2002 BUELL S3T

SERVICE MANUAL

Part Number 99489-02Y

Section 1: Maintenance

Section 2: Chassis

Section 3: Engine

Section 4: Fuel System

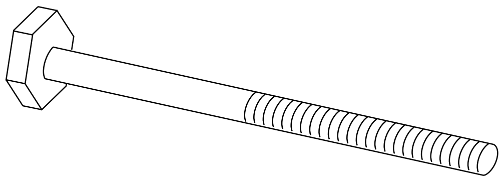
Section 5: Starter

Section 6: Drive/Transmission

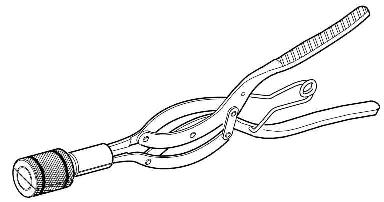
Section 7: Electrical

Appendix

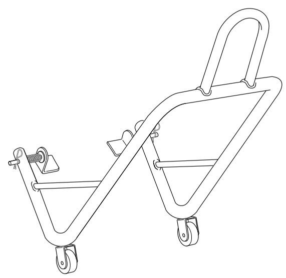
APPENDIX A–TOOLS



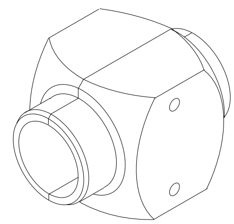
Part No. B-35316-5 12 Inch Bolt.
Used with Part No. HD-39302.



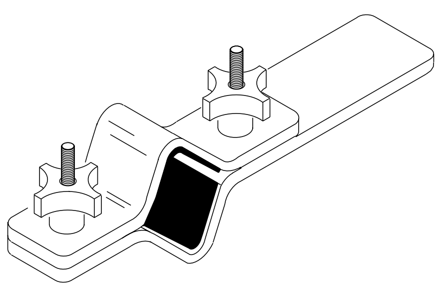
Part No. B-42887 Brake Caliper Piston Remover



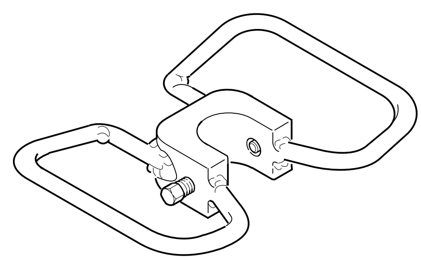
Part No. B-41174 Rear Wheel Support Stand and
Part No. B-41174-2 Replacement Pad



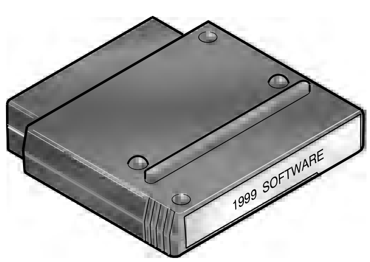
Part No. B-43721 Front Fork Seal Driver



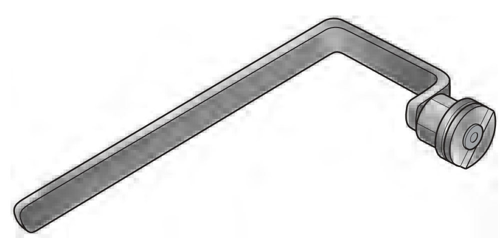
Part No. B-41177 Front Fork Holding Tool



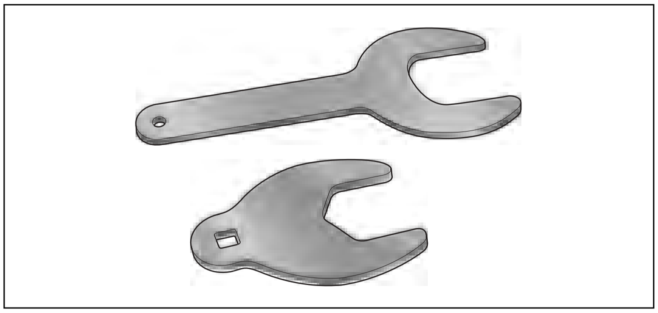
Part No. B-43875 Fork Spring Compressor



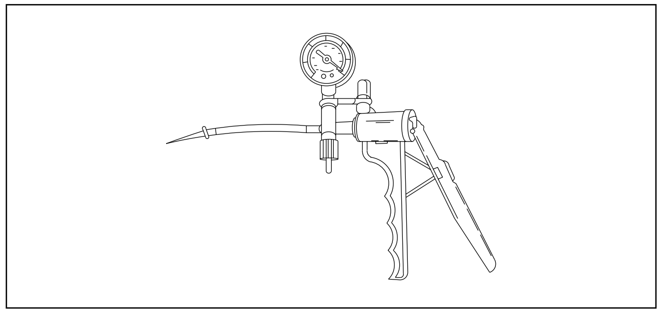
Part No. B-41325-99 Scanalyzer Software Cartridge



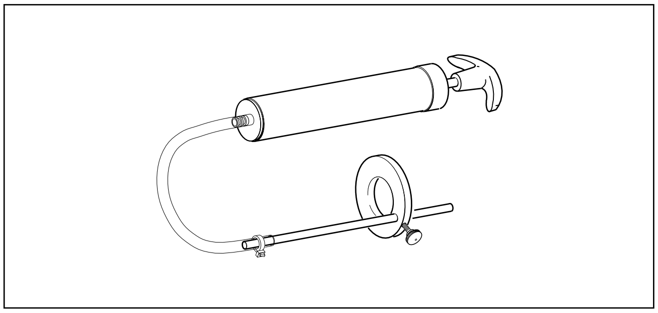
Part No. B-44623 Isolator Tool



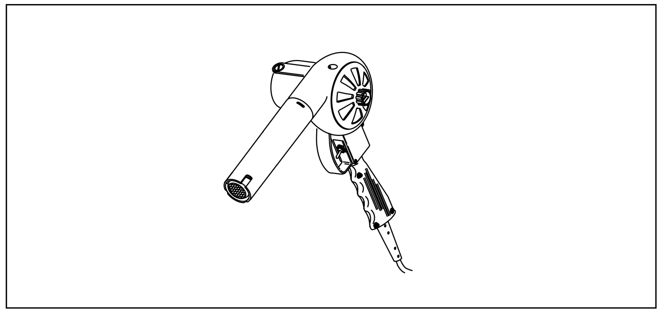
Part No. B-45110 Shock Preload Adjustment Tools



Part No. HD-23738 Vacuum Pump



Part No. B-59000A Pro Level Oil Gauge



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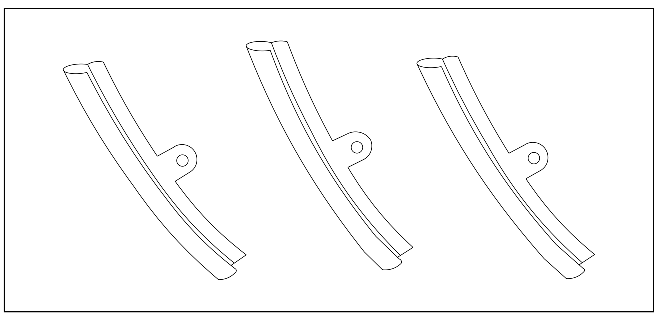
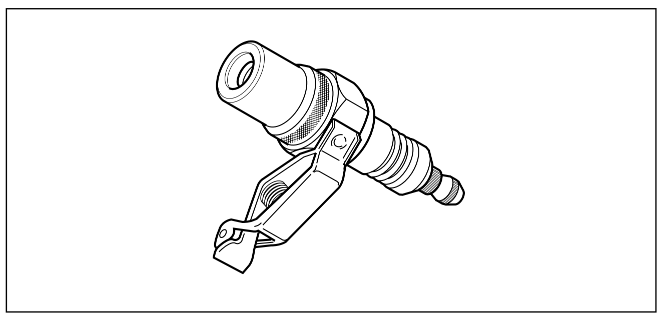
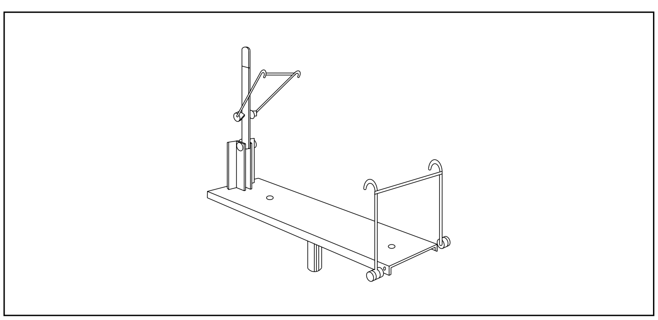


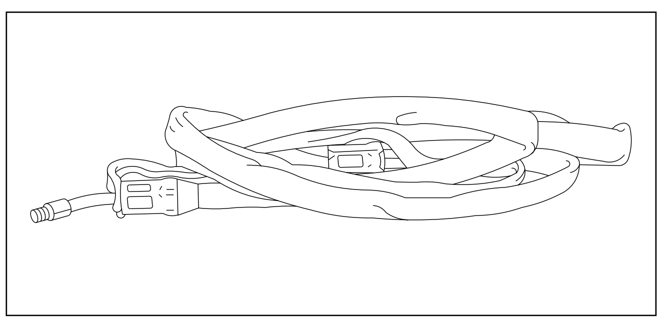
Part No. HD-01289 Rim Protectors



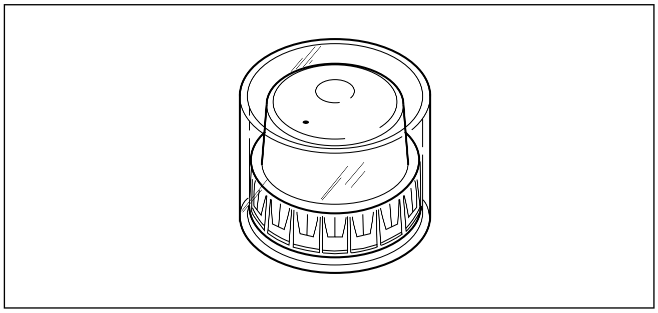
Part No. HD-26792 Spark Plug Tester



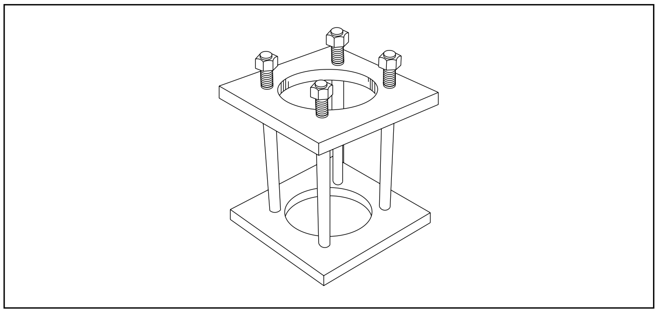
Part No. HD-21000 Tire Spreader



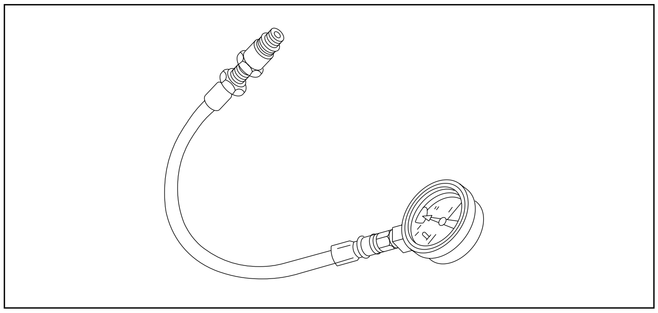
Part No. HD-28700 Tire Bead Expander



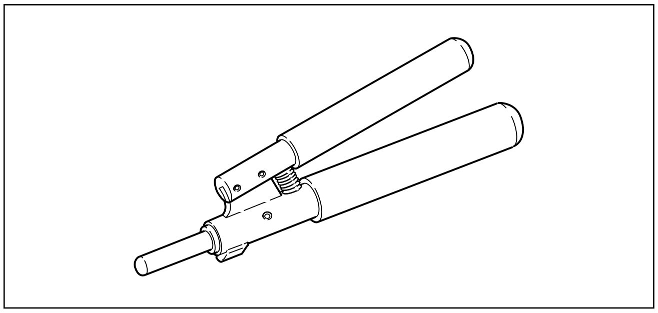
Part No. HD-33067 Wheel Bearing Packer



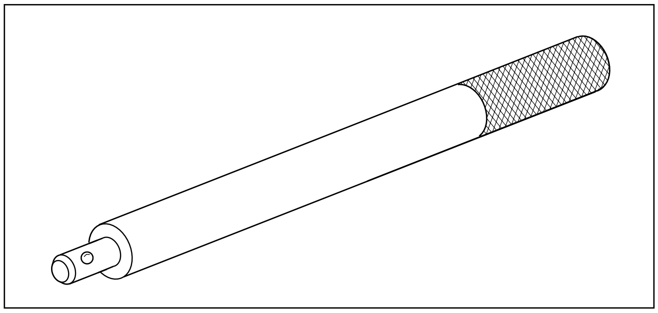
Part No. HD-33446A Cylinder Torque Plates and Torque Plate Bolts Part No. HD-33446-86



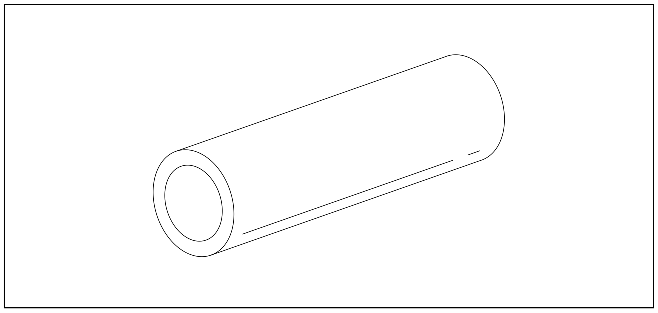
Part No. HD-33223-1 Cylinder Compression Gauge



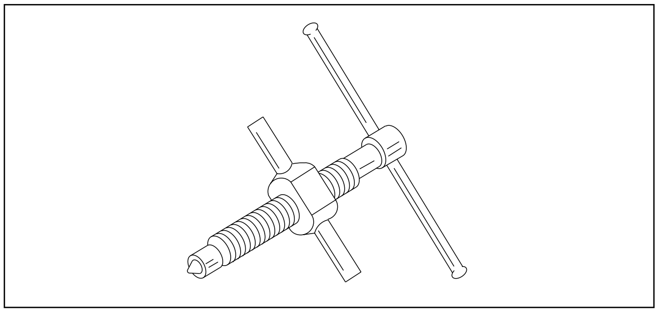
Part No. HD-34623B Piston Pin Retaining Ring Installer/Remover



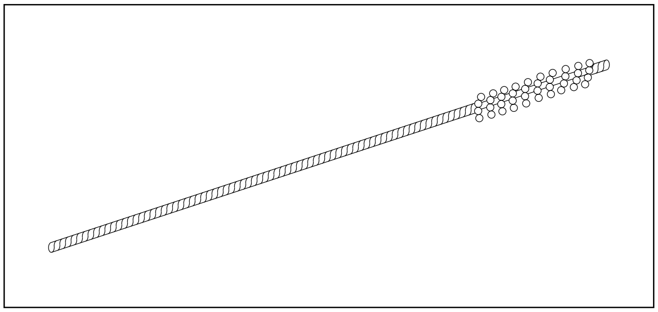
Part No. HD-33416 Universal Driver Handle



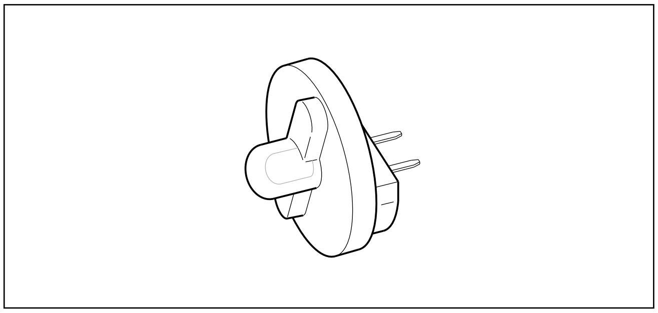
Part No. HD-34643A Shoulderless Valve Guide Seal Installer



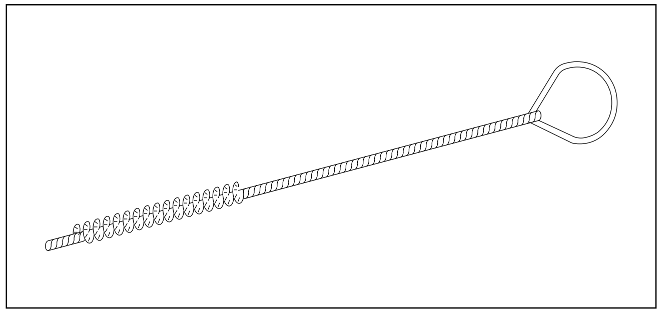
Part No. HD-33418 Universal Puller Forcing Screw



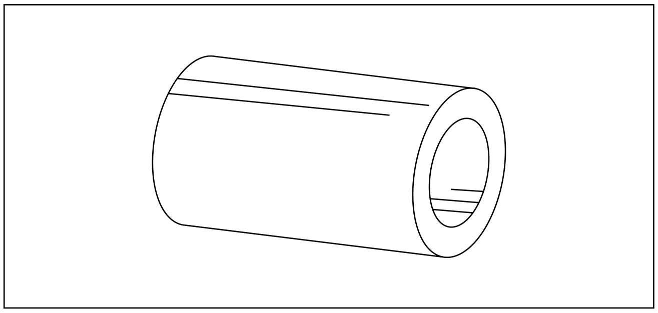
Part No. HD-34723 Valve Guide Hone (8 mm)



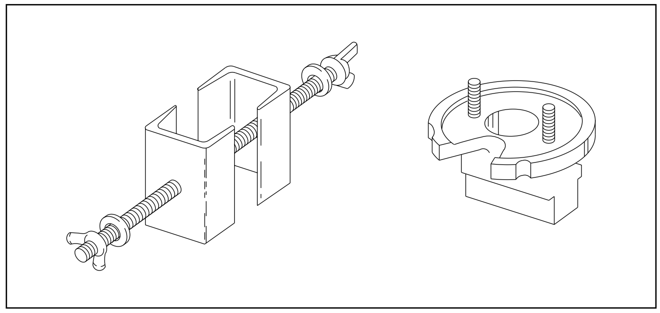
Part No. HD-34730-2C Fuel Injector Test Lamp



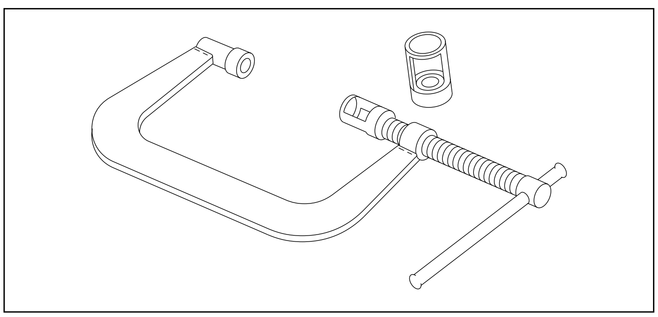
Part No. HD-34751 Nylon Valve Guide Brush



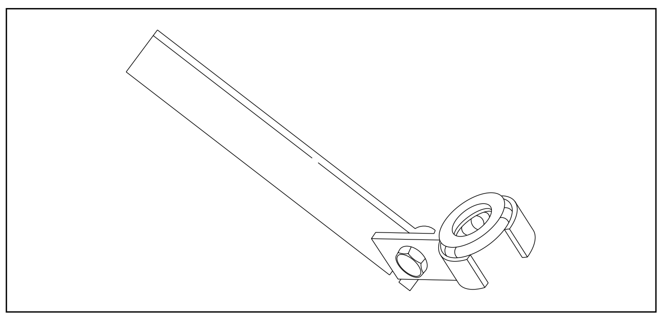
Part No. HD-34731 Shoulderless Valve Guide Installation Tool



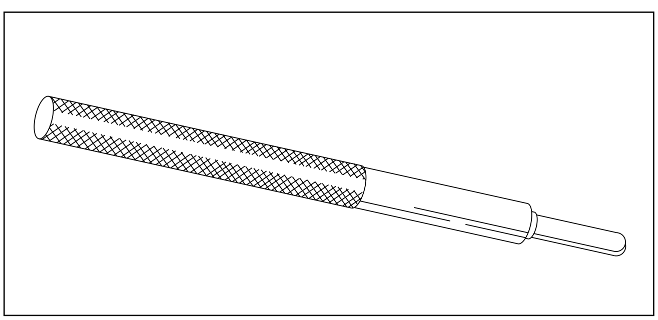
Part No. HD-34813 Rowe Flywheel Rebuilding Jig



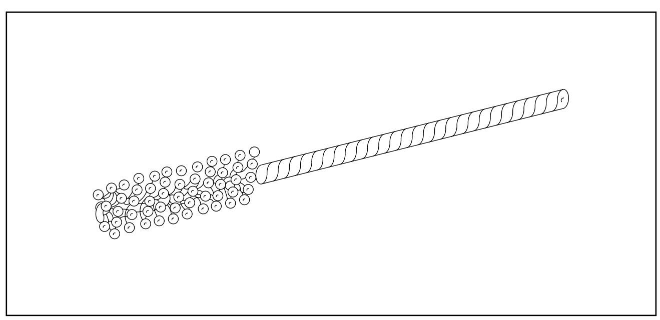
Part No. HD-34736B Valve Spring Compressor



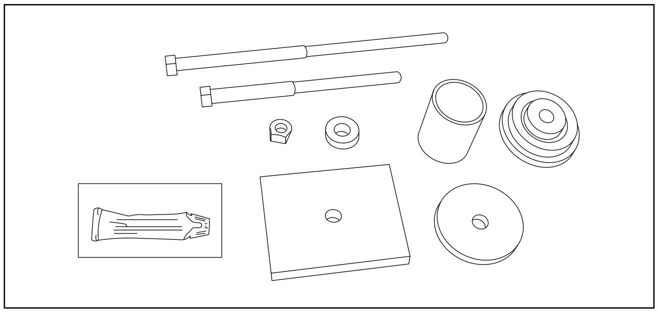
Part No. HD-34816 Oil Pressure Switch Wrench



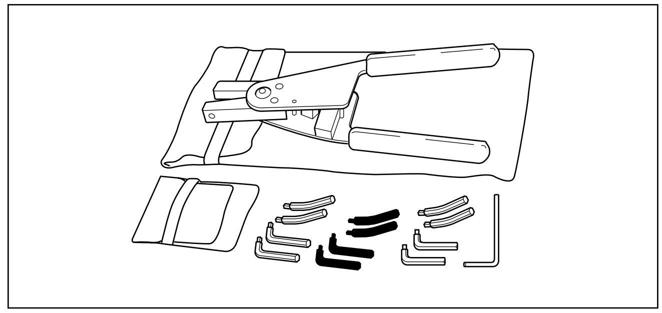
Part No. HD-34740 Driver Handle and Remover. Used with HD-34643A and HD-34731.



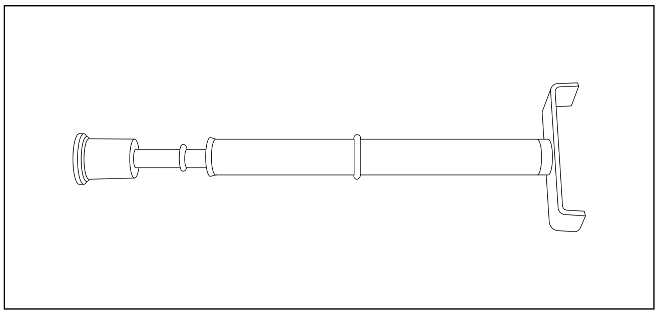
Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)



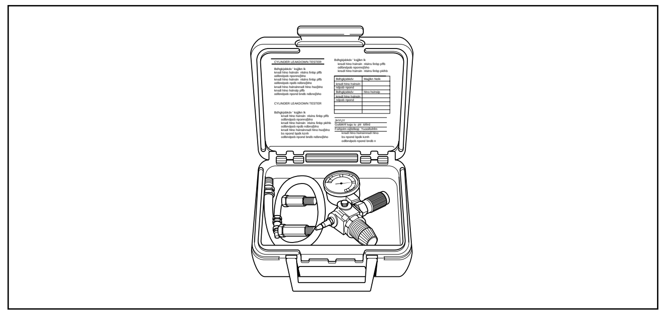
Part No. HD-35316-A Main Drive Gear Remover/Installer and Main Drive Gear Bearing Installer



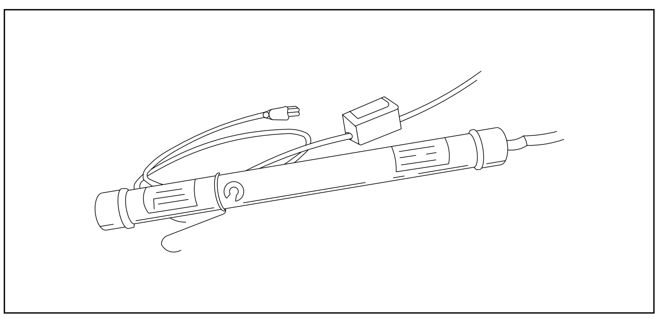
Part No. HD-35518 Internal/External Retaining Ring Pliers



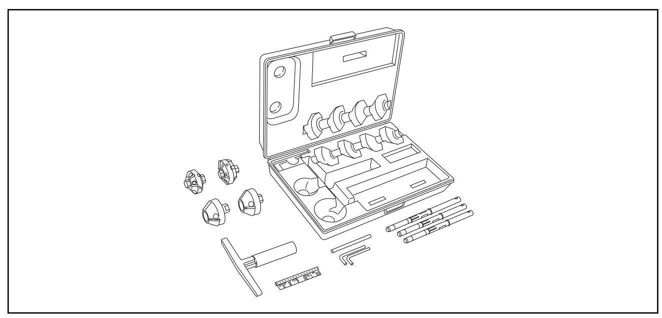
Part No. HD-35381 Belt Tension Gauge



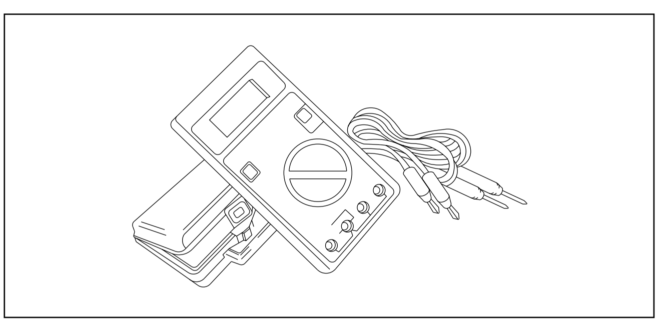
Part No. HD-35667A Cylinder Leakdown Tester



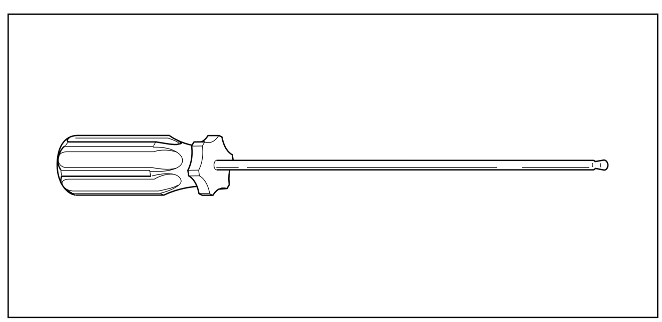
Part No. HD-35457 Black Light Leak Detector



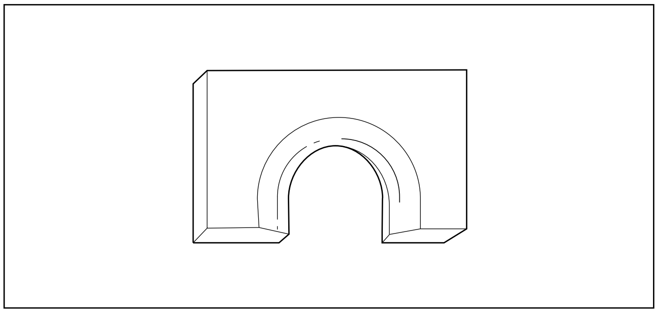
Part No. HD-35758A Neway Valve Seat Cutter Set



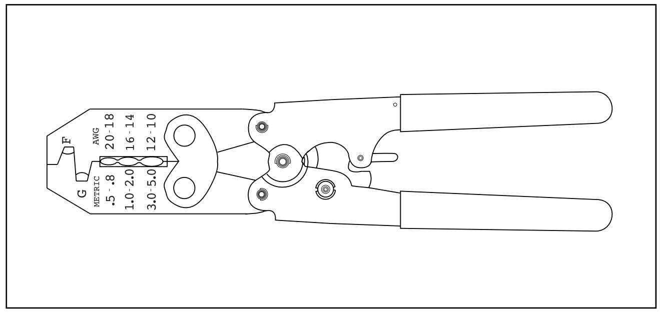
Part No. HD-35500A Digital Multi-Meter (FLUKE 23)



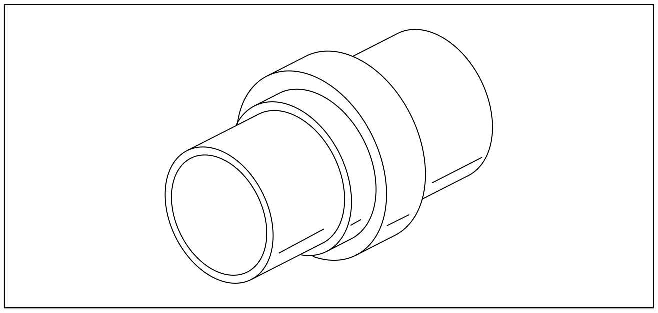
Part No. HD-35801 Intake Manifold Screw Wrench



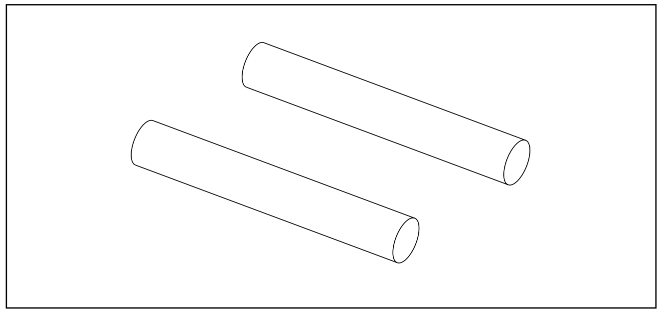
Part No. HD-37404 Countershaft Gear Support Plate



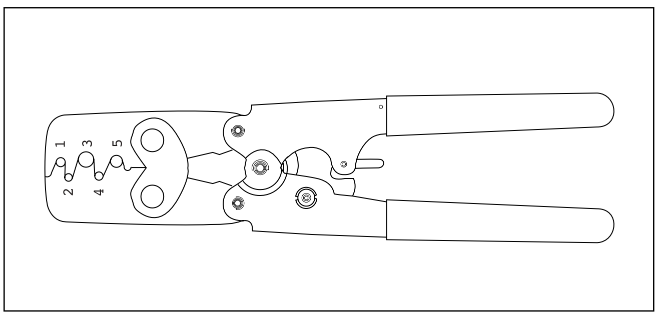
Part No. HD-38125-8 Packard Terminal Crimp Tool



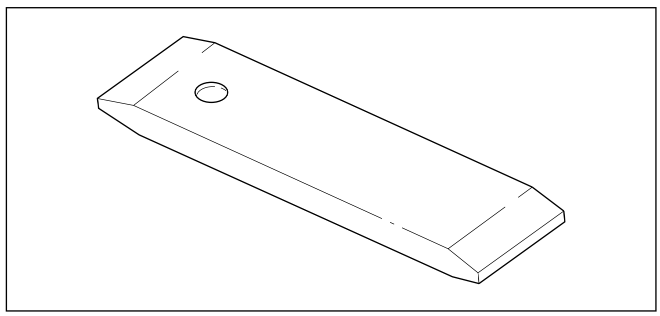
Part No. HD-37842A Inner/Outer Main Drive Gear Needle Bearing Installer



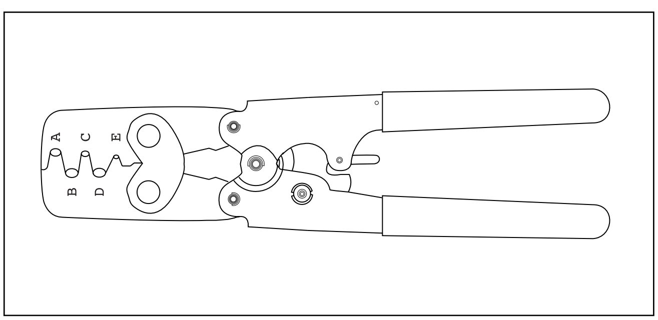
Part No. HD-38361 Cam Gear Gauge Pin Set (0.108 in. (2.74 mm) Diameter)



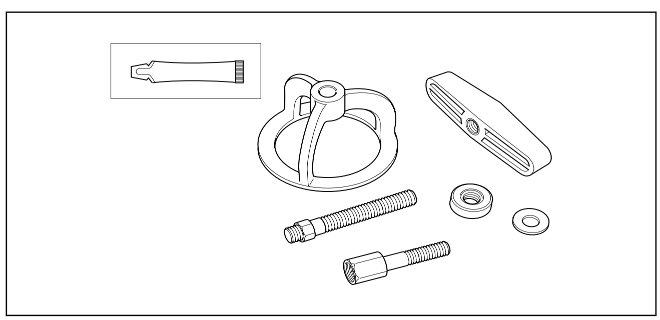
Part No. HD-38125-6 Packard Terminal Crimp Tool (Sealed and non-sealed connectors)



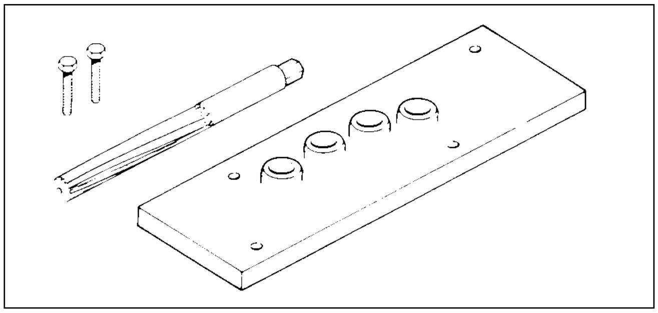
Part No. HD-38362 Sprocket Locking Link



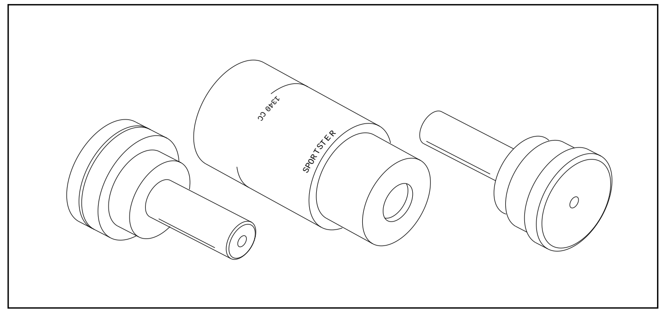
Part No. HD-38125-7 Packard Terminal Crimp Tool (Sealed connectors)



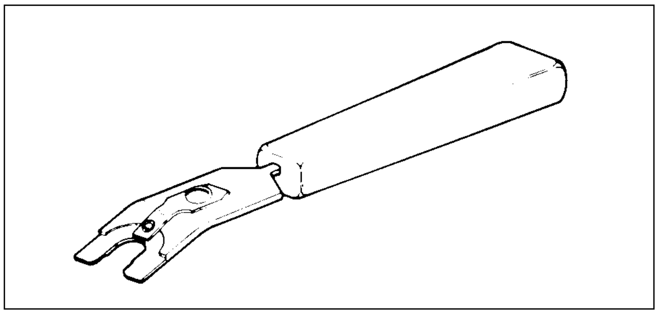
Part No. HD-38515-A Clutch Spring Compressing Tool and Part No. HD-38515-91 Forcing Screw



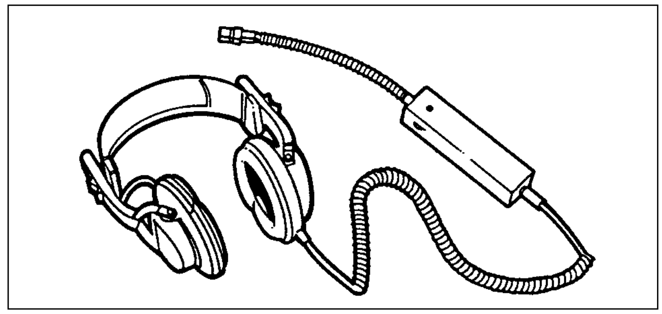
Part No. HD-38871 Camshaft Bushing Plate Pilot and Reamer



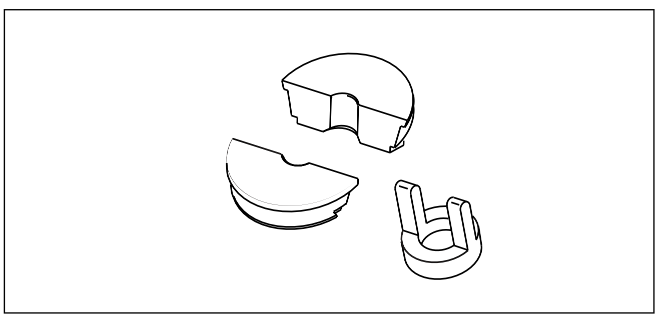
Part No. HD-39458 Sprocket Shaft Bearing Outer Race Installer



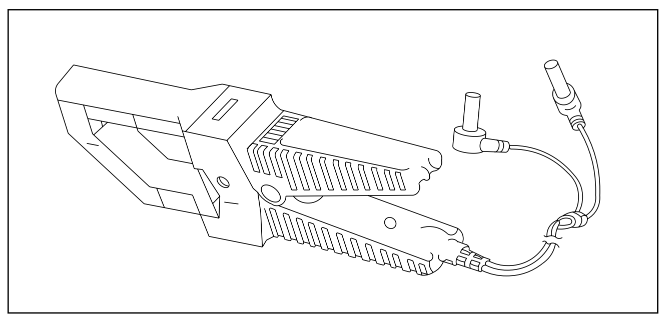
Part No. HD-39151 Shift Drum Retaining Ring Installer



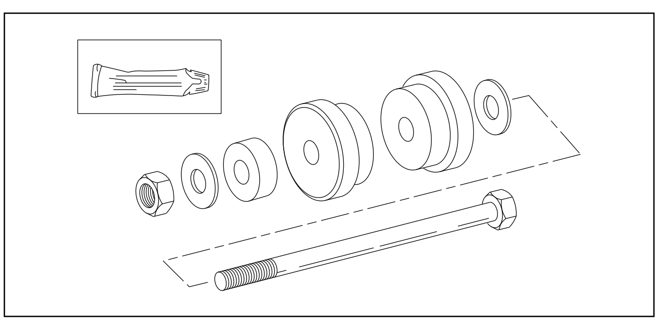
Part No. HD-39565 Engine Sound Probe



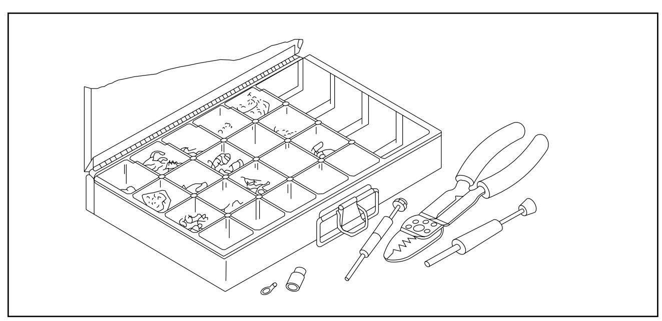
Part No. HD-39301A Steering Head Bearing Race Remover



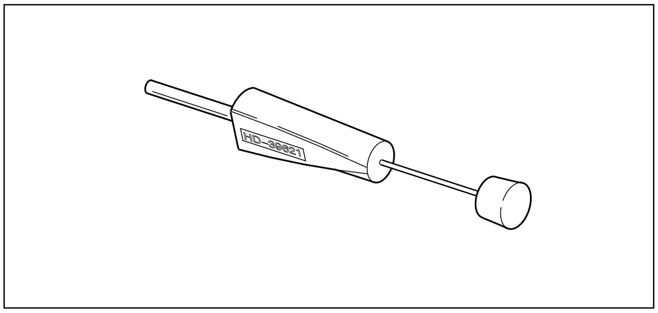
Part No. HD-39617 Inductive Amp Probe. Use with HD-35500A.



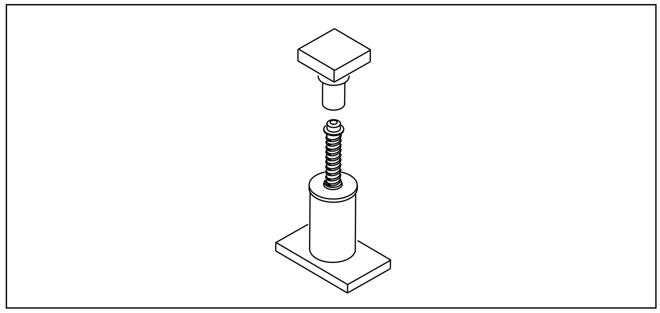
Part No. HD-39302 Steering Head Bearing Race Installer



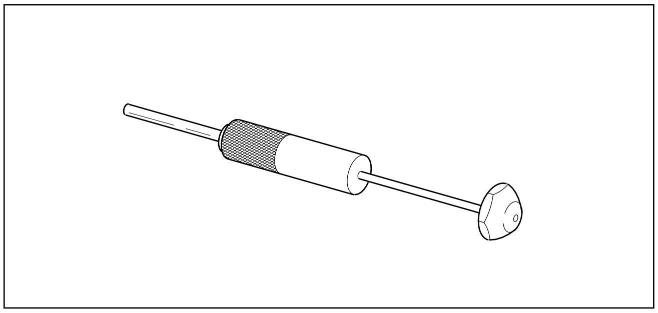
Part No. HD-39621 Electrical Terminal Repair Kit



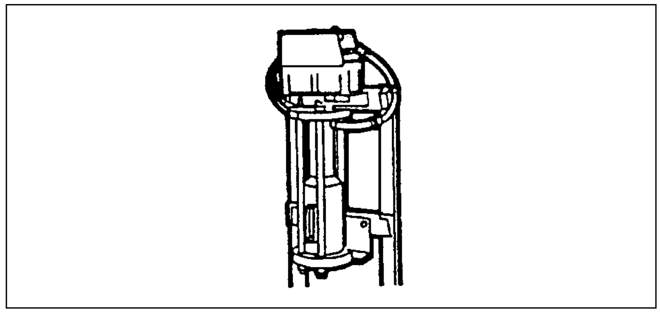
Part No. HD-39621-27 Socket Terminal Remover



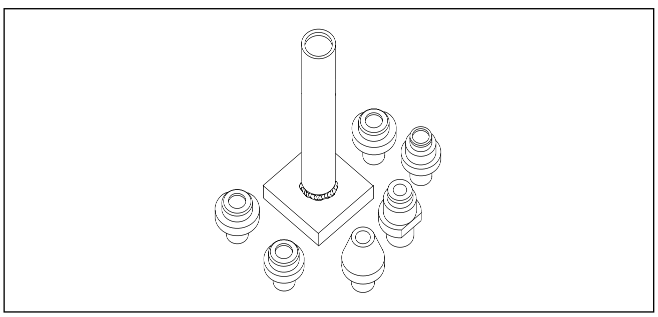
Part No. HD-39800 Oil Filter Crusher, Small



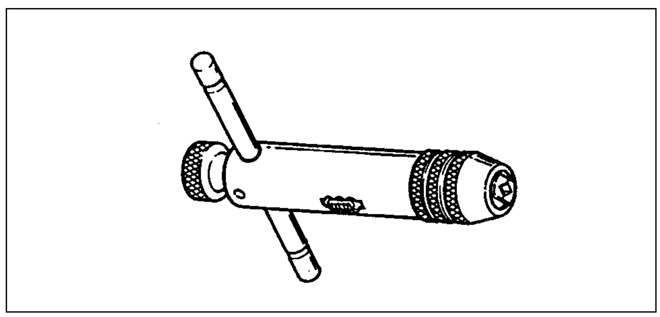
Part No. HD-39621-28 Pin Terminal Remover



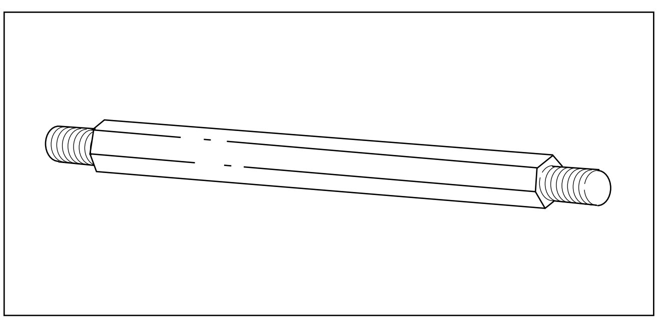
Part No. HD-39823 Oil Filter Crusher, Large



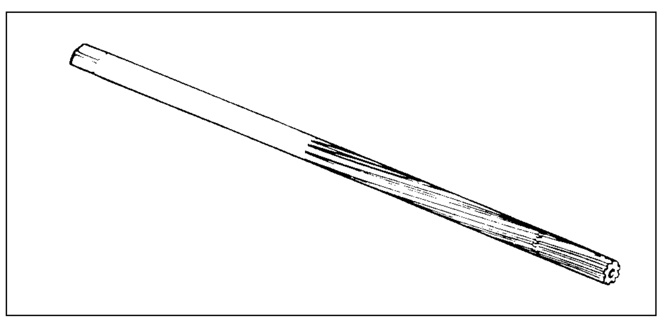
Part No. HD-39782 Cylinder Head Support



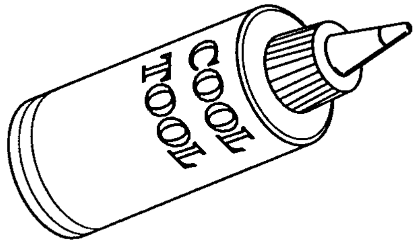
Part No. HD-39847 Universal Ratcheting Tap/ Reamer Handle



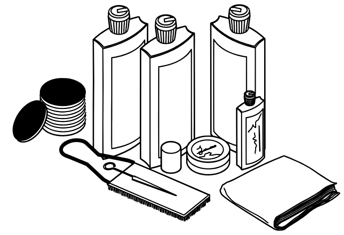
Part No. HD-39786 Cylinder Head Holding Fixture



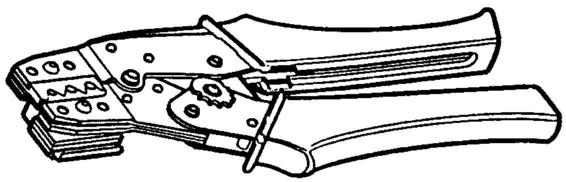
Part No. HD-39932 (Steel) or HD-39932-CAR (Carbide) Intake and Exhaust Valve Guide Reamer



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



Part No. HD-39994 Paint Repair Kit



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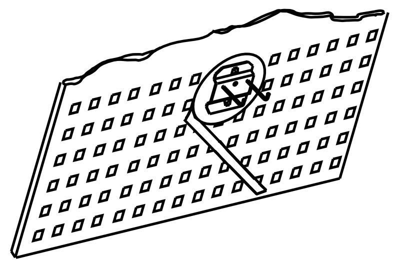

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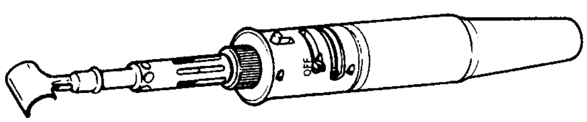

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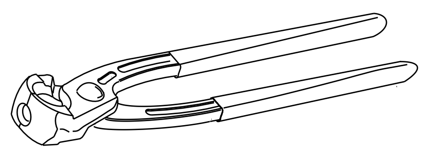
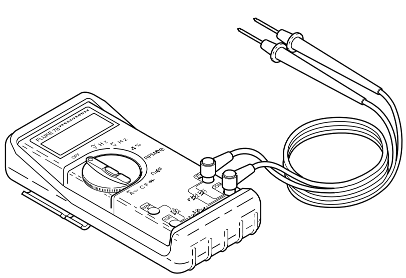


Part No. HD-41137 Hose Clamp Pliers



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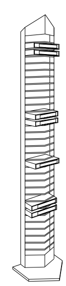

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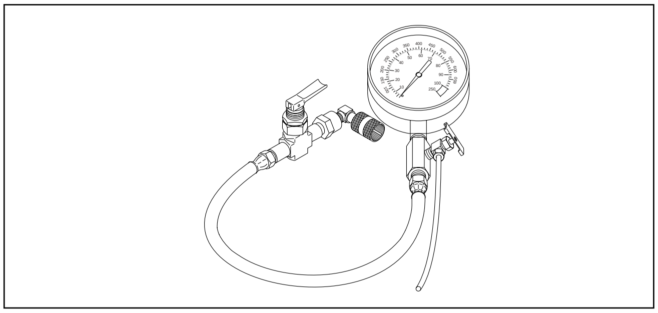

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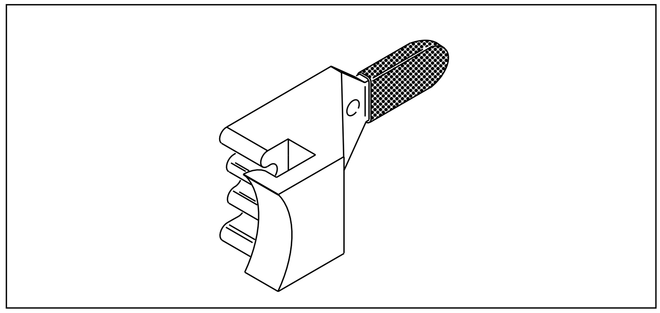

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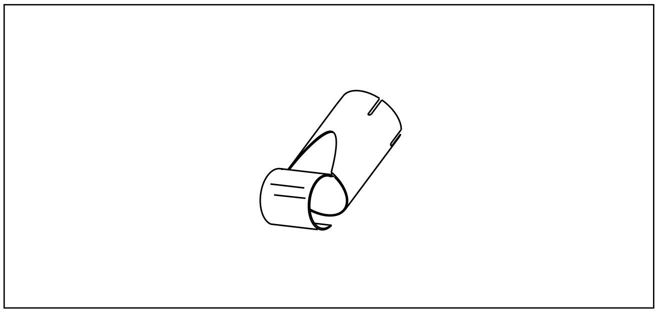

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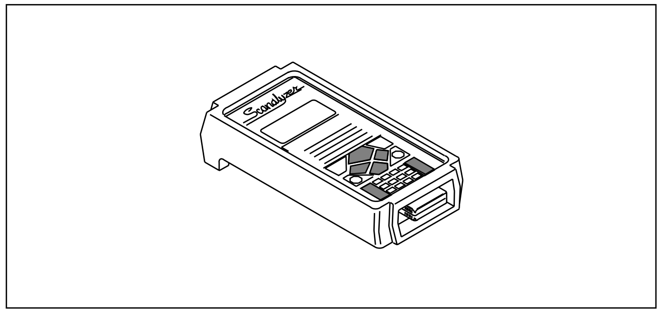
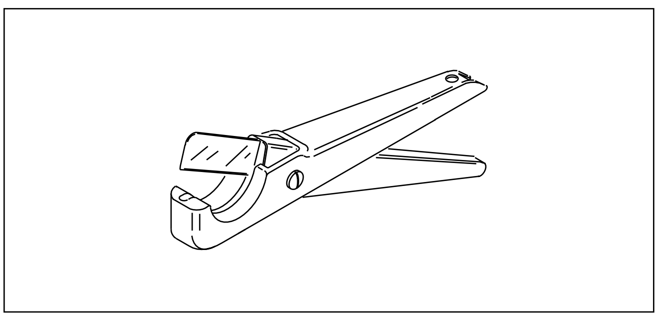
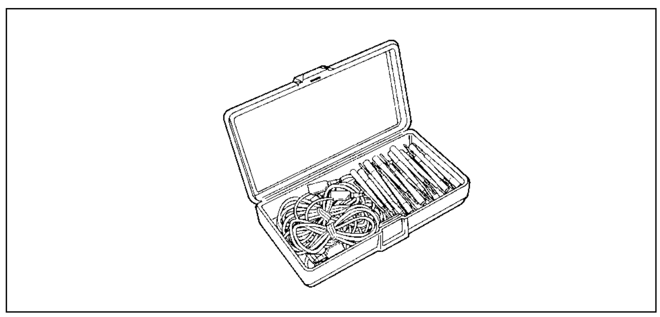
Use with Part No. HD-25070.



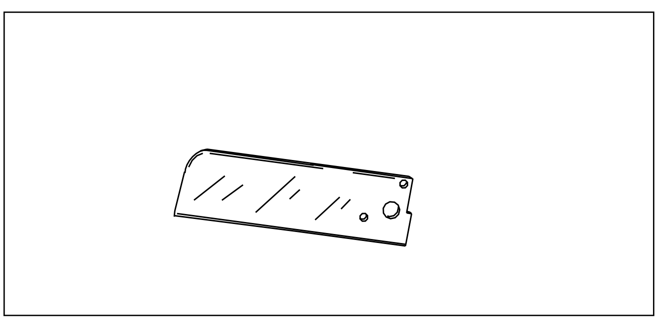
Part No. HD-41325 Scanalyzer and
Part No. HD 41325-99 Cartridge



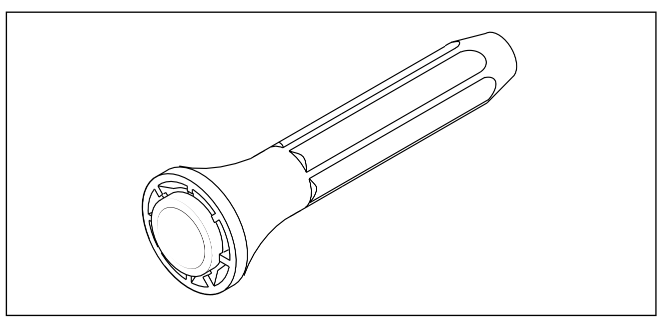
Part No. HD-41185 Hose Cutting Tool



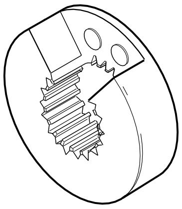
Part No. HD-41404 Test Connector Kit



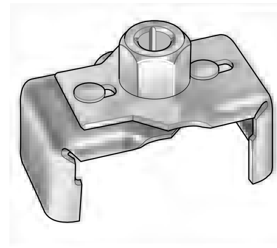
Part No. HD-41185-1 Oil Hose Cutter



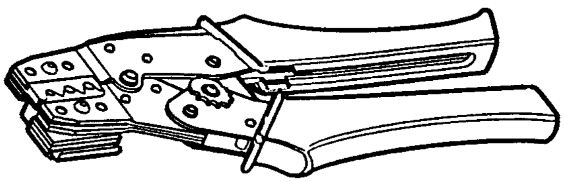
Part No. HD-41496 Main Drive Gear Seal Installer



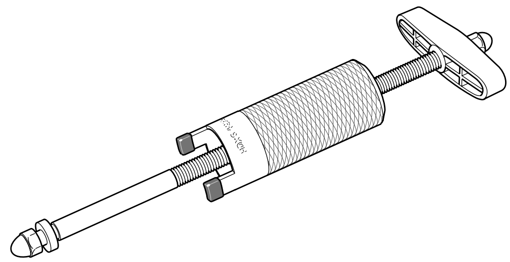
Part No. HD-41506 Crankshaft Locking Tool



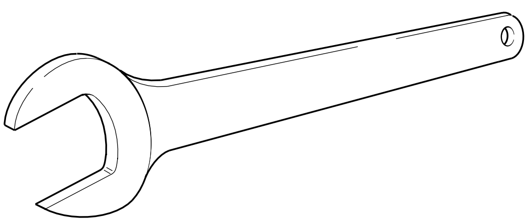
Part No. HD-42311 Oil Filter Wrench



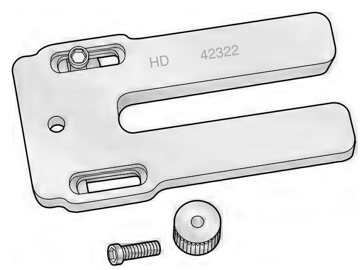
Part No. HD-41609 Amp Terminal Crimp Tool



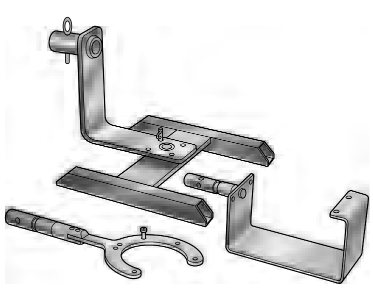
Part No. HD-42320 Piston Pin Remover/Installer



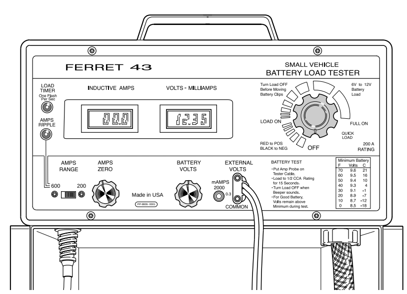
Part No. HD-41675 Oil Pressure Sending Unit Wrench



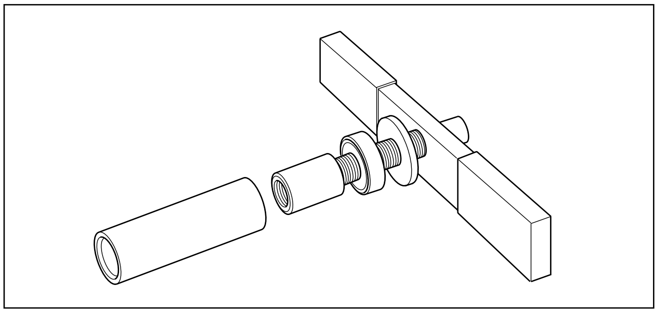
Part No. HD-42322 Piston Support Plate



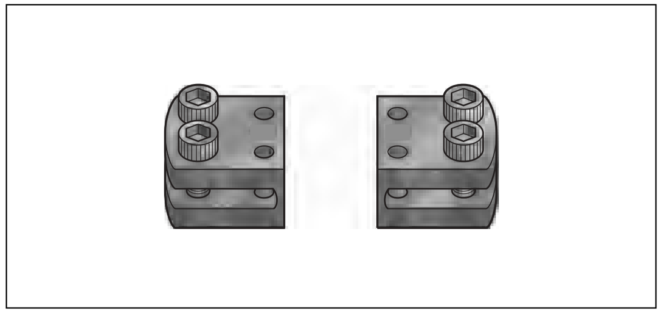
Part No. HD-42310 Engine/Transmission Stand



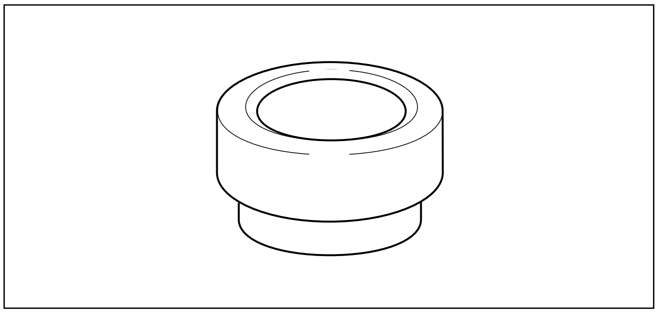
Part No. HD-42376 Battery/Charging System Load Tester



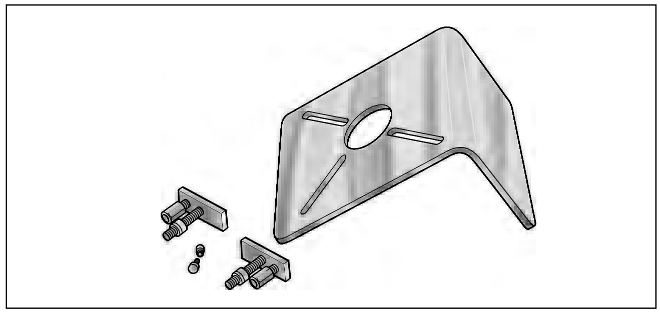
Part No. HD-42579 Sprocket Bearing/Seal Installer



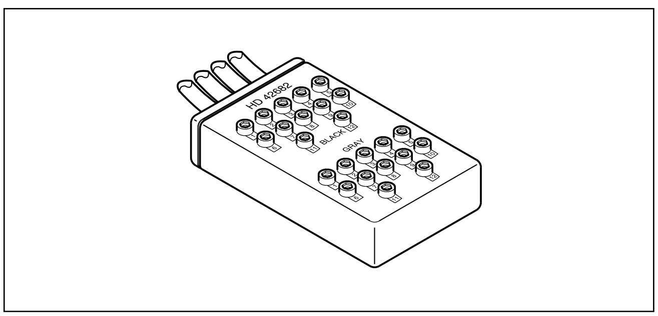
Part No. HD-44069 Timken Snap Ring Remover/Installer



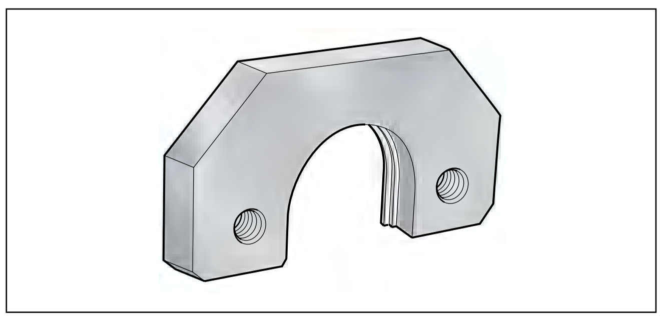
Part No. HD-42774 Sprocket Shaft Seal Installer



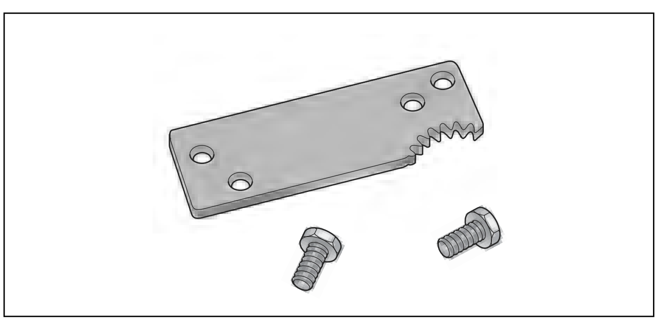
Part No. HD-44358 Flywheel Fixture (2000 Models)



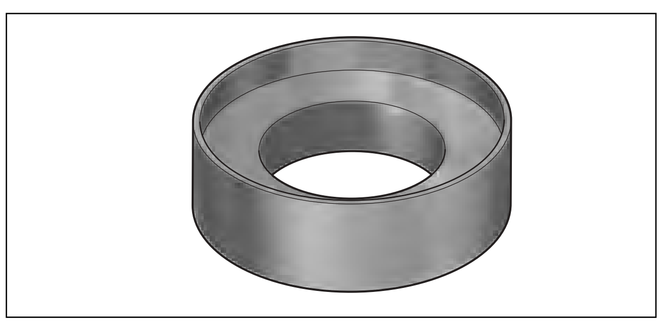
Part No. HD-42682 Breakout Box



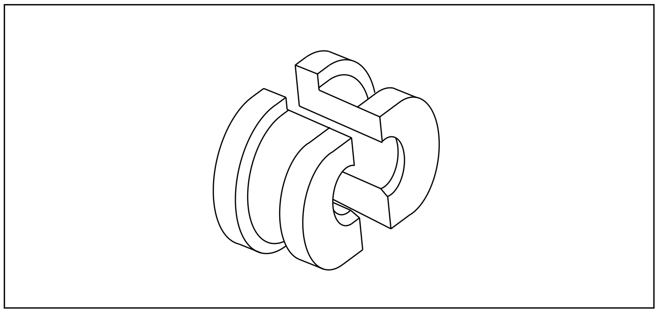
Part No. HD-44404 Sprocket Shaft Inner Timken Bearing Remover



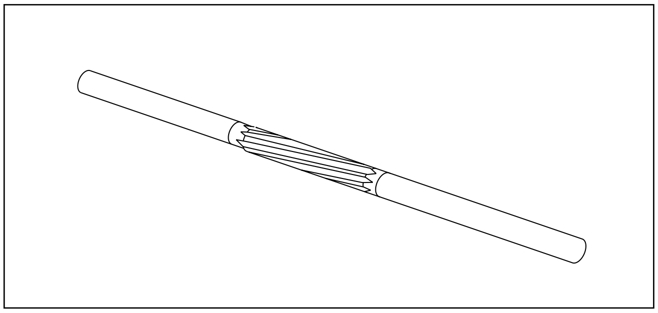
Part No. HD-43894 Crankshaft Locking Tool



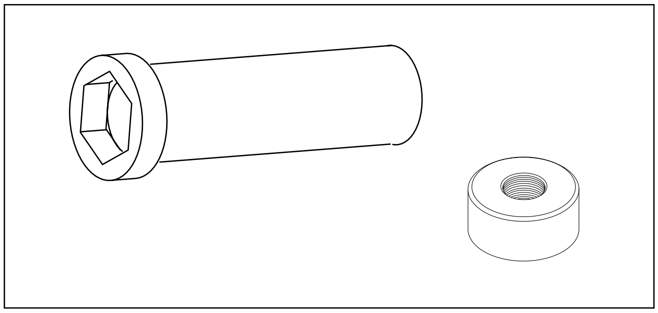
Part No. HD-45206 Sprocket Shaft Seal/Spacer Installer



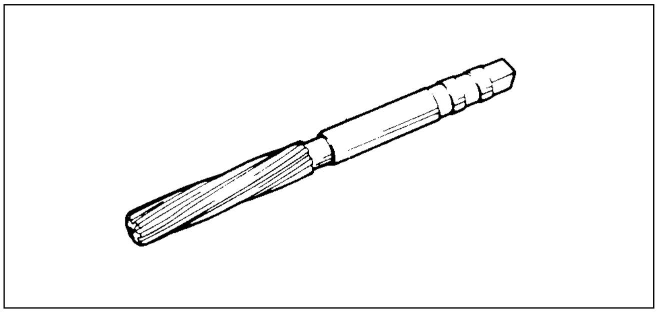
Part No. HD-94547-101 Crankshaft Bearing Outer Race Remover/Installer



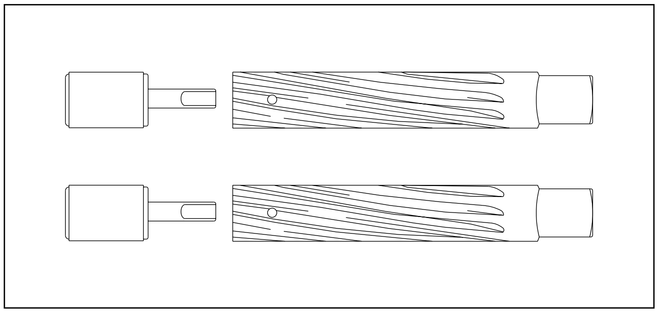
Part No. HD-94804-57 Rocker Arm Bushing Reamer



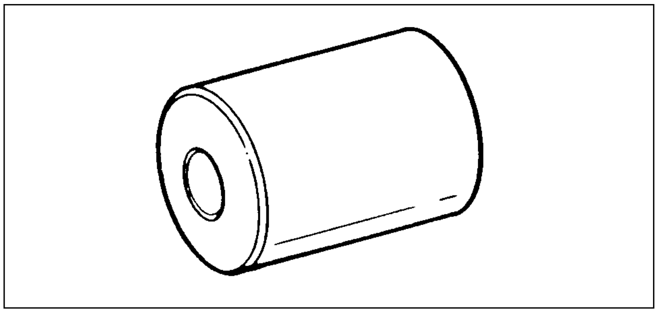
Part No. HD-94660-37B Mainshaft Locknut Wrench



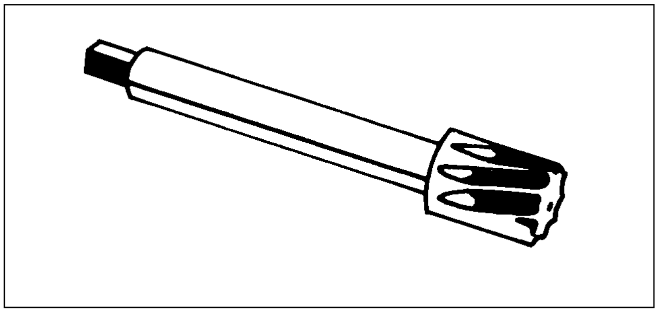
Part No. HD-94812-1 Pinion Shaft Bushing Reamer. Use with HD-94812-87.



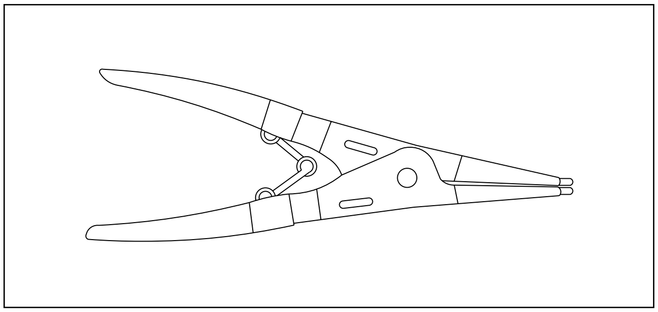
Part No. HD-94800-26A Connecting Rod Bushing Reamers and Pilots



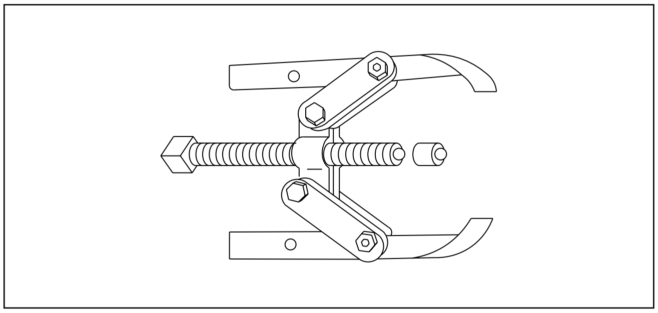
Part No. HD-94812-87 Pinion Shaft Reamer Pilot. Use with HD-94812-1.



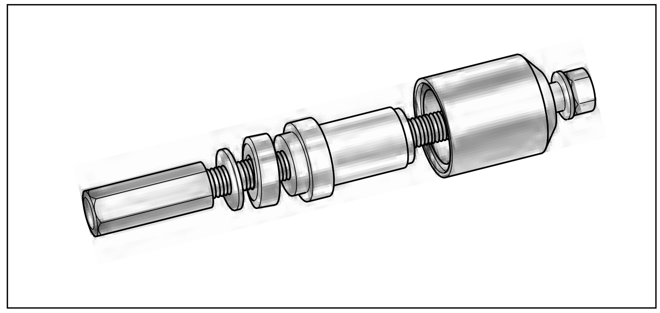
Part No. HD-94803-67 Rear Intake Camshaft Bushing Reamer



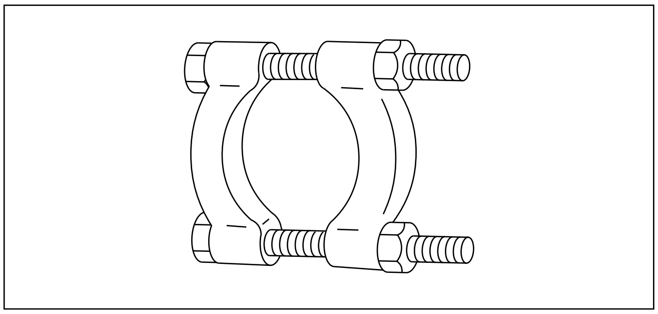
Part No. HD-95017-61 Large External Retaining Ring Pliers



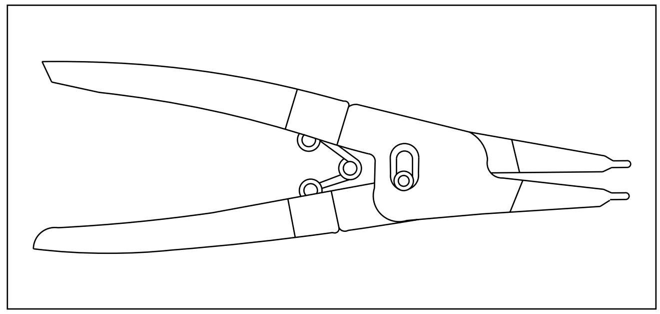
Part No. HD-95635-46 All-Purpose Claw Puller



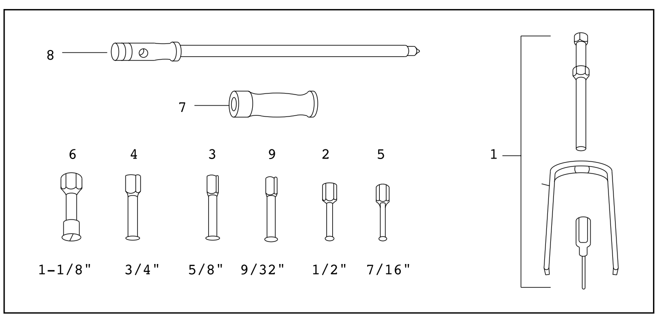
Part No. HD-95970-32D Piston Pin Bushing Tool



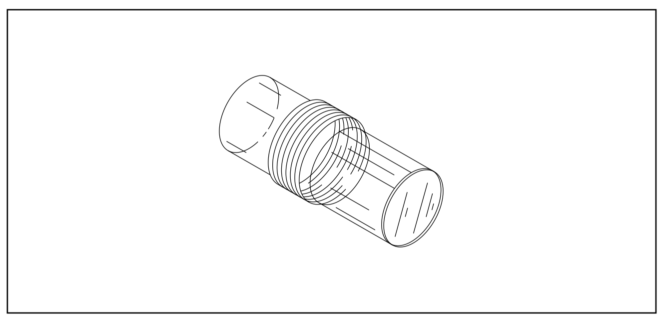
Part No. HD-95637-46A Wedge Attachment for Claw Puller. Use with HD-95635-46.



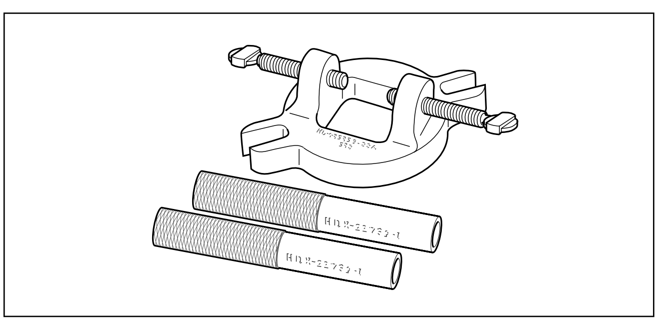
Part No. HD-96215-49 Small Internal Retaining Ring Pliers



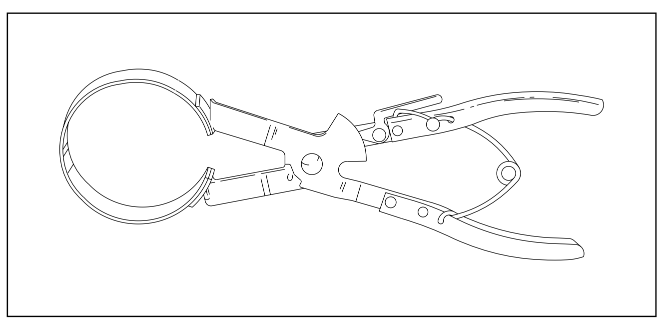
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-7. Items 8 (HD-95769-69), 9 (HD-95770-69) and 10 (HD-95771-69) are optional.



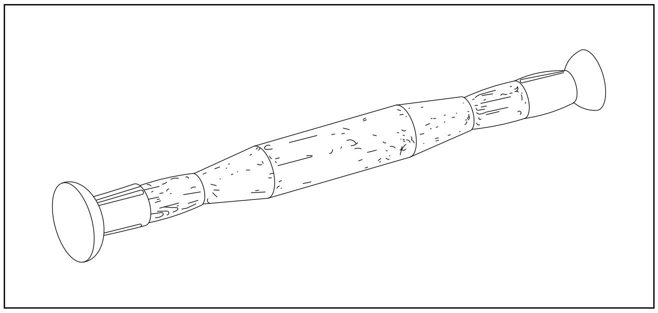
Part No. HD-96295-65D Timing Mark View Plug. Use with HD-33813.



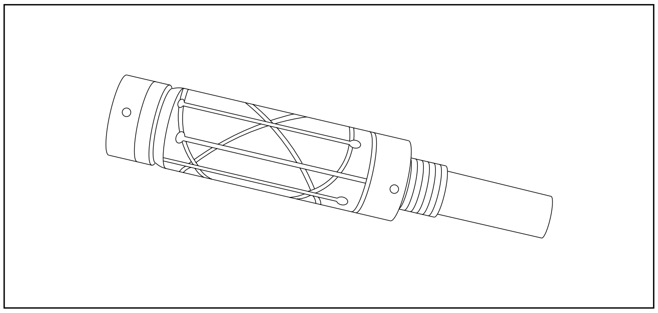
Part No. HD-95952-33B Connecting Rod Clamping Tool



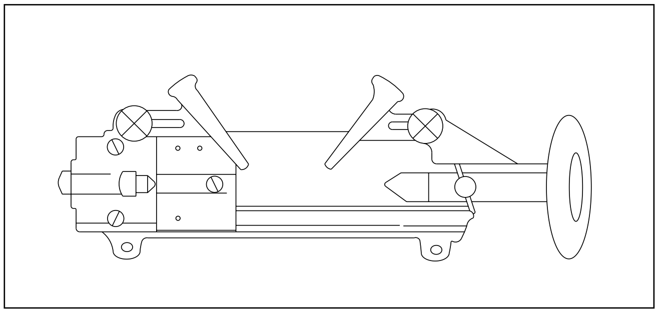
Part No. HD-96333-51C Piston Ring Compressor



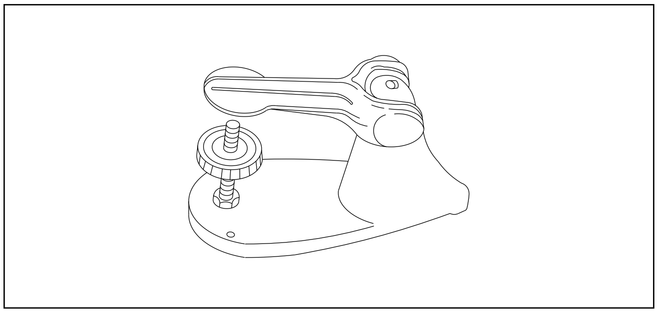
Part No. HD-96550-36A Valve Lapping Tool



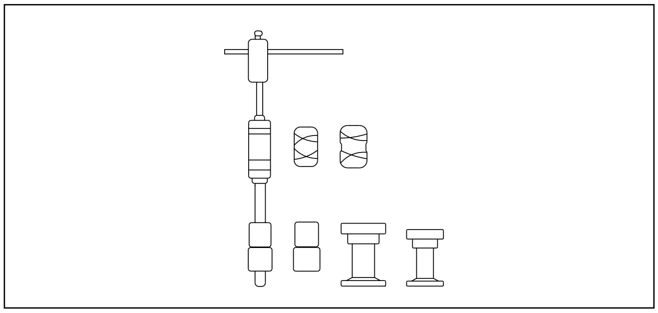
Part No. HD-96740-36 Connecting Rod Lapping Arbor



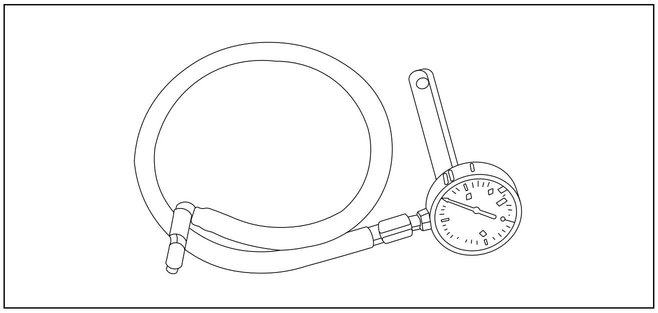
Part No. HD-96650-80 Flywheel Truing Stand



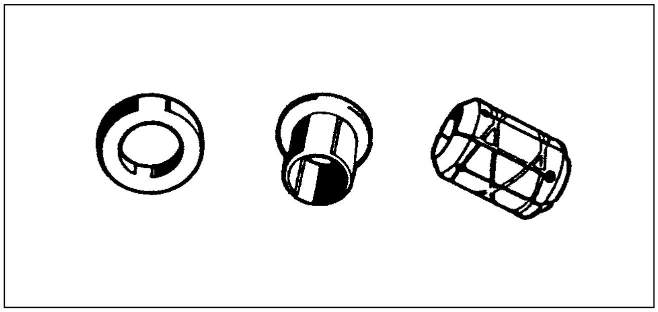
Part No. HD-96796-47 Valve Spring Tester



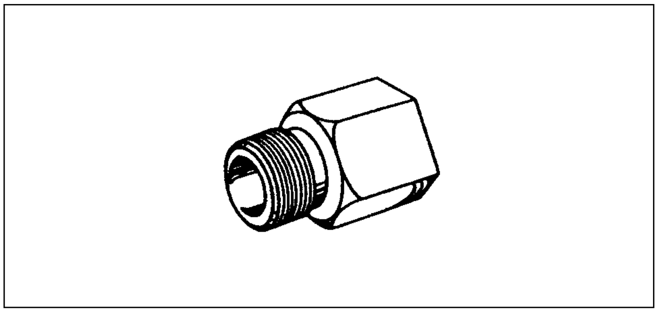
Part No. HD-96710-40B Crankcase Main Bearing Lapping Tool



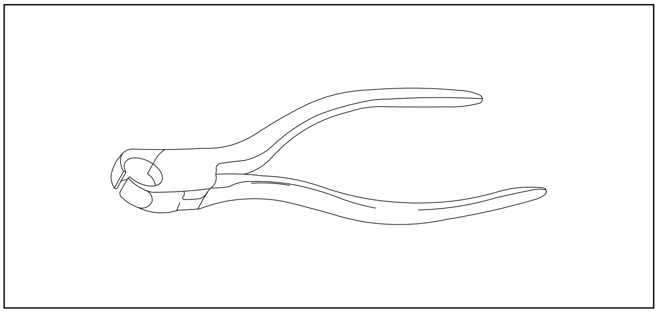
Part No. HD-96921-52A Oil Pressure Gauge



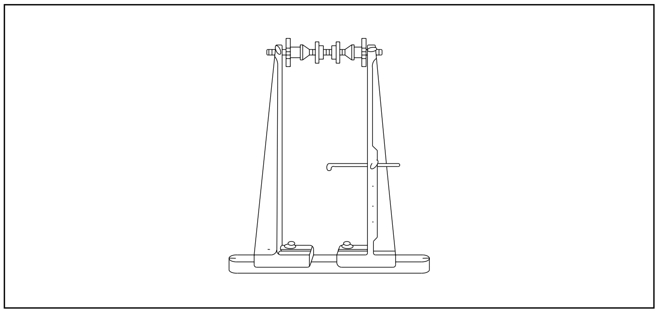
Part No. HD-96718-87 Pinion Bearing Outer Race Lapping Kit



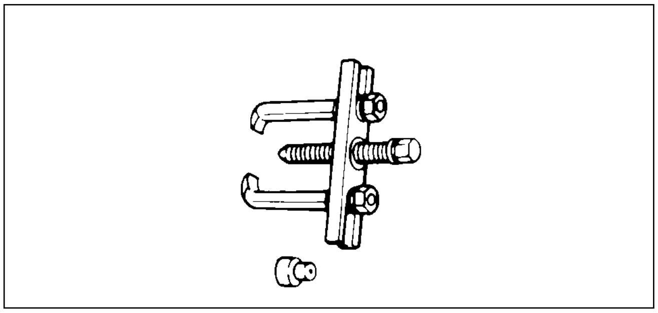
Part No. HD-96940-52A Oil Pressure Gauge Adapter. Use with HD-96921-52A.



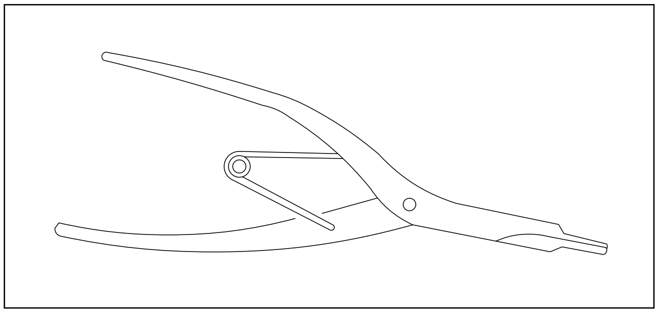
Part No. HD-97087-65B Hose Clamp Pliers



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



Part No. HD-97292-61 Two Claw Puller



Part No. J-5586 Transmission Shaft Retaining Ring Pliers

APPENDIX B - ELECTRICAL CONNECTORS B.1

GENERAL

The following table provides a brief description of the connectors found on the S3T Thunderbolt.

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

Table B-1. Electrical Connectors

Connector	Component(s)	Description
[10]	Electronic Control Module (Black)	12-place Deutsch
[11]	Electronic Control Module (Gray)	12-place Deutsch
[14]	Cam Position Sensor	3-place Deutsch
[21]	Front Brake Switch	2-place Amp Multilock
[21]	Indicator Lamps	12-place Amp Multilock
[22]	Right Handlebar Switch Housing-Ignition Power, Module and Starter	4-place connector
[24]	Left Handlebar Switch Housing- Horn, Turn Signals, Lights	9-place connector
[30]	Flasher Relay	3-place relay connector
[33]	Ignition/Headlamp Switch	4-place Packard
[38]	Headlamp	4-place Amp Multilock
[39]	Speedometer and Tachometer	10-place connector
[46]	Voltage Regulator/Stator	2-place plug
[60]	Side Stand Switch	2-place Amp Multilock
[61]	Four 15 Amp Fuses for Clock/Odometer, Instruments, Lights and Accessories and One 20 Amp Fuse for Ignition	5-slot fuse block
[65]	Speed Sensor	3-place Deutsch
[83]	Ignition Coil	3-place Packard
[84]	Front Fuel Injector	2-place connector
[85]	Rear Fuel Injector	2-place connector
[86]	Fuel Pump	4-place connector
[88	Throttle Position Sensor	3-place connector
[89]	Intake Air Temperature Sensor	2-place connector
[90]	Engine Temperature Sensor	1-place connector
[91A]	Data Link	4-place Deutsch
[95]	Clutch Switch	2-place Amp Multilock
[96]	Clock	4-place plug
[134]	Bank Angle Sensor	3-place connector

GENERAL

The Deutsch Connector features a superior seal to protect electrical contacts from dirt and moisture in harsh environments.

Three and eight pin connectors are of similar construction with one exception: eight pin connectors use two external latches on the socket side.

NOTE

*Use the DEUTSCH Terminal Crimp Tool (Part No. HD-39965) 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.*

REMOVING/INSTALLING SOCKETS

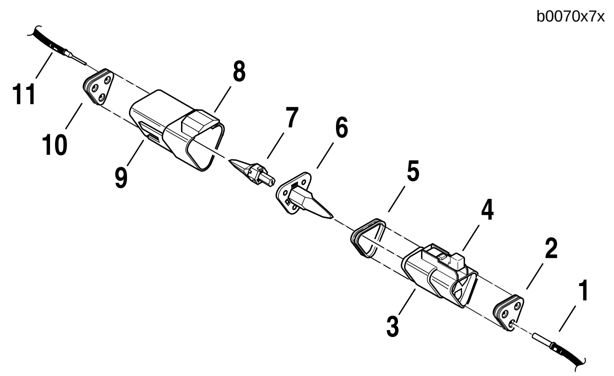
1. See Figure B-1. Remove the secondary locking wedge (6). Insert the blade of a small screwdriver between the socket housing and locking wedge inline with the groove (inline with the pin holes if the groove is absent). Turn the screwdriver 90° to pop the wedge up.
2. Gently depress terminal latches inside socket housing (3) and back out socket terminals (1) through holes in rear wire seal (2).
3. Fit rear wire seal (2) into back of socket housing, if removed. Grasp socket terminal 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.
4. Install internal seal (5) on lip of socket housing, if removed. Insert tapered end of secondary locking wedge (6) 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.

NOTE

- *The conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure B-2.*
- *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. See Figure B-1. Remove the secondary locking wedge (7). Use the hooked end of a stiff piece of mechanic's wire or a needle nose pliers, whichever is most suitable.



Socket Side

1. **Socket Terminal**
2. **Wire Seal**
3. **Socket Housing**
4. **External Latch**
5. **Internal Seal**
6. **Secondary Locking Wedge**

Pin Side

1. **Secondary Locking Wedge**
2. **Latch Cover**
3. **Pin Housing**
4. **Wire Seal**
5. **Pin Terminal**

Figure B-1. 3-Pin Connector

2. Gently depress terminal latches inside pin housing (9) and back out pin terminals (11) through holes in wire seal (10).
3. Fit wire seal (10) into back of pin housing (9). 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 (7) into pin housing (9) 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.

ASSEMBLY/INSTALLATION

Insert socket housing (3) into pin housing (9) until it snaps in place. To fit the halves of the connector together, the latch (4) on the socket side must be aligned with the latch cover (8) on the pin side.

CRIMPING INSTRUCTIONS

1. See Figure B-3. Squeeze the handles to cycle the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965) 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. (4.0 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.

NOTE

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

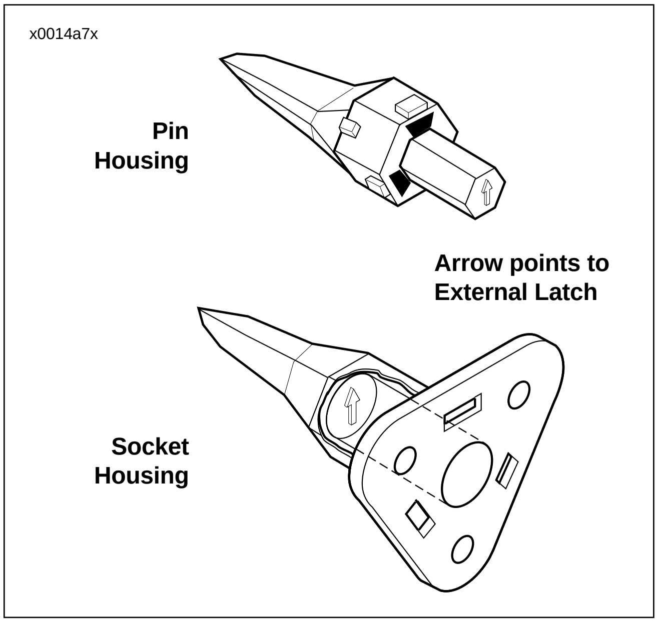


Figure B-2. 3-pin Locking Wedge Orientation

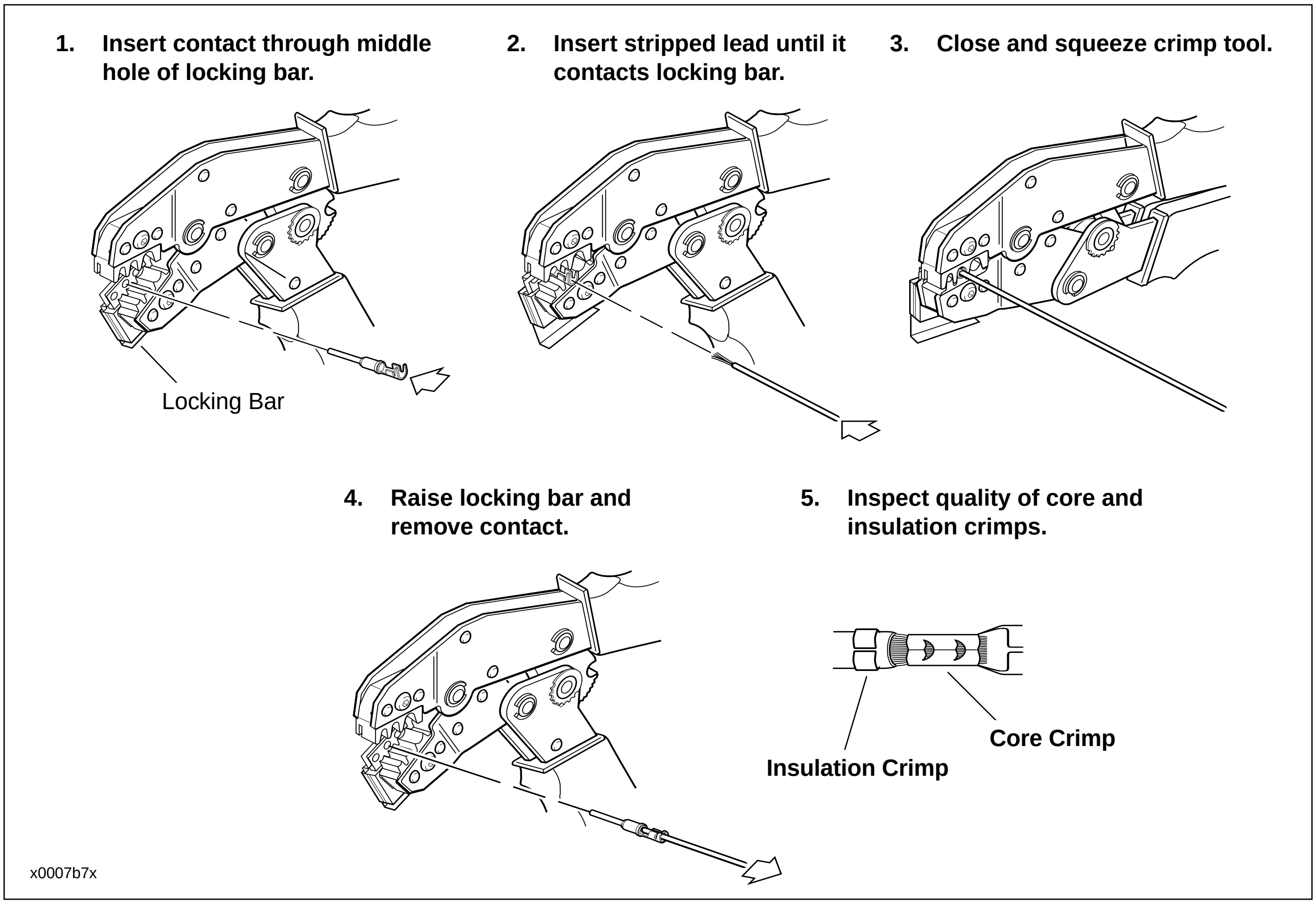


Figure B-3. Deutsch Crimping Procedure

REMOVING SOCKET/PIN TERMINALS

1. If necessary, cut any surrounding cable straps to gain access to the connector.
2. See Figure B-4. 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-5. With the flat edge against the terminal, insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal 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

*An AMP TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp Multilock pin and socket terminals on wires. If **new** terminals must be installed, see CRIMPING INSTRUCTIONS.*

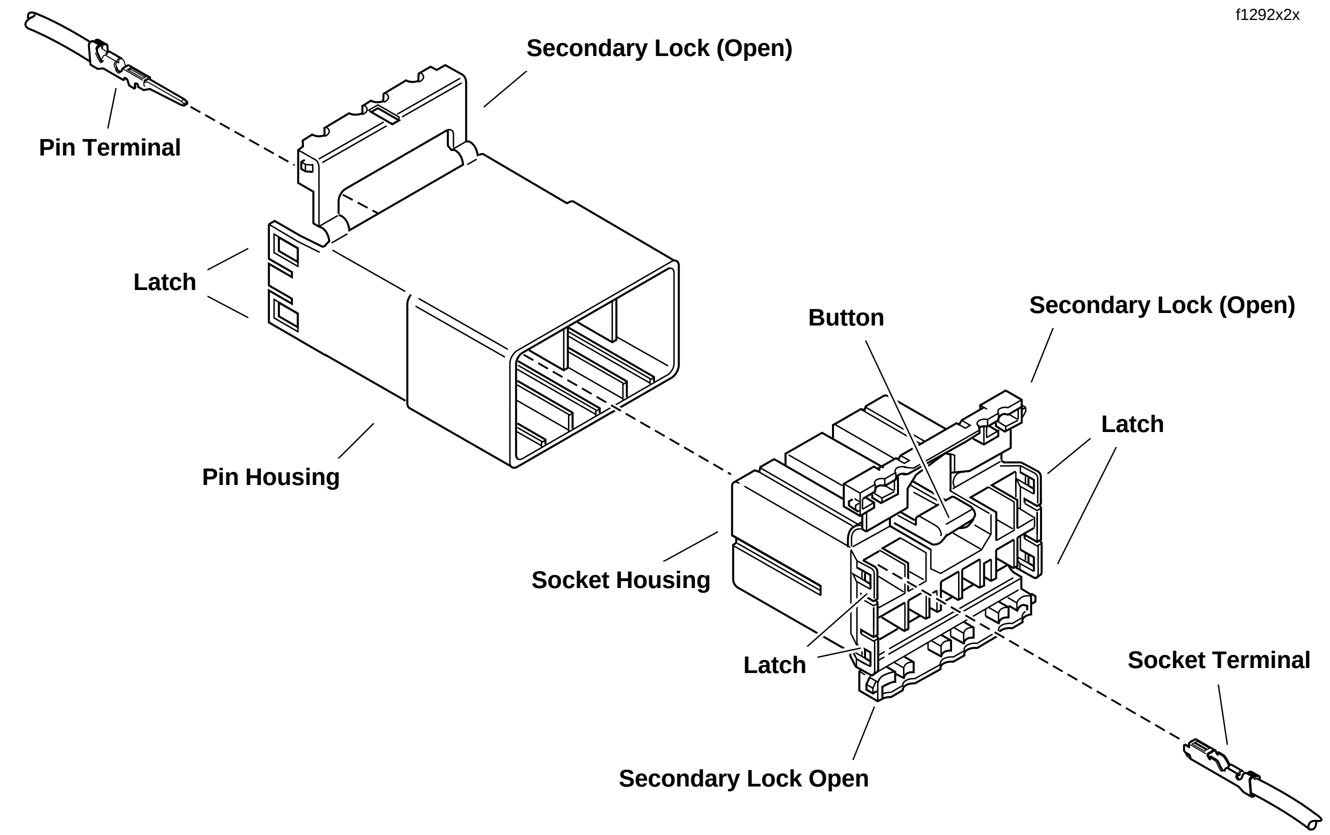


Figure B-4. Amp Multilock Connector (Exploded View)

HOME

INSTALLING SOCKET/PIN TERMINALS

NOTE

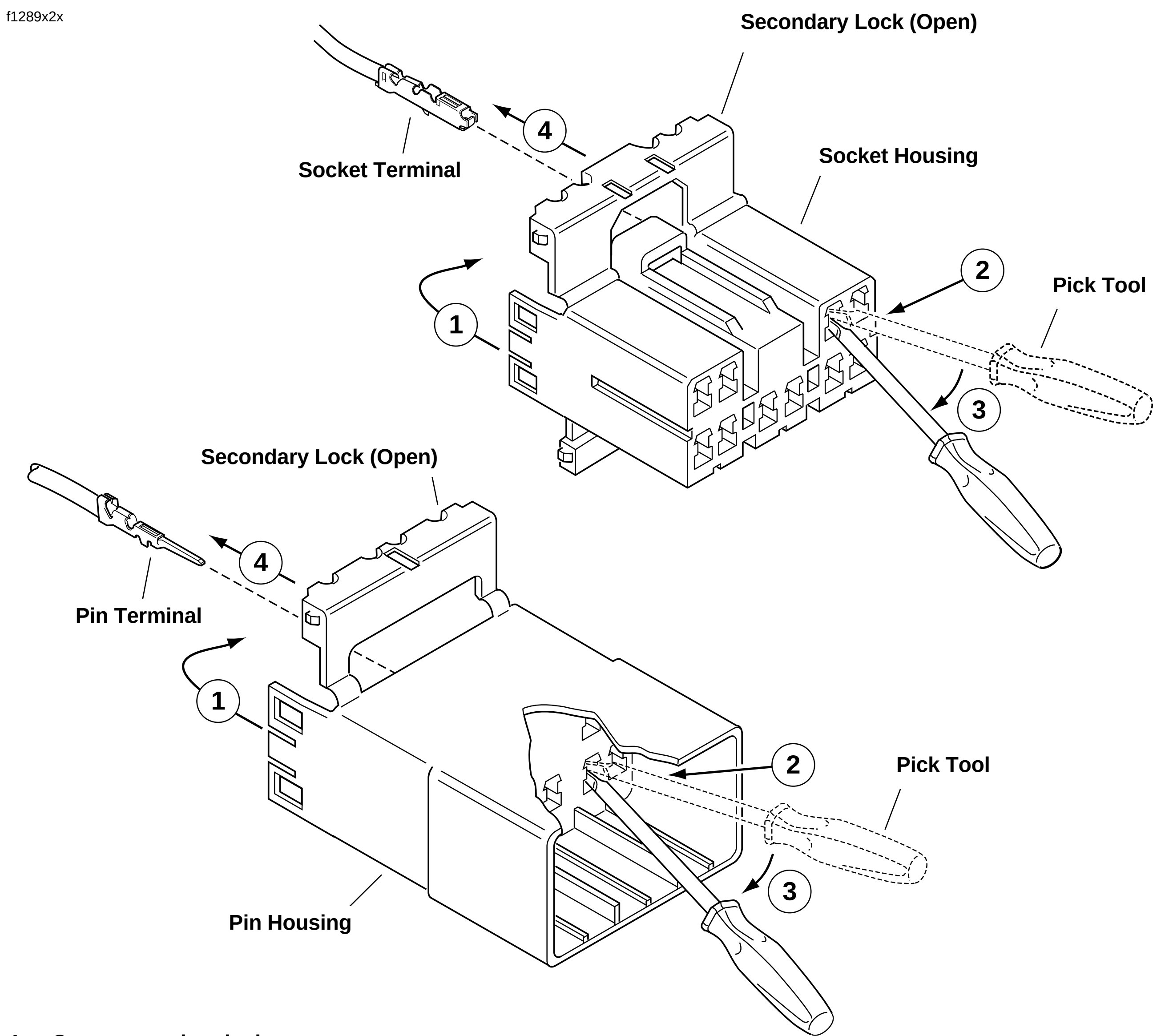
For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings.

1. See Figure B-5. 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.

NOTE

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), the button always being the 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. Secure wiring harness with **new** cable straps.



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

Figure B-5. Release Tang and Back Out Terminals

HOME

CRIMPING INSTRUCTIONS

1. See Figure B-7. Squeeze the handles to cycle the AMP TERMINAL 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 nest (concave split level area) of the crimp tool). Use the front nest for 20 gauge wire, the middle for 16 gauge and the rear for 18 gauge.
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. (4.0 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. See Figure B-7. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

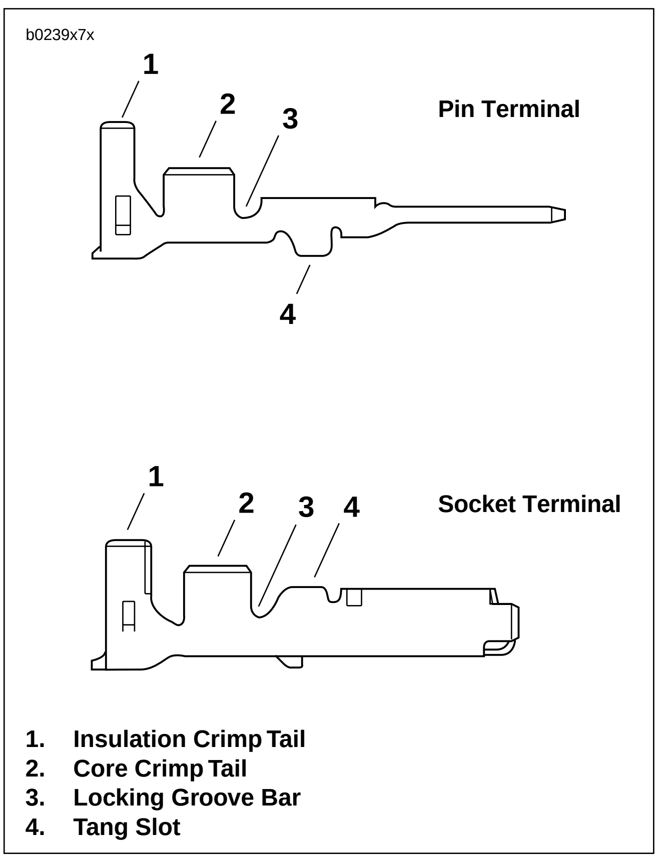


Figure B-6. Crimps

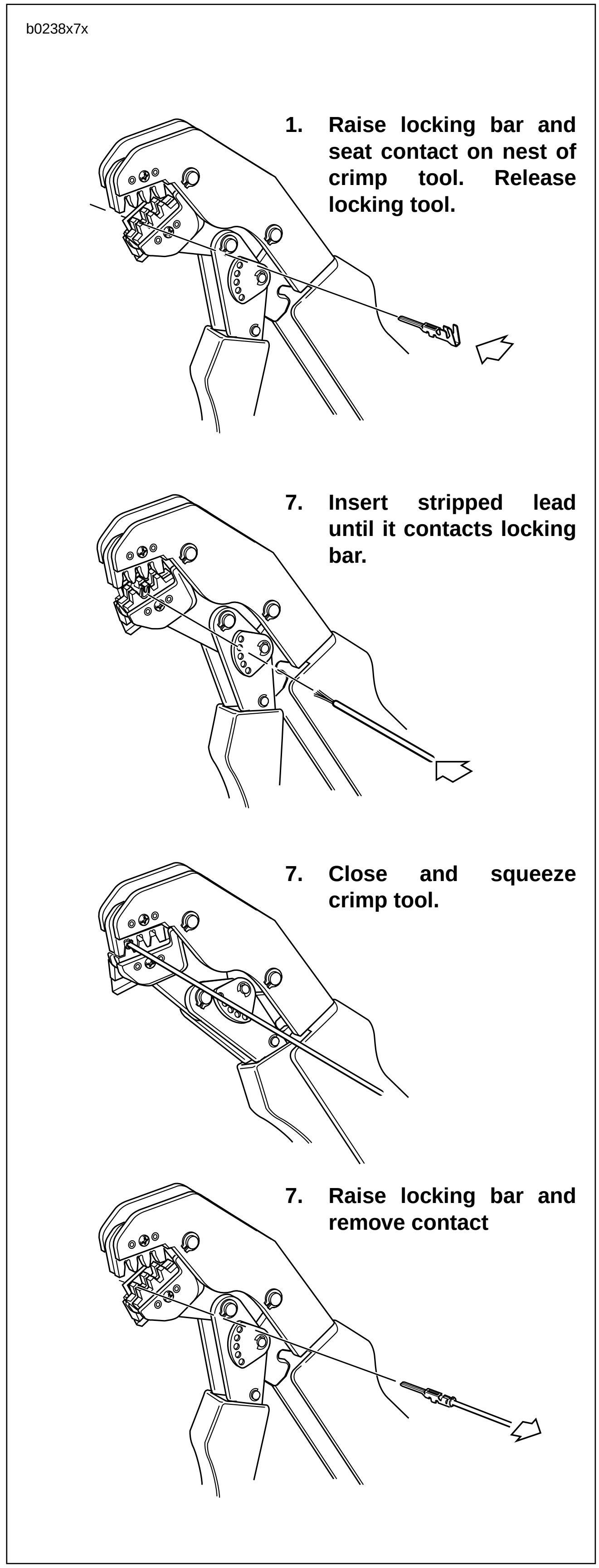


Figure B-7. Amp Multilock Crimping Procedure

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

TORQUE MASTER VALUES C.2

GENERAL

Torque specifications for specific components are listed in each section at the point of use. When converting to Newton-meters, use the formulas given under the metric chart. For all other steel fasteners, use the values listed in one of the tables below. In the English table, torque figures are listed in ft-lbs, except those marked with an asterisk (*), which are listed in **in-lbs**. In the metric table, figures are listed in Newton-meters.

WARNING

The quality fasteners used on Buell motorcycles have specific strength, finish and type requirements to perform properly in the assembly and the operating environment. Use only genuine Buell replacement fasteners tightened to the proper torque. Substitution could cause fastener failure, which could result in death or serious injury.

Table C-2. English Torque Values

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							in. (inches)									
				2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
	SAE 2 STEEL	74,000 PSI	LOW CARBON								6	12	20	32	47	69	96	155	206	310
	SAE 5 STEEL	120,000 PSI	MEDIUM CARBON HEAT TREAT						14*	22*	10	19	33	54	78	114	154	257	382	587
	SAE 7 STEEL	133,000 PSI	MEDIUM CARBON ALLOY								13	25	44	71	110	154	215	360	570	840
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	29	47	78	119	169	230	380	600	900
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	29	47	78	119	169	230	380	600	900
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON QUENCHED TEMPERED					9*	16*	30*	70*	140*	18	29	43	63	100	146		
	STUDS			Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																

*Torque values in **in-lbs.**

Table C-3. Metric Torque Values

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							mm (millimeters)									
				2	3	4	5	6	8	10	6.4	7.9	9.5	11.1	12.7	14.3	15.9	19.1	22.2	25.4
	SAE 2 STEEL	5,202 kg/cm^2	LOW CARBON								8.3	16.6	27.7	44.3	65.0	95.4	132.8	214.4	283.5	428.7
	SAE 5 STEEL	8,436 kg/cm^2	MEDIUM CARBON HEAT TREAT						1.6	2.5	13.8	26.3	45.6	74.7	107.9	157.7	213.0	355.4	528.3	811.8
	SAE 7 STEEL	9,350 kg/cm^2	MEDIUM CARBON ALLOY								18.0	34.6	60.8	98.2	152.1	213.0	297.3	497.9	788.3	1161.7
	SAE 8 STEEL	10,545 kg/cm^2	MEDIUM CARBON ALLOY								19.4	40.1	65.0	107.9	164.6	233.7	318.1	525.5	829.8	1220.0
	SAE 8 STEEL	10,545 kg/cm^2	MEDIUM CARBON ALLOY								19.4	40.1	65.0	107.9	164.6	233.7	318.1	525.5	829.8	1220.0
	SOCKET SET SCREW	14,904 kg/cm^2	HIGH CARBON QUENCHED TEMPERED					1.0	1.8	3.4	8.1	16.1	24.9	40.1	59.5	87.1	138.3	201.9		
	STUDS			Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																

foot-pounds **(ft-lbs) x 1.356 =** Newton-meters **(Nm)**inch-pounds **(in-lbs) x 0.113 =** Newton-meters **(Nm)**

Table Of Contents

SUBJECT	PAGE NO.
1.1 General	1-1
1.2 Fluid Requirements	1-5
1.3 Battery	1-11
1.4 Engine Lubrication System	1-14
1.5 Brakes	1-16
1.6 Shift Linkage Rod Adjustment	1-19
1.7 Brake Pads and Rotors	1-20
1.8 Tires and Wheels	1-21
1.9 Clutch	1-22
1.10 Drive Belt Deflection	1-24
1.11 Drive Belt and Sprocket	1-26
1.12 Primary Chain	1-28
1.13 Preload Adjustment	1-29
1.14 Suspension Damping Adjustments	1-30
1.15 Front Fork	1-31
1.16 Steering Head Bearings	1-32
1.17 Spark Plugs	1-33
1.18 Air Cleaner	1-34
1.19 Ignition Timing	1-35
1.20 Handlebars	1-37
1.21 Throttle Cables	1-38
1.22 Headlamp	1-39
1.23 Storage	1-40
1.24 Troubleshooting	1-41

SERVICING A NEW MOTORCYCLE

WARNING

Always follow the listed service and maintenance recommendations, because they affect the safe operation of the motorcycle and the personal welfare of the rider. Failure to follow recommendations could result in death or serious injury.

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.

After a new motorcycle has been driven its first 500 miles (800 km), and at every 2500 mile (4000 km) interval thereafter, have a Buell dealer perform the service operations listed in Table 1-3.

SAFE OPERATING MAINTENANCE

CAUTION

- **Do not attempt to retighten engine head bolts. Retightening can cause engine damage.**
- **During the initial 500 mile (800 km) break-in period, use only Harley-Davidson 20W50 engine oil. Failure to use the recommended oil may 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 for proper tension and condition.
3. Brakes, steering and throttle for responsiveness.
4. Brake fluid level and condition. 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

NOTE

- *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.

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.

Checking Torques on Fasteners with Lock Patches/Loctite Threadlocker

To check the torque on a fastener that has a lock patch do the following:

1. Set the torque wrench for the lowest setting in the given torque range for the fastener.
2. Attempt to tighten fastener to set torque. If fastener does not move and lowest setting is satisfied (torque wrench clicks), then the proper torque has been maintained by the fastener.
3. If the fastener does move, remove the fastener, reapply the appropriate type of LOCTITE THREADLOCKER and tighten the fastener to Service Manual specification.

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 tap or die.

Replace all damaged or missing lubrication fittings.

Use Teflon pipe sealant on pipe fitting threads.

Wiring, Hoses and Lines

Replace hoses, clamps, electrical wiring, electrical switches or fuel lines if they do not meet specifications.

Instruments and Gauges

Replace broken or defective instruments and gauges. Replace dials and glass that are so scratched or discolored that reading is difficult.

Bearings

Anti-friction bearings must be handled in a special way. To keep out dirt and abrasives, cover the bearings as soon as they are removed from the package.

⚠CAUTION

Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage un-lubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which may result in minor or moderate injury.

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.

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.

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.

Bearings

Remove shields and seals from bearings before cleaning. Clean bearings with permanent shields and seals in solution.

Clean open bearings by soaking them in a petroleum cleaning solution. Never use a solution that contains chlorine.

⚠CAUTION

Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage un-lubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which may result in minor or moderate injury.

Let bearings stand and dry. Do not dry using compressed air. Do not spin bearings while they are drying.

INSPECTING

Leak Dye

When using leak dye with the black light leak detector, add 1/4 oz. (7.4 ml) of dye for each 1 quart (0.9 l) of fluid in the system being checked.

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.

FLUID REQUIREMENTS 1.2

GENERAL

United States System

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

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

Metric System

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

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

STEERING HEAD BEARING GREASE

Use WHEEL BEARING GREASE (Part No. 99855-89).

BRAKE FLUID

⚠WARNING

D.O.T. 4 brake fluid can cause irritation of eyes and skin, and may be harmful if swallowed. If large amount of fluid is swallowed, induce vomiting by administering two tablespoons of salt in a glass of warm water. Call a doctor. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. Failure to comply could result in death or serious injury.

⚠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.

Use only **D.O.T. 4 BRAKE FLUID** (Part No. 99953-99Y).

FRONT FORK OIL

Table 1-1. Fork Oil

PROPERTY	SPECFICATION	
Fork OIl	TYPE E FORK OIL (Part No. HD-99884-80)	
Standard Capacity	15.36 oz.	450 cc
Standard Oil Level	3.15 in.	80 mm
Maximum Oil Level	2.36 in.	60 mm
Minimum Oil Level	4.33 in.	110 mm

Use only TYPE E FORK OIL (Part No. 99884-80).

FUEL

Use a good quality unleaded gasoline (**91 pump octane** or higher). Pump octane is the octane number usually shown on the gas pump. See 3.2 ENGINE for a detailed explanation of alternative fuels.

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 CE, CF, CF-4 and CG-4. 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 Buell dealer to change back to 100 percent Harley-Davidson oil.

Table 1-2. Recommended Oil Grades

HARLEY-DAVIDSON TYPE	VISCOSITY	HARLEY-DAVIDSON RATING	LOWEST AMBIENT TEMP.	COLD WEATHER STARTS BELOW 50° F
H.D. Multi-Grade	SAE 10W40	HD 360	Below 40°F (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

PRIMARY DRIVE/TRANSMISSION FLUID

Use only SPORT-TRANS FLUID (Part No. 98854-96 quart size or Part No. 98855-96 gallon size).

Table 1-3. Regular Maintenance Intervals

SERVICE OPERATIONS AND SPECIAL TOOLS	PRE-RIDE	500 MI 800 KM	2500 MI 4000 KM	5000 MI 8000 KM	7500 MI 12000 KM	10000 MI 16000 KM	12500 MI 20000 KM	15000 MI 24000 KM	17500 MI 28000 KM	20000 MI 32000 KM	22500 MI 36000 KM	25000 MI 40000 KM	27500 MI 44000 KM	30000 MI 48000 KM	ANNUAL	SERVICE DATA
Battery terminal connections (1.3 BATTERY)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	**Torque** 60-96 **in-lbs** (7-11 Nm)
Engine oil and oil filter (1.3 BATTERY) OIL FILTER WRENCH (Part No. HD-41215)	I	R	I	R	I	R	I	R	I	R	I	R	I	R	R	**Type of oil** Use the proper grade of oil for the lowest temperature expected before the next oil change. See page 1-5. **Checking oil level** Check with vehicle at operating temperature, engine off, motorcycle upright (not on side stand) on a level surface. **Oil level** Between upper and lower marks on dipstick. **Oil capacity with filter change** 2.0 quarts (1.89 liters) **Oil filter** Hand tighten filter 1/2-3/4 turn after gasket contacts surface
Brake fluid level and condition (1.3 BATTERY)		I		I		I		I		I		I		I	I	**Fluid type** **D.O.T. 4 BRAKE FLUID** (Part No. HD-99953-99Y) Change D.O.T. 4 BRAKE FLUID fluid every 2 years. See 1.3 BATTERY **Front master cylinder level** Above LOW mark on sight glass or within 1/8 in. (3.2 mm) of molded boss when cover is removed. **Rear master cylinder level** Between upper and lower marks on reservoir.
Brake pads and rotors for wear (1.7 BRAKE PADS AND ROTORS)		I	I	I	I	I	I	I	I	I	I	I	I	I		**Minimum Rotor Thickness** 0.18 in. (4.5 mm) **Minimum Pad Thickness** 0.04 in. (1.0 mm)
Rear brake pedal height adjustment 1.3 BATTERY	I	I		I		I		I		I		I		I		Pedal action should be smooth and not binding.
Condition of rear brake caliper mounting pins and boots				IL		IL		IL		IL		IL		IL		
Tire pressure and inspect tire for wear/damage (1.8 TIRES AND WHEELS)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	Check pressure when tires are cold.

Table 1-3. Regular Maintenance Intervals

SERVICE OPERATIONS AND SPECIAL TOOLS	PRERIDE	500 MI 800 KM	2500 MI 4000 KM	5000 MI 8000 KM	7500 MI 12000 KM	10000 MI 16000 KM	12500 MI 20000 KM	15000 MI 24000 KM	17500 MI 28000 KM	20000 MI 32000 KM	22500 MI 36000 KM	25000 MI 40000 KM	27500 MI 44000 KM	30000 MI 48000 KM	ANNUAL	SERVICE DATA
Front and rear wheel bearings (1.8 TIRES AND WHEELS)						I				I				I	I	Check for wear and corrosion. Replace in sets only.
Primary drive/transmission fluid (1.9 CLUTCH) REAR WHEEL SUPPORT STAND (Part No. B-41174)		R	I	R	I	R	I	R	I	R	I	R	I	R		**Fluid type and amount** 1.0 quart (0.95 liter) of SPORT-TRANS FLUID (Part No. 98854-96) **Fluid level** Fluid should reach bottom of clutch spring with motorcycle upright (not on side stand). **Drain plug torque** 14-21 ft-lbs (19-29 Nm)
Transmission magnetic drain plug (1.9 CLUTCH)		I		I		I		I		I		I		I		
Clutch and clutch control cable adjustment (1.9 CLUTCH)		A		AL		AL		AL		AL		AL		AL		**Hand lever freeplay** 1/16-1/8 in. (1.6-3.2 mm) **Clutch inspection cover screw torque** 7-9 ft-lbs (10-12 Nm) in a crosswise pattern
Rear drive belt deflection (1.10 DRIVE BELT DEFLECTION) BELT TENSION GAUGE (Part No. HD-35381)	I	A		IA		IA		IA		IA		IA		IA		**Belt deflection with 10 lbs (4.5 kg) of upward force** 7/8-1 in. (22.2-25.4 mm) **Rear axle nut torque** 68-73 ft-lbs (90-99 Nm)
Primary chain (1.12 PRIMARY CHAIN)		I		I		I		I		I		I		I		**Chain freeplay with hot engine** 1/4-3/8 in. (6.4-9.5 mm) **Chain freeplay with cold engine** 3/8-1/2 in. (9.5-12.7 mm) **Inspection screws torque** 40-60 **in-lbs** (5-7 Nm)
Rear shock absorber (1.14 SUSPENSION DAMPING ADJUSTMENTS)		I		I		I		I		I		I		I		Check for bushing wear and loose mounting hardware.
Steering head bearings (1.16 STEERING HEAD BEARINGS) FRONT WHEEL SUPPORT STAND (Part No. B-41395-A) & LIFT ADAPTER (Part No. B-42426-1)		I	IA	IA	IA	IAL	IA	IA	IA	IAL	IA	IA	IA	IAL	I	**Force to pull front wheel to center** 7.5-9.5 ft-lbs (3.4-4.3 kg) **Lubricant** WHEEL BEARING GREASE (Part No. 99855-89)

HOME

Table 1-3. Regular Maintenance Intervals

SERVICE OPERATIONS AND SPECIAL TOOLS	PRERIDE	500 MI 800 KM	2500 MI 4000 KM	5000 MI 8000 KM	7500 MI 12000 KM	10000 MI 16000 KM	12500 MI 20000 KM	15000 MI 24000 KM	17500 MI 28000 KM	20000 MI 32000 KM	22500 MI 36000 KM	25000 MI 40000 KM	27500 MI 44000 KM	30000 MI 48000 KM	ANNUAL	SERVICE DATA
Front fork oil (1.15 FRONT FORK) FRONT WHEEL SUPPORT STAND (Part No. B-41395-A) & LIFT ADAPTER (Part No. B-42426-1) PRO-LEVEL OIL GAUGE (Part No. B-59000A)										R						**Fork oil** HYDRAULIC FORK OIL, TYPE E (Part No. HD-99884-80) **Capacity** 15.36 oz. (450 cc) **Fluid level** (Standard) 3.15 in. (80 mm) from top with fork fully compressed (Maximum) 2.36 in. (60 mm) from top with fork fully compressed (Minimum) 4.33 in. (110 mm) from top with fork fully compressed
Spark plugs (1.17 SPARK PLUGS)				I		R		I		R		I		R		**Spark plug type** No. 10R12 **Spark plug gap** 0.038-0.043 in. (0.97-1.09 mm) **Lubricant** LOCTITE ANTI-SEIZE LUBRICANT **Torque** 11-18 ft-lbs (15-24 Nm)
Air cleaner filter (1.18 AIR CLEANER)		I		R		R		R		R		R		R		Check more often in dusty conditions.
Throttle control cable (2.24 THROTTLE CONTROL)	I	L		L		L		L		L		L		L		Check for damage and freeplay.
Throttle control grip sleeve (2.24 THROTTLE CONTROL)	I	IL	I	IL	I	IL	I	IL	I	IL	I	IL	I	IL		Controls must be smooth and not binding
Front brake and clutch hand levers (Section 2)		L		L		L		L		L		L		L		Check for damage and freeplay.
Engine low and fast idle speed (1.19 IGNITION TIMING)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		**Regular idle** 850-1050 RPM
Ignition timing (1.19 IGNITION TIMING) TIMING MARK VIEW PLUG (Part No. HD-96295-65D) BREAKOUT BOX (Part No. HD-42682) HARNESS CONNECTOR TEST KIT (Part No. HD-41404)				I		I		I		I		I		I		
Fuel filter (4.38 INLINE FUEL FILTER)												R				See Section 4. Make sure arrow on filter points in direction of fuel flow.
Calibrate (re-zero) Throttle Position Sensor (TP Sensor) (4.35 THROTTLE POSITION SENSOR)		X														See Section 4, THROTTLE POSITION SENSOR, Calibration

Table 1-3. Regular Maintenance Intervals

SERVICE OPERATIONS AND SPECIAL TOOLS	PRERIDE	500 MI 800 KM	2500 MI 4000 KM	5000 MI 8000 KM	7500 MI 12000 KM	10000 MI 16000 KM	12500 MI 20000 KM	15000 MI 24000 KM	17500 MI 28000 KM	20000 MI 32000 KM	22500 MI 36000 KM	25000 MI 40000 KM	27500 MI 44000 KM	30000 MI 48000 KM	ANNUAL	SERVICE DATA
Fuel supply hoses and fittings for leaks (4.36 FUEL TANK)			I	I	I	I	I	I	I	I	I	I	I	I		
Rear swingarm pivot bolt (2.19 SWINGARM)				I		I		I		I		I		I		**Lubricant** LOCTITE ANTI-SEIZE LUBRICANT
Rear swingarm bearings (2.19 SWINGARM)				I		IL		I		IL		I		IL		**Lubricant** WHEEL BEARING GREASE (Part No. HD99855-89)
Oil and brake lines (Section 2 and 3)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		Check for leaks and loose connections. It is recommended to inspect front and rear brake lines on D.O.T. 4 Brake systems every 4 years and replace as required It is recommended to inspect front and rear master cylinder and caliper seals on D.O.T. 4 Brake systems every 2 years and replace as required.
Side stand (2.36 SIDE STAND)		I		L		L		L		L		L		L		
Rubber isolator mounts - engine and exhaust (Sections 2 and 3)		I		I		I		I		I		I		I		
Starter interlock system (7.6 STARTER INTERLOCK)		I	I	I	I	I	I	I	I	I	I	I	I	I		
Operation of all electrical equipment and switches (Section 7)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	
Check tightness of all fasteners except engine head bolts		T		T		T		T		T		T		T		
Road test		X	X	X	X	X	X	X	X	X	X	X	X	X	X	

NOTES

BATTERY 1.3

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.

⚠WARNING

All batteries contain electrolyte. Electrolyte is a sulfuric acid solution that is highly corrosive and can cause severe chemical burns. Avoid contact with skin, eyes, and clothing. Avoid spillage. Always wear protective face shield, rubberized gloves and protective clothing when working with batteries. A warning label is attached to the top of the battery. See Figures 1-1 and 1-2. Never remove warning label from battery. Failure to read and understand all precautions contained in warning label before performing any service on batteries could result in death or serious injury.

Table 1-4. Battery Electrolyte Antidotes

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

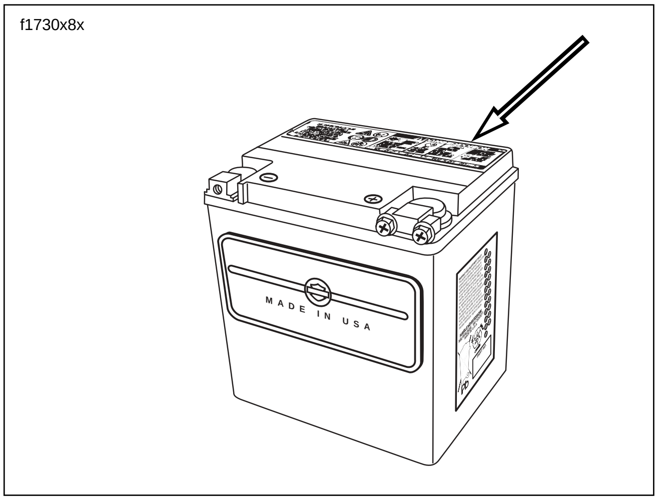


Figure 1-1. Warning Label on Maintenance-Free Battery

BATTERY TESTING

Voltmeter Test

See Table 1-5. 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 in Section 7.

Figure 1-2. Battery Warning Label

Table 1-5. Voltmeter Test

BATTERY CHARGE CONDITIONS	
Voltage (OCV)	**State of Charge**
12.8	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

DISCONNECTION AND REMOVAL

1. Remove seat. See 2.35 SEAT.

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

WARNING

Always disconnect the negative 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.

2. Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal.
3. Unthread bolt and remove battery positive cable (red) from battery positive (+) terminal.
4. Remove battery strap locknut (metric). Unhook battery strap from frame near negative terminal.
5. Cut any cable straps holding oxygen sensor connector to battery.
6. Remove battery from right side.

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.

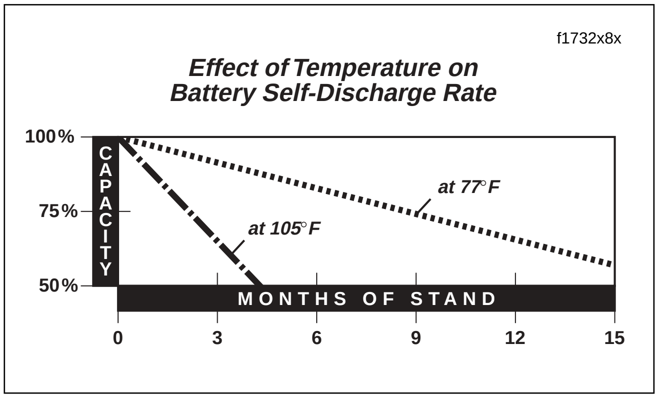


Figure 1-3. Battery Self-Discharge Rate

STORAGE

WARNING

Always store batteries where they cannot be reached by children. Contact with the battery's sulfuric acid could result in death or serious injury.

CAUTION

The electrolyte in a discharged battery will freeze if exposed to freezing temperatures. Freezing may crack the battery case and buckle battery plates.

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 CHARGING BATTERY, Section 7.

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. Figure 1-3.

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, refer to the instructions under CHARGING BATTERY, Section 7.

BATTERY INSTALLATION AND CONNECTION

1. Place the fully charged battery into the battery box, terminal side forward.

CAUTION

Connect the cables to the correct battery terminals or damage to the motorcycle electrical system will occur.

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.

CAUTION

Overtightening bolts can damage battery terminals.

2. Insert bolt through battery positive cable (red) into threaded hole of battery positive (+) terminal. Tighten bolt to 60-96 **in-lbs** (7-11 Nm).
3. Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten bolt to 60-96 **in-lbs** (7-11 Nm).
4. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.
5. Install battery strap.
   a. Insert tab on right side of battery tray. Place battery strap around top side of battery.
   b. Hook edge of strap into frame tab.
   c. Insert threaded shaft on strap through frame tab.
   d. Install battery strap locknut on threaded shaft. Tighten to 40 **in-lbs** (4.5 Nm).
6. Apply light coat of petroleum jelly or corrosion-retardant material to both battery terminals.
7. Secure oxygen sensor connector with **new** cable straps.
8. Install seat. See 2.35 SEAT.

CHECKING ENGINE OIL LEVEL

Check engine oil level:

- At least once every 500 miles (800 km).
- At every scheduled service interval.

NOTE

If engine uses more oil than normal or if vehicle is operated under harsh conditions, check oil more frequently.

When checking or changing engine oil:

- Warm vehicle to normal operating temperature.
- Turn engine off.
- Hold motorcycle upright (not leaning on side stand) on a level surface.

1. Remove seat. See 2.35 SEAT.
2. See Figure 1-5. Remove filler cap/dipstick from oil tank. Wipe dipstick clean.
3. Install filler cap onto oil tank. Make sure cap is fully seated on tank.

CAUTION

Do not switch oil brands indiscriminately because some oils interact chemically when mixed. Use of inferior oils or non-detergent oils can damage the engine.

4. Remove filler cap again and check oil level on dipstick.
   a. Oil level should be between lower and upper dipstick level marks.
   b. If oil level in tank is below lower mark of dipstick, add oil to tank.
   c. Install filler cap/dipstick.

   Recommended viscosity depends upon ambient temperature. See Table 1-6. 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 CE, CF, CF-4 and CG-4. 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 Buell dealer to change back to 100 percent Harley-Davidson oil.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

5. Install seat. See 2.35 SEAT.

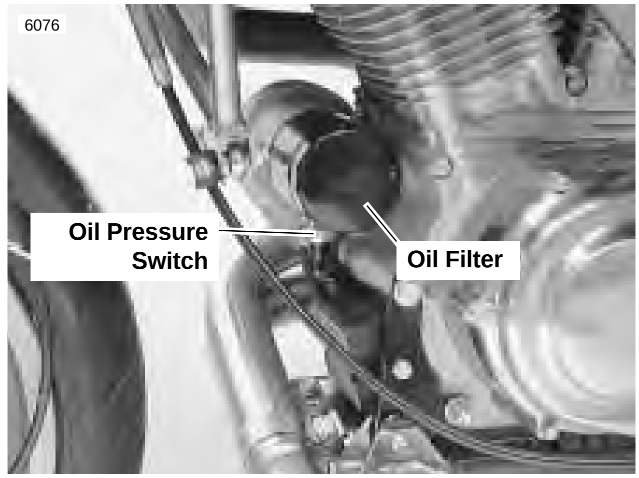


Figure 1-4. Oil Filter and Mount (Typical)

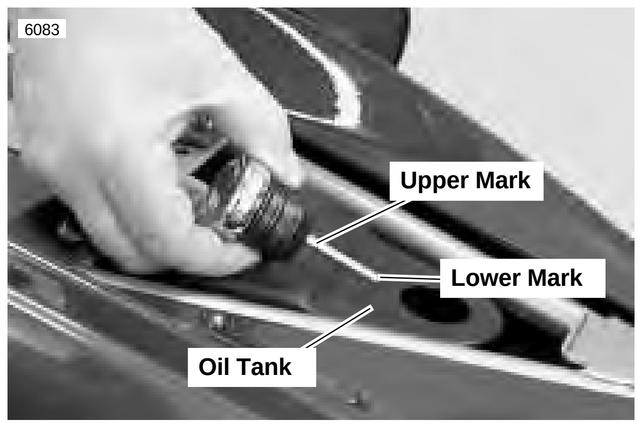


Figure 1-5. Checking Oil Tank Level

Table 1-6. Recommended Oil Grades

HARLEY-DAVIDSON TYPE	VISCOSITY	HARLEY-DAVIDSON RATING	LOWEST AMBIENT TEMP.	COLD WEATHER STARTS BELOW 50° F
H.D. Multi-Grade	SAE 10W40	HD 360	Below 40°F (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	HD360	Above 80° (27°C)	Poor

CHANGING ENGINE OIL AND FILTER

Change engine oil:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.
- When storing or removing the motorcycle for the season.

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.

