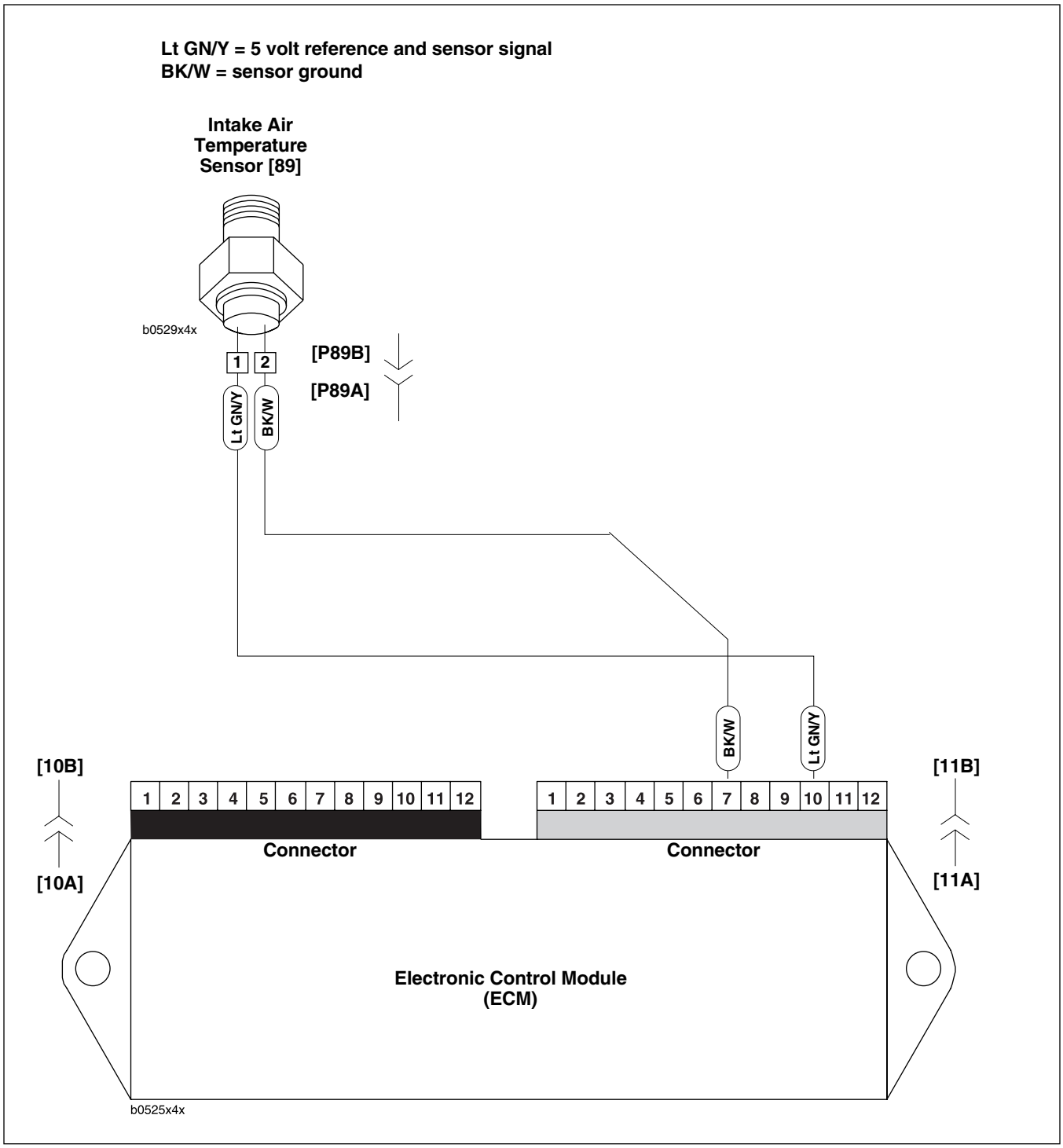
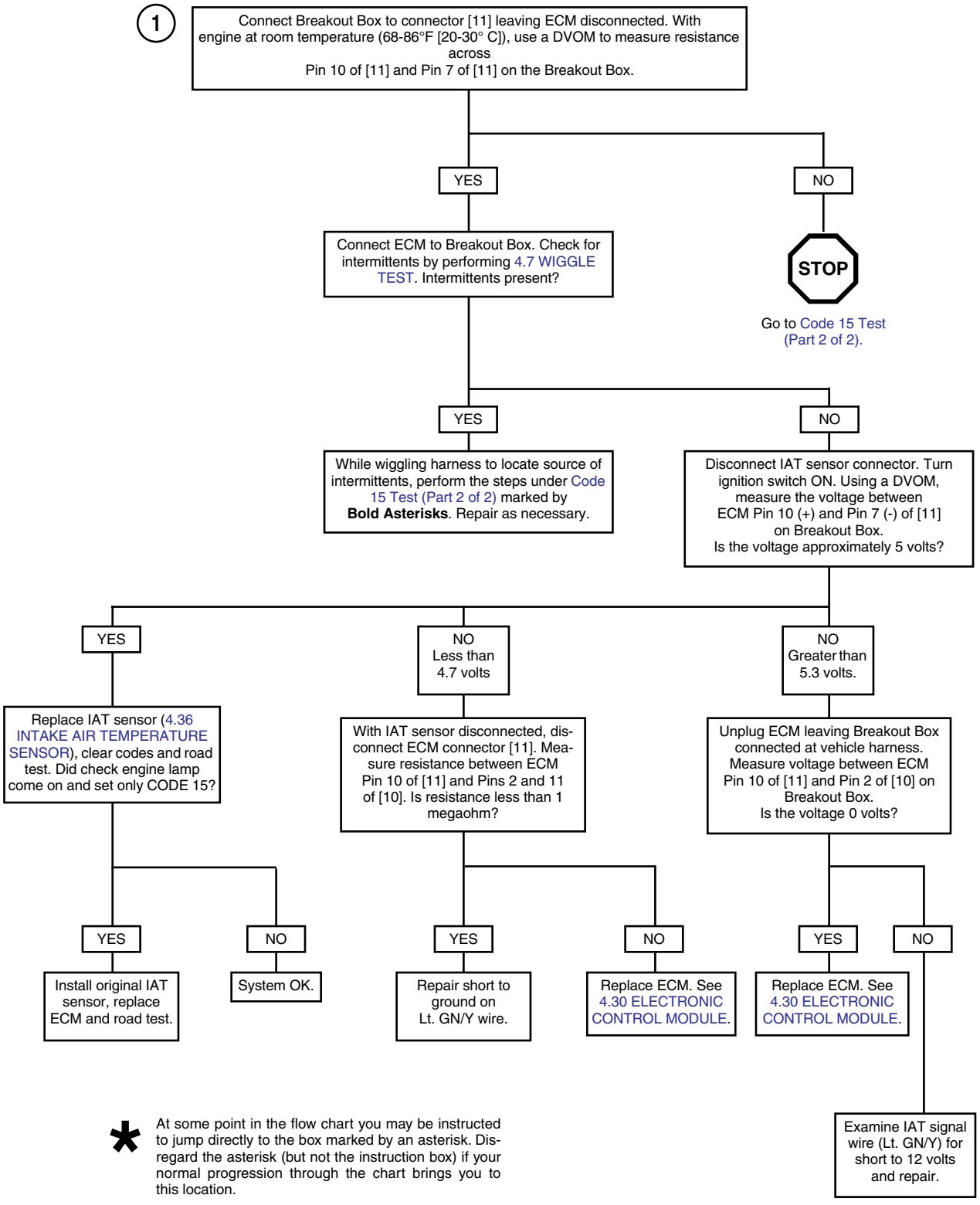


Figure 4-41. Intake Air Temperature Sensor Circuit

Table 4-23. Wire Harness Connectors in Figure 4-41.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under seat
[89]	intake air temperature sensor	2-place Amp	in air cleaner assembly baseplate

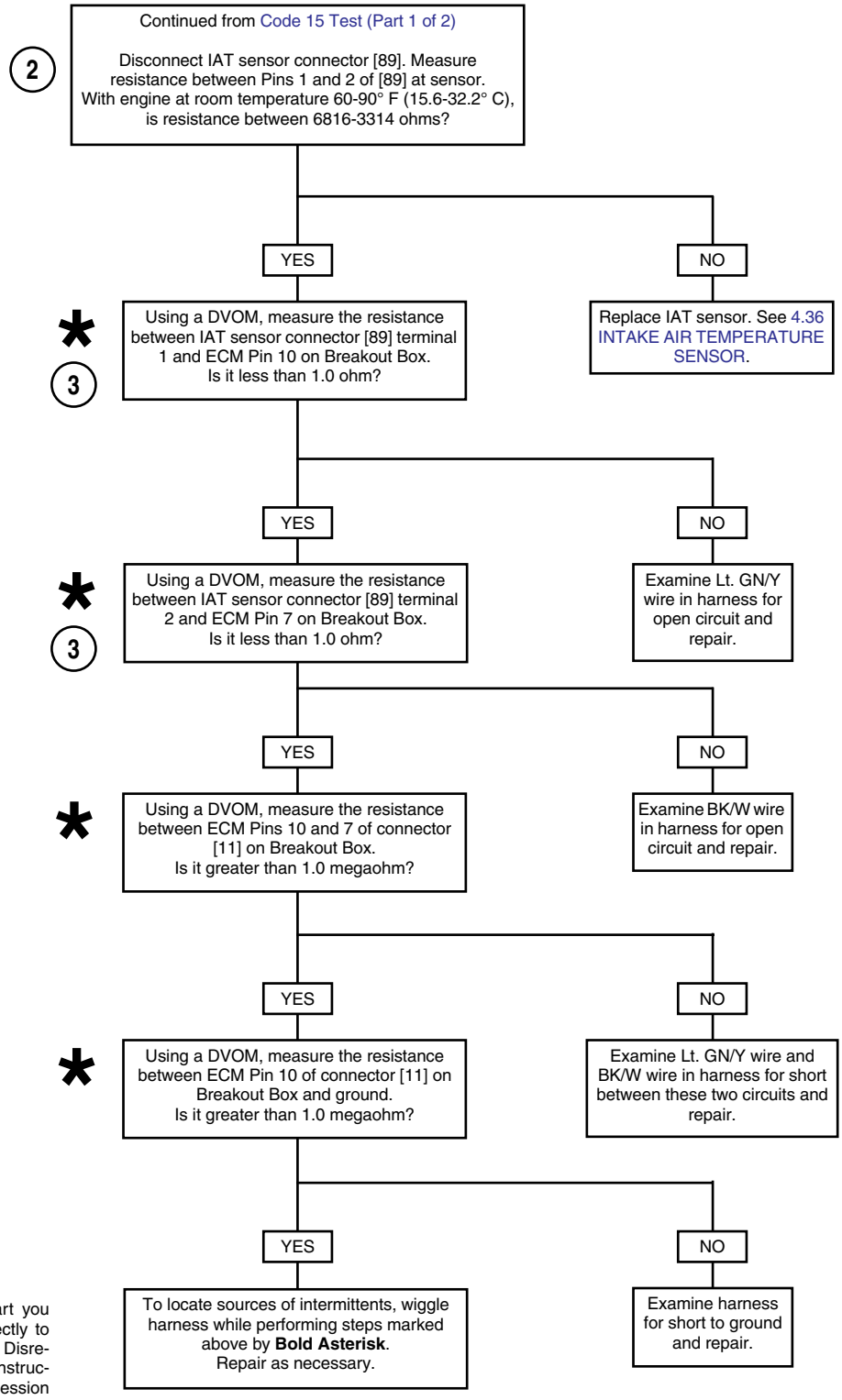
Code 15 Test (Part 1 of 2)



* 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).

Code 15 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).

TROUBLE CODE 16 4.20

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.

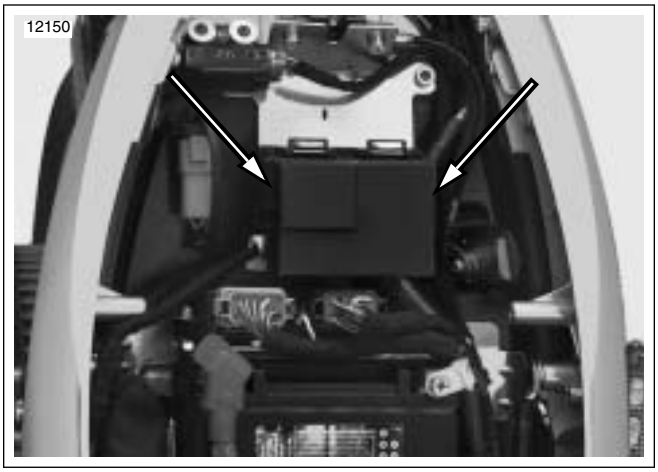
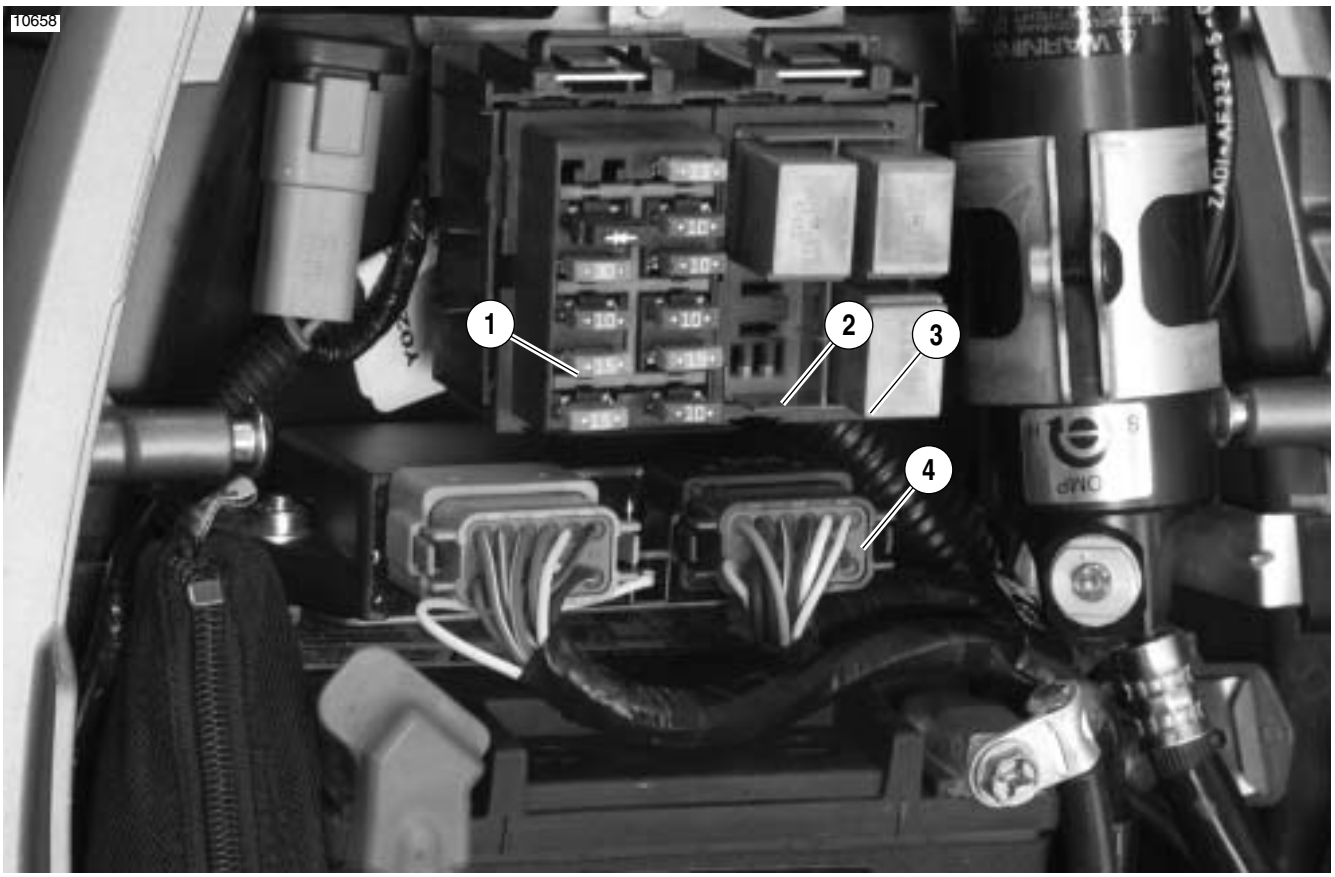


Figure 4-42. Fuse Block and Electrical Relays (XB12Ss)



1. **Fuse block**
2. **Key switch relay**
3. **Ignition relay**
4. **Start relay**

Figure 4-43. Fuse Block and Electrical Relays (Typical)

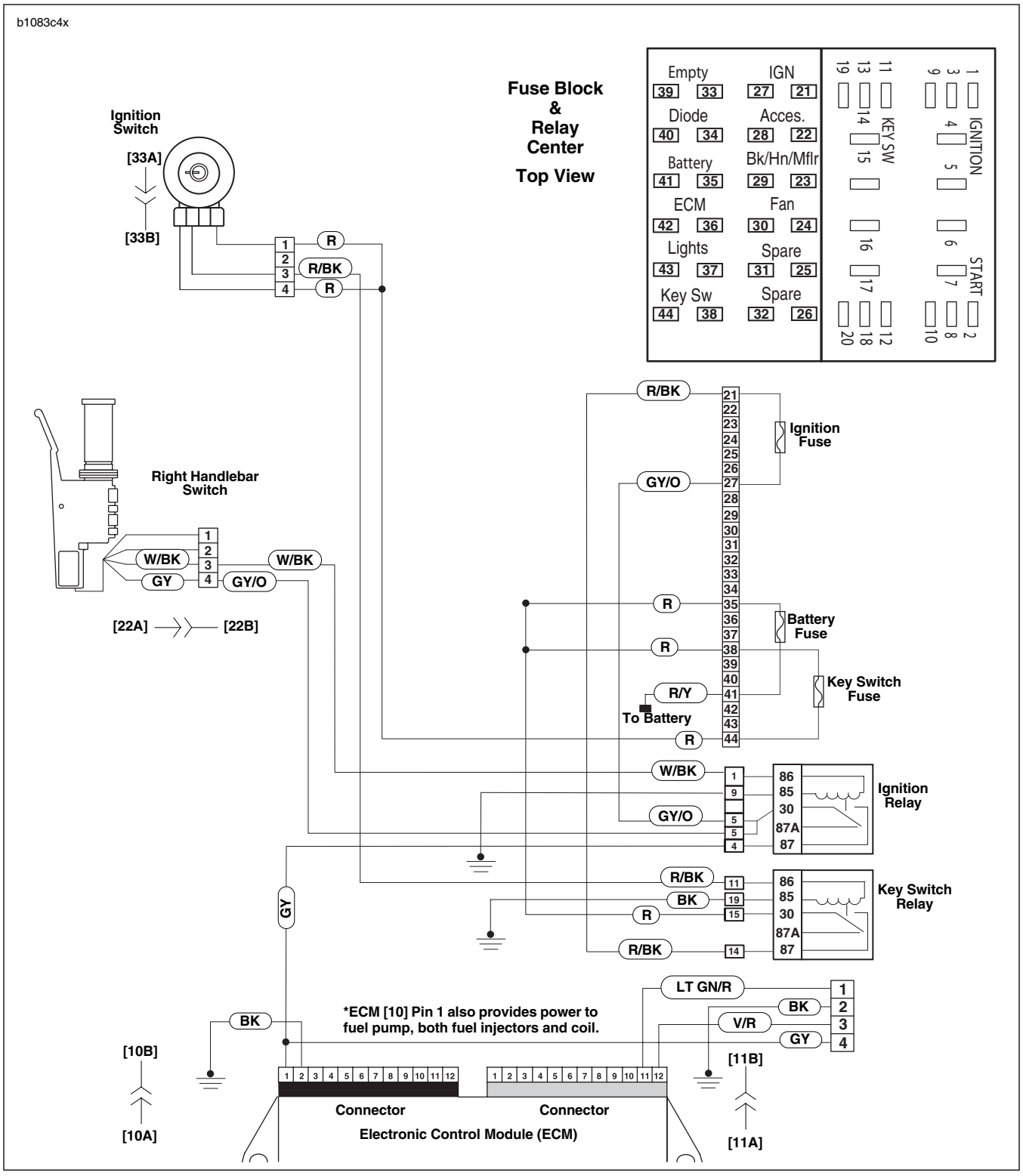
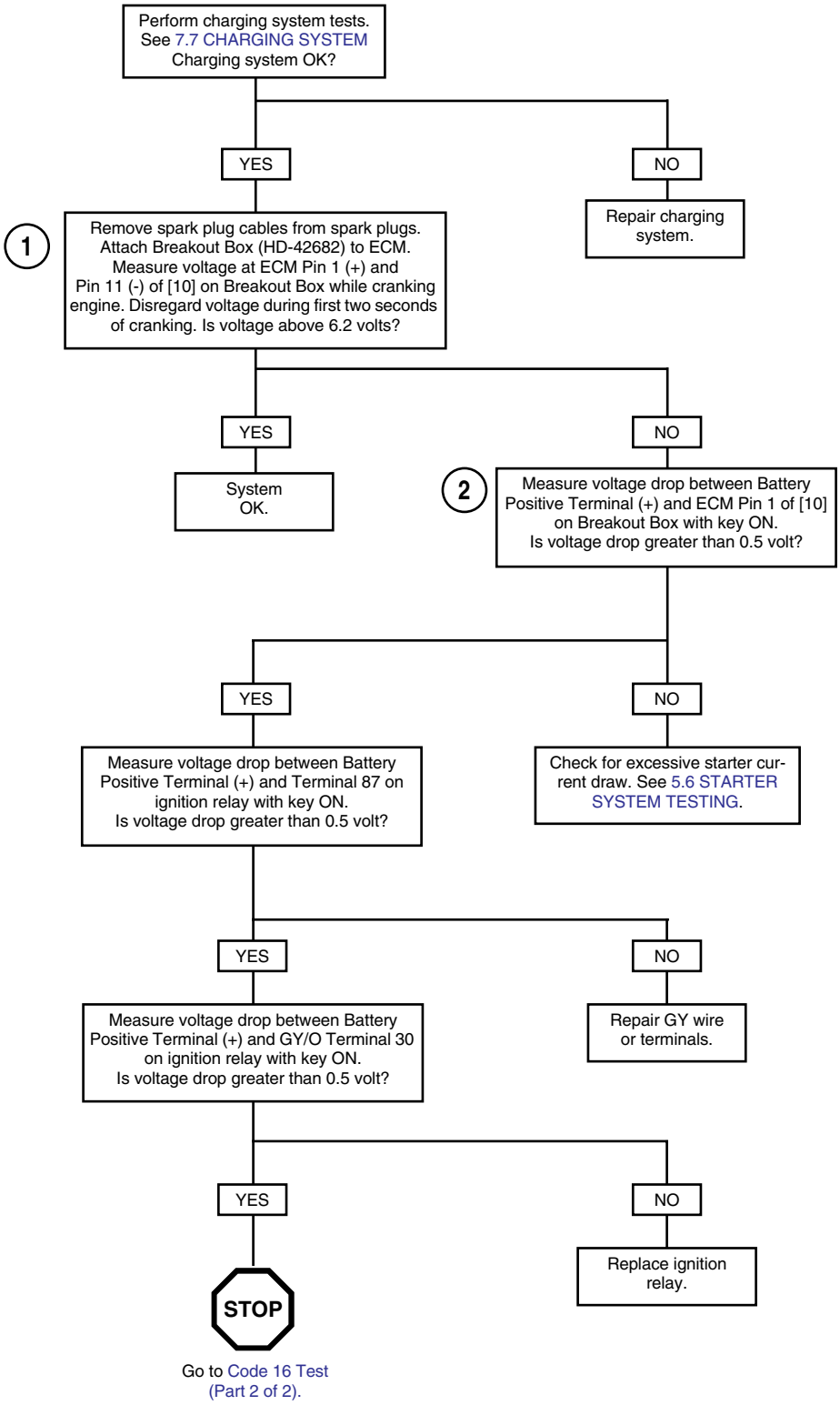


Figure 4-44. Battery Voltage Circuit

Table 4-24. Wire Harness Connectors in Figure 4-44.

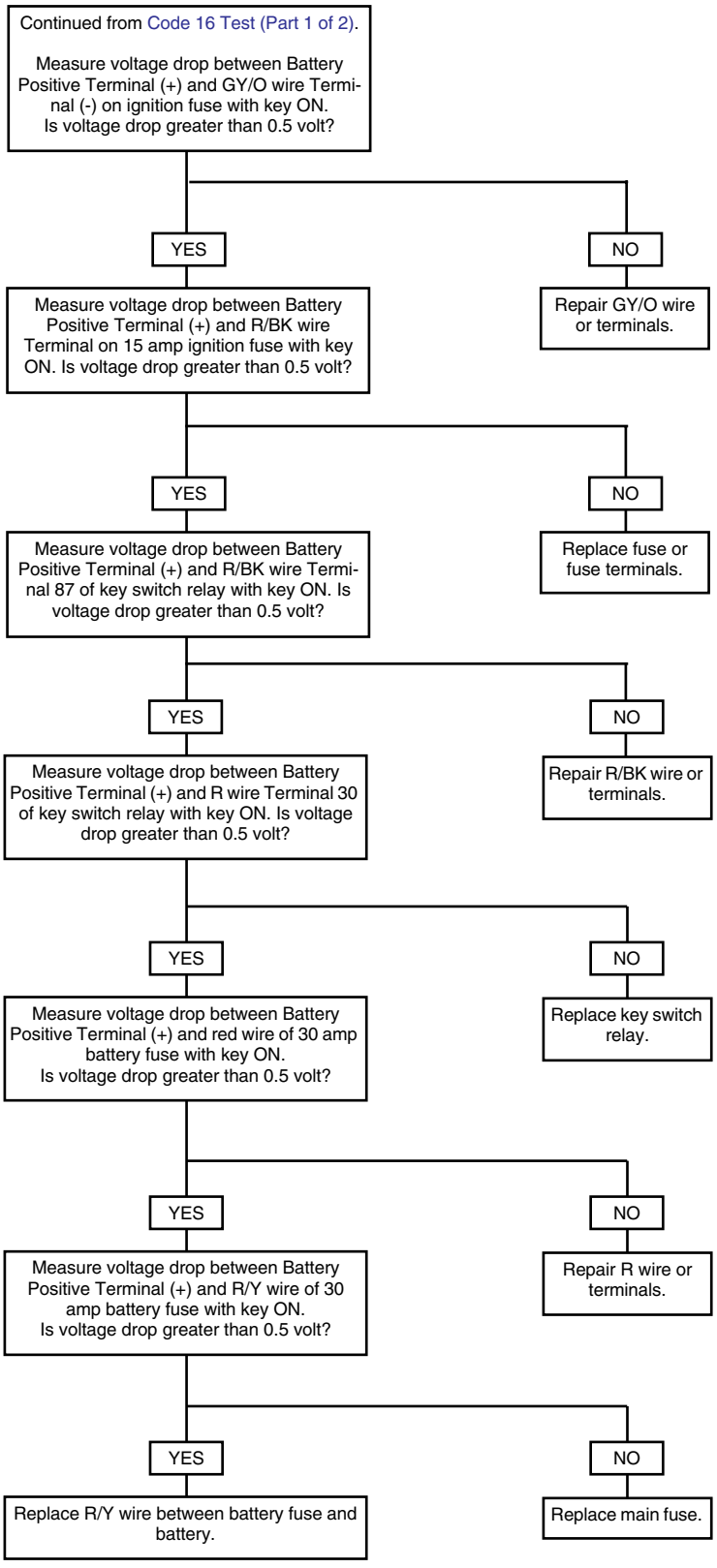
NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat

Code 16 Test (Part 1 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)



Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

TROUBLE CODE 21 4.21

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.

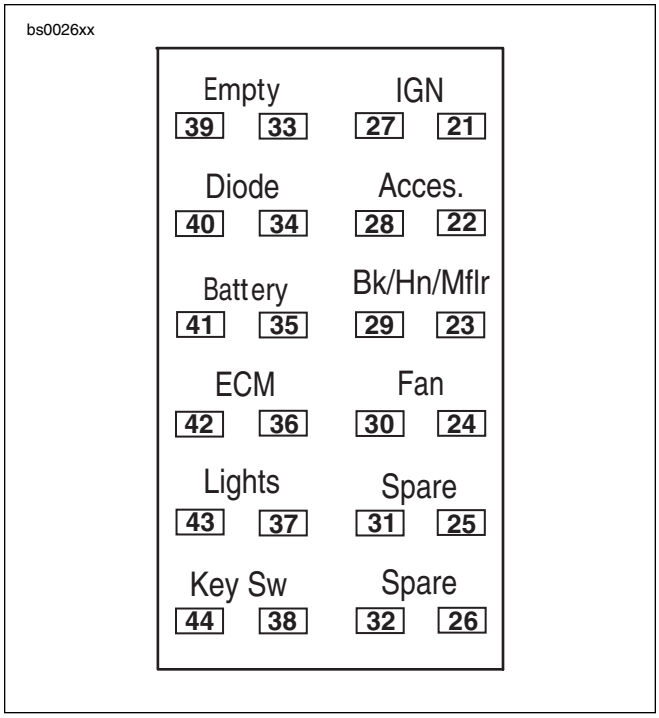


Figure 4-45. Fuses and Diodes

b1240x1x

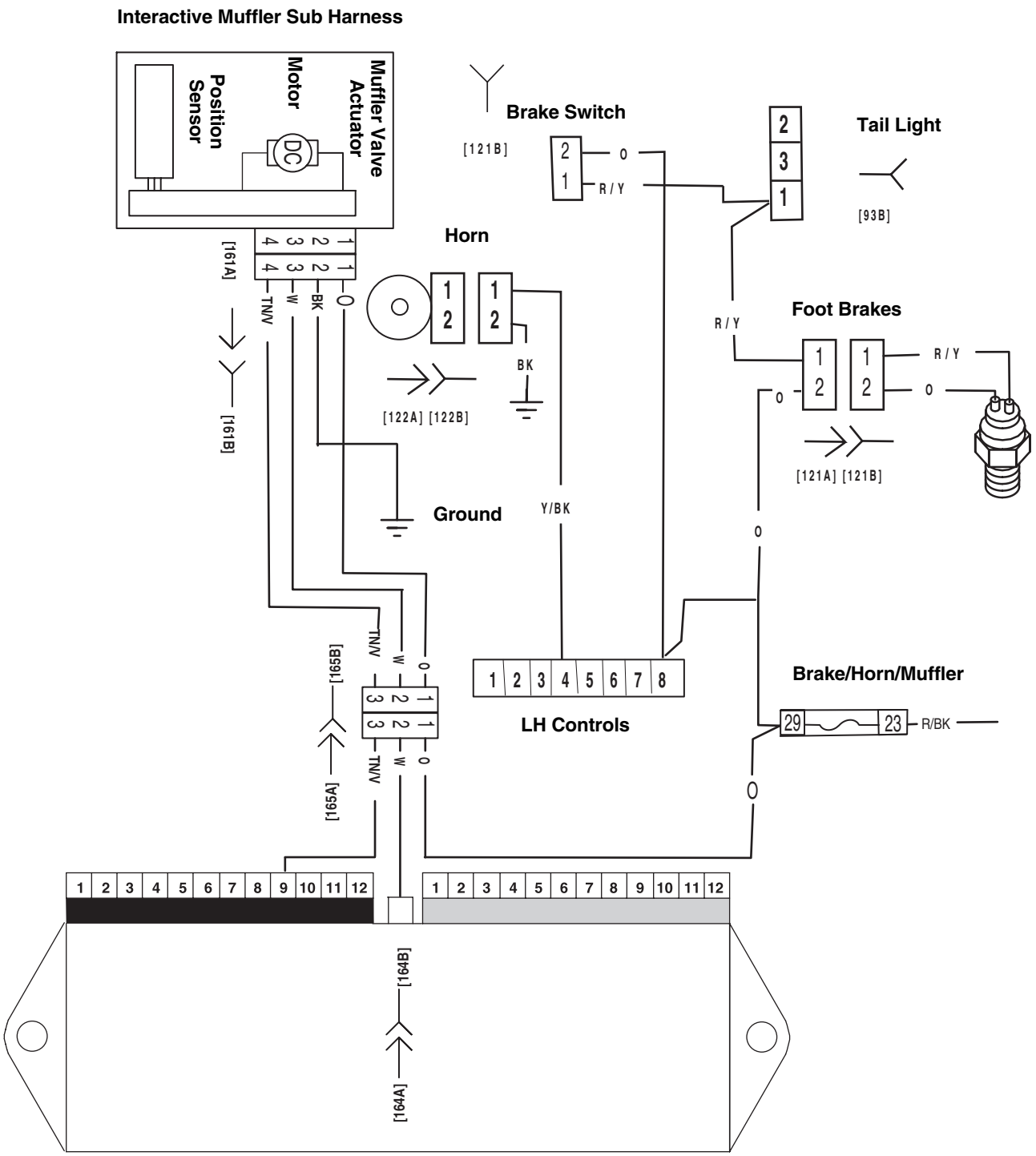
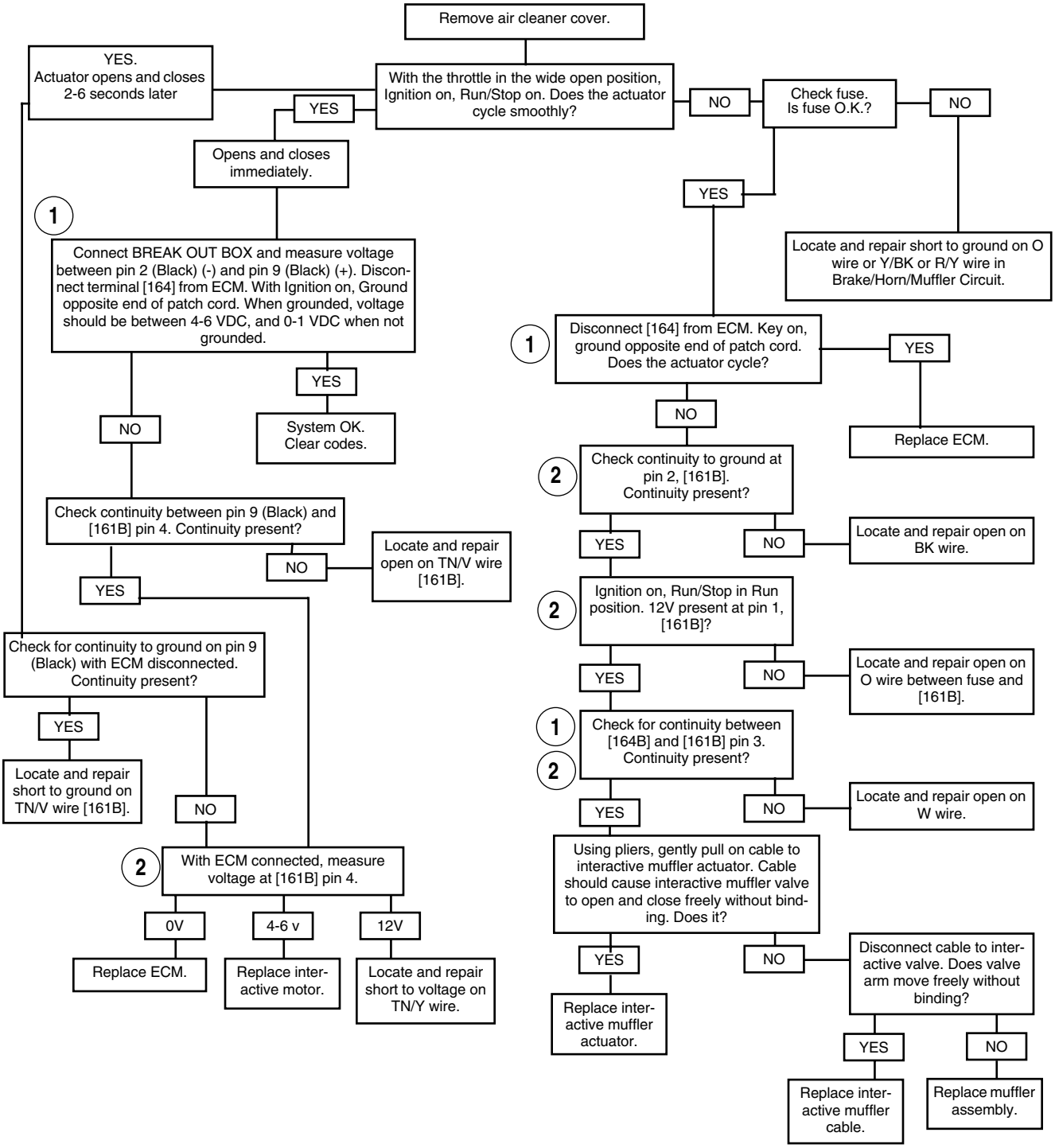


Figure 4-46. Interactive Exhaust Circuit

Code 21 Test


Remove air cleaner cover.
With the throttle in the wide open position, Ignition on, Run/Stop on. Does the actuator cycle smoothly?
YES
YES. Actuator opens and closes 2-6 seconds later
Opens and closes immediately.
NO
Check fuse. Is fuse O.K.?
NO
YES
Locate and repair short to ground on O wire or Y/BK or R/Y wire in Brake/Horn/Muffler Circuit.
1
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.
YES
System OK. Clear codes.
NO
Check continuity between pin 9 (Black) and [161B] pin 4. Continuity present?
NO
Locate and repair open on TN/V wire [161B].
YES
Check for continuity to ground on pin 9 (Black) with ECM disconnected. Continuity present?
YES
Locate and repair short to ground on TN/V wire [161B].
NO
2
With ECM connected, measure voltage at [161B] pin 4.
0V
4-6 v
12V
Replace ECM.
Replace interactive motor.
Locate and repair short to voltage on TN/Y wire.
1
Disconnect [164] from ECM. Key on, ground opposite end of patch cord. Does the actuator cycle?
YES
Replace ECM.
NO
2
Check continuity to ground at pin 2, [161B]. Continuity present?
YES
NO
Locate and repair open on BK wire.
2
Ignition on, Run/Stop in Run position. 12V present at pin 1, [161B]?
YES
NO
Locate and repair open on O wire between fuse and [161B].
1
2
Check for continuity between [164B] and [161B] pin 3. Continuity present?
YES
NO
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?
YES
Replace interactive muffler actuator.
NO
Disconnect cable to interactive valve. Does valve arm move freely without binding?
YES
Replace interactive muffler cable.
NO
Replace muffler assembly.

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.

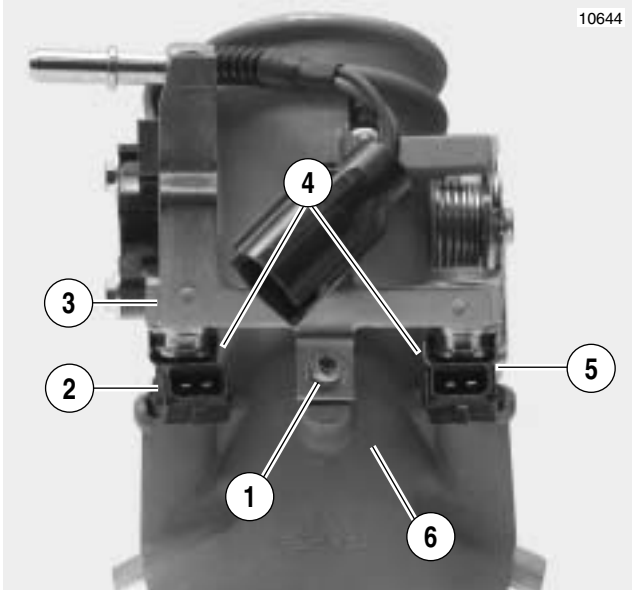
NOTE

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.



1. **Fuel rail fastener**
2. **Rear fuel injector**
3. **Fuel rail assembly**
4. **Clip (2)**
5. **Front fuel injector**

Figure 4-47. Fuel Injectors

DIAGNOSTICS

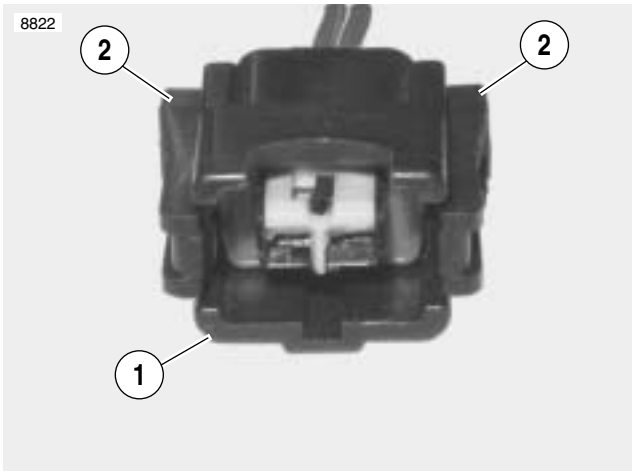
Diagnostic Notes

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).



1. **Fuel injector connector**
2. **Tab**

Figure 4-48. Fuel Injector Connector

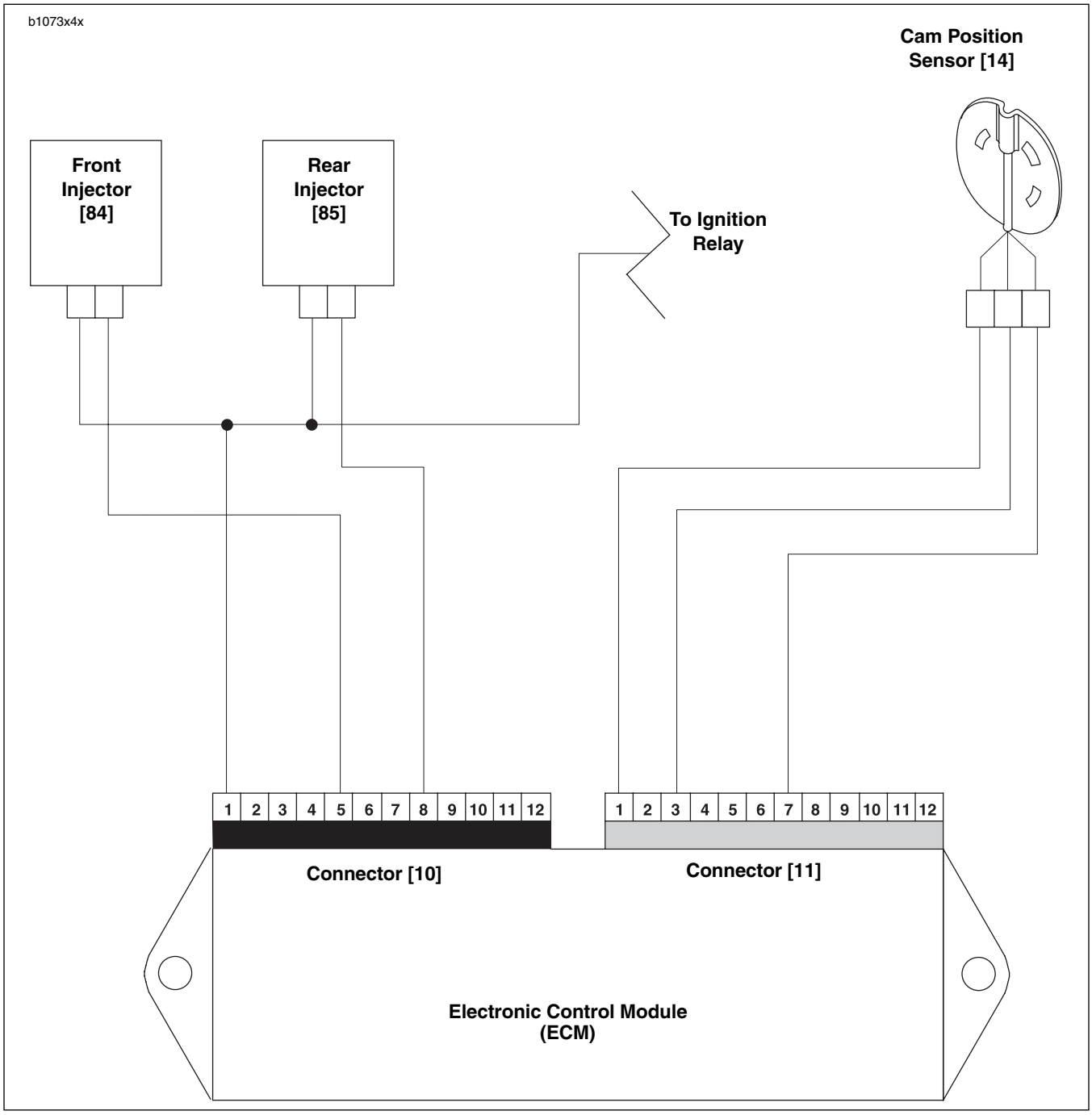
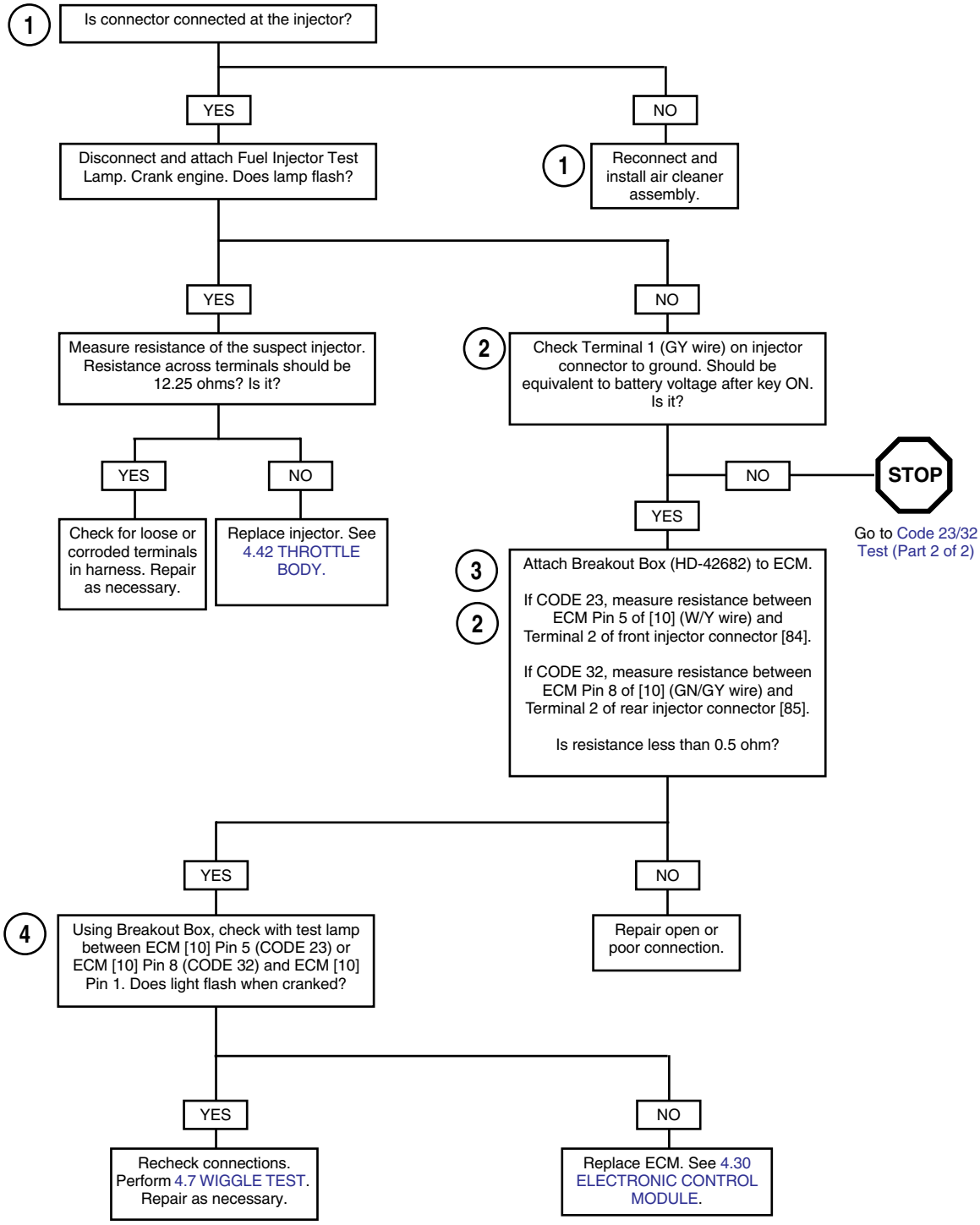


Figure 4-49. Interactive Exhaust Circuit

Table 4-25. Wire Harness Connectors in Figure 4-49.

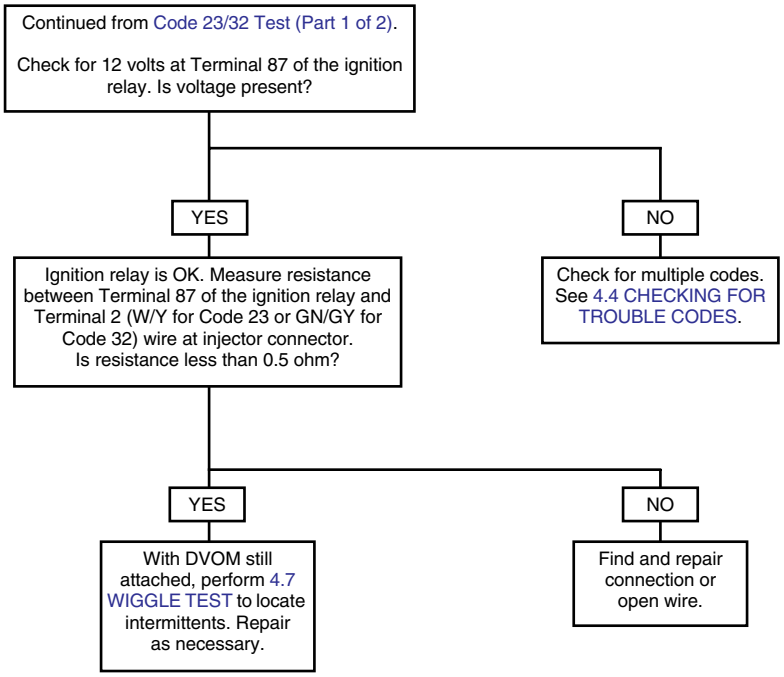
NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[161]	Interactive muffler actuator	4-place Deutsch	under intake cover assembly
[164]	ECM	1-place Amp	under seat
[165]	sub-harness	3-place Packard	beneath air cleaner assembly baseplate

Code 23/32 Test (Part 1 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 23/32 Test (Part 2 of 2)



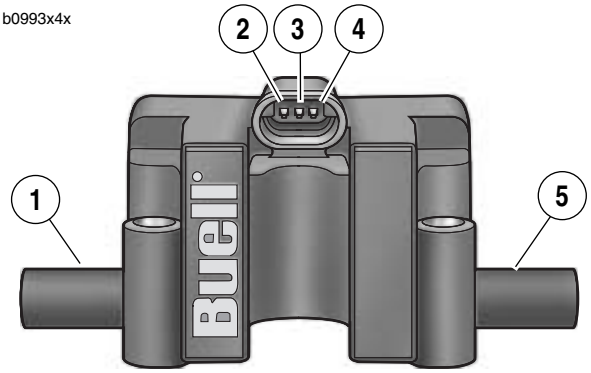
Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

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.



1. **Front cylinder post**
2. **Coil Pin A (rear cylinder)**
3. **Coil Pin B (12 VDC)**
4. **Coil Pin C (front cylinder)**
5. **Rear cylinder post**

Figure 4-50. Ignition Coil

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.



Figure 4-51. Testing Ignition Coil Connectors

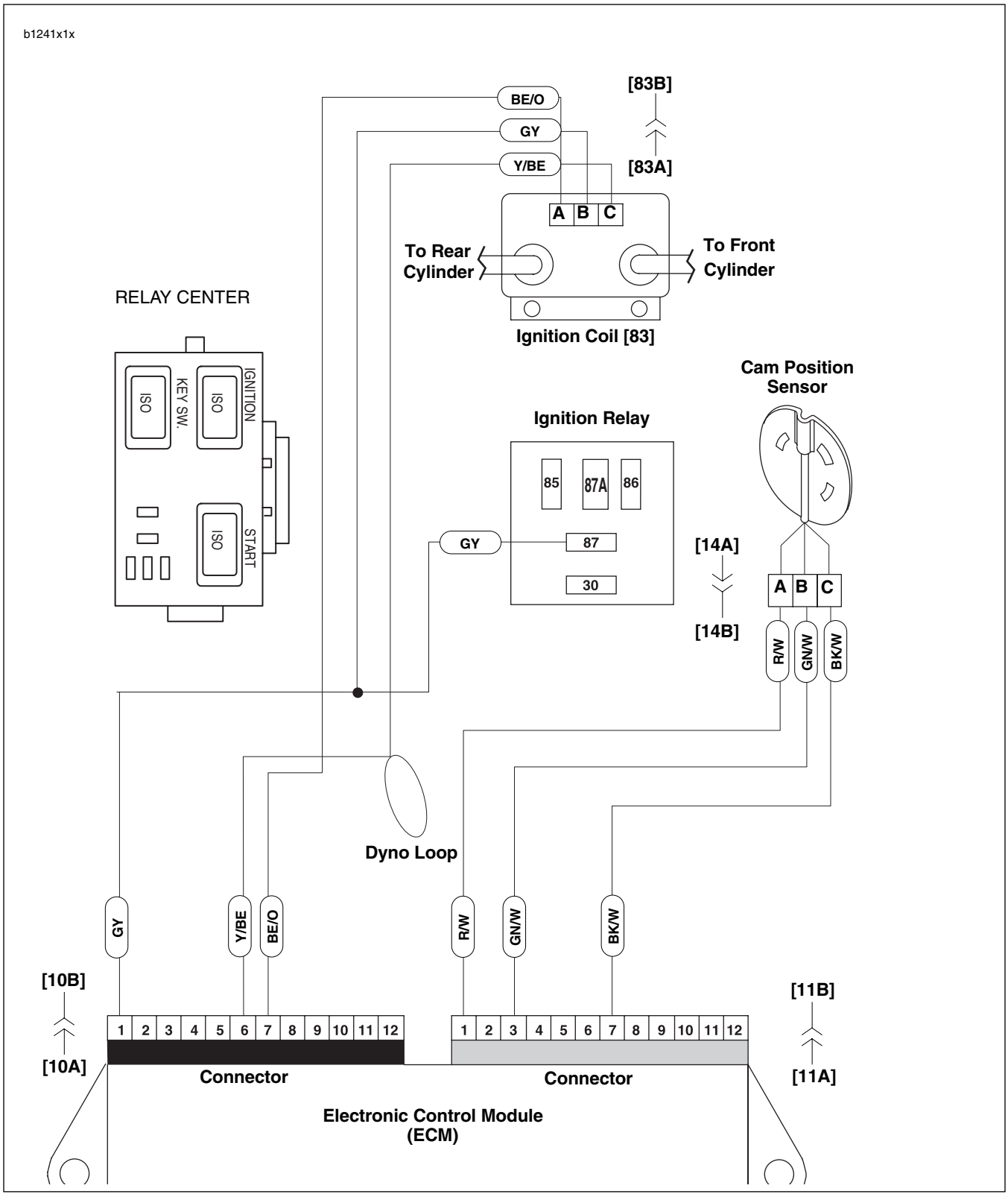
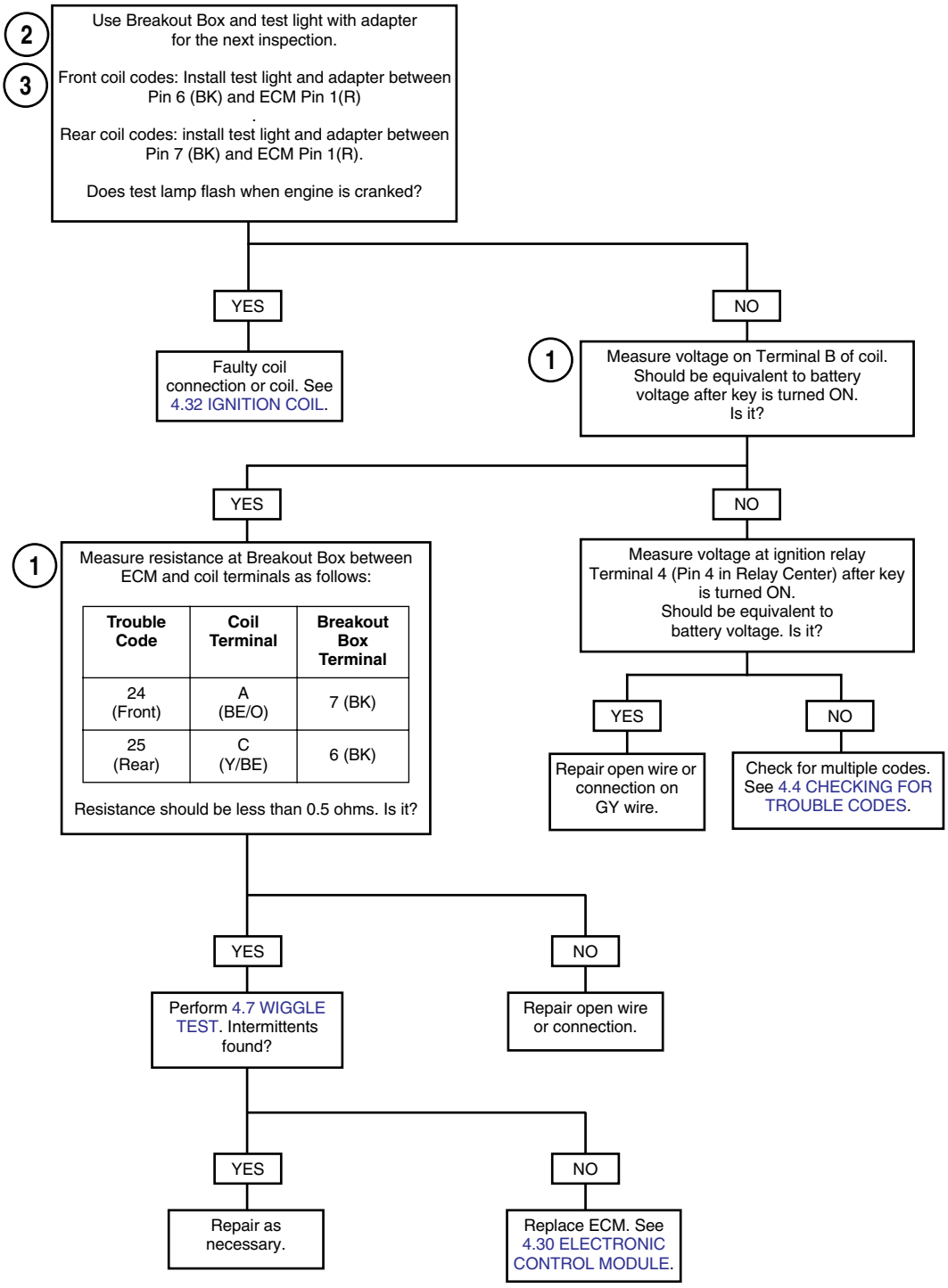


Figure 4-52. Ignition Coil Circuit

Table 4-26. Wire Harness Connectors in Figure 4-52.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[83]	ignition coil	3-place Packard	beneath air cleaner assembly baseplate

Code 24/25 Test



Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

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.



1. **Fuel screen**
2. **Wiring harness**
3. **Pressure regulator**
4. **Low fuel level sensor**

Figure 4-53. Fuel Pump Assembly

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.

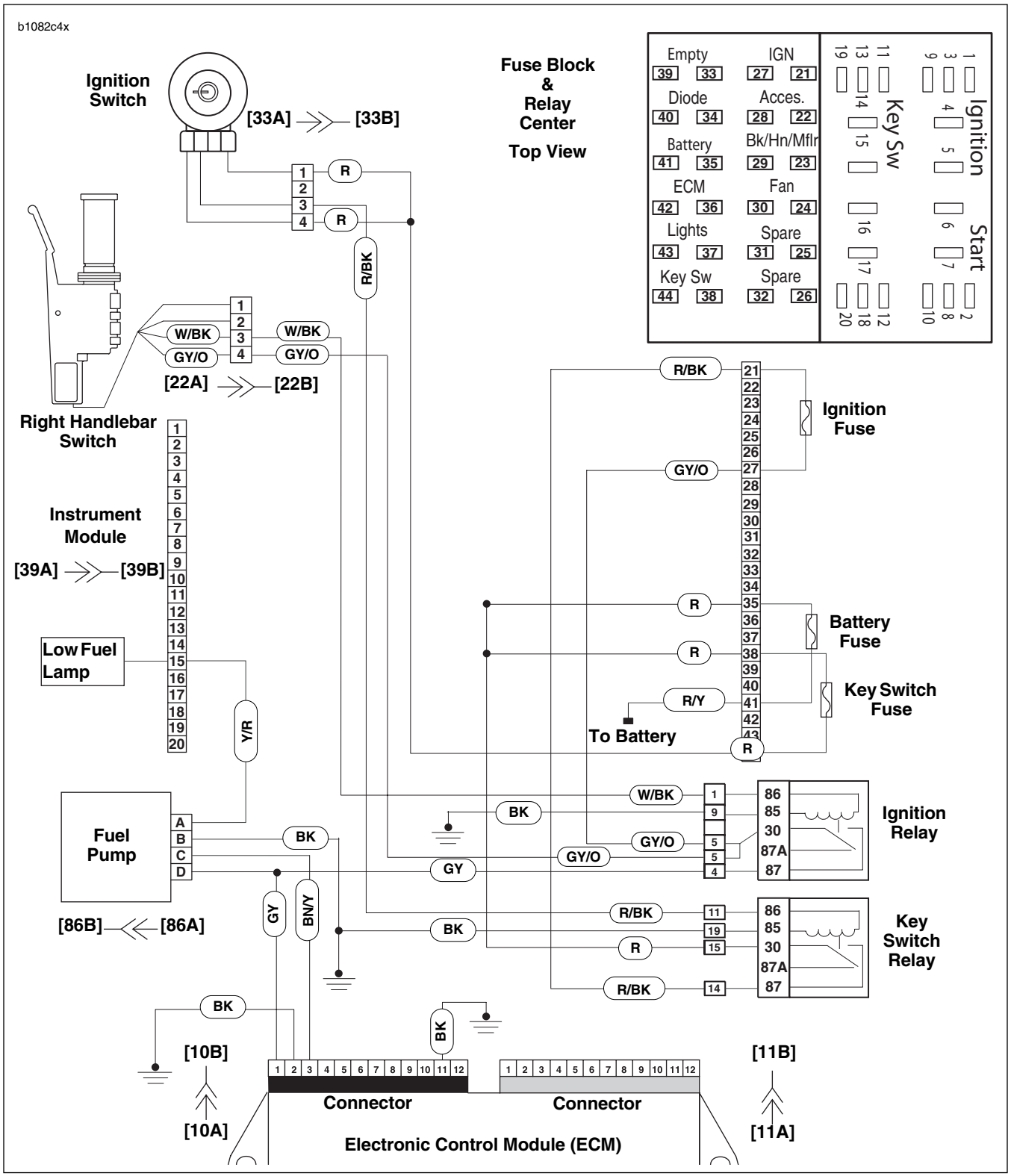
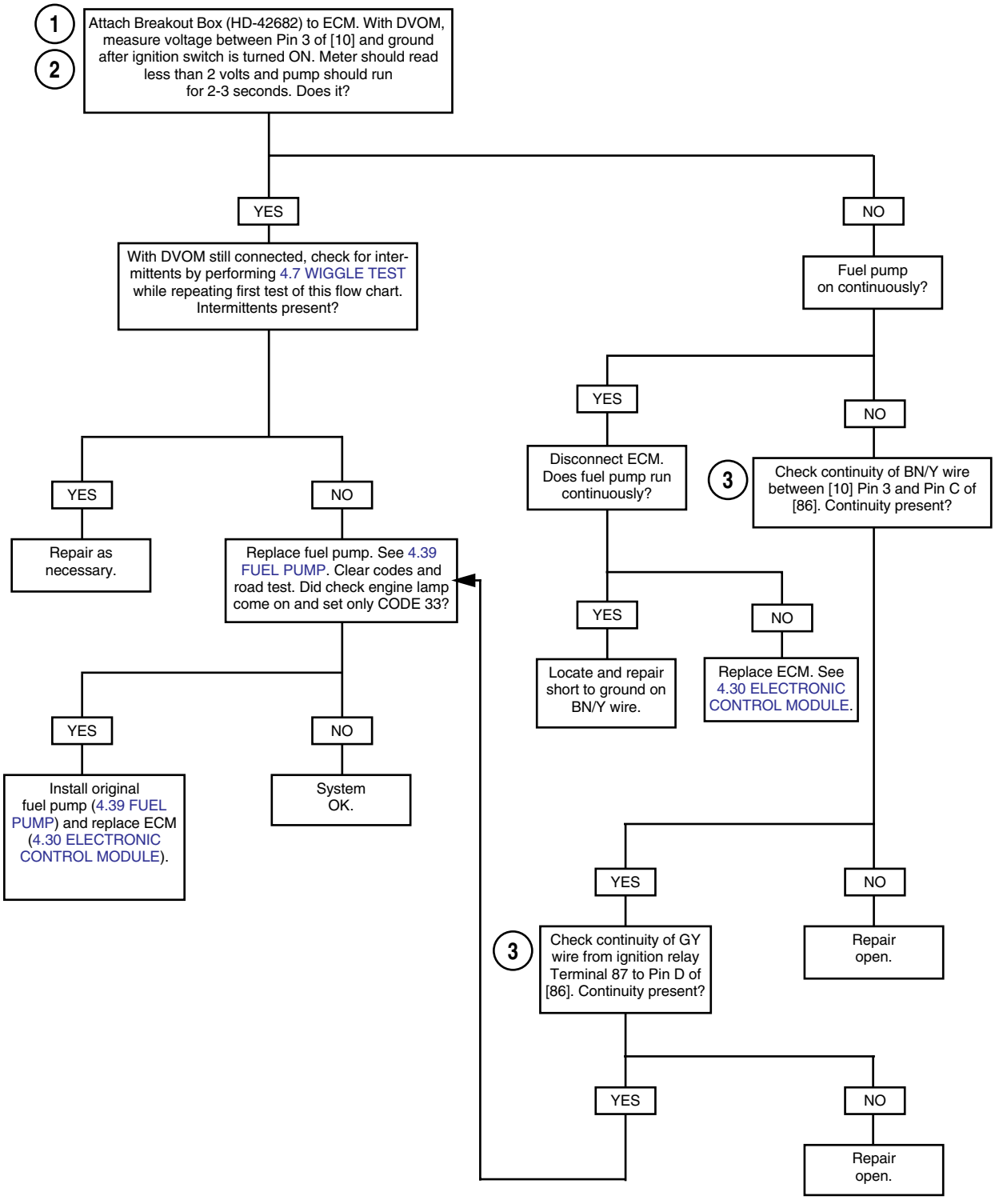


Figure 4-54. Fuel Pump Circuit

Table 4-27. Wire Harness Connectors in Figure 4-54.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[39]	instrument module	20-place Multilock	behind windscreen
[86]	fuel pump	4-place Multilock	left side of rear shock absorber

Code 33 Test



Clear codes and confirm proper operation with no check engine lamp. Codes can be cleared using DIGITAL TECHNICIAN (Part No. HD-44750).

GENERAL

Tachometer

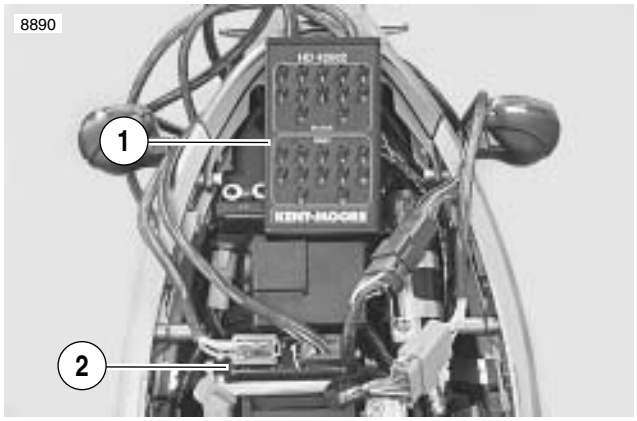
A Code 35 will set if the PK tachometer wire is shorted to power or ground.

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.



1. **Breakout box**
2. **ECM**

Figure 4-55. Installed Breakout Box (Typical)

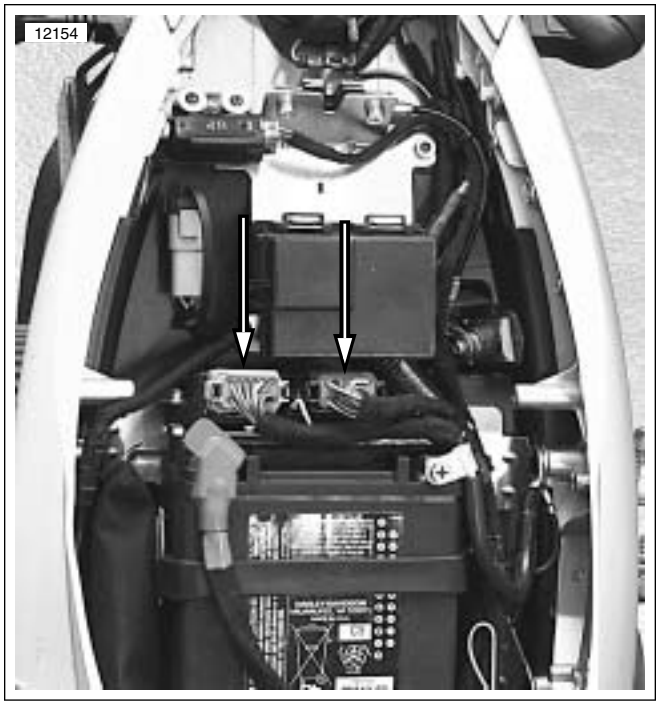


Figure 4-56. ECM Connections (XB12Ss)

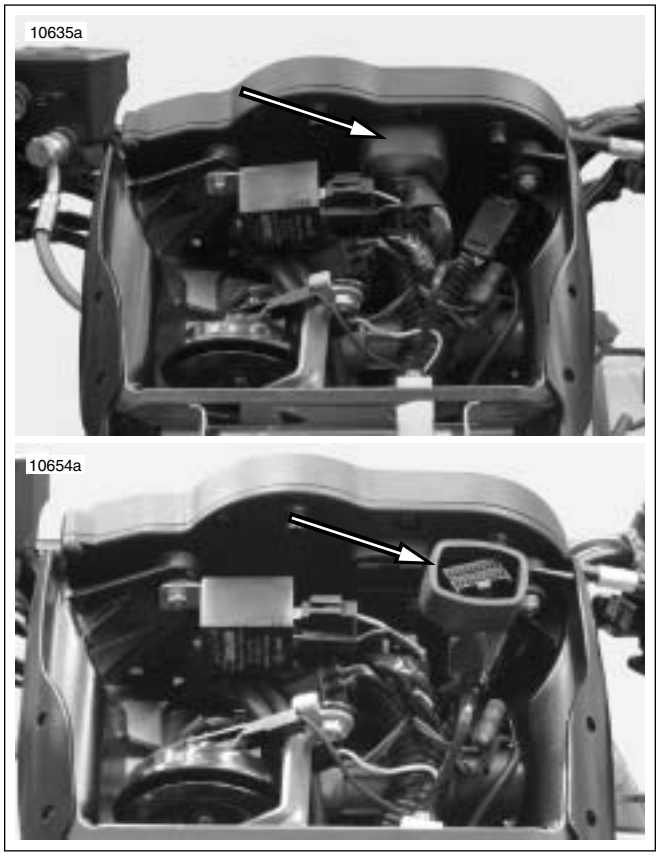


Figure 4-57. Instrument Module Connector [39] (Typical)

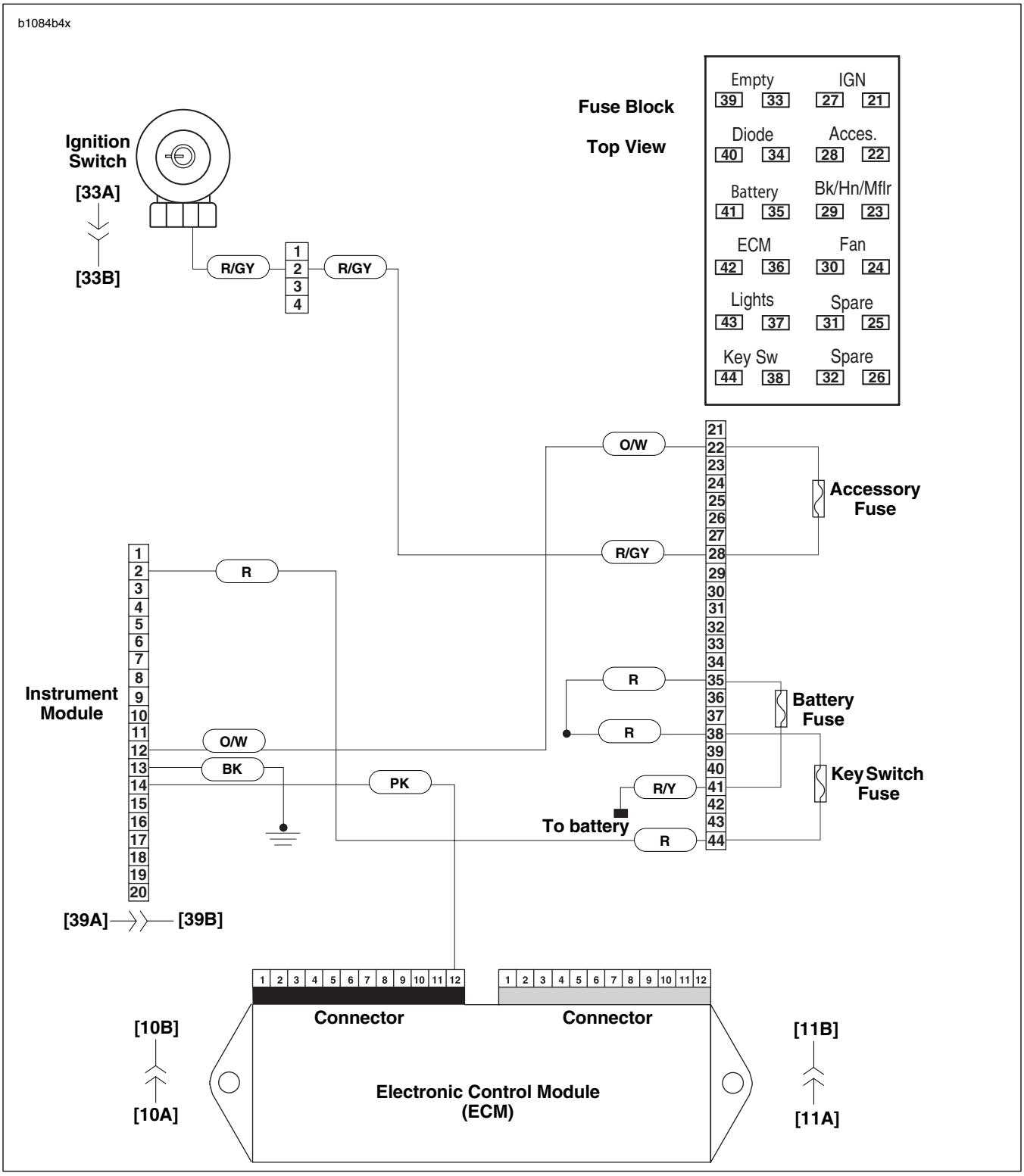
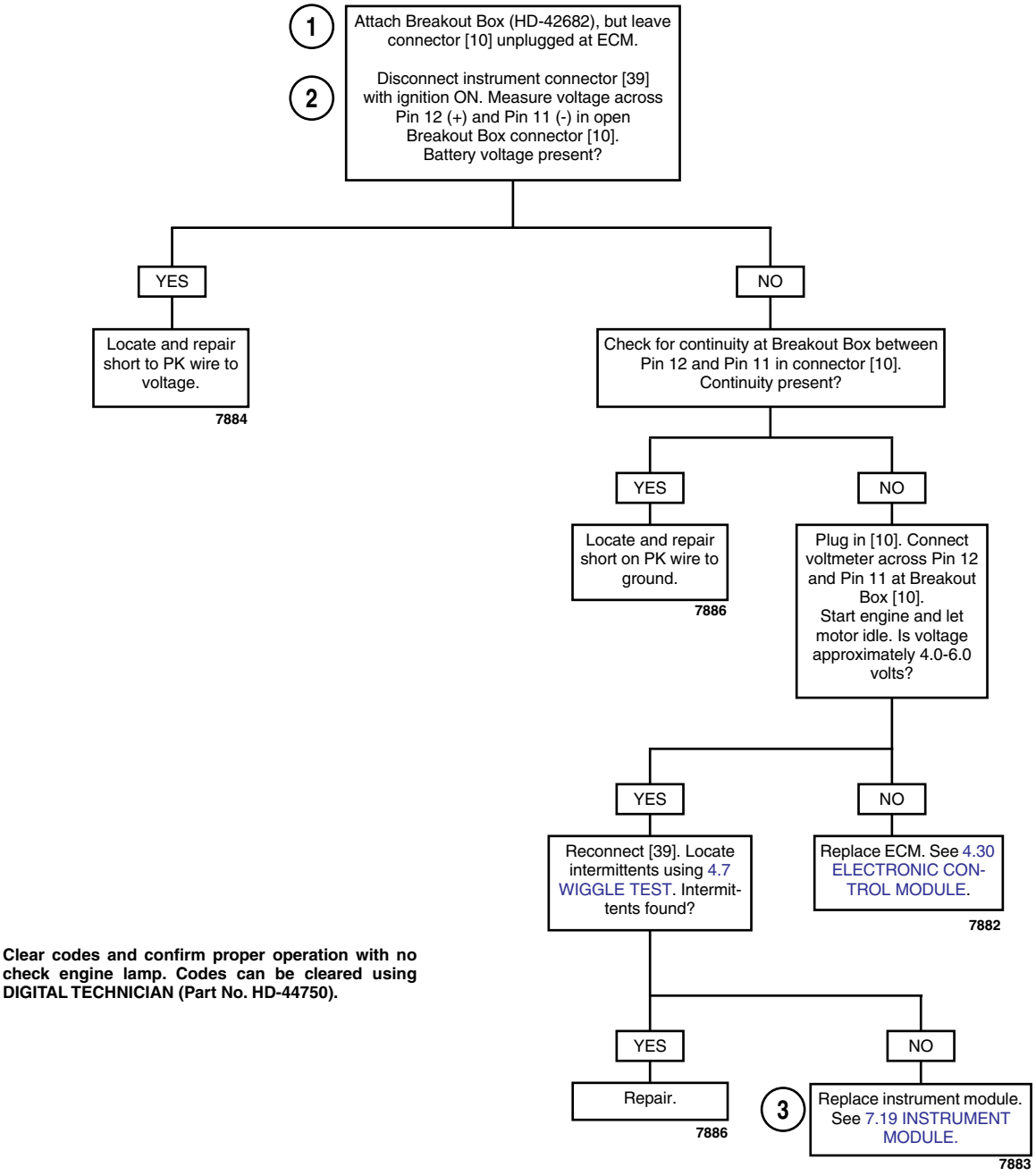


Figure 4-58. Tachometer Circuit

Table 4-28. Wire Harness Connectors in Figure 4-58.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[39]	instrument module	20-place Multilock	behind windscreen

Code 35 Test



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.

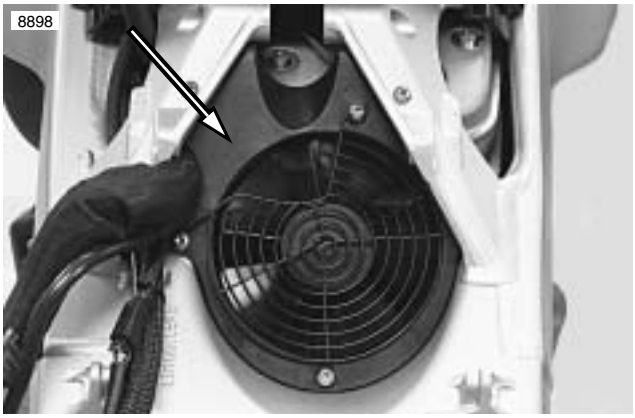


Figure 4-59. Cooling Fan

Table 4-29. Cooling Fan Specifications

	FAN ON	FAN OFF
Key ON	220° C (428° F)	180° C (356° F)
Key OFF	170° C (338° F)	150° C (302° F)

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.

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.

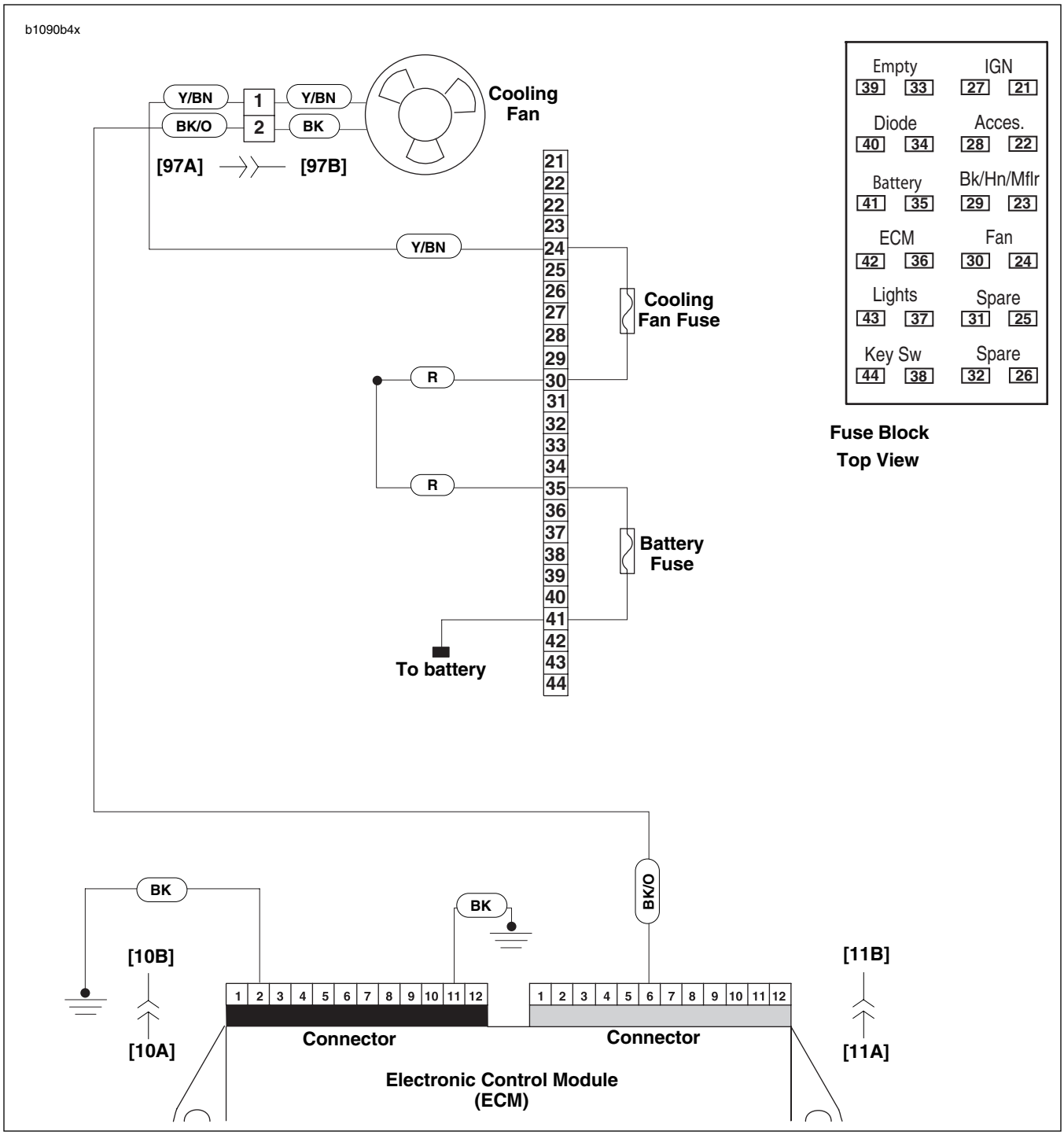
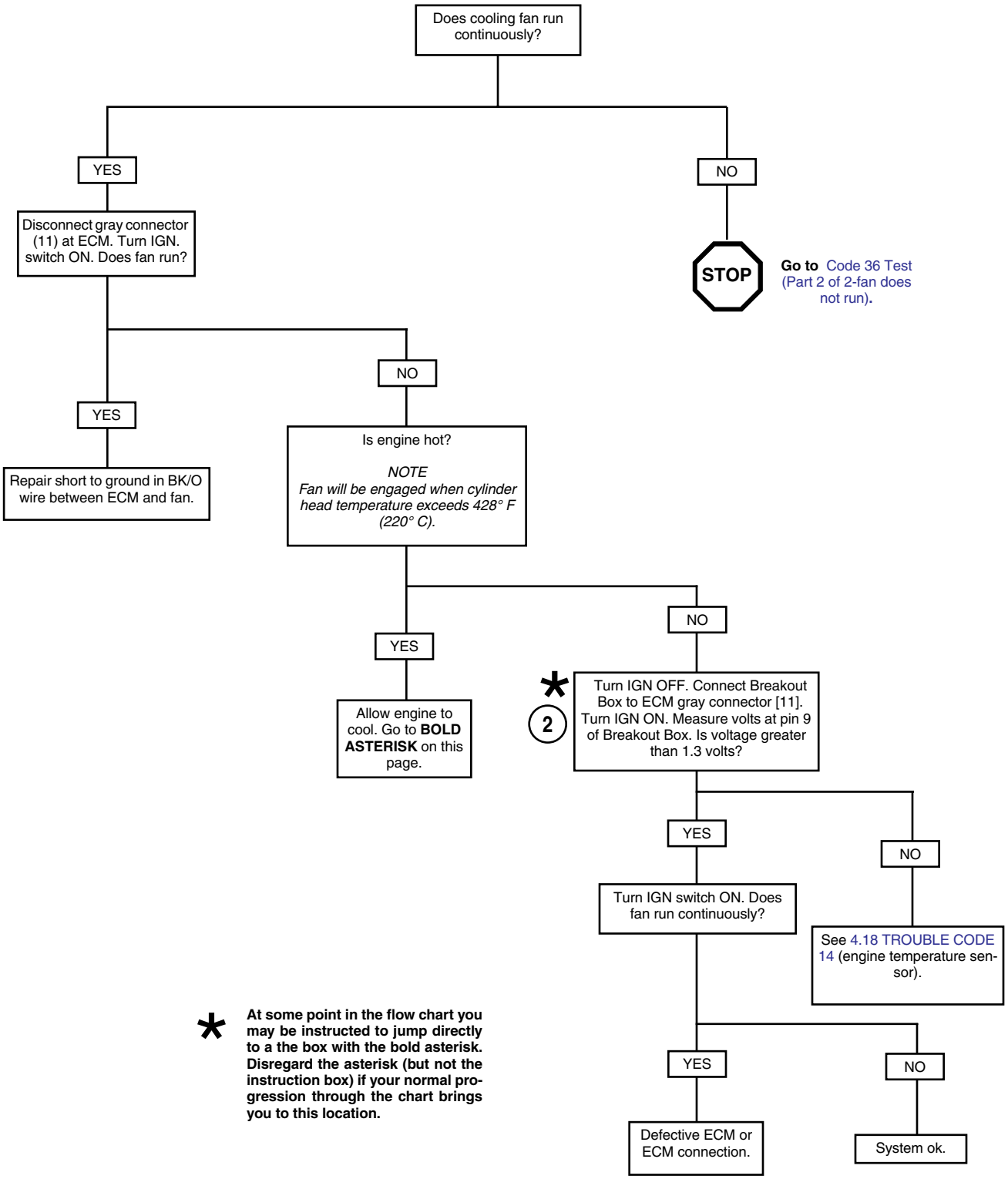


Figure 4-60. Cooling Fan Circuit

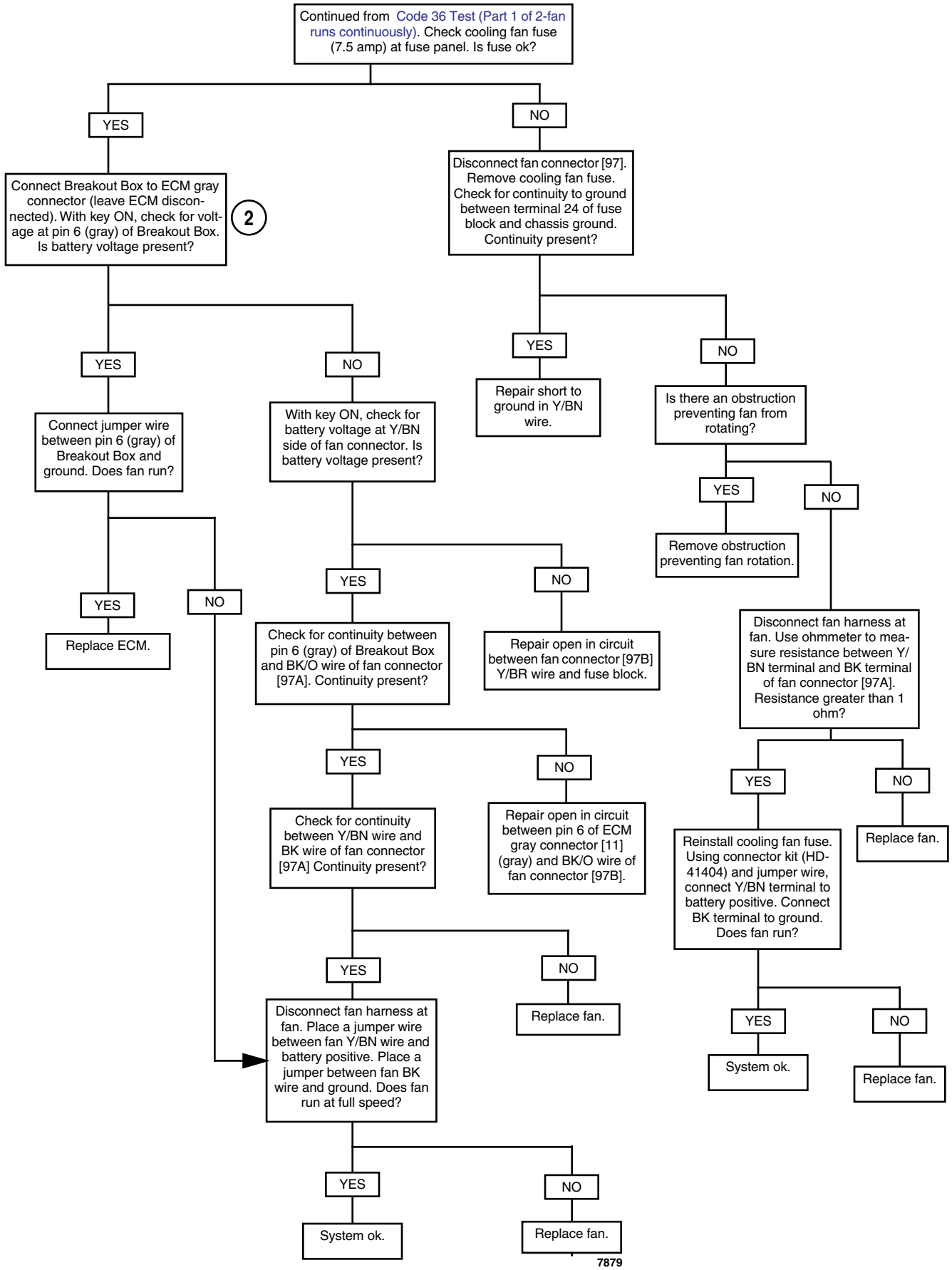
Table 4-30. Wire Harness Connectors in Figure 4-60.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under seat
[97]	cooling fan	2-place Multilock	behind rear cylinder

Code 36 Test (Part 1 of 2-fan runs continuously)



Code 36 Test (Part 2 of 2-fan does not run)



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.

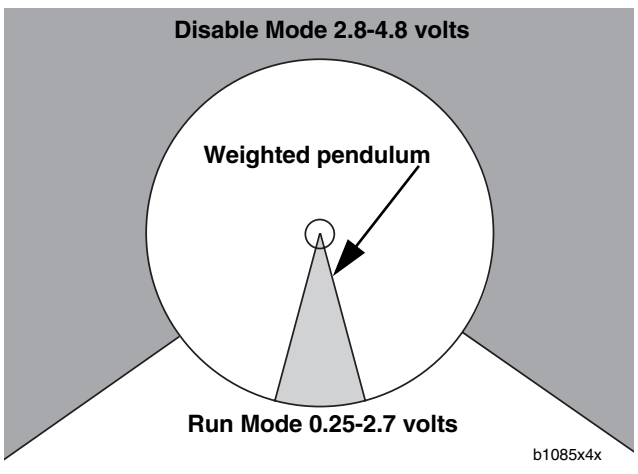


Figure 4-61. Bank Angle Sensor Operation

Table 4-31. Bank Angle Sensor Voltage

MODE	VOLTS
Run mode	0.25-2.7
Disable mode	2.8-4.8

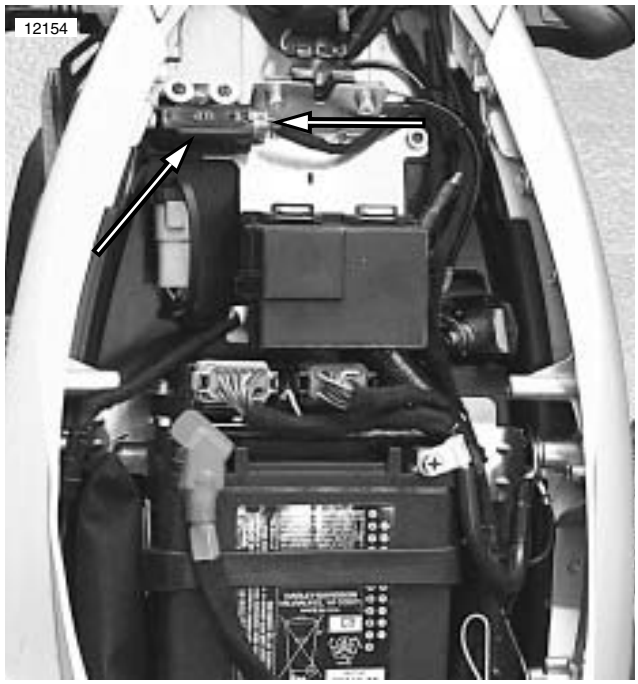


Figure 4-62. Bank Angle Sensor (XB12Ss)

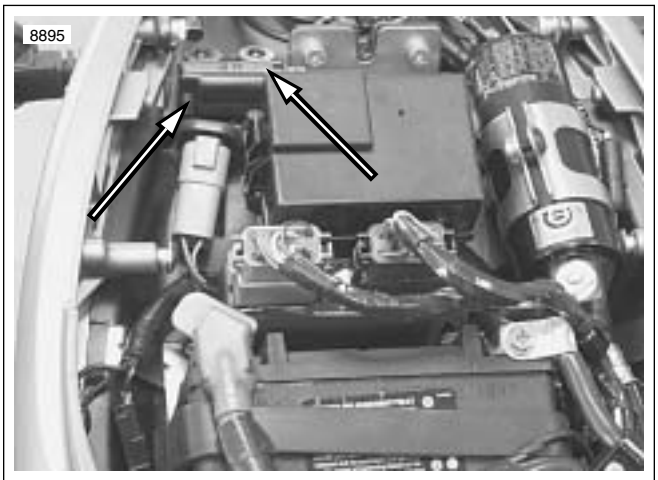


Figure 4-63. Bank Angle Sensor (Typical)

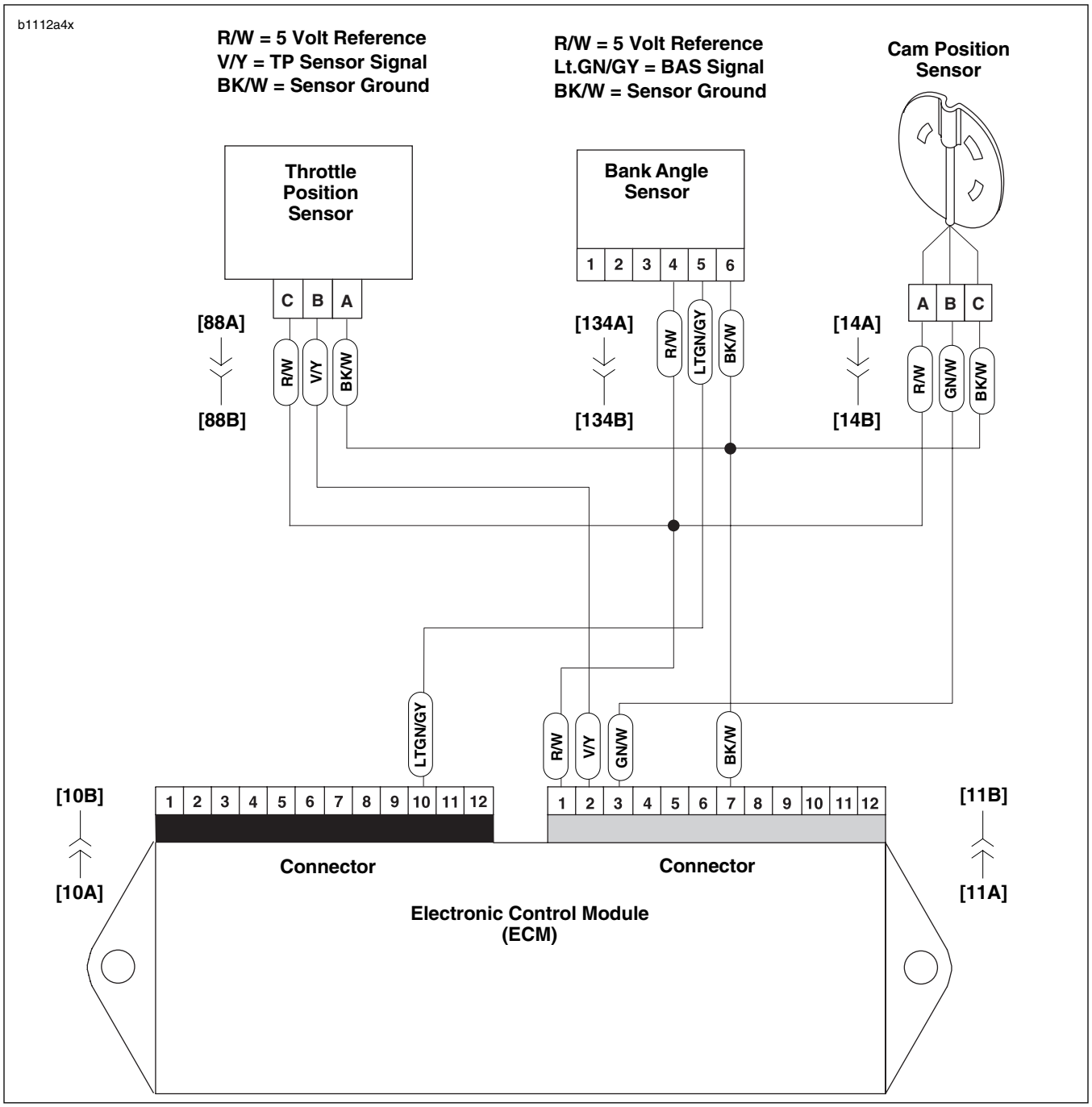
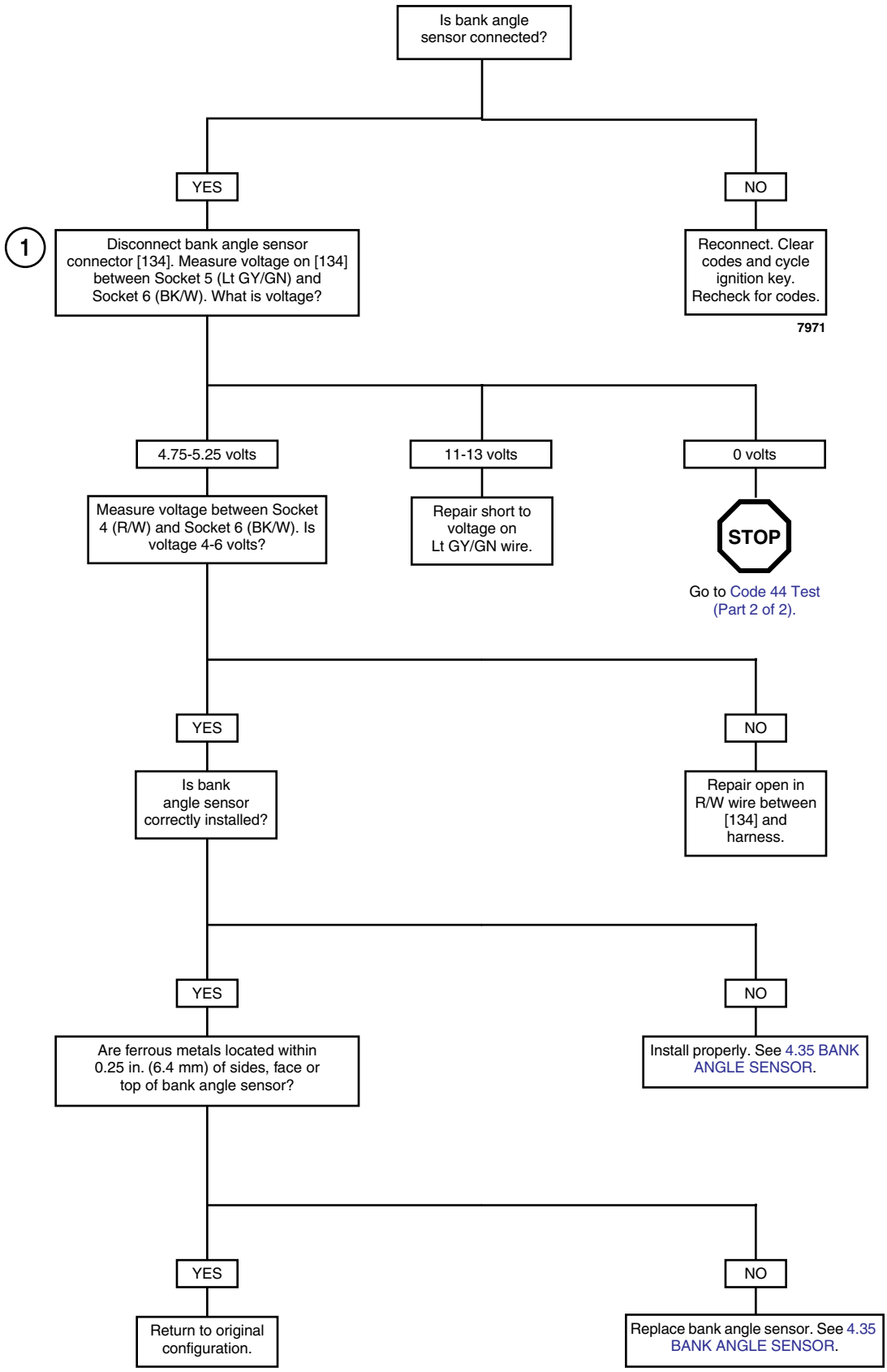


Figure 4-64. Bank Angle Sensor Circuit

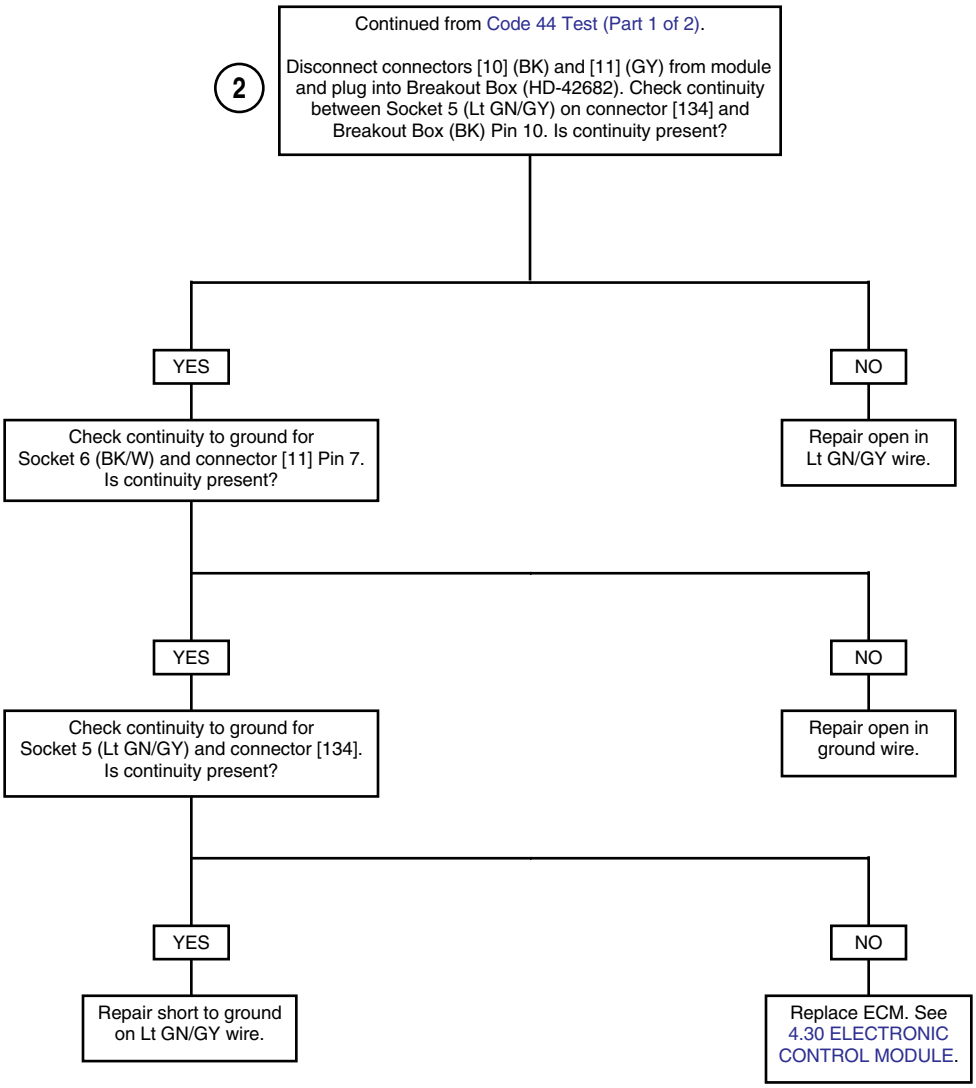
Table 4-32. Wire Harness Connectors in Figure 4-64.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[11]	ECM (gray)	12-place Deutsch	under seat
[14]	cam position sensor	3-place Deutsch	under sprocket cover
[88]	throttle position sensor	3-place Packard	right side of engine between cylinders
[134]	bank angle sensor	6-place Sumitomo	under seat

Code 44 Test (Part 1 of 2)



Code 44 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).

TROUBLE CODES 52, 53, 54 AND 55 4.28

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.

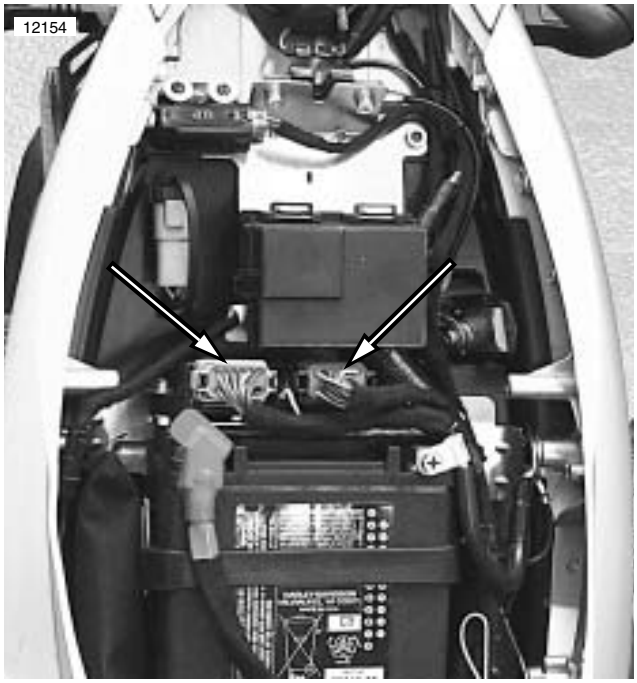


Figure 4-65. ECM (XB12Ss)

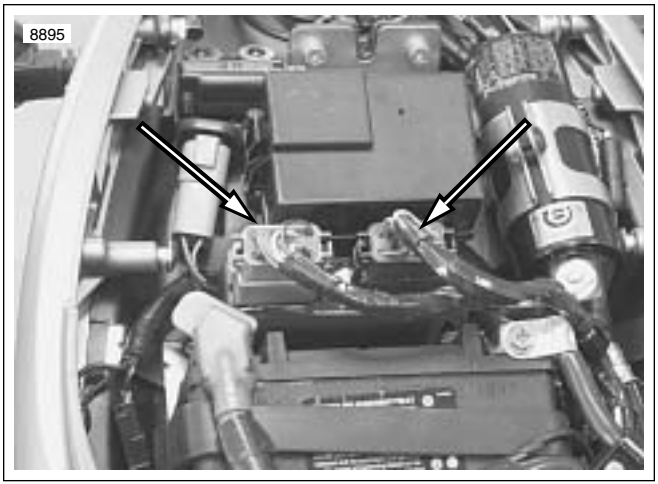


Figure 4-66. ECM (Typical)

TROUBLE CODE 56 4.29

GENERAL

Cam Sync Failure

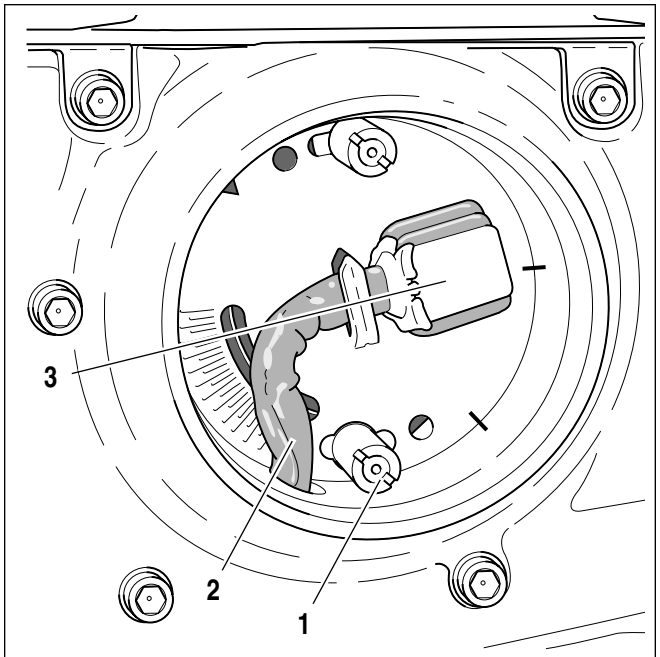
This code occurs only when the engine is running if the electronic control module either receives an intermittent (extra or missing) signal from the cam position sensor or receives an unexpected signal. The motorcycle may continue to run, not run normally or stop running altogether.

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.



1. Timer plate stud (2)
2. Sensor wiring
3. Cam position sensor

Figure 4-67. Cam Position Sensor

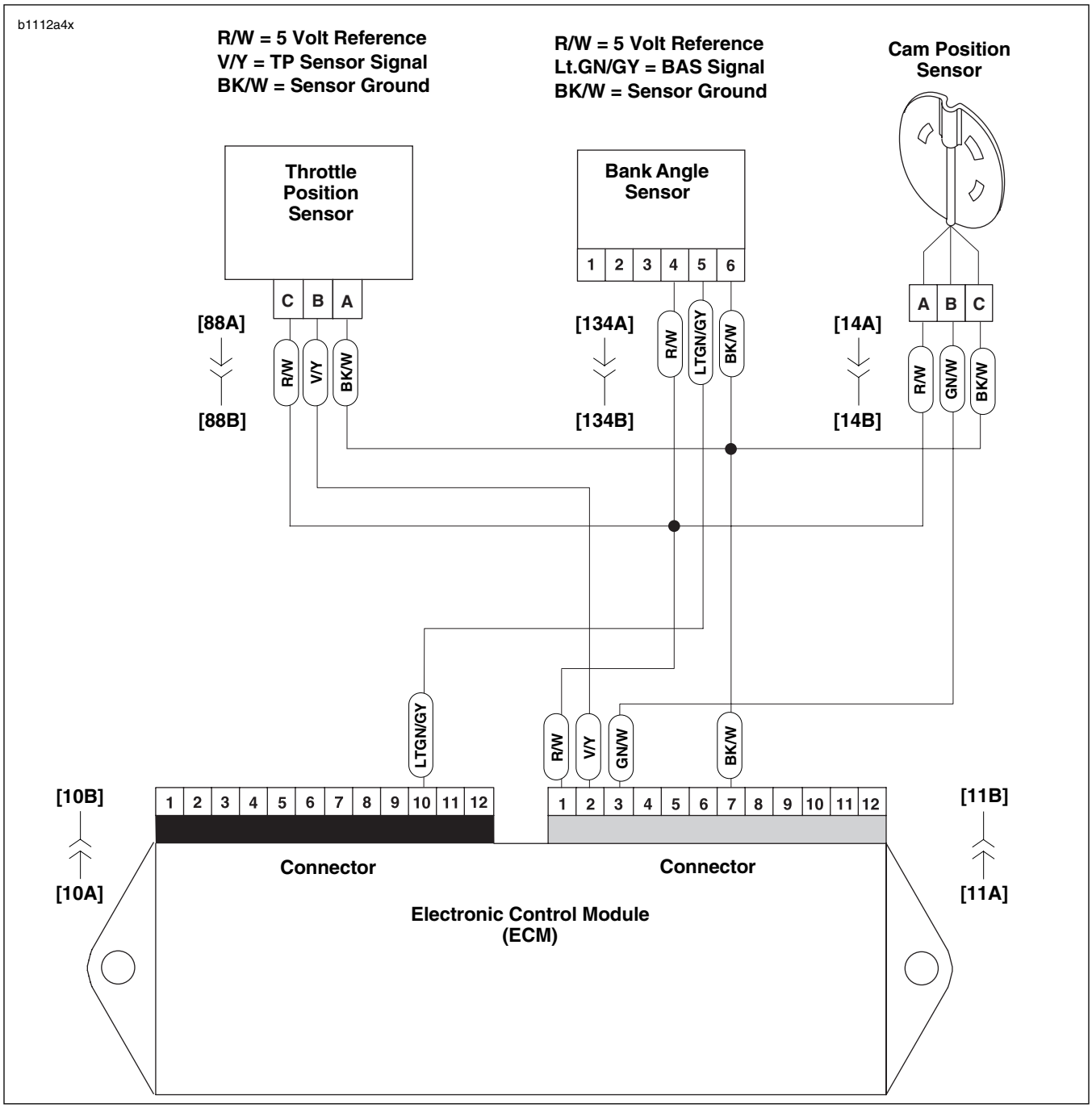
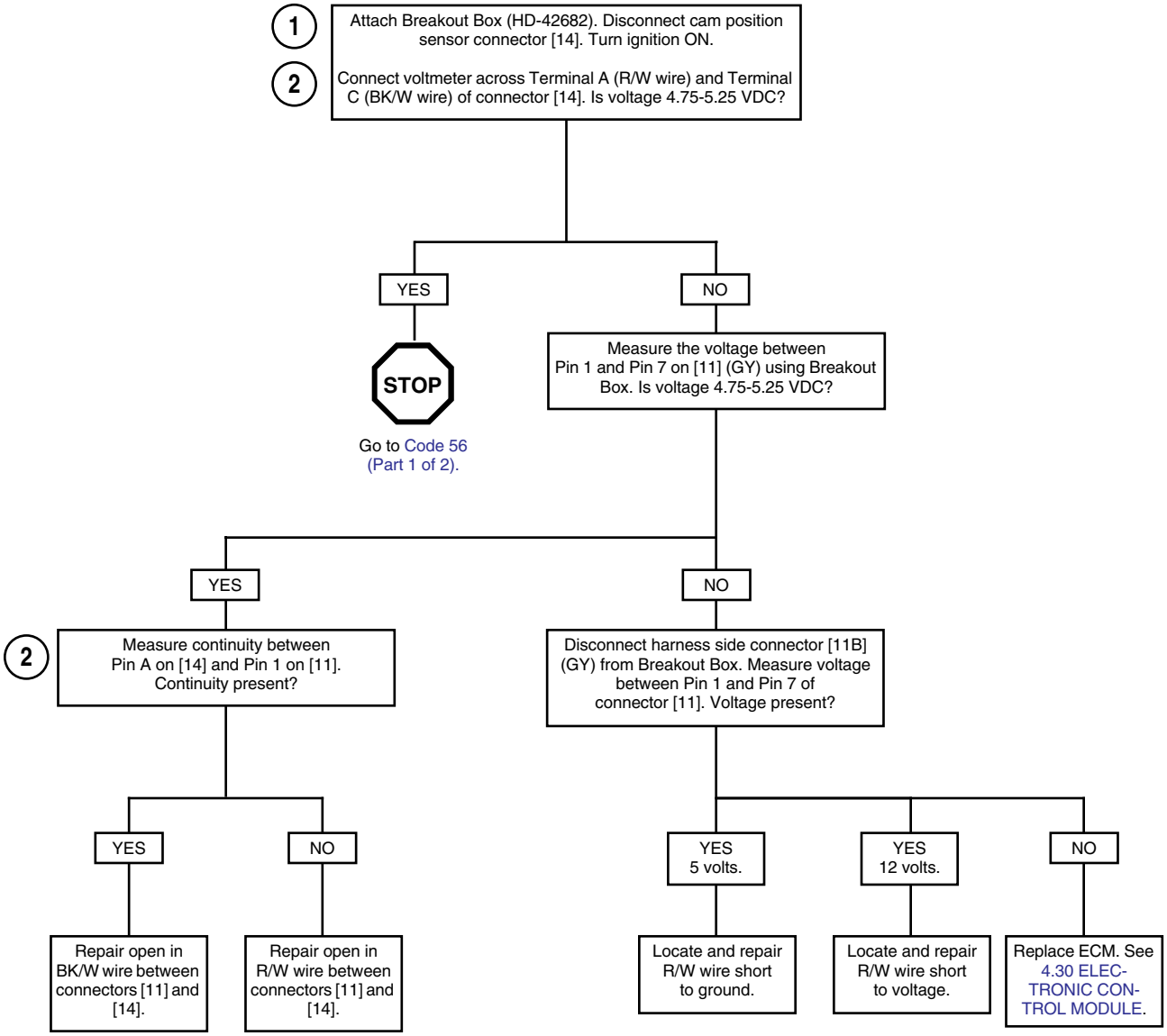


Figure 4-68. Cam Position Sensor Circuit

Table 4-33. Wire Harness Connectors in Figure 4-68.

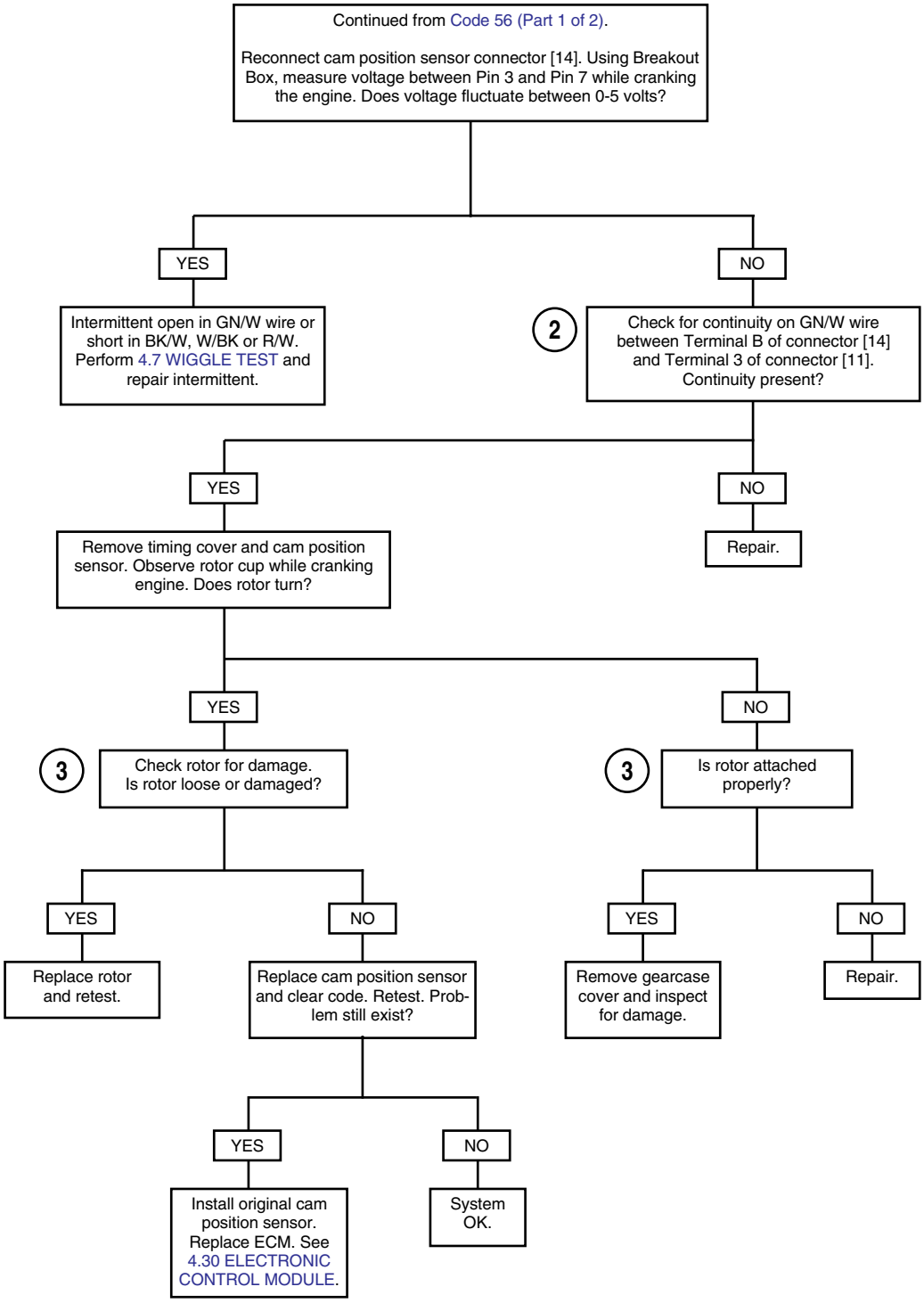
NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under seat
[11]	ECM (gray)	12-place Deutsch	under seat
[14]	cam position sensor	3-place Deutsch	under sprocket cover
[88]	throttle position sensor	3-place Packard	right side of engine between cylinders
[134]	bank angle sensor	6-place Sumitomo	under seat

Code 56 (Part 1 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 56 (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).

ELECTRONIC CONTROL MODULE 4.30

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.
3. Disconnect ECM black connector [10] and gray connector [11].
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).
2. Attach ECM connectors [10] and [11].
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. (00068a)

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).

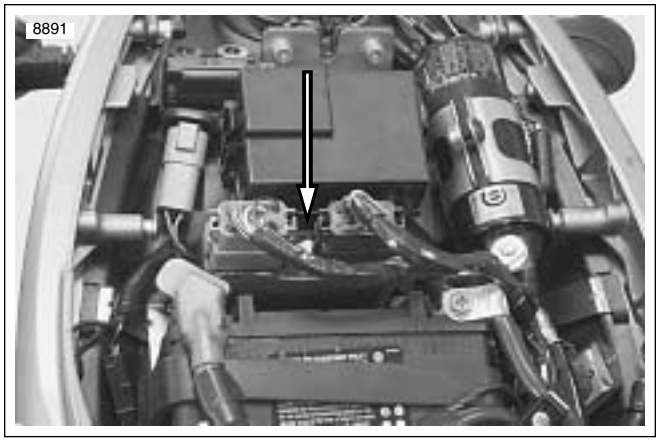


Figure 4-69. ECM (Typical)

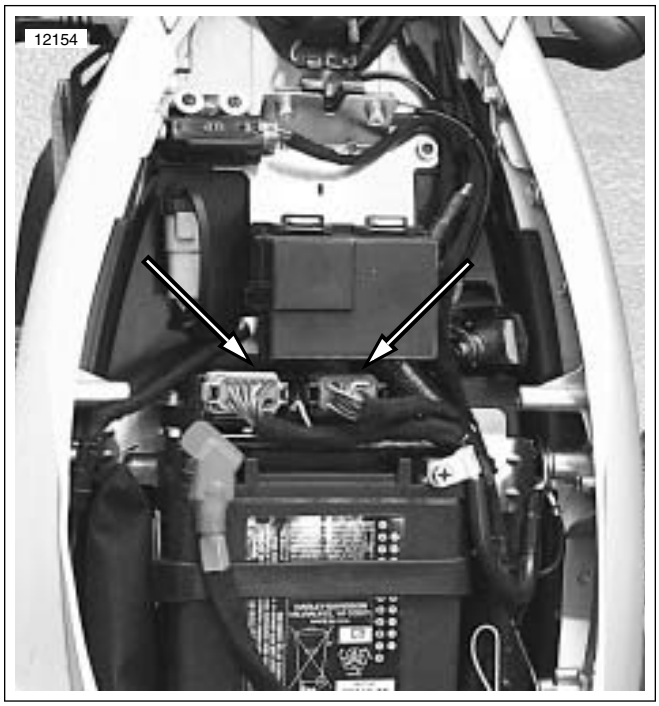


Figure 4-70. ECM (XB12Ss)

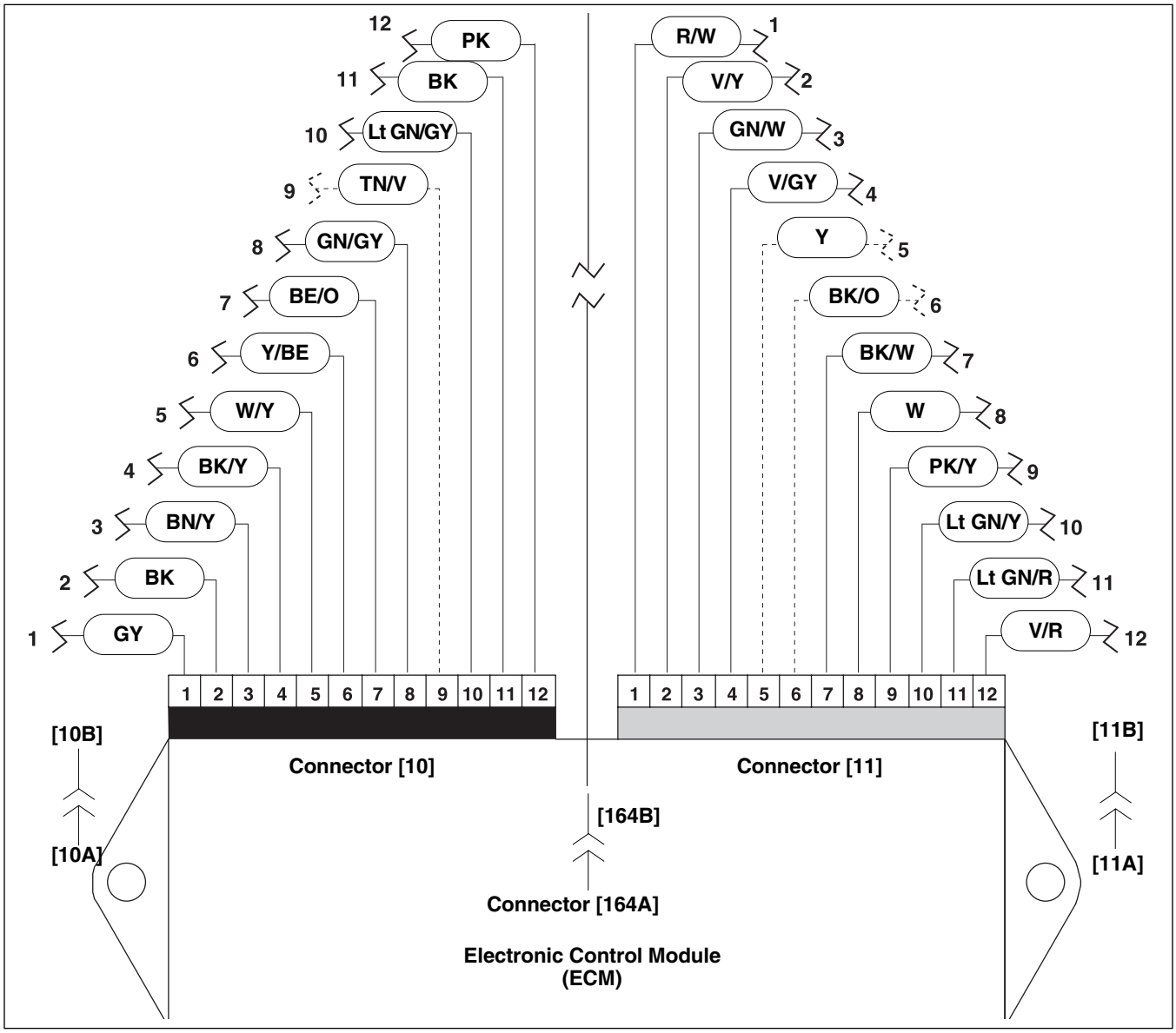


Figure 4-71. ECM Wiring (Interactive Muffler Connector [164] 1200 Models Only)

Table 4-34. Pin Table for ECM Connector [10] (Black)

PIN	FUNCTION
1	Switched ignition
2	System ground A (module)
3	Fuel pump
4	Check engine lamp
5	Injector front
6	Front coil primary
7	Rear coil primary
8	Injector rear
9	Interactive muffler control feedback
10	Bank angle sensor input
11	System ground B (coil)
12	Tachometer

Table 4-35. Pin Table for ECM Connector [11] (Gray)

PIN	FUNCTION
1	5 volt sensor power
2	Throttle position sensor
3	Camshaft position sensor
4	Oxygen sensor
5	Memory
6	Fan control
7	Sensor ground 1
8	Vehicle speed sensor
9	Engine temperature
10	Intake air temperature
11	Serial data receive
12	Serial data transmit

CAM POSITION SENSOR AND ROTOR 4.31

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 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 7.26 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.

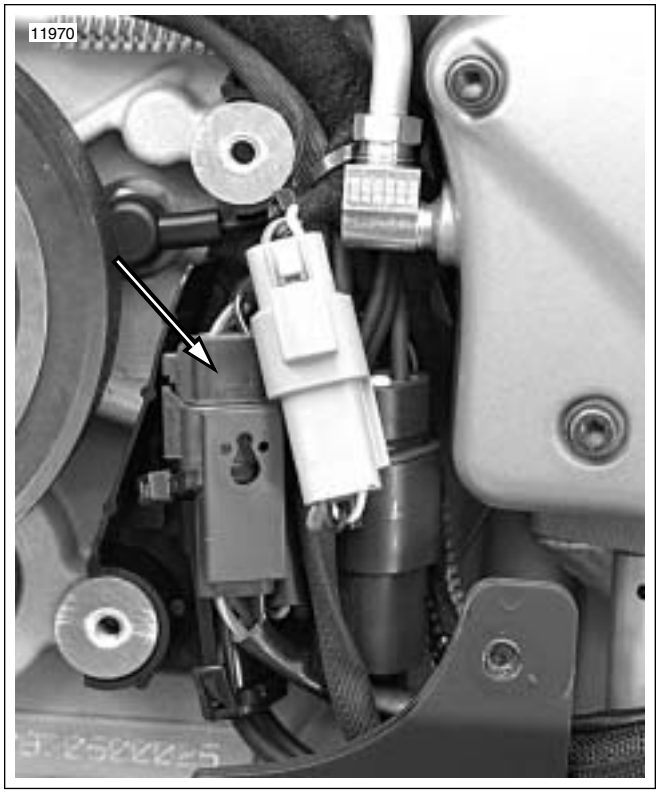
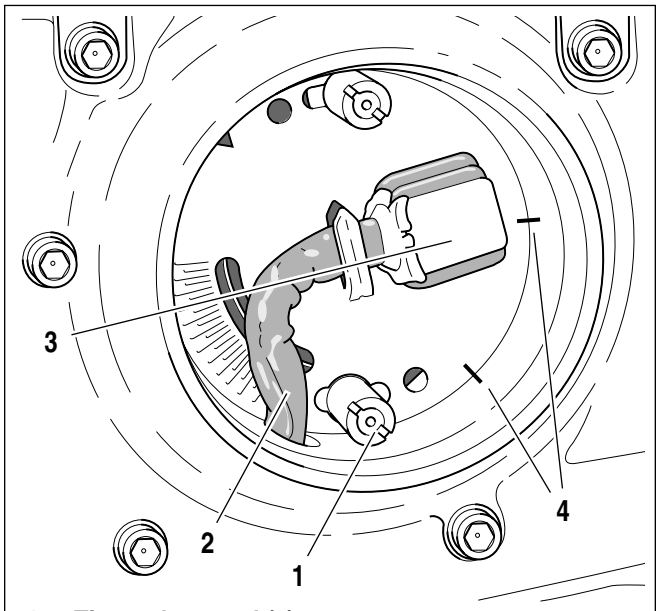


Figure 4-72. Cam Position Sensor Connector [14]



1. **Timer plate stud (2)**
2. **Sensor wiring**
3. **Cam position sensor**
4. **Scribe mark**

b0313a7x

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

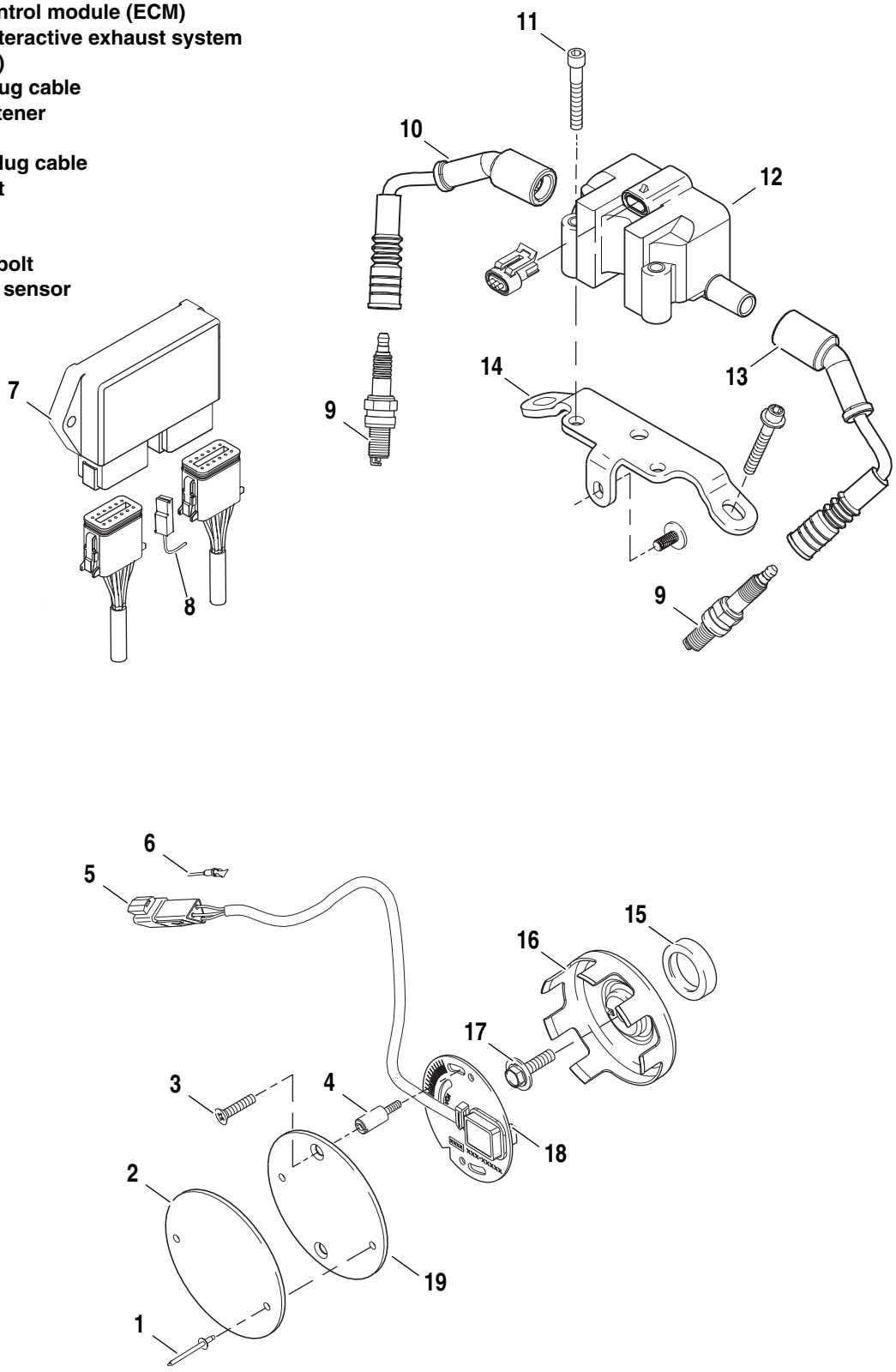


Figure 4-74. Ignition Components

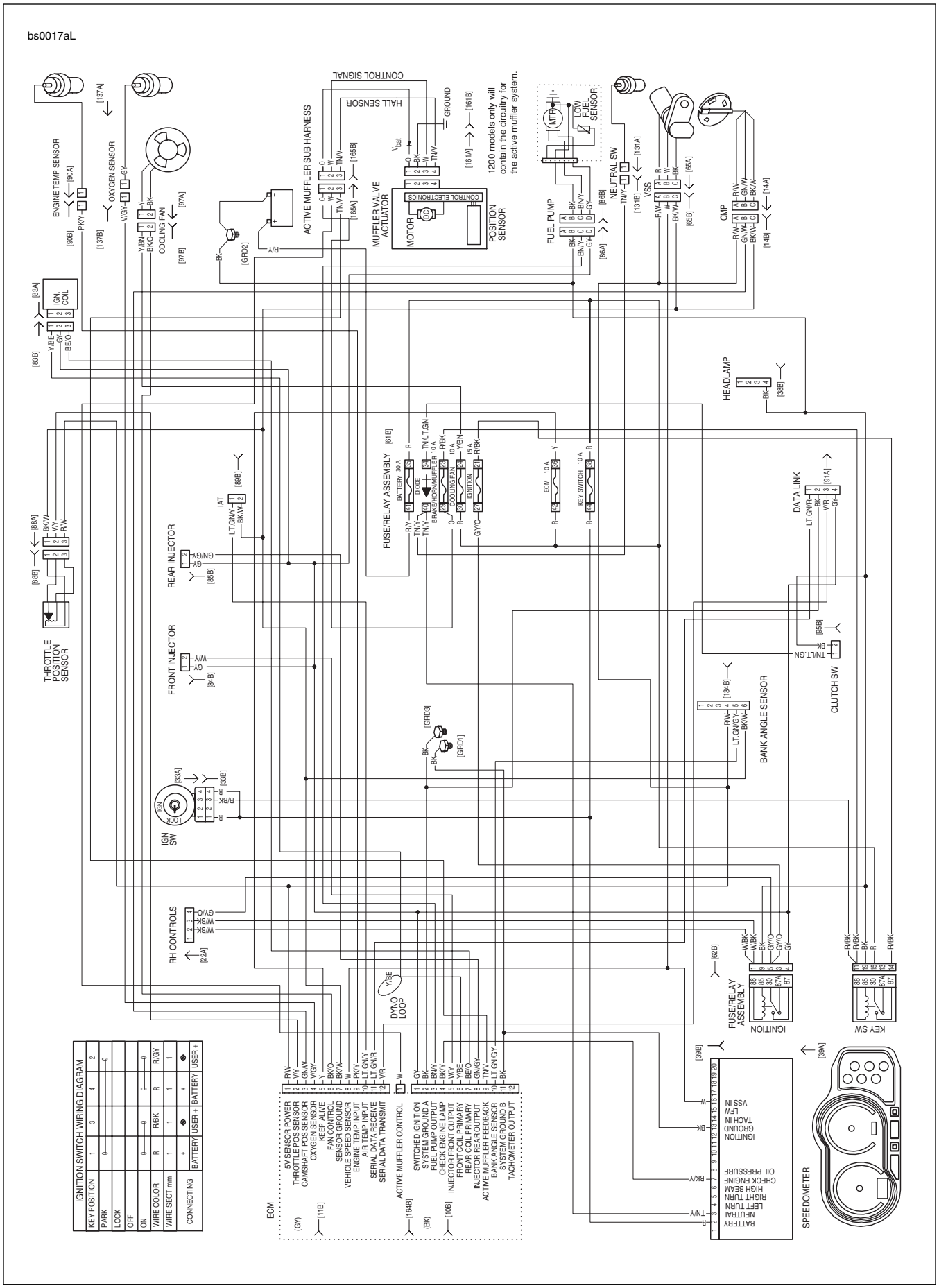


Figure 4-75. Ignition System Circuit

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 MULTILOCK 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.

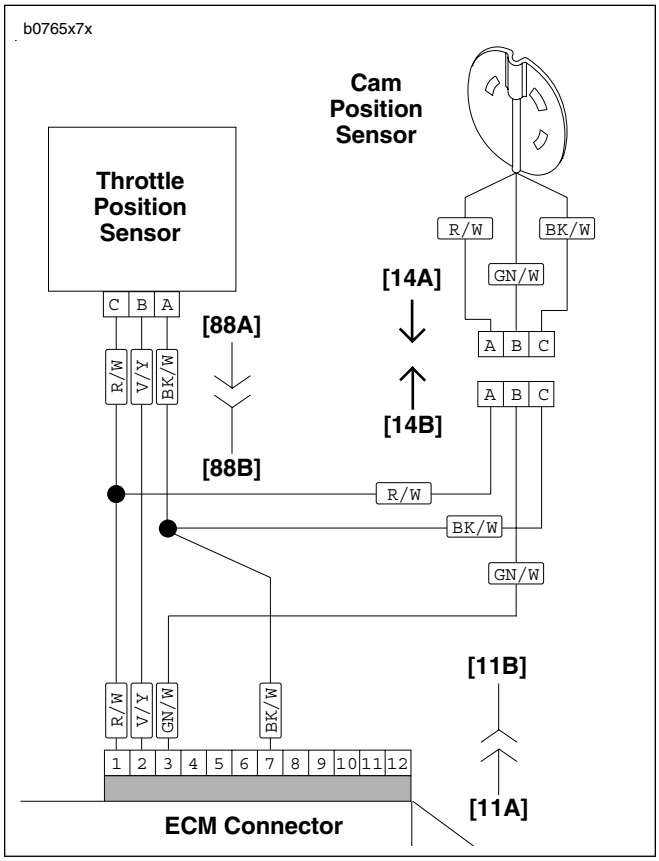


Figure 4-76. Connecting Sensor Wires

IGNITION COIL 4.32

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

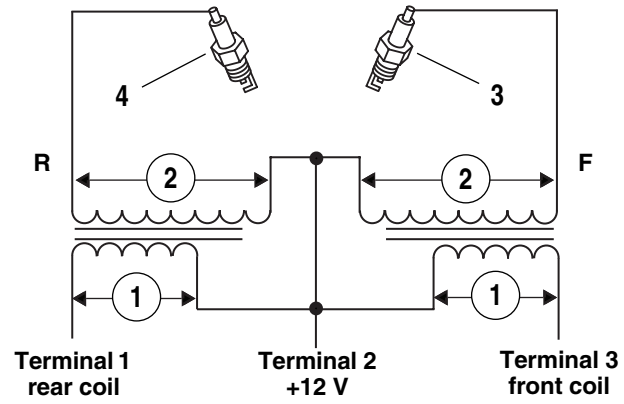
1. Remove ignition coil.
2. Set ohmmeter scale to RX1.
3. See Figure 4-77. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray socket probes, place multimeter wires on primary coil windings from terminal 1 to 2, and from terminal 2 to 3.
4. Refer to Table 4-36. Check primary coil winding resistance.
   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.

Table 4-36. Ignition Coil Winding Resistance

WINDING	OHMMETER SCALE	NORMAL RESISTANCE RANGE (IN OHMS)
Primary	R x 1	0.5-0.7
Secondary	R x 1K	5.5K-7.5K



1. Primary resistance should be 0.5-0.7 ohms.
2. Secondary resistance should be 5.5-7.5K ohms.
3. Front spark plug
4. Rear spark plug

Figure 4-77. Ignition Coil Circuit

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.

REMOVAL

⚠WARNING

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

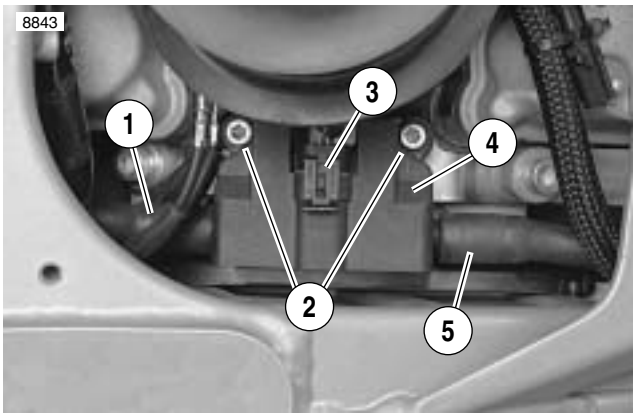
1. Disconnect negative battery cable.
2. Remove intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.
3. Remove air cleaner assembly. See 4.44 AIR CLEANER ASSEMBLY.
4. See Figure 4-78. Disconnect the spark plug cables from the coil plug posts (1, 5).
5. Detach connector (3) [83].
6. Remove coil fasteners (2).

INSTALLATION

NOTE

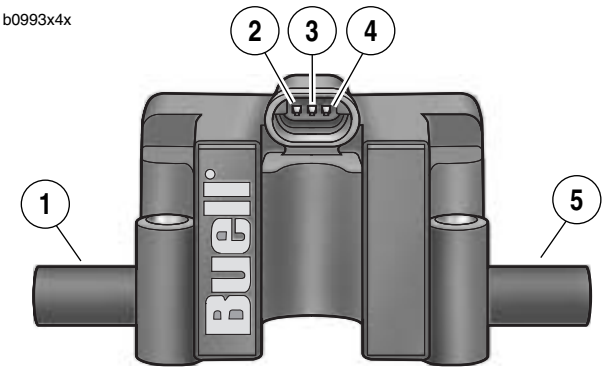
To ease installation, install spark plug cables to ignition coil first.

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.



1. **Front cylinder post**
2. **Fasteners**
3. **Coil connector [83]**
4. **Coil**
5. **Rear cylinder post**

Figure 4-78. Ignition Coil Location



1. **Rear Cylinder Post**
2. **Coil Pin A (rear cylinder)**
3. **Coil Pin B (12 VDC)**
4. **Coil Pin C (front cylinder)**
5. **Front Cylinder Post**

Figure 4-79. Ignition Coil

OXYGEN SENSOR 4.33

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 air/fuel 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.

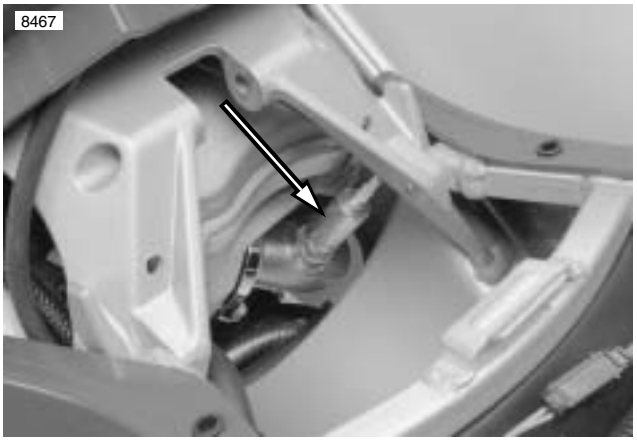
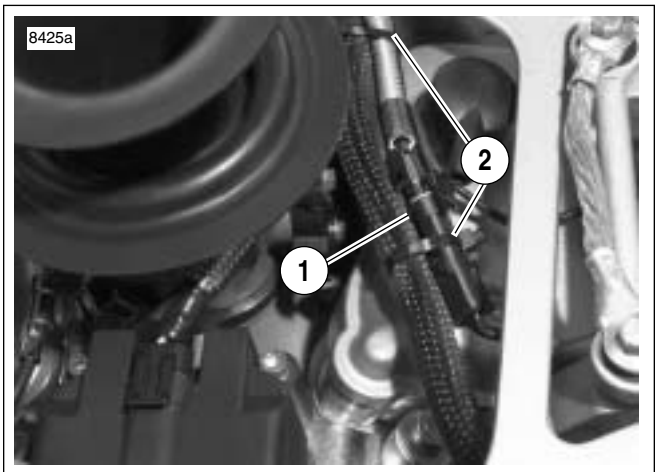
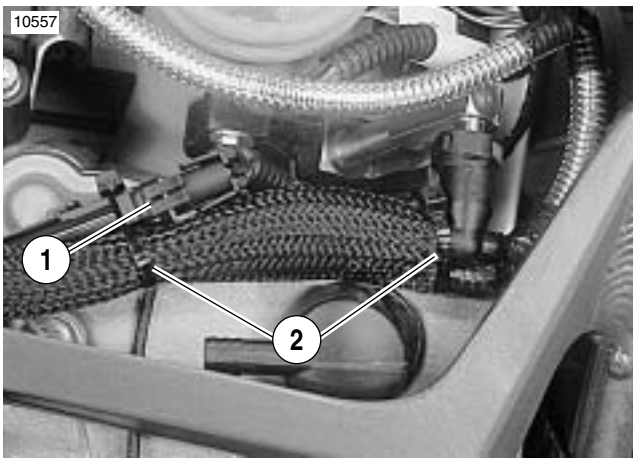


Figure 4-80. Installed Oxygen Sensor (shock absorber removed)



1. **Oxygen sensor connector [137]**
2. **Cable straps**

Figure 4-81. Oxygen Sensor Connector [137] (XB9SX)



1. **Oxygen sensor connector [137]**
2. **Cable straps**

Figure 4-82. Oxygen Sensor Connector [137] (XB12 Models)

ENGINE TEMPERATURE SENSOR 4.34

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.

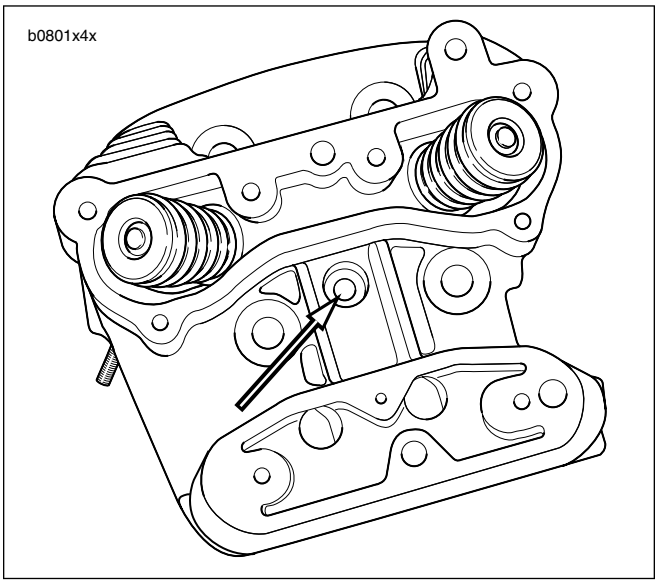
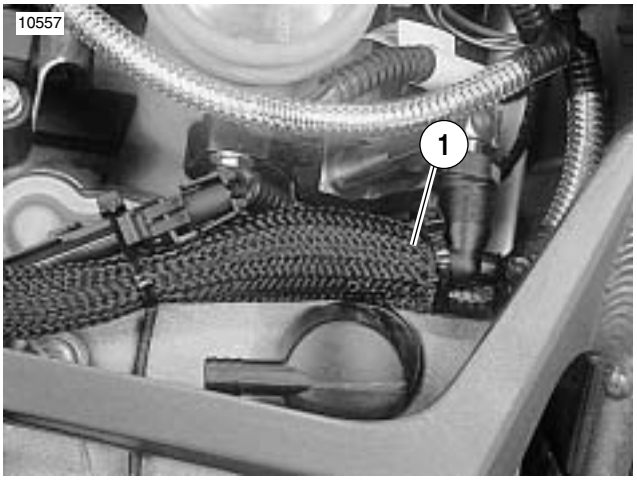


Figure 4-83. Engine Temperature Sensor Location (rear cylinder)



1. Engine temperature sensor connector [90] (approximate location)

Figure 4-84. Engine Temperature Sensor Connector [90] Approximate Location

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.

BANK ANGLE SENSOR 4.35

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

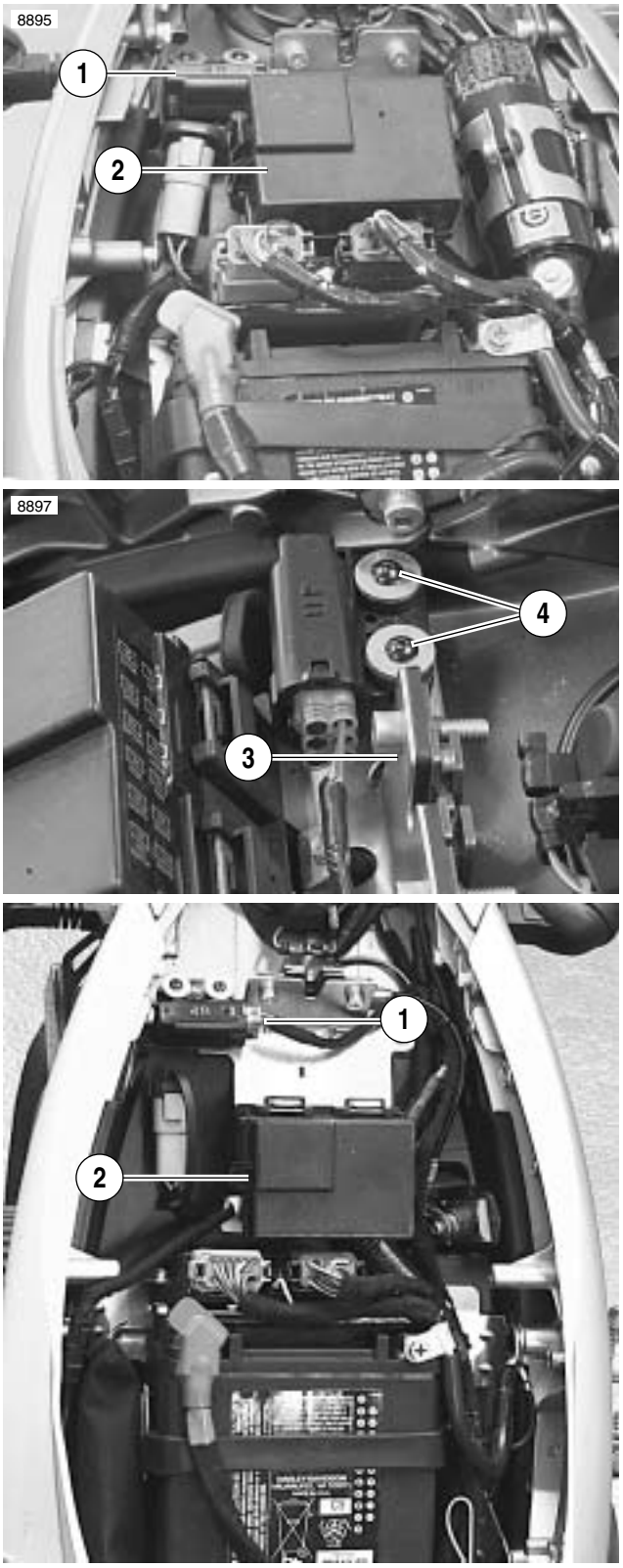
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

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.



1. **Bank angle sensor**
2. **Fuse block and electrical relays**
3. **Seat latch bracket**
4. **BAS fasteners**

Figure 4-85. Bank Angle Sensor Location Top (Lightning), Bottom (XB12Ss)

INTAKE AIR TEMPERATURE SENSOR 4.36

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.

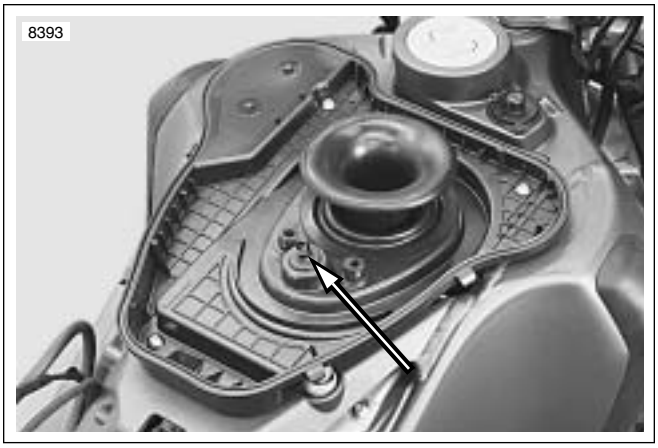


Figure 4-86. Intake Air Temperature Sensor Installed

THROTTLE POSITION SENSOR 4.37

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.

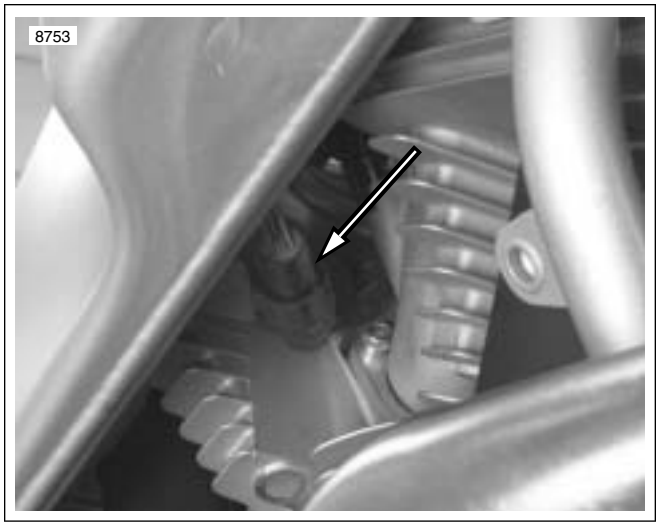


Figure 4-87. Throttle Position Sensor Location

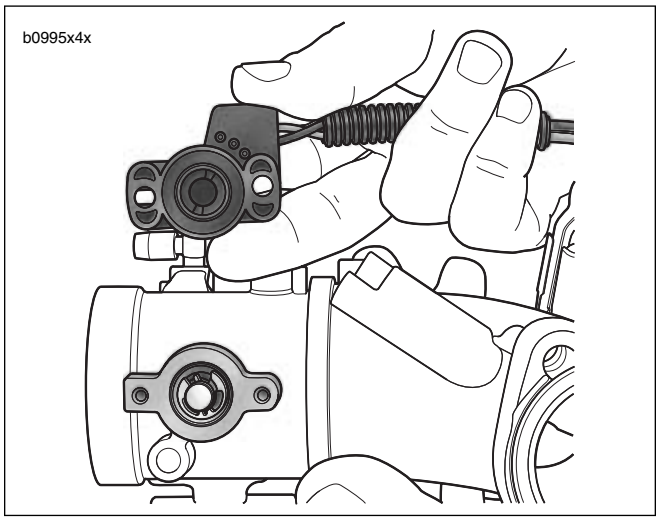


Figure 4-88. Throttle Position Sensor

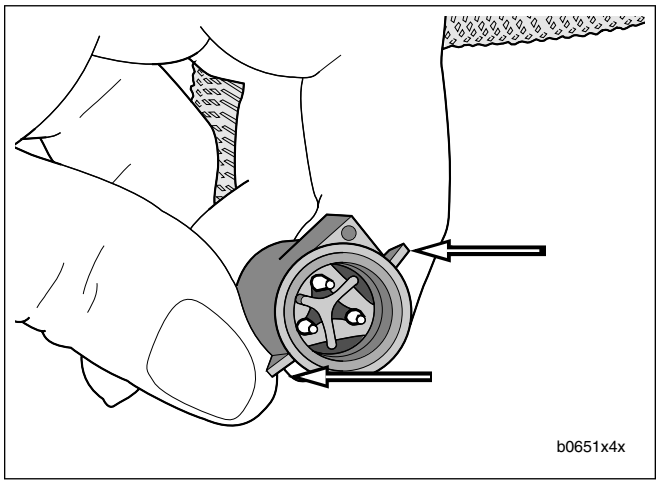


Figure 4-89. Tabs on TP Sensor Connector [88A]

COOLING FAN 4.38

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

	FAN ON	FAN OFF
Key ON	220° C (428° F)	180° C (356° F)
Key OFF	170° C (338° F)	150° C (302° F)

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

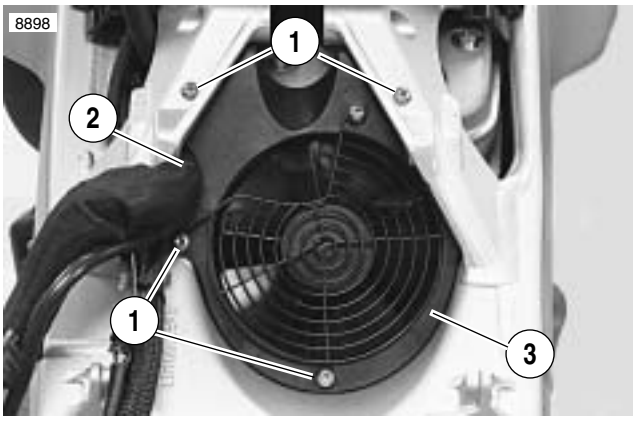
- *When installing cooling fan (3), be sure wiring, transmission vent hose and fuel line are routed through notch (2) in fan body.*
- *On California models, both fuel tank and canister vent hoses are routed through notch in fan body.*

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.

⚠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. **Cooling fan fasteners**
2. **Notch**
3. **Cooling fan**

Figure 4-90. Cooling Fan

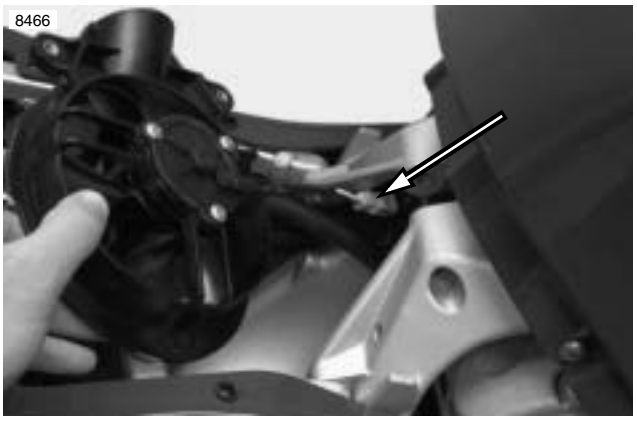


Figure 4-91. Cooling Fan Connector [97]

FUEL PUMP 4.39

GENERAL

The fuel pump is located inside the left rear portion of the fuel tank/frame.

DRAINING FUEL TANK

⚠WARNING

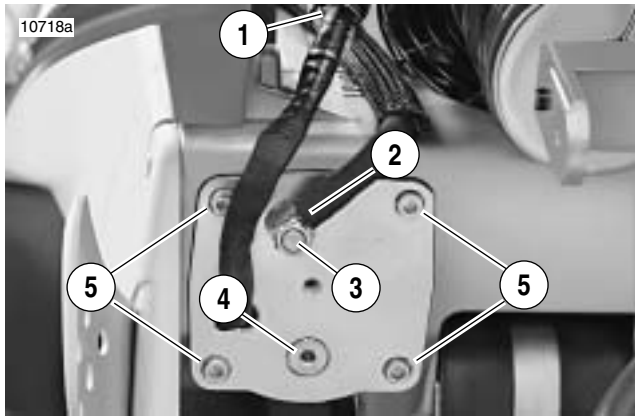
To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

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. **Connector [86]**
2. **Fuel supply fitting**
3. **Fuel supply stud**
4. **Drain plug**
5. **Fasteners**

Figure 4-92. Fuel Pump Installation

REMOVAL

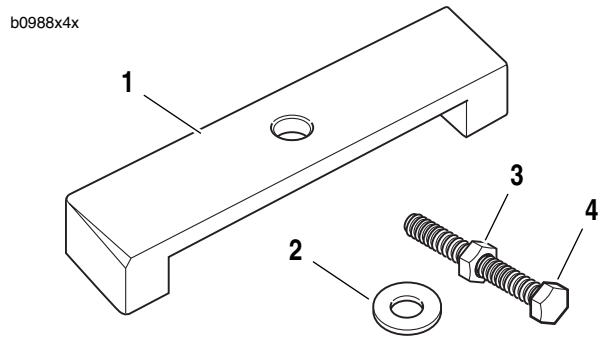
PART NO.	SPECIALTY TOOL
B-45657	Fuel pump puller

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

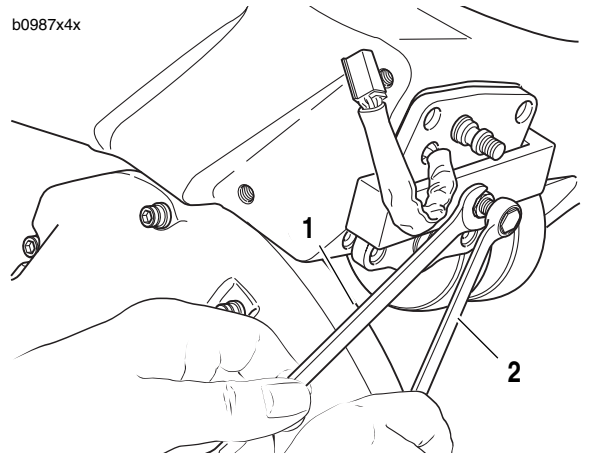
With fuel tank drained, gasoline can spill from bore when supply valve is loosened or removed. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00277a)

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.



1. **Main body**
2. **Washer**
3. **Nut**
4. **Bolt**

Figure 4-93. Fuel Pump Puller



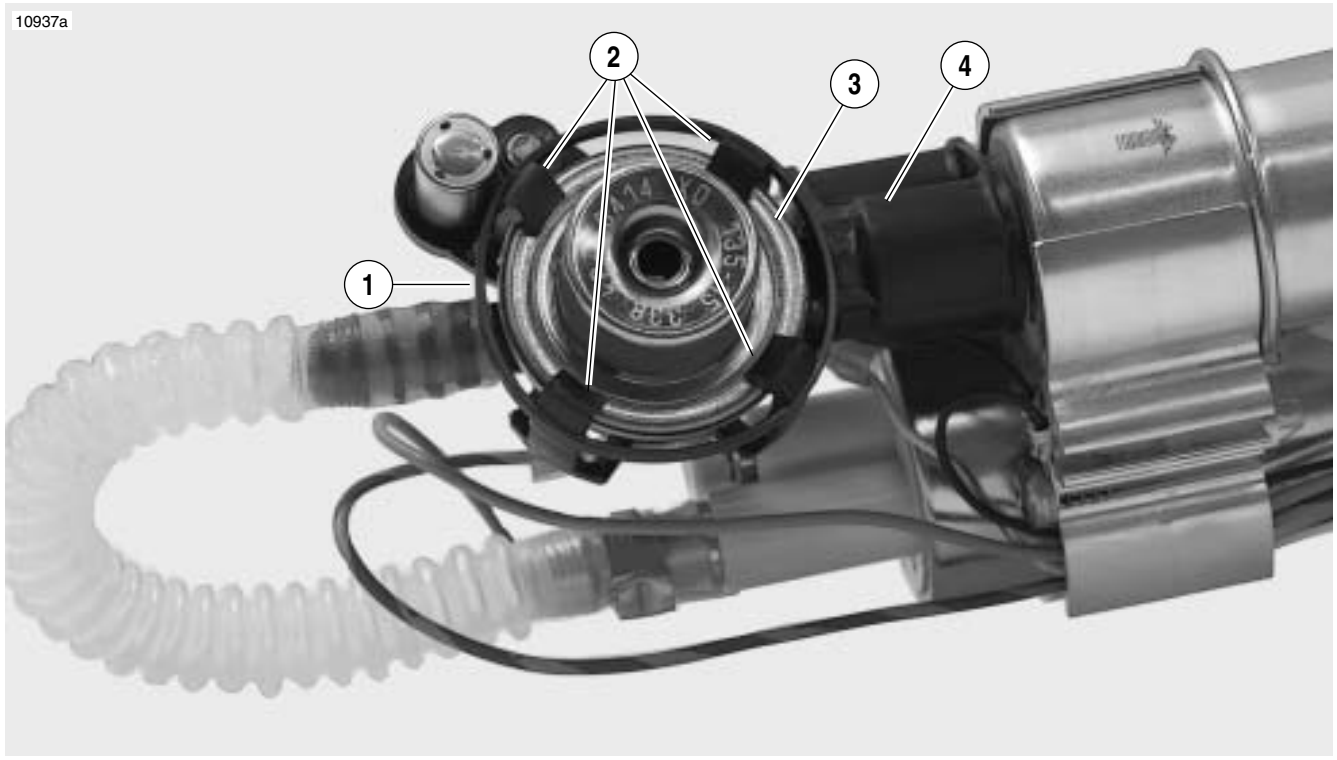
1. **Turn clockwise**
2. **Hold stationary**

Figure 4-94. Fuel Pump Removal

REPAIR

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.