1. Place a suitable container under the motorcycle.
2. See Figure 1-6. Compress clamp (2). Remove drain hose (1) from drain plug (3) by pulling hose forward. Direct hose to container and completely drain oil tank.
3. Install drain hose (1) on drain plug (3). Tighten clamp (2).
4. Remove oil filter using OIL FILTER WRENCH (Part No. HD-41215).
5. Clean filter gasket contact surface on crankcase. Surface should be smooth and free of any debris or old gasket material.
6. See Figure 1-7. Apply a thin film of oil to filter gasket contact surface on crankcase and to **new** oil filter.
7. Pour 4.0 ounces (0.12 liter) of clean oil into **new** filter when changing oil.
8. Screw filter onto adapter until filter gasket touches crankcase surface. Apply another 1/2-3/4 turn by hand.

WARNING

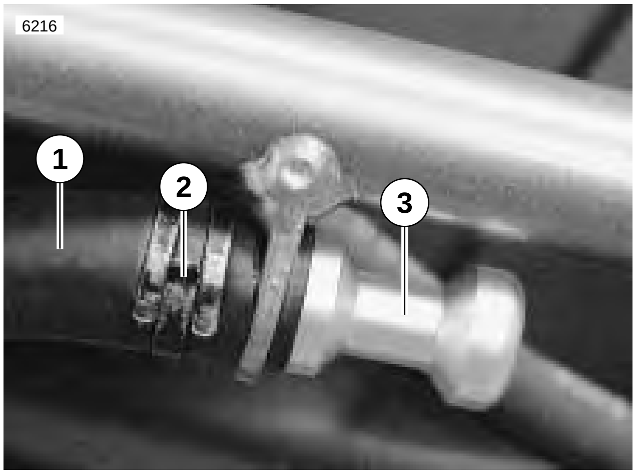
Make sure no oil gets on tires when changing oil and filter. If this occurs, traction will be adversely affected which may lead to a loss of control which could result in death or serious injury.

9. Fill oil tank with an oil from Table 1-6. Total oil capacity is 2.0 quarts (1.89 liters); including the 4 oz. (0.12 liter) in filter.
10. Install filler cap onto oil tank. Make sure filler cap is fully seated.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

11. Install seat. See 2.35 SEAT.
12. See Figure 1-8. Start engine. Verify that oil pressure signal light on dash panel turns off when engine speed is 1000 RPM or above.
13. Check for oil leaks at oil filter and drain hose.
14. Check oil level. See CHECKING ENGINE OIL LEVEL.



1. **Drain Hose**
2. **Clamp**
3. **Drain Plug**

Figure 1-6. Oil Tank Drain Line

Figure 1-7. Oil Filter

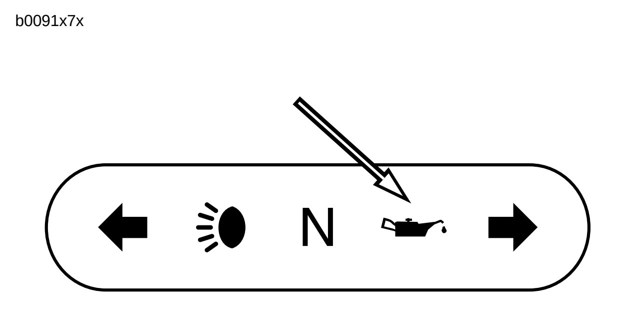


Figure 1-8. Oil Pressure Signal Light on Dash Panel

GENERAL

WARNING

D.O.T. 4 brake fluid can cause irritation of eyes and skin, and may be harmful if swallowed. If large amount of fluid is swallowed, induce vomiting by administering two tablespoons of salt in a glass of warm water. Call a doctor. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. Failure to comply could result in death or serious injury.

CAUTION

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

Check brake fluid level and condition:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.
- 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.

BLEEDING BRAKES

WARNING

D.O.T. 4 brake fluid can cause irritation of eyes and skin, and may be harmful if swallowed. If large amount of fluid is swallowed, induce vomiting by administering two tablespoons of salt in a glass of warm water. Call a doctor. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. Failure to comply could result in death or serious injury.

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 black 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

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

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.

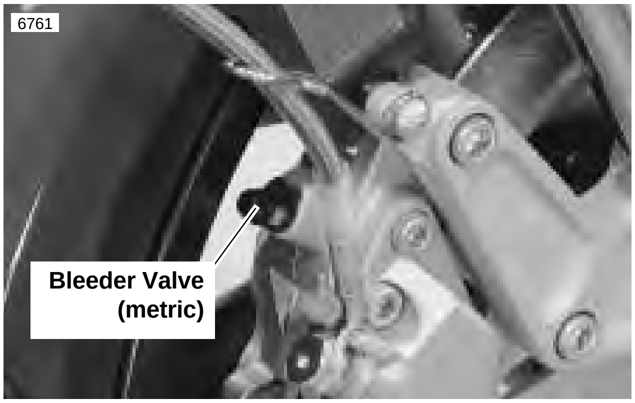


Figure 1-9. Front Brake Caliper Bleeder Valve

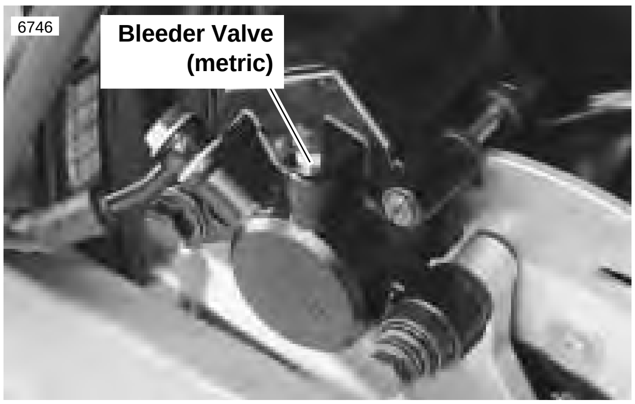


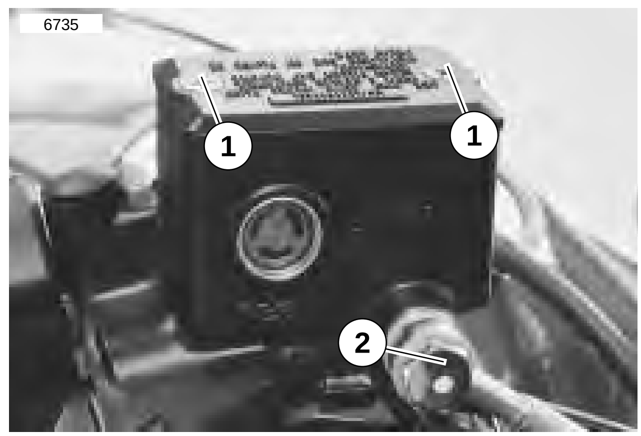
Figure 1-10. Rear Brake Caliper Bleeder Valve

1. Install end of a length of plastic tubing over caliper bleeder valve; place other end in a clean container. Stand motorcycle upright.
   a. Front brake caliper bleeder valve-Figure 1-9.
   b. Rear brake caliper bleeder valve-Figure 1-10.

CAUTION

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

2. Add **D.O.T. 4 BRAKE FLUID** to master cylinder reservoir. Do not reuse brake fluid.
   a. Cover painted surfaces and right handlebar switches.
   b. Remove two screws from front master cylinder cover. Bring fluid level to within 1/8 in. (3.2 mm) of molded boss inside front master cylinder. See Figure 1-11.
   c. Remove cap and gasket from rear master cylinder reservoir. Bring fluid level to between upper and lower marks on reservoir. See Figure 1-12.
3. Depress, release and then hold brake lever/pedal to build up hydraulic pressure.
4. Open bleeder valve about 1/2-turn counterclockwise; brake fluid will flow from bleeder valve and through tubing. When brake lever/pedal has moved 1/2 to 3/4 of its full range of travel, close bleeder valve (clockwise). Allow brake lever/pedal to return slowly to its released position.
5. Repeat Steps 2-4 until all air bubbles are purged.
6. Tighten brake caliper bleeder valves (metric) to 3-5 ft-lbs (4-7 Nm).
7. Verify master cylinder fluid level as described in Step 2.
8. Attach covers to master cylinder reservoirs.
   a. Tighten screws on front master cylinder reservoir to 9-13 **in-lbs** (1-2 Nm).
   b. Tighten cap on rear master cylinder reservoir securely.
   c. Remove cover from painted surfaces and right handlebar switches.



1. Cover Screws (2) **2. Banjo Bolt (metric)**

Figure 1-11. Front Master Cylinder

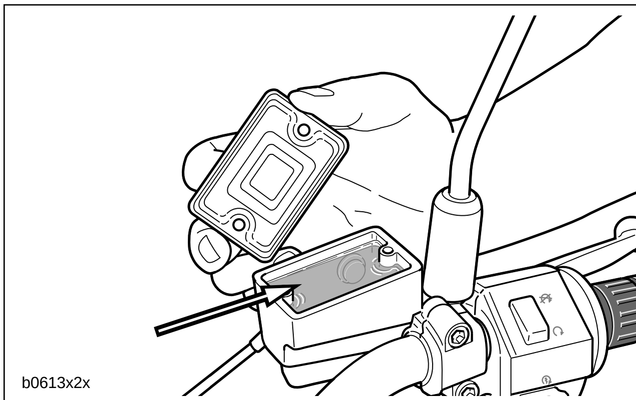


Figure 1-12. Checking Brake Fluid Level (Switch shown uncovered for clarity)

REAR BRAKE PEDAL

WARNING

Always test motorcycle brakes at low speed after servicing or bleeding system. To prevent death or serious injury, Buell recommends that all brake repairs be performed by a Buell dealer or other qualified mechanic.

Check rear brake pedal height.

- Before every ride.
- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.

1. See Figure 1-13. Slide rubber boot (1) upward.
2. Measure distance from bottom edge of rod adjuster (2) to top surface of turn buckle (4).
   a. If measurement approximately 0.84 in. (21.3 mm), slide rubber boot (1) down over assembly. Brake pedal adjustment is not needed.
   b. If measurement is not within specification, adjust brake pedal.

NOTE

See Figure 1-14. Minimum allowable pushrod thread engagement inside turn buckle is 0.24 in. (6.0 mm).

3. Adjust brake pedal.
   a. See Figure 1-13. Loosen locknut (3) while holding rod adjuster. Move locknut away from top surface of turn buckle.
   b. Turn rod adjuster to set pedal height.
   c. Return locknut (3) to fit flush against top surface of turnbuckle (4).
   d. Slide rubber boot (1) down over rod adjuster (2).

NOTE

Brake pedal has no free play adjustment.

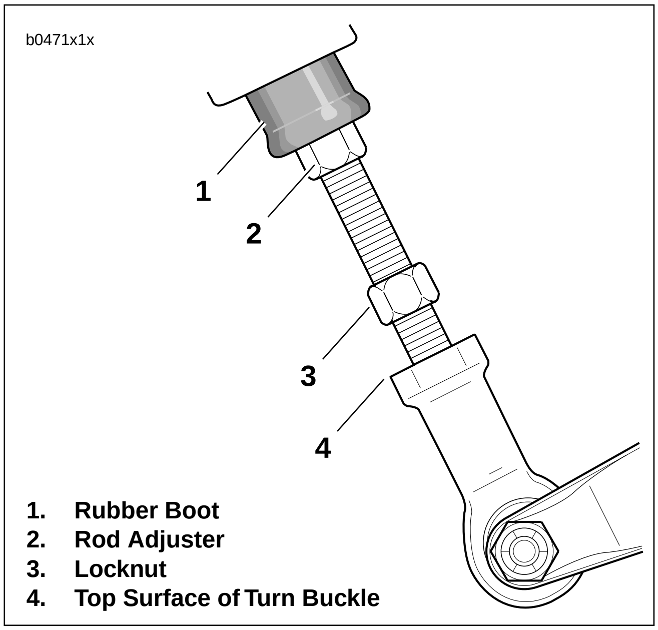


Figure 1-13. Pushrod Adjustment

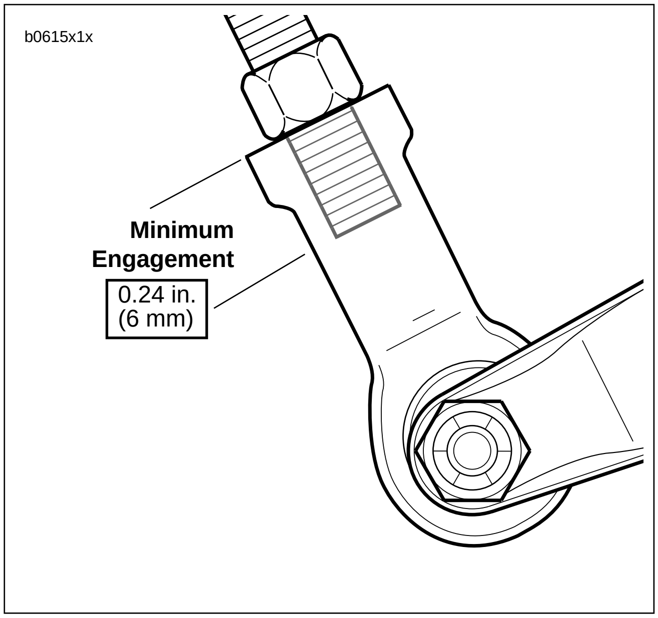


Figure 1-14. Minimum Thread Engagement

SHIFT LINKAGE ROD ADJUSTMENT 1.6

INSPECTION

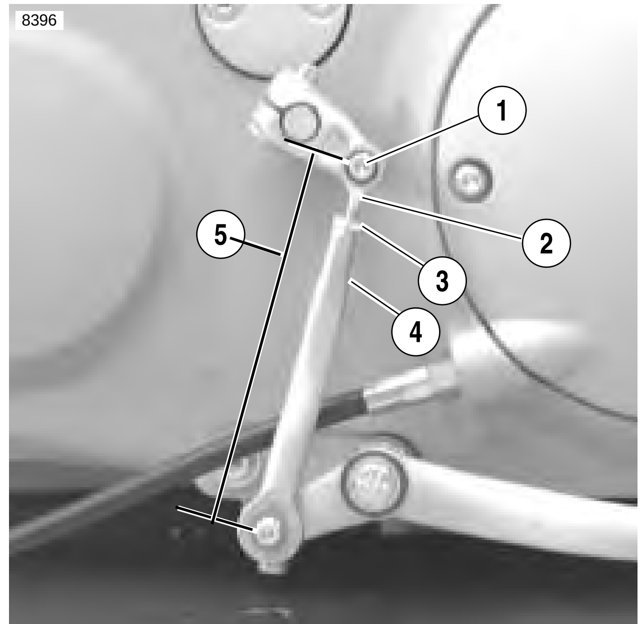
1. Inspect shift linkage for free movement.
2. See Figure 1-15. Measure the shift linkage rod by measuring the distance from the center of the lower eye to the center of the top eye (5). For settings see Table 1-7.
3. Adjust as required.

ADJUSTMENT

1. See Figure 1-15. Remove upper eye fastener (1) and upper eye (2) from shift rod (4).
2. Loosen jam nut (3). Rotate upper eye clockwise to shorten, or counterclockwise to lengthen to factory settings of 4.75 in (120.7 mm) or maximum length of 4.88 in (124 mm).
3. Tighten jam nut.
4. Apply LOCTITE THREADLOCKER 243 (Blue) to threads of upper eye fastener.
5. Install upper eye to shift rod with upper eye fastener. Tighten to 59-66 **in-lbs** (6.6-7.5 Nm).
6. Check for proper shift lever/clutch operation.

Table 1-7. Shifter Rod Adjustment

SETTINGS	MEASUREMENT
Factory	4.75 in (120.7 mm)
Maximum	4.88 in (120.7 mm)



1. **Upper Eye Fastener**
2. **Upper Eye**
3. **Jamnut**
4. **Shift Rod**
5. **Shift Linkage Rod Measurement (eye center to eye center)**

Figure 1-15. Shift Linkage Rod Adjustment

BRAKE PADS

⚠WARNING

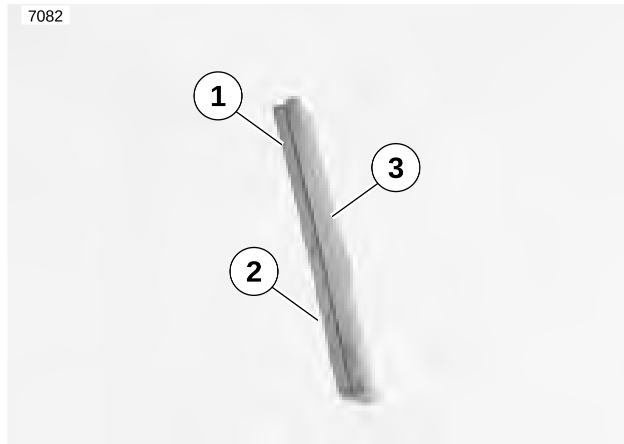
Always replace brake pads in complete sets for correct brake operation. Never replace just one brake pad. Failure to install brake pads as a set could result in death or serious injury.

Check brake pads for minimum thickness:

- At the 500 mile (800 km) service interval.
- At every scheduled service interval thereafter.

See Figure 1-16. Inspect brake pads for damage or excessive wear. Replace both pads as a set if friction material (1) of either pad is worn to 0.04 in. (1.0 mm) or less. If this amount of wear occurs, wear grooves (2) will disappear from friction material surface.

- Replace front brake pads using procedure under 2.11 FRONT BRAKE CALIPER.
- Replace rear brake pads using procedure under 2.14 REAR BRAKE CALIPER.



1. **Friction Material**
2. **Wear Groove**
3. **Backing Material**

Figure 1-16. Brake Pad Thickness

BRAKE ROTORS

Brake Rotor Thickness

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake rotor or reduced braking ability will occur, which could result in death or serious injury.

Check brake rotors for minimum thickness:

- At the 500 mile (800 km) service interval.
- At every scheduled service interval thereafter.

1. Measure rotor thickness. Replace if minimum thickness is less than 0.18 in. (4.5 mm).
2. Check rotor surface. Replace if warped or badly scored.
3. The brake rotor must be within the following specifications. If the brake rotor is suspected of being damaged, inspect rotor using the following measurements:
   - Lateral Movement: 0.5 mm
   - Radial Movement: 0.45 mm
   - Rotational Movement: 0.39 mm

Figure 1-17. Front Brake Rotor

TIRES AND WHEELS 1.8

TIRE INFLATION

WARNING

Do not inflate any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate which could result in death or serious injury.

Check tire pressure and tread:

- Before every ride.
- At the 500 mile (800 km) service interval.
- At every scheduled service interval.

Check for proper front and rear tire pressures when tires are cold. Compare pressure against Table 1-8.

Table 1-8. Tire Pressures

TIRE	PRESSURE FOR SOLO RIDING		PRESSURE AT GVWR	
Front	32 PSI	221 kPa	36 PSI	248 kPa
Rear	36 PSI	248 kPa	38 PSI	262 kPa

WHEEL BEARINGS

Check wheel bearings:

- Every time the wheel is removed.
- At every 10,000 mile (16,000 km) service interval.
- When storing or removing the motorcycle for the season.

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

TRANSMISSION FLUID

Check transmission fluid:

- Replace at the 500 mile (800 km) service interval.
- Inspect level at every 2500 mile (4000 km) service interval.
- Replace at every 5000 mile (8000 km) service interval.

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

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174). This prevents transmission fluid from spilling out of the clutch inspection cover opening.
2. Remove muffler to access drain plug. See 2.27 EXHAUST SYSTEM.
3. See Figure 1-18. Position a suitable container under drain plug (3). Remove plug and drain fluid.
4. Wipe any foreign material from the magnetic drain plug. Reinstall plug. Tighten to 14-30 ft-lbs (19-41 Nm).
5. Remove four TORX screws with washers (1) from clutch inspection cover (2). Remove clutch inspection cover from primary cover. Do not damage or dislodge Quad ring from primary cover.

CAUTION

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

6. See Figure 1-19. Add SPORT-TRANS FLUID (Part No. 98854-96 quart size; Part No. 98855-96 gallon size) as required until fluid level (4) is even with bottom of clutch diaphragm spring (3).
7. See Figure 1-18. Install clutch inspection cover (2) using four TORX screws with washers (1). Tighten in a crosswise pattern to 7-9 ft-lbs (10-12 Nm).
8. Install muffler. See 2.27 EXHAUST SYSTEM.

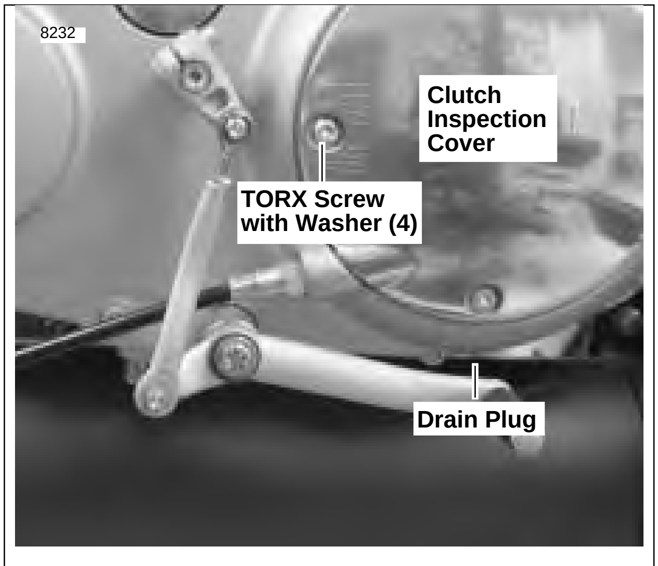


Figure 1-18. Primary Cover

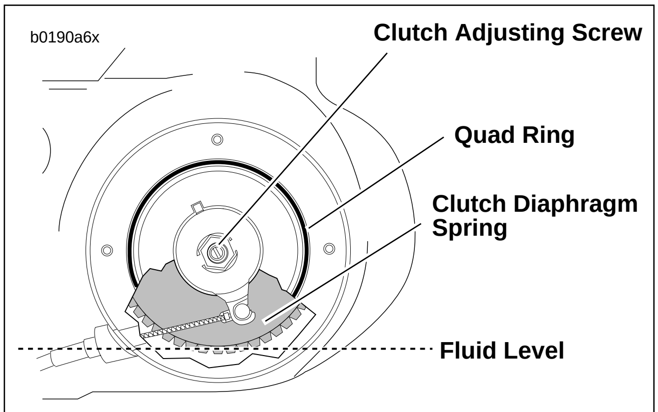


Figure 1-19. Fluid Level

ADJUSTMENT

Check clutch adjustment:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.

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. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 1-20. Slide rubber boot upward to expose adjuster mechanism. Loosen jam nut from adjuster. Turn adjuster to shorten cable housing until there is a large amount of freeplay at clutch hand lever.
3. See Figure 1-21. Remove four TORX screws with washers (1) from clutch inspection cover (2). Remove clutch inspection cover from primary cover. Do not damage or dislodge Quad ring (3) from primary cover.

NOTE

Quad ring is shown removed from primary cover for illustrative purposes only in Figure 1-21.

4. Remove spring (4) and lockplate (5). Turn adjusting screw (6) counterclockwise until it lightly bottoms.
5. Turn adjusting screw (6) clockwise 1/4 turn. Install lockplate (5) and spring (4) on adjusting screw flats. If hex on lockplate does not align with recess in outer ramp, rotate adjusting screw clockwise until it aligns.
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) freeplay at clutch hand lever. Adjust as follows.
   a. See Figure 1-22. Pull ferrule (1) (end of cable housing) away from bracket (2). Gap between ferrule and bracket should be 1/16-1/8 in. (1.6-3.2 mm).
   b. See Figure 1-20. Set freeplay by turning adjuster.
   c. Tighten jam nut against adjuster.
   d. Slide boot over cable adjuster mechanism.
7. Change or add transmission fluid if necessary.
8. See Figure 1-21. Install clutch inspection cover (2) using four TORX screws with washers (1). Tighten in a crosswise pattern to 7-9 ft-lbs (10-12 Nm).
9. Check clutch cable freeplay. See Step 6 above.

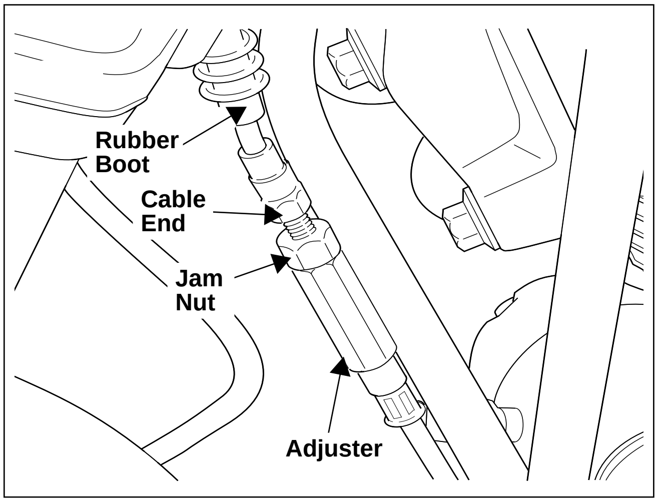
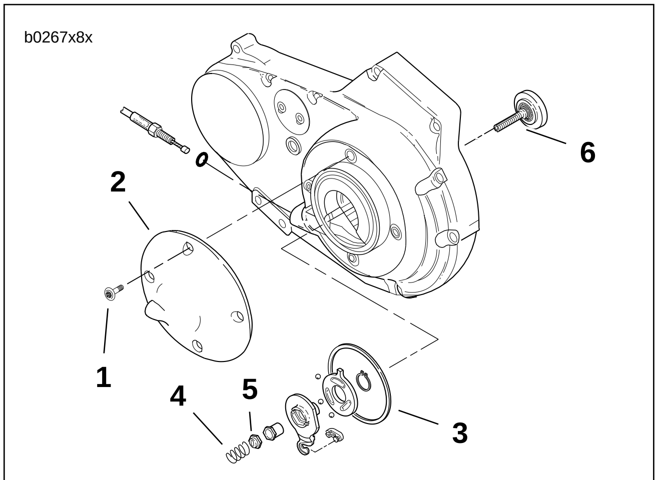


Figure 1-20. Clutch Cable Adjuster Mechanism



1. TORX Screw with Washer
2. Clutch Inspection Cover
3. Quad Ring
4. Spring
5. Lockplate
6. Adjusting Screw

Figure 1-21. Clutch Release Mechanism

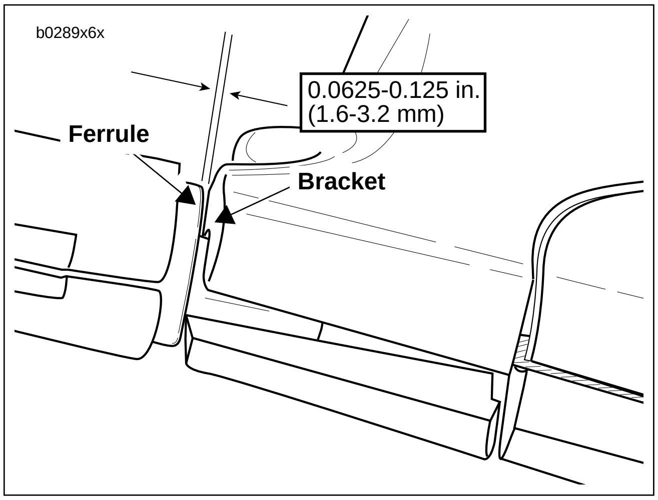


Figure 1-22. Adjusting Clutch Freeplay

DRIVE BELT DEFLECTION 1.10

INSPECTION

Check drive belt deflection:

- Inspect before every ride.
- Adjust at the 500 mile (800 km) service interval.
- Inspect at every 5000 mile (8000 km) service interval thereafter.

NOTE

There are tight and loose spots during rear wheel rotation that affect belt deflection. For a more precise measurement, take three deflection readings, rotating the rear wheel between measurements. Average the three readings for a more precise measurement.

When checking deflection, have:

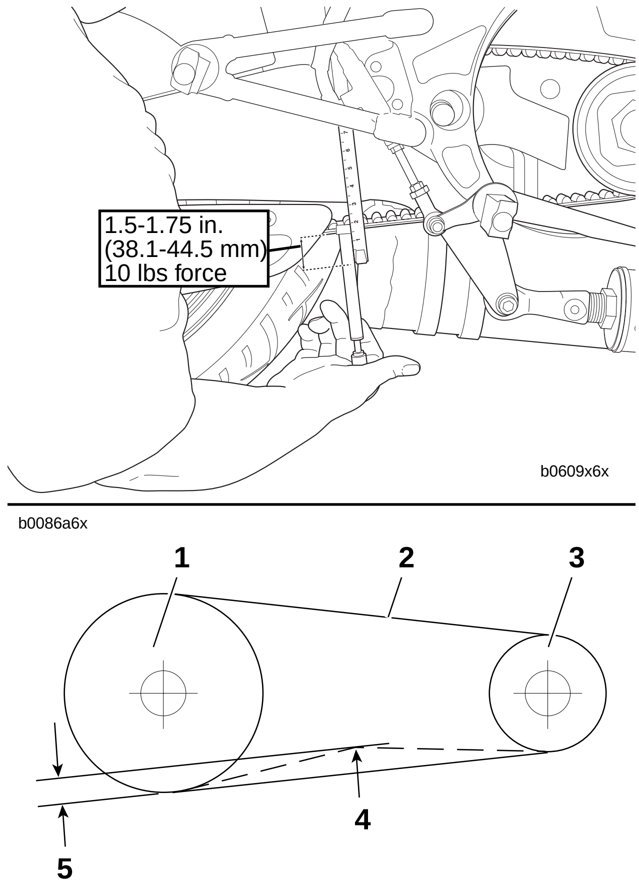
- No rider or cargo weight on motorcycle.
- Transmission in neutral.
- Belt and sprockets at room temperature.
- Motorcycle upright (not on side stand).

1. Adjust rear shock absorber spring preload.
2. Detach drive support arm and sprocket cover.
3. Unload the rear suspension by lifting the motorcycle frame under the tail section.

NOTE

When the rear suspension is fully unloaded, the motorcycle's weight is not compressing the rear shock. It is not necessary to raise the rear wheel off the ground to reach this point.

4. See Figure 1-23. Apply 10 lbs of force to belt at midpoint of bottom strand using BELT TENSION GAUGE (Part No. HD-35381). The deflection should be upwards as shown.
   a. Deflection (measured with 10 lbs of force) should be 1.50-1.75 in. (38.1-44.5 mm) at the bottom strand. If deflection is within limits, see ADJUSTMENT, Axle Alignment.
   b. If belt tension does require adjustment, see ADJUSTMENT, Deflection Adjustment. After adjusting deflection, check axle alignment.
5. Install drive support arm and sprocket cover.
   a. Apply LOCTITE THREADLOCKER 272 (red) to drive support screws. Tighten screws to 20-25 ft-lbs (27-34 Nm).
   b. Tighten drive support nut to 35 ft-lbs (40-47 Nm).



1. **Rear Wheel Sprocket**
2. **Drive Belt**
3. **Transmission Sprocket**
4. **Location to Apply Force**
5. **Location to Measure Belt Deflection**

Figure 1-23. Checking Belt Deflection

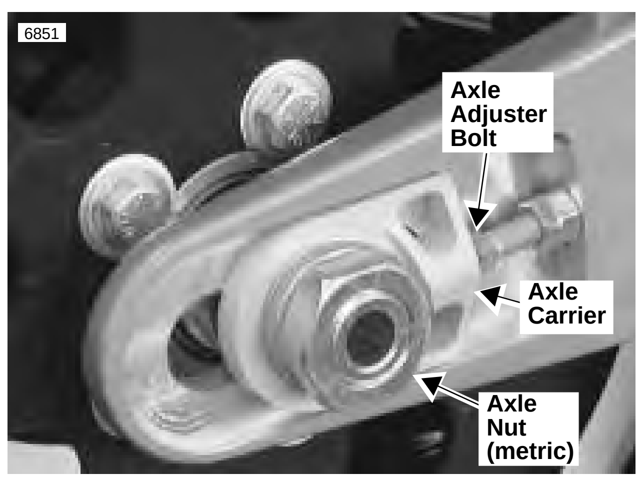


Figure 1-24. Rear Axle Adjuster

ADJUSTMENT

Axle Alignment

Check to be sure rear wheel axle is parallel with swingarm pivot shaft.

1. See Figure 1-25. Measure each side from the flat of the axle carrier to the flat of the swingarm.
   a. If the measurements are equal +/- 0.015 in. (.381 mm) the rear axle is correctly aligned.
   b. If the two measurements are not equal, adjustment is required. Follow below.

Deflection Adjustment

1. See Figure 1-24. Loosen rear axle nut (metric), if not already loose.

NOTE

See Figure 1-26. *Use an automotive-style ignition wrench to hold axle adjuster bolt in place during Step 2.*

2. To adjust belt deflection/rear wheel alignment, loosen locknut, hold axle adjuster bolt and turn adjusting nut.
   a. If belt is too loose, tighten adjusting nut to decrease deflection and therefore increase drive belt tension.
   b. If belt is too tight, loosen adjusting nut to increase belt deflection and therefore decrease drive belt tension.
   c. See Figure 1-26. Repeat this step until the distance between the flat on the axle carrier and the flat of the swingarm is the same on both sides of the rear wheel and belt deflection is correct.
3. Tighten locknut flush against adjusting nut.
4. Tighten axle nut (metric) to 66-73 ft-lbs (90-99 Nm).
5. Verify that belt deflection is correct.

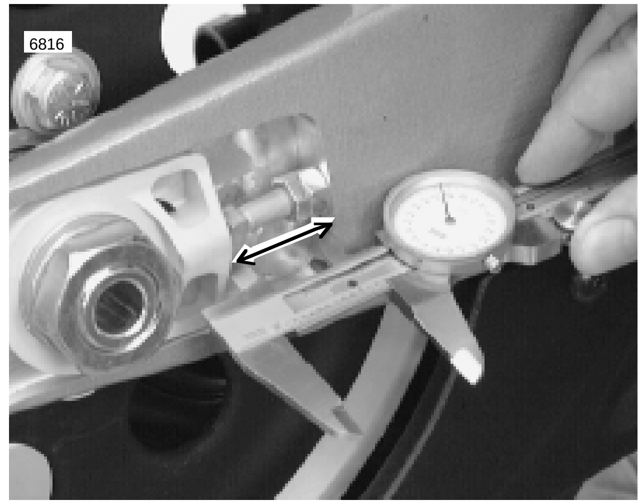


Figure 1-25. Checking Rear Wheel Alignment, Right Side Shown

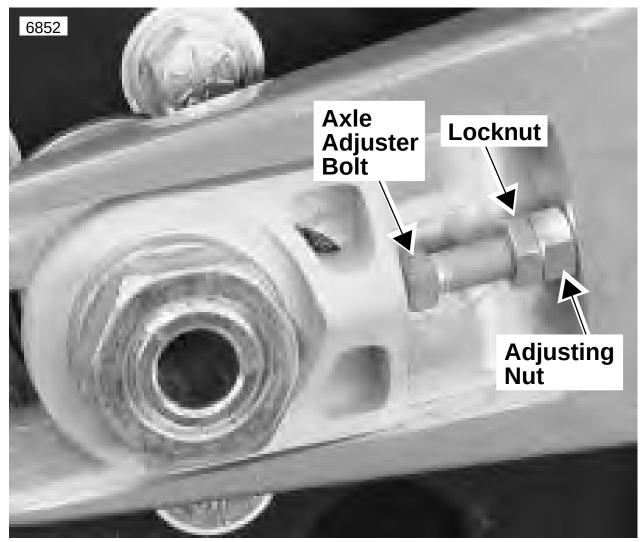


Figure 1-26. Axle Adjuster Bolt, Right Side Shown

DRIVE BELT AND SPROCKET 1.11

GENERAL

Inspect the drive belt and rear sprocket:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.

NOTE

When a drive belt is replaced for any reason other than stone damage, it is recommended that the transmission and rear sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.

INSPECTION

Rear Sprocket

NOTE

If chrome chips or 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 chrome chips with sharp edges.
   c. Gouges caused by hard objects.
   d. Excessive loss of chrome plating (see Step 2).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove between two teeth with medium pressure.
   a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
   b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.

Drive Belt

See Figure 1-27. Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn transmission sprocket teeth. Replace belt and transmission sprocket.
- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist.

NOTE

Condition 1 may develop into 2 or 3 over time. Condition 1 is not grounds for replacing the belt, but it should be watched closely before condition 2 develops which will required belt replacement.

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets. Clean the drive belt with a spray solution of mild soap and water. Wipe the solution off the belt and dry. Do not immerse the belt in the soapy water solution.

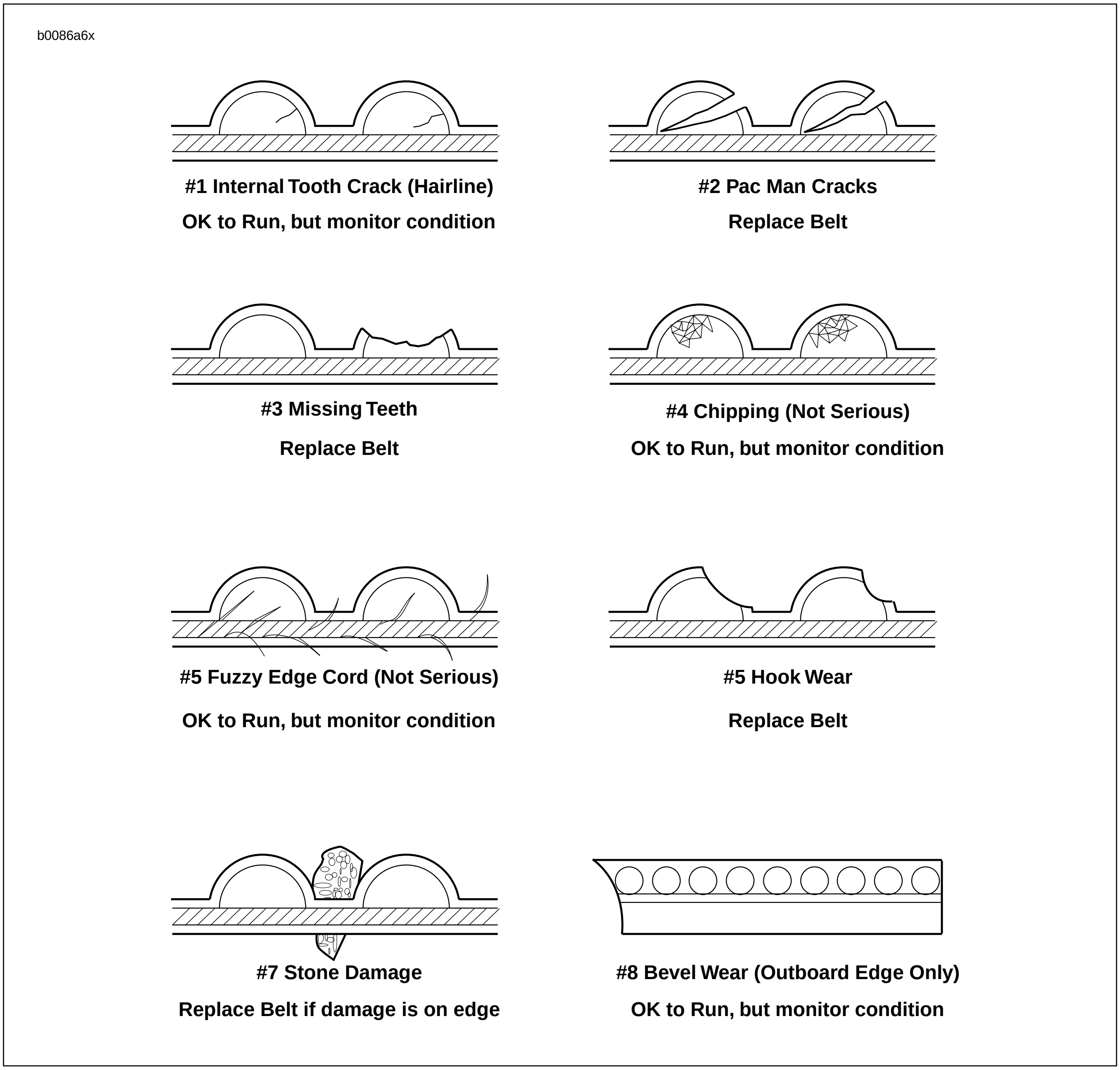


Figure 1-27. Drive Belt Wear Patterns

PRIMARY CHAIN 1.12

INSPECTION

Check primary chain tension:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.

See Figure 1-28. Measure primary chain tension through the inspection cover (3) opening. Adjust primary chains not meeting vertical freeplay specifications.

1. See Figure 1-28. Remove two screws (1) and O-rings (2).
2. Remove inspection cover (3) and O-ring (4) from primary cover (6).
3. See Figure 1-29. Check primary chain tension by measuring vertical freeplay (4).
   a. Measure vertical freeplay through inspection cover opening (2).
   b. Rotate engine to move primary chain to a different position on sprockets (1, 3).
   c. Measure vertical freeplay several times, each time with primary chain moved so that the measurement is taken with sprockets rotated to the tightest chain position.
4. The tightest measurement taken in Step 3 must be within the specifications listed in Table 1-9. If necessary, adjust as described under ADJUSTMENT.

NOTE

The initial primary chain vertical freeplay specification used at the assembly plant is 1/4-3/8 in. (6.4-9.5 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 freeplay (with a cold engine), adjust freeplay 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.

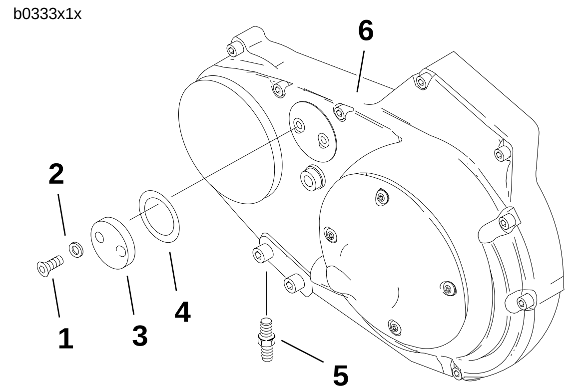
5. See Figure 1-28. Install O-ring (4).
6. Fasten inspection cover (3) to primary cover (6) using two screws (1) with O-rings (2). Tighten to 40-60 **in-lbs** (5-7 Nm).

ADJUSTMENT

NOTE

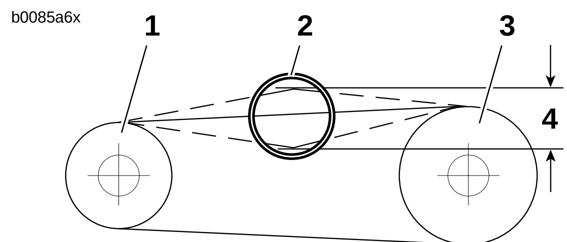
If vertical freeplay cannot be set within the limits specified, then primary chain and/or chain adjuster are worn beyond adjustment limits. Replace parts as necessary. See Section 6.

1. See Figure 1-30. Loosen locknut (1).
2. Turn adjusting screw (2):
   a. Clockwise (inward) to reduce freeplay.
   b. Counterclockwise (outward) to increase freeplay.
3. Tighten locknut (1) to 20-25 ft-lbs (27-34 Nm).



1. **Screw (2)**
2. **O-Ring (2)**
3. **Inspection Cover**
4. **O-Ring**
5. **Adjusting Screw and Locknut**
6. **Primary Cover**

Figure 1-28. Primary Chain Inspection Cover



1. **Engine Sprocket**
2. **Inspection Cover Opening**
3. **Clutch Sprocket**
4. **Vertical Freeplay**

Figure 1-29. Measuring Primary Chain Tension

Table 1-9. Primary Chain Tension

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

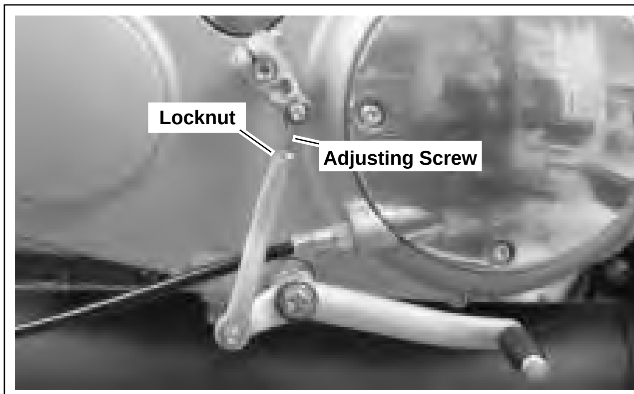


Figure 1-30. Primary Chain Adjustment

PRELOAD ADJUSTMENT 1.13

GENERAL

Adjust rear preload when:

- There is a change in load (adding luggage, etc.)
- Changing front fork or rear shock suspension settings

Optimal rear suspension spring preload assures that the rear shock has enough travel to absorb bumps without bottoming.

Spring preload is the most important suspension adjustment. Improper preload will adversely affect both the handling and motorcycle ride. Correct preload setting will result in motorcycle handling that suits the rider's size and weight.

ADJUSTMENT

Rear Shock Preload

Check and Adjust Rear Shock Preload

1. See Figure 1-31. With a rider seated on the motorcycle, measure the distance between the centers of the front and rear shock eye. The optimum preload measurement is 15.2-15.5 in. (386-394 mm).
2. See Figure 1-31. Adjust shock preload until the measurement is within the optimum preload measurement.
   a. Loosen the locknut and turn the preload adjuster at the end of the shock.
   b. See Figure 1-32. To decrease preload, move the can towards the front of the motorcycle. To increase preload, move the can towards the rear of the motorcycle.

NOTE

- *All measurements must be taken with rider seated on motorcycle.*
- *Riders with passenger at or near GVWR may exceed optimum shock length measurement (preload adjustment).*

4. See Figure 1-33. When preload adjustments have been made, apply wheel bearing grease halfway around the shock (180 degrees) to the mating faces of the locknut and adjuster nut and the first few threads on the aluminum body leading to the adjuster nut.
3. Thread locknut back into place.

NOTE

Torque wrench and crow's foot must be set at 90 degrees to prevent torque multiplication by wrench.

4. Hold adjusting nut in place and tighten locknut to 65-72 ft-lbs (88-98 Nm) with crow's foot set at 90 degrees to the torque wrench.
5. Wipe excess grease off of shock absorber.

NOTE
When preload is increased, both compression and rebound damping should be increased. If preload is decreased, both compression and rebound damping should be decreased.

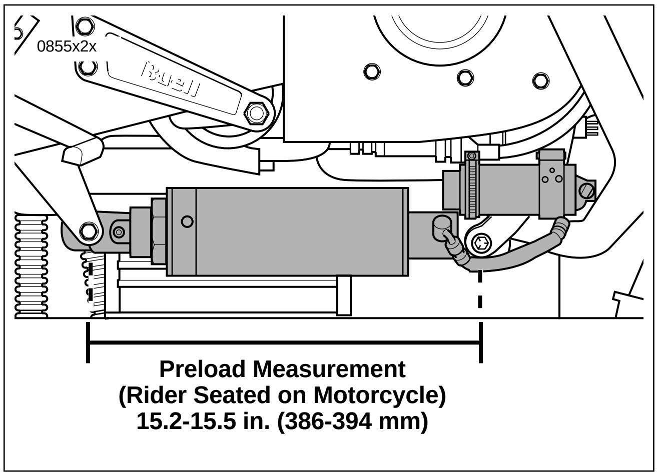


Figure 1-31. Rear Shock Preload Adjustment

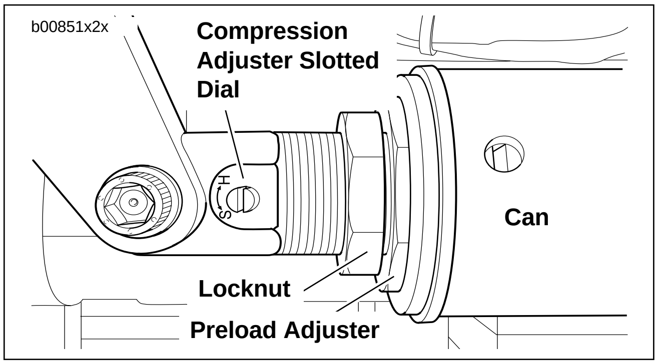


Figure 1-32. Rear Shock Preload Adjustment

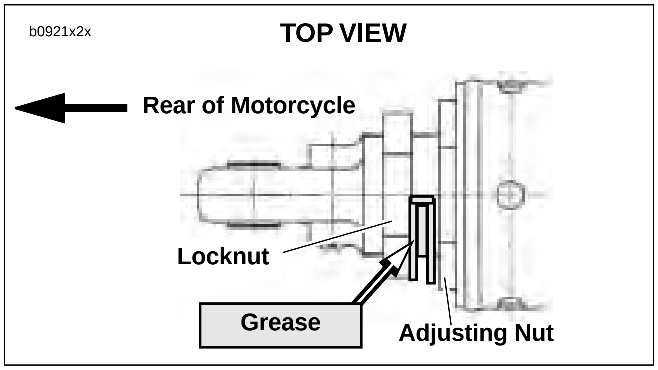


Figure 1-33. Applying Grease to Shock

SUSPENSION DAMPING ADJUSTMENTS 1.14

ADJUSTMENT

FRONT FORK ADJUSTMENTS

Rebound Damping

See Figure 1-34. Adjust rebound damping using the slotted dial on the top of each fork leg.

Factory setting-full damping	minus 0.5 turn

Compression Damping

See Figure 1-34. Adjust compression damping using the slotted dial on the bottom of each fork leg.

Factory setting-full damping	minus 1.75 turns

Adjusting Front Fork

WARNING

Always adjust each fork leg to the same settings. Uneven adjustment between left and right forks may lead to a loss of control which could result in death or serious injury.

1. Using a screwdriver, turn the slotted dial on the appropriate adjuster clockwise until it stops. This is the maximum damping setting for that adjustment.
2. Then turn the dial counterclockwise the recommended amount to align the reference marks. This is the factory recommended setting.

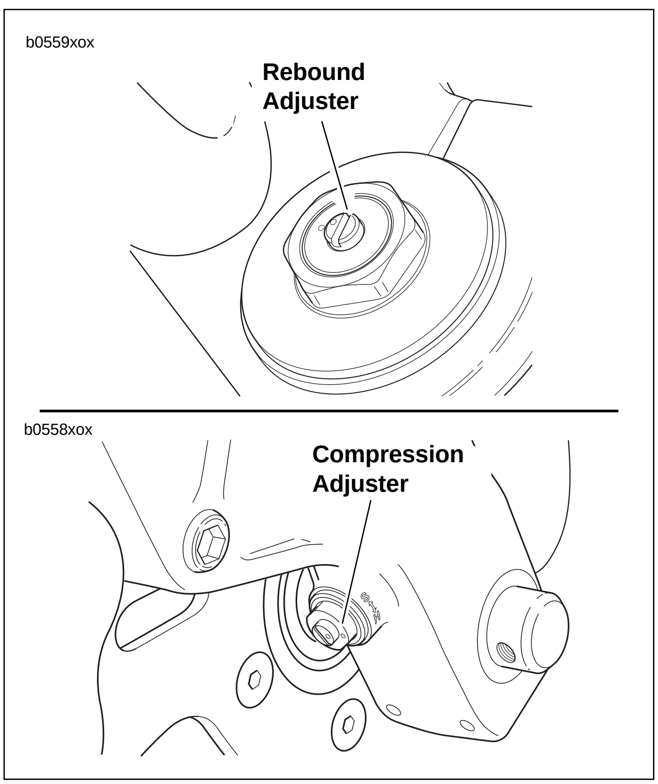


Figure 1-34. Front Fork Adjusters

REAR SHOCK ADJUSTMENTS

Rebound Damping

See Figure 1-35. Adjust rebound damping using the slotted dial on the remote reservoir at the front of the shock.

Factory setting-full damping	minus 1 turn

Compression Damping

See Figure 1-35. Adjust compression damping using the slotted dial on the shaft at the end of the shock.

Factory setting-full damping	minus 2.5 turns

Adjusting Rear Shock

1. Using a screwdriver, turn the slotted dial on the appropriate adjuster clockwise until it stops. This is the maximum damping setting for that adjustment.
2. Turn the dial counterclockwise from the maximum damping setting the recommended amount to align the reference marks. This is the factory recommended setting.

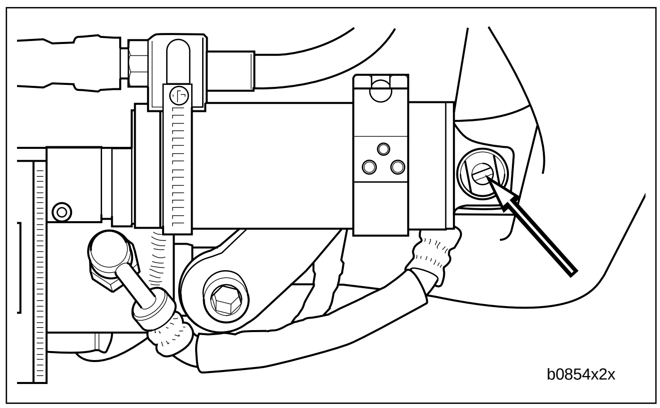


Figure 1-35. Rear Shock Rebound Adjustment

Table 1-10. Recommended Damping Settings

SETTINGS	SOLO (STD)	2-UP	SOLO (FIRM)	SOLO (SOFT)
Front Rebound	0.5	1	0.5	1.5
Front Compression	1.75	1.25	1.25	MIN
Rear Rebound	1	0.5	0.5	2.5
Rear Compression	2.5	0.25	1	MIN

FORK OIL CHANGE

Replace fork oil:

- At every 20,000 mile (32,000 km) service interval.
- If fork should be submerged in water.

NOTE

If fork oil is emulsified, aerated or light brown in color, then it has been contaminated by water. If this happens, replace the fork oil seals.

1. Remove, drain and disassemble front forks. Inspect and assemble parts as described under 2.16 FRONT FORK.

NOTE

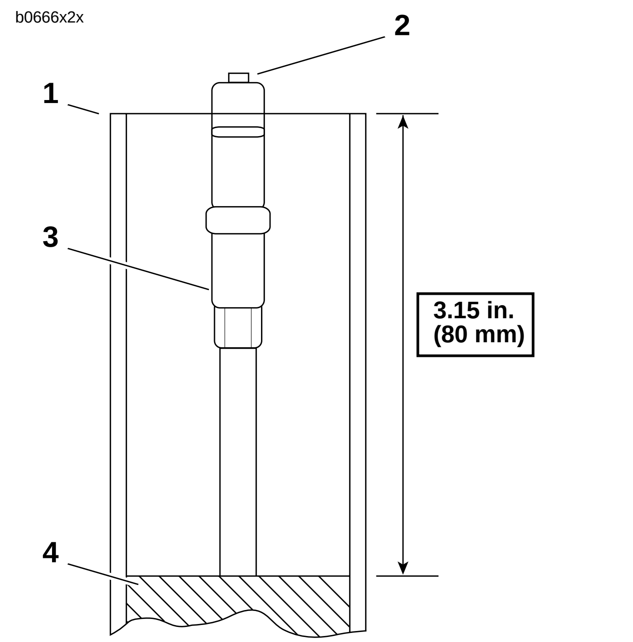
Use only TYPE E FORK OIL (Part No. HD-99884-80).

2. See Table 1-11. While supporting fork, pour one-half of the recommended amount of fork oil into fork pipe.
3. See Figure 1-36. Pump damper assembly (3) and leg slowly about 10 times, using 6.0 in. (150 mm) strokes.
4. Place damper assembly and outer tube in full bottomed position.
5. Pour remaining amount of recommended fork oil into fork pipe.
6. Check fork oil level. Maximum and minimum oil levels are listed in Table 1-11.
   a. With front fork fully compressed, clamp vertically in FRONT FORK HOLDING TOOL (Part No. B-41177).
   b. Measure distance from fork oil (4) surface to top of outer tube (1) using PRO-LEVEL OIL GAUGE (Part No. B-59000A). See Figure 1-37.
   c. Add or drain fork oil as needed until distance from top of fork tube to oil surface measures 3.15 in. (80.0 mm).

NOTE

Left and right forks must contain equal amounts of fork oil.

7. Finish fork assembly and install. See 2.16 FRONT FORK.



1. **Outer Tube**
2. **Adjuster**
3. **Damper Assembly**
4. **Fork Oil Level**

Figure 1-36. Correct Fork Oil Level

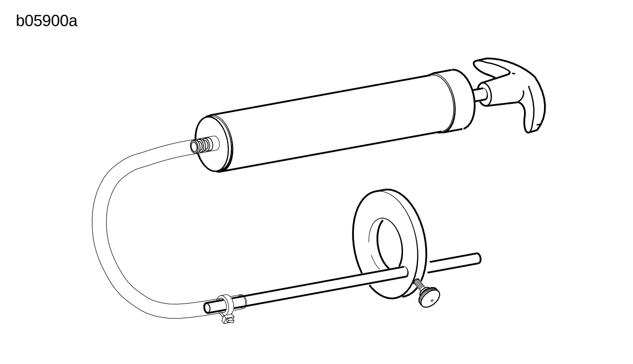


Figure 1-37. Pro Level Oil Gauge

Table 1-11. Fork Oil

PROPERTY	SPECIFICATION	
Fork Oil	TYPE E FORK OIL (Part No. HD-99884-80)	
Standard Capacity	15.36 ounces	450 cc
Standard Oil Level	3.15 in.	80 mm
Maximum Oil Level	2.36 in.	60 mm
Minimum Oil Level	4.333 in.	110 mm

INSPECTION

Check steering head bearings:

- Inspect at the 500 mile (800 km) service interval.
- Inspect and adjust at every 2500 mile (4000 km) service interval thereafter.
- Inspect when storing or removing the motorcycle for the season.
- Inspect, adjust and lubricate at every 10,000 mile (16,000 km) service interval.

1. See Figure 1-38. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395-A) and an automotive Engine Hoist.
2. Turn front wheel to full right lock.
3. Hook a spring scale into the hole in the front axle. Pull front wheel to center position. It should take 4.5-6.5 lbs (2.0-2.9 kg) to pull front wheel to center.

NOTE

Check that clutch and throttle cables do not bind when measuring bearing resistance. If binding occurs, detach cables and re-attach when complete.

Lubrication

At 10,000 miles (16,000 km) and every 10,000 miles (16,000 km) thereafter, lubricate the steering head bearings with WHEEL BEARING GREASE (Part No. 99855-89).

See 2.17 FORK STEM AND BRACKET ASSEMBLY for lubrication procedure.

ADJUSTMENT

1. Test motorcycle according to procedure listed under INSPECTION. If adjustment is needed, follow the instructions below.
2. See Figure 1-39. Loosen both pinch screws (7) on lower triple clamp.
3. Loosen small pinch screw (8) on upper triple clamp.
4. Tighten or loosen fork stem bolt (1) to set proper tension.
5. Recheck tension using spring scale. See Steps 2 and 3 of INSPECTION.
6. Tighten both lower triple clamp pinch screws (7) to 18-20 ft-lbs (24-27 Nm).
7. Tighten small pinch screw (8) on upper triple clamp to 10-12 ft-lbs (14-16 Nm).

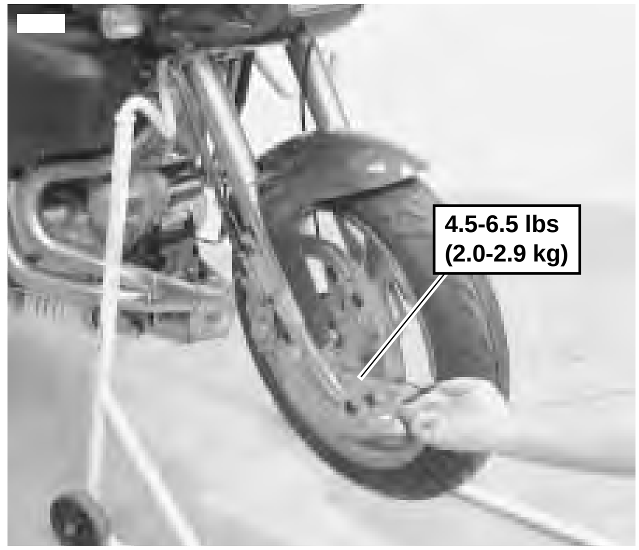
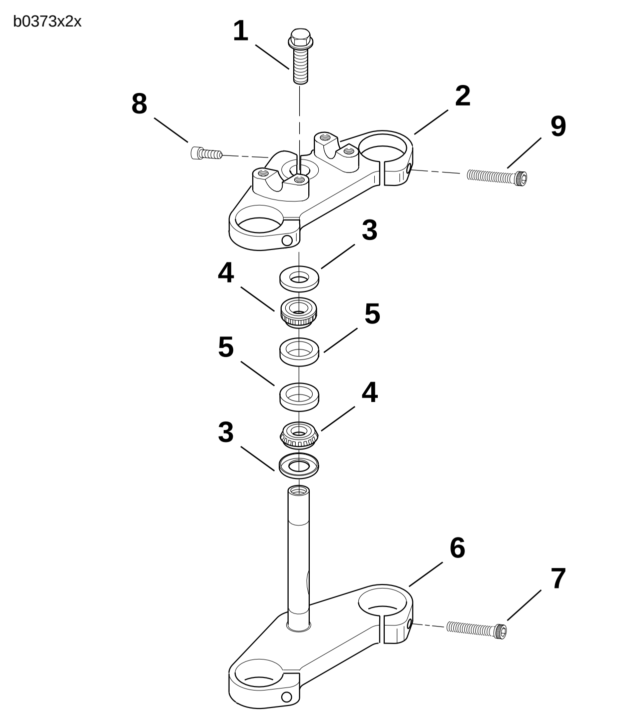


Figure 1-38. Checking Steering Head Bearings (Typical)



1. **Fork Stem Bolt**
2. **Upper Triple Clamp**
3. **Dust Shield (2)**
4. **Roller Bearing (2)**
5. **Bearing Cup (2)**
6. **Lower Triple Clamp**
7. **Lower Pinch Screws (2)**
8. **Pinch Screw**
9. **Upper Pinch Screws (2)**

Figure 1-39. Steering Head Assembly

INSPECTION

Check spark plugs:

- Inspect at every 5000 mile (8000 km) service interval.
- Replace every 10,000 mile (16,000 km) service interval.
- Use only Harley-Davidson 10R12 spark plugs (Part No. 27661-00Y).

1. Disconnect cables from both spark plugs.
2. Remove spark plugs.
3. See Figure 1-40. 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 a carburetor air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.
   c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.
   d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.
4. 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.
5. If the plugs cannot be cleaned, replace with No. 10R12 spark plugs.
6. Check electrode gap with a wire-type feeler gauge. Gap should be 0.038-0.043 in. (0.97-1.09 mm).
7. See Figure 1-41. Apply LOCTITE ANTI-SEIZE to first few threads of spark plugs. Install and tighten to 11-18 ft-lbs (15-24 Nm).
8. Connect spark plug cables. Longer cable attaches to rear cylinder spark plug. Verify that cables are securely connected to coil and spark plugs.

Figure 1-40. Typical Spark Plug Deposits

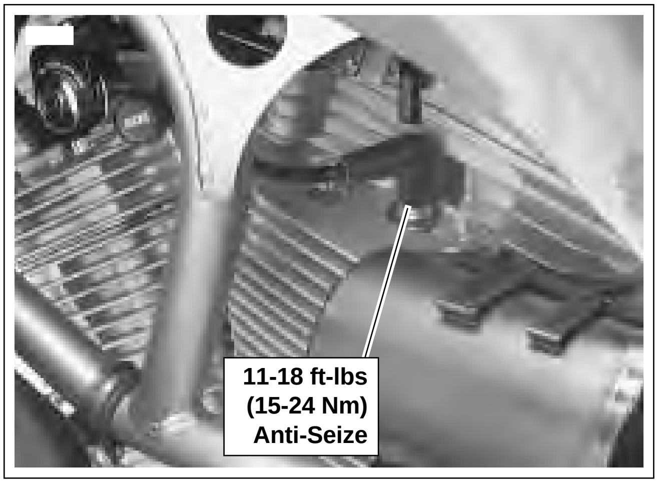


Figure 1-41. Spark Plugs (Typical)

REMOVAL

Check air cleaner filter element:

- Inspect at the 500 mile (800 km) service interval.
- Replace at every 5000 mile (8000 km) service interval thereafter.

NOTE

Service air cleaner filter element more often if the motorcycle is run in a dusty environment.

CAUTION

Do not run engine without filter element in place. Debris may be drawn into the engine causing damage.

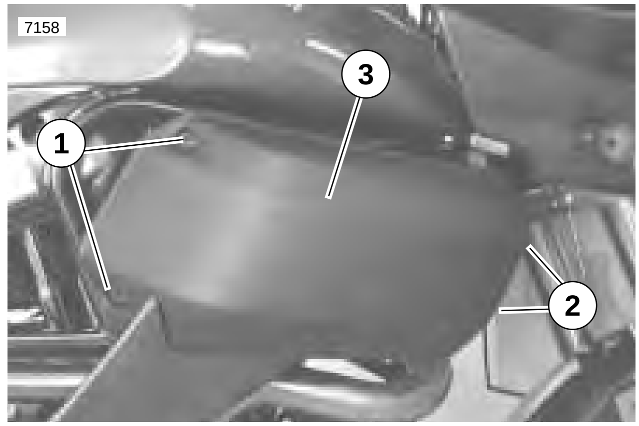
1. See Figure 1-42. Remove both front screws and nylon washers (2).
2. Remove bolt and washer holding right fairing lower to bracket on swingarm/drive support.
3. Remove both rear screws and nylon washers (1). Remove cover (3) with attached fairing lower if present.
4. See Figure 1-43. Remove bolts and washers (3) from filter box (2). Slide filter box forward, away from snorkel (1).
5. See Figure 1-44. Remove the filter element (2) from filter box (1). Inspect and replace if necessary.

INSTALLATION

⚠WARNING

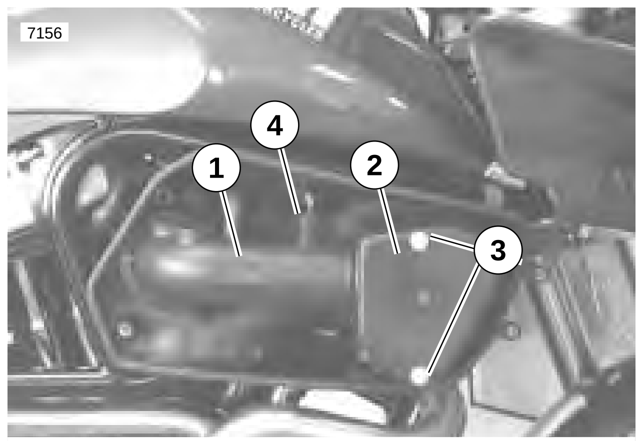
Do not use gasoline or solvents to clean the filter element. Volatile/flammable cleaning agents may cause an intake system fire which could result in death or serious injury.

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 backplate, filter box and inside of cover.
3. See Figure 1-44. Place filter element (2) in filter box (1). Attach filter box to snorkel.
4. Apply LOCTITE THREADLOCKER 243 (Blue) to the filter box bolts and LOCTITE THREADLOCKER 222 (Purple) to the four cover screws.
5. Fasten filter box to backplate with bolts and washers (3). Tighten to 40-45 in-lbs (4.5-5.1 Nm)
6. See Figure 1-42. Place cover (3) over backplate assembly. Install both rear screws and nylon washers (1).
7. Install both front screws and nylon washers (2).
8. Install bolt and washer to fasten right fairing lower to bracket on swingarm/drive support.



1. **Rear Screw and Nylon Washer (2)**
2. **Front Screw and Nylon Washer (2)**
3. **Cover**

Figure 1-42. Air Cleaner Cover



1. **Snorkel**
2. **Filter Box**
3. **Bolt and Washer (2)**
4. **IAT Sensor**

Figure 1-43. Filter Box

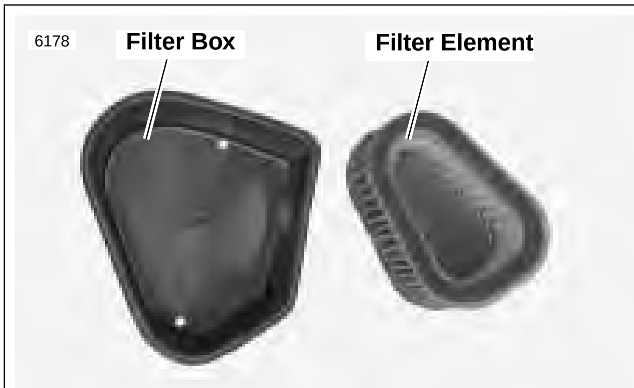


Figure 1-44. Filter Element

IGNITION TIMING 1.19

INSPECTION

Check ignition timing:

- At every 5000 mile (8000 km) service interval use the STATIC TIMING method.
- After each removal of the cam position sensor.

STATIC TIMING

⚠CAUTION

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

1. See Figure 1-45. Locate outer timer cover at bottom of gearcase cover on right side of vehicle.
   a. Drill off heads of outer timer cover rivets using a 1/8-inch (3.175 mm) drill bit. Use a punch to tap rivet shafts inboard through holes in outer timer cover. Remove outer timer cover.
   b. Remove two Phillips screws to free inner timer cover. If necessary, tap remaining rivet shafts through holes in inner timer cover.
   c. Carefully check the gearcase cover timer bore for any rivet fragments.
2. Remove seat and tail section to gain access to electronic control module. See 2.33 TAIL SECTION.
3. Prepare vehicle for testing.
   a. Remove the timing plug from the timing inspection hole centered below the cylinders on the right side of the crankcase.
   b. Remove the spark plugs.
   c. Jack up vehicle to allow rotation of the rear wheel.
   d. Shift transmission into fifth gear.
4. Bring engine to top dead center (TDC).
   a. Standing on left side of vehicle, slowly rotate rear wheel in a counter-clockwise direction until front intake valve opens and closes (as viewed through spark plug holes).
   b. See Figure 1-46. Rotate rear wheel until TDC mark is centered in timing inspection hole.
5. See Figure 1-47. Attach test components.
   a. Unplug gray connector [11] on electronic control module.
   b. Attach female gray connector on BREAKOUT BOX (Part No. HD-42682) to electronic control module.
   c. Attach male gray connector on BREAKOUT BOX to wiring harness.
   d. Connect red (+) lead on voltmeter to Pin 3 on gray side of BREAKOUT BOX.
   e. Connect black (-) lead on voltmeter to Pin 8 on gray side of BREAKOUT BOX.

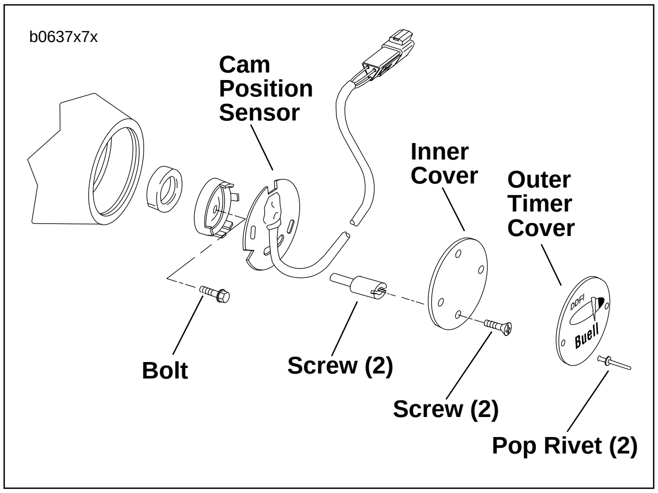


Figure 1-45. Timing Cover

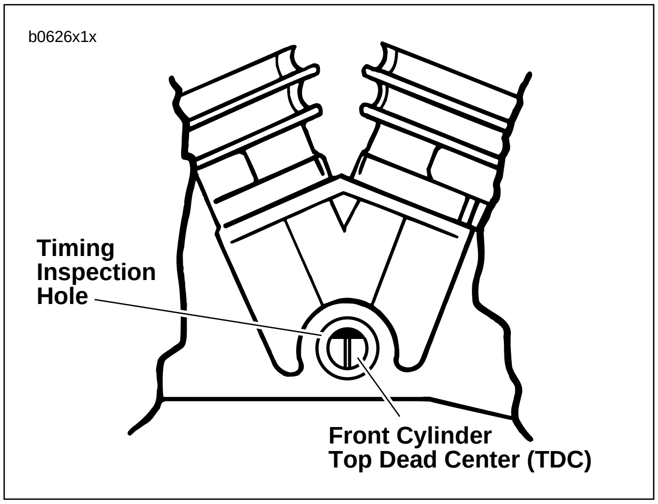


Figure 1-46. Timing Marks

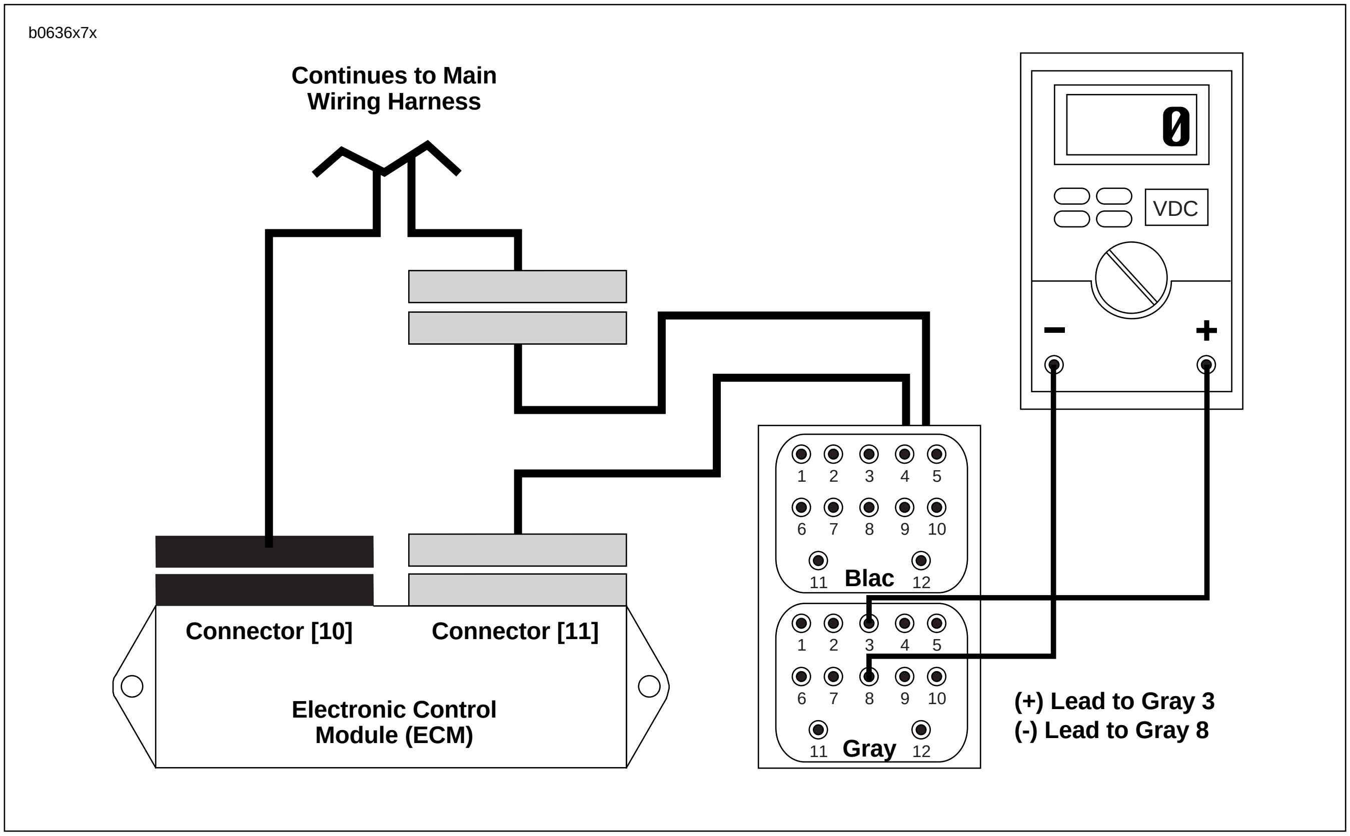


Figure 1-47. Static Timing Connections

6. See Figure 1-48. Set static timing. This will align openings (1, 2) on trigger cup with cam position sensor.

   a. Set engine stop switch to RUN.

   b. Turn ignition switch to IGN.

   c. See Figure 1-47. Loosen two screws (5) on cam position sensor (7). Rotate sensor clockwise until the voltmeter registers the change from 0.0-1.0 VDC to 5.0 VDC (+/- 0.5 volts).

   d. Tighten both sensor screws (5) to 10-20 **in-lbs** (14-27 Nm).

7. Install inner cover (4), inner cover screws (3), outer cover (2) and **new** outer cover rivets (1).

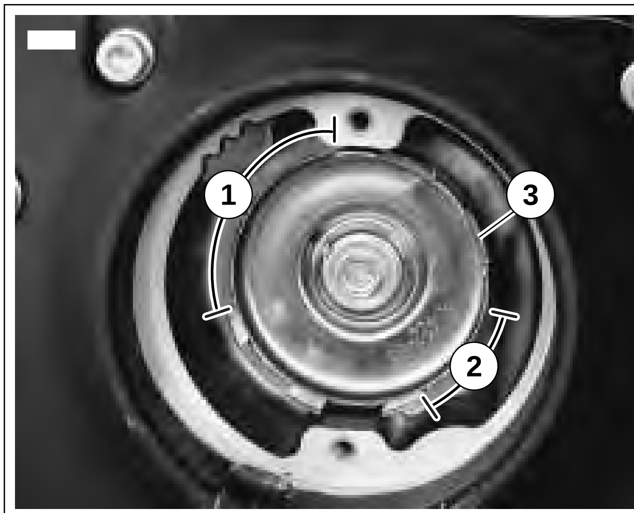
8. Install spark plugs, shift transmission into neutral and remove jack.

9. Remove BREAKOUT BOX harness and connect electronic control module connector [11].

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

10. Install seat and tail section. See 2.33 TAIL SECTION.



1. **Large Opening**
2. **Small Opening**
3. **Front Cylinder Top Dead Center Window**

Figure 1-48. Trigger Cup Openings
(Cam Position Sensor Removed For Illustration)

HANDLEBARS 1.20

INSPECTION

Check handlebar adjustment:

- Before every ride.

⚠WARNING

Handlebars must not touch front forks or gas tank. Improperly adjusted handlebars may cause loss of control which could result in death or serious injury.

1. See Figure 1-49. Check steering motion range to both fork stops. Handlebars should not make contact with the front forks, fuel tank or fairing.

2. Handlebars should be equally spaced between outside edge of handlebar clamp and inside edge of mirror mounts.

If necessary, adjust handlebars as described below.

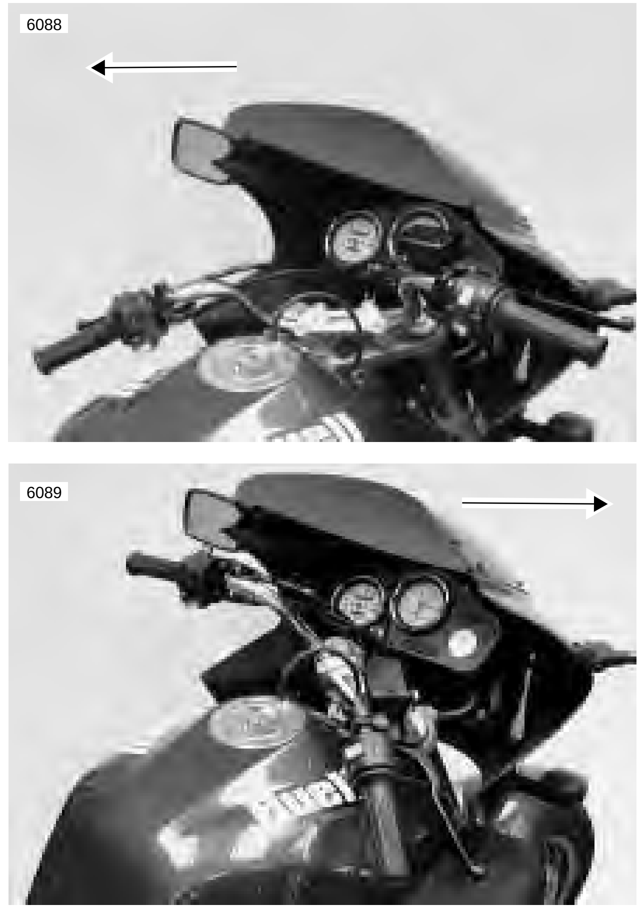


Figure 1-49. Testing Handlebars (Typical)

ADJUSTMENT

CAUTION

Never adjust handlebars using excessive force or damage to handlebars might result.

1. See Figure 1-50. Loosen clamp screws (1, 2).

2. Move handlebar to desired position.

3. Tighten clamp screws to 10-12 ft-lbs (14-16 Nm).

NOTE

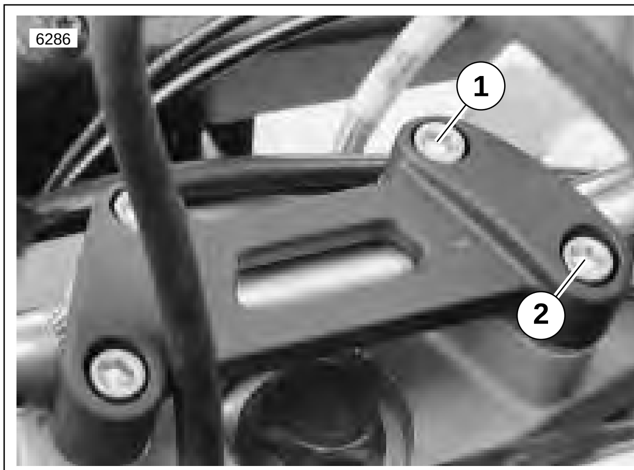
First tighten the front clamp screws (1) to 10-12 ft-lbs (14-16 Nm). Once the front clamp screws are tight, tighten the rear clamp screws to 10-12 ft-lbs (14-16 Nm).

⚠WARNING

Handlebars must not touch front forks or gas tank. Improperly adjusted handlebars may cause loss of control which could result in death or serious injury.

4. Check steering motion range to both fork stops. Handlebars should not make contact with the front forks, fuel tank or fairing.

   If handlebar needs further adjustment, repeat adjustment beginning with Step 1.



1. Front Clamp Screws (2)
2. Rear Clamp Screws (2)

Figure 1-50. Adjusting Handlebars

ADJUSTMENT

WARNING

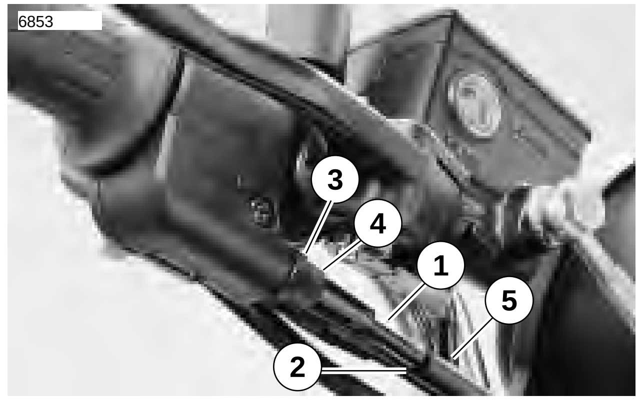
Throttle cables must not pull tight when handlebars are turned fully to left or right fork stops. Make sure wires and throttle cables are clear of fork stops at steering head so they will not be pinched when fork is turned against stops. Steering must be smooth and free with no binding or interference.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

Check throttle cable adjustment:

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

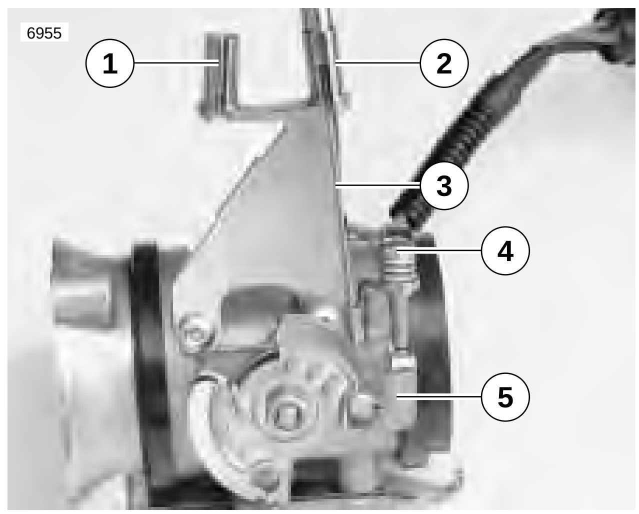
Check throttle cable adjustment with engine running. Turn handlebars through full range of travel. If engine speed changes during this maneuver, adjust throttle cables as follows:

1. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER.
2. See Figure 1-51. Slide rubber boot (5) off each cable adjuster (4).
3. Loosen cable adjuster lock (3) on each cable (1, 2).
4. Turn adjusters 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. See Figure 1-52. Turn adjuster on throttle control cable until throttle cam stop (5) touches stop plate. Tighten jam nut 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 (2).
8. See Figure 1-51. 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 (4) on idle control cable (2) (shortening cable housing) until throttle control functions properly.
9. Tighten cable adjuster lock (3) on idle control cable (2). Recheck operation of throttle control.
10. Slide rubber boot (5) over each cable adjuster (4). Recheck engine slow idle speed; adjust if required.
11. Install air cleaner assembly. See 4.41 AIR CLEANER.



1. **Throttle Control Cable**
2. **Idle Control Cable**
3. **Cable Adjuster Lock**
4. **Cable Adjuster**
5. **Rubber Boot**

Figure 1-51. Throttle and Idle Cable Control Cables



1. **Guide for Throttle Control Cable**
2. **Guide for Idle Control Cable**
3. **Idle Control Cable**
4. **Idle Adjustment Screw (Typical)**
5. **Throttle Cam Stop**

Figure 1-52. Throttle Body Manifold (Typical)

IDLE ADJUSTMENT

Check idle adjustment:

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

Regular idle speed is 850-1050 RPM. Set idle speed using idle adjuster and tachometer.

INSPECTION

⚠WARNING

DO NOT modify the ignition/headlamp switch wiring to circumvent the automatic-on headlamp feature. Riding without an operating headlamp could cause an accident. Failure to comply could result in death or serious injury.

Check headlamp for proper height and lateral alignment:

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

1. Verify correct front and rear tire pressure. See 1.8 TIRES AND WHEELS.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. See Figure 1-53. Position motorcycle 25 ft (7.62 meters) away from a screen or wall. Measure the distance from directly below the front axle to the base of the screen/ wall.
4. Draw a horizontal line 32 in. (81.3 cm) above floor on screen/wall.
5. Load vehicle with rider/passenger/cargo/accessories. Weight will compress vehicle suspension slightly.
6. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
7. Turn ignition switch to IGN. Set handlebar headlamp switch to HIGH beam position.
8. Check light beam for alignment.
   a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
   b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
   c. Adjust headlamp alignment if necessary. See ADJUSTMENT.

ADJUSTMENT

See Figure 1-54. The headlamp adjusters are located behind the dash panel.

For Vertical Adjustment:
Turn adjuster on the left side of headlamp mounting stud clockwise to raise beam or counterclockwise to lower beam.

For Horizontal Adjustment:
See Figure 1-55. Use a nut driver on the right side headlamp mounting stud clockwise to aim beam to the right or turn the stud counterclockwise to aim beam to the left.

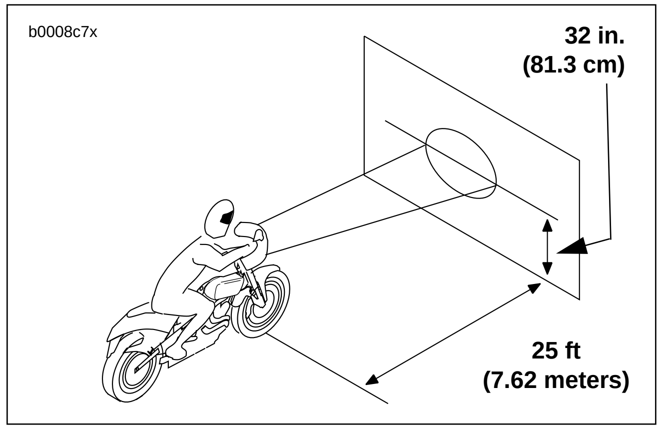


Figure 1-53. Checking Headlamp Alignment

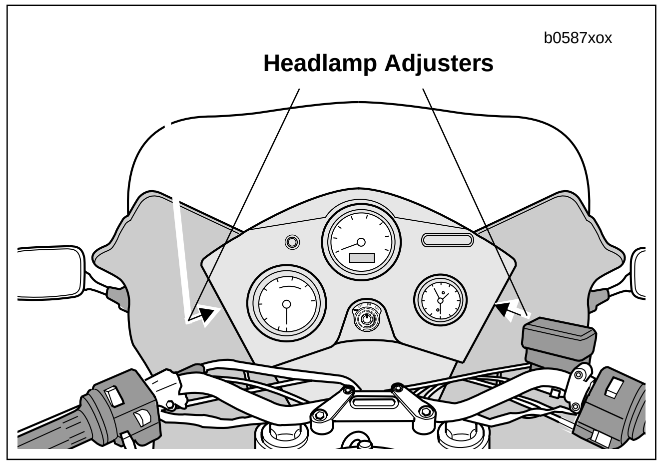


Figure 1-54. Headlamp Adjusters

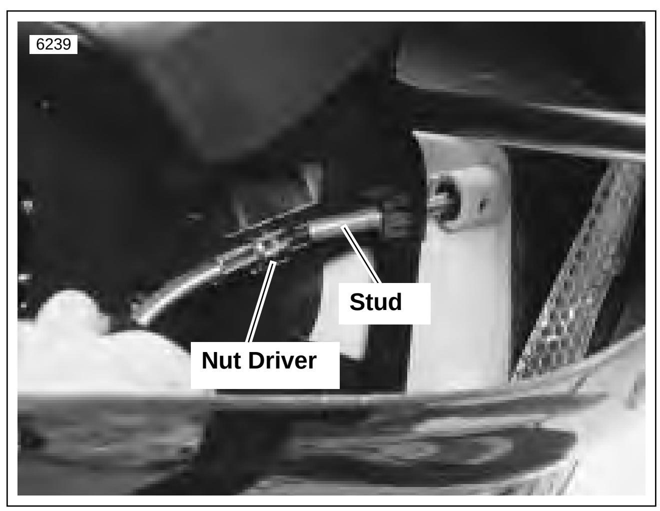


Figure 1-55. Headlamp Horizontal Adjustment

GENERAL

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.

This work should be performed by your local Buell dealer following Service Manual procedures.

WARNING

Gasoline is flammable. Do not store motorcycle having gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Inadequate safety precautions may result in a fire or explosion which could result in death or serious injury.

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 gasoline has had a chance to reach fuel injectors.
2. Fill the oil tank. See 1.3 BATTERY. Pinch off (or remove and plug) the line leading from the oil tank bottom to the oil pump feed fitting. This prevents oil from seeping past the check ball into the oil pump and filling the engine flywheel compartment.
3. Remove battery and charge as needed to maintain the correct voltage. See 1.3 BATTERY.
4. 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 1.17 SPARK PLUGS.
5. Adjust rear drive belt deflection. See 1.10 DRIVE BELT DEFLECTION.
6. Adjust primary chain. See 1.12 PRIMARY CHAIN.
7. Check tire inflation. See 1.8 TIRES AND WHEELS. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.

WARNING

Do not apply any oil to brake rotors or brake pads. Oil on brake pads degrades braking efficiency and may cause an accident which could result in death or serious injury.

8. Wash painted and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.
9. 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

After extended periods of storage and prior to starting vehicle, place transmission in gear, disengage clutch and push vehicle back and forth a few times to ensure proper clutch disengagement. Improper clutch disengagement while vehicle is in motion may cause an accident which could result in death or serious injury.

1. Charge and install battery. See 1.3 BATTERY.
2. Remove and inspect spark plugs. Replace if necessary. See 1.17 SPARK PLUGS.
3. Inspect air filter element. Replace if necessary. See 1.18 AIR CLEANER.
4. If fuel tank was drained, fill fuel tank with fresh gasoline.
5. If oil feed line was pinched off or plugged, unplug it and reconnect.
6. 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 1.3 BATTERY.
   b. Check transmission fluid level. See 1.9 CLUTCH.
7. 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.

Engine Turns Over But Does Not Start

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. Tripped bank angle sensor. Turn key to OFF and then back to IGN again to start bike.
6. Clogged fuel filter (on pump or in-line).
7. Clogged fuel injectors. See dealer.
8. Inadequate fuel pressure in fuel lines (possible leak). See dealer.
9. Inoperative fuel pump. See dealer.
10. No output from the ECM. See dealer.
11. TPS/fast idle screw not set properly. See dealer.
12. Ignition coil not functioning.
13. No output from CMP sensor. See dealer.
14. Sticking or damaged valve or valves.
15. Engine oil too heavy (winter operation).

Starts Hard

1. Spark plugs in bad condition, have improper gap or are partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Battery nearly discharged.
4. Loose wire connection at one of the battery terminals, at coil or at plug between ignition sensor and module.
5. TPS and/or fast idle screw not set properly. See dealer.
6. O2, IAT or ET sensors damaged or malfunctioning. See dealer.
7. Ignition coil not functioning.
8. Engine oil too heavy (winter operation).
9. Water or dirt in fuel system/clogged fuel filter/injector.
10. Air leak at intake manifold.
11. Valves sticking.

Starts But Runs Irregularly or Misses

1. Fuel level too low. Add gasoline.
2. Battery nearly discharged.
3. Spark plugs in bad condition or partially fouled.
4. Spark plug cables in bad condition and shorting.
5. Spark plug gap too close or too wide.
6. Ignition coil not functioning.
7. Obstructed fuel tank vent valve or pinched vent tube. See dealer.
8. O2, IAT or ET sensors damaged or malfunctioning. See dealer.
9. Damaged wire or loose connection at battery terminals or coil.
10. Intermittent short circuit due to damaged wire insulation.
11. Water or dirt in fuel system/partially clogged fuel filter/ injector.
12. Vapor vent valve plugged or carburetor float bowl vent closed off.
13. TPS and/or fast idle screw not set properly. See dealer.
14. Inoperative fuel injector. See dealer.
15. Air leak at intake manifold or air filter.
16. Damaged intake or exhaust valve.
17. Weak or broken valve springs.
18. Incorrect valve timing.

Spark Plug Fouls Repeatedly

1. Incorrect spark plug.
2. Piston rings badly worn or broken.
3. Fuel mixture too rich for conditions (see CARBURETOR TROUBLESHOOTING).
4. Valve stem seals worn or damaged.
5. Valve guides badly worn.

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. Leaking valves.
3. Heavy carbon deposit.
4. 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. Lower mounting bolts 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.

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, Etc.

1. Loose parts.
2. Imperfect seal at gaskets, push rod cover, washers, etc. To aid locating leaks, use -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

Poor Fuel Economy

1. Excessive “pumping” of throttle control grip.
2. O2 sensor damaged or malfunctioning (bike running rich). See dealer.
3. Inlet valve sticking.
4. Inlet valve and/or valve seat worn or damaged.
5. Dirt or other foreign matter between valve and its seat.

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 pawl improperly adjusted.
2. Shifter engaging parts (inside transmission) badly worn and rounded.
3. Shifter forks bent.
4. 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.
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 freeplay (brake drags).

Handling Irregularities

1. Tires improperly inflated. See 1.8 TIRES AND WHEELS. Do not overinflate.
2. Loose wheel axle nuts (metric). Tighten front nut to 48-53 ft-lbs (65-72 Nm). Tighten rear nut to 66-73 ft-lbs (90-99 Nm).
3. Excessive wheel hub bearing play.
4. Rear wheel out of alignment with frame and front wheel.
5. Rims and tires out-of-true sideways (tire runout should not be more than 0.080 in. (2.03 mm)).
6. Rims and tires out-of-round or eccentric with hub (tire runout should not be more than 0.090 in. (2.29 mm)).
7. Irregular or peaked front tire tread wear.
8. Tire and wheel unbalanced.
9. Steering head bearings improperly adjusted. See 1.16 STEERING HEAD BEARINGS. Correct adjustment and replace pitted or worn bearings and races. See 2.17 FORK STEM AND BRACKET ASSEMBLY.
10. Shock absorber not functioning normally.
11. 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.

NOTES

Table Of Contents

CHASSIS 2

SUBJECT	PAGE NO.
2.1 Specifications	2-1
2.2 Tire Specifications	2-4
2.3 Vehicle Identification Number	2-5
2.4 Wheels	2-6
2.5 Front Wheel	2-8
2.6 Rear Wheel	2-10
2.7 Checking Cast Rim Runout	2-12
2.8 Tires	2-13
2.9 Brakes	2-16
2.10 Front Brake Master Cylinder	2-18
2.11 Front Brake Caliper	2-21
2.12 Front Brake Line	2-24
2.13 Rear Brake Master Cylinder	2-25
2.14 Rear Brake Caliper	2-28
2.15 Rear Brake Line and Switch	2-30
2.16 Front Fork	2-32
2.17 Fork Stem and Bracket Assembly	2-37
2.18 Steering Head Lock	2-38
2.19 Swingarm	2-39
2.20 Rear Isolators	2-43
2.21 Rear Shock Absorber	2-46
2.22 Suspension Theory	2-48
2.23 Suspension Adjustments	2-49
2.24 Throttle Control	2-52
2.25 Clutch Control	2-53
2.26 Handlebars	2-55
2.27 Exhaust System	2-56
2.28 Footrests	2-59
2.29 Sprocket Cover	2-60
2.30 Stone Guard	2-61
2.31 Front Fender	2-62
2.32 Rear Fender	2-63
2.33 Tail Section	2-64
2.34 Front Fairing	2-66
2.35 Seat	2-68
2.36 Side Stand	2-70
2.37 Saddlebags	2-71
2.38 Fairing Lowers	2-73

SPECIFICATIONS 2.1

DIMENSIONS	IN.	CM
Wheel Base	55	139.7
Seat Height	31.0	78.7
Road Clearance	5.2	13.21
Front Wheel Travel	4.7	11.94
Rear Wheel Travel	4.6	11.68
Trail	3.8	9.65
Rake	24.5 degrees	

WEIGHTS	LBS.	KG
Wet Weight	518	235
GVWR	915	415
GAWR - Front	330	150
GAWR - Rear	585	265

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 left front down tube.

CAPACITIES	U.S.	LITERS
Fuel Tank (including reserve)	5.4 gallons	20.44
Reserve/Low Fuel indicator light at	0.4 gallons	1.51
Oil Tank	2.0 quarts	1.89
Transmission	1.0 quart	0.95

TIRE AND POSITION	SOLO RIDING	GVWR
Front-Dunlop Sportmax II Touring Radial 120/70 ZR 17 D205F	32 PSI (220 kPa)	36 PSI (248 kPa)
Rear-Dunlop Sportmax II Touring Radial 170/60 ZR 17 D205	36 PSI (248 kPa)	38 PSI (262 kPa)

⚠WARNING

Do not inflate any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate which could result in death or serious injury.

BRAKE SERVICE WEAR LIMITS	IN.	MM
Minimum Rotor Thickness (Front and Rear)	0.18	4.5
Minimum Brake Pad Thickness (Front and Rear)	0.04	1.0

TORQUE VALUES

ITEM	TORQUE		NOTES
Brake Bleeder Valve	3-5 ft-lbs	4-7 Nm	
Clutch Cable, Primary Cover Fitting	3-9 ft-lbs	4-12 Nm	turn clockwise to install
Clutch Clamp Screw	30-33 **in-lbs**	3-4 Nm	metric
Drive Support Nut	30-35 ft-lbs	41-47 Nm	
Exhaust Header Nuts	6-8 ft-lbs	8-11 Nm	
Footrest Bolts	24-30 ft-lbs	33-41 Nm	must be tight, but not binding
Footrest Mount Bolts	10-15 ft-lbs	14-20 Nm	LOCTITE THREADLOCKER 272 (red)
Front Axle Nut	48-53 ft-lbs	65-72 Nm	LOCTITE THREADLOCKER 243 (blue), metric
Front Axle Pinch Screw	13-15 ft-lbs	18-20 Nm	metric
Front Brake Caliper Half Screws	14.5-18 ft-lbs	20-24 Nm	metric
Front Brake Line Clamp Screw	30-35 **in-lbs**	3-4 Nm	
Front Brake Master Cylinder Clamp Screw	80-90 **in-lbs**	9-10 Nm	
Front Brake Rotor Mounting Screws	20-22 ft-lbs	27-30 Nm	LOCTITE THREADLOCKER 243 (blue)
Front Caliper Banjo Bolt	16-20 ft-lbs	22-27 Nm	
Front Caliper Bleeder Valve	3-5 ft-lbs	4-7 Nm	metric
Front Caliper Pad Hanger Pin	11-14.5 ft-lbs	15-20 Nm	metric
Front Caliper Mounting Bolt	22-25 ft-lbs	30-34 Nm	LOCTITE THREADLOCKER 272 (red)
Front Fairing Mount Bolts	22-25 ft-lbs	30-34 Nm	
Front Fender Lower Mounting Screws	10-15 **in-lbs**	1-2 Nm	metric
Front Fender Upper Mounting Screws	20-25 **in-lbs**	2-3 Nm	
Front Fork Damper Bolt	18-23 ft-lbs	24-31 Nm	metric
Front Fork Triple Clamp Screw (Large)	18-20 ft-lbs	24-27 Nm	LOCTITE ANTI-SEIZE
Front Fork Triple Clamp Screw (Small)	12-15 ft-lbs	16-20 Nm	LOCTITE ANTI-SEIZE
Front Master Cylinder Banjo Bolt	16-20 ft-lbs	22-27 Nm	metric
Front Master Cylinder Cover Screws	9-13 **in-lbs**	1-2 Nm	
Front Shock Mounting Bolt	40-45 ft-lbs	54-61 Nm	metric
Fuel Tank Mounting Bolt	18-23 ft-lbs, then wait 5 minutes and retighten.	24-31 Nm, then wait 5 minutes and retighten.	Special procedure.
Handlebar Clamp Screw	10-12 ft-lbs	14-16 Nm	tighten front screws first

ITEM	TORQUE		NOTES
Header Support Mounting Bolt (Upper)	30-33 ft-lbs	41-45 Nm	
Mirror Mounting Nuts	7-10 **in-lbs**	0.8-1.1 Nm	metric
Muffler Clamp	40-45 ft-lbs	54-61 Nm	discard after use
Muffler Mounting Bolts (Front)	22-24 ft-lbs	30-33 Nm	
Muffler Mounting Bolts (Rear)	22-24 ft-lbs	30-33 Nm	
Muffler Support Mounting Bolt (Rear)	12-15 ft-lbs	16-20 Nm	
Rear Axle Nut	66-73 ft-lbs	90-99 Nm	metric
Rear Brake Caliper Banjo Bolt	16-20 ft-lbs	22-27 Nm	metric
Rear Brake Caliper Bleeder Valve	3-5 ft-lbs	4-7 Nm	metric
Rear Brake Caliper Mounting Screw (Large)	18-22 ft-lbs	24-30 Nm	LOCTITE THREADLOCKER 272 (red), metric
Rear Brake Caliper Mounting Screw (Small)	14.5-18 ft-lbs	20-24 Nm	LOCTITE THREADLOCKER 272 (red), metric
Rear Brake Lamp Switch	7-8 ft-lbs	10-11 Nm	LOCTITE PIPE SEALANT WITH TEFLON
Rear Brake Line Clamp Screw	10-12 ft-lbs	14-16 Nm	
Rear Brake Reservoir Mounting Screw	12-15 **in-lbs**	1-2 Nm	
Rear Brake Rotor Screws	35-40 ft-lbs	48-54 Nm	LOCTITE THREADLOCKER 272 (red), metric
Rear Master Cylinder Banjo Bolt	16-20 ft-lbs	22-27 Nm	metric
Rear Master Cylinder Mounting Screws	8-10 ft-lbs	11-14 Nm	metric
Rear Master Cylinder Rod to Brake Pedal Screw	10-12 ft-lbs	14-16 Nm	
Rear Shock Mounting Screw	30-33 ft-lbs	41-45 Nm	metric
Saddlebag Support Bracket Upper Bolt	13-17 ft-lbs	18-23 Nm	
Sprocket Bolt	55-65 ft-lbs	75-88 Nm	LOCTITE THREADLOCKER 272 (red)
Sprocket Cover Mounting Screw	12-17 **in-lbs**	1-2 Nm	LOCTITE THREADLOCKER 243 (blue)
Sprocket Cover Screw	4-6 ft-lbs	5-9 Nm	LOCTITE THREADLOCKER 222 (purple)
Swingarm Pinch Screw	27-30 ft-lbs	37-41 Nm	LOCTITE THREADLOCKER 243 (blue)
Swingarm Threaded Rod	11-12 ft-lbs	15-16 Nm	LOCTITE THREADLOCKER 222 (purple), initial torque only
Swingarm/Drive Support Screw	20-25 ft-lbs	27-34 Nm	LOCTITE THREADLOCKER 272 (red)
Switchgear Housing Screws, (left side)	25-33 **in-lbs**	3-4 Nm	metric
Switchgear Housing Screws, (right side)	12-17 **in-lbs**	1-2 Nm	metric
Valve Stem Nut	42-44 **in-lbs**	4.7-5.0 Nm	

TIRE SPECIFICATIONS 2.2

GENERAL

⚠WARNING

Tires must be correctly matched to wheel rims. Only the tires listed in the fitment tables below can be used for replacement. Mismatching tires and rims can cause damage to the tire bead during mounting. Using tires other than those specified can adversely affect motorcycle handling and could result in death or serious injury.

Tire sizes are molded on the sidewall. Rim size and contour are marked on the rim's exterior surface.

Example: **MT 3.5 x 17.0 DOT**

- **MT** designates the rim contour.
- **3.5** is the width of the bead seat measured in inches.
- **17.0** is the normal diameter of the rim in inches, measured at the bead seat diameter.
- **DOT** means that the rim meets Department of Transportation Federal Motor Vehicle Safety Standards.

See the tables below.

Table 2-1. Tire Fitment-Tubeless Cast Wheels

WHEEL SIZE & POSITION	CONTOUR & RIM SIZE	RIM VALVE HOLE DIAMETER	DUNLOP SPORTMAX II TOURING RADIAL TIRE SIZE
17 in. – Front	MT 3.5 x 17.0 DOT	0.33 in.	120/70 ZR17 D205F
17 in. – Rear	MT 5.0 x 17.0 DOT	0.33 in.	170/60 ZR17 D205

Table 2-2. Tire Fitment-Tubeless Aluminum P/M Wheels

WHEEL SIZE & POSITION	CONTOUR & RIM SIZE	RIM VALVE HOLE DIAMETER	DUNLOP SPORTMAX II TOURING RADIAL TIRE SIZE
17 in. – Front	MT 3.5 x 17.0 DOT	0.33 in.	120/70 ZR17 D205F
17 in. – Rear	MT 5.5 x 17.0 DOT	0.33 in.	170/60 ZR17 D205

VEHICLE IDENTIFICATION NUMBER 2.3

GENERAL

The full 17 digit serial or Vehicle Identification Number (V.I.N.) is stamped on the steering head and on an information decal on the left front down tube.

See Figure 2-1. An abbreviated V.I.N. is stamped on the front left side of the crankcase.

NOTE

See Figure 2-2. Always give the V.I.N. or abbreviated V.I.N. when ordering parts or making inquiries about your Buell motorcycle.

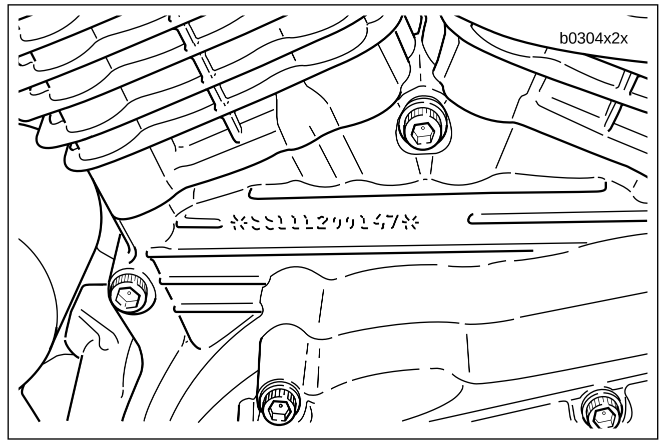


Figure 2-1. Abbreviated V.I.N. Location

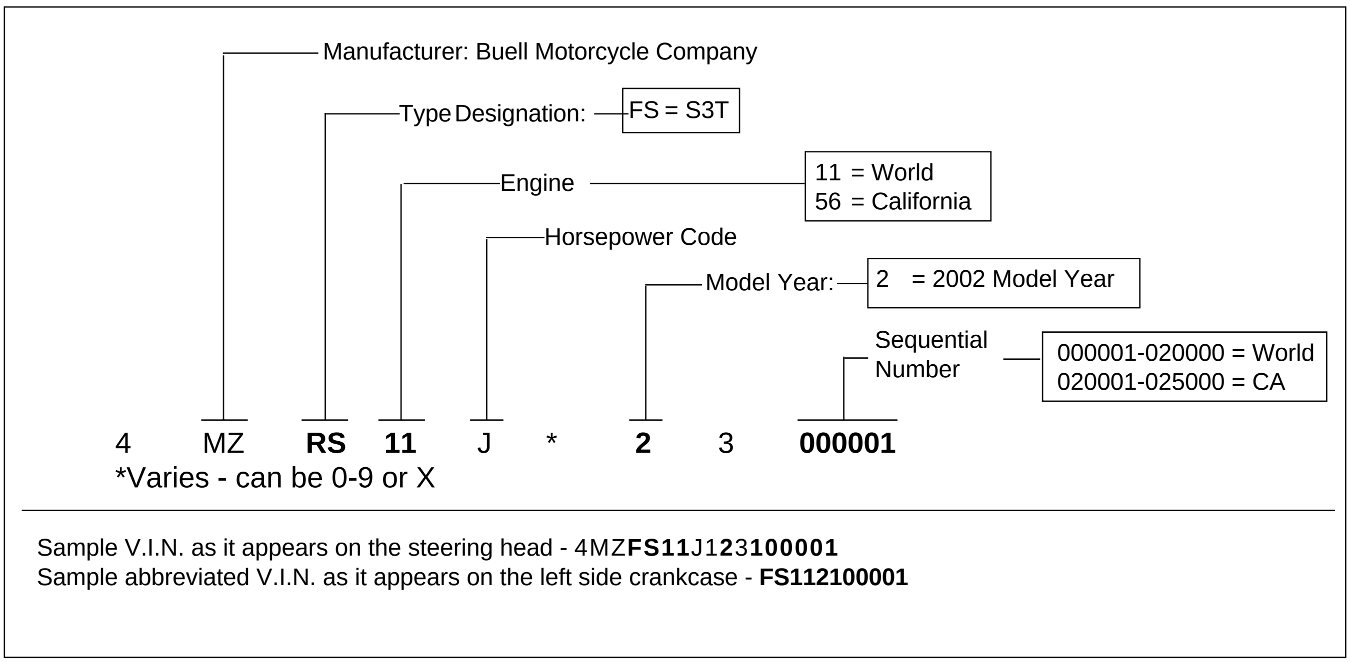


Figure 2-2. 2002 Model Year Thunderbolt S3T V.I.N.s

WHEELS 2.4

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 1.24 TROUBLESHOOTING or Table 2-3.

See 1.8 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 any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate which could result in death or serious injury.

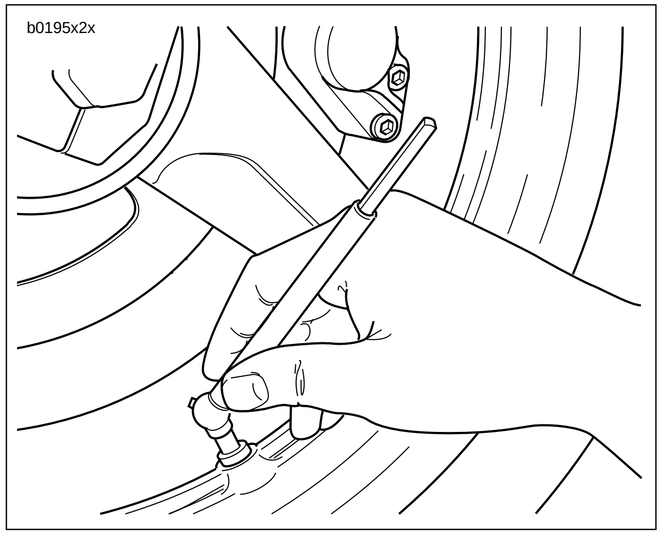


Figure 2-3. Checking Tire Inflation Pressure

TROUBLESHOOTING

See Figure 2-3. 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.

Table 2-3. Wheel Service

CHECK FOR	REMEDY
Loose axle nuts.	Tighten front axle nut (metric) with LOCTITE THREADLOCKER 243 (blue) to 48-53 ft-lbs (65-72 Nm). Tighten rear axle nut (metric) to 66-73 ft-lbs (90-99 Nm).
Excessive side-play or radial (up-and-down) play in wheel hubs.	Replace wheel hub bearings.
Alignment of rear wheel in frame or with front wheel.	Check 1.10 DRIVE BELT DEFLECTION or repair swingarm as described under 2.19 SWINGARM.
Rims and tires out-of-true sideways; should not be more than 0.080 in. (2.03 mm).	Replace rims. See 2.8 TIRES.
Rims and tires out-of-round or eccentric with hub; should not be more than 0.090 in. (2.29 mm).	Replace rims. See 2.7 CHECKING CAST RIM RUNOUT.
Irregular or peaked front tire wear.	Replace as described under 2.5 FRONT WHEEL, 2.6 REAR WHEEL and 2.8 TIRES.
Correct tire inflation.	Inflate tires to correct pressure. See 1.8 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.	Correct adjustment and replace pitted or worn bearings. See 1.16 STEERING HEAD BEARINGS.
Damper tubes.	Check for leaks. See 2.16 FRONT FORK.
Shock absorbers.	Check damping action and mounts. See 1.14 SUSPENSION DAMPING ADJUSTMENTS.
Swingarm bearings.	Check for looseness. See 2.19 SWINGARM.

⚠WARNING

Improper or improperly installed or repaired tires may adversely affect motorcycle traction, steering and handling which could result in death or serious injury. Always 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 resulting 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

Buell recommends replacement of any tire punctured or damaged. In some cases small punctures in the tread area may be repaired from within the demounted tire by your 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). In emergency situations, if a temporary repair is made, ride slowly with as light of a load as possible until the tire is permanently repaired or replaced. Failure to follow this warning could result in death or serious injury.

⚠WARNING

Do not operate a vehicle with excessively worn tires. Excessively worn tires adversely affect motorcycle traction, steering and handling and could result in death or serious injury.

At regular intervals of 5000 miles (8000 km) or whenever handling irregularities are noted, perform the recommended service checks. See Table 2-3.

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

REMOVAL

1. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (2) (Part No. B-41395-A) and an automotive engine lift.

2. Detach front brake caliper from rotor. See 2.11 FRONT BRAKE CALIPER.

NOTE

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

3. See Figure 2-4. Insert screwdriver/rod through hole in axle (1). Loosen front axle nut (4) (metric).

4. Loosen all four pinch screws (2) (metric).

5. Remove front axle nut (4) and washer (3). Pull front axle out of wheel hub while supporting front wheel.

6. See Figure 2-5. Remove front wheel.

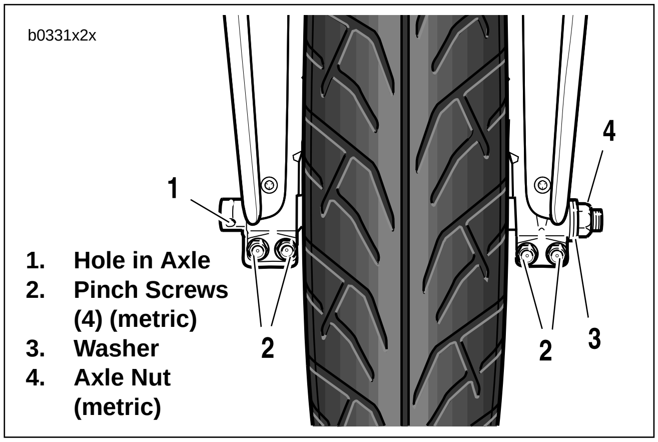


Figure 2-4. Front Wheel Mounting

DISASSEMBLY

1. See Figure 2-5. Move wheel to bench area. On brake rotor side of wheel, remove right axle spacer (10).

2. Remove wheel bearings (4, 9) using BUSHING AND BEARING PULLER (Part No. HD-95760-69A) and 3/4 in. COLLET (Part No. HD-95767-69A).

3. See Figure 2-5. Remove five screws (12) to detach front brake rotor (15) from wheel hub.

4. Remove tire. See 2.8 TIRES.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in solvent.

CAUTION

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 may result in minor or moderate injury.

2. Inspect all parts for damage or excessive wear.

3. Inspect brake rotor.

   a. Measure rotor thickness. Replace if less than service wear limit. See 1.7 BRAKE PADS AND ROTORS.

   b. Check rotor surface. Replace if warped or badly scored.

ASSEMBLY

WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake rotor or reduced braking ability will occur, which could result in death or serious injury.

1. See Figure 2-5. Install front brake rotor (13) on right side of wheel. Slots in carrier must line up with wheel spokes.
   a. Verify that the front brake carrier is thoroughly clean.
   b. Apply LOCTITE THREADLOCKER 243 (blue) to threads of each of the five T40 TORX screws (12).
   c. Install rotor (13) on wheel hub using screws (12). Tighten screws in criss-cross pattern to 20-22 ft-lbs (27-30 Nm).
2. See Figure 2-5. Install spacer (8).
3. Install **new** wheel bearings (4, 9) into hub using suitable driver. Press on outer race only.
4. On the side of the wheel opposite the brake rotor insert left axle spacer (3) into hub until it seats in bore. Spacer sleeve must not be cocked or tilted in bore.
5. On the right side of the wheel insert right axle spacer (10) into hub until it seats in bore. Spacer sleeve must not be cocked or tilted in bore.
6. Install tire, if removed. See 2.8 TIRES.
7. Verify that wheel and tire are true. See 2.7 CHECKING CAST RIM RUNOUT.
8. Balance tire. See 2.8 TIRES, Adjustment.

1. **Nut (metric)**
2. **Washer**
3. **Left Axle Spacer**
4. **Wheel Bearing**
5. **Wheel**
6. **Valve Stem**
7. **Wheel Weight**
8. **Spacer**
9. **Wheel Bearing**
10. **Right Axle Spacer**
11. **Front Axle**
12. **T-40 TORX Screws (5)**
13. **Front Brake Rotor**

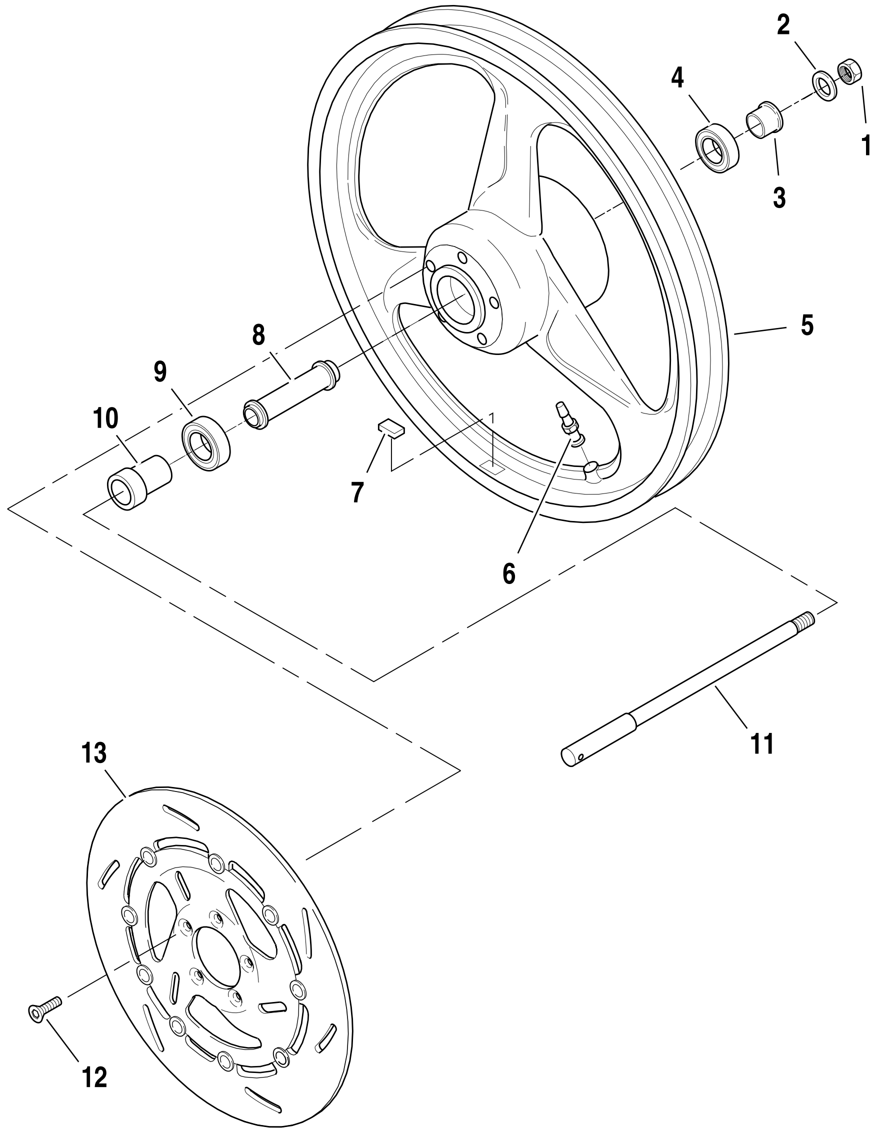


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Figure 2-5. Front Wheel

INSTALLATION

1. Install front axle.
   a. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle.
   b. Position wheel between forks with brake rotor on gearcase side of motor.
   c. With pinch screws (metric) loose, insert threaded end of axle through right side fork.
   d. Push axle through fork and wheel hub until axle begins to emerge from left side of hub.
   e. Push axle through left fork leg.
2. Compress the front suspension to make sure it is free and not binding.
3. See Figure 2-8. Install axle nut.
   a. Apply LOCTITE THREADLOCKER 243 (blue) to axle threads.
   b. Install washer (3) and axle nut (4) (metric) over threaded end of axle.
   c. Insert screwdriver or steel rod through hole (1) in axle.
   d. While holding axle stationary, tighten axle nut (4) (metric) to 48-53 ft-lbs (65-72 Nm).
4. Tighten the four front axle pinch screws (2) (metric) to 13-15 ft-lbs (18-20 Nm).
5. Install front brake caliper. See 2.11 FRONT BRAKE CALIPER.

REAR WHEEL

REMOVAL

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove saddlebags (if equipped). See 2.37 SADDLEBAGS.
3. Detach rear brake caliper from caliper mount. See 2.14 REAR BRAKE CALIPER.

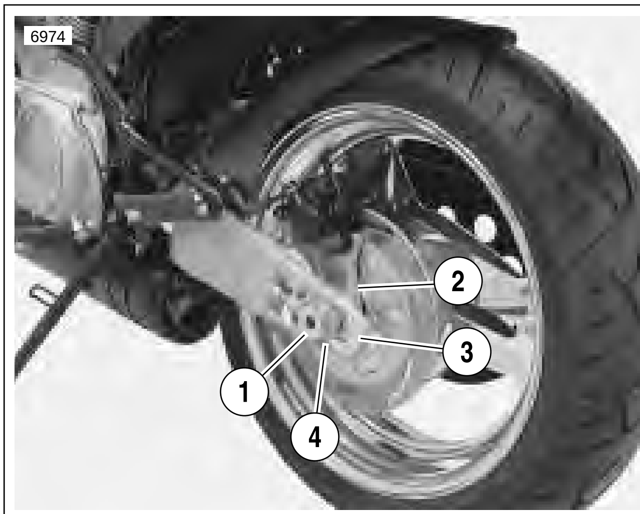
NOTE

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

4. See Figure 2-7. Loosen rear axle nut (1).
5. Loosen rear axle adjuster locknuts (6, 7) and nuts (5) on both sides. Push wheel as far forward as possible.
6. Slip secondary drive belt from bottom of belt sprocket and remove.
7. Remove rear axle nut (1) (metric), lockwasher (2), washer (3), and axle carrier (4). Pull axle and washer out from left side and remove wheel.

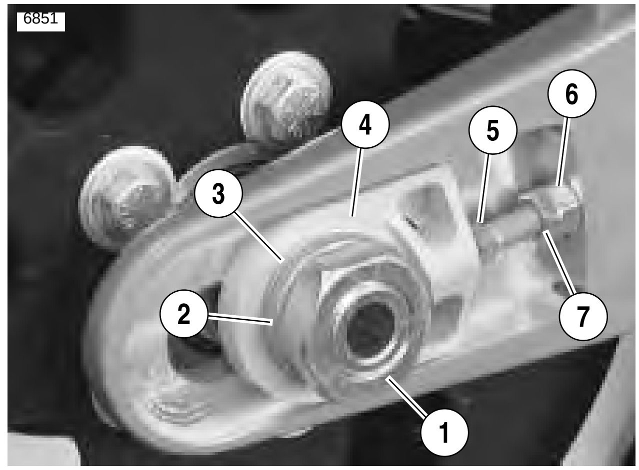
DISASSEMBLY

1. See Figure 2-8. Move wheel to bench area. On the brake rotor side of the wheel, remove bearing using BUSHING AND BEARING PULLER (Part No. HD-95760-69A) and 1 1/8 in. COLLET (Part No. HD-95769-69).
2. Remove two bearings from sprocket side of wheel.
3. Remove four screws (metric) to detach rear brake rotor from wheel hub.
4. Remove five bolts and washers to detach belt sprocket from wheel hub.



1. **Axle**
2. **Rear Brake Caliper Mount**
3. **Swingarm**
4. **Washer**

Figure 2-7. Rear Wheel With Axle Carrier (Left Side)



1. **Axle Nut (metric)**
2. **Lockwasher**
3. **Washer**
4. **Axle Carrier**
5. **Axle Adjuster Bolt**
6. **Locknut**
7. **Locknut**

Figure 2-6. Rear Wheel With Axle Carrier (Right Side)

CLEANING AND INSPECTION

1. Thoroughly clean all parts in solvent.

⚠CAUTION

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 may result in minor or moderate injury.

2. Inspect all parts for damage or excessive wear.
3. Inspect brake rotor.
   a. Measure rotor thickness. Replace if less than service wear limit. See 1.7 BRAKE PADS AND ROTORS.
   b. Check rotor surface. Replace if warped or badly scored.

ASSEMBLY

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake rotor or reduced braking ability will occur, which could result in death or serious injury.

1. Install rear brake rotor on side of wheel hub with room for a single wheel bearing. Place rotor surface listing minimum thickness specification away from wheel hub.
   a. Verify that rear brake rotor is thoroughly clean.
   b. Apply LOCTITE THREADLOCKER 272 (red) to each of the four screws (1) (metric).
   c. Fasten rotor to wheel hub using screws. Tighten to 35-40 ft-lbs (48-54 Nm).

NOTE

P/M wheels use a nut (not shown) with each screw (1).

2. Install belt sprocket on side of wheel hub with room for two wheel bearings. Place sprocket machined surface away from wheel hub.
   a. Check sprocket for unusual wear, broken teeth or a damaged flange. Replace if necessary.
   b. Apply LOCTITE THREADLOCKER 272 (red) to each of the five sprocket bolts.
   c. Install belt sprocket using bolts and washers Tighten to 55-65 ft-lbs (75-88 Nm).
3. Install bearings and spacer into wheel hub.
   a. On the belt sprocket side of the wheel, install two bearings. Insert bearings separately, pressing on outer race only. Fully seated bearings will touch shoulder for spacer sleeve.
   b. Insert spacer sleeve into wheel hub.
   c. On the brake rotor side of the wheel, insert bearing into wheel hub until it contacts end of spacer sleeve. Press on outer race only.
4. Verify that wheel is true. See 2.7 CHECKING CAST RIM RUNOUT.
5. Install tire if removed. Under all circumstances, check that wheel and tire are true. See 2.8 TIRES.

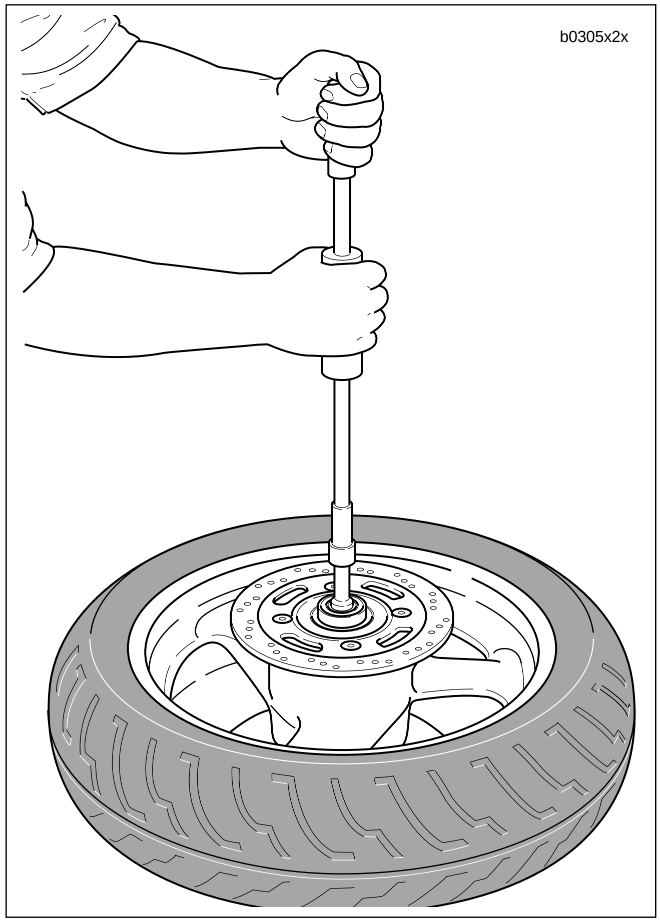


Figure 2-8. Removing Wheel Bearing

INSTALLATION

1. Place wheel centrally in the swingarm with the brake rotor in the caliper. Slide wheel far enough forward to slip belt over sprocket and then slide wheel back.
2. Install rear axle.
   a. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle.
   b. Insert axle through washer, left side of swingarm, rear brake caliper mount and wheel assembly.
   c. Place spacer between wheel hub and right side of swingarm. Slide axle through spacer and swingarm.
   d. Install washer, lockwasher and axle nut (metric). Do not fully tighten rear axle nut at this time.
3. Attach rear brake caliper to caliper mount. See 2.14 REAR BRAKE CALIPER.
4. Check for proper belt tension and wheel alignment. See 1.10 DRIVE BELT DEFLECTION.
5. Tighten rear axle nut (14) (metric) to 66-73 ft-lbs (90-99 Nm).
6. Install saddlebags (if equipped). See 2.37 SADDLEBAGS.

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 2-9. 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 2-4.

Rim Radial Runout

1. See Figure 2-10. 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 2-4.

Table 2-4. Wheel Runout

WHEEL TYPE	MAXIMUM LATERAL RUNOUT	MAXIMUM RADIAL RUNOUT
Cast	0.040 in. (1.02 mm)	0.030 in. (0.76 mm)
Aluminum P/M	0.020 in. (0.51 mm)	0.020 in. (0.51 mm)

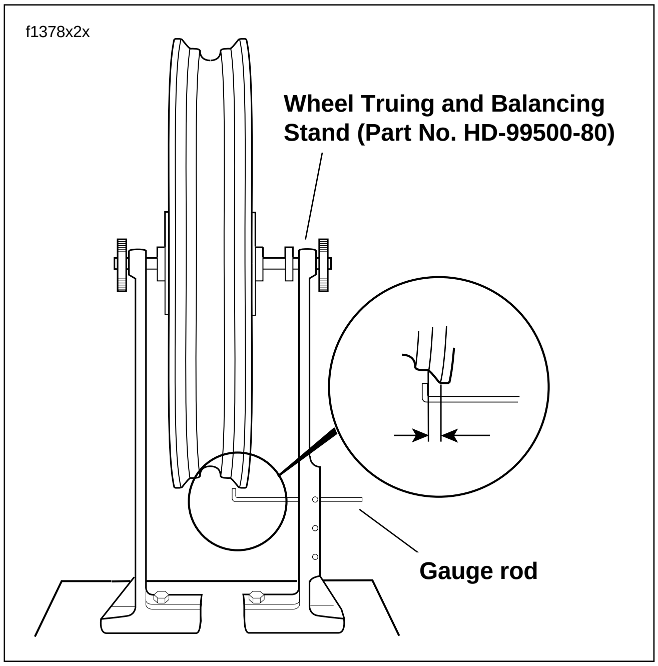


Figure 2-9. Checking Cast Rim Lateral Runout

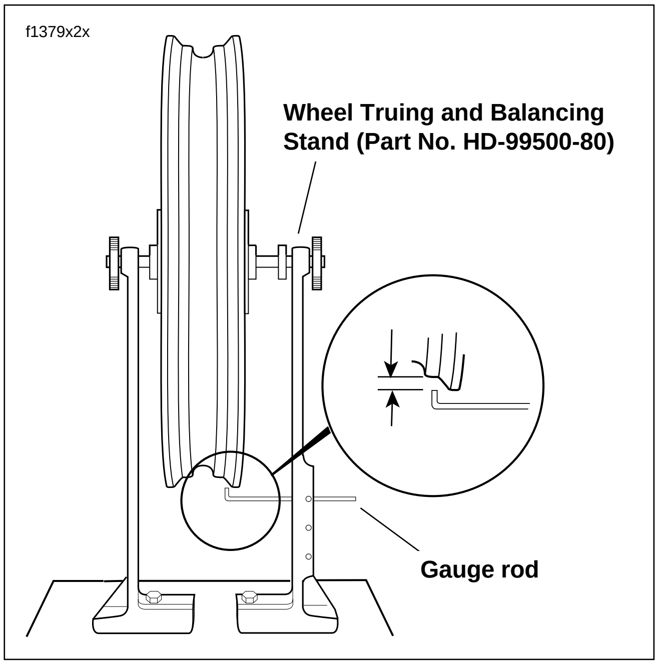


Figure 2-10. Checking Cast Rim Radial Runout

GENERAL

Inspect tires for punctures, cuts, breaks and wear at least weekly.

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.