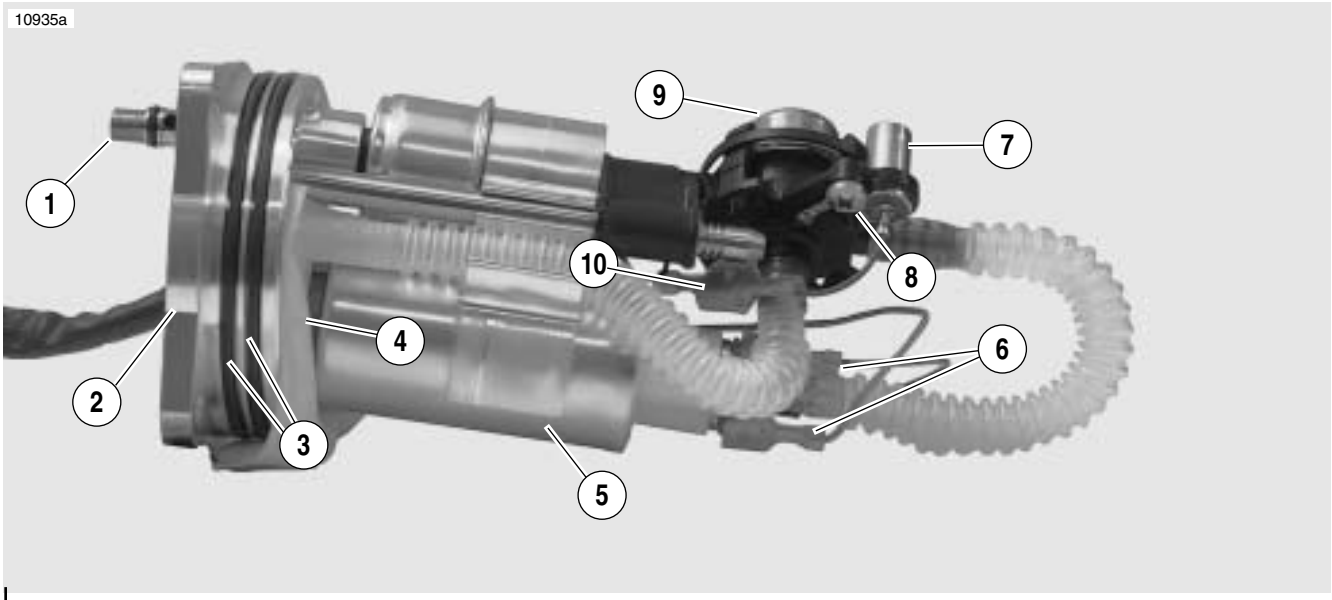


1. **Plastic retaining ring**
2. **Plastic retainers**
3. **Fuel pressure regulator**
4. **Fuel pressure regulator housing**

Figure 4-95. Fuel Pressure Regulator

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.



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**

Figure 4-96. Fuel Pump Assembly

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

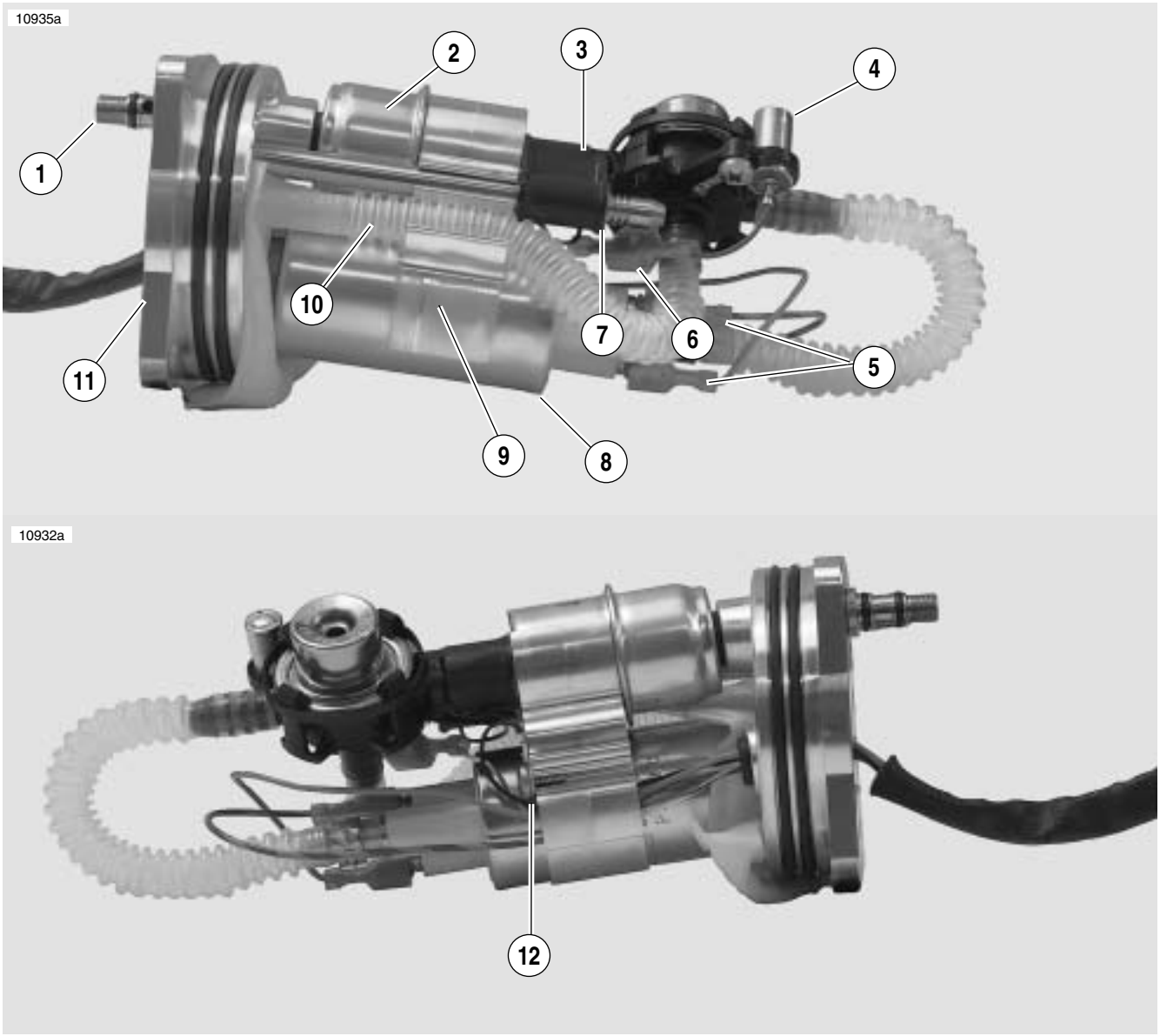
*Remove the rubber seals from each end of the original fuel filter to be used on the **new** fuel filter.*

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).

NOTE

Fuel pump connectors are two different sizes to prevent incorrect installation.

12. Route overflow hose (10) through guide in bracket (9).
13. Install fuel pump assembly. See INSTALLATION in this section.



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 (1)**
8. **Fuel pump**
9. **Bracket, fuel pump and fuel filter**
10. **Overflow hose**
11. **Fuel pump housing**
12. **Ground fastener**

Figure 4-97. Fuel Pump Assembly (Left and Right Sides)

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 **in-lbs** (2.0-2.5 Nm).
11. Connect fuel pump connectors (5, 6).

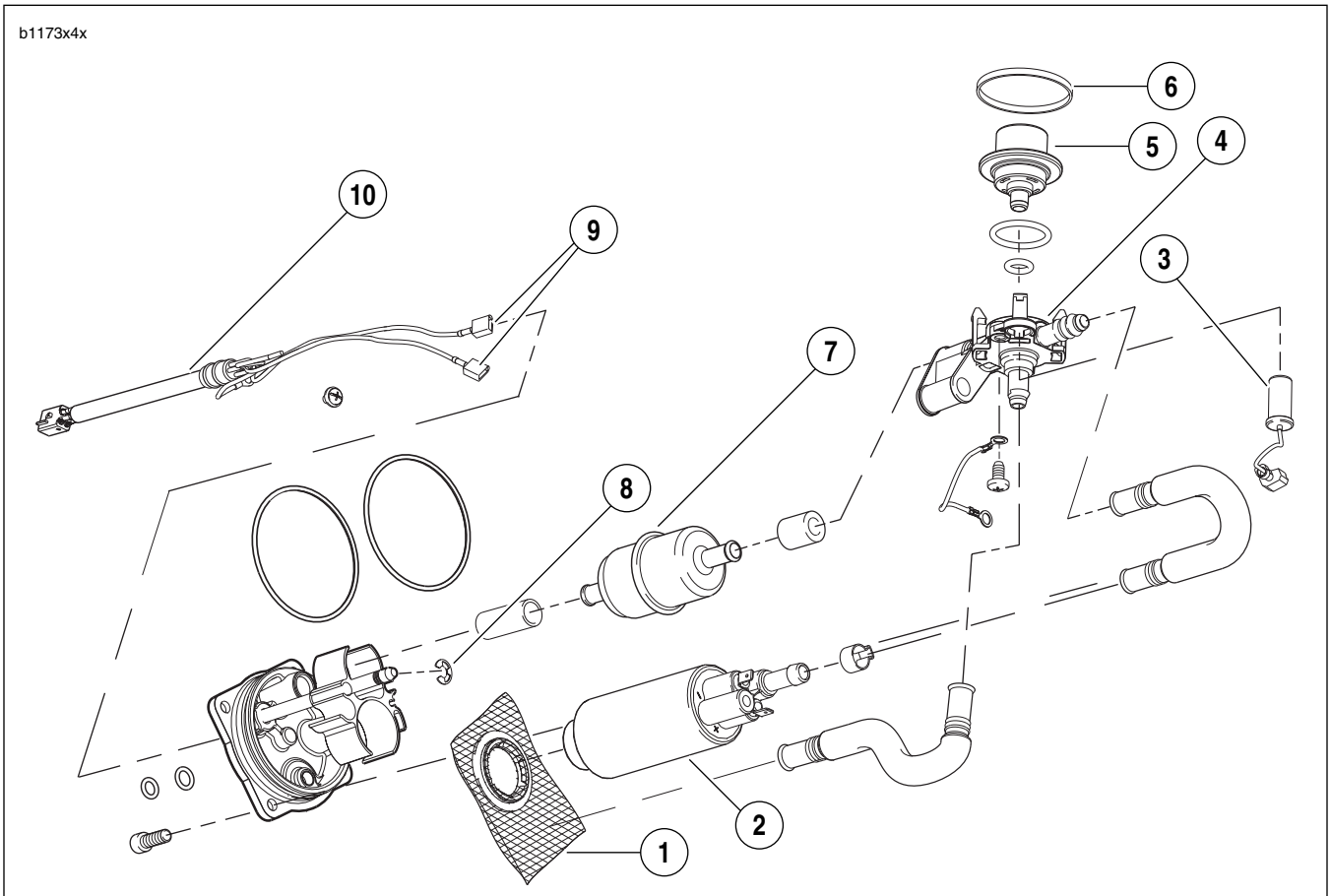
NOTE

Fuel pump connectors are two different sizes to prevent incorrect installation.

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

SPECIFICATION	DATA
Pressure Setting	49 PSI
Operating Voltage	13.2 volts
Fuel Delivery	60 LPH @ 45 PSI [310 kPa]
Current Draw	6.0 Amps



1. **Fuel screen**
2. **Fuel pump**
3. **Low fuel level sensor**
4. **Fuel pressure regulator housing**
5. **Fuel pressure regulator**
6. **Plastic retaining ring, pressure regulator**
7. **Fuel filter**
8. **E-clip**
9. **Connectors, fuel pump**
10. **Fuel pump wiring harness**

Figure 4-98. Fuel Pump Assembly

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

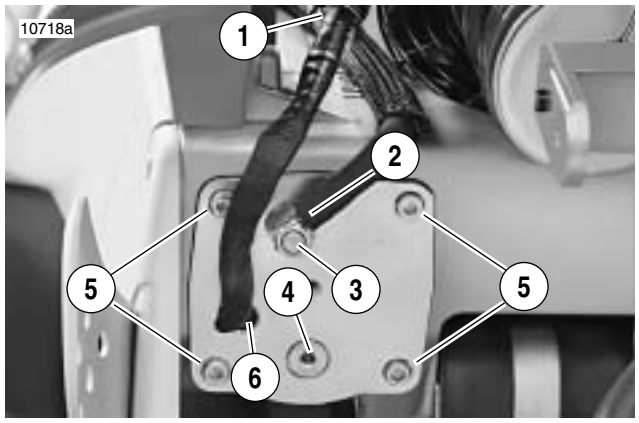
Note positions of wires in connector for correct assembly.

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

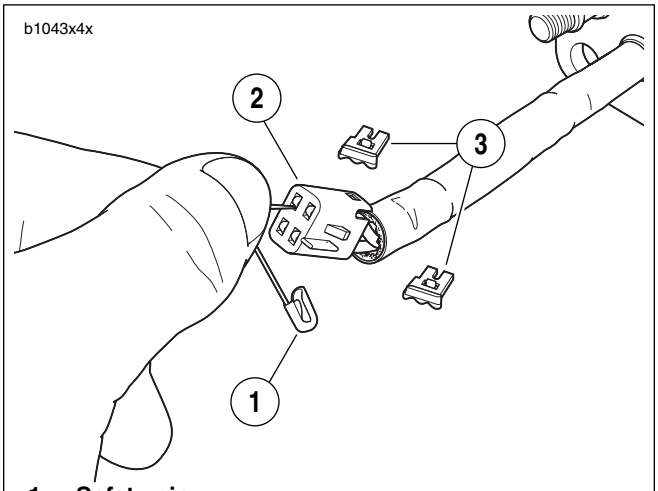
After installing terminals, pull slightly on wire to make sure it is seated. If necessary, bend tab on terminal to aid in seating wire.

9. Install terminals into proper locations of fuel pump connector [86]. Install connector clips.
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. **Connector [86]**
2. **Fuel supply fitting**
3. **Fuel supply stud**
4. **Drain plug**
5. **Fasteners**
6. **Wire harness**

Figure 4-99. Fuel Pump Wire Harness Location



1. **Safety pin**
2. **Fuel pump connector**
3. **Clips**

Figure 4-100. Fuel Pump Connector Disassembly

INSTALLATION

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

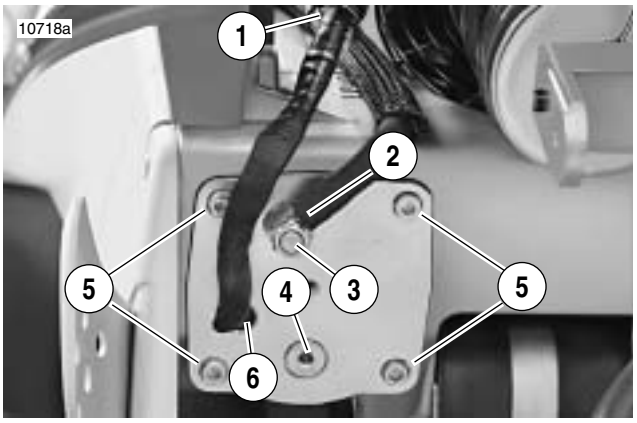
Use all four screws to draw fuel pump into frame. Using less than four screws will damage fuel pump o-rings.

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.



1. **Connector [86]**
2. **Fuel supply fitting**
3. **Fuel supply stud**
4. **Drain plug**
5. **Fasteners**
6. **Wire harness**

Figure 4-101. Fuel Pump Location

FUEL TANK VENT VALVE 4.40

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).

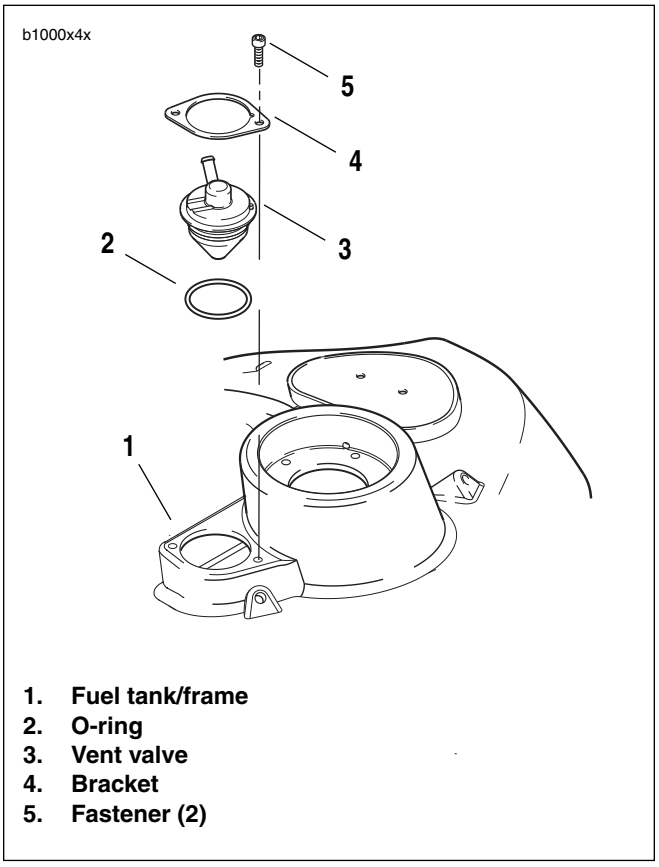
INSTALLATION

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.



1. **Fuel tank/frame**
2. **O-ring**
3. **Vent valve**
4. **Bracket**
5. **Fastener (2)**

Figure 4-102. Fuel Tank Vent Valve

FUEL CAP RETAINING RING 4.41

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.

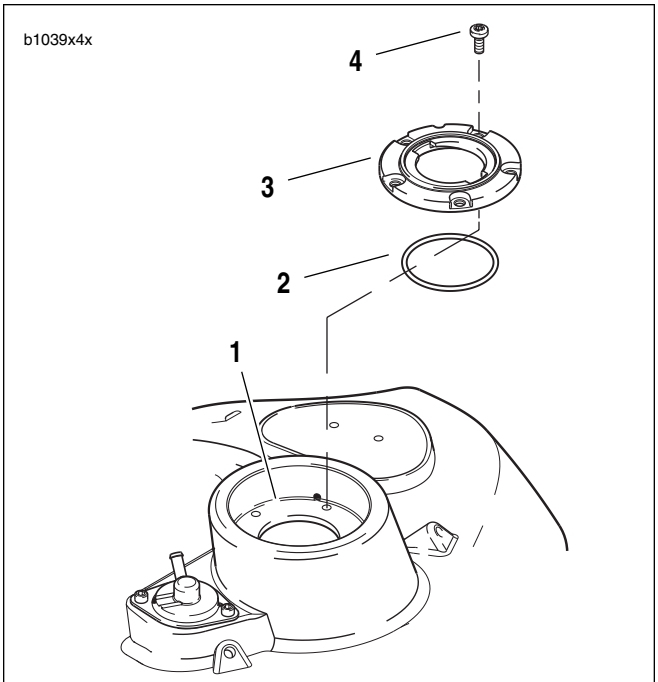
INSTALLATION

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.



1. Fuel filler neck
2. O-ring
3. Fuel cap retaining ring
4. Fastener (5)

Figure 4-103. Fuel Cap Retaining Ring

THROTTLE BODY 4.42

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.

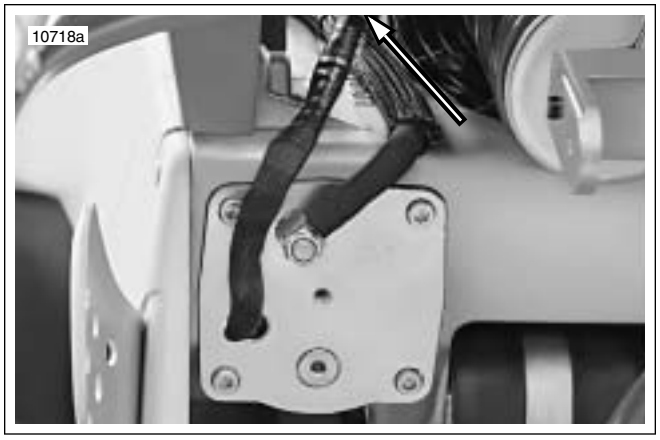
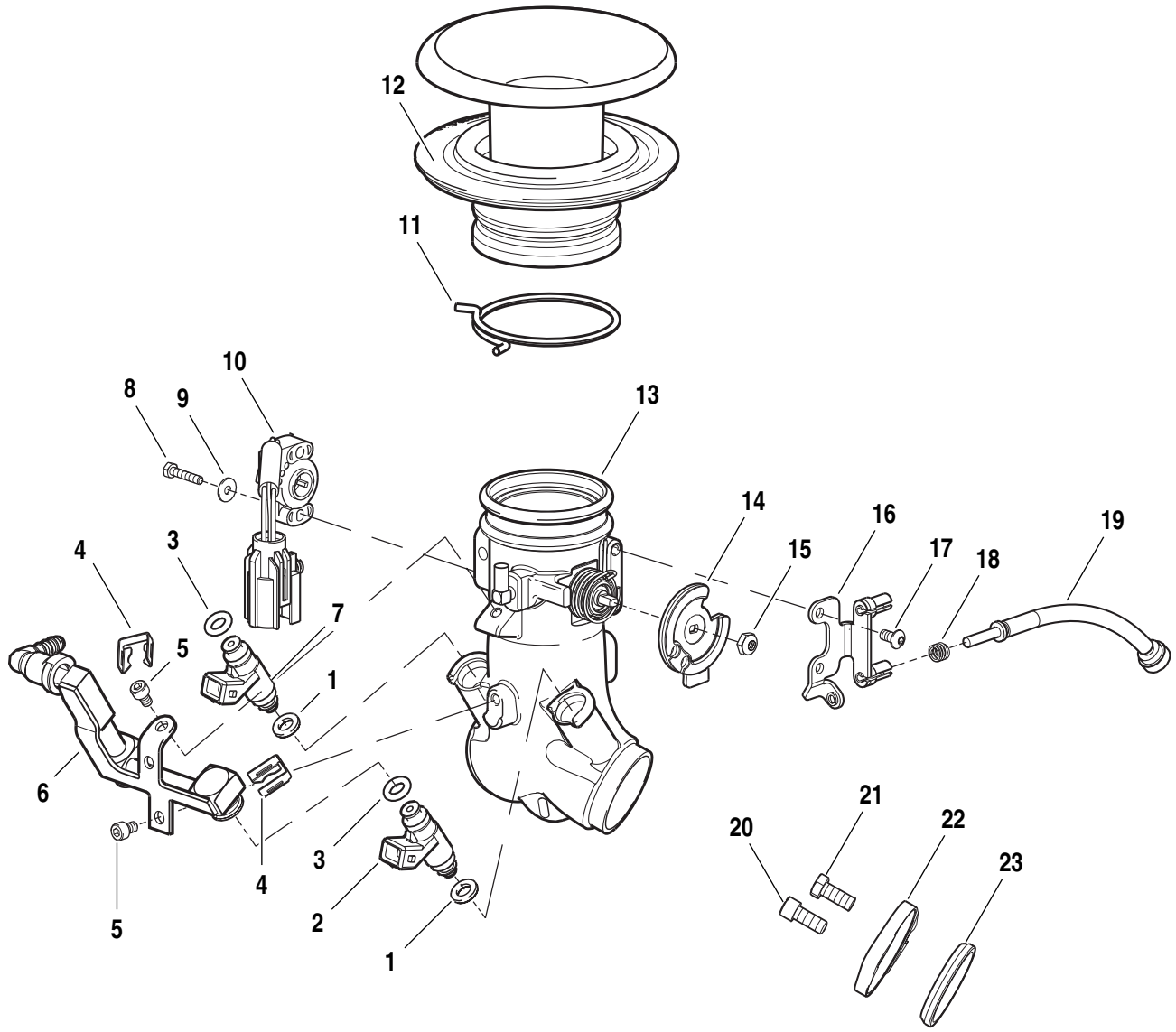


Figure 4-104. Fuel Pump Connector [86] (swingarm removed for illustration)

b0063



1. O-ring, fuel injector, outlet
2. Fuel Injector, front
3. O-ring, fuel injector, inlet
4. Clip, injector (2)
5. Screw (2)
6. Fuel Rail
7. Fuel injector, rear
8. Screw (2
9. Washer, flat (2)
10. Throttle position sensor
11. Clamp, wire spring, 49mm
12. Velocity stack, 49mm
13. Throttle body manifold assembly (45mm-984) (49mm-1203)
14. Throttle lever assembly
15. Nylock
16. Cable Bracket
17. Screw (2)
18. Spring, idle adjuster
19. Idle adjuster
20. Bolt (2)
21. Bolt (2)
22. Mounting flange, intake (1 front, 1 rear)
23. Seal, intake manifold (2)

Figure 4-105. One Piece Throttle Body/Intake Manifold Assembly (all models)

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

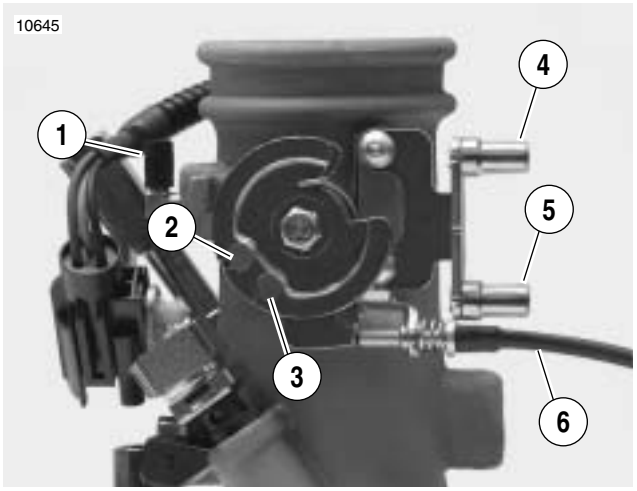
See 4.37 THROTTLE POSITION SENSOR for removal, installation and calibration information.

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.

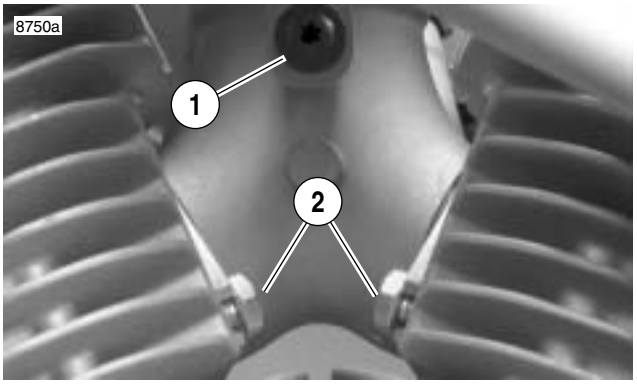
NOTE

Front and rear fuel injectors are not interchangeable.



1. **EVAP hose fitting**
2. **Throttle control cable attachment**
3. **Idle control cable attachment**
4. **Throttle control cable slot**
5. **Idle control cable slot**
6. **Idle adjuster cable**

Figure 4-106. Throttle Cable Bracket (Typical)



1. **Manifold to engine mount fastener**
2. **Intake flange fastener (2)**

Figure 4-107. Intake Manifold (primary side)

⚠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 grove 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.

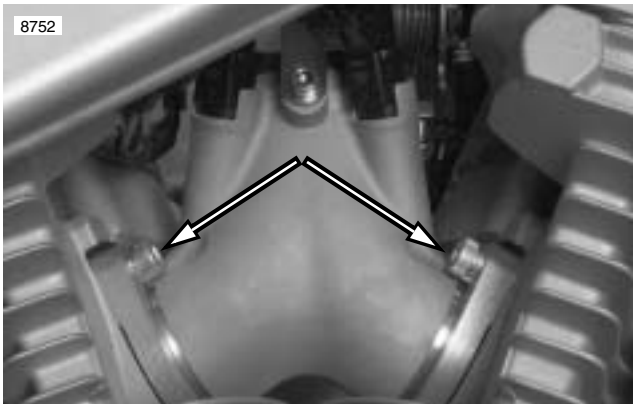
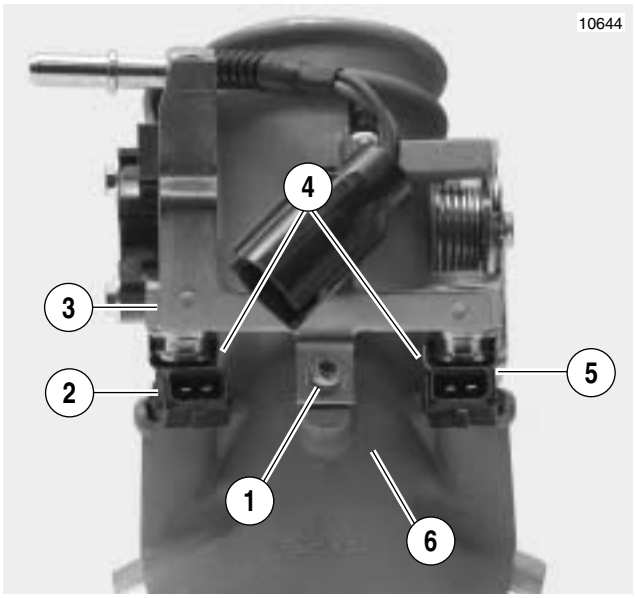


Figure 4-108. Intake Manifold Fasteners (gearcase cover side)

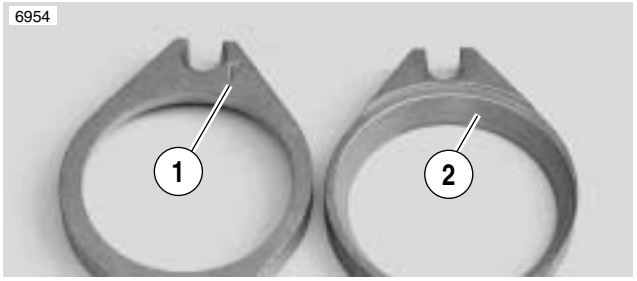


1. **Fuel rail fastener**
2. **Rear fuel injector**
3. **Fuel rail assembly**
4. **Clip (2)**
5. **Front fuel injector**

Figure 4-109. Fuel Injectors

INSTALLATION

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(ront) and R(ear) 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.



1. Label (F=front intake)
2. Counterbore

Figure 4-110. Intake Flanges

INTAKE LEAK TEST 4.43

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. (00335a)

- 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

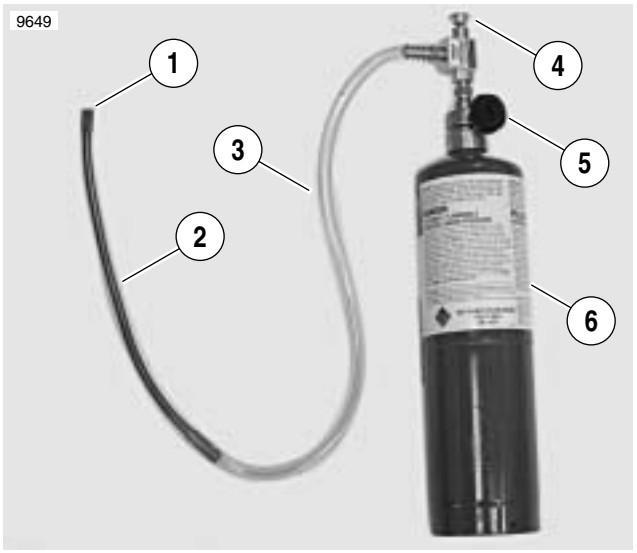
- Standard 14 oz. propane cylinder.
- HD-41417 Propane Enrichment Kit.
- 12 in. (304 mm) long-1/4 in. (6 mm) diameter copper tubing.

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



1. **Nozzle**
2. **Copper Tube**
3. **Hose**
4. **Valve**
5. **Knob**
6. **Propane bottle**

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. (00335a)

- **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

AIR CLEANER ASSEMBLY 4.44

REMOVAL

1. Remove intake cover assembly. 2.37 INTAKE COVER ASSEMBLY.

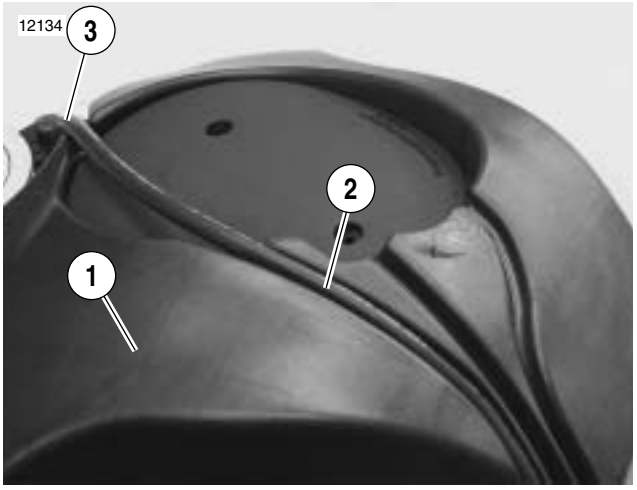
NOTEs

- *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 baseplatebaseplate.
   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 velocity stack (6).
   f. Remove baseplate from motorcycle.

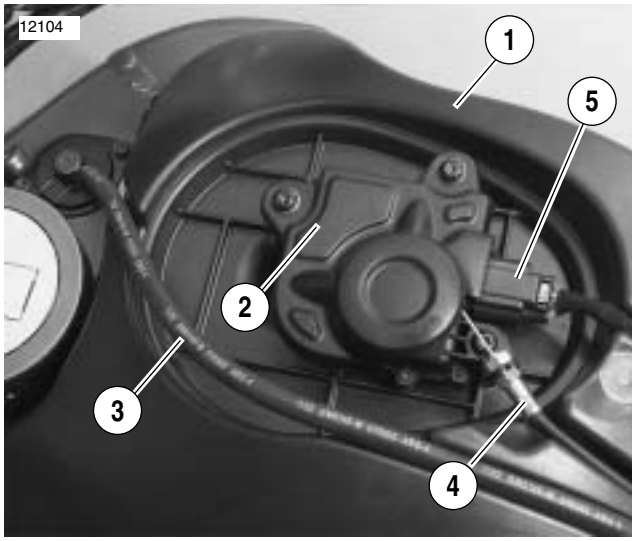
INSPECTION

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.



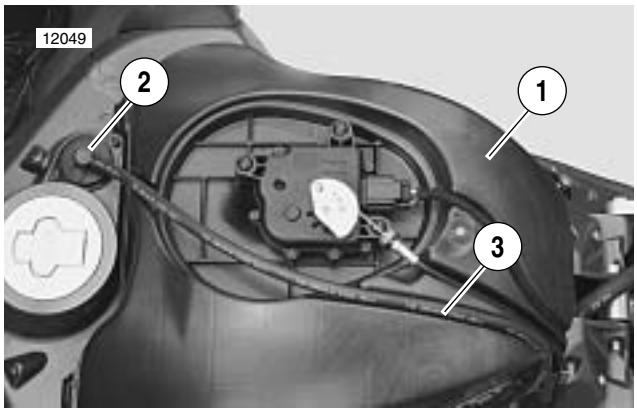
1. **Air cleaner cover**
2. **Fuel vent tube**
3. **Fuel cell vent**

Figure 4-114. Air Cover (XB9SX "Translucid" model)



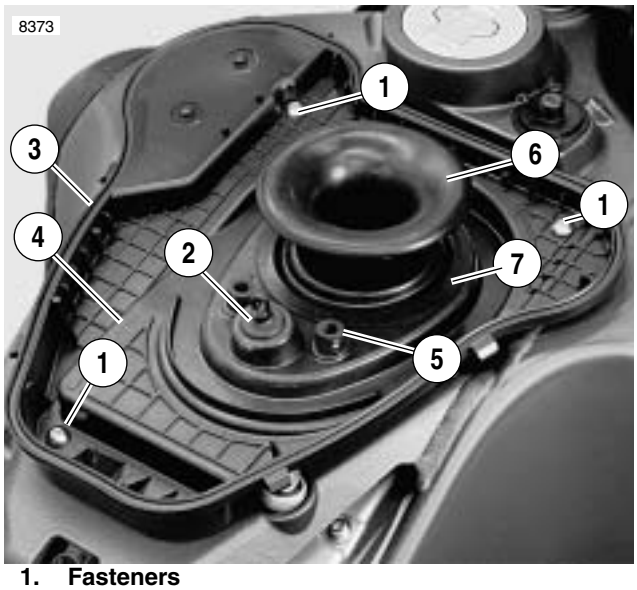
1. **Air cleaner cover**
2. **Interactive exhaust actuator cover**
3. **Fuel vent tube**
4. **Cable, interactive exhaust**
5. **Harness, interactive exhaust**

Figure 4-115. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 "Translucid" models)



1. **Air cleaner assembly cover**
2. **Fuel vent tube**
3. **Fuel cell vent**

Figure 4-116. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 solid color models)



1. **Fasteners**
2. **Intake air temperature sensor (IAT)**
3. **Gasket**
4. **Baseplate**
5. **Breather hoses**
6. **Velocity stack**
7. **Velocity stack sealing ring**

Figure 4-117. baseplate (all models)

INSTALLATION

1. See Figure 4-117. Hold baseplate above mounting position.
2. Insert IAT sensor into grommet on baseplate from underside. 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

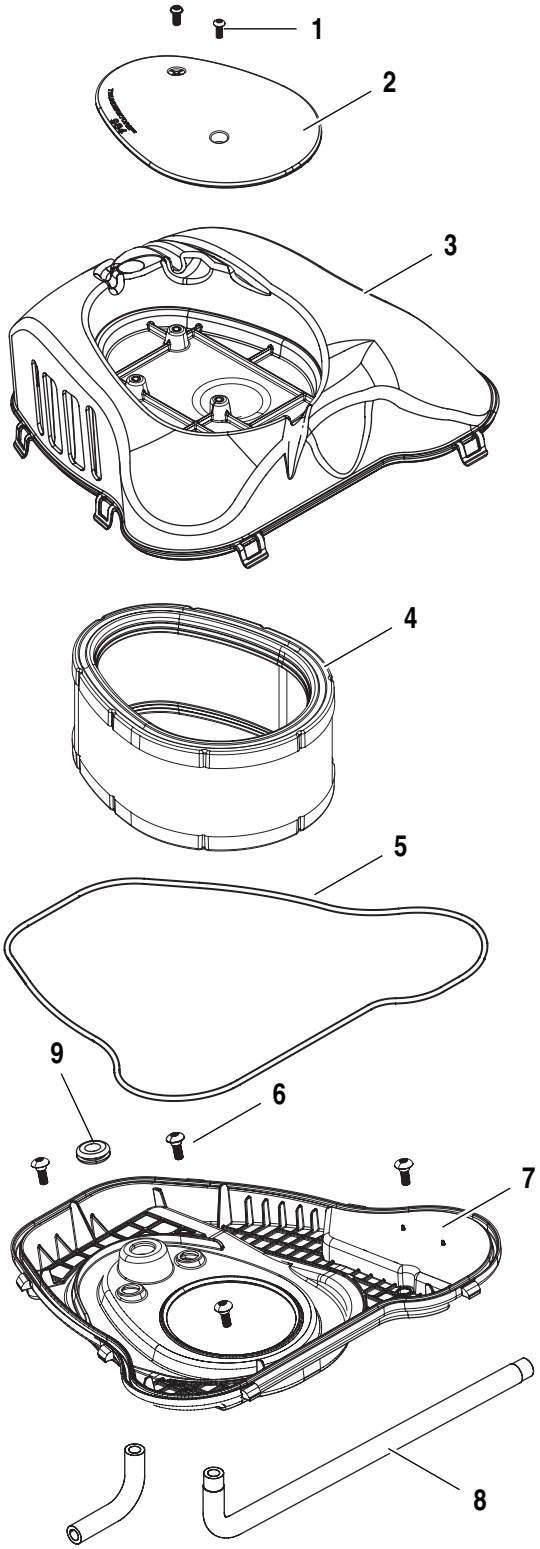
For XB12 models see 7.6 INTERACTIVE EXHAUST SYSTEM (XB12 MODELS).

10. Install intake cover assembly. See 2.37 INTAKE COVER ASSEMBLY.

⚠WARNING

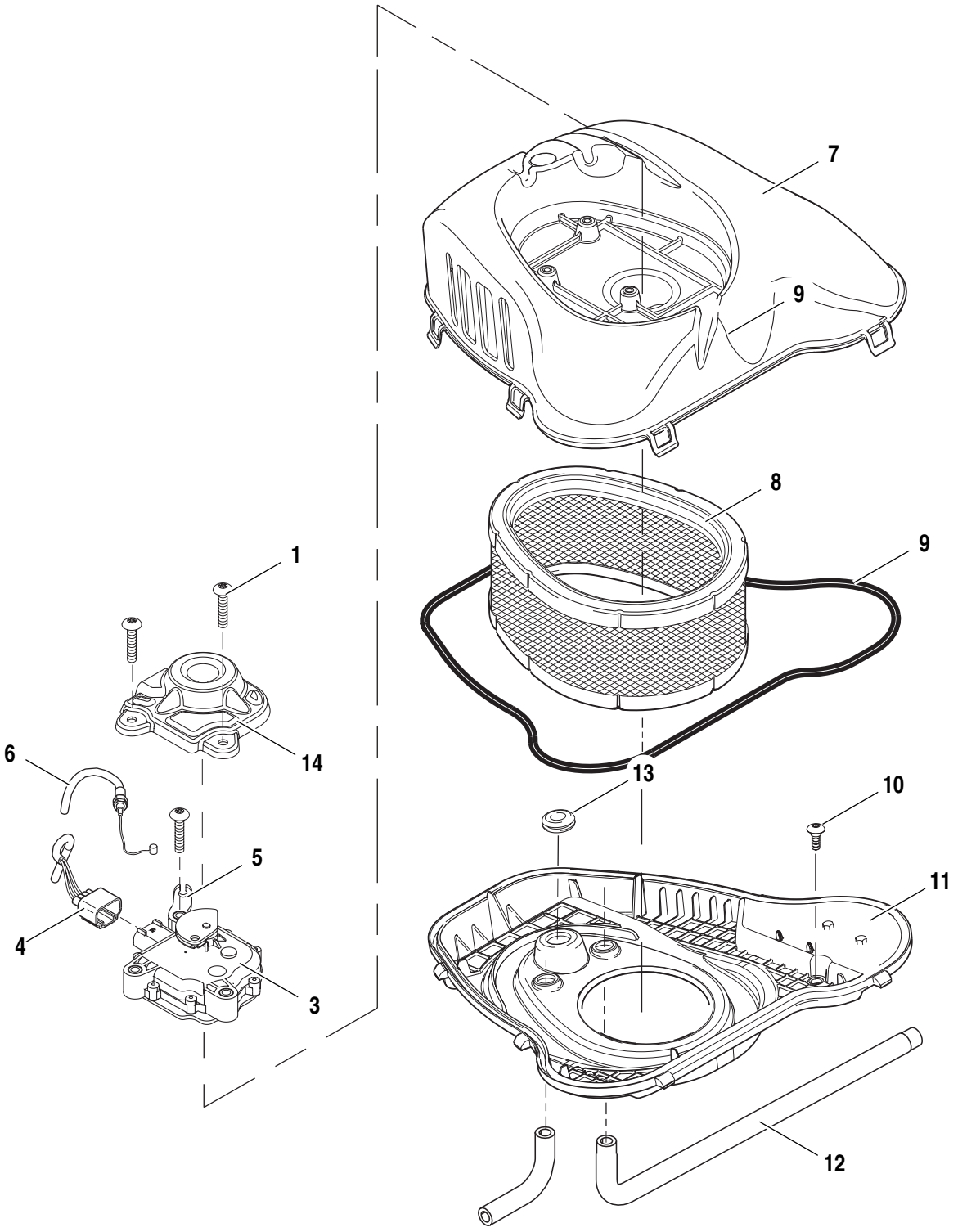
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

11. Install seat. See 2.43 SEAT.



1. **Cover screw (XB9SX) (2)**
2. **“Translucid” air cleaner cover (XB9SX)**
3. **Cover, air cleaner**
4. **Filter element**
5. **Air cleaner cover seal**
6. **Shoulder screw (4)**
7. **baseplate assembly**
8. **Breather hoses, front and rear**
9. **Grommet**

Figure 4-118. Air Cleaner Assembly (XB9SX)



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)

Figure 4-119. Air Cleaner Assembly (XB12 Models) with Interactive Exhaust Components

EVAPORATIVE EMISSIONS CONTROL-CA MODELS 4.45

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:

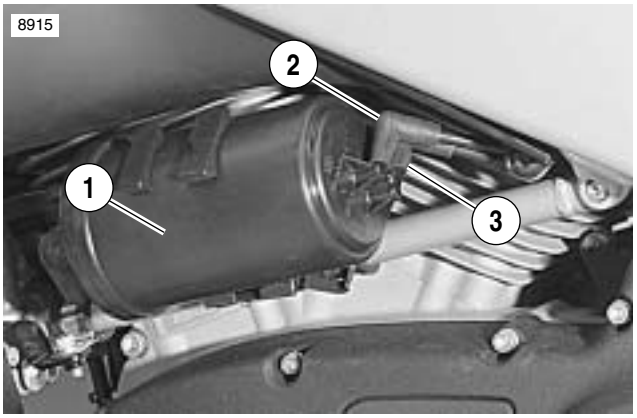
- Hydrocarbon vapors in the fuel tank are directed through the vent valve and stored in the carbon canister. If the vehicle is tipped at an abnormal angle, the vent valve closes to prevent liquid gasoline from leaking out of the fuel tank through the fuel tank vent hose.
- When the engine is running, 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.



1. **Canister**
2. **Fuel tank vent hose (to fuel tank vent valve)**
3. **Canister vent hose (to intake manifold)**

Figure 4-120. Carbon Canister Installation.

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.

INSTALLATION

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.

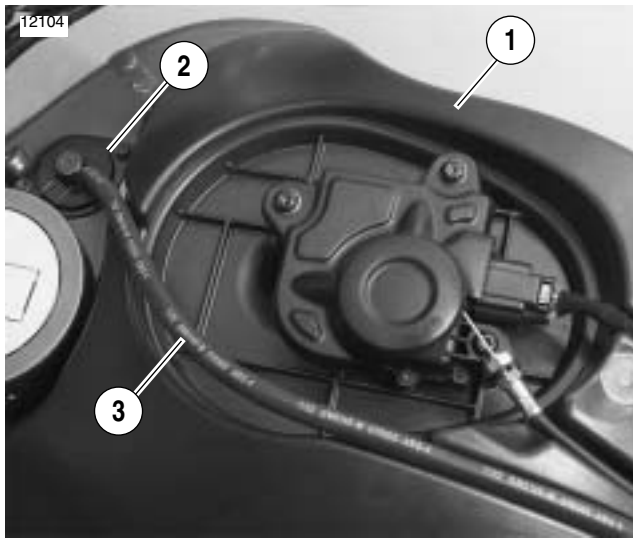
⚠WARNING

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 larger outside 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.



1. **Cover, air cleaner**
2. **Fuel vapor vent valve**
3. **Fuel vent tube**

Figure 4-121. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 "Translucid" models)

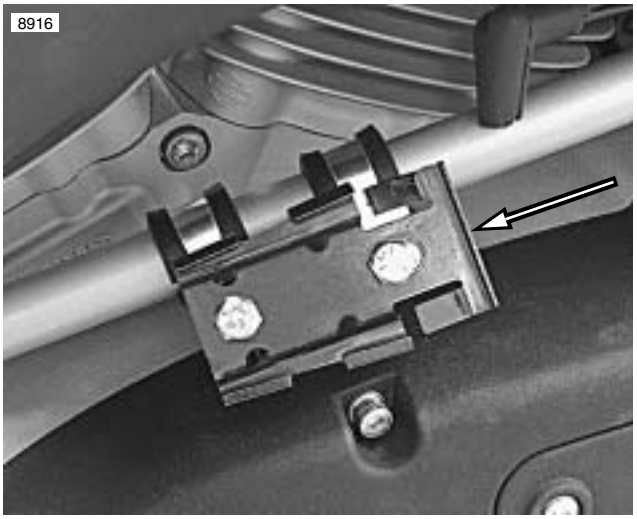


Figure 4-122. Canister Mounting Bracket

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.

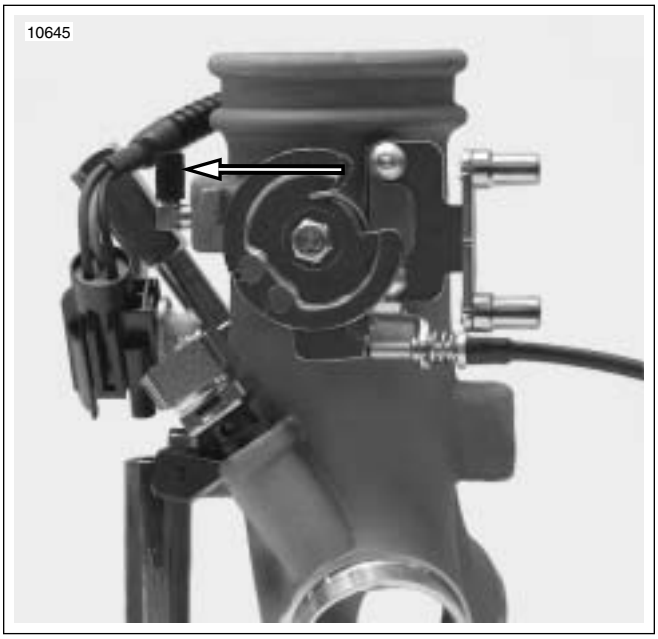


Figure 4-123. Emissions Hose Attachment, California Models Only

Table Of Contents

ELECTRIC STARTER 5

SUBJECT	PAGE NO.
5.1 Specifications	5-1
5.2 Electric Starter System	5-2
5.3 Starting System Diagnosis	5-4
5.4 Starter Activation Circuits	5-8
5.5 Diagnostics/Troubleshooting	5-9
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5.7 Starter	5-12
5.8 Starter Solenoid	5-21

SPECIFICATIONS 5.1

Table 5-1. Starter Specifications

STARTER	
Free speed	3000 RPM (min.) @ 11.5 V
Free current	90 Amp (max.) @ 11.5 V
Stall current	400 Amp (max.) @ 2.4 V
Stall torque	8 ft-lbs (11 Nm) (min.) @ 2.4 V

Table 5-2. Service Wear Specifications

SERVICE WEAR LIMITS	IN.	MM
Brush length (min.)	0.433	11.0
Commutator diameter (min.)	1.141	28.981

TORQUE VALUES

ITEM	TORQUE		NOTES
Battery terminal fasteners	72-96 **in-lbs**	8-11 Nm	page 5-19
Starter battery positive cable nut	60-85 **in-lbs**	7-10 Nm	page 5-19
Starter mounting bolts	13-20 ft-lbs	18-27 Nm	page 5-19

ELECTRIC STARTER SYSTEM 5.2

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. Simultaneously, 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).

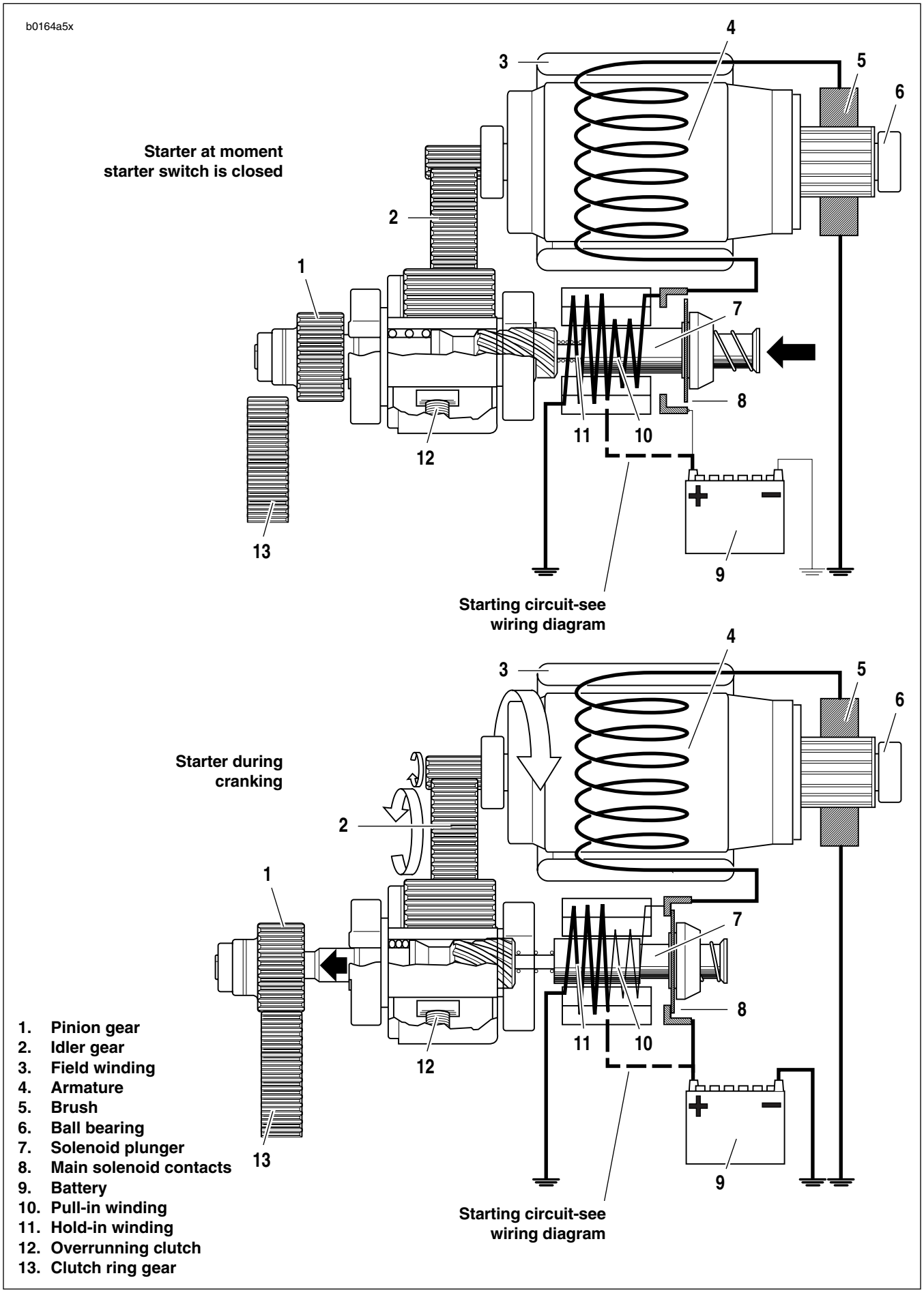


Figure 5-1. Starter Operation

STARTING SYSTEM DIAGNOSIS 5.3

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.

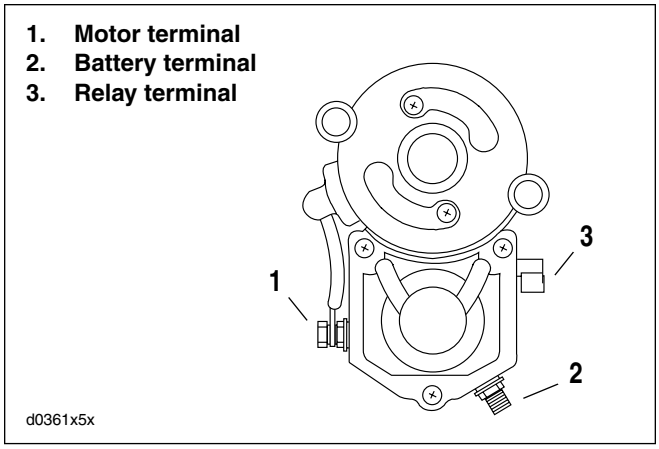
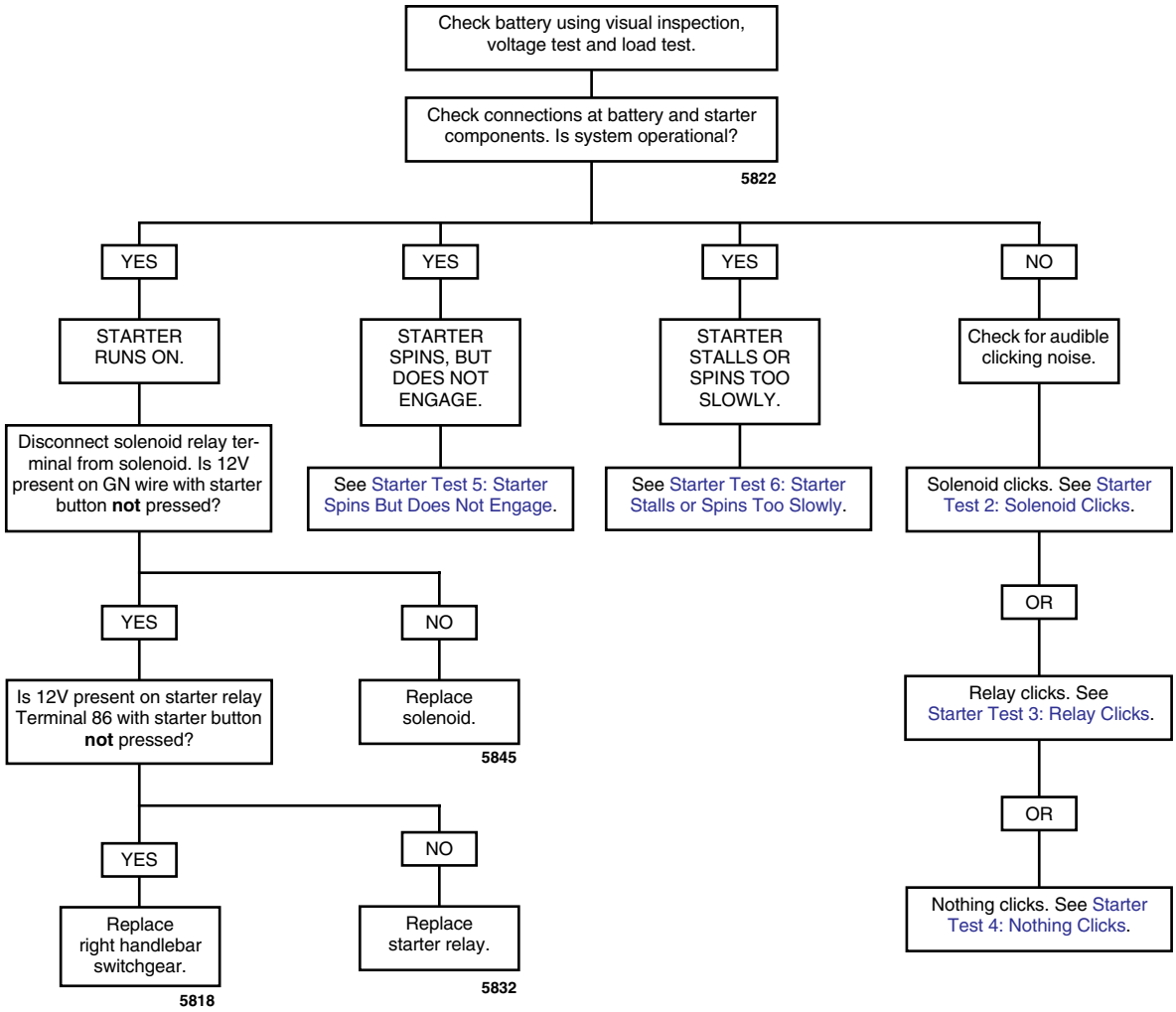
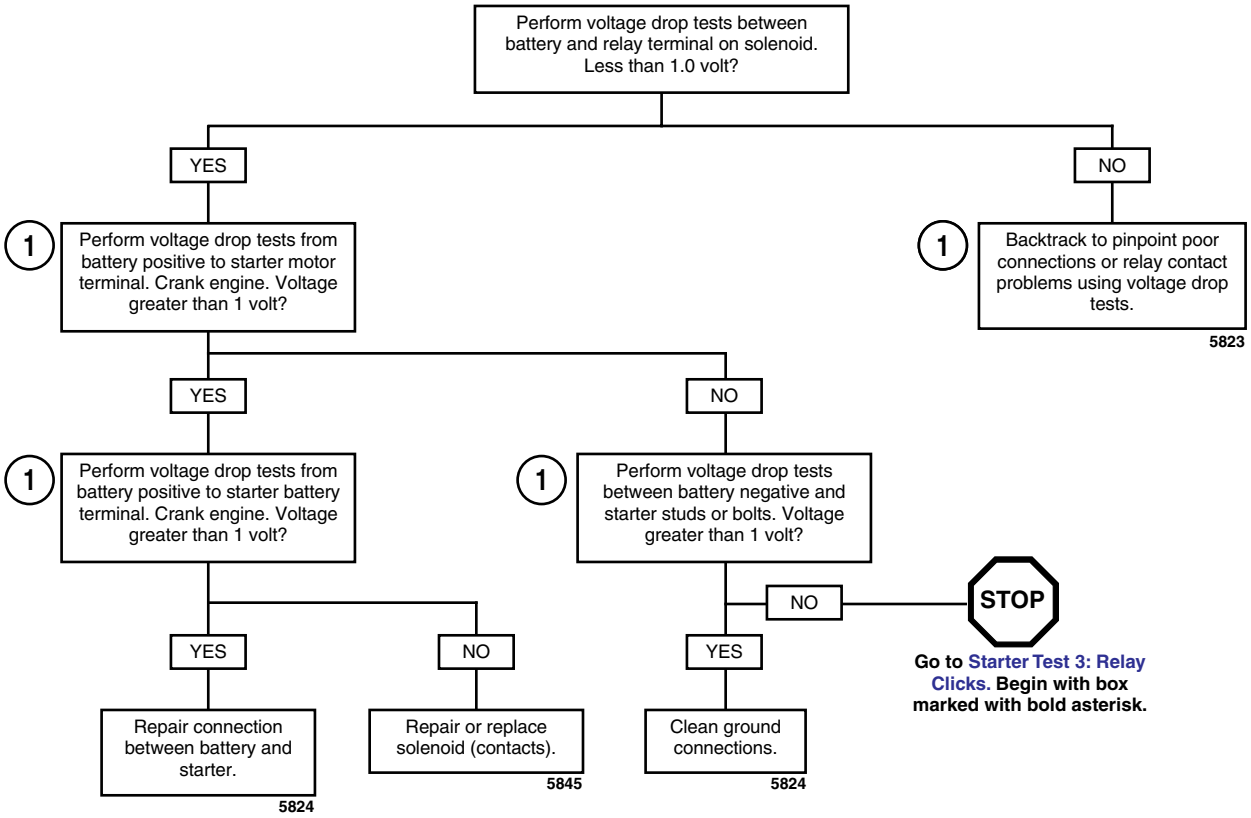


Figure 5-2. Starter Terminals

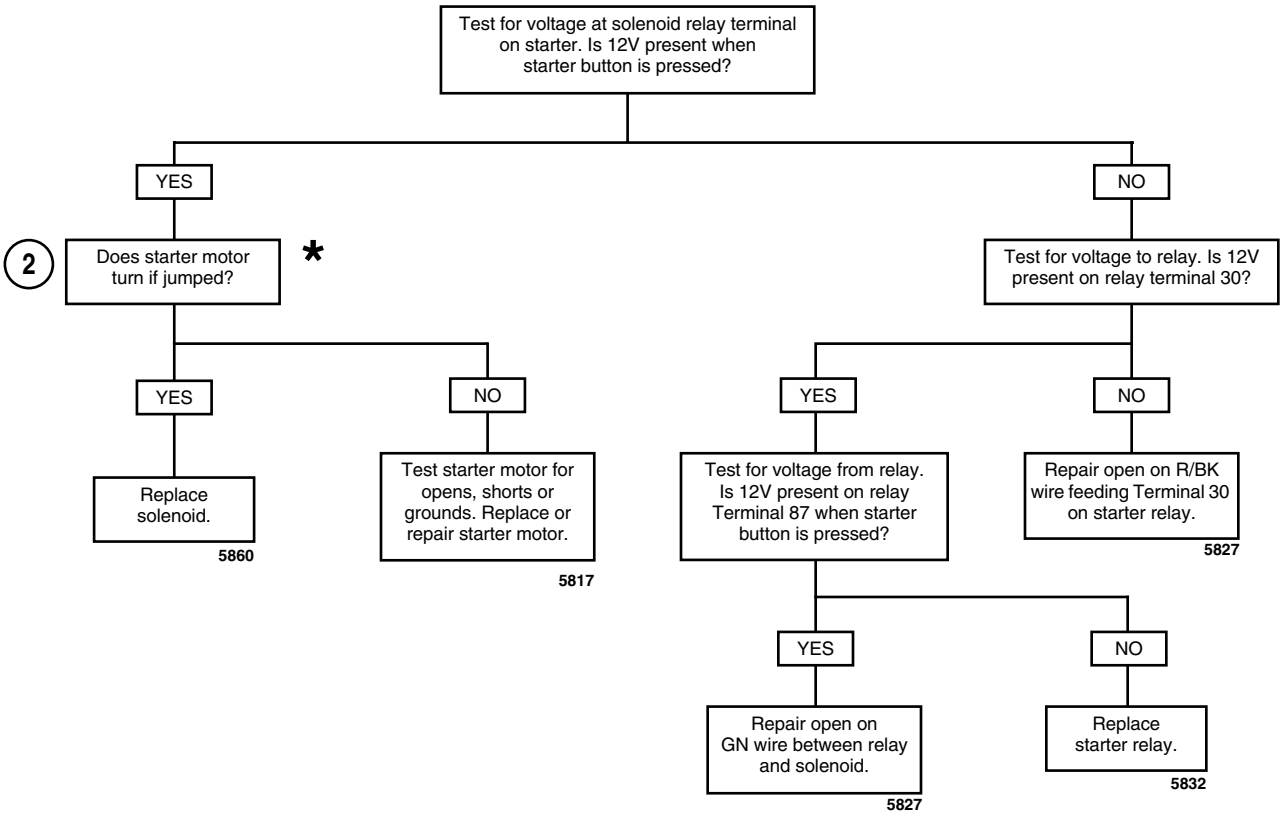
Starter Test 1



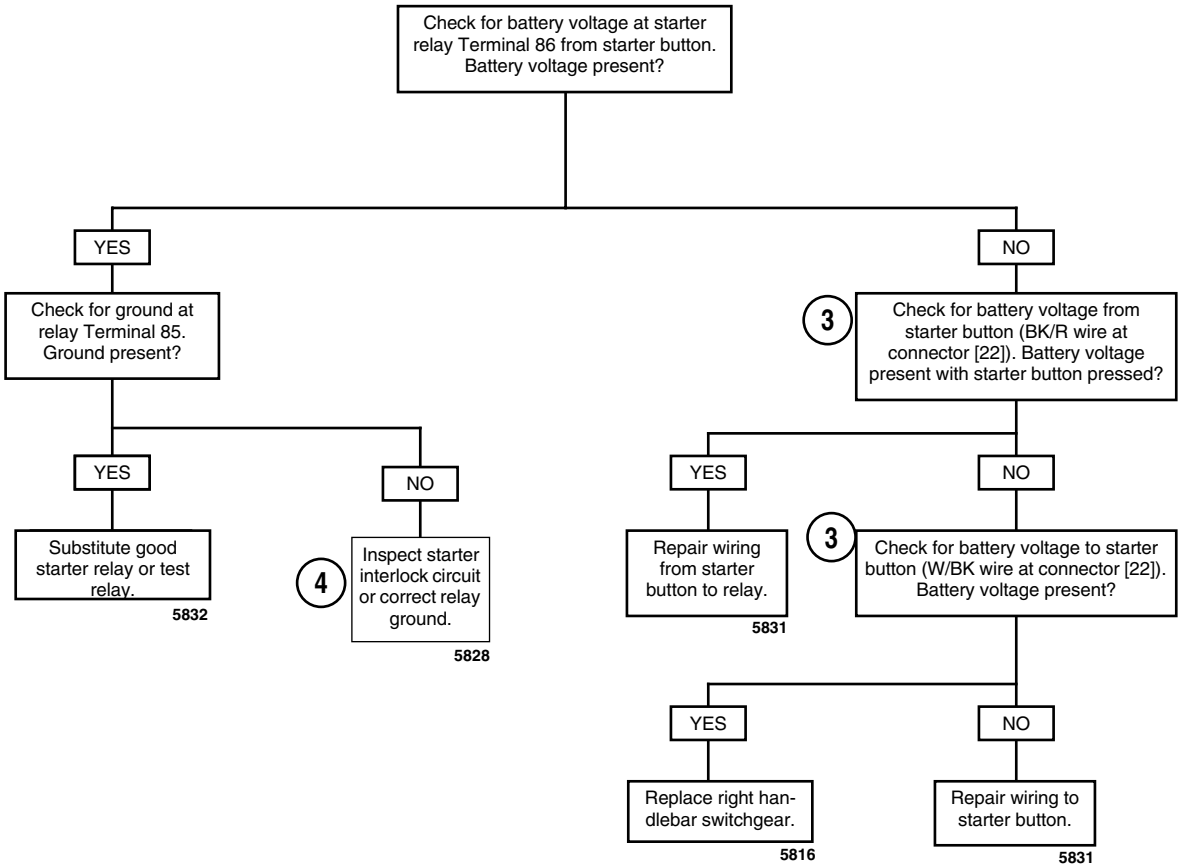
Starter Test 2: Solenoid Clicks



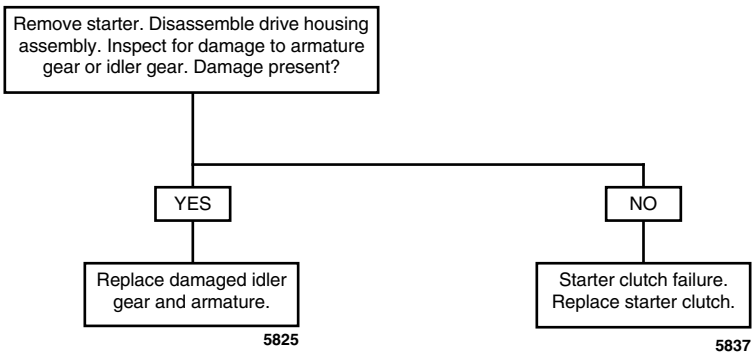
Starter Test 3: Relay Clicks



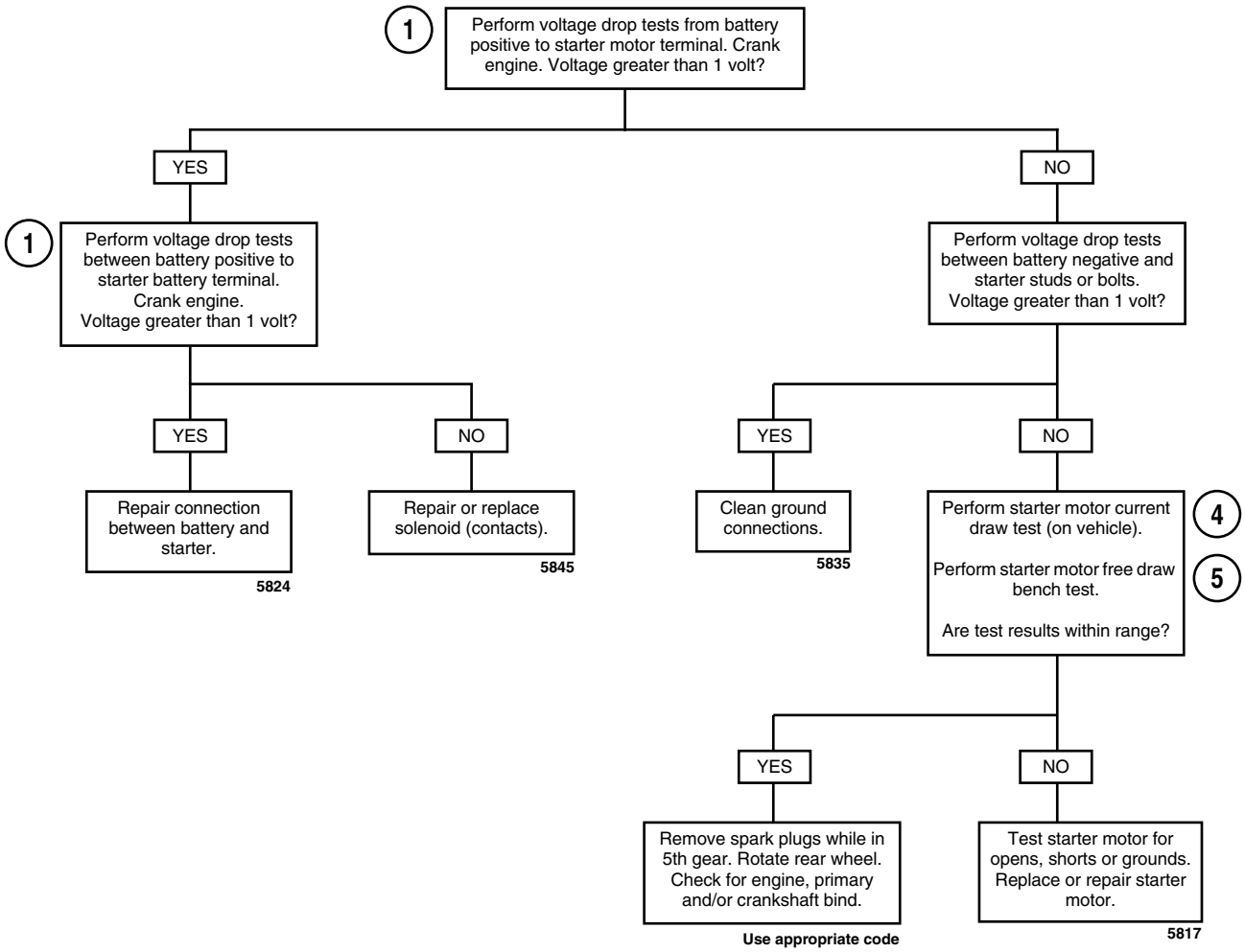
Starter Test 4: Nothing Clicks



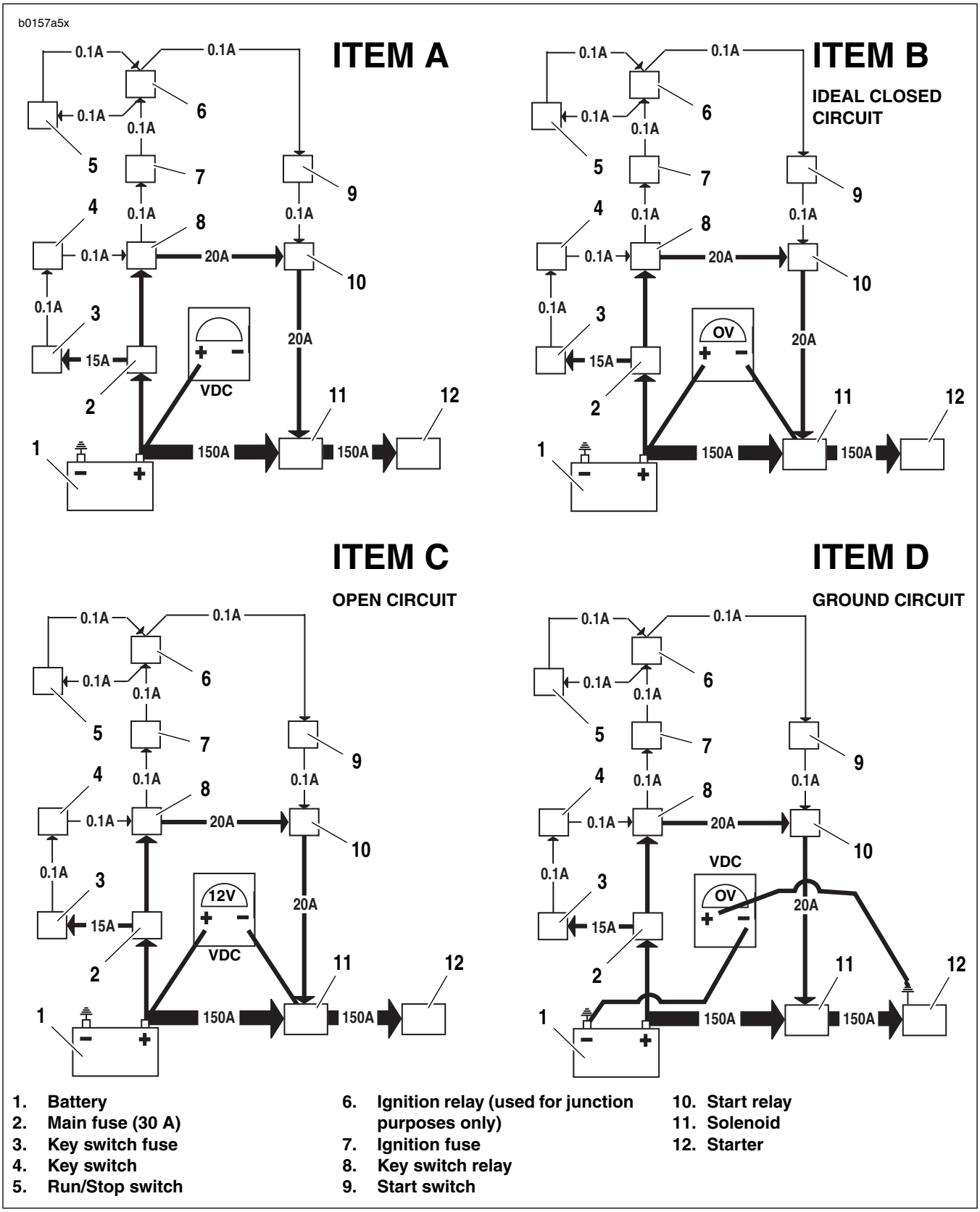
Starter Test 5: Starter Spins But Does Not Engage



Starter Test 6: Starter Stalls or Spins Too Slowly



STARTER ACTIVATION CIRCUITS 5.4



1. Battery
2. Main fuse (30 A)
3. Key switch fuse
4. Key switch
5. Run/Stop switch
6. Ignition relay (used for junction purposes only)
7. Ignition fuse
8. Key switch relay
9. Start switch
10. Start relay
11. Solenoid
12. Starter

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.

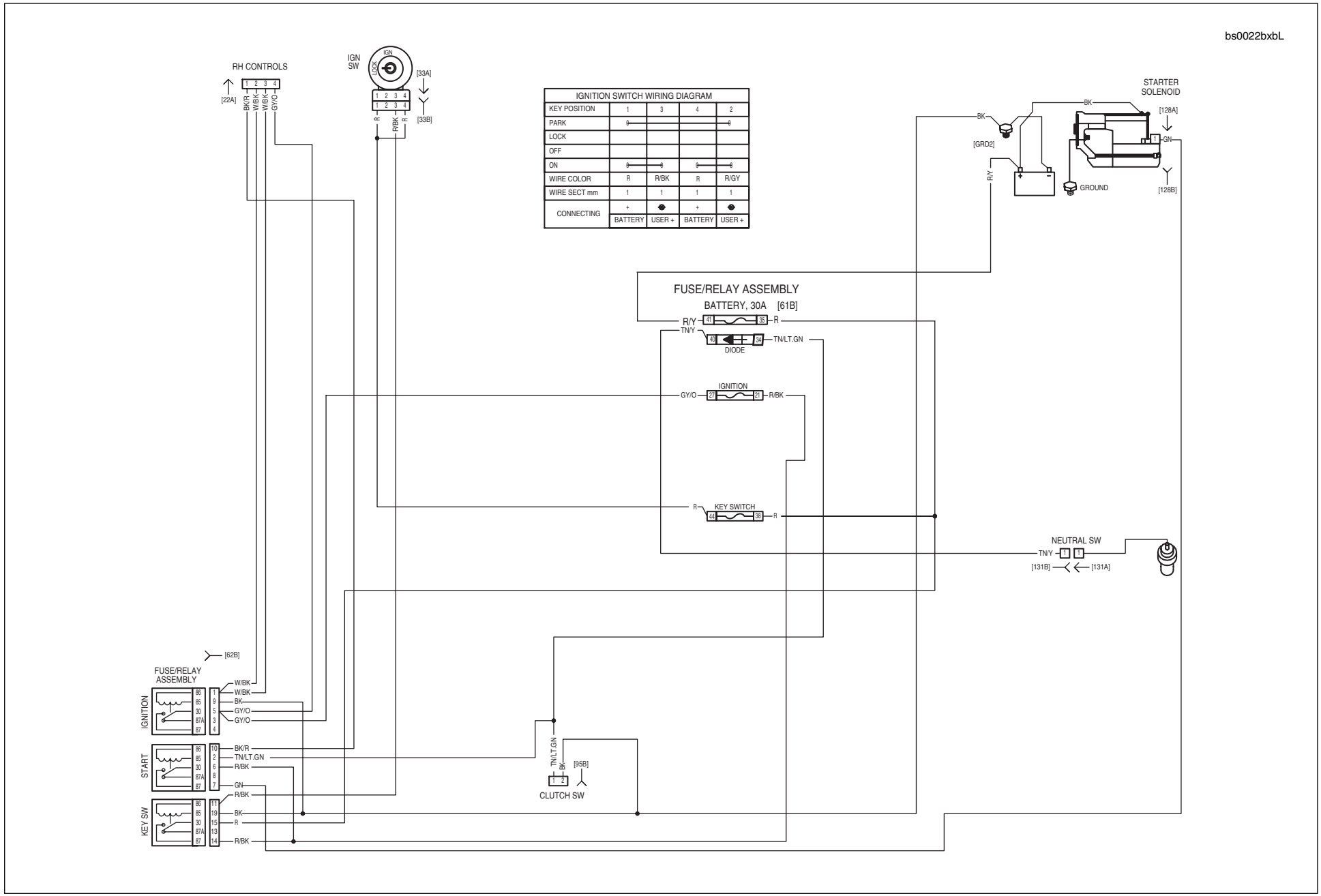


Figure 5-4. Electric Starting System Circuit

STARTER SYSTEM TESTING 5.6

"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.

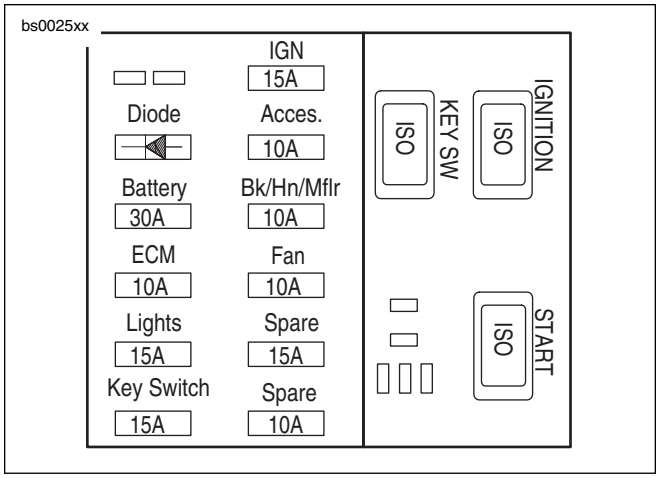


Figure 5-5. Relay Block (top view)

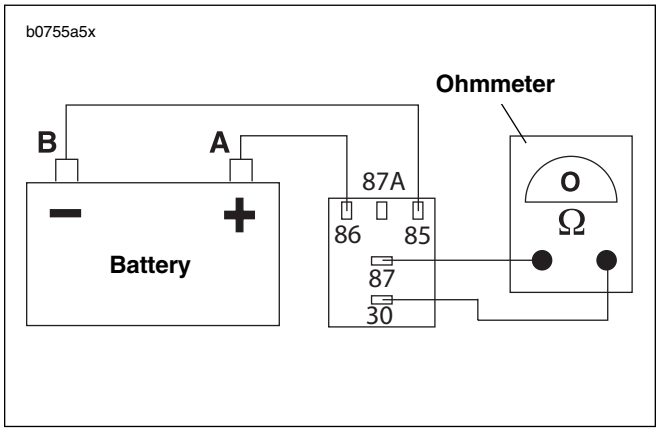


Figure 5-6. Starter Relay Test

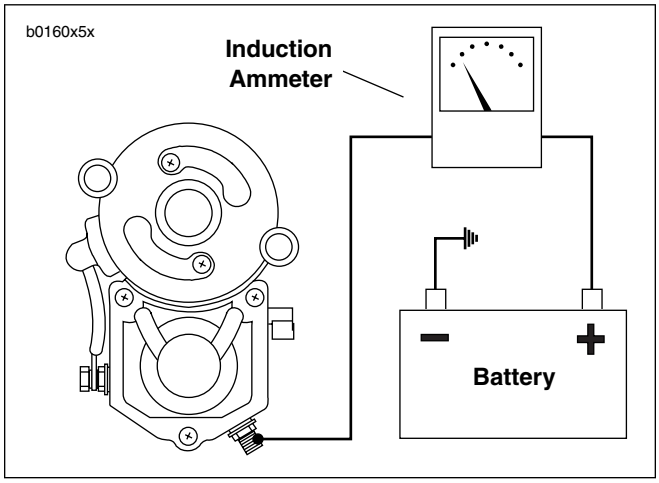


Figure 5-7. Starter Draw Test

REMOVAL

1. Remove seat. See 2.43 SEAT.

⚠WARNING

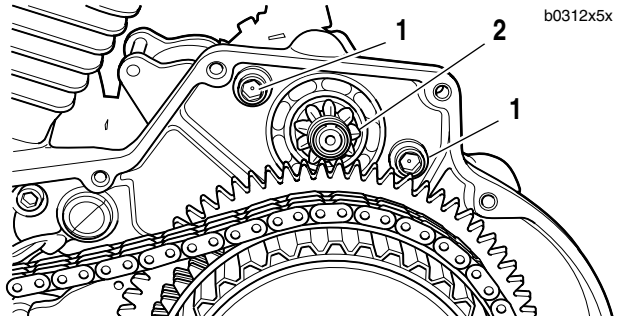
Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

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

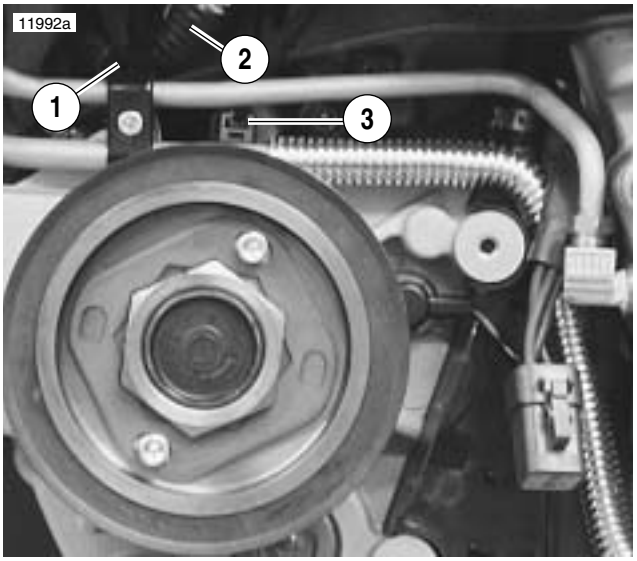
A ball hex driver may be required to gain access to the starter mounting bolts.

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.



1. **Mounting bolts and washers**
2. **Starter**

Figure 5-8. Starter Mounting



1. **Fastener with washer (metric)**
2. **Positive battery cable**
3. **Solenoid wire**

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.

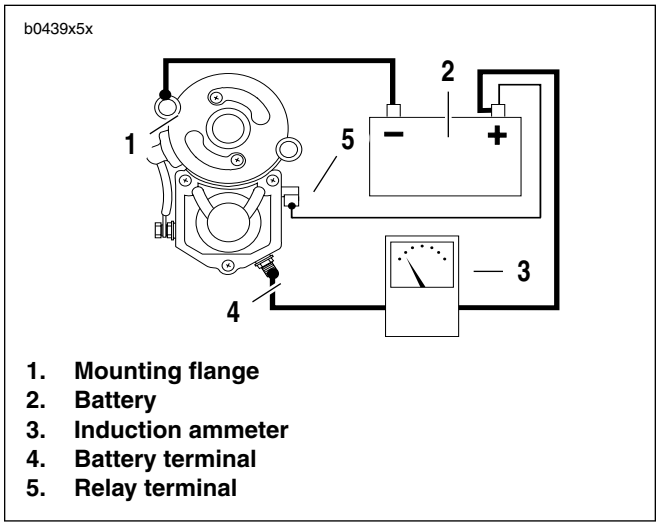


Figure 5-10. Free Running Current Draw Test

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.*

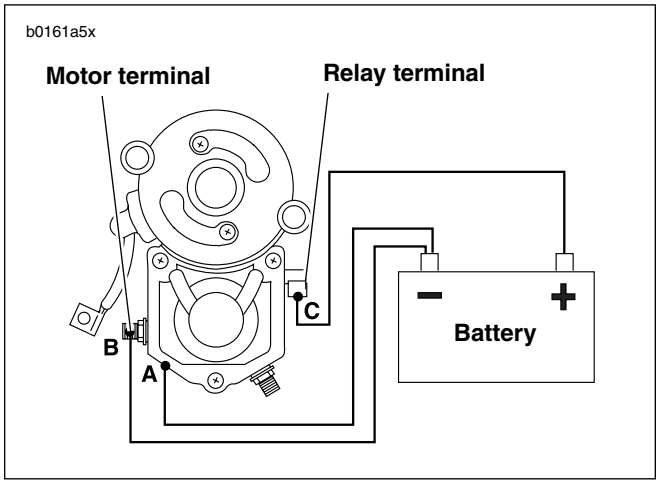


Figure 5-11. Pull-In Test

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.

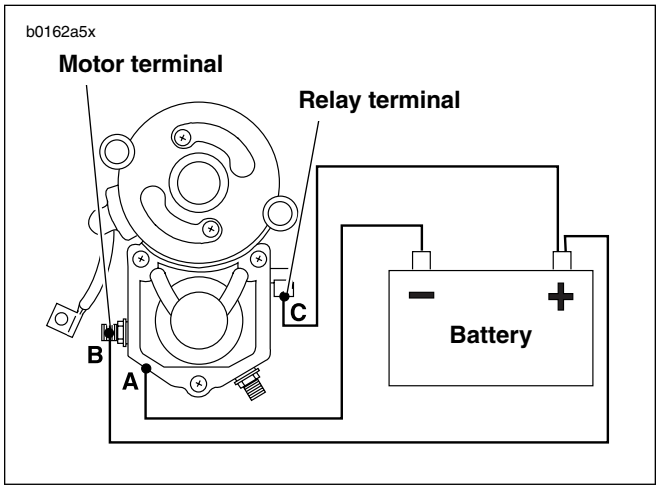


Figure 5-12. Hold-In Test

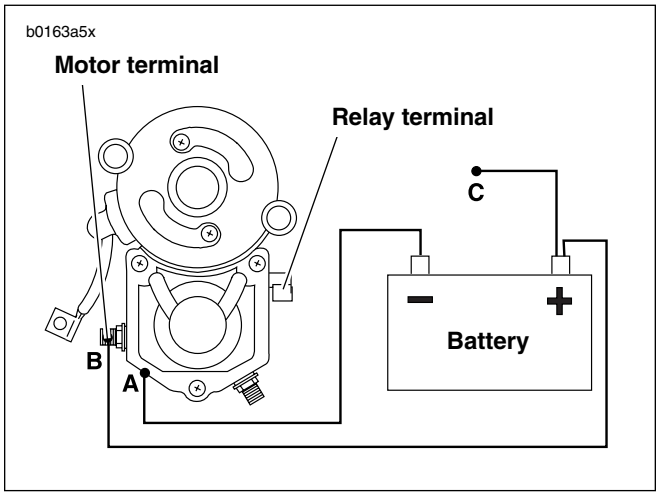


Figure 5-13. Return Test

DISASSEMBLY, INSPECTION AND REPAIR

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

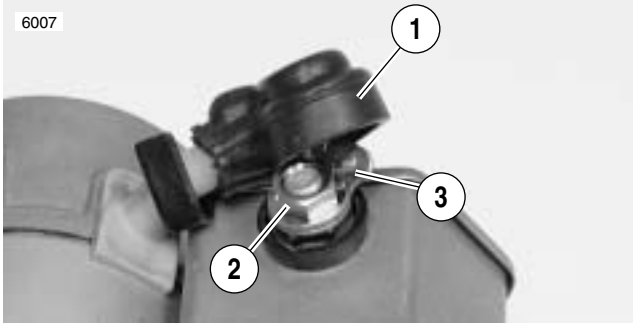
*Brushes not available separately. Purchase a **new** field frame (1) and brush holder (2) to replace brushes.*

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

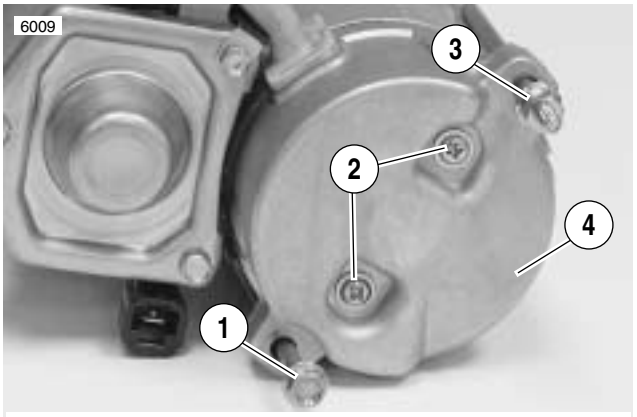
- *Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.*
- *See Figure 5-17. If an undercutting machine is not available, undercutting can be done 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.



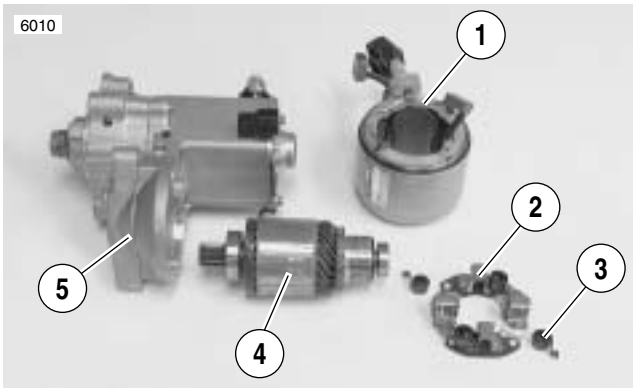
1. **Rubber boot**
2. **Field wire nut with washer (metric)**
3. **Field wire**

Figure 5-14. Field Wire



1. **Lower thru-bolt**
2. **Screw with O-ring (2)**
3. **Upper thru-bolt**
4. **End cover**

Figure 5-15. Removing the Thru-Bolts



1. **Field frame**
2. **Brush holder**
3. **Brush spring (4)**
4. **Armature**
5. **Solenoid housing**

Figure 5-16. Starter Components

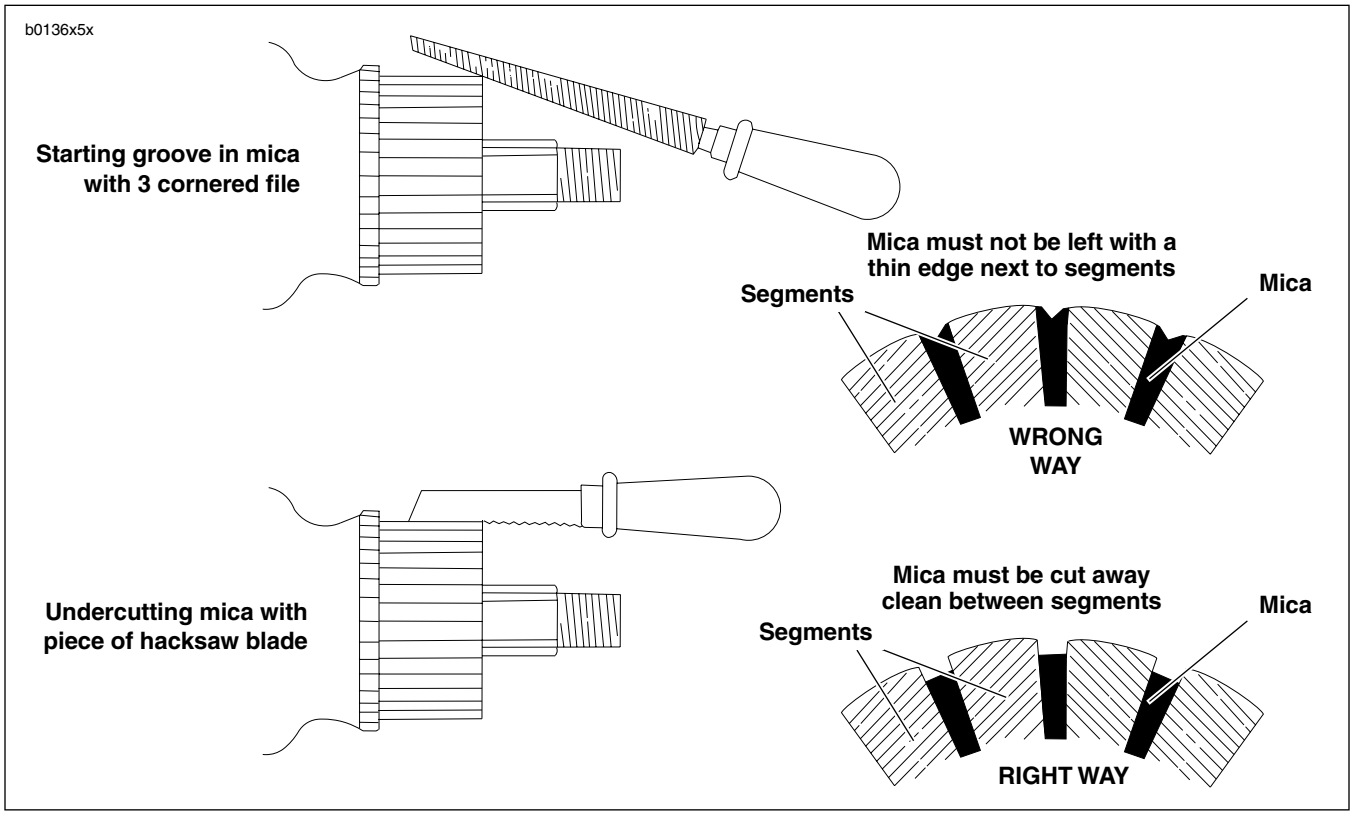


Figure 5-17. Undercutting Mica Separators

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.



Figure 5-18. Shorted Armature Test Using Growler

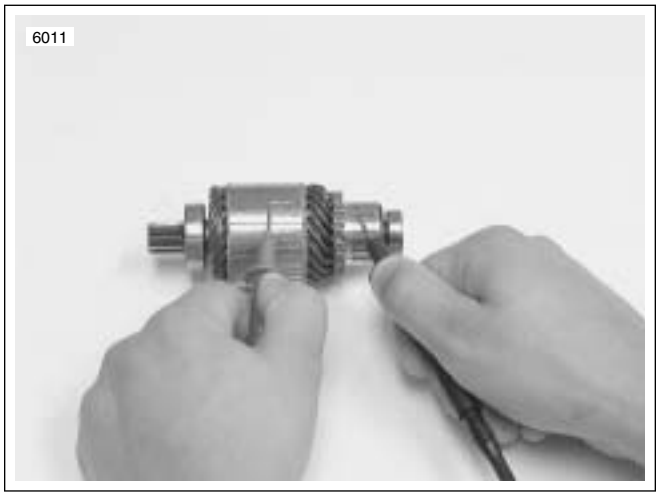


Figure 5-19. Grounded Armature Test



Figure 5-20. Open Armature Test

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).

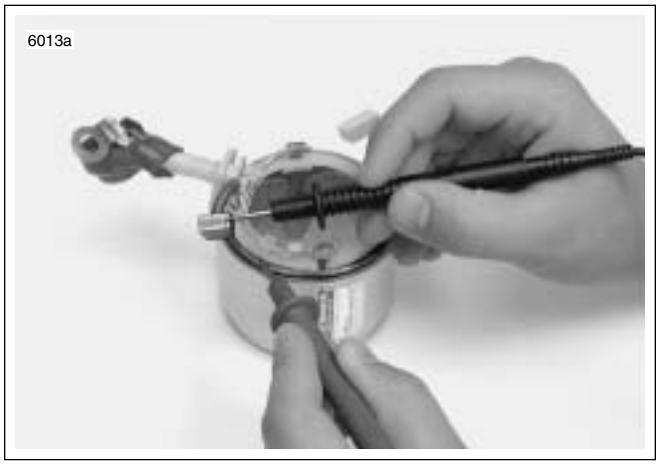


Figure 5-21. Grounded Field Test



Figure 5-22. Open Field Test

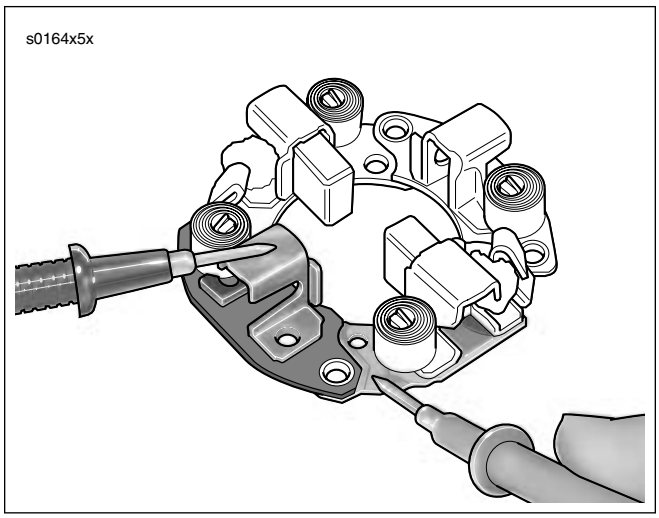


Figure 5-23. Brush Holder Insulation Test

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

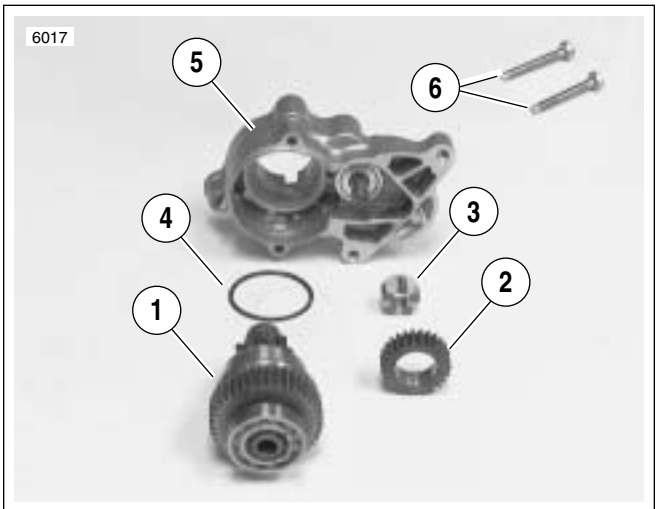
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

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

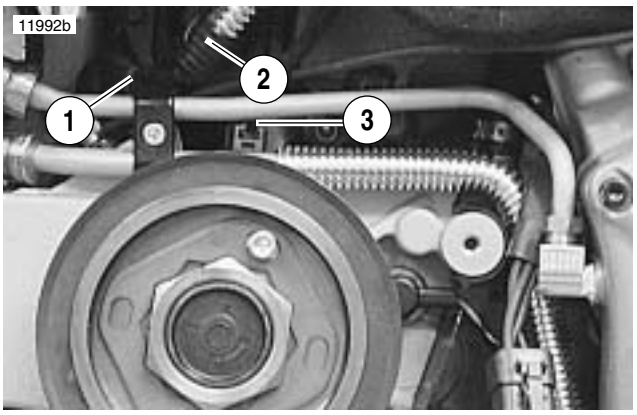
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat. See 2.43 SEAT.



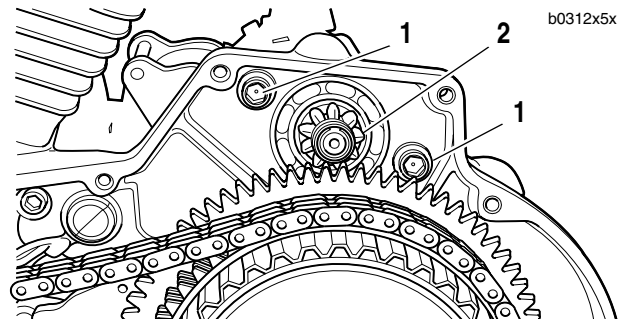
1. **Drive**
2. **Idler gear**
3. **Idler gear bearing**
4. **O-Ring**
5. **Drive housing**
6. **Screws**

Figure 5-24. Starter Drive Assembly



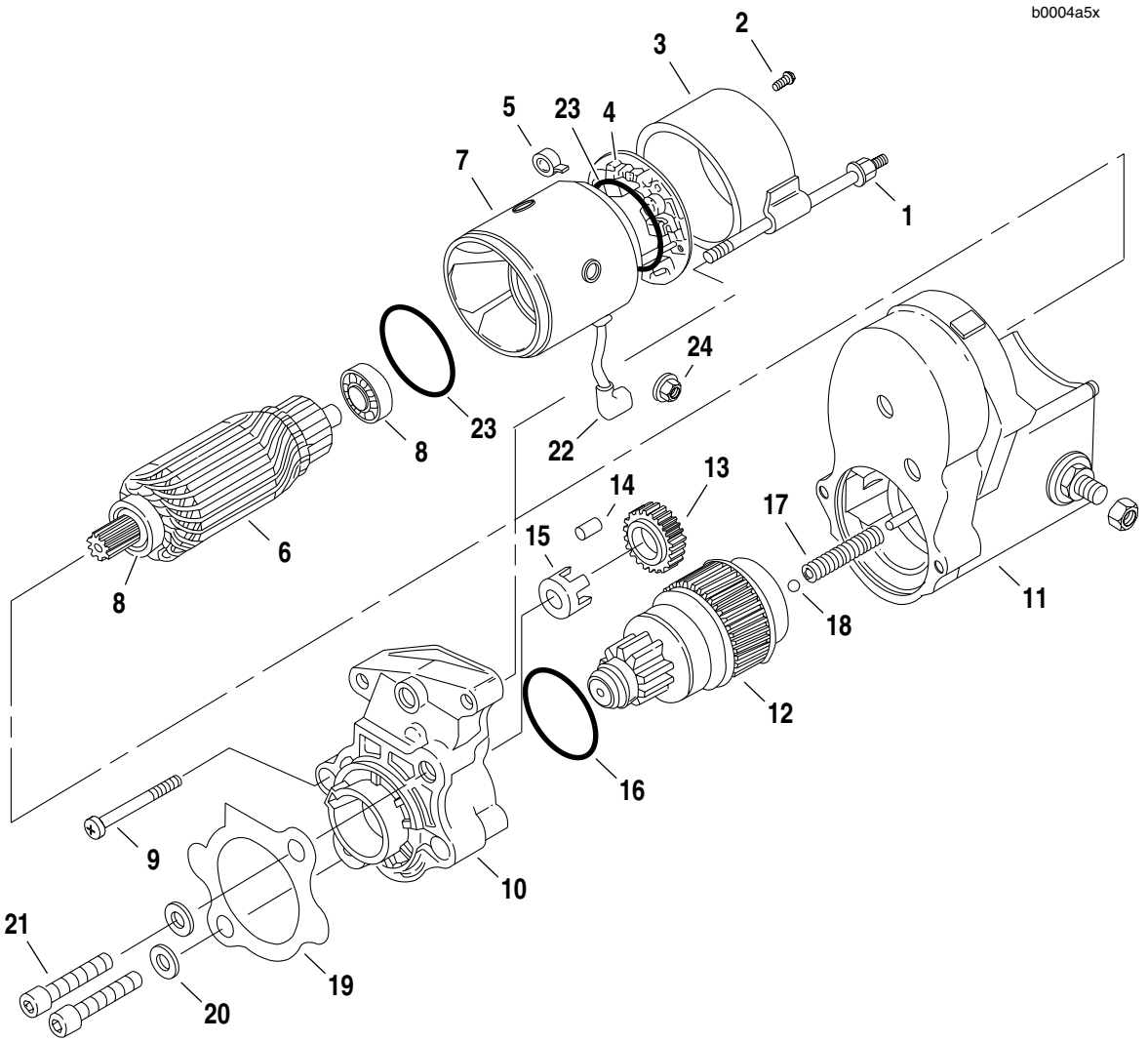
1. **Fastener with washer (metric)**
2. **Positive battery cable**
3. **Solenoid wire**

Figure 5-25. Starter Wires (protective boot not shown)



1. **Mounting bolts and washers**
2. **Starter**

Figure 5-26. Starter Mounting



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)

Figure 5-27. Starter Assembly

STARTER SOLENOID 5.8

GENERAL

NOTE

See Figure 5-28. Do not tighten nut (7) without removing items (1) through (5). Movement will cause damage to the contact.

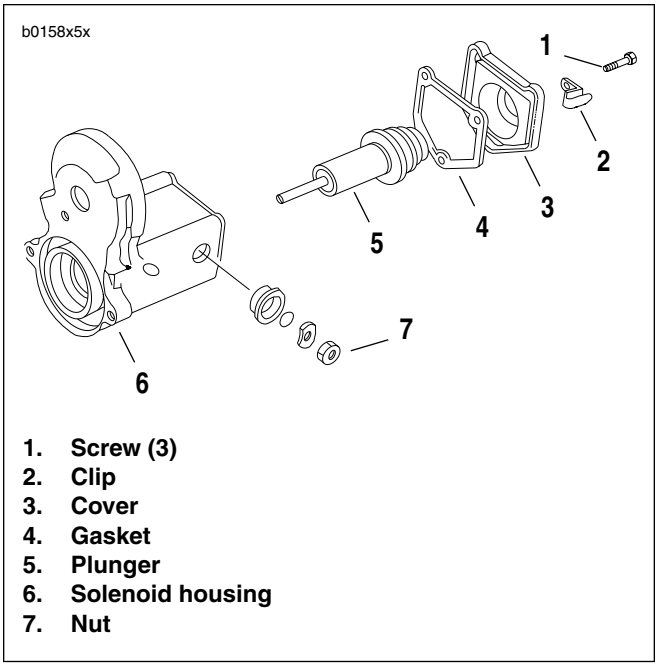
The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

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).



1. **Screw (3)**
2. **Clip**
3. **Cover**
4. **Gasket**
5. **Plunger**
6. **Solenoid housing**
7. **Nut**

Figure 5-28. Starter Solenoid

NOTES

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SPECIFICATIONS 6.1

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 6-1. Primary Drive (Engine-to-transmission)

ITEM	NEW COMPONENTS (XB9)	NEW COMPONENTS (XB12)
Engine sprocket – number of teeth	34	38
Clutch sprocket – number of teeth	57	57

Table 6-2. Final Drive (Transmission-to-rear Wheel)

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
Transmission sprocket – number of teeth	27	Inspect at 5,000 mi (8,000 km)
Rear wheel sprocket – number of teeth	65	Inspect at 5,000 mi (8,000 km)
Secondary drive belt – number of teeth (XB9SX, XB12S, XB12Scg)	128	Inspect at 5,000 mi (8,000 km)
Secondary drive belt – number of teeth (XB12Ss)	135	Inspect at 5,000 mi (8,000 km)

Table 6-3. Transmission

ITEM	NEW COMPONENTS (XB9)	NEW COMPONENTS (XB12)
Primary drive / transmission lubricant capacity (approximately)	Approximately 32 fl. oz. (946 ml)	
Overall gear ratios		
First gear (low)	10.688	9.563
Second gear	7.635	6.831
Third gear	5.678	5.080
Fourth gear	4.706	4.211
Fifth gear (high)	4.036	3.611

Table 6-4. Wet Clutch Multiple Disc-clutch Plate Thickness

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
Friction plate (fiber) (in.)	0.0866 $\pm$ 0.0031 in. (2.200 + 0.079 mm)	N/A
Steel plate	0.0629 $\pm$ 0.0020 in. (1.598 + 0.051 mm)	N/A
Clutch pack (in.)	N/A	0.661 in. (16.789 mm) (minimum)

Table 6-5. Wet Clutch Multiple Disc-maximum Allowable Warpage

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
Friction plate (fiber)	N/A	0.0059 in. (0.150 mm)
Steel plate	N/A	0.0059 in. (0.150 mm)

TORQUE VALUES

ITEM	TORQUE		NOTES
Axle pinch fastener, rear	40-45 ft-lbs	54-61 Nm	page 6-55
Axle, rear			Special procedure, ANTI-SEIZE, page 6-24, 6-55
Chin fairing fasteners	36-48 **in-lbs**	4-5 Nm	page 6-24
Clutch inspection cover fasteners	84-108 **in-lbs**	9.5-12.2 Nm	Tighten in a crosswise pattern, page 6-6, 6-8
Clutch mainshaft nut	70-80 ft-lbs	94.9-108.5 Nm	LOCTITE 262 (red), left hand threads, page 6-20
Countershaft retaining screw	33-37 ft-lbs	44.8-50 Nm	LOCTITE 262 (red), page 6-52
Crankcase 5/16 in. fasteners	15-19 ft-lbs	20.3-25 Nm	LOCTITE 262 (red), page 6-49
Engine sprocket nut	240-260 ft-lbs	325.4-352.5 Nm	Apply LOCTITE 272 (red) onto threads of sprocket shaft, page 6-19
Idler pulley wheel fastener	20-23 ft-lbs	27.1-31.2 Nm	page 6-24
Magnetic drain plug	14-30 ft-lbs	19-40.7 Nm	metric, page 6-5
Negative battery cable at battery terminal	72-96 **in-lbs**	8-11 Nm	page 6-6, 6-8
Neutral indicator switch	60-84 **in-lbs**	6.7-9.5 Nm	page 6-49
Primary cover fasteners	100-120 **in-lbs**	11.3-13.5 Nm	Follow torque sequence, page 6-5
Rear axle			Special procedure, ANTI-SEIZE, page 6-24
Shift lever pinch screw	48-60 **in-lbs**	5.4-6.8 Nm	LOCTITE 272 (red), Page 6-6
Shift linkage fasteners	36-60 **in-lbs**	4-6.8 Nm	page 6-6
Shift pedal flange head bolt	22-24 ft-lbs	30-32.5 Nm	page 6-6
Transmission sprocket nut			Special procedure, LOCTITE 262 (red), left hand threads, special torque turn method, page 6-54
Transmission sprocket screws	90-110 **in-lbs**	10.2-12.4 Nm	Replace after 3 removals, page 6-54

PRIMARY COVER 6.2

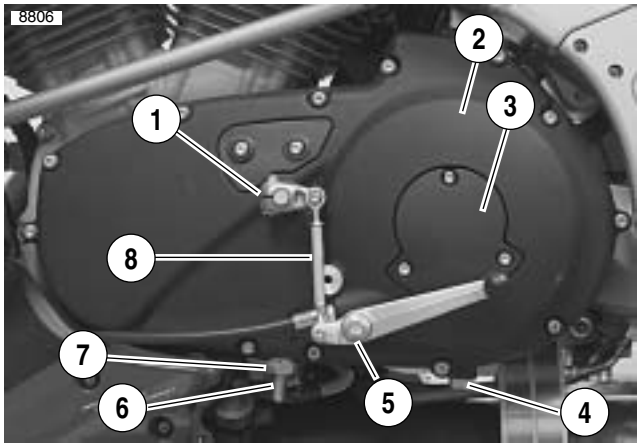
REMOVAL

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.



1. **Engine shift lever**
2. **Primary cover**
3. **Clutch inspection cover**
4. **Drain plug**
5. **Flange head bolt**
6. **Chain adjuster screw**
7. **Locknut**
8. **Shift linkage assembly**

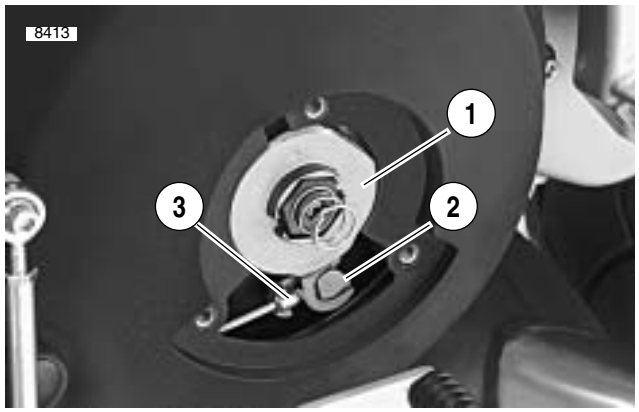
Figure 6-1. Removing Primary Cover

4. See Figure 6-1. Place a drain pan under the engine/primary 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).



1. **Outer ramp and hook**
2. **Coupling**
3. **Cable end**

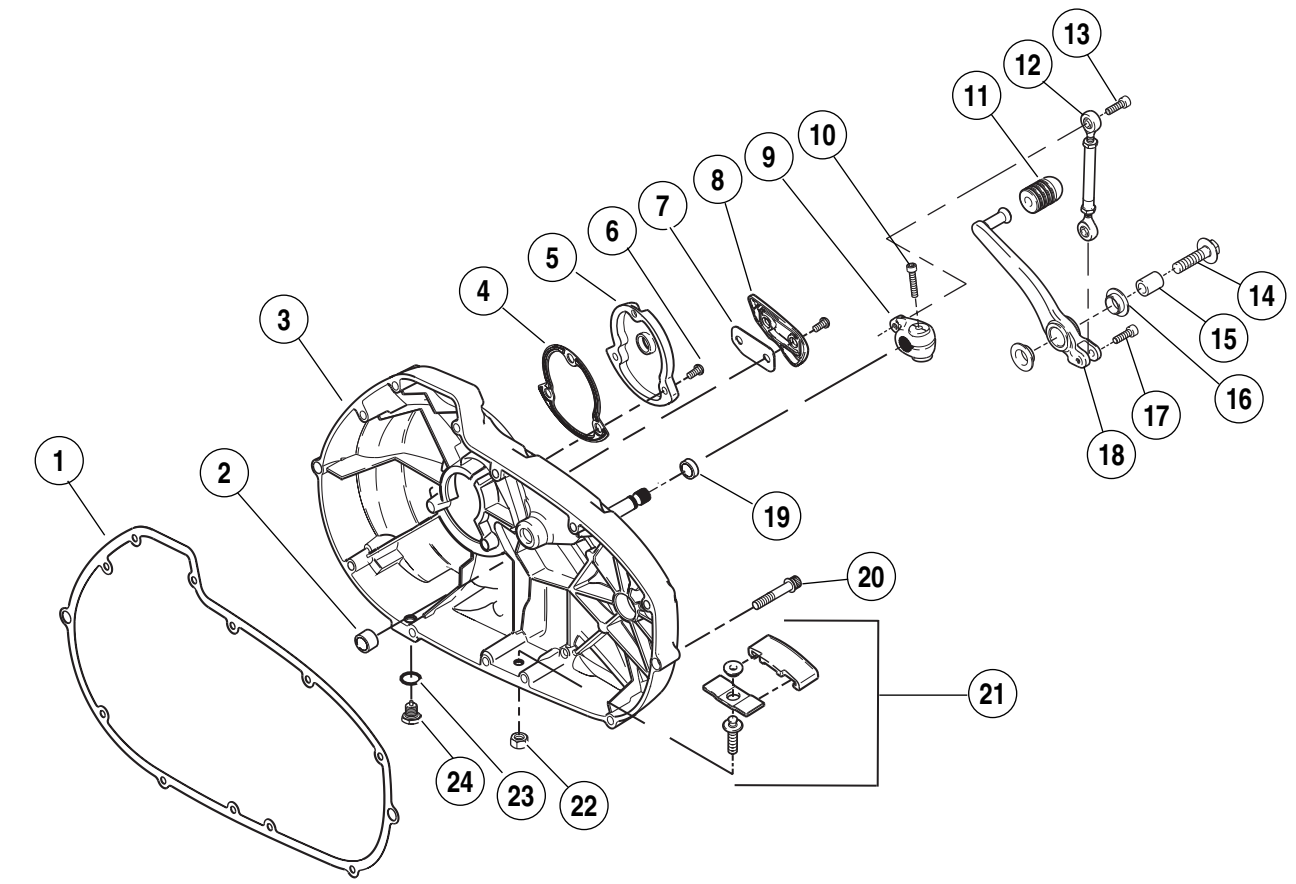
Figure 6-2. Clutch Release Mechanism

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.
13. Discard gasket.
14. Remove and discard shifter lever oil seal.
15. Clean all parts in a non-volatile cleaning solution or solvent.

⚠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.

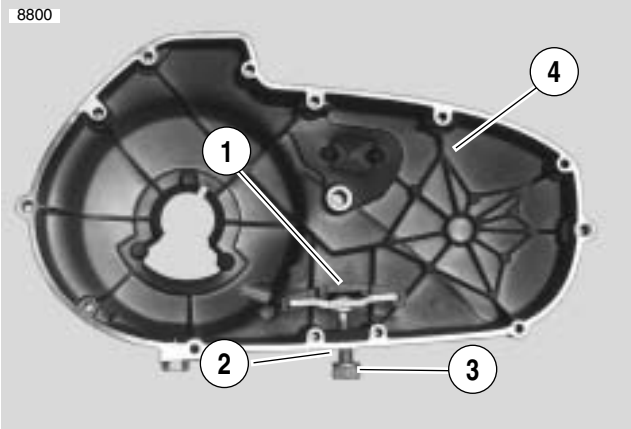


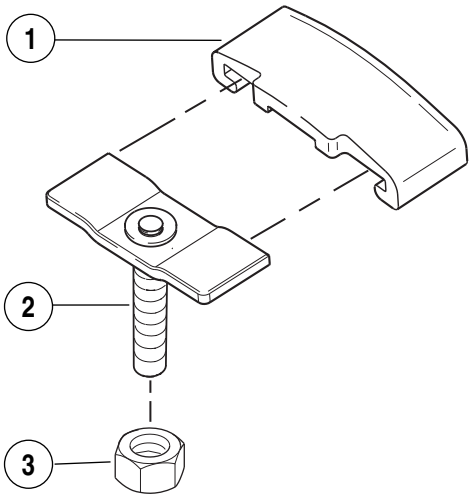
1. Gasket
2. Shifter bushing
3. Primary cover
4. Gasket
5. Cover
6. Sems screw(5)
7. Inspection cover gasket
8. Inspection cover
9. Lever
10. Screw
11. Rubber shift lever pad
12. Linkage assembly
13. Shifter linkage assembly bolt
14. Flange head bolt
15. Shift/brake lever sleeve
16. Pedal bearing (2)
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

Figure 6-3. Primary Cover, Primary Chain Adjuster and Shifter Assembly

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.





1. **Shoe, chain adjuster**
2. **Chain adjuster screw**
3. **Chain adjuster locknut**
4. **Primary cover**

Figure 6-4. Primary Chain Adjuster

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.

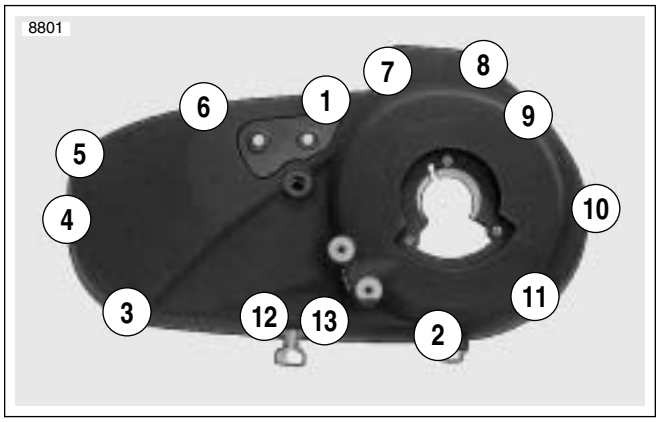
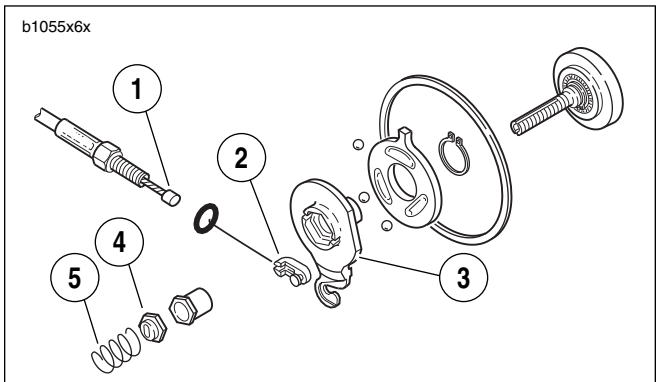


Figure 6-5. Primary Cover Tightening Sequence

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.

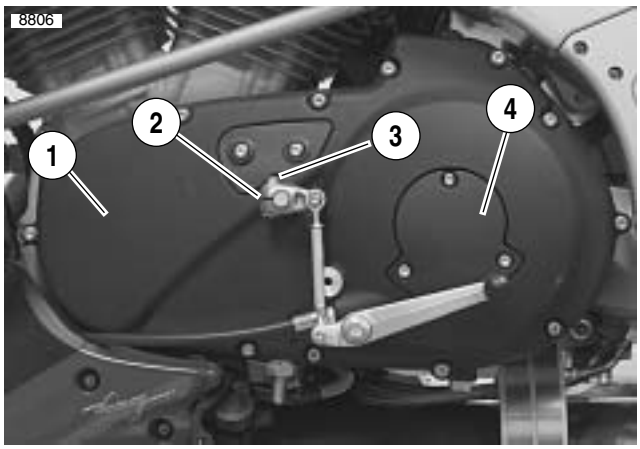


1. **Cable end**
2. **Coupling**
3. **Outer ramp and hook**
4. **Lockplate**
5. **Spring**

Figure 6-6. Clutch Release Mechanism

6. See Figure 6-6. Fit coupling (2) over cable end (1) with rounded side inboard and the ramp connector button outboard. 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.

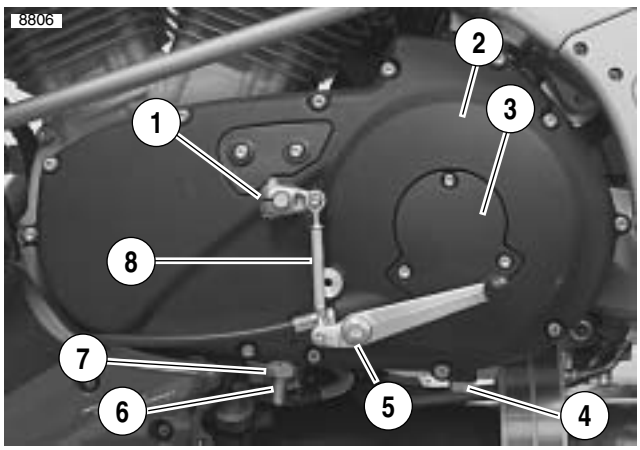
10. Fill transmission to proper level with fresh lubricant. See 1.8 CLUTCH.



1. **Primary cover**
2. **Lever, engine**
3. **Engine lever pinch screw**
4. **Clutch inspection cover**

Figure 6-7. Installing Primary Cover

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).



1. **Engine shift lever**
2. **Primary cover**
3. **Clutch inspection cover**
4. **Drain plug**
5. **Flange head bolt**
6. **Chain adjuster screw**
7. **Locknut**
8. **Shift linkage assembly**

Figure 6-8. Installing Shift Linkage

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** (4-6.8 Nm). 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.

⚠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. 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)

19. Install seat. See 2.43 SEAT.

CLUTCH RELEASE MECHANISM 6.3

DISASSEMBLY

NOTE
For clutch adjustment procedure, See 1.8 CLUTCH.

1. Remove seat. See 2.43 SEAT.

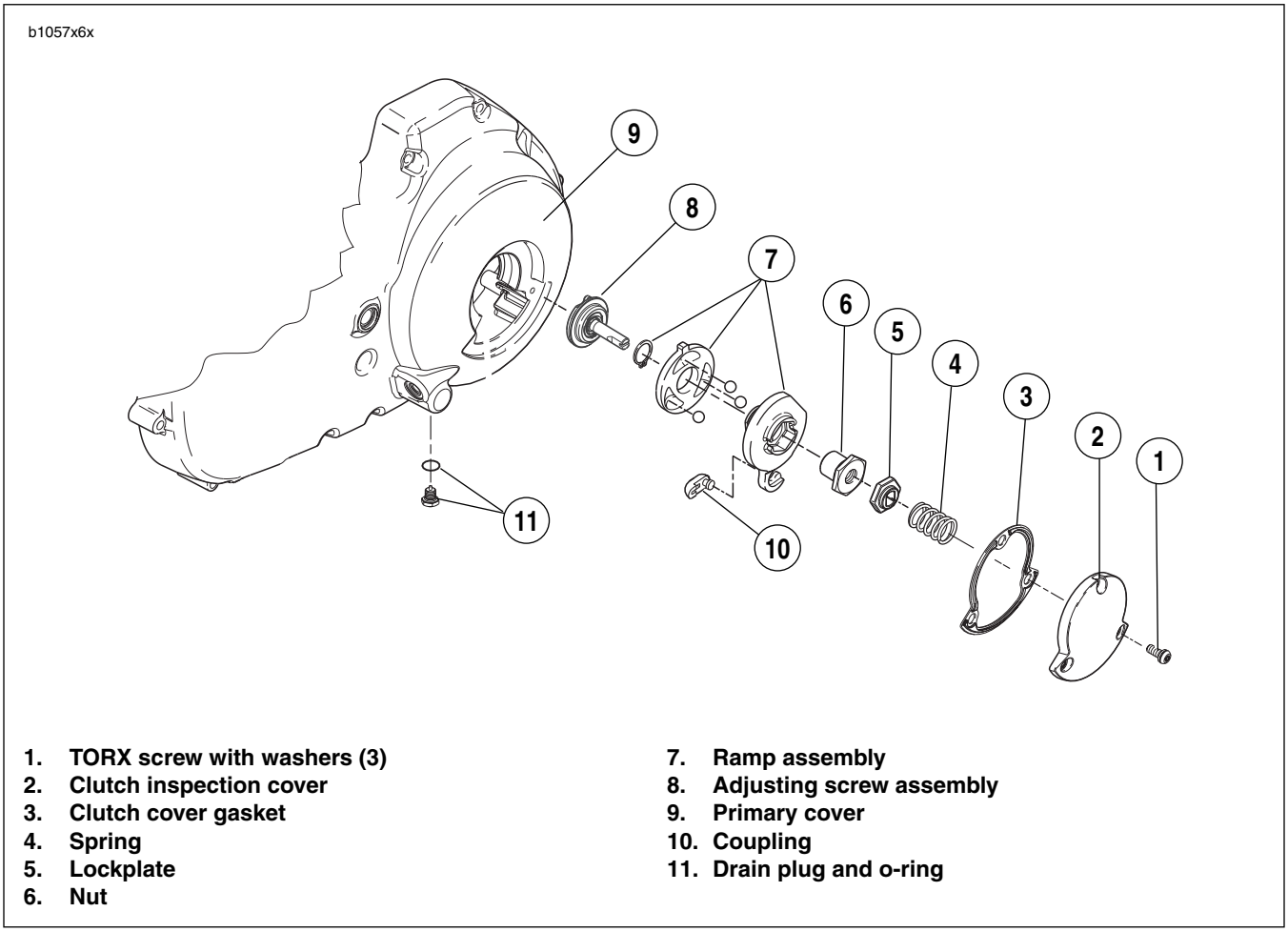
⚠WARNING

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

2. Disconnect negative battery cable.
3. 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.
4. See Figure 6-9. Remove three TORX screws with washers and clutch inspection cover.
5. Slide spring (4) with attached screw lockplate (5) from flats of adjusting screw.
6. 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.
7. Remove hook of ramp from cable end coupling (10). Remove cable end from slot in coupling.
8. 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.



1. **TORX screw with washers (3)**
2. **Clutch inspection cover**
3. **Clutch cover gasket**
4. **Spring**
5. **Lockplate**
6. **Nut**
7. **Ramp assembly**
8. **Adjusting screw assembly**
9. **Primary cover**
10. **Coupling**
11. **Drain plug and o-ring**

Figure 6-9. Clutch Release Mechanism

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.
3. Secure assembly in place.
   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

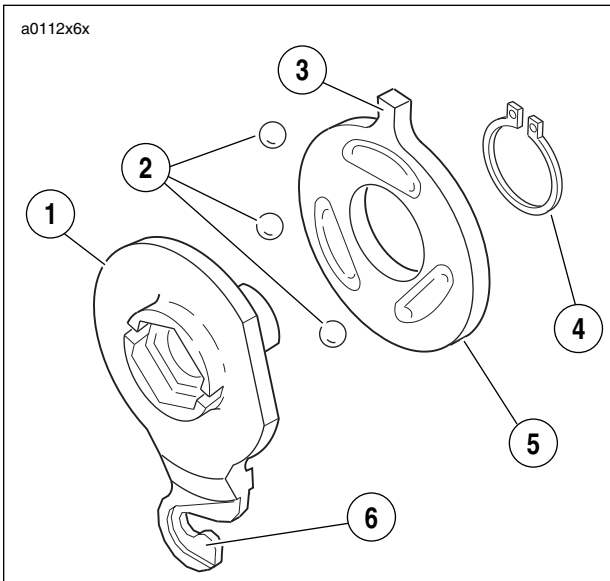
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

6. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 **in-lbs** (8-11 Nm).

CAUTION

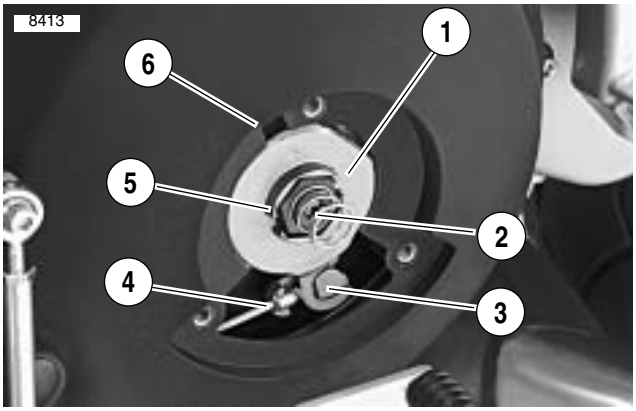
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat. See 2.43 SEAT.



1. **Outer ramp**
2. **Balls (3)**
3. **Tang**
4. **Retaining ring**
5. **Inner ramp**
6. **Hook**

Figure 6-10. Inner and Outer Ramp



1. **Outer ramp**
2. **Adjusting screw**
3. **Coupling**
4. **Cable end**
5. **Lockplate**
6. **Slot in primary cover**

Figure 6-11. Nut and Outer Ramp

CLUTCH 6.4

GENERAL

The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping and shifting gears.

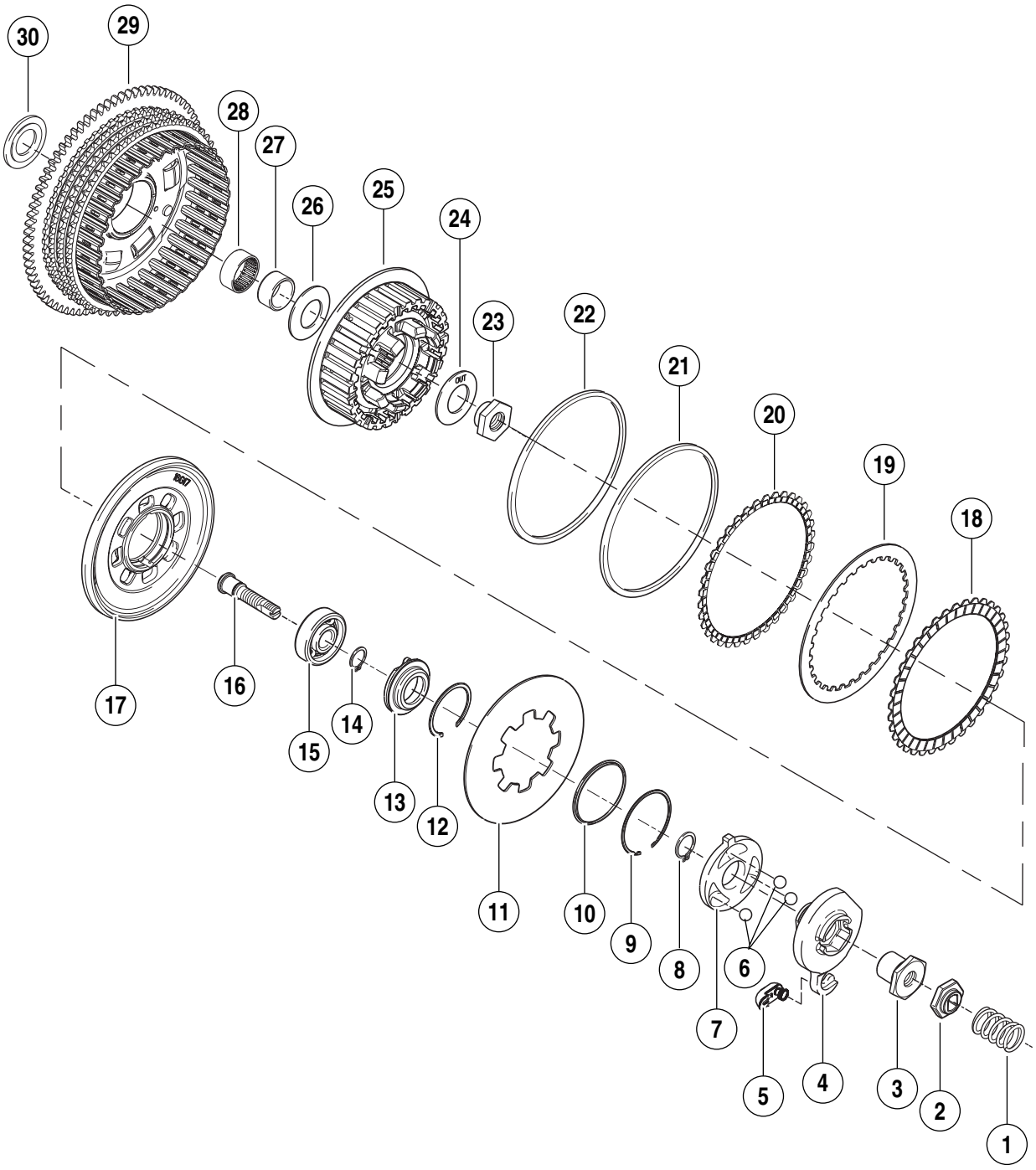
See Figure 6-12. The clutch is a wet, multiple-disc clutch with steel plates and fiber (friction) plates stacked alternately in the clutch shell. The pack consists of seven fiber plates, seven steel plates, one narrow fiber plate, one damper spring and one damper spring seat. The fiber plates (clutch 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 handlebar 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. Slippage 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 6-6. Troubleshooting

SYMPTOM	CAUSE (CHECK IN FOLLOWING ORDER)	REMEDY
Clutch slips.	Incorrect clutch release adjustment.	Check and adjust clutch release mechanism.
	Worn clutch plates.	Check service wear limits. Replace plates.
Clutch drags.	Incorrect clutch release adjustment.	Check and adjust clutch release mechanism.
	Worn clutch release ramps or balls.	Replace release ramps and/or balls.
	Warped clutch steel plates.	Replace clutch steel plates.
	Blade worn or damaged clutch gear splines.	Replace clutch gear or hub as required.
	Overfilled primary.	Drain lubricant to correct level.



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

REMOVAL

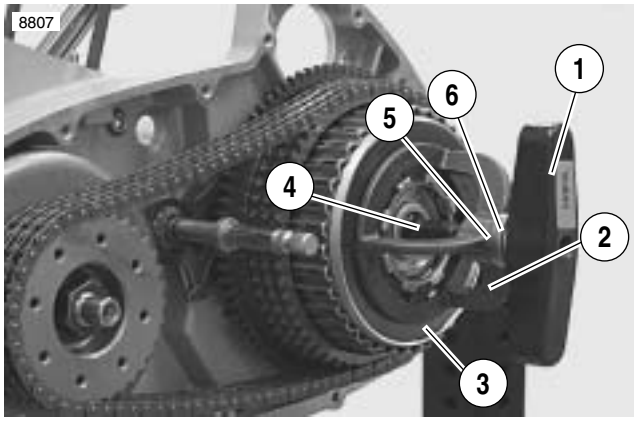
⚠WARNING

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.



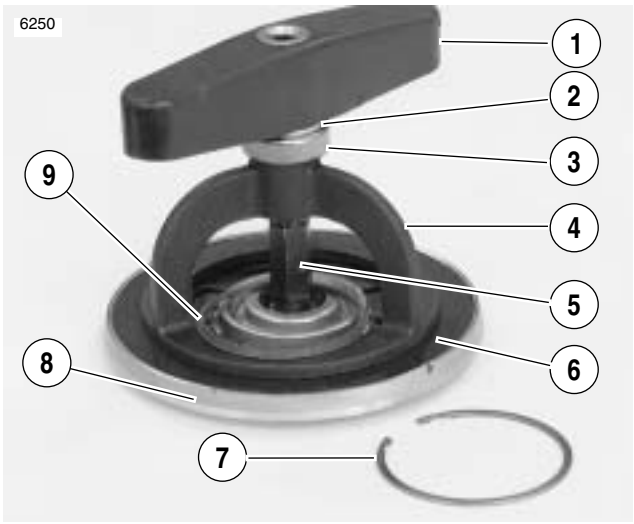
1. **Tool handle**
2. **Bridge**
3. **Diaphragm spring**
4. **Clutch spring forcing screw**
5. **Bearing**
6. **Washer**

Figure 6-13. Compressing Clutch Diagram Spring

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.

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.



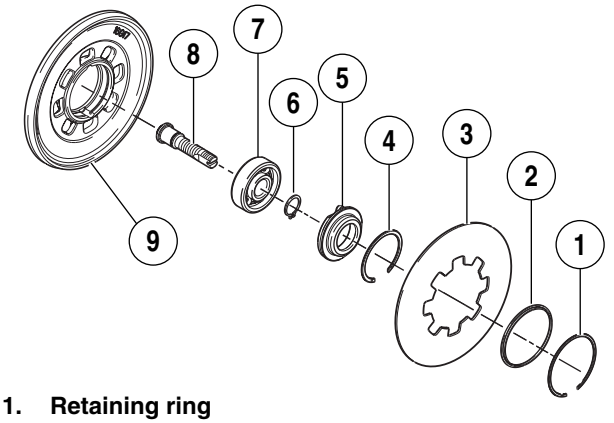
1. **Tool handle**
2. **Washer**
3. **Bearing**
4. **Bridge**
5. **Forcing screw**
6. **Diaphragm spring**
7. **Snap ring**
8. **Pressure plate**
9. **Spring seat**

Figure 6-14. Pressure Plate Assembly

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.
6. Remove the clutch pack from the shell/hub assembly.

ADJUSTING SCREW DISASSEMBLY/ASSEMBLY

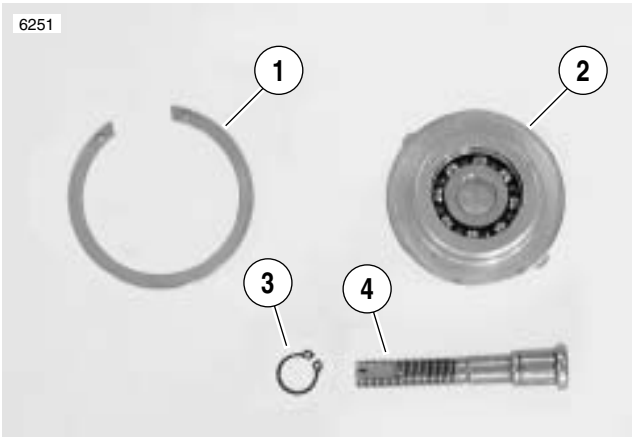
1. See Figure 6-15. Remove adjusting screw assembly.
   a. Remove large retaining ring.
   b. Remove adjusting screw assembly from pressure plate.
2. If necessary, disassemble adjusting screw assembly.
   a. Remove and discard small retaining ring (6).
   b. Separate the adjusting screw (8) from the bearing (7) and release plate (5).
   c. Remove bearing (7) from release plate (5).



1. **Retaining ring**
2. **Spring seat**
3. **Diaphragm Spring**
4. **Retaining ring**
5. **Release plate**
6. **Retaining ring**
7. **Bearing**
8. **Adjusting screw**
9. **Pressure plate**

Figure 6-15. Adjusting Screw Assembly

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.



1. **Retaining ring**
2. **Bearing and release plate**
3. **Retaining ring**
4. **Adjusting screw**

Figure 6-16. Adjusting Screw Assembly

CLUTCH PACK CLEANING AND INSPECTION

1. Separate the pack in to 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.

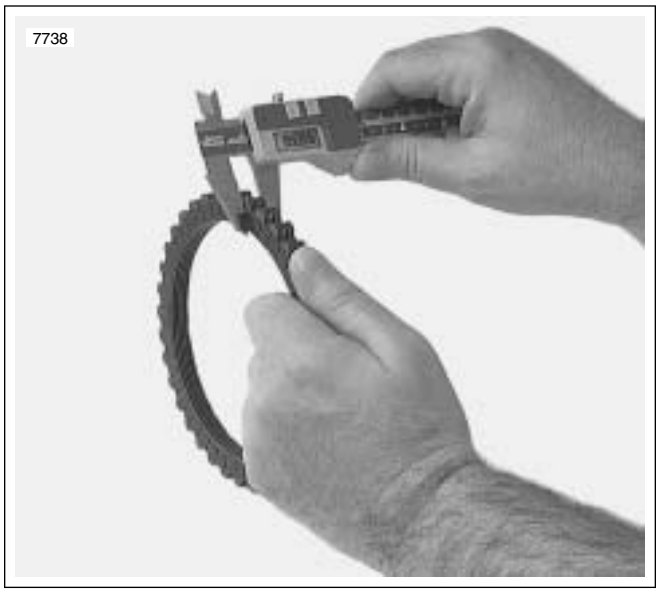
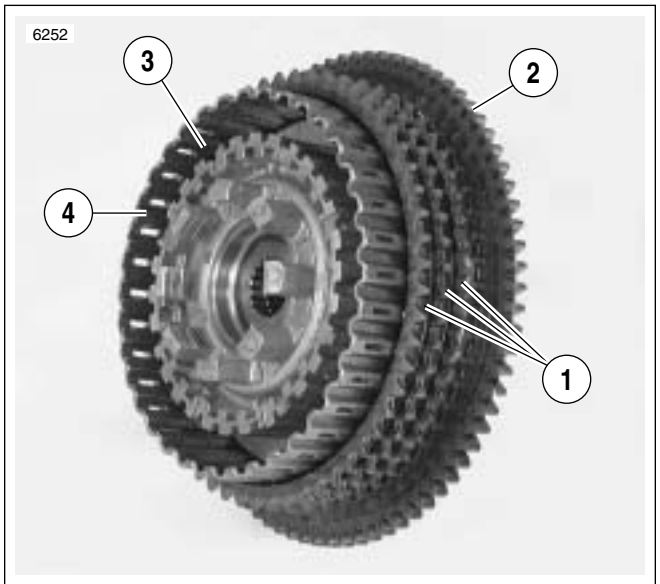


Figure 6-17. Measuring Friction Plates



1. **Primary chain sprocket**
2. **Starter ring gear**
3. **Slots on clutch hub**
4. **Slots on clutch shell**

Figure 6-18. Checking Clutch Shell (Shell Removed from Primary Shaft)

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.

ASSEMBLY AND INSTALLATION

1. Submerge and soak all friction and steel plates in FORMULA+ 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.

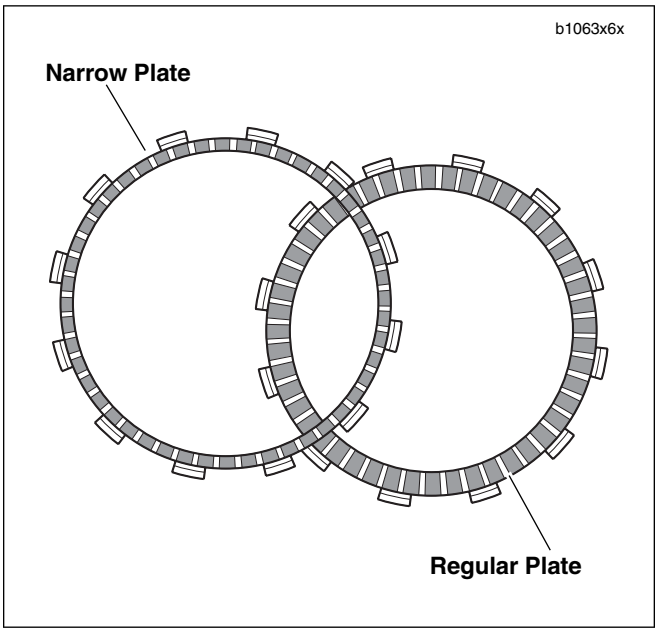


Figure 6-19. Friction Plates

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.

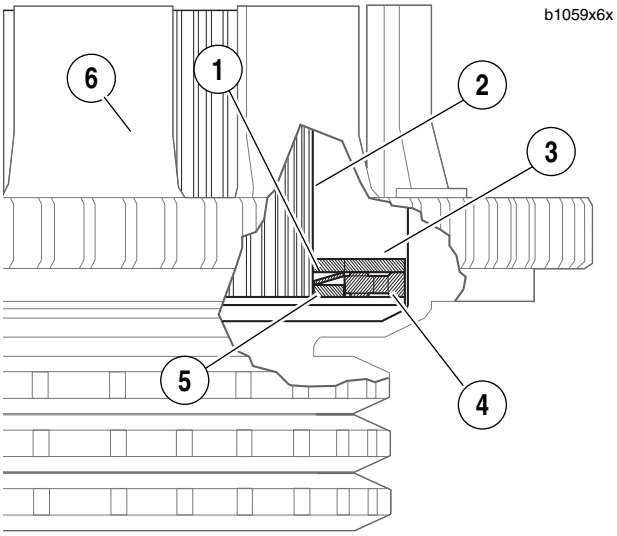
NOTE

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.

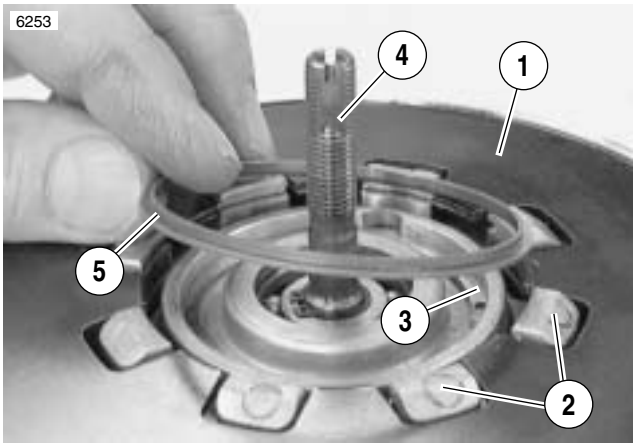
NOTE

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.



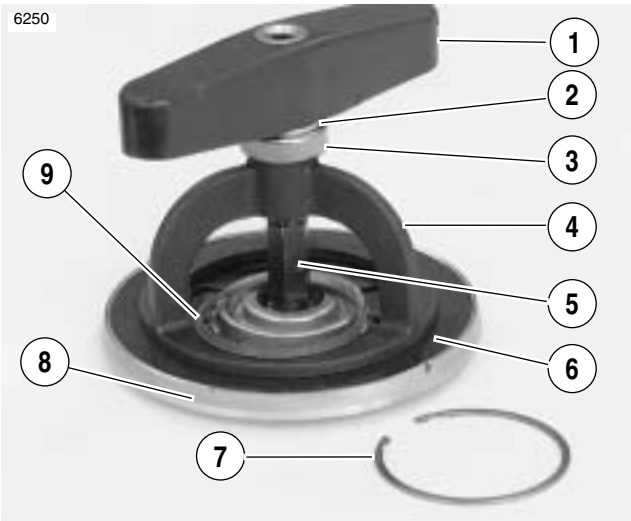
1. **Damper spring**
2. **Clutch hub**
3. **Steel plate**
4. **Narrow friction plate**
5. **Damper spring seat**
6. **Clutch shell**

Figure 6-20. Clutch Pack Stack-Up (Cut-Away View)



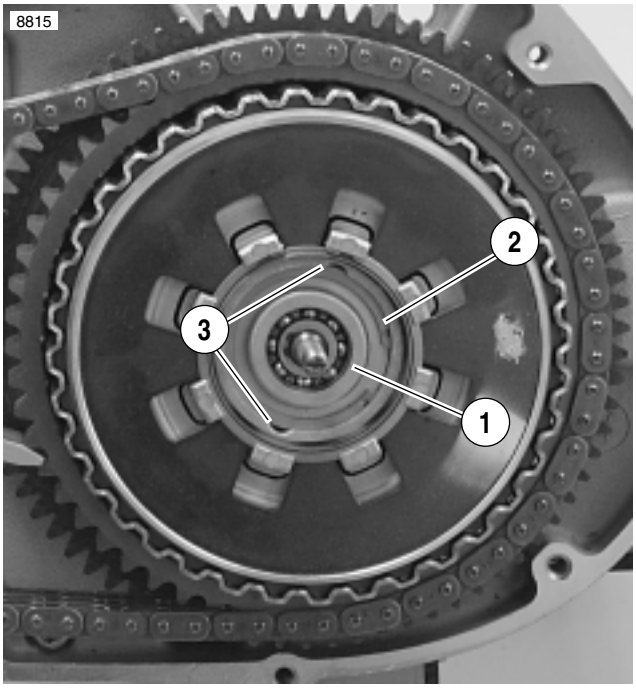
1. **Diaphragm spring (pressure plate below)**
2. **Prongs on clutch hub**
3. **Retaining ring**
4. **Adjusting screw assembly**
5. **Spring seat**

Figure 6-21. Spring Seat Installation



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 6-22. Pressure Plate Assembly



1. **Adjusting screw assembly**
2. **Retaining ring**
3. **Tab recesses**

Figure 6-23. Clutch Adjusting Screw Assembly and Retaining Ring

7. Install primary cover. See 6.2 PRIMARY COVER.
8. Adjust Clutch. See 1.8 CLUTCH.
9. 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)

10. Connect negative battery cable to battery terminal. Tighten fastener to72-96 **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)

11. Install seat. See 2.43 SEAT.

PRIMARY CHAIN 6.5

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. (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.

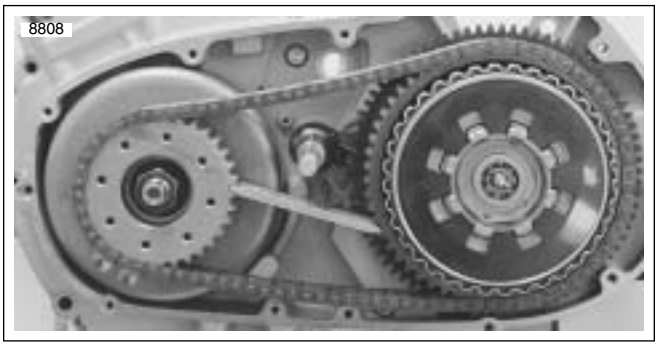


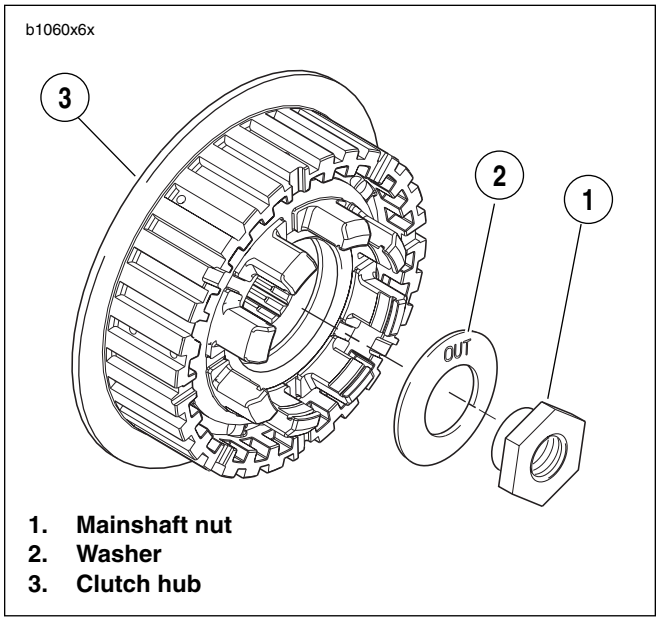
Figure 6-24. Sprocket Locking Link Tool (Part No. HD-38362) for XB9SX models and (Part No. HD-46283) for 1200 models.

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.

NOTE

See Figure 6-25. Mainshaft nut has left-hand threads. To prevent damage, turn nut clockwise to loosen and remove from mainshaft.

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. **Mainshaft nut**
2. **Washer**
3. **Clutch hub**

Figure 6-25. Mainshaft Nut and Washer

CLUTCH SHELL/HUB INSPECTION

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.

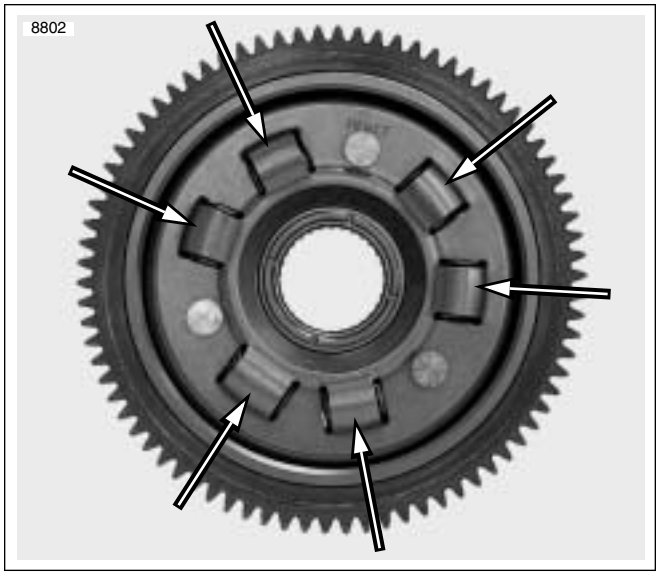


Figure 6-26. Compensating Spring Set

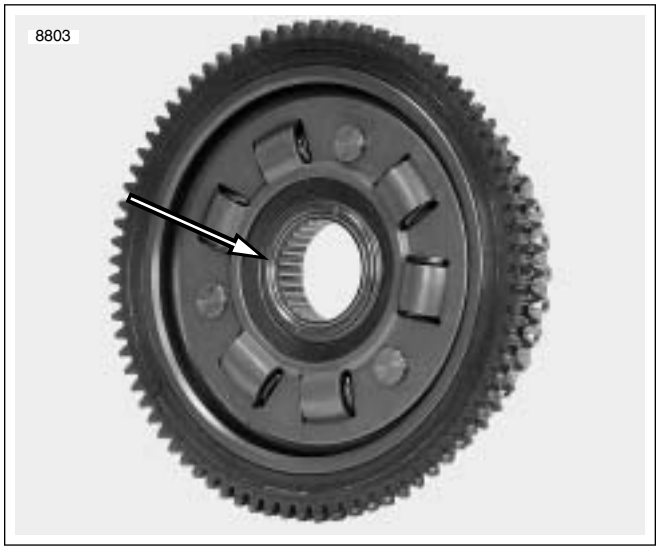


Figure 6-27. New Needle Bearing in Clutch Shell

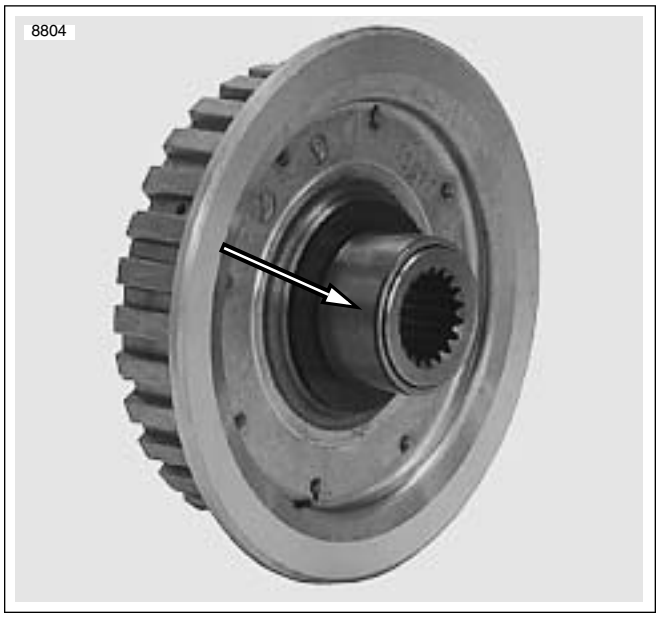


Figure 6-28. Clutch Hub Bearing Race

CLUTCH SHELL BEARING REPLACEMENT

NOTE

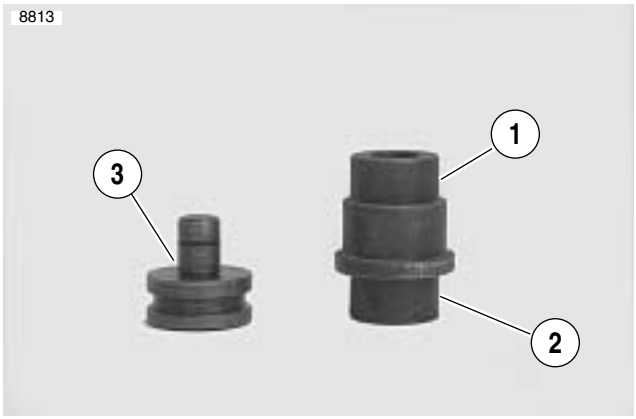
The clutch shell uses a caged needle bearing that corresponds to an inner race installed on the clutch hub.

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).



1. **Removal end of bearing tool**
2. **Installation end of bearing tool**
3. **Bearing guide, installer**

Figure 6-29. Clutch Shell Bearing Remover/Installer B-45926

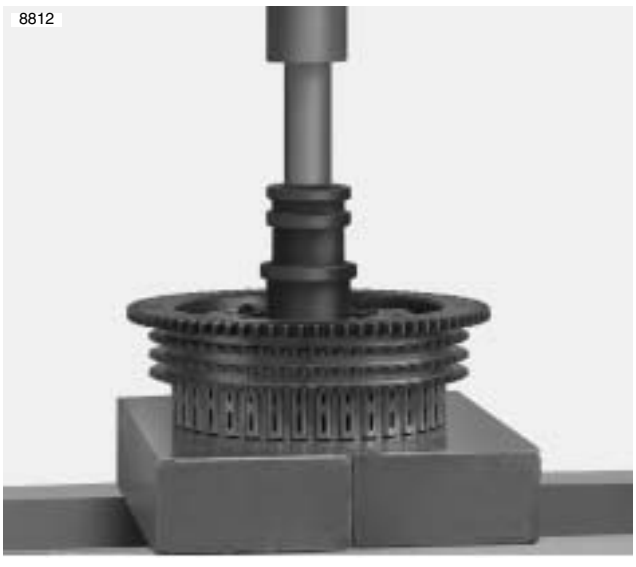
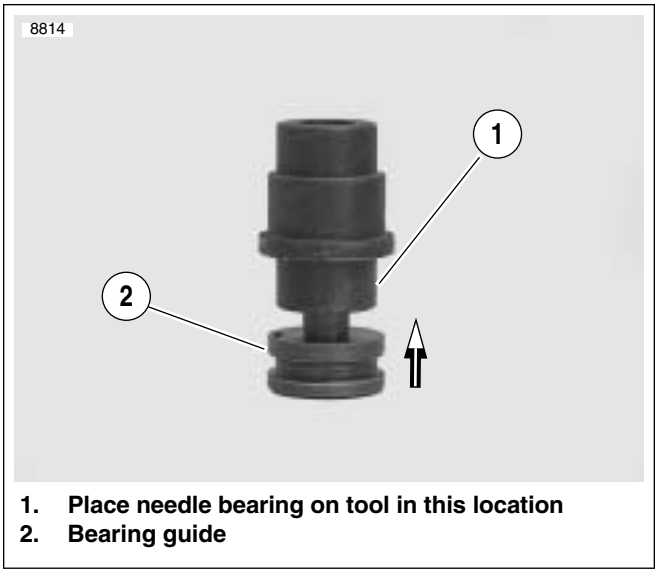


Figure 6-30. Removing Clutch Shell Needle Bearing



1. **Place needle bearing on tool in this location**
2. **Bearing guide**

Figure 6-31. Bearing Installer

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.

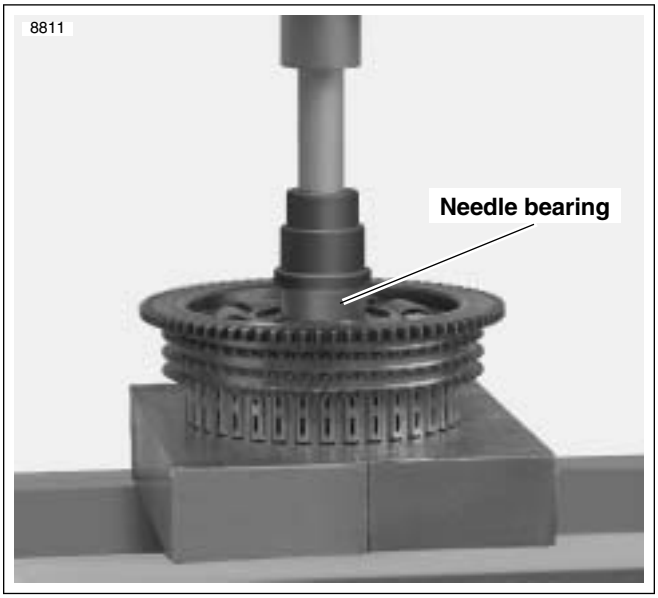


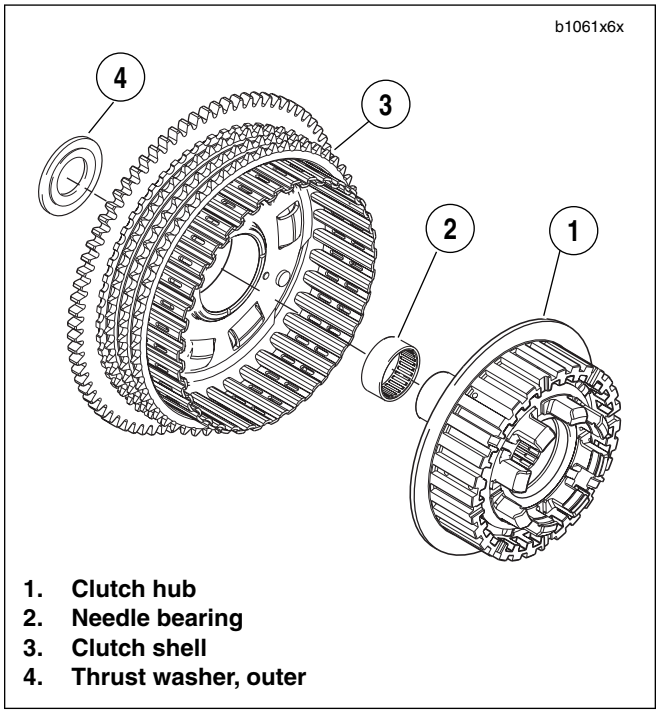
Figure 6-32. Installing Clutch Shell Needle Bearing Clutch Shell Bearing Remover/Installer B-45926

INSTALLATION

NOTE

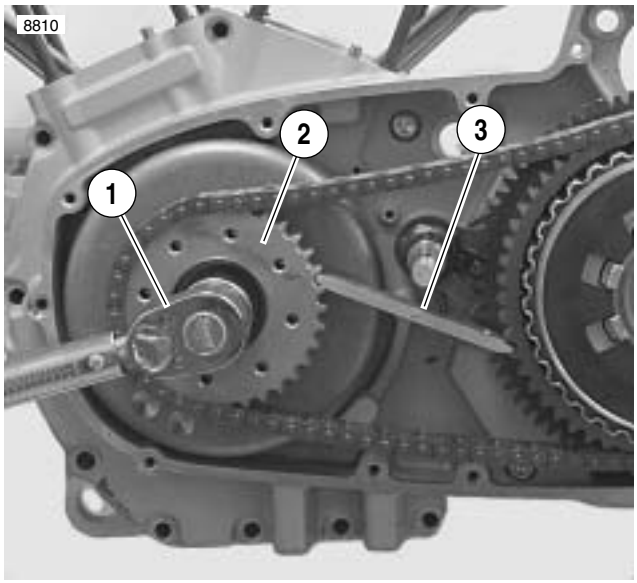
Prior to installing engine sprocket nut and the clutch hub nut, the threads on the sprocket shaft, sprocket nut, mainshaft and clutch hub nut must be thoroughly cleaned to remove any oil that might contaminate and interfere with the locking agent.