WARNING

Dunlop front and rear tires for Buell motorcycles are not the same. They are not interchangeable. Use front tire ONLY for a front tire. DO NOT put a rear tire on the front of a vehicle. Failure to comply could result in death or serious injury.

Some tires have arrows molded into the tire sidewall. These tires should be mounted on the rim with the arrow pointing in the direction of forward rotation. The red circle on the sidewall is a balance mark and should be located next to the valve stem hole.

REMOVAL

1. Remove wheel from motorcycle. See 2.5 FRONT WHEEL or 2.6 REAR WHEEL.
2. Deflate tire.
3. See Figure 2-11. 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 2-12. 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.

CLEANING AND INSPECTION

1. Clean inside of tire.
2. If rim is dirty or corroded, clean with a stiff wire brush.
3. Inspect tire for wear and damage. Replace worn tires.

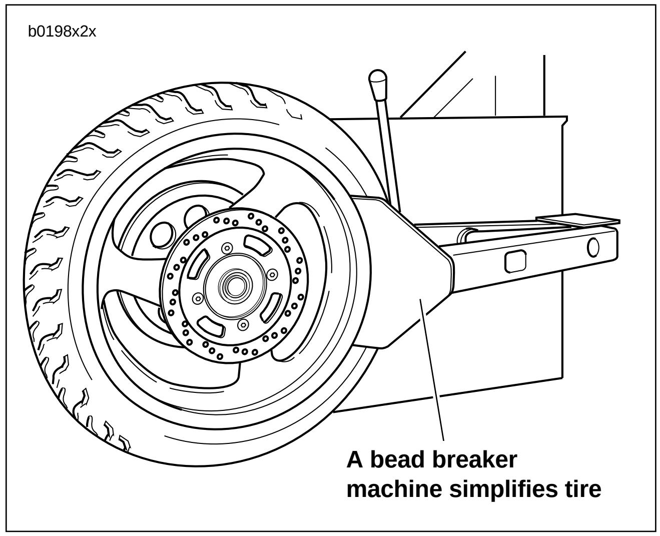


Figure 2-11. Loosening Beads from Rim Flange

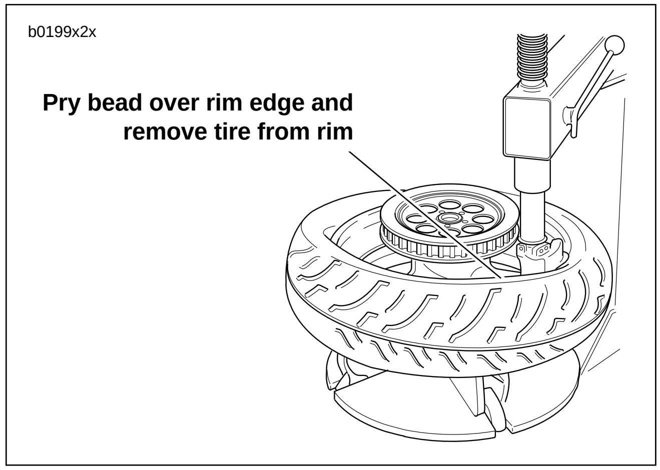


Figure 2-12. Starting Tire Off RIm

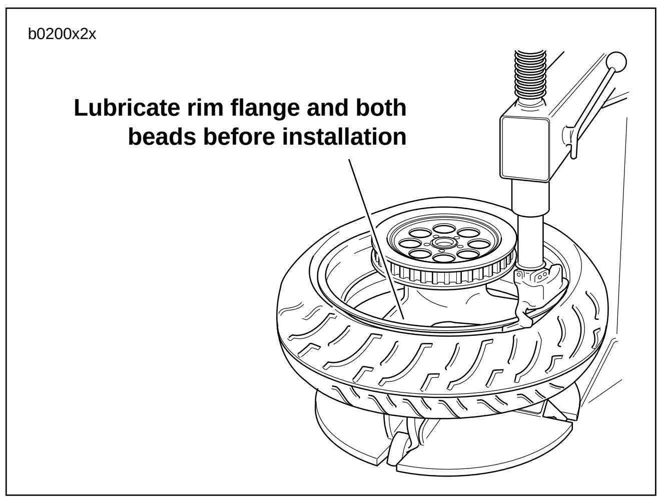


Figure 2-13. Starting Bead on Rim

INSTALLATION

⚠WARNING

Only install original equipment (stock) tire valves and valve caps. A valve or valve and cap combination that is too long may interfere with (strike) adjacent components, damage the valve and cause rapid tire deflation. Rapid tire deflation could cause loss of control which could result in death or serious injury.

⚠WARNING

Aftermarket valve caps that are heavier than the stock cap may have clearance at slow speeds; but, at high speed the valve/cap will be moved outward by centrifugal force. This outward movement could cause the valve/cap to strike the adjacent components, damage the valve and cause rapid tire deflation. Rapid tire deflation could cause loss of control which could result in death or serious injury.

1. Damaged or leaking valve stems must be replaced. Place rubber grommet on valve stem with shoulder in recess of the valve stem head.
2. Install and tighten nut to 42-44 **in-lbs** (4.7-5.0 Nm).
3. Thoroughly lubricate rim flanges and both beads of tire with tire lubricant.
4. See Figure 2-13. 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 over 40 psi (275 kPa) to seat the beads. If the beads fail to seat to 40 psi (275 kPa), deflate and relubricate the bead and rim and reinflate to seat the beads, but do not exceed 40 psi (275 kPa). Inflating the tire beyond 40 psi (275 kPa) to seat the beads can cause the tire rim assembly to burst with force sufficient to cause death or serious injury.

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 2-14. Turn wheel on axle and measure amount of displacement from a fixed point to tire sidewall.
2. Tire tread lateral runout should be no more than 0.080 in. (2.03 mm). If runout is more than 0.080 in. (2.03 mm), 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 check again for tire tread lateral runout.

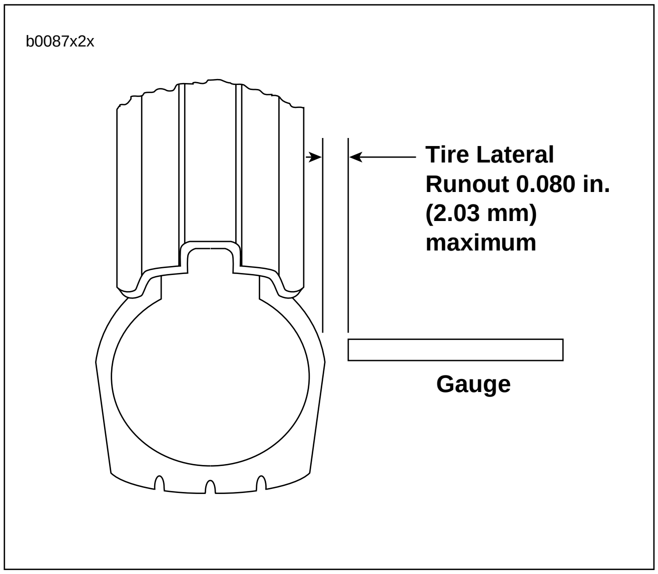


Figure 2-14. Checking Tire Lateral Runout

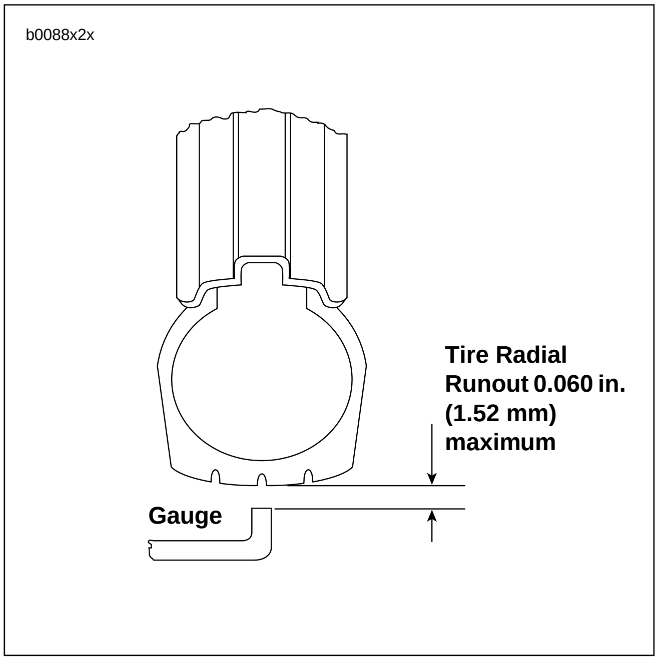


Figure 2-15. Checking Tire Radial Runout

Checking Tire Radial Runout

1. See Figure 2-15. Turn wheel on axle and measure tread radial runout.
2. Tire tread radial runout should not be greater than 0.060 in. (1.52 mm). If runout exceeds 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 check tire tread radial runout again.

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.

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 2-16. 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.
3. Place weight on flat surface of wheel rim.
4. Press weight firmly in place and hold for ten seconds.
5. Allow eight hours for adhesive to cure completely before using wheel.

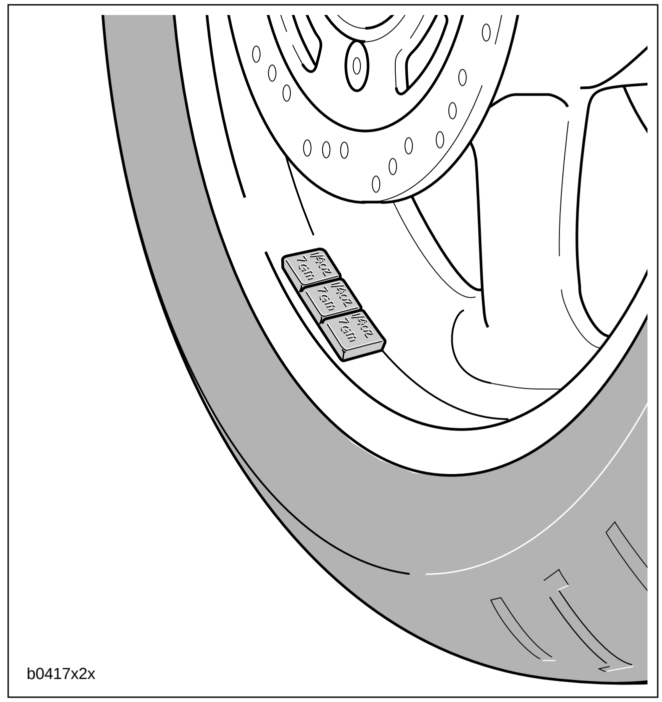


Figure 2-16. Wheel Weights (Typical)

GENERAL

The front and rear brake systems use **D.O.T. 4 BRAKE FLUID** and **D.O.T. 4** compatible banjo washers and rear brake lines.

- **D.O.T. 4** compatible banjo washers are black in color.
- **D.O.T. 4** compatible rear brake lines have an olive drab coating on the metal portion of the line.

The front and rear brakes are fully hydraulic disc brake systems that require little maintenance. The front brake master cylinder is an integral part of the brake hand lever assembly. The rear brake master cylinder is located on the right side of the motorcycle near the brake pedal.

Check the master cylinder reservoirs for proper fluid levels after the first 500 miles (800 km) and every 5000 miles (8000 km) thereafter. Also inspect fluid levels at the end of every riding season. See 1.5 BRAKES.

Check brake pads and rotors for wear at every service interval. See 1.5 BRAKES.

Replace **D.O.T. 4 BRAKE FLUID**:

- Every 2 years.

It is recommended to inspect both front and rear brake lines and replace as required:

- Every 4 years.

It is recommended to inspect both front and rear caliper and master cylinder seals and replace as required:

- Every 2 years.

If determining probable causes of poor brake operation, see Table 2-5.

⚠WARNING

Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This may result in improper brake operation which could result in death or serious injury.

⚠WARNING

Always test motorcycle brakes at low speed after servicing or bleeding system. To prevent death or serious injury, Buell recommends that all brake repairs be performed by a Buell dealer or other qualified technician.

⚠WARNING

D.O.T. 4 brake fluid can cause irritation of eyes and skin, and may be harmful if swallowed. If large amount of fluid is swallowed, induce vomiting by administering two tablespoons of salt in a glass of warm water. Call a doctor. In case of contact with skin or eyes, flush with plenty of water. Get medical attention for eyes. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. Failure to comply could result in death or serious injury.

⚠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

If rear brake line must be replaced, use only the brake line with the olive drab coating on the metal portion of the line (See Parts Catalog for Part No.) with DOT 4 brake systems. The previous black metal brake line is NOT compatible with DOT 4 brake fluid. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

⚠WARNING

Use only 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

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

Table 2-5. 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). Fill master cylinder with approved brake fluid.
Chattering sound when brake is applied.	Worn pads. Loose mounting bolts. Warped rotor.	Replace brake pads. Tighten bolts. Replace rotor.
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. 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.

FRONT BRAKE MASTER CYLINDER 2.10

REMOVAL

NOTE

Do not remove the master cylinder unless problems are being experienced.

1. See Figure 2-17. Drain brake fluid into a suitable container. Discard of used fluid according to local laws.
   a. Open bleeder valve about 1/2-turn.
   b. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   c. Pump brake hand lever to drain brake fluid.
   d. Tighten bleeder valve to 3-5 ft-lbs (4-7 Nm).

CAUTION

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

WARNING

Any leak in the brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

2. See Figure 2-18. Remove banjo bolt (6) (metric) and two banjo washers (4) to disconnect brake line (5) from master cylinder. Discard banjo washers.
3. Remove screw (10), lockwasher (9) and washer (8) to detach brake lamp switch (7).

NOTE

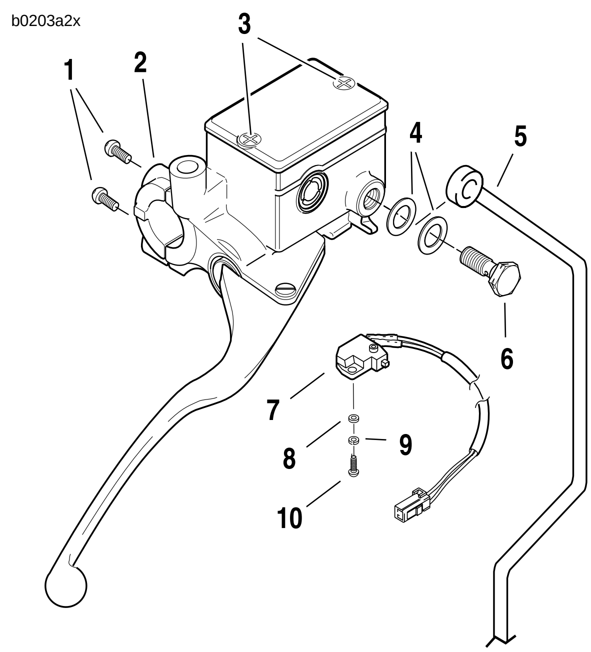
The individual parts of the brake lamp switch are not serviceable. Replace switch upon failure.

4. Remove two screws (1) (metric) and clamp (2) to detach master cylinder assembly from handlebar.

DISASSEMBLY

1. See Figure 2-19. Detach front brake hand lever.
   a. Remove nut (1) (metric) from lever pivot.
   b. Remove pivot bolt (2) from lever pivot.
   c. Detach front brake hand lever (3) from master cylinder assembly.
2. See Figure 2-20. Remove screw, lockwasher and washer (1) holding front brake switch (2) to master cylinder assembly. Remove switch.
3. See Figure 2-21. Compress piston (2) and remove boot (1).
4. Depress piston assembly and remove internal snap ring (3). Discard snap ring.
5. See Figure 2-22. Remove piston assembly (1-4) from front master cylinder.

Figure 2-17. Draining Front Brake System (Typical)



1. **Clamp Screws (2) (metric)**
2. **Clamp**
3. **Master Cylinder Cover Screws (2)**
4. **Banjo Washers (2)**
5. **Brake Line**
6. **Banjo Bolt (metric)**
7. **Front Brake Lamp Switch**
8. **Washer**
9. **Lockwasher**
10. **Screw**

Figure 2-18. Front Master Cylinder

CLEANING AND INSPECTION

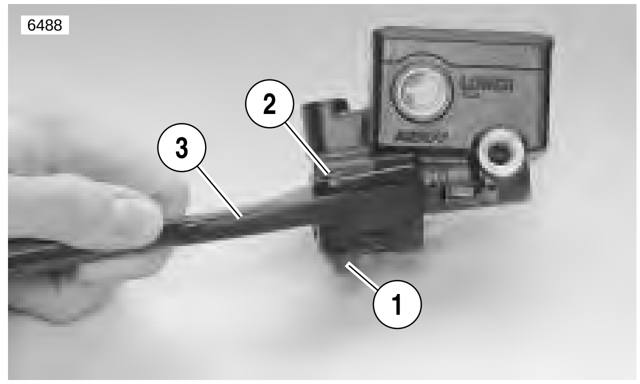
⚠WARNING

Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This may cause improper brake operation which could result in death or serious injury.

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. Carefully inspect all parts for wear or damage and replace as necessary.
3. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace housing if any of these conditions are found.
4. See Figure 2-23. 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.
5. Inspect boot for cuts, tears or general deterioration. Replace as necessary.

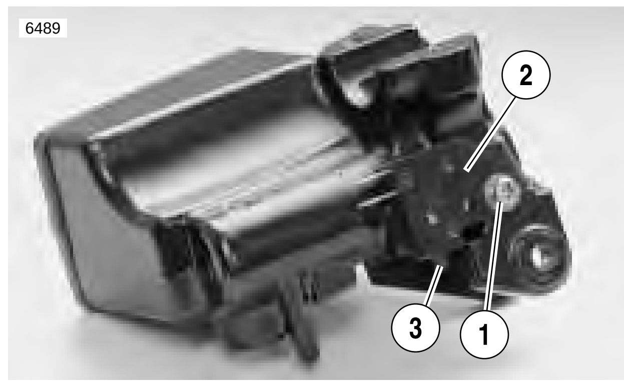
ASSEMBLY

1. See Figure 2-23. Check piston assembly components.
   a. Small end of spring (1) sits behind primary cup (2). Large side of primary cup faces spring.
   b. Secondary cup (3) sits within ridge at middle of piston (4).
2. Insert piston assembly, spring first, into master cylinder. Secure with a **new** snap ring (6).
3. Install ridge on boot (5) into groove on piston (4).
4. See Figure 2-19. Install front brake hand lever.
   a. Align hole in lever (3) with hole in master cylinder assembly.
   b. Lubricate pivot bolt (2) with LOCTITE ANTI-SEIZE.
   c. Install pivot bolt through top of assembly. Tighten to 4-13 **in-lbs** (1-2 Nm).
   d. Install nut (1) (metric). Tighten to 44-62 **in-lbs** (5-7 Nm).
5. See Figure 2-24. Install front brake switch.
   a. Attach front brake switch with screw, washer and lockwasher (1). Tighten to 7-13 **in-lbs** (1-2 Nm).
   b. Test switch action. Tang (2) on switch must release when hand lever (3) is moved.



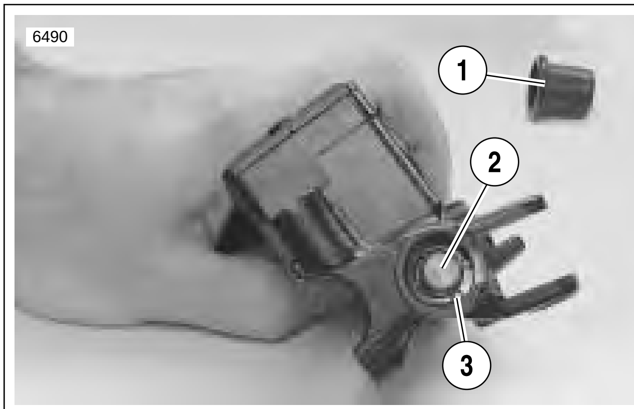
1. **Nut (metric)**
2. **Pivot Bolt**
3. **Hand Lever**

Figure 2-19. Hand Lever



1. **Screw, Lockwasher and Washer**
2. **Front Brake Switch**
3. **Tang**

Figure 2-20. Front Brake Switch



1. **Boot**
2. **Piston**
3. **Snap Ring**

Figure 2-21. Snap Ring

HOME

INSTALLATION

1. See Figure 2-18. Fasten master cylinder to handlebar by installing clamp (2) and screws (1) (metric). Tighten to 80-90 **in-lbs** (9-10 Nm).

WARNING

Use only 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

Any leak in brake system will adversely affect brake operation. To avoid leakage after assembly, verify that gaskets, banjo bolt, hydraulic brake line and bore of master cylinder are completely clean. Failure to comply could result in death or serious injury.

2. Connect brake line (5) to master cylinder using two **new** banjo washers (4) and banjo bolt (6) (metric). Tighten to 16-20 ft-lbs (22-27 Nm).
3. Attach brake lamp switch (7) with screw (10), lockwasher (9) and washer (8).
4. Remove two master cylinder cover screws (3), cover and cover gasket.
5. See Figure 2-25. 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

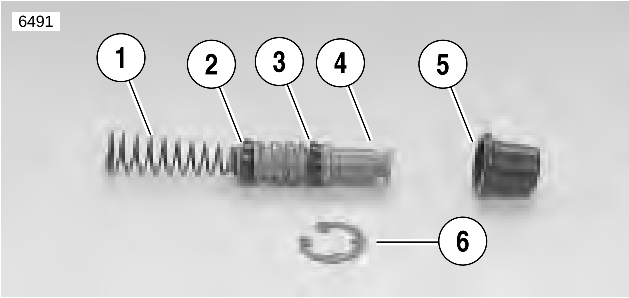
Always verify proper operation of relief port (see Step 6). A plugged or covered relief port can cause brake drag or lockup, which may cause loss of vehicle control which could result in death or serious injury.

6. 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.
7. Attach master cylinder cover, cover gasket and plastic insert with two cover screws. Tighten to 9-13 **in-lbs** (1-2 Nm).
8. Bleed brake system. See 1.5 BRAKES.

WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 9). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

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



1. **Spring**
2. **Primary Cup**
3. **Secondary Cup**
4. **Piston**
5. **Boot**
6. **Snap Ring**

Figure 2-22. Piston Assembly

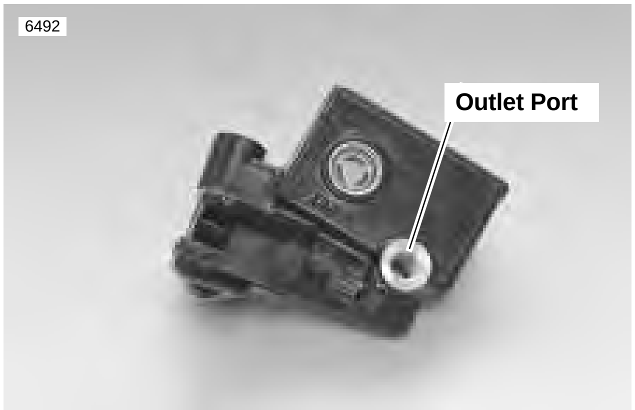
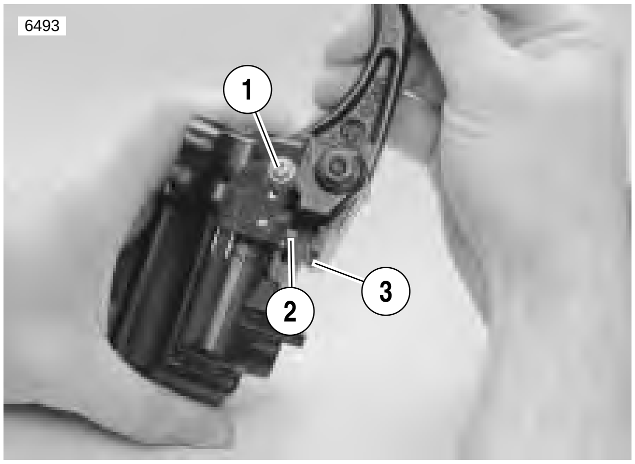


Figure 2-23. Master Cylinder Body



1. **Screw, Lockwasher and Washer**
2. **Tang**
3. **Hand Lever**

Figure 2-24. Testing Hand Lever

FRONT BRAKE CALIPER 2.11

REMOVAL

NOTE

Steps 1 and 2 are not required for detaching caliper from rotor. Drain fluid only when disassembling caliper.

1. Drain and discard brake fluid.

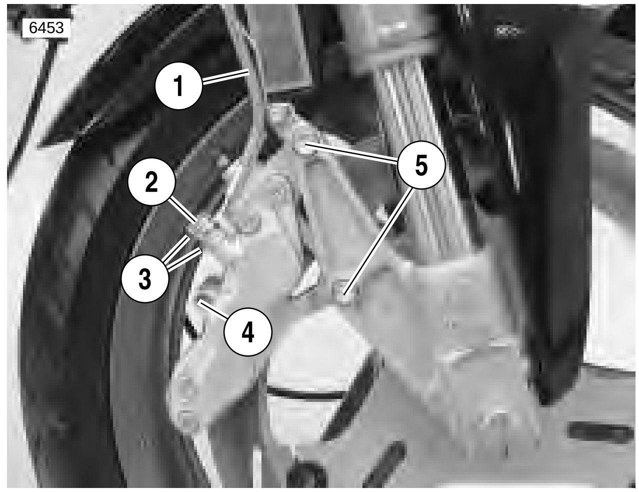
⚠WARNING

Any leak in brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

2. See Figure 2-25. Remove banjo bolt (2) (metric) and two gaskets (3) to disconnect brake line (1) from caliper. Discard gaskets.
3. Remove brake pads.
   a. Remove pin plug (4).
   b. See Figure 2-26. Remove pad hanger pin (1) (metric).
   c. Remove pad spring (2).
   d. Remove brake pads from caliper.
4. See Figure 2-25. Detach caliper from mounts.
   a. Remove both mounting screws (5) while supporting caliper above brake rotor.
   b. Slowly remove caliper by tilting away from wheel and then pulling away from rotor.

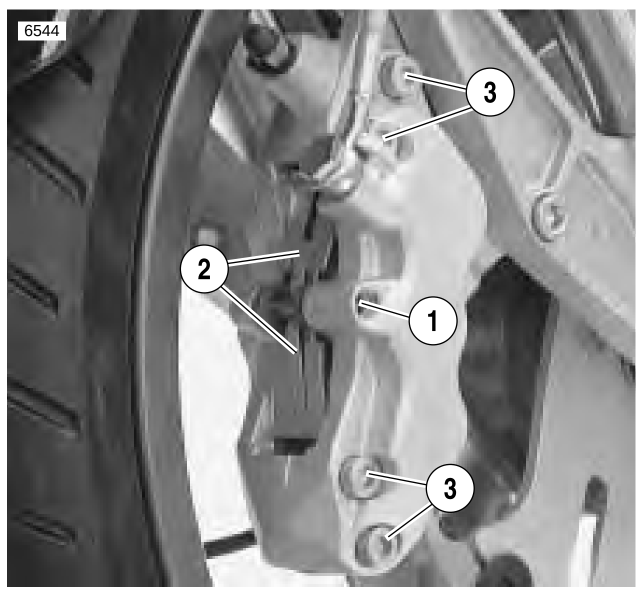
DISASSEMBLY

1. See Figure 2-26. Remove four screws (3) (metric) to separate caliper halves.
2. Remove two O-rings from between caliper halves and discard.
3. See Figure 2-27. Use BRAKE CALIPER PISTON REMOVER (Part No. B-42887) without adaptor to pull the six pistons from caliper bores.
4. See Figure 2-28. Pry O-rings (6) out of their respective grooves on each side of caliper. Discard O-rings.
5. Check bleeder valve (4) (metric). Remove and replace if damaged.



1. **Brake Line**
2. **Banjo Bolt (metric)**
3. **Banjo Washers (2 - typical))**
4. **Pin Plug**
5. **Mounting Screws (2)**

Figure 2-25. Front Brake Caliper Mounts (Typical)



1. **Pad Hanger Pin (metric)**
2. **Pad Spring**
3. **Screws (4) (metric)**

Figure 2-26. Pad Spring (Typical)

CLEANING AND INSPECTION

⚠WARNING

Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This could result in improper brake operation which could result in death or serious injury.

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.

⚠WARNING

Failure to install brake pads as a set may adversely affect brake operation. Always replace brake pads in complete sets for correct brake operation. Never replace just one brake pad. Failure to comply could result in death or serious injury.

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 2-28. Install pistons and O-rings.
    a. Apply a light coat of **D.O.T. 4 BRAKE FLUID** to O-rings, pistons and caliper piston bores.
    b. Install two **new** O-rings (6) in grooves of each piston bore.
    c. Install pistons (5) in each piston bore.
2. Install two **new** O-rings (3) between caliper halves.
3. Attach caliper halves together with four screws (7) (metric). Tighten to 14.5-18 ft-lbs (20-24 Nm).
4. Install a **new** bleeder valve (4) (metric) if necessary. Tighten to 3-5 ft-lbs (4-7 Nm).

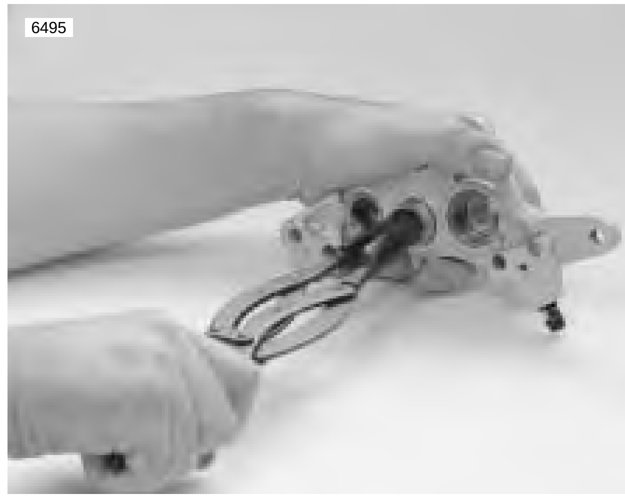
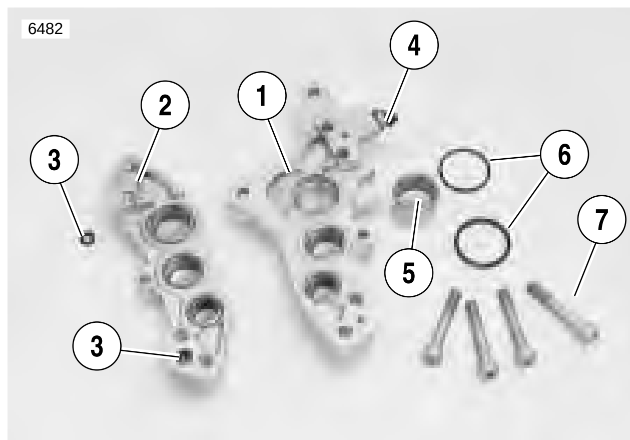


Figure 2-27. Removing Pistons



1. **Outside Caliper Half**
2. **Inside Caliper Half**
3. **O-Ring (2)**
4. **Bleeder Valve (metric)**
5. **Piston (3 sizes, 2 each)**
6. **Piston O-Rings (3 sizes, 2 each)**
7. **Screws (4) (metric)**

Figure 2-28. Caliper O-rings and Pistons

INSTALLATION

1. Fit front brake caliper on rotor.
    a. Check rotor attachment to carrier. Inspect all six brake drive pins for missing hardware.
    b. Make sure rotor is centered on carrier. Use two clamps on rotor and carrier to reduce freeplay and center rotor.
    c. Slide caliper over front brake rotor without brake pads installed.
2. See Figure 2-25. Apply LOCTITE THREADLOCKER 272 (red) to both caliper mounting screws (5). Install and tighten to 22-25 ft-lbs (30-34 Nm).
3. Install brake pads.
    a. See Figure 2-29. Insert brake pads from behind.
    b. See Figure 2-26. Install pad spring (2) with opening at top as shown.

c. Install pad hanger pin (1) (metric). Tighten to 11-14.5 ft-lbs (15-20 Nm).

d. See Figure 2-25. Install pin plug (4). Tighten to 1.5-2.1 ft-lbs (2-3 Nm).

⚠WARNING

Use only 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

Any leak in brake system will adversely affect brake operation. To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and caliper bore are completely clean. Failure to comply could result in death or serious injury.

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

CAUTION

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

5. See Figure 2-30. Remove both master cylinder cover screws (2). Remove master cylinder cover (1) and gasket.

6. With the master cylinder in a level position, verify that the brake fluid level is 1/8 in. (3.2 mm) from molded boss inside reservoir. Add **D.O.T. 4 BRAKE FLUID** if necessary.

⚠WARNING

Always verify proper operation of relief port (see Step 7). A plugged or covered relief port can cause brake drag or lockup, which may cause loss of vehicle control which could result in death or serious injury.

7. 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.

8. Install master cylinder cover and cover gasket with two screws (1). Tighten to 9-13 **in-lbs** (1-2 Nm).

9. Depress front brake lever several times to set brake pads to proper operating position within caliper. Bleed brake system. See 1.5 BRAKES.

⚠WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 10). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

10. Turn ignition key switch to IGN. Apply brake hand lever to test brake lamp operation. Turn ignition key switch to LOCK.

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.*

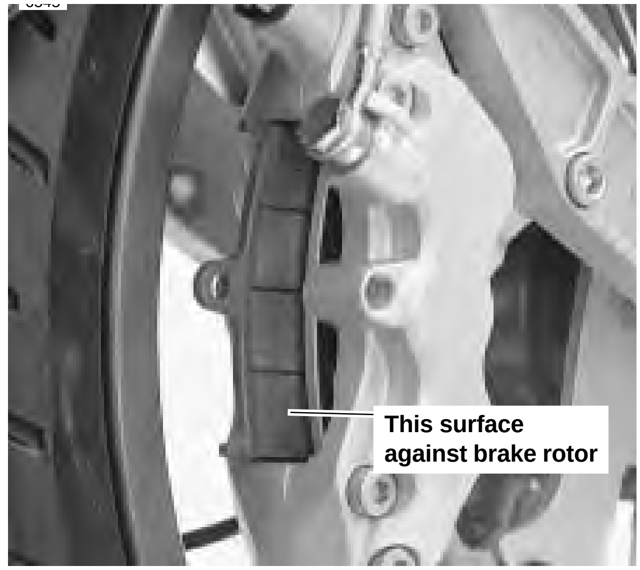
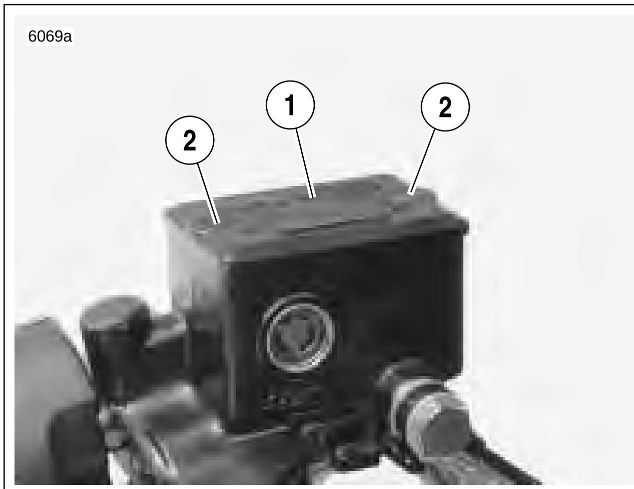


Figure 2-29. Installing Brake Pads



1. **Master Cylinder Cover**
2. **Screws (2)**

Figure 2-30. Master Cylinder Cover

FRONT BRAKE LINE 2.12

REMOVAL

1. Drain and discard brake fluid. See Step 1 under 2.11 FRONT BRAKE CALIPER.
2. See Figure 2-31. Remove screw to detach brake line clamp from right side of lower triple clamp.

CAUTION

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

⚠WARNING

Any leak in brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

3. Remove master cylinder banjo bolt (metric) and two banjo washers to disconnect brake line from master cylinder. Discard banjo washers.
4. Remove caliper banjo bolt and two banjo washers to disconnect brake line from caliper. Discard banjo washers.
5. Carefully inspect the brake line for dents, cuts or other defects. Replace the brake line if any damage is noted.

INSTALLATION

⚠WARNING

Use only 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 banjo washers, banjo bolt, hydraulic brake line and master cylinder bore are completely clean.

1. See Figure 2-31. Connect brake line to master cylinder using two **new** banjo washers and banjo bolt (metric).
2. From the master cylinder, the brake line runs downward in front of the right handlebar, where it turns inboard at the upper triple clamp. Loosely install clamp with screw to attach front brake line to right side of lower triple clamp.
3. Connect brake line to caliper using two **new** banjo washers and banjo bolt. Loosely install bolt into caliper.
4. Tighten clamp screw on lower triple clamp to 30-35 in-lbs (3-4 Nm)
5. Tighten master cylinder banjo bolt (metric) to 16-20 ft-lbs (22-27 Nm).
6. Tighten brake caliper banjo bolt to 16-20 ft-lbs (22-27 Nm).

CAUTION

Cover painted surfaces and right handlebar switches and use care when removing brake reservoir cover and adding D.O.T. 4 brake fluid. Spilling D.O.T. 4 brake fluid on painted surfaces will result in cosmetic damage. Spilling brake fluid on switches may render them inoperative.

7. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See 1.5 BRAKES
8. Turn ignition key switch to IGN. Apply brake hand lever to test brake lamp operation. Turn ignition key switch to OFF.

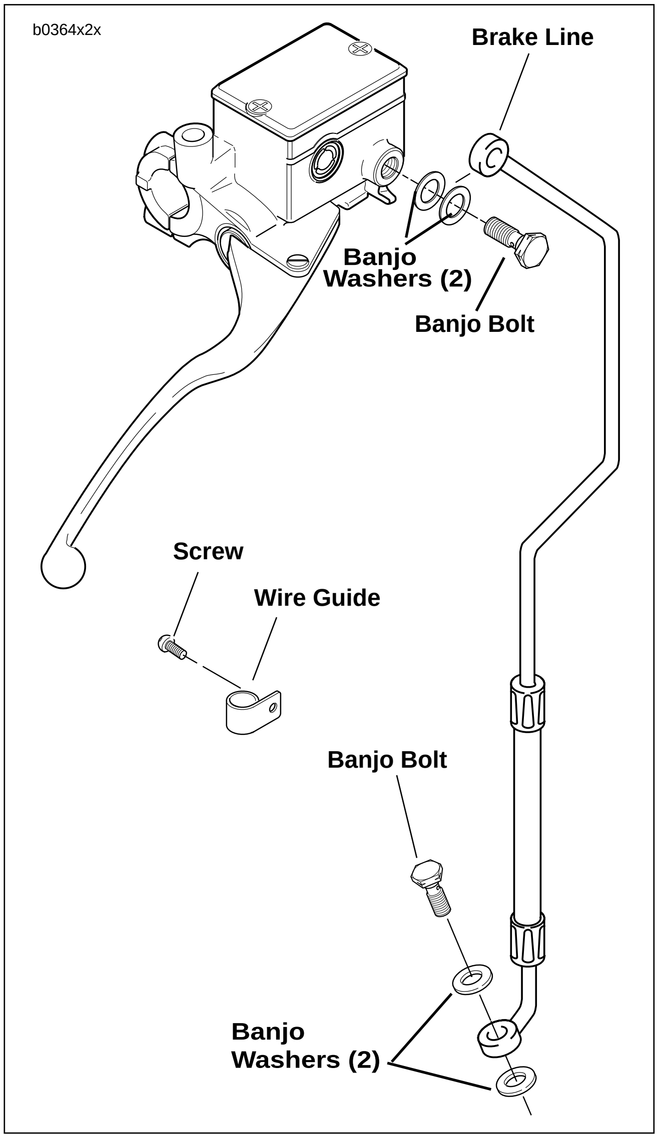


Figure 2-31. Front Brake Line

REAR BRAKE MASTER CYLINDER 2.13

REMOVAL

1. See Figure 2-32. Drain brake fluid into a suitable container. Discard of used fluids according to local laws.
   a. Remove cap from rear caliper bleeder valve. Open bleeder valve (metric) about 1/2 turn.
   b. Install a length of plastic tubing over caliper bleeder valve. Place free end in a suitable container.
   c. Pump brake pedal to drain brake fluid.
   d. Tighten bleeder valve (metric) to 3-5 ft-lbs (4-7 Nm). Reinstall cap.

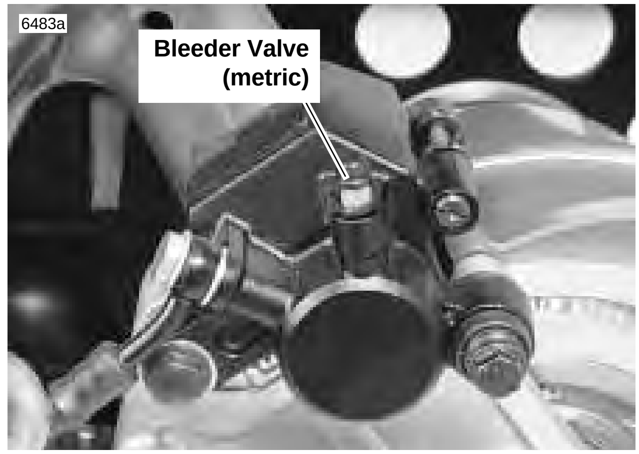
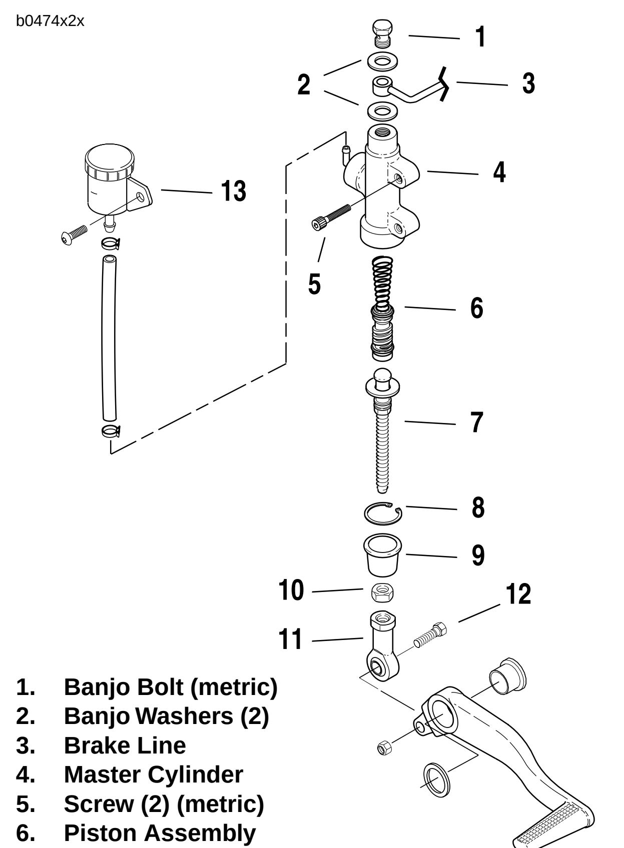


Figure 2-32. Rear Caliper Bleeder Valve (Metric)

⚠WARNING

Any leak in brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

2. See Figure 2-33. Remove banjo bolt (1) (metric) and two banjo washers (2) to detach brake line (3) from master cylinder (4). Discard banjo washers.
3. See Figure 2-34. Disconnect push rod from brake pedal turn buckle (4).
   a. Spin locknut (3) away from top surface of turn buckle.
   b. Turn rod adjuster (2) to free rod from turn buckle (4).
4. See Figure 2-35. Remove two screws (2) (metric) to detach master cylinder (3) from frame.
5. See Figure 2-36. Detach remote reservoir.
   a. Remove top or bottom clamp on hose connected to master cylinder.
   b. Remove screw to detach reservoir from frame if necessary.



1. **Banjo Bolt (metric)**
2. **Banjo Washers (2)**
3. **Brake Line**
4. **Master Cylinder**
5. **Screw (2) (metric)**
6. **Piston Assembly**
7. **Push Rod**
8. **Snap Ring**
9. **Rubber Boot**
10. **Locknut**
11. **Turnbuckle**
12. **Screw**
13. **Remote Reservoir**

Figure 2-33. Rear Master Cylinder Assembly

DISASSEMBLY

NOTE

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

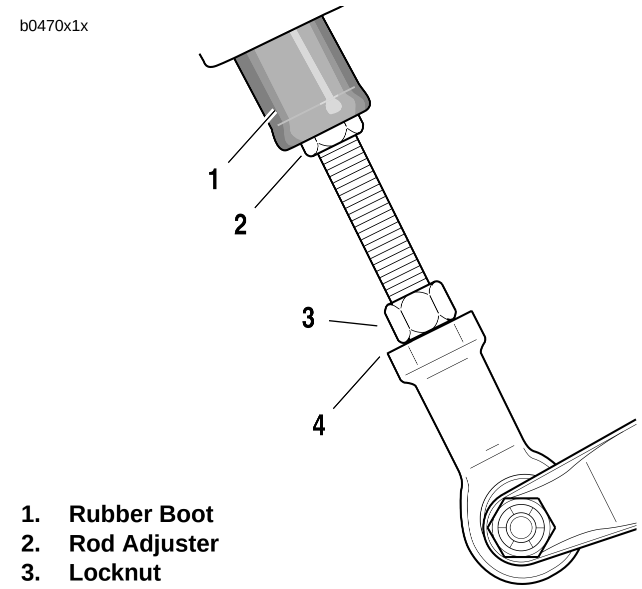
1. See Figure 2-37. Slide rubber boot on rod assembly (3) away from master cylinder body (1).
2. Depress rod assembly (3) and remove internal snap ring (2). Discard snap ring.
3. Remove piston assembly (4) from master cylinder body.

CLEANING AND INSPECTION

WARNING

Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This could result in improper brake operation which could result in death or serious injury.

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



1. **Rubber Boot**
2. **Rod Adjuster**
3. **Locknut**
4. **Top Surface of Turn Buckle**

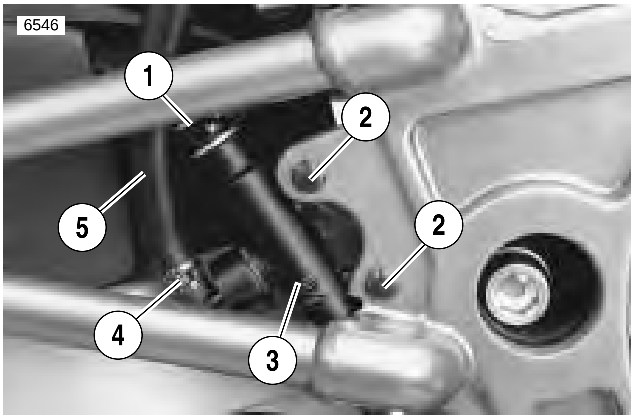
Figure 2-34. Brake Push Rod

ASSEMBLY

1. See Figure 2-37. Insert piston assembly (4), spring first, into master cylinder.
2. Place round side of rod assembly (3) over piston. Depress piston into master cylinder body (1) and secure with a **new** snap ring (2).
3. Tuck rubber boot on rod assembly (3) into master cylinder body (1).

INSTALLATION

1. See Figure 2-36. Connect remote reservoir.
   a. If removed, attach remote reservoir to frame using screw. Tighten to 12-15 **in-lbs** (1-2 Nm).
   b. Attach line to master cylinder using clamp.
2. See Figure 2-35. Attach master cylinder (3) to frame using two screws (2) (metric). Tighten to 8-10 ft-lbs (11-14 Nm).



1. **Banjo Bolt (metric)**
2. **Screw (2) (metric)**
3. **Master Cylinder Body**
4. **Clamp**
5. **Remote Reservoir Hose**

Figure 2-35. Master Cylinder Mounting

WARNING

Use only 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

Any leak in brake system will adversely affect brake operation. To avoid leakage after assembly, verify that gaskets, banjo bolt, hydraulic brake line and bore of master cylinder are completely clean. Failure to comply could result in death or serious injury.

3. See Figure 2-33. Connect brake line (3) to master cylinder (4) with two **new** banjo washers (2) and banjo bolt (1) (metric). Tighten to 16-20 ft-lbs (22-27 Nm).

4. See Figure 2-34. Install push rod.
   a. Screw push rod into turn buckle.
   b. Seat brake pedal height adjustment. See 1.5 BRAKES.

⚠WARNING

Always verify proper operation of relief port (see Step 7). A plugged or covered relief port can cause brake drag or lockup, which may cause loss of vehicle control which could result in death or serious injury.

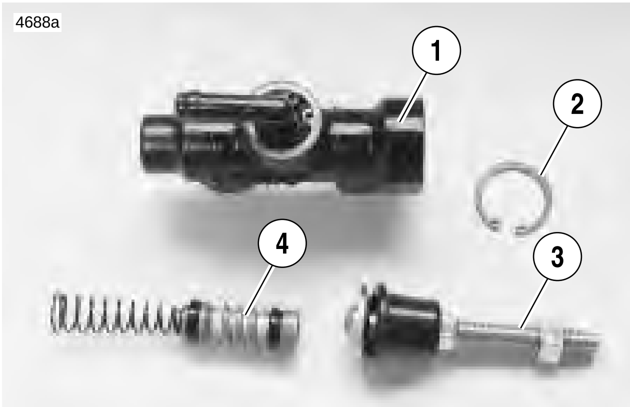
5. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
6. Add brake fluid and bleed brake system. See 1.5 BRAKES.
7. Figure 2-36. With motorcycle in a level position, check that brake fluid is between the upper and lower marks on reservoir. Add **D.O.T. 4 BRAKE FLUID** if necessary. Be sure gasket and cap on reservoir fit securely.

⚠WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 8). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

8. Turn ignition key switch to IGN. Apply rear brake pedal to test brake lamp operation. Turn ignition key switch to LOCK.

Figure 2-36. Remote Reservoir



1. **Master Cylinder Body**
2. **Snap Ring**
3. **Rod Assembly**
4. **Piston Assembly**

Figure 2-37. Master Cylinder Internals

REMOVAL

NOTE

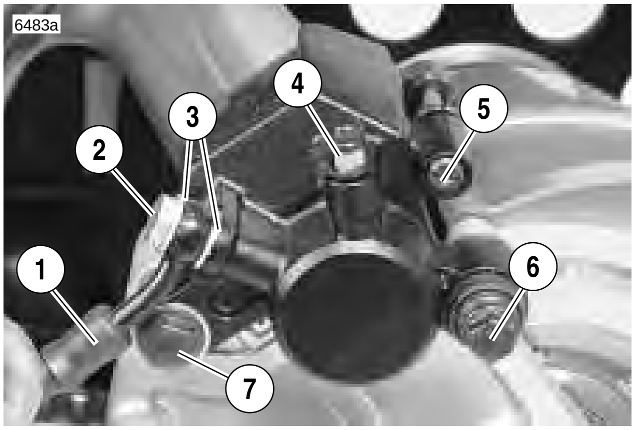
Steps 1 and 2 are not required for detaching caliper from rotor. Drain fluid only when disassembling caliper.

1. Drain and discard brake fluid. See Step 1 under 2.13 REAR BRAKE MASTER CYLINDER.

WARNING

Any leak in brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

2. See Figure 2-38. Remove banjo bolt (2) (metric) and two banjo washers (3) to disconnect brake line (1) from caliper. Discard banjo washers.
3. Remove small screw (6) (metric) and large screw (7) (metric) to detach caliper from mount.
4. See Figure 2-39. Remove clip (1) from rear caliper mount (2) if necessary.

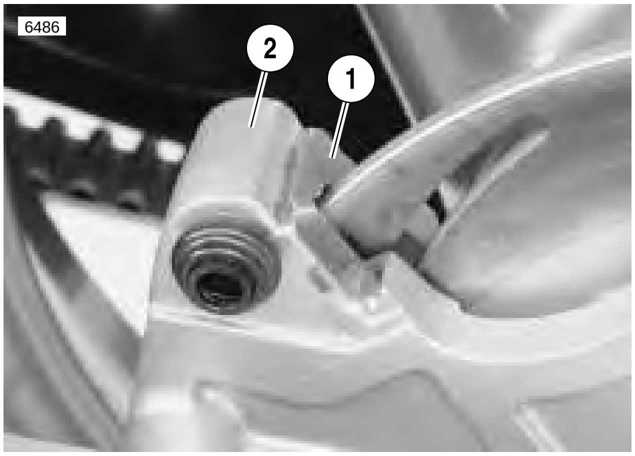


1. **Brake Line**
2. **Banjo Bolt (metric)**
3. **Banjo Washers (2 - typical)**
4. **Bleeder Valve (metric)**
5. **Pin Plug and Pad Hanger (metric)**
6. **Small Screw (metric)**
7. **Large Screw (metric)**

Figure 2-38. Rear Brake Caliper (Typical)

DISASSEMBLY

1. See Figure 2-38. Remove pin plug and pad hanger (5) (metric) to free brake pads.
2. See Figure 2-40. Remove clip (1) from caliper body.
3. See Figure 2-41. Remove piston (3) using BRAKE CALIPER PISTON REMOVER (1) (Part No. B-42877) with adaptor (2).
4. Remove two O-rings from groove in caliper bore. Discard O-rings.



1. **Clip**
2. **Rear Caliper Mount**

Figure 2-39. Caliper Mount Clip

CLEANING AND INSPECTION

WARNING

Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This could result in improper brake operation which could result in death or serious injury.

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.

WARNING

Failure to install brake pads as a set may adversely affect brake operation. Always replace brake pads in complete sets for correct brake operation. Never replace just one brake pad. Failure to comply could result in death or serious injury.

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 2-40. 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. See Figure 2-41. 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 (3) inside caliper body.
3. See Figure 2-40. Install brake pads (3) using pad hanger and pin plug (1).
   a. Install pad hanger pin (metric). Tighten to 11-14.5 ft-lbs (15-20 Nm).
   b. Install pin plug. Tighten to 1.5-2.1 ft-lbs (2-3 Nm).
4. Install a **new** bleeder valve (metric) if necessary. Tighten to 3-5 ft-lbs (4-7 Nm).

INSTALLATION

1. See Figure 2-39. Install caliper mount clip (1) if removed.
2. See Figure 2-38. Install caliper assembly on caliper mount. Brake pad surfaces must face rear brake rotor.
   a. Apply LOCTITE THREADLOCKER 272 (red) to both caliper mounting screws (6, 7) (metric).
   b. Install large caliper screw (7) (metric). Tighten to 18-22 ft-lbs (24-30 Nm)
   c. Install small caliper screw (6) (metric). Tighten to 14.5-18 ft-lbs (20-24 Nm).

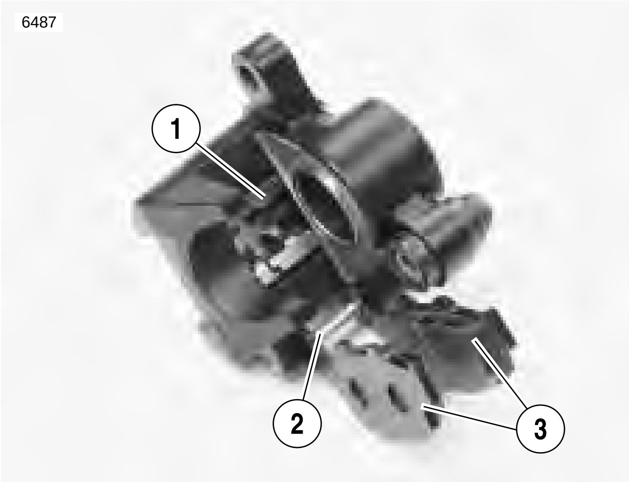
⚠WARNING

Use only 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

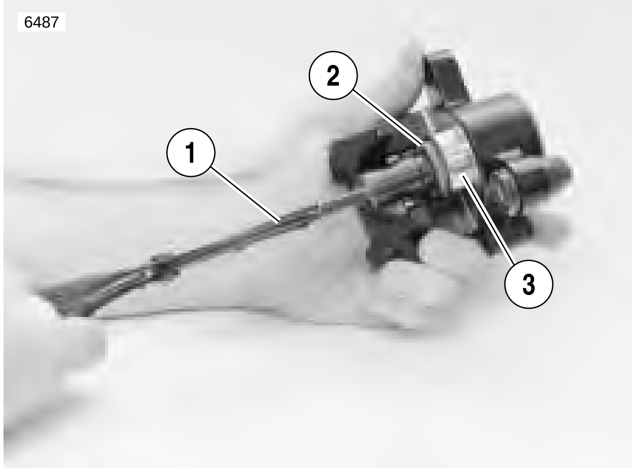
Any leak in brake system will adversely affect brake operation. To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and caliper bore are completely clean. Failure to comply could result in death or serious injury.

3. Connect brake line (1) to caliper using two **new** banjo washers (3) and banjo bolt (2) (metric). Tighten to 16-20 ft-lbs (22-27 Nm).



1. Clip
2. Pin Plug and Pad Hanger (metric)
3. Brake Pads (2)

Figure 2-40. Brake Pads



1. Brake Caliper Piston Remover
2. Adaptor
3. Piston

Figure 2-41. Removing Rear Brake Caliper Piston

4. Depress rear brake pedal several times to set brake pads to proper operating position within caliper. Bleed brake system. See 1.5 BRAKES.
5. Verify proper fluid level in reservoir.

⚠WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 6). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

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

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.*

REAR BRAKE LINE AND SWITCH 2.15

REMOVAL

1. Drain and discard brake fluid. See Step 1 under 2.13 REAR BRAKE MASTER CYLINDER.

⚠WARNING

Any leak in brake system will adversely affect brake operation. Damaged banjo bolt seating surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components. Failure to comply could result in death or serious injury.

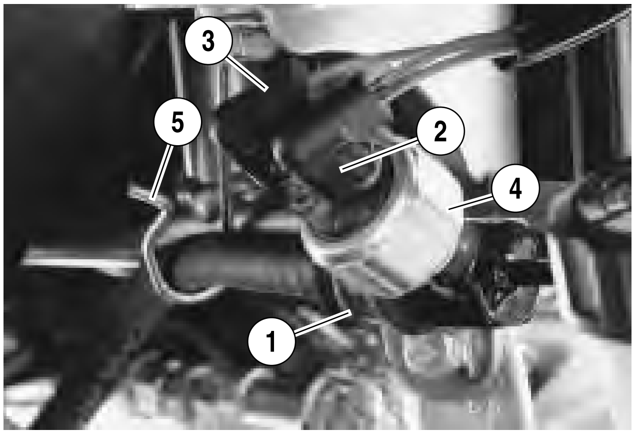
2. See Figure 2-42. Remove banjo bolt (2) (metric) and two banjo washers (3) to disconnect brake line (1) from rear brake caliper. Discard banjo washers.
3. Remove banjo bolt and two banjo washers to disconnect brake line from rear master cylinder. Discard banjo washers.
4. Remove screw and clamp to detach brake line clamp from frame.
5. See Figure 2-44. Remove bolt, washer, wireform and brake line from under oil tank.
6. Remove wires from terminals (2,3) at top of brake lamp switch (4). Unthread brake lamp switch from tee nut.

INSTALLATION

⚠WARNING

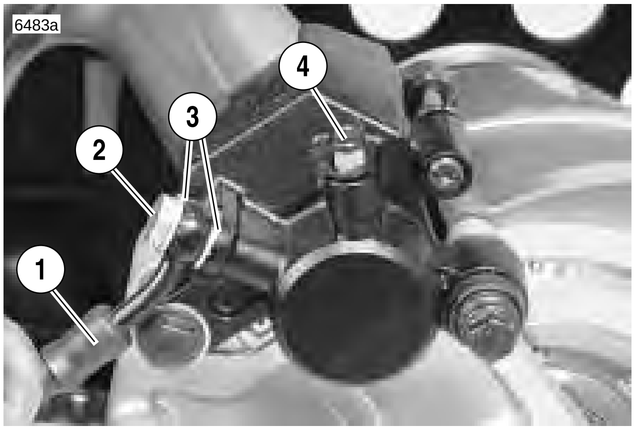
If rear brake line must be replaced, use only the brake line with the olive drab coating on the metal portion of the line (See Parts Catalog for Part No.) with DOT 4 brake systems. The previous black metal brake line is NOT compatible with DOT 4 brake fluid. Failure to comply may adversely affect braking ability and lead to brake failure which could result in death or serious injury.

1. See Figure 2-45. Install wireform to rear brake line as shown in figure.
2. From left side of vehicle, feed **new** brake line from rear brake caliper mount forward to frame mount. Route brake line to the right towards rear master cylinder.
3. See Figure 2-42. Install screw and clamp (1) to fasten rear brake line to frame tube. Tighten to 10-12 ft-lbs (14-16 Nm).
4. Place brake line inside wire guide (5) closest to master cylinder.
5. See Figure 2-44. Attach the wireform under the oil tank with bolt and washer.



1. **Clamp**
2. **Double Wire Terminal**
3. **Single Wire Terminal**
4. **Rear Brake Lamp Switch**
5. **Wire Guide**

Figure 2-42. Rear Brake Line and Switch



1. **Brake Line**
2. **Banjo Bolt (metric)**
3. **Banjo Washers (2 - typical)**
4. **Bleeder Valve (metric)**

Figure 2-43. Rear Brake Caliper Banjo Bolt (Typical)

WARNING

Use only 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

Any leak in brake system will adversely affect brake operation. To avoid leakage, verify that banjo washers, banjo bolt, hydraulic brake line and caliper bore are completely clean. Failure to comply could result in death or serious injury.

6. Connect brake line to master cylinder with two **new** banjo washers and banjo bolt (metric). Tighten to 16-20 ft-lbs (22-27 Nm).
7. See Figure 2-43. Connect brake line (1) to caliper with two **new** banjo washers (2) and banjo bolt (1) (metric). Tighten to 16-20 ft-lbs (22-27 Nm).
8. See Figure 2-42. Install brake lamp switch (4).
   a. Coat brake lamp switch threads with LOCTITE PIPE SEALANT WITH TEFLON and install to tee nut of brake line. Tighten to 7-8 ft-lbs (10-11 Nm).
   b. Install wires on terminals (2, 3).
9. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See 1.5 BRAKES.

WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 10). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

10. Turn ignition key switch to IGN. Apply rear brake pedal to test brake lamp operation. Turn ignition key switch to LOCK.

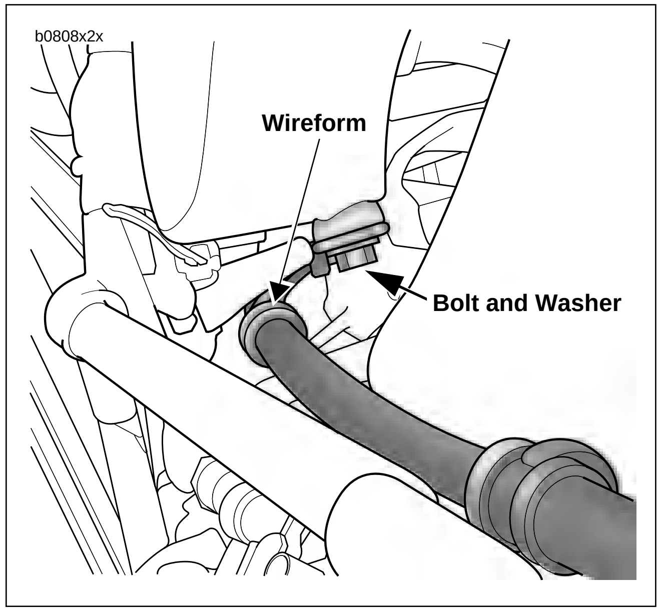


Figure 2-44. Rear Brake Line Wireform

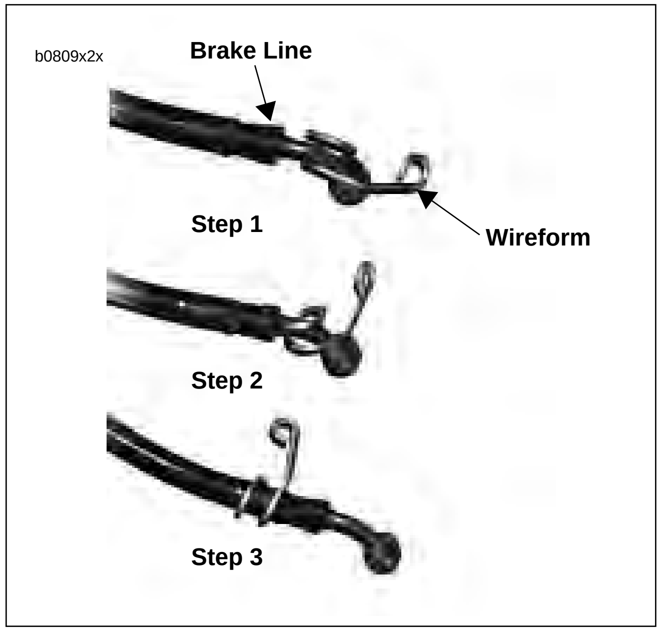


Figure 2-45. Wireform Installation

GENERAL

The front forks 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 1.14 SUSPENSION DAMPING ADJUSTMENTS for more information.

REMOVAL

1. Raise front wheel off floor using procedure under 1.16 STEERING HEAD BEARINGS.
2. Detach front brake caliper from rotor. See 2.11 FRONT BRAKE CALIPER.
3. Remove front wheel. See 2.5 FRONT WHEEL.
4. Remove front fender. See 2.31 FRONT FENDER.
5. Loosen left and right headlamp brackets.
6. Loosen the four large pinch screws on both the upper and lower triple clamps.
7. Remove front forks through bottom of triple clamps.

DISASSEMBLY

NOTE

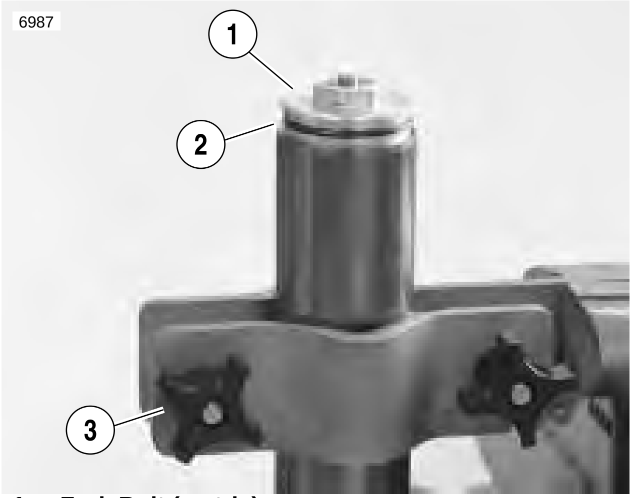
To prevent change in set position of damping force adjuster needle, do not loosen the lock nut.

1. See Figure 2-46. Loosen the fork bolt (1) (metric) from the outer tube and slightly compress the fork leg. Remove the fork bolt with attached O-ring (2).
2. See Figure 2-47. Set the FRONT FORK SPRING COMPRESSOR (Part No. B-43875) (1) onto the spring collar (2). Push down on the collar and remove the spring seat stopper (3).
3. See Figure 2-48. Remove the spring collar (4), the spring joint (5) and the spring (6).
4. Remove the fork oil by pumping the fork leg and rod 8-10 times until the rod moves freely.
5. Clamp the axle holder in a vise with soft jaws or use a shop towel. Remove the center bolt (19) (metric) and the special washer (18).
6. Remove the damper (14) and the centering plate (15) from the slide pipe (17).

⚠WARNING

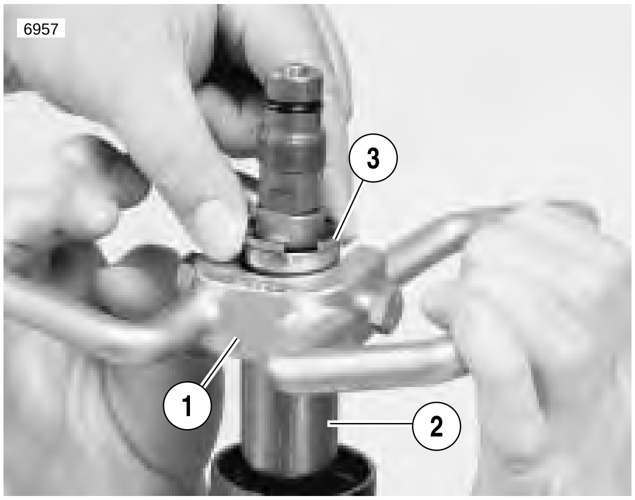
Be careful not to scratch the slide pipe or the outer tube. Improperly operating forks may lead to a loss of control and death or serious injury.

7. Remove the dust seal (13) and the stopper ring (12) from the outer tube (8).
8. Pull the slide pipe (17) out of the outer tube (8).
9. Remove the guide bushing (9), seal spacer (10), oil seal (11) stopper ring (12), and the dust seal (13) from the slide pipe (17).
10. Remove the slide bushing (16)



1. **Fork Bolt (metric)**
2. **O-Ring**
3. **Front Fork Holding Tool (Part No. B-41177)**

Figure 2-46. Fork Bolt



1. **Fork Spring Compressor**
2. **Spring Collar**
3. **Spring Seat Stopper**

Figure 2-47. Front Fork Spring Compressor

1. Fork Bolt
2. O-Ring
3. Spring Seat Stopper
4. Spring Collar
5. Spring Joint
6. O-Ring
7. Spring
8. Outer Tube
9. Guide Bushing
10. Seal Spacer
11. Oil Seal
12. Stopper Ring
13. Dust Seal
14. Damper Assembly
15. Centering Plate
16. Slide Bushing
17. Slide Pipe
18. Special Washer
19. Center Bolt
20. Mounting Bolt

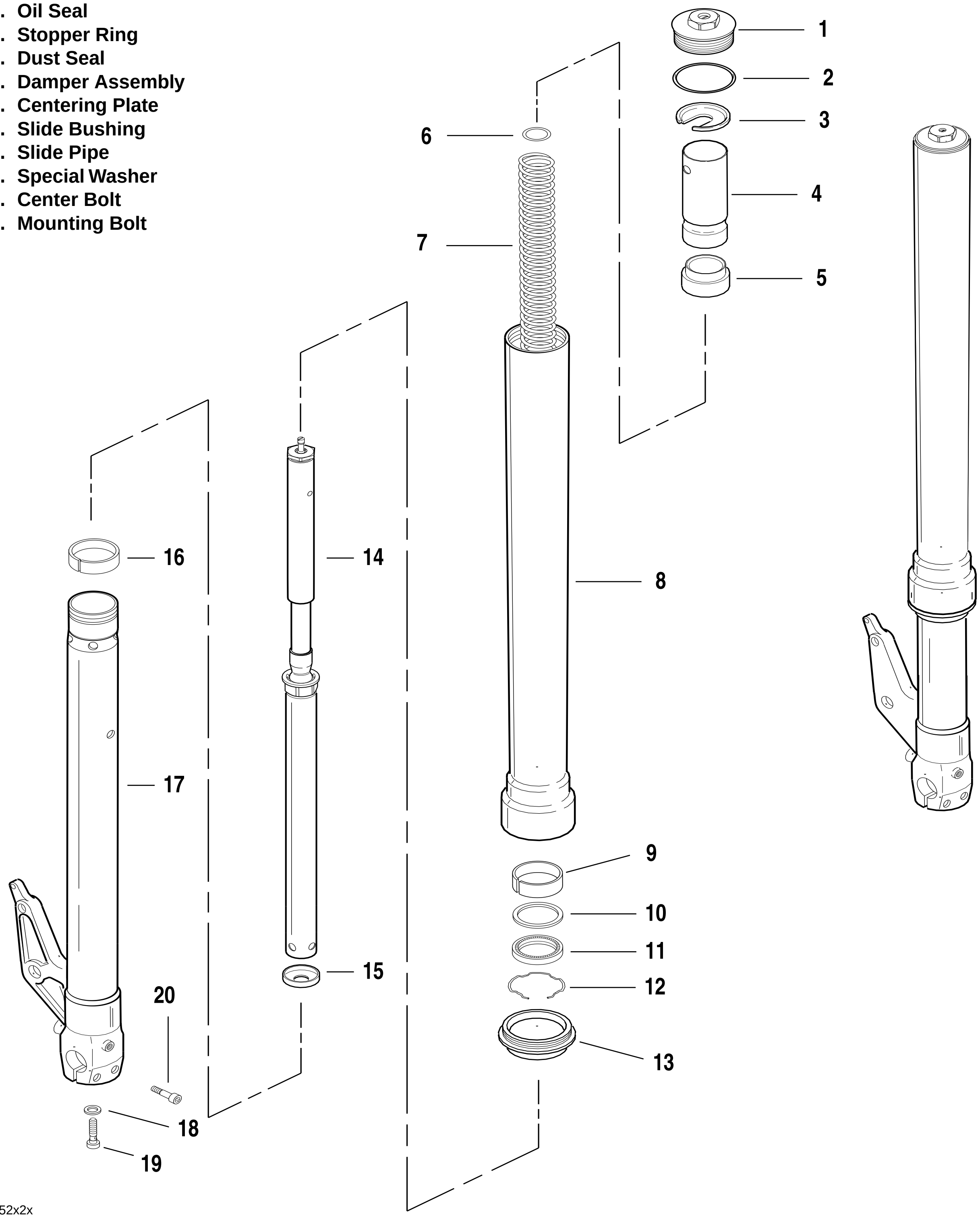


Figure 2-48. Front Fork Assembly

HOME

CLEANING AND INSPECTION

1. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.
2. See Figure 2-48. Check the slide pipe (17) and outer tube (8) for score marks, scratches and excessive or abnormal wear. Replace if worn or damaged.
3. Check the slide bushing (16) and the guide bushing (9) for excessive wear or scratches. Replace if damaged or worn.
4. Replace the stopper ring (12) if distorted.
5. Measure spring (7) free length. Replace springs shorter than service wear limit of 9.13 in. (232 mm).
6. See Figure 2-50. Measure slide pipe runout. Replace pipe if runout exceeds the service wear limit of 0.008 in. (0.2 mm).

ASSEMBLY

1. See Figure 2-51. Wrap the end of the slide pipe and the slide bushing channel with tape to avoid damaging the oil seal lip when installing.
2. See Figure 2-49. Install a **new** dust seal (5) and stopper ring (4) onto the slide pipe.
3. Coat the sealing lips of the **new** oil seal (3) with fork oil or sealing grease and install onto the slide pipe with its marked side facing the dust seal (5). Remove the tape from the slide pipe end.
4. Install the seal spacer (2), the guide bushing (1) and the slide bushing (6) onto the slide pipe.
5. Coat the slide bushing (6) and the guide bushing (1) with fork oil.

CAUTION

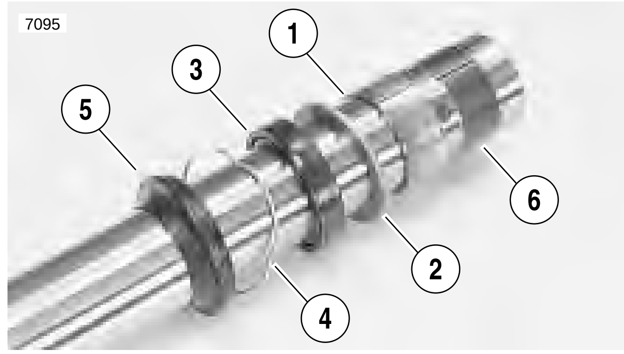
The outer tube can move freely up and down on the slide pipe. Always hold both the slide pipe and outer tube to prevent damage to bushings and seals.

6. See Figure 2-48. Carefully place the slide pipe (17) into the outer tube (8).
7. Move and tape or tie the dust seal (13) and stopper ring (12) out of the way.
8. Using FORK SEAL DRIVER (Part No. B-43721), drive the guide bushing (9) with the seal spacer (10) and oil seal (11) into position in the outer tube (4). See Figure 2-52.
9. See Figure 2-48. Remove any tape or ties and reinstall the stopper ring (12) and a **new** dust seal (13).
10. Clamp the axle holder in a vise with soft jaws or use a shop towel. Replace the special washer (18) and center bolt (19) (metric). Tighten the center bolt to 22-29 ft-lbs (30-39 Nm).

NOTE

The recommended fork oil is hydraulic fork oil Type "E".

11. While supporting the fork, pour one-half of the recommended amount of fork oil, 8 oz. (225 cc), into the fork pipe.
12. Pump the piston rod and leg slowly at least 10 times, about 6 in. (150 mm) strokes.



1. **Guide Bushing**
2. **Seal Spacer**
3. **Oil Seal**
4. **Stopper Ring**
5. **Dust Seal**
6. **Slide Bushing**

Figure 2-49. Slide Pipe Components

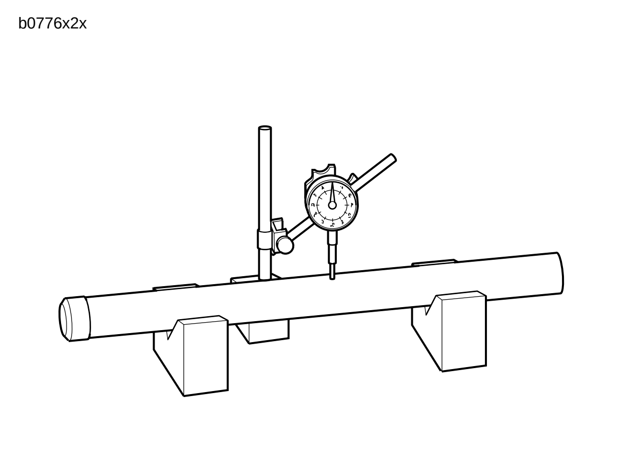
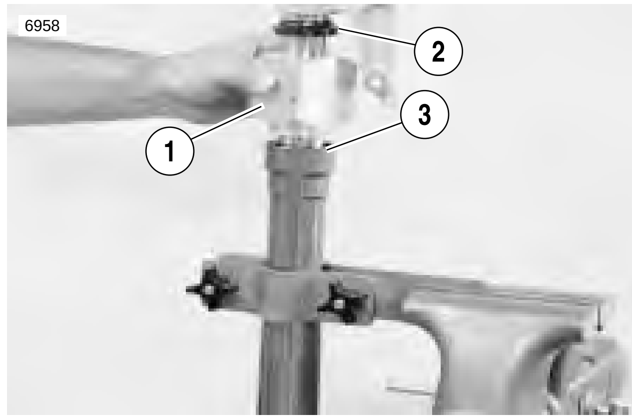


Figure 2-50. Pipe Runout

Figure 2-51. Slide Pipe Protection

13. Place the centering plate (15) onto the damper (14) and insert the assembly into the slide pipe (17).
14. Place the piston rod and outer tube (8) in the full bottomed position.
15. See Figure 2-53. Pour the recommended fork oil into the slide pipe to a level between the maximum and minimum limits. Additional information on setting oil levels can be found under 1.15 FRONT FORK.
16. See Figure 2-54. Install the spring, with the taper side at top, and the spring collar and spring joint.
17. See Figure 2-47. Place FRONT FORK SPRING COMPRESSOR (Part No. B-43875) (1) into position and press down on the spring collar (2).
18. Set the spring seat stopper (3) between the spring collar (2) and the locknut. Remove the FRONT FORK SPRING COMPRESSOR.
19. See Figure 2-46. Apply oil to a **new** O-ring and install it into position on the fork bolt. Install fork bolt. Tighten to 22-29 ft-lbs (30-39 Nm).
20. Tighten rebound adjuster against the fork bolt.
21. Set rebound and compression adjusters to factory positions. See 1.14 SUSPENSION DAMPING ADJUSTMENTS.



1. **Fork Seal Driver**
2. **Guide Bushing with Seal Spacer**
3. **Outer Tube**

Figure 2-52. Fork Seal Driver

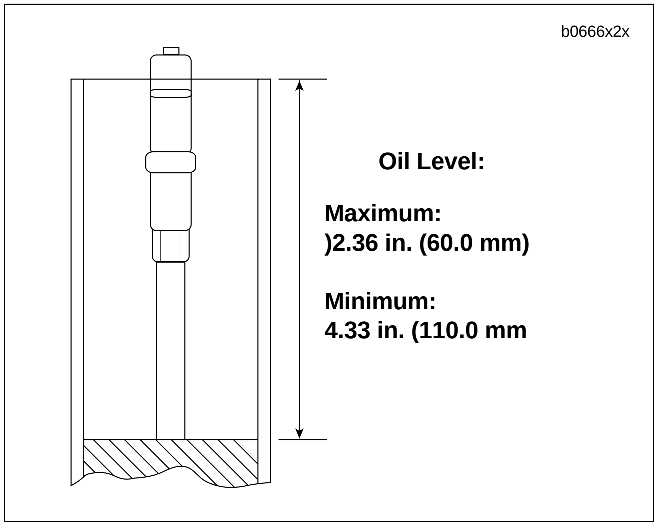


Figure 2-53. Oil Level Measurement

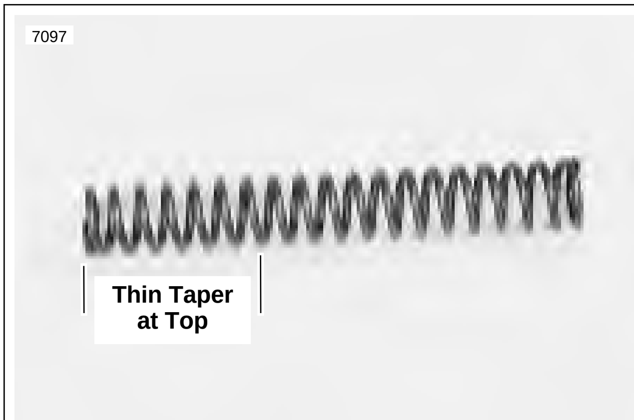


Figure 2-54. Spring Installation

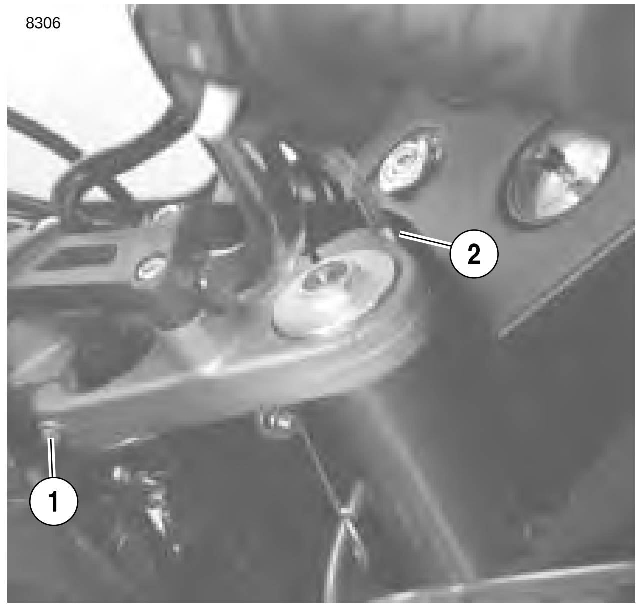
INSTALLATION

1. Insert fork tubes through triple clamps.

NOTE

When installing the front forks, use a suitable tool to pry apart the triple clamps.

2. See Figure 2-55. Spread LOCTITE ANTI-SEIZE on the last three threads of all five triple clamp pinch screws. Loosely install triple clamp fasteners. If removed, small screw (1) installs at rear of upper triple clamp.
3. Align and secure fork tubes.
   a. Position fork tubes so that top of each slider tube is flush with the top surface of upper triple clamp and cap protrudes slightly. Be sure that top surface of fork is not below top surface of upper triple clamp.
   b. Tighten large screws to 18-20 ft-lbs (24-27 Nm).
   c. Tighten small screw to 10-12 ft-lbs (14-16 Nm) if loosened during fork stem service.
4. Install front fender. See 2.31 FRONT FENDER.
5. Install front wheel. See 2.5 FRONT WHEEL.
6. Install front brake caliper. See 2.11 FRONT BRAKE CALIPER.
7. Adjust front forks to rider preferences. See 1.15 FRONT FORK.



1. **Small Upper Triple Clamp Screw**
2. **Large Upper Triple Clamp Screw (2)**

Figure 2-55. Front Fork

FORK STEM AND BRACKET ASSEMBLY 2.17

REMOVAL/DISASSEMBLY

1. Remove fork assemblies. See 2.16 FRONT FORK.
2. Remove handlebar clamp. See 2.26 HANDLEBARS.
3. See Figure 2-56. Remove all upper triple clamp screws (7, 11), fork stem bolt (1) and upper triple clamp (2).
4. Remove upper dust shield (3) and roller bearing (4).
5. Remove lower roller bearing.
    a. Remove two lower triple clamp screws (7). Pull the lower triple clamp (6) downward.
    b. The lower bearing cone is a press fit on fork stem. Chisel through outer bearing cage to allow rollers to fall free.
    c. Apply heat to remove the remaining portion of bearing cone. Continuously move flame around its entire circumference until bearing falls free.
    d. Remove lower dust shield (3).
6. If replacement of bearing cups (5) is necessary, drive cups from steering head using STEERING HEAD BEARING RACE REMOVER (Part No. HD-39301A) and UNIVERSAL DRIVER HANDLE (Part No HD-33416).

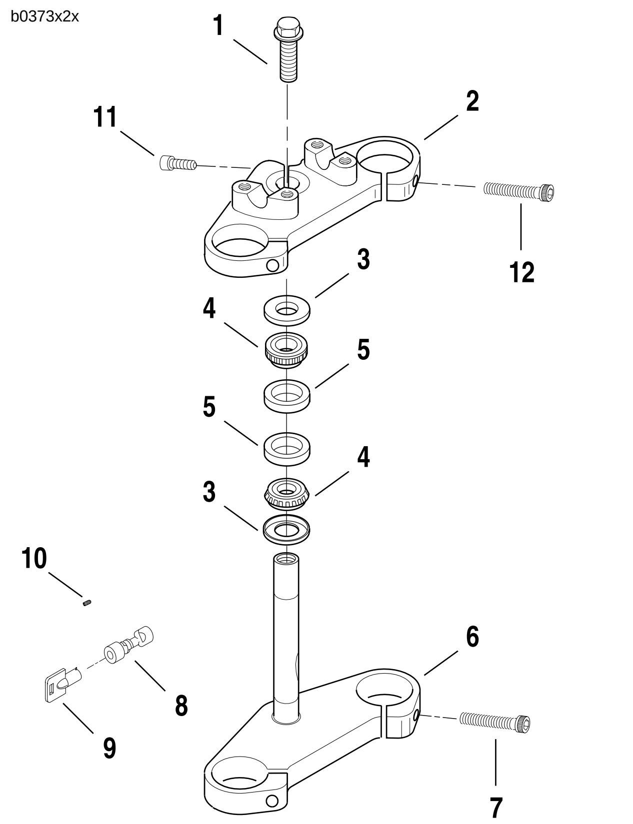
CLEANING AND INSPECTION

See 1.15 FRONT FORK for adjustment procedures.

1. See Figure 2-56. Clean the dust shields (3), bearing cups (5), fork stem and lower triple clamp (6) and frame with solvent.
2. Carefully inspect bearing races and assemblies for pitting, scoring, wear and other damage. Replace damaged bearings (4) as a set (3, 4 and 5).
3. Check the fork stem and lower triple clamp (6) for damage. Replace if necessary.

ASSEMBLY/INSTALLATION

1. See Figure 2-56. If removed, install **new** bearing cups (5) into frame steering head using STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302).
2. Liberally coat the bearing cones (4) with grease using WHEEL BEARING PACKER TOOL (Part No. HD-33067). Work the grease into the rollers.
3. Install lower bearing.
    a. Place lower bearing dust shield (3) over fork stem.
    b. Find a section of pipe having an inside diameter slightly larger than the outside diameter of the fork stem.
    c. Press bearing (4) with small end up onto fork stem and lower triple clamp (6). Use the pipe as a press-on tool.
4. Insert lower triple clamp (6) through the steering head. Install the upper bearing (4) with small end down and dust shield (3) onto fork stem.
5. Apply LOCTITE ANTI-SEIZE to fork stem bolt (1). Loosely install upper triple clamp (2) using fork stem bolt.



1. **Fork Stem Bolt**
2. **Upper Triple Clamp**
3. **Dust Shield (2)**
4. **Roller Bearing (2)**
5. **Bearing Cup (2)**
6. **Lower Triple Clamp**
7. **Lower Clamp Pinch Screws (2)**
8. **Steering Head Lock**
9. **Steering Lock Key**
10. **Set Screw**
11. **Small Pinch Screw**
12. **Upper Clamp Pinch Screws (2)**

Figure 2-56. Fork Stem

6. Install fork assemblies. See 2.16 FRONT FORK.
7. Check adjustment.
    a. Install fork stem bolt (1).
    b. Check bearing adjustment to tighten fork stem bolt to proper tension. See 1.16 STEERING HEAD BEARINGS.
    c. Make sure the fork stem turns freely, then tighten the fork stem clamp screw (11).
8. Install and adjust handlebars. See 2.26 HANDLEBARS.

STEERING HEAD LOCK 2.18

REMOVAL

1. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and an automotive engine lift.
2. See Figure 2-57. Loosen handlebars.
   a. Place a protective cover over the fuel tank.
   b. Remove both front clamp screws (1).
   c. Remove both rear clamp screws (2) and handlebar clamp (3).
   d. Move handlebars to the rear without stretching the attached cables. Place handlebar assembly on the protective cover.
3. Loosen the three upper triple clamp screws.
4. Slowly loosen fork stem bolt (4) until forks drop 0.5 in. (12.7 mm) in triple clamps.
5. See Figure 2-58. Remove set screw behind lock.
6. Extract steering head lock from fork stem.
   a. Insert fork key in lock.
   b. Lift front wheel upward.
   c. Twist key to pull steering head lock from fork stem.
   d. Release front wheel.

NOTE

Steering head lock is not repairable. Replace the unit if it fails.

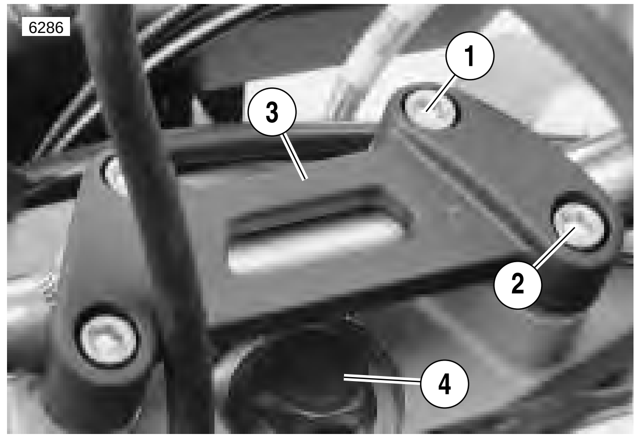
INSTALLATION

1. Install steering head lock in fork stem.
   a. See Figure 2-59. Dished area of steering head lock faces front wheel.
   b. Lift front wheel upward.
   c. See Figure 2-58. Lock must be in the unlocked position to install. Insert lock with key openings positioned as shown.
   d. Release front wheel.
2. See Figure 2-57. Tighten fork stem bolt and triple clamp screws. Check bearing adjustment. See 2.17 FORK STEM AND BRACKET ASSEMBLY.
3. Install and adjust handlebars. See 1.20 HANDLEBARS.

⚠WARNING

Operating a vehicle with steering head locked will restrict the vehicle's turning ability and may result in an accident. Always make sure the steering head is not locked before operating vehicle. Failure to comply could result in death or serious injury.

4. Install set screw in lock. Test lock.
   a. Turn handlebars all the way to the left.
   b. Insert ignition key in lock.
   c. Turn key clockwise while pushing in.
   d. Remove key and verify that steering head is locked.
   e. Unlock steering head by inserting key and turning



1. **Front Clamp Screws (2)**
2. **Rear Clamp Screws (2)**
3. **Handlebar Clamp**
4. **Fork Stem Bolt**

Figure 2-57. Loosening Handlebars

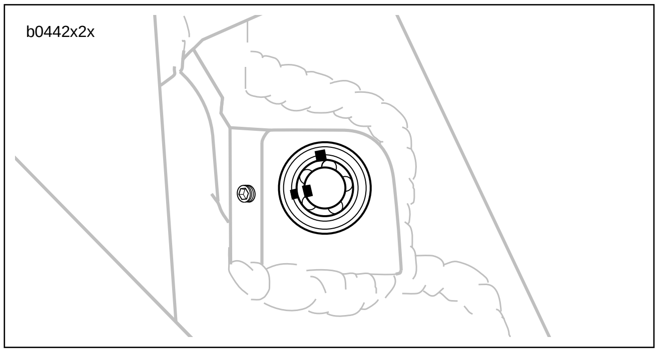


Figure 2-58. Set Screw

Figure 2-59. Steering Head Lock

REMOVAL

NOTE
Mark all hardware as it is removed so that it may be returned to its original location.

1. Compress suspension to access rear fender fasteners. Remove rear fender and lower belt guard.
2. Place vehicle on a lift and anchor front wheel in place.

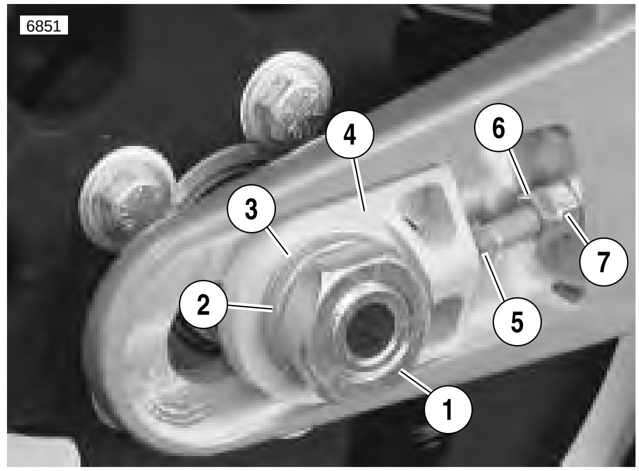
⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

⚠WARNING

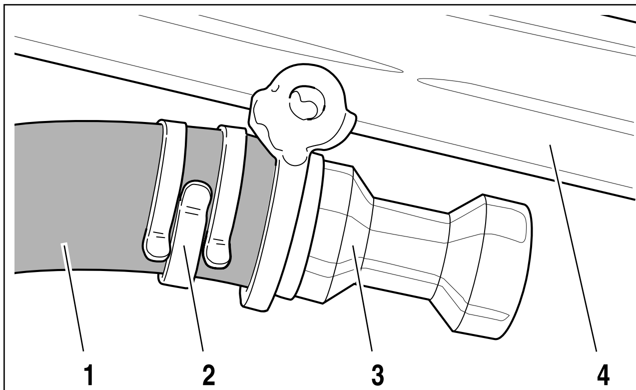
Always disconnect the negative battery cable first. If the positive battery cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion which could result in death or serious injury.

3. Disconnect **both** battery cables, negative cable first.
4. Remove seat and attach lifting straps to motorcycle.
   a. Insert lifting straps under frame tubes. It is not necessary to remove tail section.
5. Attach lifting straps to a floor hoist placed behind the lift. Raise motorcycle off lift until rear suspension is unloaded.
6. Remove mounting bolt attaching swingarm to rear shock.
7. See Figure 2-60. Remove rear wheel. See 2.6 REAR WHEEL.
8. Remove cap from oil tank. See Figure 2-61. Drain oil tank by removing clamp (2) from drain hose (1). Pull hose from drain plug (3).
9. Detach feed line from bottom of oil tank.
10. Detach rear brake pedal from master cylinder pushrod.
11. Remove left side rider footrest and shifter lever.



1. **Axle Nut (metric)**
2. **Lockwasher**
3. **Washer**
4. **Axle Carrier**
5. **Axle Adjuster Bolt**
6. **Locknut**
7. **Adjusting Nut**

Figure 2-60. Rear Axle, Right Side



1. **Drain Hose**
2. **Clamp**
3. **Drain Plug**
4. **Frame Tube**

b0451xox

Figure 2-61. Oil Tank Drain, Typical

12. See Figure 2-62. Place a jack under the crankcase.
13. Detach rear tie bar from swingarm.
14. See Figure 2-63. Remove left and right isolator bolts and washers (7).

CAUTION

Do not attempt to raise frame with oil filter installed. Remove oil filter before raising frame. Failure to comply may result in damage to oil filter.

15. Place a drip pan under the oil filter. Remove oil filter.
16. Using floor hoist, raise frame enough to remove both rubber isolators (6) from frame mounted pins.
17. Loosen swingarm pinch screw (4) on right side.
18. Remove threaded rod (1) from between bearing adjusting bolts (2, 3).
19. Loosen remaining swingarm pinch screw.
20. See Figure 2-64. Using floor hoist, raise frame while pushing down on swingarm. Frame must be raised until bearing adjustment bolts (2) clear pin on frame and can be removed.

NOTE

If swingarm mount block doesn't drop from frame as lift is raised, insert the REAR ISOLATOR REPLACEMENT TOOL (Part No. B-44623) between mount block and frame on the right side first. NOTE: Ledge on tool should engage top of mount block. See Figure 2-72.

21. After removing both bearing adjustment bolts, remove swingarm.

INSTALLATION

1. See Figure 2-63. Align **new** swingarm between posts on swingarm mount block (5).
2. Insert left (threaded) and right bearing adjustment bolts (2, 3) into swingarm until flush with mount block surface.
3. Tighten left side swingarm pinch screw (4) to 18-20 ft-lbs (24-27 Nm).
4. Install threaded rod (1).
   a. Apply LOCTITE THREADLOCKER 222 (purple) to threaded rod.
   b. Insert threaded rod through right side bearing adjustment bolt (2) into threads on left side bolt (3).
   c. Verify that swingarm is centered between mounts.
   d. Tighten rod to an initial torque of 11-12 ft-lbs (15-16 Nm).
5. Check swingarm preload using a scale as shown in Figure 2-65. Preload should be 3.0-3.75 lbs (1.36-1.70 kg). If preload does not meet specifications, tighten or loosen threaded rod and recheck.

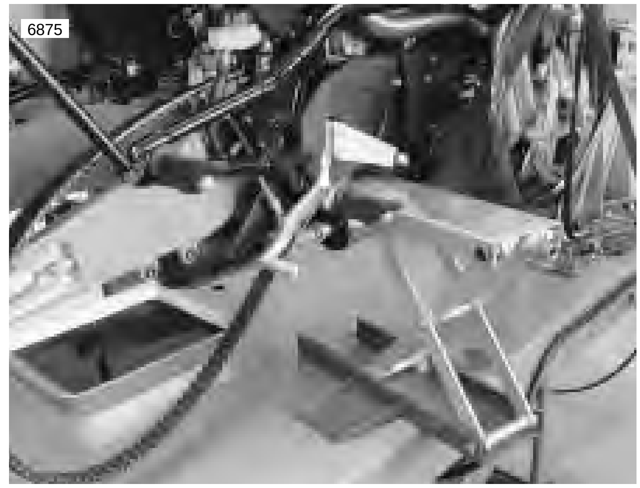
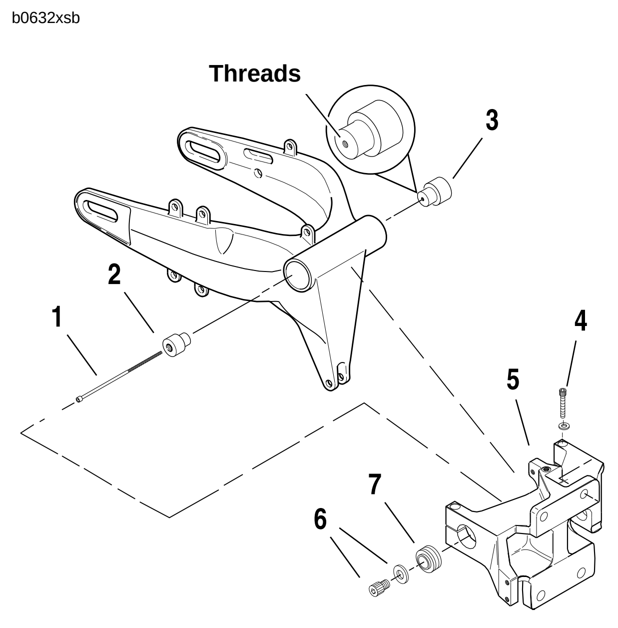


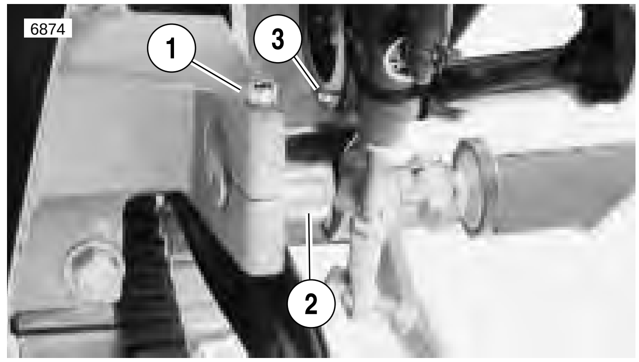
Figure 2-62. Scissors Jack



1. **Threaded Rod**
2. **Bearing Adjustment Bolt (Right)**
3. **Bearing Adjustment Bolt (Left, Threaded)**
4. **Pinch Screw (2)**
5. **Swingarm Mount Block**
6. **Rear Isolator TORX Bolt and Washer (2)**
7. **Rear Isolator (2) (Typical)**

Figure 2-63. Swingarm Assembly

6. See Figure 2-63. Secure swingarm in place.
   a. Remove both pinch screws (1).
   b. Apply LOCTITE THREADLOCKER 243 (blue) to threads of pinch screws.
   c. Install both pinch screws. Tighten to 18-20 ft-lbs (24-27 Nm).
7. Insert REAR ISOLATOR REPLACEMENT TOOL (Part No. B-44623) between mount block and frame. NOTE: Ledge on tool should engage top of mount block.
8. Position rear isolators in mounting position. Slowly lower frame to place rubber isolators in front of bearing adjustment bolts.
9. Install isolator bolts. See 2.20 REAR ISOLATORS .
10. Attach rear tie bar to swingarm mount block. Tighten to 30-33 ft-lbs (41-45 Nm).
11. Remove scissors jack from under crankcase.
12. Install rear shock bolt (metric). Tighten to 30-33 ft-lbs (41-45 Nm).
13. Attach feed and drain lines to oil tank and frame. Install filter and fill motorcycle with proper oil.
    a. Use 2.0 quarts (1.89 liters).
14. Attach rear brake pedal to master cylinder pushrod.
15. Attach left side rider footrest and shifter lever. Apply LOCTITE THREADLOCKER 272 (red) to bolt. Tighten to 23-25 ft-lbs (31-34 Nm).
16. Install rear wheel. See 2.6 REAR WHEEL.



1. **Pinch Screw**
2. **Bearing Adjustment Bolt**
3. **Pin on Frame for Rear Isolator**

Figure 2-64. Swingarm Mount Block, Right Side

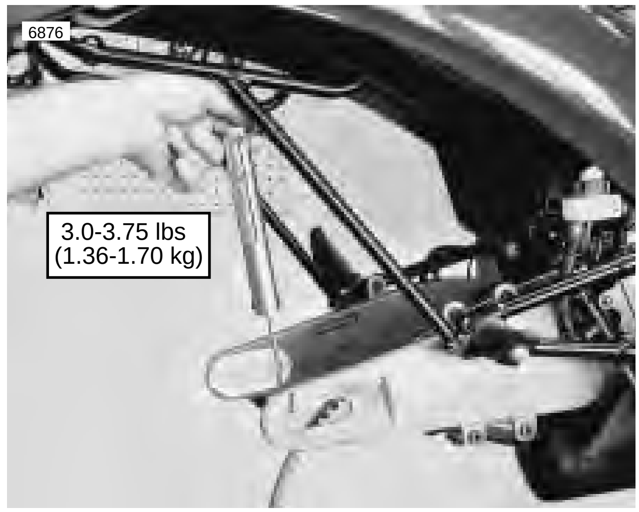


Figure 2-65. Checking Preload

17. Set axle alignment and belt deflection. See 1.10 DRIVE BELT DEFLECTION.
    a. See Figure 2-66. Check rear axle alignment.
    b. See Figure 2-67. Check belt deflection.
    c. Proceed to the next step when both axle alignment and belt deflection are correct.
18. See Figure 2-68. Tighten locknut (2) flush against adjusting nut (3). Tighten axle nut (metric) to 66-73 ft-lbs (90-99 Nm). Verify that belt deflection is correct. Lower motorcycle onto lift.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

19. Remove lifting straps and install seat. See 2.35 SEAT.

WARNING

Always connect 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.

20. Attach both battery cables, positive cable first.
21. Remove motorcycle from lift.
22. Compress suspension to install rear fender and lower belt guard.
23. Check oil level after starting motorcycle and allowing it to reach operating temperature.

WARNING

After completing repairs or bleeding the system, always test motorcycle brakes at low speed. If brakes are not operating properly or braking efficiency is poor, testing at high speeds could result in death or serious injury.

24. Check rear brake operation.

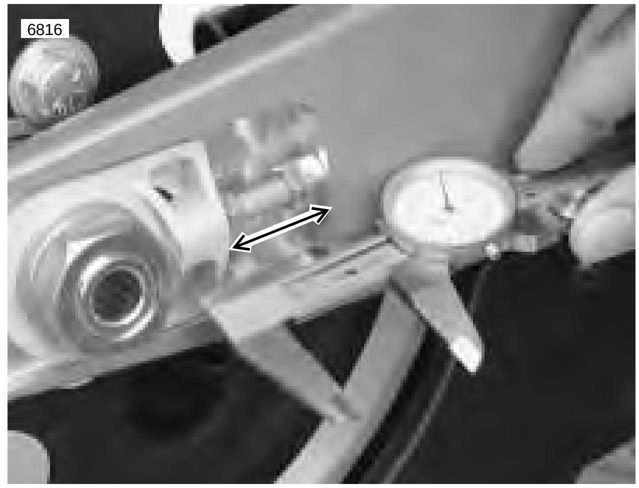


Figure 2-66. Checking Rear Wheel Alignment, Right Side Shown

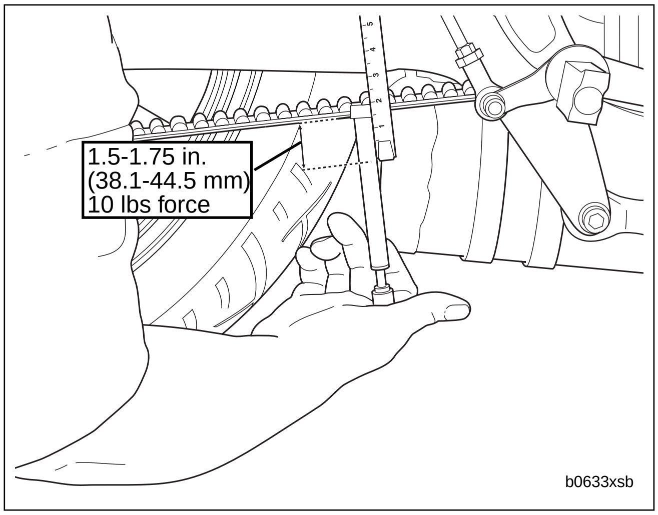


Figure 2-67. Belt Deflection

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1. **Axle Adjuster Bolt**
2. **Locknut**
3. **Adjusting Nut**

Figure 2-68. Axle Adjuster Bolt, Right Side Shown

REMOVAL

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

WARNING

Always disconnect the negative battery cable first. If the positive battery 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.

1. Disconnect **both** battery cables from battery, negative cable first.

2. Remove seat and fuel tank. See 2.35 SEAT and 4.36 FUEL TANK.

3. Remove the left side rider footpeg mounting bolt and footpeg. Allow footpeg and shift linkage to hang being careful not to scratch primary cover.

4. See Figure 2-69. On the right side of the motorcycle, remove the front sprocket cover assembly.

5. See Figure 2-69. Remove two screws that attach sprocket cover to the backside of the swingarm/drive support. Retain screws.

NOTE

See Figure 2-70. Route strap under frame rails with tail section installed. Make sure strap is in "V" formed by frame rails to prevent rearward movement and that it does not pinch wiring harness, vent lines or cables.

6. See Figure 2-70. Strap tail section of frame to overhead beam or hoist and put slight tension on strap to secure frame assembly.

7. See Figure 2-71. Remove frame side tie bar mounting hardware from front lower and center tie bars. Leave fourth tie bar (front upper) attached to both frame and engine.

8. See Figure 2-71. Remove rear tie bar bolt, lockwasher and washers from mount block.

9. See Figure 2-71. Loosen left side isolator bolt from swing arm bearing adjusting bolt. Do not remove.

10. See Figure 2-71. Remove right side isolator bolt and washer from swingarm bearing adjustment bolt.

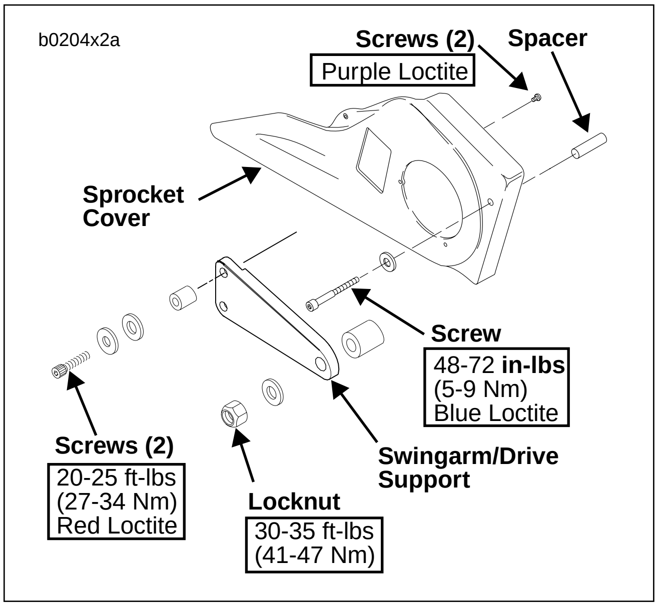


Figure 2-69. Sprocket Cover

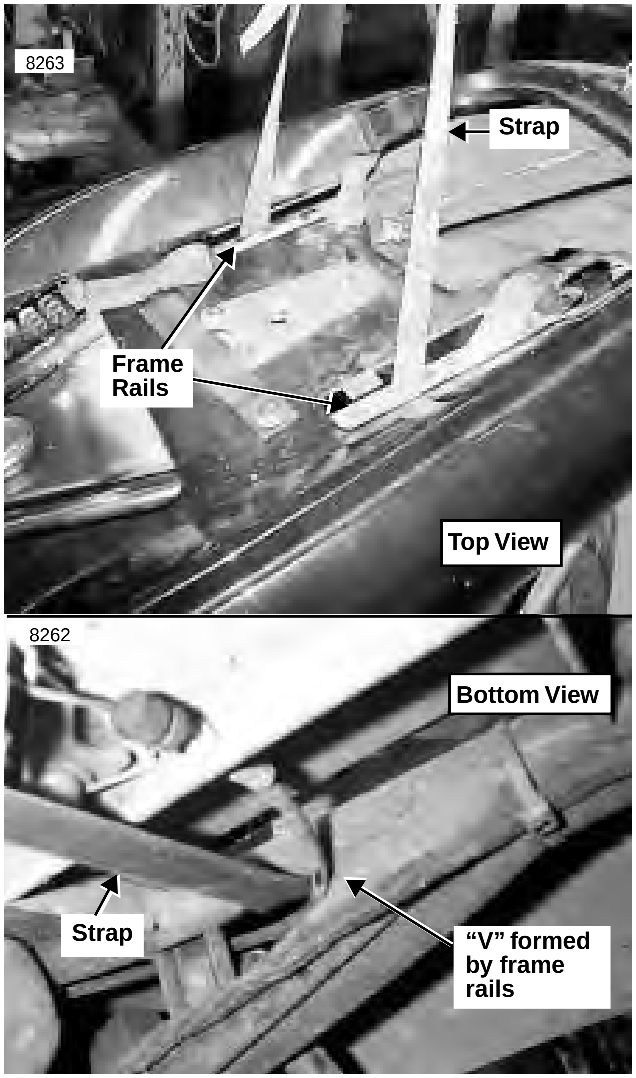


Figure 2-70. Floor Hoist

11. See Figure 2-72. Working on the right side first, insert the REAR ISOLATOR REPLACEMENT TOOL (Part No. B-44623) between mount block and frame. NOTE: Ledge on tool should engage top of mount block.

CAUTION

Do not alter tool or shim in an attempt to spread frame further than tool will allow. Failure to comply may result in frame distortion or damage.

12. Turn nut on rear isolator replacement tool clockwise to expand frame from swingarm mount block until isolator can be removed. Nut will stop when limit of travel is reached.
13. Disengage right side rear isolator from roll pin in frame by pulling inboard. Remove isolator by pulling out from 5:00 or 6:00 position.
14. Remove rear isolator replacement tool by turning nut counterclockwise.
15. Remove left side isolator bolt and washer from bearing adjusting bolt.
16. Remove nut and back out bolt (until flush with the mount block) from upper rear of muffler Z bracket and swingarm mount block.
17. Pull frame to left and remove left side isolator from 6:00 or 7:00 position.

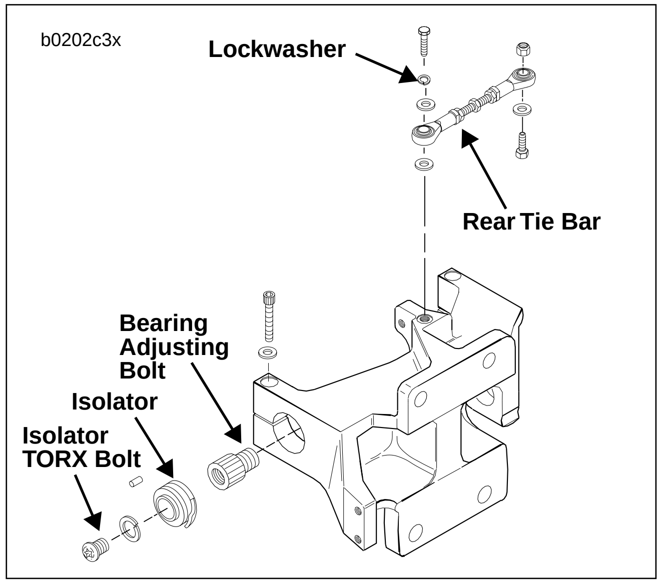


Figure 2-71. Mount Block

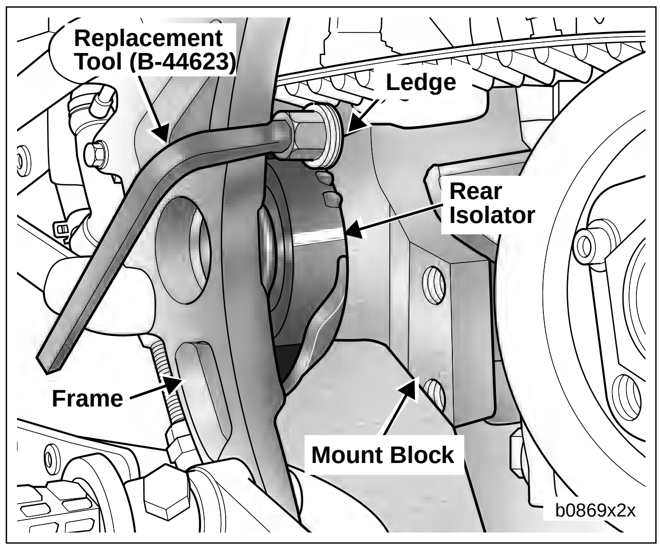


Figure 2-72. Rear Isolator Replacement Tool In Use

INSPECTION

NOTE

If roll pin protrudes beyond specification, check to make sure it is fully seated. A channel lock pliers may be used to squeeze/push roll pin in. Protect frame with a shop rag when using pliers.

See Figure 2-73. Measure isolator roll pin protrusion on both left and right isolator mounts with calipers or metal rule. Roll pin should not protrude more than 0.120 in. (3 mm). If roll pin protrudes more than 0.120 in. (3 mm) file or grind until within specification; 0.080-0.120 in. (2.032-3.048 mm). Use care when filing to avoid creating sharp edges.

INSTALLATION

1. On left side of motorcycle, align locator hole with roll pin and install left rear isolator provided in kit. The left isolator backing plate has an “L” stamped on it.
2. Move to right side of motorcycle. Lower the frame approximately two inches with the hoist to allow clearance between isolator replacement tool.
3. See Figure 2-72. On right side of motorcycle, insert rear isolator replacement tool between mount block and frame.

CAUTION

Do not alter tool or shim in an attempt to spread frame further than tool will allow. Failure to comply may result in frame distortion or damage.

4. Turn nut on tool clockwise to expand frame from mount block. Nut will stop when limit of travel is reached.

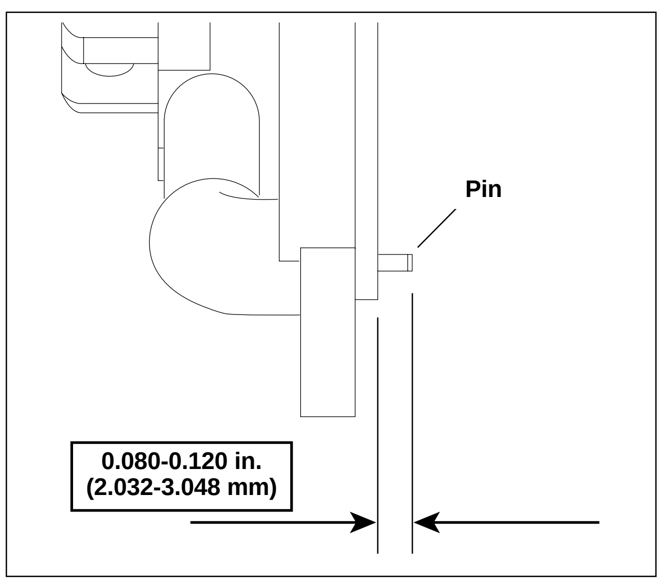


Figure 2-73. Measuring Roll Pin Protrusion

5. On right side of motorcycle, align locator hole with roll pin and install right rear isolator provided in kit. The right isolator backing plate has an "R" stamped on it.
6. Turn nut on tool counterclockwise to allow frame to return to position. Remove tool from between frame and mount block.
7. Raise frame with hoist to align isolator bolt holes with threaded holes in bearing adjusting bolts.
8. Mark a horizontal line across the front of each isolator with a light colored grease pencil or by other non-permanent means.
9. Apply anti-seize to underside of isolator bolt heads.

CAUTION

Use caution when installing isolator bolts. Make sure isolator bolt hole is aligned with threaded hole in bearing adjusting bolt to avoid cross-threading bolt.

10. See Figure 2-71. Install isolator TORX bolts and washers through both rubber isolators into bearing adjustment bolts on each side.

CAUTION

See Figure 2-74. Observe marked line on both rubber isolators after isolator bolts are tightened. If line twists, apply more LOCTITE ANTI-SEIZE to underside of isolator bolt heads. Failure to comply will result in damage to rubber isolators.

11. Tighten right and left isolator bolts to 63-70 ft-lbs (85-95 Nm).
12. Push rear upper Z bracket bolt until it protrudes from mount block and install nut. Tighten rear upper Z-bracket bolt to 22-24 ft-lbs (30-33 Nm).
13. Erase grease pencil marked lines from both isolators.
14. Install front lower and center tie bars to frame with original locknuts. Tighten bolts to 30-33 ft-lbs (41-45 Nm). Install rear tie bar to mount block with lockwasher. Tighten bolt to 30-33 ft-lbs. (41-45 Nm).
15. Remove hoist from tail section.
16. Install left side rider footpeg. Tighten bolt to 25-30 ft-lbs (34-41 Nm).
17. See Figure 2-69. Apply LOCTITE THREADLOCKER 243 (Blue) to threads of two sprocket cover to swingarm/drive support screws and install new sprocket cover to swingarm/drive support.
18. See Figure 2-69. Install sprocket cover assembly with original hardware.
    a. Apply LOCTITE THREADLOCKER 243 (blue) to screw. Install sprocket cover assembly with screw, washer and spacer. Tighten to 48-72 **in-lbs** (5-9 Nm).
    b. Apply LOCTITE THREADLOCKER 272 (red) to swingarm/drive support mounting screws and install. Tighten screws to 20-25 ft-lbs (27-34 Nm).
    c. Install locknut and washer. Tighten to 30-35 ft-lbs (41-47 Nm).

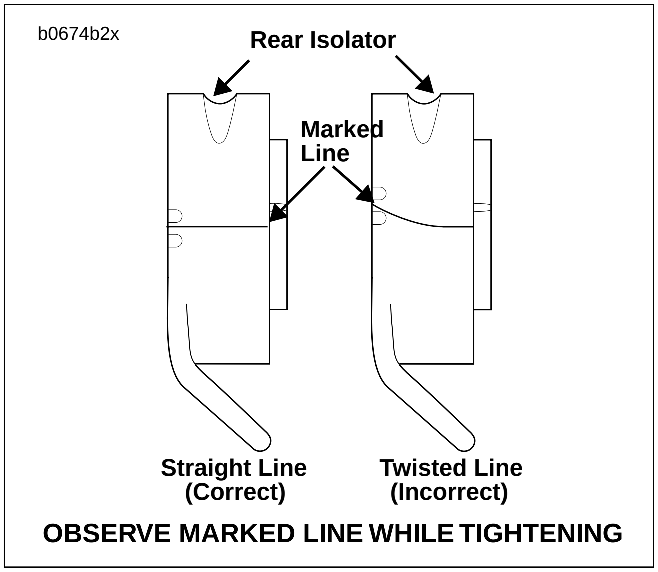


Figure 2-74. Isolator Alignment

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

19. Install fuel tank and seat. See 2.35 SEAT and 4.36 FUEL TANK.

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.

20. Connect battery cables, positive cable first, to battery terminals.
21. Test ride motorcycle at low speed and check for proper operation.

REAR SHOCK ABSORBER 2.21

GENERAL

See Figure 2-76. 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 1.13 PRELOAD ADJUSTMENT.

NOTE

The rear shock absorber contains no user serviceable parts.

REMOVAL

1. Lift rear wheel off ground using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove seat and attach lifting straps to motorcycle. Insert lifting straps under frame tubes. It is not necessary to remove tail section.
3. Attach lifting straps to a floor hoist placed behind the motorcycle. Raise motorcycle off lift until rear suspension is unloaded.
4. Use a flex socket and extension to remove locknut and washer from front reservoir clamp. Discard clamp and locknut.
5. Loosen rear reservoir clamp. Slide reservoir and mount block out of clamp. Remove and discard clamp.
6. See Figure 2-75. Remove allen screw (metric) and locknut on front mount. Discard locknut.
7. While supporting the shock absorber, remove the allen screw (metric) and locknut from the rear mount. Discard locknut.
8. Remove shock absorber assembly.

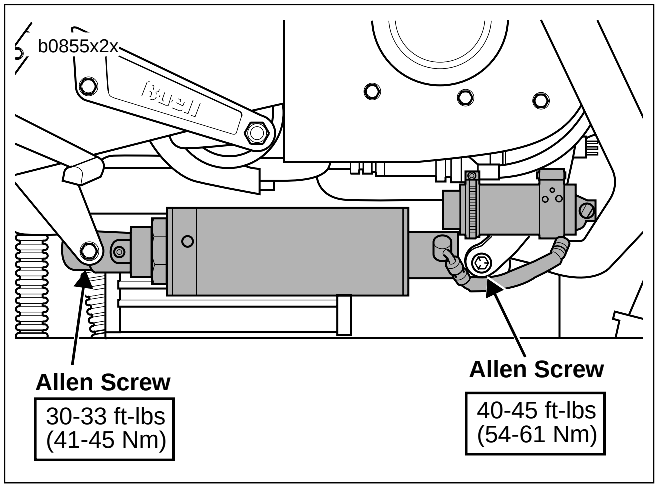


Figure 2-75. Shock Mounting Hardware

INSTALLATION

1. See Figure 2-76. Place **new** bushings into mounting holes of shock absorber (if only replacing bushings).
2. See Figure 2-75. Loosely install rear allen screw (metric) and **new** locknut.
3. Loosely install front allen screw (metric) and **new** locknut.
4. Install rear clamp over front oil pump fitting.
5. Slide reservoir through rear clamp.
6. Position front clamp over reservoir and loosely install front reservoir clamp to front shock mount with washer and nylon locknut.
7. Install reservoir mount block between oil pump fitting and remote reservoir.
8. Tighten clamps around reservoir.

NOTE

Tighten front hardware from the screw side only. Tighten rear hardware from the nut side only.

9. Tighten front allen screw to 40-45 ft-lbs (54-61 Nm).
10. Tighten rear locknut to 30-33 ft-lbs (41-45 Nm).

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

11. Remove lifting straps and install seat. See 2.35 SEAT.
12. Check rear shock preload. See 1.13 PRELOAD ADJUSTMENT.

HOME

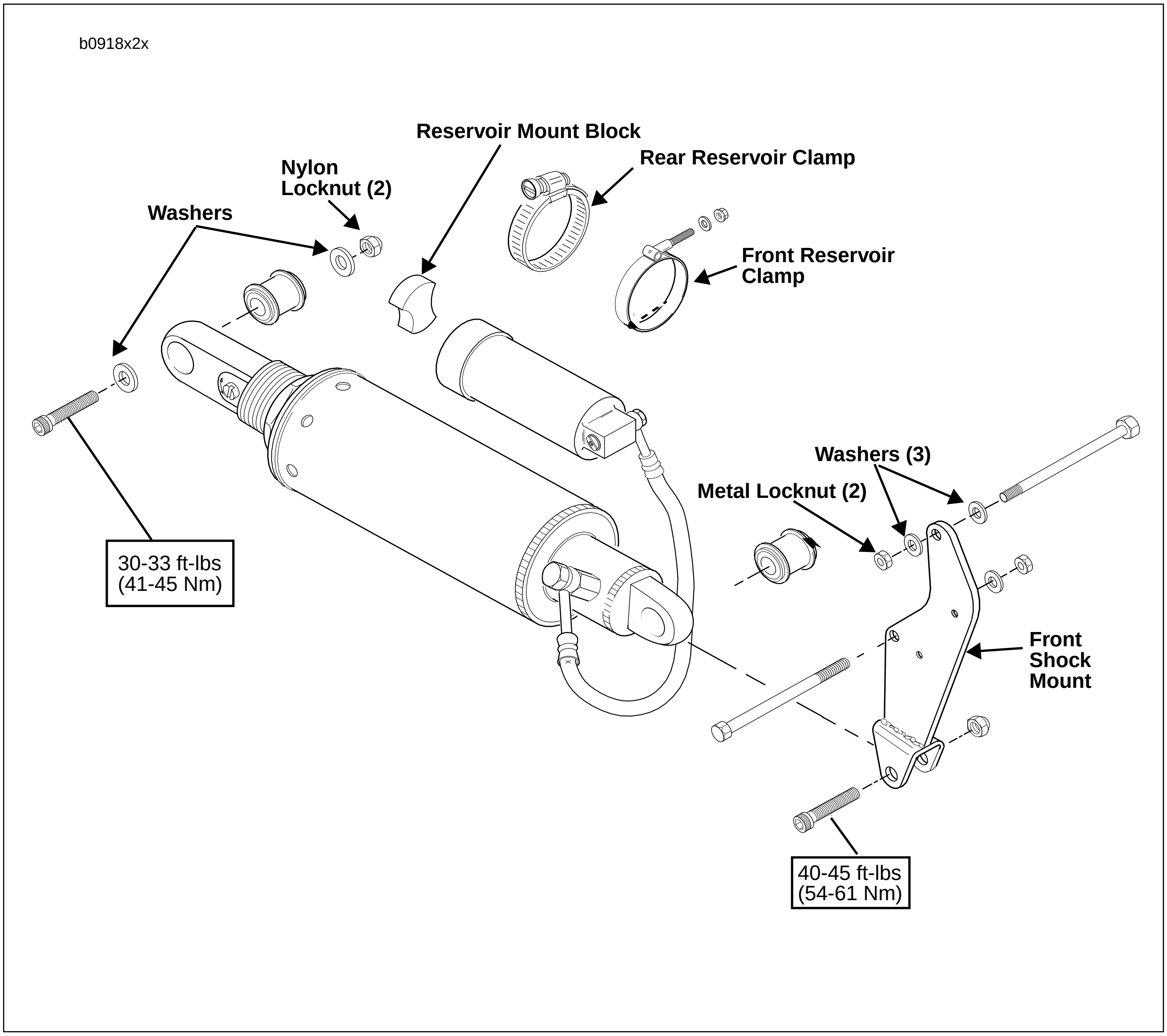


Figure 2-76. Rear Shock Absorber

DEFINITIONS

- **Damping:** Resistance to movement. Damping affects how easily the suspension can move and limits oscillation of the system once movement has begun.
- **Compression:** Suspension is compressed when the wheel moves upward.
- **Rebound:** The suspension is rebounding when it is moving back from being compressed.
- **Vehicle Sag:** The amount the rear shock and fork springs are compressed by the weight of the motorcycle.
- **Rider Sag:** The amount the rear shock and fork springs are compressed by the weight of the rider.
- **Preload:** An adjustment made to the rear shock and fork springs (if applicable) to limit vehicle and rider sag to a standard percentage of total suspension travel. Proper preload adjustment allows the suspension to absorb most bumps without bottoming.

GENERAL

⚠WARNING

Before evaluating and adjusting suspension settings, check the motorcycle's tires. Tires must be in good condition and properly inflated. Riding on worn or under inflated tires could result in death or serious injury.

See Figure 2-77. See Figure 2-78. The rear suspension adjusts for compression and rebound damping and spring preload.

See Figure 2-79. The front suspension adjusts for compression and rebound damping.

If the rear preload adjustment is correct, and you have the rebound and compression damping set at the factory recommended points, the motorcycle should handle and ride properly. If you are unhappy with 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. Consult Table 2-10.

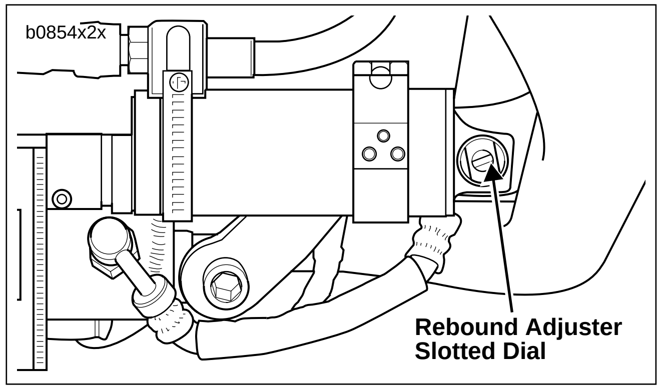


Figure 2-77. Rear Shock Rebound Damping Adjustment

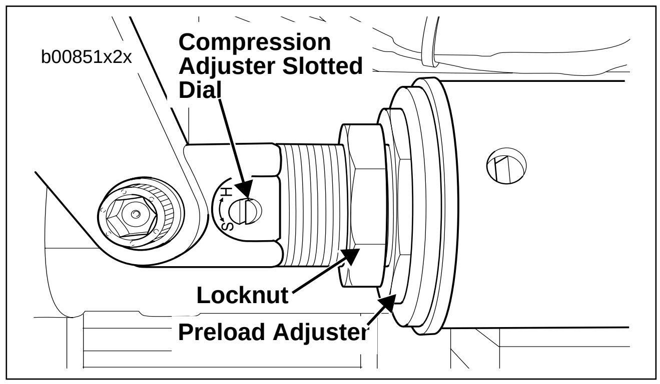


Figure 2-78. Preload and Compression Damping Adjustment

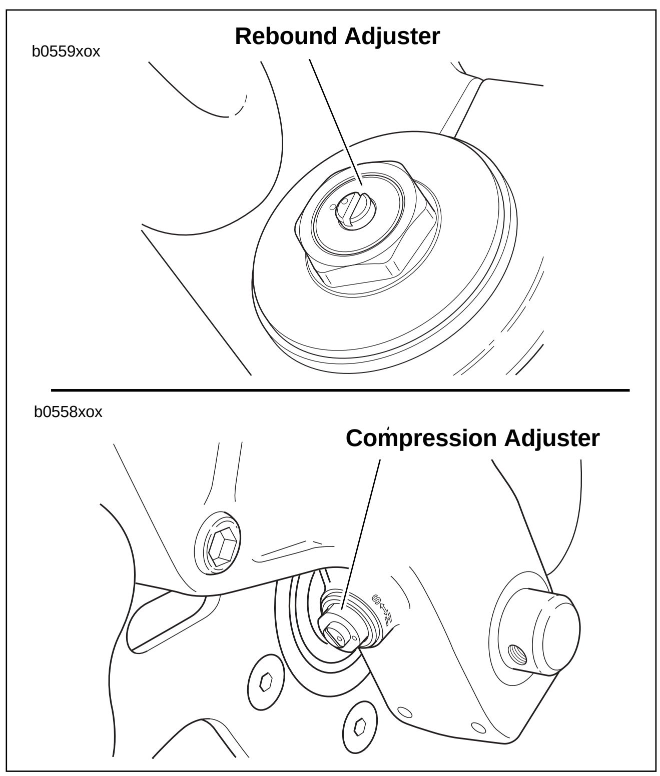


Figure 2-79. Front Fork Adjusters

SPRING PRELOAD

Adjust rear spring preload before attempting any other adjustments. See 1.13 PRELOAD ADJUSTMENT. This setting assures that the rear suspension has the proper amount of travel for the rider's weight and the motorcycle's cargo load.

Make this adjustment before the motorcycle is ridden any distance. Your Buell dealer can assist you if necessary.

ADJUSTMENTS

Evaluating and changing the rebound and compression damping is a very subjective process. A good performing suspension finds a proper balance between spring, spring preload, damping, track conditions and riding speed. However, all settings are at best a compromise. If a rider fails to find a good set-up, go back to the factory recommended settings and start over again.

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.

To find the optimum settings you will need the preload properly adjusted, the tires properly inflated and a familiar bumpy road. It is useful if the road contains a variety of different bumps from small sharp bumps such as potholes or frost heaves to large undulations. Begin the process by putting all the damping adjustments at the factory recommended settings. Ride the bike over a variety of different surfaces and bumps at different speeds. When the suspension is set properly the motorcycle will be stable and comfortable.

REAR SHOCK DAMPING ADJUSTMENTS

Beyond the rear preload adjustment, the rear shock can also be adjusted for compression and rebound damping. However, it is important to note the rear preload must be set correctly before performing any other adjustments.

See Figure 2-77. Adjust **rebound** damping using the slotted dial on the remote reservoir at the front of the shock.

- Factory setting-full damping minus 1 turn.

See Figure 2-78. Adjust **compression** damping using the slotted dial on the shaft at the end of the shock.

- Factory setting-full damping minus 2.5 turns.

Adjusting Rear Shock

1. Using a screwdriver, turn the slotted dial on the appropriate adjuster clockwise until it stops. This is the maximum damping setting for that adjustment.
2. Then turn the dial counterclockwise the recommended amount to align the reference marks. This is the factory recommended setting.