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. Verity 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).



1. **Clutch hub**
2. **Needle bearing**
3. **Clutch shell**
4. **Thrust washer, outer**

Figure 6-33. Clutch Hub and Shell Assembly

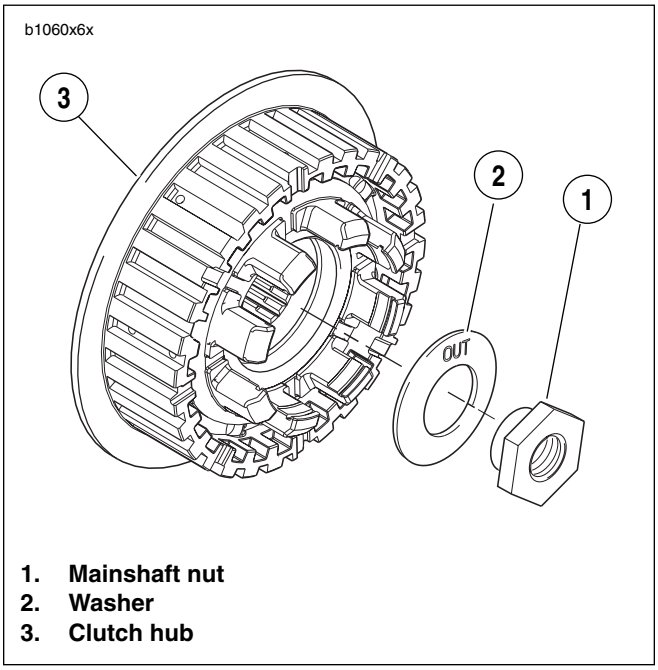


1. **Torque wrench**
2. **Engine sprocket**
3. **Sprocket locking link (Part No. HD-38362)**

Figure 6-34. Sprocket Locking Link

NOTE

See Figure 6-35. Washer must be installed with the word "out" facing the mainshaft nut or transmission may be damaged.



1. **Mainshaft nut**
2. **Washer**
3. **Clutch hub**

Figure 6-35. Mainshaft Nut and Washer

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.

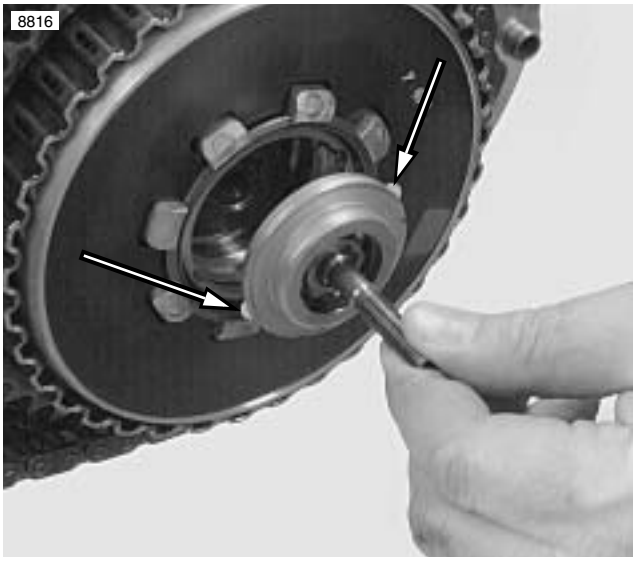
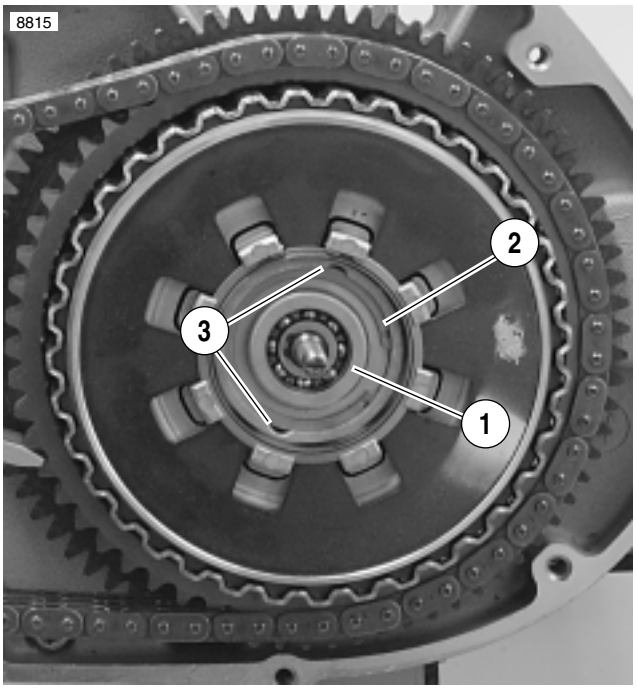


Figure 6-36. Adjusting Screw Assembly Aligning Tabs



1. **Adjusting screw assembly**
2. **Retaining ring**
3. **Tab recesses**

Figure 6-37. Clutch Adjusting Screw Assembly and Retaining Ring

DRIVE BELT SYSTEM 6.6

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.

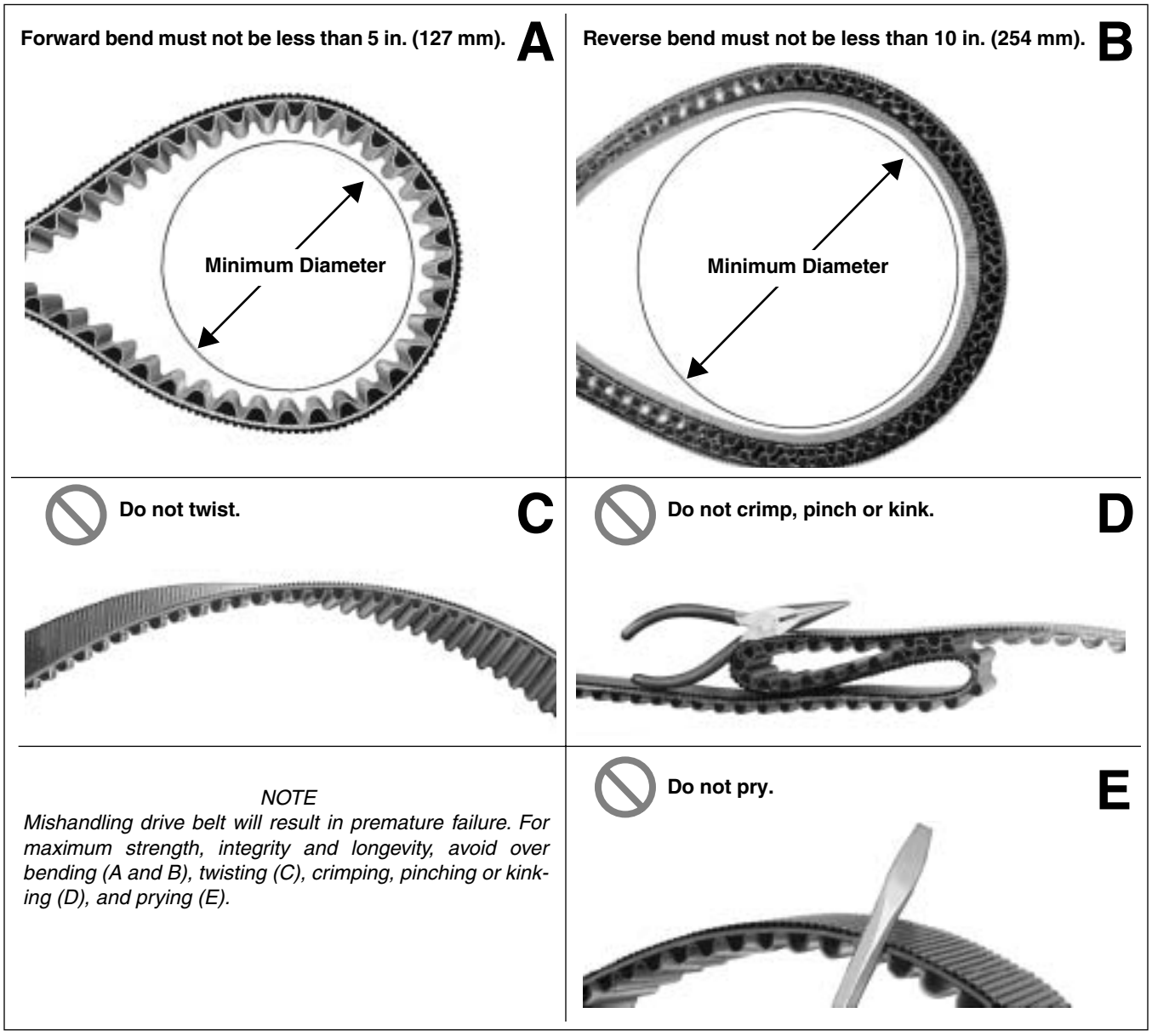


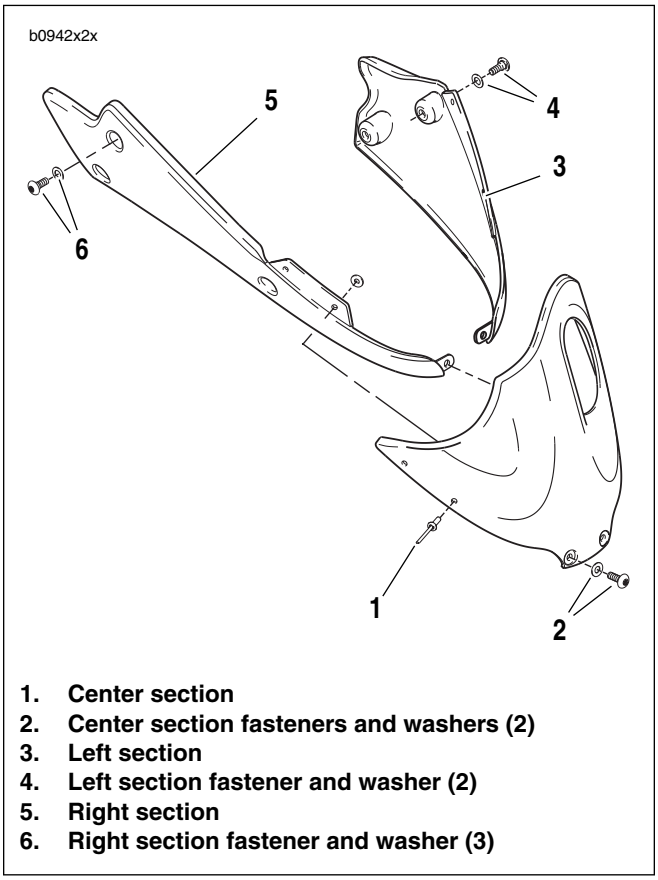
Figure 6-38. Proper Drive Belt Handling

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

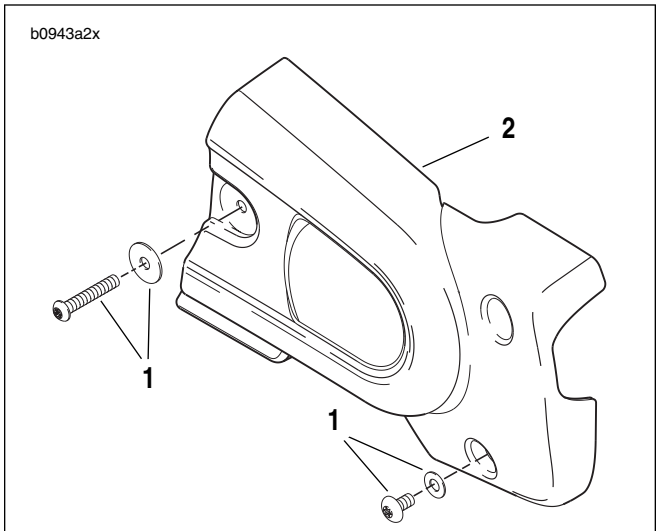
The right rear chin fairing fasteners must be removed to access the front sprocket cover.



1. **Center section**
2. **Center section fasteners and washers (2)**
3. **Left section**
4. **Left section fastener and washer (2)**
5. **Right section**
6. **Right section fastener and washer (3)**

Figure 6-39. Chin Fairing Assembly

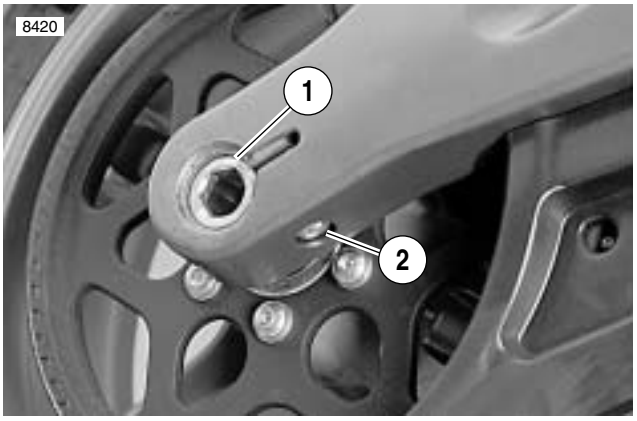
3. Remove right rear chin fairing fasteners. See 2.36 CHIN FAIRING.
4. **For XB12Ss Models:** Remove rear fender. See 2.34 FENDERS.
5. Remove belt guards. See 2.35 BELT GUARDS.



1. **Sprocket cover fastener and washers**
2. **Sprocket cover**

Figure 6-40. Sprocket Cover

6. See Figure 6-40. Remove front sprocket cover (5) by removing fasteners. See 2.33 SPROCKET COVER.



1. **Axle**
2. **Pinch bolt fastener**

Figure 6-41. Rear Wheel Mounting, Right Side

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

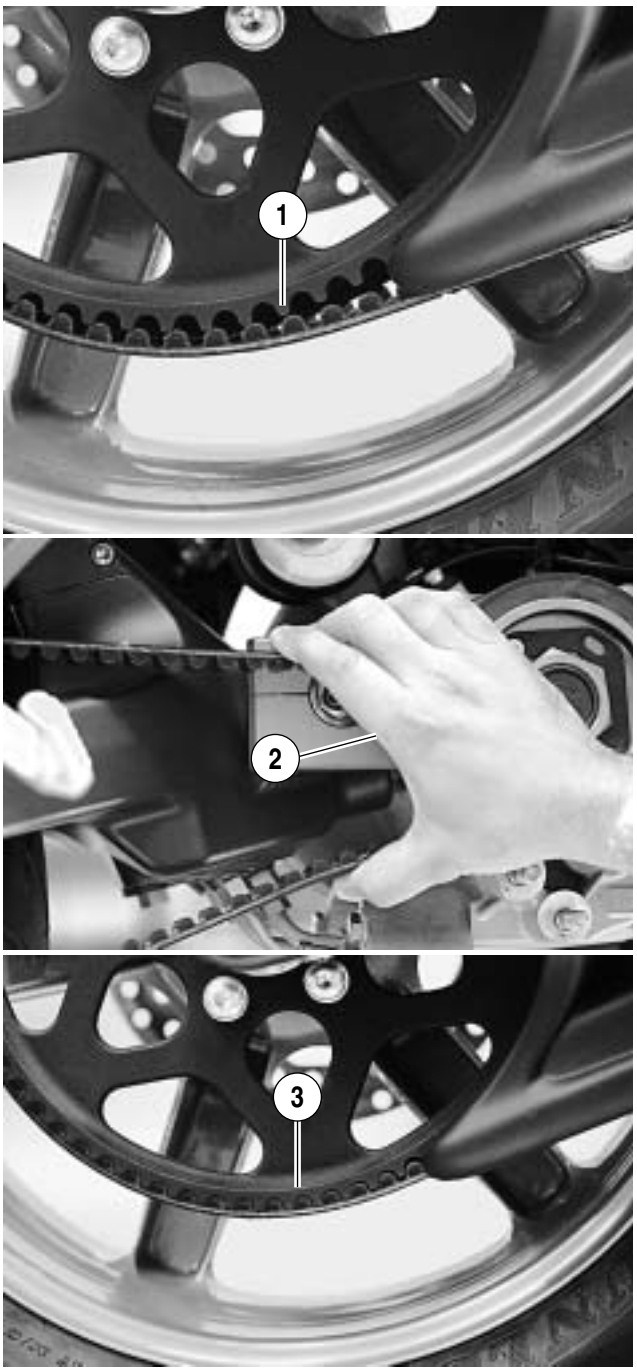
When removing or installing belt, do not bend or twist belt, partially slide belt onto sprocket and "roll" wheel or belt damage will occur.

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 tightening 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 FOOTPEG, 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.



1. Drive belt not fully seated in rear sprocket
2. Squeezing drive belt in order to seat in pulleys
3. Drive belt fully seated in rear sprocket

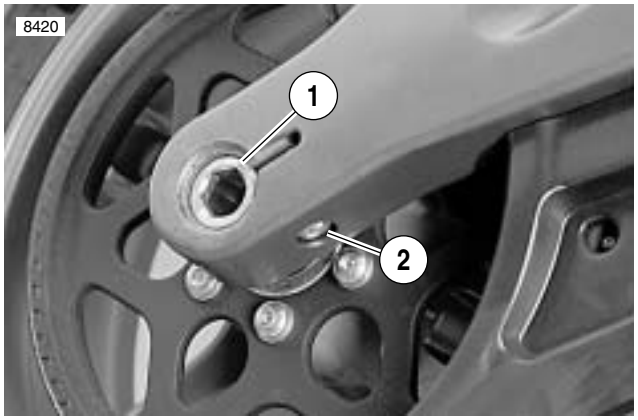
Figure 6-42. Seating Drive Belt Into Pulley Teeth

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 can not be replaced separately.



1. **Axle**
2. **Pinch bolt fastener**

Figure 6-43. Rear Wheel Mounting, Right Side

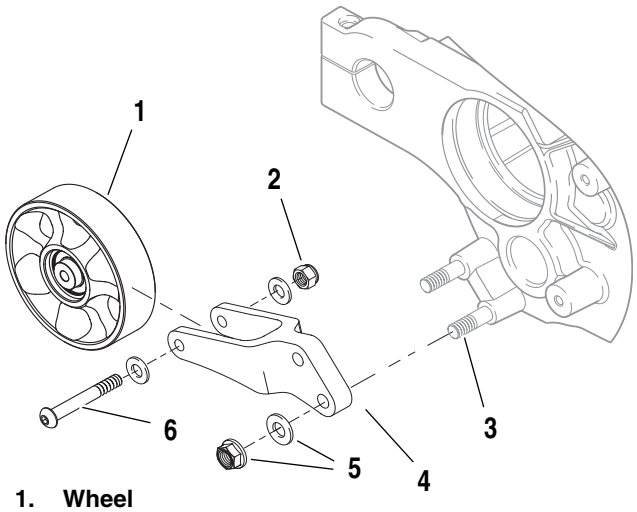
IDLER PULLEY INSTALLATION

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) to23-27 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).



1. **Wheel**
2. **Wheel nut**
3. **Stud**
4. **Idler pulley bracket**
5. **Idler pulley bracket nut and washer**
6. **Wheel fastener**

Figure 6-44. Idler Pulley Assembly

GENERAL

See Figure 6-45. The transmission is a five-speed constant-mesh type housed in an extension of the crankcase. The transmission permits the rider to vary the ratio of engine speed-to-rear driving wheel speed in order to meet the varying conditions of operation.

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.

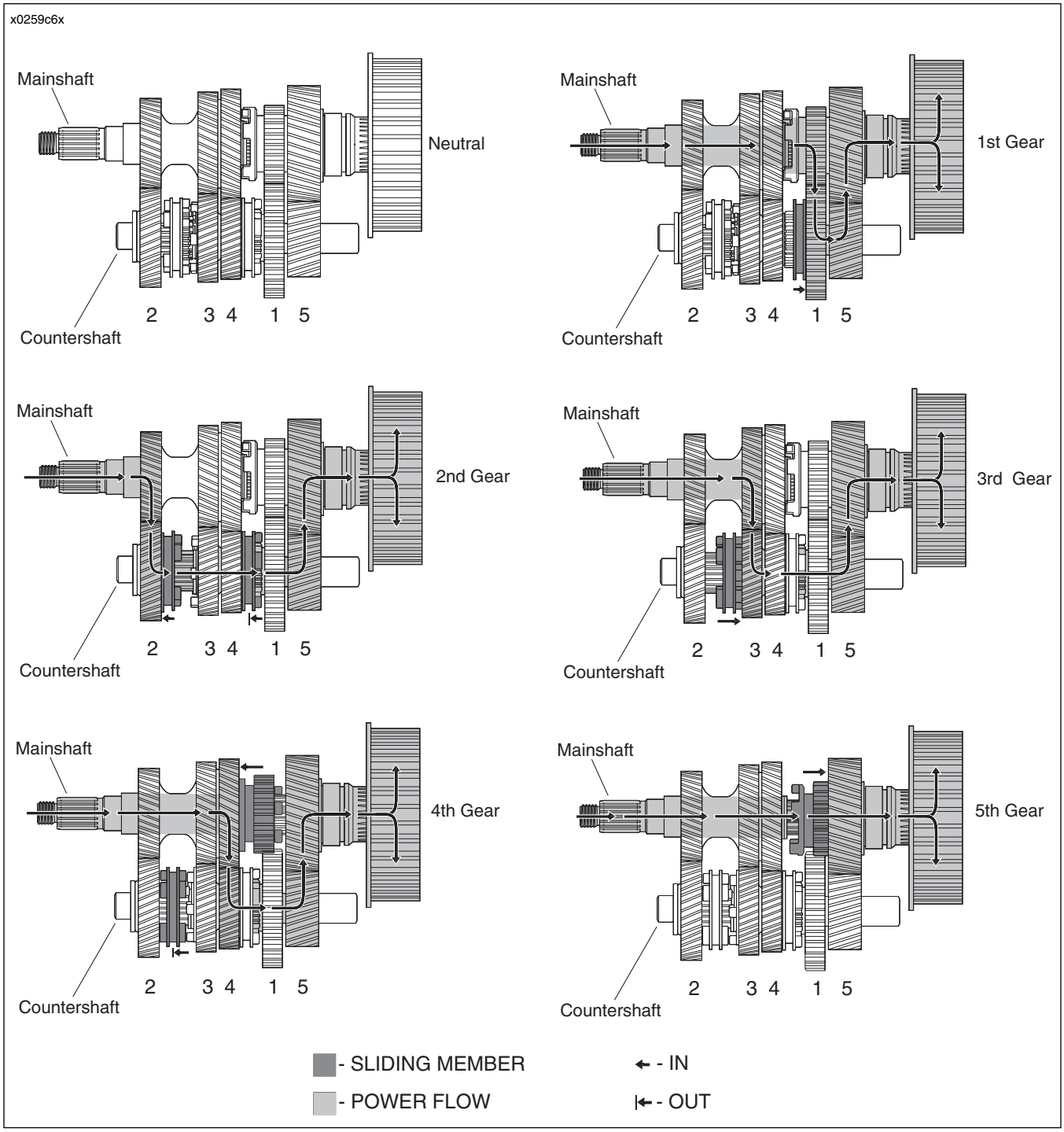


Figure 6-45. Transmission Power Flow

CASE DISASSEMBLY FOR TRANSMISSION REMOVAL 6.8

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.
3. Support engine using ENGINE SUPPORT STAND (Part No. HD-42310/HD-43646 or HD-43682).
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.

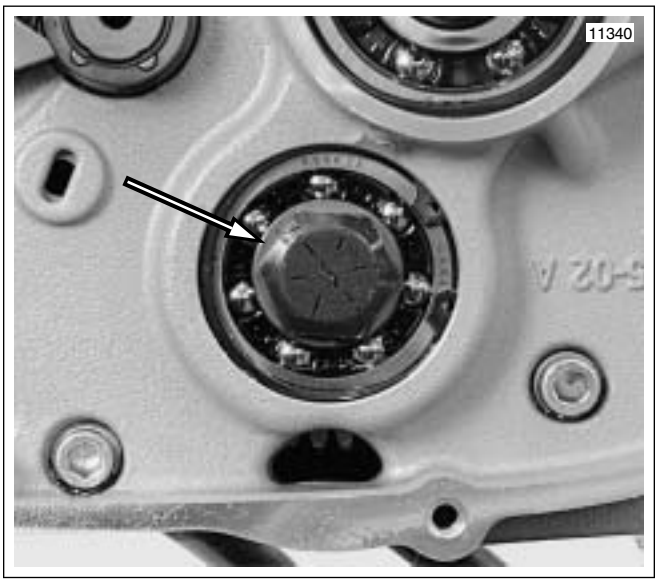


Figure 6-46. Hex Fastener Countershaft Retainer

8. See Figure 6-46. Place transmission in 1st gear. Remove hex fastener.

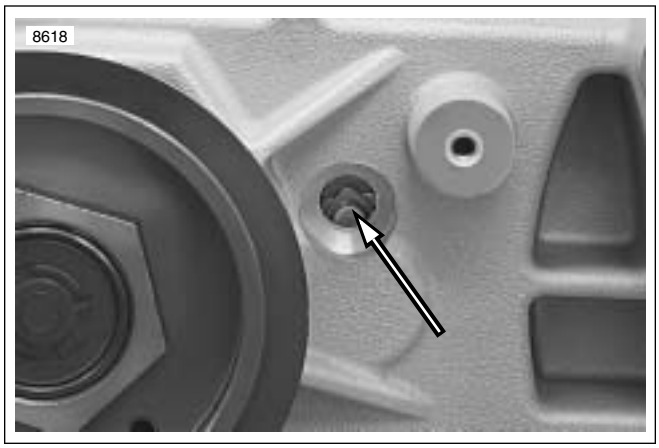


Figure 6-47. Shifter Drum Neutral Detent

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.

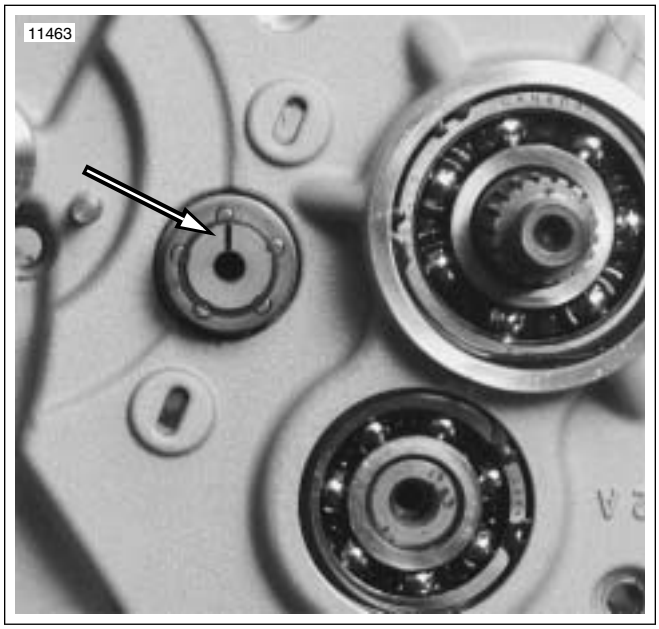


Figure 6-48. Shifter Drum and Mainshaft (Transmission in Neutral)

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.

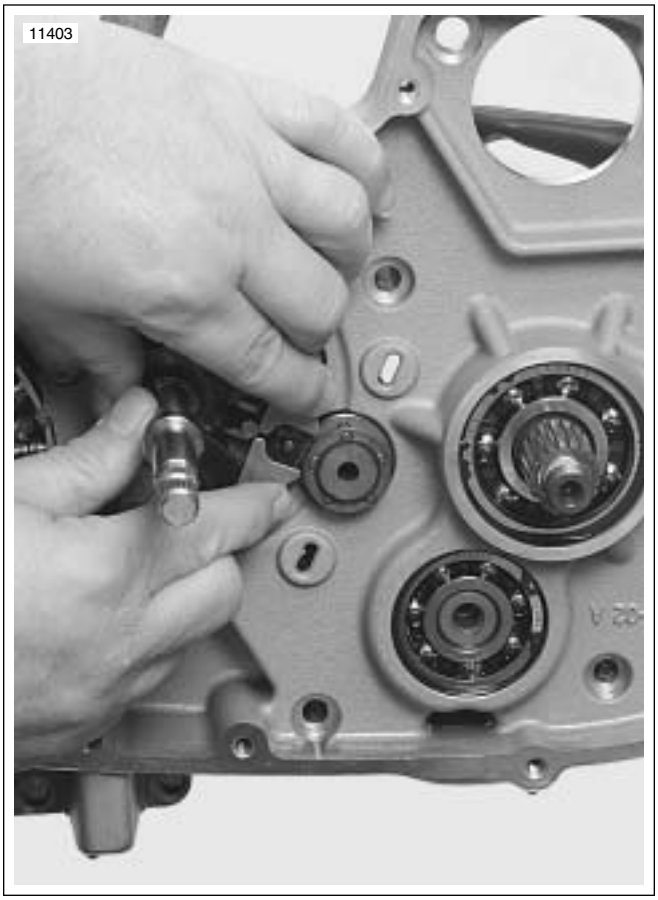
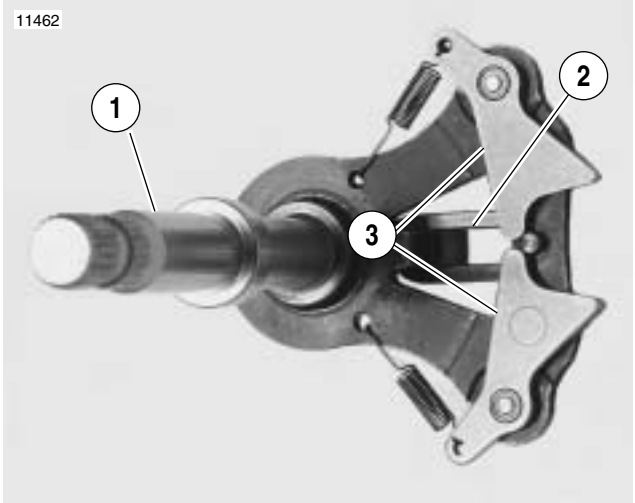


Figure 6-49. Removing Shifter Shaft Assembly

11. See Figure 6-49. Remove shifter shaft assembly.



1. **Shifter shaft**
2. **Return spring**
3. **Ratchet arms**

Figure 6-50. 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.

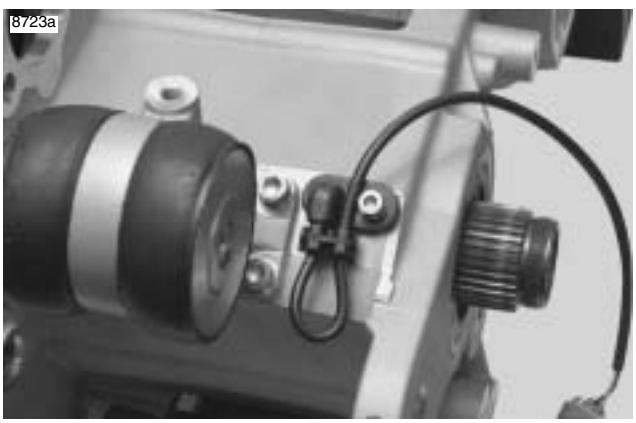


Figure 6-51. Rear Isolator Assembly

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).

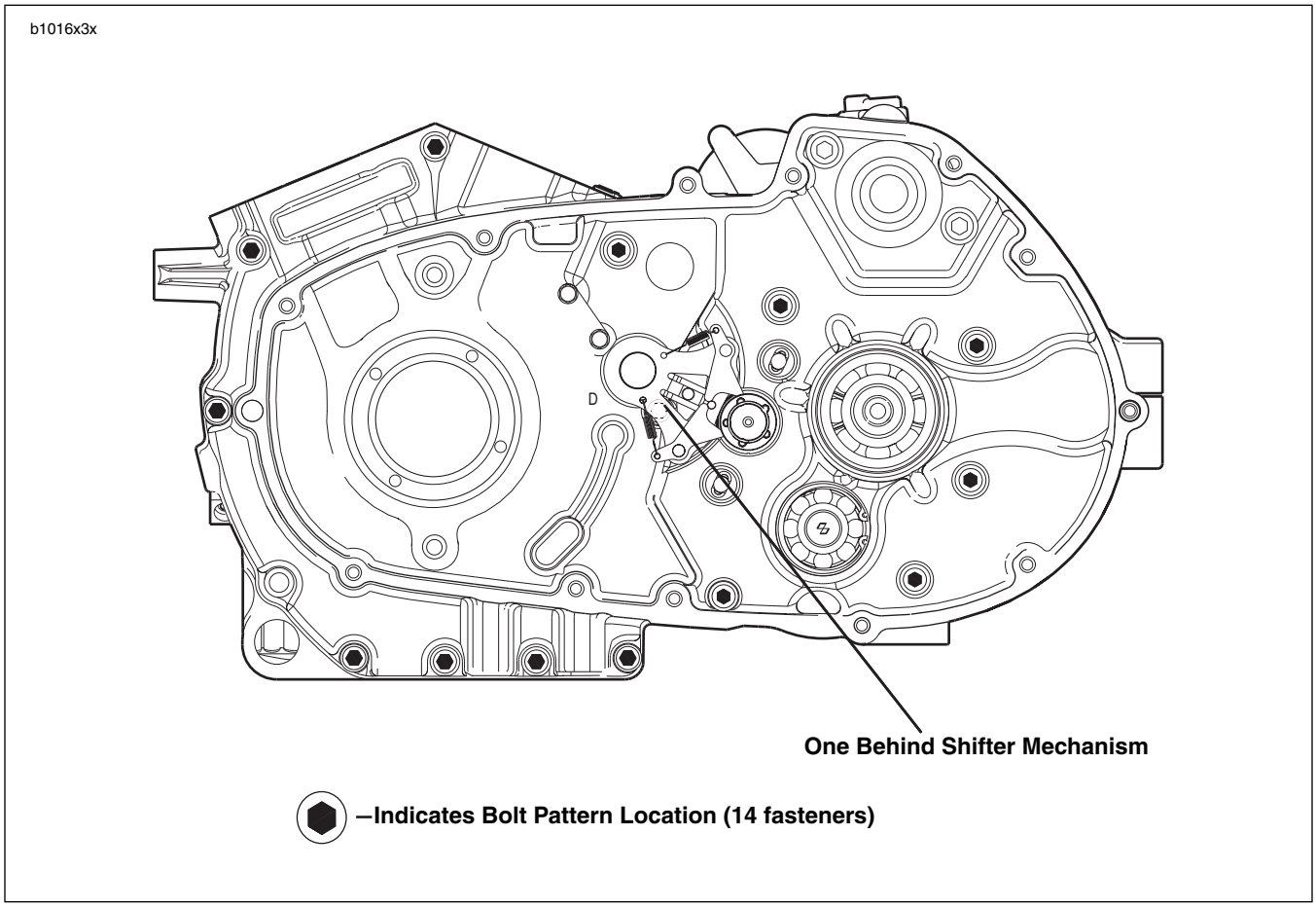


Figure 6-52. Crankcase Fasteners

15. See Figure 6-52. Remove crankcase bolt set (14 fasteners).

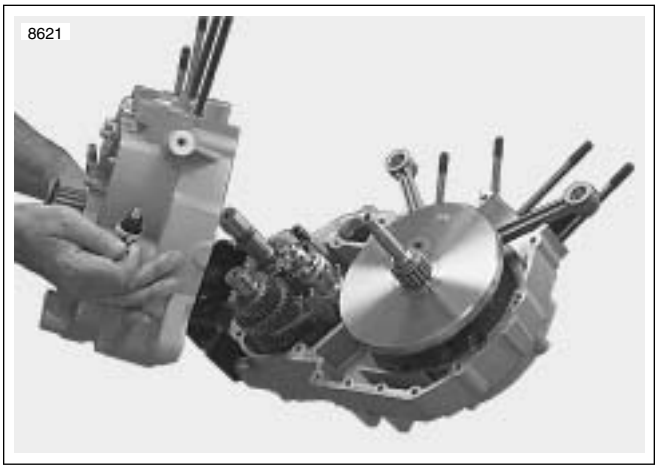


Figure 6-53. Separating Crankcase Halves

16. See Figure 6-53. Separate crankcase halves.

NOTE

Flywheel assembly slides out of the left main bearing by hand. No tools are required for this operation.



Figure 6-54. Removing Flywheels from Left Case Half

17. See Figure 6-54. Remove the flywheel assembly from left crankcase half.

TRANSMISSION DISASSEMBLY 6.9

GENERAL

PART NO.	SPECIALTY TOOL
B-43985-1	Transmission remover
J-5586	Retaining ring pliers

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.

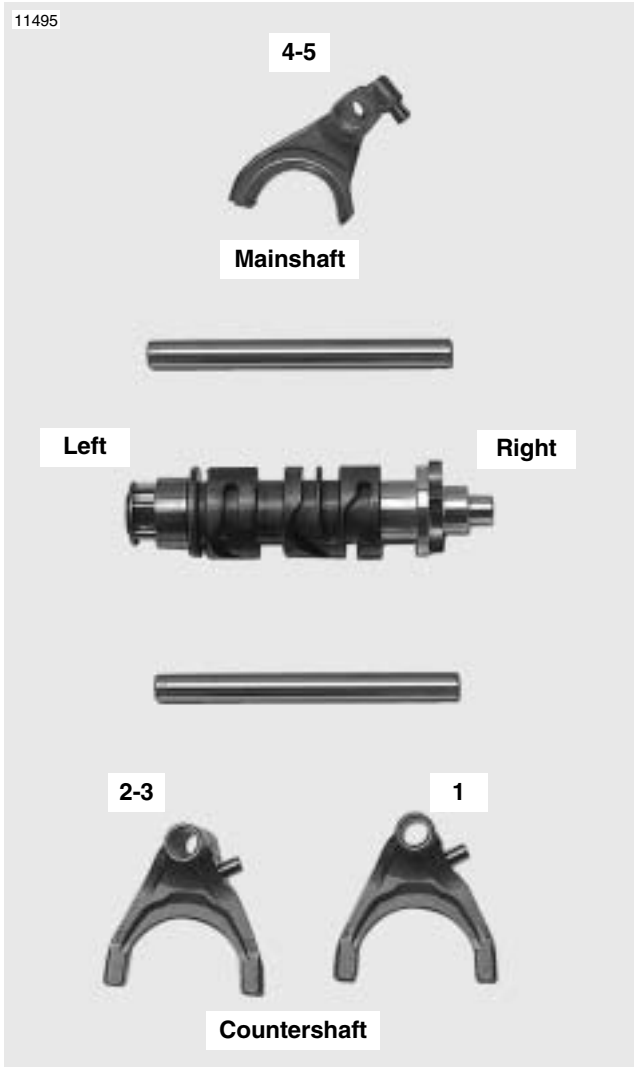


Figure 6-55. Shifter Forks, Drum and Shafts

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.

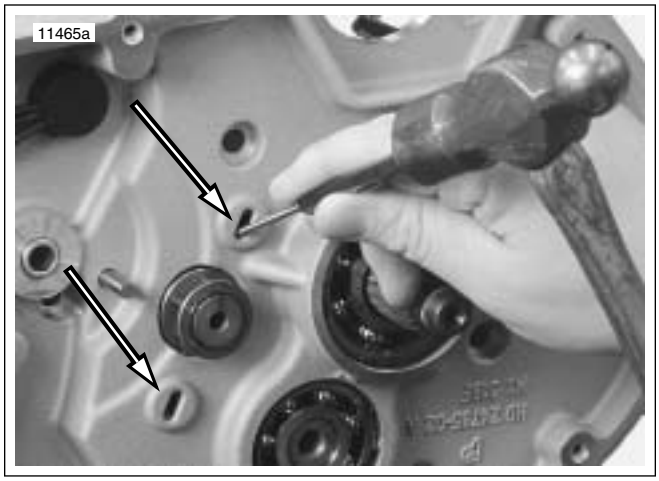
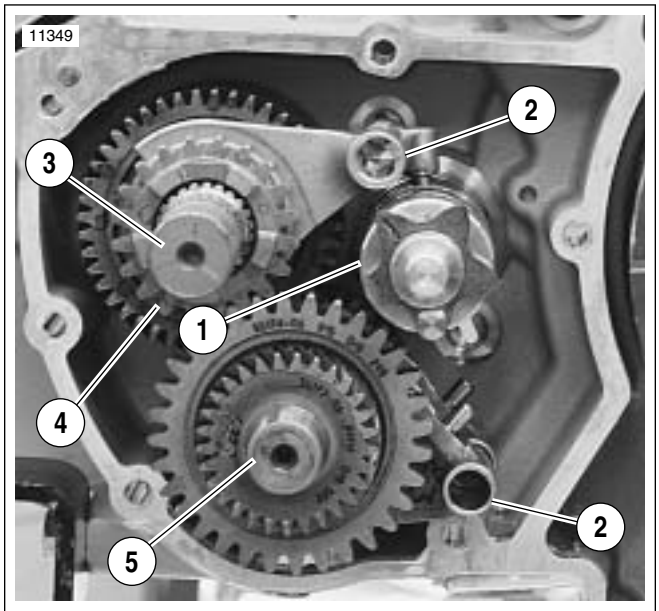


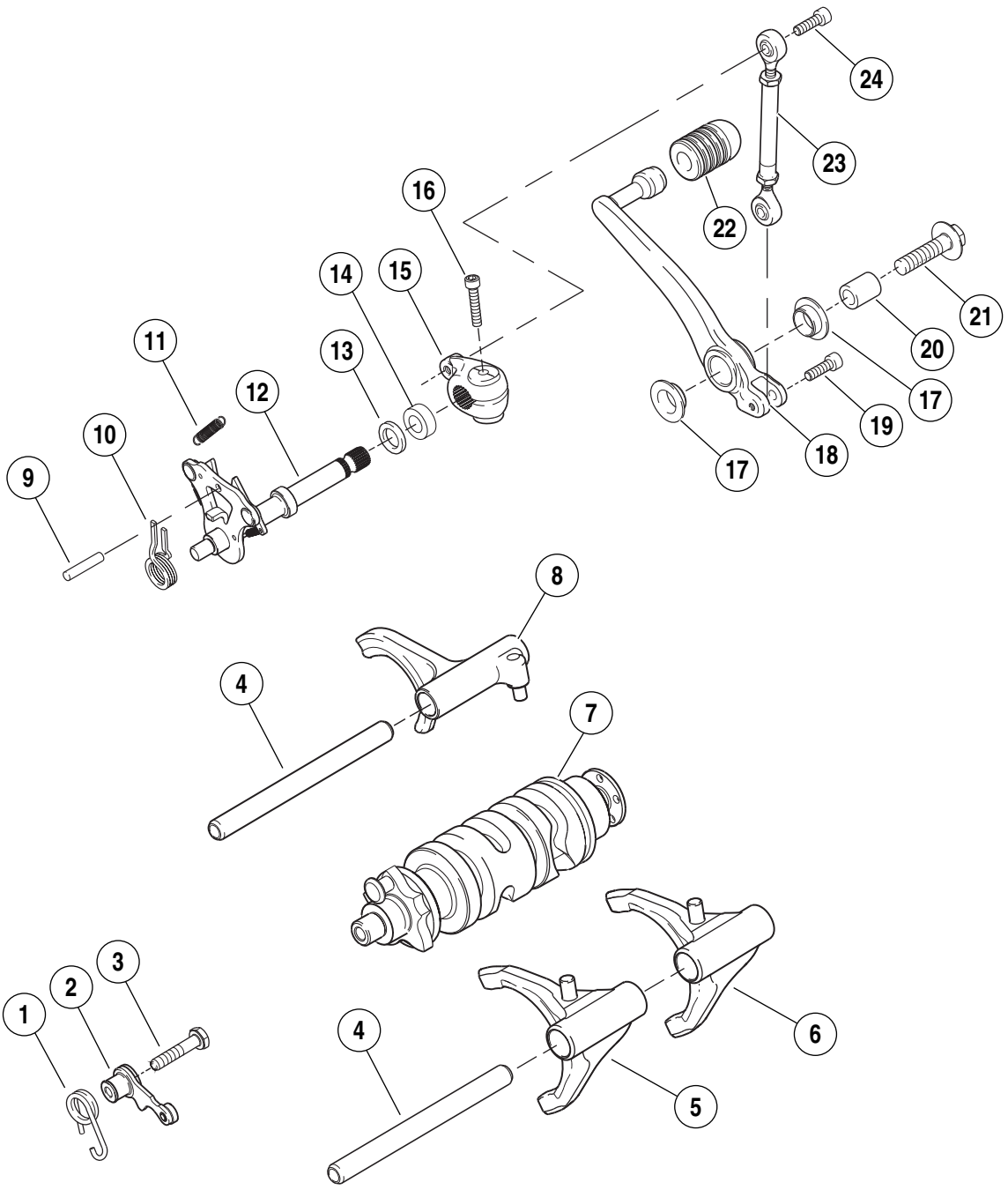
Figure 6-56. Slots For Removing Shifter Fork Shafts



1. **Shifter drum**
2. **Shifter fork (3)**
3. **Mainshaft**
4. **Mainshaft 2nd gear**
5. **Countershaft**

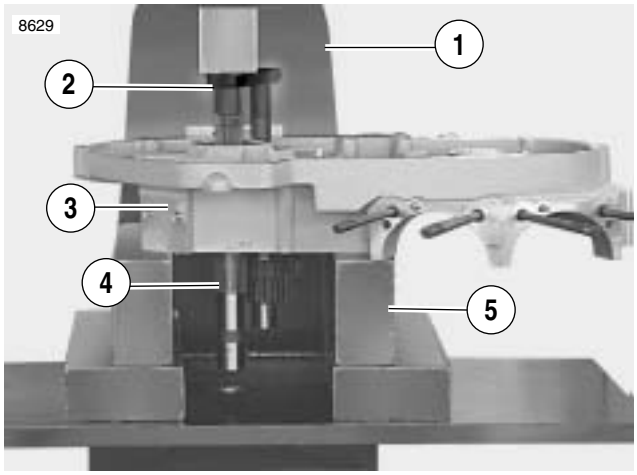
Figure 6-57. Transmission Assembly

b1183b6x



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



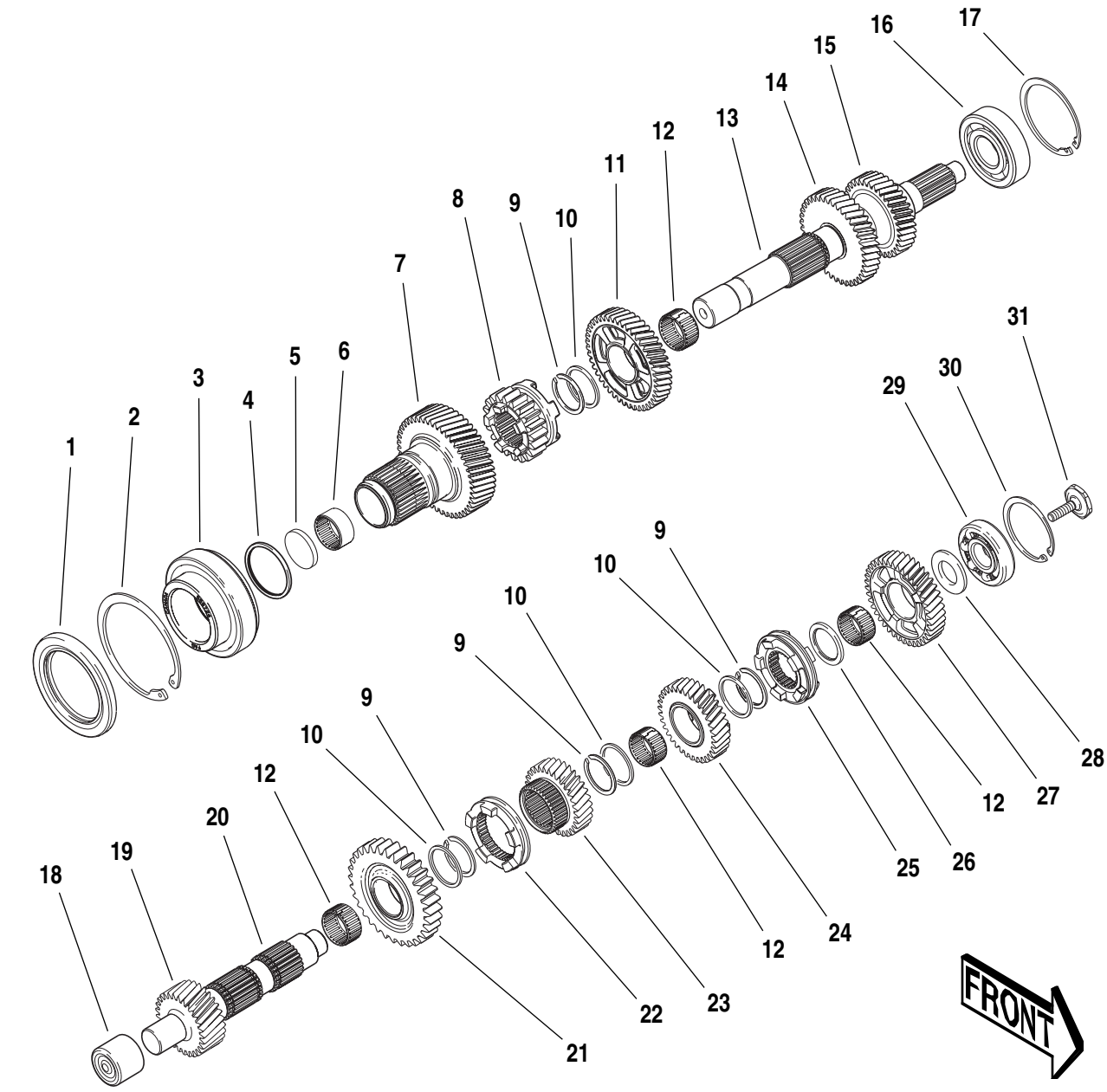
1. **Arbor press**
2. **Transmission remover (Part No. B-43985-1)**
3. **Crankcase**
4. **Transmission assembly**
5. **Parallel supports**

Figure 6-59. Removing Transmission Assembly from Left Case Half

⚠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.



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.

Figure 6-60. Transmission Assembly

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.*

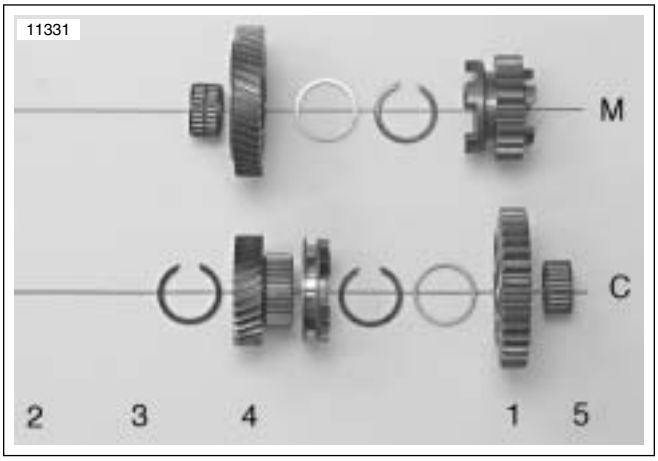


Figure 6-61. Transmission Parts Identification

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.*
- *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)

NOTE

Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

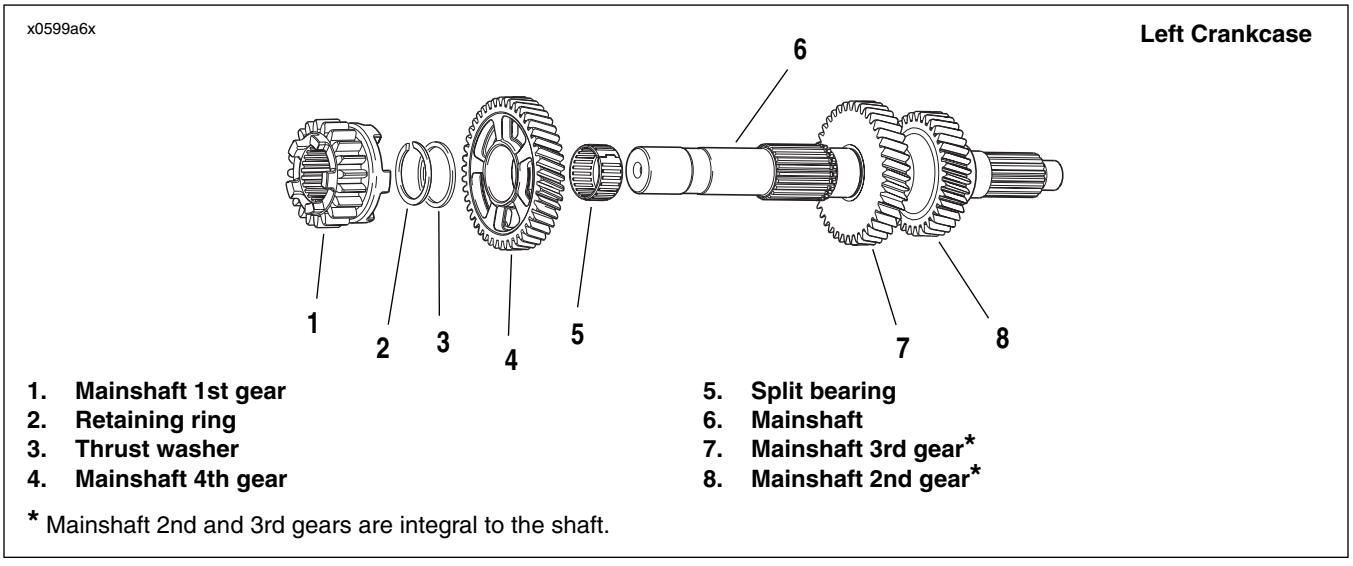
1. See Figure 6-62. Remove 1st gear (1).
2. Use RETAINING RING PLIERS (Part No. J-5586) to expand and remove retaining ring (2). Discard retaining ring.
3. Slide thrust washer (3) off end of mainshaft.
4. Remove 4th gear (4) and split bearing (5). Discard bearing.

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.



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.

Figure 6-62. Transmission Mainshaft Assembly Once Removed from Left Crankcase/Disassembly

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.

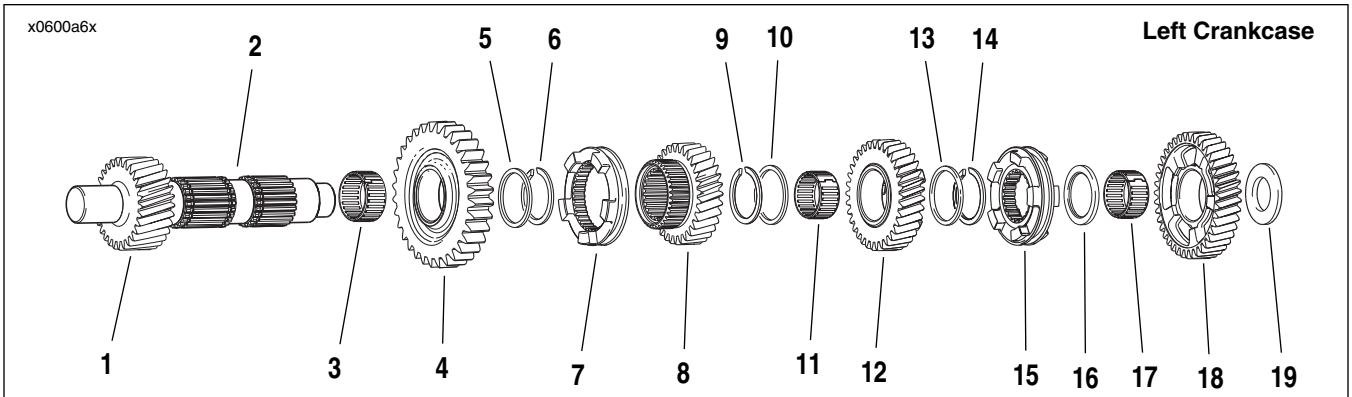
3. Remove dog ring (15).
4. Using RETAINING RING PLIERS (Part No. J-5586), expand and remove retaining ring (14). Discard retaining ring.
5. Remove thrust washer (13), 3rd gear (12), and split bearing (11). Discard bearing.
6. Remove thrust washer (10).
7. Expand, remove and discard retaining ring (9).
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.



1. **Countershaft 5th gear***
2. **Countershaft**
3. **Split bearing**
4. **Countershaft 1st gear**
5. **Thrust washer**
6. **Retaining ring**
7. **Dog ring**
8. **Countershaft 4th gear**
9. **Retaining ring**
10. **Thrust washer**
11. **Split bearing**
12. **Countershaft 3rd gear**
13. **Thrust washer**
14. **Retaining ring**
15. **Dog ring**
16. **Spacer**
17. **Split bearing**
18. **Countershaft 2nd gear**
19. **Spacer**

* Countershaft 5th gear is integral to the shaft.

Figure 6-63. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly

TRANSMISSION ASSEMBLY 6.10

GENERAL

PART NO.	SPECIALTY TOOL
J-5586	Retaining ring pliers

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)

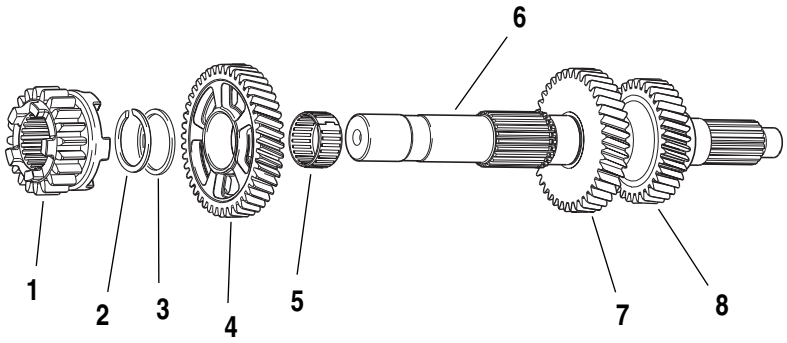
NOTES

- *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).
3. Using RETAINING RING PLIERS (Part No. J-5586), expand and install **new** retaining ring (2).
4. Install 1st gear (1).

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Left Crankcase



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.

Figure 6-64. Transmission Mainshaft Assembly/Reassembly

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)

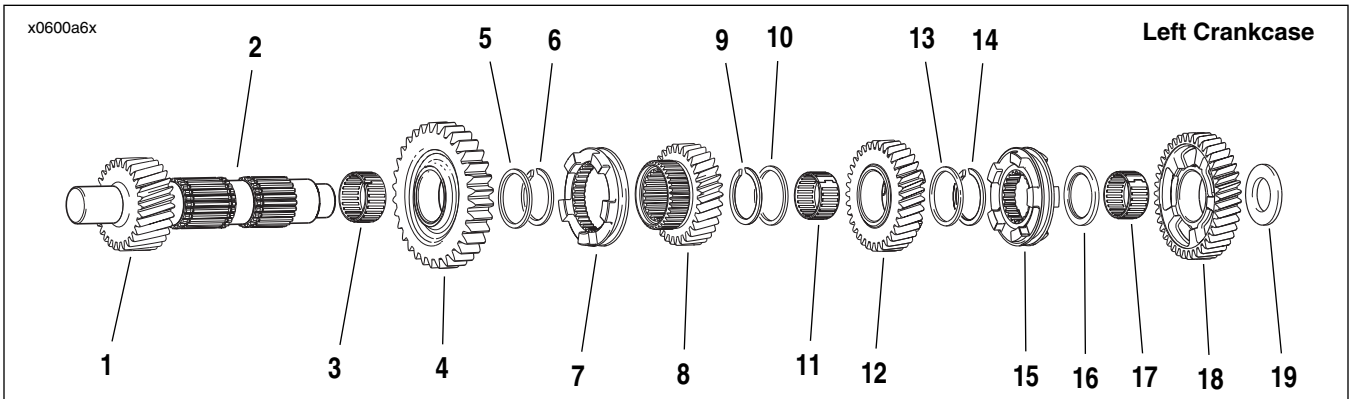
NOTES

- *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).
3. Using RETAINING RING PLIERS (Part No. J-5586), expand and install **new** retaining ring (6).
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.



1. **Countershaft 5th gear***
2. **Countershaft**
3. **Split bearing**
4. **Countershaft 1st gear**
5. **Thrust washer**
6. **Retaining ring**
7. **Dog ring**
8. **Countershaft 4th gear**
9. **Retaining ring**
10. **Thrust washer**
11. **Split bearing**
12. **Countershaft 3rd gear**
13. **Thrust washer**
14. **Retaining ring**
15. **Dog ring**
16. **Spacer**
17. **Split bearing**
18. **Countershaft 2nd gear**
19. **Spacer**

* Countershaft 5th gear is integral to the shaft.

Figure 6-65. Transmission Countershaft Assembly Once Removed from Left Crankcase/Disassembly

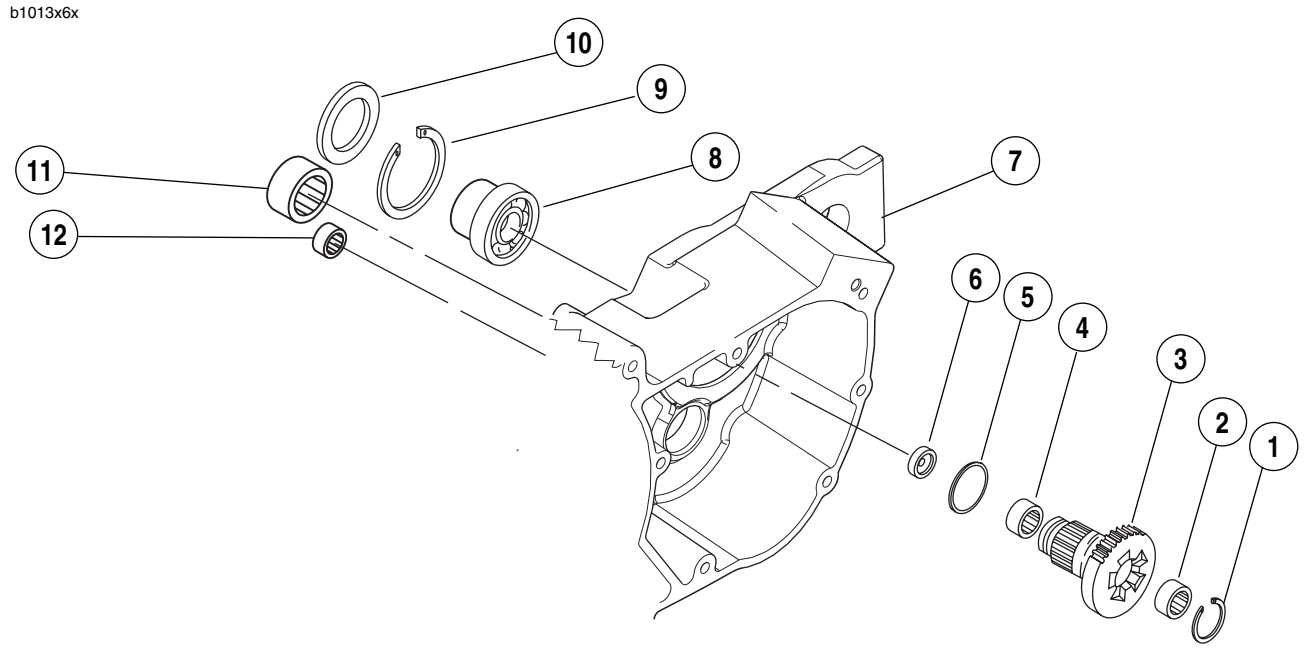
MAIN DRIVE GEAR 6.11

GENERAL

PART NO.	SPECIALTY TOOL
HD-35316-C	Main drive gear remover and installer
B-45847	Cross plate
HD-47855	Inner/outer main drive gear needle bearing installation tool
HD-95637-46A	Bearing race puller
HD-47856	Seal driver

NOTE

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.

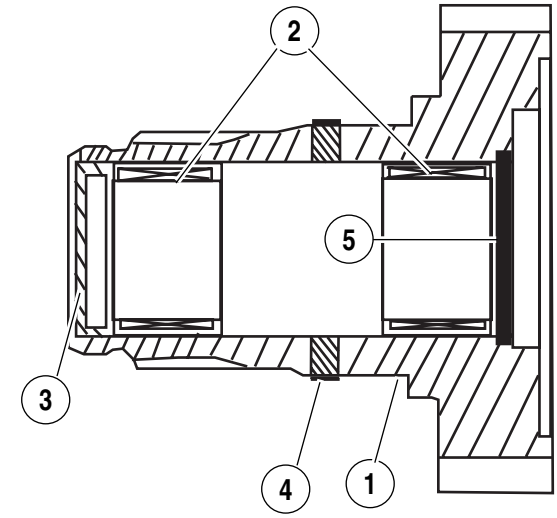


1. **Retaining ring**
2. **Bearing (Inner)**
3. **Fifth gear mainshaft**
4. **Bearing (Outer)**
5. **O-ring**
6. **Oil seal**
7. **Right crankcase half**
8. **Ball bearing with spacer**
9. **Retaining ring**
10. **Oil seal**
11. **Bearing, (closed end) countershaft**
12. **Bushing, shifter drum**

Figure 6-66. Transmission Assembly-Right Crankcase Half

REMOVAL

1. Split crankcases in half. See 6.8 CASE DISASSEMBLY FOR TRANSMISSION REMOVAL.
2. Remove transmission as an assembly. See 6.9 TRANSMISSION DISASSEMBLY.



1. **Main drive gear**
2. **Needle bearing (2)**
3. **Seal**
4. **O-ring**
5. **Retaining ring**

Figure 6-67. Main Drive Gear Assembly

3. See Figure 6-67. From inside case tap out seal at end of mainshaft 5th gear. Discard seal.

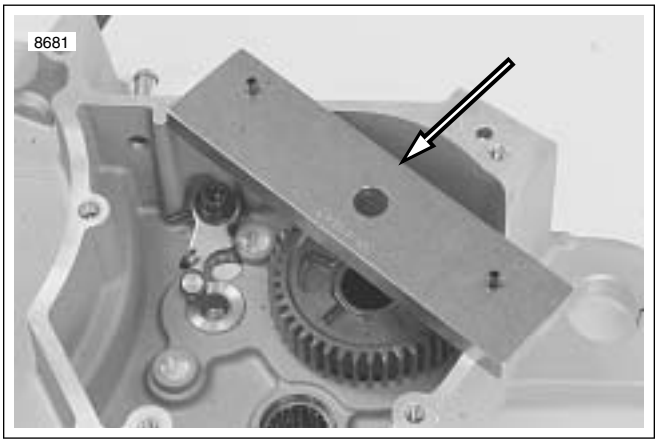
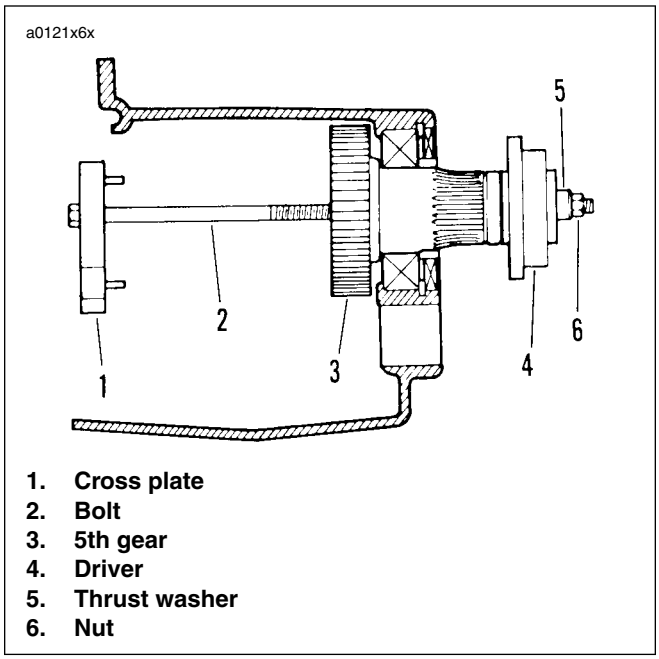


Figure 6-68. Bearing Remover Cross Plate Mounting (Part No. B-45847)

4. See Figure 6-68. Place cross plate on crankcase as shown.



1. **Cross plate**
2. **Bolt**
3. **5th gear**
4. **Driver**
5. **Thrust washer**
6. **Nut**

Figure 6-69. Removing Main Drive Gear

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

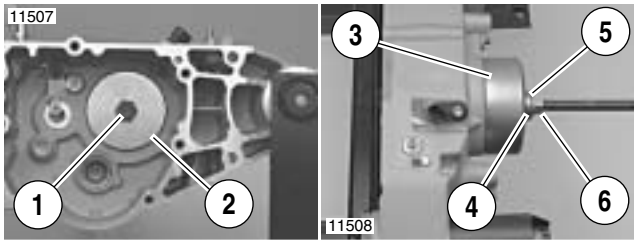
Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

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.



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 6-70. Removing Main Drive Gear Bearing (Typical)

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

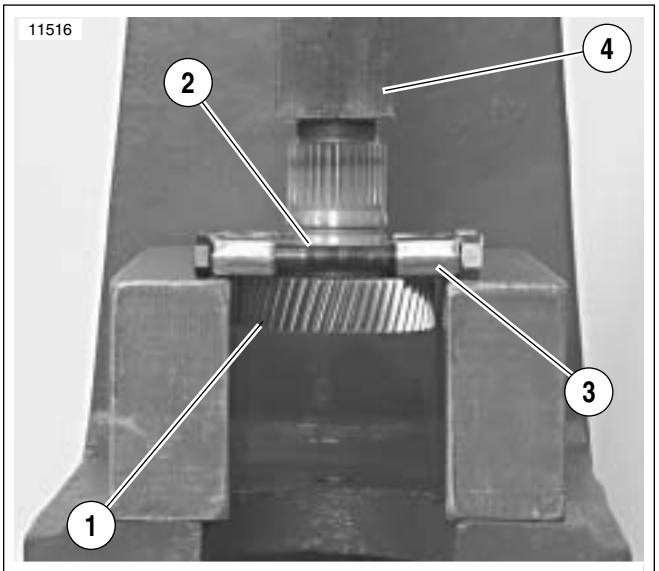
When the main drive gear is removed, a portion of the bearing inner race remains attached to the main drive gear. This inner race must be removed before the main drive gear can be re-installed.

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.

6. Press main drive gear out of inner bearing race. Discard inner bearing race.

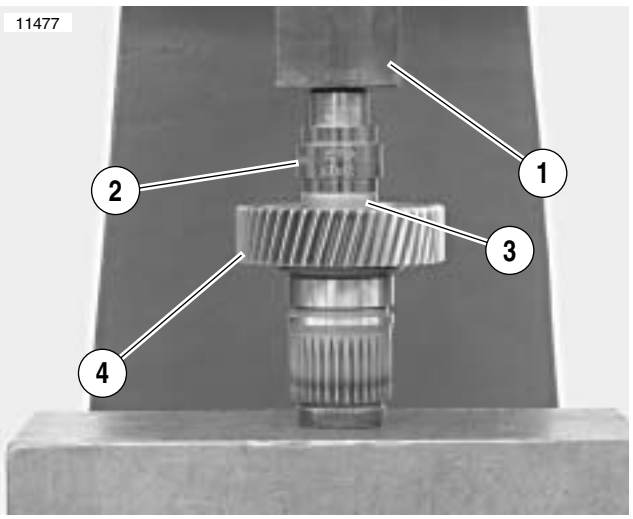


1. **Main drive gear**
2. **Inner bearing race (not visible in this photo)**
3. **Bearing race puller (Part no. HD-95637-46A)**
4. **Press ram**

Figure 6-71. Removing Inner Bearing Race From Main Drive Gear

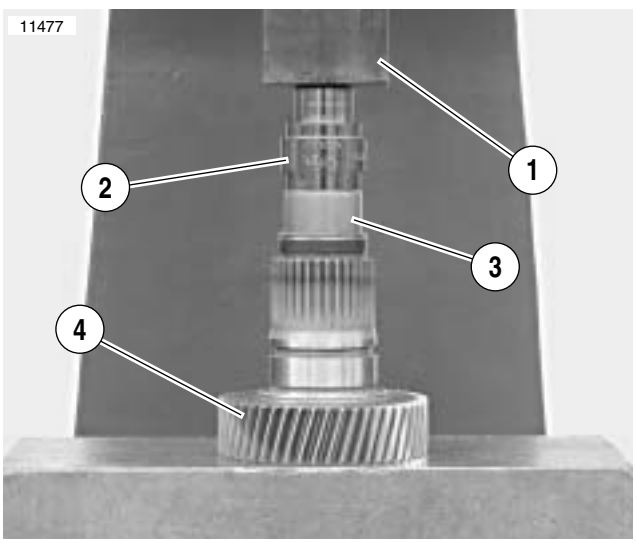
ASSEMBLY

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.



1. Press ram
2. Needle bearing installation tool (Part No. HD-47855)
3. Needle bearing
4. Main drive gear

Figure 6-72. Pressing Inner Needle Bearing Assembly into Main Drive Gear



1. Press ram
2. Needle bearing installation tool (Part No. HD-47855)
3. Needle bearing
4. Main drive gear

Figure 6-73. Pressing Outer Needle Bearing Assembly into Main Drive Gear

INSTALLATION

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.

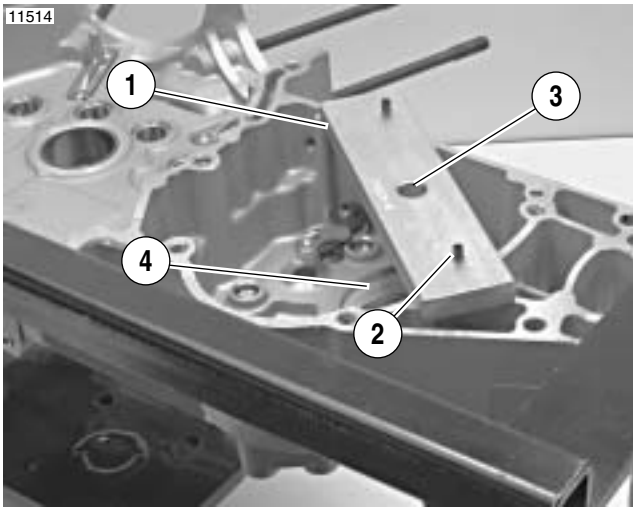
⚠WARNING

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

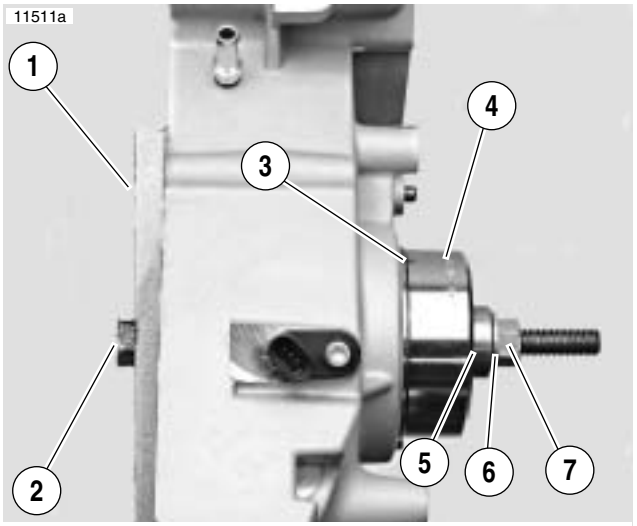
Use correct retaining ring pliers and correct tips. Verify that tips are not excessively worn or damaged.

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).



1. **Cross plate (Part No. B-45847)**
2. **Roll pin (2)**
3. **Bolt hole**
4. **Crankcase bearing bore**

Figure 6-74. Positioning Cross Plate (Typical)



1. **Cross plate (Part No. B-45847)**
2. **8 in. bolt (Part No. HD-35316-4A)**
3. **Main drive gear bearing**
4. **Bearing driver (Part No. HD-35316-8)**
5. **Nice bearing**
6. **Flat washer**
7. **Nut**

Figure 6-75. Installing Main Drive Gear Bearing

INSTALLATION: MAIN DRIVE GEAR

Main Drive Gear

1. See Figure 6-76. Lubricate both main drive gear needle bearing assemblies and the mating surface of the mainshaft with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (Part No. 99857-97).



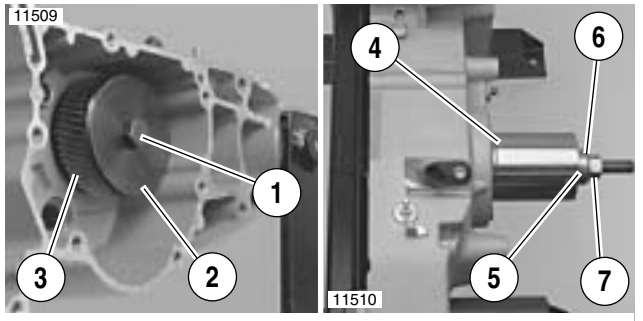
Figure 6-76. Lubricating Main Drive Gear Needle Bearings

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).



1. **8 in. bolt (Part No. HD-35316-4A)**
2. **Washer (Part No. HD-35316-7)**
3. **Main drive gear**
4. **Installer cup (Part No. HD-35316-12)**
5. **Nice bearing**
6. **Flat washer**
7. **Nut**

Figure 6-77. Installing Main Drive Gear (Typical)

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.

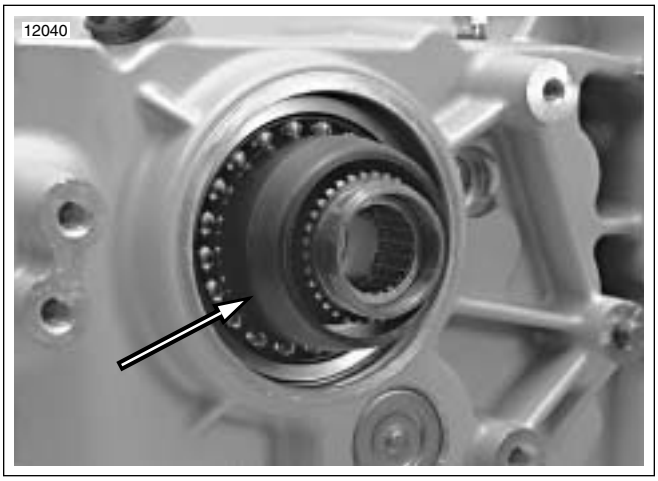


Figure 6-78. Install PILOT (Part No. HD-47856-2) (Typical)

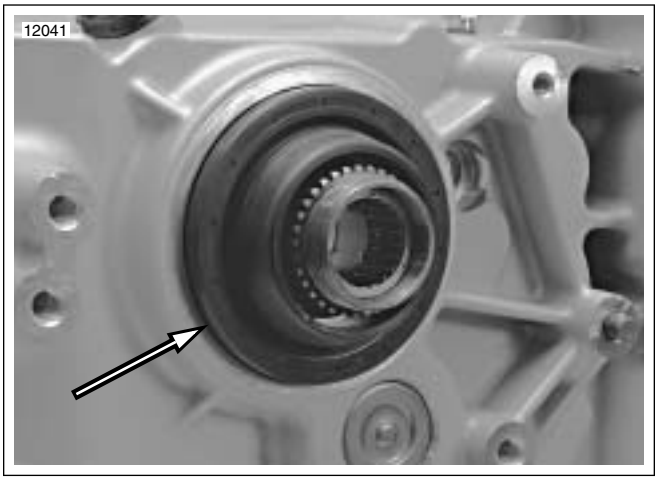


Figure 6-79. Install Main Drive Gear Seal (Typical)

3. See Figure 6-79. Place seal over pilot and position seal squarely in end of crankcase bore.

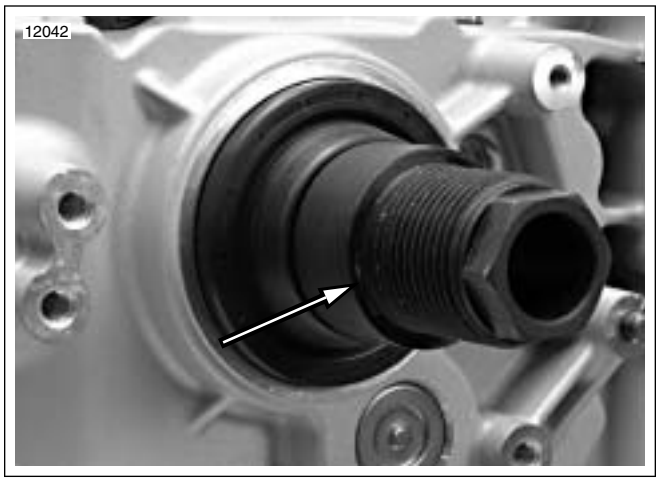


Figure 6-80. Install ADAPTER (Part No. HD-47856-4) (Typical)

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.

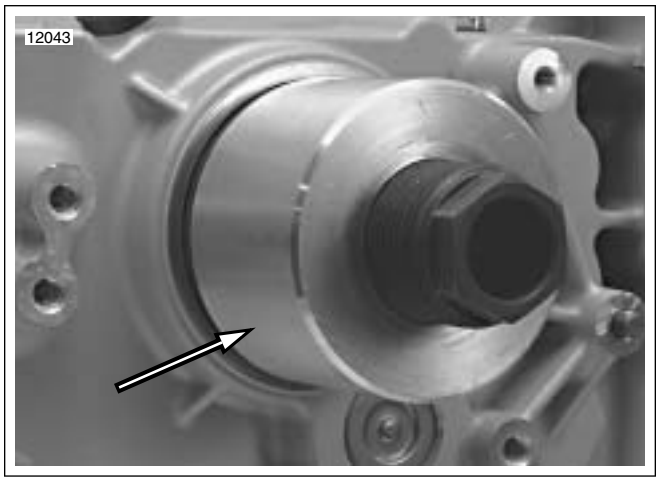


Figure 6-81. Place INSTALLER (Part No. HD-47856-1) over ADAPTER (Typical)

5. See Figure 6-81. Slide INSTALLER (Part No. HD-47856-1) over ADAPTER until cupped end of installer is flat against seal.

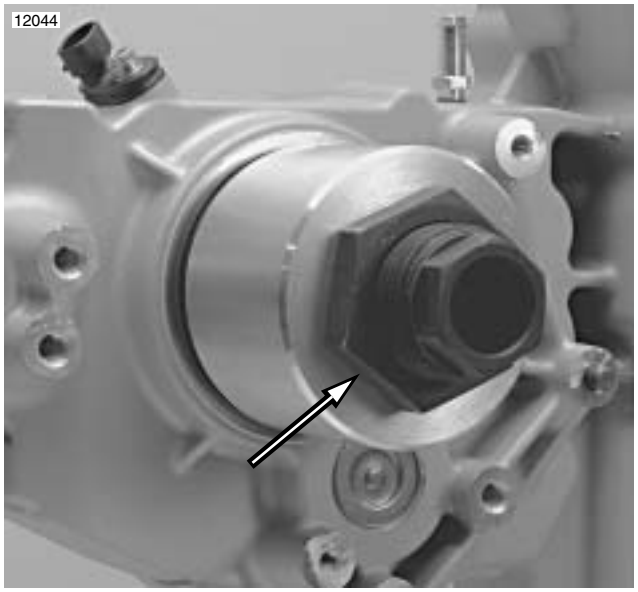
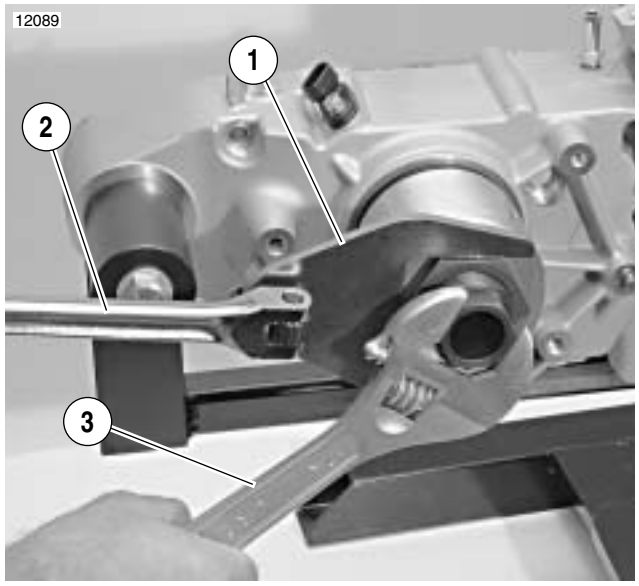


Figure 6-82. Install NUT (Part No. HD-47856-5) (Typical)

6. See Figure 6-82. Thread NUT (Part No. HD-47856-5) onto end of adapter, until it tightens against installer.



1. **CROWFOOT WRENCH**
2. **1/2 inch breaker bar**
3. **Adjustable wrench**

Figure 6-83. Press Seal Into Crankcase

7. See Figure 6-83. Place CROWFOOT WRENCH (Part No. HD-47856-7) (1) with 1/2 inch drive 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.

TRANSMISSION RIGHT CASE BEARINGS 6.12

GENERAL

PART NO.	SPECIALTY TOOL
HD-95760-69A	Bushing and bearing puller
HD-95765-69A	1/2 in. collet

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.

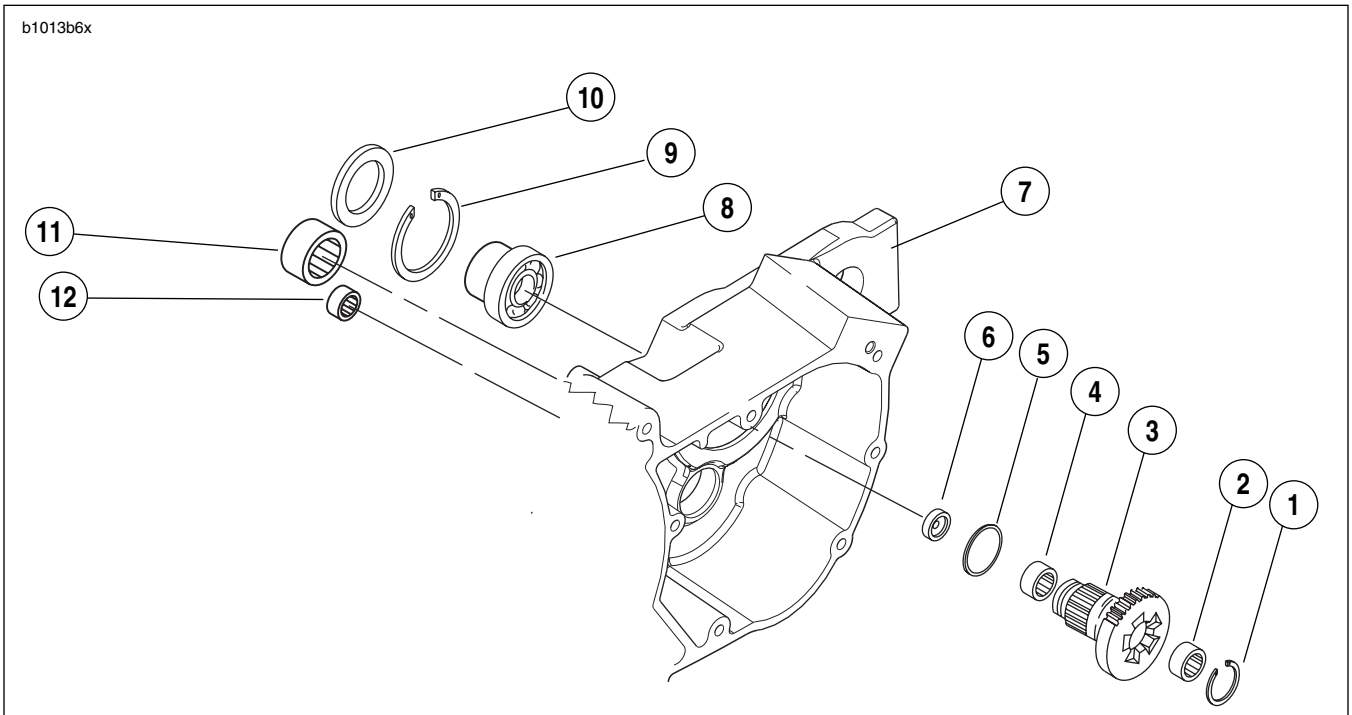
INSTALLATION

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).



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**

Figure 6-84. Transmission Assembly-Right Crankcase Half

TRANSMISSION LEFT CASE BEARINGS 6.13

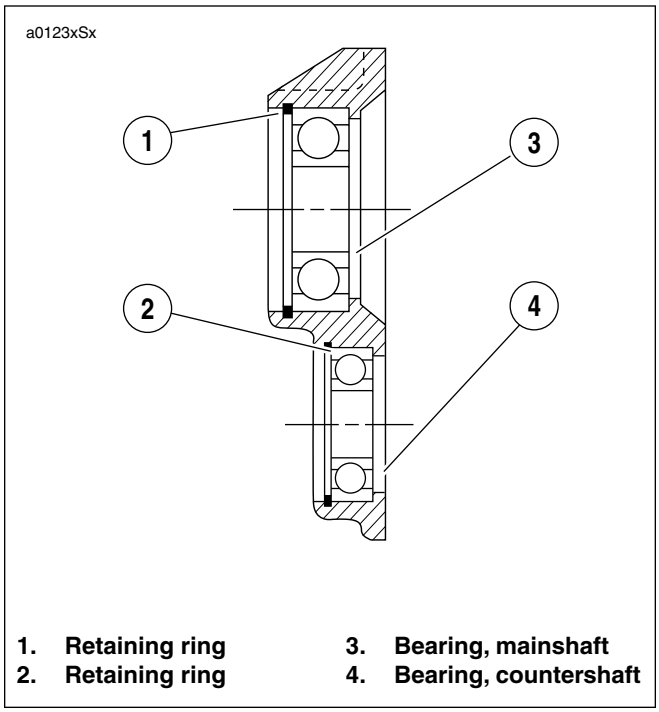
REMOVAL

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.



1. **Retaining ring**
2. **Retaining ring**
3. **Bearing, mainshaft**
4. **Bearing, countershaft**

Figure 6-85. Ball Bearing Assembly

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.

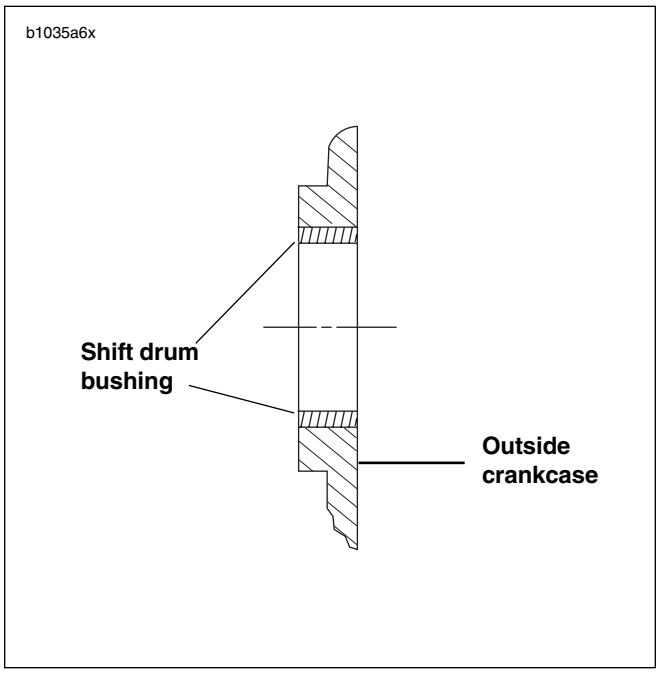


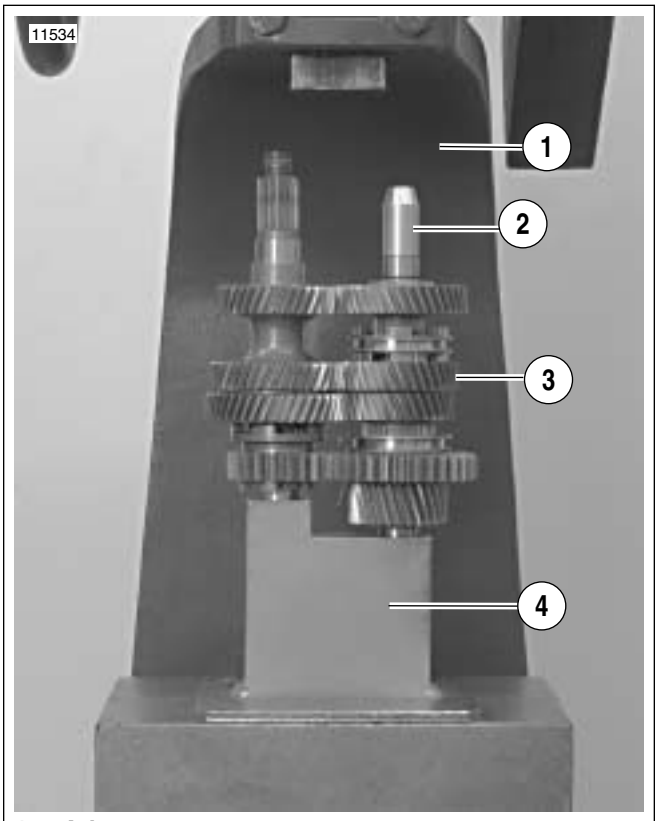
Figure 6-86. Shift Drum Bushing Assembly

INSTALLATION

NOTES

After re-installing the transmission assembly, verify that all parts have been properly installed. See:

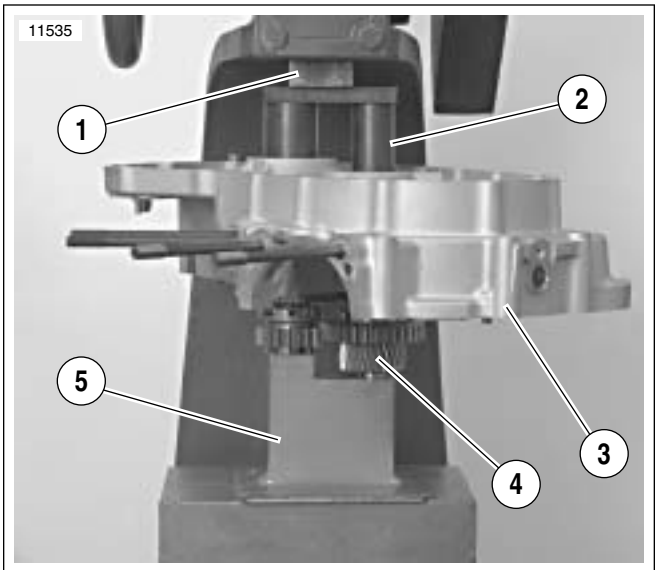
- 6.11 MAIN DRIVE GEAR
- 6.10 TRANSMISSION ASSEMBLY
- 6.13 TRANSMISSION LEFT CASE BEARINGS
- 6.12 TRANSMISSION RIGHT CASE BEARINGS
- *Make sure crankcase does not begin to tilt when pressed onto transmission assembly. It may be necessary to place press ram on transmission installer closer to mainshaft 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. **Arbor press**
2. **Guide tool (Part No. B-43985-4)**
3. **Transmission assembly**
4. **Transmission Remover/Installer fixture (Part No. HD-46285)**

Figure 6-87. Transmission Assembly in Fixture (Typical)

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).



1. **Press ram**
2. **Transmission installer (Part No. B-43985-3)**
3. **Crankcase**
4. **Transmission assembly**
5. **Transmission assembly 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.

SHIFTER FORKS AND DRUM ASSEMBLY

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.

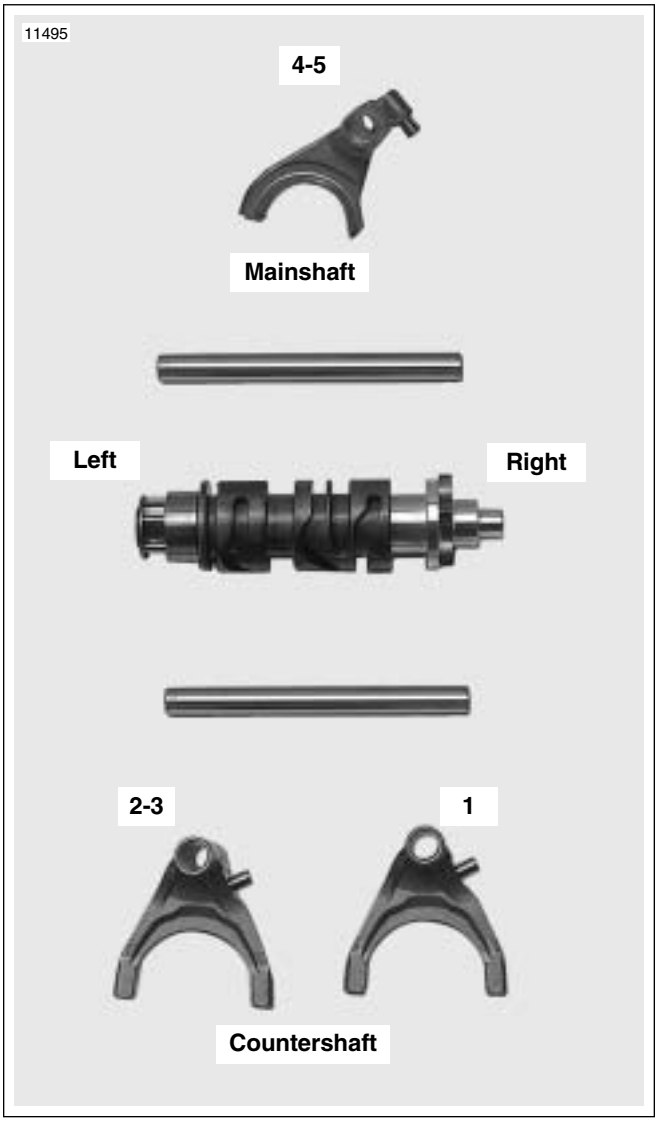


Figure 6-89. Shifter Forks, Drum and Shafts

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.

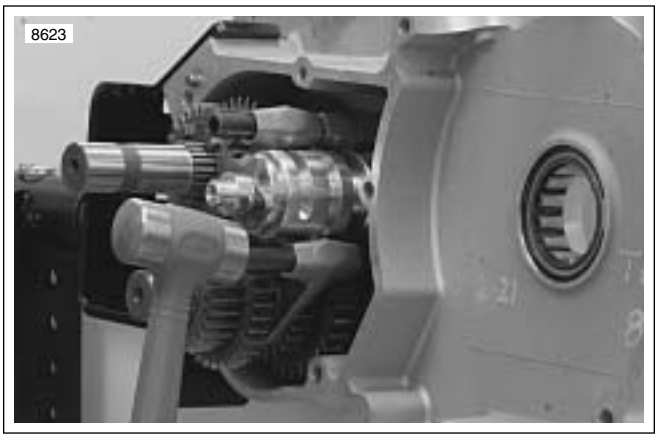


Figure 6-90. Installing Shift Fork Shafts

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.

INSTALLING RIGHT CRANKCASE

1. See Figure 6-91. Install the flywheel assembly into the left crankcase half using CRANKSHAFT GUIDE TOOL Part No. HD-42326.

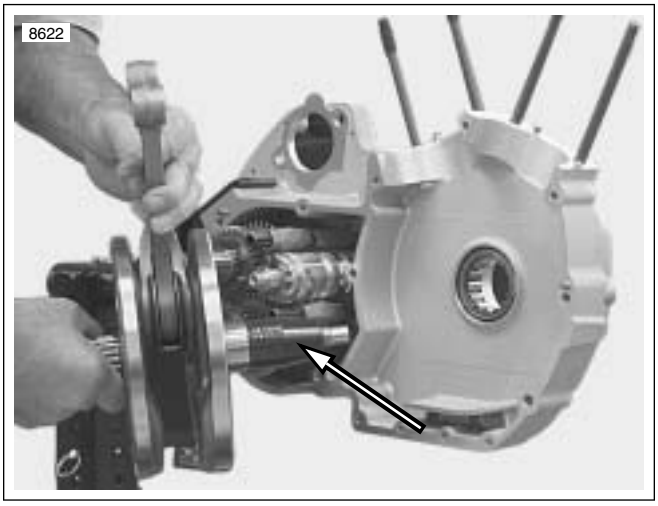
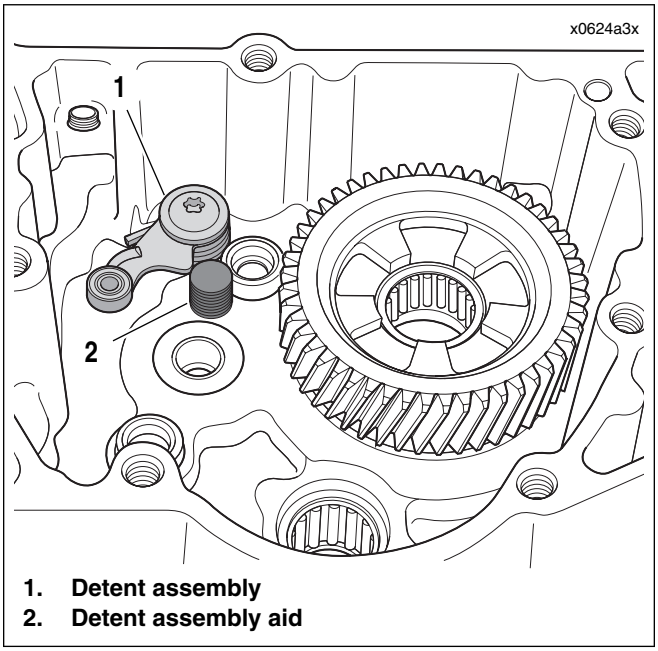


Figure 6-91. Installing Flywheel Assembly Using Crankshaft Guide Tool (Part No. HD-42326)

NOTE

The Gear Detent Assembly Aid is used to move the gear detent lever clear of the shifter drum for assembly purposes.



1. **Detent assembly**
2. **Detent assembly aid**

Figure 6-92. Using Gear Detent Assembly Aid (Part No. B-45520)

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).

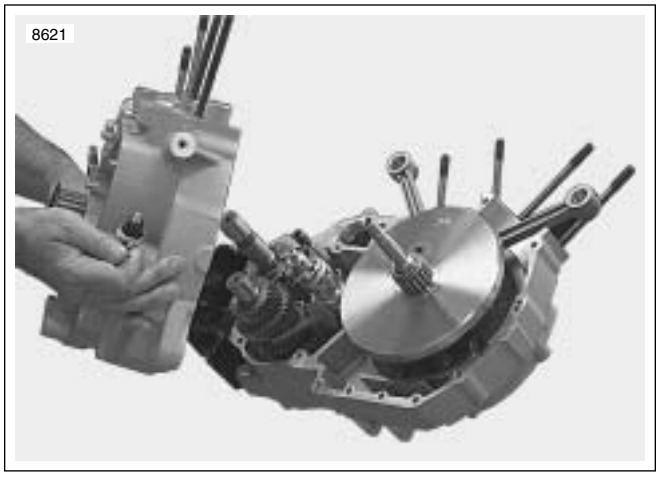


Figure 6-93. Crankcase Halves

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.

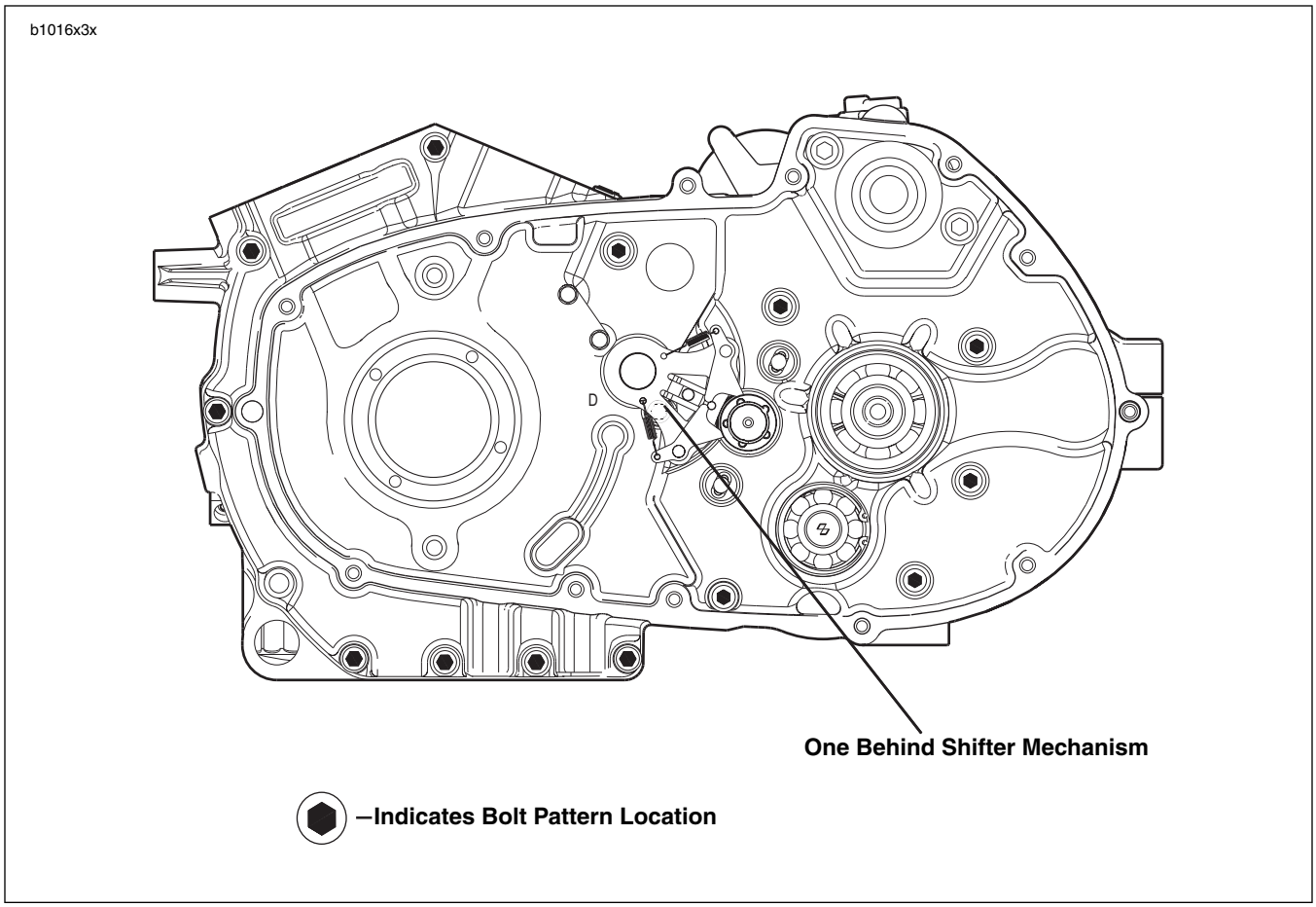


Figure 6-94. Crankcase Fasteners

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.

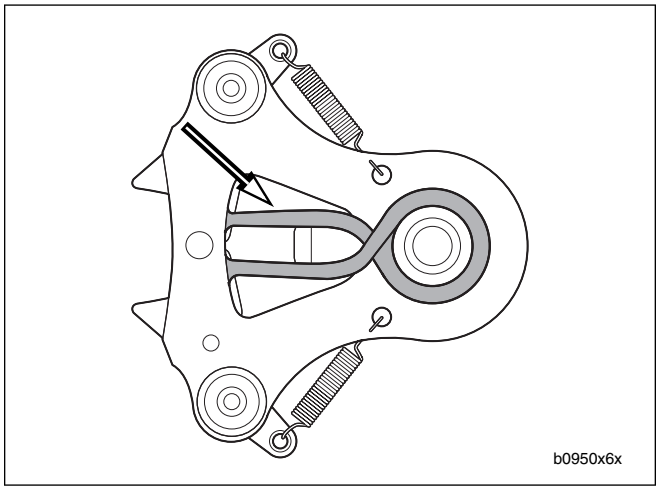


Figure 6-95. Shifter Shaft Return Spring (Correctly Installed)

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.

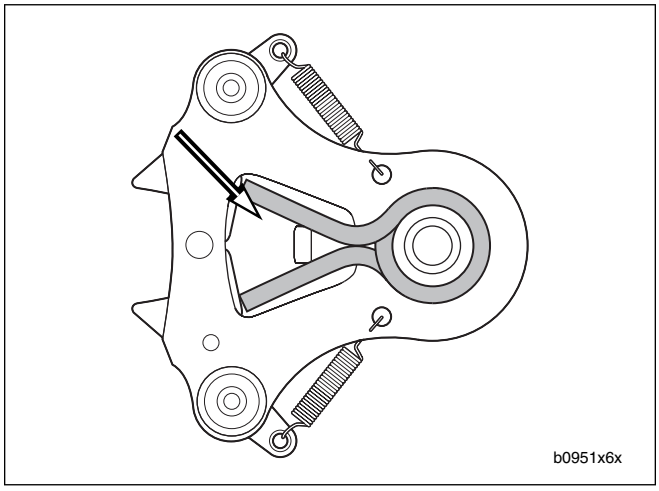
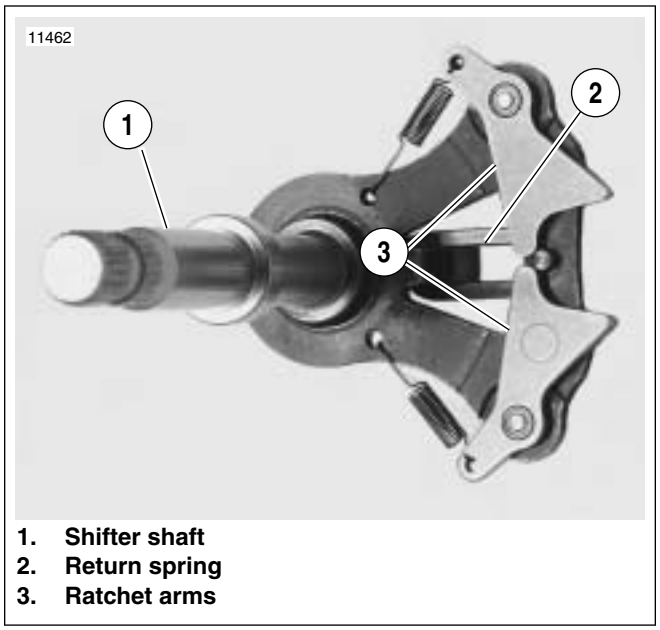


Figure 6-96. Shifter Shaft Return Spring (Incorrectly Installed)



1. **Shifter shaft**
2. **Return spring**
3. **Ratchet arms**

Figure 6-97. Shifter Shaft Assembly

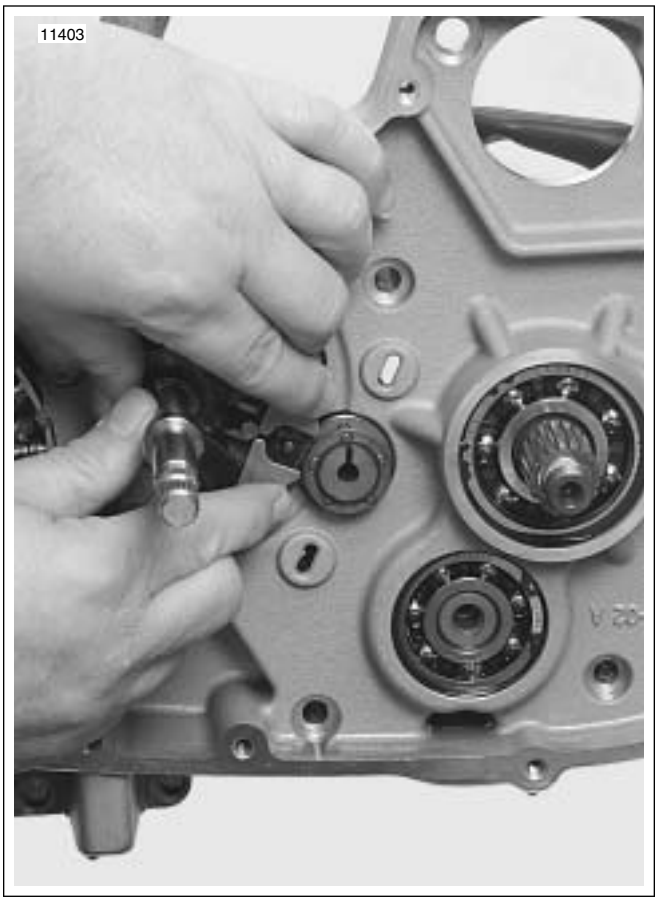


Figure 6-98. Installing Shifter Shaft Assembly

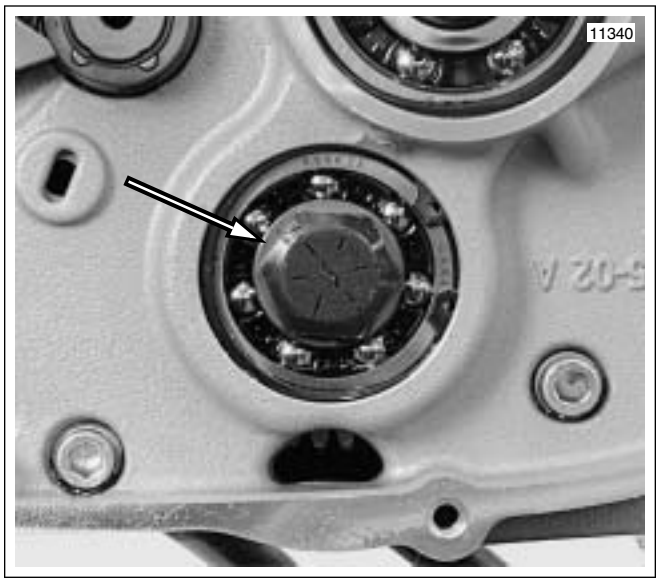


Figure 6-99. Hex Fastener Countershaft Retainer

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.

TRANSMISSION SPROCKET 6.16

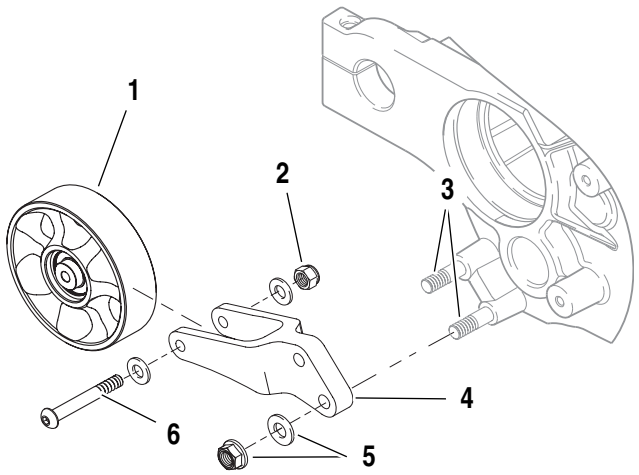
REMOVAL

NOTE

Use spacer and fastener from B-45659 to install sprocket locking tool.

PART NO.	SPECIALTY TOOL
B-45659	Transmission sprocket locking tool
HD-94660-37B	Mainshaft locknut wrench

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.



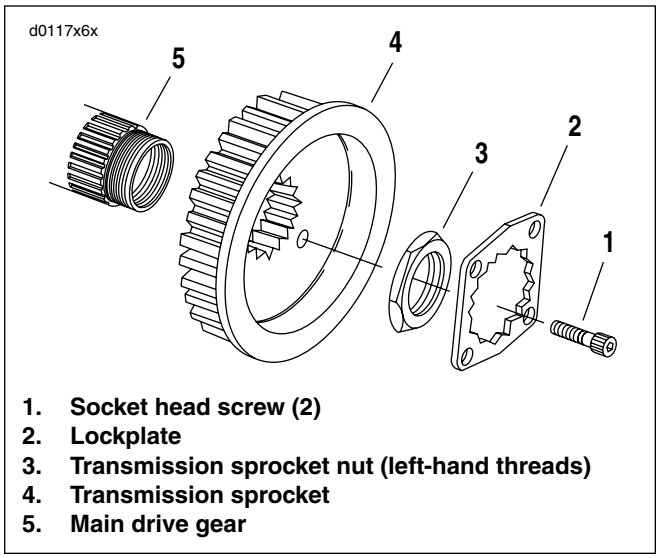
1. **Wheel**
2. **Wheel nut**
3. **Stud (2)**
4. **Idler pulley bracket**
5. **Idler pulley bracket nut with washer (2)**
6. **Wheel fastener**

Figure 6-100. Idler Pulley Assembly

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.



1. **Socket head screw (2)**
2. **Lockplate**
3. **Transmission sprocket nut (left-hand threads)**
4. **Transmission sprocket**
5. **Main drive gear**

Figure 6-101. Transmission Sprocket

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).

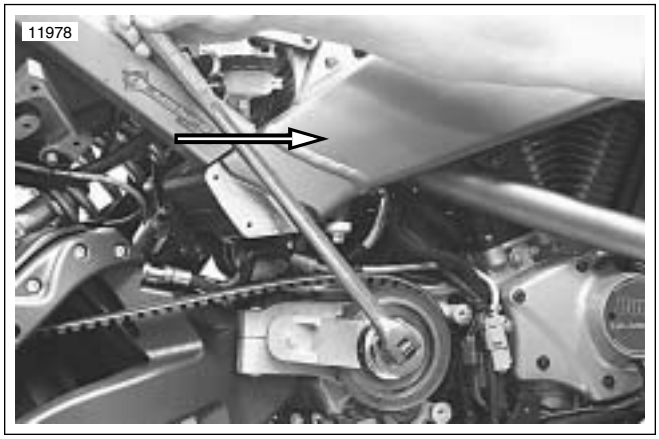


Figure 6-102. Removing Transmission Sprocket Locknut

INSTALLATION

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°.

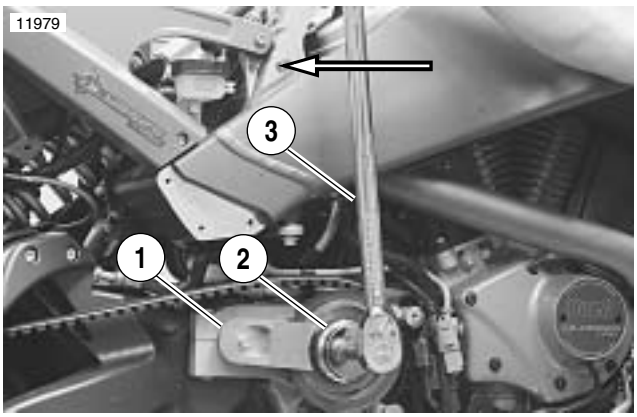
NOTE

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 lockplate 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 lockplate'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 lockplate and into tapped holes of sprocket. Tighten to 90-110 **in-lbs** (10.2-12.4 Nm).

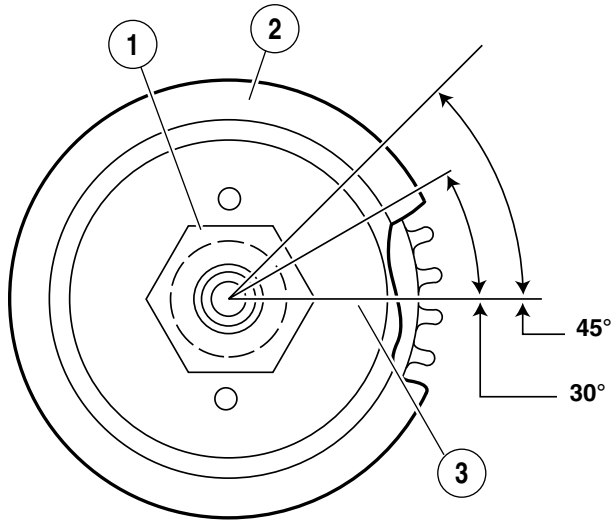
NOTE

*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.*



1. **Sprocket holding tool**
2. **Mainshaft locknut wrench**
3. **Torque wrench**

Figure 6-103. Transmission Sprocket Tightening



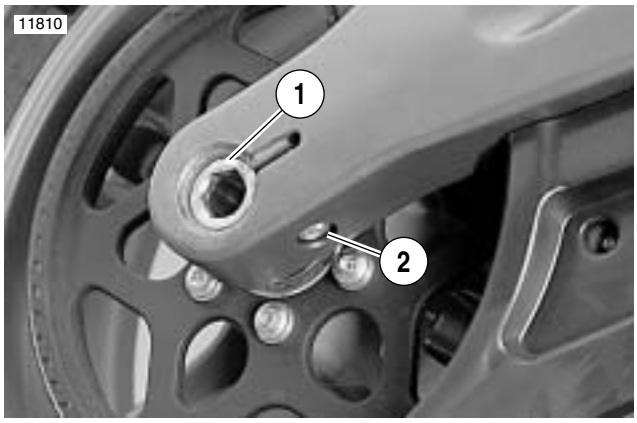
1. **Transmission sprocket nut**
2. **Transmission sprocket**
3. **Line scribed on nut and sprocket**

Figure 6-104. Aligning Transmission Sprocket

11. Install idler pulley. See IDLER PULLEY INSTALLATION- under 6.6 DRIVE BELT SYSTEM.

NOTE

Never tighten rear axle with swingarm brace removed.



1. Axle
2. Pinch bolt fastener

Figure 6-105. Rear Wheel Mounting, Right Side

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).

NOTES

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ELECTRICAL 7

SPECIFICATIONS 7.1

Table 7-1. Battery Specifications

BATTERY	
Size	12 VDC/12 AH/200CCA
Type	Sealed, AGM

Table 7-2. Spark Plug Specifications

SPARK PLUGS		
Size	12 mm	
Type	10R12A	
Gap	0.035 in.	0.9mm
Torque	11-18 ft-lbs	15-24 Nm
Cable resistance (front and rear)	1,350-3,465 ohms	

Table 7-3. Alternator Specifications

ALTERNATOR	
AC voltage output	16-20 VAC per 1000 engine RPM
Stator coil resistance	0.1-0.3 Ohms

Table 7-4. Regulator Specifications

REGULATOR	
Voltage output @ 3600 RPM	14.4-14.6 VDC@ 75° F (24° C)
Amperes @ 3600 RPM	34 Amps

Table 7-5. Ignition Coil Specifications

IGNITION COIL RESISTANCE	
Primary winding	0.5-0.7 ohms
Secondary winding	5500-7500 ohms

Table 7-6. Electrical System Specifications

ELECTRICAL SYSTEM	AMPERES
Battery fuse	30
Ignition fuse	15
Light fuse	15
Accessory fuse	10
Brake/horn/active muffler fuse (1200 models only)	10
ECM fuse	10
Key switch fuse	15
Cooling fan fuse	10

Table 7-7. Bulb Chart

BULB CHART		BULBS REQUIRED	WATTS	AMPS	PART NUMBER
Headlights	Bulb (H3)	2	55	4.58	Y0148.1AD
	Position lamp (European models only)	1	5	0.37	53436-97
Marker lamps	Tail/Stop Lamp	1	5/21	0.42/1.75	68169-90A
	Turn signal lamp (front and rear 1 bulb each)	4	10.0	0.84	Y0042.K
	License plate illumination lamp (European models only)	1	5	0.37	53436-97
	License plate illumination lamp	1	5	0.37	Y0514B.C

Table 7-7. Bulb Chart

BULB CHART		BULBS REQUIRED	WATTS	AMPS	PART NUMBER
Instruments	Turn signal indicator	1	1.12	0.08	Y0163.02A8
	Check engine	1	1.12	0.08	Y0163.02A8
	High beam	1	0.7	0.05	Y0162.02A8
	Oil indicator	1	1.12	0.08	Y0163.02A8
	Neutral	1	1.12	0.08	Y0163.02A8
	Backlight	2	1.12	0.08	Y0163.02A8
		1	0.7	0.05	Y0162.02A8
	Low fuel	Replace instrument cluster if low fuel warning lamp fails.			

TORQUE VALUES

ITEM	TORQUE		NOTES
Actuator ground wire	72-96 **in-lbs**	8-11 Nm	page 7-76
Battery (+) to starter fastener	60-85 **in-lbs**	7-10 Nm	page 7-34
Battery terminal fasteners	72-96 **in-lbs**	8-11 Nm	page 7-74
Clutch switch fasteners	7-10 **in-lbs**	0.8-1.12 Nm	page 7-16
Handlebar control housing screws (left side)	25-33 **in-lbs**	3-4 Nm	page 7-53
Handlebar control housing screws (right side)	25-33 **in-lbs**	3-4 Nm	Longer screw on bottom, page 7-52
Horn fastener	72-96 **in-lbs**	8-11 Nm	page 7-62
Ignition switch body fastener	12-36 **in-lbs**	1.4-4.0 Nm	page 7-8
Ignition switch fastener	18-20 ft-lbs	24.4-27.1 Nm	LOCTITE (red) 272, page 7-9
Instrument module fastener	12-36 **in-lbs**	1.4-4.0 Nm	page 7-56
Interactive exhaust actuator fasteners	36-40 **in-lbs**	4.0-4.5 Nm	page 7-76
Main battery ground	48-72 **in-lbs**	5.4-8.1 Nm	page 7-34
Neutral indicator switch	36-60 **in-lbs**	4-6.8 Nm	LOCTITE 243 (blue), page 7-64
Retainer plate fasteners	56 **in-lbs**	6.3 Nm	page 7-31
Rotor mounting fasteners	90-110 **in-lbs**	10-12 Nm	LOCTITE THREADLOCKER 243, page 7-31
Spark plugs	11-18 ft-lbs	15-24 Nm	page 7-1
Stator TORX mounting screws	30-40 **in-lbs**	3-4 Nm	T-27 TORX with retaining compound, replace with new after each removal, page 7-31
Tail lamp lens and tail light	6-7 **in-lbs**	0.7-0.8 Nm	page 7-45
Turn signal fastener (rear)	25-28 **in-lbs**	2.8-3.2 Nm	page 7-49
Turn signal fasteners (front)	25-28 **in-lbs**	2.8-3.2 Nm	page 7-49
Turn signal flasher fastener	30-40 **in-lbs**	3-4 Nm	page 7-50
Voltage regulator mounting screws	36-60 **in-lbs**	4.1-6.8 Nm	Use new fasteners, page 7-32

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 opening 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, 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, 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 asymmetrical 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.

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

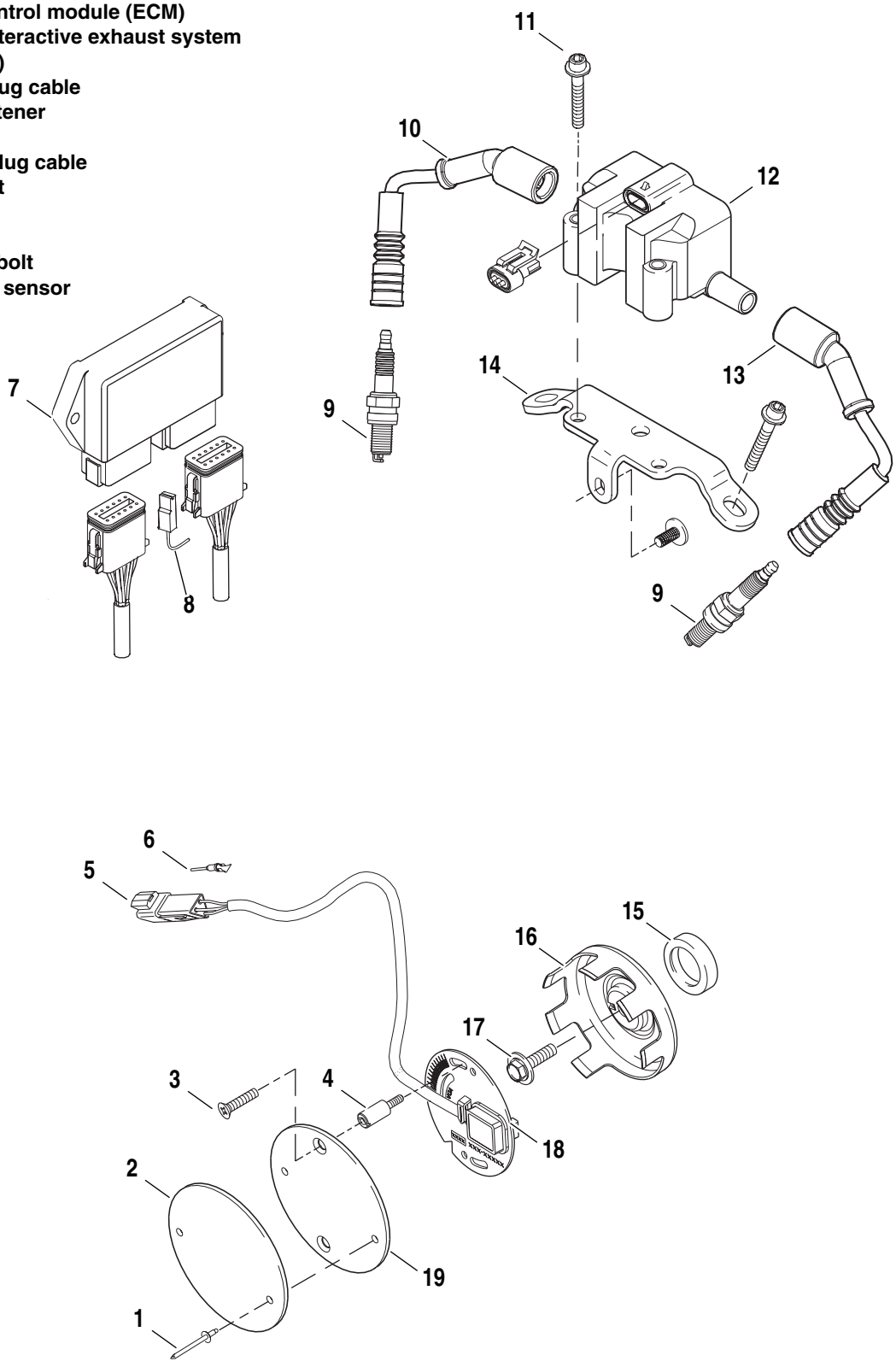


Figure 7-1. Ignition Components

IGNITION/HEADLIGHT KEY SWITCH 7.3

GENERAL

⚠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.

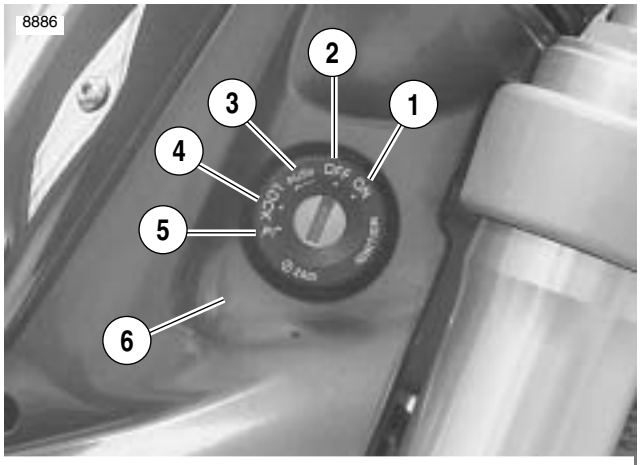
Switch positions are explained in Table 7-8.

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 counterclockwise 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.



1. **ON position**
2. **OFF position**
3. **PUSH DETENT**
4. **LOCK position**
5. **PARKING LIGHT position**
6. **Left headlamp module**

Figure 7-2. Ignition/Headlight Key Switch

Table 7-8. Ignition Key Switch Positions

LABEL	IGN.	LAMPS	REMOVE KEY
OFF	Off	Off	Yes
P	Off	See note & Table 7-9.	Yes
ON	On		No
LOCK	Off	Off	Yes

Table 7-9. Indicator Markers

ITEM	P	ON
Headlight position marker (European models only)	On	On
Headlight high beam	Off	Can be activated
Headlight low beam	Off	On
Instrument module illumination lamps	On	On
Stop lamp	Off	Can be activated
Front and rear turn signals	Can be activated	
Horn	Cannot be activated	Can be activated

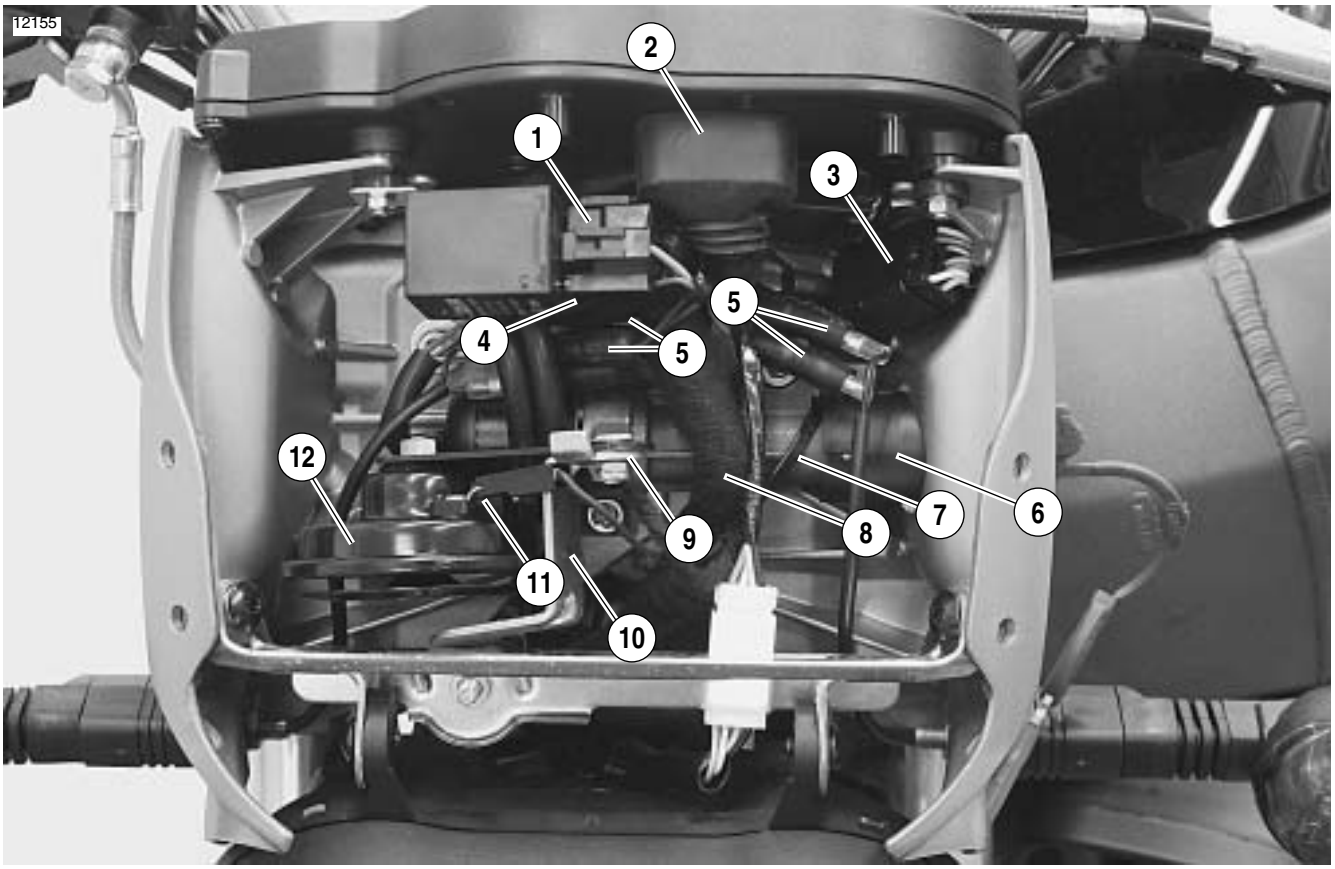
REMOVAL

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)

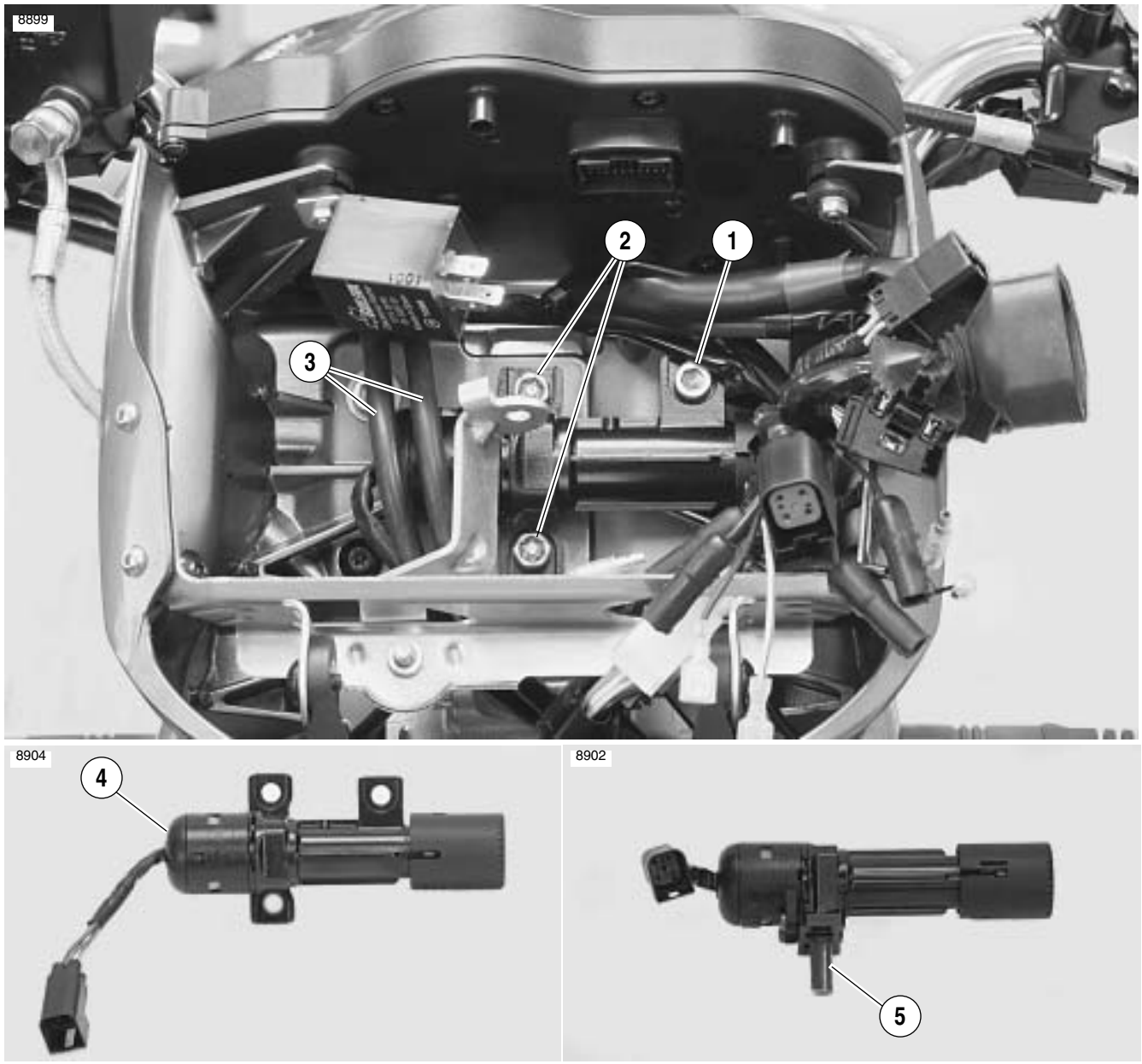
2. Disconnect negative battery cable.
3. Remove windscreen.
4. See Figure 7-3. Disconnect:
   - Turn signal flasher [30]
   - Turn signals [31]
   - Left [24] and right [22] handlebar wiring harnesses
   - Instrument cluster [39]
   - Horn [122]
5. Remove horn (12) from horn mount (10).
6. Cut cable strap (7) that loosely holds main wiring harness (8) to the ignition switch (6) and disconnect ignition switch connector [33].



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**

Figure 7-3. Electrical Connectors Behind Windscreen

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).



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)**

Figure 7-4. Ignition Switch (Typical)

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

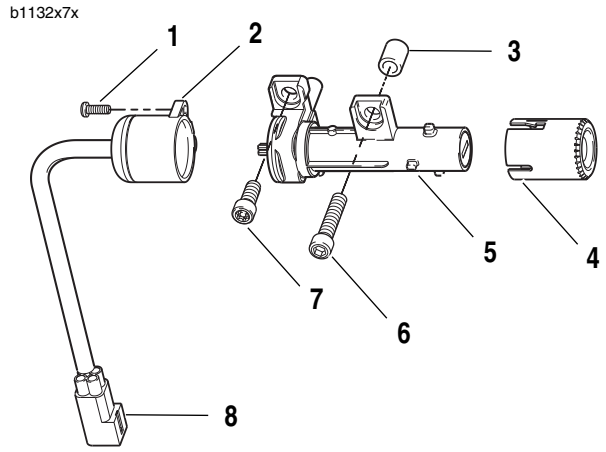
See Figure 7-5. In next step, be sure wide slot in ignition switch housing (4) is installed over wide boss on ignition switch (5).

1. Push ignition switch housing (4) on to ignition switch (5).

NOTE

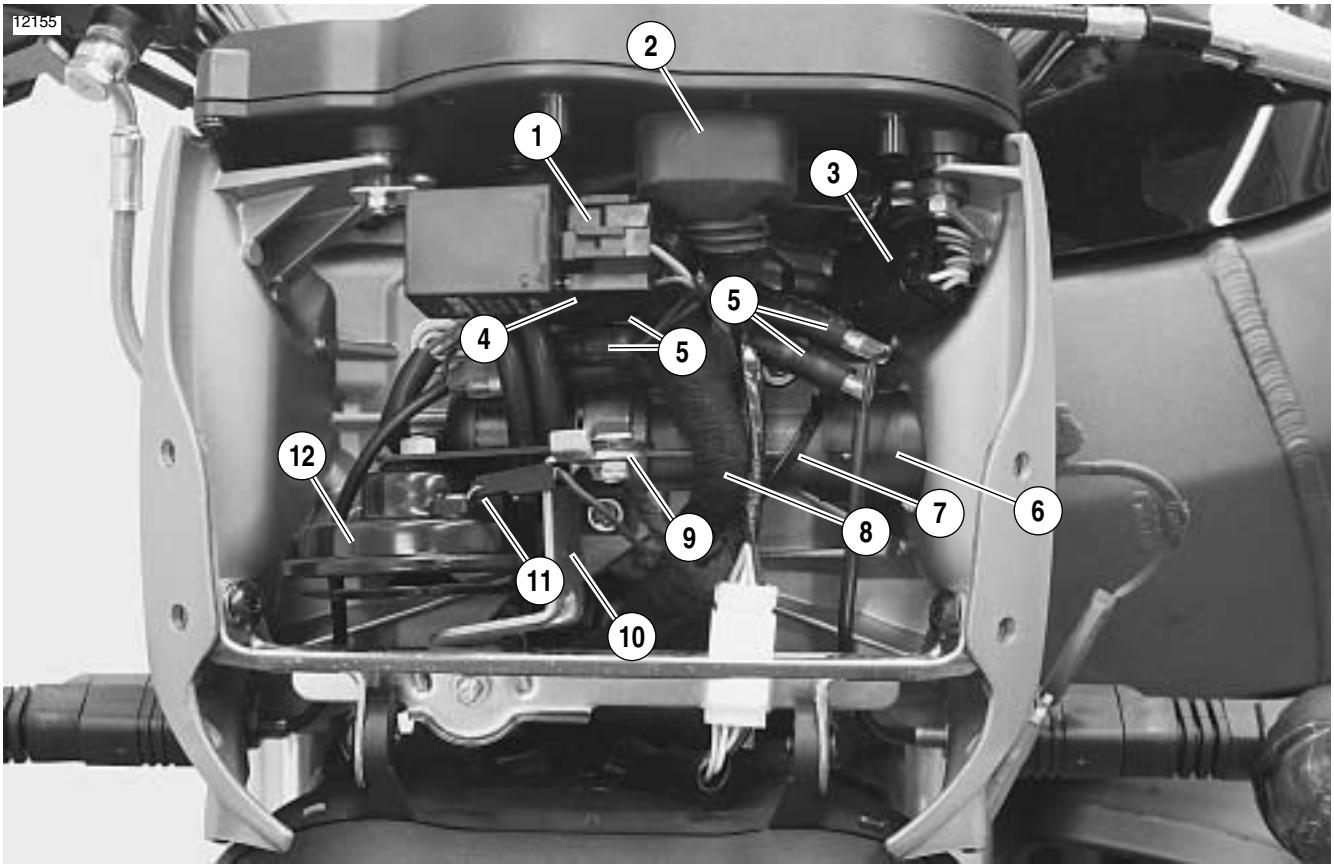
In next step, do not force ignition switch (5) into ignition switch body (2). If ignition switch does not easily slide into ignition switch body, rotate slot in ignition switch body with screwdriver until proper installation can be achieved.

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).



1. **Body fastener (2)**
2. **Body**
3. **Spacer**
4. **Housing**
5. **Ignition switch**
6. **Socket head fastener**
7. **Tamper-resistant Torx fasteners (2)**
8. **Ignition switch connector [33]**

Figure 7-5. Ignition Switch Assembly



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**

Figure 7-6. Electrical Connectors Behind Windscreen

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. (00068a)

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 windscreen and tighten fasteners to 10-12 **in-lbs** (1.1-1.4 Nm).

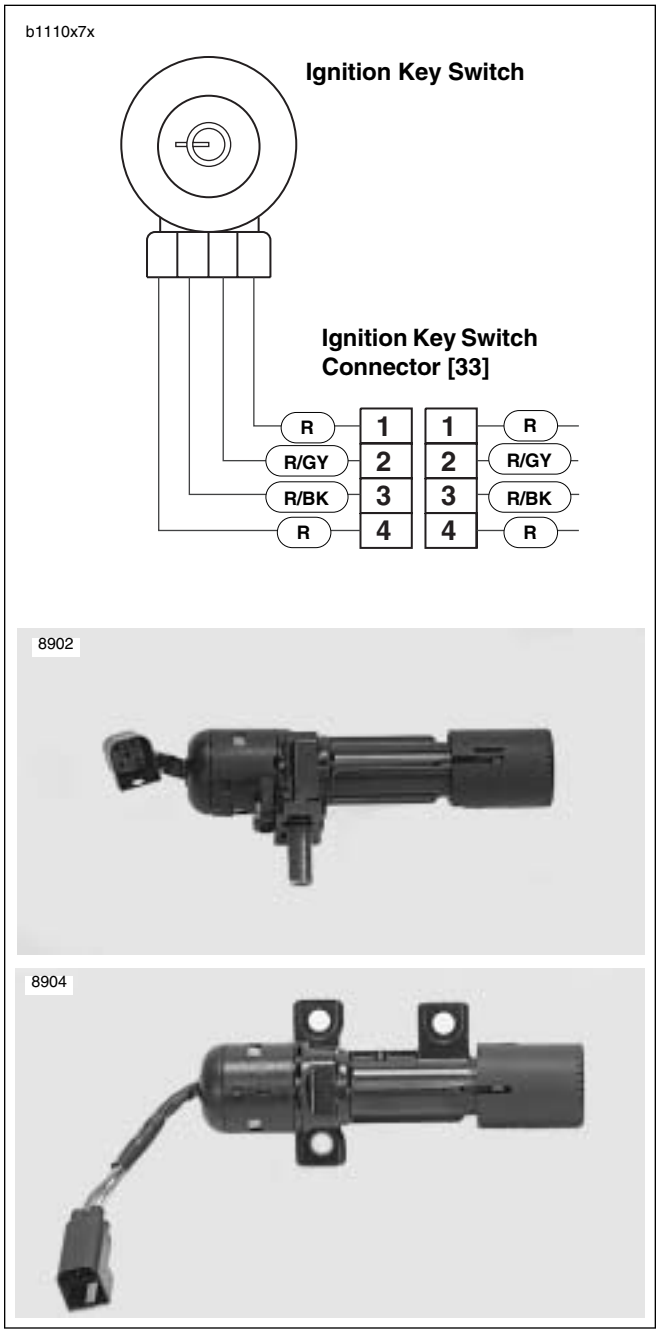


Figure 7-7. Ignition Key Switch Wiring

SPARK PLUG CABLES 7.4

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

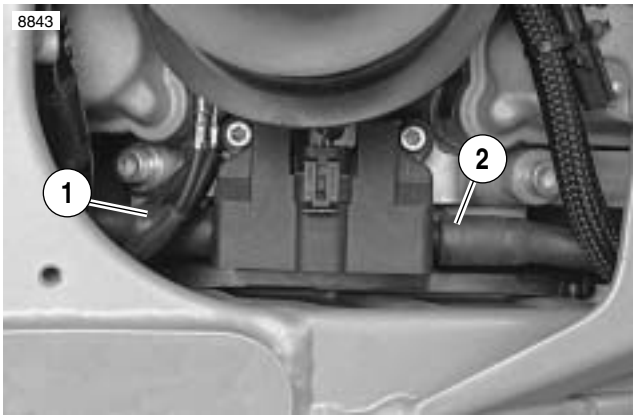
⚠WARNING

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.



1. **Front spark plug cable**
2. **Rear spark plug cable**

Figure 7-8. Spark Plug Cable Location

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

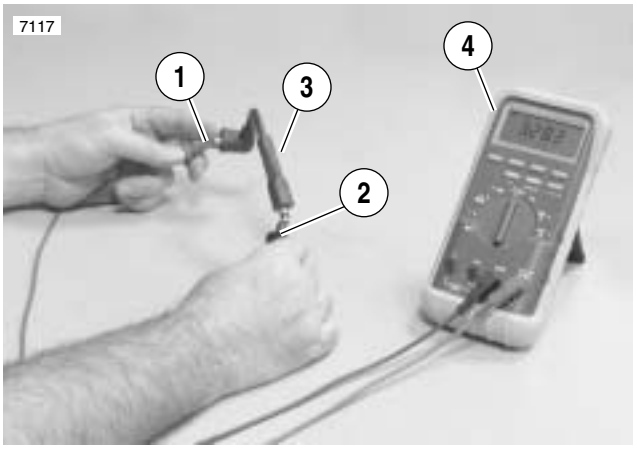
SPECIFICATION	FRONT & REAR
Length - in. (mm)	5.70 ± 0.25 (145)
Resistance - Ohms	1,350-3,465

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.



1. **Ohmmeter positive lead**
2. **Ohmmeter negative lead**
3. **Spark plug cable (typical)**
4. **Ohmmeter**

Figure 7-9. Testing Resistance

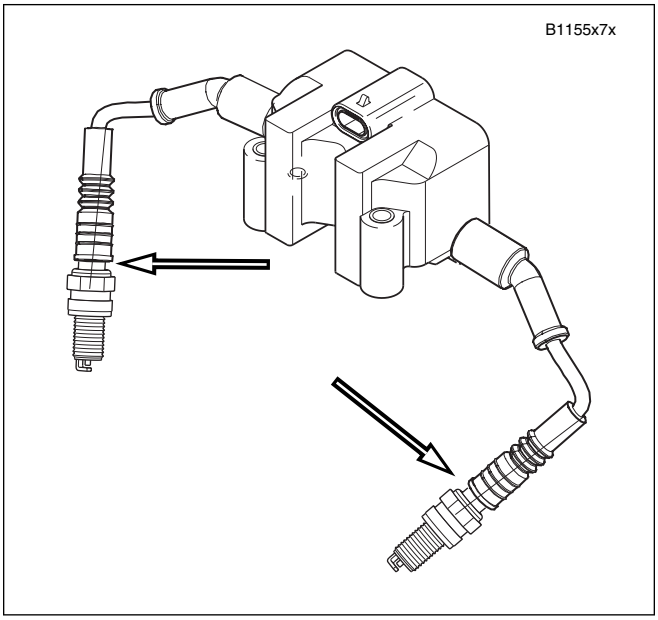


Figure 7-10. Boot Gap Should Not exceed 1/8 in. (3.2 mm)

STARTER INTERLOCK 7.5

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

PROBLEM	CHECK FOR	CORRECTION
Electric starter will not crank.	Battery problems.	See 7.11 BATTERY.
	Inappropriate gear selected.	Place vehicle in neutral.
	Clutch lever not disengaged.	Pull in clutch lever.
	Starter relay problems.	Listen for starter relay “click”. If click is not heard, perform starter relay tests.
		Follow starter troubleshooting in Section 5.

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.

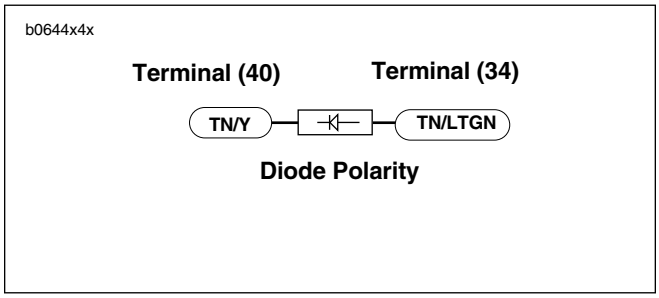


Figure 7-11. Diode Polarity

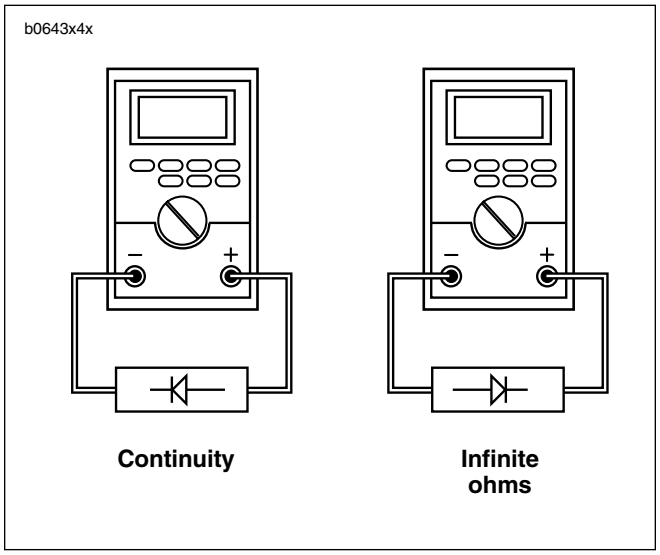


Figure 7-12. Ohmmeter Diode Test

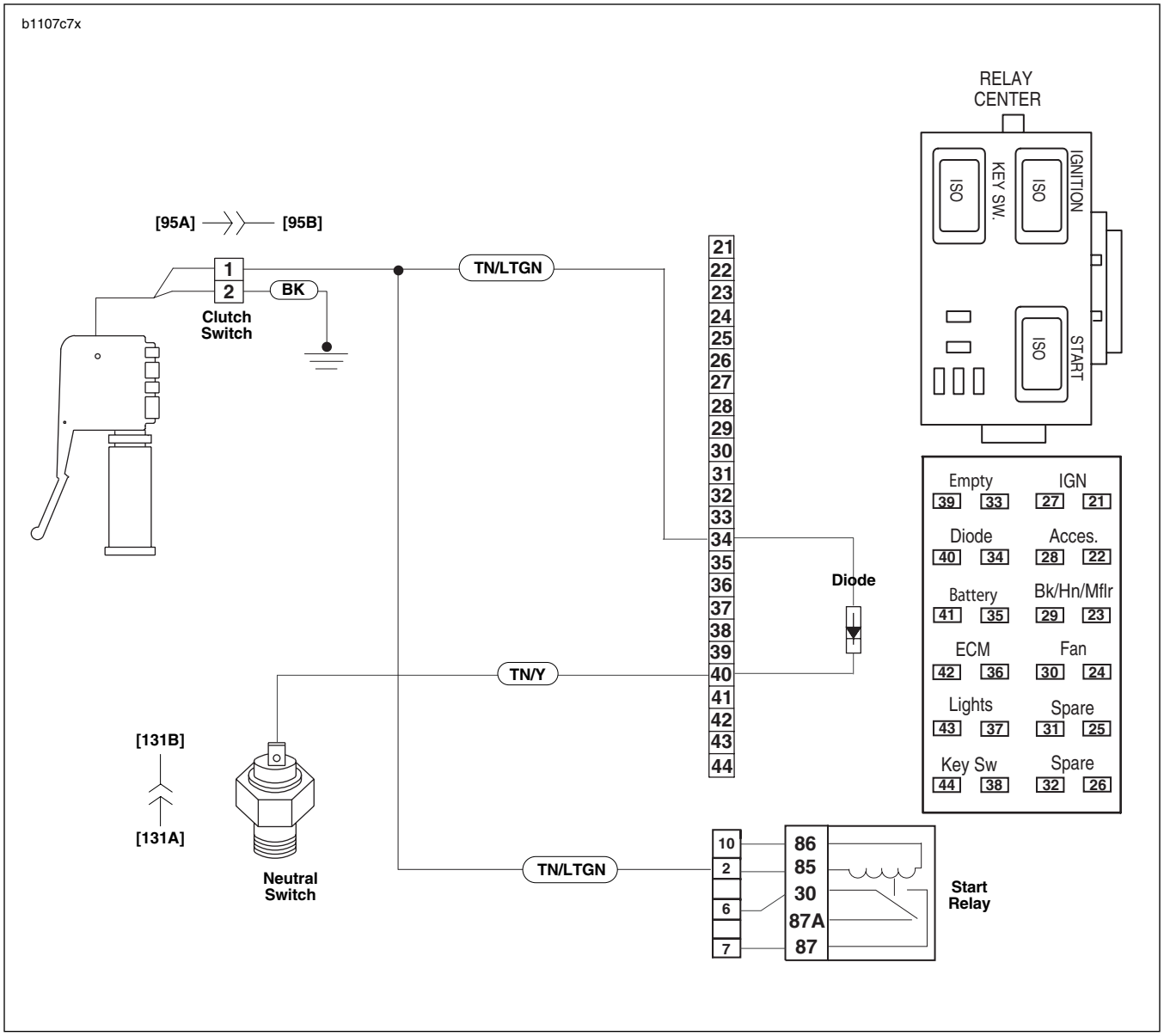
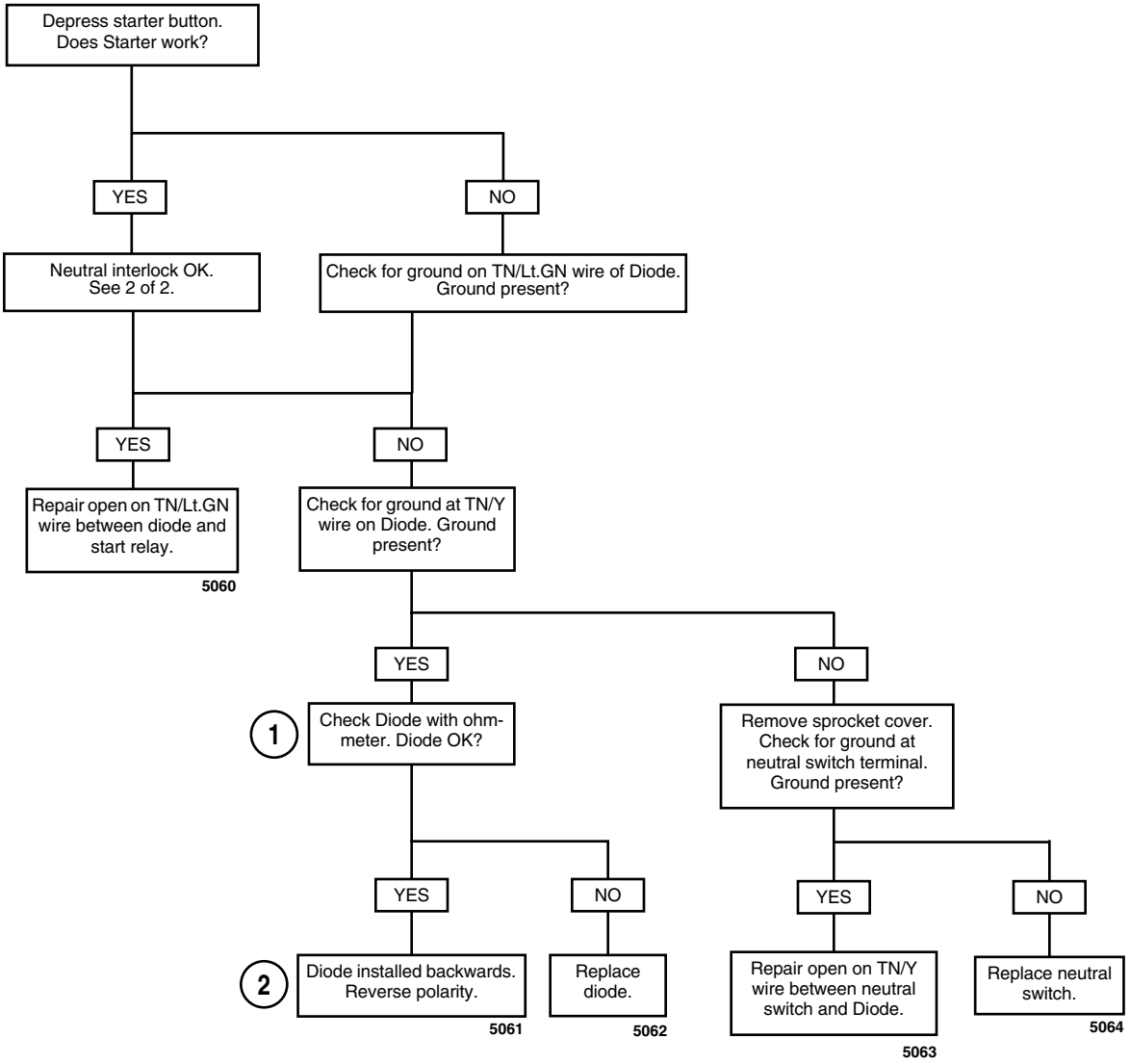


Figure 7-13. Diode Wiring

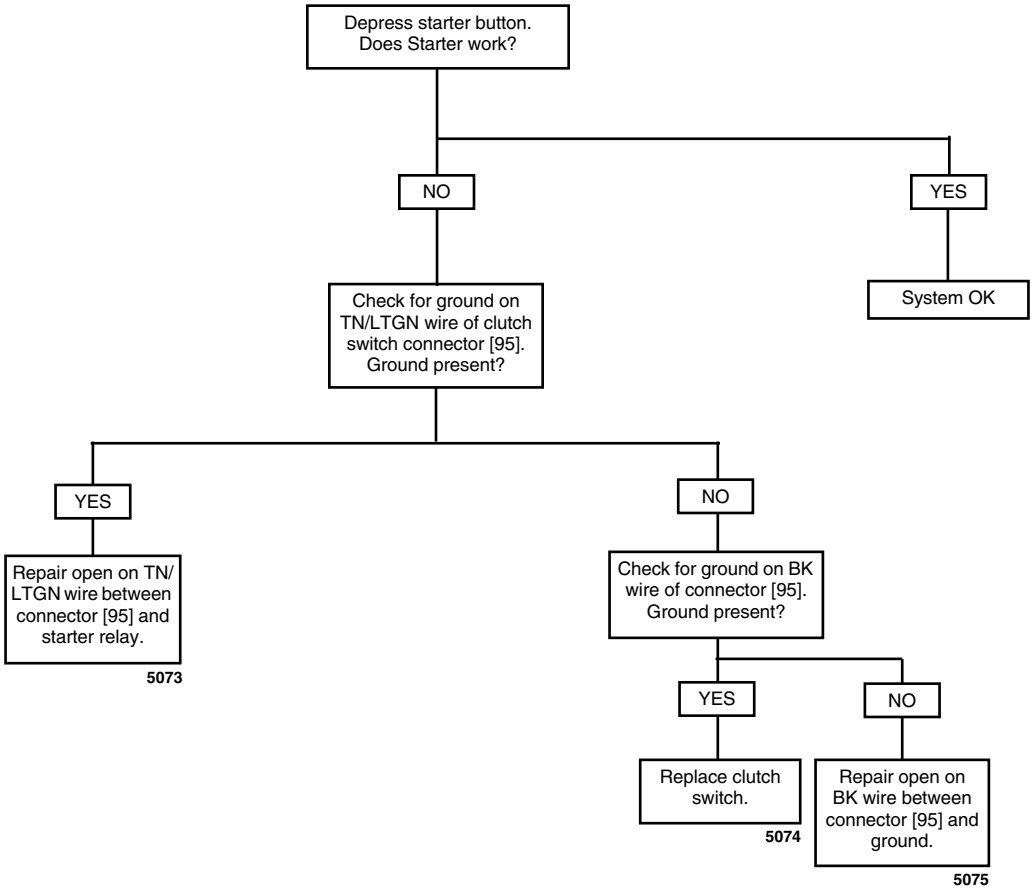
Starter Test (Part 1 of 2)

CONDITION: Key ON, transmission in neutral and clutch engaged



Starter Test (Part 2 of 2)

CONDITION: Key ON, transmission in gear and clutch disengaged

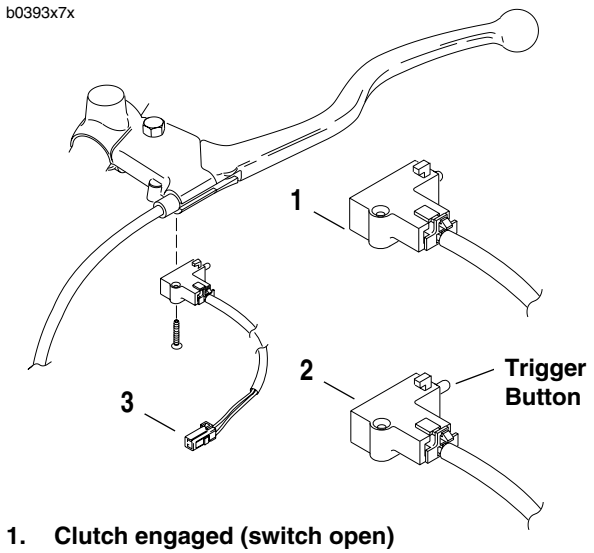


TESTING/REPLACEMENT

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 ∞ 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).



1. Clutch engaged (switch open)
2. Clutch disengaged (switch closed)
3. Connector [95]

Figure 7-14. Clutch Switch

Ignition Relay

The ignition relay is located under the seat. Test the relay as follows:

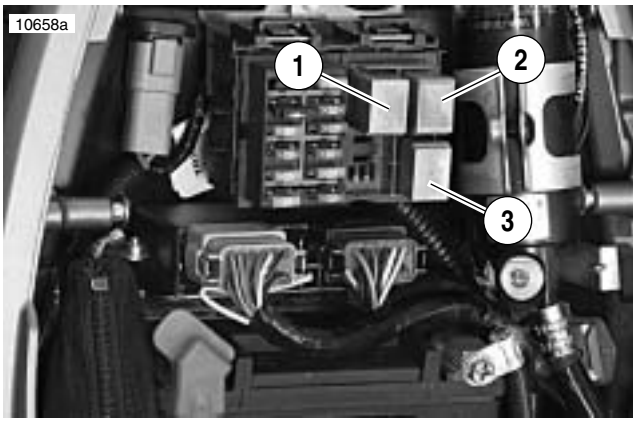
1. See Figure 7-15. Locate ignition relay (2) within relay block.
2. To test relay, proceed to Step 3. If installing a **new** starter relay, remove old relay. Install **new** relay into relay block.
3. See Figure 7-17. Obtain a 12 volt battery and a continuity tester or ohmmeter.
   a. Pull relay from 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.