Table 2-6. Recommended Rear Shock Damping Settings

SETTINGS	SOLO (STD)	2 UP	SOLO (FIRM)	SOLO (SOFT)
Front Rebound	0.5	1	0.5	1.5
Front Compression	1.75	1.25	1.25	MIN
Rear Rebound	1	0.5	0.5	2.5
Rear Compression	2.5	0.25	1	MIN

fRONT FORK DAMPING ADJUSTMENTS

See Figure 2-79. Adjust **rebound** damping using the slotted dial on the top of each fork leg.

- Factory setting-full damping minus 0.5 turn.

See Figure 2-79. Adjust **compression** damping using the slotted dial on the bottom of each fork leg.

- Factory setting-full damping minus 1.75 turns.

Adjusting Front Forks

⚠WARNING

Always adjust each fork leg to the same settings. Uneven adjustment between left and right forks may lead to a loss of control which could result in death or serious injury.

1. Using a screwdriver, turn the slotted dial on the appropriate adjuster clockwise until it stops. This is the maximum damping setting for that adjustment.
2. Then turn the dial counterclockwise the recommended amount to align the reference marks. This is the factory recommended setting.

TROUBLESHOOTING

⚠WARNING

This section is intended solely as a guide to diagnosing problems. Carefully read the appropriate sections of this manual before performing any work. Improper suspension adjustments may cause loss of control which could result in death or serious injury.

The following tables list possible suspension and operating troubles and their probable causes. Use the tables to keep your motorcycle in good operating condition.

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 problems. Handling and a swinging fork are geometry-related, but often these unwanted characteristics can be solved by suspension adjustments.

Table 2-7. 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 2-8. 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 2-9. 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.

Table 2-10. Rider Suspension Preferences

NOTE

All adjustments require rear shock preload to be properly adjusted for the rider's size and weight. For information on setting rear shock preload, see 1.13 PRELOAD ADJUSTMENT.

DATE	FRONT FORK REBOUND	FRONT FORK COMPRESSION	REAR SHOCK REBOUND	REAR SHOCK COMPRESSION	RESULTS
	Max damping minus 0.5 turn	Max damping minus 1.75 turns	Max damping minus 1 turn	Max damping minus 2.5 turns	Factory recommended settings.

REMOVAL/DISASSEMBLY

1. See Figure 2-81. Slide rubber boot (5) off the cable adjusters (4). Loosen cable adjuster lock (3) on each adjuster.
2. See Figure 2-82. Remove two screws (1, 6) on front housing. Separate housings from handlebar.
3. Unhook ferrules (7) from cable wheel (8).
4. Remove cables from notches in housings (5, 9).
5. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER. NOTE:
6. Remove the right fairing lower. See 2.38 FAIRING LOWERS.
7. See Figure 2-80. Remove screw and throttle cable clamps from cables by throttle body.
8. Disconnect cables from throttle body manifold to remove.

CLEANING AND INSPECTION

Clean all parts in a non-flammable cleaning solvent. Blow dry with compressed air. Replace cables if frayed, kinked or bent.

ASSEMBLY/INSTALLATION

1. See Figure 2-82. Place cable assemblies (3, 4) into housings (5, 9). Throttle control cable (4) has a molded fitting end and is positioned inside the front housing (5). Idle control cable (3) has a smaller fitting end and is positioned inside the rear housing (9).
2. Run cables inside grooves of each housing (5, 9).
3. Attach ferrules (7) to cable wheel (8). When properly assembled, notches for ferrules will be at 12 o'clock.
4. Position housings on right handlebar by engaging locating pin (10) on front housing with hole in handlebar. Attach housings with two screws (1, 6), installing longer screw on bottom. Tighten to 12-17 **in-lbs** (1-2 Nm).
5. Adjust throttle cables. See 1.21 THROTTLE CABLES.
6. See Figure 2-80. Attach throttle cable clamp to ferrules with screw (arrow on clamp points up).
7. Install air cleaner assembly. See 4.41 AIR CLEANER.
8. Install the right fairing lower. See 2.38 FAIRING LOWERS.

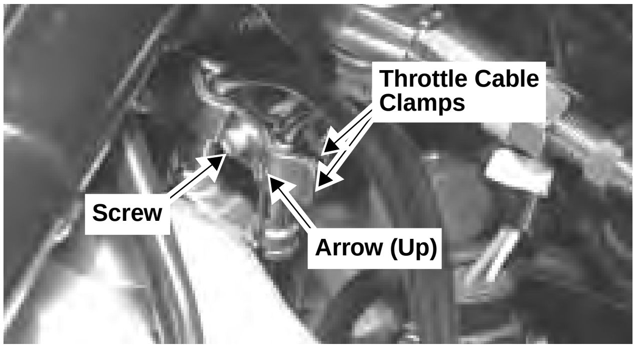
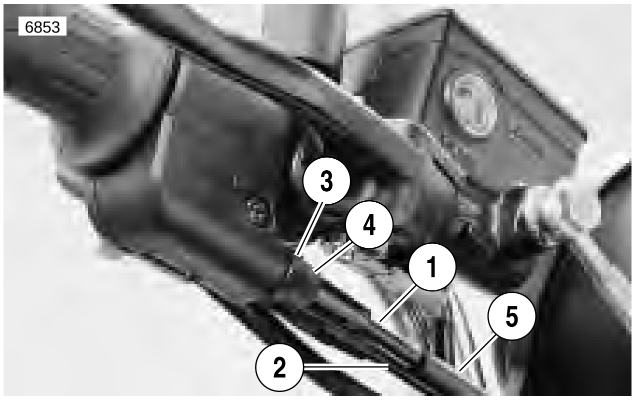
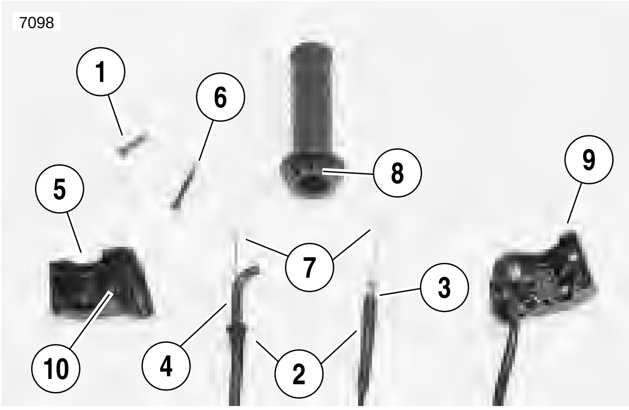


Figure 2-80. Throttle Cable Clamps



1. Throttle Control Cable
2. Idle Control Cable
3. Cable Adjuster Lock
4. Cable Adjuster
5. Rubber Boot

Figure 2-81. Throttle Control Cables



1. Screw (short, top)
2. Cable Adjusters (2)
3. Idle Control Cable
4. Throttle Control Cable with Molded End
5. Front Housing
6. Screw (long, bottom)
7. Ferrules
8. Cable Wheel
9. Rear Housing
10. Locating Pin

Figure 2-82. Cable Connections

REMOVAL/DISASSEMBLY

NOTE

For information on clutch adjustment, see 1.9 CLUTCH.

Clutch Cable-Lower

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 2-83. Remove four TORX screws (1) with washers and clutch inspection cover (2). Do not damage or dislodge quad ring (14) in primary cover (11).
3. Slide spring (3) with attached hex lockplate (4) from flats of adjusting screw (12).
4. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (5) from end of adjusting screw.
5. Remove hook of ramp (6) from button at the rear of cable end coupling (16). Remove cable end (10) from slot in coupling.
6. Turn cable end fitting (9) counterclockwise to remove clutch cable lower section from primary cover (11). Remove O-ring (8) from cable end fitting.

Clutch Hand Control

1. See Figure 2-84. Detach clutch switch (7).
   a. Remove screw (8).
   b. Depress clutch lever and hold.
   c. Detach switch by depressing switch trigger button and pulling switch towards the end of the handlebar.

NOTE

The individual parts of the clutch switch are not serviceable. Replace switch upon failure.

2. Remove bolt (2) (metric) and nut (6) (metric).
3. Remove handlever from clutch clamp (5). Detach clutch cable from handlever.
4. Remove clutch cable clamp (10) from frame.
5. Remove clutch clamp.
   a. Cut off left handgrip.
   b. Remove left handlebar switch housing. See 7.5 HANDLEBAR SWITCHES.
   c. Remove clamp screw (4) (metric). Slide clamp off the end of the handlebar.

1. **TORX Screw with Washer (4)**
2. **Clutch Inspection Cover**
3. **Spring**
4. **Adjusting Screw Lockplate**
5. **Nut**
6. **Outer Ramp**
7. **Ball (3)**
8. **O-Ring**
9. **Cable End Fitting**
10. **Clutch Cable End**
11. **Primary Cover**
12. **Clutch Adjusting Screw Assembly**
13. **Retaining Ring**
14. **Quad Ring**
15. **Inner Ramp**
16. **Coupling**

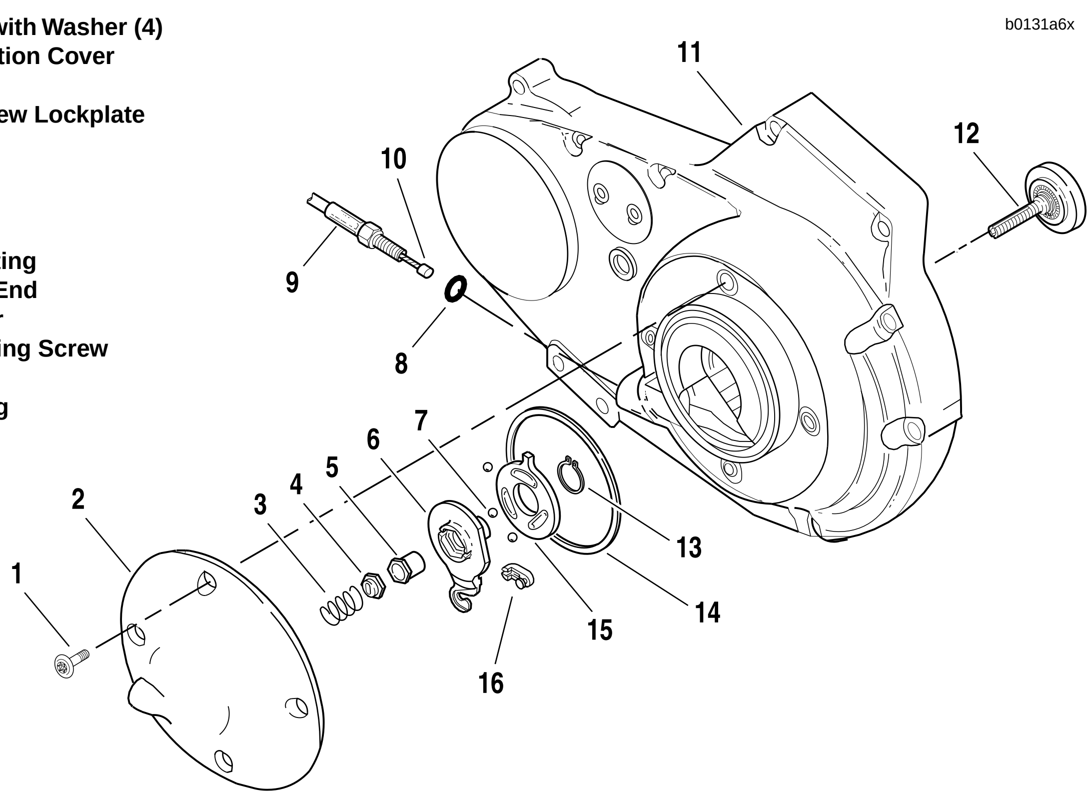


Figure 2-83. Clutch Release Mechanism

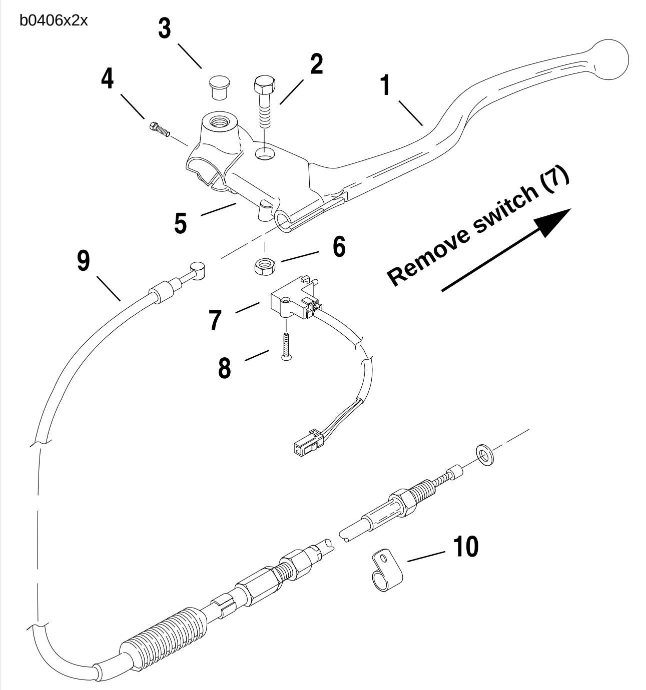
ASSEMBLY/INSTALLATION

Clutch Cable-Lower

1. See Figure 2-83. Install O-ring (8) over cable end fitting (9) of clutch cable lower section. Turn fitting clockwise to install into primary cover (11). Tighten to 3-7 ft-lbs (4-12 Nm).
2. Fit coupling (16) over cable end. Place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp (15) fits in slot of primary cover (11).
3. Thread nut (5) on adjusting screw (12) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (6) and turn adjusting screw counter-clockwise.
4. If not yet performed, route clutch cable to hand control.
   a. See Figure 2-85. Route cable along left side of primary chaincase and up through clamp on front isolator tie bar.
   b. Continue above and behind lower triple clamp, between left fork leg and steering neck.
   c. Route cable across front of upper triple clamp to hand grip.
5. With clutch cable upper section connected to clutch lever, check primary chain tension. Adjust if necessary. See 1.12 PRIMARY CHAIN.
6. Adjust clutch. See 1.9 CLUTCH.

Clutch Hand Control

1. See Figure 2-84. Attach clutch clamp (5) as follows.
   a. Slide clamp over handlebar.
   b. Install left switchgear housing. See 7.5 HANDLEBAR SWITCHES.
   c. Place clamp next to switchgear housing. Fasten to handlebar with screw (4) (metric). Tighten to 30-35 **in-lbs** (3-4 Nm).
   d. Install a **new** left handgrip. See 2.26 HANDLEBARS.
2. Connect end of clutch cable upper section to clutch handlever. Position lever within clutch clamp.
3. Apply small amount of LOCTITE ANTI-SEIZE LUBRICANT to bolt (2). Attach handlever with bolt (2) (metric) and nut (6) (metric).
4. Attach clutch switch (7) with screw (8).
5. If not yet performed, route clutch cable to primary cover.
   a. Route cable from hand grip across front of upper triple clamp.
   b. Continue to left side, down between left fork leg and steering neck, above lower triple clamp.
   c. See Figure 2-85. Route cable down left side of bike, through clamp, along primary chaincase to clutch.
6. With clutch cable lower section connected to primary cover, adjust clutch. See 1.9 CLUTCH.



1. Clutch Handlever
2. Bolt (metric)
3. Plug
4. Screw (metric)
5. Clutch Clamp
6. Nut (metric)
7. Clutch Switch
8. Screw
9. Clutch Cable
10. Cable Clamp

Figure 2-84. Clutch Hand Control

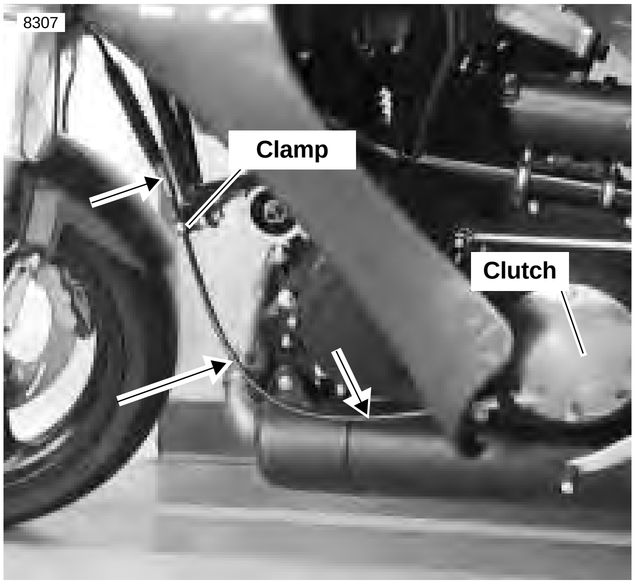


Figure 2-85. Clutch Cable Routing, Lower

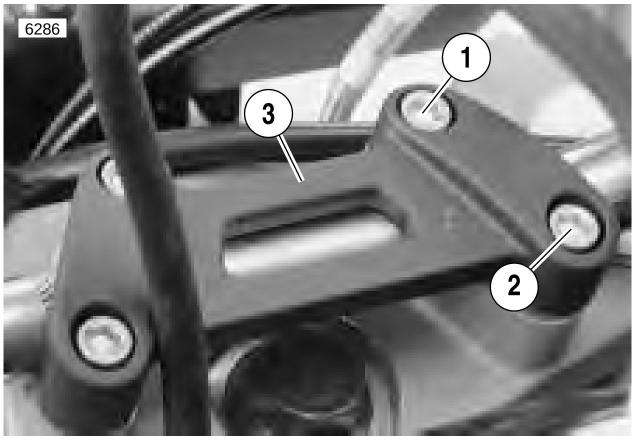
HANDLEBARS 2.26

REMOVAL

1. Remove front brake master cylinder. See 2.10 FRONT BRAKE MASTER CYLINDER.
2. Remove left handlebar switch housing. See 7.5 HANDLEBAR SWITCHES. Cut left handlebar grip and remove.
3. Detach clutch hand control from handlebars. See 2.25 CLUTCH CONTROL.
4. Loosen screws on right handlebar switch housing, but do not detach throttle grip assembly from handlebar. See 2.24 THROTTLE CONTROL.
5. See Figure 2-86. Remove four screws (1, 2) from handlebar clamp (3).
6. Slide handlebars out of throttle grip assembly to remove.

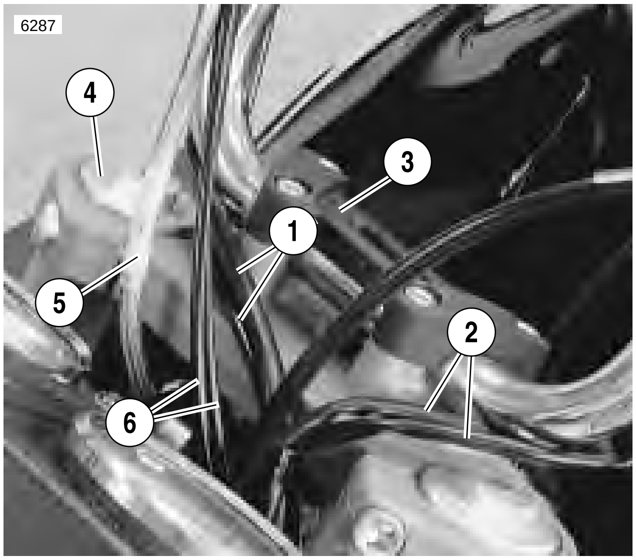
INSTALLATION

1. Slide handlebars into throttle grip assembly. Fasten right handlebar switch housing to handlebar. See 2.26 HANDLEBARS.
2. Install clutch hand control. See 2.25 CLUTCH CONTROL.
3. See Figure 2-87. Install handlebar clamp.
   a. Route right hand control wires (1) under handlebar and in front of fork tube (4) and handlebar clamp (3).
   b. Route left hand control wires (2) under handlebar and in front of fork tube (4) and handlebar clamp (3).
   c. See Figure 2-86. Tighten both front screws (1) to 10-12 ft-lbs (14-16 Nm).
   d. Then tighten both rear screws (2) 10-12 ft-lbs (14-16 Nm).
4. Install left switch housing. See 7.5 HANDLEBAR SWITCHES
5. Install a **new** left handgrip.
   a. Clean end of handlebar with M600.
   b. Place LOCTITE 411 ADHESIVE around inside of grip.
   c. Push grip onto handlebar end. Twist grip on bar until end touches left switchgear housing.
   d. Wipe off excess adhesive with a rag.
6. Install front brake master cylinder. See 2.10 FRONT BRAKE MASTER CYLINDER.
7. Check steering motion range to both fork stops. See 1.16 STEERING HEAD BEARINGS.



1. **Front Clamp Screws (2)**
2. **Rear Clamp Screws (2)**
3. **Handlebar Clamp**

Figure 2-86. Handlebar Clamp



1. **Right Hand Control Cables**
2. **Left Hand Control Cables**
3. **Handlebar Clamp on Upper Triple Clamp**
4. **Fork Tube**
5. **Front Brake Line**
6. **Throttle Cables**

Figure 2-87. Routing Hand Control Wires

REMOVAL/DISASSEMBLY

Muffler

NOTE

The muffler may be removed for replacement without removing the exhaust header.

1. Remove right side fairing lower. See 2.38 FAIRING LOWERS.
2. See Figure 2-88. Remove bolts, lockwashers and washers securing muffler to Z-bracket.
3. See Figure 2-89. Remove bolts and locknuts with washers from header support mount.
4. Loosen screw securing muffler clamp.
5. Remove muffler and muffler clamp. Discard clamp.
6. If necessary, remove muffler support Z-bracket.
   a. Remove bolts, locknuts and washers.
   b. Remove muffler support Z-bracket.
   c. Remove rear muffler mounts and mount spacers from swingarm mount block.
7. If necessary, remove header support mount.
   a. See Figure 2-90. Support motorcycle with jack.
   b. Remove bolts, locknuts and washers.
   c. Remove nuts and washers securing front muffler support to voltage regulator bracket and crankcase.
   d. Remove header support mount.

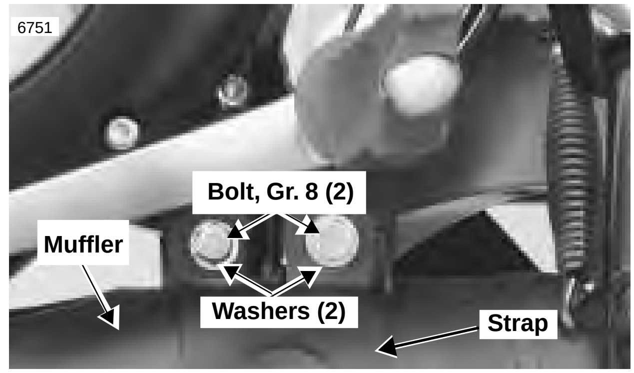


Figure 2-88. Rear Muffler Mounts

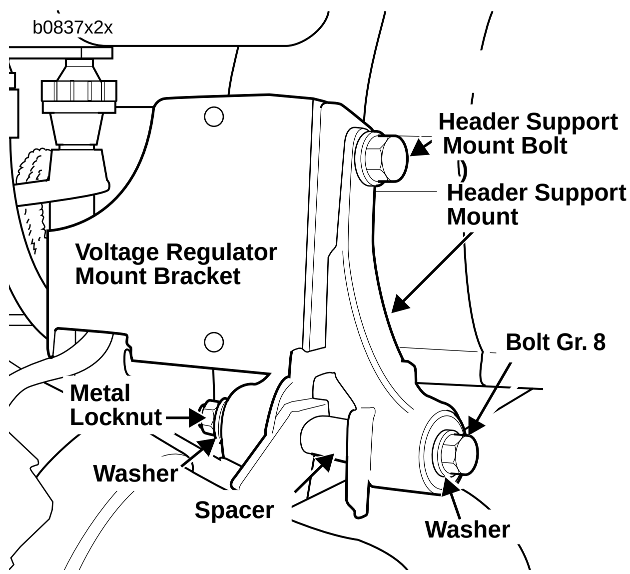


Figure 2-89. Header Support Mount

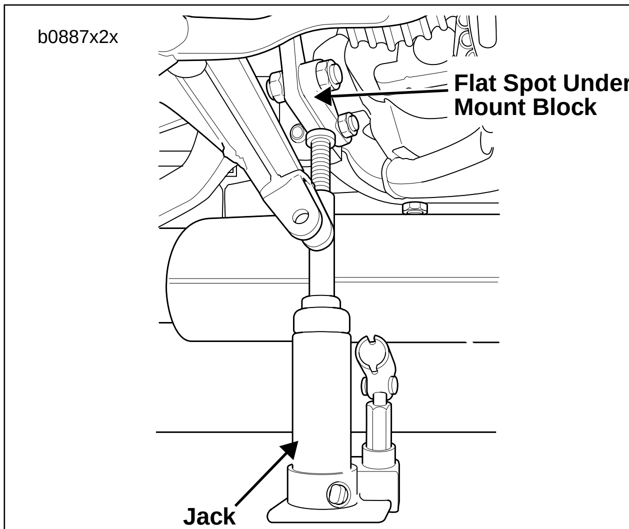


Figure 2-90. Supporting Motorcycle with Jack

Exhaust Header

1. Remove muffler.
2. See Figure 2-91. Loosen the four exhaust header nuts (20) using SNAP-ON SWIVEL SOCKET (Part No. PFSX916).
3. Disconnect oxygen sensor at connector [137].
4. See Figure 2-92. Remove exhaust header by swiveling and lifting exhaust header as shown. Slide exhaust header from behind frame.
5. See Figure 2-93. Remove exhaust header clamps (22), exhaust clamp retaining rings (23) and exhaust port gaskets (24) from exhaust header.

HOME

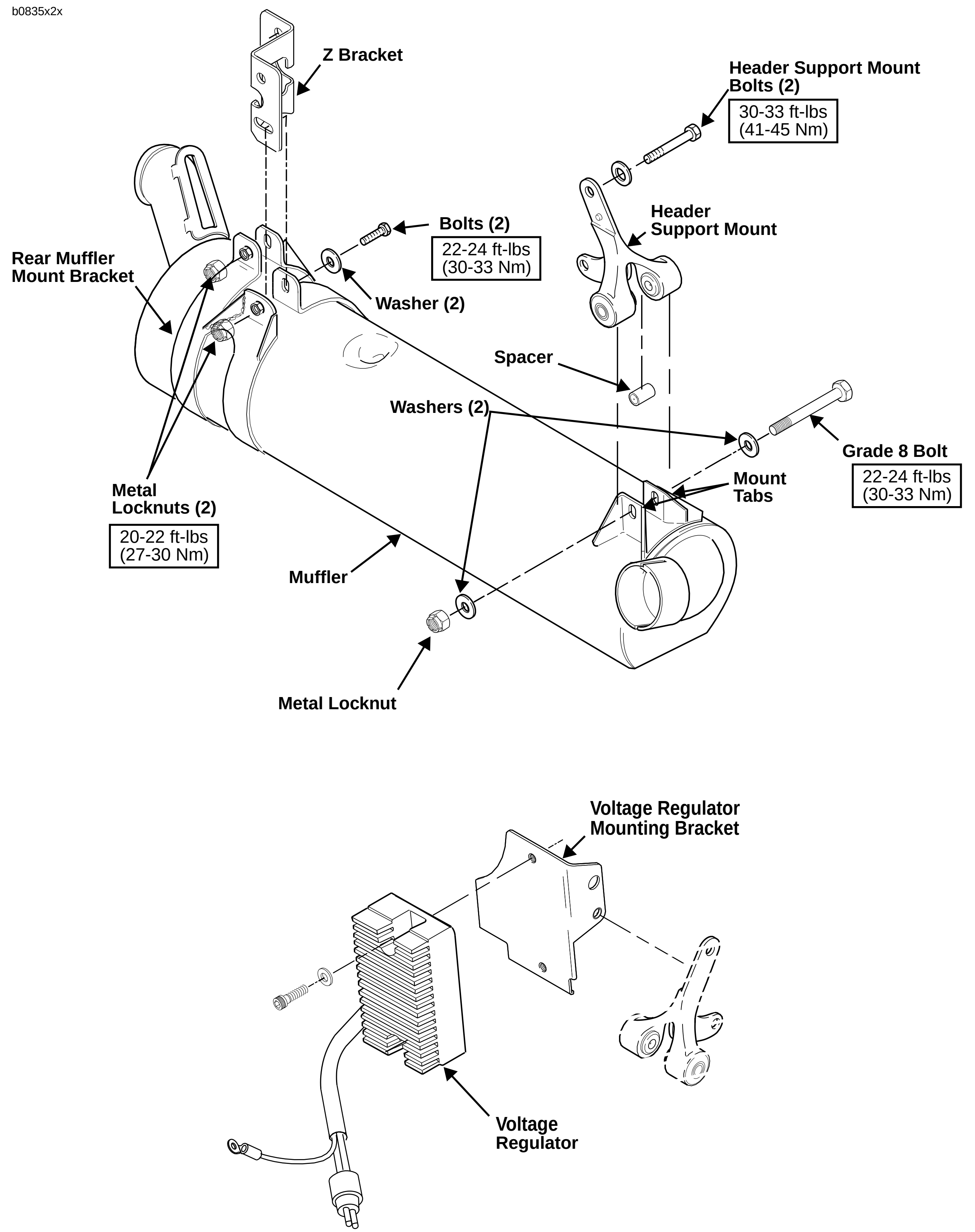


Figure 2-91. Exhaust System

ASSEMBLY/INSTALLATION

Muffler

1. If removed, install exhaust header.
2. See Figure 2-91. If removed, install Z-bracket.
   a. Install rear muffler mounts and mount spacers on swingarm mount block.
   b. Attach Z-bracket with bolts, locknuts and washers. Bolt heads install on opposite side of the swingarm mount block from Z-bracket. Tighten to 22-24 ft-lbs (30-33 Nm).
3. See Figure 2-89. If removed, attach header support mount to crankcase.
   a. Insert two front muffler mounts and mount spacer into muffler support.
   b. Install nuts and washers securing header support mount to voltage regulator bracket and crankcase.
   c. Attach header support mount to crankcase using two upper bolts. Tighten to 30-33 ft-lbs (41-45 Nm).
4. Coat inside of muffler inlet with PERMATEX ULTRA-COPPER HIGH TEMP RTV SILICON GASKET material.

NOTE

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

5. Place a **new** muffler clamp over muffler inlet. Place muffler and clamp on end of exhaust header. Snug clamp but do not tighten.

WARNING

Before tightening muffler hardware, position muffler to provide adequate clearance from rear shock absorber, side stand spring post and rear tire. Failure to provide adequate clearance may cause loss of control during motorcycle operation which could result in death or serious injury.

6. See Figure 2-88. Position muffler and install to rear mounting support and weldnuts in rear muffler straps with two sets of bolts, washers and locknuts. Tighten to 22-24 ft-lbs (30-33 Nm).
7. See Figure 2-89. Secure muffler to header support mount with bolt, locknut and washers. Tighten to 22-24 ft-lbs (30-33 Nm).
8. When only the muffler is being replaced, tighten muffler clamp to 40-45 ft-lbs (54-61 Nm). If also installing the exhaust header, leave muffler clamp loose.

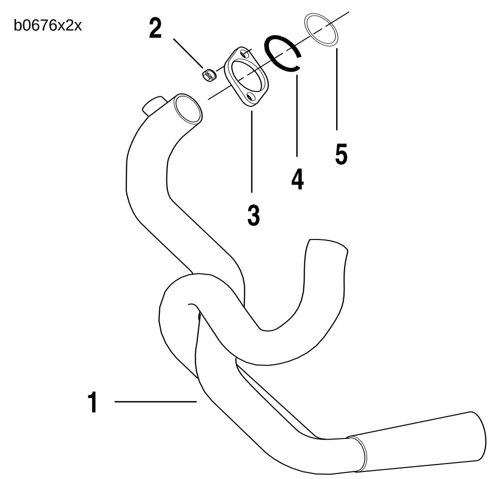
Exhaust Header

NOTE

Muffler hardware must be tightened before tightening exhaust header hardware.

1. See Figure 2-93. Install **new** exhaust port gaskets (5) and exhaust clamp retaining rings (2).
2. Slide exhaust header clamps (3) over ends of exhaust header (1).
3. See Figure 2-92. Slide exhaust header under frame by positioning as shown, threading oxygen sensor wire under frame.

Figure 2-92. Exhaust Header Positioning (Typical)



1. **Exhaust Header**
2. **Exhaust Header Nut (4)**
3. **Exhaust Header Clamp (2)**
4. **Exhaust Clamp Retaining Ring (2)**
5. **Exhaust Port Gasket (2)**

Figure 2-93. Exhaust Header

4. Position rear end of exhaust header in port. Do not install exhaust header clamp over port.
5. Rotate exhaust header so that front end of exhaust header is in position at front port to cylinder head.
6. See Figure 2-93. Fasten exhaust header to cylinder heads with exhaust header clamps and nuts. Tighten the four exhaust header nuts to 6-8 ft-lbs (8-11 Nm) using SNAP-ON SWIVEL SOCKET (Part No. PFSX916).
7. Install oxygen sensor to header if removed. Apply LOCTITE ANTI-SEIZE LUBRICANT to threads of sensor and install to exhaust header. Tighten sensor to 42-45 ft-lbs (57-61 Nm). Attach oxygen sensor connector [137]. Secure wiring and sensor with **new** cable ties.
8. Tighten muffler clamp to 40-45 ft-lbs (54-61 Nm).
9. Install right fairing lower. See 2.38 FAIRING LOWERS.

FOOTRESTS 2.28

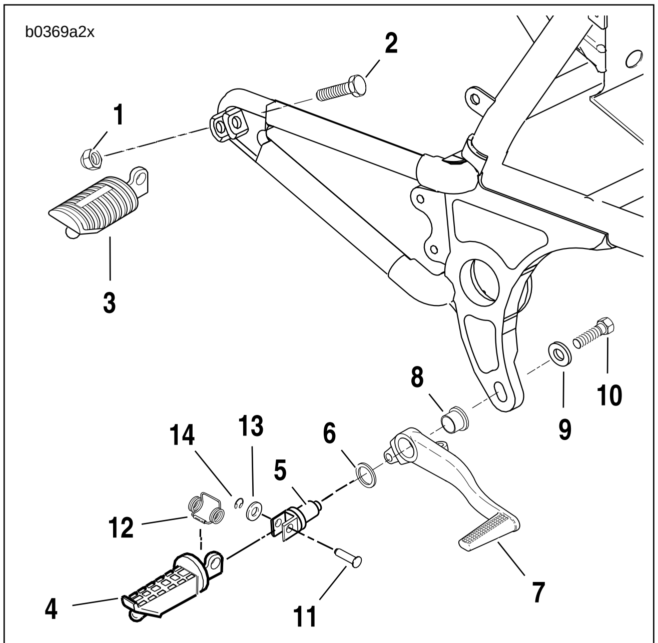
REMOVAL

1. See Figure 2-94. Remove locknut (1), bolt (2) and passenger footrests (3) from frame.
2. Remove rider footrests from footrest mounts.
   a. Remove retaining ring (14) and washer (13) from pin (11).
   b. Hold hand over spring (12) and remove pin (11), spring (12) and footpeg (4) from mount (5).

NOTE

Locknuts for passenger footrests are within the saddlebag support bracket.

3. If necessary, remove footrest mounts.
   a. If removing brake pedal mount, remove sprocket cover. See 2.29 SPROCKET COVER. Detach brake pedal from master cylinder push rod.
   b. If removing shift lever pedal mount, detach shift lever from shift rod.
   c. See Figure 2-94. Remove bolt (10) and washer (9) to detach footrest mount (5) from frame.
   d. Slide bushing (8), pedal and thrust washer (6) off footrest mount.



1. **Locknut (2)**
2. **Bolt (2)**
3. **Passenger Footrest (2)**
4. **Rider Footrest (2)**
5. **Footrest Mount (2)**
6. **Thrust Washer (2)**
7. **Rear Brake Pedal**
8. **Bushing (2)**
9. **Washer (2)**
10. **Bolt (2)**
11. **Pin (2)**
12. **Spring (2)**
13. **Washer (2)**
14. **Retaining Ring**

Figure 2-94. Footrests, Right Side

INSTALLATION

1. See Figure 2-94. If removed, install passenger footrests.

NOTE

Tighten bolts (2) so footrests are tight, but not binding.

   a. Apply LOCTITE THREADLOCKER 243 (blue) to footrest bolts (2).
   b. Install passenger footrests with allen bolts (2) and locknuts (1). Tighten to 24-30 ft-lbs (33-41 Nm).
2. If removed, install footrest mounts (5).
   a. Slide thrust washer (6), shift/brake pedal and bushing (8) on footrest mount.
   b. Apply LOCTITE THREADLOCKER 272 (red) to bolt (10).
   c. Install footrest mount assembly using bolt (10) and washer (9). Tighten to 10-15 ft-lbs (14-20 Nm).
   d. Attach master cylinder push rod to brake pedal. Install sprocket cover. See 2.29 SPROCKET COVER.
   e. Attach shift lever to shift rod.
3. Install rider footrests.
   a. Position spring (12) on mount (5) with thick side of spring inboard.
   b. Install pin (11) through spring (12), mount (5) and footrest (4).
   c. Install washer (13) and retaining ring (14) to pin. Make sure retaining ring engages groove on pin.
4. Adjust shift lever and brake pedal for smooth operation.

SPROCKET COVER 2.29

REMOVAL/DISASSEMBLY

1. See Figure 2-96. Remove screw on fairing lower. Remove bracket from stud.
2. See Figure 2-95. Remove two screws from swingarm/ drive support.
3. Remove sprocket cover forward screw, washer and spacer.
4. Remove swingarm drive/support and sprocket cover as an assembly.
5. Remove two screws to separate sprocket cover from swingarm/drive support.

ASSEMBLY/INSTALLATION

1. See Figure 2-95. If removed, attach sprocket cover to swingarm/drive support.
   a. Place sprocket cover behind swingarm/drive support. Align holes in cover with holes in support.
   b. Apply LOCTITE THREADLOCKER 243 (blue) to both screws.
   c. Install screws. Tighten to 12-17 **in-lbs** (1-2 Nm).
2. Apply LOCTITE THREADLOCKER 243 (blue) to forward screw. Install sprocket cover assembly with screw, washer and spacer. Tighten to 48-72 **in-lbs** (5-9 Nm).
3. Apply LOCTITE THREADLOCKER 272 (red) to two swingarm/drive support screws and install. Tighten screws to 20-25 ft-lbs (27-34 Nm).
4. See Figure 2-96. Place fairing lower bracket on stud. Fasten fairing lower to bracket using screw.

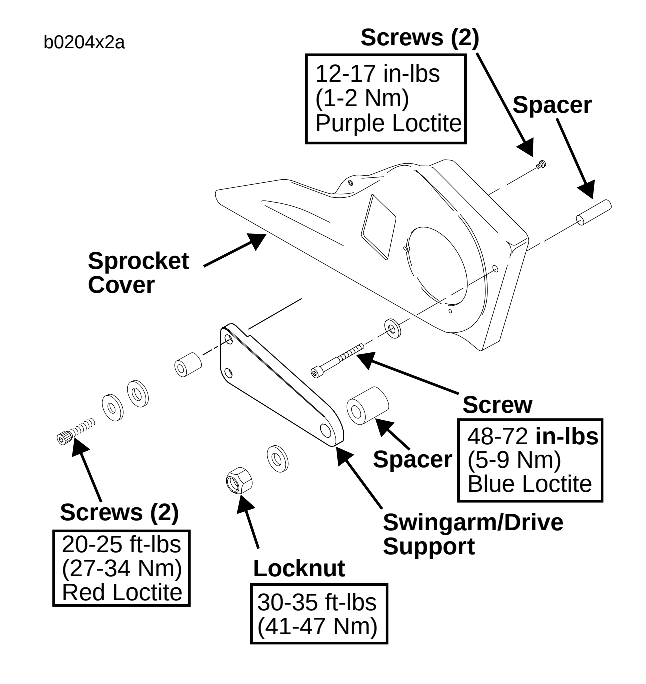
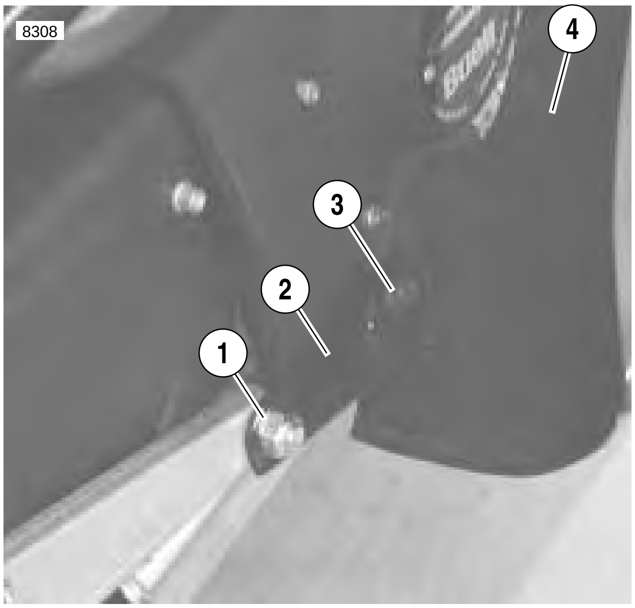


Figure 2-95. Sprocket Cover



1. **Nut**
2. **Bracket**
3. **Screw and Wellnut**
4. **Right Fairing Lower**

Figure 2-96. Fairing Lower Mount

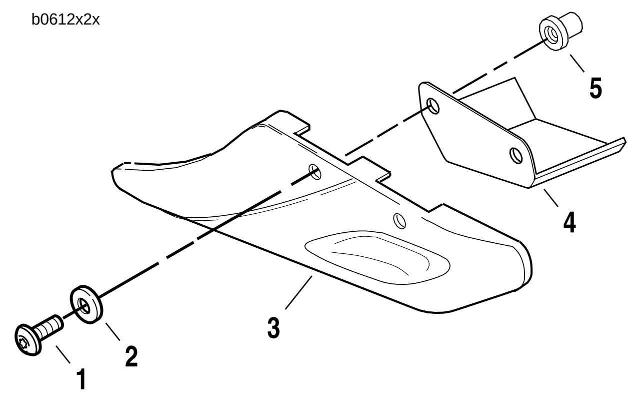
STONE GUARD 2.30

REMOVAL

1. See Figure 2-97. Remove two screws (1) and washers (2) securing lower belt guard (3) to swing arm.
2. Remove lower belt guard (3), stone guard (4) and wellnuts (5) from swing arm.

INSTALLATION

1. See Figure 2-97. Position stone guard (4) with wellnuts (5) and lower belt guard (3) on swing arm.
2. Secure with two screws (1) and washers (2).



1. **Screw (2)**
2. **Washer (2)**
3. **Lower Belt Guard**
4. **Stone Guard**
5. **Wellnut (2)**

Figure 2-97. Stone Guard

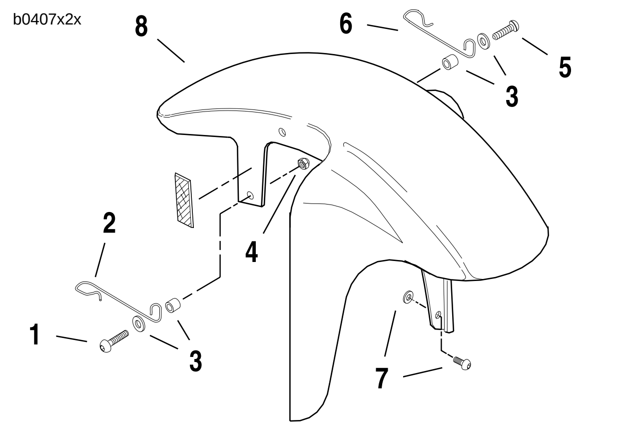
FRONT FENDER 2.31

REMOVAL

1. Remove front wheel. See 2.5 FRONT WHEEL.
2. See Figure 2-98. Remove both lower mounting screws (metric) and washers (7).
3. Remove upper mounting screws (1, 5) and washer and spacer (3) on each side. Do not remove brake line guide (2) and speedometer cable guide (6) from around lines/ cables unless necessary.
4. Carefully slide fender downward between fork legs.

INSTALLATION

1. Place washer and spacer (3) around brake line guide (2) as shown in Figure 2-98. The guide retaining loop points outward and back. Install screw (1) through assembly, but do not tighten at this time.
2. Place washer and spacer (3) around speedometer cable guide (6). The guide retaining loop points outward and back. Install screw (5) through assembly, but do not tighten at this time.
3. Install lower mounting screws (7) (metric). Plastic washer fits between fork leg and back of fender. Tighten to 10-15 **in-lbs** (1-2 Nm).
4. Tighten upper mounting screws (1, 5) to 20-25 **in-lbs** (2-3 Nm).
5. Install front wheel. See 2.5 FRONT WHEEL.



1. **Screw**
2. **Brake Line Guide**
3. **Washer and Spacer (2)**
4. **Locknut (2)**
5. **Screw**
6. **Speedometer Cable Guide**
7. **Screw (metric) and Washer (2)**
8. **Front Fender**

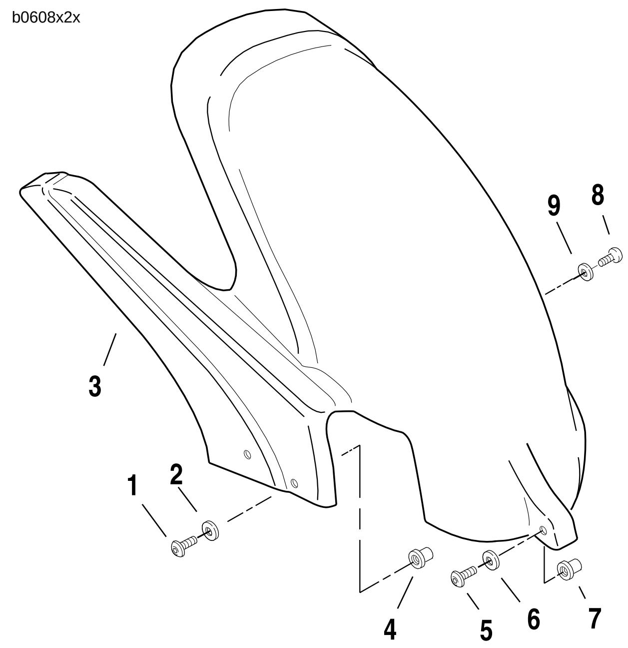
Figure 2-98. Front Fender

REMOVAL

1. Have someone sit on the vehicle to compress the motorcycle's suspension.
2. See Figure 2-99. Remove two screws (1) and washers (2) from right side wellnuts (4).
3. Remove screw (5) and washer (6) from front wellnut (7).
4. Remove screw (8) washer (9) from brake line clamp on the left side.
5. Pull fender over rear tire.

INSTALLATION

1. See Figure 2-100. Position fender over tire, making sure that the brake hose is on the outside of the fender as shown.
2. See Figure 2-99. Secure clamp with screw (8) and washer (9).
3. Have someone sit on the motorcycle to compress the motorcycle's suspension.
4. Apply LOCTITE THREADLOCKER 243 (blue) to all screws.
    a. Install screw (5) and washer (6) into wellnut (7).
    b. Install screws (1) and washers (2) into wellnuts (4).



1. **Screw (2)**
2. **Washer (2)**
3. **Fender**
4. **Wellnut (2)**
5. **Screw**
6. **Washer**
7. **Wellnut**
8. **Screw**
9. **Washer**

Figure 2-99. Rear Fender

Figure 2-100. Rear Fender With Brake Hose

REMOVAL

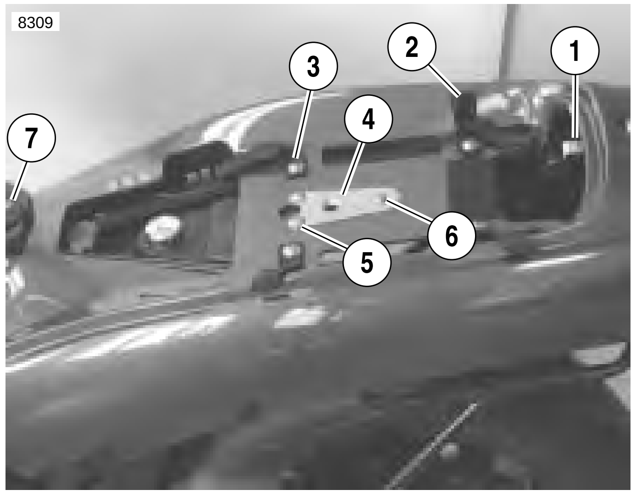
Tail Section

1. Remove both saddlebags.
   a. Place ignition key in saddlebag lock. Turn key 1/4 turn.
   b. Open saddlebag cover and remove saddlebag liner.
   c. Remove saddlebag from support brackets by turning the three fasteners counterclockwise.
2. See Figure 2-101. Remove seat.
   a. Place ignition key in seat lock (1). Turn key 1/4 turn.
   b. Pull seat release lever under the tail section.
   c. Lift seat away from motorcycle.
3. Remove fuel tank bolt (7).

NOTE

See 4.36 FUEL TANK for information on removing fuel tank from frame.

4. Remove two screws from tail lamps lens. Remove lens and set aside.
5. Remove four screws and plastic washers (3) from tail section. Remove helmet brackets (2) from longer rear screws.
6. Remove three screws (5, 6) from seat strike plate (4).
7. Lift fuel tank and withdraw tail section from frame.

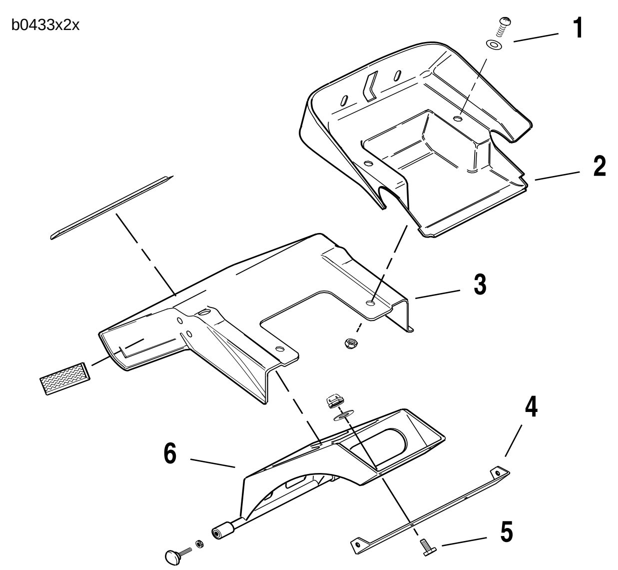


1. Seat Lock
2. Helmet Bracket (2)
3. Screw and Plastic Washer (4)
4. Strike Plate
5. Screw
6. Self Tapping Screw (2)
7. Fuel Tank Bolt

Figure 2-101. Tail Section Hardware

Glove Box and License Plate Holder

1. Remove tail section.
2. Unplug tail lamp/brake light connections and remove tail lamp mount. See 7.2 TAIL LAMP.
3. Remove rear turn signals. See 7.3 TURN SIGNALS.
4. See Figure 2-102. Remove bolts, washers and nuts (1) holding glove box (2) to license plate holder (3) and frame.
5. Lift and remove glove box. Slide wiring harness through hole in side.
6. See Figure 2-103. You may remove bolts, washers and nuts (2) to detach rear saddlebag support bracket (3) from turn signal support bracket (1).



1. Bolt, Washer and Nut (2)
2. Glove Box
3. License Plate Holder
4. Turn Signal Support Bracket
5. Bolt, Washer and Nut (2)
6. Rear Saddlebag Support Bracket

Figure 2-102. Glove Box

INSTALLATION

Tail Section

1. Install glove box and license plate holder if removed.
2. Lift fuel tank and place tail section on frame. Align tail section with mounting holes in frame.

NOTE

If fuel tank was removed, see 4.36 FUEL TANK.

3. See Figure 2-101. Loosely install strike plate (4) using three screws. Both self tapping screws (6) fit in forward holes of strike plate.
4. Install tail section hardware.
   a. Loosely install two short screws with plastic washers (4) in the forward mounting holes.
   b. Place a helmet bracket (2) over a long screw (3). Place plastic washer under helmet bracket. Loosely install as an assembly in the rear mounting holes.
   c. Tighten all fasteners (3, 4, 5 and 6) in a crosswise pattern until snug.
5. Install fuel tank bolt. See 4.36 FUEL TANK.
6. Install tail lamp lens with two screws.

⚠WARNING

Check for proper brake lamp operation before riding motorcycle (see Step 7). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

7. Turn ignition key switch to IGN. Apply rear brake pedal to test brake lamp operation. Turn ignition key switch to LOCK.

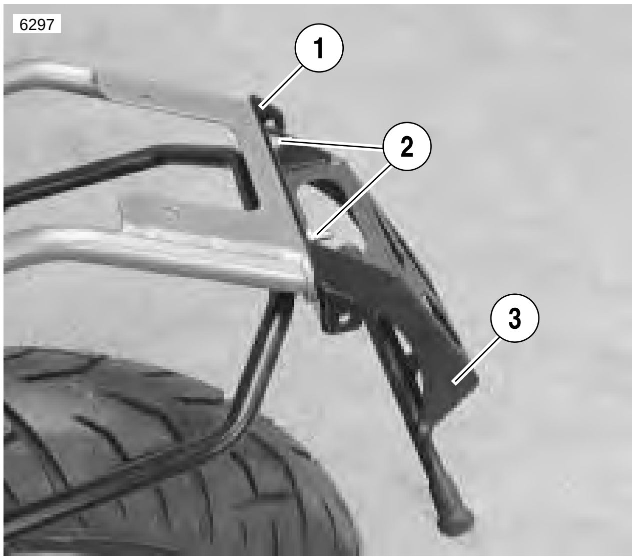
⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

8. Install and lock seat. See 2.35 SEAT.
9. Attach saddlebags. See 2.37 SADDLEBAGS.

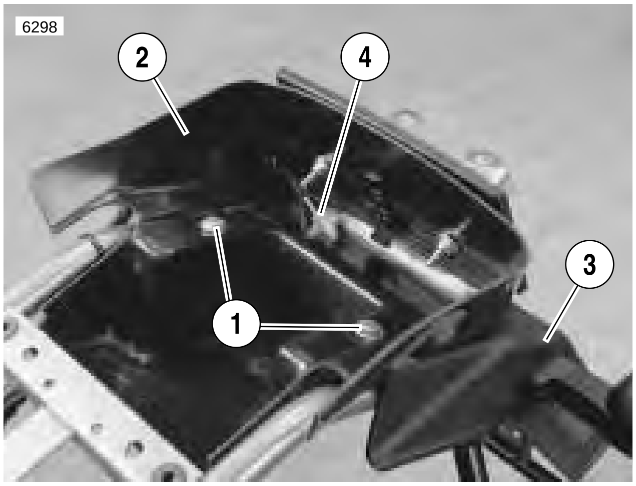
Glove Box and License Plate Holder

1. See Figure 2-103. Install turn signal support bracket (1) and rear saddlebag support bracket (3) using bolts, washers and nuts (2).
2. See Figure 2-104. Place license plate holder (3) on frame. Install turn signals. See 7.3 TURN SIGNALS.
3. Place glove box (2) on license plate holder. Secure with two bolts, washers and nuts (1).
4. Thread tail lamp wiring (4) through hole in glove box.
5. Install tail lamp mount. Attach tail lamp/brake light connections. See 7.2 TAIL LAMP.



1. **Turn Signal Support Bracket**
2. **Bolt, Washer and Nut (2)**
3. **Rear Saddlebag Support Bracket**

Figure 2-103. Saddlebag Brackets



1. **Bolt, Washer and Nut (2)**
2. **Glove Box**
3. **License Plate Holder**
4. **Tail Lamp Wiring**

Figure 2-104. Assembled Glove Box/License Plate Holder

REMOVAL

Front Fairing

1. See Figure 2-105. Remove both fairing bags (4).
2. Remove both front turn signals (7).
   a. Disconnect bullet connectors on turn signal wires.
   b. Remove nut and screw (6) to detach turn signals. Use caution not to scratch front fairing.
3. Remove two nuts (metric) on each mirror (5). Remove mirrors while supporting front fairing. Pull front fairing away from front fairing bracket.
4. Remove six screws and washers (1) to separate windshield (2) from front fairing (3).

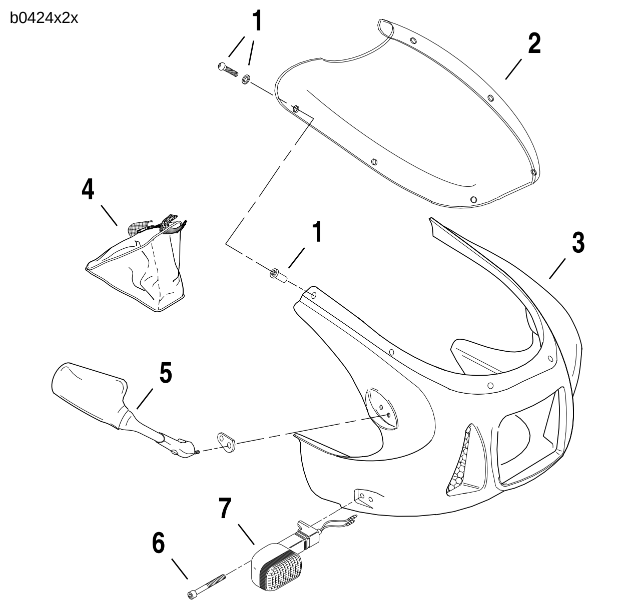
Front Fairing Mount

1. Remove front fairing.
2. Remove dash panel and gauges. See 2.26 HANDLEBARS.
3. Detach headlamp connector from bulb. See 7.1 HEADLAMP.

NOTE

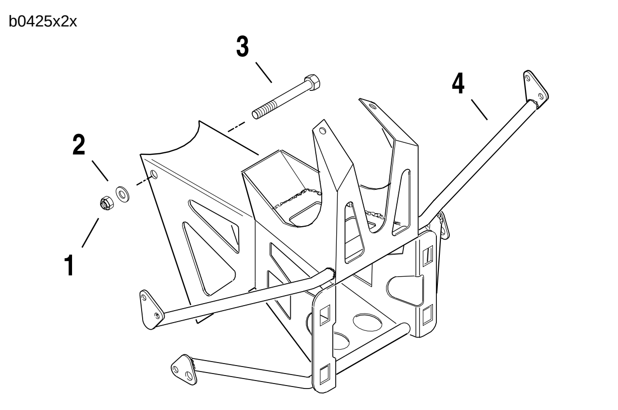
If replacing front fairing mount, remove headlamp.

4. Cut all cable straps holding wiring to front fairing mount. Note routing of wires before removing wires from mount.
5. See Figure 2-106. Remove two locknuts (1), washers (2) and bolts (3) to detach front fairing mount from steering head.



1. **Screw, Washer and Wellnut (6)**
2. **Windshield**
3. **Front Fairing**
4. **Fairing Bag (2)**
5. **Mirror (2) (4 metric Nuts not shown)**
6. **Screw (2) (2 Nuts not shown)**
7. **Turn Signal (2)**

Figure 2-105. Front Fairing



1. **Locknut (2)**
2. **Washer (2)**
3. **Bolt (2)**
4. **Front Fairing Mount**

Figure 2-106. Front Fairing Mount

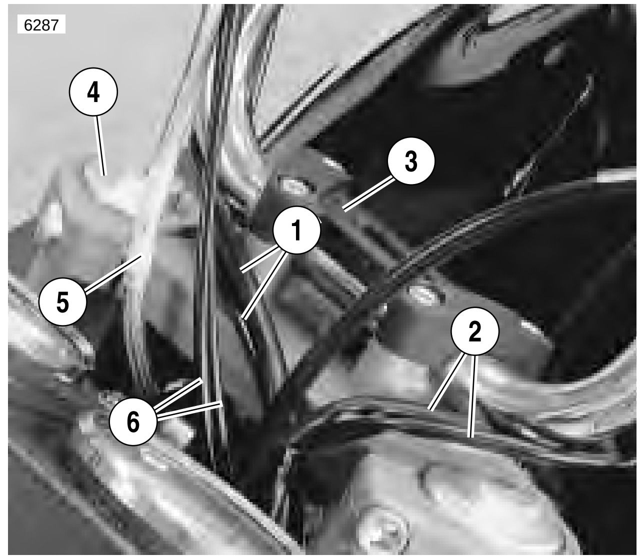
INSTALLATION

Front Fairing Mount

1. Align and install front fairing mount on frame.
   a. See Figure 2-107. Front brake line (5) must run on gearcase cover side of fairing mount.
   b. Throttle cables (6) and all other wiring must run on primary cover side of fairing mount.
   c. See Figure 2-106. Attach fairing mount to steering head using two locknuts (1), washers (2) and bolts (3). Tighten to 22-25 ft-lbs (30-34 Nm).
2. Install and/or connect headlamp. See 7.1 HEADLAMP.
3. See Figure 2-108. Use **new** cable straps (3) to secure wires (1, 2) to front fairing mount.
4. Install dash panel and both gauges. See 2.26 HANDLEBARS.
5. Install front fairing.

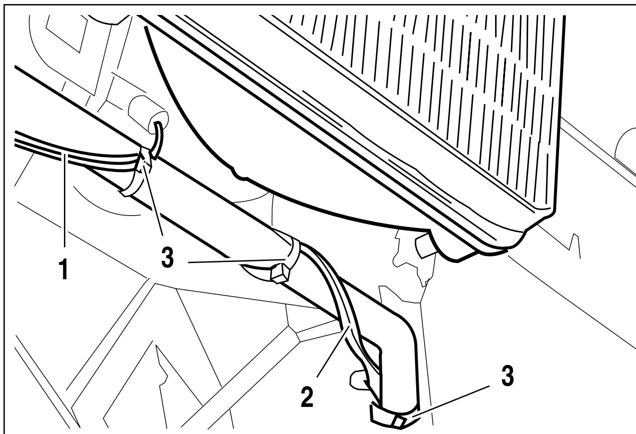
Front Fairing

1. See Figure 2-105. Attach windshield to front fairing using six screws and washers (1).
2. Align front fairing on front fairing mount. Loosely install both mirrors (5) using two nuts (metric) on each.
3. Install front turn signals (7). See 7.3 TURN SIGNALS.
4. Tighten both nuts (metric) on mirrors to 7-10 **in-lbs** (0.8-1.1 Nm).
5. Install both fairing bags (4).



1. **Right Hand Control Cables**
2. **Left Hand Control Cables**
3. **Handlebar Clamp on Upper Triple Clamp**
4. **Fork Tube**
5. **Front Brake Line**
6. **Throttle Cables**

Figure 2-107. Front Fairing Mount Alignment



1. **Right Turn Signal Wires**
2. **Left Turn Signal Wires**
3. **Cable Straps**

b0469x2x

Figure 2-108. Cable Straps

REMOVAL

Seat

1. See Figure 2-109. Place ignition key in seat lock. Turn key 1/4 turn.
2. Pull seat release lever under the tail section.
3. Lift seat and remove.

Seat Lock

1. Remove seat.
2. See Figure 2-110. Remove locknut (10) and star washer (9) from lock (2).
3. Slowly remove seat tang (8). As seat tang is lowered, cam (7) will follow. Note orientation of cam (top/bottom and slot position) for later installation.
4. Remove nut (6).
5. Remove D-washer (5) and O-ring (4).
6. Pull lock (2) and O-ring (3) from top of tail section.

Seat Release

1. Remove seat.
2. See Figure 2-111. Remove shoulder bolt (1), spring (2) and washer (3) from frame.

NOTE

Depending upon vehicle production date, some S3T models may have a remote seat release handle. This handle attaches to the seat latch lever via a cable.

3. Remove seat latch lever (4) and bushing (5).

INSTALLATION

Seat

1. See Figure 2-112. Install seat by sliding metal locating tab (2) on bottom of seat under frame tab (3).
2. Press down on seat until seat release lever clicks.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

3. See Figure 2-109. Turn ignition key 1/4 turn. Remove key from seat lock.

NOTE

- *Seat lock must be in the locked position before ignition key may be removed.*
- *See Figure 2-112. Metal tabs on tail section are helmet brackets (1). Place helmet D-ring under tab. Install and lock seat to secure helmet for storage while motorcycle is stationary.*

Figure 2-109. Removing Seat

1. Key
2. Lock
3. O-Ring
4. O-Ring
5. D-Washer
6. Nut
7. Cam
8. Seat Tang
9. Star Washer
10. Locknut

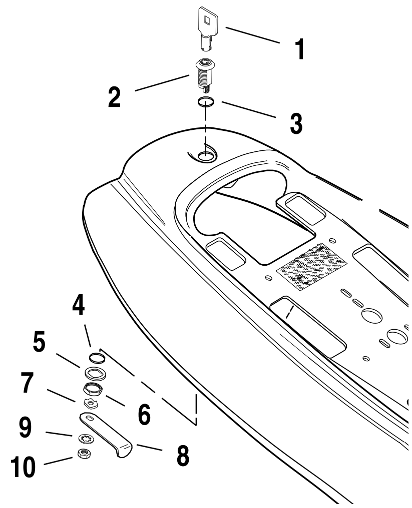


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Figure 2-110. Seat Lock

1. Shoulder Bolt
2. Spring
3. Washer
4. Seat Latch Lever
5. Bushing

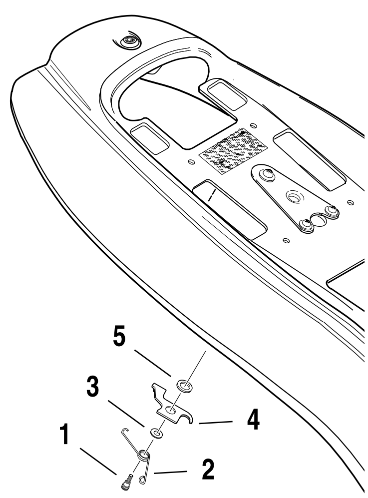

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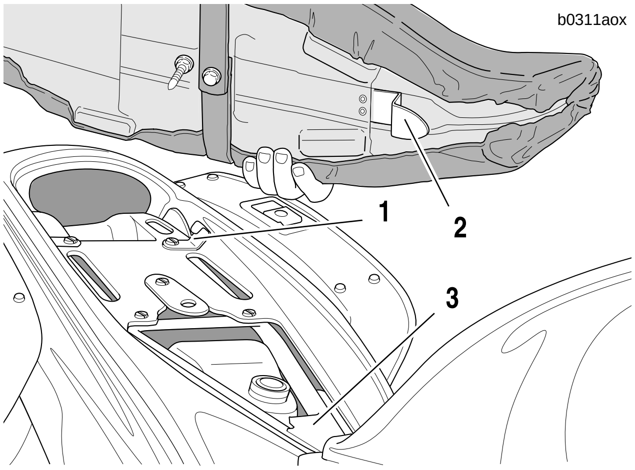
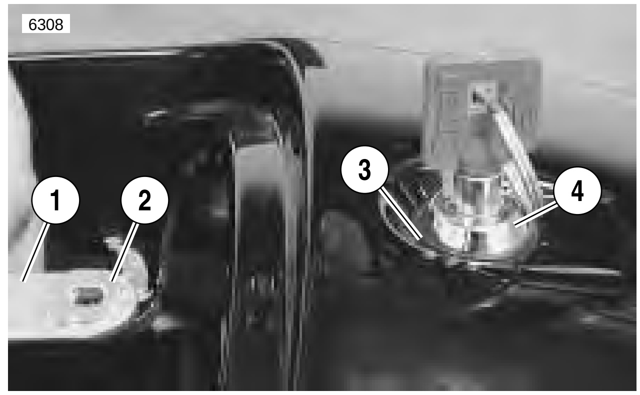
Figure 2-111. Seat Release



1. Helmet Bracket
2. Metal Locating Tab
3. Frame Tab

Figure 2-112. Seat



1. Seat Tang
2. Cam
3. O-Ring
4. Lock

Figure 2-113. Installing Seat Lock

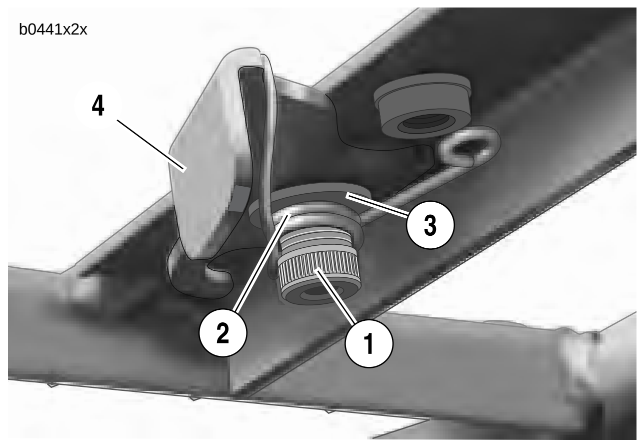
Seat Lock

1. See Figure 2-113. Place O-ring (3) and lock (4) in tail section as shown.
2. See Figure 2-110. Install O-ring (4) and D-washer (5). Secure seat lock using nut (6). Tighten nut until seat lock does not rotate in tail section.
3. See Figure 2-113. Position cam (2) on seat tang (1). Install assembly on lock.
4. See Figure 2-110. Install star washer (9) and nut (10).
5. Test lock action.
   a. Key should only be removable in the locked position. Check cam (7) position if there is problem.
   b. Seat tang and key should smoothly rotate without binding. If assembly binds, remove and reinstall.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

6. Install seat and test as described.



1. Shoulder Bolt
2. Spring
3. Washer
4. Seat Latch Lever

Figure 2-114. Installing Seat Release

Seat Release

1. See Figure 2-111. Place bushing (5) on top of seat latch lever (4).
2. See Figure 2-114. Place washer (3) and spring (2) under seat latch lever (4).
3. Hook edge of spring (2) over seat latch lever (4). Small loop of spring will rest against frame as shown.
4. Align seat release assembly under tail section. Secure with shoulder bolt (1). Shoulder bolt must not compress washer or seat latch lever.
5. If installed, attach remote seat release cable to seat latch lever.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

6. Install seat and test as described.

SIDE STAND

GENERAL

WARNING

- **If the side stand is not in the full forward position when vehicle weight is rested on it, the vehicle could fall over which could result in death or serious injury.**
- **Always park motorcycle on a level, firm surface. Vehicle weight could cause motorcycle to fall over, which could result in death or serious injury.**

The side stand is located on the left side of the motorcycle. The side stand swings outward to support the motorcycle for parking.

See Figure 2-115. The side stand activates the side stand switch which is part of the starter interlock system. See 7.6 STARTER INTERLOCK for more information.

REMOVAL/DISASSEMBLY

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 2-116. Remove spring (6) from side stand and spring pin (5).
3. Remove retaining clip (7) and pivot pin (8). Detach side stand from frame.
4. Remove bumper (3) from frame.
5. Remove screw (2) and side stand dragger (1).

INSPECTION

1. Replace dragger when worn to wear line shown in Figure 2-117.
2. Test the side stand in the following manner. Without vehicle weight resting on it, side stand should move freely into extended (down) and retracted (up) positions.
3. Check sidestand switch (starter interlock) for proper operation after the first 500 miles and every 2500 miles thereafter. See 7.6 STARTER INTERLOCK.

ASSEMBLY/INSTALLATION

1. See Figure 2-116. Attach bumper (3) to frame.
2. Attach side stand dragger (1) to side stand with screw (2).
3. Apply LOCTITE ANTI-SEIZE to pivot pin (8). Install side stand using pivot pin (8) and retaining clip (7). Do not crush side stand switch during installation.
4. Connect spring (6) to side stand and spring pin (5).
5. Remove REAR WHEEL STAND.

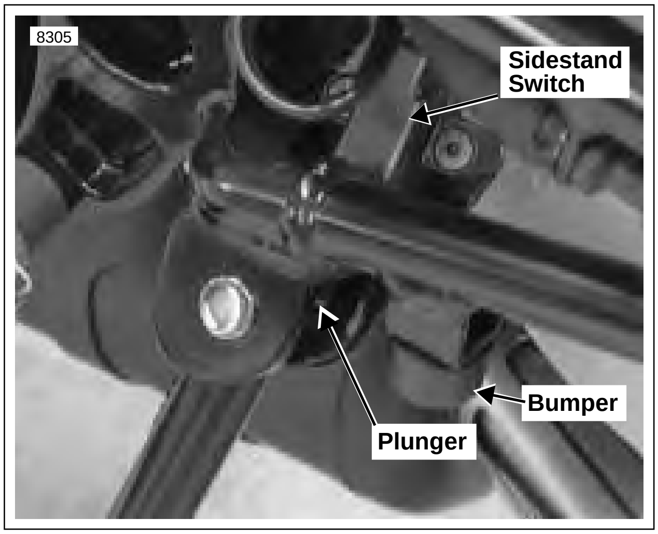


Figure 2-115. Side Stand Switch

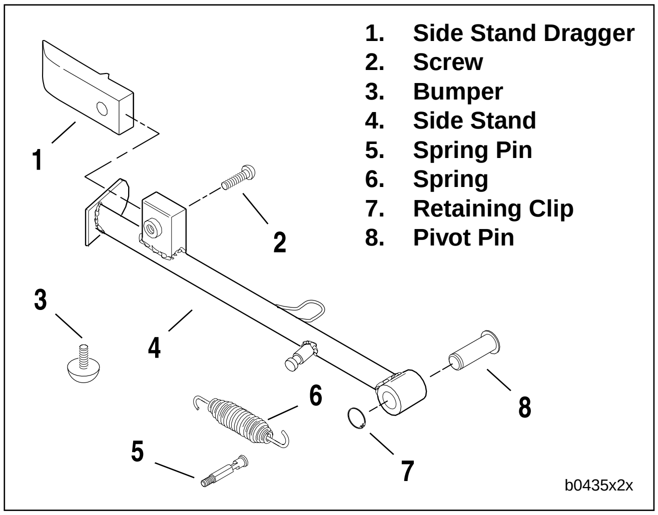


Figure 2-116. Side Stand

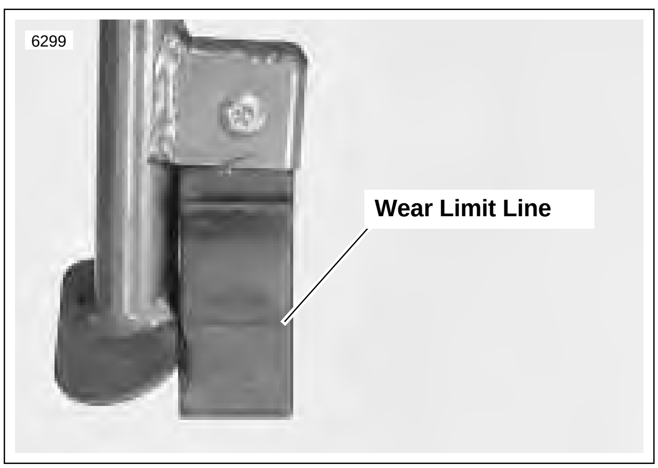


Figure 2-117. Side Stand Dragger Wear Limit

GENERAL

WARNING

Keep cargo weight concentrated close to the motorcycle and as low as possible to minimize the change in the motorcycle's center of gravity. Distribute weight evenly on both sides of the vehicle and do not load bulky items too far behind the rider or add weight to the handlebars or front forks. Do not load saddlebag beyond maximum weight capacity. See label inside saddlebag for weight capacity limit. Improper loading can adversely affect handling which could result in death or serious injury.

See Figure 2-118. Each saddlebag features a barrel-style lock and a removable saddlebag liner.

See Figure 2-119. Two different sizes of saddlebag covers are available. Exchange covers by opening saddlebag cover to 90°. Opening (3) in saddlebag cover hinge mates with corresponding tab (2) on saddlebag body hinge.

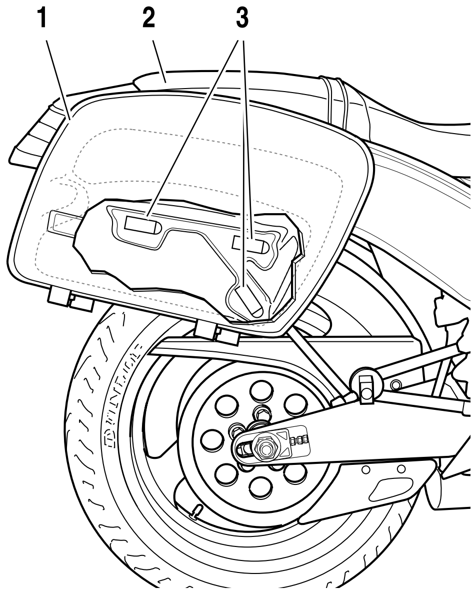


Figure 2-118. Saddlebags

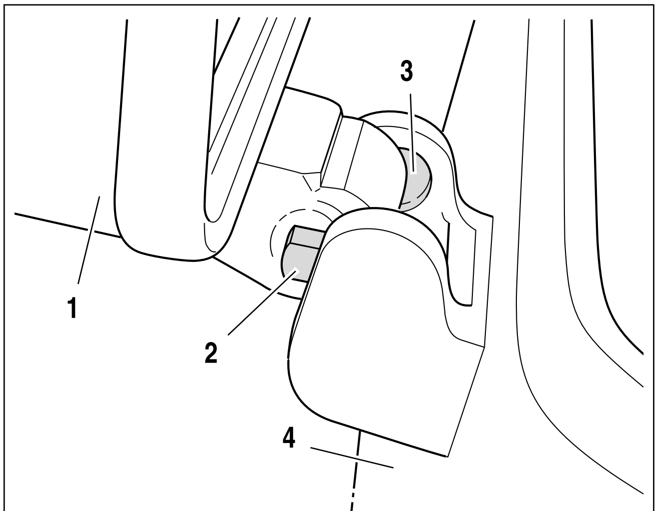


Figure 2-119. Saddlebag Cover Hinge

OPERATION

1. See Figure 2-118. Place ignition key in saddlebag lock (2). Turn key 1/4 turn.
2. Lift saddlebag latch.

CAUTION

Do not rest items on an open saddlebag cover. Placing objects on an open saddlebag cover could damage cover and mounting hardware.

CAUTION

Make sure contents do not interfere with cover seal when closing. If seal is disturbed, bags will not close properly.

3. Open cover and remove saddlebag liner.

REMOVAL

See Figure 2-118. Three fasteners (3) attach each saddlebag to the support brackets.

1. Unlock and unload saddlebag.

WARNING

Saddlebag support brackets are not "grab handles" for passenger. Using support bracket as a passenger grab handle could result in death or serious injury.

2. Pull fastener handle open.
3. Turn handle 1/4 turn to release saddlebag from support bracket.

INSTALLATION

1. Align molded channels on rear of saddlebag with support brackets.

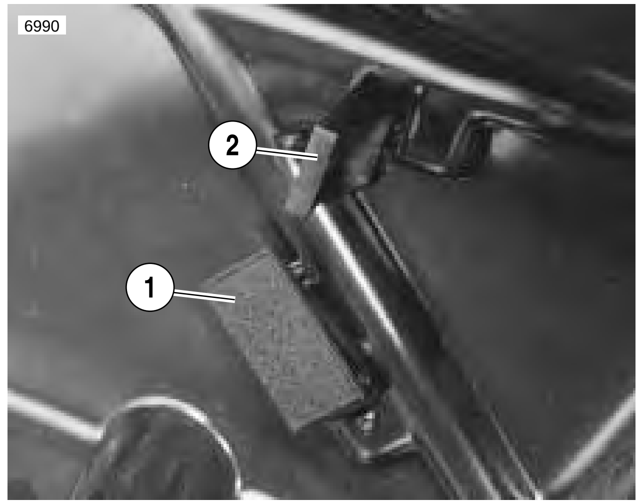
CAUTION

Be sure saddlebag is fully seated on bracket. Failure to do so could result in the saddlebags becoming detached and/or damaged.

CAUTION

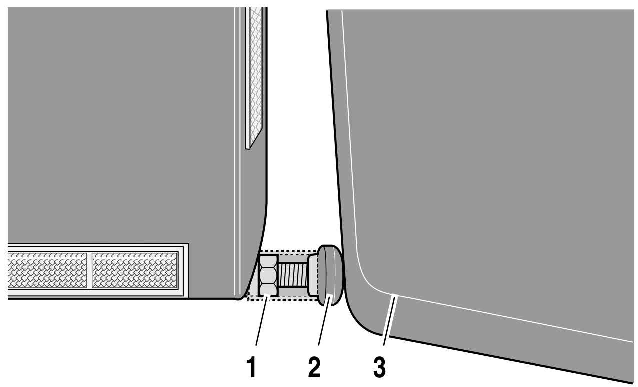
Do not slam saddlebag lids closed. Excessive force will damage saddlebags.

2. See Figure 2-120. Attach saddlebags to brackets by turning fasteners 1/4 turn to the rear. Handles will be parallel to molded channels inside saddlebag. Gently push fastener handles closed, do not force.
3. Install saddlebag liner. Close cover by aligning hooks on saddlebag cover with openings on saddlebag body and firmly pushing inward. Do not force saddlebag covers closed.
4. Lock saddlebag and remove key.
5. See Figure 2-121. If saddlebags are difficult to close or install, check rear saddlebag bracket alignment on both sides.
   a. Slide rubber boot away from bumper assembly.
   b. Turn bumper (2) counterclockwise until it contacts saddlebag (3).
   c. Turn bumper one additional full turn counterclockwise.
   d. Tighten jamnut (1) against rear saddlebag support bracket.
   e. Slide rubber boot over bumper assembly.



1. **Latch (closed)**
2. **Latch (open)**

Figure 2-120. Saddlebag Latches



1. **Jamnut**
2. **Bumper**
3. **Saddlebag**

b0438x2x

Figure 2-121. Saddlebag Alignment

FAIRING LOWERS 2.38

REMOVAL

Right Side

1. See Figure 2-122. Remove bottom screw (2), nylon washer (3) and locknut (6) from bracket (4).

2. Remove two upper screws (2), nylon washers (3) and locknuts from fairing. Remove fairing.

Left Side

1. Remove seat and fuel tank screw. See 2.35 SEAT.

2. See Figure 2-122. Remove screw (2), clamp (7), nylon washer (3) and locknut (6) from left fairing lower (8).

3. Disengage clamp (7) from metal bracket on fairing lower.

4. Lift fuel tank and remove left fairing lower.

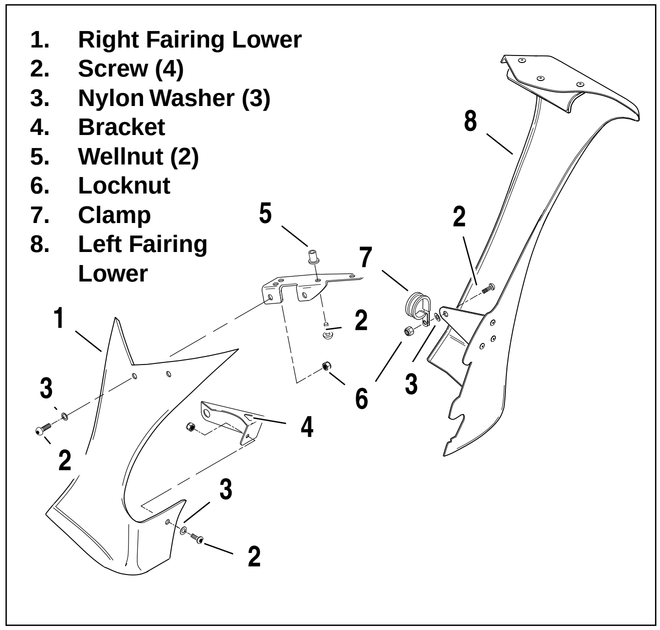


Figure 2-122. Fairing Lowers

Figure 2-123. Left Fairing Lower Clamp

INSTALLATION

Right Side

1. See Figure 2-122. Attach fairing lower (1) to bracket (4) with screw (2), nylon washer (3) and locknut (6).

2. Install two screws (2), nylon washers (3) and locknuts (6) to air cleaner cover bracket.

Left Side

1. Lift fuel tank and insert fairing lower lip over frame tube.

2. See Figure 2-123. Align clamp with metal bracket on fairing lower. Place nylon washer between clamp and metal bracket. Insert screw through clamp, nylon washer, metal bracket and opposite side of clamp. Fasten with locknut.

3. Tighten fuel tank screw to 18-23 ft-lbs (24-31 Nm). Wait five minutes and tighten again to 18-23 ft-lbs (24-31 Nm).

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

4. Install seat. See 2.35 SEAT.

NOTES

ENGINE 3

Table Of Contents

SUBJECT	PAGE NO.
3.1 Specifications	3-1
3.2 Engine	3-5
3.3 Stripping Motorcycle For Engine Repair	3-8
3.4 Installing The Engine	3-10
3.5 Cylinder Head	3-12
3.6 Cylinder and Piston	3-24
3.7 Lubrication System	3-31
3.8 Oil Hose Routing	3-32
3.9 Oil Tank	3-33
3.10 Oil Pressure Indicator Switch	3-34
3.11 Crankcase Breathing System	3-35
3.12 Oiling System (Color Foldout)	3-36
3.13 Oil Pump	3-37
3.14 Oil Filter Mount	3-40
3.15 Hydraulic Lifters	3-41
3.16 Gearcase Cover and Cam Gears	3-43
3.17 Crankcase	3-50

SPECIFICATIONS 3.1

GENERAL		
Number of Cylinders	2	
Type	Air cooled, four-stroke 45 Degree V-twin	
Horsepower	101 @ 6200 RPM	
Torque	90 ft-lbs @ 5500 RPM	
Compression Ratio	10.0 to 1	
Bore	3.498 in.	88.849 mm
Stroke	3.8125 in.	96.838 mm
Engine Displacement	73.4 cu. in.	1203 cc
Oil Tank Capacity (with filter change)	2.0 quarts	1.89 liters

CAMSHAFT SPECIFICATIONS	
Lift @ Valve (TDC) Intake/Exhaust	0.211 in./0.191 in.
Duration @ 0.053 Lift Intake/Exhaust	256°/256°
Timing @ 0.053 Lift Open/Close	Intake: 28° BTDC/48° ABDC Exhaust: 52° BBDC/24° ATDC

ENGINE IGNITION SPECIFICATIONS		
Type	Sequential, non waste spark	
Regular Idle	850-1050 RPM	
Spark Plug Size	12 mm	
Spark Plug Type	Harley-Davidson No. 10R12	
Spark Plug Gap	0.038-0.043 in.	0.97-1.09 mm
Spark Plug Torque	11-18 ft-lbs	15-24 Nm

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.*

ITEM		NEW COMPONENTS		SERVICE WEAR LIMITS	
VALVE					
Fit in guide	Exhaust	0.0015-0.0033 in.	0.0381-0.0838 mm	0.0040 in.	0.1016 mm
	Intake	0.0008-0.0026 in.	0.0203-0.0660 mm	0.0035 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		1.975-2.011 in.	50.165-51.079 mm	2.031 in.	51.587 mm
OUTER VALVE SPRING					
Free length		2.105-2.177 in.	53.467-55.296 mm	2.105 in. (min)	53.467 mm (min)
Intake	1.751-1.848 in. (closed)	72-92 lbs	33-42 kg		
	1.286-1.383 in. (open)	183-207 lbs	83-94 kg		
Exhaust	1.751-1.848 in. (closed)	72-92 lbs	33-42 kg		
	1.332-1.429 in. (open)	171-195 lbs	78-88 kg		

ITEM		NEW COMPONENTS		SERVICE WEAR LIMITS	
INNER VALVE SPRING					
Free length		1.926-1.996 in.	48.920-50.698 mm	1.926 in. (min)	48.920 (min)
Intake	1.577-1.683 in. (closed)	38-49 lbs	17-22 kg		
	1.112-1.218 in. (open)	98-112 lbs	44-51 kg		
Exhaust	1.577-1.683 in. (closed)	38-49 lbs	17-22 kg		
	1.158-1.264 in. (open)	91-106 lbs	41-48 kg		
ROCKER ARM					
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					
Shaft fit in rocker cover (loose)		0.0007-0.0022 in.	0.018-0.056 mm	0.0035 in.	0.0889 mm
PISTON					
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
CYLINDER HEAD					
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
CYLINDER					
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
	0.005 OS	3.502 in.	88.951 mm	3.5050 in.	89.0270 mm
	0.010 OS	3.507 in.	89.078 mm	3.5100 in.	89.1540 mm
OS=over size	0.020 OS	3.517 in.	89.332 mm	3.5200 in.	89.4080 mm
	0.030 OS	3.527 in.	89.586 mm	3.5300 in.	89.6620 mm

ITEM		NEW COMPONENTS		SERVICE WEAR LIMITS	
CONNECTING ROD					
Piston pin fit (loose)		0.00125-0.00175 in.	0.03175-0.04445 mm	0.00200 in.	0.05080 mm
Side play between flywheels		0.005-0.025 in.	0.127-0.635 mm	0.030 in.	0.762 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
LIFTER					
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
OIL PUMP					
Oil pressure	1000 RPM	7-12 PSI	48-83 kN/m^2		
	2500 RPM	10-17 PSI	69-117 kN/m^2		
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
GEARCASE					
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) (except rear intake)		0.005-0.024 in.	0.127-0.610 mm	0.025 in.	0.635 mm
Rear intake cam gear shaft end play (min)		0.006-0.024 in.	0.152-0.610 mm	0.040 in.	1.016 mm
FLYWHEEL					
Runout	Flywheels 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
End play		0.001-0.005 in.	0.025-0.127 mm	0.005 in.	0.127 mm
SPROCKET SHAFT BEARING					
Outer race fit in crankcase (tight)		0.0004-0.0024 in.	0.0102-0.0610 mm		
Bearing inner race fit on shaft (tight)		0.0002-0.0015 in.	0.0051-0.0381 mm		
PINION SHAFT BEARINGS					
Pinion shaft jounal 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
Anti-Rotation Screws	55-65 **in-lbs**	6-7 Nm	
Crankcase 3/8 in. Screws	22-27 ft-lbs	30-37 Nm	
Crankcase 5/16 in. Screws	15-19 ft-lbs	20-26 Nm	
Cylinder Head Screws	7-9 ft-lbs then 13-15 ft-lbs then loosen and repeat torque sequence	10-12 Nm then 18-20 Nm then loosen and repeat torque sequence	special pattern to tighten
Cylinder Studs	10-20 ft-lbs	14-27 Nm	special method to tighten
Front Isolator to Cylinder Head Bolt	Special Procedure: 60 ft-lbs (81 Nm), back off one full turn and retighten to 60 ft-lbs (81 Nm).		Special Procedure: Oiled Washers, LOCTITE THREADLOCKER 271 (red)
Isolator Bolt (Front)	100-110 ft-lbs	136-149 Nm	
Isolator TORX Bolts (Rear)	63-70 ft-lbs	85-95 Nm	LOCTITE THREADLOCKER 262 (red), LOCTITE ANTI-SEIZE under bolt heads
Oil Filter Adapter	8-12 ft-lbs	11-16 Nm	LOCTITE THREADLOCKER 243 (blue)
Oil Pressure Signal Light Switch	50-70 **in-lbs**	6-8 Nm	
Oil Pump Cover Screws	70-80 **in-lbs**	7.9-9 Nm	
Oil Pump Mounting Screws	125-150 **in-lbs**	14-17 Nm	
Pinion Shaft Nut	35-45 ft-lbs	48-61 Nm	LOCTITE THREADLOCKER 262 (red)
Rocker Box Bolts	10-14 ft-lbs	14-19 Nm	
Rocker Box Cover Screws	10-14 ft-lbs	14-19 Nm	
Rocker Box Screws	135-155 **in-lbs**	15-18 Nm	
Rocker Box to Head Bolts	18-22 ft-lbs	24-30 Nm	
Swingarm Mount Block Bolts (Lower)	68-75 ft-lbs	92-102 Nm	
Swingarm Mount Block Bolts (Upper)	41-45 ft-lbs	56-61 Nm	
Tie Bar Bolts	30-33 ft-lbs	41-45 Nm	

GENERAL

The Thunderstorm^{TM} high performance engine is a two-cylinder, four-cycle, air-cooled, overhead-valve V-twin. It has three major component assemblies.

Cylinder

The cylinder assembly includes cylinder head, valves, rocker arm cover, rocker arms and piston. Cylinders mount on the crankcase in a 45 degree “V” with both connecting rods connected to a single crank pin.

Thunderstorm engines have modified cylinder heads with a black finish and unique pistons.

Crankcase

The up-and-down motion of the piston in the cylinder is converted to circular motion in the crankcase. The multi-piece crankshaft consists of a crank pin mounted between two counterweighted flywheels, which rotate on two end shaft bearings. The lower end of the rear cylinder connecting rod is forked to fit around the single-end front cylinder connecting rod, allowing a single connecting rod crank pin connection to the flywheel.

Gearcase

The gearcase is located on the right side of the crankcase. The gearcase houses the gear train, which operates and times the valves and ignition. The cam gear train, consisting of four cam shafts with one cam lobe on each shaft, is gear driven. The engine valves are opened and closed through the mechanical linkage of lifters, push rods and rocker arms. Hydraulic lifters automatically compensate for heat expansion to maintain the no-lash fit of valve train components. Lifters serve to transmit the cam action to the valve linkage. Valve timing is obtained by aligning timing marks when installing cam gears.

Ignition spark is produced by the operation of a microprocessor-controlled electronic control module (ECM), ignition coil and spark plugs. Spark timing is determined by a trigger rotor, magnetic sensing unit and the ECM.

The trigger rotor has six openings which time the cylinders and communicate engine speed to the ECM.

The spark plugs fire independently during the compression stroke on each cylinder (no waste spark).

FUEL

Gasoline/alcohol Blends

Buell motorcycles were designed to obtain the best performance and efficiency using unleaded gasoline (**91 pump octane** or higher). 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.
- 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%.
- 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 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 to the engine, lubricating lower connecting rod bearings, rocker arm bushings, valve stems, valve springs, push rods and hydraulic lifters. Cylinder walls, pistons, piston pins, timing gears and 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 lifter guide. A small amount of oil is sprayed through an oil galley jet onto the rear intake cam gear in the gearcase; 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 3.7 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 heads, cylinders and pistons 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 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR to strip motorcycle for removal of cylinder heads, cylinders, and pistons.

After disassembling "upper end" only, it may be found that crankcase repair is necessary. In this situation, remove the engine crankcase from the chassis. See 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR.

CAUTION

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.

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. See 1.22 TROUBLESHOOTING. 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:

CAUTION

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 wires. Clean around plug base and remove plugs.
2. Connect compression tester to front cylinder.
3. With carburetor throttle plates 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. Connect compression tester to rear cylinder.
6. Repeat Steps 3 and 4 on rear cylinder.
7. Compression is normal if final readings are 120 psi (827 kN/m^2) or more and do not indicate more than a 10 psi (69 kN/m^2) variance between cylinders. See Table 3-1.
8. Inject approximately 1/2 oz. (15 ml) of SAE 30 oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

Table 3-1. 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 plugs and remove spark plugs.
3. Remove air cleaner and set carburetor throttle 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. Listen for air leaks at carburetor intake, exhaust, head gasket and timing inspection hole. See Table 3-2.

NOTE

If air is escaping through valves, check push rod length.

9. Repeat procedure on rear cylinder.

CAUTION

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 3-2. Air Leakage Test

AIR LEAK LOCATION	POSSIBLE CAUSES
Intake Manifold	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.
- Oil return passages for clogging.

STRIPPING MOTORCYCLE FOR ENGINE REPAIR 3.3

DISASSEMBLING ENGINE FOR CYLINDER HEAD REPAIR

1. Lift and secure the motorcycle.
   a. Place vehicle on a lift and anchor front wheel in place. Raise lift so the top of the cylinder head is easy to access.
   b. Raise rear wheel off lift using REAR WHEEL SUPPORT STAND (Part No. B-41174).

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

WARNING

Always disconnect the negative 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.

2. Disconnect both battery cables, negative cable first and remove battery.
3. Remove seat and fuel tank. See 4.36 FUEL TANK.
4. Remove left and right fairing lower. See 2.38 FAIRING LOWERS.
5. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER.
6. Remove throttle body, intake manifold and ignition key switch bracket. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD.
7. Remove exhaust header and muffler. See 2.27 EXHAUST SYSTEM.
8. Disconnect spark plug cables. Remove spark plugs.
9. If removing front cylinder, remove ignition coil (7.4 IGNITION COIL) and horn (7.6 HORN).
10. If removing rear cylinder, remove the Engine Temperature Sensor.

NOTE

At this stage, the lower rocker boxes, cylinder heads and cylinders may be removed. See 3.5 CYLINDER HEAD.

ENGINE CRANKCASE REPLACEMENT OR COMPLETE ENGINE REMOVAL

1. Perform the steps listed above.
2. Remove tail section. See 2.33 TAIL SECTION.
3. See Figure 3-1. Place a floor hoist behind the lift. Attach straps to frame and hoist. Raise hoist until straps tighten.
4. Detach clutch cable from handlebar lever.

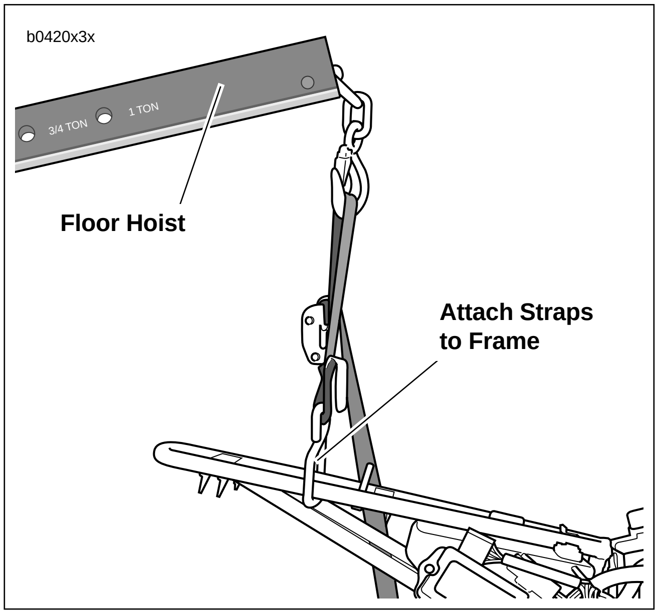


Figure 3-1. Floor Hoist (Typical)

5. Remove rear fender and lower belt guard. See 2.32 REAR FENDER.
6. Remove sprocket cover. See 2.29 SPROCKET COVER.
7. Detach rear brake caliper from caliper mount. See 2.14 REAR BRAKE CALIPER.
8. Detach belt from rear sprocket and remove rear wheel. See 2.6 REAR WHEEL.
9. Drain oil tank and remove oil filter. See 1.3 BATTERY.
10. Detach hoses from all three fittings on oil tank. See 3.9 OIL TANK.
11. Remove both rider footrest mounts from frame. See 2.28 FOOTRESTS.
12. Remove rear shock mounting bolt (metric) from swingarm. Allow rear shock to hang from front mount.
13. Disconnect wiring. See Section 7.
    a. Disconnect neutral switch wire from crankcase.
    b. Unplug cam position sensor from wiring harness.
    c. Disconnect sensor connectors from sensors.
    d. Remove solenoid wire, battery positive cable and circuit breaker charging wire from starter motor.
    e. Locate voltage regulator connector near the oil pump. Disconnect from alternator stator.
    f. Detach wire from oil pressure indicator switch. See 3.10 OIL PRESSURE INDICATOR SWITCH.
14. See Figure 3-2. Place a wooden cradle underneath the crankcase.
15. Place a crating strap between the engine cylinders and around the lift. Tighten crating strap until snug.
16. See Figure 3-3. Remove engine ground strap (1) from swingarm mount block.
17. Detach remaining tie bars from frame.

a. Remove rear tie bar using a swivel socket.
b. See Figure 3-4. Detach front tie bar (1) and clutch cable clamp (3). Remove tie bar bolt (2), clutch cable clamp (3), washer (4) and locknut (5).
c. Remove washer and nut to detach front upper tie bar (11) from isolator (8).

18. Detach front isolator (8). Remove front isolator bolt (6), nut (10), D-washer (9) and washer (7).
19. See Figure 3-3. Remove isolator bolt (7) and lockwasher (6) on each side.
20. Slowly raise floor hoist until rubber isolators (5) can be removed. Frame will rise while engine remains secured to lift by crating strap.

NOTE

Rubber isolators align with a frame mounted metal pin.

21. Raise frame and walk forward over and away from the engine.
22. If necessary, remove rear swingarm. See 2.19 SWINGARM.
23. If necessary, detach swingarm mount block from powertrain by removing bolts (3, 4), washers and locknuts.

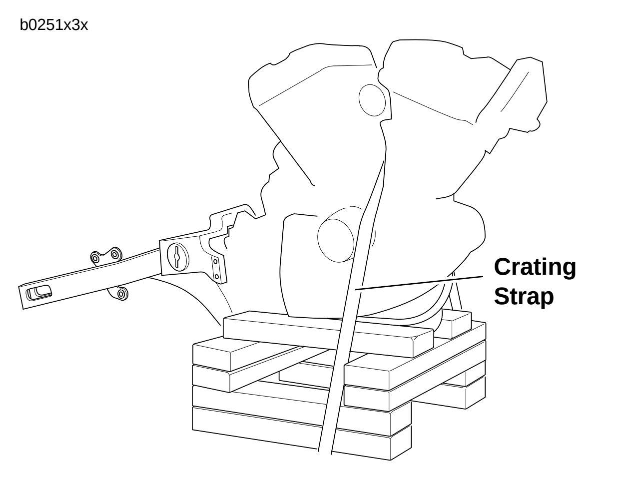
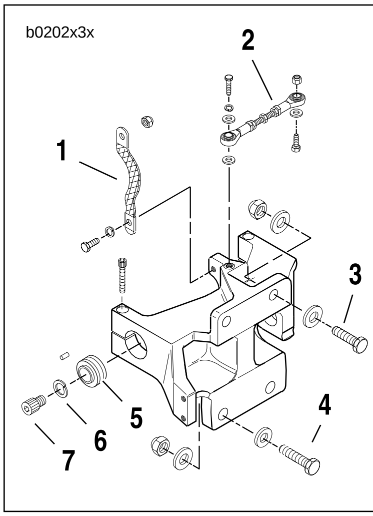
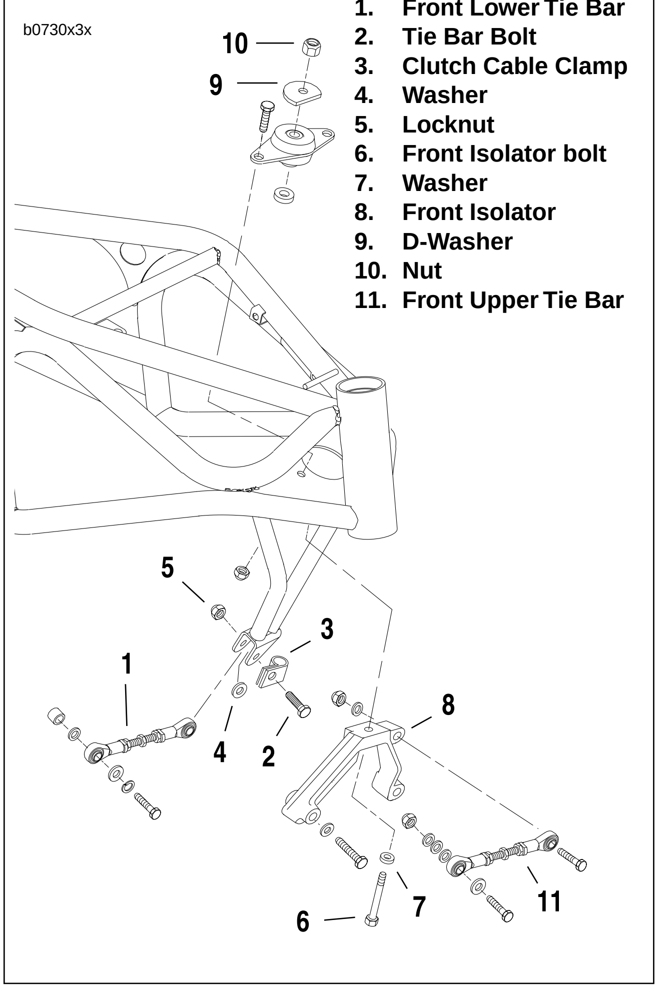


Figure 3-2. Supporting the Engine



1. **Ground Strap**
2. **Rear Isolator**
3. **Swingarm Mount Block Bolts (2, upper)**
4. **Swingarm Mount Block Bolts (2, lower)**
5. **Rubber Isolator (2)**
6. **Lockwashers (2)**
7. **Isolator TORX Bolts (2)**

Figure 3-3. Rear Tie Bar Assembly



1. **Front Lower Tie Bar**
2. **Tie Bar Bolt**
3. **Clutch Cable Clamp**
4. **Washer**
5. **Locknut**
6. **Front Isolator bolt**
7. **Washer**
8. **Front Isolator**
9. **D-Washer**
10. **Nut**
11. **Front Upper Tie Bar**

Figure 3-4. Front Tie Bar Assembly

ENGINE CRANKCASE INSTALLATION

1. See Figure 3-2. Place engine crankcase on supports so frame may be installed over the top of the engine.
2. See Figure 3-3. If removed, attach swingarm mount block to engine. Install upper bolts (3), washers and locknuts finger tight. Install lower bolts (4), washers and locknuts finger tight. Tighten upper bolts to 41-45 ft-lbs (56-61 Nm) and lower bolts to 68-75 ft-lbs (92-102 Nm).
3. If removed, install swingarm. Adjust swingarm bearing preload. See 2.19 SWINGARM.
4. If removed, install transmission mainshaft sprocket. See 6.13 TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT.
5. Remove oil filter (if installed). Walk frame over powertrain.
6. See Figure 3-4. Attach front isolator (8). Install front isolator mount with bolt (6), washers (7), D-washer (9) and locknut (10). Flat on D-washer faces steering neck (forward). Tighten bolt finger tight.
7. See 2.20 REAR ISOLATORS for installation. Install rear isolators but do not tighten isolator bolts at this time.

CAUTION

Do not adjust tie bar assemblies. Tie bar tension is set at the factory. Any attempt at adjusting tension will cause damage to tie bars. Damaged tie bars must be replaced.

8. See Figure 3-3. Rear tie bar must be horizontal and below frame tab. Insert bolt upwards through washer, tie bar and frame. Fasten with nut. Tighten bolt to 30-33 ft-lbs (41-45 Nm).
9. See Figure 3-4. Place clutch cable clamp (3) on front tie bar bolt (2). Clamp should hold cable on primary cover side of motor. Insert bolt from front through frame and install washer (4). Continue through tie bar (1) and frame. Install locknut (5) and tighten to 30-33 ft-lbs (41-45 Nm).
10. Attach front upper tie bar (11). Insert bolt through tie bar front isolator, and frame. Secure with nut and washer. Tighten to 30-33 ft-lbs (41-45 Nm).
11. See Figure 3-3. Tighten the two rear isolator TORX bolts to 63-70 ft-lbs (85-95 Nm)
12. See Figure 3-4. Tighten front isolator bolt (6) to 100-110 ft-lbs (136-149 Nm).
13. Connect feed, return and vent lines to oil tank. See 3.8 OIL HOSE ROUTING. Use **new** hose clamps.
14. Attach battery ground strap to swingarm mount block.
15. Attach clutch cable to handlebar lever.
16. Remove strap from between engine cylinders. Using a floor hoist, lift motorcycle by the frame and remove the wooden cradle from underneath the crankcase.
17. Install rear shock. See 2.21 REAR SHOCK ABSORBER. Remove floor hoist straps.
18. Install rear wheel and attach drive belt. See 2.6 REAR WHEEL.
19. Install rear brake caliper. See 2.14 REAR BRAKE CALIPER.
20. Attach disconnected wires. See Section 7.
    a. Connect solenoid wire, circuit breaker charging wire and battery positive cable to starter.
    b. Connect voltage regulator connector to alternator stator wiring.
    c. Attach cam position sensor to wire harness.
    d. Connect neutral switch wire to crankcase.
    e. Attach oil pressure indicator switch wire.
21. Install rear fender and lower belt guard. See 2.32 REAR FENDER.
22. Install sprocket cover. See 2.29 SPROCKET COVER.
23. Install footrests. See 2.28 FOOTRESTS.
24. Continue with the steps listed under ENGINE INSTALLATION AFTER CYLINDER HEAD REPAIR.

ENGINE INSTALLATION AFTER CYLINDER HEAD REPAIR

1. Install **new** oil filter, engine oil and primary chaincase fluid as necessary. See Section 1.
2. Install intake manifold, throttle body and ignition key switch bracket. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD.
    a. Plug ignition key switch connector into main wiring harness.
    b. Connect sensor connectors to sensors.
3. Install exhaust system. See 2.27 EXHAUST SYSTEM.
4. Install air cleaner assembly. See 4.41 AIR CLEANER.
5. If removed, install horn (7.6 HORN) and ignition coil (7.4 IGNITION COIL).
6. Install spark plugs and connect cables. See 1.17 SPARK PLUGS.

WARNING

Always connect 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.

7. Install battery. Connect battery cables, positive cable first.
8. Install left and right fairing lowers. See 2.38 FAIRING LOWERS.
9. Install tail section, fuel tank and seat. See 2.33 TAIL SECTION.
10. If engine crankcase installation was performed:
    a. Adjust rear belt deflection. See 1.10 DRIVE BELT DEFLECTION.
    b. Adjust rear shock spring preload. See 1.13 PRELOAD ADJUSTMENT.
    c. Adjust clutch lever. See 1.9 CLUTCH.
    d. Check rear brake pedal height. See 1.5 BRAKES.
11. Check all electrical components for proper operation.

REMOVAL

Before removing the cylinder head assembly, see 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR. The rocker arm covers and internal components must be removed before removing cylinder heads.

1. See Figure 3-5. Remove screws with washers (1) and fiber seals (2). Discard fiber seals.

CAUTION

All washers and fasteners used in the engine are hardened. Do not mix or replace hardened washers and fasteners with unhardened parts. Do not reuse fiber cover seals. These actions may result in accelerated wear and increased noise.

2. Remove upper (4) and middle (5) sections of rocker cover. Remove and discard gaskets (6, 7 and 8).
3. Rotate crankshaft until piston on head being repaired reaches top dead center of compression stroke.

NOTE

Both valves in the cylinder head will be closed when viewed through the spark plug hole.

4. Remove hardware holding lower rocker cover to cylinder head in the following order.
   a. Remove two screws and washers (14).
   b. Remove three bolts and washers (15).
   c. Remove the two rocker arm retaining bolts (12) near the push rods.
   d. Remove the remaining two rocker arm retaining bolts (13).
5. Remove lower rocker cover (18).

NOTE

Remove lower rocker boxes as an assembly; then disassemble as required.

6. Mark the location and orientation (top/bottom) of each push rod. Remove push rods.

CAUTION

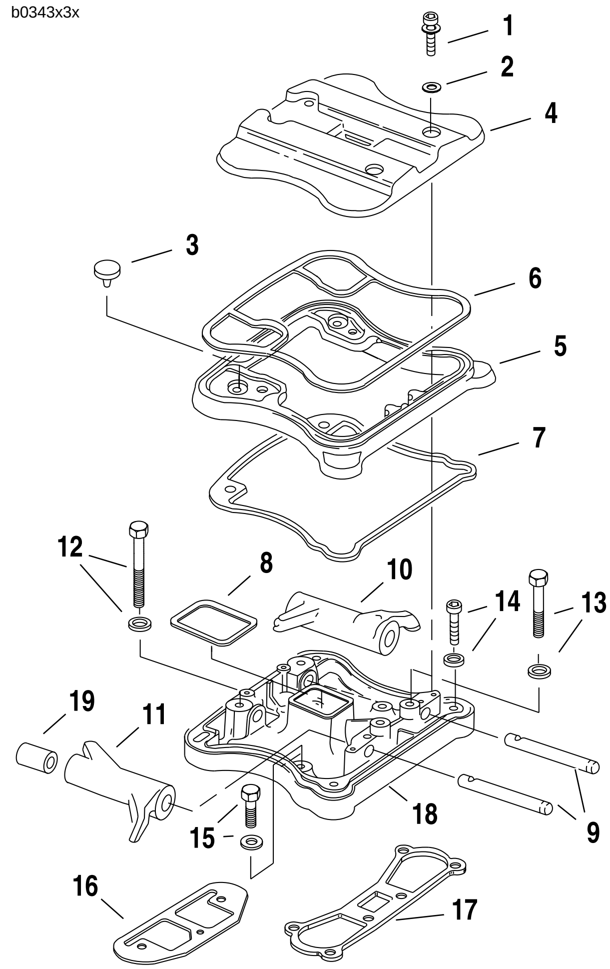
Mark rocker arm shafts for reassembly in their original positions. Valve train components must be reinstalled in their original positions to prevent accelerated wear and increased valve train noise.

7. See Figure 3-6. Remove rocker arm shafts by tapping them out using a hammer and a soft metal punch.
8. See Figure 3-5. Remove rocker arms (10, 11); mark them for reassembly in their original locations.

CAUTION

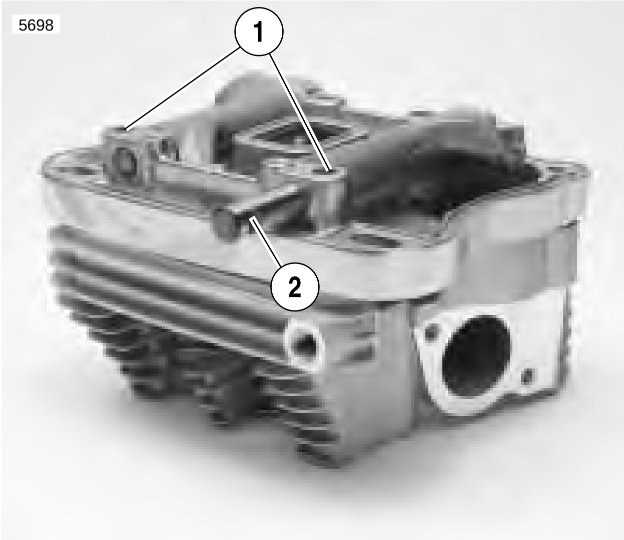
Distortion to the head, cylinder and crankcase studs may result if head screws are not loosened (or tightened) gradually in the sequence shown in Figure 3-7.

9. See Figure 3-7. Loosen each head screw 1/8-turn following the sequence shown.



1. Screws with Washers (4)
2. Fiber Seal (4)
3. Umbrella Valve (2)
4. Upper Rocker Cover
5. Middle Rocker Cover
6. Gasket
7. Gasket
8. Gasket
9. Rocker Arm Shafts
10. Rocker Arm
11. Rocker Arm
12. Bolt and Washer (2) (long)
13. Bolt and Washer (2) (short)
14. Screw and Washer (2)
15. Bolt and Washer (3)
16. Gasket
17. Gasket
18. Lower Rocker Cover
19. Rocker Arm Bushing (8)

Figure 3-5. Rocker Arm Cover



1. **Position of Rocker Arm Retaining Bolts**
2. **Retaining Notch**

Figure 3-6. Removing Rocker Arm Shafts

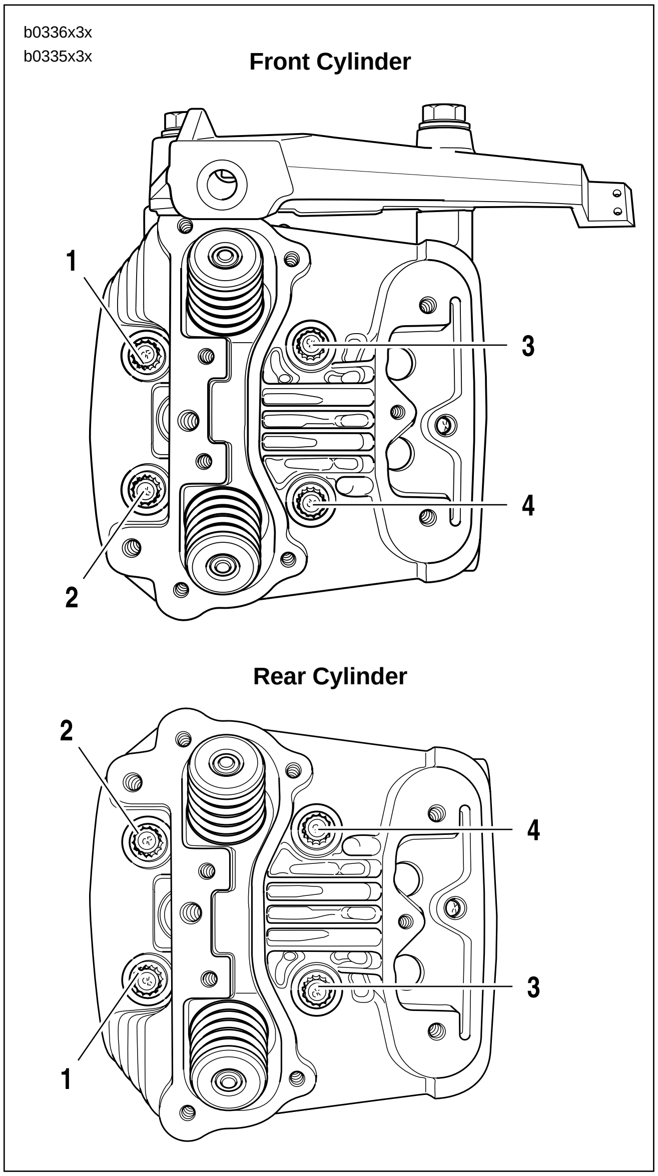


Figure 3-7. Head Screw Loosening/Tightening Sequence

CAUTION

See Figure 3-8. Do not attempt to remove the front isolator mount from front cylinder head. Isolator mount is an integral component and is not meant to be removed unless absolutely necessary. Repeated removals and installations will damage cylinder head threads.

10. Support motorcycle under front header mount. Do not allow engine to drop when performing the next Step.
11. Continue loosening in 1/8-turn increments until screws are loose. Remove head screws.
12. See Figure 3-9. Remove cylinder head (18), head gasket (4), and O-rings (14).

NOTE

Front cylinder must be removed through upper triangular frame members with front isolator mount attached.

13. See Figure 3-11. Remove both push rod covers (7) and hydraulic lifters (6). See 3.15 HYDRAULIC LIFTERS.
14. Repeat the above procedure for the other cylinder head.

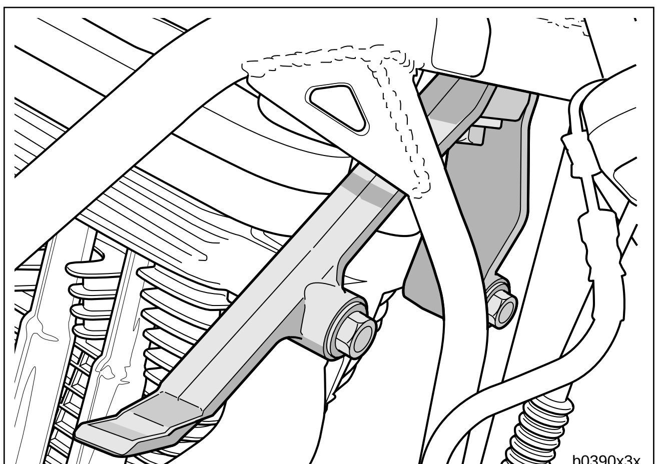
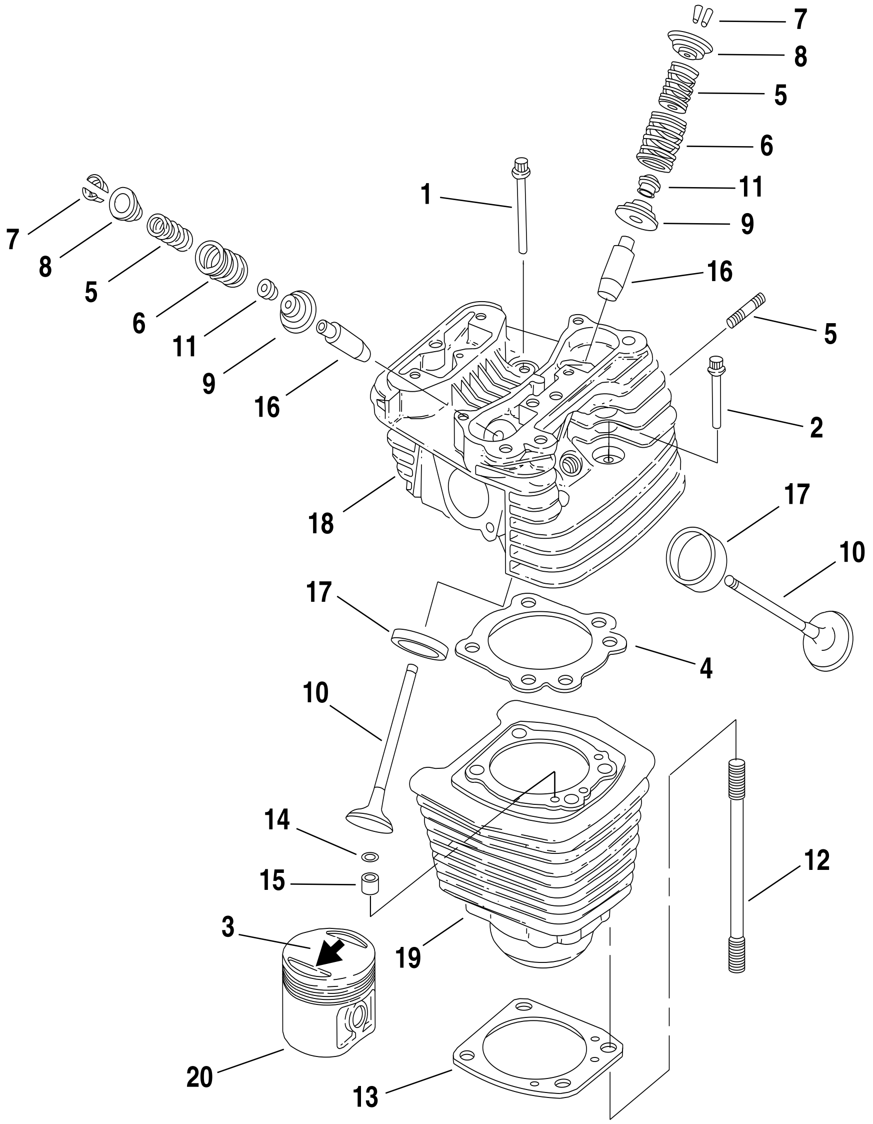


Figure 3-8. Front Isolator Mount (4th Tie Bar Not Shown)

xlhcylhead



1. Head Screw, Long (2)
2. Head Screw, Short (2)
3. Arrow, Piston Direction
4. Head Gasket
5. Inner Valve Spring (2)
6. Outer Valve Spring (2)
7. Valve Keeper (4)
8. Upper Collar (2)
9. Lower Collar (2)
10. Valve (1 Intake, 1 Exhaust)
11. Valve Stem Seal (2)
12. Cylinder Stud (4)
13. Base Gasket
14. O-Ring (2)
15. Insert/Dowel (2)
16. Valve Guide (2)
17. Valve Seat (2)
18. Cylinder Head
19. Cylinder
20. Piston

Figure 3-9. Cylinder Head, Cylinder and Piston

DISASSEMBLY

NOTE
Disassembly of front cylinder exhaust valve components requires front isolator mount removal.

1. See Figure 3-10. Compress valve springs with VALVE SPRING COMPRESSOR (Part No. HD-34736B).
2. See Figure 3-9. Remove valve keepers (7), upper collar (8) and valve springs (5, 6). Mark valve keepers for reassembly in their original locations.
3. Use a fine tooth file to remove any burrs on the valve stem at the keeper groove.
4. Mark valve to ensure that it will be reassembled in the same head. Remove valve (10), valve stem seal (11) and lower collar (9).
5. Repeat the above procedure for the other valve.
6. Disassemble the other head using the same procedure.

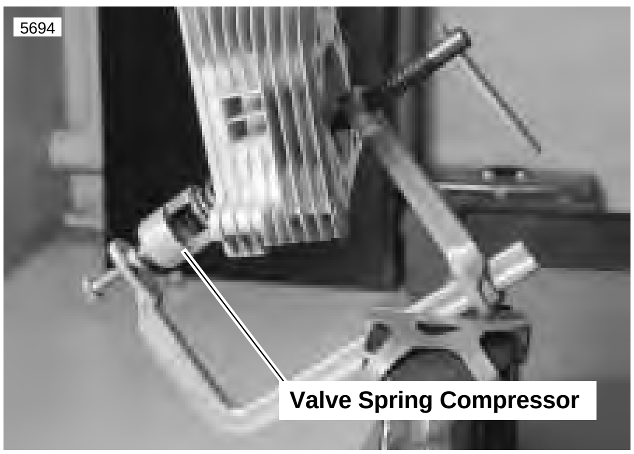
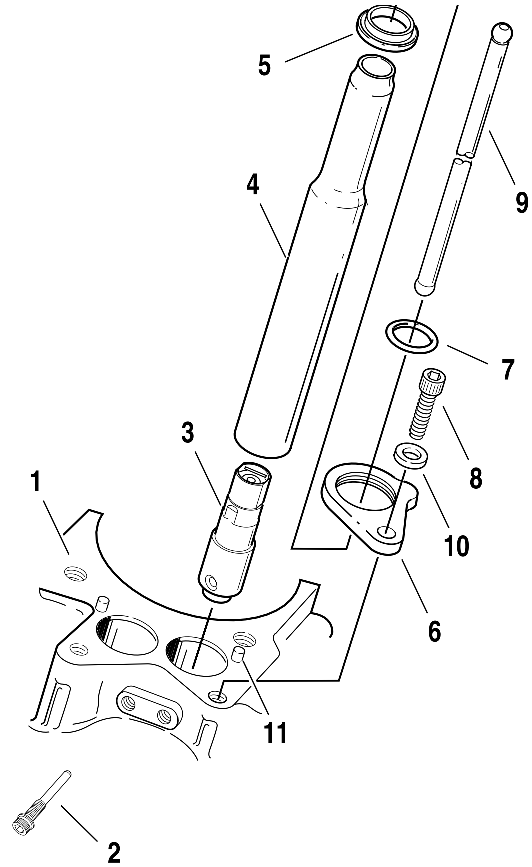


Figure 3-10. Valve Spring Compressor (Part No. HD-34736B)



1. **Right Crankcase Half**
2. **Anti-Rotation Screws with Washers (2)**
3. **Hydraulic Lifter (2)**
4. **Push Rod Cover (2)**
5. **Seal (2)**
6. **Retainer (2)**
7. **O-Ring (2)**
8. **Screw (2)**
9. **Push Rod (2)**
10. **Washer (2)**
11. **Locating Pin (2)**

Figure 3-11. Middle Valve Train Components (Quantities per Engine Cylinder)

CLEANING AND INSPECTION

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.

Figure 3-12. Measuring Rocker Arm Shaft Diameter (Rocker Cover Position)

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.
4. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.
5. Measure and record rocker arm shaft diameter.
   a. Where shaft fits in lower rocker arm cover. See Figure 3-12.
   b. Where rocker arm bushings ride. See Figure 3-13.
6. Measure and record rocker arm shaft bore diameter.
   a. In lower rocker cover. See Figure 3-14.
   b. Rocker arm bushing inner diameter. See Figure 3-15.
7. Check the measurements obtained in Steps 5-6 against the SERVICE WEAR LIMITS. Repair or replace parts exceeding limits.
8. Assemble rocker arms and rocker arm shafts into lower rocker cover.
9. Check end play of rocker arm with feeler gauge.

Figure 3-13. Measuring Rocker Arm Shaft Diameter (Rocker Arm Bushing Position)

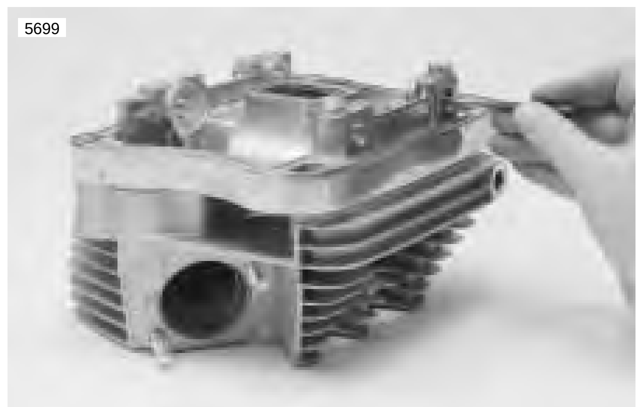


Figure 3-14. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover

Figure 3-15. Measuring Rocker Arm Bushing Inner Diameter

10. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.635 mm).
11. Valve heads should have a seating surface width of 0.040-0.062 in. (1.016-1.575 mm), and should be free of pit marks and burn spots. The color of carbon on exhaust valves should be black or dark brown. White or light buff carbon indicates excessive heat and burning.
12. Valve seats are also subject to wear, pitting, and burning. Resurface valve seats whenever valves are refinished.
13. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).
14. 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 SERVICE WEAR LIMITS.
15. 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.
16. Inspect valve springs for broken or discolored coils.

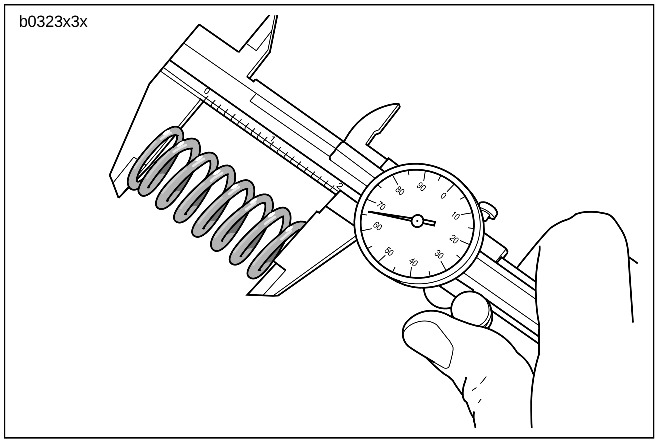


Figure 3-16. Checking Spring Free Length

17. See Figure 3-16. Check free length and compression force of each spring. Compare with SERVICE WEAR LIMITS. If spring length is shorter than specification or if spring compression force is below specification, replace spring.
18. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored or broken.
19. See Figure 3-17. 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 Arms and Bushings

1. See Figure 3-18. 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.
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.

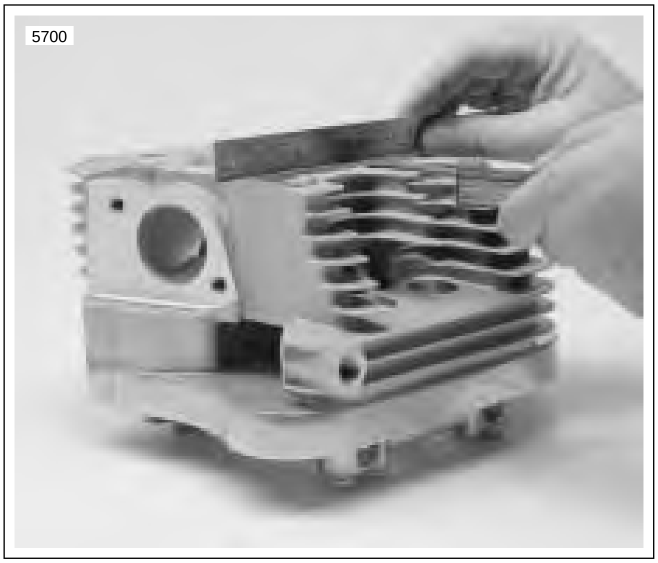


Figure 3-17. Checking Gasket Surface

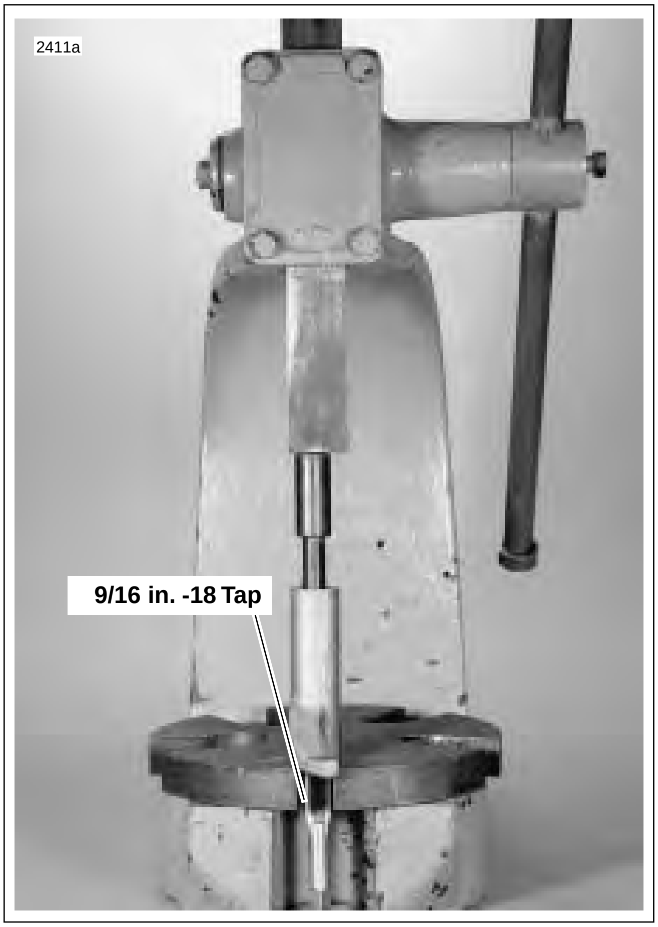


Figure 3-18. Removing Rocker Arm Bushing

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 3-3. If valve stems and/or guides are worn beyond limits, install **new** parts.