1. **Key switch relay**
2. **Ignition relay**
3. **Start relay**

Figure 7-15. Relay Block



Figure 7-16. Relay Block (XB12Ss)

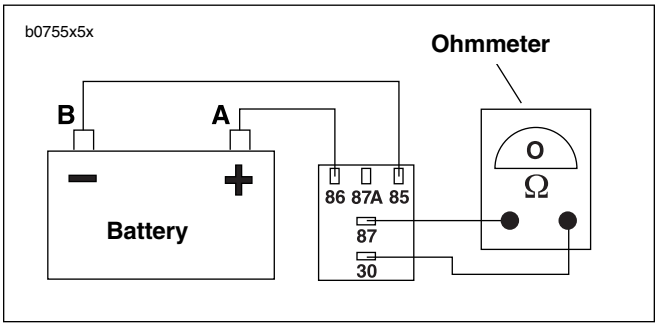


Figure 7-17. Starter Relay Test

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)

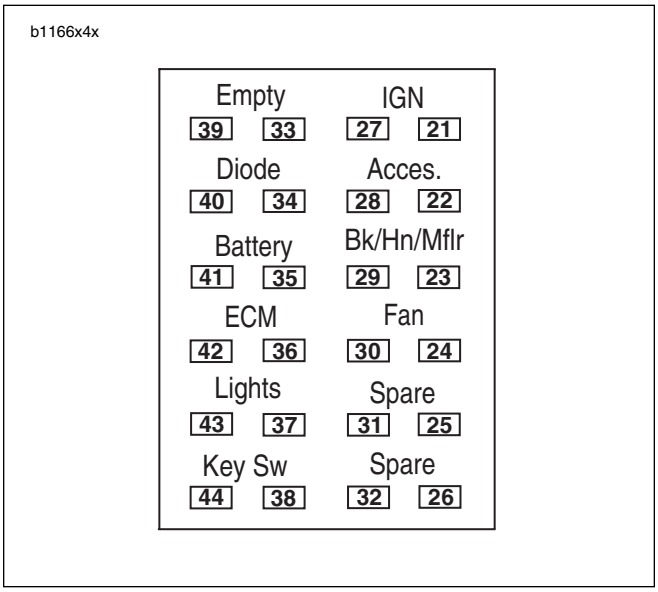


Figure 7-20. Fuse Blocks

INTERACTIVE EXHAUST SYSTEM (XB12 MODELS) 7.6

GENERAL

NOTE

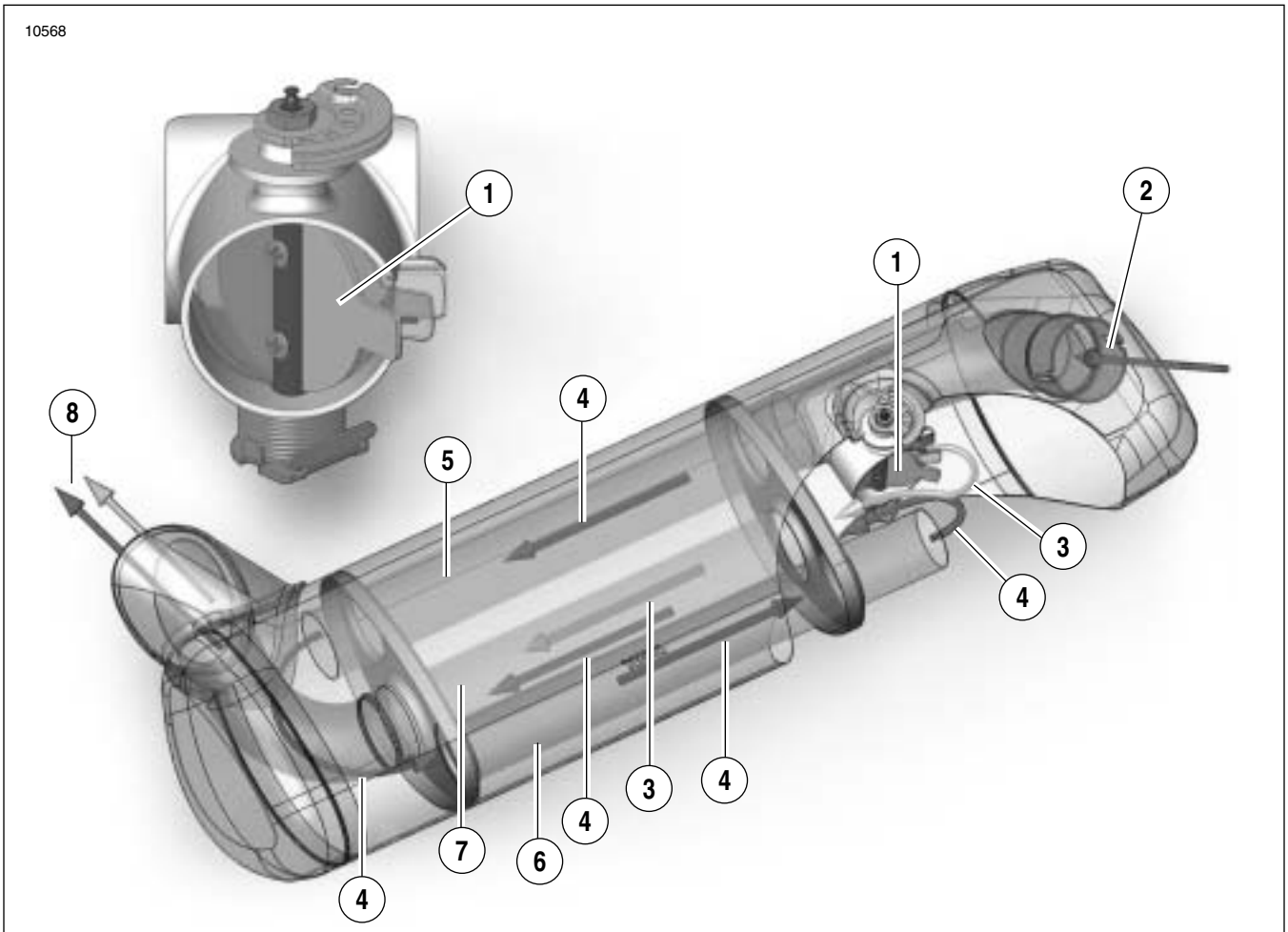
The interactive exhaust system is standard equipment on the XB12 models only.

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.

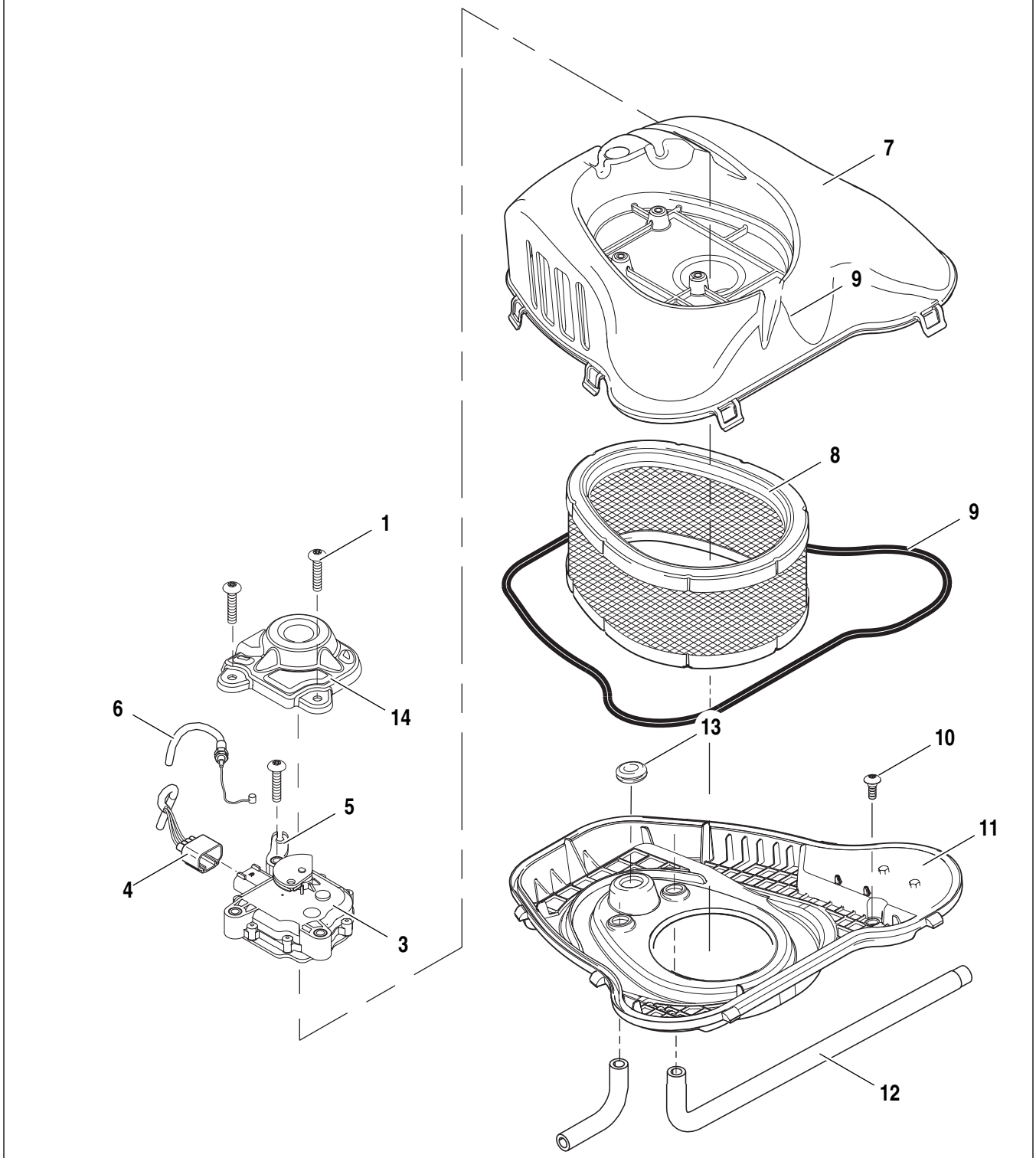
For example:

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).



1. **Butterfly valve**
2. **Exhaust in**
3. **Valve open (exhaust flow - chamber C)**
4. **Valve closed (exhaust flow - chamber A to B to C)**
5. **Chamber A**
6. **Chamber B**
7. **Chamber C**
8. **Exhaust exit**

Figure 7-21. Interactive Exhaust System Muffler



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)

Figure 7-22. Air Cleaner Assembly (XB12 Models) with Interactive Exhaust Components

REMOVAL

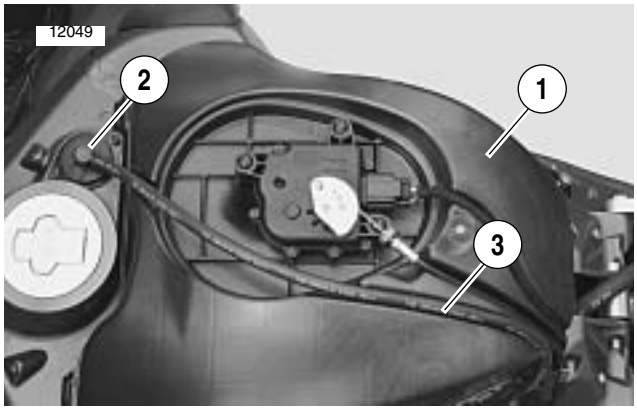
1. Remove seat. See 2.43 SEAT.

⚠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.

[



1. **Air cleaner assembly cover**
2. **Fuel vent tube**
3. **Fuel cell vent**

Figure 7-23. Air Cleaner Cover, Fuel Vent Tube and Fuel Vapor Valve (XB12 solid color models)

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.

INSTALLATION

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.



Figure 7-24. Interactive Exhaust Cable Behind Wire Harness Strap and Guide

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.

⚠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)

9. Install 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)

10. Install seat. See 2.43 SEAT.

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).

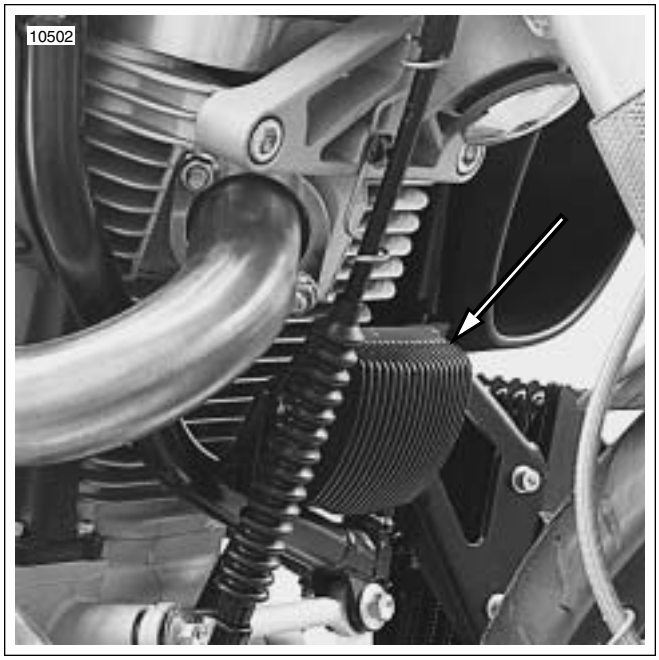


Figure 7-25. Voltage Regulator

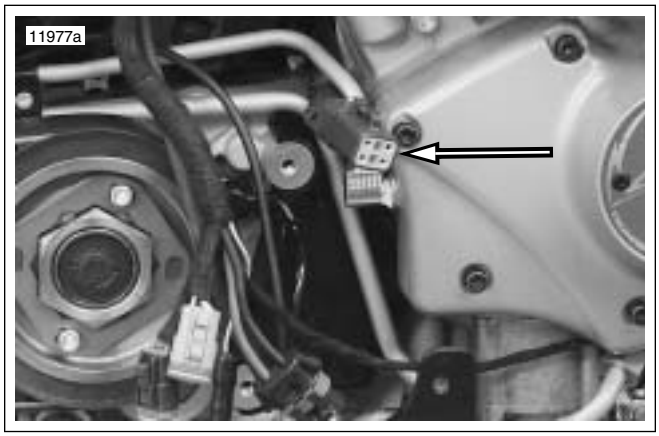


Figure 7-26. Stator Connector [46]

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

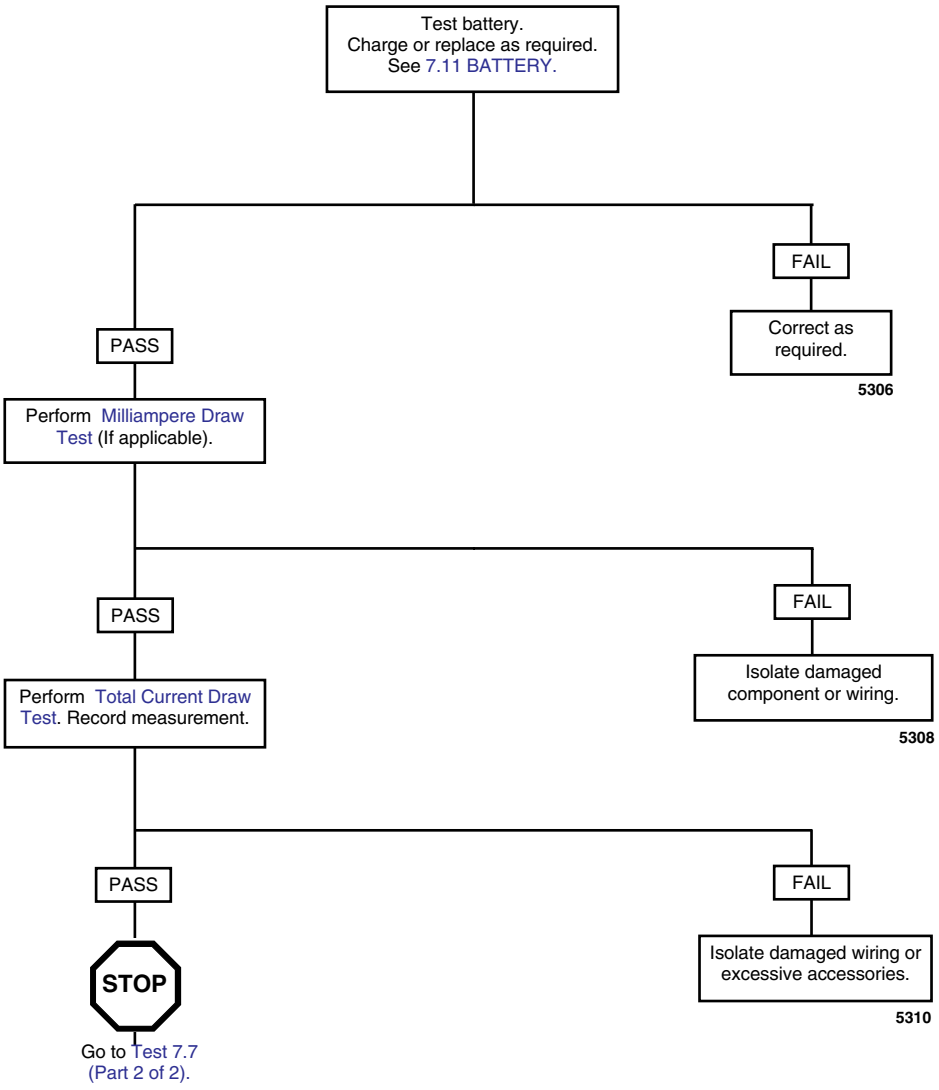
Check for corroded or loose connections in the charging circuit. See Figure 7-27.

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

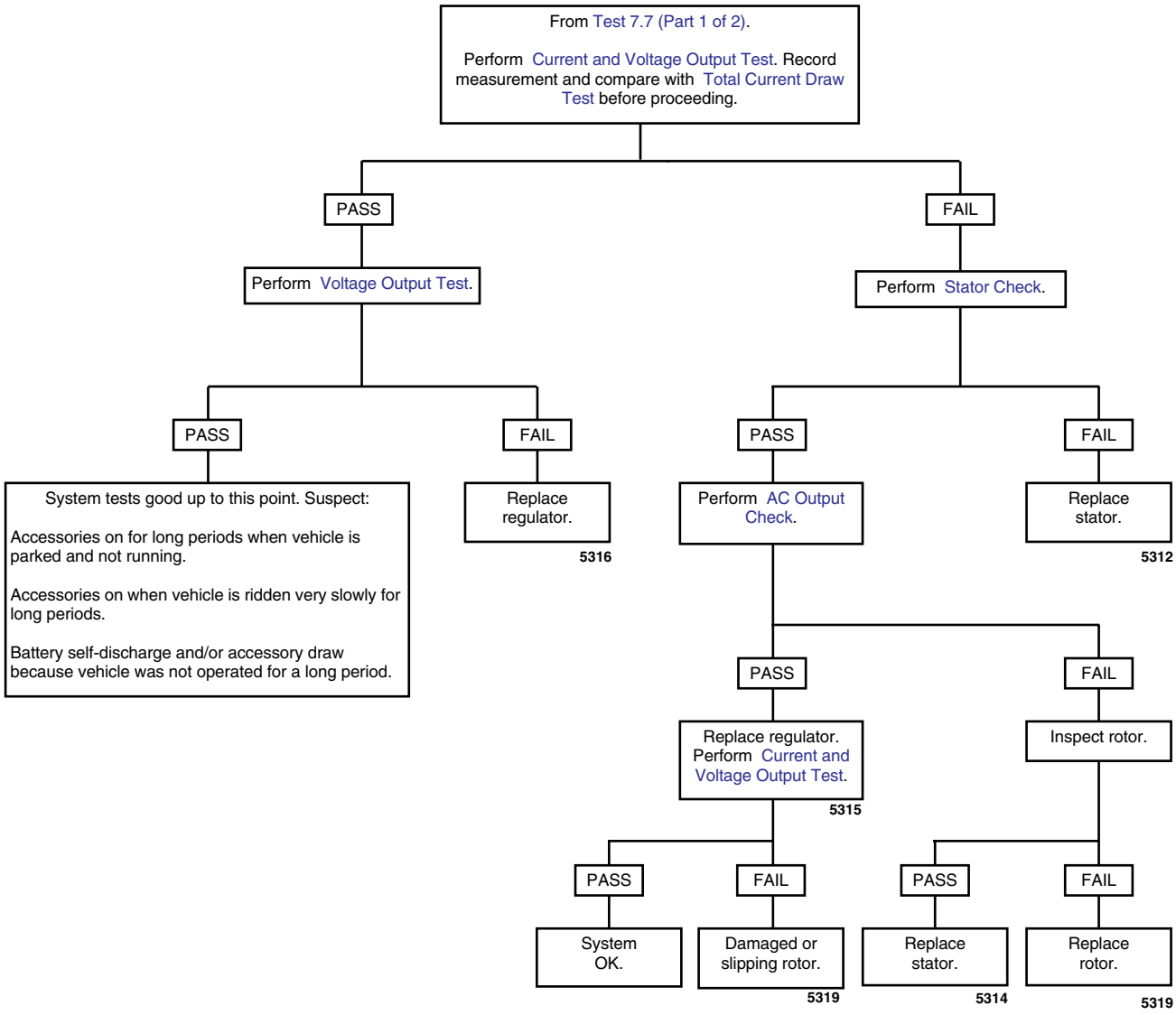


NOTE

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



NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

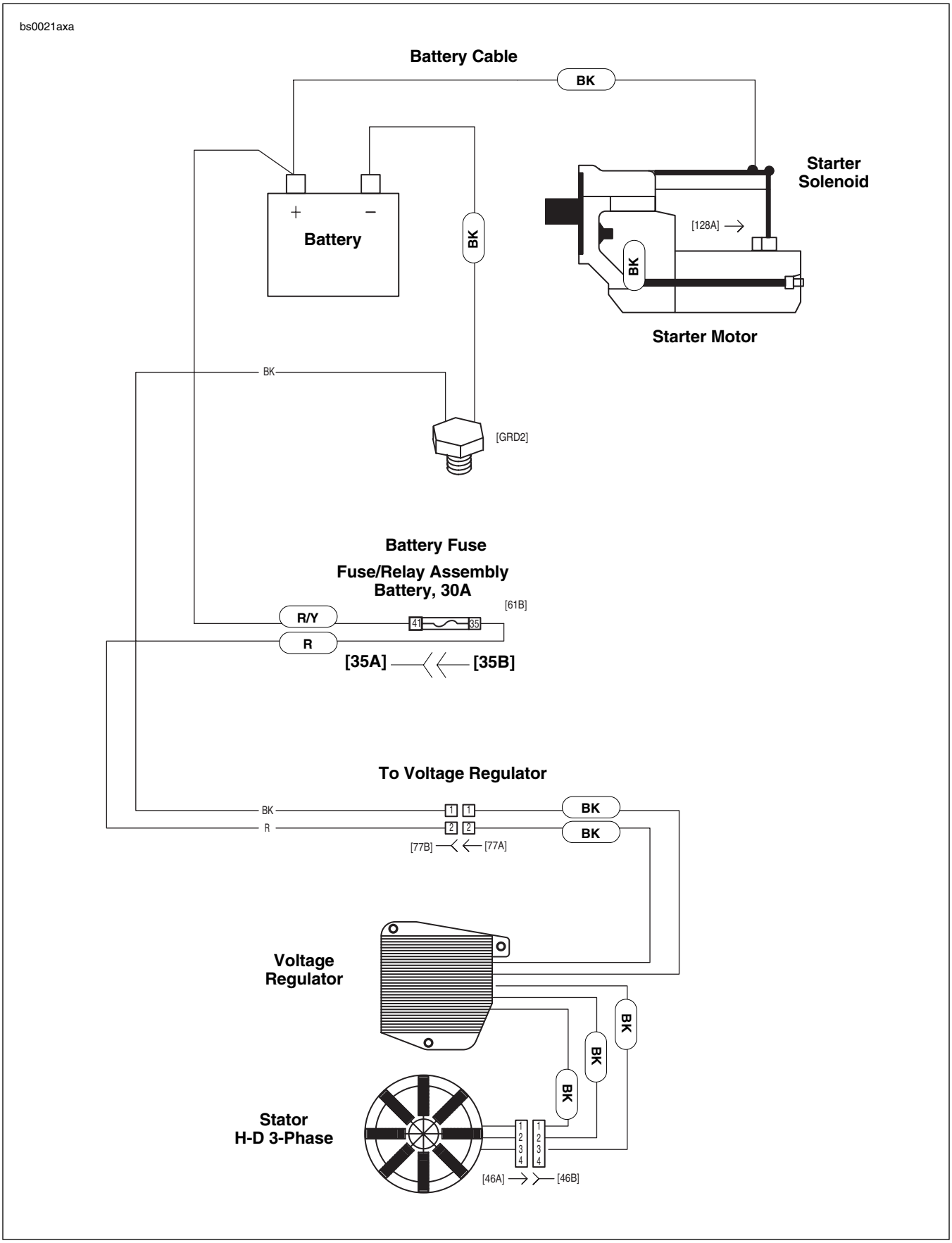


Figure 7-27. Charging System Circuit

TESTING

Milliampere Draw Test

NOTE

Be sure accessories are not wired so they stay on at all times. This condition could drain battery completely if vehicle is parked for a long time. Check for this by connecting ammeter between negative battery terminal and battery.

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.

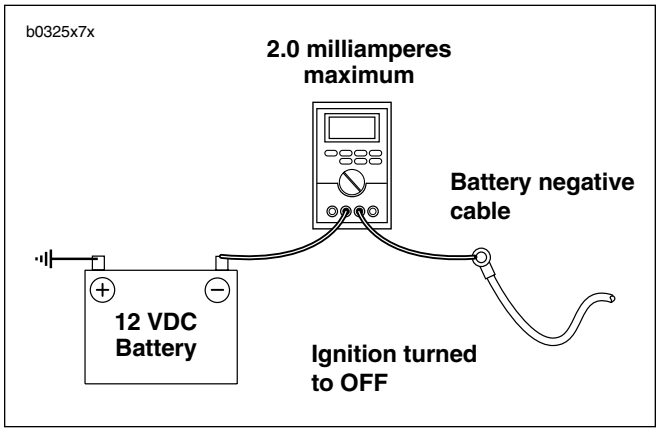


Figure 7-28. Milliampere Draw Test

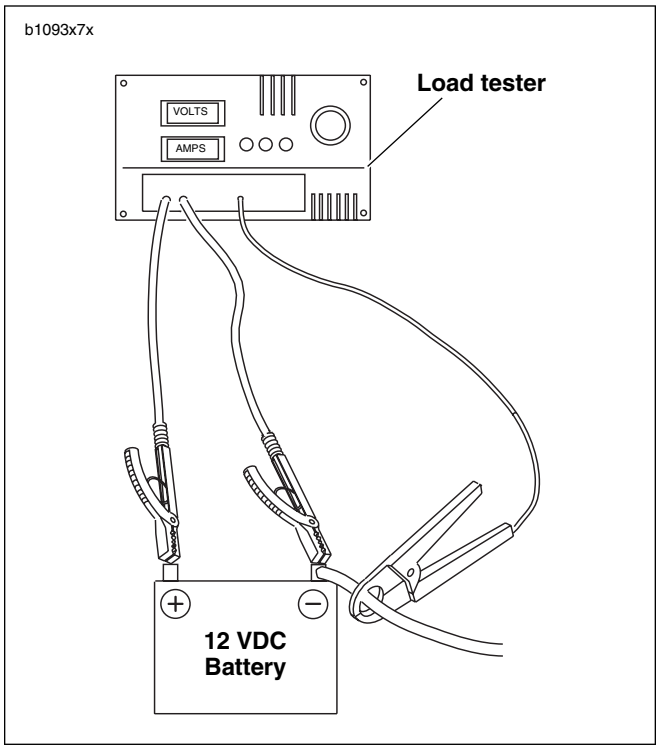


Figure 7-29. Check Current Draw (Ignition Switch On)

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.
   a. Locate voltage regulator connector [46] under sprocket cover. See 7.26 SPROCKET COVER WIRING. Disconnect from alternator stator wiring.
   b. Insert one ohmmeter lead into a stator socket.
   c. Attach the other lead to a suitable ground.
3. Test for continuity with ohmmeter set on the RX1 scale.
   a. A good stator will show no continuity (∞ ohms) across **all** stator sockets 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.

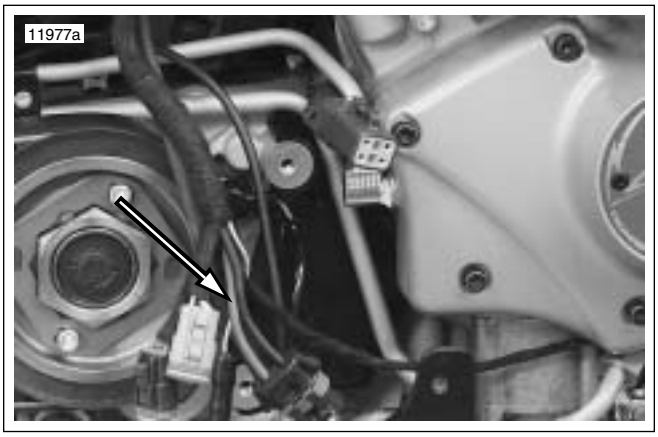


Figure 7-30. Positive Regulator Cable (red wire)

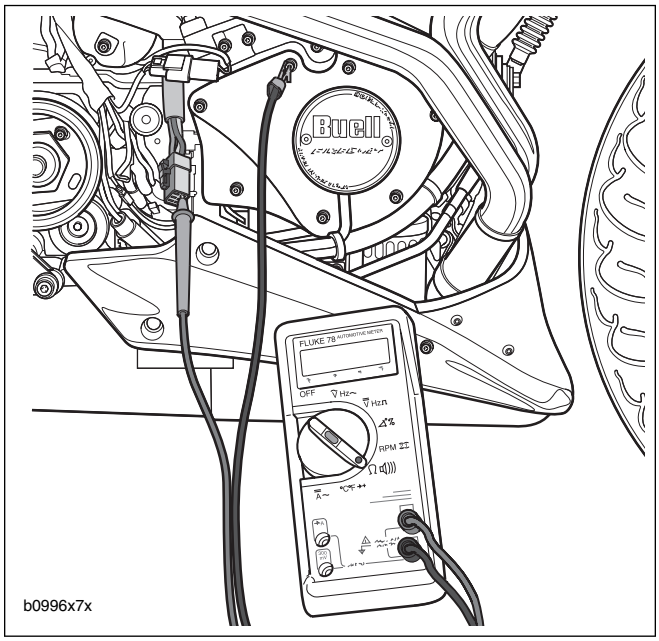


Figure 7-31. Test for Grounded Stator

AC Output Check

1. See Figure 7-33. Test AC output.
   a. Locate voltage regulator connector [46] under sprocket cover. See 7.26 SPROCKET COVER WIRING. Disconnect from alternator stator wiring.
   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.

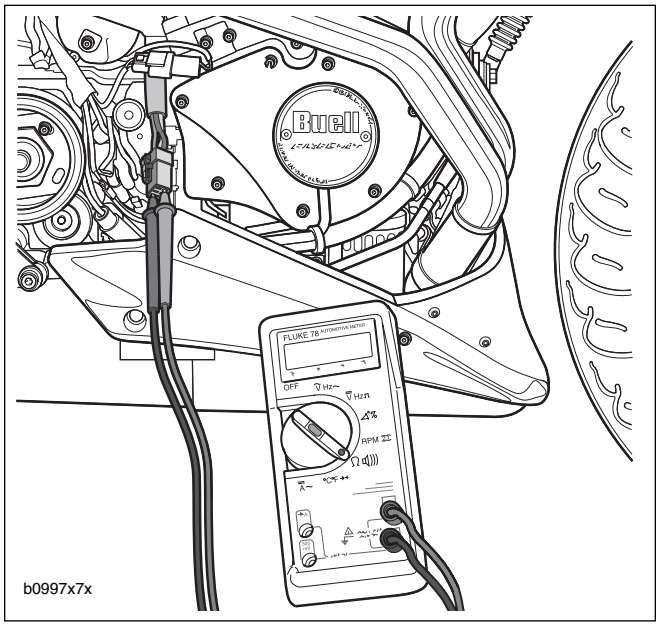


Figure 7-32. Check for Stator Resistance

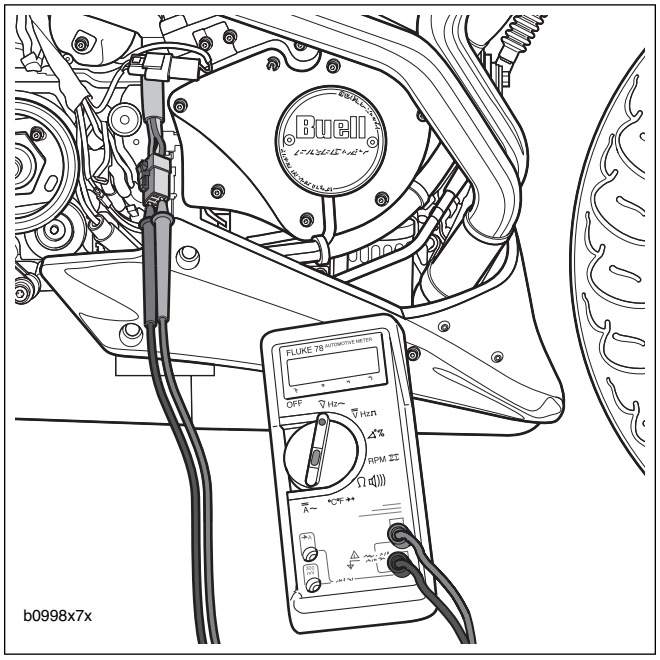


Figure 7-33. Check Stator AC Voltage Output

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.

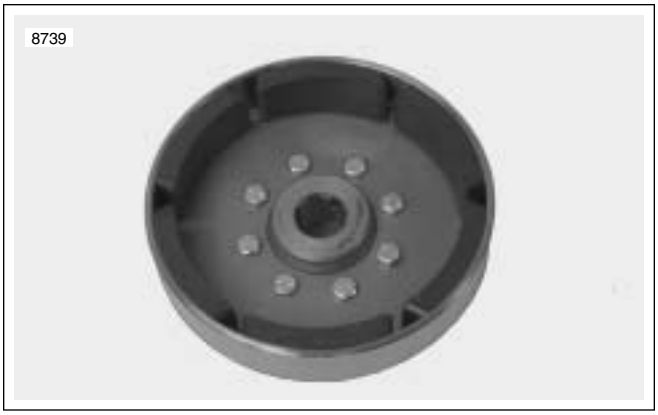
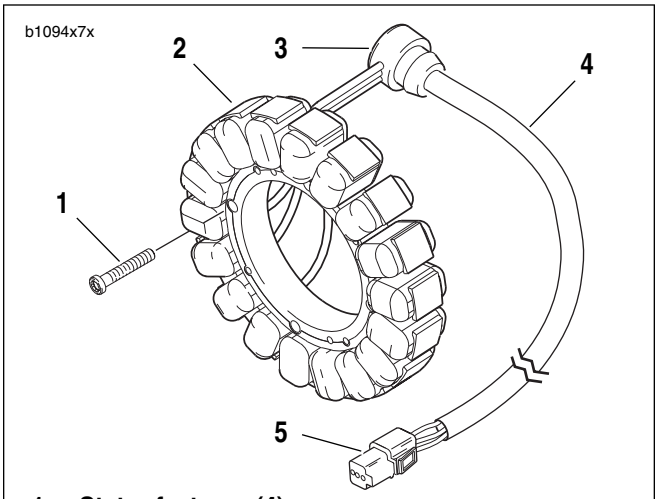


Figure 7-34. Rotor Assembly



Figure 7-35. Removing Rotor From Sprocket



1. **Stator fastener (4)**
2. **Stator**
3. **Grommet**
4. **Stator wiring**
5. **Connector [46]**

Figure 7-36. Stator Assembly

CLEANING AND INSPECTION

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

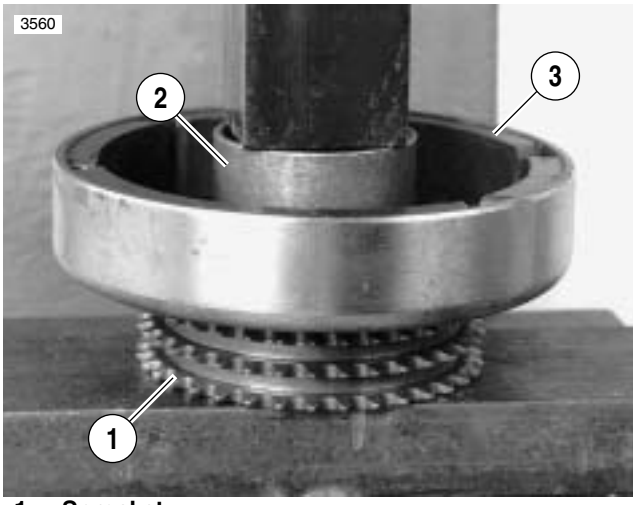
Depending on whether the rotor, the stator, or both the rotor and stator were removed/disassembled, perform the applicable procedures which follow:

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.



1. **Sprocket**
2. **Pipe section**
3. **Rotor**

Figure 7-37. Pressing Rotor onto Sprocket

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.

VOLTAGE REGULATOR 7.9

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.

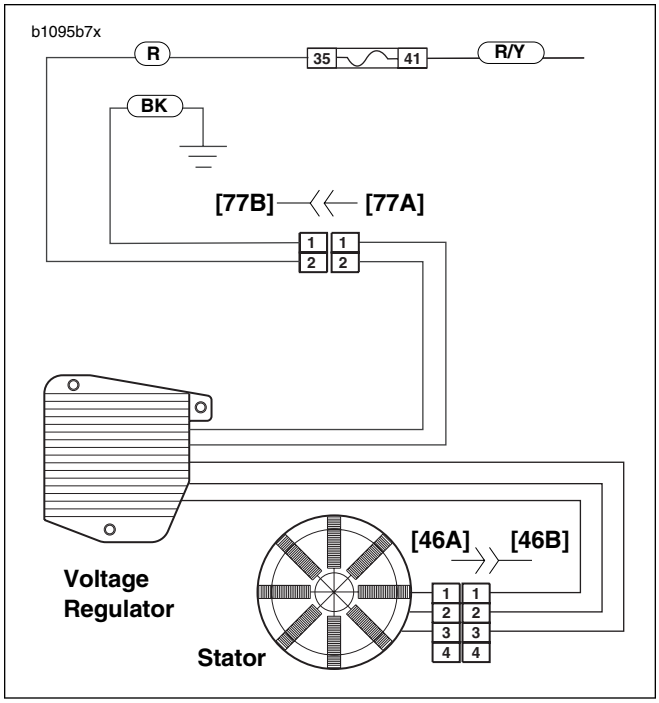
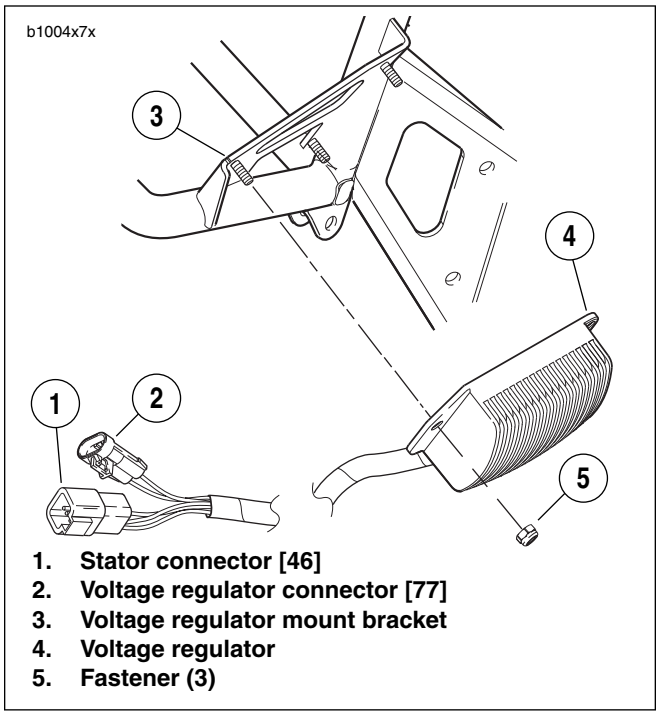


Figure 7-38. Voltage Regulator Connector [77]



1. **Stator connector [46]**
2. **Voltage regulator connector [77]**
3. **Voltage regulator mount bracket**
4. **Voltage regulator**
5. **Fastener (3)**

Figure 7-39. Voltage Regulator

BATTERY CABLES 7.10

REMOVAL

WARNING

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

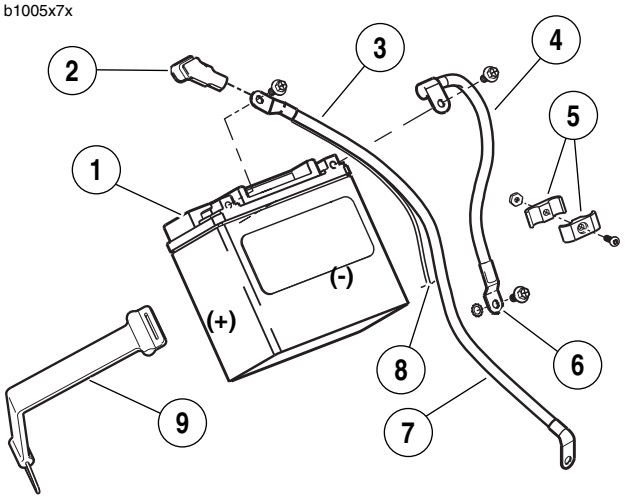
WARNING

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.



1. **Battery**
2. **Battery boot**
3. **Positive cable**
4. **Negative cable**
5. **Cable separator (not used on XB12Ss)**
6. **To frame**
7. **To starter**
8. **Red/Yellow wire (14 gauge, to be spliced)**
9. **Battery strap**

Figure 7-40. Battery

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)



Figure 7-41. Negative Battery Cable (XB12Ss)

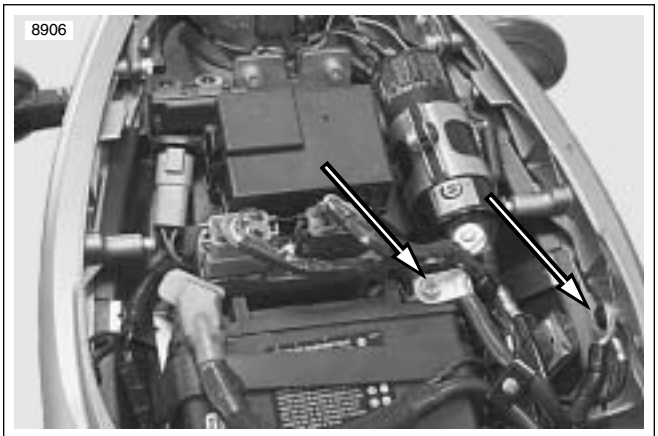
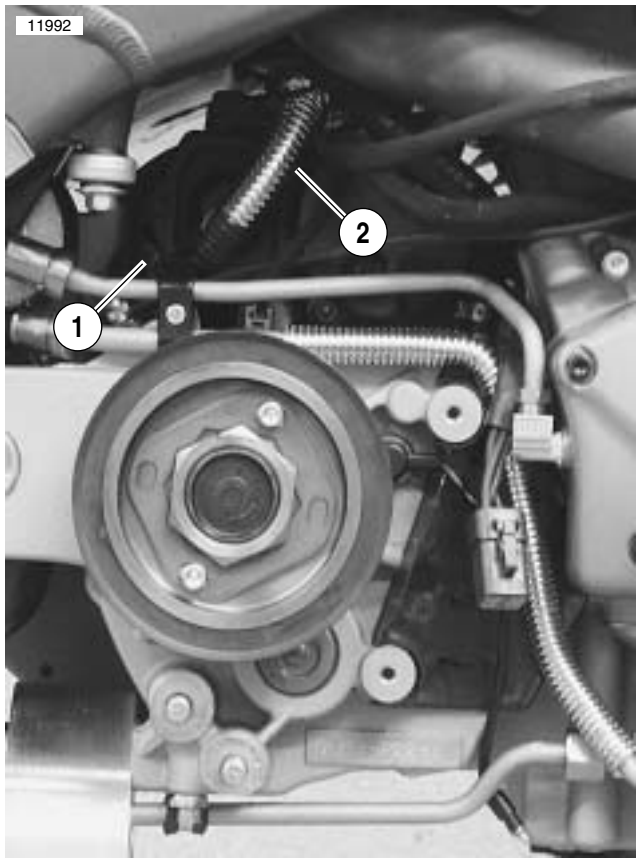


Figure 7-42. Negative Battery Cable

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).



1. **Protective boot, positive battery cable**
2. **Positive battery cable**

Figure 7-43. Positive Battery Cable

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)

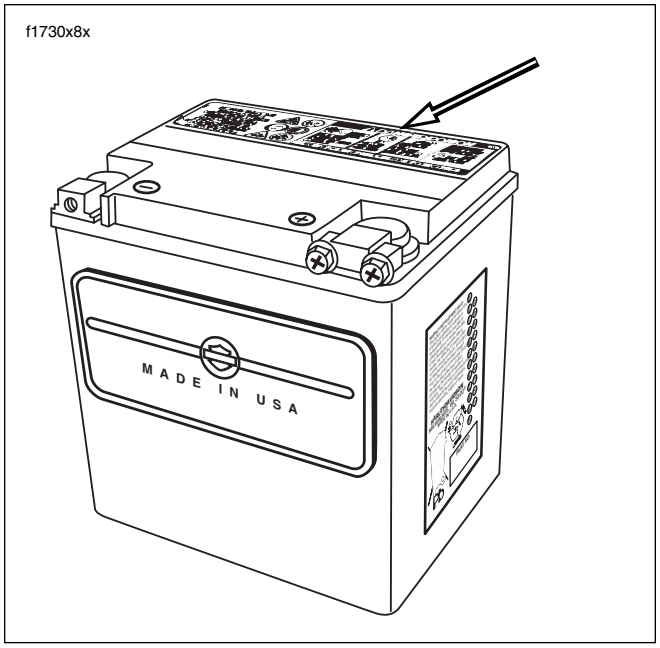


Figure 7-44. Battery Warning Label Location

Table 7-12. Battery Electrolyte Antidotes

CONTACT	SOLUTION
External	Flush with water.
Internal	Drink large quantities of milk or water, followed by milk of magnesia, vegetable oil or beaten eggs. Call doctor immediately.
Eyes	Flush with water, get immediate medical attention.



Figure 7-45. Battery Warning Label

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

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

CONDUCTANCE TEST

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

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

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

See Figure 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.

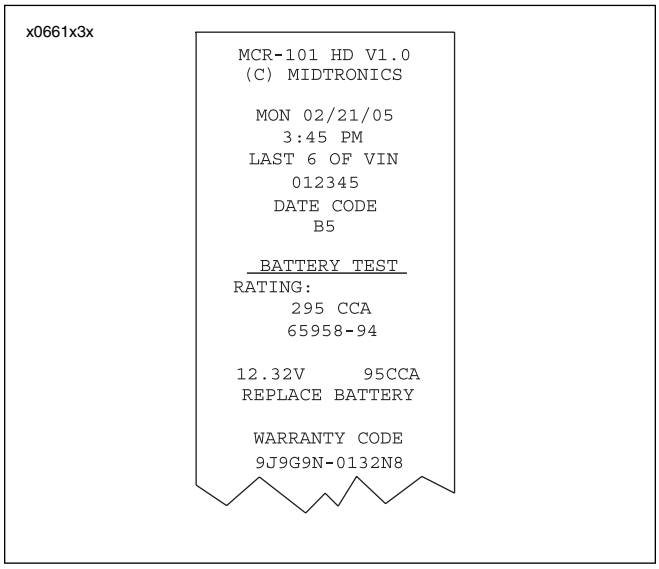


Figure 7-46. Battery Test Results–Printout

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. (00252a)

3. Connect tester leads to battery posts and place induction pickup over negative (black) cable. See Figure 7-47.

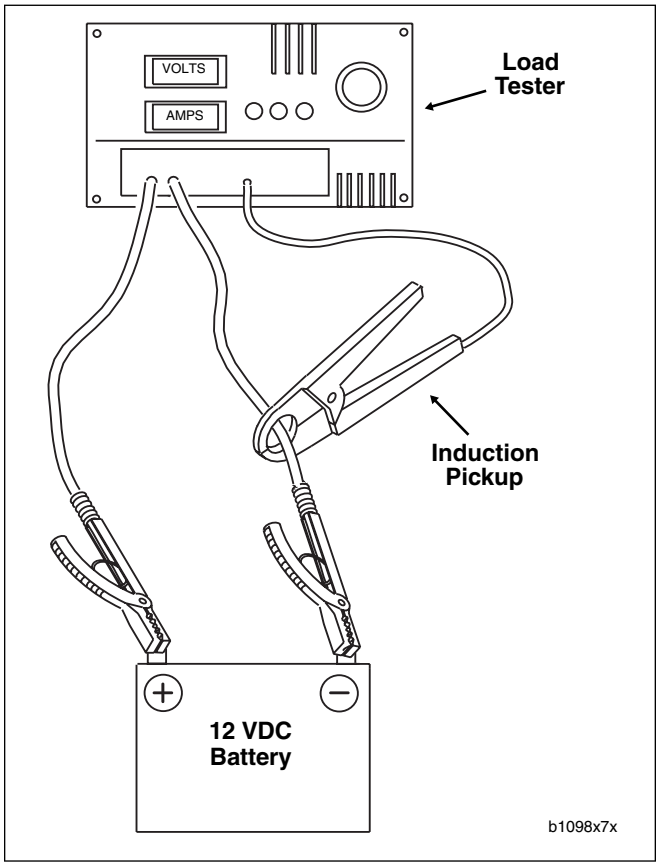


Figure 7-47. Load Test

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).

Table 7-14. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
Buell Lightning	200	100

⚠WARNING

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

5. Install the battery on the motorcycle. See BATTERY INSTALLATION AND CONNECTION.

DISCONNECTION AND 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)

⚠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. 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.

⚠WARNING

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

NOTE

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

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)

Battery Amp-Hour	State of Charge		3 Amp Charger	6 Amp Charger	10 Amp Charger	20 Amp Charger
	Voltage Reading	% of Charge				
12	12.7 V	100%	-	-	-	-
	12.6 V	75%	1 hour, 10 minutes	34 minutes	20 minutes	10 minutes
	12.3 V	50%	2 hours, 20 minutes	1 hour, 10 minutes	40 minutes	20 minutes
	12.0 V	25%	3 hours, 20 minutes	1 hour, 40 minutes	1 hour	30 minutes
	11.8 V	0%	4 hours, 30 minutes	2 hours, 14 minutes	1 hour, 20 minutes	40 minutes

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.

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 over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

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.



Figure 7-48. Negative Battery Cable (XB12Ss)



Figure 7-49. Negative Battery Cable

5. Install battery strap.

⚠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.

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 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.

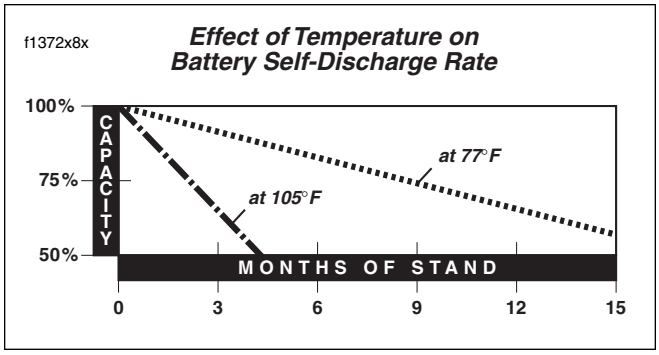


Figure 7-50. Battery Self-Discharge Rate

HEADLIGHT 7.12

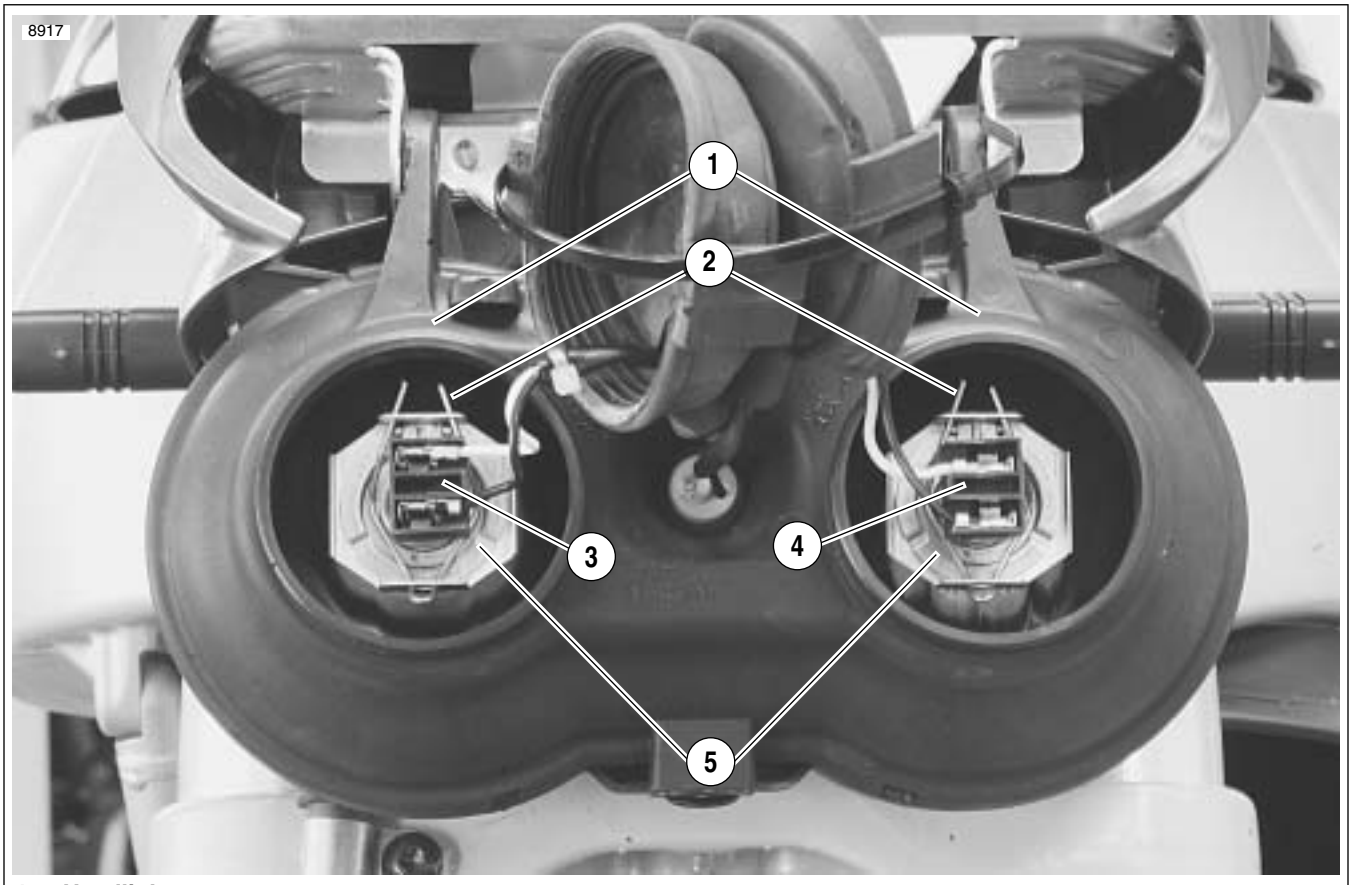
GENERAL

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.
- For information on headlight housing and bracket disassembly/assembly see 2.27 HEADLIGHT ASSEMBLY AND SUPPORT BRACKET.

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.



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**

Figure 7-51. Headlight Assembly/Rear View

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.

⚠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)

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.

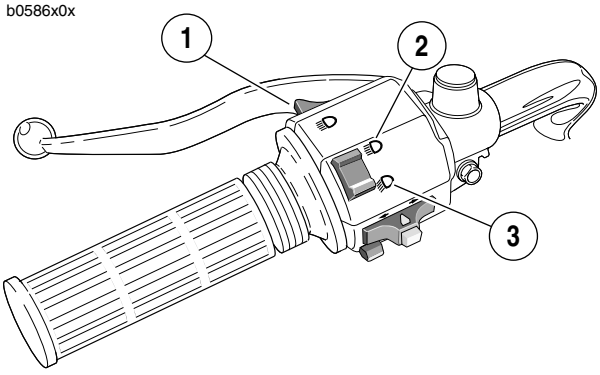
NOTE

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.
   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.
5. Connect negative battery cable.

⚠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)



1. Passing lamp switch
2. HIGH beam
3. LOW beam (always on when bike is running)

Figure 7-52. Headlight Controls

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.

⚠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.

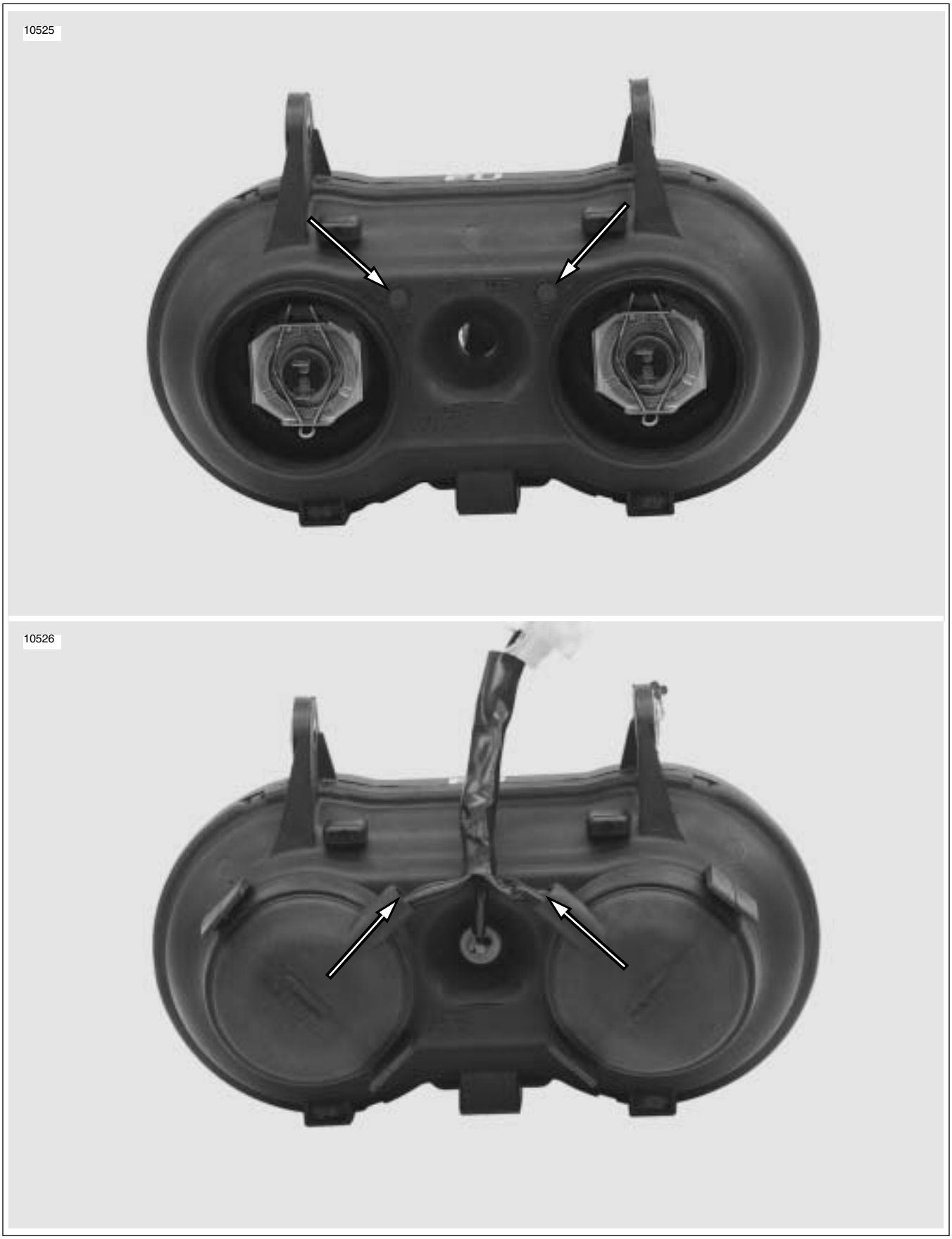


Figure 7-53. Headlight Housing 20 Degree Alignment Marks for Rubber Boot Wiring Harness Guides or Spigots

TAIL LAMP 7.13

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).

WARNING

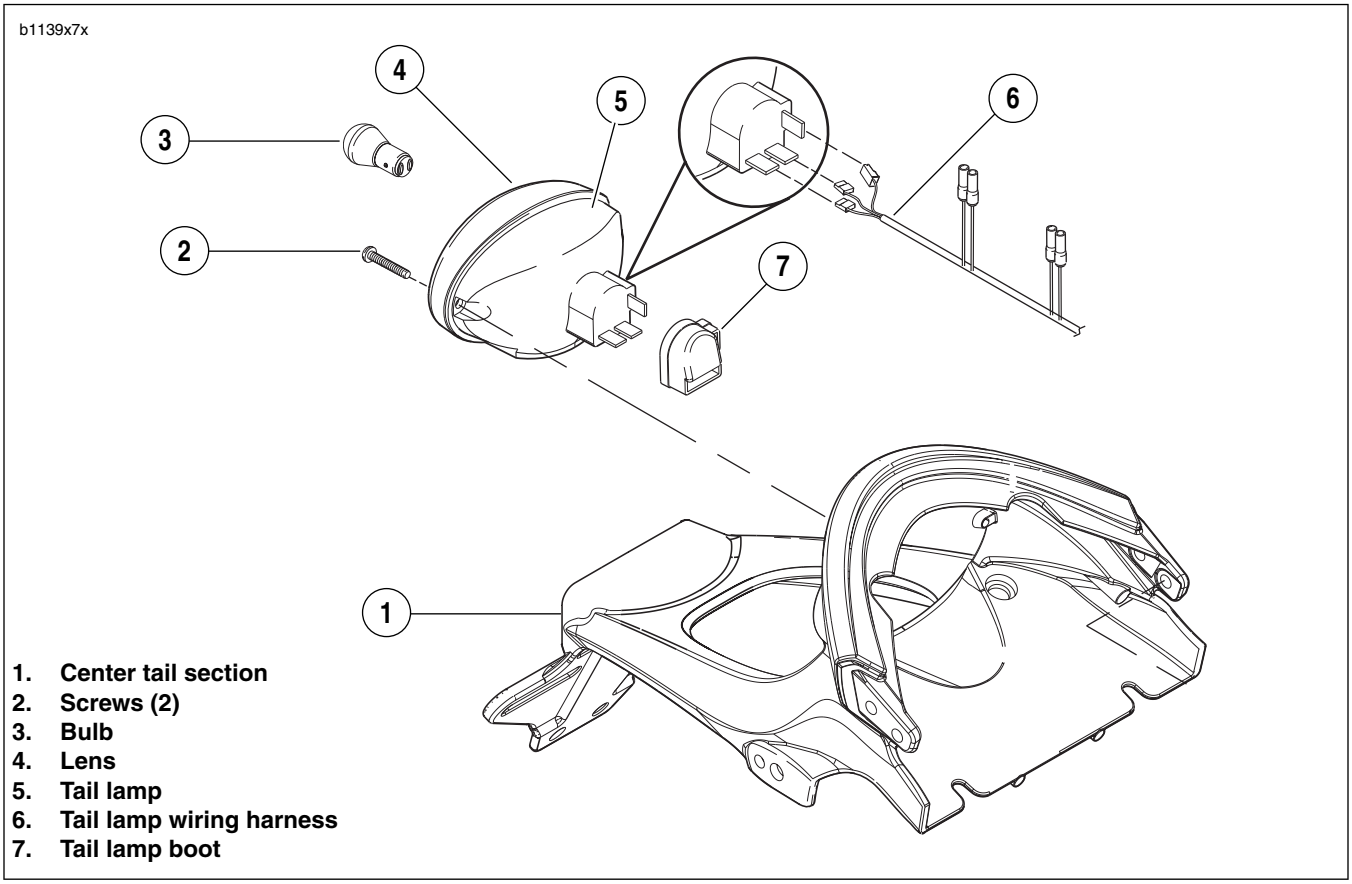
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

3. Check 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.
   c. Squeeze front brake hand lever. Check for brake lamp illumination. Release front brake hand lever.
   d. Press rear brake pedal. Check for brake lamp illumination. Release rear brake pedal.
   e. 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)

4. Install seat. See 2.43 SEAT.



1. **Center tail section**
2. **Screws (2)**
3. **Bulb**
4. **Lens**
5. **Tail lamp**
6. **Tail lamp wiring harness**
7. **Tail lamp boot**

Figure 7-54. Tail Lamp Assembly

LICENSE PLATE LAMP ASSEMBLY 7.14

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.

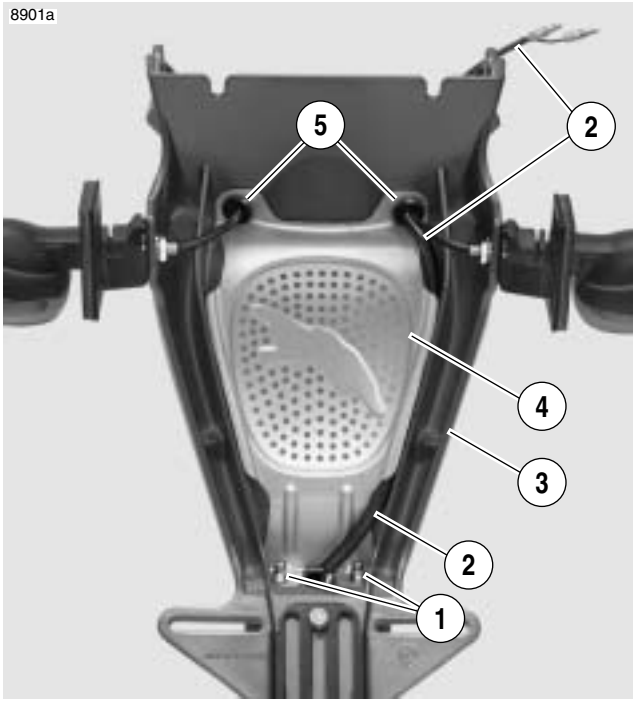
ASSEMBLY/INSTALLATION

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

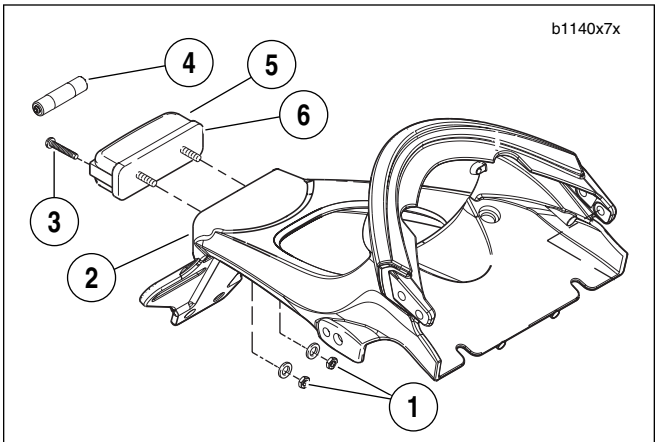
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat. See 2.43 SEAT.



1. **Jam nuts (2)**
2. **Lamp wiring harness and connectors [45]**
3. **Center tail section**
4. **Tail screen**
5. **Grommets (2)**

Figure 7-55. License Plate Lamp Mounting



1. **Jam nuts with washers (2)**
2. **Center tail section**
3. **Screws (2)**
4. **Bulb**
5. **Lamp lens**
6. **License plate lamp**

Figure 7-56. License Plate Lamp

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 windscreen. 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).

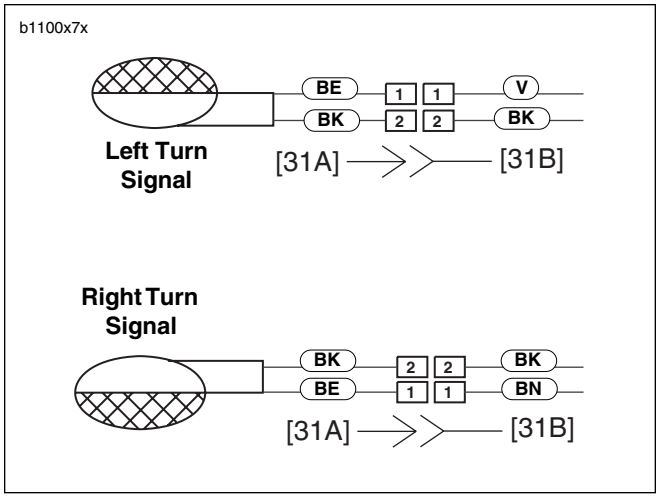


Figure 7-57. Front Turn Signal Connections

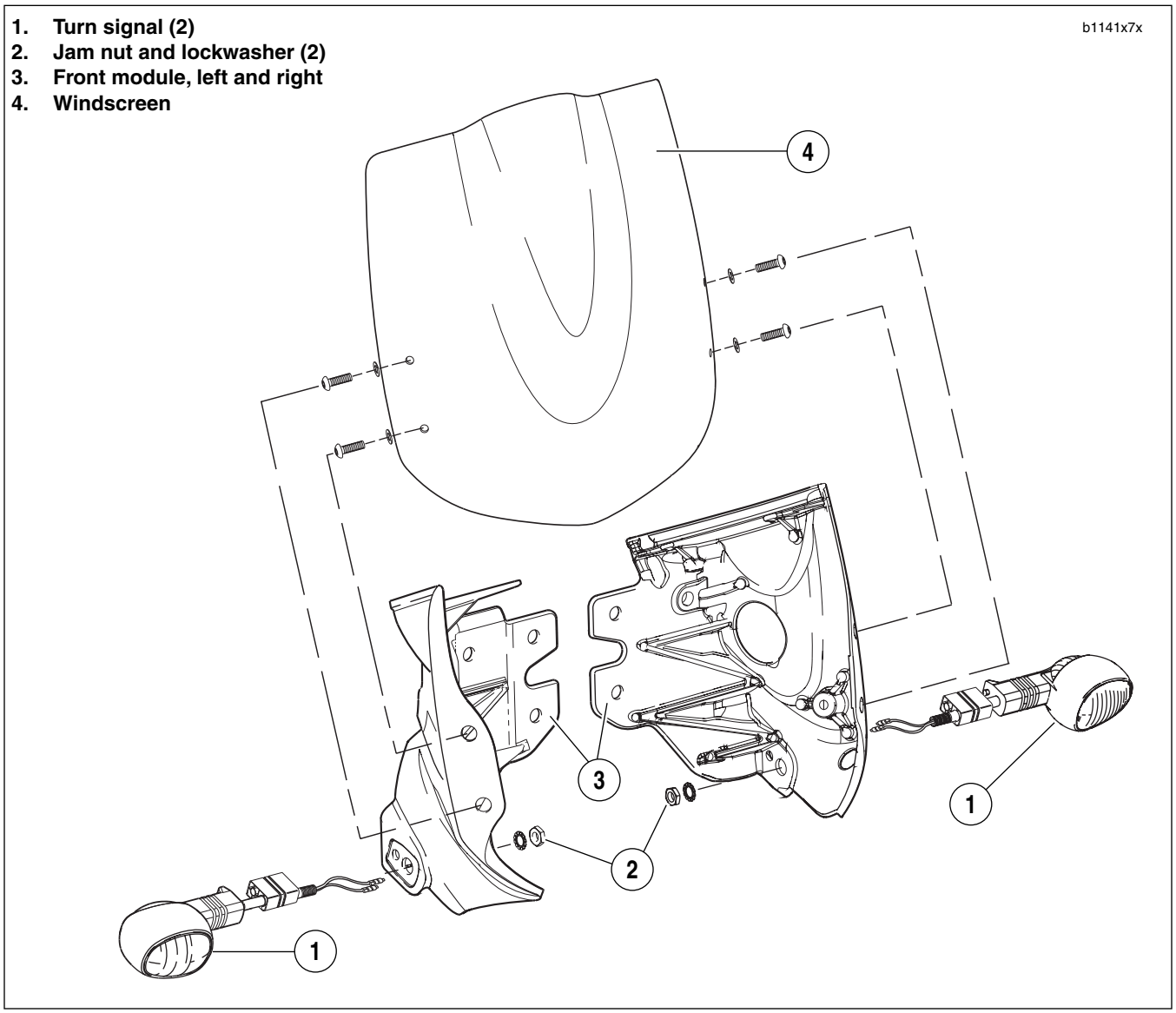


Figure 7-58. Front Turn Signals

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).

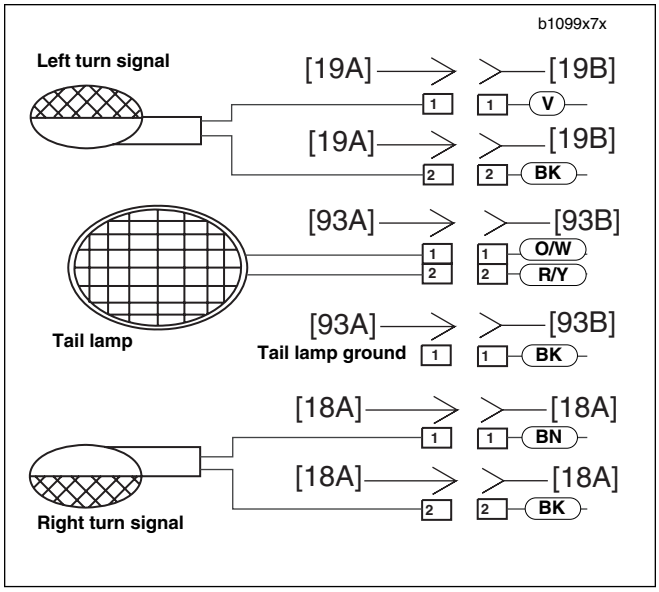
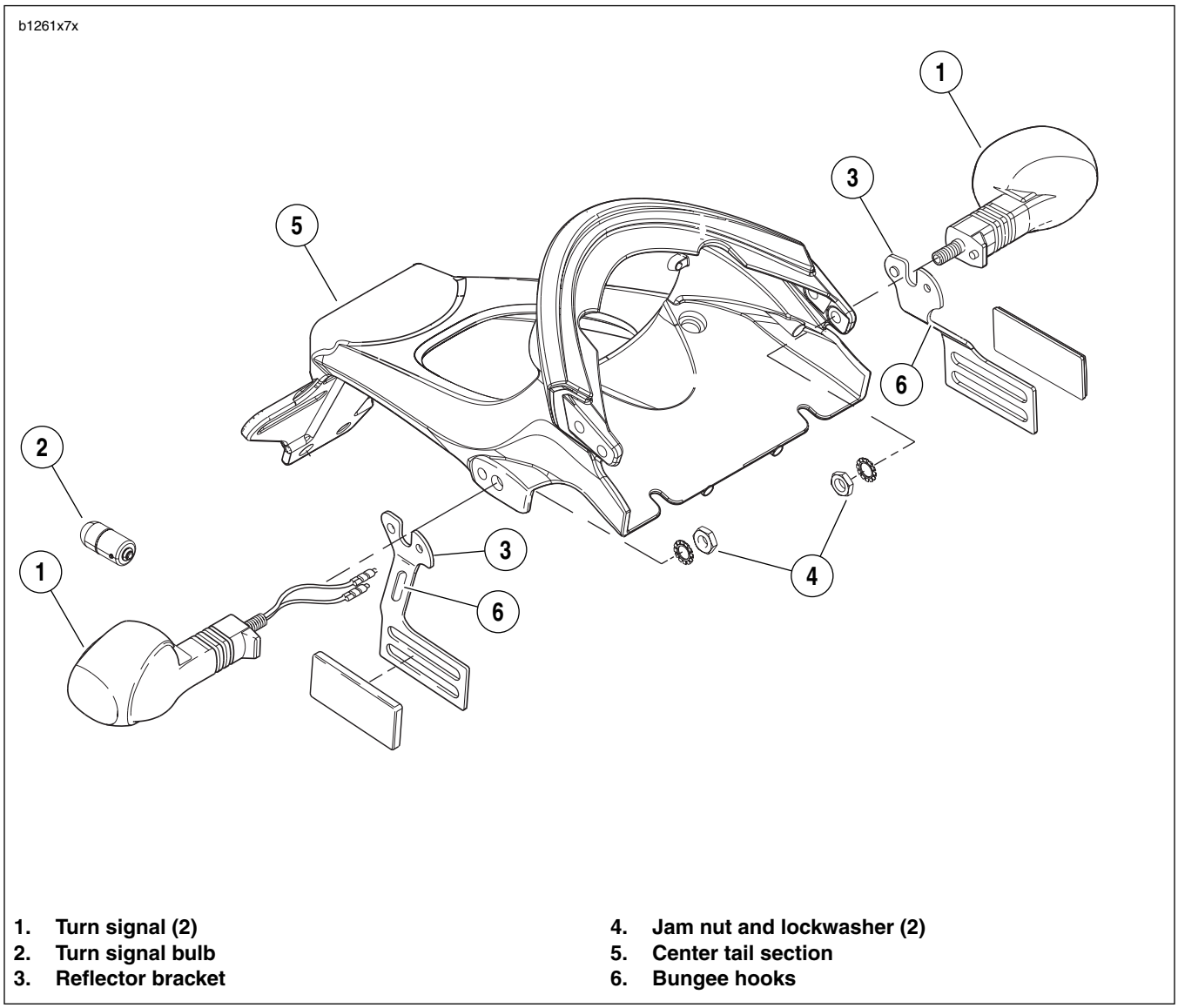


Figure 7-59. Rear Turn Signal Connections



1. **Turn signal (2)**
2. **Turn signal bulb**
3. **Reflector bracket**
4. **Jam nut and lockwasher (2)**
5. **Center tail section**
6. **Bungee hooks**

Figure 7-60. Rear Turn Signals

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).

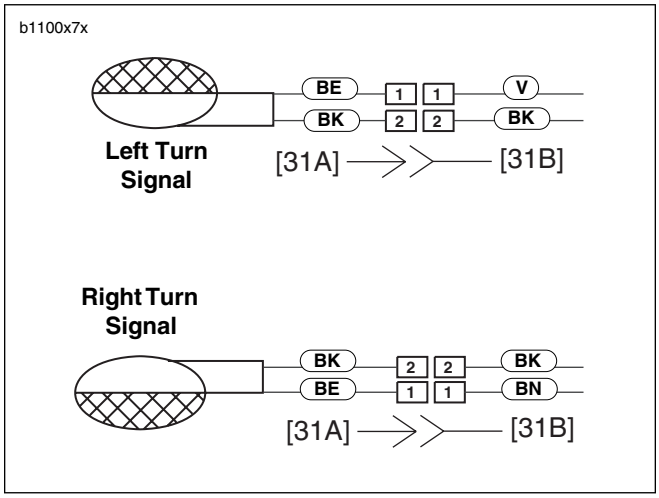


Figure 7-61. Front Turn Signal Connections

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 windscreen. 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).

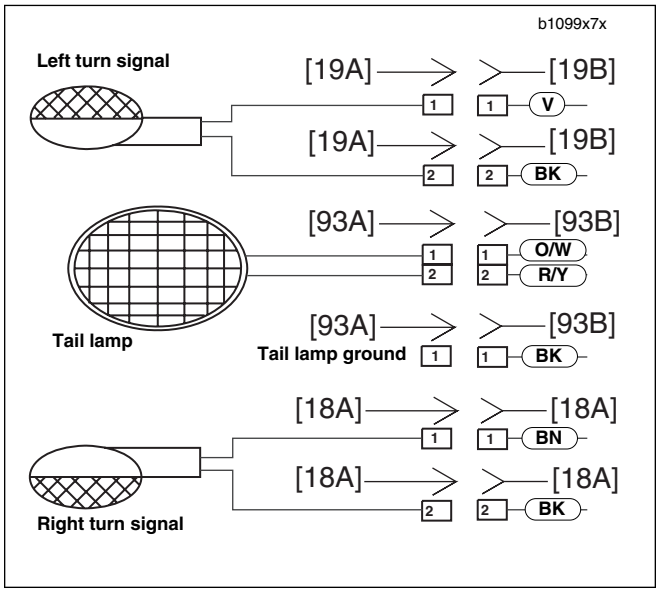


Figure 7-62. Rear Turn Signal Connections

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.

TURN SIGNAL FLASHER 7.16

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.

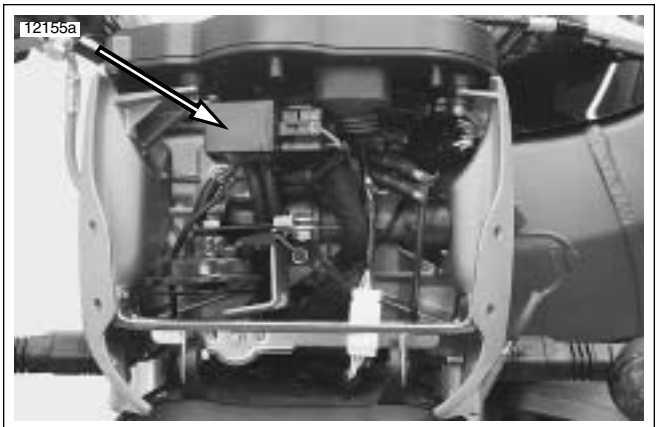
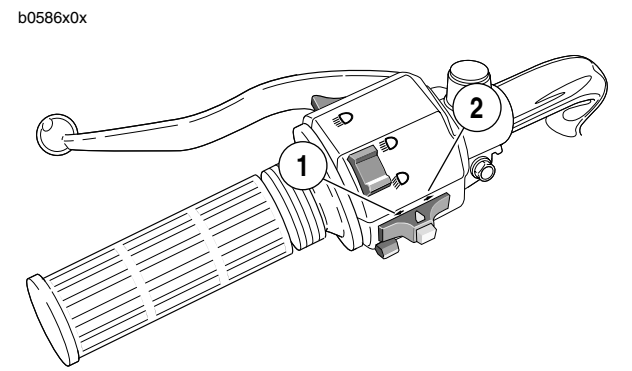


Figure 7-63. Turn Signal Flasher



1. Left turn signal
2. Right turn signal

Figure 7-64. Turn Signal Controls

HANDLEBAR SWITCHES 7.17

REMOVAL

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.
2. Access right handlebar switch connector [22] under windscreen. Remove cable straps. Detach connector [22] from wiring harness.
3. Detach brake switch connector [121].

Left Side

1. Remove left switch housing mounting fasteners.
2. Unplug the clutch switch [95].
3. Access left handlebar switch connector [24] under windscreen. Remove cable straps. Detach connector [24] from wiring harness.

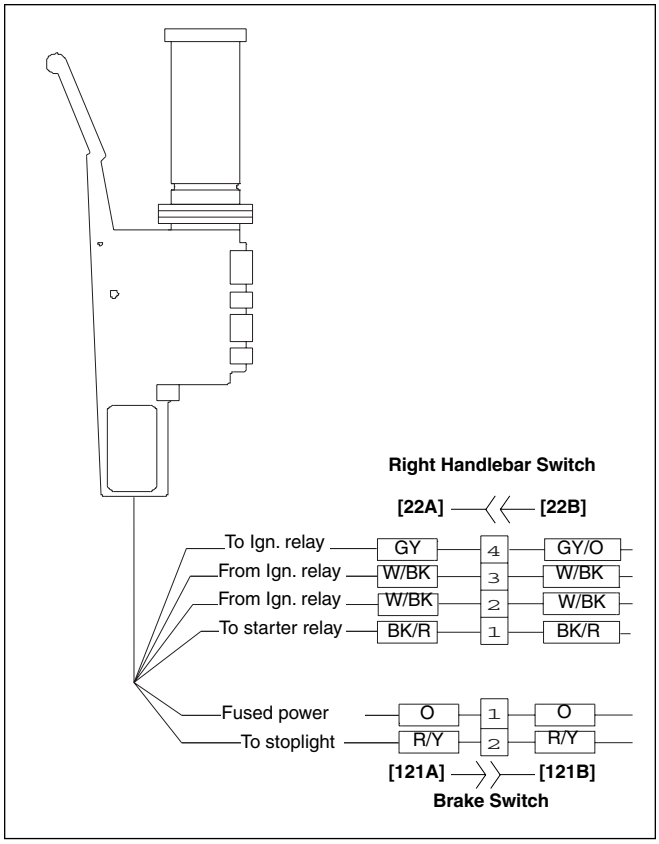


Figure 7-65. Right Handlebar Switch Connection

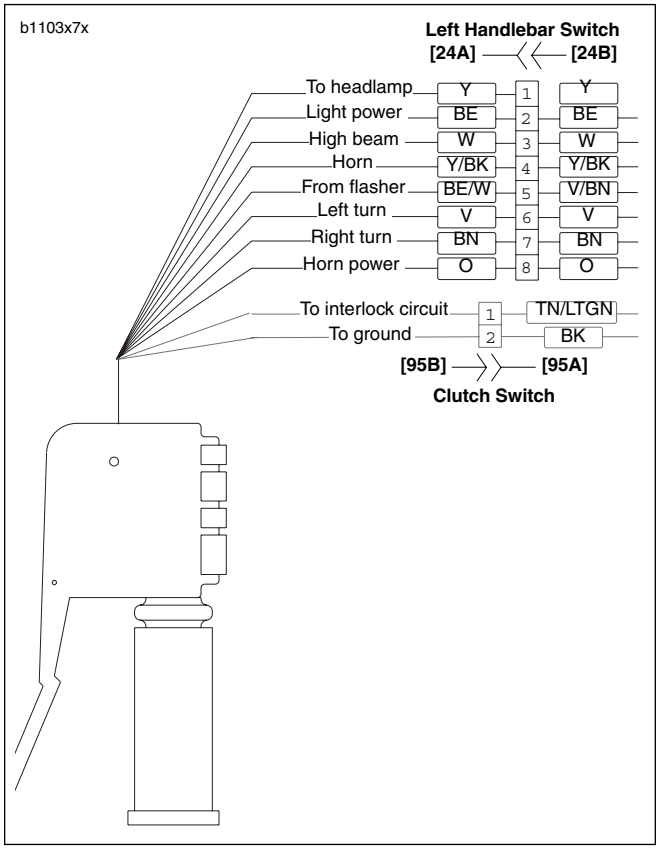


Figure 7-66. Left Handlebar Switch Connection

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.

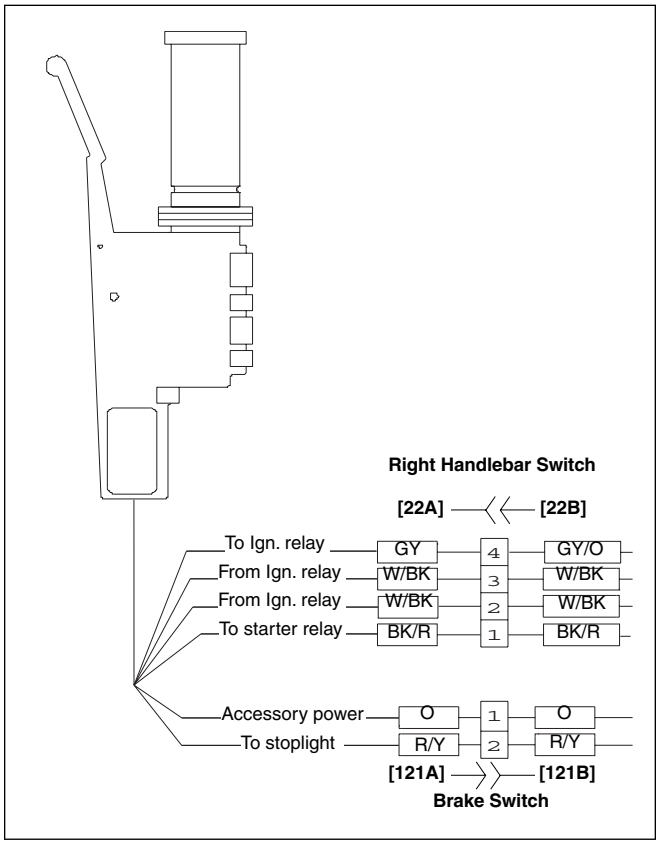


Figure 7-67. Right Handlebar Switch Connection

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].
3. Attach right handlebar switch connector [24] 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)

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.

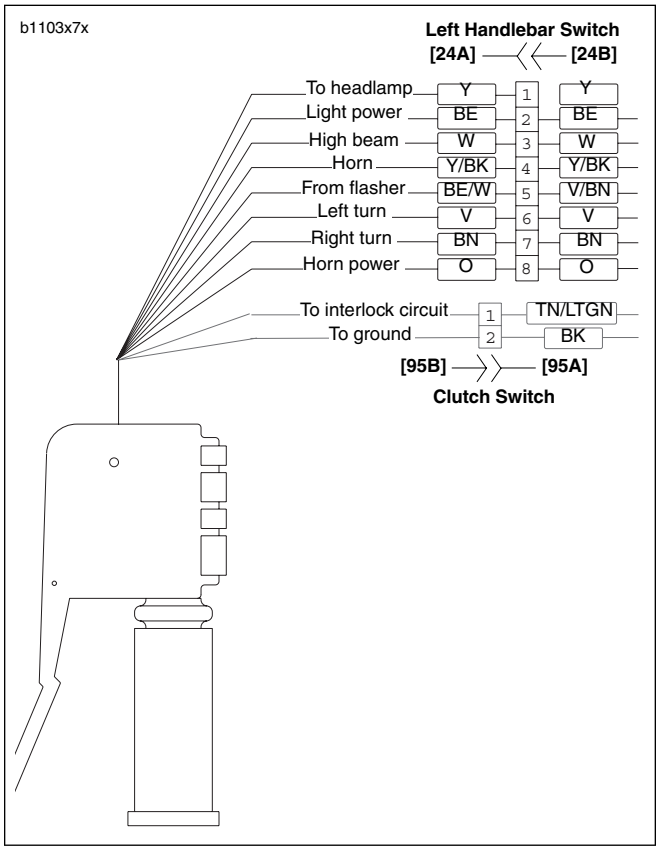


Figure 7-68. Left Handlebar Switch Connection

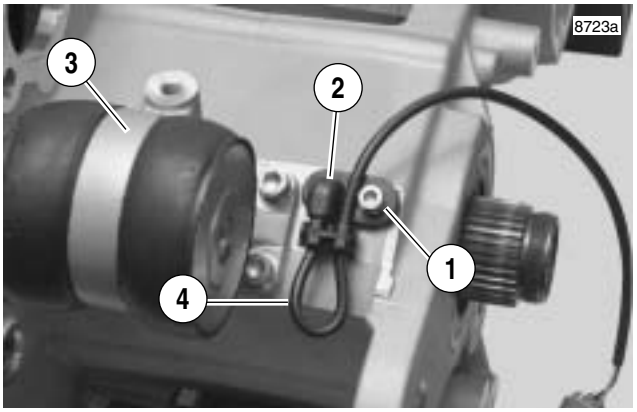
VEHICLE SPEED SENSOR 7.18

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.



1. **Fastener**
2. **Vehicle speed sensor**
3. **Rear isolator assembly**
4. **Strain relief**

Figure 7-69. Speedometer Sensor

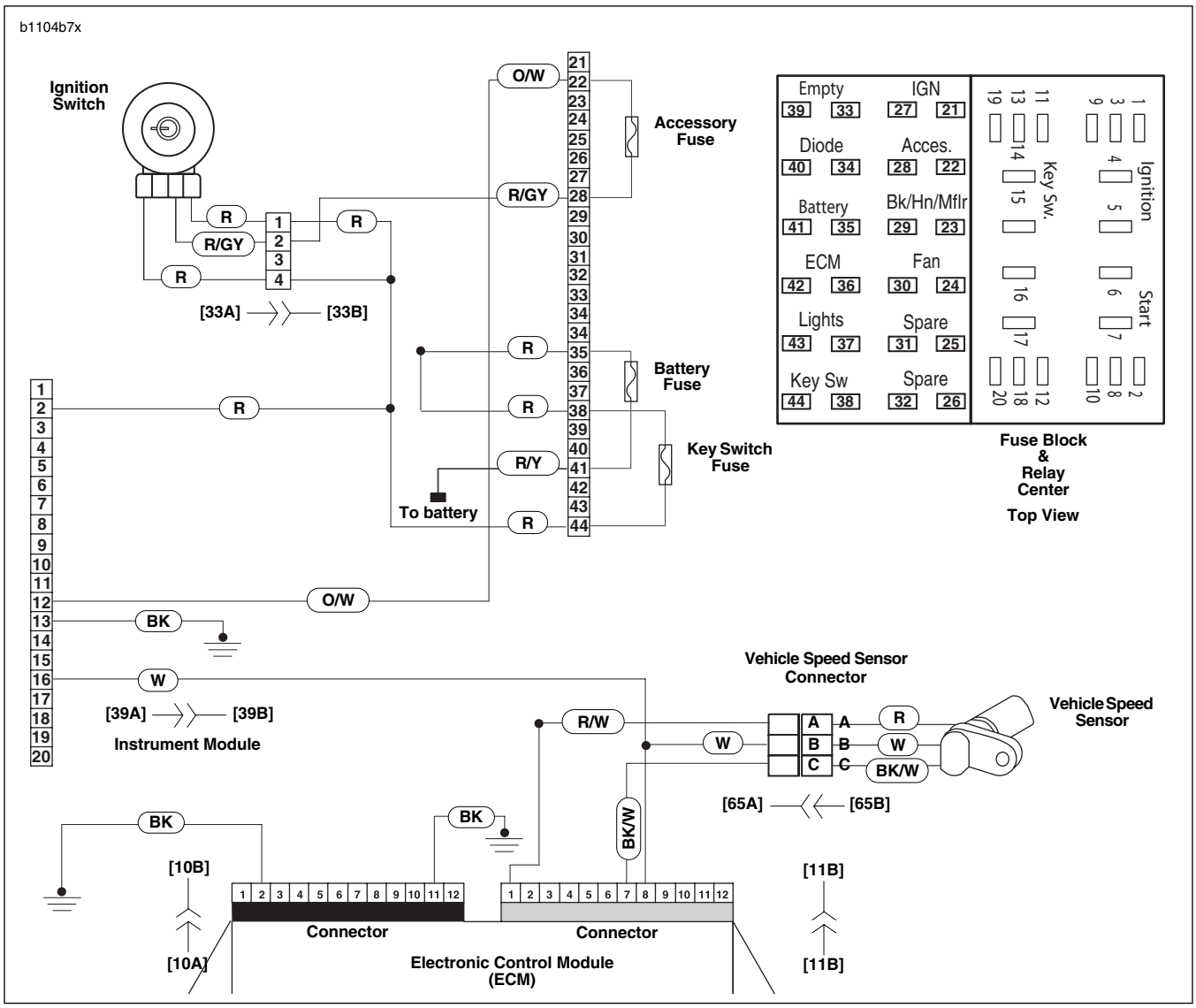


Figure 7-70. Vehicle Speed Sensor Wiring

INSTRUMENT MODULE 7.19

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.



Figure 7-71. Instrument Module

REMOVAL

⚠WARNING

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

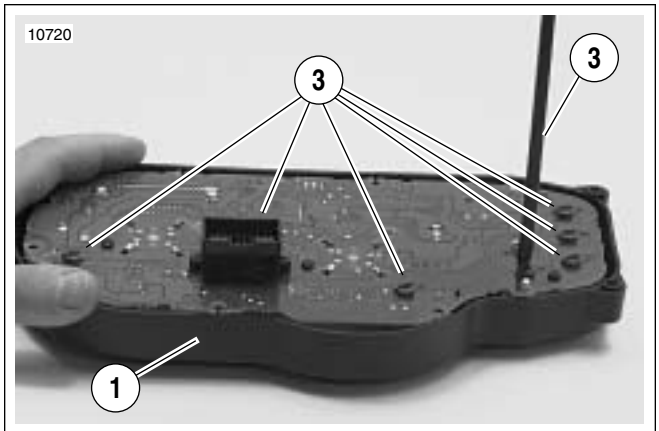
1. Remove seat. See 2.43 SEAT.
2. Disconnect negative battery cable.
3. Remove windscreen. See 2.42 WINDSCREEN.
4. See Figure 7-70. Disconnect instrument module connector [39].
5. See Figure 7-75. Remove fasteners (5) and washers (4).
6. Pull instrument module (2) from front support module (1).

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

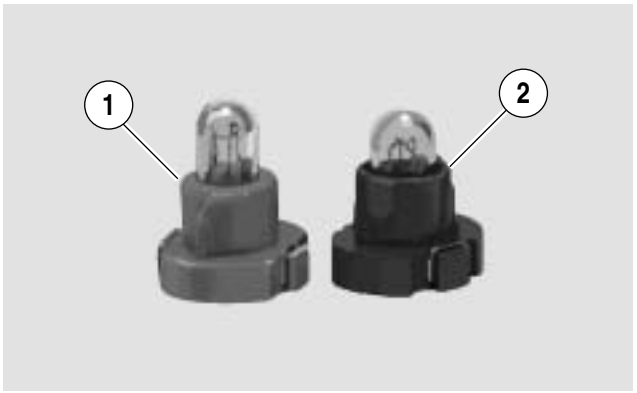
Do not turn display over. Speedometer and tachometer will fall out possibly causing damage to instruments.



1. **Instrument module**
2. **Bulbs**
3. **Screwdriver**

Figure 7-72. Bulb Replacement for Instrument Module

3. See Figure 7-72. Insert screwdriver blade into the slot on the back of the bulb to be replaced and lightly turn counterclockwise and remove bulb.



1. **Light grey/taller bulb-Y0162.02A8**
2. **Dark grey/shorter bulb-Y0163.02A8**

Figure 7-73. Instrument Module Bulbs

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.

INSTALLATION

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.

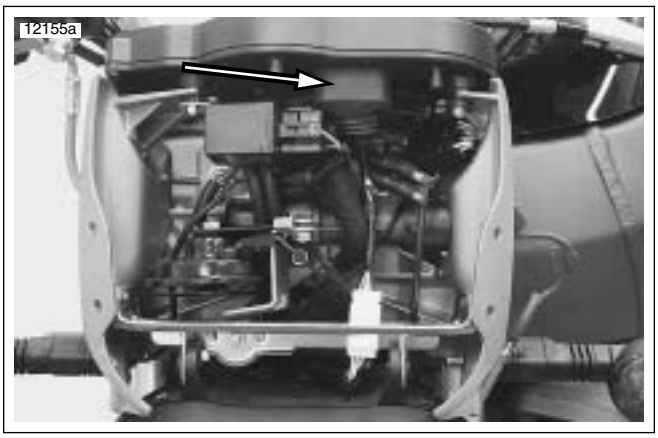
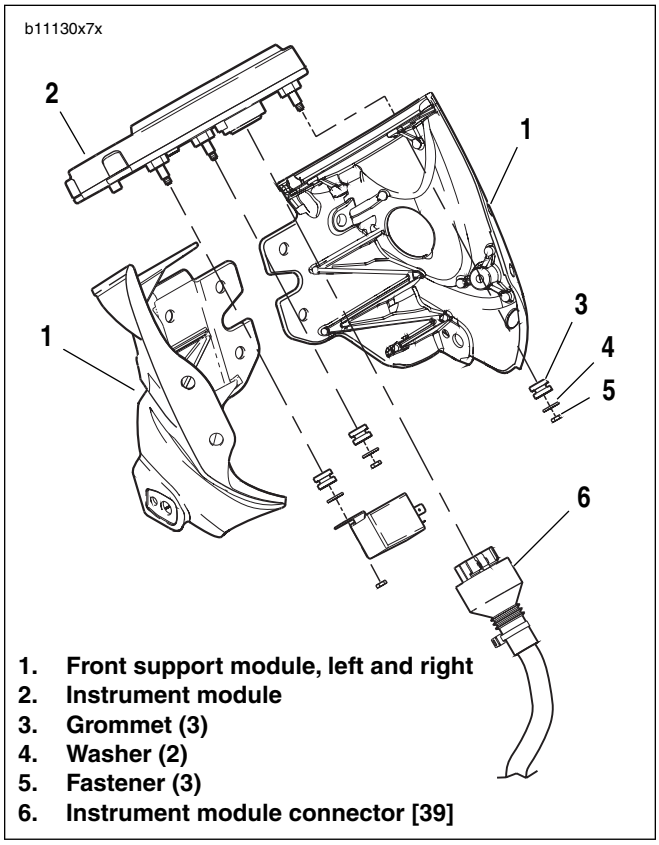


Figure 7-74. Instrument Module Connector [39]



1. **Front support module, left and right**
2. **Instrument module**
3. **Grommet (3)**
4. **Washer (2)**
5. **Fastener (3)**
6. **Instrument module connector [39]**

Figure 7-75. Instrument Module

SPEEDOMETER PERFORMANCE CHECK 7.20

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.*

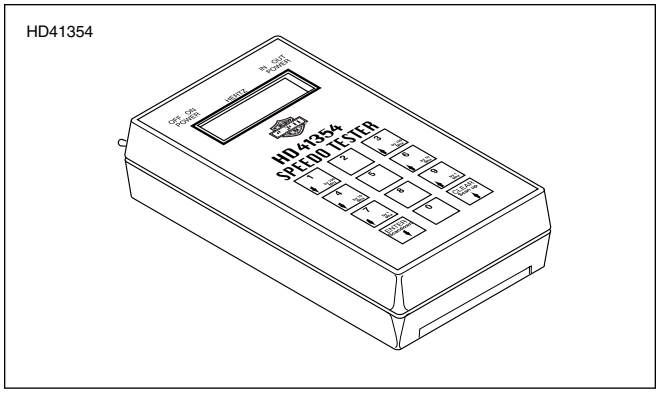


Figure 7-76. Speedometer Tester (Part No. HD-41354)

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. It's 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.
4. Begin test.
   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).

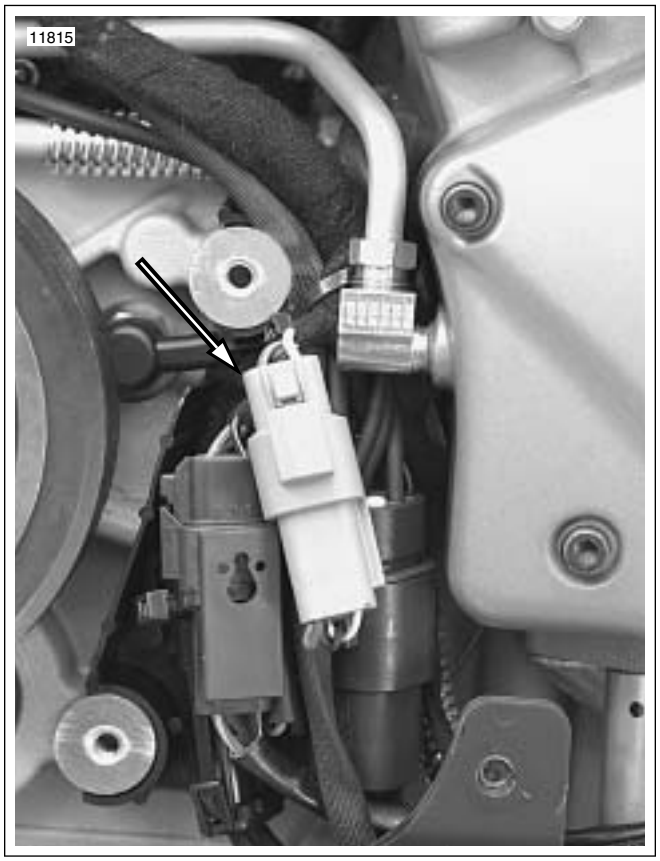


Figure 7-77. Vehicle Speed Sensor Connector [65]

Table 7-16. Speedometer Test Frequency in Hertz (Hz)

MARKET	SPEED	FREQUENCY
USA	20 MPH	531
	40 MPH	1062
	60 MPH	1593
	80 MPH	2124

Table 7-16. Speedometer Test Frequency in Hertz (Hz)

MARKET	SPEED	FREQUENCY
ENG, AUS, EUR, CAN, JPN	40 KPH	660
	60 KPH	990
	80 KPH	1320
	100 KPH	1650

Speedometer Needle Sweep Test

NOTE

Speedometer needle sweep test works on the speedometer only. Use the diagnostics available with DIGITAL TECHNICIAN (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.

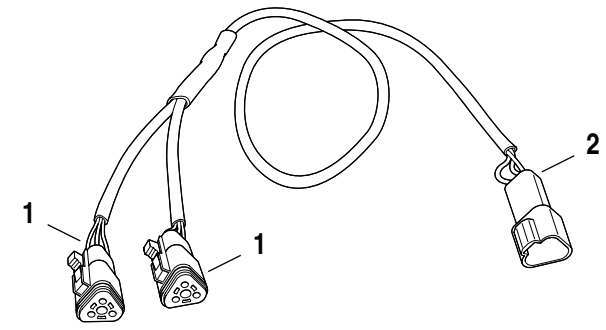
Speedometer Sensor Test

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.

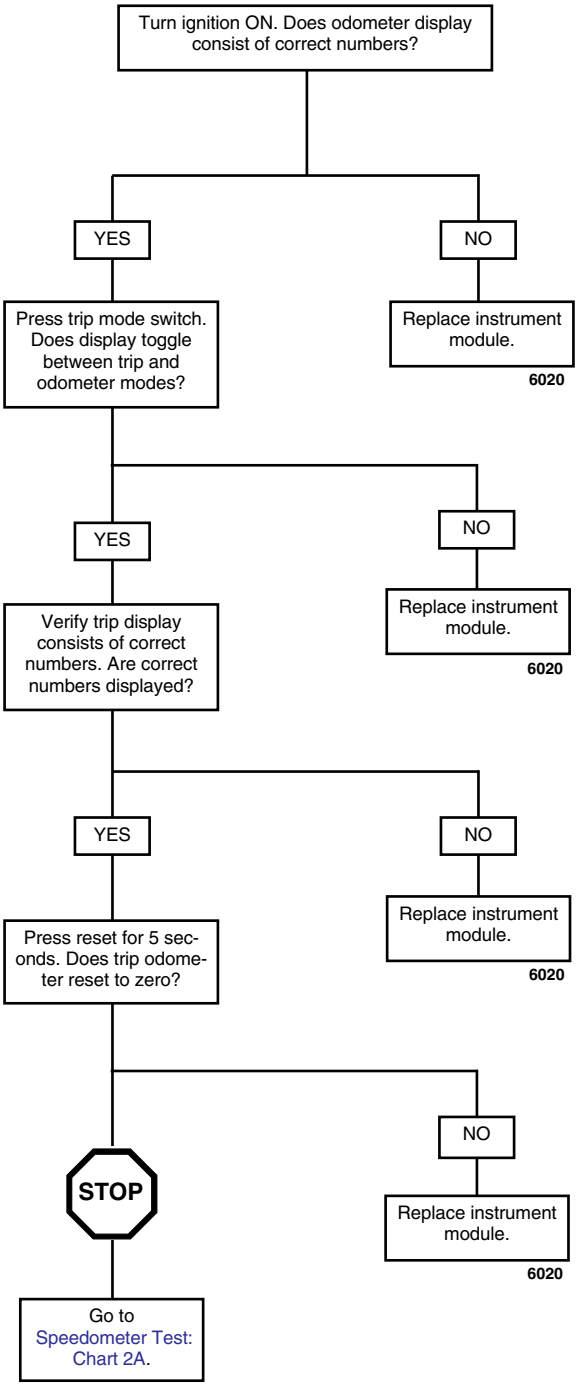


1. Deutsch socket housing (2)
2. Deutsch pin housing

Figure 7-78. Test Harness

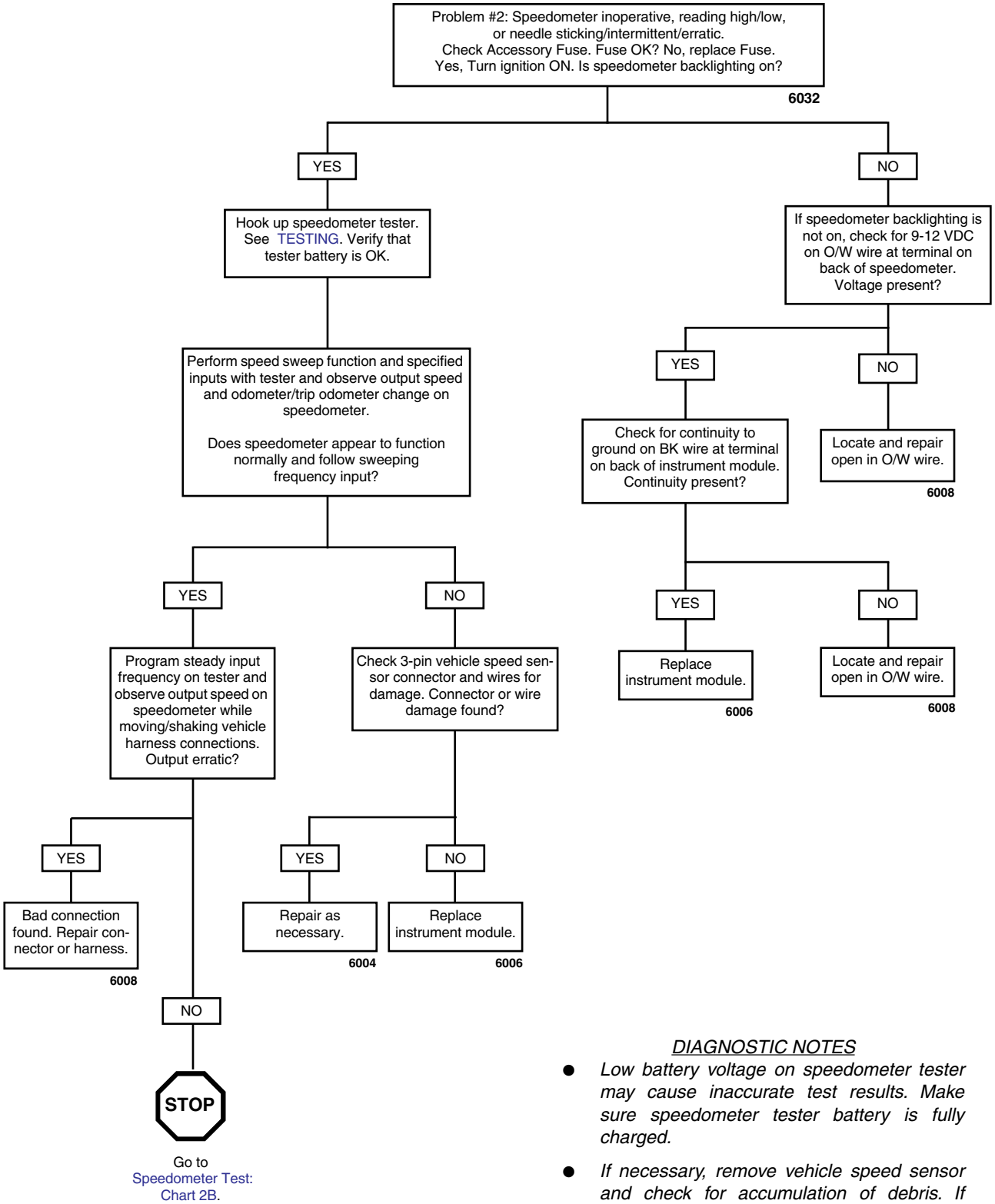
Speedometer Test: Chart 1

ODOMETER, TRIP ODOMETER AND RESET SWITCH TESTING



Speedometer Test: Chart 2A

INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER

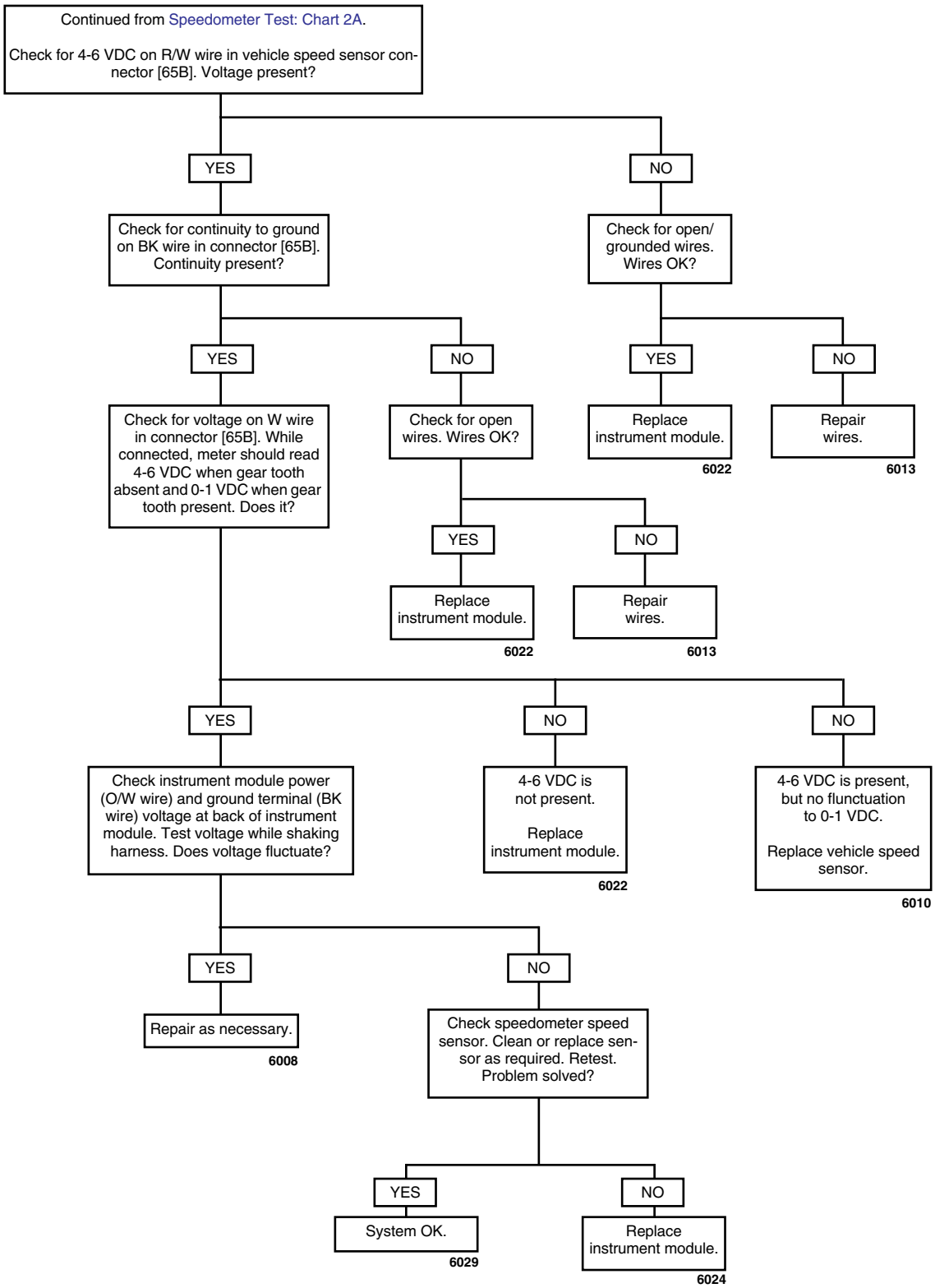


DIAGNOSTIC NOTES

- *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.*

Speedometer Test: Chart 2B

INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER



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.

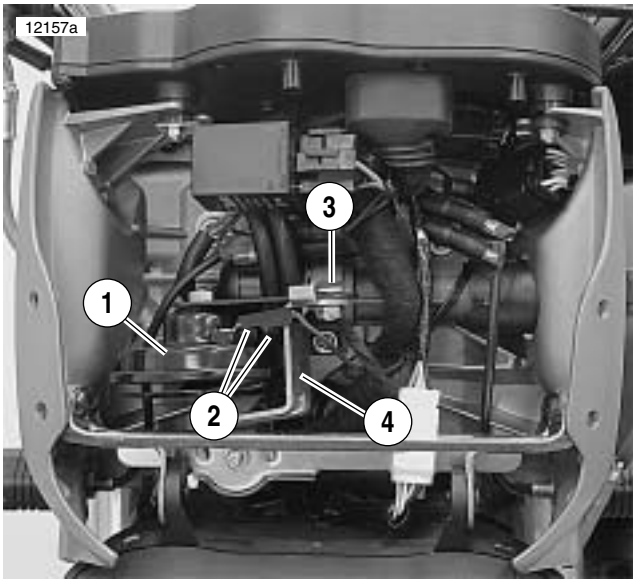
INSTALLATION

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.



1. Horn
2. Horn connectors [122]
3. Horn fastener
4. Support bracket

Figure 7-79. Horn Assembly

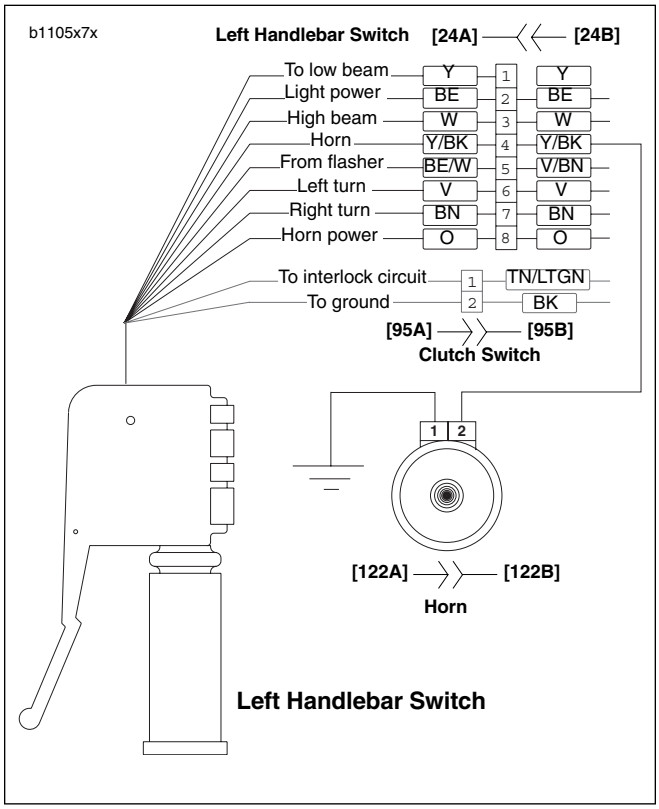


Figure 7-80. Horn Wiring

TROUBLESHOOTING

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 HANDLEBAR SWITCHES.

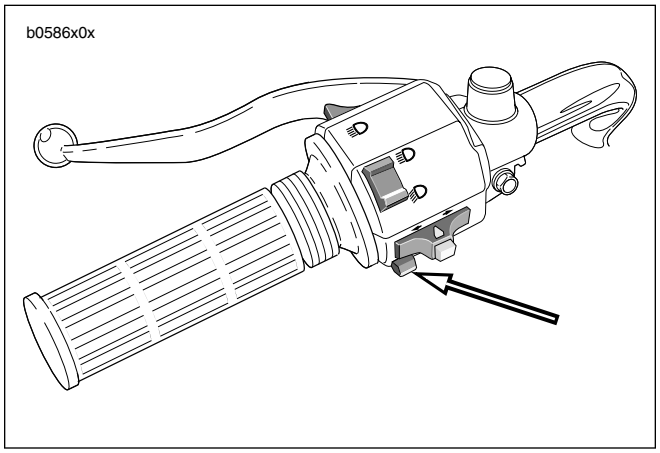


Figure 7-81. Horn Switch

NEUTRAL INDICATOR SWITCH 7.22

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.

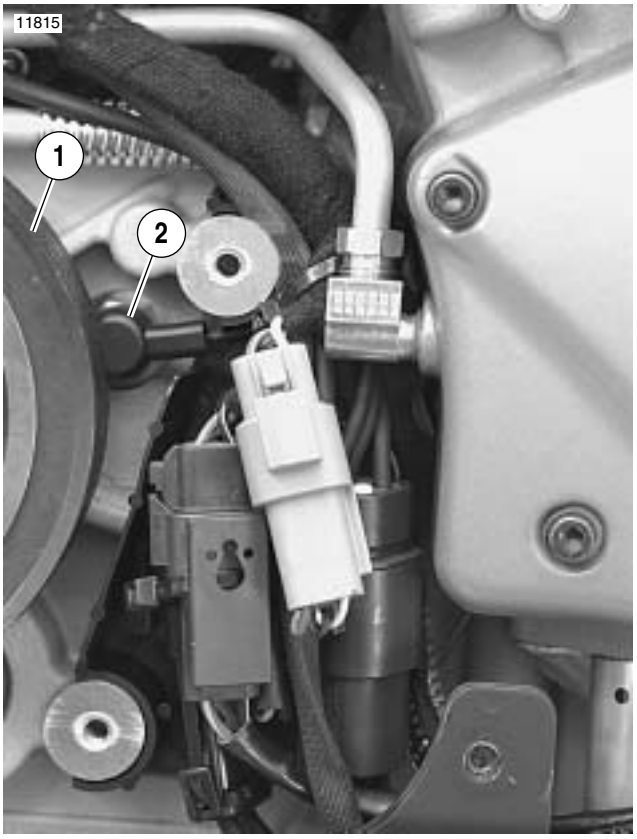
REMOVAL/INSTALLATION

1. Verify that the ignition key switch is turned to OFF.
2. Remove sprocket cover. See 2.33 SPROCKET COVER.

NOTE

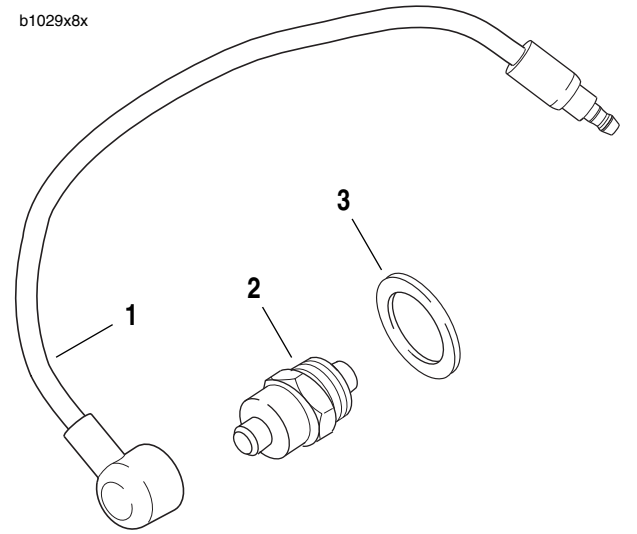
If replacing neutral indicator switch wiring, see 7.26 SPROCKET COVER WIRING for correct wire routing.

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.



1. Transmission sprocket
2. Neutral indicator switch

Figure 7-82. Neutral Indicator Switch Location



1. Neutral indicator switch wire lead
2. Neutral indicator switch
3. Washer

Figure 7-83. Neutral Indicator Switch

BATTERY FUSE AND FUSES 7.23

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.

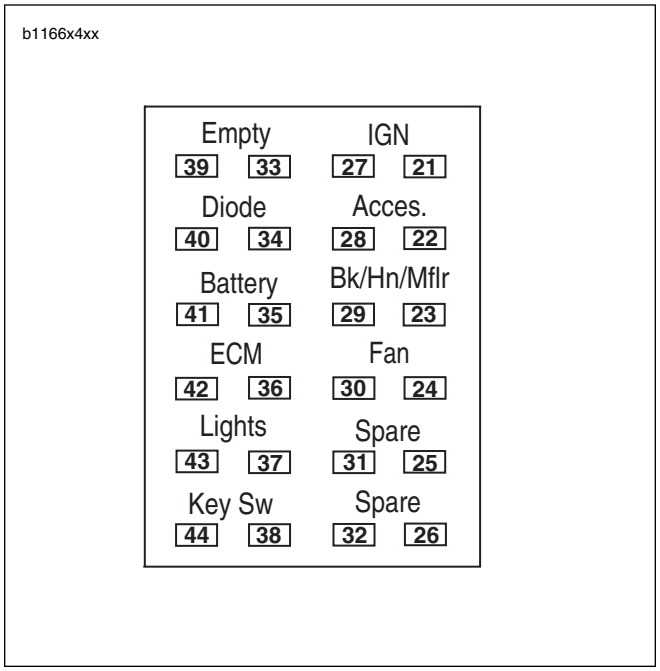
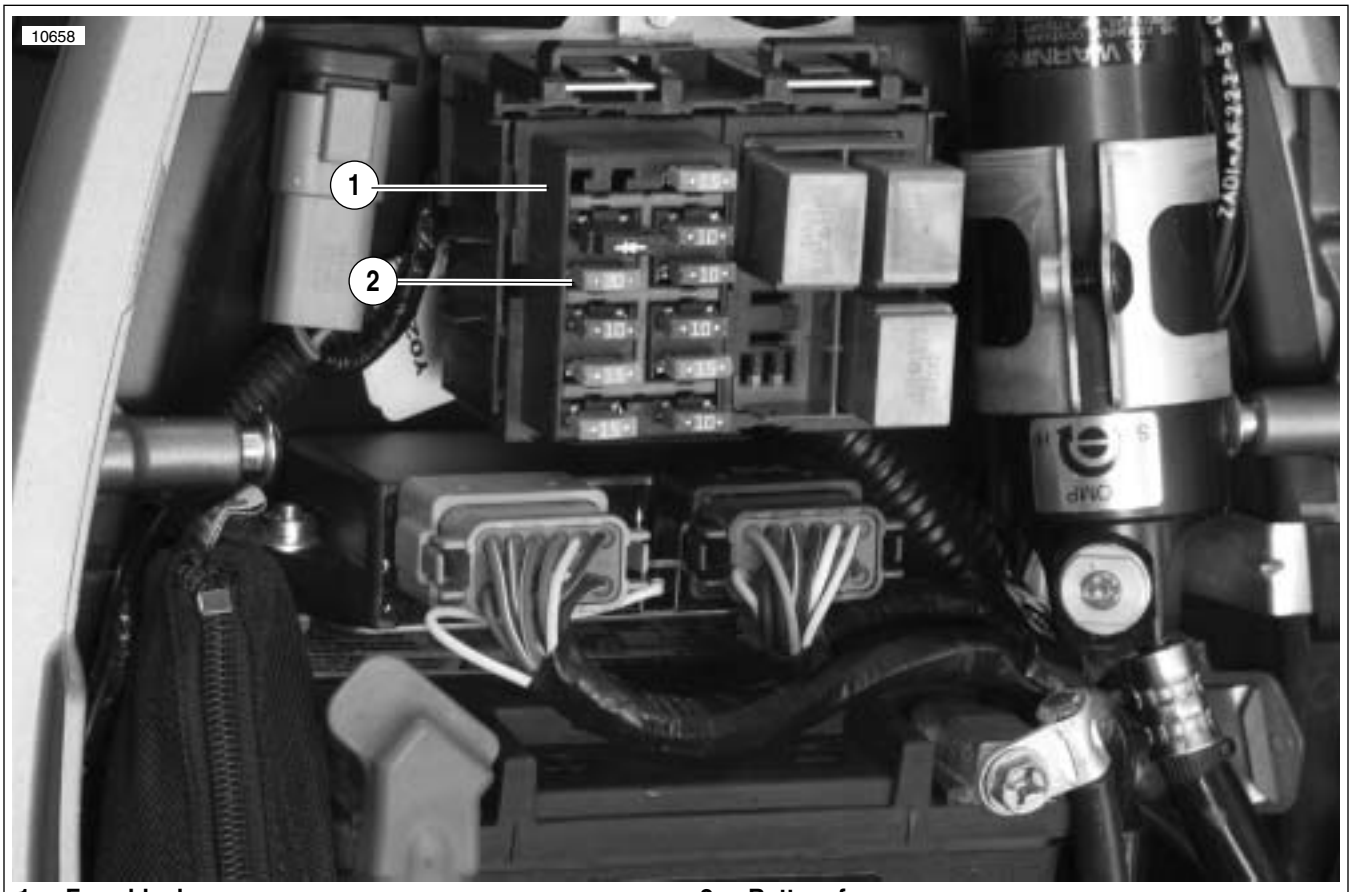


Figure 7-84. Fuse Block



1. **Fuse block**
2. **Battery fuse**

Figure 7-85. Fuse Block and Battery Fuse Location

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

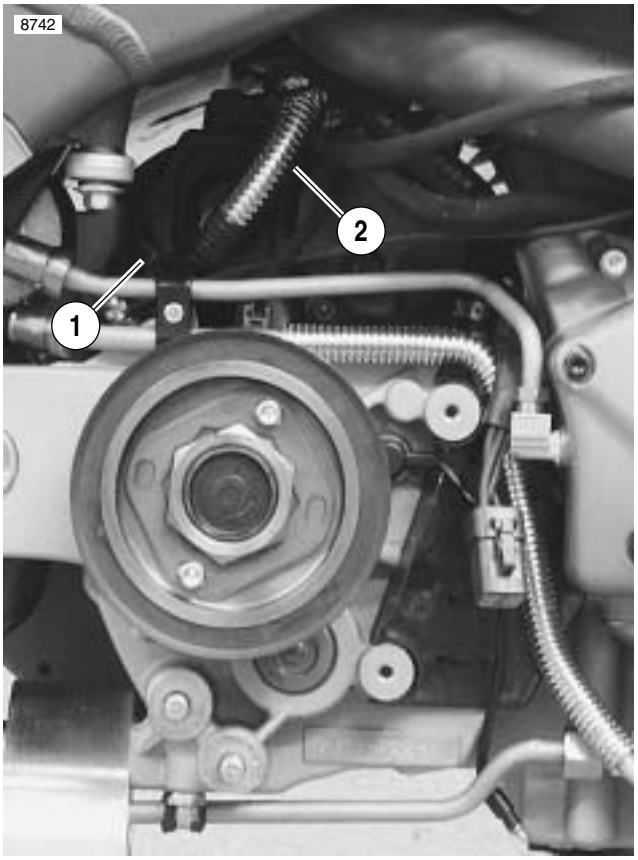
- *To ensure correct installation, make note of wire routing and cable strap locations before removing main wire harness.*
- *Main wire harness is removed from rear of vehicle through fan section of frame.*

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.



1. Protective boot, positive battery cable
2. Positive battery cable

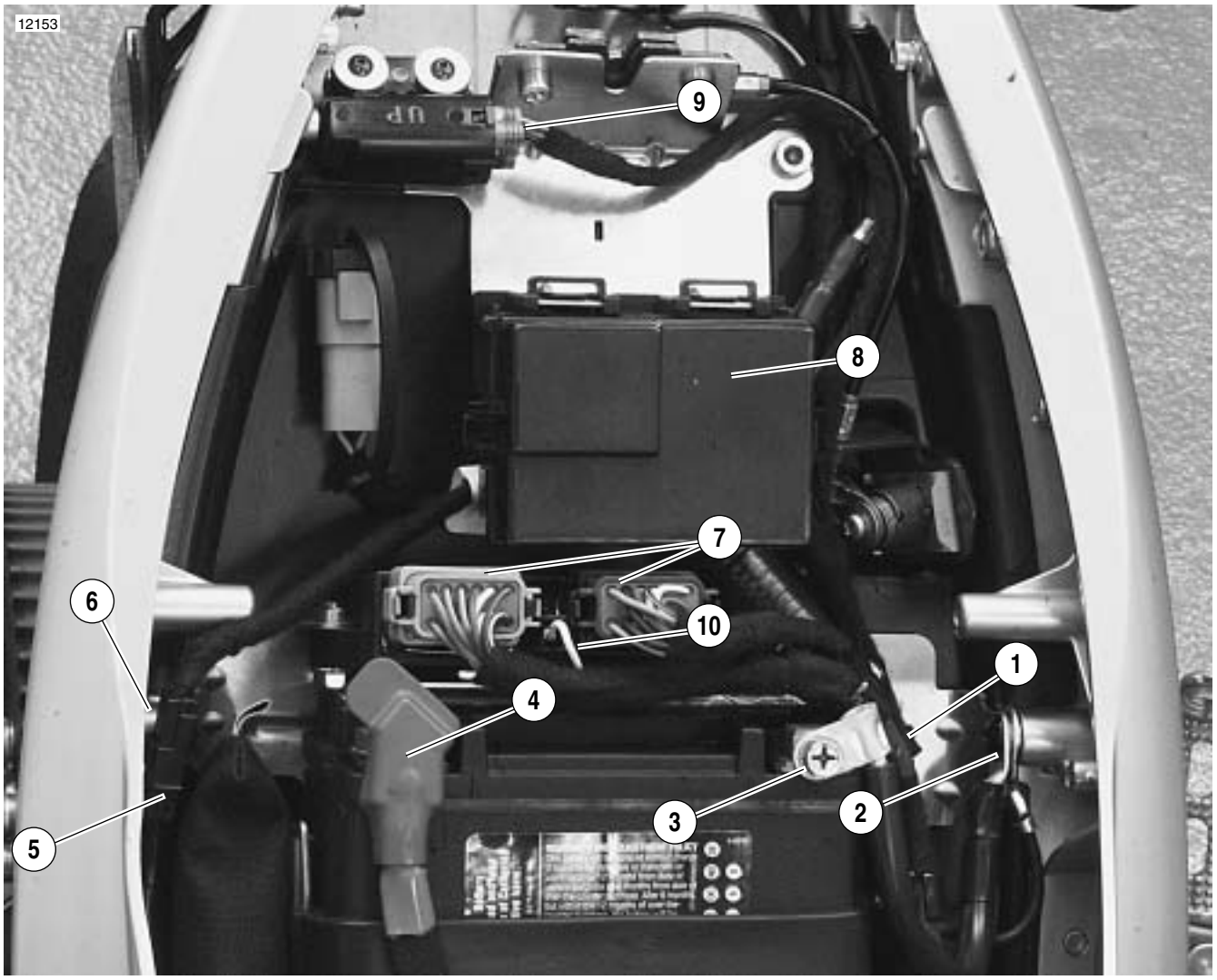
Figure 7-86. Positive Battery Cable

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].
   - ECM connectors [10] and [11]. (ECM connector [164] on 1200 models)
   - 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.



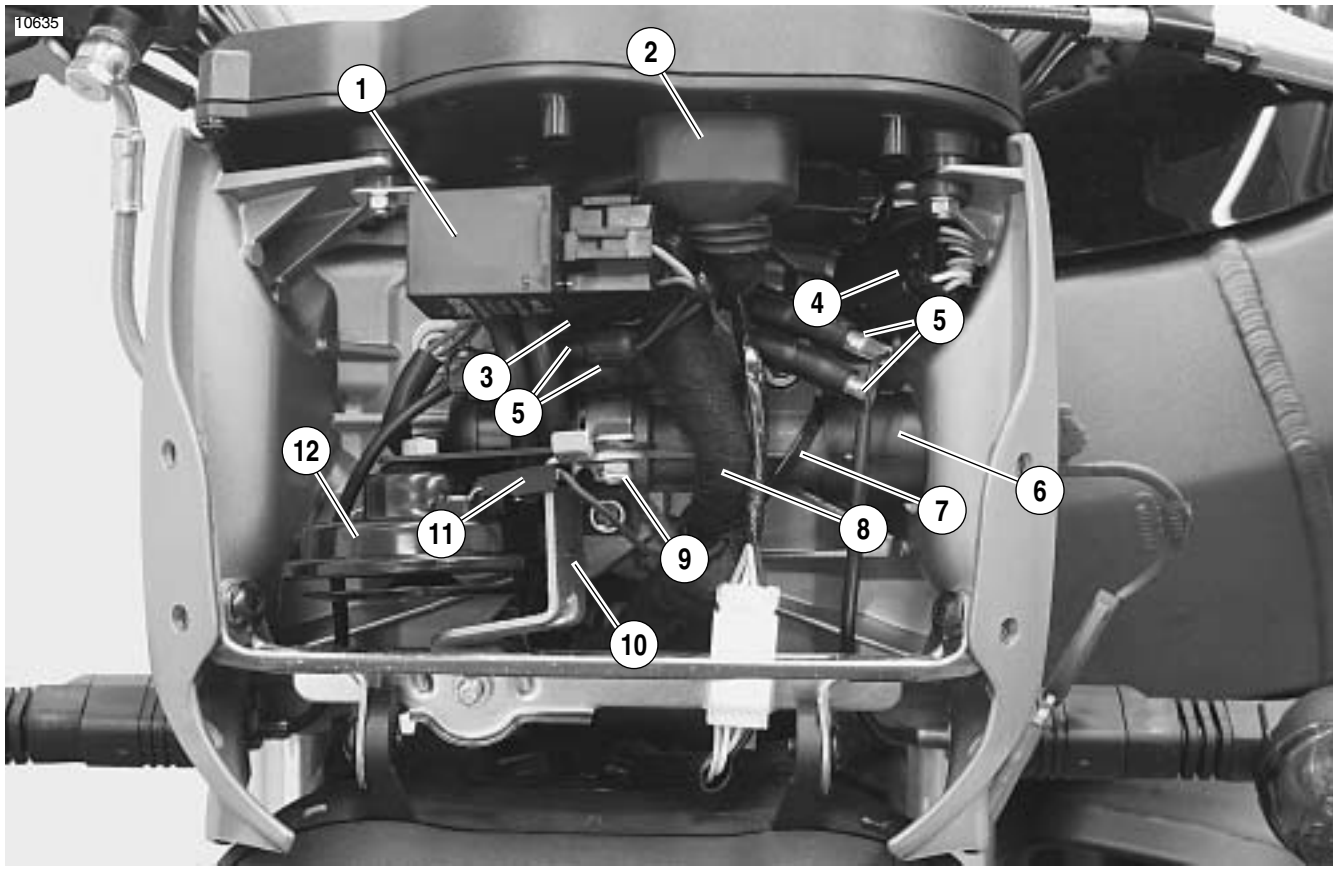
1. Main harness
2. Main harness ground (high voltage ground wire)
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
6. Ground terminals (low voltage ground wires)
7. ECM connectors [10] & [11]
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Right turn signal connector [18]
11. Left turn signal connector [19]
12. License plate lamp connector [45]
13. Tail light connectors [93]
14. Interactive exhaust connector [165B], (1200 models only)

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)
7. ECM connectors [10] & [11]
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Interactive exhaust connector [165B]

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**

Figure 7-89. Electrical Connectors Behind Windscreen

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.

INSTALLATION

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.

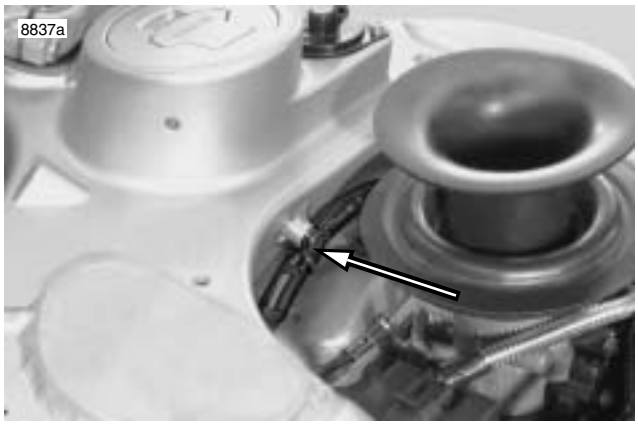
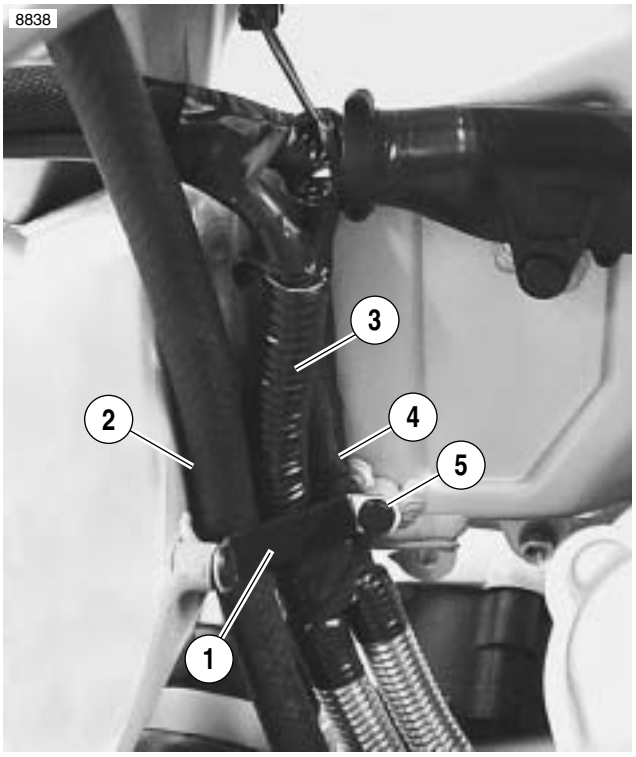


Figure 7-90. Wire Harness Clip

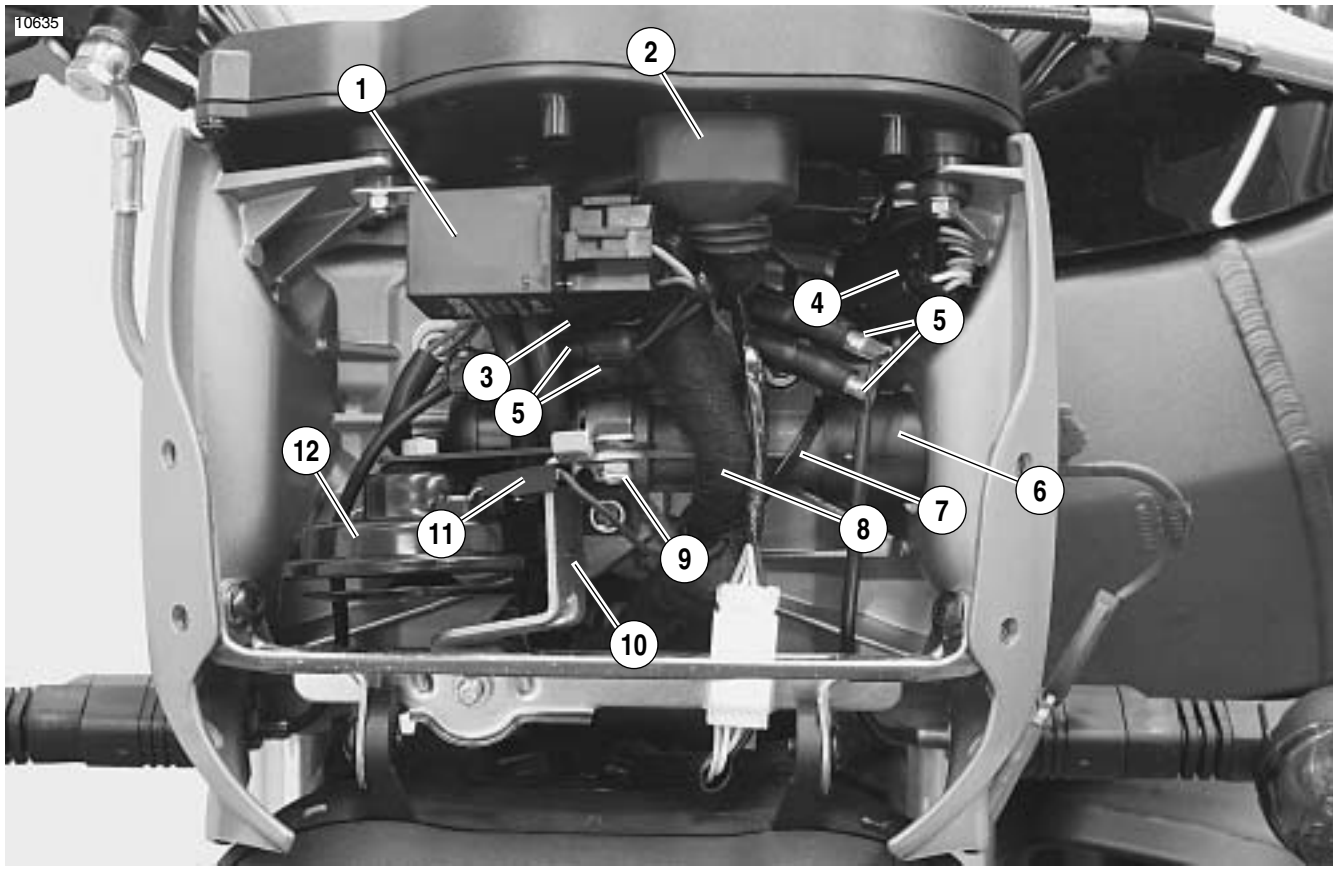
6. See Figure 7-90. Install clamp over portion of harness that leads to engine connectors. Install clamp as shown using **new** plastic tree fastener.



1. **Mounting strap and guide**
2. **Transmission vent hose**
3. **Positive battery cable**
4. **Sprocket cover wiring**
5. **Tree fastener (2)**

Figure 7-91. Wire Harness Strap and Guide

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.



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**

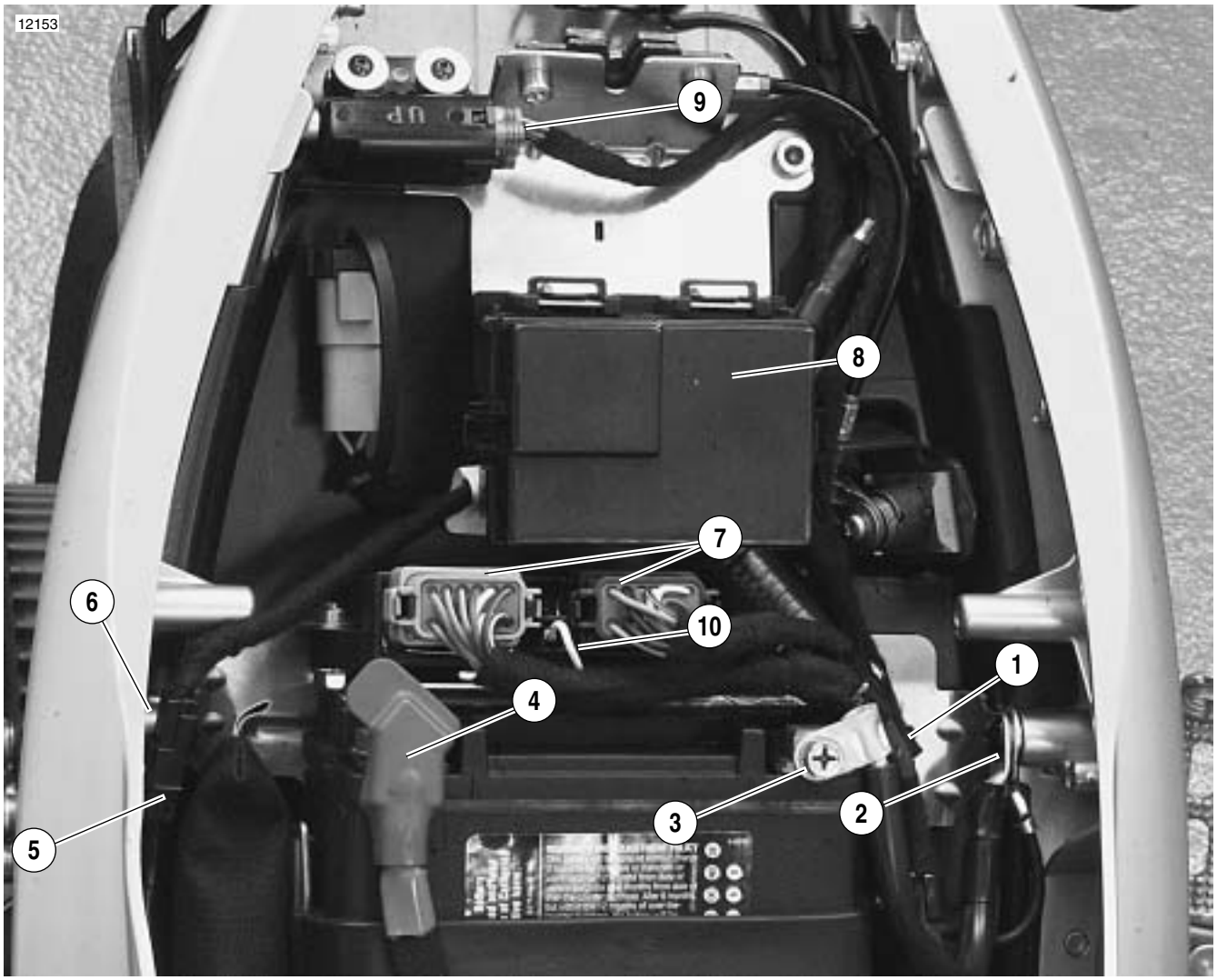
Figure 7-92. Electrical Connectors Behind Windscreen

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.



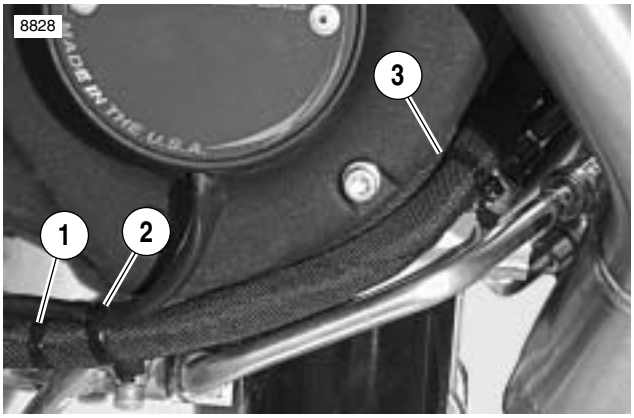
1. Main harness
2. Main harness ground (high voltage ground wire)
3. Battery ground cable
4. Battery positive cable
5. Rear brake light switch connector [121]
6. Ground terminals (low voltage ground wires)
7. ECM connectors [10] [11] & [164] (1200 models only)
8. Fuse block and relay center
9. BAS (bank 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)



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)
7. ECM connectors [10] & [11]
8. Fuse block and relay center
9. BAS (bank angle sensor) connector [134]
10. Interactive exhaust connector [165B]

Figure 7-94. Main Harness and Electrical Connectors Under Seat (XB12Ss)



1. **Rear cable strap**
2. **Middle cable strap**
3. **Front cable strap**

Figure 7-95. Cable Straps

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.

⚠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)

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.

⚠WARNING

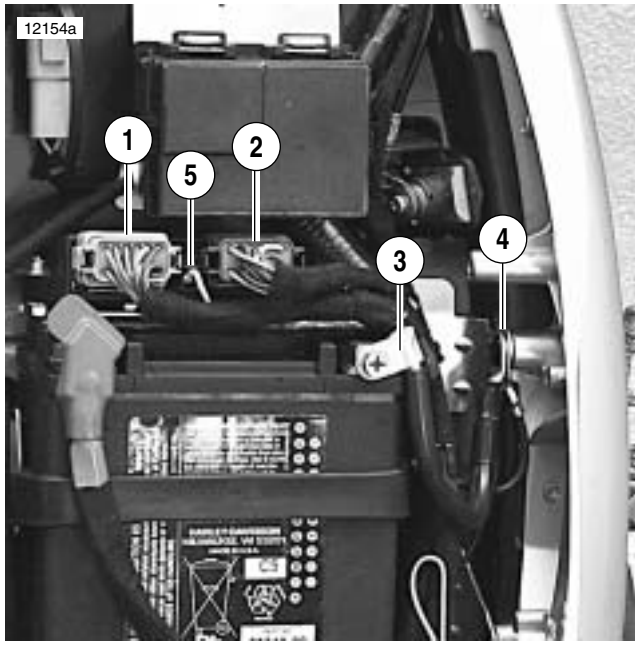
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

28. Install seat. See 2.43 SEAT.

INTERACTIVE EXHAUST ACTUATOR HARNESS 7.25

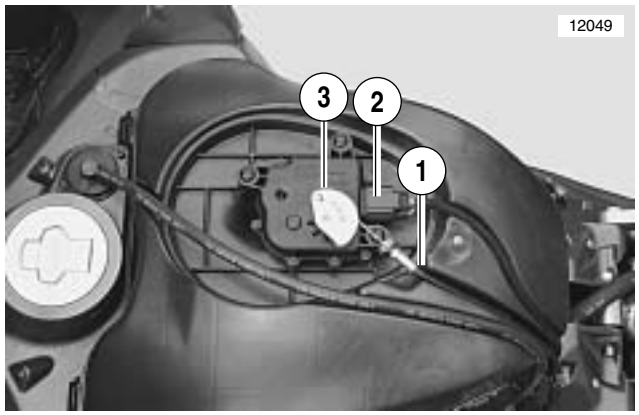
REMOVAL

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.
9. Disconnect connector [161B] from actuator.
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.



1. **ICM connector [10]**
2. **ICM connector [11]**
3. **Negative battery cable**
4. **Battery and actuator ground**
5. **Active muffler connector [164]**

Figure 7-96. Harness and Cable Routing (XB12 Models)



1. **Interactive exhaust cable**
2. **Actuator connector [161B]**
3. **Interactive exhaust cable wheel**

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)

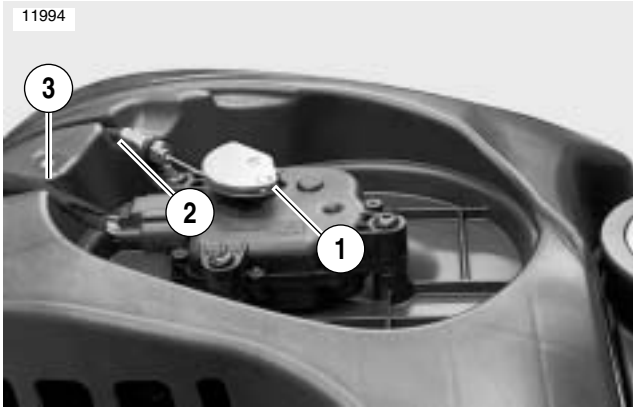
7. Install cooling fan. See 4.38 COOLING FAN.
8. Connect negative battery cable to battery terminal. Tighten fastener to 72-96 **in-lbs** (8-11 Nm).
9. Install intake cover. Tighten fasteners to 12-36 **in-lbs** (1.4-4.0 Nm).

⚠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)

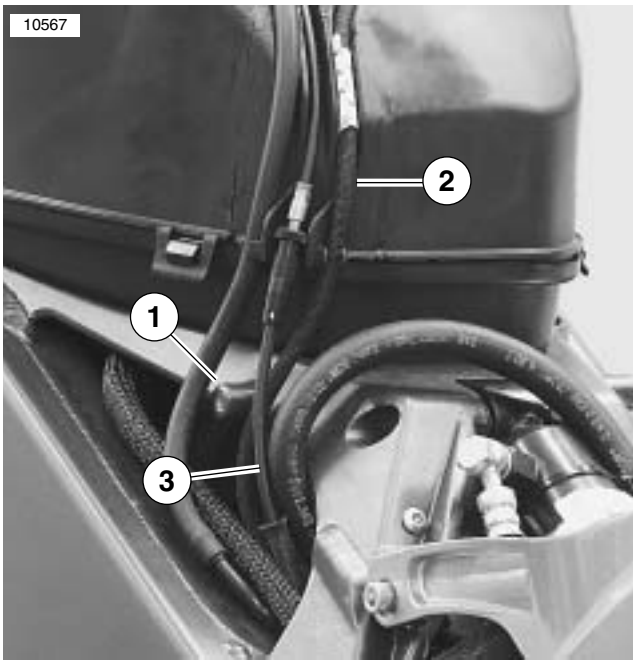
10. Install seat.

.



1. **Interactive exhaust actuator cable wheel**
2. **Cable and bracket**
3. **Wire harness**

Figure 7-98. Interactive Exhaust Actuator



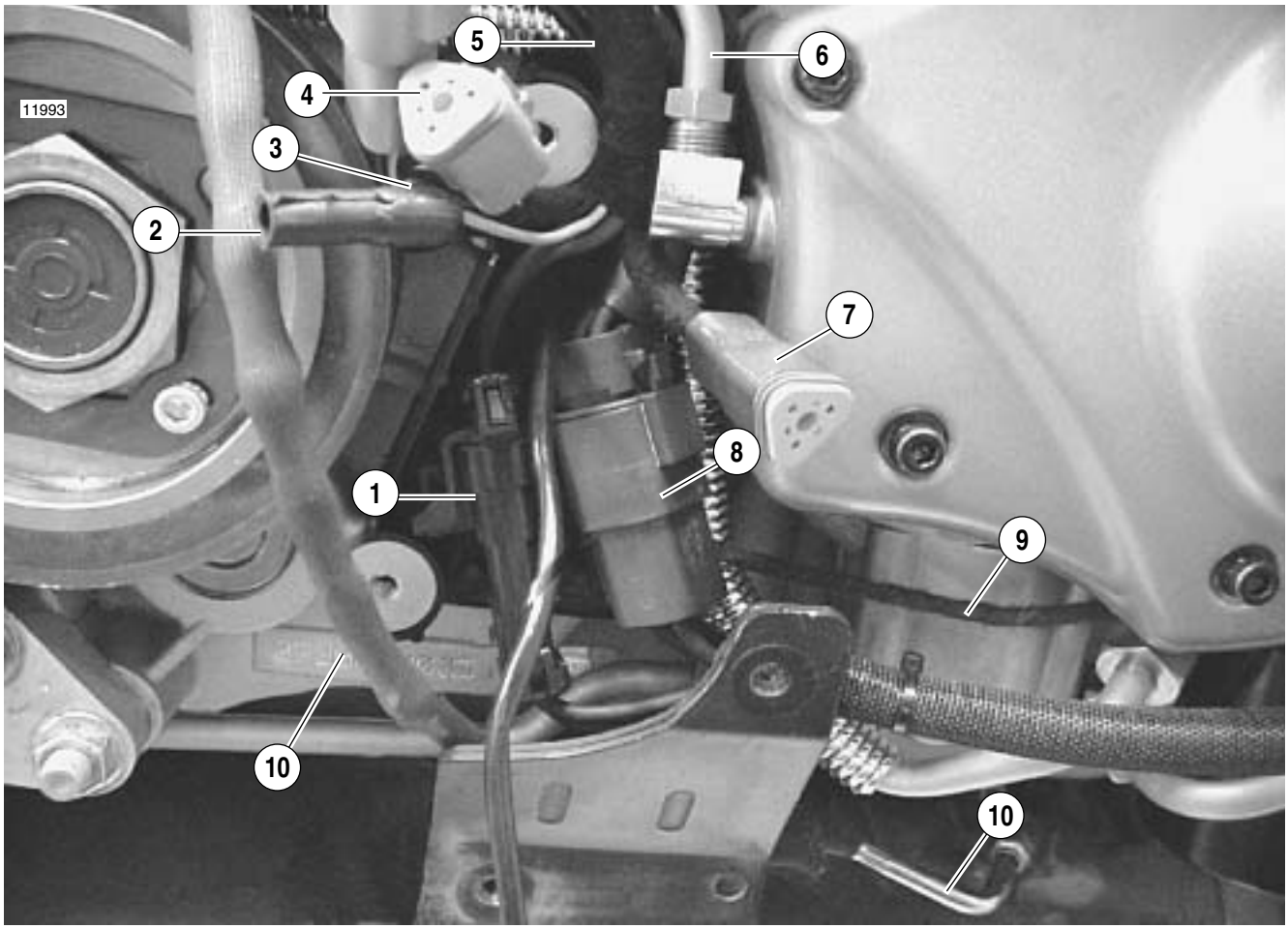
1. **Frame lug**
2. **Wire harness**
3. **Cable**

Figure 7-99. Correct Cable Routing Behind Frame Lug

SPROCKET COVER WIRING 7.26

GENERAL

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.



1. Voltage regulator connector [77]
2. Neutral switch connector [131]
3. Neutral switch location
4. Vehicle speed sensor connector [65]
5. Main harness
6. Gear cover vent line
7. Cam position sensor connector [14]
8. Stator connector [46]
9. Oil pressure switch wiring
10. Interactive exhaust cable

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

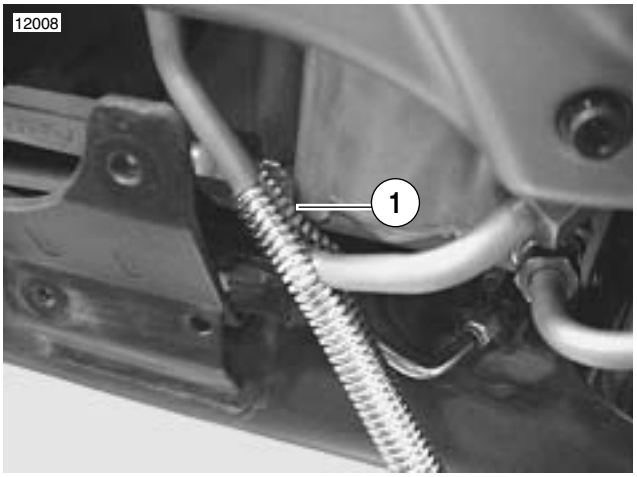
See *Figure 7-101. Convolute covering the return oil line should have the seam rotated to the back side of the oil line away from wiring.*

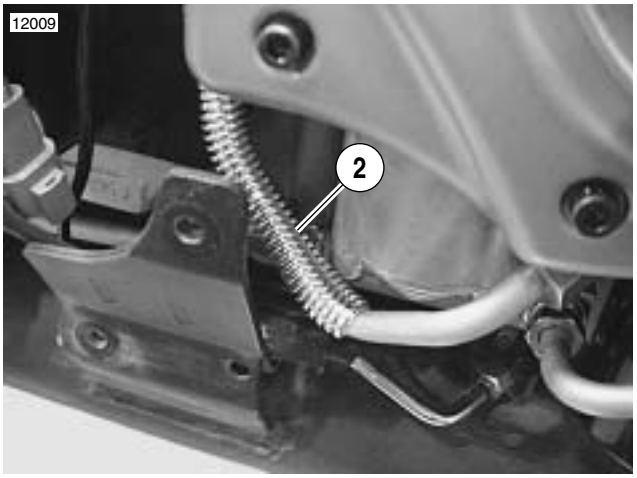
1. Route the vehicle speed sensor wiring behind the starter trigger wire and secure in place with a cable strap.
2. See Figure 7-100. Route oil pressure switch wiring (9) from main harness (5), to oil pressure switch located on front of engine and connect to the oil pressure switch.

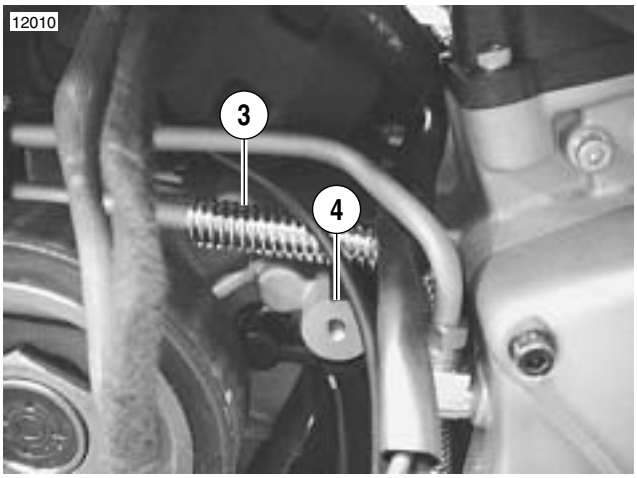
NOTES

- *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).







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

Figure 7-101. Convoluted Covering for Oil Return Line

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.

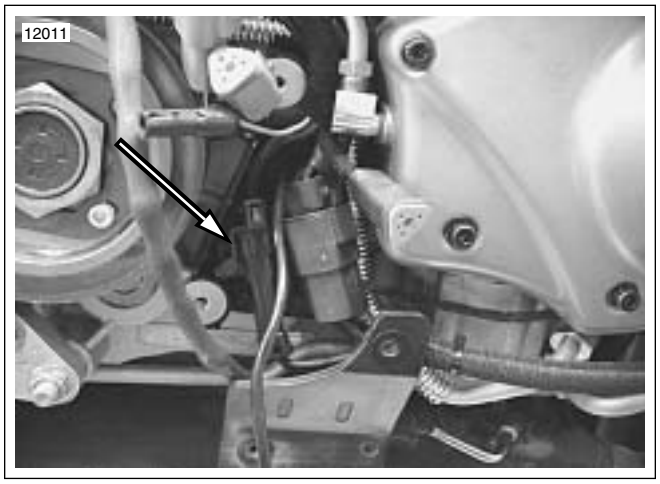


Figure 7-102. Voltage Regulator Connector Latch



Figure 7-103. Cable Strap Locations

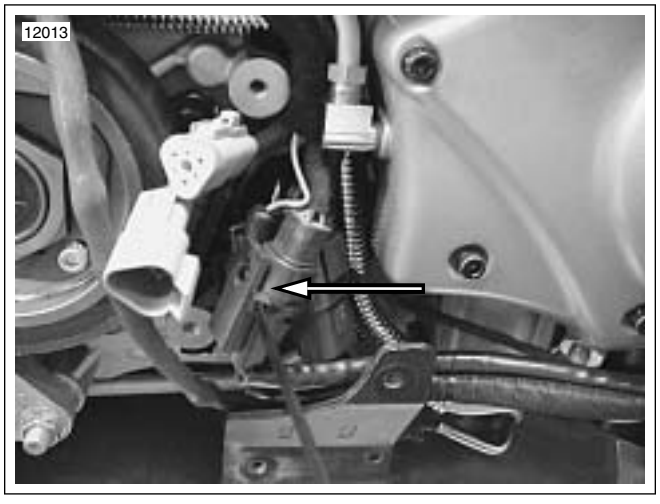


Figure 7-104. Cam Position Sensor Connector with Cable Strap

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.

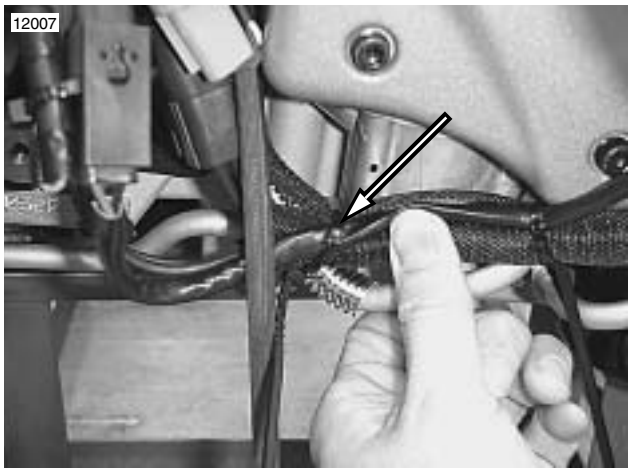


Figure 7-105. Cable Strap Wire Bundle to Return Oil Line

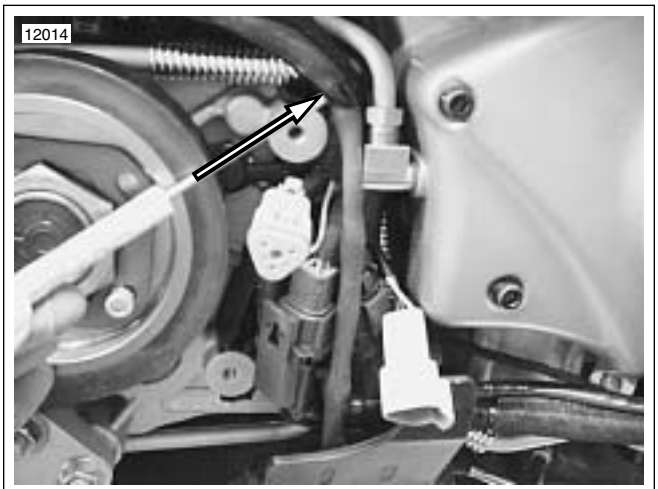


Figure 7-106. Cable Strap Wire Bundle to Return Oil Line, Upper Part of Sprocket Cover

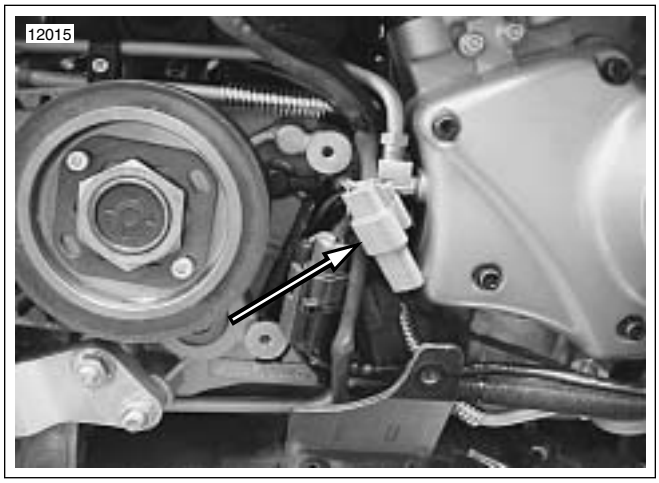
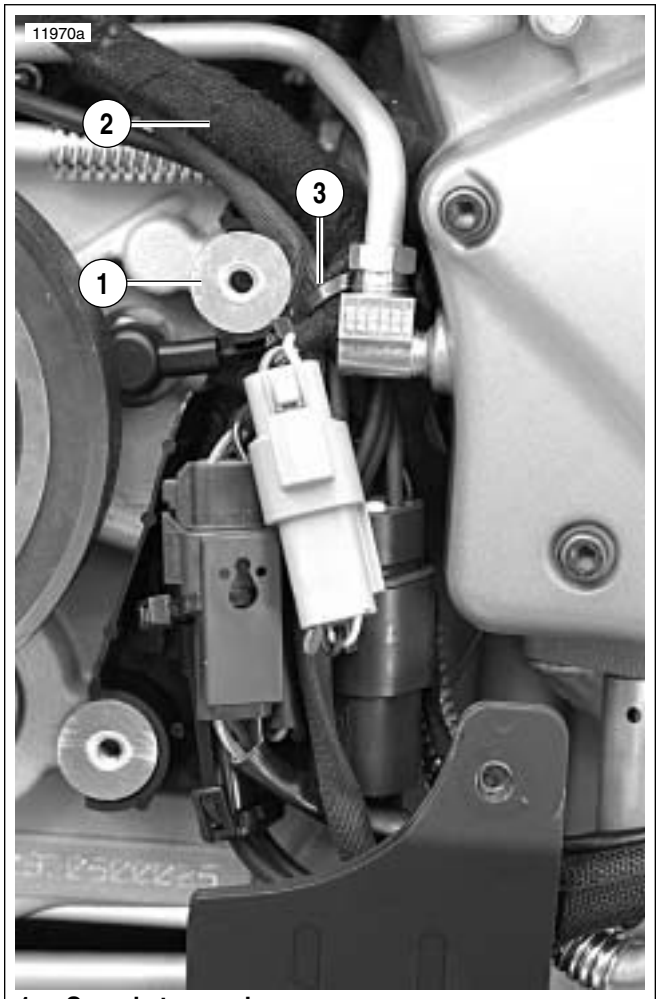


Figure 7-107. Vehicle Speed Sensor



1. **Sprocket cover boss**
2. **Main harness**
3. **Cable strap securing main harness wiring**

Figure 7-108. Correct Location for Sprocket Cover Wiring

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APPENDIX