Table 3-3. Valve Stem Clearances and Service Wear Limits

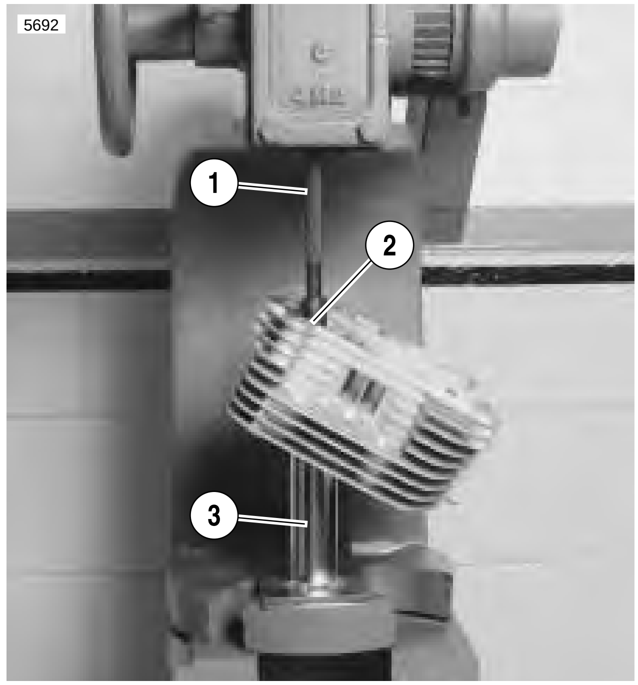
VALVE	CLEARANCE	SERVICE WEAR LIMIT
Exhaust	0.0015-0.0033 in. (0.0381-0.0838 mm)	0.0040 in. (0.1016 mm)
Intake	0.008-0.0026 in. (0.203-0.0660 mm)	0.0035 in. (0.0889 mm)

1. To remove shoulderless guides, press or tap guides toward combustion chamber using DRIVER HANDLE AND REMOVER (Part No. HD-34740).
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 it is not, select one of the following oversizes: +0.001 in. (+0.025 mm), +0.002 in. (+0.051 mm) or +0.003 in. (+0.076 mm) (intake and exhaust).
4. See Figure 3-19. Install shoulderless guides using VALVE GUIDE INSTALLATION TOOL (2) (Part No. HD-34731) and DRIVER HANDLE (1) (Part No. HD-34740). 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 (Steel, Part No. HD-39932 or Carbide, Part No. HD-39932-CAR). Use REAMER LUBRICANT (Part No. HD-39964) or liberal amounts of suitable cutting oil to prevent reamer chatter.
6. Apply the proper surface finish to the valve guide bores using the VALVE GUIDE HONE (Part No. HD-34723). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60°.

NOTE

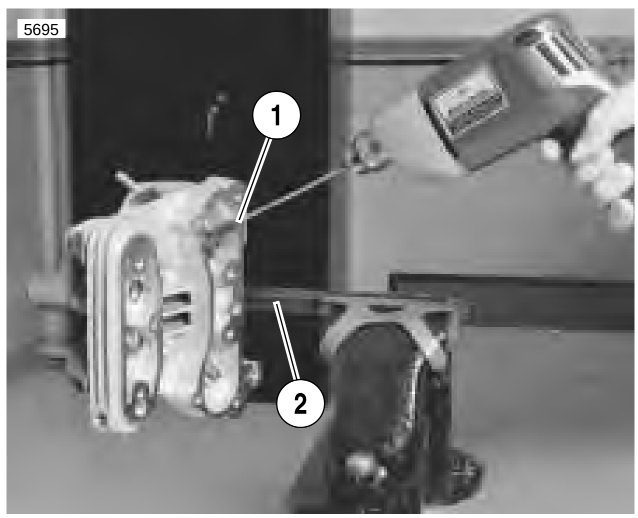
The hone is not intended to remove material.

7. See Figure 3-20. Thoroughly clean valve guide bores using VALVE GUIDE BRUSH (1) (Part No. HD-34751) and hot soapy water.



1. **Driver Handle (Part No. HD-34740)**
2. **Valve Guide Installation Tool (Part No. HD-34731)**
3. **Cylinder Head Stand (Part No. HD-39782)**

Figure 3-19. Installing Shoulderless Valve Guide



1. **Valve Guide Brush (Part No. HD-34751)**
2. **Cylinder Head Holding Fixture (Part No. HD-39786)**

Figure 3-20. Cleaning Valve Guides

Grinding Valve Faces and Seats

After installing valve guides, reface valve seats to make them concentric with guides.

Valve face angle is 45° for both intake and exhaust valves. If a valve refacing grinder is used, it must be adjusted exactly to this angle. It is important to remove no more metal than is necessary to clean up and true valve face. Install a **new** valve if grinding leaves the valve edge (the margin) with a width of less than 1/32 in. (0.8 mm). A valve with too thin a margin does not seat normally, burns easily, may cause pre-ignition and can also lead to valve cracking. Valves that do not clean up quickly are probably warped or too deeply pitted to be reused. Replace the valve if end of valve stem shows uneven wear. After valves have been ground, handle with care to prevent damage to the ground faces.

The valve seats may be refinished with cutters or grinders. Cut seats to a 46° angle or grind seats to a 45° angle. Valve seat tools and fixtures are available commercially. Seat each valve in the same position from which it was removed.

The correct 3-angle valve seat angles are shown in Figure 3-21. Use NEWAY VALVE SEAT CUTTER SET (Part No. HD-35758) to cut the seats. Always grind valves before cutting seats.

1. Cut 46° (or grind 45°) valve seat angle first. Use cutting oil to avoid chatter marks. Cut or grind only enough to clean up the seat.
2. Apply a small amount of lapping compound to the valve face. Rotate valve against seat using VALVE LAPPING TOOL (Part No. HD-96550-36A).
3. See Figure 3-21. Check the contact pattern on valve face. It should be 0.040-0.062 in. (1.016-1.575 mm) wide, and its center should be positioned 2/3 of the way toward the outside edge of face.
4. If valve seat pattern is too close to the stem side of valve face, cut 60° angle in order to raise seat. If pattern is too close to the edge of valve face, cut 31° angle in order to lower seat.
5. After cutting either or both 31° or 60° angles to position seat, final cut 46° (or grind 45°) seat angle to obtain proper 0.040-0.062 in. (1.016-1.575 mm) width.
6. Recheck valve seat width and location with lapping compound as described in Step 2.
7. To achieve a smooth even finish, place a piece of 280 grit emery paper under the cutter head and rotate cutter.

CAUTION

Do not grind valve to shorten. Grinding will remove the case hardening and expose the stem's mild steel core resulting in rapid end wear.

8. See Figure 3-23. Wipe valve seats and valve faces clean. Measure valve stem protrusion.
   a. If valve stem protrudes more than 2.031 in. (51.587 mm), replace valve seat or cylinder head.
   b. If valve stem protrusion is acceptable, valves and seats are ready for lapping.

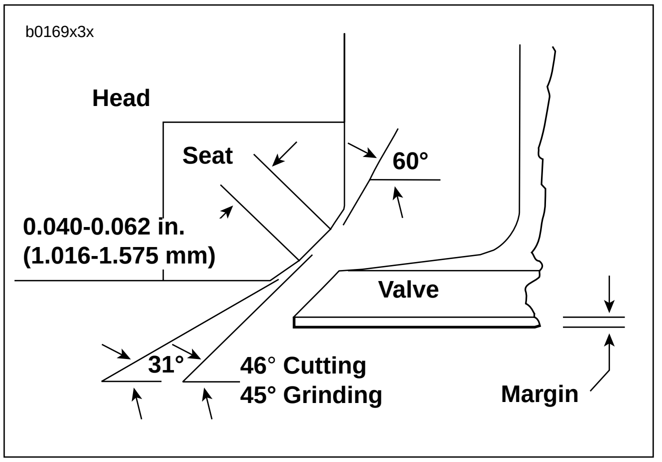


Figure 3-21. Valve Seat Angles

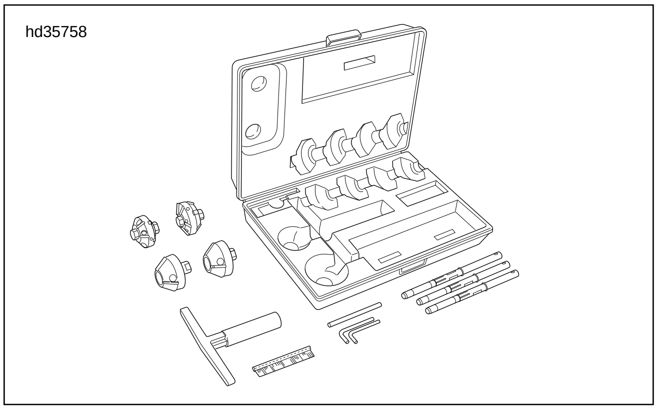


Figure 3-22. Valve Seat Cutter

Table 3-4. Neway Valve Seat Cutters

VALVE SEAT	60° CUTTER	31° AND 46° CUTTERS
Exhaust	Part No. 205	Part No. 622
Intake	Part No. 293	Part No. 642

Replacing Valve Seats

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.

To remove the old seat, lay a bead of weld material around the inside diameter of the seat. This will shrink the seat outside diameter and provide a surface for driving the seat out the port side.

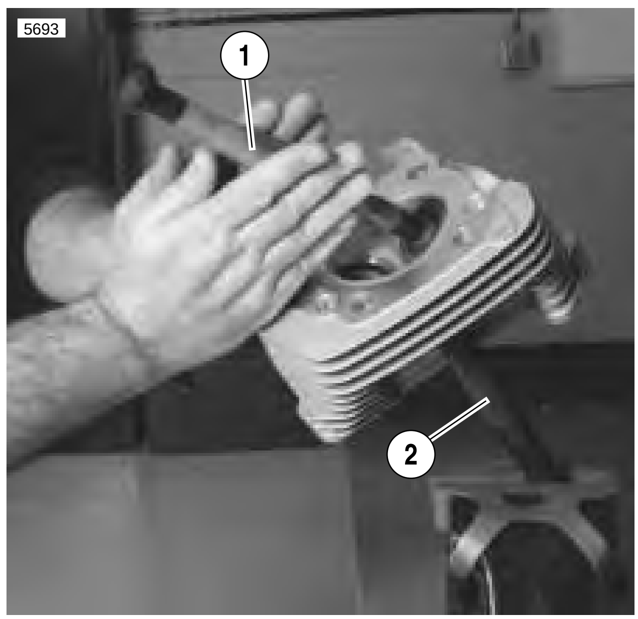
Lapping Valve Faces and Seats

NOTE

If valve faces and seats have been smoothly and accurately refaced, very little lapping will be required to complete the seating operation.

1. See Figure 3-24. Use CYLINDER HEAD HOLDING FIXTURE (2) (Part No. HD-39786) to secure cylinder head.
   a. Apply a light coat of fine lapping compound to valve face. Insert valve in guide.
   b. Place one rubber cup end of VALVE LAPPING TOOL (1) (Part No. HD-96550-36A) onto head of valve.
   c. Holding lapping tool as shown, apply only very light pressure against valve head.
   d. Rotate lapping tool and valve alternately clockwise and counterclockwise a few times.
2. Lift valve and rotate it about 1/3 of a turn clockwise. Repeat lapping procedure in Step 1.
3. Repeat Step 2. Then, remove valve.
4. Wash valve face and seat. Dry parts with a **new**, clean cloth or towel.
5. Inspect valve and seat.
   a. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated.
   b. If lapped finish is not complete, further lapping (or grinding and lapping) is necessary.

Figure 3-23. Measuring Valve Stem Protrusion



1. **Valve Lapping Tool (Part No. HD-96550-36A)**
2. **Cylinder Head Holding Fixture (Part No. HD-39786)**

Figure 3-24. Lapping Valves

ASSEMBLY

CAUTION

Make sure all lapping compound is removed from cylinder head and valves after lapping is completed. If lapping compound contaminates any internal engine components or engine oil, excessive engine wear and damage may result.

1. Wash cylinder head and valves in warm, soapy water to remove all lapping compound.
2. Scrub valve guide bores with VALVE GUIDE BRUSH (Part No. HD-34751) and hot, soapy water.
3. Blow dry with compressed air.
4. Apply a liberal amount of engine oil to the valve stem.
5. See Figure 3-25. Insert valve into valve guide (5) and install lower collar (4).
6. See Figure 3-26. Place a protective sleeve over the valve stem keeper groove. Coat the sleeve with oil and place a **new** seal over the valve stem.

CAUTION

Always use a protective sleeve on the valve stem keeper groove when installing valve stem seal. If the seal is installed without using the protective sleeve, the seal will be damaged.

CAUTION

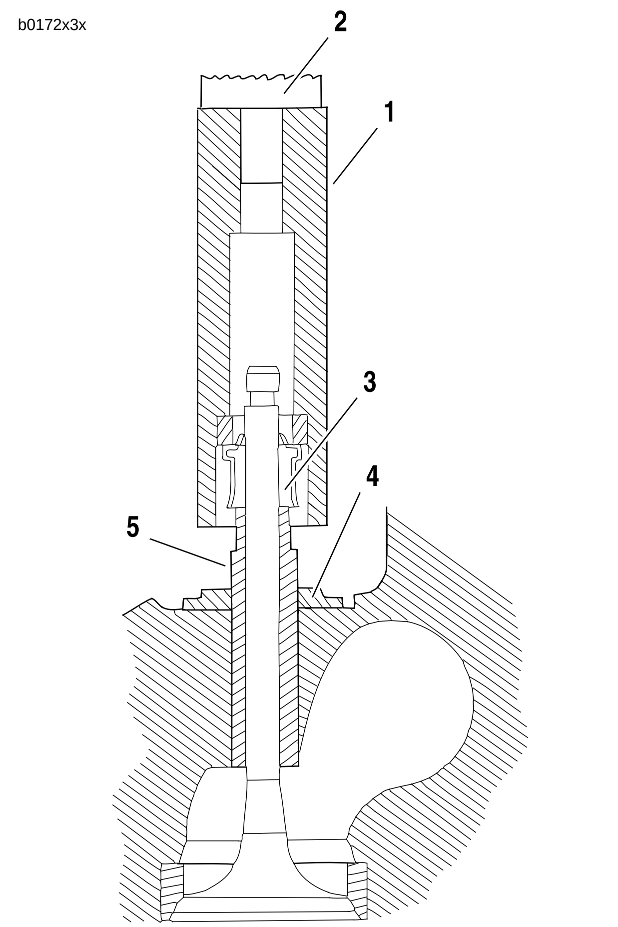
Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.

7. See Figure 3-25. Tap the valve stem seal (3) onto the valve guide (5) using the VALVE SEAL INSTALLATION TOOL (Part No. HD-34643A) and DRIVER HANDLE (Part No. HD-34740). The seal is completely installed when the tool touches the lower collar (4).
8. See Figure 3-9. Install valve springs (5, 6) and upper collar (8).
9. Compress springs with VALVE SPRING COMPRESSOR (Part No. HD-34736B).
10. Insert valve keepers (7) into upper collar (8), making sure they engage groove in valve stem. The keeper gaps should be equal.
11. Release and remove VALVE SPRING COMPRESSOR.
12. Repeat Steps 4-11 for the remaining valve(s).

WARNING

Always wear proper eye protection and gloves when working with compressed air. Debris or solvent may be blown out with enough force to penetrate skin or cause eye injury. Failure to comply could result in death or serious injury.

13. If front isolator mount was removed, install as follows.
    a. Clean residual loctite from threads in engine with a suitable nonflammable solvent and dry with compressed air.
    b. Apply LOCTITE THREADLOCKER 271 (red) to threads of **new** front isolator mount bolts.
    c. Apply a thin film of clean HD 20W50 engine oil to both sides of **new** thick washers and to bottom of bolt heads. Exercise caution to avoid mixing oil on washers with loctite on bolts.
    d. Position front isolator mount and secure with two **new** front bolts with **new** thick washers. Tighten bolts to 60 ft-lbs (81 Nm) initially and then loosen each bolt one full turn. Tighten bolts again to 60 ft-lbs (81 Nm).



1. Valve Seal Installation Tool
2. Driver Handle
3. Valve Stem Seal
4. Lower Collar
5. Valve Guide

Figure 3-25. Valve Seal Installation

Figure 3-26. Valve Guide Seal Protector Sleeve

INSTALLATION

If only cylinder head work was needed, reinstall cylinder head following these instructions. If further repair is required, see 3.6 CYLINDER AND PISTON.

1. See Figure 3-9. Coat mating surfaces of cylinder studs (12) and head screws (1, 2) with parts cleaning solution.
2. Scrape old oil and any carbon deposits from threads by using a back-and-forth motion, threading each head screw onto its mating cylinder stud.
3. Remove head screws from studs. Wipe or blow dry thread surfaces.
4. Apply oil to stud threads and to the underside of the head screw shoulder.

CAUTION

Only oil film must remain on the head screw surfaces. Too much oil will pool in the head screw sleeve. Pooled oil may prevent proper torque application and full thread engagement.

5. Blow or wipe off excess oil from head screws.
6. Thoroughly clean and dry the gasket surfaces of cylinder (19) and cylinder head (18).
7. Install a **new** O-ring (14) on each dowel (15).

NOTE

O-rings (14) help to properly position the head gasket (4). O-rings must be installed before the head gasket.

8. Install a **new** head gasket (4) to cylinder.
9. Carefully lower cylinder head over studs and position on dowels. Use great care so as not to disturb head gasket.

CAUTION

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.

10. See Figure 3-7. For each cylinder head, start with screw numbered one, as shown. In increasing numerical sequence (i.e. – 1, 2, 3 and 4):
    a. Tighten each screw to 8-10 ft-lbs (11-14 Nm).
    b. Tighten each screw to 13-15 ft-lbs (18-20 Nm).
    c. Loosen all screws.
11. 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 8-10 ft-lbs (11-14 Nm).
    b. Tighten each screw to 13-15 ft-lbs (18-20 Nm).
    c. See Figure 3-27. Mark cylinder head and head screw shoulder with a line as shown (View A). Tighten each screw a 1/4-turn (85°-90°) (View B).
12. See Figure 3-11. Rotate engine so that both lifters (6), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.
13. Apply a liberal amount of engine oil to lifter assembly (especially roller needles) for smooth initial operation.

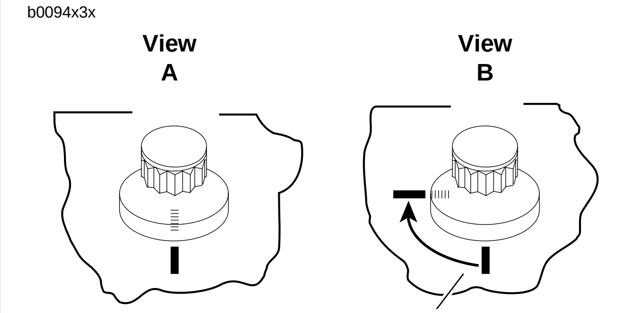


Figure 3-27. Tightening Head Screws

14. Insert lifter (6) into bore in crankcase (1). Rotate lifter so that flats at upper end of lifter face the front and rear of the engine. If the lifter is installed incorrectly, pins (2) cannot be inserted.
15. See Figure 3-11. Insert anti-rotation screws (2). Tighten to 55-65 **in-lbs** (6-7 Nm).
16. Install push rod covers.
    a. Slide **new** seal (8) and retainer (9) over top of push rod cover (7).
    b. Position **new** O-ring (10) at top of push rod cover.
    c. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with lifter bore in crankcase.
    d. Lower retainer (9) with seal (8) onto crankcase, aligning locating pin (15) with hole in retainer.
    e. Insert screw (11) with washer (13) through hole in retainer (9). Thread screw (11) into tapped hole in crankcase. Tighten to 15-18 ft-lbs (20-24 Nm).

NOTE

Intake push rods and valves are located next to the carburetor's intake manifold; exhaust push rods and valves are next to the exhaust headers.

17. Identify push rod color coding, length and respective push rod positions in engine. See Table 3-5. Place intake and exhaust push rods onto seat at top of lifter.

Table 3-5. Push Rod Selection Table

POSITION	COLOR CODE	LENGTH	PART NUMBER
Exhaust (Front & Rear)	3 Band-Pink	10.800 in. (274.320 mm)	17904-89
Intake (Front & Rear)	1 Band-Brown	10.746 in. (272.948 mm)	17897-89

18. See Figure 3-5. Install **new** gaskets (16, 17) with the bead facing up. Place lower rocker box assembly (with rocker arms and shafts) into position. Place push rods in rocker arm sockets.

CAUTION

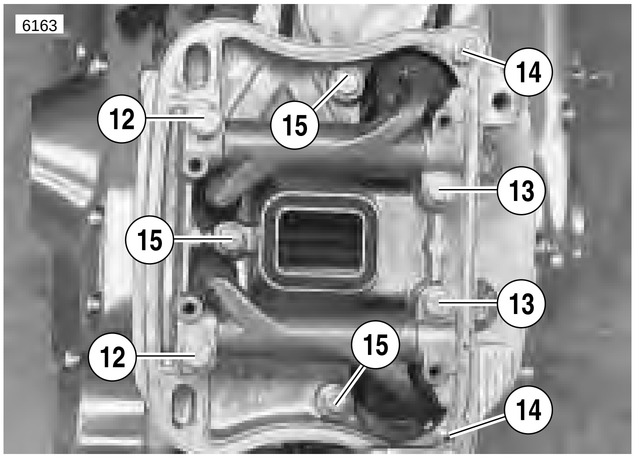
Do not turn engine over until both push rods can be turned with fingers. Otherwise, damage to push rods or rocker arms may result.

19. See Figure 3-28. Install fasteners (12, 13, 14 and 15). Slowly snug all fasteners in small increments (one turn at a time). Use a cross pattern on the four large bolts (12, 13) that fasten the lower rocker box to head. This will bleed the lifters.
    a. Tighten bolts (12, 13) to 15-19 ft-lbs (20-26 Nm).
    b. Tighten bolts (15) to 10-14 ft-lbs (14-19 Nm).
    c. Tighten screws (14) to 130-150 **in-lbs** (15-17 Nm).

NOTES

Tubular frame prohibits direct access to bolt (12) on right rear cylinder. Use TORQUE ADAPTOR (SNAP-ON Part No. FRDH 181) and TORQUE COMPUTER (SNAP-ON Part No. SS-306G) to correctly assemble.

20. See Figure 3-5. Install middle and upper rocker covers.
    a. Place a **new** gasket (7) on lower rocker box assembly.
    b. Install middle rocker cover (5) with umbrella valve next to intake manifold.
    c. Place a **new** gasket (6) on middle rocker cover.
    d. Install upper rocker cover (4) using screws with washers (1) and **new** fiber seals (2). Tighten screws to 10-14 ft-lbs (14-19 Nm).
21. Install the other cylinder using the same procedure.



ITEM NUMBER IN FIGURE 3-5.	SIZE	TORQUE
Bolt with washer (12)	5/16-18 X 2-3/4	15-19 ft-lbs (20-26 Nm)
Bolt with washer (13)	5/16-18 X 2-1/2	
Screw with washer (14)	1/4-20 X 1-1/2	130-150 **in-lbs** (15-17 Nm)
Bolt with washer (15)	1/4-20 X 1-1/4	10-14 ft-lbs (14-19 Nm)

Figure 3-28. Lower Rocker Box Fasteners

CYLINDER AND PISTON 3.6

REMOVAL/DISASSEMBLY

1. Strip motorcycle as described under 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR.
2. Remove cylinder head. See 3.5 CYLINDER HEAD.
3. Clean crankcase around cylinder base to prevent dirt and debris from entering crankcase while removing cylinder.
4. See Figure 3-29. Turn engine over until piston (3) of cylinder being removed is at bottom of its stroke.
5. Carefully raise cylinder (1) 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 (4). Do not allow piston to fall against cylinder studs. Discard cylinder base gasket (5).

CAUTION

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 6.0 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 pistons.

⚠WARNING

The piston pin retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

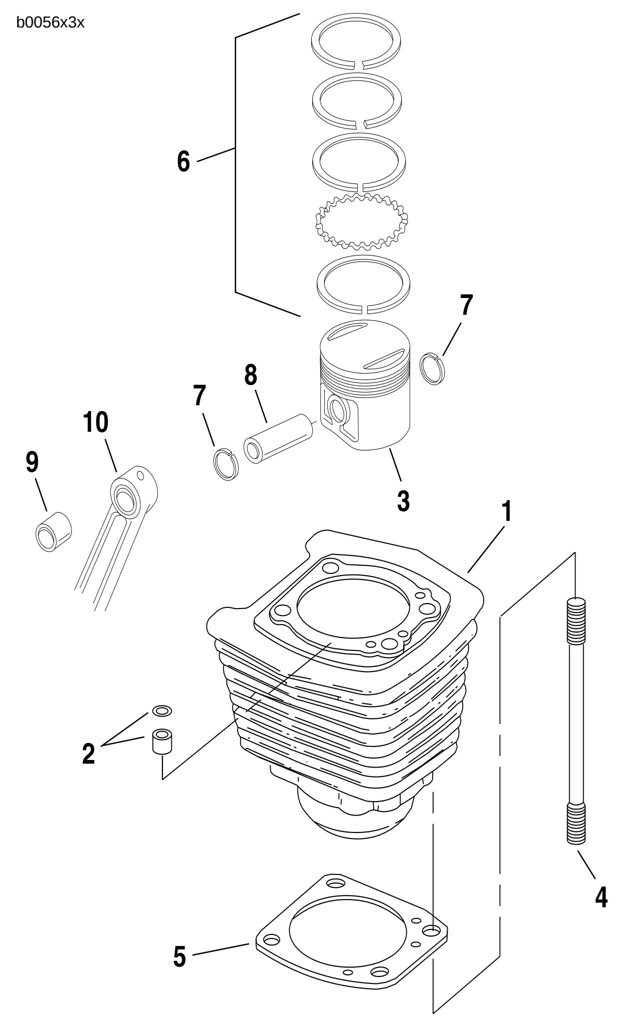
CAUTION

The piston pin retaining rings must not be reused. Removal may weaken retaining rings and they may break or dislodge. Either occurrence may damage engine.

8. Insert an awl in the recessed area below the piston pin bore and pry out the piston pin retaining rings. To prevent the ring from flying out, place your thumb over the retaining ring.

NOTE

Since the piston pin is a loose fit in the piston, the pin will easily slide out. The pins have tapered ends to help seat the round retaining rings. See Figure 3-30. 1203cc piston pins are stamped with a V-groove at one end.



1. Cylinder
2. Dowel (2) and O-Ring (2)
3. Piston
4. Cylinder Stud (4)
5. Base Gasket
6. Ring Set
7. Retaining Ring (2)
8. Piston Pin
9. Piston Pin Bushing
10. Connecting Rod

Figure 3-29. Cylinder and Piston

9. Mark each pin boss with either an “F” or an “R” to indicate front or rear cylinder, respectively. See Figure 3-30. The arrow at the top of 1203cc pistons must always point toward the front of the engine.

CAUTION

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.

10. See Figure 3-29. Spread piston rings (6) outward until they clear grooves in piston (3) and lift off.

CLEANING AND INSPECTION

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 to 0.00175 in. (0.03175-0.04445 mm) clearance in bushing.
   b. If piston pin-to-bushing clearance exceeds 0.00200 in. (0.05080 mm), replace worn parts. See CONNECTING ROD BUSHING on page 3-29.
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

CAUTION

If either cylinder gasket surface does not meet flatness specifications, replace cylinder and piston. Proper tolerances will extend component life and prevent leaks.

1. See Figure 3-31. Check cylinder head gasket surface for flatness.
   a. Lay a straightedge across the surface.
   b. Try to insert a feeler gauge between the straightedge and the gasket surface.
   c. If cylinder head gasket surface is not flat within 0.006 in. (0.152 mm), replace cylinder and piston.
2. Check cylinder base gasket surface for flatness.
   a. Lay a straightedge across the surface.
   b. Try to insert a feeler gauge between the straightedge and the gasket surface.
   c. If cylinder base gasket surface is not flat within 0.008 in. (0.203 mm), replace cylinder and piston.

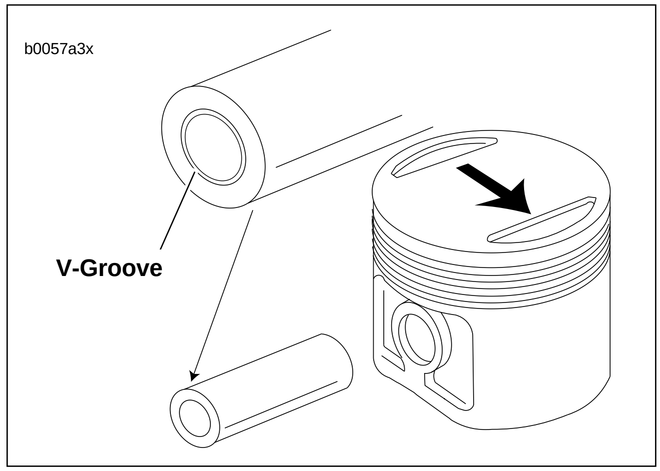


Figure 3-30. Piston Pin and Piston Identification

Figure 3-31. Checking Gasket Surfaces

Measuring Cylinder Bore

1. Remove any burrs from the cylinder gasket surfaces.
2. See Figure 3-32. Install a head and base gasket, and CYLINDER TORQUE PLATES (Part No. HD-33446A) 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 3.5 CYLINDER HEAD.

NOTE

Torque plates, properly tightened and installed with gaskets, simulate engine operating conditions. Measurements will vary as much as 0.001 in. (0.025 mm) without torque plates.

3. Take cylinder bore measurement in ring path, starting about 1/2 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 (or "egged") and will also show any cylinder taper or bulge.
5. See Table 3-6. If cylinder is not scuffed or scored and is within service limit, see FITTING CYLINDER TO PISTON on page 3-27.

NOTE

If piston clearance exceeds service limit, cylinders should be rebored and/or honed to next standard oversize, and refitted with the corresponding piston and rings. Do not fit piston tighter than 0.0007 in. (0.0178 mm). See 3.1 SPECIFICATIONS.

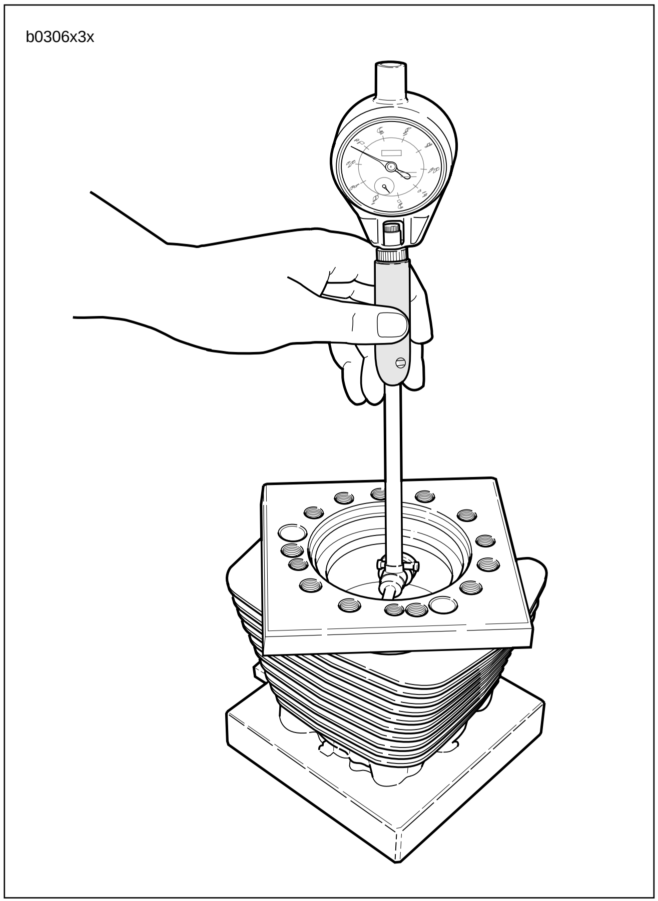


Figure 3-32. Measuring Cylinder Bore Using Torque Plates (Part No. HD-33446A)

Table 3-6. Cylinder Bore Service Wear Limits

BORE SIZES	IN.	MM
Standard Bore	3.5008	88.9203
0.005 in. OS Bore (0.127 mm)	3.5050	89.0270
0.010 in. OS Bore (0.254 mm)	3.5100	89.1540
0.020 in. OS Bore (0.508 mm)	3.5200	89.4080
0.030 in. OS Bore (0.762 mm)	3.5300	89.6620

Measuring Piston

Because of their complex shape, the pistons cannot be accurately measured with standard measuring instruments.

The pistons have the typical elliptical shape when viewed from the top. However, they also are barrel-shaped when viewed from the side. This barrel shape is not symmetrical.

Any damage to the piston will change its shape, which will lead to problems.

Fitting Cylinder to Piston

Since pistons cannot be accurately measured with standard measuring instruments, the bore sizes must be observed. Bore sizes are listed in Table 3-7. Example: A 0.005 in. (0.127 mm) oversize piston will have the proper clearance with a bore size of 3.502 in. ± 0.0002 in. (88.951 mm ± 0.0051 mm) for the 1203cc engine.

Boring and Honing Cylinder

When cylinder requires oversize reboring to beyond 0.030 in. (0.762 mm), the oversize limit has been exceeded and cylinder must be replaced.

1. Bore cylinder with gaskets and torque plates attached. Bore to 0.003 in. (0.076 mm) under the desired finished size.
2. Hone the cylinder to its finished size using a 280 grit rigid hone followed by a 240 grit flexible ball hone. Honing must be done with the torque plates attached. All honing must be done from the bottom (crankcase) end of the cylinder. Work for a 60° crosshatch pattern.

Fitting Piston Rings

NOTE

Ring sets and pistons, 0.040 in. (1.016 mm) oversize, are not available on 1203cc engines.

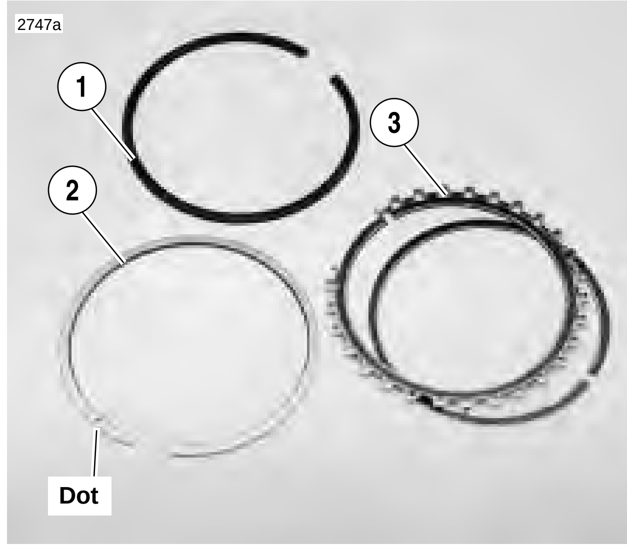
See Figure 3-33. Piston rings are of two types: compression (1, 2) and oil control (3). The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward. Ring sets are available to fit standard and oversize pistons.

Piston ring sets must be properly fitted to piston and cylinder:

1. See Figure 3-34. Place piston in cylinder about 1/2 in. (12.7 mm) from top. Set ring to be checked squarely against piston as shown. Check end gap with thickness gauge. See 3.1 SPECIFICATIONS for tolerance.

NOTE

See SERVICE WEAR LIMITS for end gap dimensions. Do not file rings to obtain proper gap.



1. **Top Compression Ring – Install either side up**
2. **Second Compression Ring – Dot Toward Top**
3. **Oil Control Rings**

Figure 3-33. Piston Rings

Table 3-7. Final Cylinder Bore Sizes

BORE SIZES	IN.	MM
Standard Bore*	3.4978 in.	88.8441 mm
0.005 in. OS Bore (0.127 mm)	3.502 in.	88.951 mm
0.010 in. OS Bore (0.254 mm)	3.507 in.	89.078 mm
0.020 in. OS Bore (0.508 mm)	3.517 in.	89.332 mm
0.030 in. OS Bore (0.762 mm)	3.527 in.	89.586 mm

*All bore sizes + 0.0002 in. (0.0051 mm)

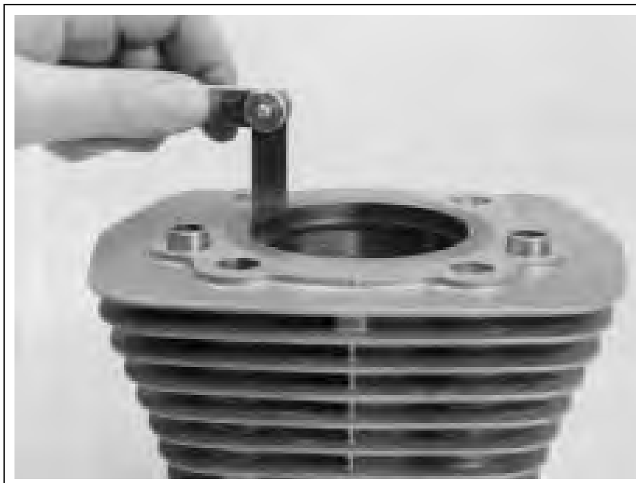


Figure 3-34. Measuring Ring End Gap

NOTE

The same piston may be used if cylinder bore was not changed, unless it is scuffed or grooved. However, replace rings and hone the cylinder walls with a No. 240 grit flexible hone to facilitate ring seating.

2. See Figure 3-35. Apply engine oil to piston grooves. Use TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586) to slip compression rings over piston into their respective grooves. Be extremely careful not to over expand, twist rings or damage piston surface when installing rings.

NOTE

Install second compression ring with dot towards top.

3. See Figure 3-36. Install rings so end gaps of adjacent rings are a minimum of 90° apart. Ring gaps are not to be within 10° of the thrust face centerline.
4. See Figure 3-37. Check for proper side clearance with thickness gauge, as shown. See 3.1 SPECIFICATIONS for tolerance.

NOTE

If the ring grooves are clean and the side play is still not correct, replace the rings, the piston or both.

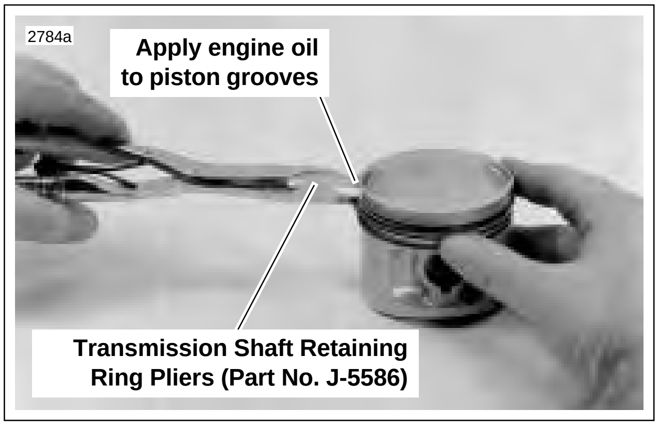


Figure 3-35. Installing Piston Rings

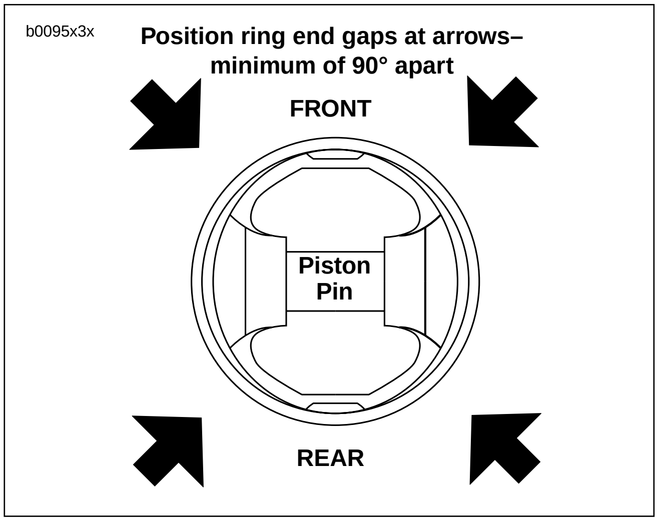


Figure 3-36. Ring End Gap Position

Figure 3-37. Measuring Ring Clearance in Groove

Connecting Rod Bushing

REMOVAL/INSTALLATION

When connecting rod bushing is worn to excessive pin clearance (0.002 in. or more) (0.051 mm) it must be replaced.

1. See Figure 3-38. Install plastic hoses (3) over studs.
2. Secure connecting rod with CONNECTING ROD CLAMPING TOOL (2) (Part No. HD-95952-33A).

NOTE

If CONNECTING ROD CLAMPING TOOL holes are too small, enlarge the holes in the tool.

3. See Figure 3-39. Attach PISTON PIN BUSHING TOOL (Part No. HD-95970-32C) to the connecting rod. The receiver cup (1) fits on one side of the rod while the driver (2) fits on the opposite side as shown.
4. Use two box wrenches and push worn bushing from connecting rod.
5. Remove piston pin bushing tool from connecting rod.
6. Remove bushing from receiver cup.
7. Attach PISTON PIN BUSHING TOOL to connecting rod. Place **new** bushing between connecting rod and driver.

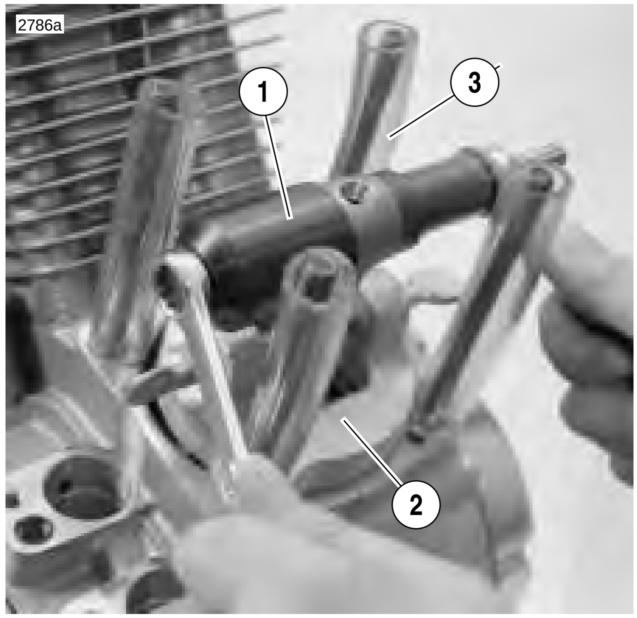
NOTE

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

8. 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.
9. 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.

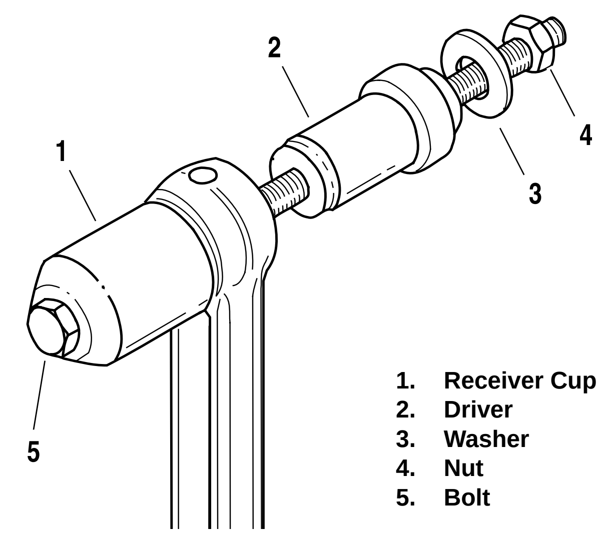
CAUTION

Replace bent connecting rods. Do not attempt to straighten. Straightening rods by bending will damage the bearing on the crank pin and the piston pin bushing. Installing bent connecting rods will damage cylinder and piston beyond repair.



1. **Piston Pin Bushing Tool (Part No. HD-95970-32C)**
2. **Rod Clamping Tool (Part No. HD-95952-33A)**
3. **Plastic Hose**

Figure 3-38. Installing New Piston Pin Bushing



1. **Receiver Cup**
2. **Driver**
3. **Washer**
4. **Nut**
5. **Bolt**

Figure 3-39. Piston Pin Bushing Tool Assembly for Bushing Removal

ASSEMBLY/INSTALLATION

1. See Figure 3-40. Place PISTON SUPPORT PLATE (3) (Part No. HD-42322) around connecting rod.
2. Install piston assembly over connecting rod.

NOTE

New 1203cc pistons must be installed with the arrow, at the top of the piston, pointing towards the front of the engine.

3. Install piston pin.

WARNING

The piston pin retaining rings are highly compressed in the ring groove and may “fly out” with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

CAUTION

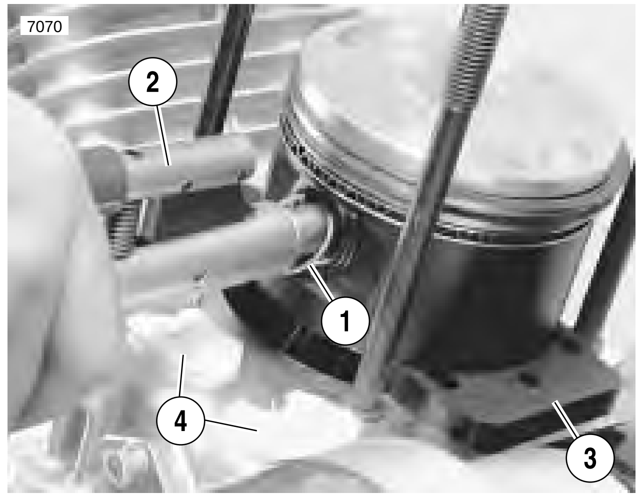
Always use new retaining ring. Make sure retaining ring groove is clean and that ring seats firmly in groove. If it does not, discard the ring. Never install a used retaining ring or a new one if it has been installed and then removed for any reason. A loosely installed ring will come out of the piston groove and damage cylinder and piston beyond repair.

4. See Figure 3-40. Install **new** piston pin retaining rings (1) using PISTON PIN RETAINING RING INSTALLER (2) (Part No. HD-34623B). Place **new** retaining ring on tool with gap pointing up. See Figure 3-41.

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.

5. See Figure 3-36. Make sure the piston ring end gaps are properly positioned as shown.
6. Remove PISTON SUPPORT PLATE.
7. Lubricate cylinder wall, piston, pin and rod bushing with engine oil.
8. Turn engine until piston is at top dead center.
9. See Figure 3-42. Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51C).
10. Remove protective sleeves from cylinder studs. Install a **new** cylinder base gasket. Make sure the piston does not bump the studs or crankcase.
11. Install cylinder over piston.
12. Remove PISTON RING COMPRESSOR.
13. Assemble cylinder head. See 3.5 CYLINDER HEAD.
14. Install cylinder head. See 3.5 CYLINDER HEAD.
15. Install assembled engine. See 3.4 INSTALLING THE ENGINE.



1. **Piston Pin Retaining Ring**
2. **Piston Pin Retaining Ring Installer**
3. **Piston Support Plate**
4. **Plugged Lifter Bores**

Figure 3-40. Installing Piston Retaining Rings

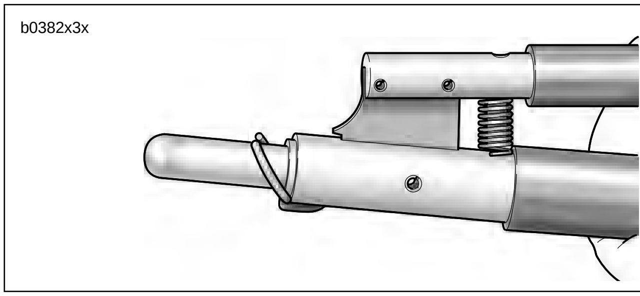
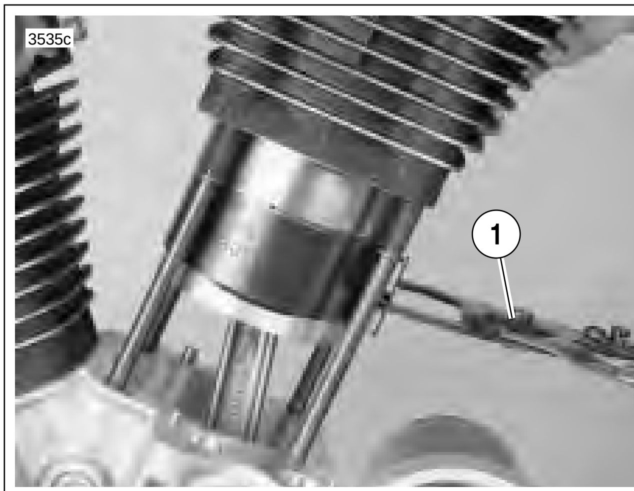


Figure 3-41. Aligning Retaining Ring



1. **Piston Ring Compressor (Part No. HD-96333-51C)**

Figure 3-42. Compressing Piston Rings

LUBRICATION SYSTEM 3.7

CHECKING AND ADDING OIL

Check engine oil level in oil tank 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. Oil tank capacity with filter change is 2.0 quarts (1.89 liters).

CHANGING OIL AND FILTER

After a new engine has run its first 500 miles (800 km) and at 5000 mile (8000 km) intervals or annually thereafter, completely drain oil tank of used oil. Refill with fresh oil. If vehicle is driven extremely hard, used in competition or driven on dusty roads, change engine oil at shorter intervals. Always change oil filter when changing engine oil.

NOTE

See 1.4 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 tank. 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 3.8

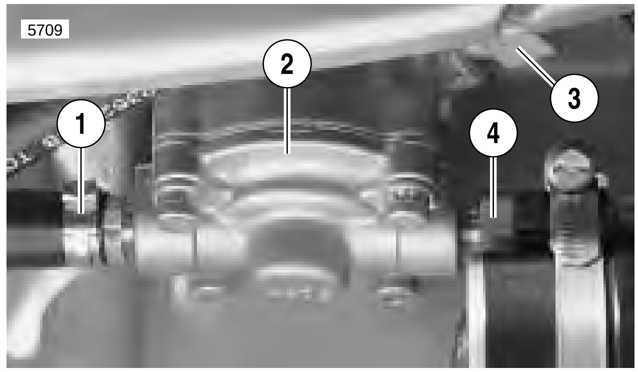
GENERAL

See Figure 3-43. The oil tank has three fittings. From the top of the tank, the vent hose (3) and the return hose (4) run downward below the battery tray. Cable straps secure the hoses in place.

A T-fitting (5) on the bottom of the oil tank supplies the feed hose (1) and the drain hose (2). The drain hose (2) attaches to the left side of the frame.

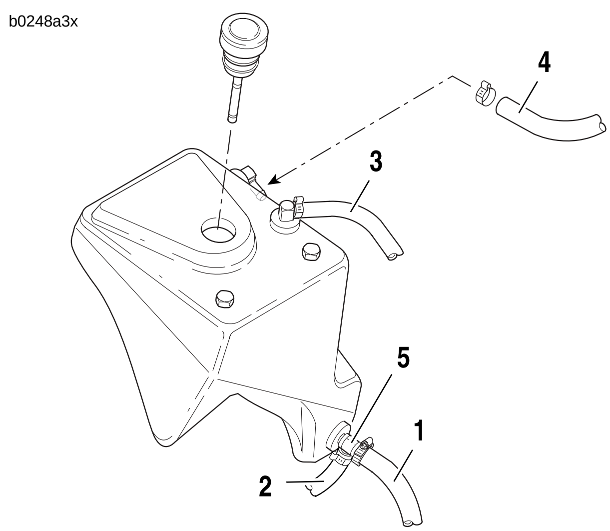
See Figure 3-44. The feed (1) and return hoses (3) run together between the swingarm mount block and crankcase. Protective covers prevent damage to the hoses. The hoses continue on beneath the engine and forward to the oil pump. The feed hose (1) attaches to the rear most oil pump fitting; the return hose (3) connects forward and above.

After diverging from the feed and return hoses, the vent hose is routed beneath the starter. It continues on to the right side of the motorcycle. See Figure 3-45. Here the vent hose (1) connects to an elbow fitting (3) on the gearcase cover (4).



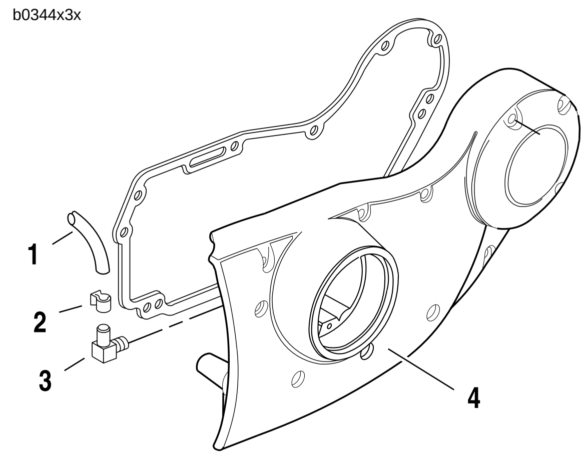
1. **Feed Hose**
2. **Oil Pump**
3. **Return Hose**
4. **Oil Filter Hose Connection**

Figure 3-44. Oil Pump Connections



1. **Feed Hose**
2. **Drain Hose**
3. **Vent Hose**
4. **Return Hose**
5. **T-Fitting**

Figure 3-43. Oil Tank Hoses



1. **Vent Hose**
2. **Clamp**
3. **Elbow Fitting**
4. **Gearcase Cover**

Figure 3-45. Vent Hose Connection (Typical)

OIL TANK 3.9

REMOVAL/DISASSEMBLY

1. Remove seat, fuel tank and tail section. See 2.33 TAIL SECTION.
2. Remove rear fender. See 2.32 REAR FENDER.
3. Drain oil tank. See 1.4 ENGINE LUBRICATION SYSTEM. The oil filter need not be removed unless it is due to be replaced.
4. See Figure 3-46. Remove clamps to detach hoses from oil tank. Label each hose upon removal.
   a. Remove feed hose worm clamp (3) from T-fitting.
   b. Remove 3/8 in. drain hose clamp (5) from T-fitting.
   c. Remove 1/4 in. clamp (8) from vent hose (7).
   d. Remove 3/8 in. clamp (10) from return hose (9).
5. Remove four bolts and lockwashers from wellnuts (1).
6. Detach oil tank from frame.

ASSEMBLY/INSTALLATION

1. See Figure 3-46. Place oil tank on frame and align mounts. Loosely install bolts and lockwashers (1) at all four mounting points.

NOTE
Starting at the top mounting points will simplify installation.

2. Connect the four oil tank hoses. Tighten **new** clamps (5, 8 and 10) using HOSE CLAMP PLIERS (Part No. HD-41137).

NOTE
Worm clamp (3) may be reused on feed hose (4).

3. Fill oil tank. See 1.4 ENGINE LUBRICATION SYSTEM.
4. Install rear fender. See 2.32 REAR FENDER.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, which could result in death or serious injury.

5. Install tail section, fuel tank and seat. See 2.33 TAIL SECTION.

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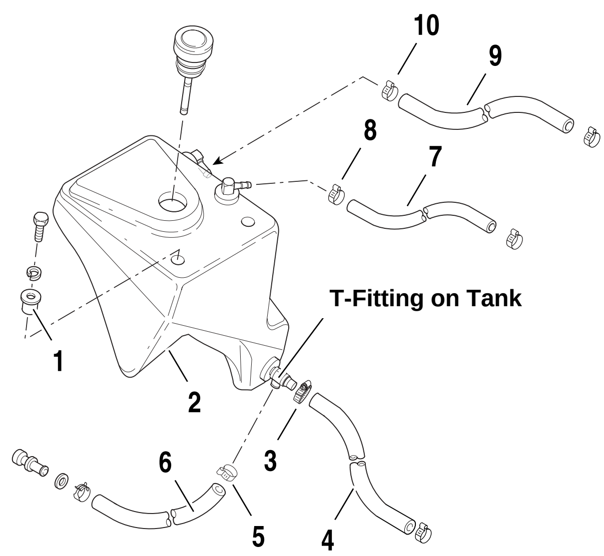


1. **Bolt, Lockwasher and Wellnut (4)**
2. **Oil Tank**
3. **Worm Clamp, 3/8 in.**
4. **Feed Hose**
5. **Hose Clamp, 3/8 in.**
6. **Drain Hose**
7. **Vent Hose**
8. **Hose Clamp, 1/4 in.**
9. **Return Hose**
10. **Hose Clamp, 3/8 in.**

Figure 3-46. Oil Tank

OIL PRESSURE INDICATOR SWITCH 3.10

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 abnormally 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 on the running engine.
- Engine is idling far 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 3-8.

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 3-47. The oil pump is nonregulatory 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). During start-up of a cold engine, oil pressure will be higher than normal and oil circulation will be somewhat restricted within the oiling system. As the engine warms to normal operating temperature, the engine oil will warm up and become less viscous — oil pressure decreases.

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-96921-52A) and OIL PRESSURE GAUGE ADAPTER (Part No. HD-96940-52A). Remove oil pressure indicator switch and insert pressure gauge fitting. See Figure 3-48.

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 10-17 psi (69-117 kN/m^2). At idle speed (950-1050 RPM), oil pressure will vary from 7-12 psi (48-83 kN/m^2).

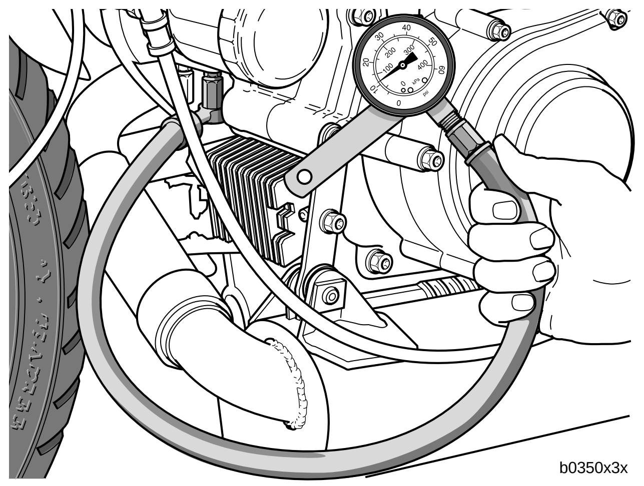


Figure 3-47. Checking Oil Pressure (Typical)

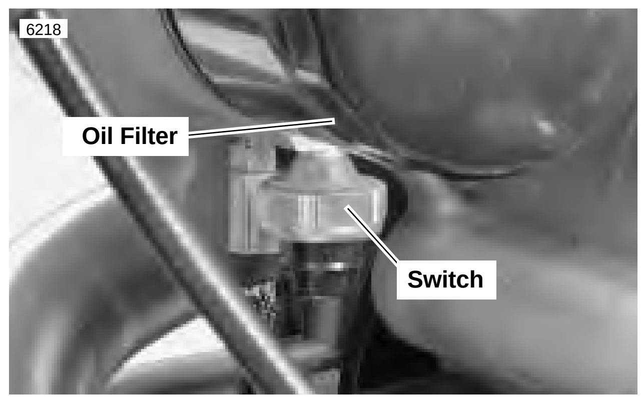


Figure 3-48. Oil Pressure Indicator Switch

Table 3-8. Troubleshooting Oil Pressure Signal Light

LIGHT	PROBABLE CAUSES
Stays on at speeds above idle.	● Empty oil tank. ● 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 3.14 OIL FILTER MOUNT).
Flickers at idle.	● Incorrect idle speed. Malfunctioning or improperly installed check valve (see 3.14 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 above).

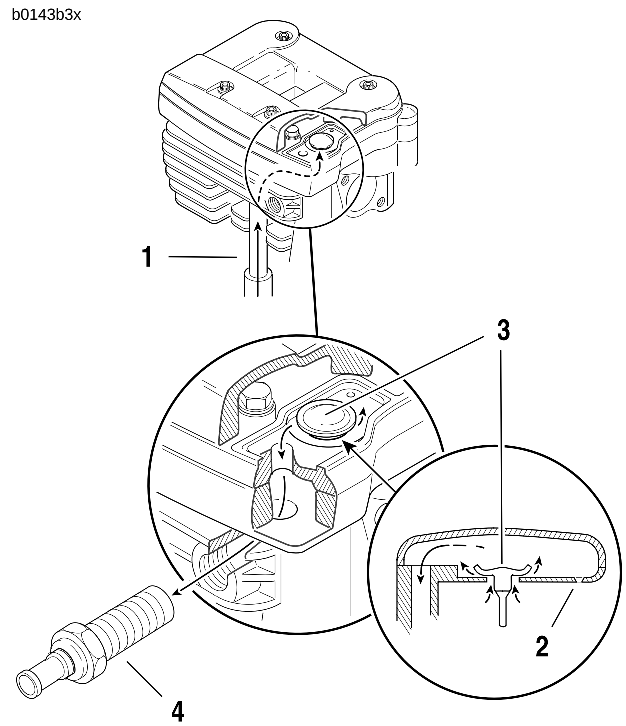
CRANKCASE BREATHING SYSTEM 3.11

GENERAL

See Figure 3-49. On piston downstroke, a mixture of crankcase air and oil mist is vented up the push rod covers (1) through an umbrella valve (3) in each middle rocker box section.

The oil mist separates from the crankcase air, collects and passes through a small drain hole (2) where it eventually returns to the crankcase.

The crankcase air is routed through a passage in each cylinder head. The air then travels through each air cleaner breather bolt (4). Hoses leading from the air cleaner bolts vent the air to the air cleaner's snorkel.



1. **Push Rod Cover (2)**
2. **Oil Drain Hole**
3. **Umbrella Valve**
4. **Breather Bolt**

Figure 3-49. Crankcase Breathing System, Typical Cylinder

OILING SYSTEM (COLOR FOLDOUT) 3.12

NOTE

The following paragraph numbers correspond with the numbered callouts in the INTERNAL ENGINE PASSAGES illustration.

1. Oil is gravity-fed from the oil tank 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 3.13 OIL PUMP for a complete explanation of the gerotor pump sets.

2. The feed pump transfers oil from the inlet cavity through the **feed hose** to the oil filter mount.
3. Oil flows through the **filter mount cavity** to the oil filter.
4. 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).
5. Adequate oil pressure in the filter mount cavity activates the **oil pressure signal light switch** and shuts off the oil pressure signal light.
6. Oil flowing from the filter adapter opens the **check ball.** The check ball opens at 4-6 psi (28-41 kN/m^2) oil pressure.
7. With the check ball open, oil flows into the **crankcase feed galley.**
8. Oil flows through the feed galley in the crankcase to the lifter blocks and hydraulic lifters. **Cross-drilled passages** intersect the main feed galley and carry oil to each hydraulic lifter.
9. Oil also enters an **intersecting passage** in the gearcase cover. Oil flow is then routed to the crankshaft area.
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 flows up passages in the **push rods** to the rocker arm shafts and bushings.
12. The valve stems are lubricated by oil supplied through drilled oil holes in the **rocker arms.**
13. Oil collected in the push rod areas of the cylinder heads flows down the **push rod covers,** through drain holes in the **lifter blocks** and into the gearcase.
14. Feed oil to the rocker area is returned to the crankcase through a **passage** in the head and cylinder.
15. Oil collected in the **sump** is splash-fed to the pistons, cylinder walls and flywheel components.
16. 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.
17. Return oil fills a **cavity** above the pump's return gears. The return gears pump oil back to the oil tank.
18. A small amount of oil flows from the feed galley in the right crankcase half through a **restricted orifice,** which sprays the oil onto the rear intake cam gear in the gearcase. Oil is transferred to the teeth of all the cam gears through the gear meshing action.

GENERAL

See Figure 3-50. The oil pump consists of two gerotor gear sets, feed and scavenge (return), housed in one pump body. The feed set distributes oil to the engine, the scavenge set returns oil to the tank. The pump body features ”split kidney” scavenge ports.

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. The illustration below shows the principle of gerotor operation:

1. During the first 180° of rotation, the cavity between inner and outer gerotors gradually increases in size until it reaches its maximum size, equivalent to the full volume of the “missing tooth.” The gradually enlarging cavity creates a vacuum into which oil flows from the inlet.
2. During the next 180° of rotation, the size of the cavity decreases forcing oil into the outlet.

See Figure 3-52. Gravity-fed oil from the oil tank enters the pump through the feed hose connector (5). It is forced by the gerotor feed set (7) through a hose to the oil filter. Return oil from the flywheel compartment is drawn back into the pump and is forced by the gerotor scavenge set (9) back to the oil tank.

See INTERNAL ENGINE PASSAGES for oil passages within the engine.

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be absolutely certain that all possible related malfunctions have been eliminated:

1. Make sure all oil hose clamps are tight and that hoses are not pinched or damaged.
2. Check oil level and condition of oil in tank. Pressure will be affected if oil is diluted. In freezing weather, proper circulation of oil can be affected if the oil feed hose becomes clogged with ice and sludge.
3. Check for a grounded oil pressure switch wire or faulty switch if oil indicator light fails to go out with engine running.

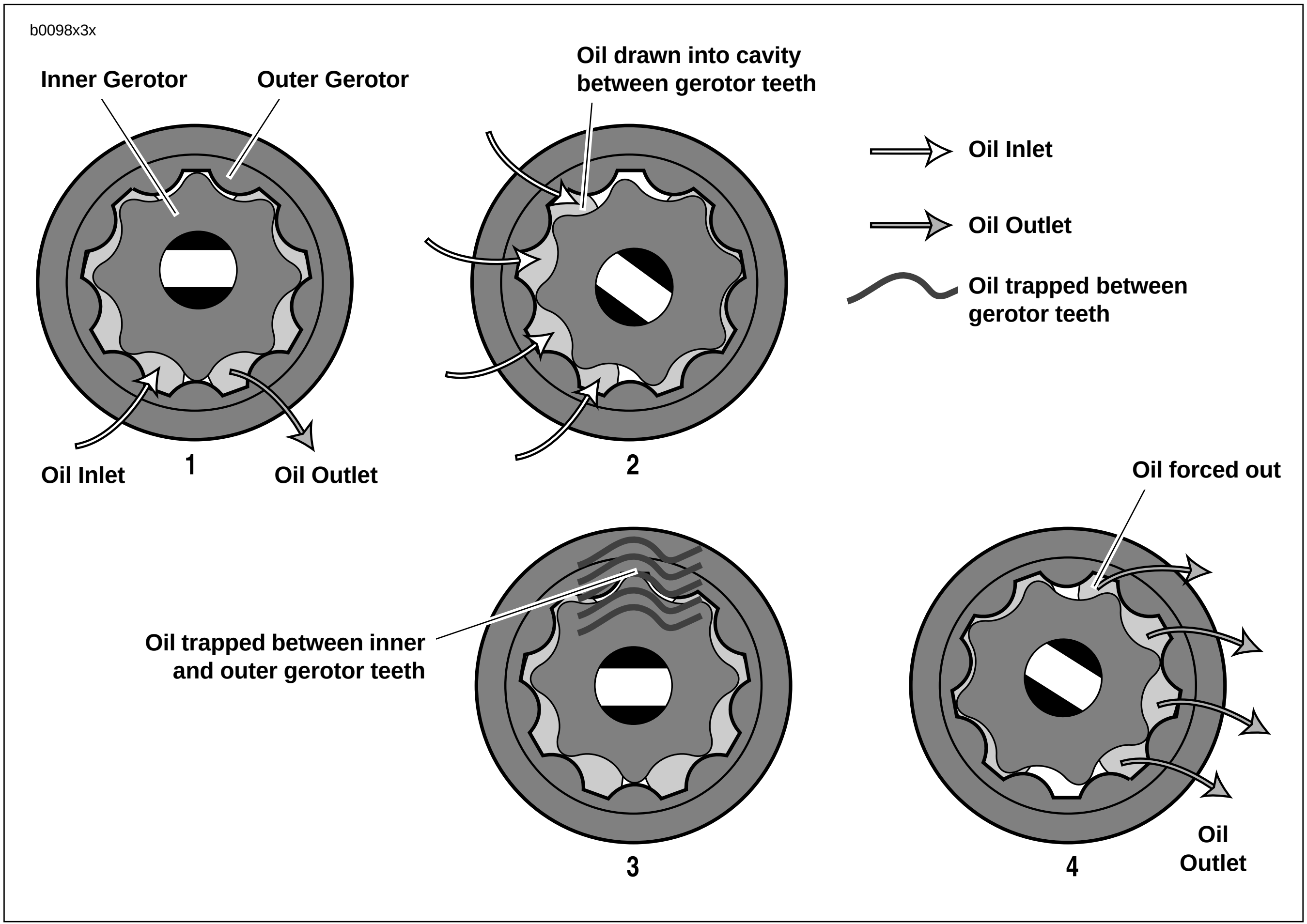


Figure 3-50. Principle of Gerotor Operation

REMOVAL/DISASSEMBLY

NOTE

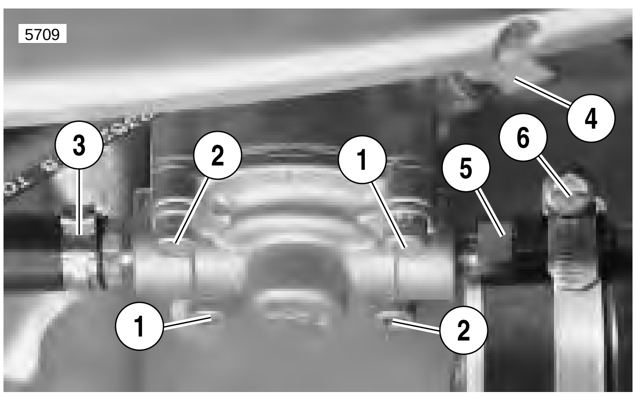
Oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil tank. See 1.4 ENGINE LUBRICATION SYSTEM.
2. See Figure 3-51. Disconnect feed hose (3).
3. Remove clamp (6) from filter hose. Detach oil filter hose connection (5).

NOTE

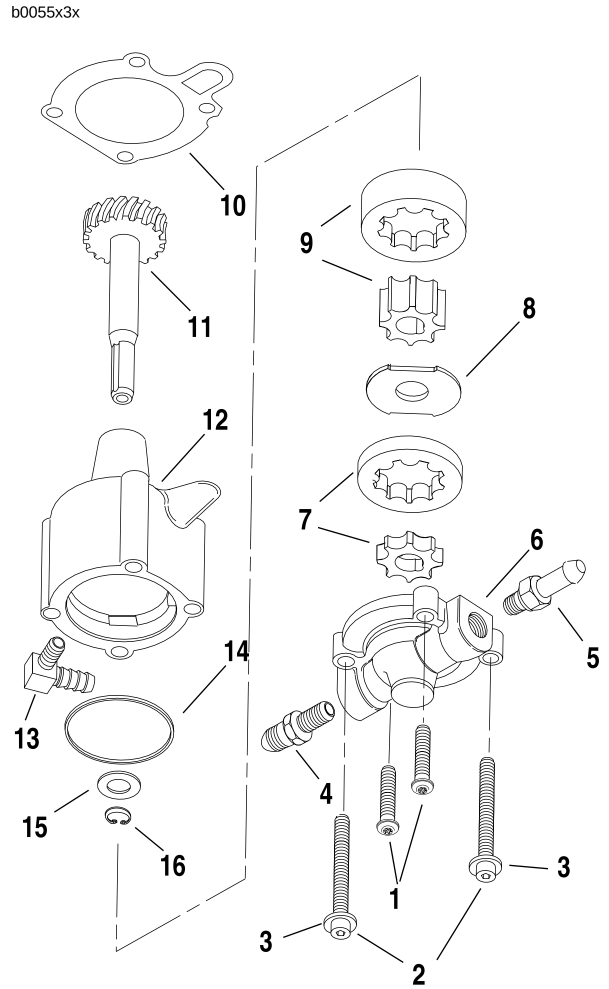
Loosen nut on oil filter hose connection (5) and then remove pressurized hose.

4. Carefully remove mounting screws and washers (1). Pump will drop with screws removed. Discard mounting gasket.
5. Remove clamp and detach return hose connection (4).
6. See Figure 3-52. Remove T27 TORX cover screws (2) and washers (3). Lift cover (6) off body (12). Remove and discard O-ring (14).
7. Slide both pieces of gerotor feed set (7), separator plate (8) and both pieces of gerotor scavenge set (9) off gear shaft (11).
8. Remove and discard retaining ring (16). Remove thrust washer (15) and gear shaft (11).



1. **Mounting Screw and Washer (2) (long)**
2. **Cover Screw and Washer (2) (short)**
3. **Feed Hose Connection**
4. **Return Hose Connection**
5. **Oil Filter Hose Connection**
6. **Clamp**

Figure 3-51. Oil Pump Hardware



1. **Mounting Screw (2)**
2. **Cover Screw (2)**
3. **Washer (4)**
4. **Oil Filter Mount Connector**
5. **Feed Hose Connector**
6. **Cover**
7. **Gerotor Feed Set**
8. **Gerotor Separator Plate**
9. **Gerotor Scavenge Set**
10. **Mounting Gasket**
11. **Gear Shaft**
12. **Body**
13. **Return Hose Elbow Connector**
14. **O-Ring**
15. **Thrust Washer**
16. **Retaining Ring**

Figure 3-52. Oil Pump

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
2. See Figure 3-53. 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. Check gear shaft (11) teeth for damage or wear. Replace if necessary.

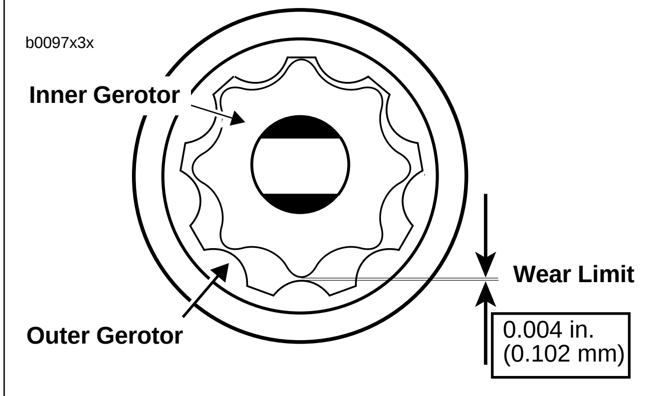


Figure 3-53. Gerotor Wear Limits

ASSEMBLY/INSTALLATION

NOTE

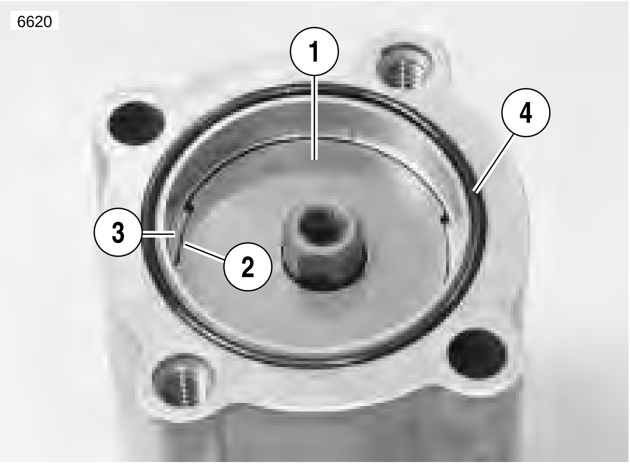
Liberally coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

1. See Figure 3-52. Install gear shaft (11) through body (12). Position thrust washer (15) over end of shaft. Install **new** retaining ring (16) into groove in shaft.
2. Insert inner gerotor of the gerotor scavenge set (9) over gear shaft.
3. Place outer gerotor over inner to complete scavenge set (9).
4. See Figure 3-54. Position gerotor separator plate into case and line up slots on perimeter with tabs inside oil pump body.
5. Place gerotor feed set (7) over gear shaft (11).
6. Install a **new** O-ring (14) into groove in cover (6). Place cover onto pump body. Install T27 TORX cover screws (2) with washers (3). Tighten to 70-80 **in-lbs** (7.9-9 Nm).
7. Place **new** mounting gasket (10) in position.

NOTE

*Use **new** hose clamps. If fittings were removed, use TEFLON® PIPE SEALANT or HYLOMAR® on fitting threads.*

8. See Figure 3-51. Attach return hose connection (4).
9. Secure pump to crankcase with mounting screws (1) and washers. Tighten to 125-150 **in-lbs** (14.1-16.9 Nm).
10. Attach feed hose (3) and oil filter hose connection (5).
11. Attach clamp (6) and canister to hose.
12. Prime oil pump. Loosen feed hose connection and start engine. Operate at idle and allow about 2.0 ounces (0.06 liter) of engine oil to be forced through hose connection. Stop engine and tighten hose connection.
13. Check engine oil level. Add oil to correct level if needed. See 1.4 ENGINE LUBRICATION SYSTEM.



1. **Gerotor Separator Plate**
2. **Slot on Separator Plate**
3. **Tab on Oil Pump Body**
4. **O-Ring**

Figure 3-54. Separator Plate Slots

OIL FILTER MOUNT 3.14

GENERAL

See Figure 3-55. Oil is pressure-fed from the oil pump to the filter mount (4) via a hose (5). Oil travels through the filter mount into the filter via outer filter holes.

Adequate oil pressure activates the oil pressure indicator switch (6) in the filter mount, which turns off the oil pressure indicator lamp.

The check ball (2) in the filter adapter (1) “opens” at 4-6 psi (28-41 kN/m^2) oil pressure. Filtered oil leaves the filter, flowing past the check ball.

DISASSEMBLY

1. Drain oil tank and remove filter. See 1.4 ENGINE LUBRICATION SYSTEM.
2. Remove filter adapter (1) from filter mount (4). Remove check ball (2) and spring (3).
3. Detach indicator lamp wire (7) from oil pressure indicator switch (6). Remove switch using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675).

CLEANING AND INSPECTION

Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

ASSEMBLY

NOTE

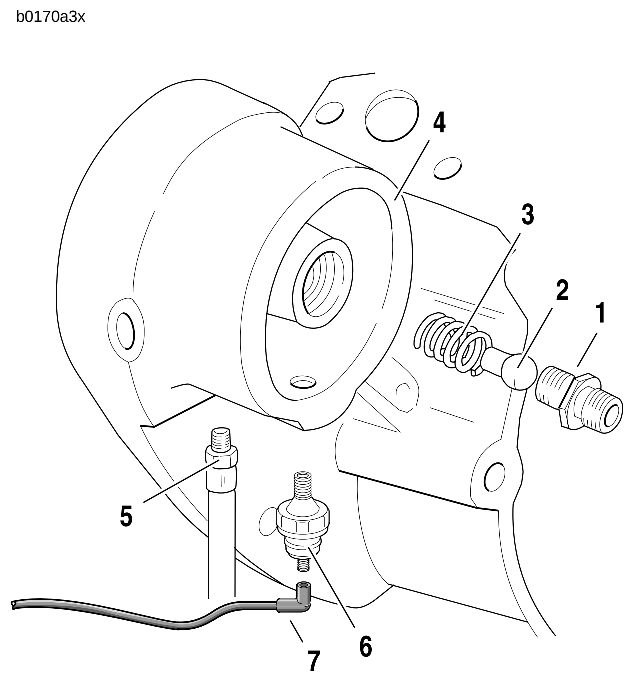
Use TEFLON PIPE SEALANT or HYLOMAR on all fittings installed to oil filter mount.

1. Install oil pressure indicator switch (6) using OIL PRESSURE SENDING UNIT WRENCH (Part No. HD-41675). Tighten to 5-7 ft-lbs (7-10 Nm).

NOTE

The filter adapter (1) has identical ends; either end may be installed into the filter mount (4).

2. Apply LOCTITE THREADLOCKER 243 (blue) to the threads on that end of the filter adapter (1) which is installed into filter mount (4). Do not apply LOCTITE to adapter threads on filter element side.



1. **Filter Adapter**
2. **Check Ball**
3. **Spring**
4. **Filter Mount (part of Right Crankcase Half)**
5. **Hose from Oil Pump**
6. **Oil Pressure Indicator Switch**
7. **Indicator Lamp Wire**

Figure 3-55. Oil Filter Mount

3. Install filter mount components.
   a. Place spring (3) and check ball (2) into threaded hole at center of mount (4).
   b. Push threaded end of filter adapter (with LOCTITE) (1) against check ball to compress spring.
   c. Screw adapter into threaded hole. Tighten to 8-12 ft-lbs (11-16 Nm).
4. Attach indicator lamp wire (7).
5. Install a **new** filter and fill oil tank with proper oil. See 1.4 ENGINE LUBRICATION SYSTEM.

HYDRAULIC LIFTERS 3.15

GENERAL

See Figure 3-56. The hydraulic lifter assembly consists of a 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 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. Lifters have a definite leakdown rate which permits the oil in the lifters to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain correct clearance operation. Lifters are functioning properly if they become quiet after a few minutes of engine operation.

REMOVAL

1. Clean all dirt from around crankcase. Blow loose particles from area with compressed air.
2. Remove the upper, middle, and lower rocker covers. See 3.5 CYLINDER HEAD. Pull each push rod upward through top of cylinder head.
3. See Figure 3-58. Remove both push rod covers (4).
   a. Remove screw (8) and washer (10).
   b. Lift retainer (6) and seal (7) upward a few inches on push rod cover (4).
   c. Push upward on push rod cover while pulling bottom of cover clear of crankcase. Remove cover.
4. Remove both hydraulic lifters (3).
   a. Remove two anti-rotation screws with washers (2).
   b. Remove lifters (3) from crankcase bore using a thin-bladed screwdriver. Mark the location and orientation (front/back) of each lifter.

CLEANING AND INSPECTION

1. Clean all parts, except roller/lifter assembly, thoroughly in solvent. Blow dry with compressed air.

NOTE

Inside and outside micrometers used for measuring lifters and lifter guides must be calibrated to ensure accurate readings.

2. Inspect hydraulic 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).

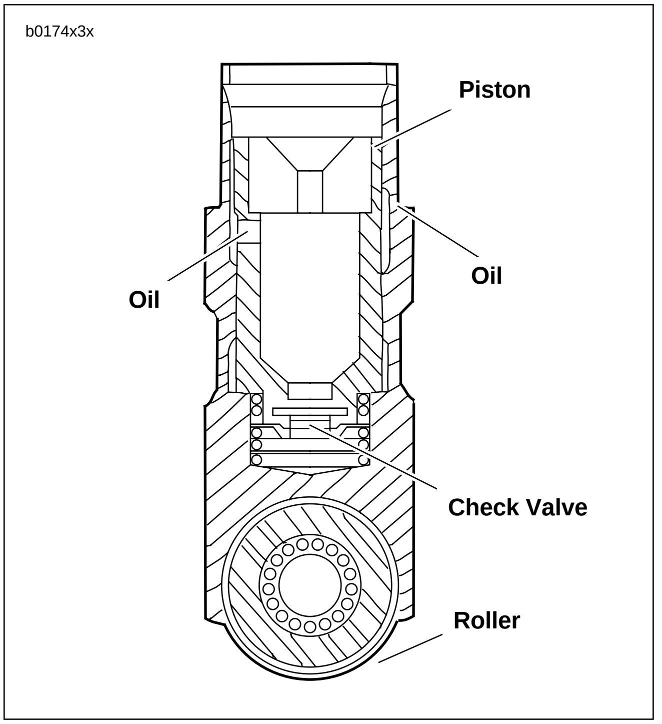


Figure 3-56. Lifter Assembly (Typical)

3. Check lifter roller freeplay.
   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 3-57. Rotate engine so that both lifters, from the cylinder being serviced, will be installed on the base circle (1) of the cam.

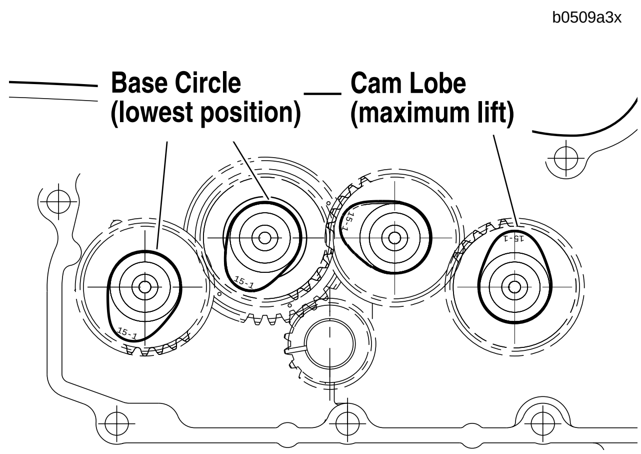
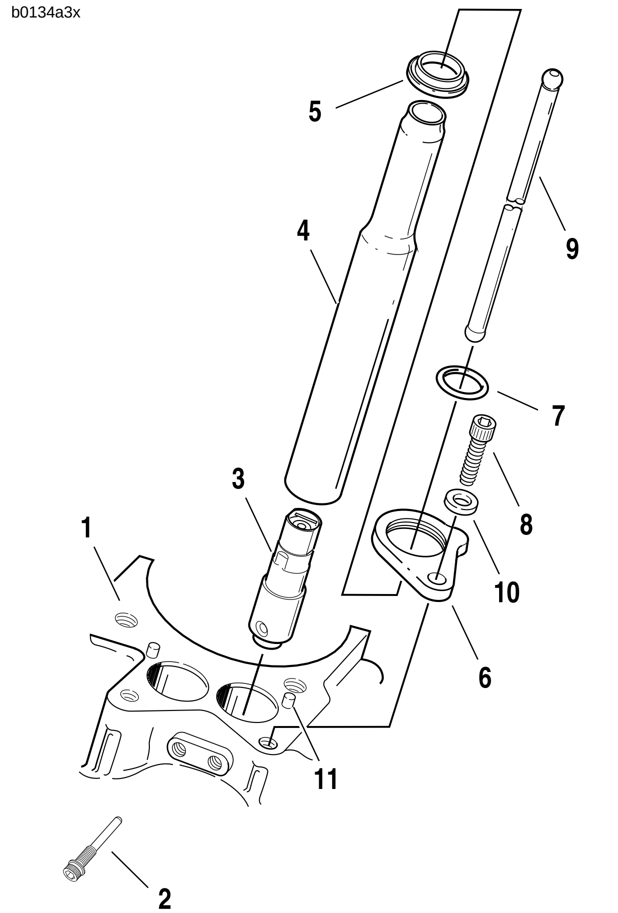


Figure 3-57. Base Circle

2. Apply a liberal amount of engine oil to each lifter assembly (especially the roller needles) for smooth initial operation.
3. See Figure 3-58. Insert lifter (3) into bore in crankcase (1) with lifter oil hole facing towards the oil trough. Rotate lifter so that flats at upper end of lifter faces the front and rear of the engine. If the lifter is installed incorrectly, anti-rotation screws (2) cannot be inserted.
4. Secure lifters in place.
   a. Insert anti-rotation screws with washers (2) in the threaded holes in crankcase.
   b. Tighten anti-rotation screws to 55-65 **in-lbs** (6-7 Nm)
5. Install push rod covers.
   a. Slide **new** seal (5) and retainer (6) over top of push rod cover (4).
   b. Position **new** O-ring (7) at top of push rod cover.
   c. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with lifter bore in crankcase.
   d. Lower retainer (6) with seal (5) onto crankcase, aligning locating pin (11) with hole in retainer.
   e. Insert screw (8) with washer (10) through hole in retainer (6). Thread screw (8) into tapped hole in crankcase. Tighten to 15-18 ft-lbs (20-24 Nm).
6. Install push rods and rocker covers. See 3.5 CYLINDER HEAD.



1. **Right Crankcase Half**
2. **Anti-Rotation Screws with Washers (2)**
3. **Hydraulic Lifter (2)**
4. **Push Rod Cover (2)**
5. **Seal (2)**
6. **Retainer (2)**
7. **O-Ring (2)**
8. **Screw (2)**
9. **Push Rod (2)**
10. **Washer (2)**
11. **Locating Pin (2)**

Figure 3-58. Hydraulic Lifter Service

GEARCASE COVER AND CAM GEARS 3.16

CAUTION

Use only the correct gearcase cover gasket (see parts catalog for Part No.). Using pre-2002 model year gasket will obstruct oil galley and result in engine damage.

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.

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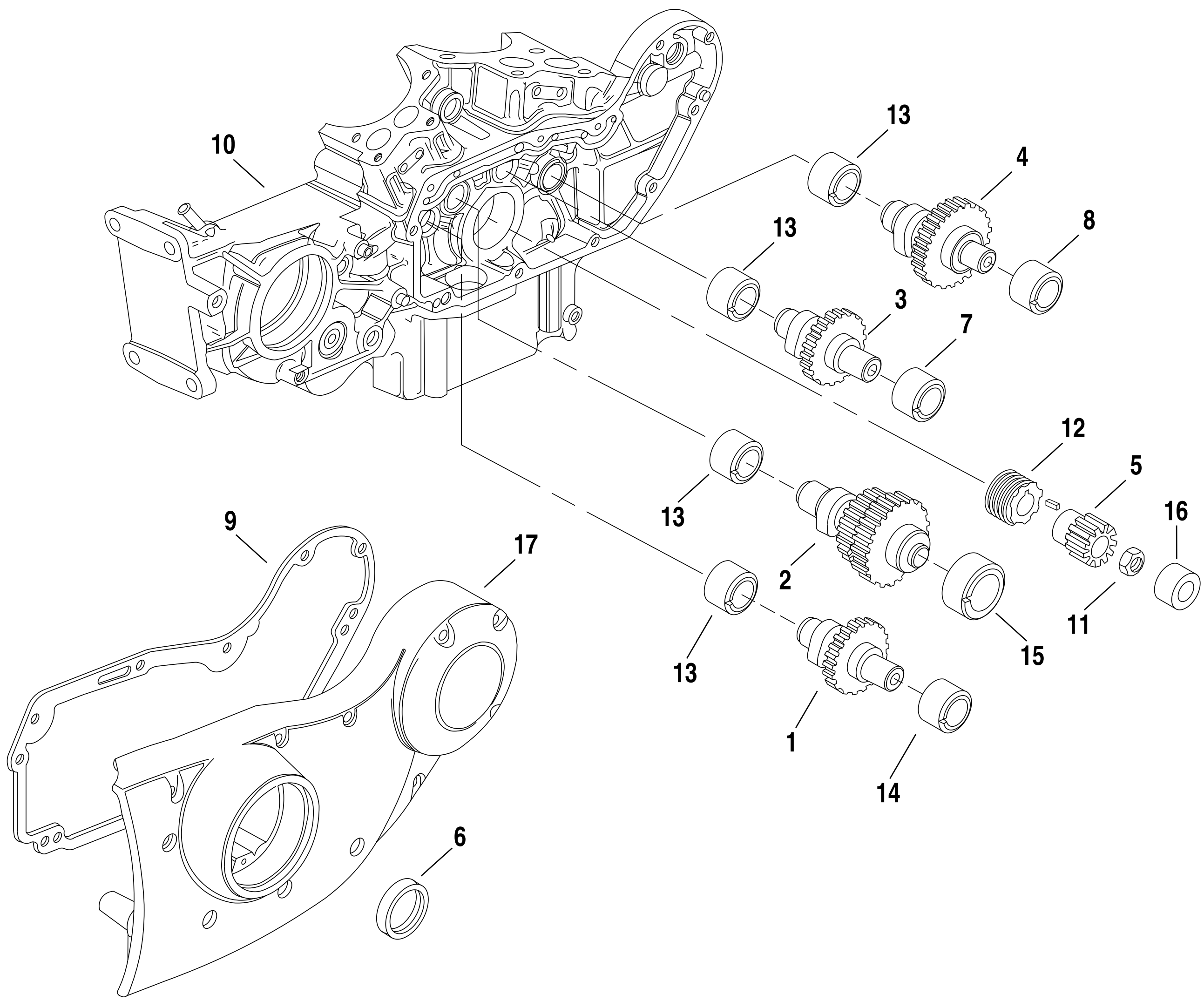


1. Rear Exhaust Cam Gear	7. Front Intake Cam Gear Bushing	13. Cam Gear Bushing (4)
2. Rear Intake Cam Gear	8. Front Exhaust Cam Gear Bushing	14. Rear Exhaust Cam Gear Bushing
3. Front Intake Cam Gear	9. Gearcase Cover Gasket	15. Rear Intake Cam Gear Bushing
4. Front Exhaust Cam Gear	10. Right Crankcase Half	16. Pinion Shaft Bushing
5. Pinion Gear	11. Nut	17. Gearcase Cover
6. Seal	12. Oil Pump Drive Gear	

Figure 3-59. Gearcase and Valve Train Components

REMOVAL/DISASSEMBLY

1. See Figure 3-59. Thoroughly clean area around gearcase cover (17) and lifters. Blow loose dirt from crankcase with compressed air.
2. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust header, air cleaner, etc.).
3. Remove push rods. See 3.5 CYLINDER HEAD.
4. Remove hydraulic lifters. See 3.15 HYDRAULIC LIFTERS.
5. Check for minimum cam gear end play. Record readings.
6. Remove cam position sensor and rotor from gearcase cover. See 4.30 CAM POSITION SENSOR AND ROTOR.
7. Place a pan under gearcase to collect oil. Remove cover screws. Carefully remove gearcase cover. Discard old gasket (9).

NOTE

If cover does not come loose on removal of screws, tap lightly with a plastic hammer. Never pry cover off.

8. Remove cam gears (1, 2, 3 and 4). Carefully mark each component to ensure correct installation.

NOTE

Nut (11) is secured by LOCTITE THREADLOCKER 262 (red) on the nut threads.

9. Remove nut (11). Slide pinion gear (5) and oil pump drive gear (12) off pinion shaft.

CLEANING AND INSPECTION

1. Thoroughly clean gearcase compartment, gearcase cover and gears in solvent to remove oil and carbon deposits.
2. Blow out all cover oil passages and bushings with compressed air.
3. Clean old gasket material from gearcase and cover faces with cleaning solvent.

Cam and Pinion Gear Identification

See Figure 3-60. Cam lobes are stamped with the number “15” followed by a number (1, 2, 3 or 4). The number “15” indicates model year application; the number identifies the cam location/function.

Bushing Inspection and Removal

1. See Figure 3-59. Bushings (7, 8, 13, 14, 15 and 16) are press fit in gearcase cover (17) and crankcase. Inspect each bushing against its corresponding cam gear shaft or pinion gear shaft. See Table 3-9.
2. See Figure 3-61. Use a BUSHING AND BEARING PULLER (Part No. HD-95760-69A) to remove bushings from gearcase cover and crankcase.

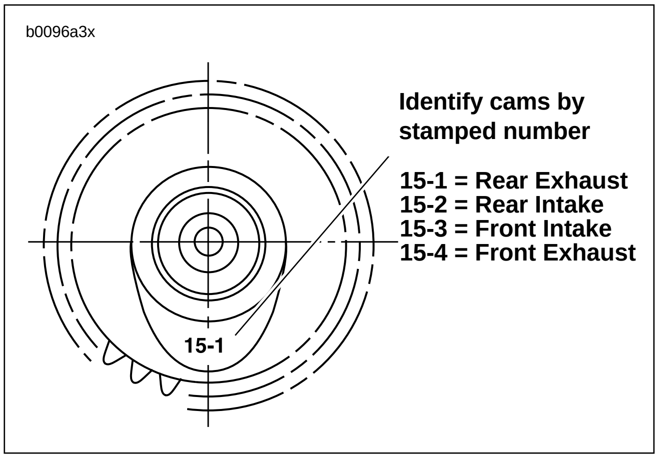
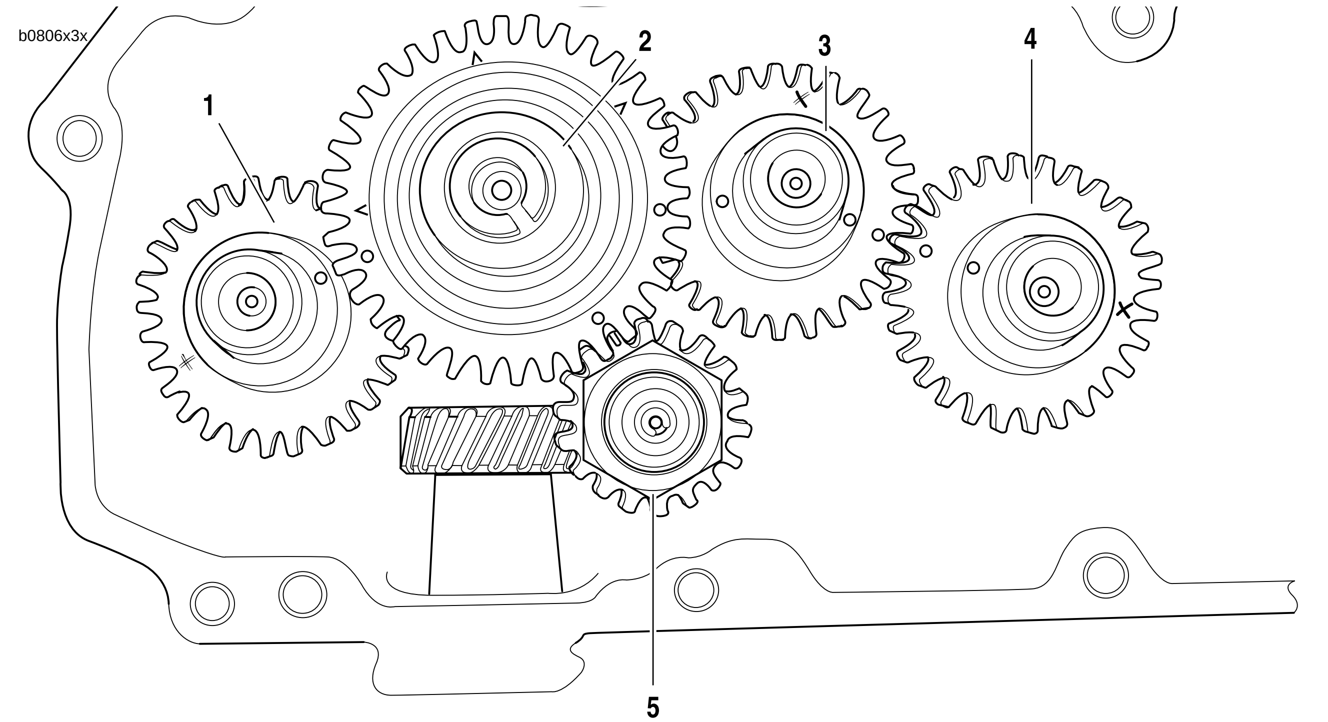


Figure 3-60. Cam Identification

Table 3-9. 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)

Figure 3-61. Removing Bushing



1. **Rear Exhaust Cam Gear (15-1)**
2. **Rear Intake Cam Gear (15-2)**
3. **Front Intake Cam Gear (15-3)**
4. **Front Exhaust Cam Gear (15-4)**
5. **Pinion Gear**

NOTE

Though not depicted, Rear Intake Cam Gear has 46 teeth and Pinion Gear has 23 teeth.

Figure 3-62. Cam and Pinion Gear Timing Mark Indexing

Bushing Installation

NOTE

Installing and reaming crankcase and gearcase cover bushings may alter the center distances between mating gears and may result in an increase in gear noise. For quiet-running gears, the gears should be matched to the center distances.

CAM GEAR BUSHINGS IN RIGHT CRANKCASE HALF

1. See Figure 3-64. Each cam gear bushing (1), to be installed in right crankcase half (2), must be positioned in crankcase bore with its oiling slot at exact top of bore (12 o'clock position).
2. Using an arbor press, install each bushing in its crankcase bore so that bushing shoulder contacts crankcase boss.
3. After you install a **new** bushing in right crankcase half, ream the bushing to correct size. See BUSHING REAMING.

CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

1. See Figure 3-59. Using an arbor press, install each bushing (7, 8 and 14) in its gearcase cover (17) bore so that bushing shoulder contacts cover boss. Orient each bushing so the oiling slot is at the 9 o'clock position within the gearcase cover bore.
2. After you install a **new** bushing in gearcase cover, line-ream the bushing to correct size. See BUSHING REAMING.

REAR INTAKE CAM GEAR BUSHING IN GEARCASE COVER.

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in its gearcase cover (17) bore using an arbor press. You will need to orient the bushing in a specific position of rotation within the cover bore, and will need to drill a lubrication hole in the bushing, according to the following procedures.
2. See Figure 3-63. Position bushing (1) over bore of gearcase cover (2) with chamfered edge downward and slot upward. Align slot in bushing with slot in gearcase cover boss. Press bushing into cover bore until bushing is flush with cover boss.
3. Drill a 5/32 in. (3.97 mm) diameter hole through bushing using existing hole in gearcase cover as a guide.
4. After you install a **new** bushing in gearcase cover, line-ream the bushing to the correct size. See BUSHING REAMING.

PINION SHAFT BUSHING IN GEARCASE COVER

1. See Figure 3-59. Using an arbor press, install pinion shaft bushing (16) in its gearcase cover (17) so that bushing is flush with cover boss. There is no need to orient this particular bushing in any specific position of rotation within the gearcase cover bore.

2. Although the original pinion shaft bushing is not "pinned," the replacement bushing must be secured, from possible rotation within the cover bore, by installation of a dowel pin. See Figure 3-65. Drill a No. 31 hole, 0.281 in. (7.137 mm) deep, at top side of boss (side toward top of gearcase cover), centering the drill bit on the cover bore circle (hole is drilled half in bushing OD and half in cover bore ID).

3. Drive a **new** dowel pin no more than 0.20 in. (5.08 mm) below the bushing face. Carefully peen edges of hole to lock the pin in place.

4. After you install a **new** bushing in gearcase cover, line-ream the bushing to the correct size. See BUSHING REAMING.

Bushing Reaming

NOTE

- *Installing and reaming crankcase and gearcase cover bushings may alter the center distances between mating gears and may result in an increase in gear noise. For quiet-running gears, the gears should be matched to the center distances.*

- *Bushings in right crankcase half serve as pilots for reaming gearcase cover bushings and must, therefore, be reamed to size first.*

- *After reaming any bushing, check shaft fit in the bushing. It may be necessary to make a second pass with reamer to attain proper fit.*

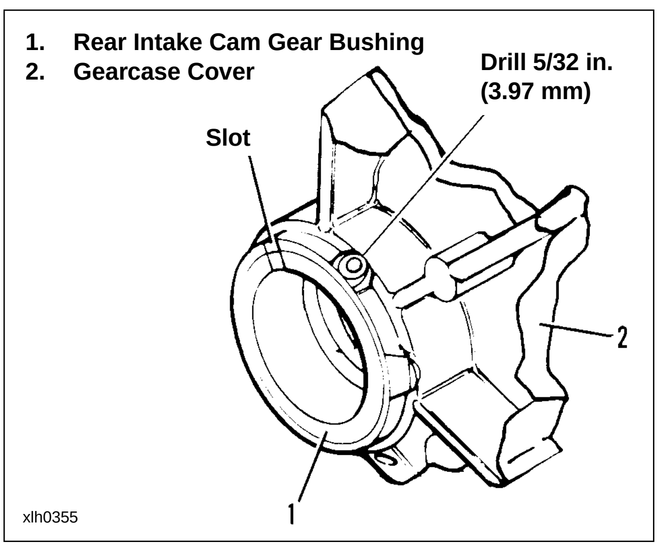


Figure 3-63. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

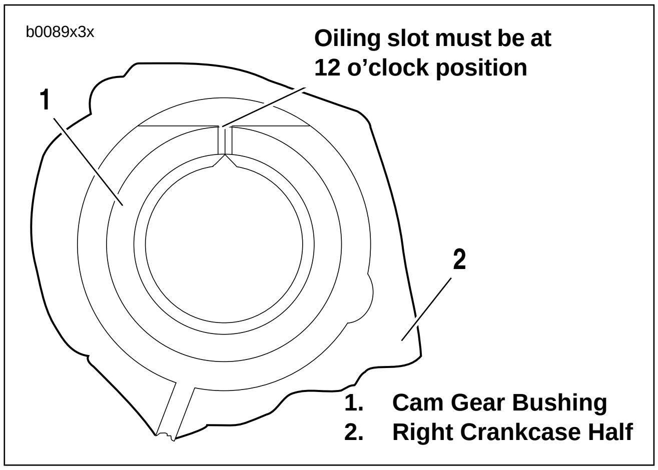


Figure 3-64. Cam Gear Bushing Installed in Crankcase

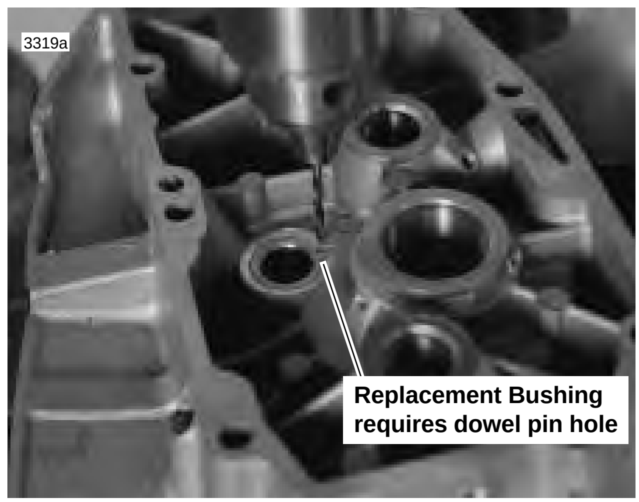


Figure 3-65. Drilling Dowel Pin Hole

CAM GEAR BUSHINGS IN RIGHT CRANKCASE HALF

1. Separate two halves of crankcase, if not already accomplished. Place right crankcase half on flat surface with gearcase side upward. Bushing to be reamed must be oriented as shown in Figure 3-64.

2. See Figure 3-66. Position CAMSHAFT BUSHING REAMER PILOT (Part No. HD-38871) onto gearcase side of crankcase half; upper right and lower left indexing holes in pilot must be placed over dowels in crankcase half. Insert two bolts (supplied with pilot) through two remaining holes in pilot, and into threaded holes of crankcase half. Tighten bolts securely.

3. Insert the 11/16 in. diameter reamer through pilot hole and into bushing while turning reamer clockwise. Continue turning reamer clockwise through bushing until smooth shank of reamer passes through hole in pilot.

4. Detach reamer from handle. Pull reamer out opposite side of crankcase half.

5. Thoroughly clean right crankcase half, removing all metal chips/shavings. Blow out all oil passages using compressed air.

CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

NOTE

Newly installed cam gear bushings in the gearcase cover must be line reamed, using the right crankcase half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Bushings (7, 8 and 14) to be reamed must be installed in gearcase cover (17) as described in BUSHING INSTALLATION. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.
2. Insert a standard 11/16 in. diameter reamer through the previously reamed cam gear bushing (13) in right crankcase half, which is in line with one of the bushings to be reamed in gearcase cover.
3. Turn reamer clockwise through bushing in cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
4. Repeat Steps 2 and 3 for remaining two cam gear bushings (except rear intake bushing) in gearcase cover, if required.
5. Separate gearcase cover from right crankcase half. Inspect bushings for proper cam gear shaft fit. Repeat line reaming operation if necessary.
6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

REAR INTAKE CAM GEAR BUSHING IN GEARCASE COVER

NOTE

A newly installed rear intake cam gear bushing in the gearcase cover must be line reamed, using the right crankcase half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION.
2. Identify the previously reamed rear intake cam gear bushing (13) in right crankcase half (10), which has been disassembled from left crankcase half. Insert the shank end of REAR INTAKE CAMSHAFT BUSHING REAMER (Part No. HD-94803-67) through gearcase side of this bushing.
3. With reamer inserted into bushing in right crankcase half, attach gearcase cover to right crankcase half, securing with a minimum of three mounting screws.
4. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
5. Separate gearcase cover from right crankcase half. Inspect bushing for proper cam gear shaft fit. Repeat line reaming operation if necessary.

6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

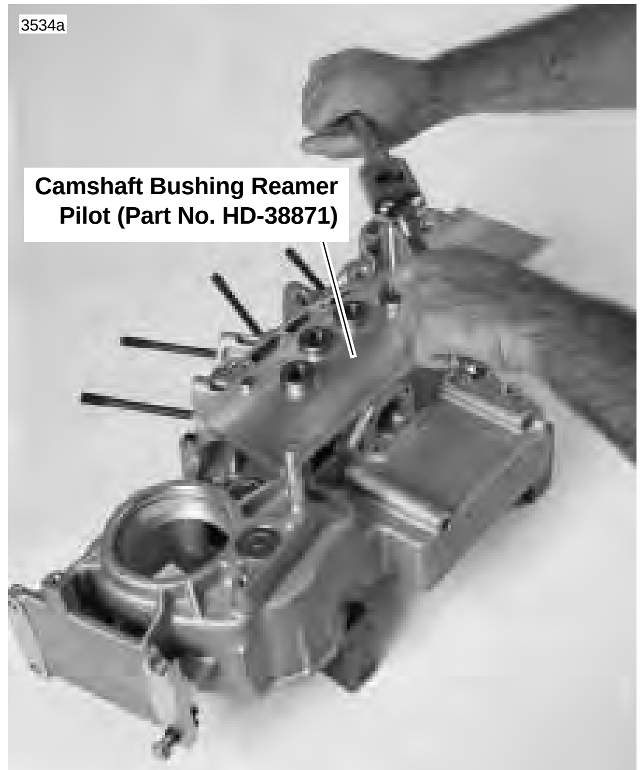


Figure 3-66. Reaming Cam Gear Bushing in Right Crankcase Half

PINION SHAFT BUSHING IN GEARCASE COVER

NOTE

*A **newly** installed pinion shaft bushing in the gearcase cover must be line reamed, using both the right crankcase half and Part No. HD-94812-87 as pilots for the reamer, to establish correct clearance and to ensure proper alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.*

1. See Figure 3-59. Pinion shaft bushing (16) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.
2. See Figure 3-67. Install PINION SHAFT BUSHING REAMER PILOT (Part No. HD-94812-87) into right crankcase roller race. Insert PINION SHAFT BUSHING REAMER (Part No. HD-94812-1) through the pilot.
3. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
4. Separate gearcase cover from right crankcase half. Inspect bushing for proper pinion shaft fit. Repeat line reaming operation if necessary.

5. Remove pilot from right crankcase roller race. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

ASSEMBLY/INSTALLATION

1. See Figure 3-68. Install oil pump drive gear (5) and pinion gear on pinion shaft.
   a. Slide oil pump gear drive gear (5) over pinion shaft (1). Drive gear must align with shaft key (4).
   b. Align keyway (3) in ID of pinion gear with shaft key (4).
   c. Slide pinion gear over shaft key (4) and against oil pump drive gear (5).
2. See Figure 3-59. Install nut (11).
   a. Clean threads on pinion shaft and nut.
   b. See Figure 3-69. Install CRANKSHAFT LOCKING TOOL (Part No. HD-43984) to gearcase with "Side A" facing out, over pinion shaft, with two screws.
   c. Apply several drops of LOCTITE THREADLOCKER 262 (red) to threads of nut.
   d. Install nut to pinion shaft. Tighten nut to 35-45 ft-lbs (48-61 Nm).
3. 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. See Figure 3-62.

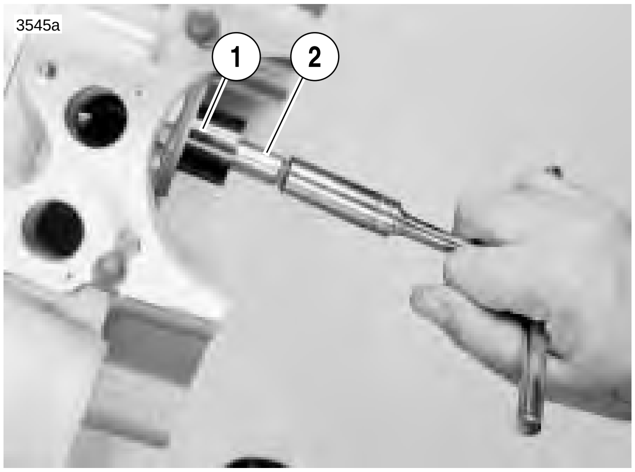
NOTE

Because of the larger diameter additional gear (which meshes with the pinion gear) on the outboard end of the rear intake (15-2) cam gear, the rear exhaust (15-1) and front intake (15-3) cam gears must both be installed before the rear intake (15-2) cam gear is installed.

CAUTION

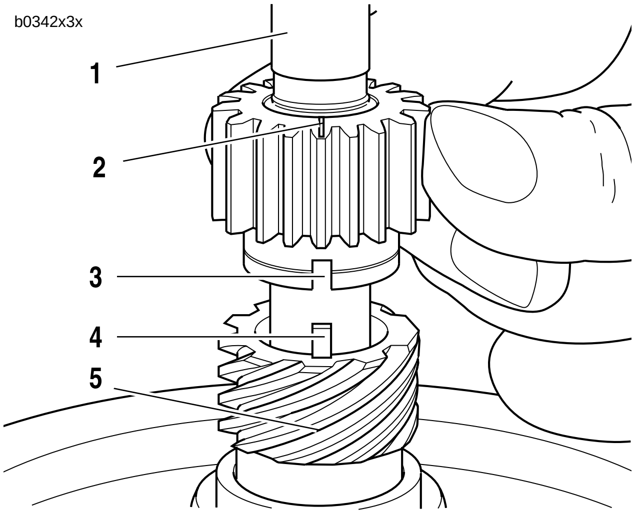
Use only the correct gearcase cover gasket (see parts catalog for Part No.). Using pre-2000 model year gasket will obstruct oil galley and result in engine damage.

4. See Figure 3-59. Install a **new** seal (6) and **new** dry gearcover gasket (9) on gearcase cover (17).



1. **Pilot (Part No. HD-94812-87)**
2. **Reamer (Part No. HD-94812-1)**

Figure 3-67. Line Reaming Pinion Shaft Bushing



1. **Pinion Shaft**
2. **Timing Mark on Pinion Gear**
3. **Keyway**
4. **Shaft Key**
5. **Oil Pump Drive Gear**

Figure 3-68. Aligning Pinion Gear

5. Install gearcase cover over all gears and onto right crankcase half (10). Secure cover to crankcase half with 11 socket head screws. Tighten screws evenly to 80-110 **in-lbs** (9-12 Nm). Use torque sequence shown in Figure 3-70.
6. See Figure 3-71. 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 lifter 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 3.15 HYDRAULIC LIFTERS.
8. Install cam position sensor and rotor in gearcase cover. See 4.30 CAM POSITION SENSOR AND ROTOR.
9. Install any components removed to gain access to gearcase (i.e. exhaust system components, air cleaner, etc.).

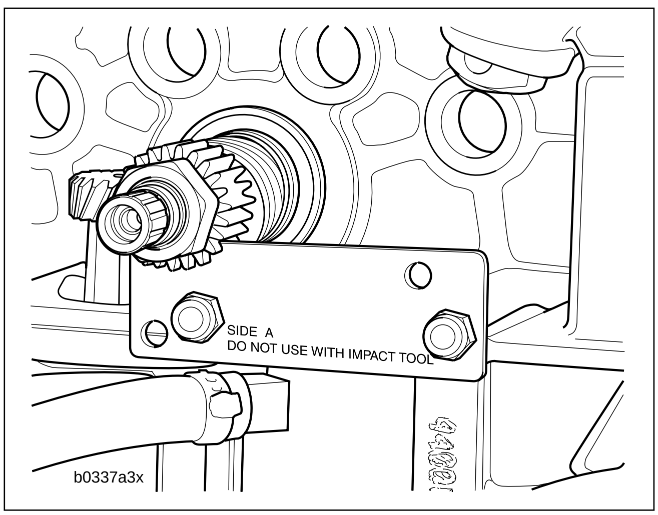


Figure 3-69. Crankshaft Locking Tool (HD-43984)

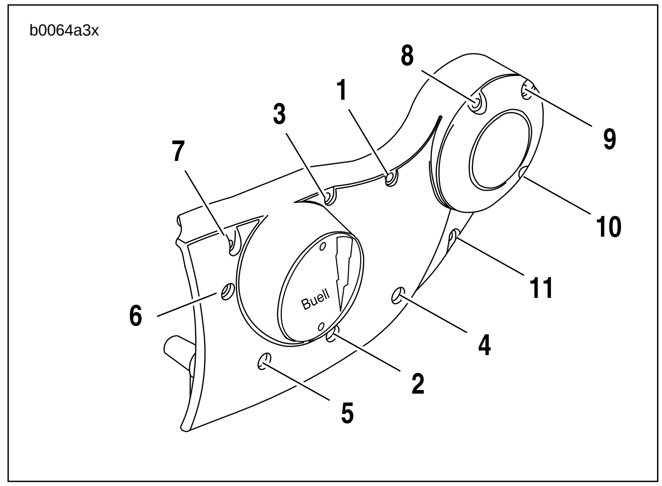


Figure 3-70. Gearcase Cover Mounting Screw Torque Sequence

Figure 3-71. Checking Cam Gear End Play

GENERAL

CAUTION

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.

Remove engine from chassis to repair rod bearings, pinion shaft bearing or sprocket shaft bearing. See 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR.

It is recommended procedure to overhaul engine if removed. This includes inspecting and repairing cylinder heads, cylinders, gearcase and transmission.

ADJUSTMENT/TESTING

Flywheel End Play

Before completely disassembling crankcases, check flywheel end play.

1. After engine has been removed from chassis, securely fasten it to a stand or workbench.
2. Remove gearcase cover. See 3.16 GEARCASE COVER AND CAM GEARS.
3. See Figure 3-72. Attach a dial indicator to gear side crankcase with indicator stem on end of gearshaft.
4. To obtain an accurate flywheel end play reading, preload sprocket shaft bearings. Create a suitable tool by welding two handles to an old engine sprocket nut. Install the nut and sprocket. Tighten to 190-210 ft-lbs (258-285 Nm).
5. Check flywheel end play.
   a. Rotate and **push** on sprocket shaft while reading dial indicator.
   b. Then rotate and **pull** on sprocket shaft while reading dial indicator.
   c. Replace bearing inner shim (See Figure 3-75.) if difference (end play) in indicator readings is not 0.001-0.005 in. (0.025-0.127 mm). Choose shim from Table 3-10.

NOTE

Use a thinner shim for less end play; use a thicker shim for more end play.

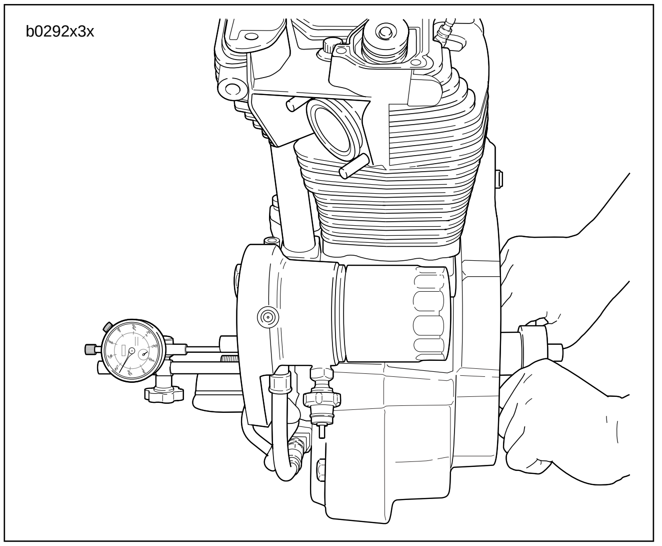


Figure 3-72. Checking Flywheel End Play

Table 3-10. Flywheel End Play Shims

PART NUMBER	THICKNESS	
	IN.	MM
9155	0.0975-0.0985	2.4765-2.5019
9142	0.0995 - 0.1005	2.5273-2.5527
9143	0.1015-0.1025	2.5781-2.6035
9144	0.1035 - 0.1045	2.6289-2.6543
9145	0.1055 - 0.1065	2.6797-2.7051
9146	0.1075 - 0.1085	2.7305-2.7559
9147	0.1095 - 0.1105	2.7813-2.8067
9148	0.1115 - 0.1125	2.8321-2.8575
9149	0.1135 - 0.1145	2.8829-2.9083

Table 3-11. Gearshaft Bearings

PART NUMBER	COLOR
24647-87	Blue
24650-87	Red
24659-87	White/Grey
24660-87	Green

DISASSEMBLY

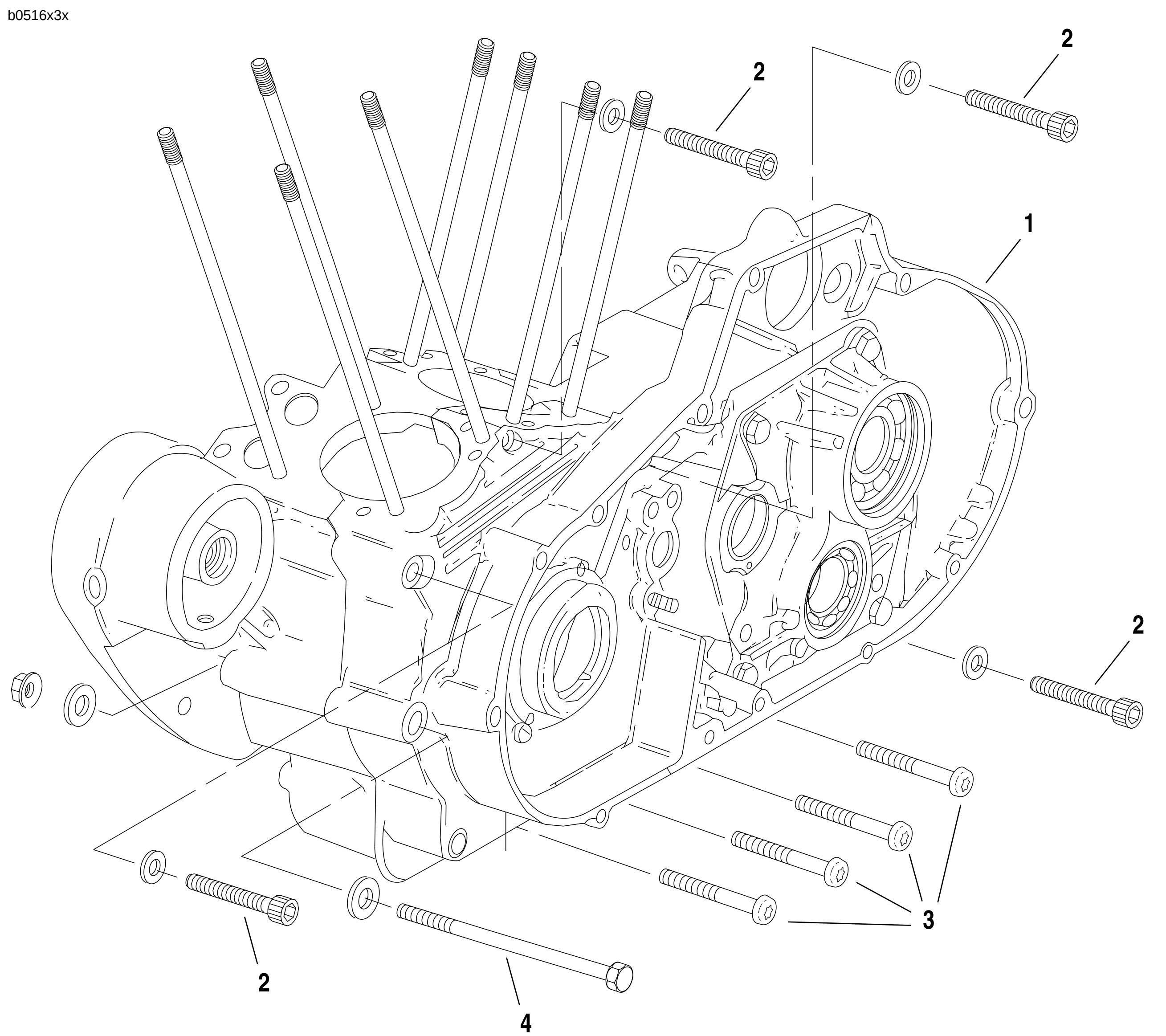
Crankcase Halves

1. Remove cylinder heads. See 3.5 CYLINDER HEAD.

CAUTION

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 AND PISTON.
3. Remove oil pump. See 3.13 OIL PUMP.
4. Remove gearcase components. See 3.16 GEARCASE COVER AND CAM GEARS.
5. Remove primary cover and primary drive/clutch components. See Primary Chain/Drive under 6.5 PRIMARY DRIVE/CLUTCH.
6. Remove starter motor. See 5.7 STARTER.
7. Remove transmission. See 6.7 TRANSMISSION CASE.
8. See Figure 3-73. Remove screws and rear engine mount bolt securing crankcase halves together.
9. Position crankcase on work bench, gearcase side up. Tap crankcase with plastic mallet to loosen top half and separate the halves.



1. **Crankcase**
2. **Upper Case Hex Socket Head Screw – 5/16-18 X 2-1/2 in. (4)**
3. **Bottom Case T40 TORX Bolt – 5/16-18 X 3/4 in. (4)**
4. **Muffler Mount Bolt – 3/8-16 X 5-1/2 in. (2, with Washers and Locknuts)**

Figure 3-73. Crankcase Hardware (Typical)

HOME

⚠WARNING

The next step requires using a press. Wear eye protection and make certain set-up is stable. The pressure involved could cause parts to "fly out" with considerable force. Inadequate safety precautions could result in death or serious injury.

10. See Figure 3-74. Mount the left crankcase half and flywheel assembly on a press table, supporting crankcase on parallel bars. Press on end of sprocket shaft with arbor press until flywheel assembly is free from crankcase half. Do not drive flywheel assembly from crankcase half as flywheels may be knocked out of alignment.

NOTE

See Figure 3-74. If it is necessary to remove either the pinion shaft bearing (11) or sprocket shaft bearing (4 and 9), proceed as follows:

11. Gearshaft bearing will remain on flywheel pinion shaft. Remove retaining ring, and bearing may be slipped off pinion shaft.
12. See Figure 3-76. Place flywheel assembly in FLYWHEEL FIXTURE (Part No. HD-44358). Pull sprocket shaft bearing with SPROCKET SHAFT INNER TIMKIN BEARING REMOVER (Part No. HD-44404) and ALL PURPOSE CLAW PULLER (Part No. HD-95635-46) using bolts in place of jaws. Insert a penny (or suitable coin) between shaft and claw puller to avoid damaging shaft.
13. See Figure 3-77. Use CRANKSHAFT BEARING TOOL (Part No. HD-94547-101) to remove sprocket shaft outer races.

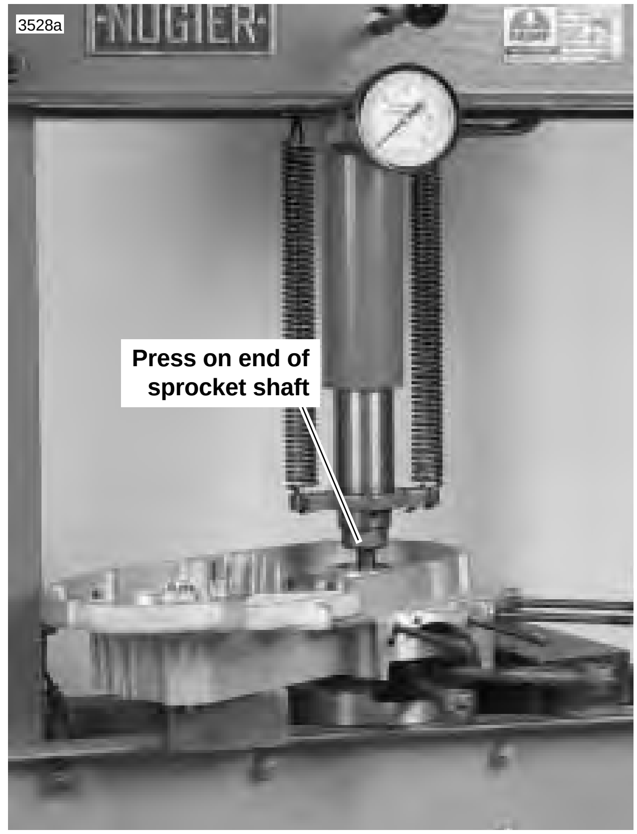


Figure 3-74. Pressing Flywheel from Crankcase

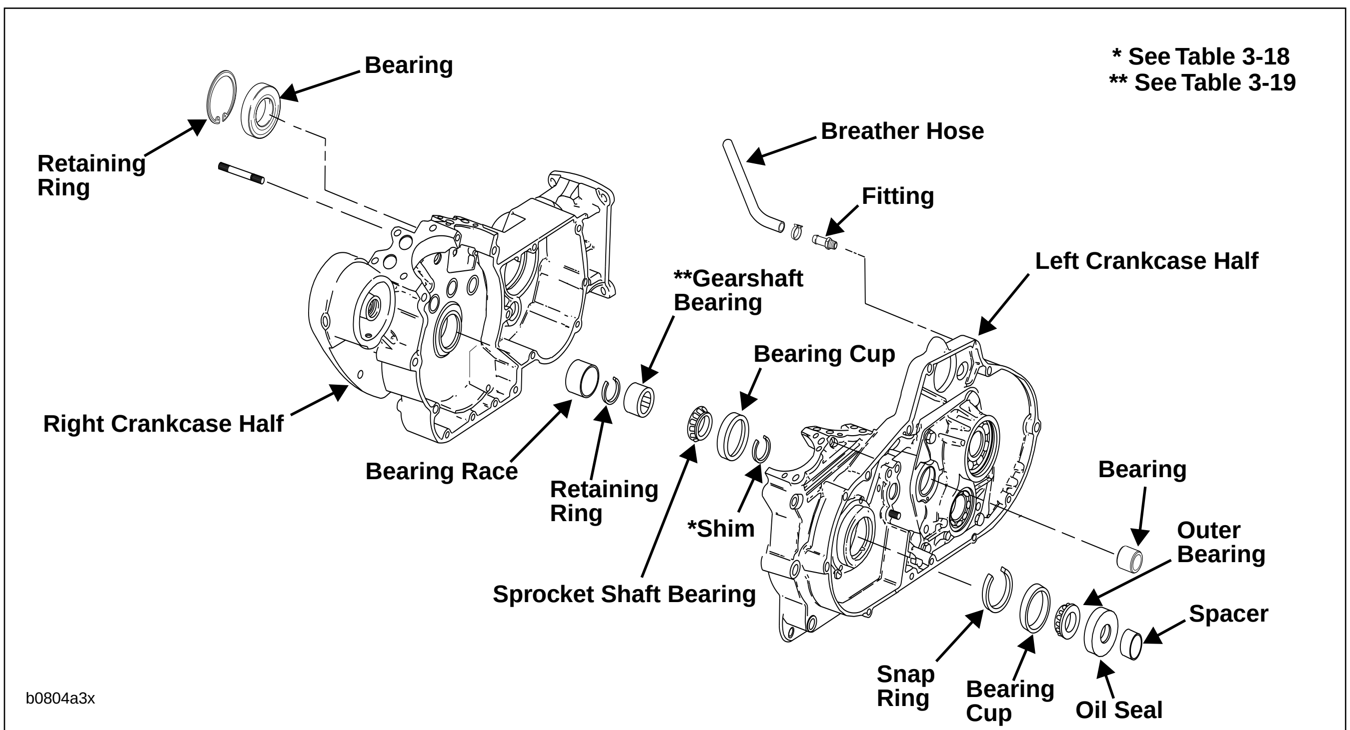
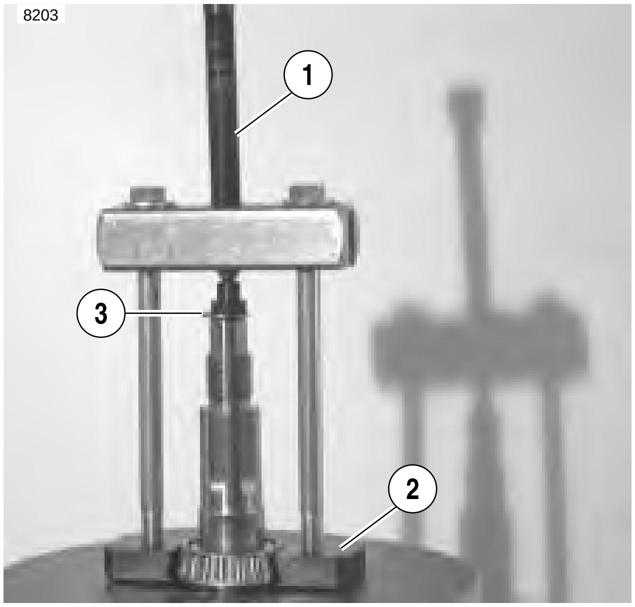


Figure 3-75. Crankcase Assembly



1. All Purpose Claw Puller (Part No. HD-95637-46)
2. Sprocket Shaft Inner Timken Bearing Remover (Part No. HD-44404)
3. Penny (or suitable coin)
4. Flywheel Fixture (Part No. HD-44385) (Not Shown)

Figure 3-76. Removing Sprocket Shaft Inner Timken Bearing (Typical)

Figure 3-77. Sprocket Shaft Outer Race Removal

14. Remove crankcase retaining ring from crankcase bore.
    a. Pace the crankcase half on a flat surface with the outboard side facing up.
    b. Obtain the two TIMKEN SNAP RING REMOVER/ INSTALLER (HD-44069).
    c. See Figure 3-78. With the gap in the retaining ring being the 12 o'clock position, place the two claws so that the slotted sides engage the inside edge of the retaining ring at the 10 and 2 o'clock positions.
    d. Using a 9/64 inch allen head bit, tighten the screws to fix the position of the claws on the retaining ring.
    e. See Figure 3-79. Inserting the tips of a large retaining ring pliers (Snap-On PR-56A) into one hole in each claw, compress the retaining ring and remove it from the crankcase bore.
    f. Loosen allen head screws and remove claws from retaining ring.

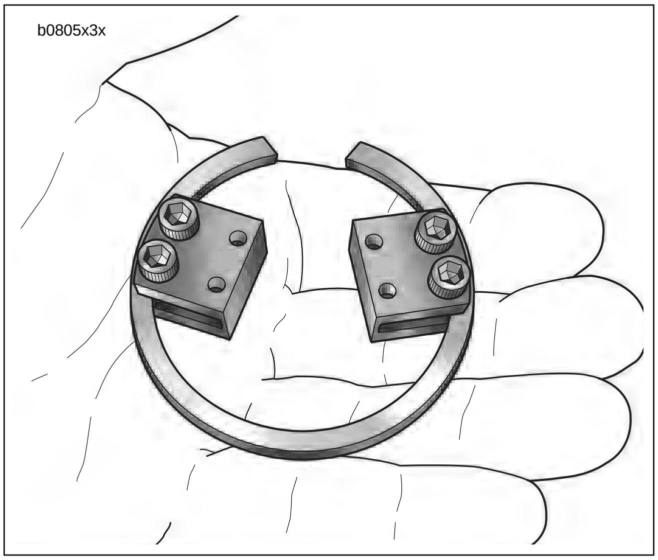


Figure 3-78. Install Claws on Snap Ring

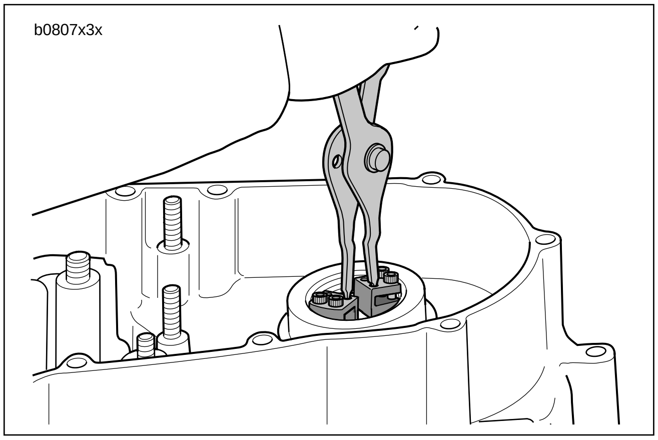


Figure 3-79. Remove Snap-Ring From Crankcase Bore

HOME

Flywheel/Connecting Rod Assembly Replacement

If the flywheel or connecting rods need to be replaced, then they must be replaced together as one assembly. Return the flywheel/connecting rod assembly to the factory for service or replacement.

CLEANING AND INSPECTION

Wash all parts in solvent and blow dry with compressed air.

Flywheel/Connecting Rod Assembly

1. Replace the flywheel/connecting rod assembly is any of the following conditions are noted:
   - Connecting rods are bent or twisted.
   - Connecting rods do not fall under their own weight or are in a bind.
   - The crankshaft (roller) bearing inner race is burnelled, burnt, scored, blued or damaged.
2. Inspect connecting rods for correct free play.
   - Holding the shank of each rod just above the bearing bore, pull up and down on the connecting rods. Any discernible up and down movement indicates excessive lower bearing clearance. Replace the flywheel/connecting rod assembly.
3. See Figure 3-80. Check connecting rod side play.
   a. Insert a feeler gauge between the thrust washer and the outboard side of the connecting rod.
   b. Replace the assembly if the rod side play exceeds 0.030 inch (0.762 mm).

Fitting Sprocket Bearings

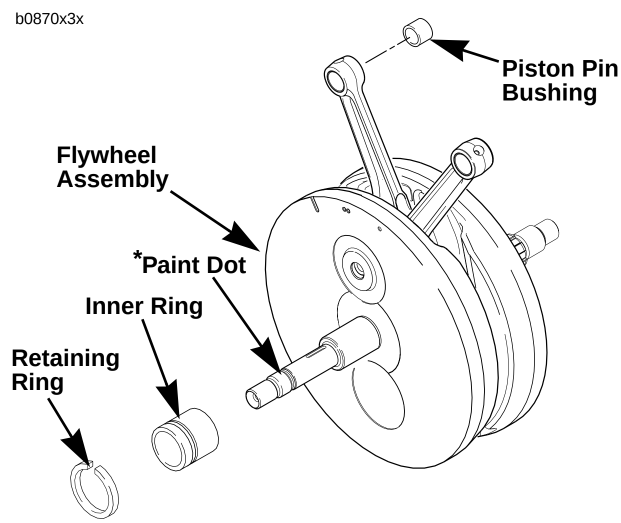
If flywheel end play is within tolerance, and if tapered roller bearings and races pass visual check and have no apparent wear, the same set may be reinstalled. Make certain all parts of bearing are installed in exactly the same order in which they were removed. If any part of bearing assembly is worn, entire assembly should be replaced.

Fitting Pinion Bearings

See Figure 3-75. A pressed-in bushing in the right crankcase half is the outer race. The inner race is pressed on the pinion shaft.

See Figure 3-83. To remove pinion shaft inner race, use TWO CLAW PULLER (Part No. HD-97292-61), CENTER CAP (Part HD-95652-43A), and BEARING SEPARATOR (SNAP-ON TOOLS Stock No. CJ950). Apply heat to race to aid removal. Four sizes of pinion bearings are available. Pinion bearing selection at the factory, during engine rebuild, 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.

Figure 3-80. Checking Connecting Rod Side Play



RACE OD	CLASS	IDENTIFICATION*
1.2498-1.2500 in. (31.7449-31.7500 mm)	A	White
1.2496-1.2498 in. (31.7398-31.7449 mm)	B	Green

*** Paint dot on end of spline**

SERVICE WEAR LIMIT: 1.2492 in. (31.7297 mm)

Figure 3-81. Low Inertia Flywheel and Connecting Rod Assembly/Factory Inner Race Sizes

HOME

See Figure 3-81. Installed inner races are identified at the factory as shown.

See Figure 3-82. Outer races are identified at the factory as shown.

See Figure 3-83. To remove pinion shaft inner race, use TWO CLAW PULLER (Part No. HD-97292-61), CENTER CAP (Part HD-95652-43A), and BEARING SEPARATOR (SNAP-ON TOOLS Stock No. CJ950). Apply heat to race to aid removal. Four sizes of pinion bearings are available. Pinion bearing selection at the factory, during engine rebuild, 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.

See Figure 3-81. Installed inner races are identified at the factory as shown.

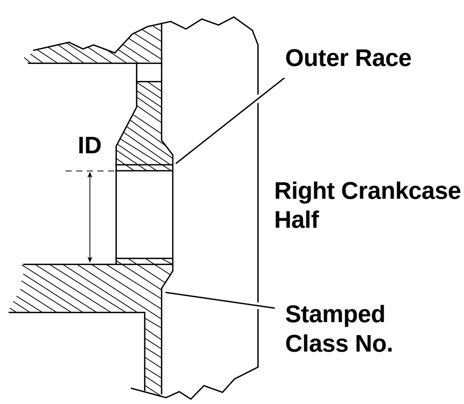
See Figure 3-82. Outer races are identified at the factory as shown.

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 outer race. Replacement flywheel assemblies will have either a class A or B inner race.

See Figure 3-85. Pinion bearings are identified as shown.

b0176x3x



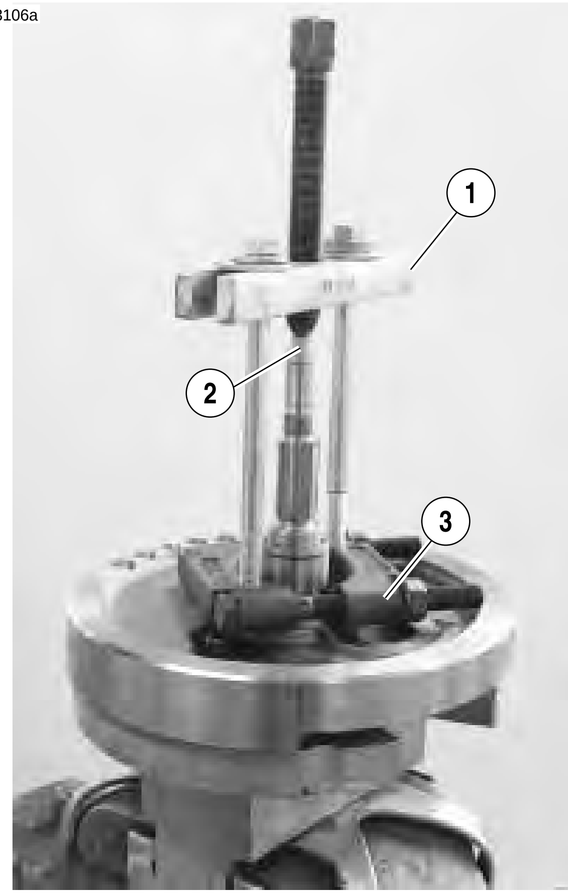
RACE ID	CLASS NO.	STAMPED IDENTIFICATION*
1.5646-1.5648 in. (39.7408-39.7459 mm)	1	1
1.5648-1.5650 in. (39.7459-39.7510 mm)	2	2
1.5650-1.5652 in. (39.7510-39.7561 mm)	3	3

*** Stamped number inside crankcase near race**

SERVICE WEAR LIMIT: 1.5672 in. (39.8069 mm)

Figure 3-82. Factory Outer Race Sizes

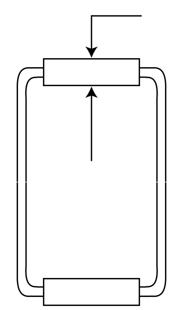
3106a



1. **Puller (Part No. HD-97292-61)**
2. **Center Cap (Part No. HD-95652-43A)**
3. **Bearing Separator (Snap-On Part No. CJ950)**

Figure 3-83. Pulling Pinion Shaft Inner Race (Typical)

b0065x3x



A – Roller OD cannot be measured to required accuracy with micrometer

ROLLER OD (A)	IDENTIFICATION*
Largest	Red
	Blue
	White (Grey)
Smallest	Green

*** Package color**

Figure 3-84. Bearing Identification

BEARING SELECTION

Select bearings using the identification information given for inner and outer races and bearings. See Table 3-11. and Table 3-12.

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 ENGINE MAIN BEARING RACES. Lap race until all wear marks are removed.
3. Measure and record ID of race at four places.
4. Check measurements against these specifications:

   Largest ID measured: 1.5672 in. (39.8069 mm) or less

   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. Press **new** outer race into crankcase flush with inside edge of cast-in insert.

   See Figure 3-86. Dimensions are shown for fabrication of tools used in pressing the outer race into or out of crankcase.
6. The **new** outer race must be lapped slightly to true and align with left case bearing and to meet the following specifications. See LAPPING ENGINE MAIN BEARING RACES.

   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
7. See Figure 3-83. Pull inner race from pinion shaft using TWO CLAW PULLER (Part No. HD-97292-61), CENTER CAP (Part No. HD-95652-43A), and BEARING SEPARATOR (SNAP-ON TOOLS Stock No. CJ950). Apply heat to race to aid removal.

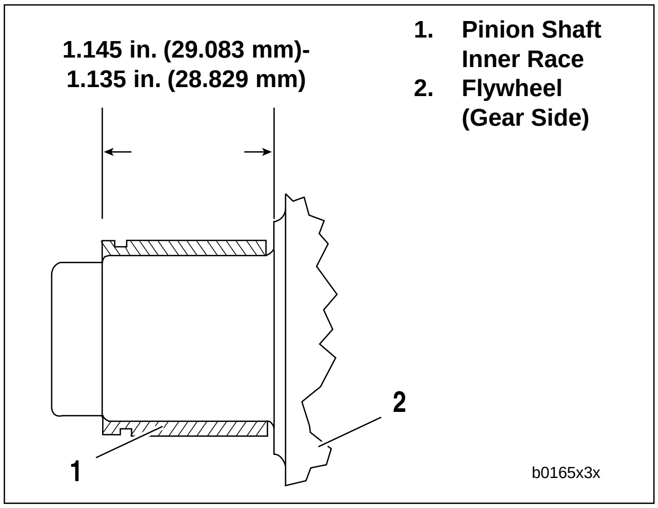


Figure 3-85. Inner Race Location

8. See Figure 3-85. Press **new** inner race on pinion shaft as shown. 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 3-12. The finished inner race must meet these specifications. For necessary dimensions for constructing a press-on tool see Figure 3-86. When the tool bottoms against the flywheel, correct inner race location is automatically established.

   Roundness: within 0.0002 in. (0.0051 mm)

   Taper: within 0.0002 in. (0.0051 mm)

   Surface finish: 16 RMS

NOTE

Always use the smallest outer race ID measurement and the largest OD inner race measurement when selecting bearings.

9. The following example illustrates how to determine the required inner race OD.
   a. See Table 3-12. 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).

NOTE

Have machinist grind outer race to center or middle of required OD range. This will prevent grinding outer race undersize and gives a more easily achieved tolerance range.

   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.

HOME

Lapping Engine Main Bearing Races

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 3-87. 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 “bell,” 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. 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.

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.

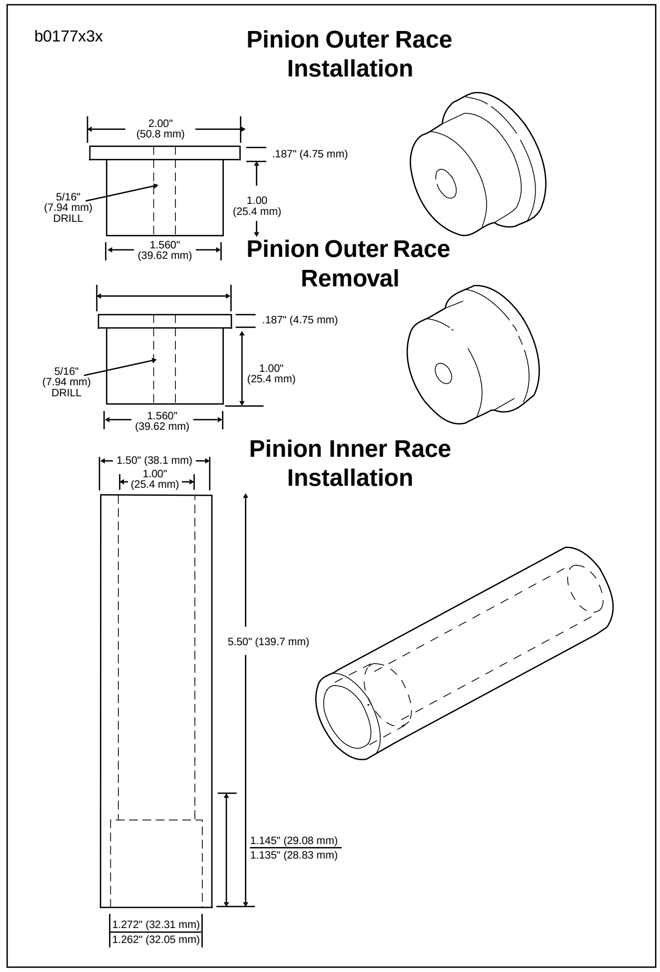


Figure 3-86. Pinion Shaft Bearing Tools

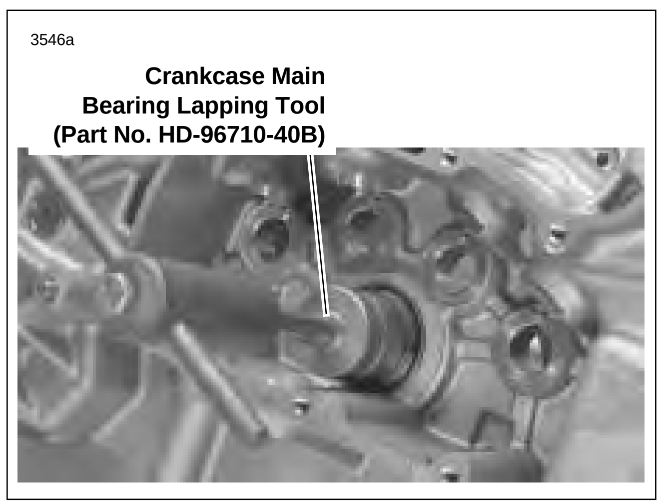


Figure 3-87. Lapping Pinion Shaft Main Bearing

Table 3-12. 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**									

ASSEMBLY

Crankcase Halves

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

1. Install **new** snap ring to crankcase bore (if bearings were replaced).
   a. Pace the crankcase half on a flat surface with the outboard side facing up.
   b. Obtain the two TIMKEN SNAP RING REMOVER/ INSTALLER (HD-44069).
   c. See Figure 3-78. With the gap in the snap ring being the 12 o'clock position, place the two claws so that the slotted sides engage the inside edge of the snap ring at the 10 and 2 o'clock positions.
   d. Using a 9/64 inch allen head bit, tighten the screws to fix the position of the claws on the snap ring.
   e. See Figure 3-79. Inserting the tips of a large retaining ring pliers (Snap-On PR-56A) into one hole in each claw, compress the snap ring and install in groove of crankcase bore.
   f. See Figure 3-88. Verify that the gap in the snap ring is centered below the oil hole at the top of the ring groove. Move snap ring if not properly centered.
   g. Loosen allen head screws and remove claws from snap ring.

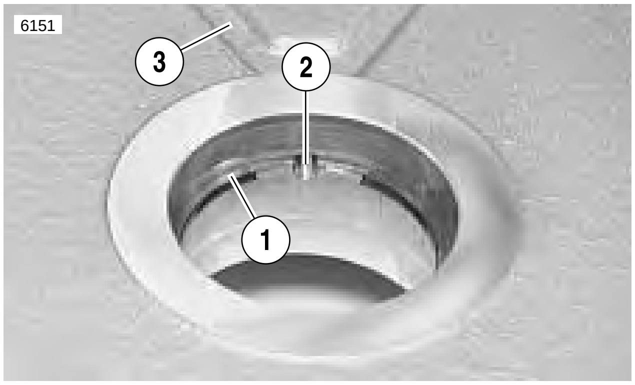
NOTE

See Figure 3-89. Use SPROCKET SHAFT BEARING OUTER RACE INSTALLATION TOOL (1, 2) (Part No. HD-39458) to install left and right outer races (4, 5) of sprocket shaft tapered roller bearings into left crankcase half (6). Always install left outer race (4) prior to installing right outer race (5) because the installer base (1) is usable only when you follow this sequence of race installation.

2. Insert "SPORTSTER" end of installer base (1) into inboard side of left crankcase half (6) bearing bore until base contacts installed retaining ring (3).
3. Position left outer race (4) over bearing bore on outboard side of left crankcase half (6).
4. Insert shaft of installer plug (2) through left outer race (4) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).
5. Insert "SPORTSTER" end of installer base (1) into outboard side of left crankcase half (6) bearing bore until base contacts outboard surface of installed left outer race (4).
6. Position right outer race (5) over bearing bore on inboard side of left crankcase half (6).
7. Insert shaft of installer plug (2) through right outer race (5) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).

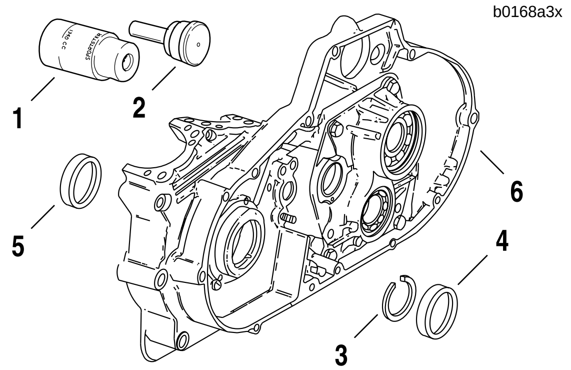
NOTE

See Figure 3-93. Use SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42579) to install sprocket shaft tapered roller bearings and seal.



1. **Snap Ring**
2. **Oil Supply Hole**
3. **Oil Supply Channel**

Figure 3-88. Snap Ring



1. **Installer Base**
2. **Installer Plug**
3. **Snap Ring**
4. **Left Outer Race**
5. **Right Outer Race**
6. **Left Crankcase Half**

Figure 3-89. Installing Sprocket Shaft Bear Outer Races

8. See Figure 3-90. Install inner bearing (6).

    a. Place **new** bearing, small end upward, over end of sprocket shaft.

    b. Thread pilot (1) onto sprocket shaft until pilot bottoms on sprocket shaft shoulder.

    c. Sparingly apply graphite lubricant to threads of pilot shaft to ensure smooth operation.

    d. Slide sleeve (5) over pilot (1) until sleeve contacts inner bearing race. Install Nice bearing (4), washer (3) and handle (2) on top of sleeve.

    e. Rotate handle clockwise until bearing (6) contacts flywheel shoulder. Remove tool from sprocket shaft.

9. See Figure 3-75. Install shim and outer bearing.

    a. See Figure 3-91. Carefully place crankcase half over sprocket shaft so that it rests flat on inner bearing.

    b. Slide **new** inner spacer over sprocket shaft until it contacts inner bearing race.

    c. Place **new** outer bearing, small end downward, over sprocket shaft.

    d. Assemble SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42579) onto sprocket shaft. Follow procedure in Step 8.

    e. Rotate handle clockwise until bearing firmly contacts inner spacer. Inner and outer bearings must be tight against inner spacer for correct bearing clearance. Remove tool from sprocket shaft.

    f. Spin crankcase half to verify that flywheel assembly is free.

10. See Figure 3-92. Install **new** spacer in seal ID. With the open (lipped) side facing outward, center seal/spacer assembly over bearing bore.

CAUTION

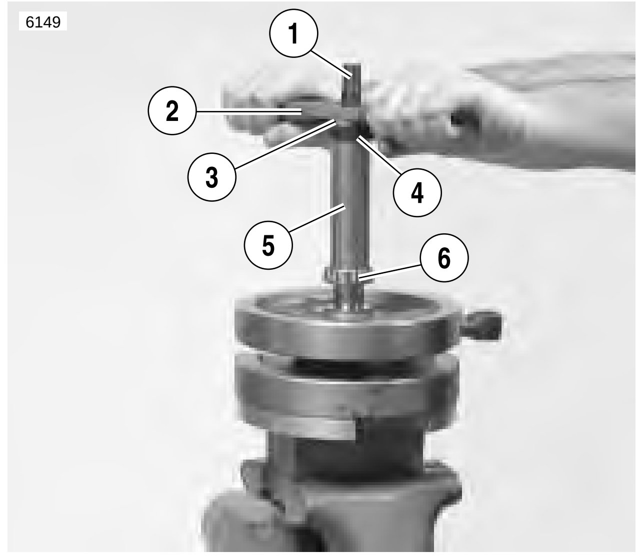
Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

11. See Figure 3-93. Install bearing seal and spacer.

    a. Center seal/spacer driver (2) over seal, so that the sleeve (smaller OD) seats between seal wall and garter spring.

    b. Assemble SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (1) (Part No. HD-42579) and SPROCKET SHAFT SEAL/SPACER INSTALLER (Part No. HD-45206) onto sprocket shaft. Follow procedure in Step 8.

    c. Rotate handle clockwise until the spacer makes contact with the bearing. Remove tool from sprocket shaft.



1. **Pilot**
2. **Handle**
3. **Washer**
4. **Nice Bearing**
5. **Sleeve**
6. **Inner Bearing**

Figure 3-90. Inner Bearing Installation (Typical)

Figure 3-91. Installing Flywheel Spacer and Outer Bearing

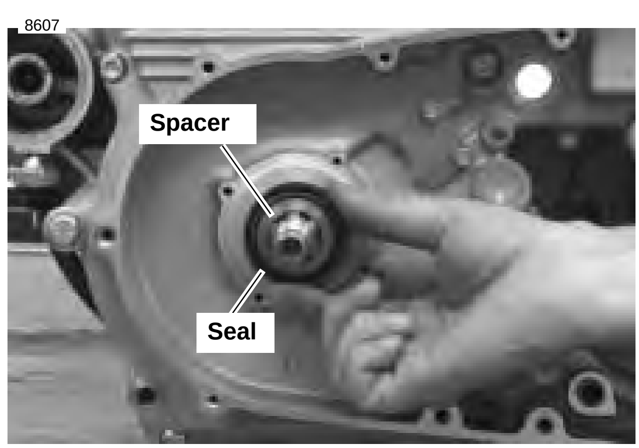


Figure 3-92. Install Spacer in Seal

12. See Figure 3-94. 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.
13. Assemble crankcase halves together.
    a. Apply a thin coat of DOW CORNING SILASTIC or 3-M 800 sealant to crankcase joint faces.
    b. Slide pinion shaft through outer race in right crankcase.
    c. Attach crankcase halves using hardware shown in Figure 3-73.
    d. Tighten the 3/8-in. fasteners to 22-27 ft-lbs (30-37 Nm)
    e. Tighten the 5/16-insteners to 15-19 ft-lbs (20-26 Nm).
14. See Figure 3-95. Install cylinder studs.
    a. Pack clean towels into crankcase opening.
    b. Place a steel ball into a head screw (1).
    c. The cylinder studs (2) have a shoulder (3) 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 (4) 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).
15. Install pistons and cylinders. See 3.6 CYLINDER AND PISTON.
16. Install oil pump. See 3.13 OIL PUMP.
17. Install cam gears, gearcase cover, lifter guides and lifters. See 3.16 GEARCASE COVER AND CAM GEARS.
18. Install cylinder heads. See 3.5 CYLINDER HEAD.
19. Install starter. See 5.7 STARTER.
20. Install transmission. See 6.13 TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT.
21. Install all primary drive components. This includes engine sprocket, primary chain, complete clutch assembly, engine sprocket nut and mainshaft nut. See 6.5 PRIMARY DRIVE/CLUTCH.
22. Install primary cover. See Primary Cover under 6.2 PRIMARY CHAIN.

NOTE

Be sure to refill transmission to proper level with fresh lubricant. See 1.9 CLUTCH.

23. See 3.4 INSTALLING THE ENGINE and perform the applicable steps.

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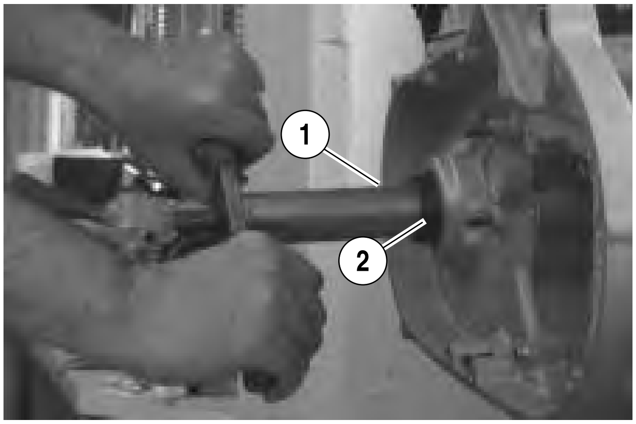


1. **Bearing/Seal Installer (Part No. HD-42579)**
2. **Seal/Spacer Installer (Part No. HD-45206)**

Figure 3-93. Install Bearing Seal/Spacer

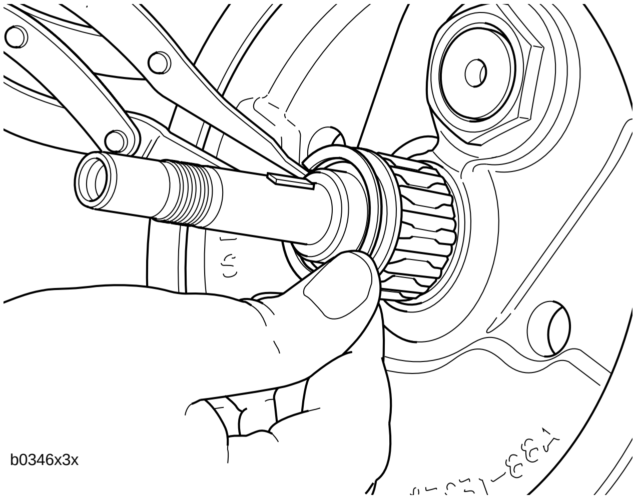
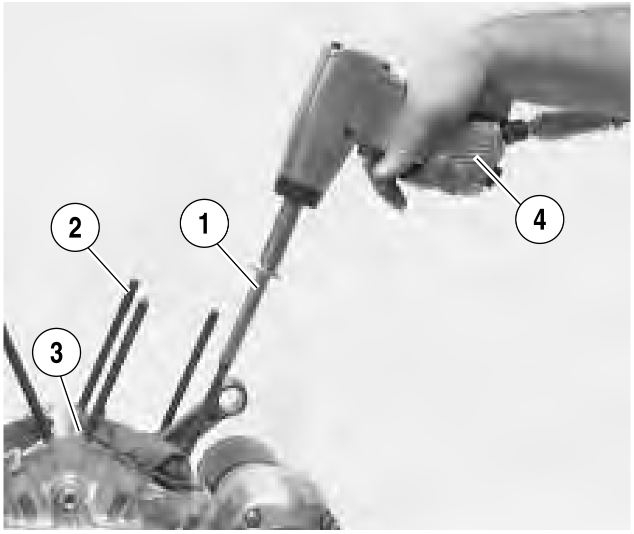


Figure 3-94. Pinion Shaft Bearing

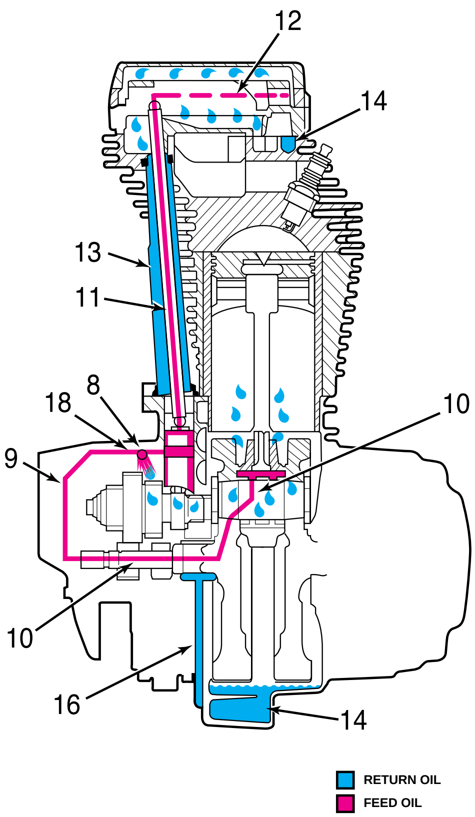


1. **Head Screw with Ball Inside**
2. **Cylinder Stud**
3. **Shoulder on Cylinder Stud**
4. **Air Gun**

Figure 3-95. Cylinder Studs

NOTES

INTERNAL ENGINE PASSAGES



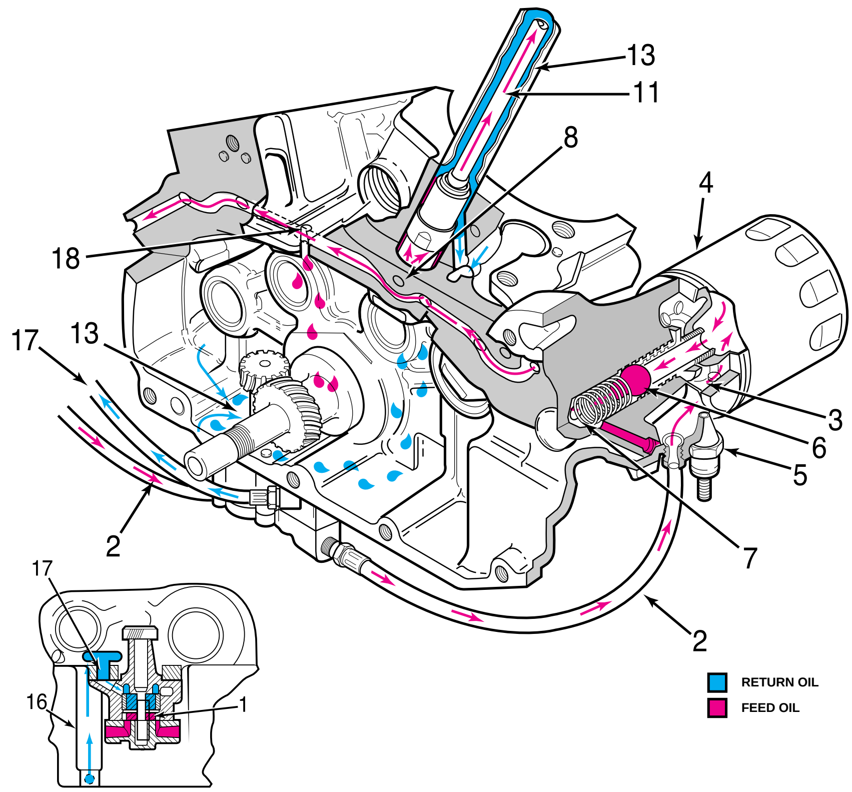


Table Of Contents

FUEL SYSTEM 4

SUBJECT	PAGE NO.
4.1 Specifications	4-1
4.2 Dynamic Digital Fuel Injection	4-2
4.3 Diagnostic Introduction	4-4
4.4 Checking For Trouble Codes	4-5
4.5 Scanalyzer	4-7
4.6 Check Engine Lamp Diagnostics	4-10
4.7 Breakout Box	4-12
4.8 Wiggle Test	4-13
4.9 Initial Diagnostic Check	4-14
4.10 Check Engine Lamp Not Illuminated at Key ON	4-20
4.11 Check Engine Lamp On Continuously	4-23
4.12 Engine Cranks But Will Not Start	4-26
4.13 No ECM Power	4-31
4.14 Fuel Pressure Test	4-34
4.15 Idle Speed Control	4-39
4.16 Misfire	4-40
4.17 Trouble Code 11	44
4.18 Trouble Code 13	48
4.19 Trouble Code 14	53
4.20 Trouble Code 15	57
4.21 Trouble Code 16	61
4.22 Trouble Codes 23 and 32	65
4.23 Trouble Codes 24 and 25	69
4.24 Trouble Code 33	72
4.25 Trouble Code 35	75
4.26 Trouble Code 44	78
4.27 Trouble Codes 52, 53, 54 and 55	82
4.28 Trouble Code 56	83
4.29 Electronic Control Module	87
4.30 Cam Position Sensor and Rotor	89
4.31 Oxygen Sensor	91

Continued on the next page

SUBJECT	PAGE NO.
4.32 Engine Temperature Sensor	92
4.33 Bank Angle Sensor	93
4.34 Intake Air Temperature Sensor	94
4.35 Throttle Position Sensor	95
4.36 Fuel Tank	96
4.37 Fuel Tank Vent Valve	99
4.38 Inline Fuel Filter	101
4.39 Fuel Pump	102
4.40 Throttle Body and Intake Manifold	104
4.41 Air Cleaner	108
4.42 Evaporative Emissions Control	110

SPECIFICATIONS 4.1

FUEL TANK CAPACITY	GALLONS	LITERS
Total (including Reserve)	5.4	20.44
Reserve	0.4	1.51
Low Fuel Indicator Light at	0.4	1.51

ADJUSTMENTS	
Normal Idle Speed	850-1050 RPM

TORQUE VALUES

ITEM	TORQUE		NOTES
Backplate Mount Bolts	3-5 ft-lbs	4-7 Nm	LOCTITE THREADLOCKER 243 (blue)
Canister Mounting Clamp Screws	6-8 ft-lbs	8-11 Nm	
Cylinder Head Breather Bolts	10-15 ft-lbs	14-20 Nm	HYLOMAR
Fuel Cap Flange Screws	22-25 **in-lbs**	2.5-2.8 Nm	special pattern to tighten
Fuel Pump Stud Nuts	68-75 **in-lbs**	8-9 Nm	LOCTITE THREADLOCKER 243 (blue)
Fuel Supply Valve Screws	25-27 **in-lbs**	2.8-3.1 Nm	
Fuel Tank Mounting Bolt	18-23 ft-lbs, then wait 5 min. and retighten to 18-23 ft-lbs.	24-31 Nm	special procedure
Ignition Bracket Screw	25-30 ft-lbs	34-41 Nm	
Intake Manifold Screws	6-10 ft-lbs	8-14 Nm	
Snorkel Plate Screws	6-8 ft-lbs	8-11 Nm	LOCTITE THREADLOCKER 243 (blue)
Tie Bar Bolts	30-33 ft-lbs	41-45 Nm	

DYNAMIC DIGITAL FUEL INJECTION 4.2

INTRODUCTION

The Buell Dynamic Digital Fuel Injection (DDFI) System provides microprocessor-based electronic engine management for the 1203cc Buell Thunderstorm engine. 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.
- Engine speed and position determined using a single sensor (Cam Position Sensor).
- Full diagnostic capability compatible with the SCANALYZER (Part No. HD-41325).
- Returnless fuel system (excess pressure relieved in tank by Fuel Pressure Regulator Valve).

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.
- Camshaft 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.

GENERAL

The Buell DDFI operates both as an open and closed loop system which allows it to adjust for all possible operating conditions. High lift cams make it necessary for an open loop system at idle and at wide open throttle. During open loop operation, the system utilizes programmed fuel and spark maps in the ECM which provide stable idle and ease of cold starting, and maximum power at wide open throttle (WOT).

During closed loop operation, the system relies on input from the O2 sensor to provide for the most efficient, stoicheometric air fuel mixture (14.6:1) 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 above 2500 RPM (approximately 40-60 mph in 4th or 5th gear).

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

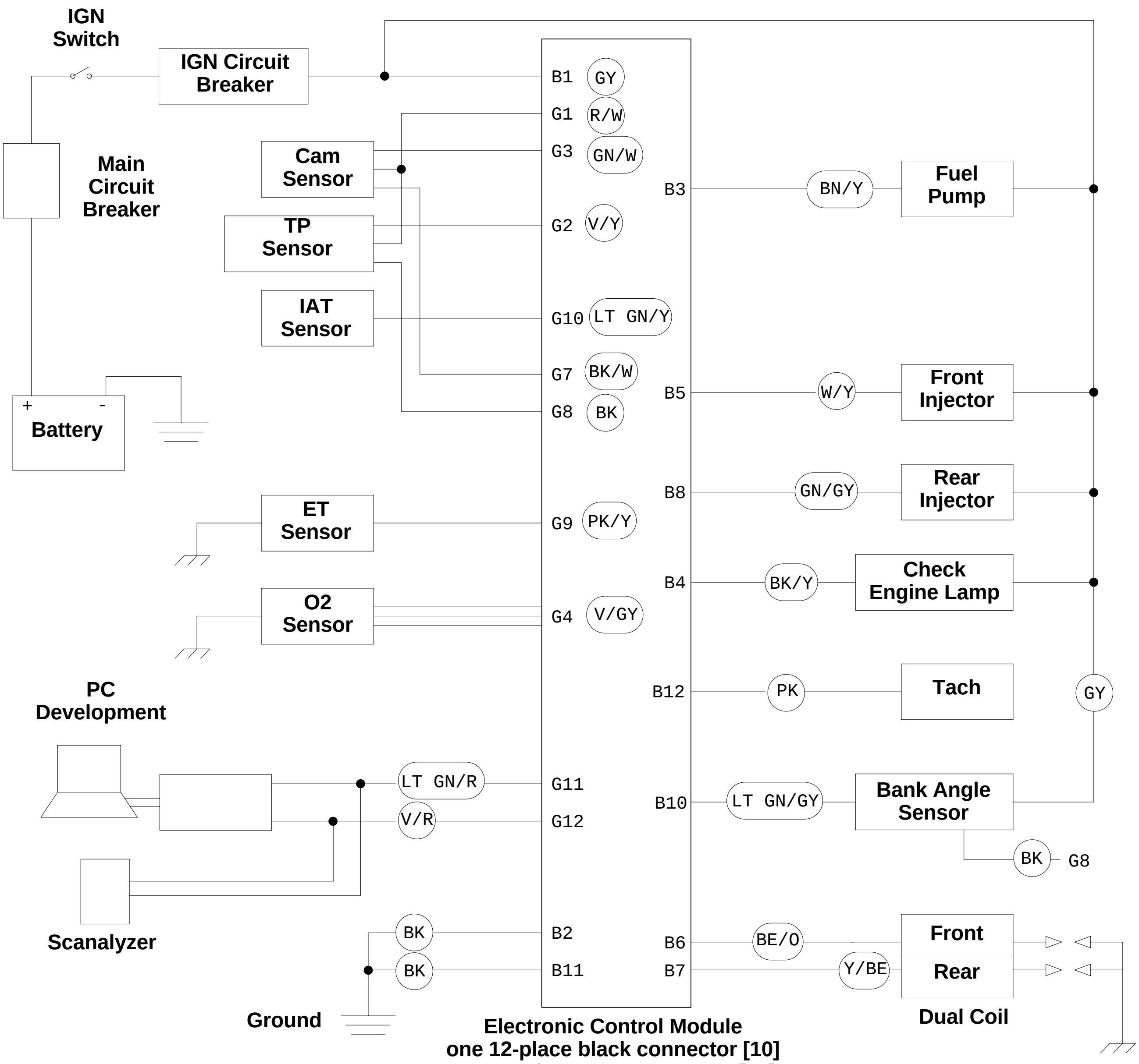
To learn more about the Buell DDFI system, read the following topics in this section. A system diagram can be found on the next page in Figure 4-1.

Troubleshooting

- 4.3 DIAGNOSTIC INTRODUCTION.
- 4.4 CHECKING FOR TROUBLE CODES.
- 4.6 CHECK ENGINE LAMP DIAGNOSTICS.
- 4.9 INITIAL DIAGNOSTIC CHECK.
- TABLE 4-5. TROUBLE CODES AND FAULT CONDITIONS.

Fuel Injection Components

- 4.29 ELECTRONIC CONTROL MODULE
- 4.31 OXYGEN SENSOR
- 4.32 ENGINE TEMPERATURE SENSOR
- 4.33 BANK ANGLE SENSOR
- 4.34 INTAKE AIR TEMPERATURE SENSOR
- 4.35 THROTTLE POSITION SENSOR
- 4.39 FUEL PUMP
- 4.40 THROTTLE BODY AND INTAKE MANIFOLD



WIRE COLOR CODES USED IN THIS DOCUMENT

LT	Light	**GY**	Gray	**V**	Violet
BK	Black	**O**	Orange	**W**	White
BE	Blue	**PK**	Pink	**Y**	Yellow
BN	Brown	**R**	Red		
GN	Green	**TN**	Tan		

Figure 4-1. Buell Dynamic Digital Fuel Injection

DIAGNOSTIC INTRODUCTION 4.3

SYSTEM PROBLEMS

All system problems fall into at least one of three general categories.

No Start

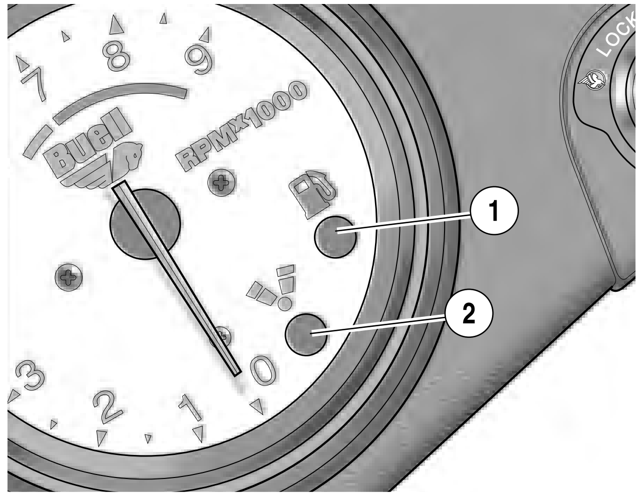
The engine cranks over freely, but will not start. This does not include situations where the engine will not crank, such as a bad starter, dead battery, etc. This condition assumes that all obvious checks (fuel in tank, etc.) have been made.

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 (2) indicates the ECM has determined 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

RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for trouble codes by observing check engine lamp. See 4.4 CHECKING FOR TROUBLE CODES.
2. Retrieve trouble codes using SCANALYZER (Part No. HD-41325) or check engine lamp diagnostics. See 4.5 SCANALYZER, 4.6 CHECK ENGINE LAMP DIAGNOSTICS and Figure 4-3.
3. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
4. Correct problems through the replacement and/or repair of the affected components.
5. After repairs are performed, the work must be validated. This involves clearing the trouble codes and confirming proper vehicle operation as indicated by the behavior of the check engine lamp.

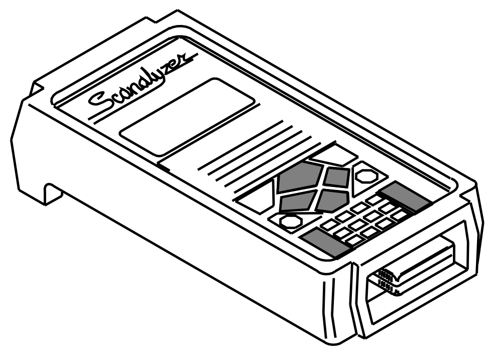


Figure 4-3. Scanalyzer (Part No. HD-41325)

CHECKING FOR TROUBLE CODES 4.4

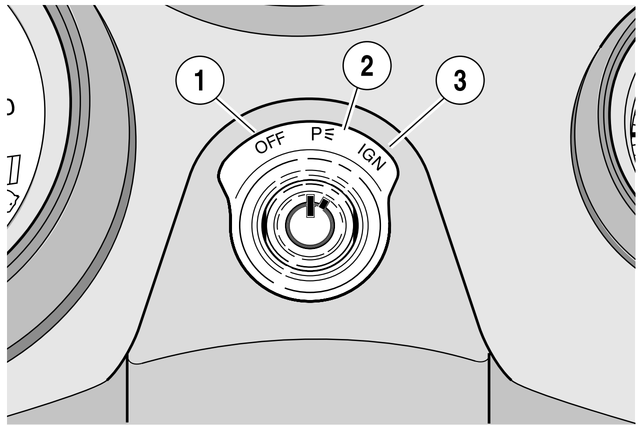
CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

NOTE

- *See Figure 4-4. All references to "Key ON" or "Ignition Switch ON" require that the ignition key be in the IGN 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 4.10 CHECK ENGINE LAMP NOT ILLUMINATED AT KEY ON or 4.11 CHECK ENGINE LAMP ON CONTINUOUSLY for more information.*

1. When the ignition switch is turned ON after being OFF for 10 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.



1. **Ignition OFF**
2. **Marker Lights ON**
3. **Ignition ON**

b0466xox

Figure 4-4. Ignition Key Switch

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 exercised by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

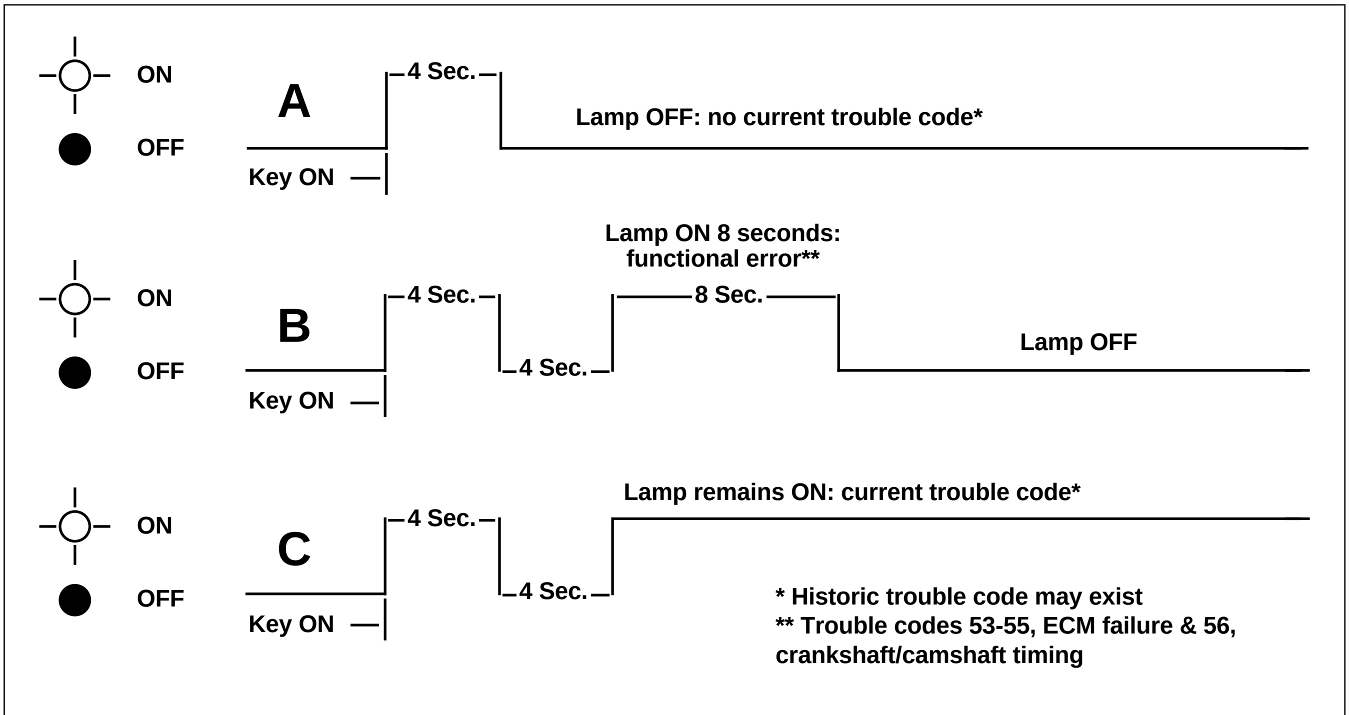


Figure 4-5. Check Engine Lamp Operation

CODE TYPES

There are three types of trouble codes: current, historic or functional. If a trouble code is stored, it can be read using either a Scanalyzer or check engine lamp diagnostics.

All trouble codes reside in the memory of the ECM until the code is cleared by use of the Scanalyzer or a total of 50 trips has elapsed. A trip consists of a start and run cycle, the run cycle lasting at least 30 seconds. After the 50 trip retention period, the trouble code is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

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 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 indicate the existence of only historic trouble codes.

It is important to note that historic trouble codes may also be present whenever the system indicates the existence of a current fault. See MULTIPLE TROUBLE CODES if multiple trouble codes are found.

Functional

A functional trouble code indicates 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 a portable diagnostic tool called a Scanalyzer. This device plugs into the motorcycle wiring harness. It facilitates the diagnosis of system problems through a direct interface with the ECM. See 4.5 SCANALYZER.
- The second mode requires using the check engine lamp. See 4.6 CHECK ENGINE LAMP DIAGNOSTICS for more information.

MULTIPLE TROUBLE CODES

The TP and CMP 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, bank angle sensor 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. See list of fault conditions on page 4-17 (Table 4-5.).

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.

SCANALYZER DIAGNOSTICS

Data Link Connector

See Figure 4-6. Using the Scanalyzer requires access to the data link connector [91A] located in the trunk. Remove the seat to access the data link connector. See 2.35 SEAT.

Scanalyzer Cartridge

See Figure 4-7. Through a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data. The device enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

Sample Scanalyzer menu selections are shown in Figure 4-8.

INSTALLATION

The behavior of the check engine lamp (as described under CHECK ENGINE LAMP) indicates the presence of trouble codes. When trouble codes are present, and a SCANALYZER (Part No. HD-41325) and DIAGNOSTIC CARTRIDGE (Part No. B-41325-99) are available, proceed as follows:

1. Turn ignition/light key switch OFF.
2. See Figure 4-6. Remove the seat. See 2.35 SEAT.
3. Remove rubber protective plug from data link connector. Plug Scanalyzer into connector. If necessary, detach connector from frame.
4. Turn ignition/light key switch ON. Set engine stop switch to RUN, but do not start engine.
5. See Figure 4-7. Insert the diagnostic application cartridge (2) into the Scanalyzer (1). During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ECM. Once communications is established with the ECM, the diagnostic menu appears. See Figure 4-8.
6. Continue with the instructions under USAGE.

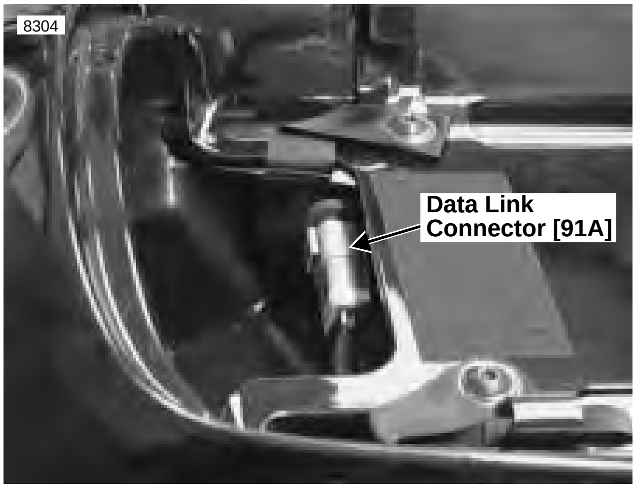
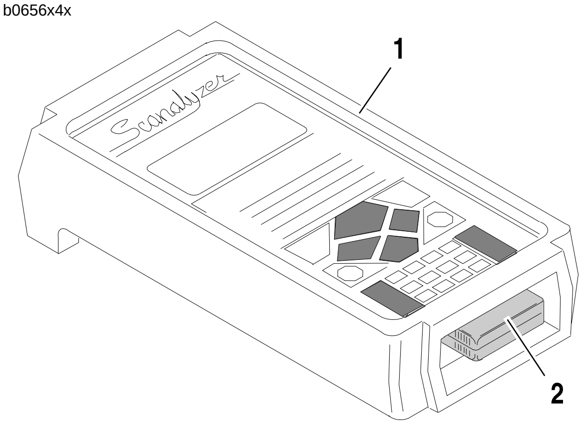


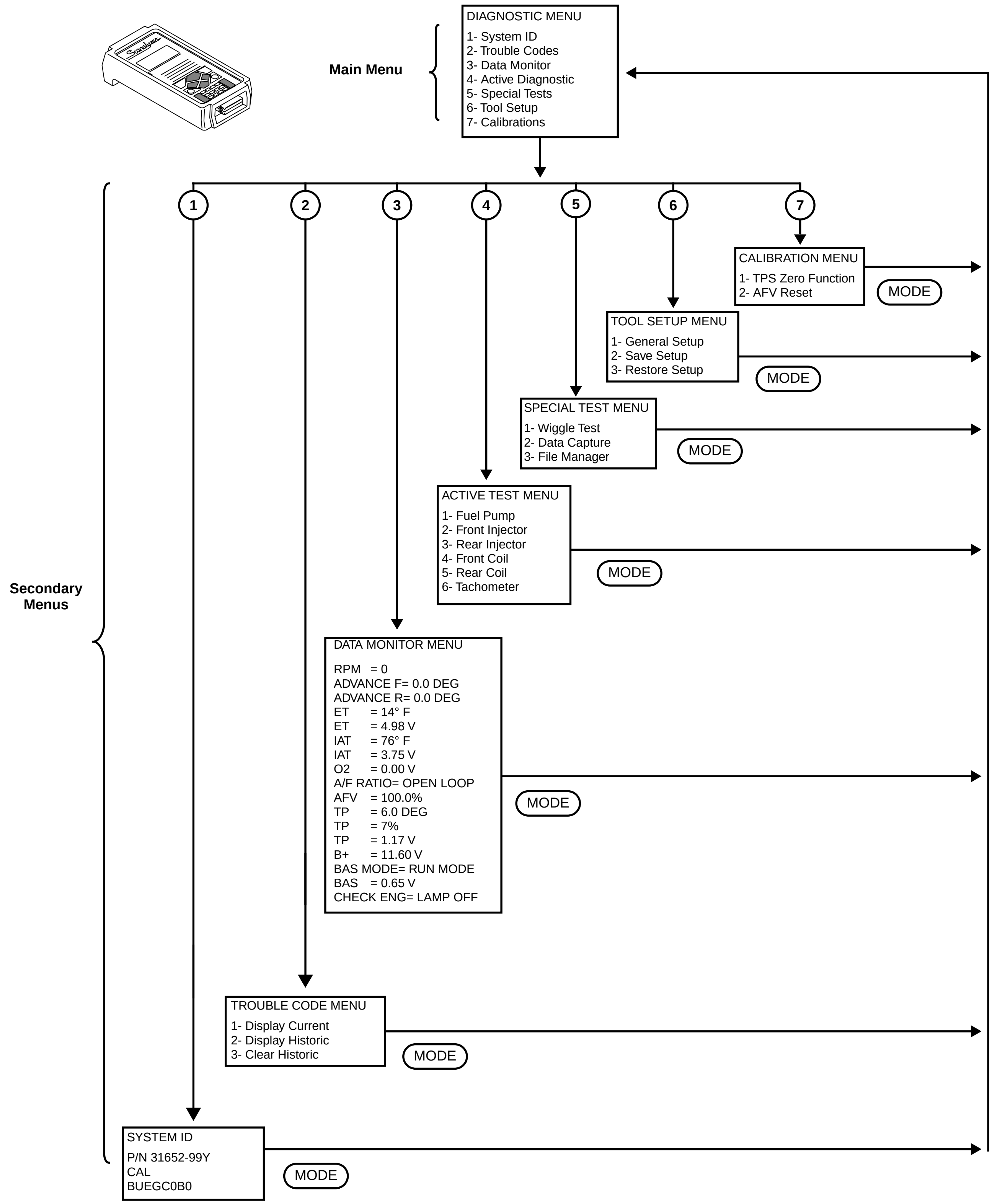
Figure 4-6. Data Link Location



1. **Scanalyzer (Part No. HD-41325)**
2. **Cartridge (Part No. B-41325-99)**

Figure 4-7. Scanalyzer and Cartridge

HOME



NOTE

The system ID part number varies depending upon market.

Figure 4-8. Scanalyzer Menus

USAGE

See Figure 4-8. The diagnostic menu is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.

Checking Codes

1. See Figure 4-9. From the diagnostic menu, press number "2" to access the trouble codes menu. At this point, the unit allows the operator to:
   a. Press number "1" to display current trouble codes.
   b. Press number "2" to display historic trouble codes.
   c. Press number "3" to clear trouble codes. See Clearing Codes below.
2. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, see Table 4-5. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.9 INITIAL DIAGNOSTIC CHECK.
   c. After reading current/historic trouble codes, simply press the mode key to return to the trouble codes menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.
4. After correcting system problems, clear trouble codes using the trouble codes menu of the scanalyzer.

Clearing Codes

Unlike the check engine lamp diagnostics, note that the Scanalyzer **does** allow the operator to clear trouble codes from memory as well as differentiate between current and historic codes.

Trouble codes cannot be cleared while the engine is running. Turn the engine off by setting handlebar stop switch to the OFF position, but leaving the ignition/light key switch ON. Return the handlebar engine stop switch to the RUN position and restart motorcycle.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

REMOVAL

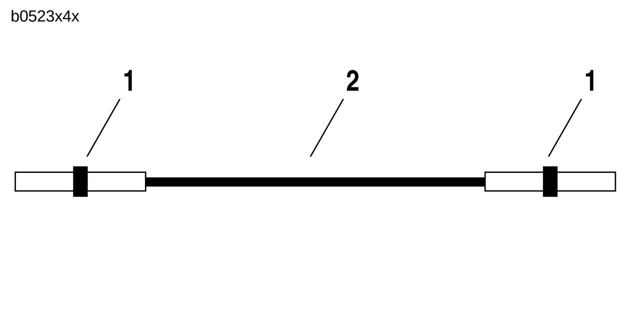
1. Turn ignition/light key switch OFF. Set engine stop switch to the OFF position.
2. Unplug Scanalyzer from data link connector. Install protective plug connector.
3. Attach data link connector to frame.
4. Road test vehicle and observe check engine lamp. Confirm proper operation without the reoccurrence of trouble codes. See 4.4 CHECKING FOR TROUBLE CODES.

Figure 4-9. Scanalyzer Diagnostic Menu

RETRIEVING TROUBLE CODES

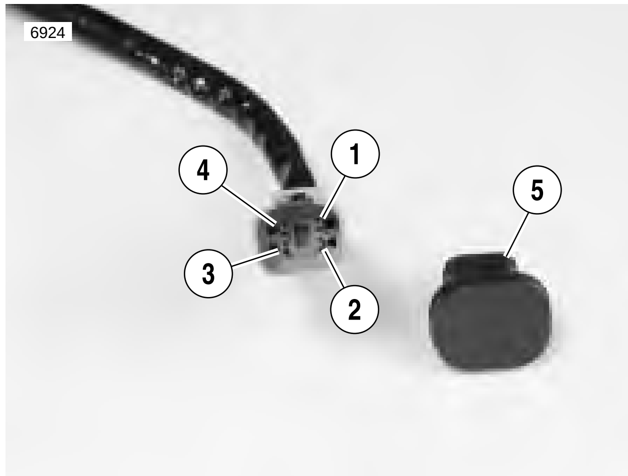
Trouble codes may be retrieved without the use of the SCAN-ALYZER (Part No. HD-41325).

1. Remove seat. See 2.35 SEAT.
2. Detach data link connector [91A] from trunk. Remove protective cover from data link connector [91A].
3. To activate the diagnostic feature of the check engine lamp, proceed as follows:
   a. See Figure 4-10. Create diagnostic test wire from parts shown.
   b. See Figure 4-11. 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.
4. See Figure 4-12. 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.
5. 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.
6. 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.
7. 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 4-10. 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 4-11. Installing Diagnostic Test Wire

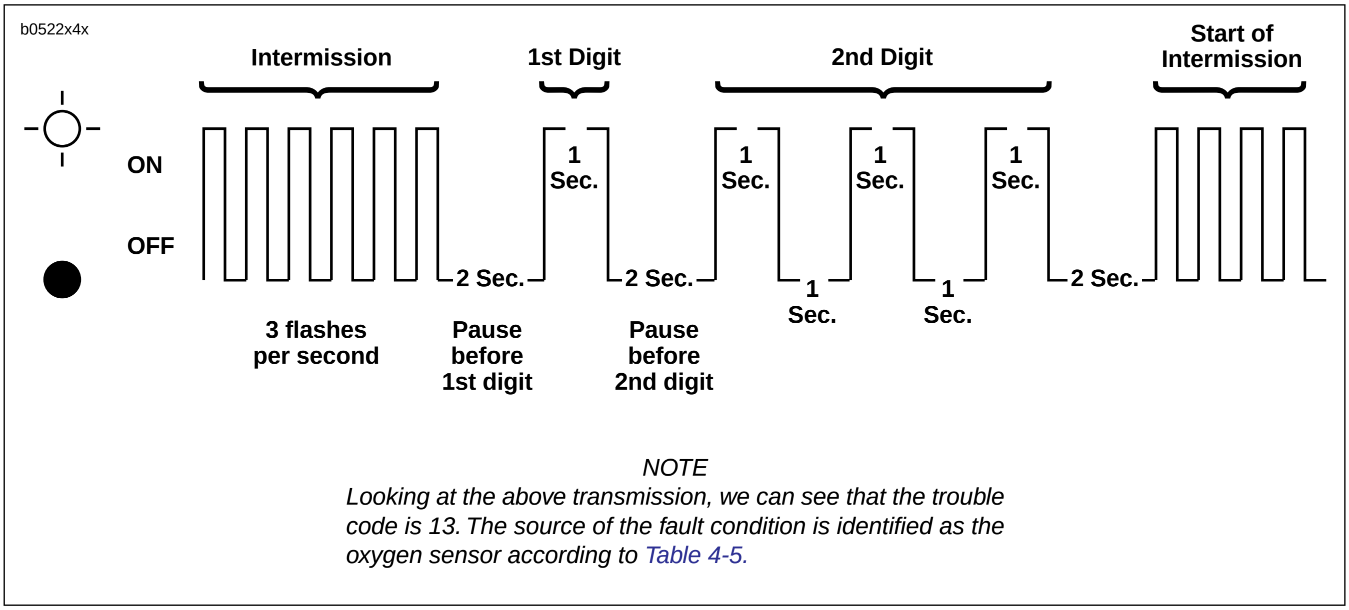


Figure 4-12. Check Engine Lamp Diagnostics

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.

8. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, see Table 4-5. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.9 INITIAL DIAGNOSTIC CHECK.
9. Turn the ignition/light key switch OFF.
10. Install protective cover over data link connector. Attach connector to trunk.
11. Install seat. See 2.35 SEAT.

IMPORTANT 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 Scanalyzer 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 4.7

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

NOTE

ECM is mounted to right side of frame.

1. See Figure 4-13. Remove seat and tail section. See 2.33 TAIL SECTION.
2. Depress latches on each side of connectors [10] (black) and [11] (gray).
3. See Figure 4-14. Attach Breakout Box (1) 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.

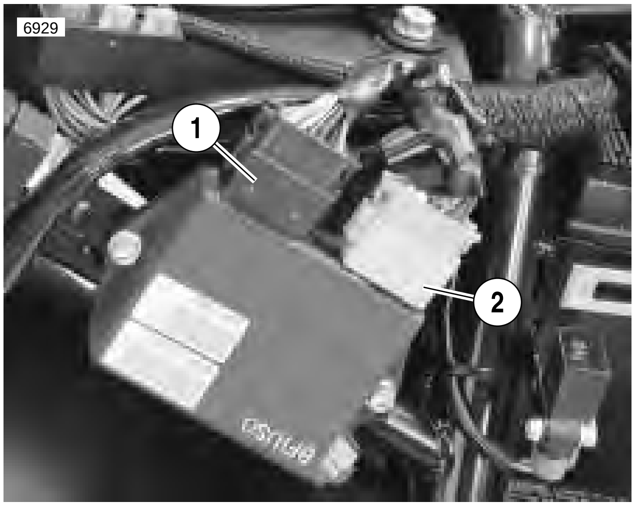
REMOVAL

1. See Figure 4-14. 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. Reattach ECM connectors to wiring harness.

⚠WARNING

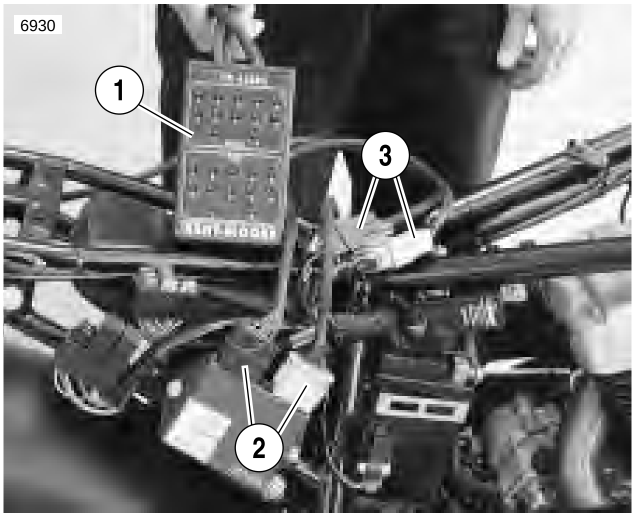
After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

5. Install tail section and seat. See 2.33 TAIL SECTION.



1. ECM Connector [10] (Black)
2. ECM Connector [11] (Gray)

Figure 4-13. ECM Connectors (S3 Shown)



1. Breakout Box
2. ECM Connection
3. Wiring Harness Connection

Figure 4-14. Installed Breakout Box

WIGGLE TEST 4.8

GENERAL

The wiggle test checks for the presence of intermittents in a wiring harness. Depending upon the availability of diagnostic tools, either version of this test may be used.

PROCEDURE

Using DVOM (Part No. HD-39978)

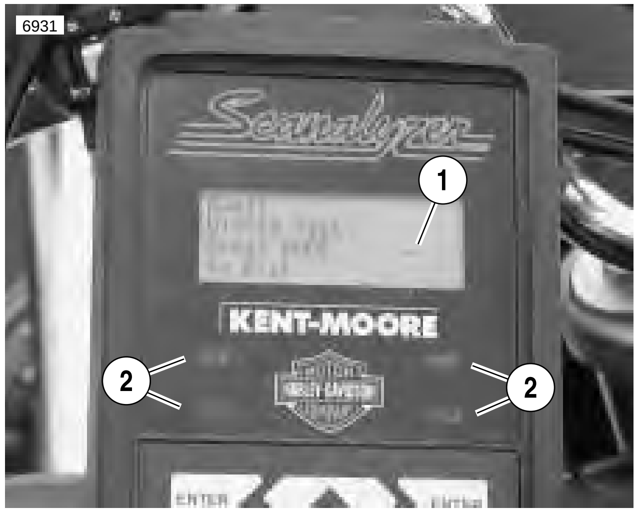
1. Connect DVOM to wiring harness between the suspect connections. When diagnosing ECM connections, a BREAKOUT BOX (Part No. HD-42682) may be used to simplify the procedure. See 4.7 BREAKOUT BOX.
2. Set DVOM to read voltage changes.
3. Start motorcycle engine and run at idle.
4. Shake or wiggle harness to detect intermittents. If intermittents are present, radical voltage changes will register on the DVOM.

Using Scanalyzer (Part No. HD-41325)

1. Connect Scanalyzer to vehicle. See 4.5 SCANALYZER.
2. Start motorcycle engine and run at idle.
3. Enter wiggle test mode.
   a. Press “5” from the DIAGNOSTIC MENU to enter the SPECIAL TESTS menu.
   b. Press “1” from the SPECIAL TESTS menu to enter the WIGGLE TEST.
4. Shake or wiggle harness to detect intermittents. If intermittents are present the Scanalyzer will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. See Figure 4-15.

NOTE

If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With key ON and engine off, clear trouble codes and then perform wiggle test with vehicle running.



1. **Minus Sign**
2. **Corner LED (4)**

Figure 4-15. Wiggle Test Indicators

INITIAL DIAGNOSTIC CHECK 4.9

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Scanalyzer Icon

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the Scanalyzer notes, which are similar to the diagnostic notes, but are restricted to information on the use of the Scanalyzer. All Scanalyzer notes may be found at the end of the respective flow chart.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a DVOM are required. See 4.7 BREAKOUT BOX.

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

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

INITIAL DIAGNOSTICS

General Information

The diagnostic check is an organized approach to identifying a problem caused by an electronic control system malfunction. If no problems are found after completion of the diagnostic check, a comparison of Scanalyzer parameters may be used to help locate intermittents and out-of-specification sensors. See Table 4-1.

Diagnostic Tips

- If the Scanalyzer is not working properly, check operation on another vehicle.
- If proper Scanalyzer function is verified, check data link connector [91A] for 12 volts (Terminal 4) and proper ground (Terminal 2). See Figure 4-16.
- See Figure 4-11. If Scanalyzer reads “No Response” with the ignition key switch turned ON (engine stop switch at RUN with the engine off), check serial receive data wire for an open or short to ground between data link Terminal 1 (Lt GN/R wire) and ECM.
- Check for an open diagnostic test terminal between data link Terminal 3 (V/R wire) and ECM. With ignition key switch turned ON, transmit data line (V/R wire) should have between 11-12 volts and receive data line (Lt GN/R wire) between 5-6 volts.

IMPORTANT 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 page 4-18.

1. Compare engine behavior to symptoms tables.
   a. Starts hard. See Table 4-2.
   b. Hesitates, stumbles, surges, misfires and/or sluggish performance. See Table 4-3.
   c. Engine exhaust emits black smoke or fouls plugs. See Table 4-4.
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 4.7 BREAKOUT BOX.

All diagnostic codes are listed on page 4-17 in Table 4-5.

Table 4-1. Typical Scan Values

ITEM	MIN. VALUE	MAX. VALUE	HOT IDLE
RPM	500	6900	1000*
ET (temperature, °F)	3	558	varies
ET (voltage)	0.05	4.95	varies
IAT (temperature)	varies	varies	varies
IAT (voltage)	0.05	4.95	varies
TP (degrees)	0	85	6-6.5*
TP (voltage)	0.5	4.8	0.5-1.5*
INJ PW	varies	varies	varies
Advance (degrees)	0	45	3-30° (varies)
Battery (voltage)	8	16	13.5
Eng run	STOP	RUN	RUN
O2 (voltage)	0	1	0.4-0.6

*Depends on position of idle set screw

Table 4-2. Engine Starts Hard

SYMPTOM	SOLUTION
Engine temperature circuit	4.19 TROUBLE CODE 14.
Improper fuel pressure	4.14 FUEL PRESSURE TEST.
Spark plugs and/or wires	4.16 MISFIRE.
Battery discharged	See charging system trouble-shooting in Section 7 of a 1998 service manual.
CMP sensors	4.28 TROUBLE CODE 56.
Manifold leak	Spray water around induc-tion module seals with engine idling. If RPM changes, change seals.
Ignition coil	4.16 MISFIRE.
Leaky injectors	Test fuel injectors. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD.
Valve sticking	See Section 3 of a 1998 ser-vice manual.

Table 4-3. Engine Performance Problems

SYMPTOM	SOLUTION
Engine temperature circuit	4.19 TROUBLE CODE 14.
CMP circuit	4.28 TROUBLE CODE 56.
Spark plugs and/or wires	4.16 MISFIRE.
Improper fuel pressure	4.14 FUEL PRESSURE TEST.
Improper TP sensor adjustment	Calibrate sensor. See 4.35 THROTTLE POSITION SENSOR.
Manifold leak	Spray water around induc-tion module seals with engine idling. If RPM changes, change seals.
Throttle plates not opening fully	See Section 1.
EVAP hose disconnected from induction module (CA)	Connect.
Water or dirt in fuel system	Drain and refill with fresh fuel.

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

SYMPTOM	SOLUTION
Engine temperature circuit	4.19 TROUBLE CODE 14.
Clogged air filter	See Section 1.
Improper TP sensor adjustment	Calibrate sensor. See 4.35 THROTTLE POSITION SENSOR.
Leaky injectors	Test fuel injectors. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD.
Improper fuel pressure	4.14 FUEL PRESSURE TEST.

Table 4-5. Trouble Codes and Fault Conditions

CODE NO.	FAULT CONDITION	RELEVANT TOPIC	PAGE
11	Throttle Position Sensor	4.17 TROUBLE CODE 11	page 4-44
13	Oxygen Sensor	4.18 TROUBLE CODE 13	page 4-48
14	Engine Temperature Sensor	4.19 TROUBLE CODE 14	page 4-53
15	Intake Air Temperature Sensor	4.20 TROUBLE CODE 15	page 4-57
16	Battery Voltage	4.21 TROUBLE CODE 16	page 4-61
23	Front Fuel Injector	4.22 TROUBLE CODES 23 AND 32	page 4-65
24	Front Ignition Coil	4.23 TROUBLE CODES 24 AND 25	page 4-69
25	Rear Ignition Coil	4.23 TROUBLE CODES 24 AND 25	page 4-69
32	Rear Fuel Injector	4.22 TROUBLE CODES 23 AND 32	page 4-65
33	Fuel Pump	4.24 TROUBLE CODE 33	page 4-72
35	Tachometer	4.25 TROUBLE CODE 35	page 4-75
44	Bank Angle Sensor	4.26 TROUBLE CODE 44	page 4-78
52, 53, 54, 55	ECM Failure	4.27 TROUBLE CODES 52, 53, 54 AND 55	page 4-82
56	Cam Sync Failure	4.28 TROUBLE CODE 56	page 4-83

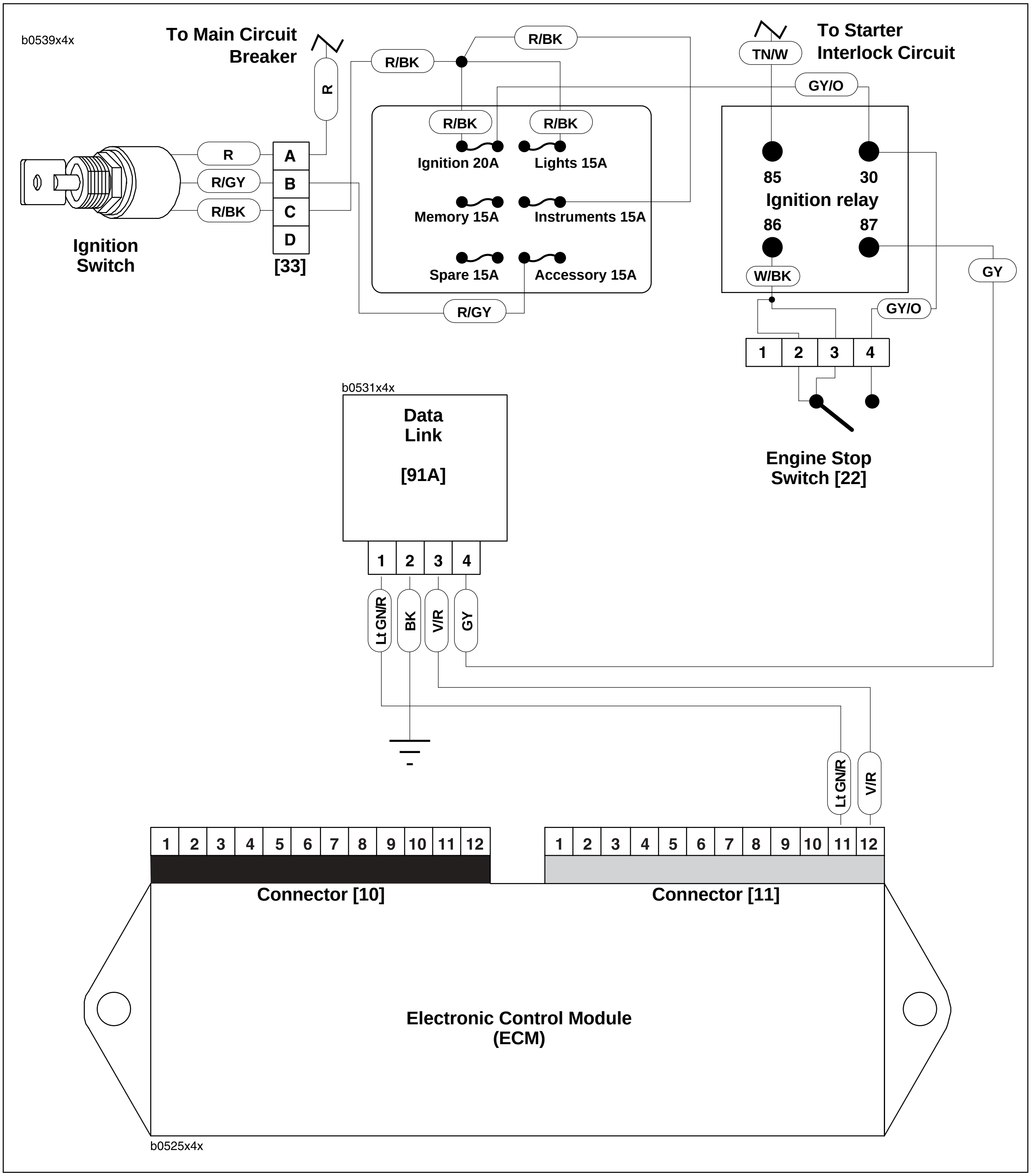


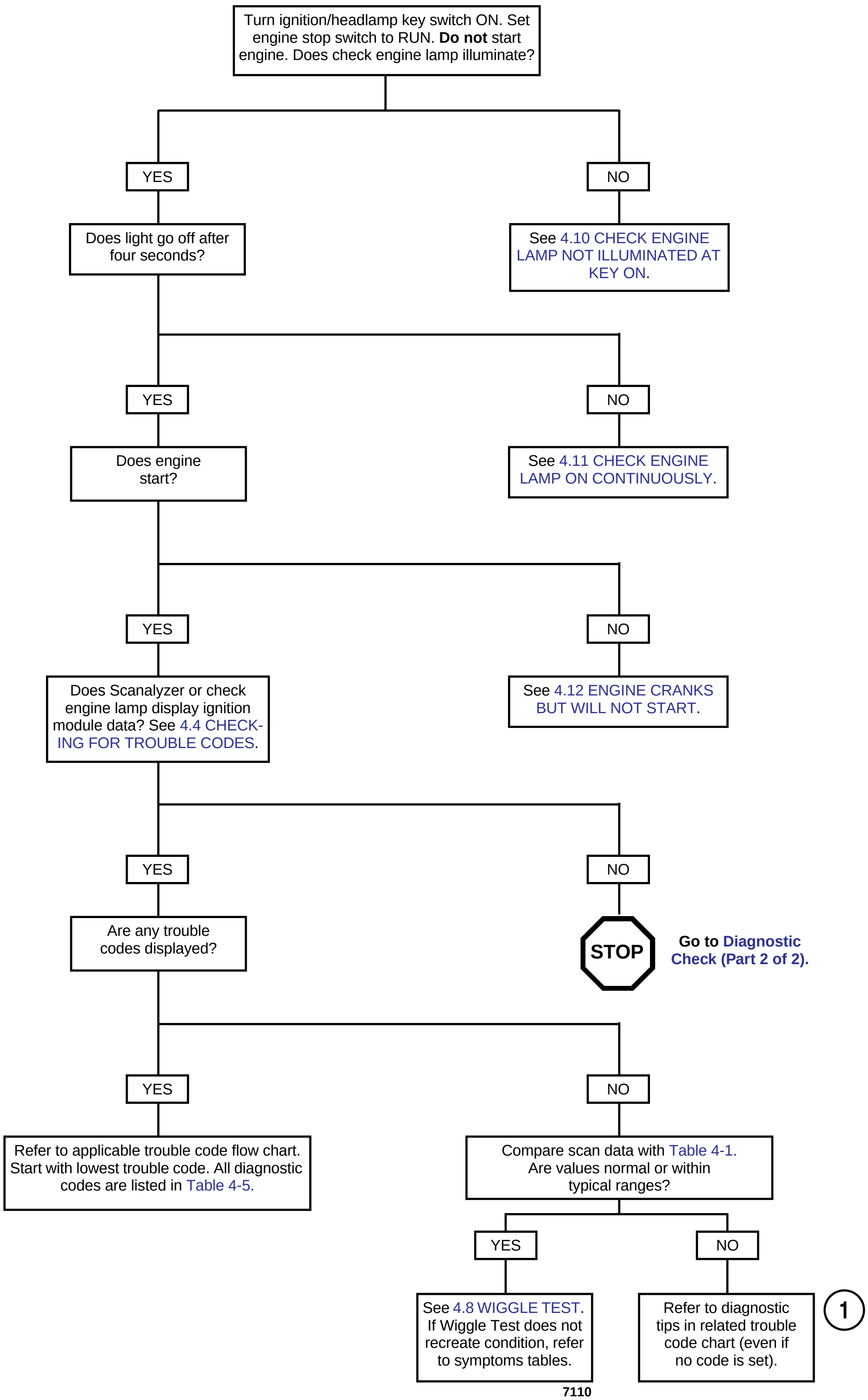
Figure 4-16. Diagnostic Check

Table 4-6. Wire Harness Connectors in Figure 4-16.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[11]	ECM (gray)	12-place Deutsch	under tail section
[91A]	Data Link	4-place Deutsch	in trunk

HOME

Diagnostic Check (Part 1 of 2)



HOME

Diagnostic Check (Part 2 of 2)

2

Continued from Diagnostic Check (Part 1 of 2).

Remove ECM connectors [10B] (BK) and [11B] (GY). Check for continuity to ground at data link connector [91A] Terminals 1, 3 and 4. Continuity to ground?

YES

Repair short to ground.

7115

NO

2

3

Test the four data link connector terminals against their ECM connector pins for continuity.

DATA LINK TERMINAL		ECM TERMINAL	
Pin	**Wire Color**	**Pin**	**Connector**
1	Lt. GN/R	11	[11B]
2	BK	11	[10B]
3	V/R	12	[11B]
4	GY	1	[10B]

Continuity present in all four circumstances?

YES

Check Scanalyzer on another vehicle. Scanalyzer OK?

YES

Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE.

7125

NO

Scanalyzer malfunction.

NO

Inspect terminals for damage or repair opens as necessary.

7120

CHECK ENGINE LAMP NOT ILLUMINATED AT KEY ON 4.10

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 4-17.

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

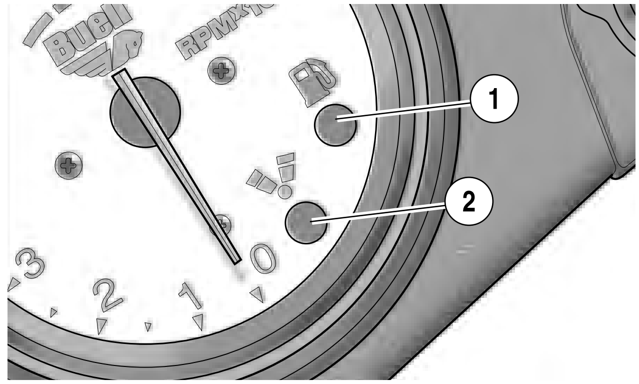
Check for the following conditions:

- Check for open in BK/Y wire.
- Check for blown instrument fuse.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.10 flow chart.

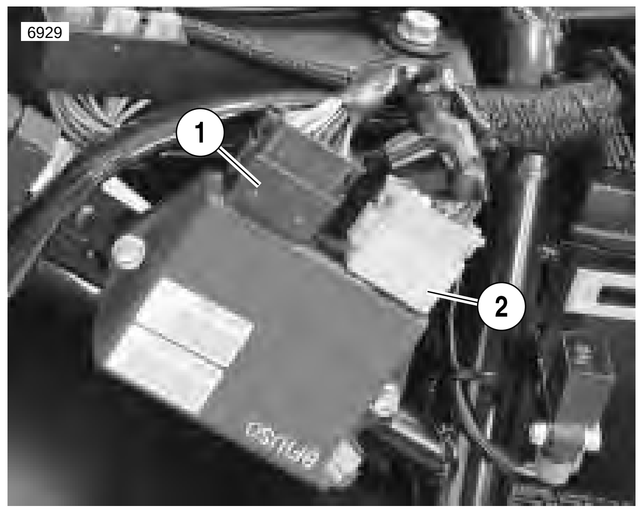
1. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probe and patch cord.
2. See Figure 4-18. Inspect connector [10] (black) for contamination or corrosion. If connection is good, replace ECM. See 4.29 ELECTRONIC CONTROL MODULE.
3. Check continuity between instrument connector [39] Pin 8 and ECM connector [10] (black), Pin 4.
   a. Gain access to tachometer cover by removing fairing.
   b. Remove tachometer cover and pull check engine lamp from back of tachometer. See Figure 4-19. Remove check engine bulb from bulb socket.
   c. If continuity is present, check for short to battery on the BK/Y wire between connectors [39] and [10].
   d. If no continuity, check for damaged/open wires in the check engine lamp circuit.



1. **Low Fuel Lamp**
2. **Check Engine Lamp**

b0548xox

Figure 4-17. Check Engine Lamp



1. **ECM Connector [10] (Black)**
2. **ECM Connector [11] (Gray)**

Figure 4-18. Electronic Control Module

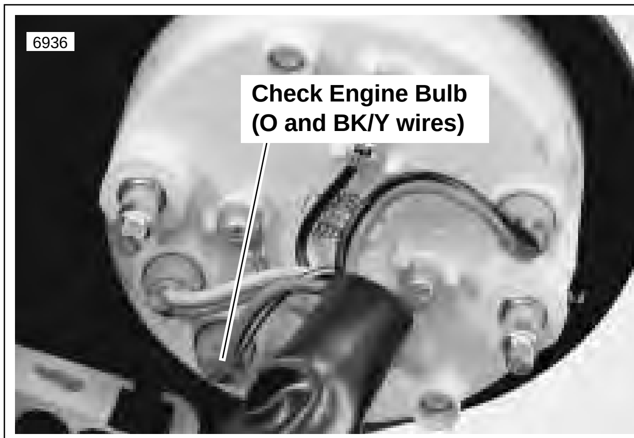


Figure 4-19. Check Engine Lamp Bulb

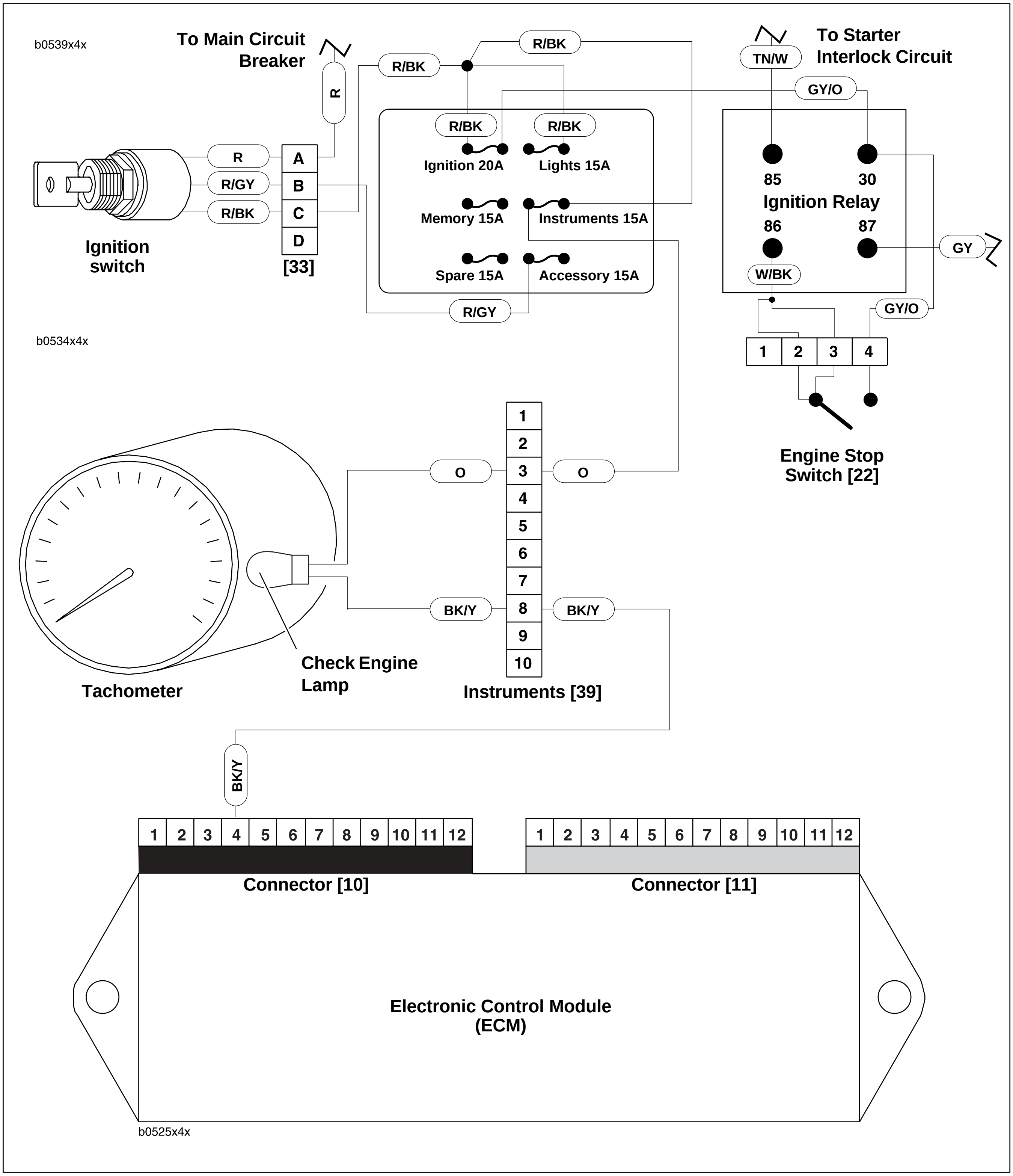


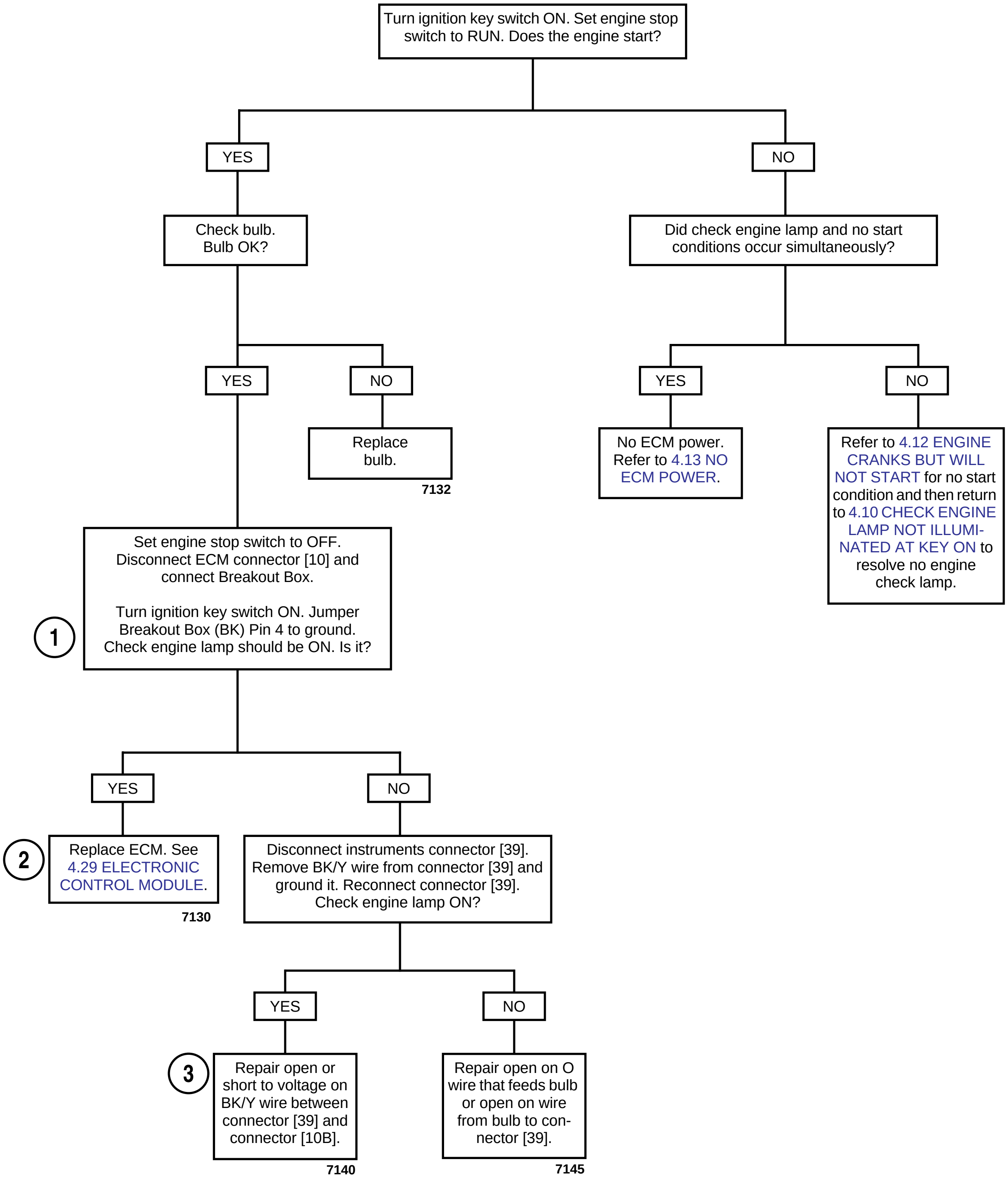
Figure 4-20. Check Engine Lamp Circuit

Table 4-7. Wire Harness Connectors in Figure 4-20.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[39]	Main harness to instruments	10-place Multilock	under fuel cell

HOME

Test 4.10

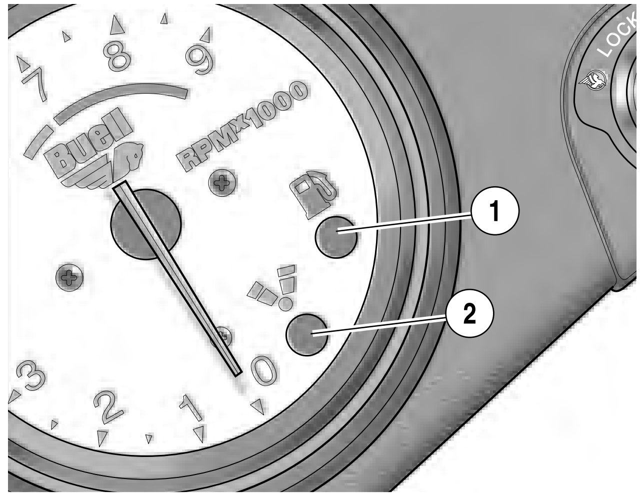


CHECK ENGINE LAMP ON CONTINUOUSLY 4.11

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 4-21.

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).



1. Low Fuel Lamp
2. Check Engine Lamp

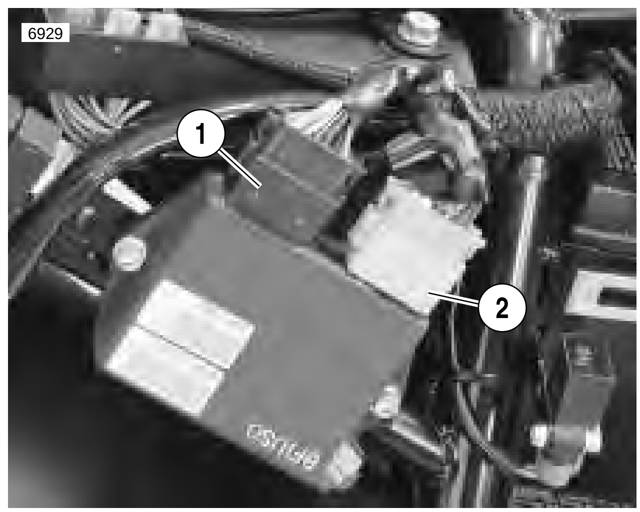
Figure 4-21. Check Engine Lamp

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.11 flow chart.

1. See Figure 4-22. If the lamp goes off when the black ECM connector [10] is unplugged, the BK/Y wire is **not** shorted to ground.



1. ECM Connector [10] (Black)
2. ECM Connector [11] (Gray)

Figure 4-22. Electronic Control Module

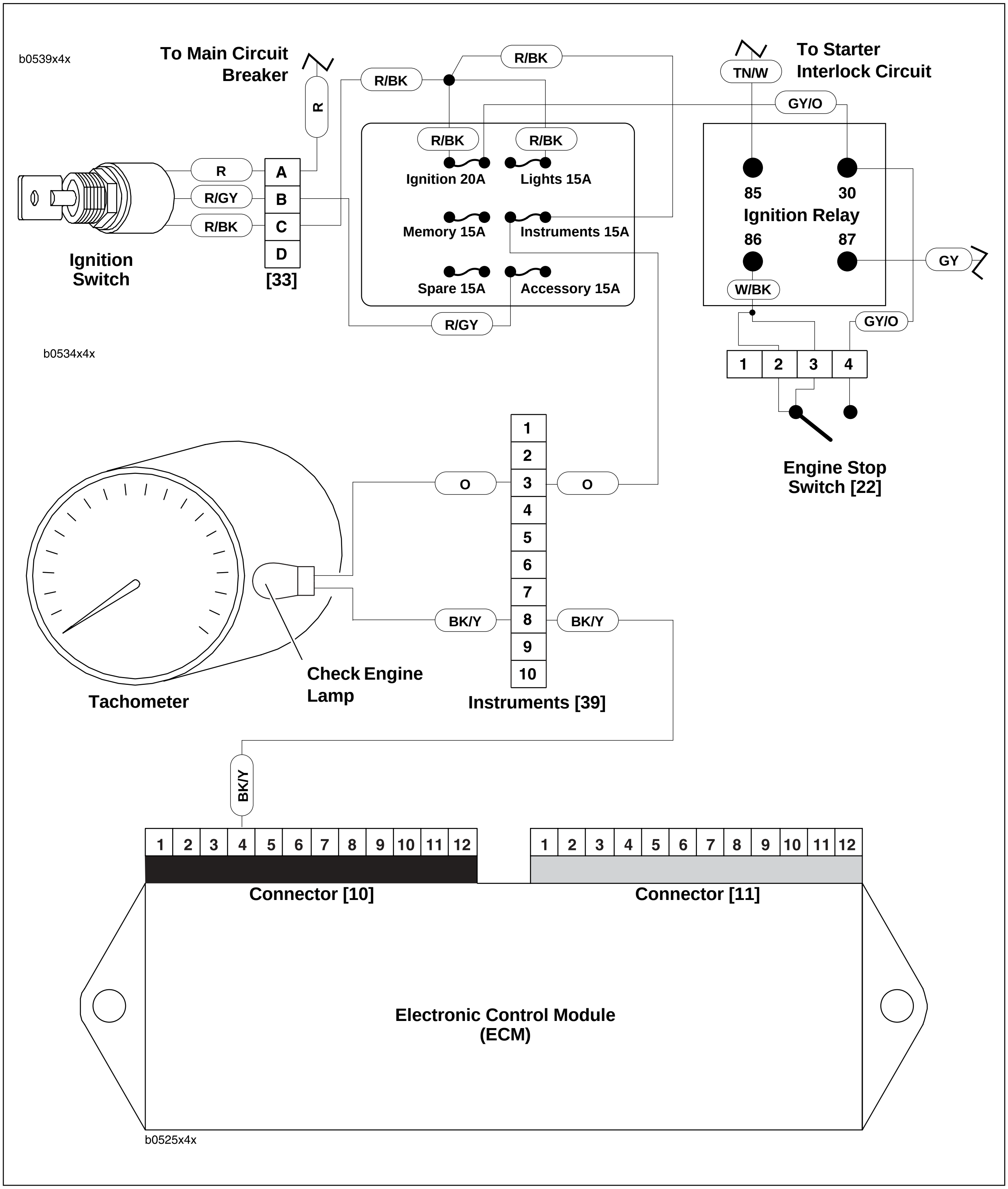


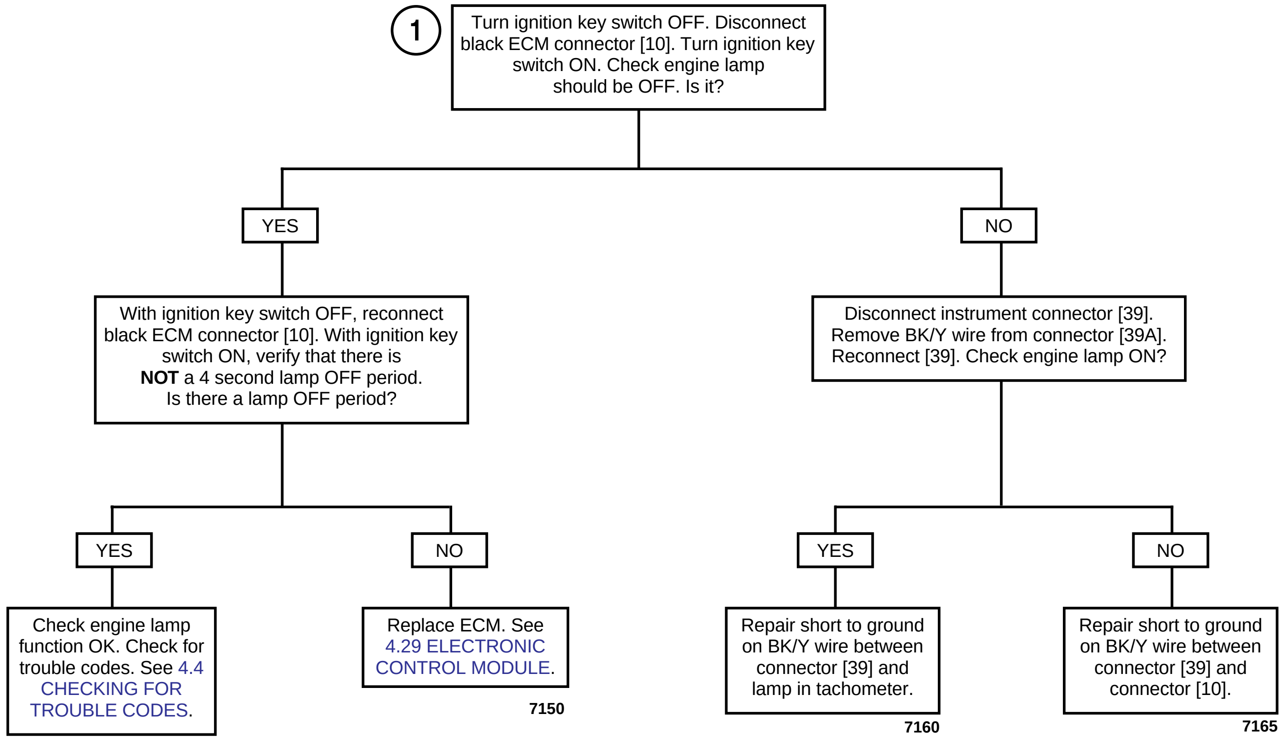
Figure 4-23. Check Engine Lamp Circuit

Table 4-8. Wire Harness Connectors in Figure 4-23.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[39]	Main harness to instruments	10-place Multilock	under fuel cell

HOME

Test 4.11



ENGINE CRANKS BUT WILL NOT START 4.12

GENERAL

If the starter will not crank engine, the problem is not ignition related. See Section 5-Electric Starter.

IMPORTANT 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 4.12 flow charts.

1. 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.
2. Remove spark plug cable from spark plug.
   a. Visually check condition of plug.
   b. See Figure 4-24. 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

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

3. Purge fuel line and remove fuel tank to access fuel injectors. See 4.36 FUEL TANK. Use test lamp as shown in Figure 4-25.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray pin probe and patch cord.

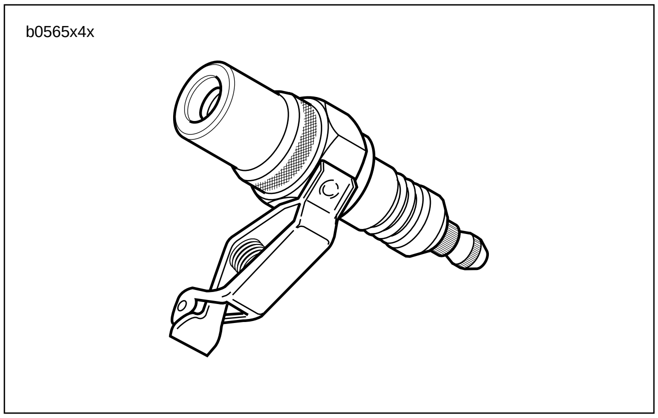


Figure 4-24. Spark Plug Tester

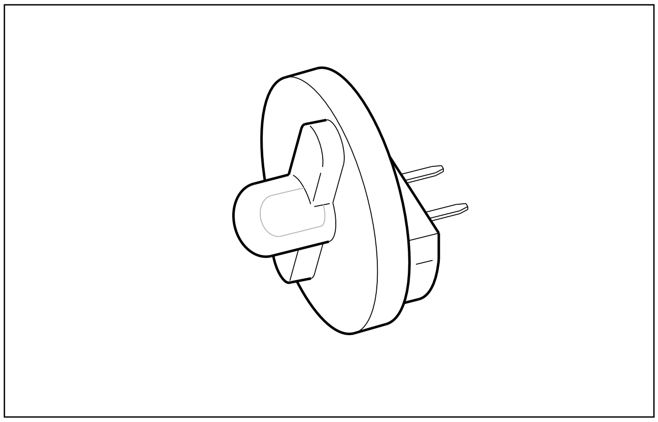


Figure 4-25. Test Lamp

5. Connect BREAKOUT BOX (Part No. HD-42682) between harness and ECM. See 4.7 BREAKOUT BOX.
6. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray pin probe and patch cord.
7. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) black pin probe and patch cord.

Table 4-9. Wire Harness Connectors in Figure 4-26.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[11]	ECM (gray)	12-place Deutsch	under tail section
[14]	CMP Sensor	3-place Deutsch	next to starter
[18]	Ignition Coil	3-place Packard	under fuel cell, left side

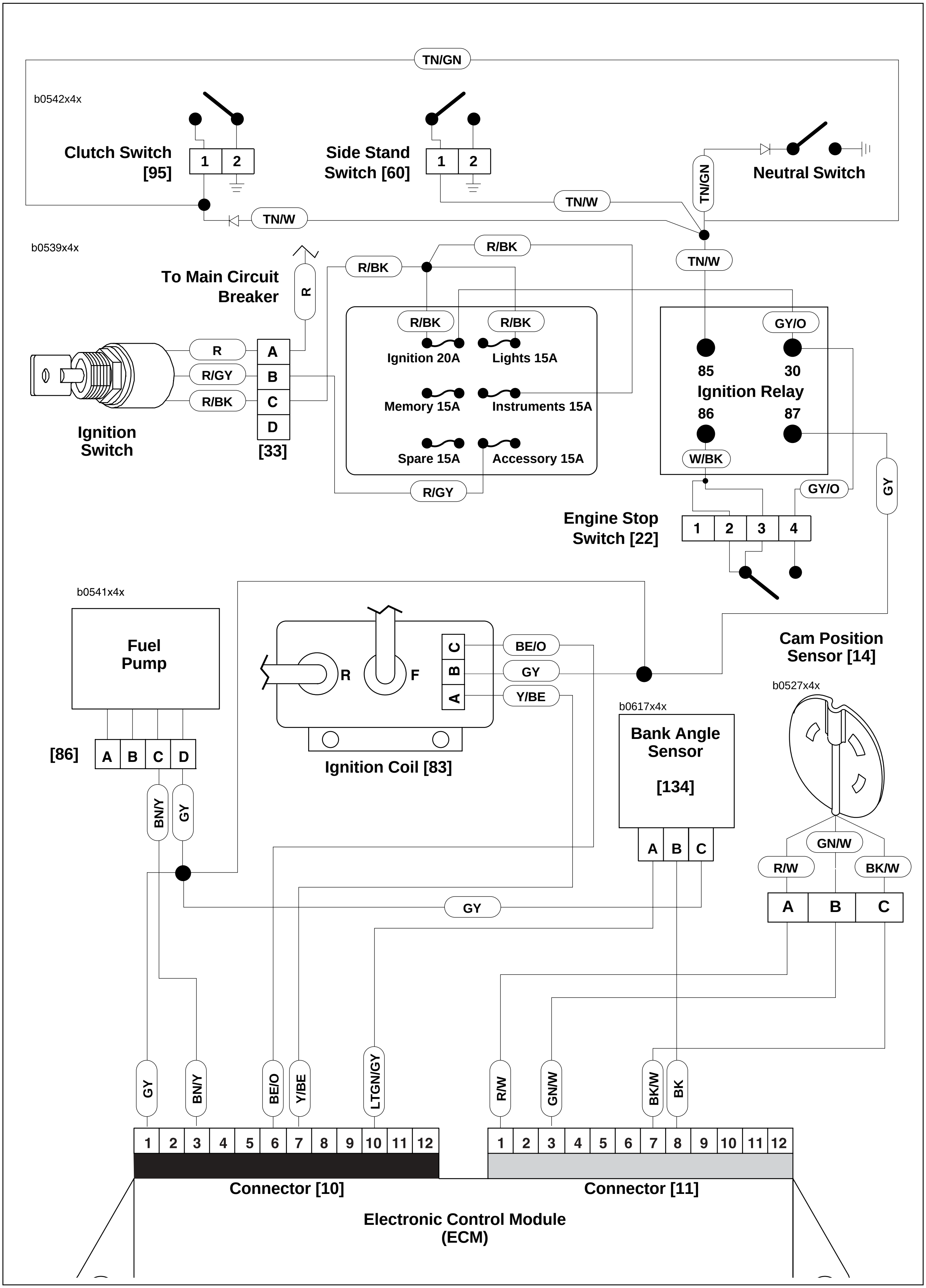
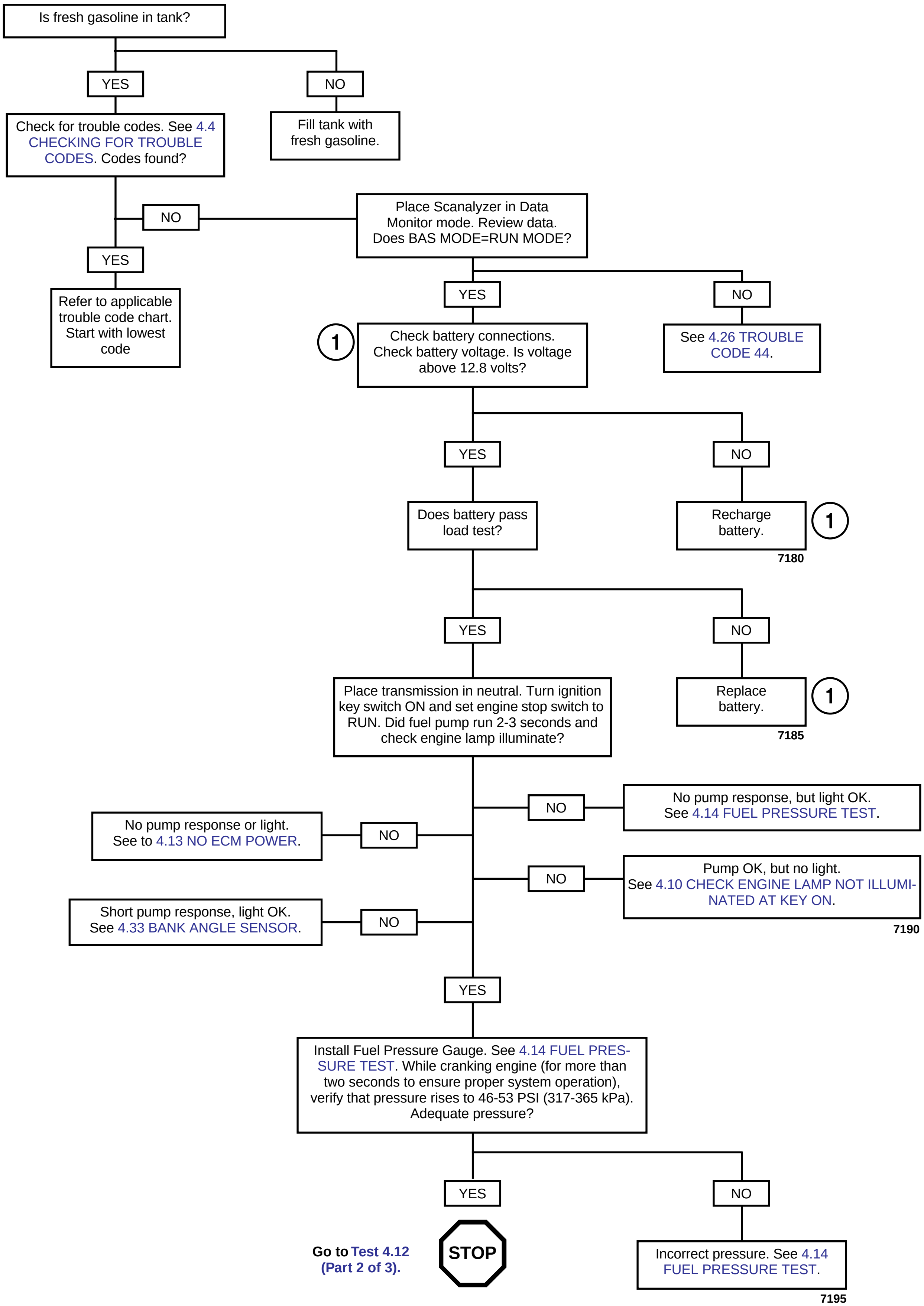
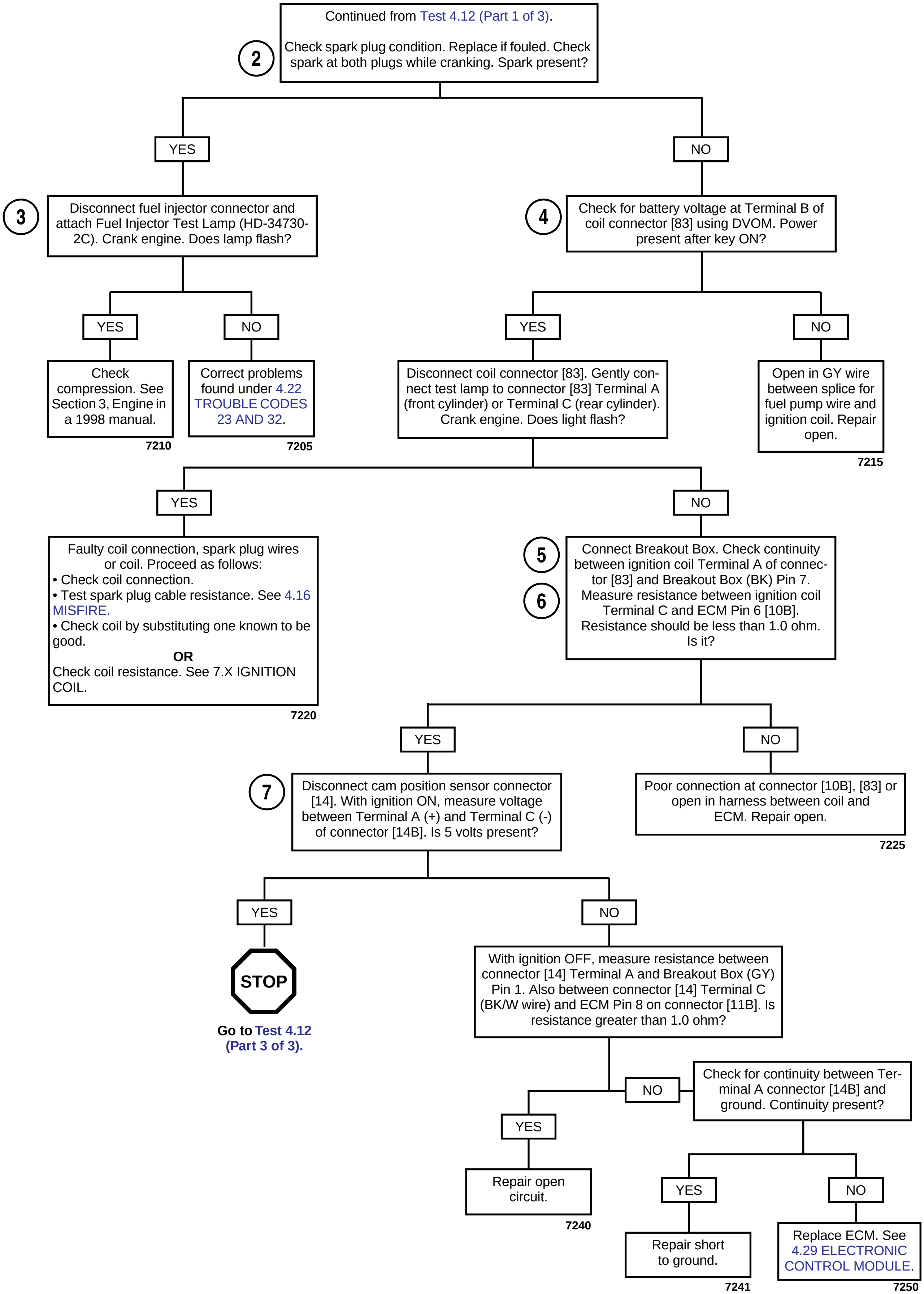


Figure 4-26. Ignition Circuit

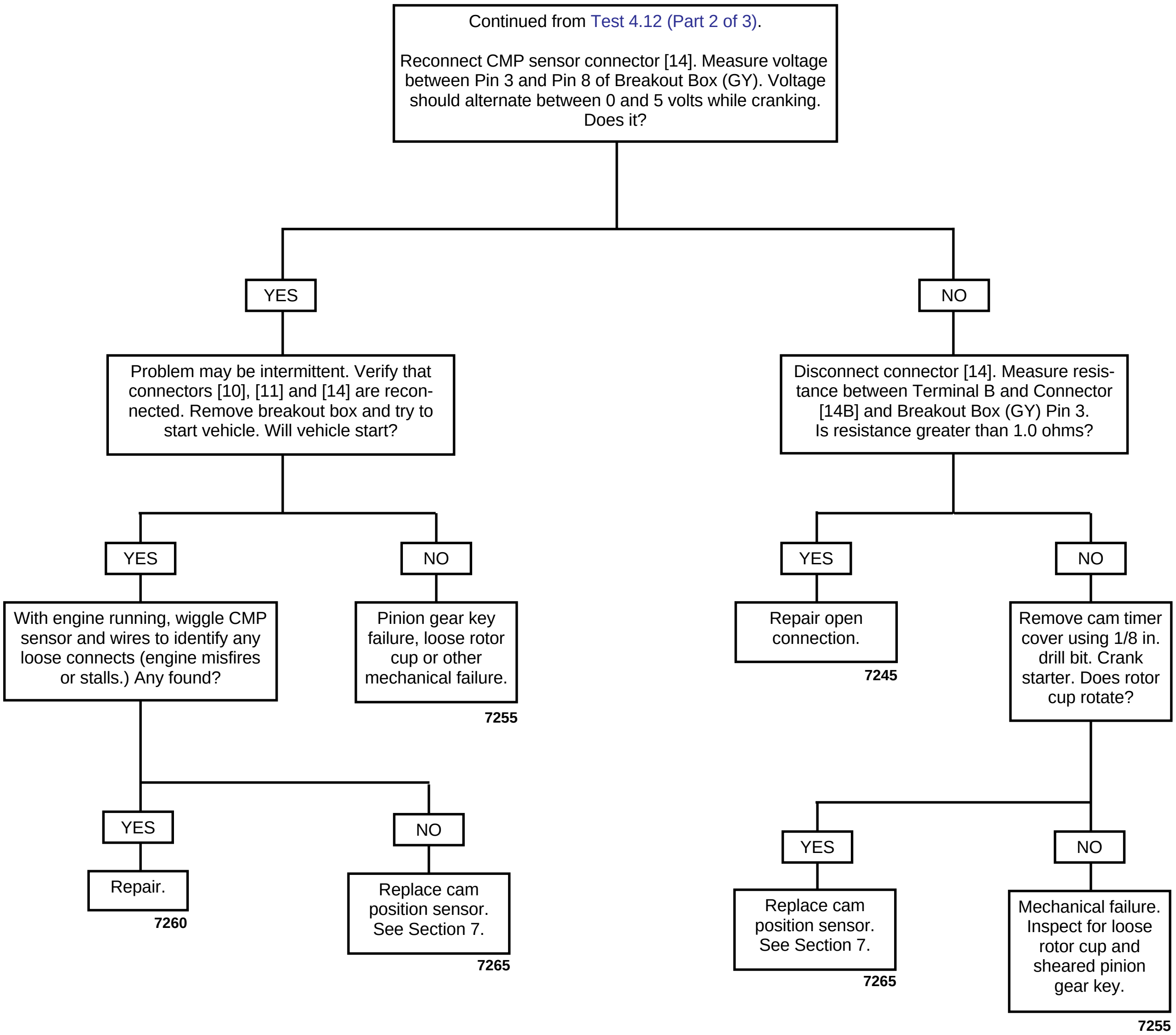
Test 4.12 (Part 1 of 3)



Test 4.12 (Part 2 of 3)



Test 4.12 (Part 3 of 3)



NO ECM POWER 4.13

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. Grounds may be established three ways.

- By placing the motorcycle in neutral and grounding the relay through the neutral switch. See Figure 4-27.
- By retracting the side stand and grounding the relay through the side stand switch. See Figure 4-28.
- By disengaging the clutch and grounding the relay through the clutch switch. See Figure 4-29.

If the ECM does not appear to be receiving power, check the ground sources. A blown ignition fuse can also disable the ECM.

DIA GNOSTICS

Diagnostic Notes

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

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.7 BREAKOUT BOX.

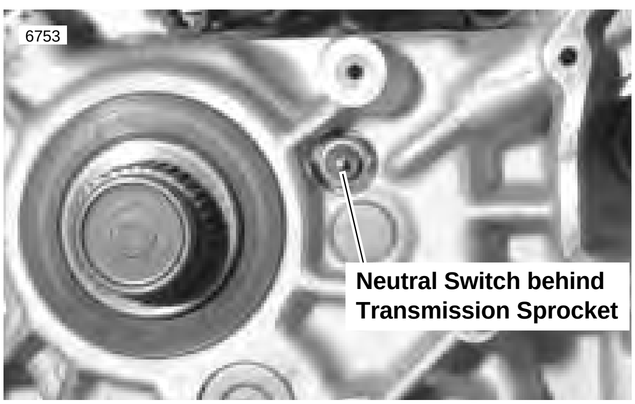


Figure 4-27. Neutral Switch

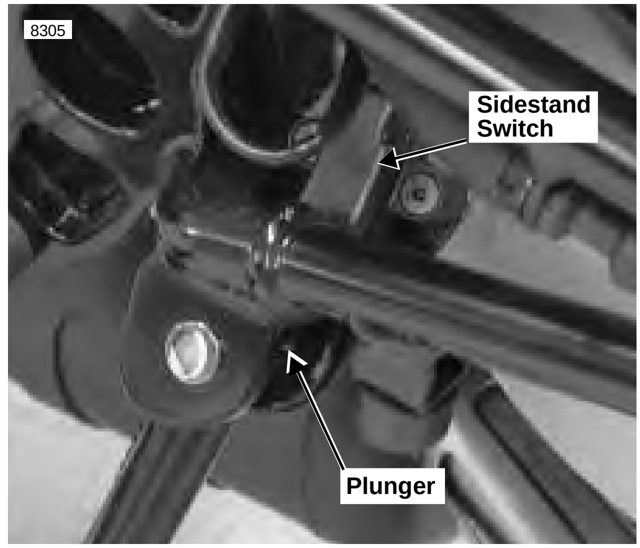
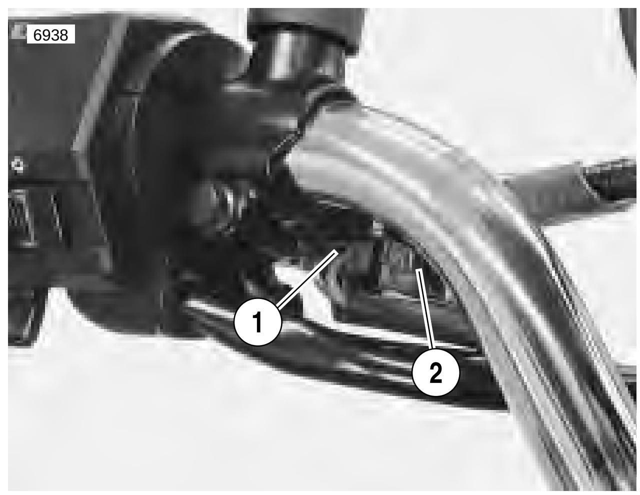


Figure 4-28. Side Stand Switch



1. **Connector [95]**
2. **Clutch Switch**

Figure 4-29. Clutch Switch

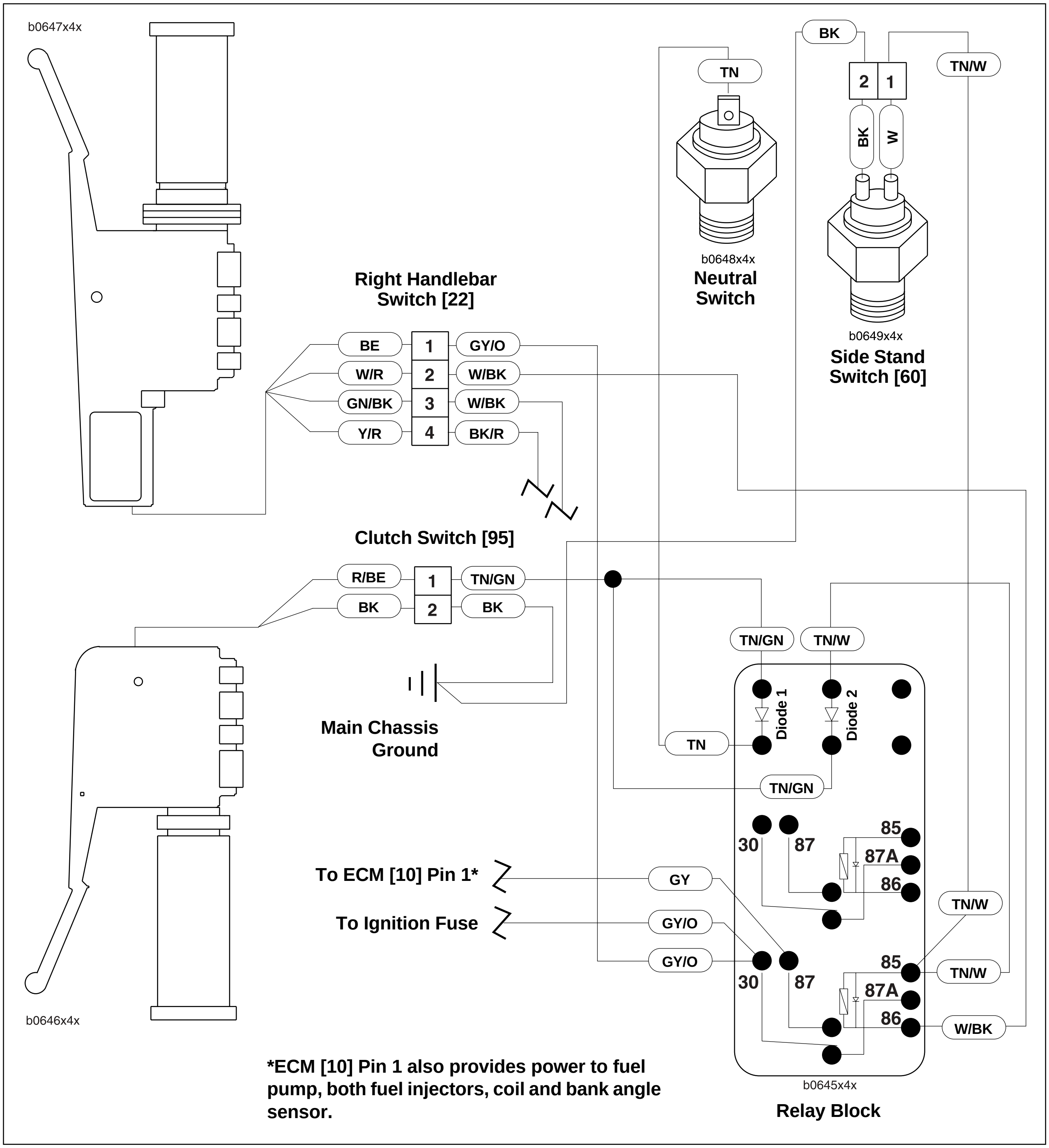


Figure 4-30. ECM Power Circuit

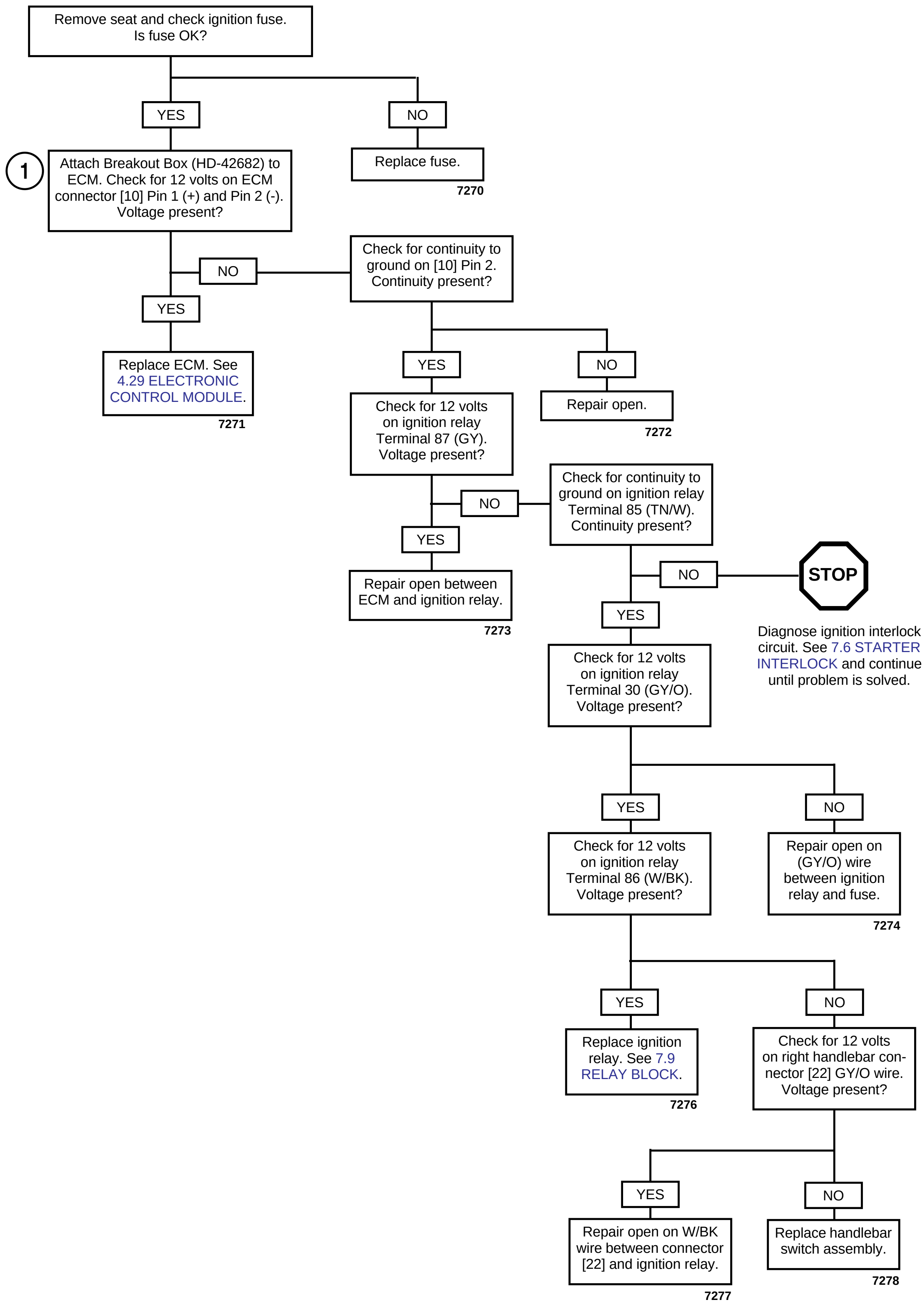
Table 4-10. Wire Harness Connectors in Figure 4-30.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[22]	Right Handlebar Switch	4-place	under fuel cell, right side
[95]	Clutch Switch	2-place	clutch lever bracket

HOME

No ECM Power

CONDITION: Sidestand up, key ON and transmission in neutral



FUEL PRESSURE TEST 4.14

INSPECTION

⚠WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before attaching fuel pressure gauge. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-31. Disconnect the 4-place fuel pump connector [86]. Connector is on the left side, above the rear cylinder spark plug.
   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.
2. Wrap a shop towel around the fuel supply fitting.

⚠WARNING

A small amount of gasoline will drain from the valve when the gauge is installed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

3. See Figure 4-32. Attach FUEL PRESSURE GAUGE (Part No. HD-41182) to Schraeder valve on fuel supply fitting.
   a. Verify that fuel valve (2) and air bleed petcock (4) on the gauge are closed.
   b. See Figure 4-33. Remove protective cap (3) from Schraeder valve (2).
   c. Thread gauge into Schraeder valve.
4. See Figure 4-31. Attach fuel pump connector to main wiring harness.
5. See Figure 4-32. 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 (5) in the beaker.
   d. Open and close the air bleed petcock (4) 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 (5).
   e. Close the air bleed petcock (4).

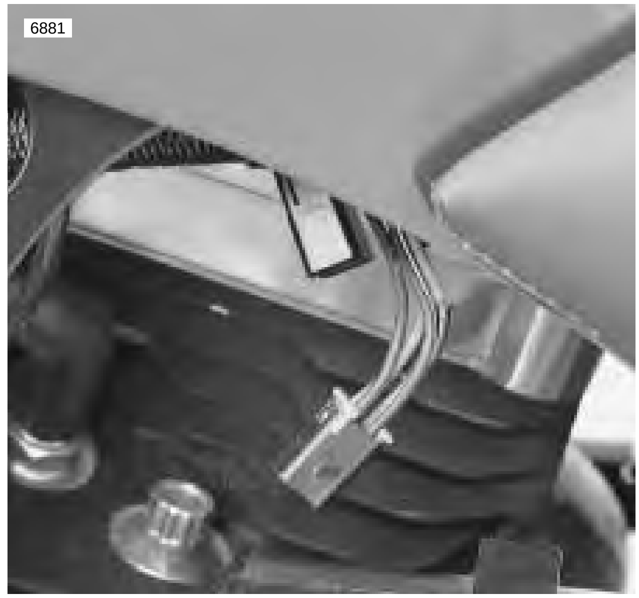
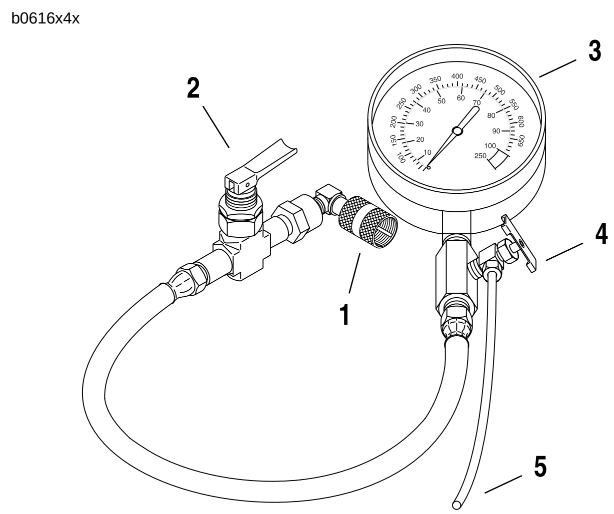


Figure 4-31. Fuel Pump Connector [86]



1. **Attachment Fitting**
2. **Fuel Valve (shown closed)**
3. **Fuel Pressure Gauge**
4. **Air Bleed Petcock**
5. **Air Bleed Tube**

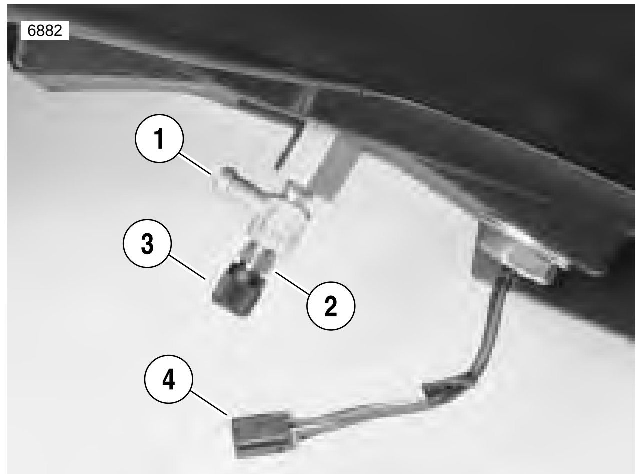
Figure 4-32. Fuel Pressure Gauge

6. Open throttle and increase engine speed to 2500-3000 RPM. Note the reading on the pressure gauge.
   a. If pressure is 46-53 psi (317-365 kPa) then system is operating within limits.
   b. If pressure is not within limits, see Test 4.14 (Part 1 of 2) flow chart after disconnecting pressure gauge.

⚠WARNING

A small amount of gasoline will drain from the valve when the valve is removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

7. See Figure 4-33. Turn engine off. Detach pressure gauge from Schraeder valve.
   a. Open the air bleed petcock to relieve fuel system pressure and purge the pressure gauge of gasoline.
   b. Remove pressure gauge from valve.
   c. Install protective cap on valve.



1. **Fuel Outlet**
2. **Schraeder Valve**
3. **Protective Cap**
4. **Fuel Pump Connector**

Figure 4-33. Schraeder Valve and Cap (Fuel Tank Removed From Chassis)

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.14 flow charts.

1. See Figure 4-34. 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 4.7 BREAKOUT BOX.

Figure 4-34. Harness Connector Kit

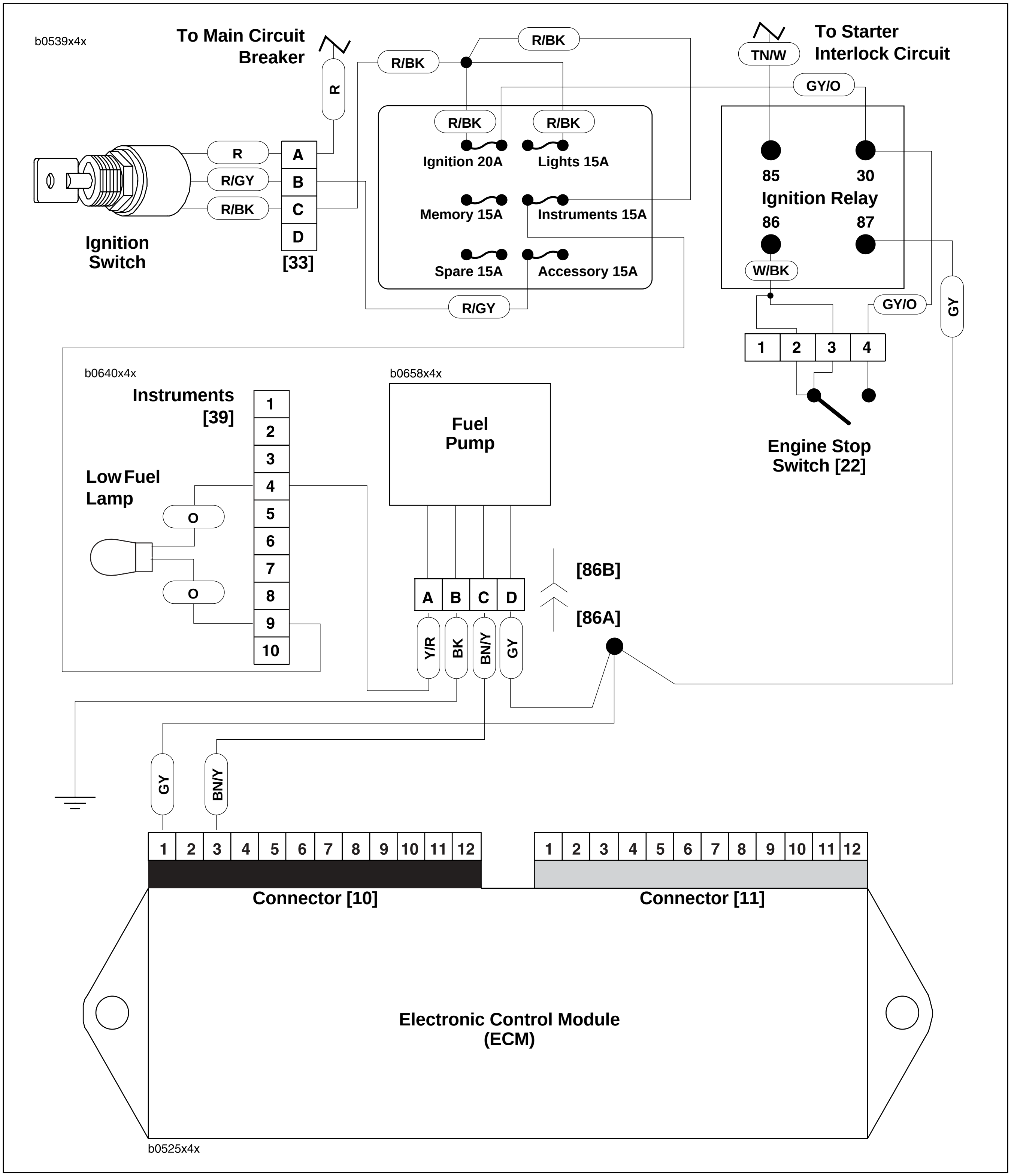


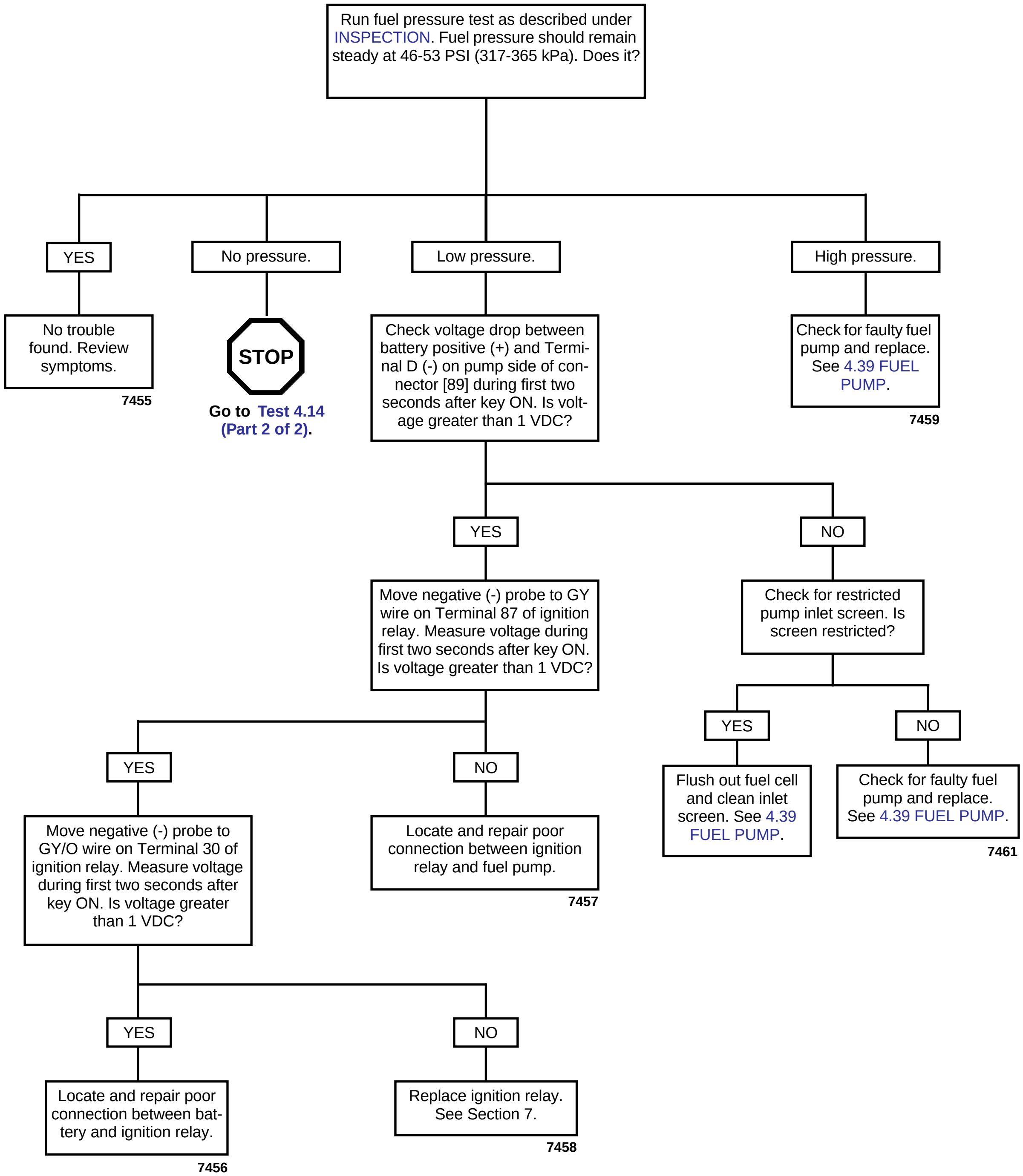
Figure 4-35. Fuel Pump Circuit

Table 4-11. Wire Harness Connectors in Figure 4-35.

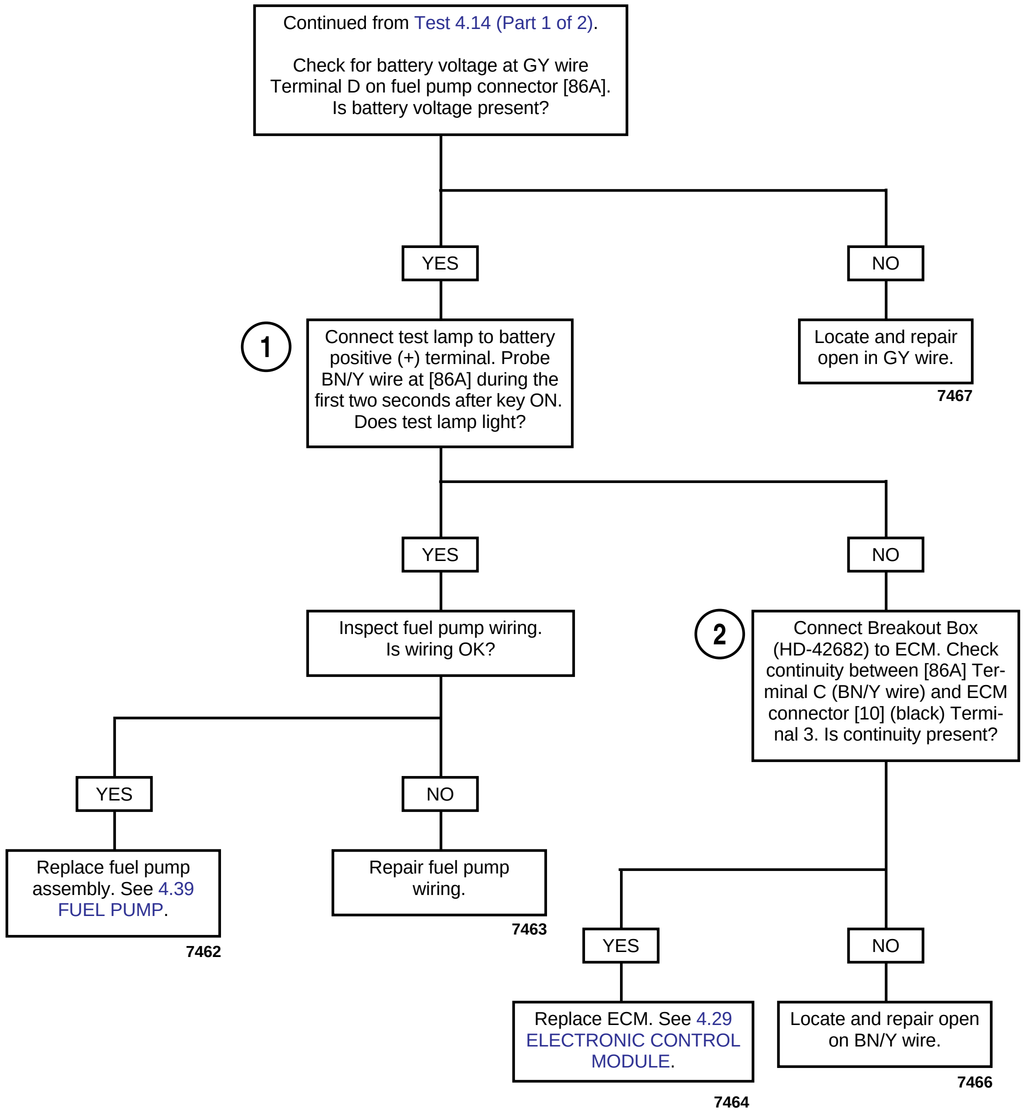
NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[39]	Instruments	10-place Multilock	under fuel cell
[86]	Fuel Pump	4-place Packard	above rear cylinder head, left side

HOME

Test 4.14 (Part 1 of 2)



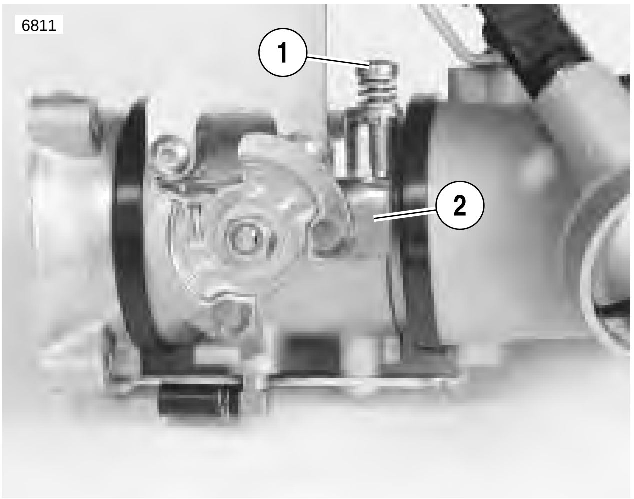
Test 4.14 (Part 2 of 2)



IDLE SPEED CONTROL 4.15

ADJUSTMENTS

See Figure 4-36. Use the adjuster attached to the throttle body to make idle speed adjustments. Normal idle speed 850-1050 RPM.



1. **Idle Adjustment Screw (Cable not shown)**
2. **Stop Plate**

Figure 4-36. Idle Adjustment Screw (Typical)

GENERAL

Misfire At Idle or Under Load

Misfire conditions may be caused by:

- Battery condition and connections.
- Fuel system problems. See tables under 4.9 INITIAL DIAGNOSTIC CHECK.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.16 flow charts.

WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion. Thoroughly wipe up an spilt fuel and dispose of rags in a suitable manner. Failure to comply could result in death or serious injury.

1. See Figure 4-37. 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. For best results, use a needle nose pliers for removal/installation on coil. Gently grasp cable as close to terminals as possible.
   b. Using an ohmmeter, touch probes to terminals on each end plug wire.
   c. Compare resistance values to Table 4-12. Replace cables not meeting specifications. Reinstall and repeat procedure on other spark plug cable.

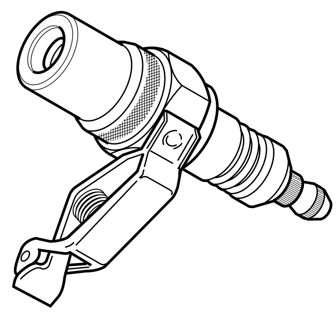


Figure 4-37. Spark Tester

Table 4-12. Spark Plug Cables

SPECIFICATION	REAR	FRONT
Length in. (mm)	19.0-19.25 (482.6-489.0)	7.25-7.50 (184.2-190.5)
Resistance-ohms	4750-11,230	1812-4375

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 7.4 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 7.4 IGNITION COIL.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probe and patch cord to the coil connector [18].
6. Inspect for corrosion at battery terminals, main circuit breakers, ignition fuse terminals (GY/O and R/BK), right handlebar connector [1] and coil connector.

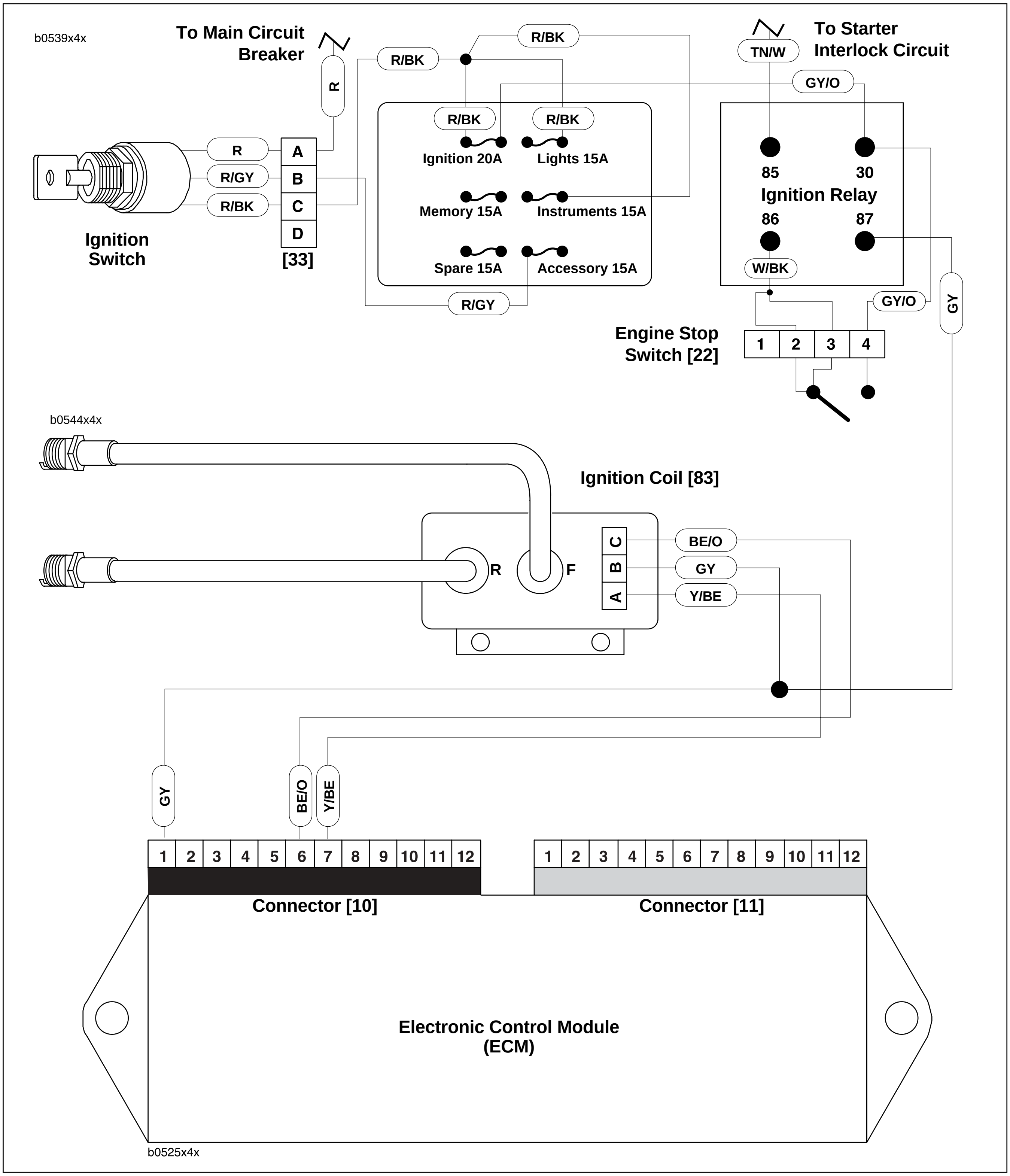
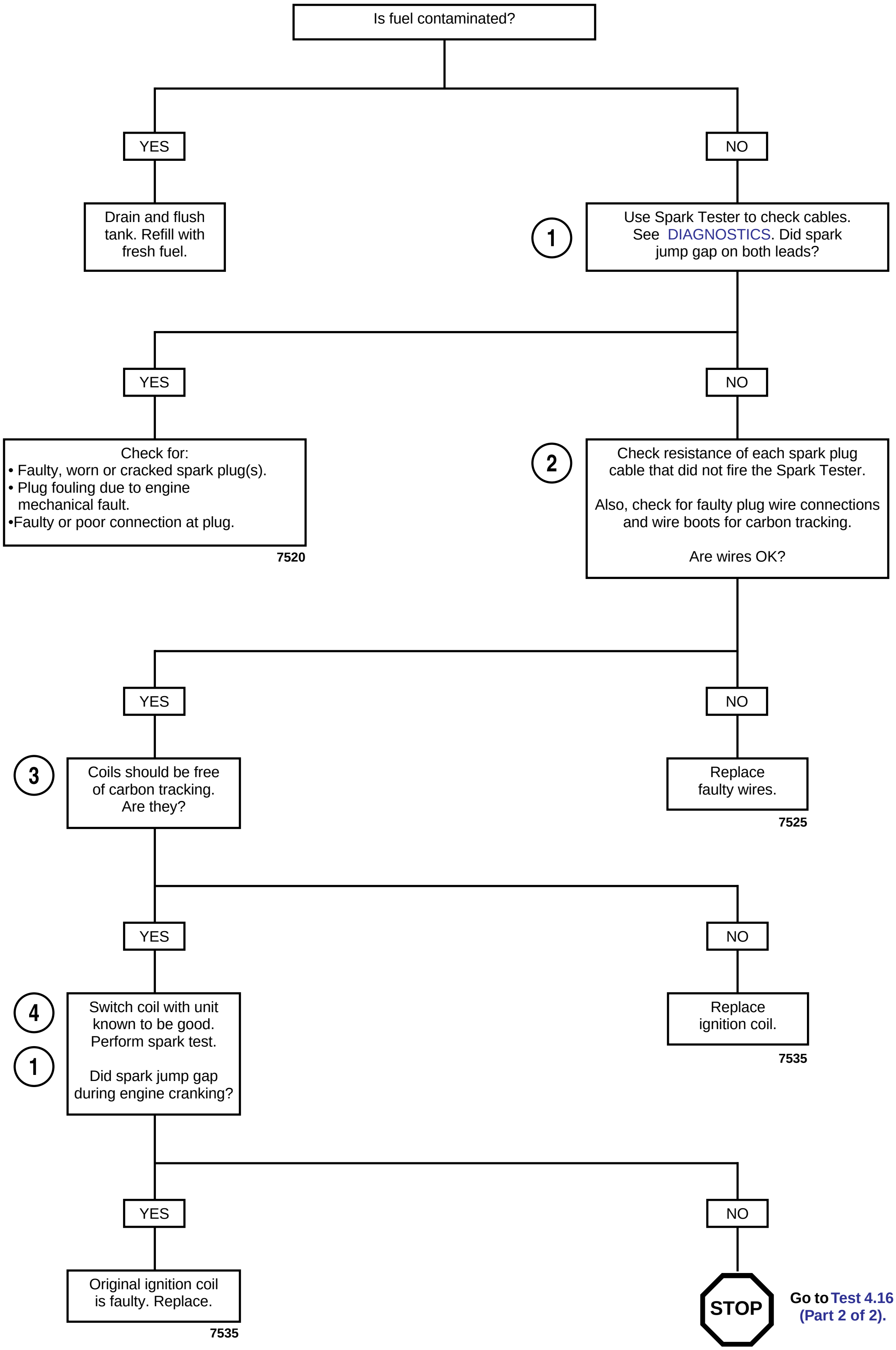


Figure 4-38. Ignition Coil Circuit

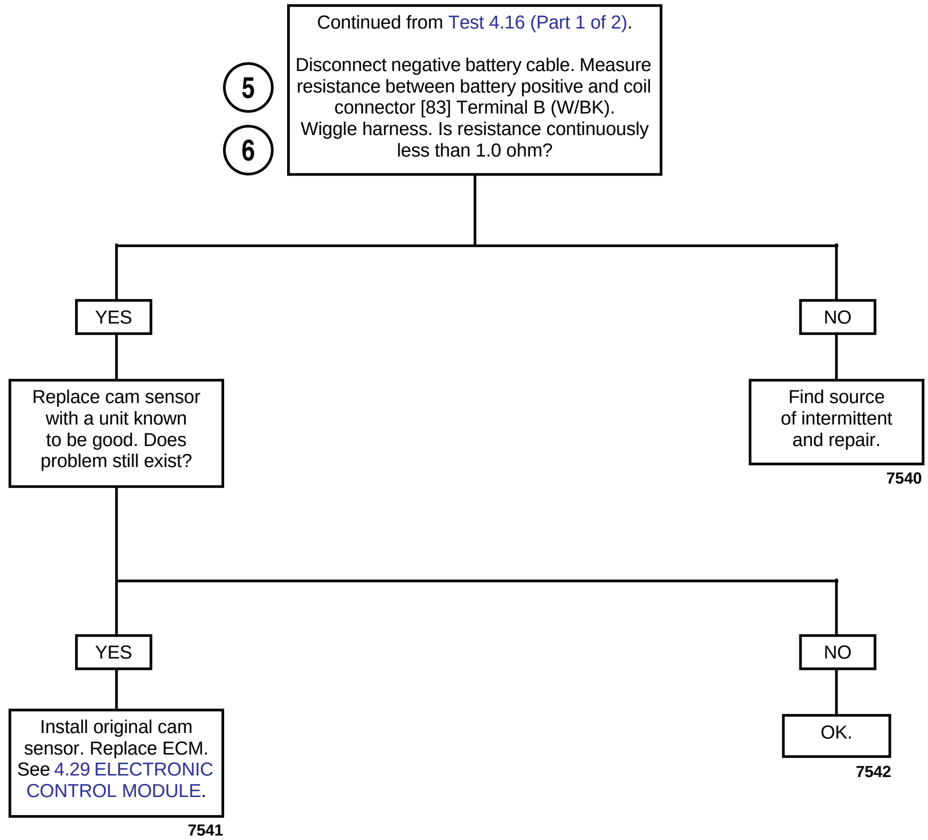
Table 4-13. Wire Harness Connectors in Figure 4-38.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[22]	Right Handlebar Switch	4-place	under fuel cell
[83]	Coil	3-place Packard	under fuel cell, left side

Test 4.16 (Part 1 of 2)



Test 4.16 (Part 2 of 2)



GENERAL

Throttle Position Sensor

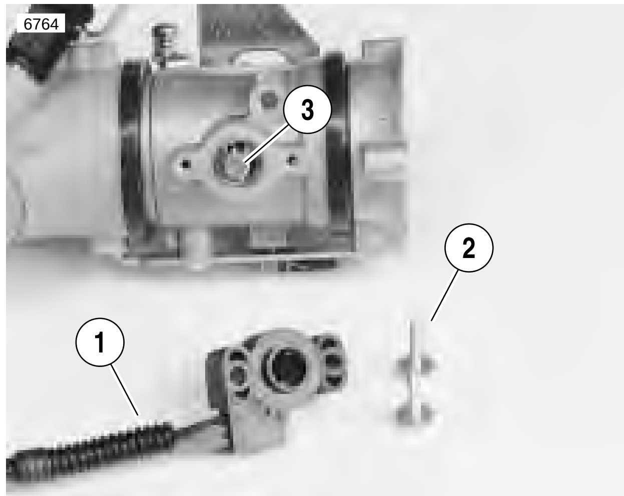
See Figure 4-39. The throttle position sensor (TP sensor) is supplied 5.0 volts from the ECM (5v REF) and sends a signal back to the ECM (TP sensor signal) which varies according to throttle position. The output signal from the TP sensor varies from:

- 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 a Scanalyzer. See 4.35 THROTTLE POSITION SENSOR.



1. **Sensor and Harness**
2. **Screws (2) (metric)**
3. **Throttle Shaft**

Figure 4-39. TP Sensor Assembly

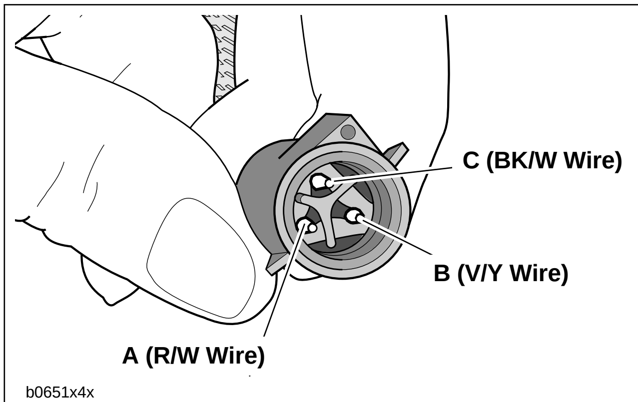


Figure 4-40. TP Sensor Terminals [88A]

DIAGNOSTICS

Diagnostic Tips

The Scanalyzer reads throttle position in degrees. 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 4.8 WIGGLE TEST to locate intermittents.** If connections and harness check out OK, monitor TP sensor voltage using a Scanalyzer or DVOM while moving related connectors and wiring harness. If the failure is induced, the TP sensor display will change.
- **TP sensor scaling.** Observe the TP sensor voltage display while opening the throttle with engine stopped and ignition 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.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

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 4.7 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probe and patch cord.

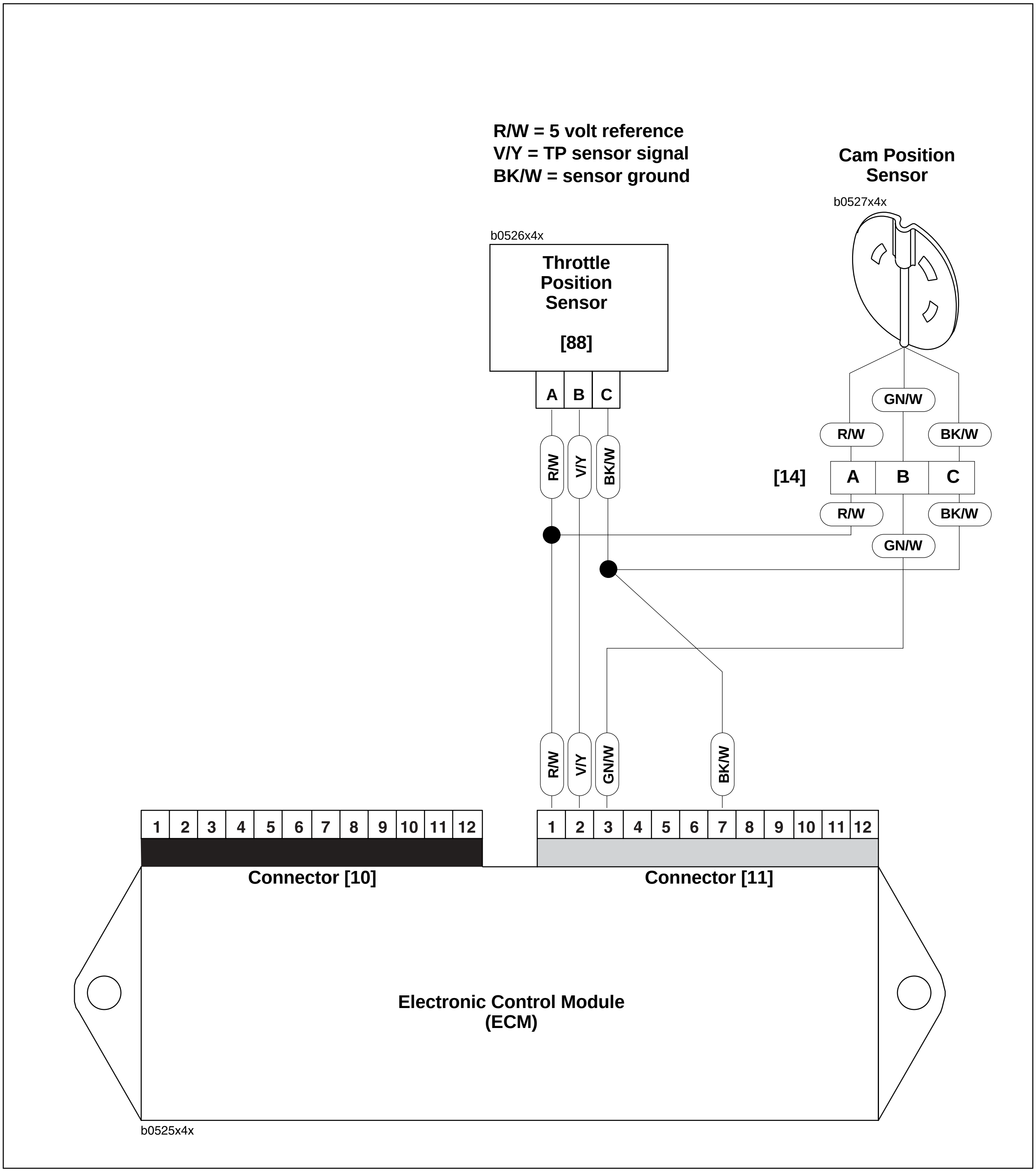
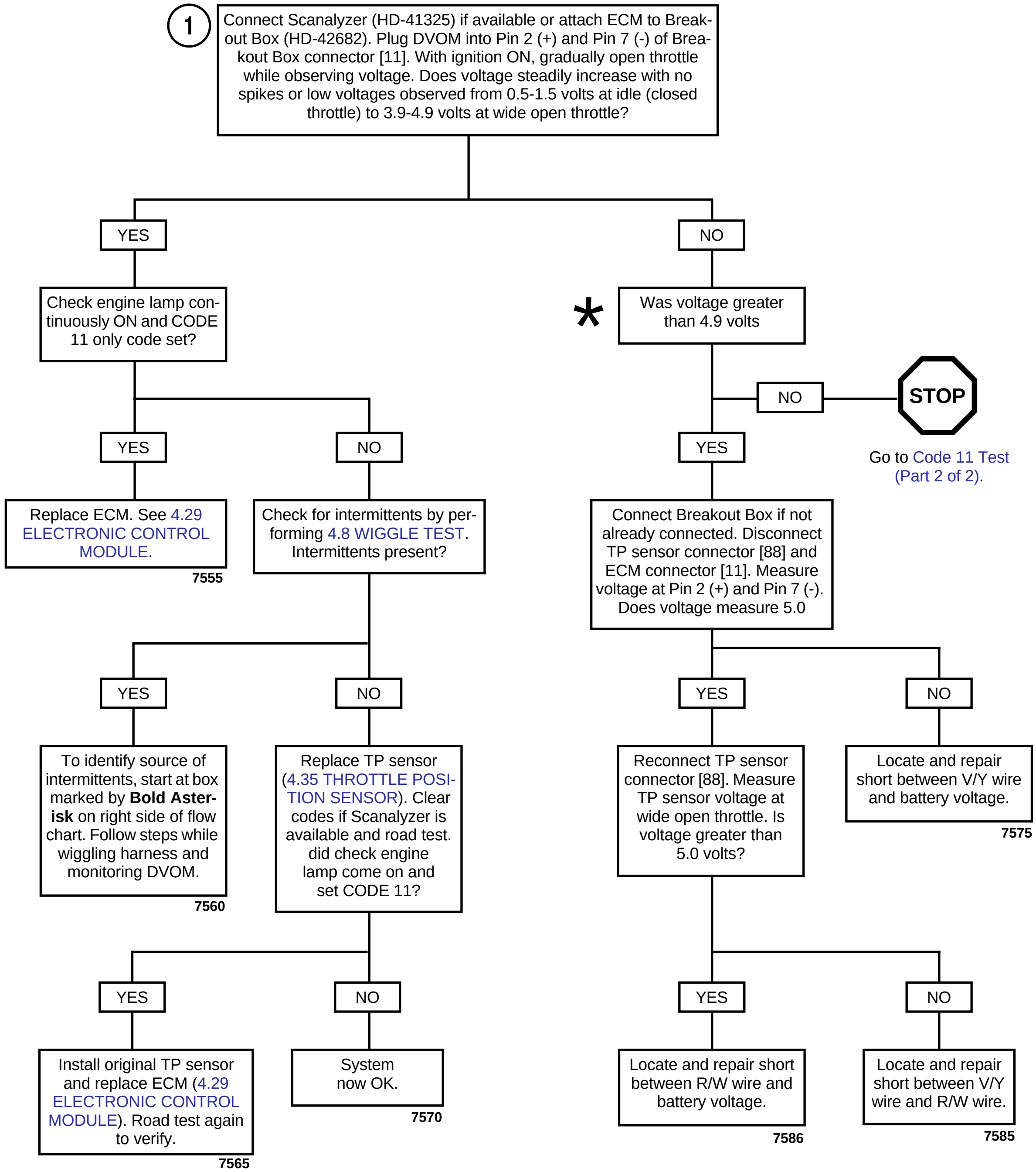


Figure 4-41. Throttle Position Sensor Circuit

Table 4-14. Wire Harness Connectors in Figure 4-41.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under tail section
[14]	Cam Position Sensor	3-place Deutsch	near starter
[88]	TP Sensor	3-place Packard	behind air cleaner backplate

Code 11 Test (Part 1 of 2)



Clear codes and confirm proper operation with no check engine lamp.

Code 11 Test (Part 2 of 2)

2 Continued from Code 11 Test (Part 1 of 2).

Unplug TP sensor connector [88]. Measure voltage between Terminal A (R/W wire) (+) and C (BK/W wire) (-) with ignition ON. Is voltage 5.0 +/- 0.25?

- **YES**
  - **1** Connect Breakout Box if not already connected. Check resistance between ECM Pin 2 on connector [11] to chassis ground. Is resistance greater than 1 megaohm?
    - **YES**
      - **2** Check continuity from Pin 2 of connector [11] to Terminal B on connector [88]. Continuity present?
        - **YES**
          - Replace TP sensor. See 4.35 THROTTLE POSITION SENSOR. 7590
        - **NO**
          - Locate and repair open in V/Y wire. 7580
    - **NO**
      - Find short to ground on V/Y wire. 7605
- **NO**
  - **1** Connect Breakout Box if not already connected. Turn ignition switch OFF. Disconnect ECM connector [11]. Check for continuity between connector [88] Terminal A (R/W wire) and Pin 1 of connector [11]. Continuity present?
    - **YES**
      - Check continuity between connector [88] Terminal B (V/Y wire) and Pin 2 of connector [11]. Continuity present?
        - **YES**
          - Check continuity between connector [88] Terminal C and Pin 7 of connector [11]. Continuity present?
            - **YES**
              - Disconnect cam position sensor connector [14]. Measure resistance between connector [88] Terminal A and Terminal C. Is resistance greater than 1 megaohm?
                - **YES**
                  - Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE. 7591
                - **NO**
                  - Locate and repair short between R/W and BK/W wires. Reconnect [14]. 7592
            - **NO**
              - Locate and repair open in BK/W wire. 7610
        - **NO**
          - Locate and repair open in V/Y wire. 7580
    - **NO**
      - Locate and repair open in R/W wire. 7615

Clear codes and confirm proper operation with no check engine lamp.

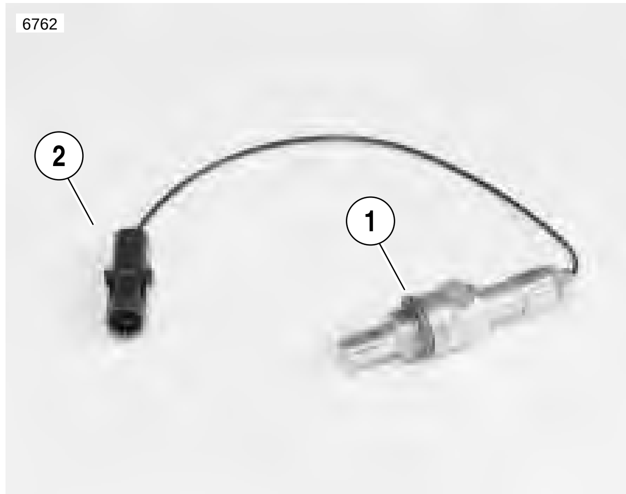
GENERAL

Oxygen (O2) Sensor

See Figure 4-42. The oxygen (O2) 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 parts air to 1 part fuel, the voltage will be approximately 0.48 V.



1. **Oxygen Sensor**
2. **Connector [137]**

Figure 4-42. Oxygen Sensor

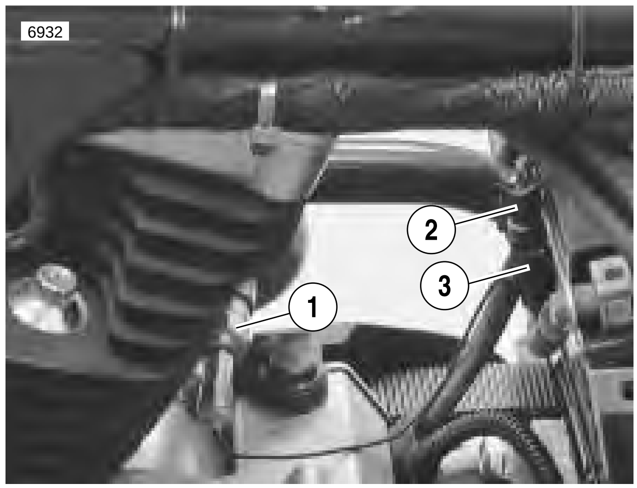
DIAGNOSTICS

Diagnostic Tips

The Scanalyzer or 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). The engine must be running at part throttle (2500 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 4-43. If the O2 sensor is loose engine performance may be affected. This could also show up as a slow changing O2 sensor voltage on the Scanalyzer.
- **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.



1. **Oxygen Sensor**
2. **Connector [137]**
3. **Cable Strap**

Figure 4-43. Oxygen Sensor Installed

Diagnostic Notes

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.7 BREAKOUT BOX.

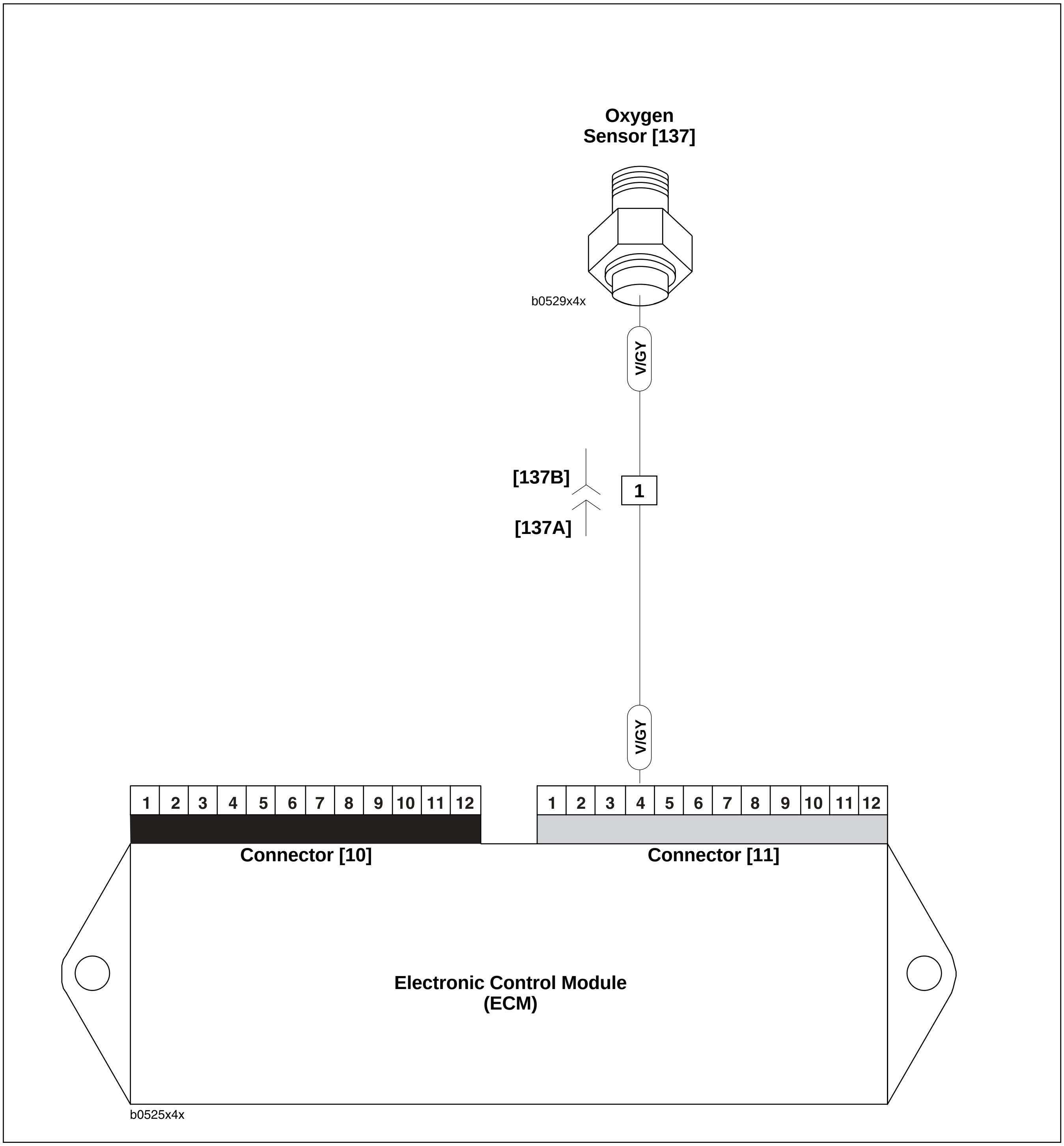
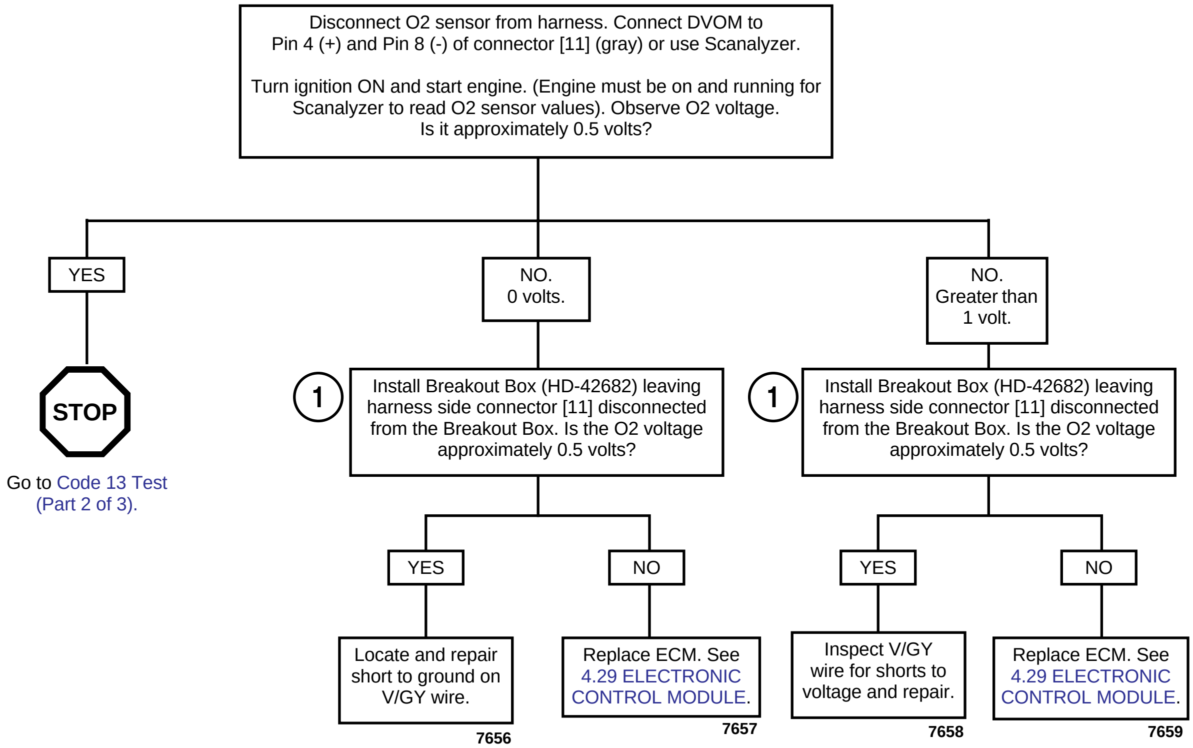


Figure 4-44. Oxygen Sensor Circuit

Table 4-15. Wire Harness Connectors in Figure 4-44.

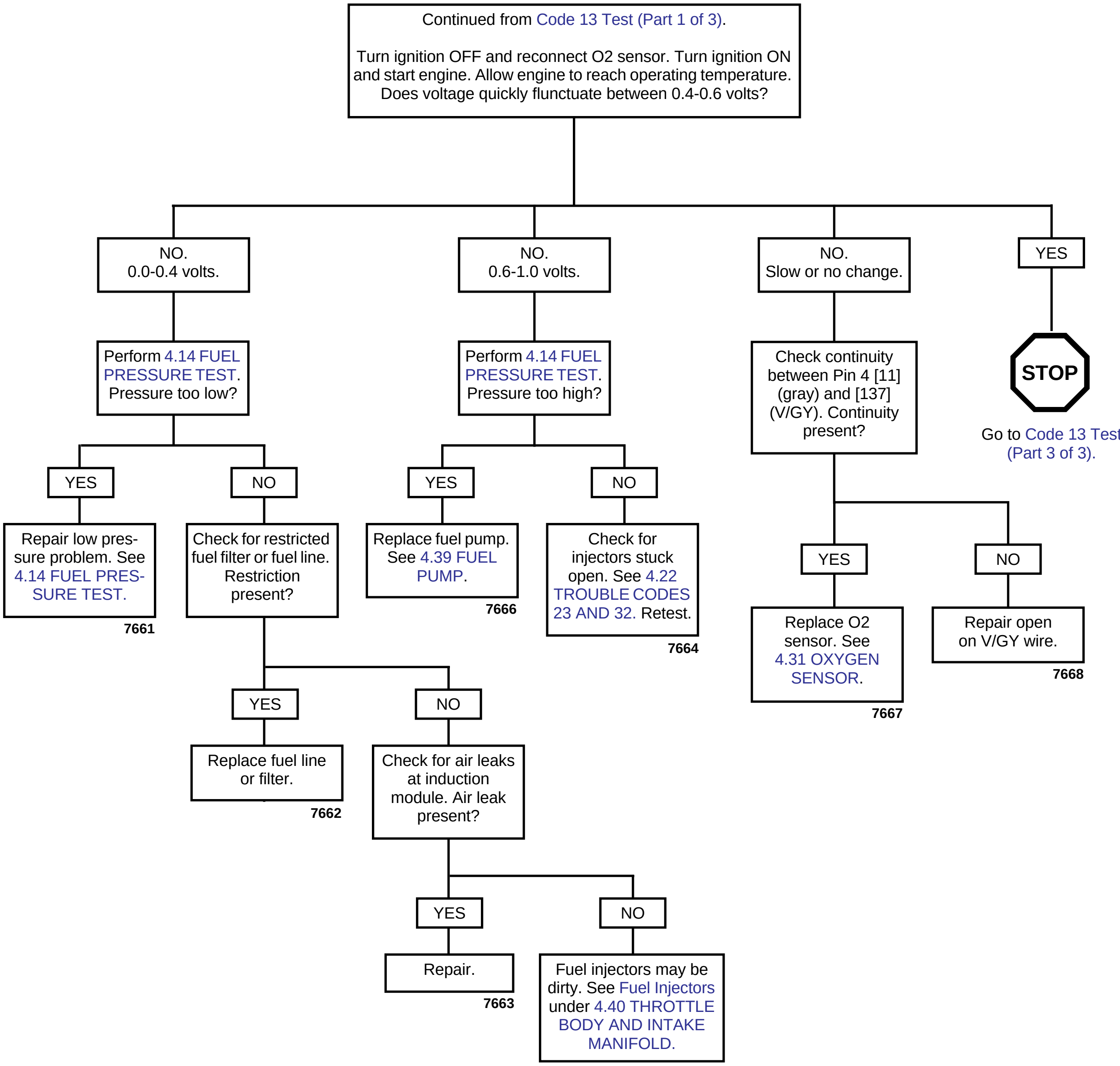
NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under tail section
[137]	Oxygen Sensor	1-place	above starter

Code 13 Test (Part 1 of 3)



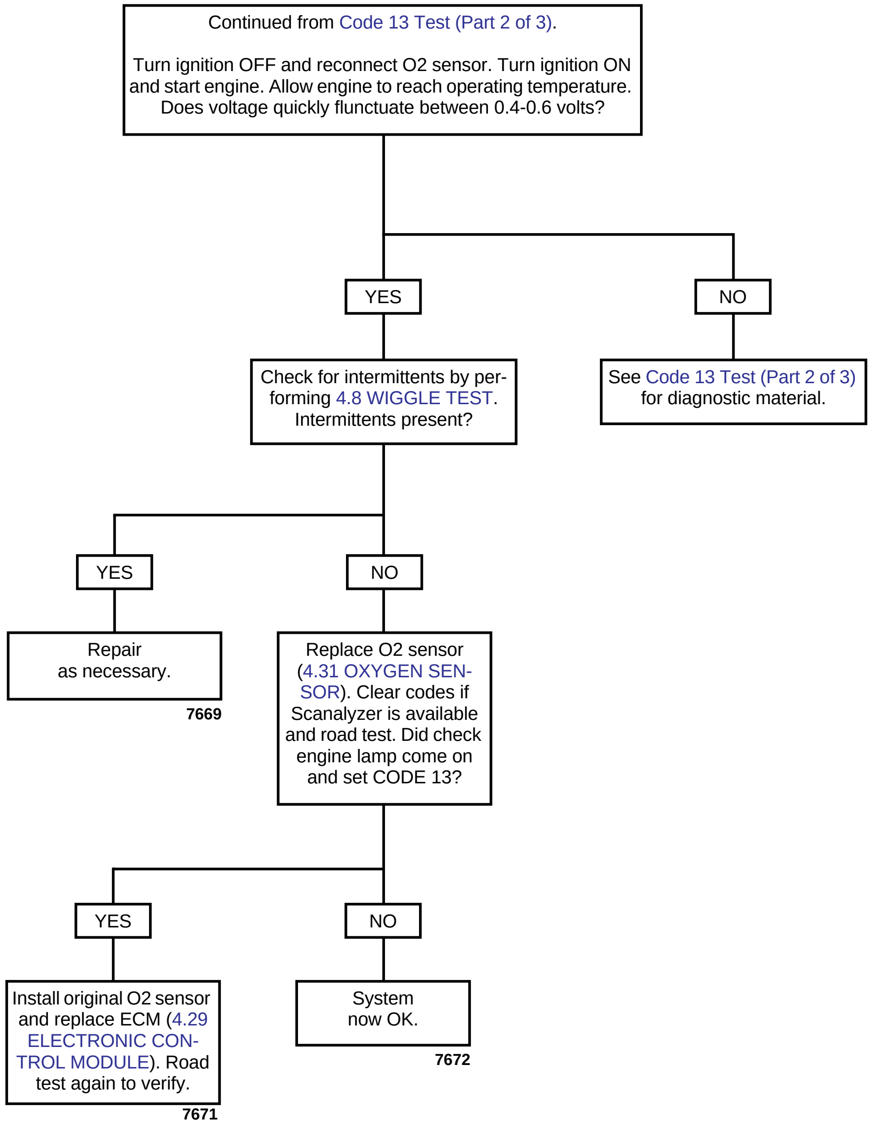
Clear codes and confirm proper operation with no check engine lamp.

Code 13 Test (Part 2 of 3)



Clear codes and confirm proper operation with no check engine lamp.

Code 13 Test (Part 3 of 3)



Clear codes and confirm proper operation with no check engine lamp.

TROUBLE CODE 14

GENERAL

Engine Temperature Sensor

CAUTION

Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

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 4-16. 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.

Table 4-16. 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]).

DIAGNOSTICS

Diagnostic Tips

The Scanalyzer displays engine temperature in degrees. Once the engine is started, the temperature should rise steadily.

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 4.7 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probes and patch cord.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

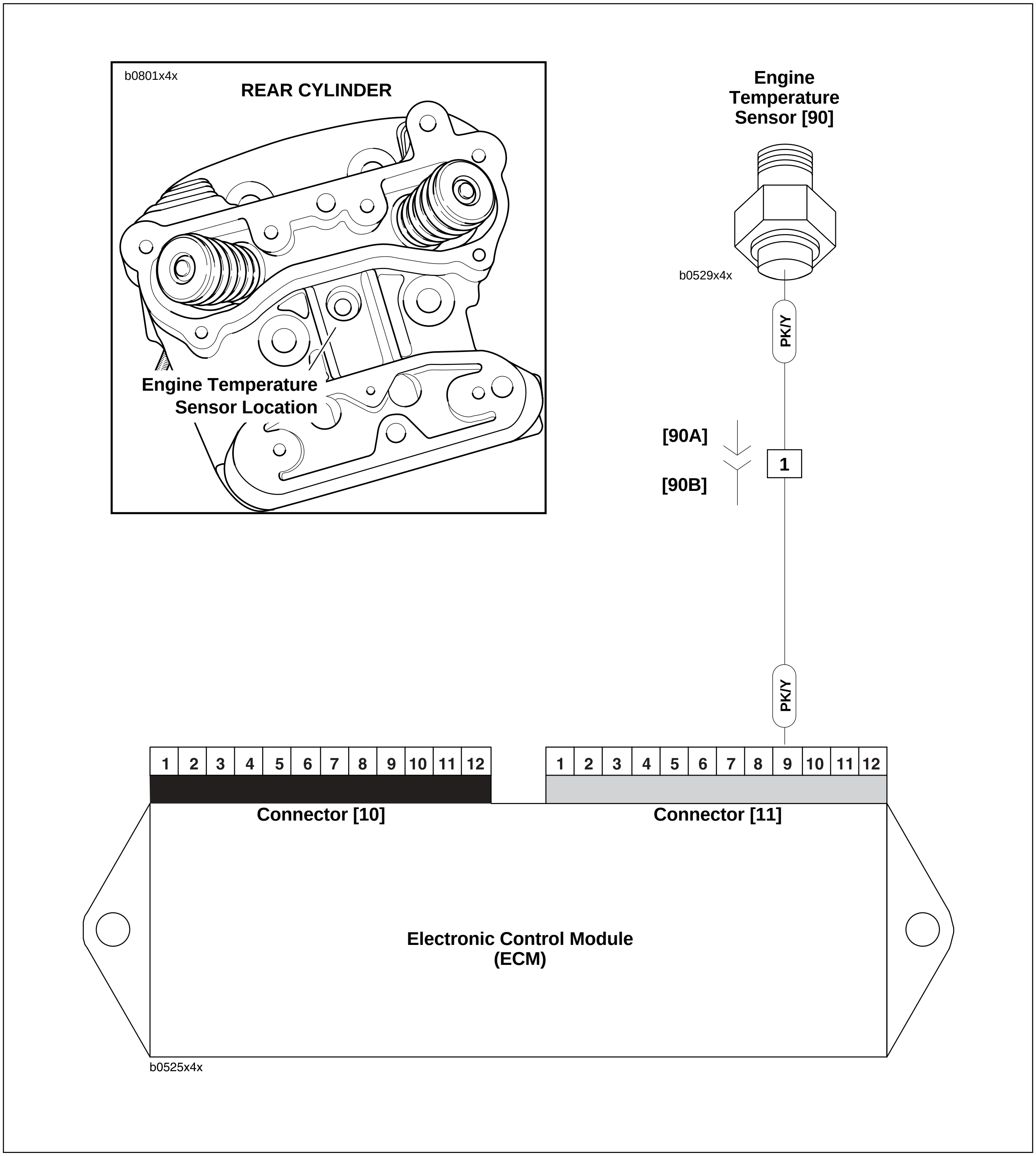
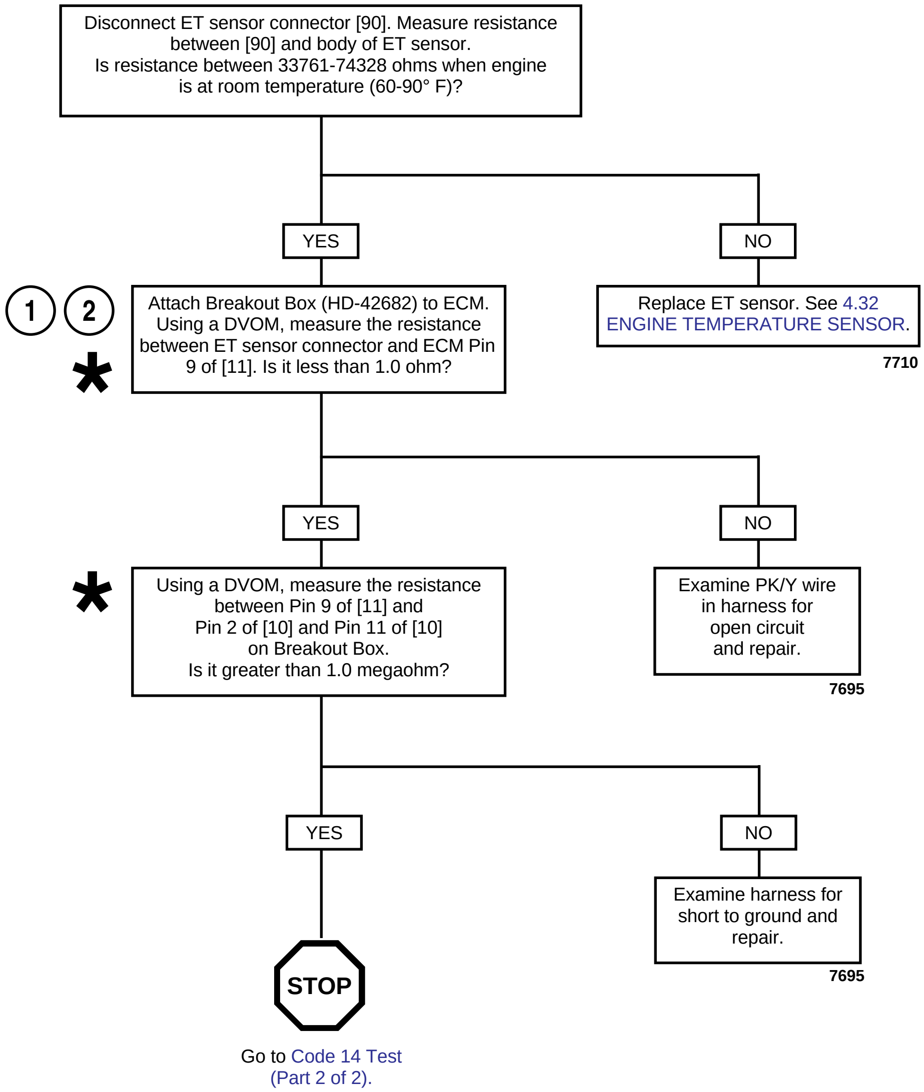


Figure 4-45. Engine Temperature Sensor Circuit

Table 4-17. Wire Harness Connectors in Figure 4-45.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under tail section
[90]	Engine Temperature Sensor	1-place bullet	above rear cylinder head, left side

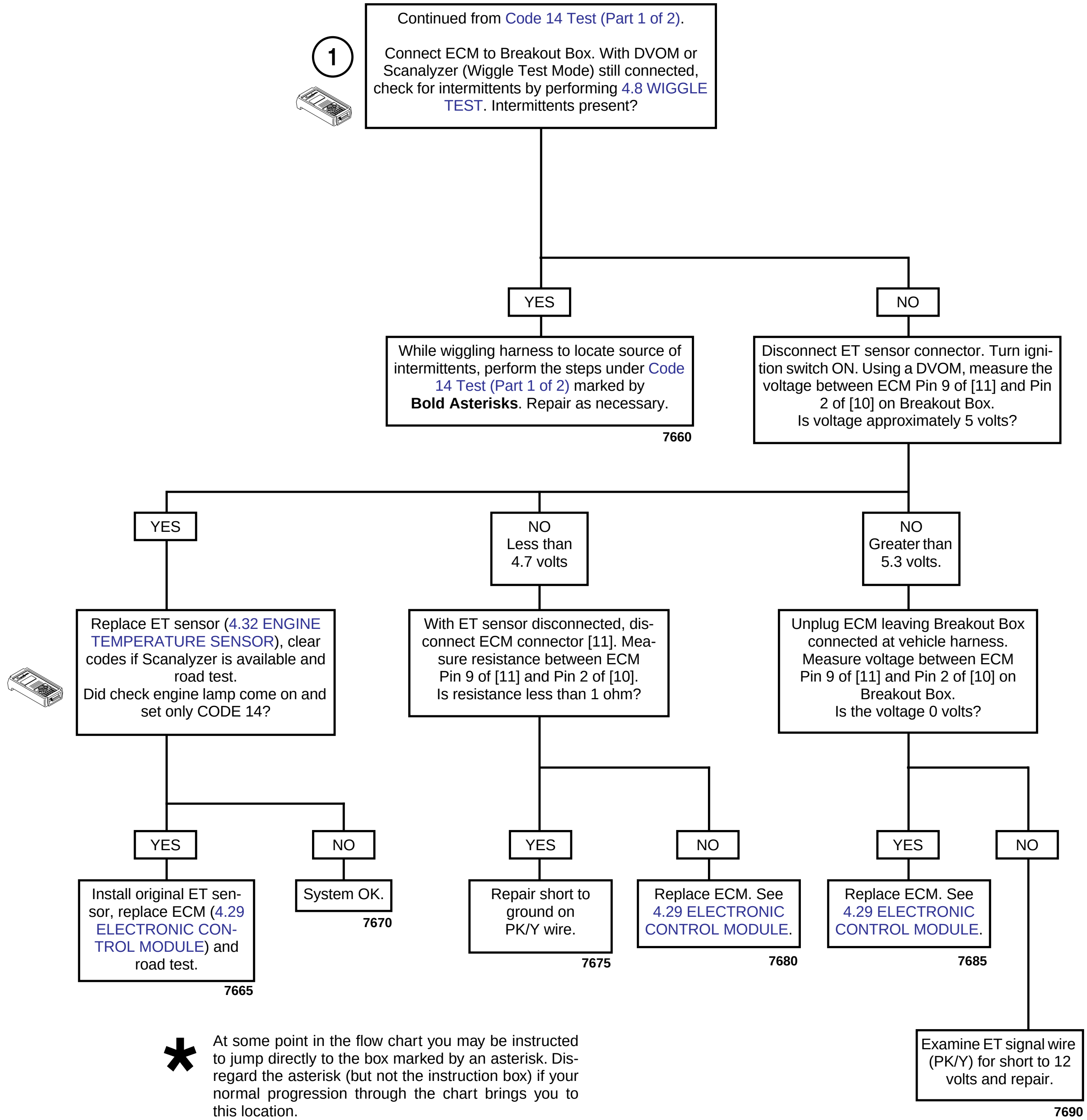
Code 14 Test (Part 1 of 2)



* 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.

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.

TROUBLE CODE 15 4.20

GENERAL

Intake Air Temperature Sensor

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]).

See Table 4-18. 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

The Scanalyzer displays intake air temperature in degrees.

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 4.8 WIGGLE TEST to locate intermittents.** If connections and harness check out OK, use the Scanalyzer to 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 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 15 flow charts.

1. Connect BREAKOUT BOX (Part No. HD-42682) to EFI harness **only** (leave ECM disconnected). See 4.7 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray socket probes and patch cord.
3. Use HARNESS CONNECTOR TEST KIT, gray pin probe and patch cord.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

Table 4-18. Intake Air Temperature Sensor Specifications

VOLTS	RESISTANCE	TEMP °C	TEMP °F
0.49	1086	125	257
0.68	1561	113	234.5
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]).

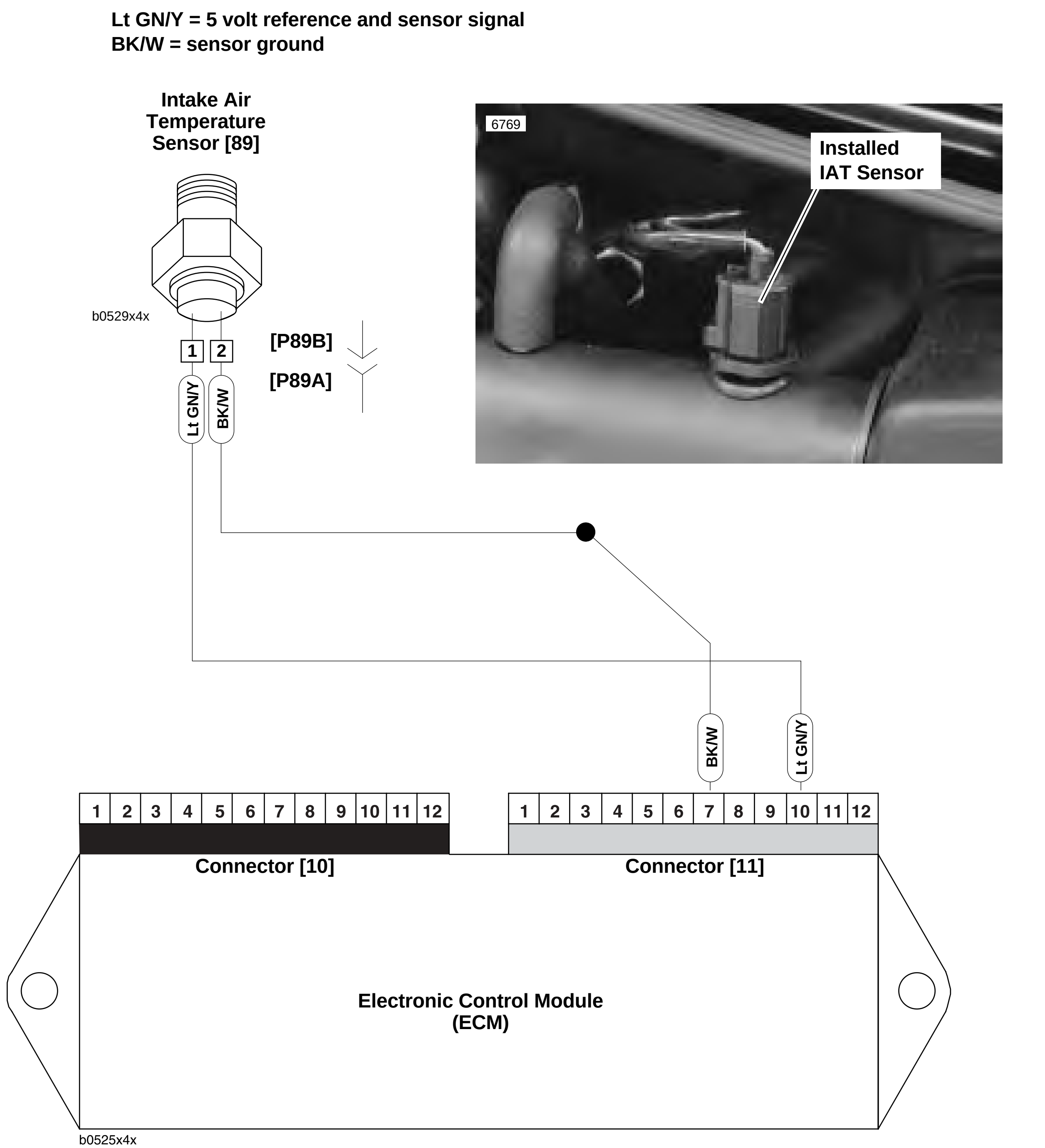


Figure 4-46. Intake Air Temperature Sensor Circuit

Table 4-19. Wire Harness Connectors in Figure 4-46.

NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under tail section
[89]	IAT Sensor	2-place Deutsch	inside air box

Code 15 Test (Part 1 of 2)

1

Connect Breakout Box to connector [11] leaving ECM disconnected. With engine at room temperature (68-86°F), use a DVOM to measure resistance across Pin 10 of [11] and Pin 7 of [11] on the Breakout Box.
Is the resistance between 23,670-37,170 ohms?

YES

Connect ECM to Breakout Box. Check for intermittents by performing 4.8 WIGGLE TEST. Intermittents present?

YES

STOP

Go to Code 15 Test (Part 2 of 2).

YES

While wiggling harness to locate source of intermittents, perform the steps under Code 15 Test (Part 2 of 2) marked by **Bold Asterisks**. Repair as necessary.

7715

NO

Disconnect IAT sensor connector. Turn ignition switch ON. Using a DVOM, measure the voltage between ECM Pin 10 (+) and Pin 7 (-) of [11] on Breakout Box.
Is the voltage approximately 5 volts?

YES

Replace IAT sensor (4.34 INTAKE AIR TEMPERATURE SENSOR), clear codes if Scanalyzer is available and road test. Did check engine lamp come on and set only CODE 15?

YES

Install original IAT sensor, replace ECM and road test.

7720

NO

System OK.

7725

NO
Less than
4.7 volts

With IAT sensor disconnected, disconnect ECM connector [11]. Measure resistance between ECM Pin 10 of [11] and Pins 2 and 11 of [10]. Is resistance less than 1 megaohm?

YES

Repair short to ground on Lt. GN/Y wire.

7730

NO

Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE.

7735

NO
Greater than
5.3 volts.

Unplug ECM leaving Breakout Box connected at vehicle harness. Measure voltage between ECM Pin 10 of [11] and Pin 2 of [10] on Breakout Box.
Is the voltage 0 volts?

YES

Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE.

7740

NO

Examine IAT signal wire (Lt. GN/Y) for short to 12 volts and repair.

7745

* 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.

HOME

Code 15 Test (Part 2 of 2)

Continued from Code 15 Test (Part 1 of 2)

2

Disconnect IAT sensor connector [89]. Measure resistance between Pins 1 and 2 of [89] at sensor. With engine at room temperature (60-90° F), is resistance between 6816 -3314 ohms?

NO: Replace IAT sensor. See 4.34 INTAKE AIR TEMPERATURE SENSOR. 7760

YES:

*

3

Using a DVOM, measure the resistance between IAT sensor connector [89] terminal 1 and ECM Pin 10 on Breakout Box. Is it less than 1.0 ohm?

NO: Examine Lt. GN/Y wire in harness for open circuit and repair. 7750

YES:

*

3

Using a DVOM, measure the resistance between IAT sensor connector [89] terminal 2 and ECM Pin 7 on Breakout Box. Is it less than 1.0 ohm?

NO: Examine BK/W wire in harness for open circuit and repair. 7750

YES:

*

Using a DVOM, measure the resistance between ECM Pins 10 and 7 of connector [11] on Breakout Box. Is it greater than 1.0 megaohm?

NO: Examine Lt. GN/Y wire and BK/W wire in harness for short between these two circuits and repair. 7750

YES:

*

Using a DVOM, measure the resistance between ECM Pin 10 of connector [11] on Breakout Box and ground. Is it greater than 1.0 megaohm?

NO: Examine harness for short to ground and repair. 7750

YES: To locate sources of intermittents, wiggle harness while performing steps marked above by **Bold Asterisk**. Repair as necessary. 7755

* 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.

TROUBLE CODE 16 4.21

GENERAL

Battery Voltage

A Code 16 will set if the ECM sees battery positive voltage less than 6 volts or greater than 18 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

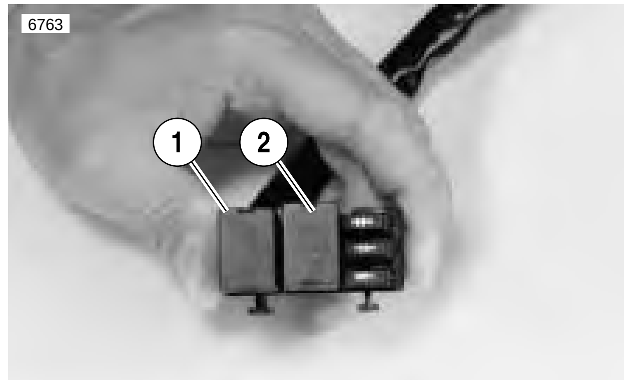
Diagnostic Notes

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 4.7 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.
3. See 5.5 DIAGNOSTICS/TROUBLESHOOTING.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.



1. **Ignition Relay**
2. **Starter Relay**

Figure 4-47. Electrical Relays

Figure 4-48. Fuse Holder

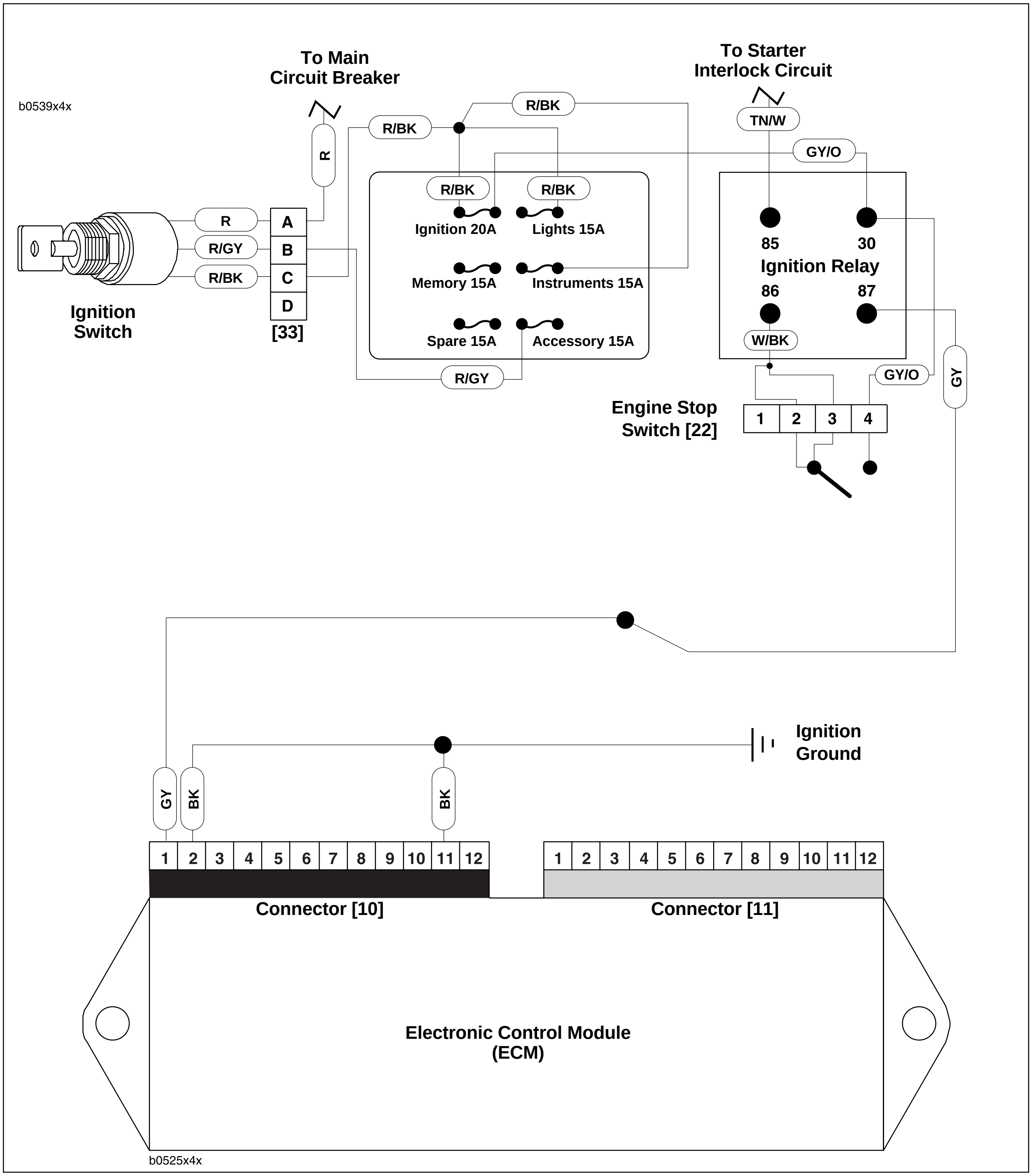


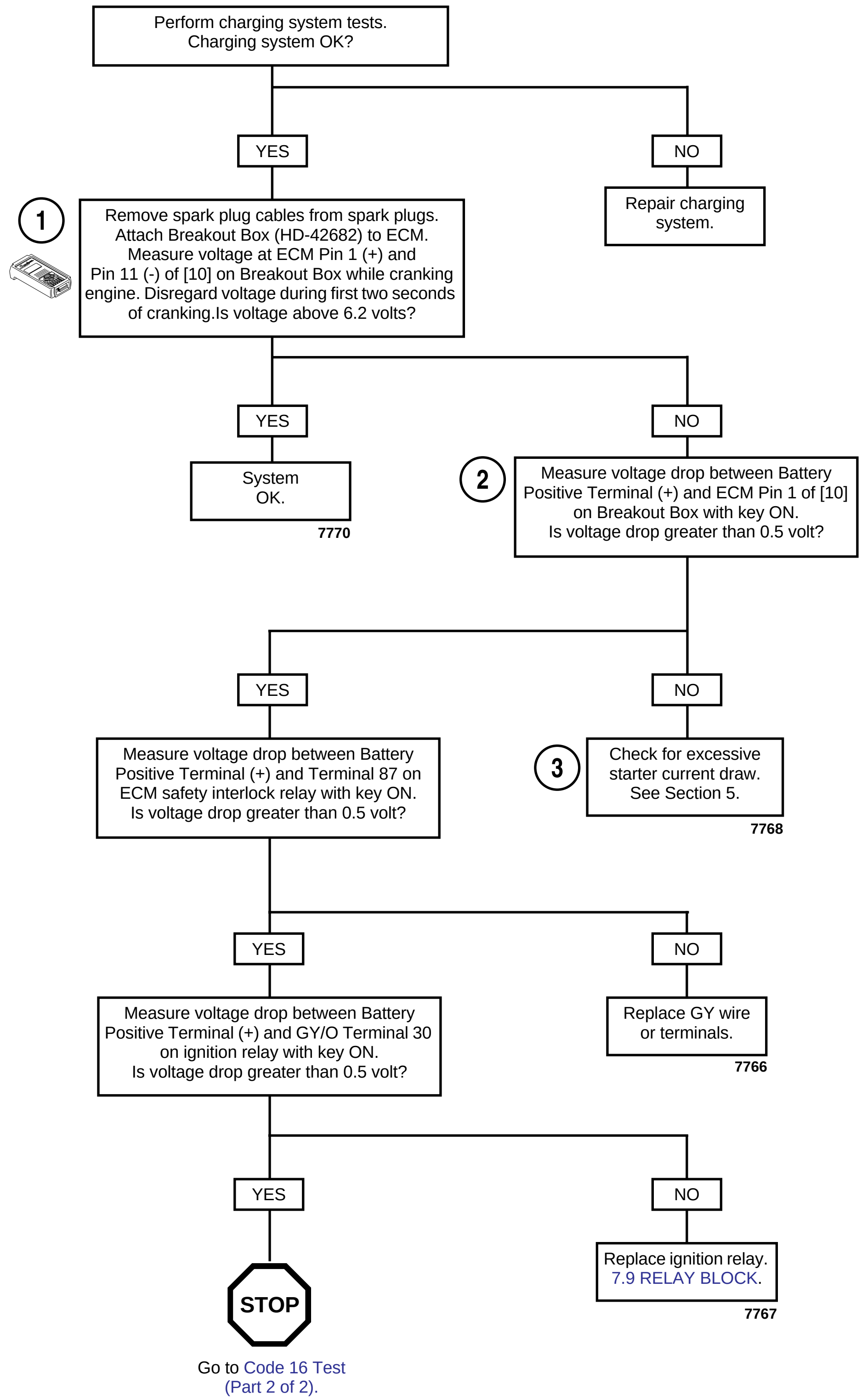
Figure 4-49. Battery Voltage Circuit

Table 4-20. Wire Harness Connectors in Figure 4-49.

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

HOME

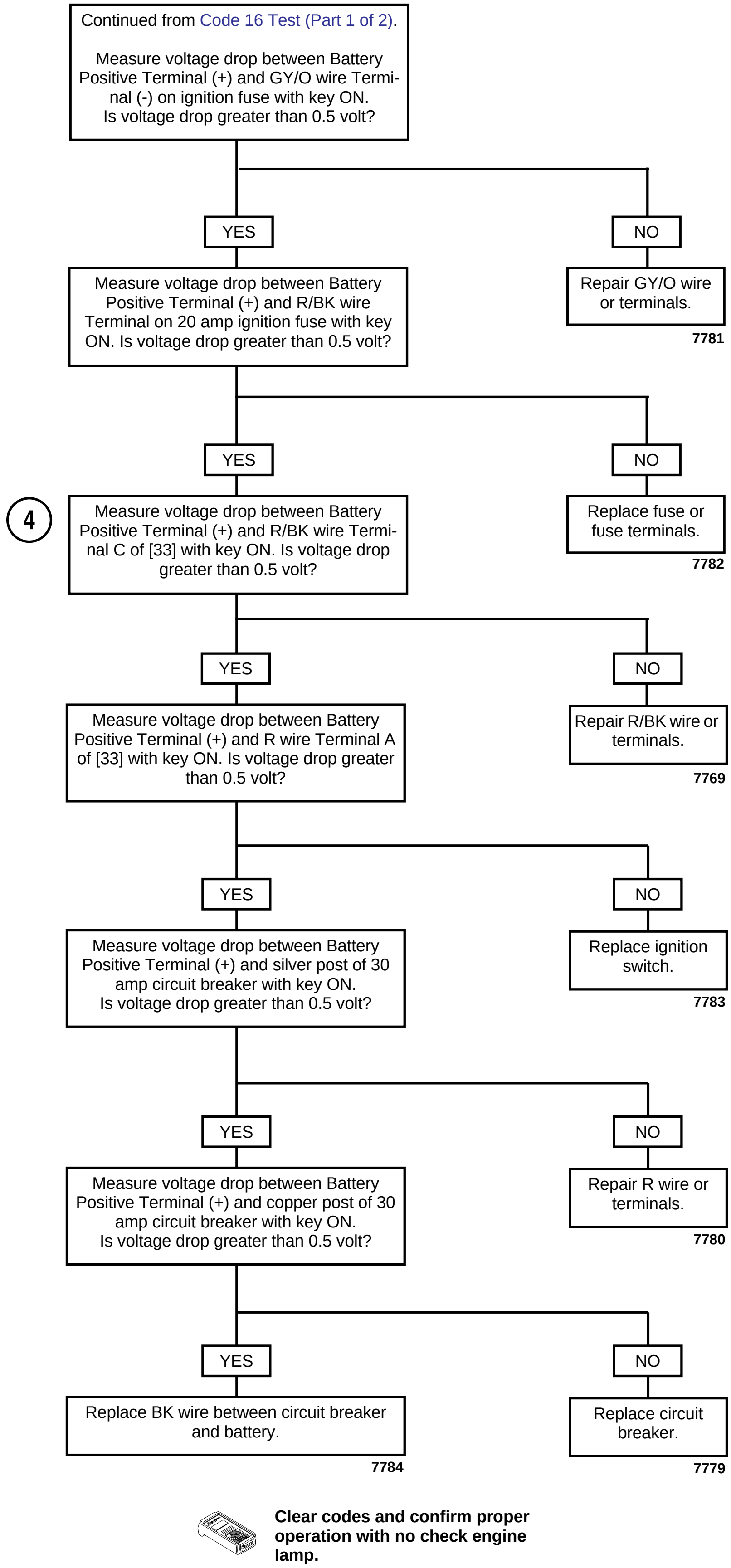
Code 16 Test (Part 1 of 2)



Clear codes and confirm proper operation with no check engine lamp.

HOME

Code 16 Test (Part 2 of 2)



TROUBLE CODES 23 AND 32 4.22

GENERAL

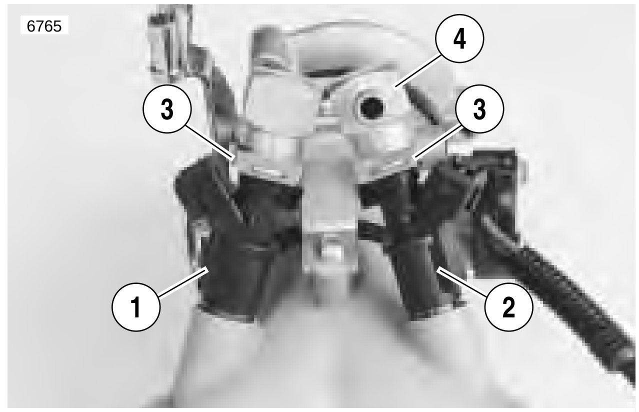
Front Fuel Injector (Code 23) And Rear Fuel Injector (Code 32)

See Figure 4-50. The fuel injectors (1, 2) are solenoids that allow pressurized fuel into the engine intake tract. The injectors are timed to the engine cycle and are triggered sequentially.

See Figure 4-51. The power for the injectors comes from the ignition relay. The ignition relay also provides power for fuel pump, ECM, bank angle sensor and the ignition coils. The ECM provides the path to ground to trigger the injectors.

NOTE

System fuse and ignition relay failures or wiring harness problems will cause 12 volt power to be lost to both injectors, ignition coils, ECM, bank angle sensor and fuel pump.



1. **Front Fuel Injector**
2. **Rear Fuel Injector**
3. **Clip (2)**
4. **Fuel Rail**

Figure 4-50. Fuel Injectors

Figure 4-51. Fuel Injector Connector

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 23/32 flow charts.

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.
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 4.7 BREAKOUT BOX.
4. Use HARNESS CONNECTOR TEST KIT, purple pin probes and patch cord to BREAKOUT BOX and gray socket probes and patch cord to FUEL INJECTOR TEST LAMP (Part No. HD-34730-2C).

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used. If a number is printed next to the icon, then refer to the Scanalyzer notes at the bottom of the flow chart.

HOME

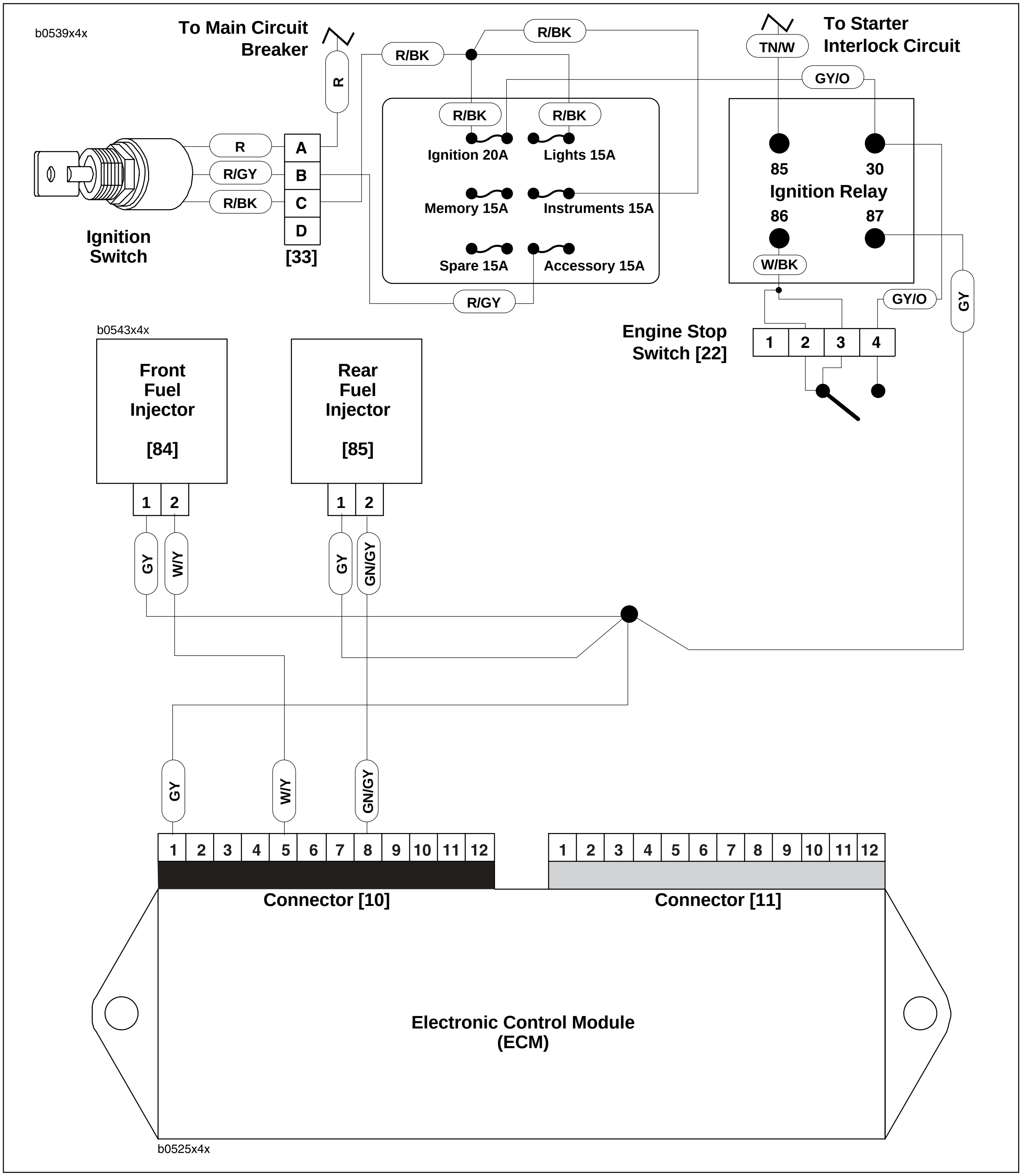


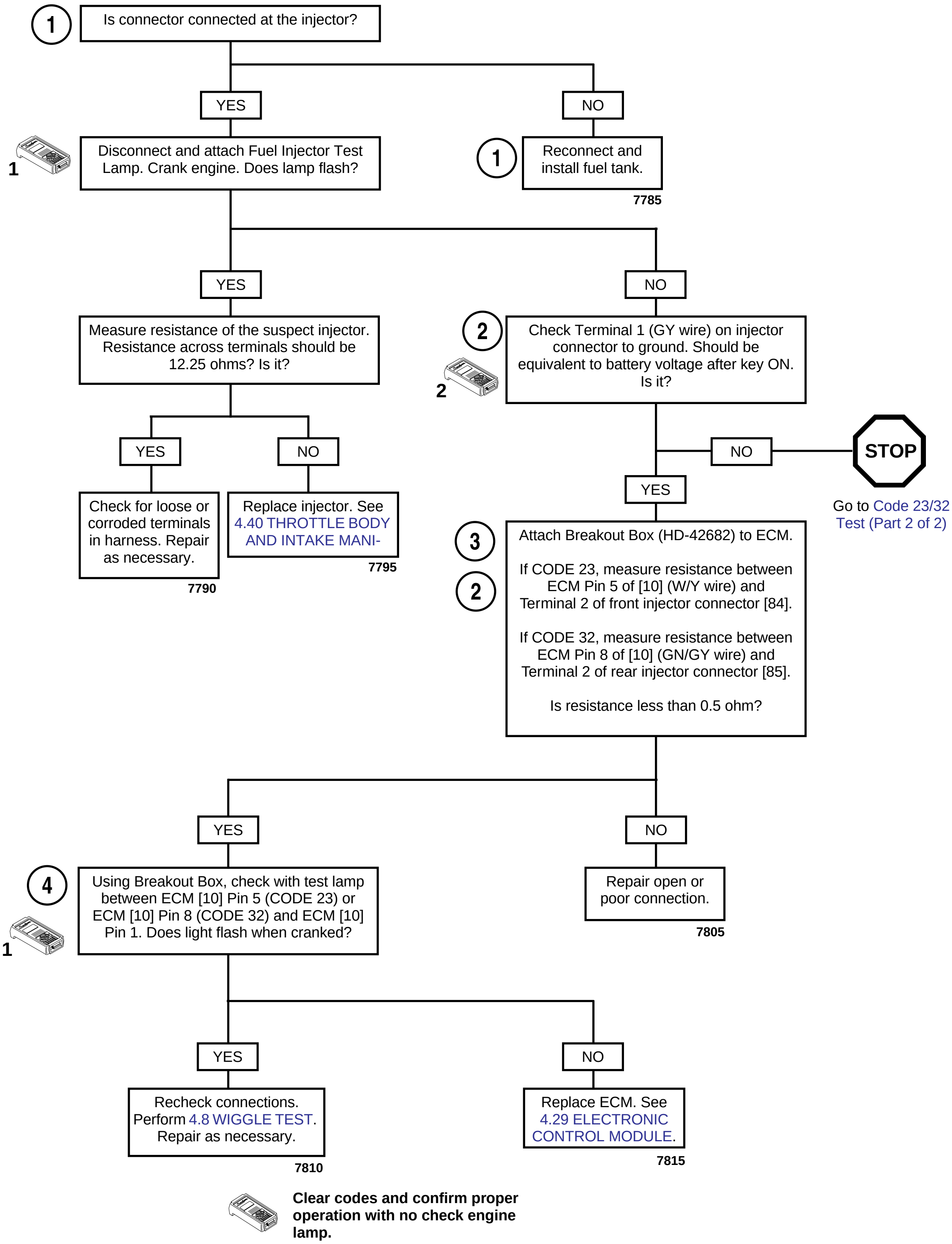
Figure 4-52. Fuel Injector Circuit

Table 4-21. Wire Harness Connectors in Figure 4-52.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[84]	Front Injector	2-place	under fuel cell
[85]	Rear Injector	2-place	under fuel cell

HOME

Code 23/32 Test (Part 1 of 2)



SCANALYZER NOTES

1 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear injector once each second for a total of five seconds.

2 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds. Power to the pump also includes power to the fuel injectors and ignition coil.

Code 23/32 Test (Part 2 of 2)

2 Continued from Code 23/32 Test (Part 1 of 2).

Check for 12 volts at Terminal 87 of the ignition relay.
Is there 12 volts at Terminal 87?

- **YES**: Ignition relay is OK. Measure resistance between Terminal 87 of the ignition relay and Terminal 2 (W/Y for Code 23 or GN/GY for Code 32) wire at injector connector.
  Is resistance less than 0.5 ohm?
  - **YES**: With DVOM still attached, perform 4.8 WIGGLE TEST to locate intermittents. Repair as necessary.
    7820
  - **NO**: Find and repair connection or open wire.
    7825
- **NO**: Check for multiple codes. See 4.3 DIAGNOSTIC INTRODUCTION.

Clear codes and confirm proper operation with no check engine lamp.

SCANALYZER NOTES

1 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear injector once each second for a total of five seconds.

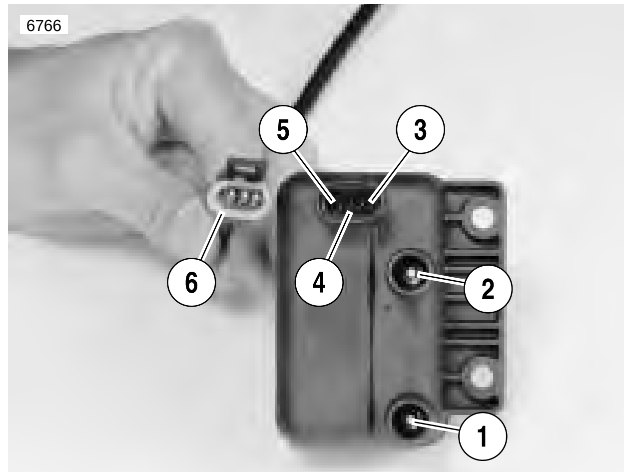
2 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds. Power to the pump also includes power to the fuel injectors and ignition coil.

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 4-53. The coil receives power from the ignition relay at coil pin B (4) at the same time that the fuel pump and injectors are activated. The fuel pump is active for the first two seconds after the ignition switch is turned ON and then shuts off until RPM is detected from the cam position sensors, at which time it is reactivated.



1. **Rear Cylinder Spark Plug Cable**
2. **Front Cylinder Spark Plug Cable**
3. **Coil Pin A (Rear Cylinder)**
4. **Coil Pin B (12 VDC)**
5. **Coil Pin C (Front Cylinder)**
6. **Connector [83]**

Figure 4-53. 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 4.7 BREAKOUT BOX.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used. If a number is printed next to the icon, then refer to the Scanalyzer notes at the bottom of the flow chart.

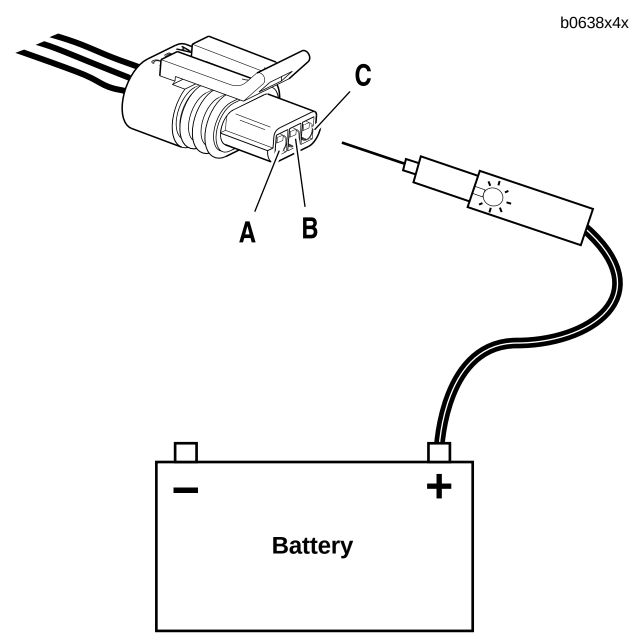


Figure 4-54. Testing Ignition Coil Connectors

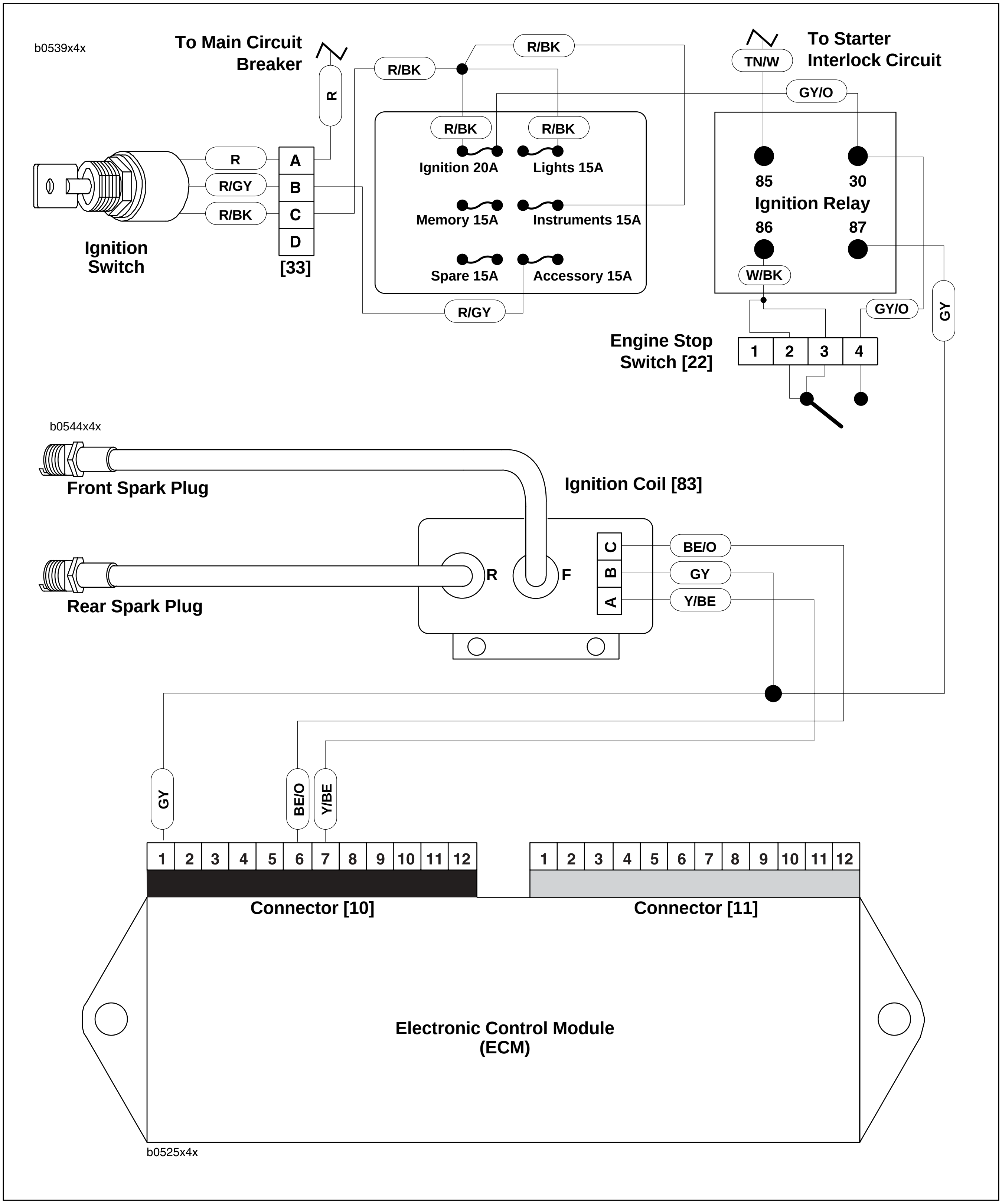


Figure 4-55. Ignition Coil Circuit

Table 4-22. Wire Harness Connectors in Figure 4-55.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[83]	Ignition Coil Connector	3-place Packard	under fuel cell, left side

HOME

Code 24/25 Test

1

Disconnect coil connector [83]. Attach Test Lamp to [83] as shown in Figure 4-54.
Crank engine.
Do test lamp lights flash when cranked?

YES

Faulty coil connection or coil. See Section 7.

7856

NO

1

2

Measure voltage on Terminal B of coil. Should be equivalent to battery voltage after key is turned ON.
Is it?

YES

1

2

Attach Breakout Box (HD-42682) to ECM. Measure resistance between ECM and coil terminals as follows:

Trouble Code	Coil Terminal	ECM Terminal
24 (Front)	C (BE/O)	6
25 (Rear)	A (Y/BE)	7

Resistance should be less than 0.5 ohms. Is it?

NO

2

Measure voltage at ignition relay Terminal 87 after key is turned ON. Should be equivalent to battery voltage. Is it?

YES

Repair open wire or connection on GY wire.

7875

NO

Check for multiple codes. See 4.3 DIAGNOSTIC INTRODUCTION.

YES

Perform 4.8 WIGGLE TEST. Intermittents found?

YES

Repair as necessary.

7865

NO

Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE.

7870

NO

Repair open wire or connection.

7860

Clear codes and confirm proper operation with no check engine lamp.

SCANALYZER NOTES

1 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear injector once each second for a total of five seconds.

2 With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to turn fuel pump on for periods up to 30 seconds. Power to the pump also includes power to the fuel injectors and ignition coil.

TROUBLE CODE 33 4.24

GENERAL

Fuel Pump

The fuel pump assembly is shown in Figure 4-56. ECM Pin 3 provides ground to the fuel pump. Code 33 will set if:

- BN/Y wire is shorted to 12 volts. This will also cause the ignition fuse to blow. See Figure 4-57.
- BN/Y wire is shorted to ground. This will cause the fuel pump to run continuously even when the motor is not running.
- Fuel pump motor stalls or spins without providing fuel pressure.

DIAGNOSTICS

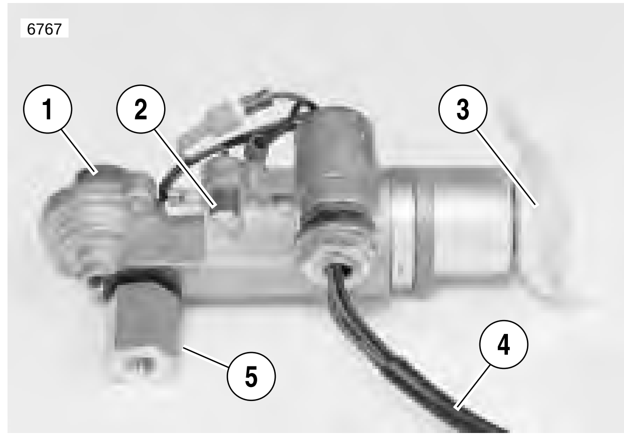
Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Code 33 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.7 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), red pin probe and patch cord.
3. Use HARNESS CONNECTOR TEST KIT, gray socket probe and patch cord.

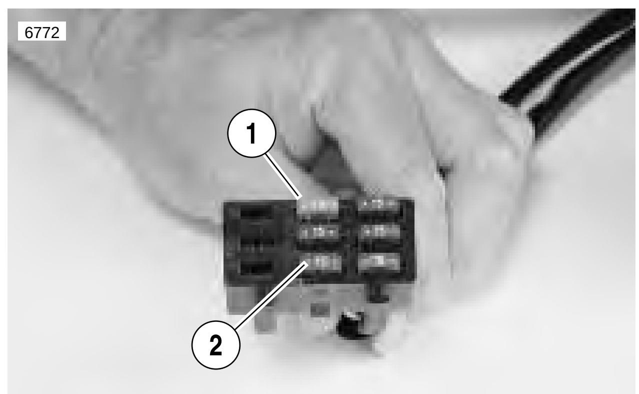
Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.



1. **Pressure Regulator**
2. **Low Fuel Level Sensor**
3. **Filter**
4. **Wiring Harness**
5. **Fuel Fitting Nut (Schraeder Valve not shown)**

Figure 4-56. Fuel Pump Assembly



1. **Ignition Fuse**
2. **Spare Fuse Slot (may be 15 or 20 amp)**

Figure 4-57. Ignition Fuse

HOME

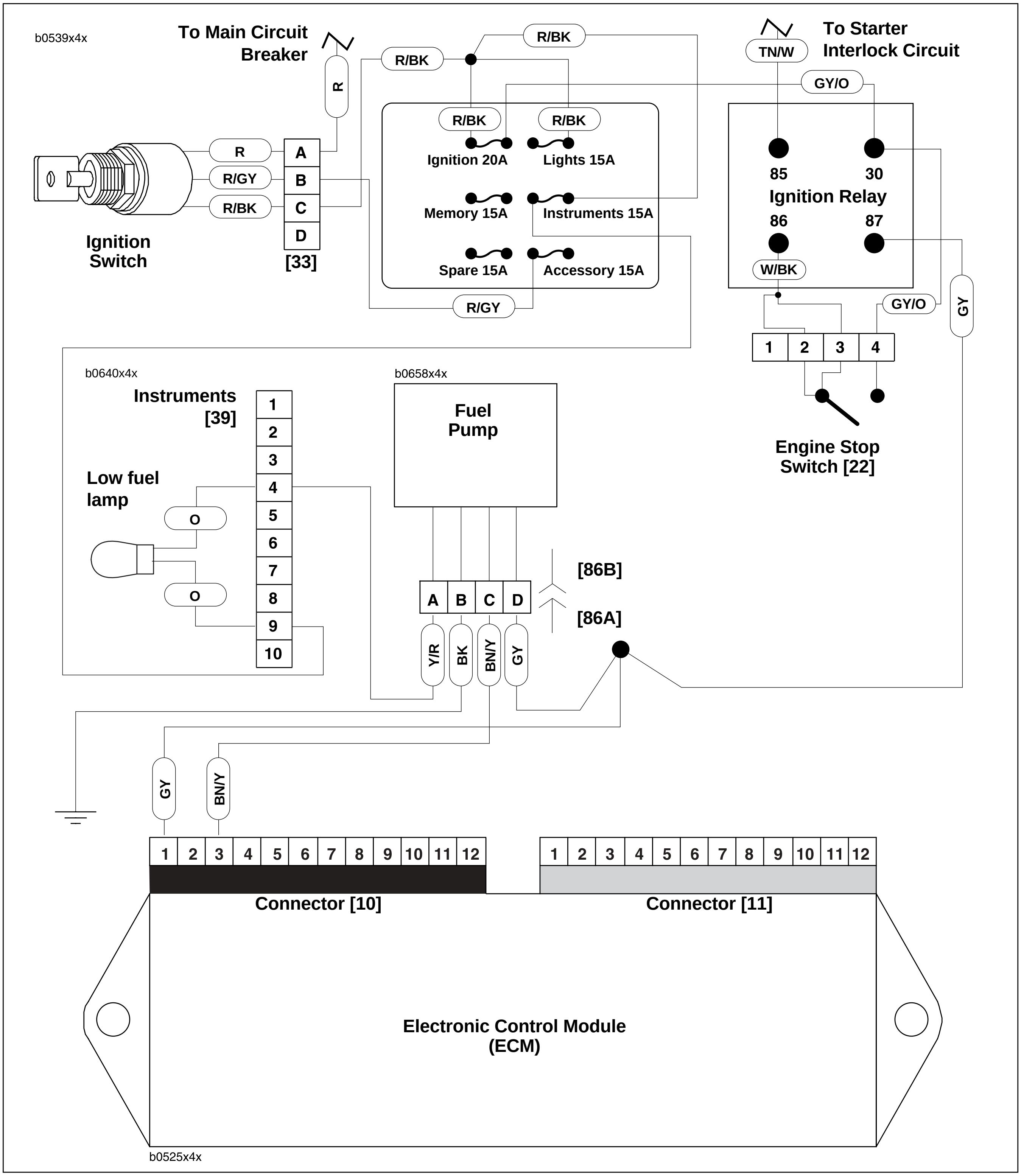


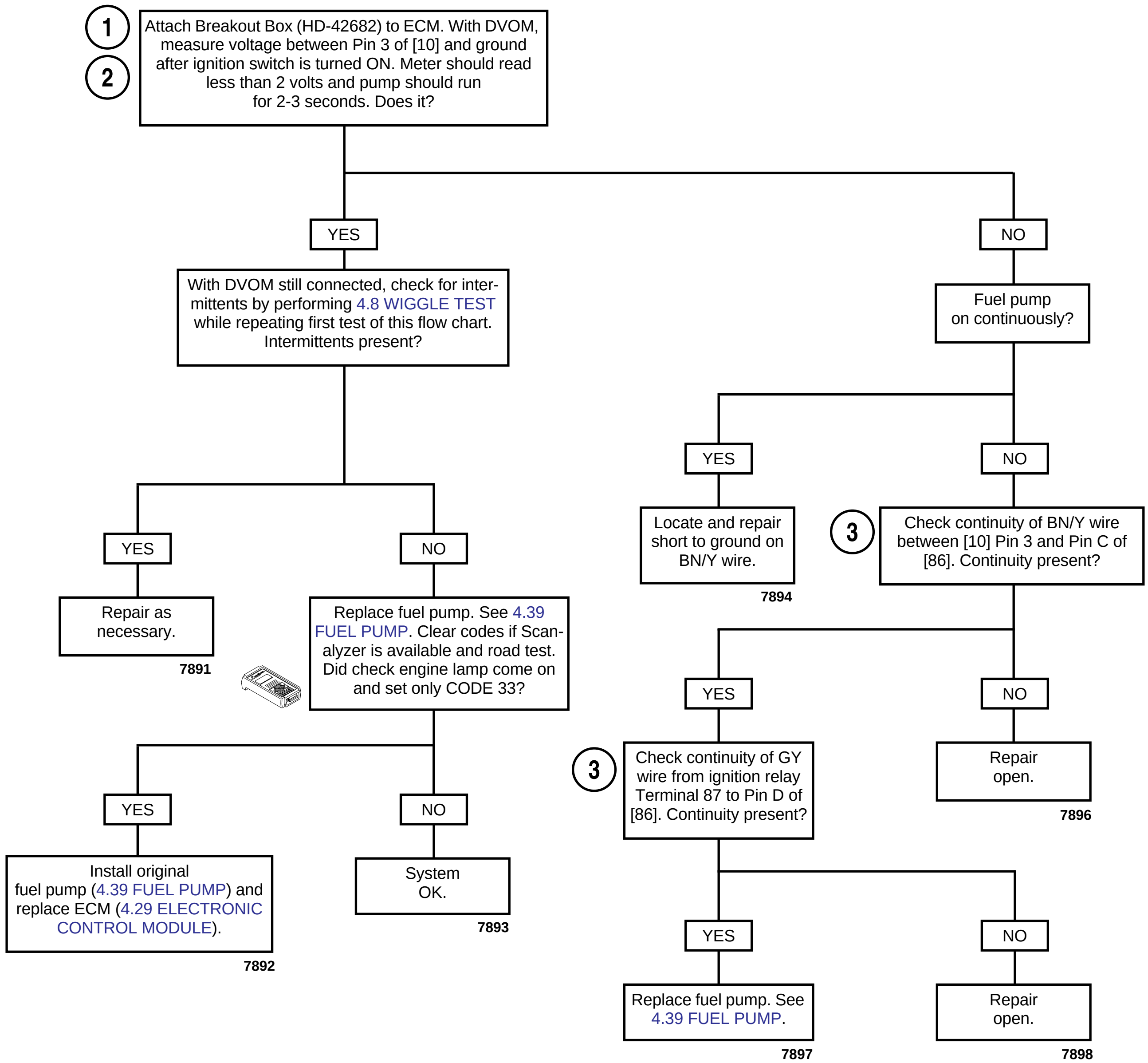
Figure 4-58. Fuel Pump Circuit

Table 4-23. Wire Harness Connectors in Figure 4-58.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[39]	Instruments	10-place Multilock	under fuel cell
[86]	Fuel Pump	4-place Packard	above rear cylinder head, left side

HOME

Code 33 Test



Clear codes and confirm proper operation with no check engine lamp.

TROUBLE CODE 35

GENERAL

Tachometer

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

DIAGNOSTICS

Diagnostic Notes

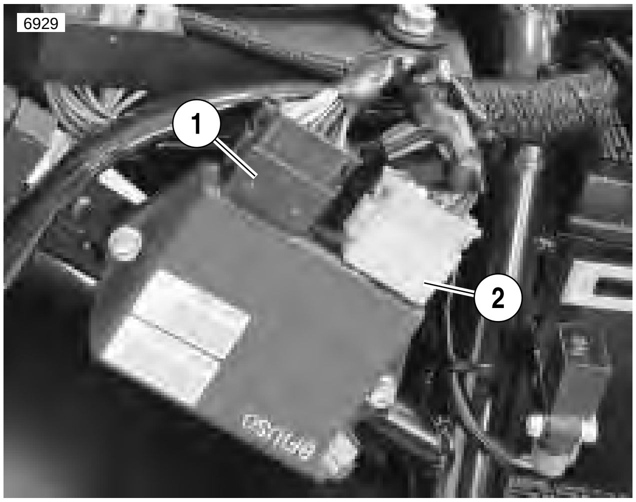
The reference numbers below correlate with the circled numbers on the Code 35 flow chart.

1. Connect BREAKOUT BOX (Part No. HD-42682) to ECM. See 4.7 BREAKOUT BOX.

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

2. Purge fuel line and remove fuel tank to access instrument connector [39]. See 4.36 FUEL TANK.
3. Replace tachometer. See 7.13 TACHOMETER.



1. **ECM Connector [10] (Black)**
2. **ECM Connector [11] (Gray)**

Figure 4-59. ECM Connectors

Figure 4-60. Instrument Connector [39]

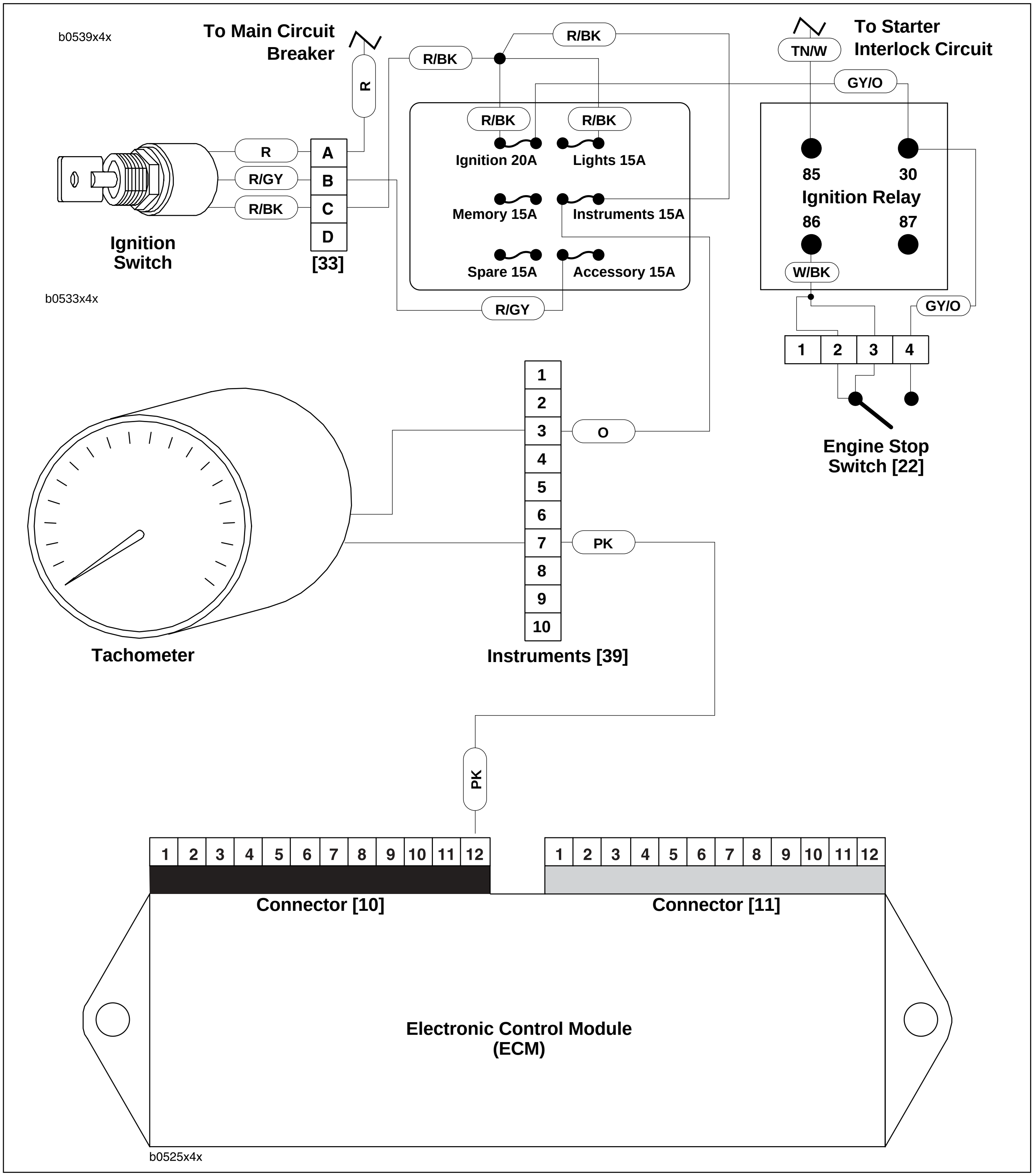
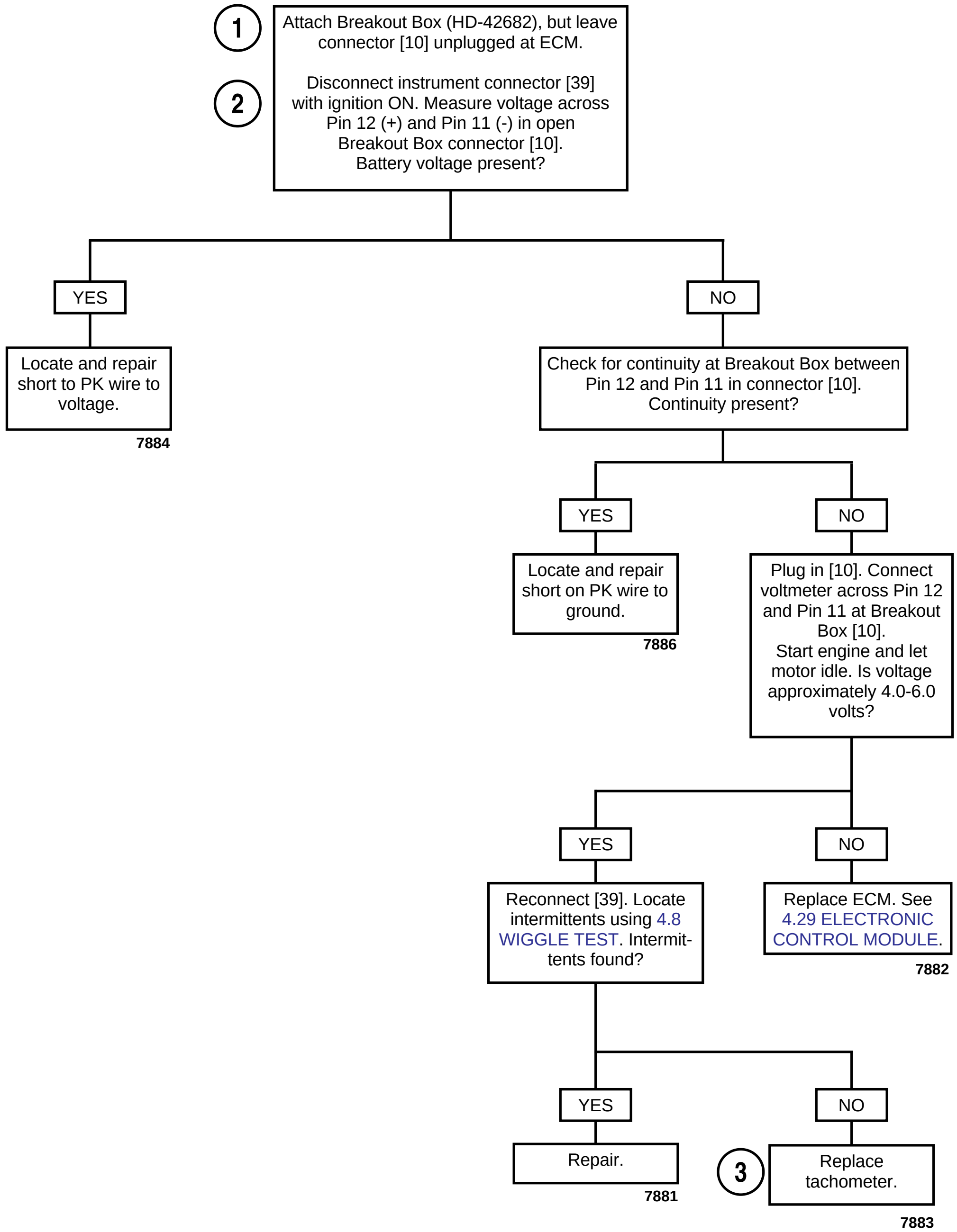


Figure 4-61. Tachometer Circuit

Table 4-24. Wire Harness Connectors in Figure 4-61.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[39]	Main Harness to Instruments	10-place Multilock	under fuel cell

Code 35 Test



Clear codes and confirm proper operation with no check engine lamp.

TROUBLE CODE 44 4.26

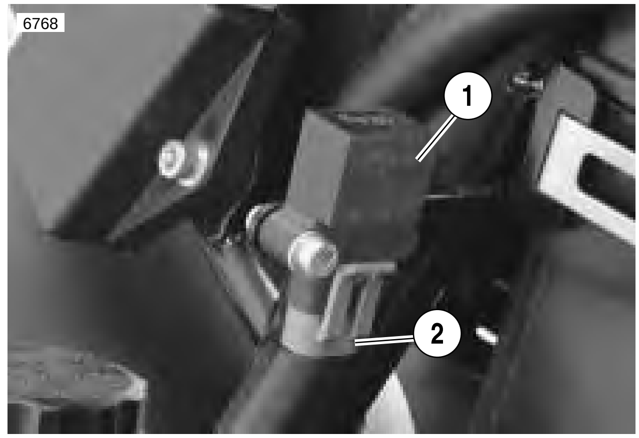
GENERAL

Bank Angle Sensor

See Figure 4-62. A Code 44 occurs when the bank angle sensor voltage is outside the normal operating range of 0.6-1.1 volts. This may be caused by:

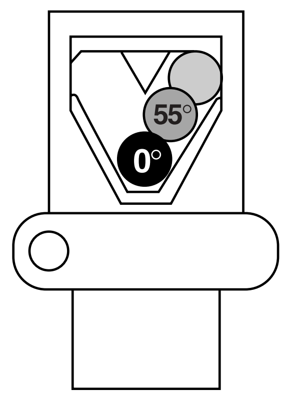
- Short to ground in harness between sensor and electronic control module.
- Short to voltage in harness between sensor and electronic control module.
- Failed sensor.

If this code occurs, the engine may stop running. The engine may still be restarted and ridden to the dealership for repair.



1. **Bank Angle Sensor**
2. **Bank Angle Sensor Connector [134]**

Figure 4-62. Bank Angle Sensor



When vehicle lean angle exceeds 55°, ECM shuts off ignition and fuel systems.

Figure 4-63. Normal Bank Angle Sensor Operation

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 4.7 BREAKOUT BOX.

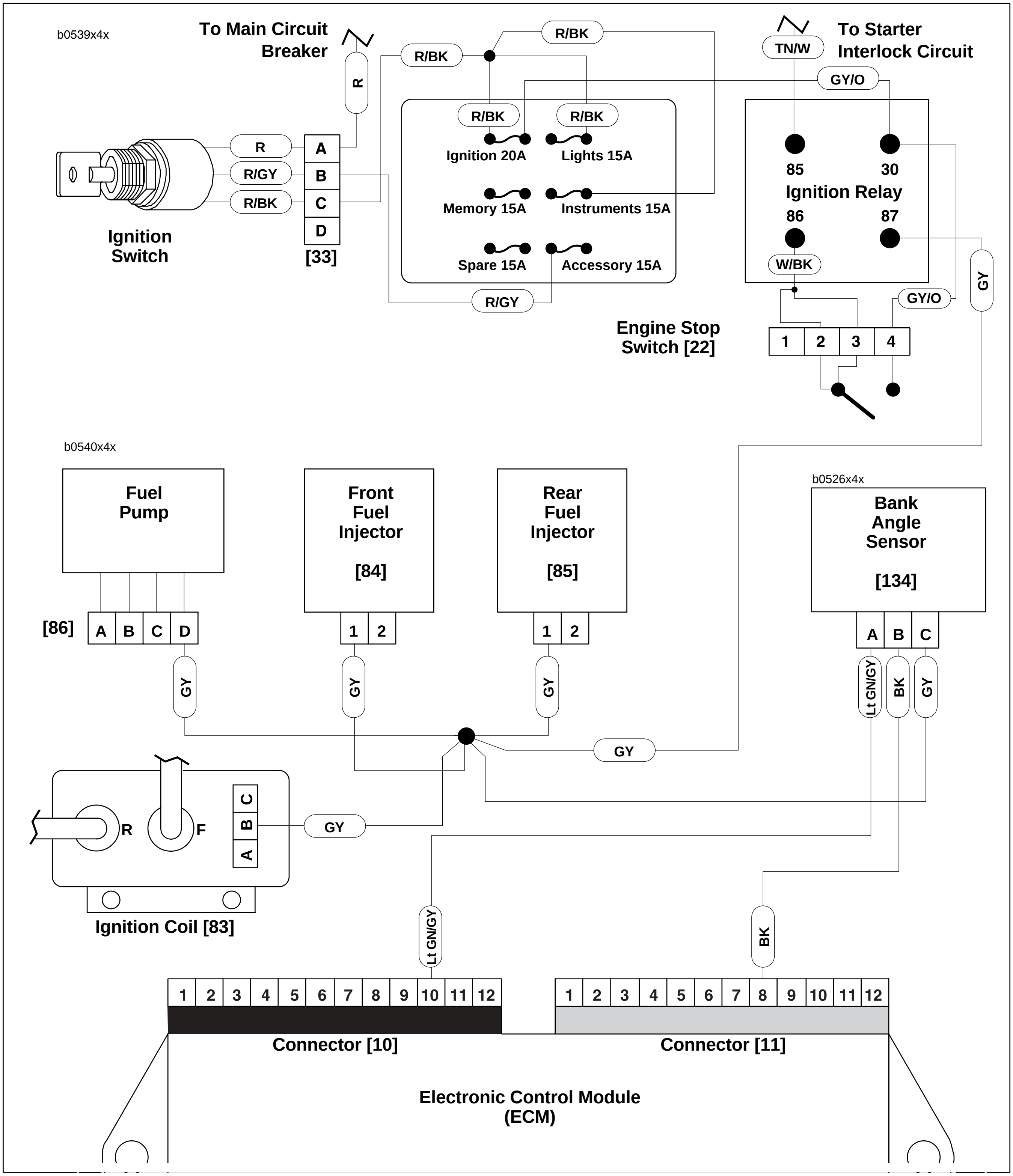


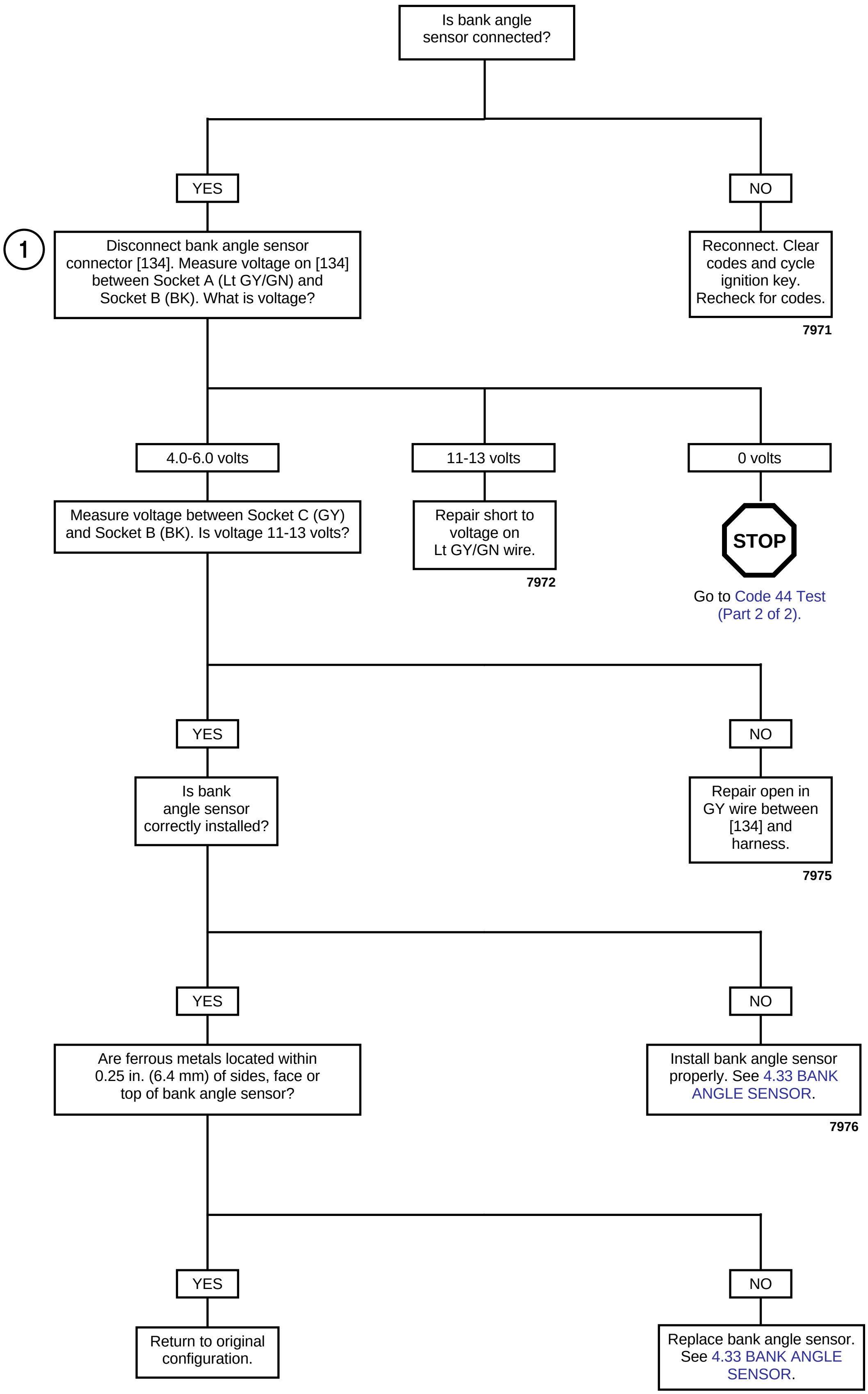
Figure 4-64. Bank Angle Sensor Circuit

Table 4-25. Wire Harness Connectors in Figure 4-64.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	ECM (black)	12-place Deutsch	under tail section
[134]	Bank Angle Sensor	3-place Packard	under tail section, right side

HOME

Code 44 Test (Part 1 of 2)



HOME

Code 44 Test (Part 2 of 2)

2

Continued from Code 44 Test (Part 1 of 2).

Disconnect connectors [10] (BK) and [11] (GY) from module and plug into Breakout Box (HD-42682). Check continuity between Socket A (Lt GN/GY) on connector [134] and Breakout Box (BK) Pin 10. Is continuity present?

- **YES:** Check continuity to ground for Socket B (BK) and connector [11] Pin 8. Is continuity present?
  - **YES:** Check continuity to ground for Socket A (Lt GN/GY) and connector [134]. Is continuity present?
    - **YES:** Repair short to ground on Lt GN/GY wire. 7973
    - **NO:** Replace ECM. See 4.29 ELECTRONIC CONTROL MODULE. Check for codes. 7974
  - **NO:** Repair open in ground wire. 7975
- **NO:** Repair open in Lt GN/GY wire. 7975

Clear codes and confirm proper operation with no check engine lamp.

TROUBLE CODES 52, 53, 54 AND 55 4.27

GENERAL

ECM Failure

All of the following codes indicate a failure which requires replacement of the ECM. See 4.29 ELECTRONIC CONTROL MODULE.

- Code 52 - RAM failure.
- Code 53 - ROM failure.
- Code 54 - EE PROM failure.
- Code 55 - Microprocessor failure.

NOTE

*Dealership technicians filing warranty claims should use job/time code **7913** for all Code 52, 53, 54 and 55 ECM replacements.*

TROUBLE CODE 56

GENERAL

Cam Sync Failure

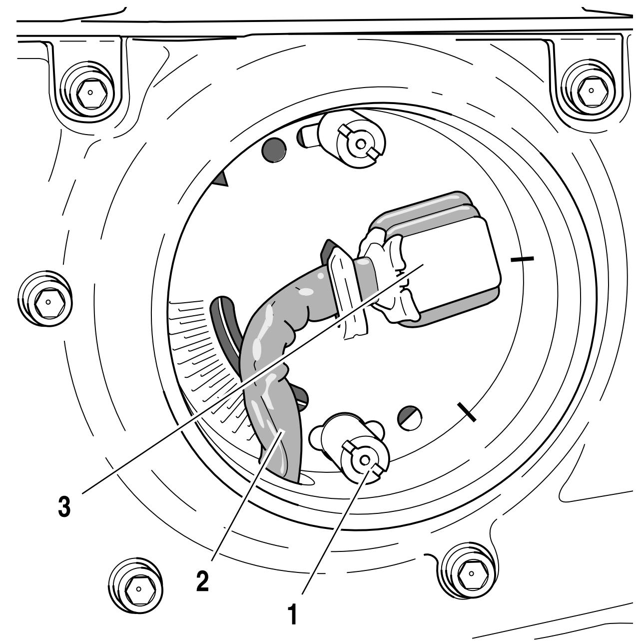
This code occurs only when the engine is running if the electronic control module either does not receive a signal from the cam position sensor or receives an unexpected signal. The motorcycle may continue to run, not run normally or stop running altogether.

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 4.7 BREAKOUT BOX.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probes and patch cord.
3. See 4.30 CAM POSITION SENSOR AND ROTOR.



1. **Timer Plate Stud (2)**
2. **Sensor Wiring**
3. **Cam Position Sensor**

b0313a7x

Figure 4-65. Cam Position Sensor

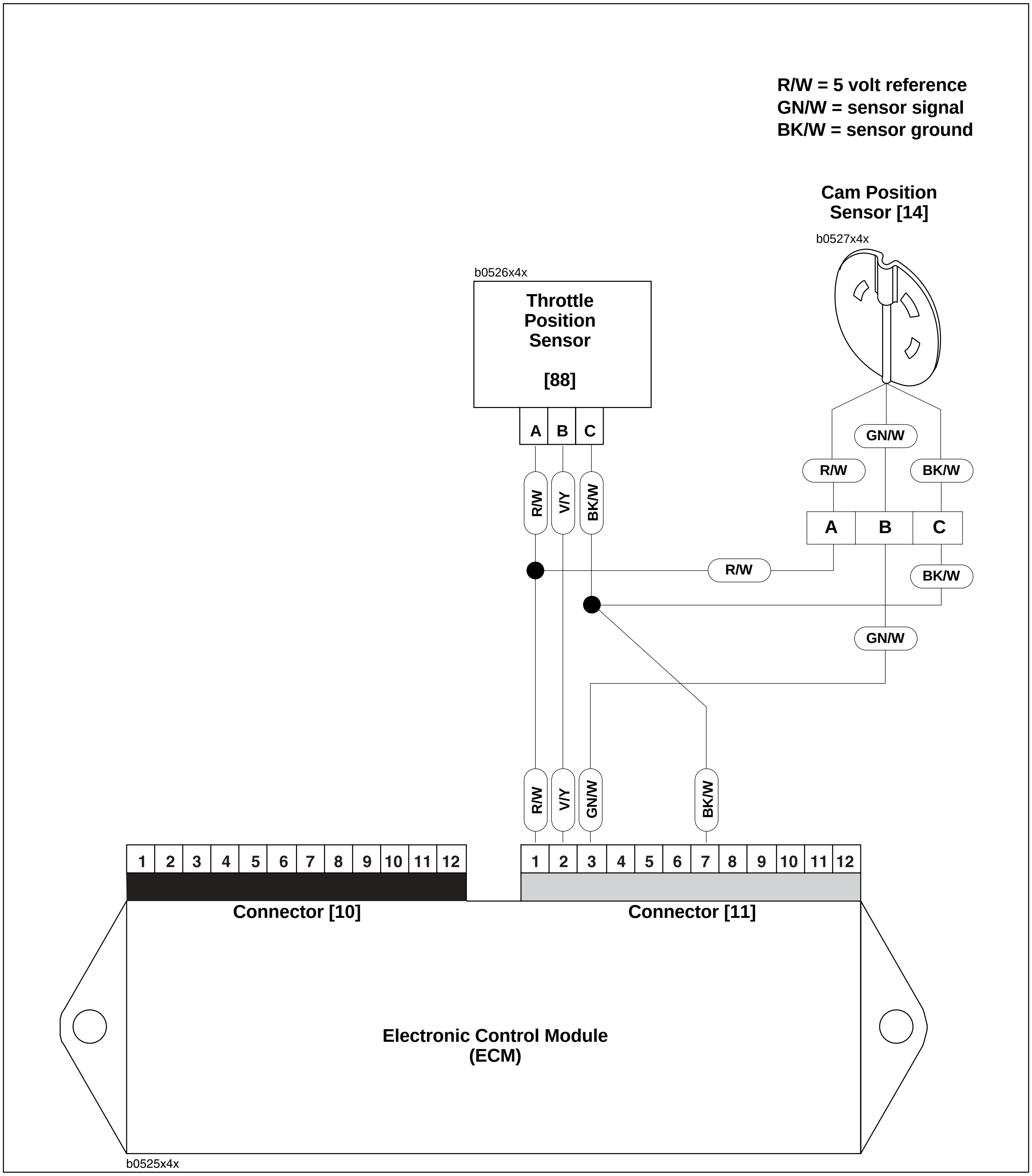
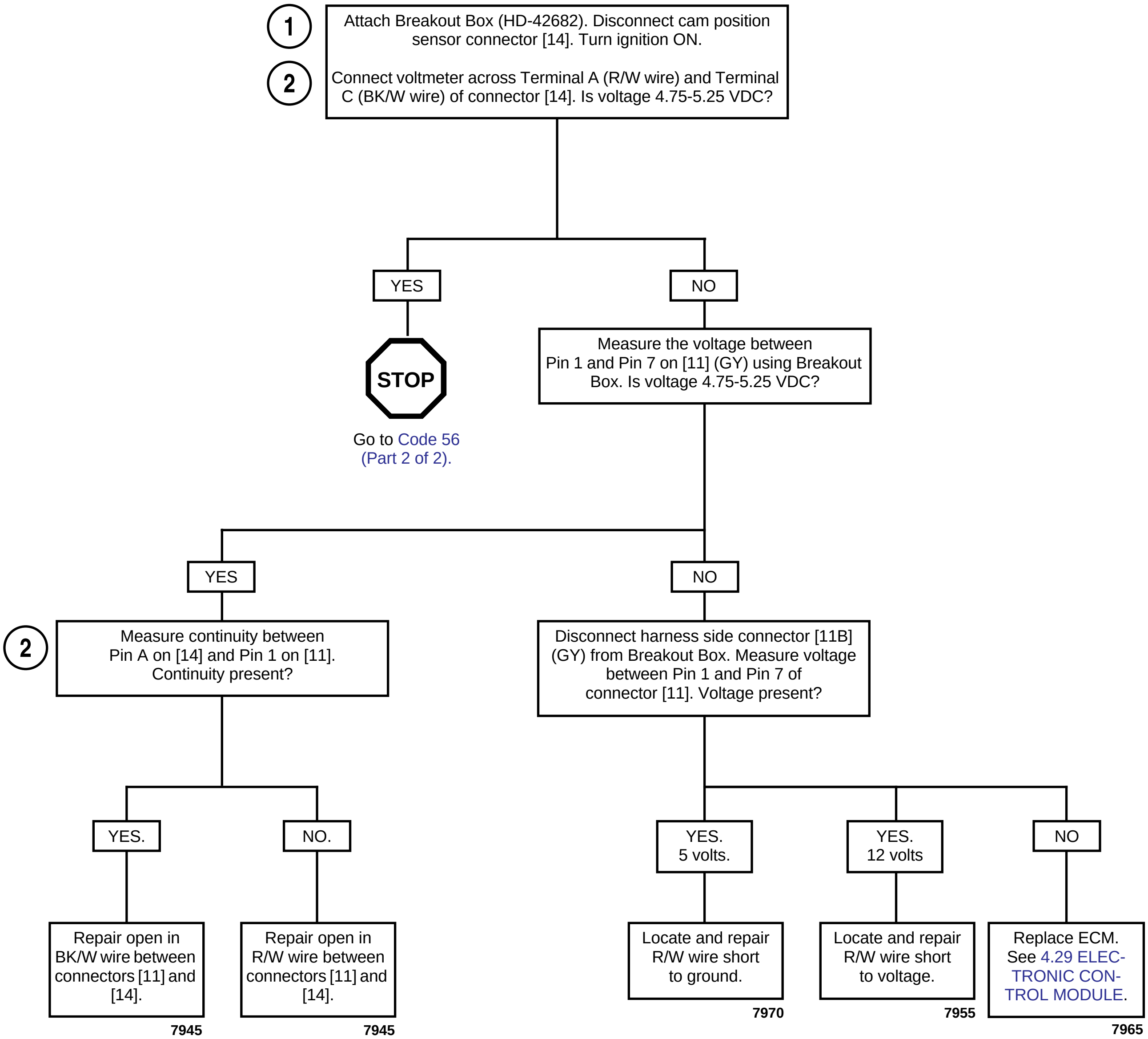


Figure 4-66. Cam Position Sensor Circuit

Table 4-26. Wire Harness Connectors in Figure 4-66.

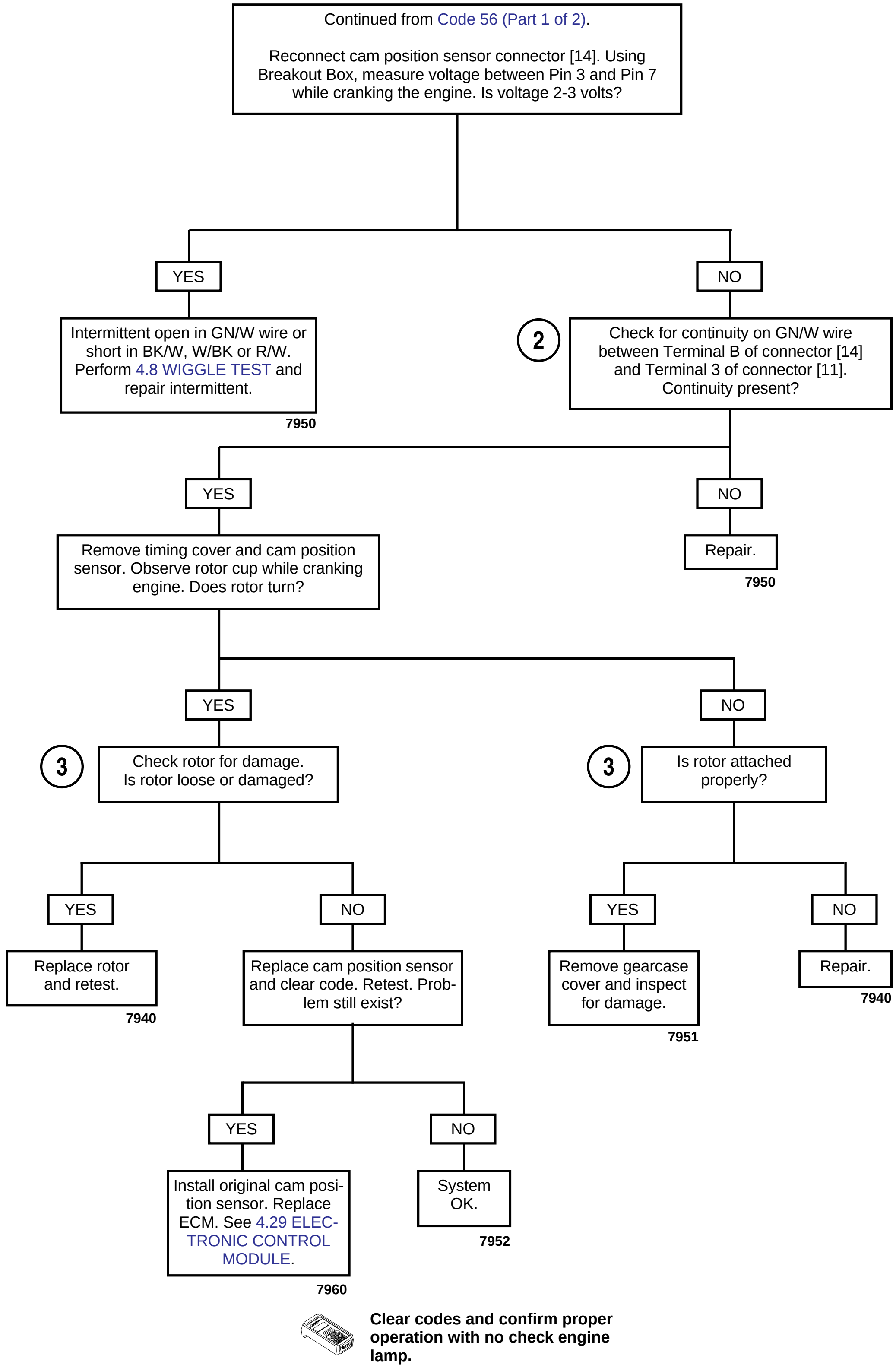
NO.	DESCRIPTION	TYPE	LOCATION
[11]	ECM (gray)	12-place Deutsch	under tail section
[14]	Cam Position Sensor	3-place Deutsch	near starter
[88]	TP Sensor	3-place Packard	behind air cleaner backplate

Code 56 (Part 1 of 2)



Clear codes and confirm proper operation with no check engine lamp.

Code 56 (Part 2 of 2)



ELECTRONIC CONTROL MODULE 4.29

REMOVAL

1. Remove seat and tail section. See 2.33 TAIL SECTION.
2. See Figure 4-67. Unplug ECM connectors [10] and [11].
3. Remove two screws and washers (3) to detach ECM from frame.

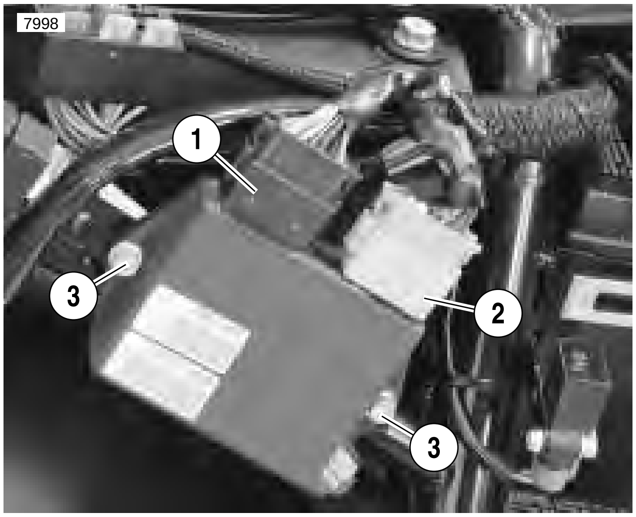
INSTALLATION

1. See Figure 4-67. Align ECM with frame mounting holes. Install using two screws and washers (3).
2. Attach ECM connectors [10] and [11].
3. If installing a **new** ECM, calibrate throttle position sensor using SCANALYZER (Part No. HD-41325). See 4.35 THROTTLE POSITION SENSOR.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

4. Install tail section and seat. See 2.33 TAIL SECTION.



1. **ECM Connector [10] (Black)**
2. **ECM Connector [11] (Gray)**
3. **Screw and Washer (2)**

Figure 4-67. Electronic Control Module (ECM)

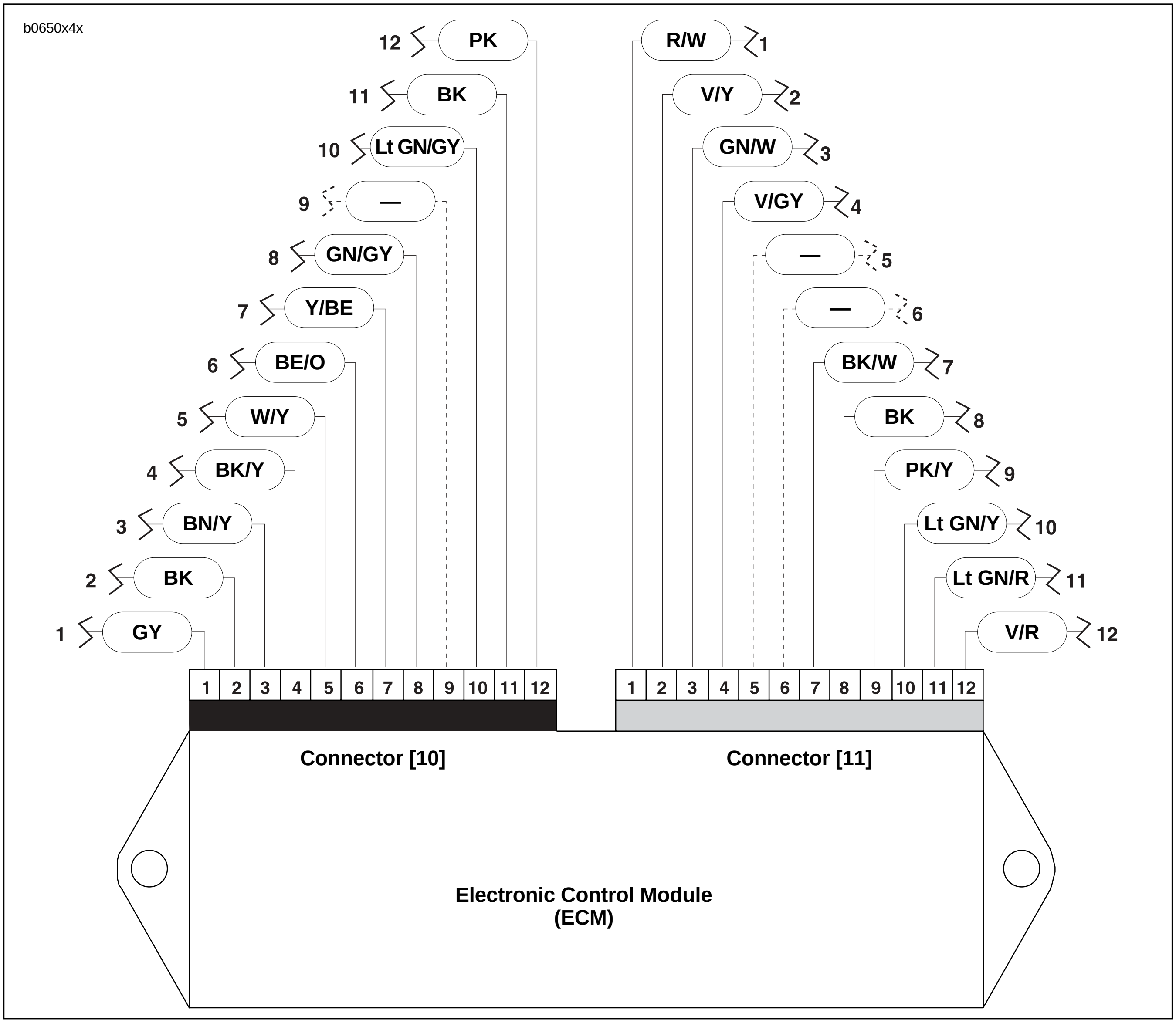


Figure 4-68. ECM Wiring

Table 4-27. Pin Table for ECM Connector [10] (Black)

PIN	FUNCTION
1	Switched ignition
2	System ground A (module)
3	Fuel pump output
4	Check engine lamp
5	Injector front output
6	Front coil primary
7	Rear coil primary
8	Injector rear output
9	No function
10	Bank angle sensor input
11	System ground B (coil)
12	Tachometer out

Table 4-28. 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	No function
6	No function
7	Sensor ground 1
8	Sensor ground 2
9	Engine temperature input
10	Intake air temperature input
11	Serial data receive
12	Serial data transmit

CAM POSITION SENSOR AND ROTOR 4.30

GENERAL

See Figure 4-70. The cam position sensor and trigger rotor are located in the gearcase cover on the right side of the vehicle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. The sensor wiring is connected to the ignition module wiring harness.

REMOVAL

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Remove right fairing lower. See 2.38 FAIRING LOWERS.
3. Remove sprocket cover. See 2.29 SPROCKET COVER.
4. Cut cable straps holding cam position sensor wiring at the following locations:
   a. Starter.
   b. Edge of gearcase cover.
   c. Oil line.
5. See Figure 4-69. Disconnect cam position sensor wiring at connector [14] located behind the starter motor.
6. See Figure 4-69. Note position of each cam position sensor wiring terminal in plug end of connector.
7. See Figure 4-70. Remove connector terminal pins. See Appendix B.
8. Remove timer cover.
   a. Drill off heads of outer timer cover pop rivets using a 3/8 in. (9.525 mm) drill bit.
   b. Tap remaining rivet shafts inboard through holes in timer cover and inner cover.
   c. Remove timer cover. Remove inner cover screws and inner cover.
   d. Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
9. See Figure 4-70. To obtain approximate ignition timing during installation, scribe alignment marks across cam position sensor in two places.
10. See Figure 4-70. Remove timer plate studs. Carefully remove cam position sensor. Remove bolt and trigger rotor.
11. Carefully remove camshaft oil seal if damaged or if there is any evidence of oil leakage past the seal.

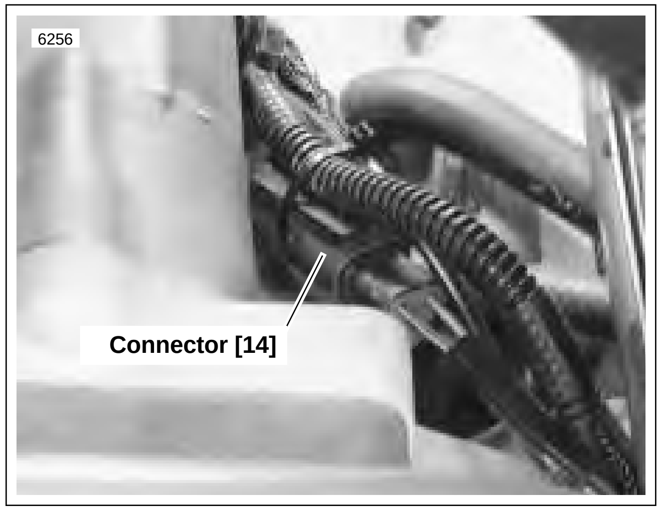


Figure 4-69. Cam Position Sensor Connector [14]

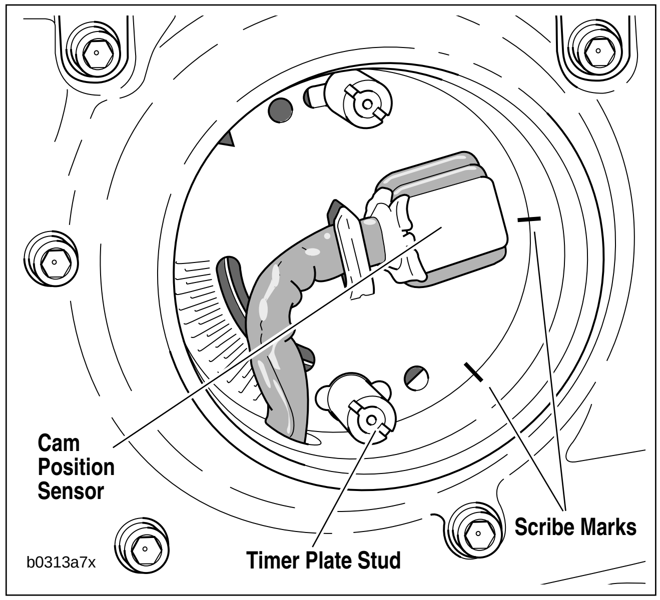


Figure 4-70. Marking Ignition Timing

INSTALLATION

1. See Figure 4-69. With the lipped side facing inboard, install **new** camshaft oil seal into gearcase cover, if removed. Press seal into position until flush with surface of timer bore.
2. Install trigger rotor.
   a. Apply LOCTITE THREADLOCKER 243 (blue) to threads of bolt.
   b. Position trigger rotor 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 and timer plate studs. Rotate cam position sensor to its previously marked position to obtain approximate ignition timing.

CAUTION

See Figure 4-71. Route sensor wires about 1-1/2 in. (38 mm) forward of secondary drive belt and sprocket. If wires are routed too far to the rear of this position, they could contact the moving secondary drive belt and/or sprocket resulting in damage to sensor wiring.

4. Route sensor wiring leads.
   a. Downward through hole (7 o'clock position) in timer bore of gearcase cover.
   b. Upward through bottom opening between right crankcase half and rear of gearcase cover.
   c. Route wiring in front of tower shaft behind gearcase cover. Route wires upward to starter motor.
   d. Cable strap wiring. See Step 4 of REMOVAL.
5. See Figure 4-72. 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 Appendix B.
6. See Figure 4-69. Attach connector [14].
7. Check ignition timing. See 1.19 IGNITION TIMING.
8. Tighten timer plate studs to 15-30 **in-lbs** (2-3 Nm).
9. Install inner cover using screws. Tighten to 12-20 **in-lbs** (1-2 Nm).

CAUTION

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 to inner cover using **new** rivets.
11. Install right fairing lower. See 2.38 FAIRING LOWERS.
12. Install negative battery cable to battery.

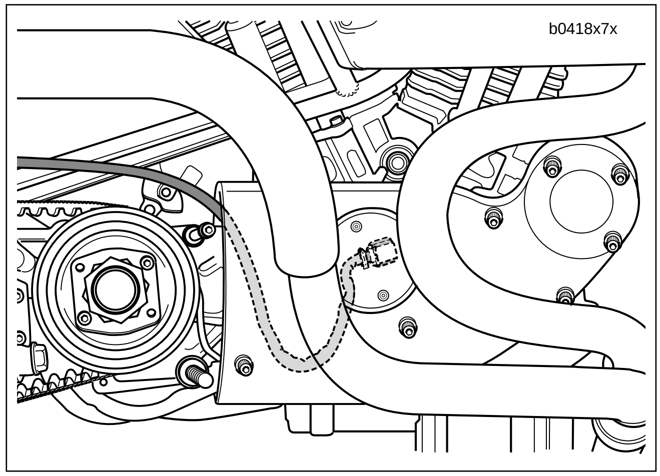


Figure 4-71. Routing Sensor Wires

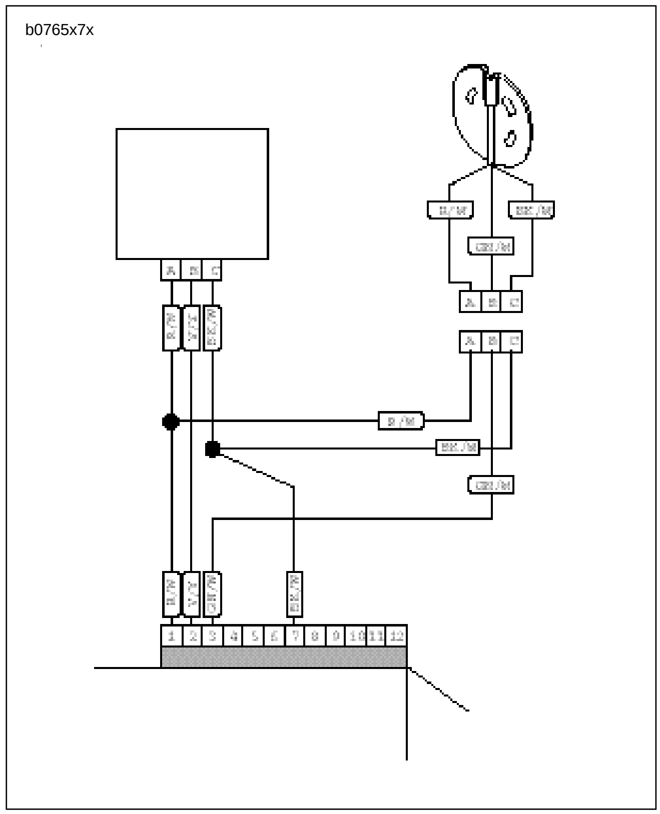


Figure 4-72. Connecting Sensor Wires

OXYGEN SENSOR 4.31

GENERAL

The oxygen sensor (O2 Sensor), located in the header pipe, monitors oxygen gas content in the exhaust 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

1. See Figure 4-73. Unplug 1-place connector [137] under battery tray.
2. Remove oxygen sensor from exhaust header using a 22 mm (or 7/8 in.) crow's foot or flare nut socket.

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 4-73. Thread sensor into exhaust header. Tighten to 42-45 ft-lbs (57-61 Nm).
3. Connect 1-place connector [137] to wiring harness.

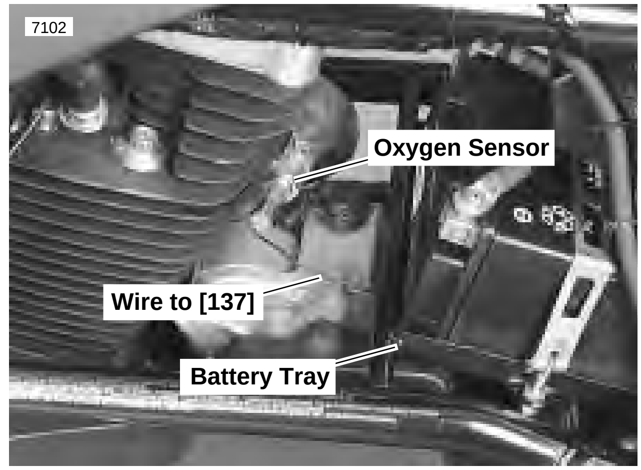


Figure 4-73. Installed Oxygen Sensor

ENGINE TEMPERATURE SENSOR 4.32

GENERAL

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 fuel tank. See 4.36 FUEL TANK

CAUTION

Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

2. See Figure 4-74. Unplug 1-place connector [90] above rear cylinder head.
3. Slide rubber boot up and remove sensor from rear cylinder head using ET Sensor Socket or equivalent.

INSTALLATION

CAUTION

Do not pull on engine temperature sensor wiring. Excess strain to sensor wiring will cause sensor damage.

1. See Figure 4-75. Screw sensor into rear cylinder head with special ET sensor socket. Make sure wire is in cut-out portion (slot) of socket to prevent damage. Tighten ET sensor to 10-14 ft-lbs (14-19 Nm).
2. Install rubber boot to ET Sensor wire (push wire through hole in boot) with smaller OD side towards sensor.
3. Push rubber boot down sensor wire towards cylinder head until it seats in hole on top of ET sensor.

NOTE

Orient the rubber boot so the flat on the boot is towards the left side of the motorcycle.

4. Route ET sensor wire lead through opening at rear of cylinder head, under rocker box and cover and connect ET sensor 1-place connector [90] to wiring harness.
5. Install fuel tank. See 4.36 FUEL TANK.

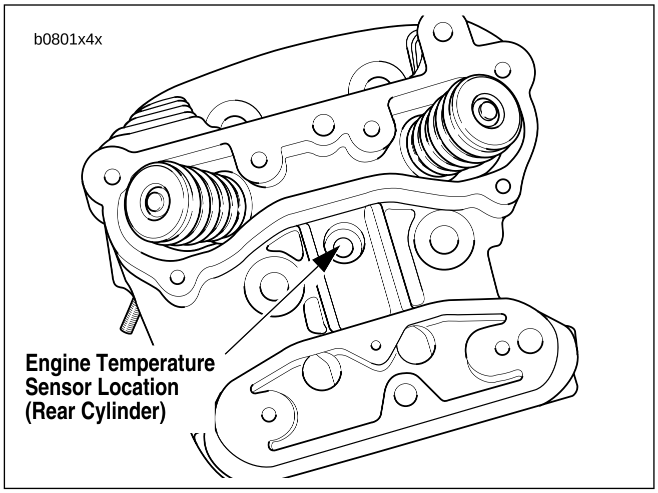


Figure 4-74. Engine Temperature Sensor Location

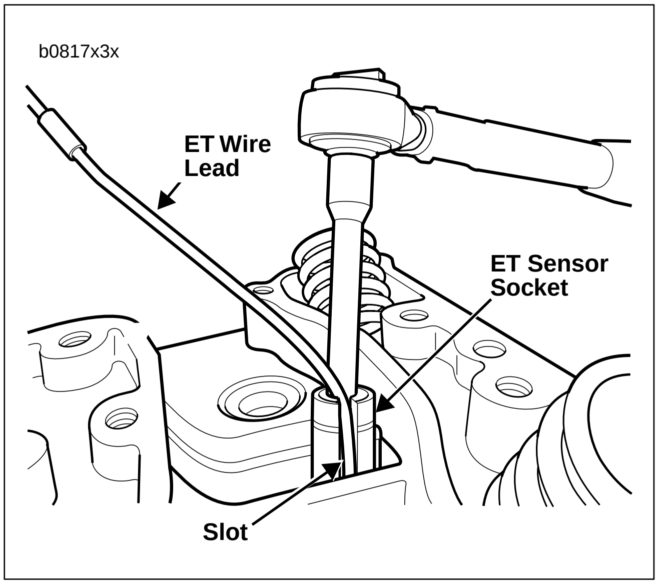
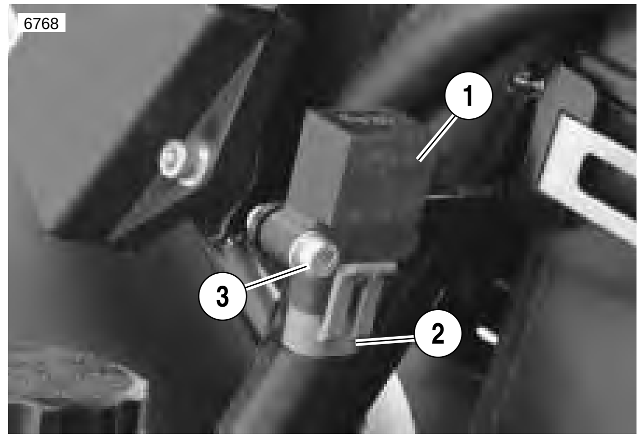


Figure 4-75. Engine Temperature Sensor Installation

BANK ANGLE SENSOR 4.33

REMOVAL

1. Remove seat and tail section. See 2.33 TAIL SECTION.
2. See Figure 4-76. Locate bank angle sensor (1) on right side between ECM and battery. Unplug sensor connector (2) [134].
3. Remove screw, washer and nut (3) to detach sensor from frame.



1. **Bank Angle Sensor**
2. **Bank Angle Sensor Connector [134]**
3. **Screw, Washer and Nut**

Figure 4-76. Bank Angle Sensor

INSTALLATION

1. See Figure 4-76. Plug connector (2) [134] into bank angle sensor.
2. Attach bank angle sensor to frame using screw, washer and nut (3). Make sure location post on sensor engages hole in mounting tab.
3. Tighten screw to 25-27 **in-lbs** (2.8-3.1 Nm).

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

4. Install tail section and seat. See 2.33 TAIL SECTION.

INTAKE AIR TEMPERATURE SENSOR 4.34

GENERAL

The intake air temperature sensor (IAT Sensor), located on top of the snorkel under the air cleaner cover, measures the air temperature allowing the ECM to calculate the density of the air entering the manifold.

REMOVAL

1. See Figure 4-108. Remove two screws (3) and washers (2) from front and one bolt (27) and washer (2) from back of air cleaner cover (1).
2. Remove air cleaner cover and air filter. See 4.41 AIR CLEANER.
3. Disconnect connector [89] from intake air temperature sensor.
4. Remove IAT sensor from top of snorkel.

INSPECTION

Inspect sensor grommet for damage and replace as required.

INSTALLATION

1. Install IAT sensor and grommet into snorkel.
2. Connect IAT sensor connector [89] to sensor.
3. Place a small piece of double sided tape at the upper-center of the air filter foam gasket that fits against the backing plate.
4. Position air filter on air cleaner backing plate.
5. Install air cleaner cover and air filter. See 4.41 AIR CLEANER.

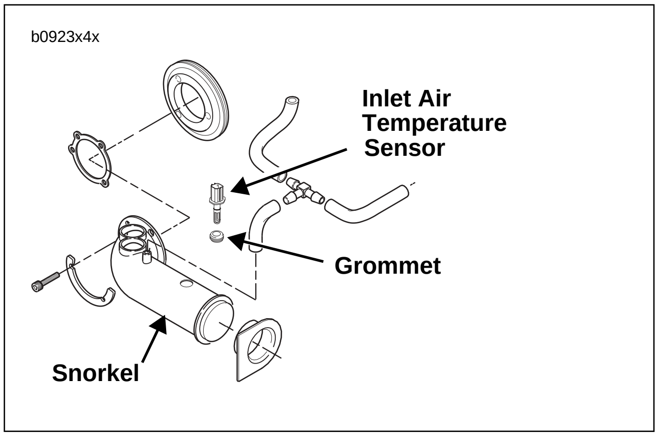


Figure 4-77. Intake Air Temperature Sensor

Figure 4-78. Intake Air Temperature Sensor Installed

THROTTLE POSITION SENSOR

REMOVAL

1. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER.
2. Remove throttle body from intake manifold. Note that it is not necessary to detach intake manifold from cylinder heads. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD.
3. See Figure 4-79. Remove two screws and washers (2) (metric) to detach TP sensor.

INSTALLATION

1. See Figure 4-79. Attach TP sensor with two screws and washers (2) (metric).
2. Install throttle body and throttle cables. See 4.40 THROTTLE BODY AND INTAKE MANIFOLD. Do not install air cleaner backplate at this time.
3. See Figure 4-80. Attach throttle position sensor connector [88]. Slots on female connector [88B] must fully engage tabs on male connector housing [88A].
4. Calibrate throttle position sensor using SCANALYZER (Part No. HD-41325). See CALIBRATION.

CALIBRATION

1. Back out idle cable until screw no longer touches the throttle plate stop. Back out idle adjuster cable one to two additional turns.
2. Open and **snap shut** throttle control grip 3-5 times.
3. Install air cleaner backplate and cover. See 4.41 AIR CLEANER.
4. Attach Scanalyzer (Part No. HD-41325) to data link [91A] with cable (Part No. HD-42921). See 4.5 SCANALYZER.
5. Turn the ignition/light key switch to IGNITION. Turn the handlebar mounted Engine Stop Switch to the RUN position (but do not start the engine).
6. Calibrate TP sensor using Scanalyzer (Part No. HD-41325).
   a. From Diagnostic Menu, press "7" to display Calibration Menu.
   b. Press "1" to activate TPS Zero Function.
   c. Press "Enter" to verify throttle plate is fully closed. Scanalyzer will then calibrate sensor.
7. Set idle speed.
   a. Press the mode key to return to Options Data Screen. Scroll to TP degrees. Turn idle adjuster cable clockwise until TP degree reading reaches 5.8.
   b. Start engine and bring the engine temperature to a minimum of 265° F (129.4° C).
   c. Set the warm idle speed at 1000-1100 rpm with the idle adjuster cable.

NOTE

Cold idle start quality is affected by the warm idle setting. The higher the RPM range that the warm idle is set to, the better the cold start idle quality will be. High RPM warm idle speed will also result in cleaner unassisted (not having to roll on the throttle) cold starts. Do not set the warm idle speed above 1100 RPM.

TP sensor voltage at hot idle will vary according to position of idle set screw.

8. Disconnect the Scanalyzer and turn the Ignition/Light Key Switch to OFF or LOCK. Turn the handlebar mounted Engine Stop Switch to the OFF position.
9. Disconnect Scanalyzer from motorcycle.

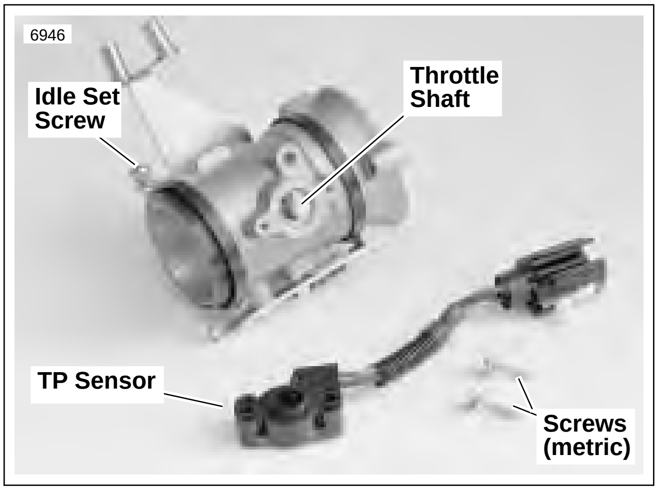


Figure 4-79. Throttle Position Sensor

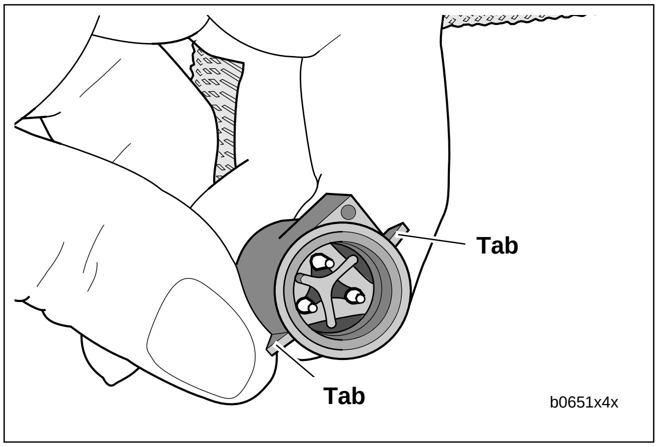


Figure 4-80. Tabs on TP Sensor Connector [88A]

REMOVAL

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before attaching fuel pressure gauge. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-81. Disconnect the 4-place fuel pump connector [86]. Connector is on the left side, above the rear cylinder spark plug.
   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.
2. See Figure 4-82. Remove seat. Remove bolt, mounting plates and retention plates from rear tank mount. See 2.35 SEAT.
3. Prop fuel tank against frame to gain access to fuel supply fitting. Wrap a shop towel around the fuel supply fitting.

WARNING

A small amount of gasoline will drain from the fuel supply fitting and fuel line when removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

4. Remove fuel line from fuel supply fitting.
5. See Figure 4-83. Cut cable tie and disconnect hose from vent valve assembly.

CAUTION

Use caution when removing fuel tank. If tank should contact other chassis parts, tank finish may be damaged.

6. Remove fuel tank from frame.

Figure 4-81. Fuel Pump Connector [86]

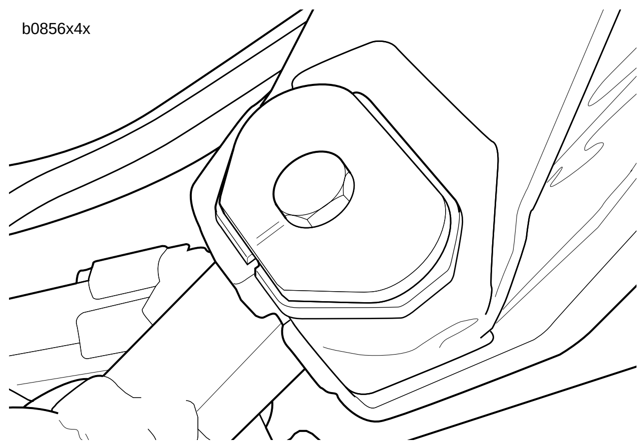


Figure 4-82. Fuel Tank Mount

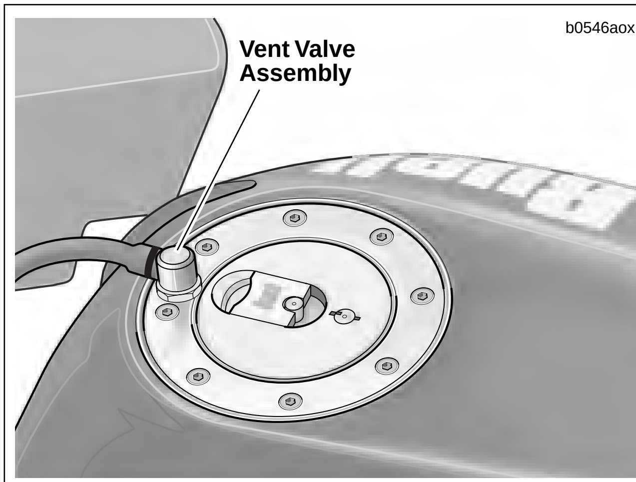


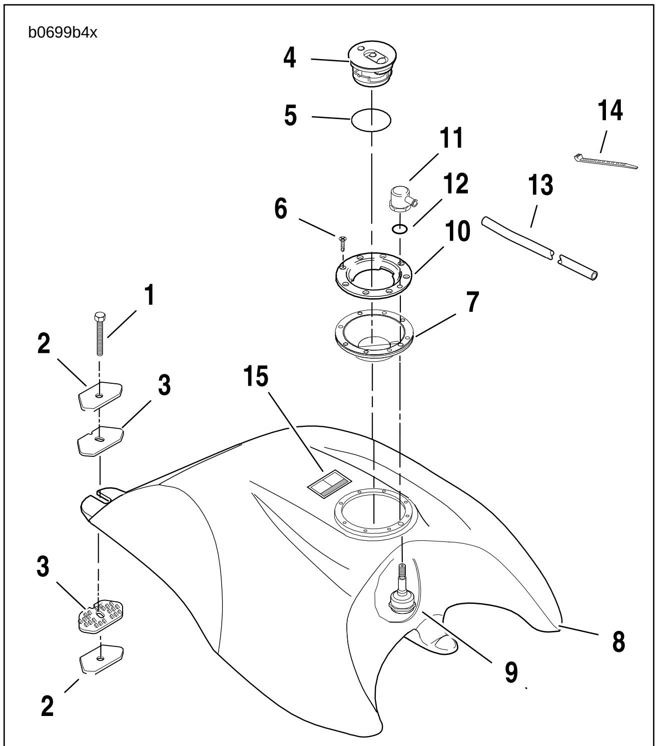
Figure 4-83. Vapor Vent Valve

DISASSEMBLY/ASSEMBLY

WARNING

An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Drain fuel tank before disassembly.
   a. Using suitable external fuel pump, such as a Gas Caddy, pump fuel from tank and into suitable clean container.
   b. See instructions for external fuel pump for correct use.
2. See Figure 4-84. Remove fuel filler cap (4) with attached O-ring (5).
3. Remove screws (6) from fuel cap flange (10).
4. Remove fuel cap flange and fuel cap boot (7).
5. Detach vent valve fitting (11) and vent valve (9) from fuel cap flange.
6. For all fuel pump removal and repair instructions, see 4.39 FUEL PUMP.
7. Assemble in reverse order. Note that if fuel pump is removed, it must be reinstalled before fuel cap flange.
   a. Apply HYLOMAR to fuel cap boot, fuel cap flange and top of fuel tank.
   b. See Figure 4-85. Tighten screws to 22-25 **in-lbs** (2.5-2.8 Nm) in the order shown.
8. Install vent valve. See 4.37 FUEL TANK VENT VALVE.
9. Perform Fuel Tank Pressure Test.



1.	**Bolt**	8.	**Fuel Tank**
2.	**Mounting Plate (2)**	9.	**Vent Valve**
3.	**Retention Plate (2)**	10.	**Fuel Cap Flange**
4.	**Fuel Cap**	11.	**Vent Valve Fitting**
5.	**O-Ring**	12.	**O-Ring**
6.	**Screw (8)**	13.	**Vent Hose**
7.	**Fuel Cap Boot**	14.	**Cable Strap**
		15.	**Decal**

Figure 4-84. Fuel Tank

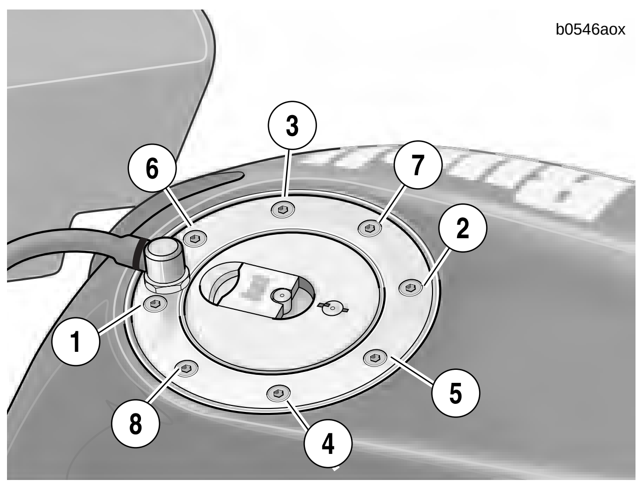


Figure 4-85. Tightening Sequence

CLEANING AND INSPECTION

WARNING

An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

Clean tank interior with commercial cleaning solvent or a soap and water solution.

1. Plug all tank openings except fuel cap hole.
2. Add cleaning agent. Replace fuel cap to seal tank.
3. Shake tank to agitate agent.
4. Thoroughly flush fuel tank after cleaning. Allow tank to air dry.
5. Carefully inspect fuel hose and vent hose for damage, wear or general deterioration. Replace as necessary.

INSTALLATION

NOTE

The retention plates have decals on them showing the position and direction that they are to be mounted. Also, they have a V-shaped notch on the shorter straight side which must face to the rear of the vehicle.

IMPORTANT NOTE

It is important that the prongs on the retention plate face toward the rear of the vehicle and be in direct contact with the fuel tank. All vehicles require two retention plates, one above and one below the fuel tank.

1. See Figure 4-84. Carefully raise the back of the fuel tank and place a mounting plate and a retention plate in position on the frame. Make sure shorter straight side of both retention plate and mounting plate face to rear of vehicle.
2. Carefully place the fuel tank onto the lower retention plate.

NOTE

For motorcycles having a tank mask and/or tank bag as an accessory, be sure to secure mask/bag so that it is between the top retention plate and the mounting plate. The retention plate teeth must be in direct contact with the fuel tank.

3. Place the remaining retention plate and mounting plate in position on top of the fuel tank rear mounting projections. Make sure shorter straight side of both retention plate and mounting plate face to rear of vehicle.
4. See Figure 4-84. Install mounting bolt and tighten to 18-23 ft- lbs. (24-31 Nm).
5. Wait five minutes and tighten bolt again to 18-23 ft-lbs (24-31 Nm).

CAUTION

Avoid pinching wiring harness and vent hose between fuel tank and frame during tank installation. Pinched hoses will negatively affect vehicle operation.

6. See Figure 4-84. Connect vent hose (13) to vent valve fitting (11). Clamp hose to fitting with a **new** cable strap (14).
7. Connect fuel hose to fuel outlet with a **new** clamp.
8. Attach 4-place fuel pump connector [86].

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

9. Install seat. See 2.35 SEAT

NOTE

Use a good quality unleaded gasoline (91 pump octane or higher). Octane rating is usually found on the pump.

10. Fill fuel tank. Turn ignition key ON and listen for fuel pump activation.
11. Carefully inspect for leaks. Perform fuel pressure test if necessary.

FUEL TANK PRESSURE TEST

The fuel tank is a sealed, pressure-tested assembly when it leaves the factory. If the fuel cap flange seal is broken the fuel tank must be pressure tested as listed below before installation.

1. With fuel filter removed, gas cap installed and fuel vent valve installed, spray soap and water solution around fuel cap flange and fuel vent valve fitting.
2. Connect air hose to fuel vent valve. Shake the tank several times to seat the ball in the vent valve.

NOTE

Fuel tank must be pressurized slowly or fuel vent will snap shut and tank will not be pressurized. Slowly remove the fuel cap when complete to verify that tank was pressurized during test.

3. *Slowly* pressurize fuel tank to 3.3-4.3 psi (22.8-29.7 kPa). Check for air bubbles around fuel cap and flange.
4. Spray soap and water solution around two fittings on bottom of fuel tank. Check for air bubbles around two fittings.
5. Remove fuel cap from tank to make sure tank was pressurized.
6. Clean soap and water solution from fuel tank.
7. If bubbles were seen around fuel cap or flange, rework gas cap or fuel tank and retest until no bubbles are present when fuel tank is pressurized. If bubbles were seen around fittings on bottom of fuel tank, tighten fittings to specification. Reinstall fuel pump with new seals if required. See 4.39 FUEL PUMP.

FUEL TANK VENT VALVE

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 unusual angle.

NOTE

The aids used for installing the fuel tank vent valve are available in the Fuel Tank Vent Tool Kit (Part No. 91432-96Y) *which consists of the* Fuel Tank Vent Valve Installation Aid *and the* Fuel Tank Vent Valve Fitting Socket*.*

REMOVAL

NOTE

The fuel tank must be drained to perform this service. The fuel tank does not need to be removed.

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.

⚠WARNING

An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

2. Remove gas cap.
3. Relieve pressure from fuel system. Drain fuel tank.
   a. Using suitable external fuel pump, such as a Gas Caddy, pump fuel from tank and into suitable clean container.
   b. See instructions for external fuel pump for correct use.
4. See Figure 4-84. Cut cable tie holding vent hose to fitting and remove vent hose from fuel tank.
5. While holding vent valve with angled needle nose pliers, remove fitting from vent valve.
6. Pull the vent valve from the gasket and remove from fuel tank.

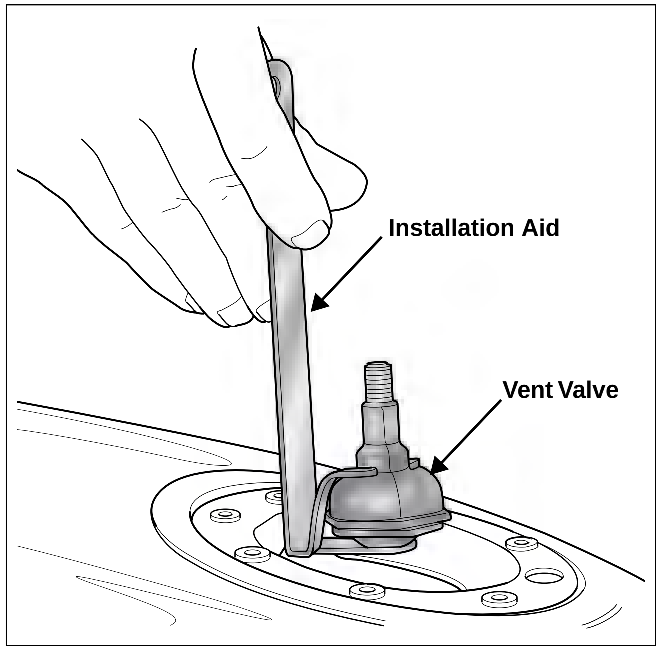


Figure 4-86. Installing Fuel Tank Vent

INSTALLATION

1. Wipe inside and outside vent valve mounting hole to make sure there is no gasoline or excess Hylomar sealant present.
2. See Figure 4-86. Using the fuel vent valve installation aid, lower the fuel tank vent valve into the fuel tank through the fuel filler neck.
3. Position the fuel tank vent valve so the threaded portion at the top protrudes from the fuel vent opening on the fuel cap flange. Verify hole on top of vent valve is not blocked by Hylomar sealant and that vent protrudes completely from hole.

NOTE

The fuel vent fitting is installed dry. Do NOT use teflon tape or loctite products when installing vent fitting.

4. See Figure 4-84. Install **new** O-ring in groove on bottom of **new** fitting.
5. While holding vent valve with fuel vent valve installation aid, install fitting and O-ring to threaded portion of vent valve. Do not tighten. Remove fuel vent valve installation aid.

NOTE

It may take a few tries and slight rotation of the vent valve to get the alignment mentioned in Step 6.

6. See Figure 4-87. Align fitting so right front point of hex is oriented to 12:00 position when fitting is tightened finger tight. Make sure O-ring remains in groove of fitting while tightening.

CAUTION

Do not overtighten vent fitting or attempt to tighten with standard "click-type" torque wrench. Overtightening vent will cause it to snap off and fall into fuel tank, requiring fuel tank removal.

7. Using a dial-type torque wrench and the Fuel Tank Vent Valve Fitting Socket, tighten vent fitting to 40-60 **in-lbs**. (5-7 Nm) until top fitting nozzle points to 12:00 position.

NOTE

If fitting nozzle does not point to 12:00 position when tightening within specified torque range, loosen fitting, rotate vent valve and try again. Repeat as required to get proper alignment of nozzle within specified torque range.

8. See Figure 4-84. Attach vent hose to nozzle on fitting with **new** cable tie.
9. Fill fuel tank with proper fuel (91 Octane) and install gas cap.
10. Connect negative battery cable. Tighten to 40 **in-lbs** (4.5 Nm).
11. Pressurize fuel system.
12. Check for leaks.

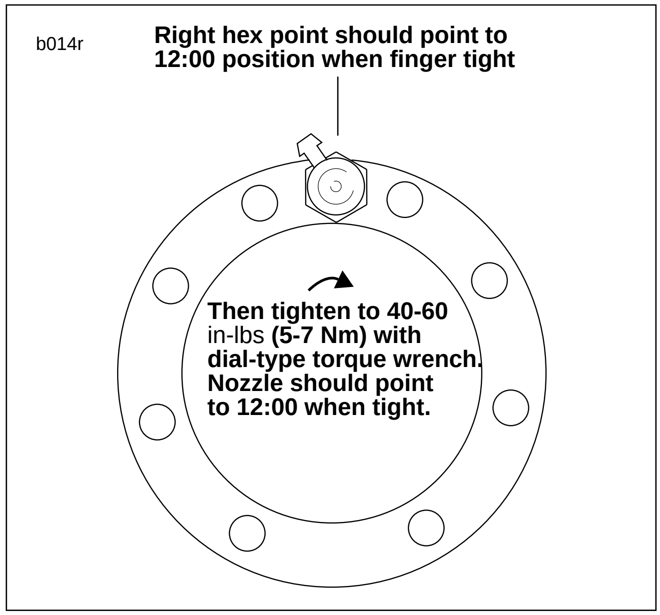


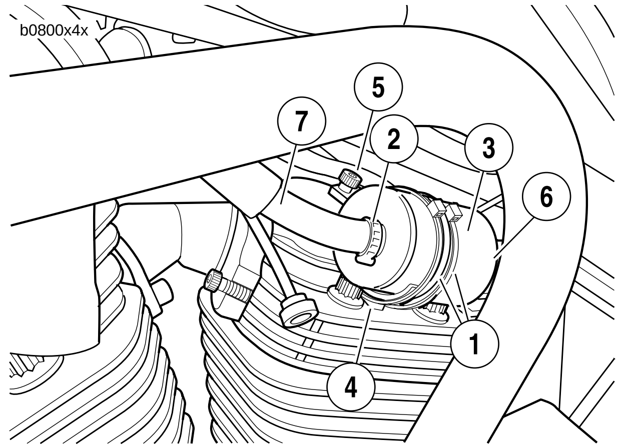
Figure 4-87. Fuel Tank Vent Alignment

INLINE FUEL FILTER 4.38

GENERAL

See Figure 4-88. There is a replaceable inline fuel filter between the fuel pump outlet at the fuel tank and the fuel rail assembly.

Replace this (metal) filter every 25,000 miles (40,000 km).



1. **Cable Ties (2)**
2. **Hose Clamps (2)**
3. **Fuel Filter**
4. **Bracket**
5. **Bolt**
6. **From Fuel Tank**
7. **To Fuel Rail Assembly**

Figure 4-88. Inline Fuel Filter

REMOVAL/INSTALLATION

⚠WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.
2. See Figure 4-88. Cut two cable ties that secure fuel filter to bracket.
3. Wrap a shop towel around the fuel filter.

⚠WARNING

A small amount of gasoline will drain from the fuel line when the filter is removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

4. See Figure 4-88. Remove hose clamps from both sides to detach filter.
5. Position **new** filter in bracket with arrow pointing in direction of fuel flow. Install two cable ties around filter and bracket. NOTE: If bracket was removed for any reason, tighten bolt to 30-33 ft-lbs (41-45 Nm).

⚠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.

6. Install **new** filter with two **new** hose clamps. Arrow on filter must be pointing in direction of fuel flow. Make sure to push fuel hoses all the way on to fittings and position hose clamp on fitting side of barb.
7. Install fuel tank. See 4.36 FUEL TANK.
8. Pressurize fuel system and check for leaks.

FUEL PUMP

REMOVAL

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.

WARNING

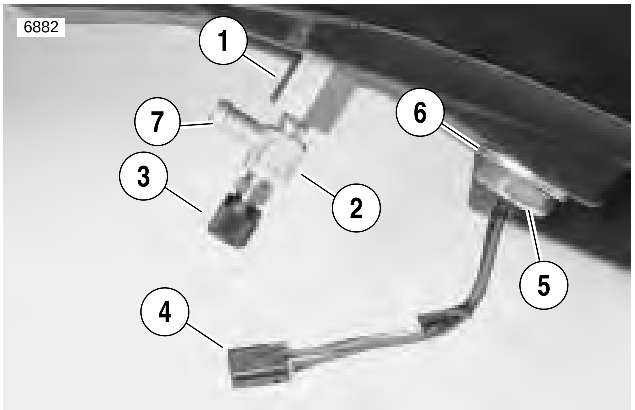
An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

2. Drain fuel from tank.
   a. Using suitable external fuel pump, such as a Gas Caddy, pump fuel from tank and into suitable clean container.
   b. See instructions for external fuel pump for correct use.
3. Remove fuel filler cap flange assembly. See 4.36 FUEL TANK.
4. See Figure 4-89. Remove fuel fitting nut (1).
5. Remove electrical fitting nut (5), washer, sealing washer and rubber seal (6).
6. Push electrical and fuel fitting studs back into tank.
7. Reach inside fuel filler cap hole and remove pump assembly.

REPAIR

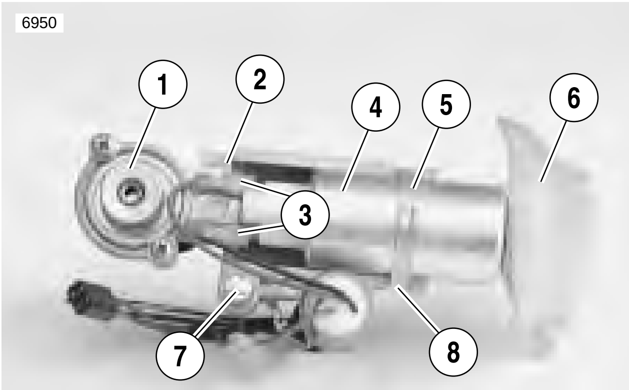
Fuel Pump Replacement

1. Remove fuel pump assembly from tank.
2. See Figure 4-90. Remove retaining clamp (5) from pump body (4) using a pair of cutters.
3. Pull pump outlet fitting from pump holder housing (2). Detach electrical wires (3) and discard old pump.
4. Place **new** rubber sleeve on **new** pump's outlet fitting.
5. Attach both electrical connectors (3) to **new** pump. Note that connectors are two different sizes.
6. Press pump fitting outlet into pump holder housing (2).
7. Place a **new** retaining clamp (5) over pump body. Position clamp inside groove (8) on pump holder housing.



1. **Fuel Fitting Nut**
2. **Fuel Outlet with attached Schraeder Valve**
3. **Protective Cap**
4. **Fuel Pump Connector [86]**
5. **Electrical Fitting Nut**
6. **Electrical Fitting Washer, Sealing Washer and Rubber Seal**
7. **Barb (on Fitting)**

Figure 4-89. Fuel Pump Within Tank



1. **Pressure Regulator**
2. **Pump Holder Housing**
3. **Pump Wiring (2 connectors, 2 sizes)**
4. **Pump Body**
5. **Retaining Clamp**
6. **Filter**
7. **Low Fuel Level Sensor**
8. **Groove**

Figure 4-90. Fuel Pump Assembly

Table 4-29. Fuel Pump Assembly Specifications

SPECIFICATION	DATA
Pressure Setting	49 PSI
Operating Voltage	14 volts
Fuel Delivery	70 LPH @ 49 PSI
Current Draw	3 amps

8. Tighten clamp around pump.
9. Press **new** filter (6) onto pump being careful not to damage the pump assembly.
10. Install pump assembly inside fuel tank.

Fuel Pressure Regulator Replacement

1. Remove fuel pump assembly from tank.
2. See Figure 4-91. Remove two screws and washers holding fuel pressure regulator in place. Detach regulator from pump housing.
3. Remove and discard O-rings from pump holder housing.
4. Install **new** O-rings in pump holder housing. Press **new** regulator into place.
5. Install screws and washers. Tighten to 15-20 **in-lbs** (1.7-2.3 Nm).
6. Install pump assembly inside fuel tank.

Low Fuel Level Sensor Replacement

1. Remove fuel pump assembly from tank.
2. See Figure 4-92. Pull apart the wire connect.
3. Remove screw holding low fuel level sensor in place. Remove sensor from housing.
4. Install **new** sensor. Secure ground wire terminal under screw. Tighten to 16-20 **in-lbs** (1.8-2.3 Nm).
5. Attach wire connect.
6. Install pump assembly inside fuel tank.

INSTALLATION

1. See Figure 4-93. Check rubber seals on electrical and fuel outlet studs that go through tank.
2. Pump may be placed inside fuel tank by hand. Bending a 90 degree twist in the pump wiring will simplify locating the fuel and electrical outlet holes. However, if problems occur during installation:
   a. Obtain a stiff piece of wire approximately 24 in. (61 cm) long.
   b. Attach pump electrical connector to wire.
   c. Feed wire into tank through fuel filler cap hole and out through electrical fitting hole (smaller hole) in bottom of tank. Gently pull on wire to seat pump.
3. Install pump assembly inside tank through fuel filler cap hole. Position pump assembly with filter facing motorcycle license plate. When properly aligned, press both studs through the holes in the bottom of tank.
4. Install **new** O-ring on brass adaptor nut (for fuel stud).
5. Install rubber seal, sealing washer and washer on electrical outlet stud.

⚠WARNING

Do NOT overtighten fuel fitting nuts. Overtightening fasteners may result in excessive compression of rubber sealing washers and fuel leakage which could result in death or serious injury.

6. Apply two drops of LOCTITE THREADLOCKER 243 (blue) to middle threads of the fuel and electrical outlet studs. Use care to avoid getting threadlocker on the fuel tank. Install nuts on studs.
7. Using a crow's-foot attachment installed at a 90° angle to body of torque wrench, torque both nuts to 68-75 **in-lbs** (8-9 Nm).
8. Install fuel filler cap flange assembly. See 4.36 FUEL TANK.
9. Install fuel tank. See 4.36 FUEL TANK.

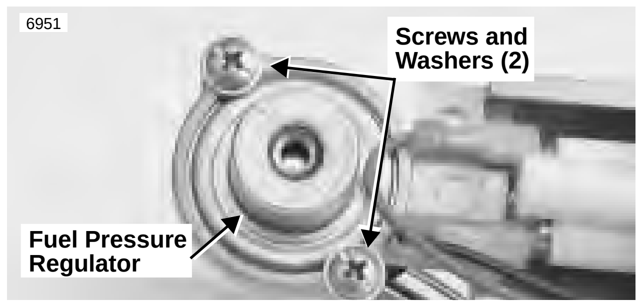


Figure 4-91. Fuel Pressure Regulator

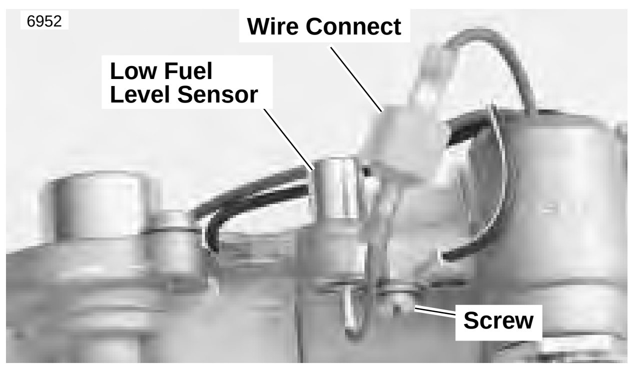


Figure 4-92. Low Fuel Level Sensor

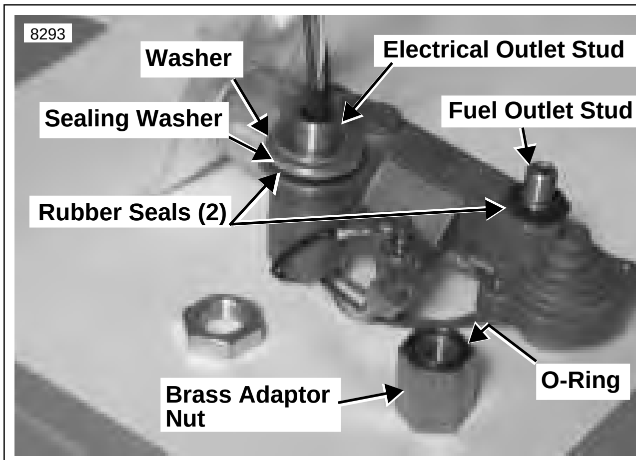


Figure 4-93. Rubber Seals and Washers

THROTTLE BODY AND INTAKE MANIFOLD 4.40

GENERAL

See Figure 4-94. The throttle body and intake manifold consist of the following components:

- Fuel injectors (front and rear).
- Fuel supply fitting.
- Idle speed adjustment screw.
- Cable bracket.
- Throttle position sensor.
- Throttle lever.

REMOVAL

⚠WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

1. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.
2. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER.
3. See Figure 4-94. On California models, pull EVAP hose from fitting (3).

1. Air Intake
2. Seal Ring (2)
3. EVAP Fitting
4. Rail and Screws (2) (metric)
5. Throttle Body
6. Throttle Position Sensor
7. Injector Clip (2)
8. Fuel Rail Assembly
9. Screw (metric)
10. Injector Seals (4)
11. Injector (2)
12. Intake Manifold
13. Screw (4)
14. Intake Flange (2, Front and Rear)
15. Intake Seal (2)

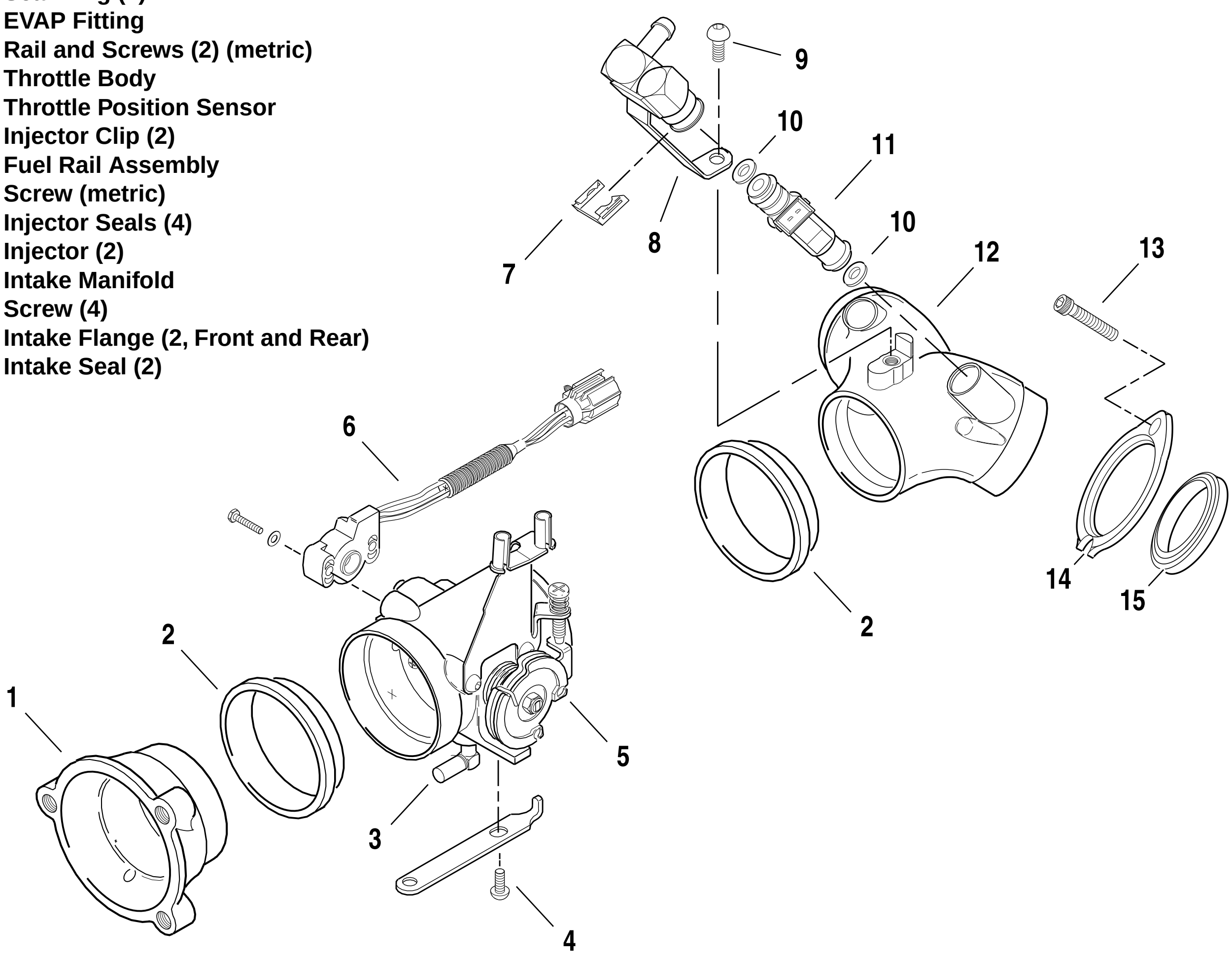


Figure 4-94. Throttle Body and Intake Manifold

4. Label and detach throttle cables.

   a. Remove screw and throttle cable brackets from throttle cables.

   b. See Figure 4-95. Increase throttle cable freeplay. Through the slots (1, 2) in the side of the bracket (3), remove both throttle cables.

   c. Using needle nose pliers, pull the cable barrels from attachment points (4, 5).

5. Detach wiring.

   a. Disconnect throttle position sensor by lifting both tabs on the connector while rocking the connection and pulling apart.

   b. If removing entire throttle body and intake manifold assembly, disconnect fuel injectors. Depress wire form on connector and use a rocking motion to detach electrical connectors from injectors.

6. If only removing front portion of throttle body, remove two screws (6) (metric). Detach hook on rail from tab on manifold (7) and slide front portion out.

7. See Figure 4-94. Remove assembly from motorcycle.

   a. On primary cover side, loosen but do not remove the two front and rear intake flange screws (13). For best results use a 1/4 inch ball Allen bit with an end driver at least 4 inches long.

   b. On gearcase cover side, remove both intake flange screws from cylinder heads.

   c. Slide the throttle body and intake manifold assembly out from the right side of the bike frame.

8. Remove intake flanges (14) from intake manifold. Remove and discard seals (15).

REPAIR

Throttle Position Sensor

See 4.35 THROTTLE POSITION SENSOR for removal, installation and calibration procedures.

Fuel Injectors

REMOVAL

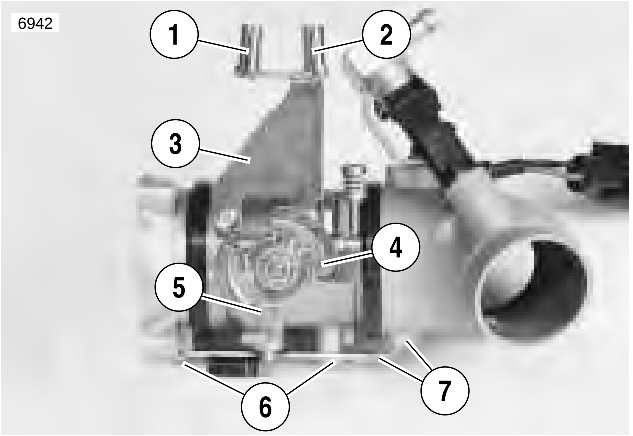
1. Remove throttle body and intake manifold.

2. See Figure 4-96. Separate fuel rail assembly (3) from intake manifold.

   a. Remove both injector clips (4).

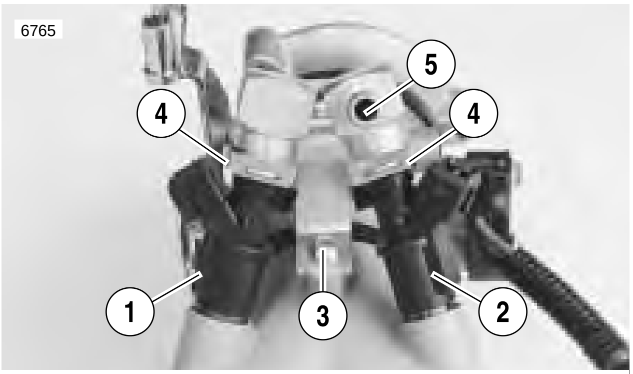
   b. Remove screw (3) (metric) that holds the fuel rail to the manifold.

   c. Separate fuel rail from injectors (1, 2) by gently rocking the fuel rail and pulling it away from the injectors.



1. **Throttle Control Cable Slot**
2. **Idle Control Cable Slot**
3. **Bracket**
4. **Idle Control Cable Attachment**
5. **Throttle Control Cable Attachment**
6. **Screws (2) (metric)**
7. **Hook and Tab**

Figure 4-95. Throttle Cable Bracket



1. **Front Fuel Injector**
2. **Rear Fuel Injector**
3. **Fuel Rail Assembly and Screw (metric)**
4. **Clip (2)**
5. **Fuel Inlet**

Figure 4-96. Fuel Injectors

3. Remove fuel injectors (1, 2) from manifold by gently rocking and pulling it away from the manifold.

⚠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 O-rings if they have been damaged or have taken a definite set.

INSTALLATION

1. Apply a thin coat of clean engine oil to top and bottom injector O-rings.
2. See Figure 4-97. Install fuel injectors.
   a. Place an O-ring on each side of injector.
   b. Install both injectors (4) into intake manifold.
   c. Press the fuel rail (1) onto the top of the injectors.
   d. Secure the fuel rail to the manifold with screw (metric). Tighten securely.
3. Snap the injector clips (2) over the flange on the fuel rail outlet and into the top grove in the injector.
4. Install throttle body and intake manifold. See INSTALLATION.

TESTING

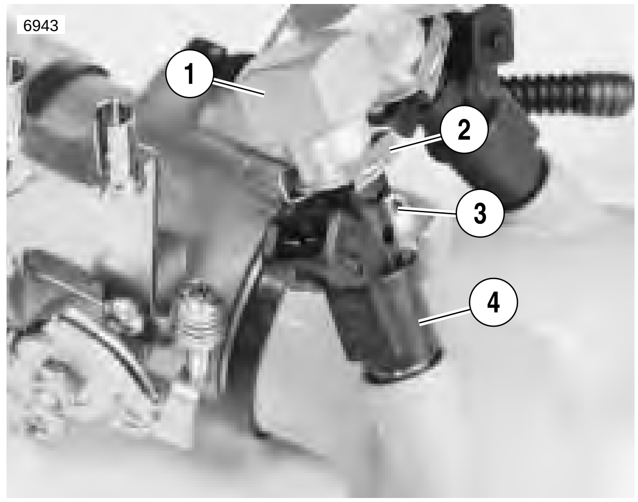
1. Remove air cleaner cover.
2. Conduct test.
   a. With throttle held wide open, turn key ON for two seconds.
   b. Turn key OFF for two seconds.
   c. Repeat Steps A and B five consecutive times. Replace fuel injectors if there is any evidence of raw fuel in throttle bottle manifold.
3. Install air cleaner cover.

INSTALLATION

NOTE

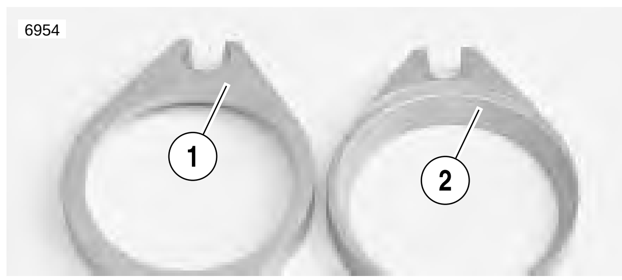
If only installing front portion of throttle manifold, begin installation with Step 3.

1. See Figure 4-98. Install front and rear intake flanges onto manifold 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. See Figure 4-99. Attach both throttle cables. Add freeplay to cables if necessary.
   a. With the manifold assembly close to the right side of the bike but not fully installed, place idle control cable end (1) into hole on guide (2). Wrap the cable into the channel.
   b. Place the end of the cable housing into the bracket by sliding the cable through the slot (3). Adjust the cable so it will not dislodge from the bracket.
   c. Repeat procedure for the throttle control cable.
   d. Verify that the cables are seated in the channels on the guide. Check that the cable ends are positioned in the bosses on the cable bracket.
   e. Install screw and throttle cable clamps to throttle cables.
   f. Verify operation by turning throttle grip and observing the cable action and throttle valve movement.



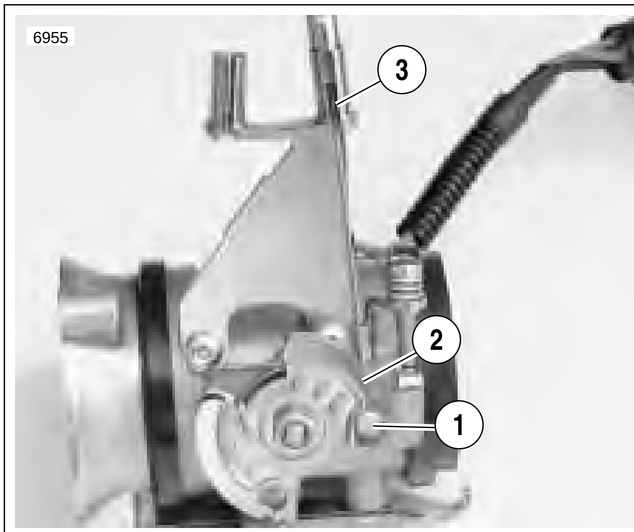
1. **Fuel Rail Assembly**
2. **Clip (2)**
3. **Screw**
4. **Fuel Injector (2)**

Figure 4-97. Installing Injectors



1. **Label (F = front cylinder)**
2. **Counterbore**

Figure 4-98. Intake Flanges

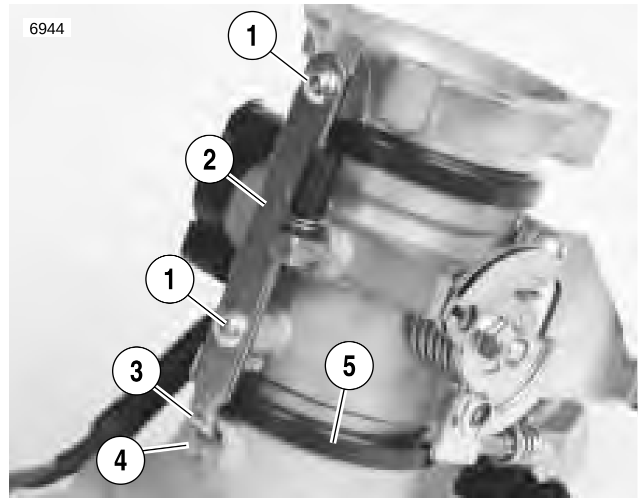


1. **Cable End**
2. **Guide**
3. **Slot**

Figure 4-99. Idle Control Cable Installation

HOME

4. Install front portion of throttle body. See the next step for entire assembly installation.
   a. See Figure 4-100. If front portion of throttle body was removed, lubricate surface of seal ring (5) that will contact manifold.
   b. Press throttle body into manifold.
   c. Place hook (3) on bottom rail (2) over tab (4) on manifold. Secure with two screws (1) (metric).
5. Install throttle body and intake manifold as an assembly.
   a. See Figure 4-101. Standing on the gearcase cover side of the vehicle, slide the assembly toward installed position. Manifold should slide over screws on primary cover side of engine.
   b. Align holes in intake flanges with those in cylinder heads and start screws. For best results, use a 1/4 inch Allen head with end driver 8 inches long.
   c. Make sure throttle body is centered between cylinders and tighten all intake flange screws to 6-10 ft-lbs (8-14 Nm).
6. 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.
7. Connect EVAP hose to port at bottom of throttle body (California models only).
8. Install fuel tank. See 4.36 FUEL TANK.
9. Calibrate throttle position sensor if removed or replaced. See 4.35 THROTTLE POSITION SENSOR.
10. Install air cleaner backplate and cover. See 4.41 AIR CLEANER.
11. Check throttle cable adjustment.



1. **Screw (metric)**
2. **Rail**
3. **Hook**
4. **Tab**
5. **Seal Ring**

Figure 4-100. Front Portion of Throttle Body

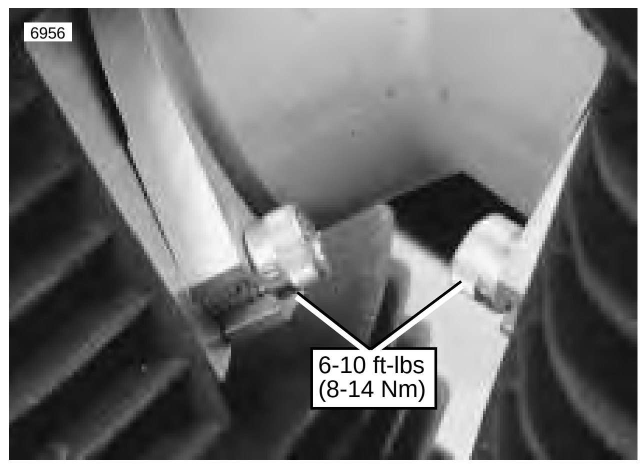


Figure 4-101. Intake Flange Screws, Primary Cover Side

GENERAL

The air cleaner prevents foreign material from entering the carburetor and engine by trapping airborne dust and dirt in the filter element.

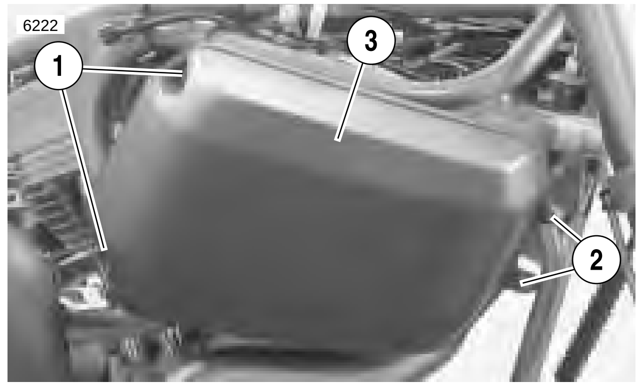
Service air cleaner filter element every 5000 miles (8000 km) or more often if the motorcycle is run in a dusty environment. See 1.18 AIR CLEANER for more information.

REMOVAL

CAUTION

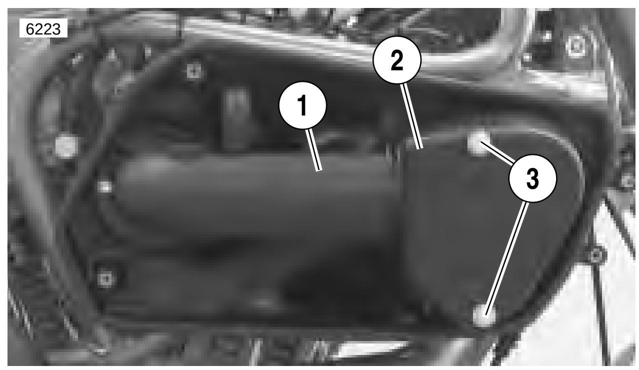
Do not run engine without filter element in place. Debris could be drawn into the engine causing damage.

1. See Figure 4-102. Remove both front screws and nylon washers (2).
2. Remove bolt and washer holding right fairing lower to bracket on swingarm/drive support.
3. Remove both rear screws and nylon washers (1). Remove cover (3) and fairing lower if present.
4. To separate air cleaner cover from right fairing lower, remove two mounting bolts and washers.
5. See Figure 4-103. Remove two bolts and washers (3) from filter box (2). Slide filter box forward, away from snorkel (1).
6. If inspecting filter element, see 1.18 AIR CLEANER.
7. See Figure 4-104. Disconnect hoses.
   a. Detach breather tee (4) from rear breather hose (1).
   b. Detach front breather hose (3) from front breather bolt (2).
8. Before the snorkel is removed, detach IAT sensor.
   a. See Figure 4-105. Press the catch on the intake air temperature (IAT) sensor.
   b. While holding catch, remove sensor from the snorkel by pulling upward.
9. See Figure 4-106. Remove two screws (1) and snorkel plate (2). Remove snorkel (3).
10. Before the backplate is removed, unseat the IAT sensor wiring grommet from the backplate. Gently pull the IAT sensor wiring through the backplate
11. Detach backplate.
    a. See Figure 4-107. Remove nuts (2) and bolts (1) from front mount.
    b. See Figure 4-108. Remove spacer screw (2) and spacer and gasket (1).
    c. Remove front breather bolt (4).
    d. Pull backplate (5) away from motorcycle and rear breather hose (3). On California models, slide fresh air inlet hose from carbon canister through backplate.
    e. Remove breather gasket from backplate.



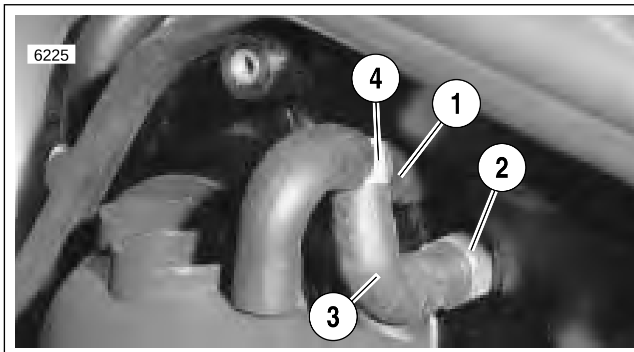
1. **Rear Screw and Nylon Washer (2)**
2. **Front Screw and Nylon Washer (2)**
3. **Cover**

Figure 4-102. Air Cleaner Cover



1. **Snorkel**
2. **Filter Box**
3. **Bolt and Washer (2)**

Figure 4-103. Filter Box



1. **Rear Breather Hose**
2. **Front Breather Bolt**
3. **Front Breather Hose**
4. **Breather Tee**

Figure 4-104. Breather Hoses

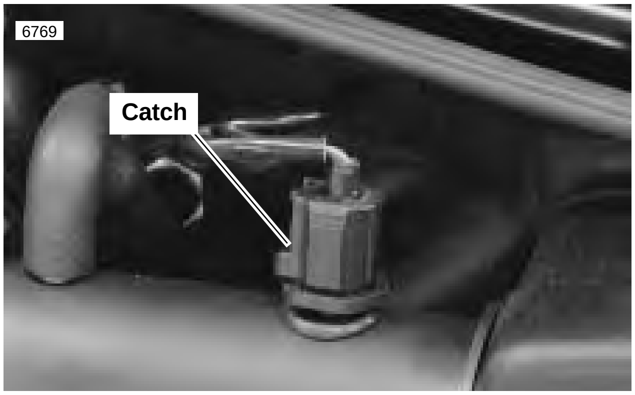


Figure 4-105. IAT Sensor

NOTE

Air cleaner support ring fits around rear breather bolt. Fitting on rear breather bolt may not clear the frame if bolt removal is attempted. Do not remove the rear breather bolt unless absolutely necessary.

12. Before the backplate is removed, unseat the IAT sensor wiring grommet from the backplate. Gently pull the IAT sensor wiring through the backplate.

INSTALLATION

1. Slide the IAT sensor wiring through the hole in the backplate. Seat the grommet inside the backplate.
2. Install backplate.
   a. Apply HYLOMAR to breather bolt threads. If removed, install air cleaner support ring.
   b. See Figure 4-108. Slide rear breather hose (3) through backplate (5). On California models, slide canister fresh air inlet hose from carbon canister through backplate.
   c. Install a **new** breather gasket behind backplate.
   d. Install front breather bolt (4). Tighten to 10-15 ft-lbs (14-20 Nm).
3. Apply LOCTITE THREADLOCKER 243 (blue) to spacer screw (2). Install spacer and gasket (1) using spacer screw (2). Tighten to 7-9 ft-lbs (10-12 Nm).
4. See Figure 4-107. Apply LOCTITE THREADLOCKER 243 (blue) to bolts (1). Insert bolts (1) through backplate and mount. Install nuts (2). Tighten to 3-5 ft-lbs (4-7 Nm).
5. Attach IAT sensor to snorkel. See Figure 4-105.
6. See Figure 4-106. Install snorkel.
   a. Apply LOCTITE THREADLOCKER 243 (blue) to screws (1).
   b. Align snorkel (3) on spacer (4) and spacer screw.
   c. Attach snorkel to backplate assembly using snorkel plate (2) and two screws (1). Tighten to 6-8 ft-lbs (8-11 Nm).
7. See Figure 4-103. Install front breather hose (3) on front breather bolt (2). Attach rear breather hose (1) to breather tee (4).
8. Inspect filter element. See 1.18 AIR CLEANER.
9. See Figure 4-103. Place filter element in filter box (2). Attach filter box to snorkel (1).
10. Apply LOCTITE THREADLOCKER 243 (blue) to bolts (3). Fasten filter box to backplate with bolts and washers (3).
11. If removed, attach right fairing lower to air cleaner cover using two mounting bolts and washers.
12. See Figure 4-102. Place cover (3) over backplate assembly. Install both rear screws and nylon washers (1).
13. Install both front screws and nylon washers (2).
14. Install bolt and washer to fasten right fairing lower to bracket on swingarm/drive support.

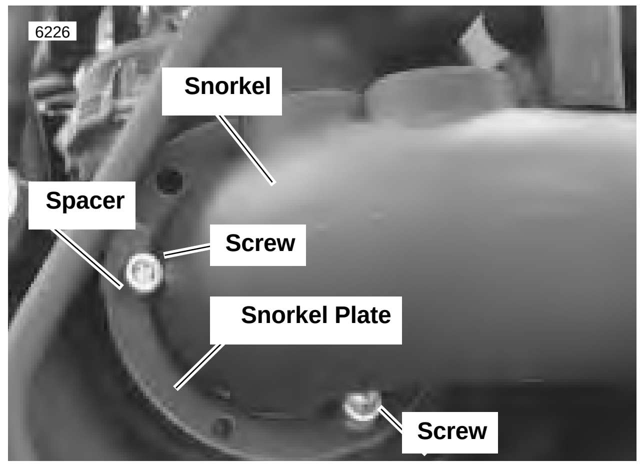


Figure 4-106. Air Cleaner Front Mount

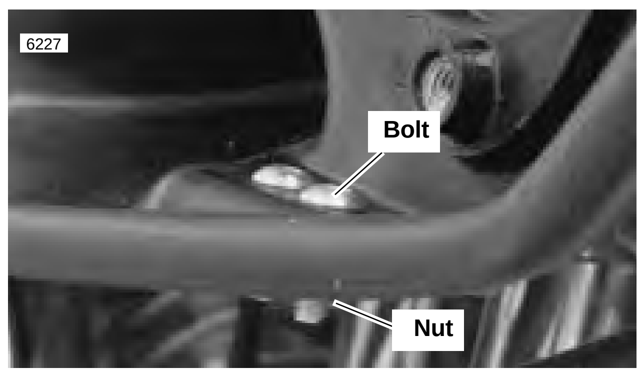
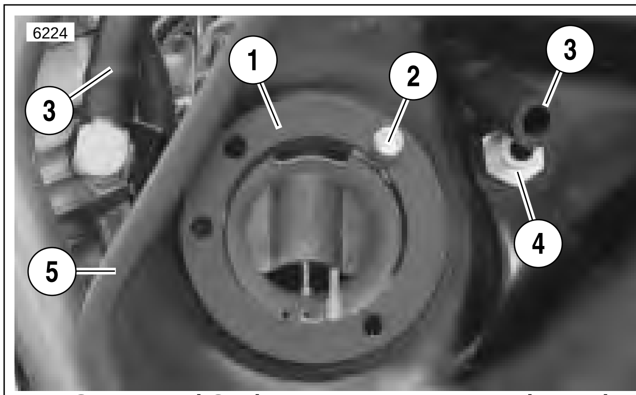


Figure 4-107. Air Cleaner Front Mount



1. Spacer and Gasket
2. Spacer Screw
3. Rear Breather Hose
4. Front Breather Bolt
5. Backplate

Figure 4-108. Air Cleaner Spacer

EVAPORATIVE EMISSIONS CONTROL 4.42

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:

- See Figure 4-109. 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.
- See Figure 4-110. 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 and are burned as part of normal combustion in the engine. The large diameter canister-to-air cleaner backplate hose (canister fresh air inlet hose) supplies the canister with fresh air from the air cleaner.

TROUBLESHOOTING

⚠WARNING

Verify that the evaporative emissions system hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, which could result in death or serious injury.

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. Periodically check all mounting hardware for tightness.

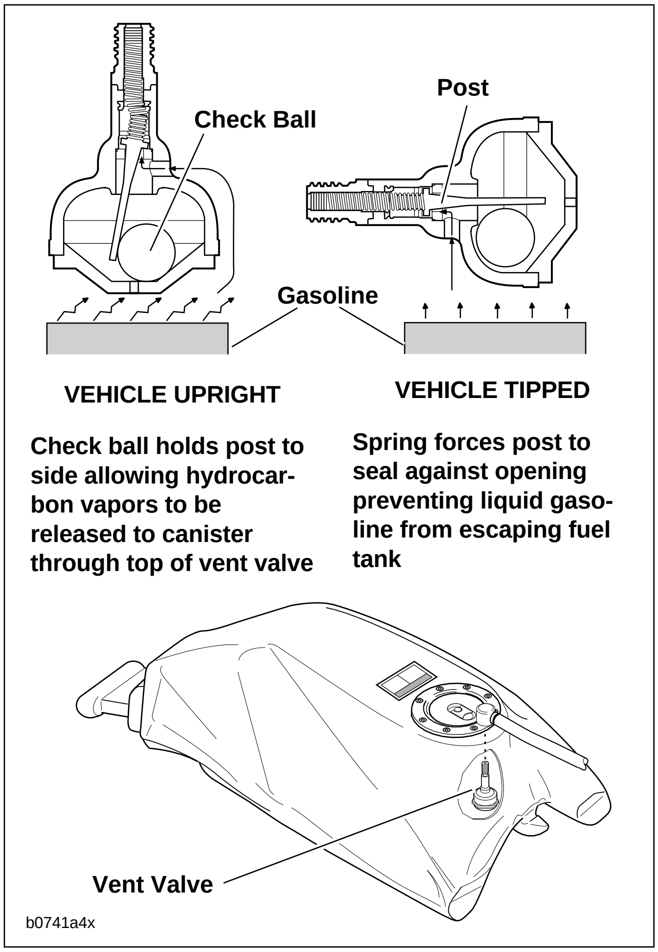


Figure 4-109. Vent Valve Operation

Figure 4-110. Carbon Canister Installed

REMOVAL

Vent Valve

1. Remove vent valve. See 4.37 FUEL TANK VENT VALVE
2. See Figure 4-110. If necessary, label fuel tank vent hose (1) at canister fitting and remove.

Canister

1. See Figure 4-110. The canister assembly mounts on a frame tube along the left side of the motorcycle.
2. Label and disconnect the three hoses connected to the canister.
3. See Figure 4-112. Depress both locking tabs (3) on the canister mounting bracket (4). Slide canister towards the front wheel until it disengages from the mounting bracket and remove.
4. Remove screws, washers and locknuts (6) to detach mounting plate (2) from clamps (1).
5. Remove countersunk screws and locknuts (5) to separate bracket (4) from mounting plate (2).

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.

1. Install vent valve. See 4.37 FUEL TANK VENT VALVE.
2. See Figure 4-110. Attach fuel tank vent hose (1) to canister if disconnected.

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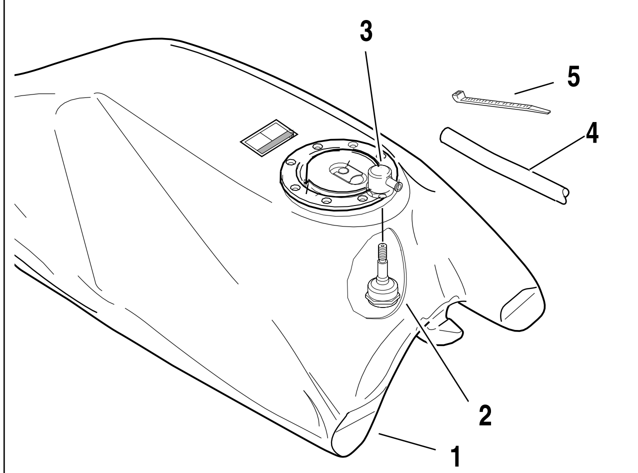

1. **Fuel Tank**
2. **Vent Valve**
3. **Vent Valve Fitting**
4. **Fuel Tank Vent Hose**
5. **Cable Strap**

Figure 4-111. Vent Valve

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1. **Clamp (2)**
2. **Mounting Plate**
3. **Locking Tabs**
4. **Canister Mounting Bracket**
5. **Countersunk Screw and Locknut (2)**
6. **Screw, Washer and Locknut (2)**

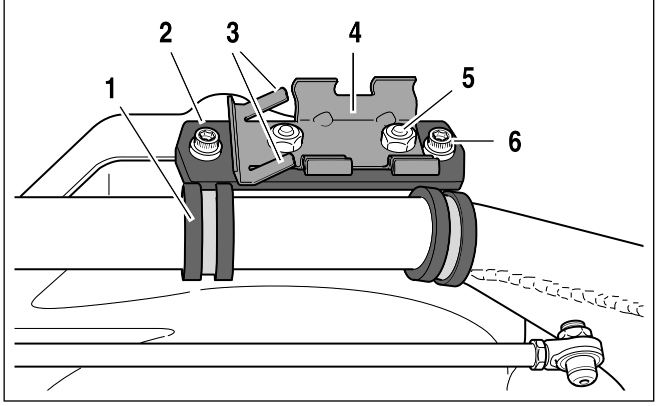


Figure 4-112. Carbon Canister Mounting

Canister

1. See Figure 4-112. Install canister mounting bracket (4) on mounting plate (2) with countersunk screws and locknuts (5).
2. Install mounting plate assembly on frame by attaching mounting clamps (1) using screws, washers and locknuts (6). Tighten to 6-8 ft-lbs (8-11 Nm).
3. Depress locking tabs (3) and slide canister into locked position on canister mounting bracket (4). Locking tabs (3) must engage canister; bend tabs outward somewhat if canister is not held securely.

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.

4. See Figure 4-110. Connect all three hoses to the canister. Make sure to push fuel tank vent hose all the way on to carbon canister fitting and position hose clamp on fitting side of barb.
5. Measure distance to closest point of rear cylinder head. If clearance is not at least 0.5 in. (12.7 mm), move canister bracket clamps.

HOSE ROUTING

Intake Manifold

See Figure 4-113. Route the evaporative emissions control hose at the intake manifold. To gain access to the hose, remove the fuel tank and/or air cleaner and backplate assembly if necessary.

Canister Hose Routings

1. See Figure 4-110. Connect one end of the canister fresh air inlet hose (3) to the carbon canister.

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. Connect fuel tank vent hose (1) and canister vent hose (2) to the carbon canister. Canister vent hose attaches to the top fitting. Make sure to push fuel tank vent hose all the way on to carbon canister fitting and position hose clamp on fitting side of barb.

Figure 4-113. Emissions Hose Attachment

3. Route both hoses (1, 2) towards fresh air inlet hose (3) at rear of canister.
4. Cable strap the three hoses together where the hose connector attaches the two pieces of fresh air inlet hose (3).
5. Route the smaller hoses forward along the top left frame tube. The canister vent hose (2) and fuel tank hose (1) run together until the canister vent hose (2) turns between the cylinders.

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.

6. See Figure 4-113. Connect the canister vent hose to elbow fitting. Make sure to push hose all the way on to elbow and position hose clamp on fitting side of barb.
7. See Figure 4-111. Connect the fuel tank vent hose (4) to vent valve fitting (3) using a **new** cable strap (5).
8. Route fresh air inlet hose upward and forward along the top left frame tube. Continue running hose to air cleaner backplate fitting. Secure hose to frame using **new** cable straps.

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 5-6
5.4 Starter Activation Circuits 5-8
5.5 Diagnostics/Troubleshooting 5-9
5.6 Starter System Testing 5-11
5.7 Starter 5-12
5.8 Starter Solenoid 5-19

SPECIFICATIONS 5.1

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	8.1 ft-lbs (11 Nm) (min.) @ 2.4 V

SERVICE WEAR LIMITS	IN.	MM
Brush Length (minimum)	0.433	11.0
Commutator Diameter (minimum)	1.141	28.981

TORQUE VALUES

ITEM	TORQUE		NOTES
Battery Terminal Bolts	60-96 **in-lbs**	7-11 Nm	metric
Starter Battery Positive Cable Nut	60-85 **in-lbs**	7-10 Nm	metric
Starter Mounting Bolts	13-20 ft-lbs	18-27 Nm	

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.

OPERATION

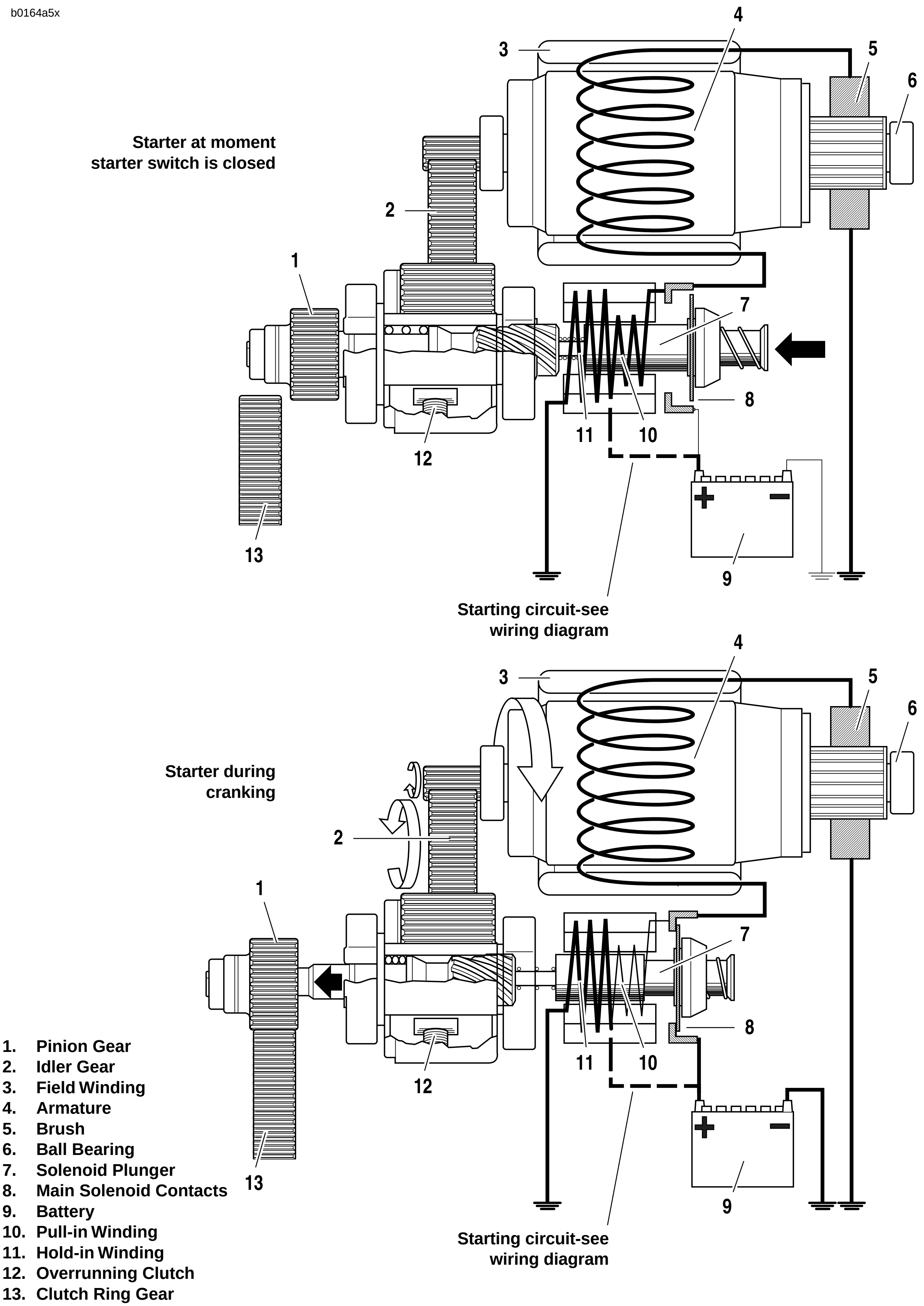
See Figure 5-1. When the starter switch is pushed, the starter relay is activated and battery current flows into the pull-in winding (10) and the hold-in winding (11), to ground.

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).



1. Pinion Gear
2. Idler Gear
3. Field Winding
4. Armature
5. Brush
6. Ball Bearing
7. Solenoid Plunger
8. Main Solenoid Contacts
9. Battery
10. Pull-in Winding
11. Hold-in Winding
12. Overrunning Clutch
13. Clutch Ring Gear

Figure 5-1. Starter Operation

Table 5-1. Troubleshooting

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
1. Starter does not run or runs at very low speeds.	Battery.	Voltage drop due to discharged battery.	Charge battery.
		Short-circuit or open between electrodes.	Replace battery.
		Poor contact condition of battery terminal(s).	Clean and retighten.
	Wiring.	Disconnection between starter switch and solenoid terminal.	Repair or replace wire.
	Starting switch or starter relay.	Poor contact condition or poor connection.	Replace.
	Solenoid.	Poor contact condition caused by burnt contact.	Polish contact surface or replace solenoid assembly.
		Contact plate removed.	Repair.
		Pull-in winding open or short-circuited.	Replace solenoid assembly.
		Hold-in winding open.	Replace solenoid assembly.
	Starting motor.	Poor contact condition of brushes.	Check brush spring tension.
		Commutator burnt.	Correct on lathe or replace.
		Commutator high mica.	Correct by undercutting.
		Field winding grounded.	Replace.
		Armature winding grounded or short-circuit.	Replace.
		Reduction gears damaged.	Replace.
		Insufficient brush spring tension.	Replace.
		Disconnected lead wire between solenoid and field windings.	Repair or replace lead wire.
		Ball bearing sticks.	Replace bearing.

Table 5-1. Troubleshooting (Continued)

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
2. Pinion does not engage with ring gear while starter is running or engine cannot be cranked.	Battery.	Voltage drop due to discharged battery.	Charge battery.
		Short-circuit or open between electrodes.	Replace battery.
		Poor contact condition of battery terminal(s).	Clean and retighten.
	Wiring.	Disconnection between starter switch and solenoid terminal.	Repair or replace wire.
	Overrunning clutch.	Overrunning clutch malfunction (rollers or compression spring).	Replace overrunning clutch.
		Pinion teeth worn out.	Replace overrunning clutch.
		Pinion does not run in overrunning direction.	Replace overrunning clutch.
		Poor sliding condition of spline teeth.	Remove foreign materials, dirt, or replace overrunning clutch.
		Reduction gears damaged.	Replace overrunning clutch and idler gear.
	Ring gear.	Excessively worn teeth.	Replace ring gear.
3. Starter does not stop running.	Solenoid.	Return spring worn.	Replace solenoid.
		Coil layer shorted.	Replace solenoid.
		Contact plate melted and stuck.	Replace solenoid.
	Starting switch or starter relay.	Unopened contacts.	Replace starting switch or starter relay.
		Poor returning.	Replace starting switch or starter relay.

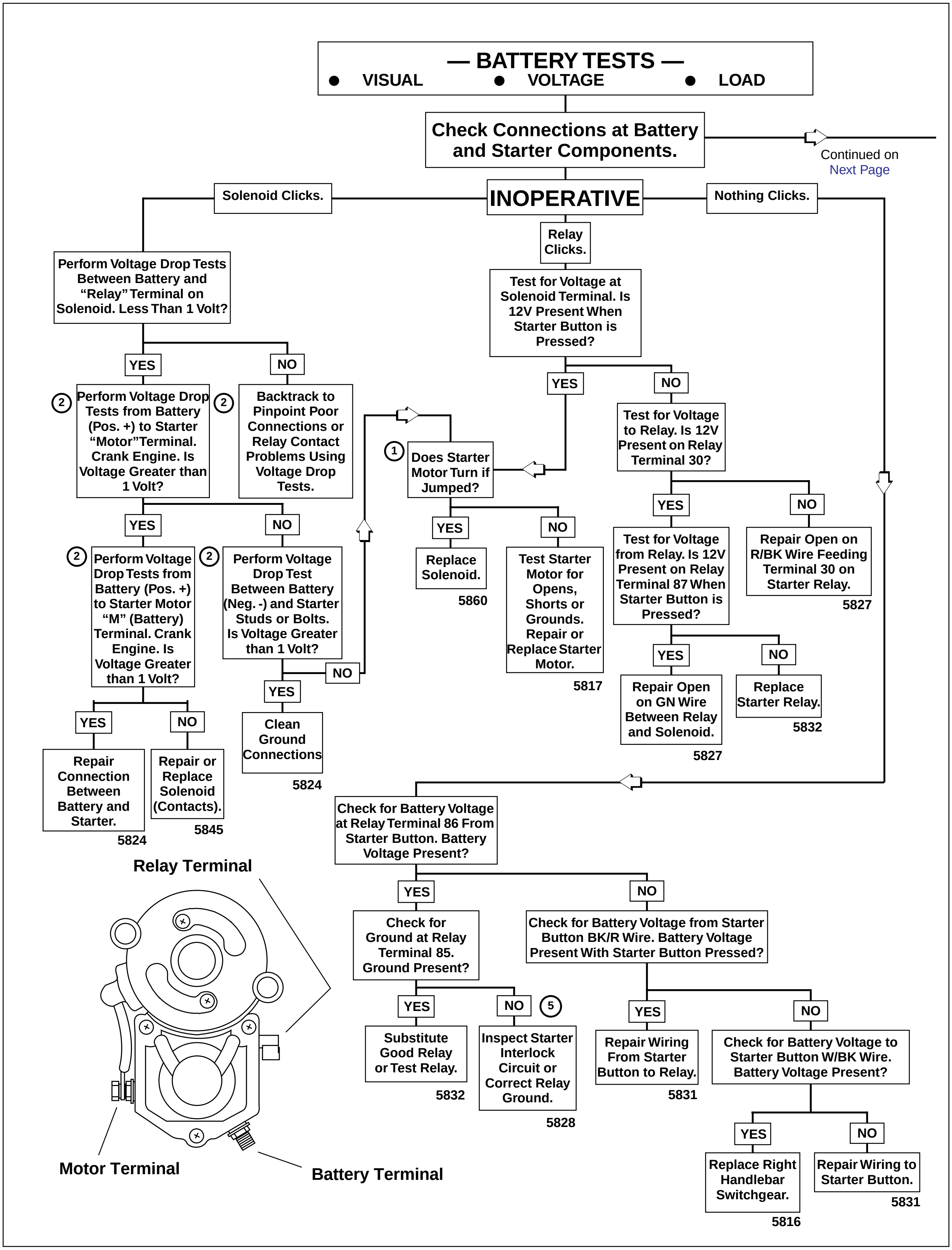


Figure 5-2. Starting System Diagnosis, Part 1

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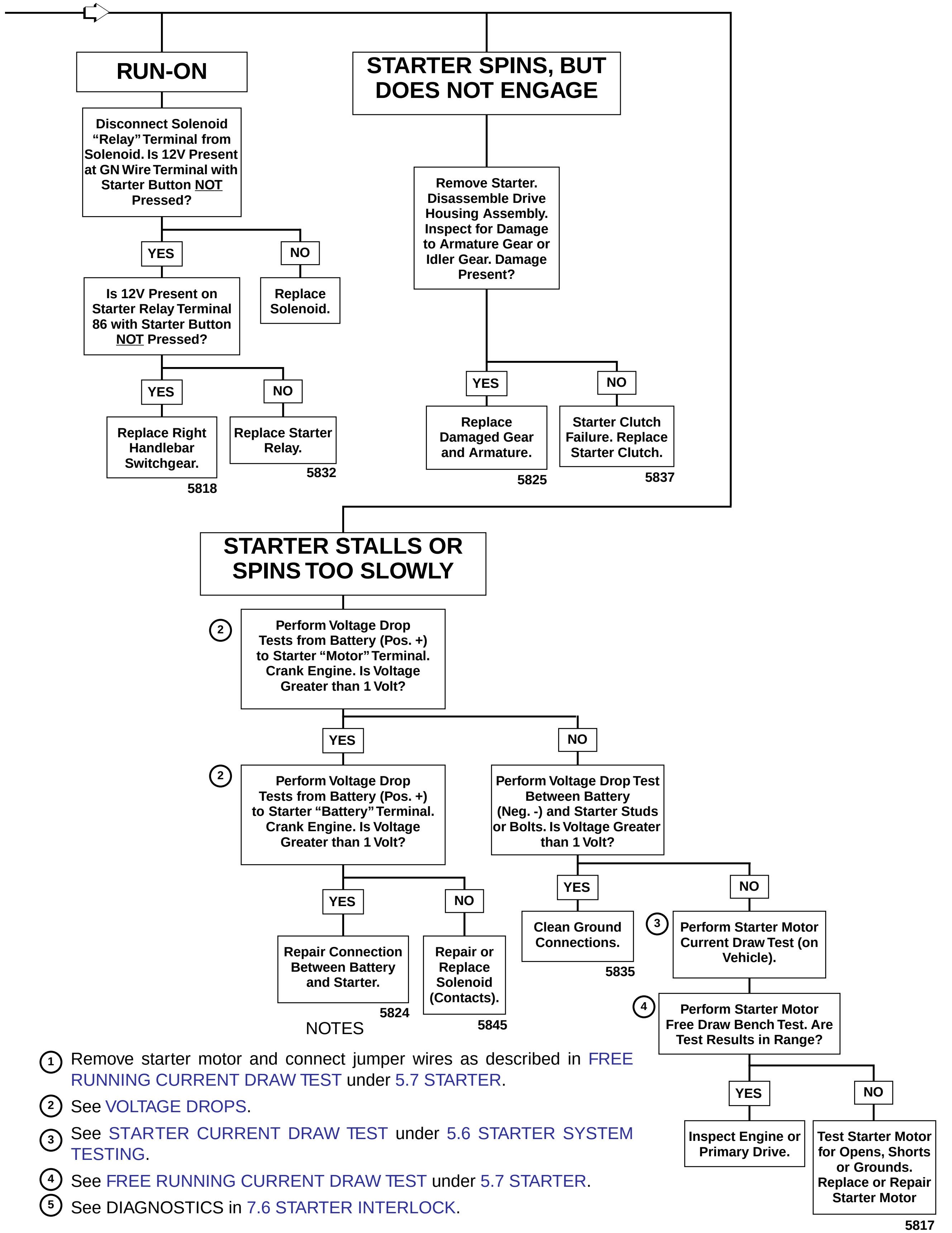
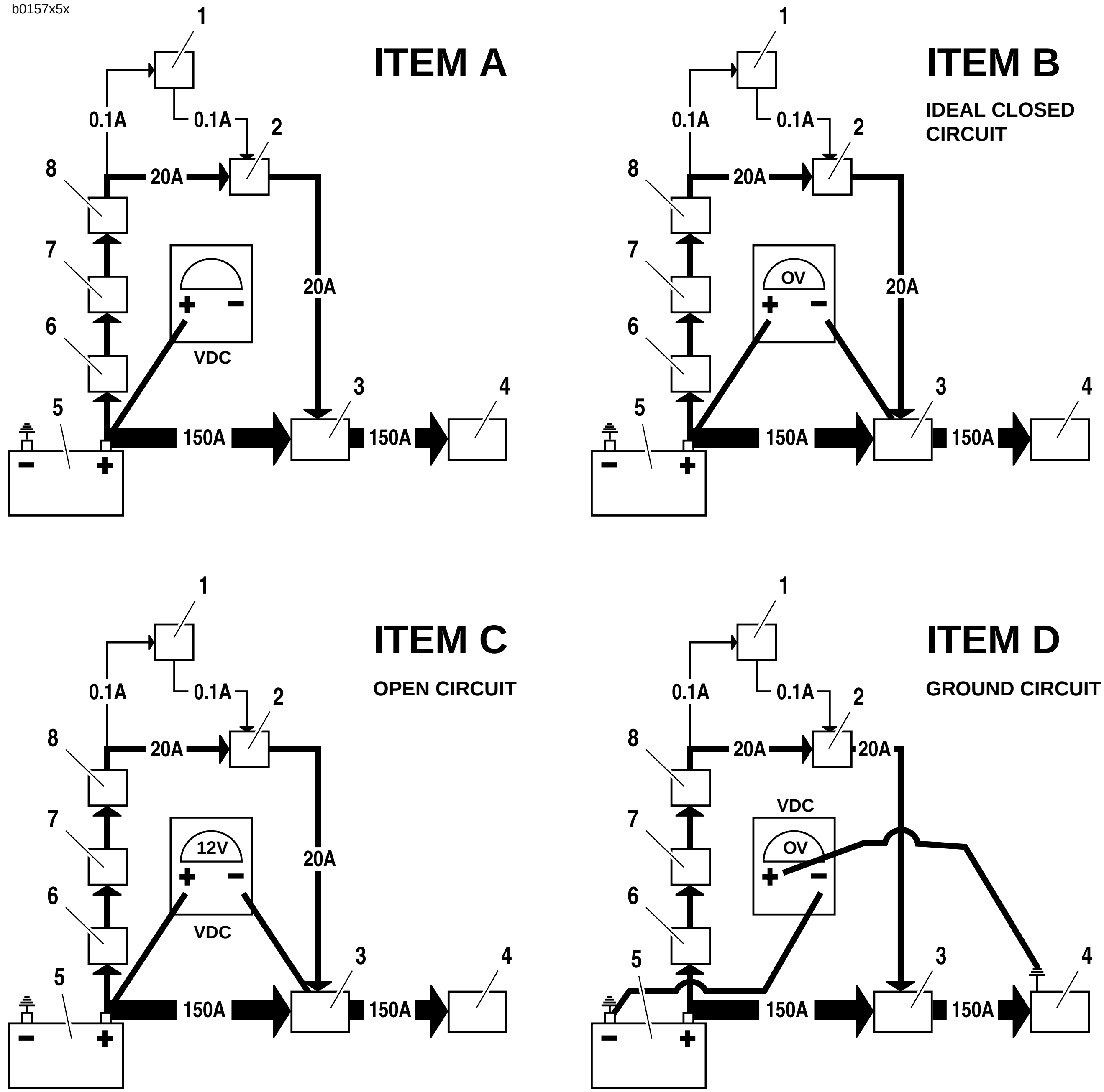
Previous Page



NOTES

1. Remove starter motor and connect jumper wires as described in FREE RUNNING CURRENT DRAW TEST under 5.7 STARTER.
2. See VOLTAGE DROPS.
3. See STARTER CURRENT DRAW TEST under 5.6 STARTER SYSTEM TESTING.
4. See FREE RUNNING CURRENT DRAW TEST under 5.7 STARTER.
5. See DIAGNOSTICS in 7.6 STARTER INTERLOCK.

Figure 5-3. Starting System Diagnosis, Part 2



1. Start Switch
2. Relay
3. Solenoid
4. Starter
5. Battery
6. Main Circuit Breaker
7. Ignition Switch
8. Ignition Circuit Breaker

Figure 5-4. Typical Circuity. Refer to wiring diagrams for more information.

GENERAL

The troubleshooting table beginning on page 5-4 contains detailed procedures to solve and correct problems. 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, circuit breakers and connectors between the source and destination.

The voltage drop test measures the difference in potential or the actual voltage dropped between the source and destination.

1. See ITEM A in Figure 5-4. Attach your red meter lead to the most positive part of the circuit, which in this case would be the positive post of the battery (5).
2. See ITEM B in Figure 5-4. 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 5-4. 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 5-4. 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.

HOME

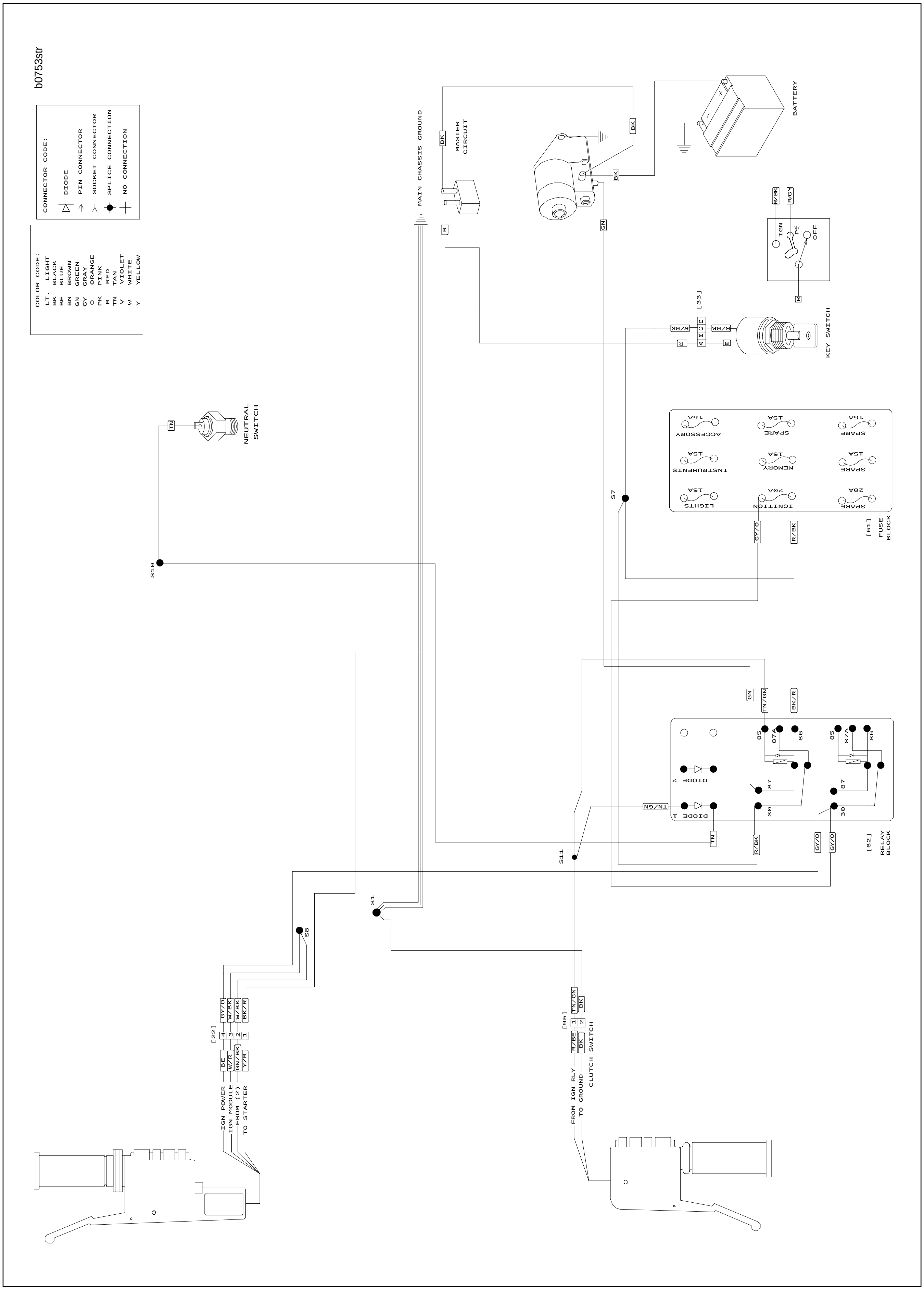


Figure 5-5. Electric Starting System Circuit

"ON-MOTORCYCLE" TESTS

Starter Relay Test

1. See Figure 5-6. Locate starter relay. The relay is on the relay block on the right side of the vehicle under the tail section. Unplug relay connector.

2. To test relay, proceed to Step 3. If installing a **new** starter relay, remove old relay. Attach relay connector plug.

3. See Figure 5-7. Obtain a 12 volt battery and a continuity tester or ohmmeter.

   a. Connect positive battery lead to the 86 terminal.

   b. Connect negative battery lead to the 85 terminal to energize relay.

   c. Check for continuity between the 30 and 87 terminals. A good relay shows continuity (continuity tester lamp "on" or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.

4. If starter relay is functioning properly, proceed to STARTER CURRENT DRAW TEST.

Starter Current Draw Test

NOTE

- *Engine temperature should be stable and at room temperature.*

- *Battery should be fully charged.*

See Figure 5-8. 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 REMOVAL.

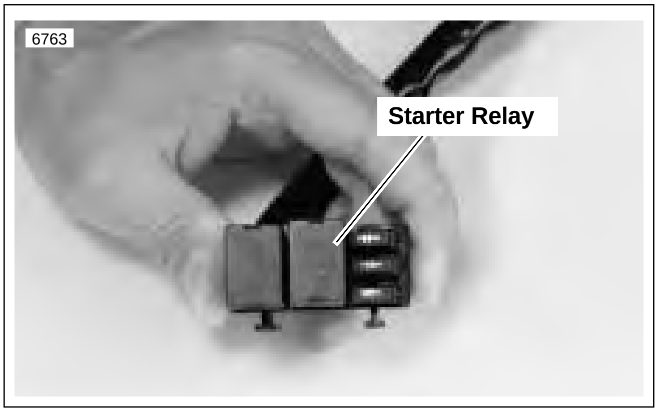


Figure 5-6. Starter Relay Location

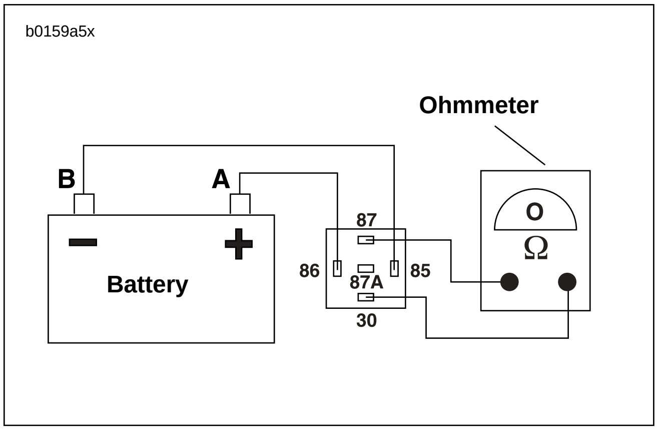


Figure 5-7. Starter Relay Test

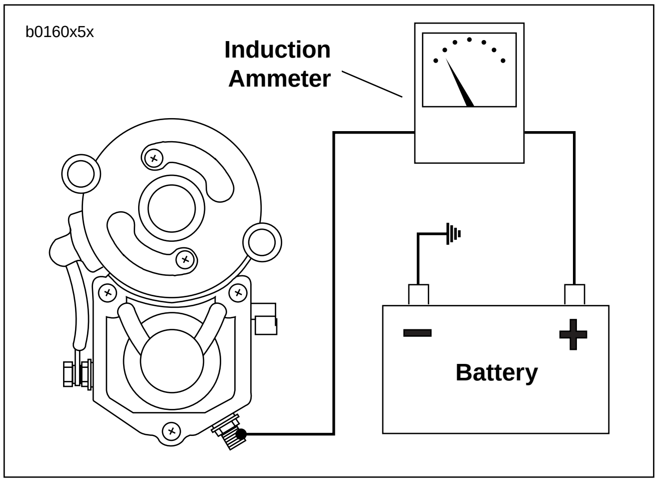


Figure 5-8. Starter Draw Test

REMOVAL

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

⚠WARNING

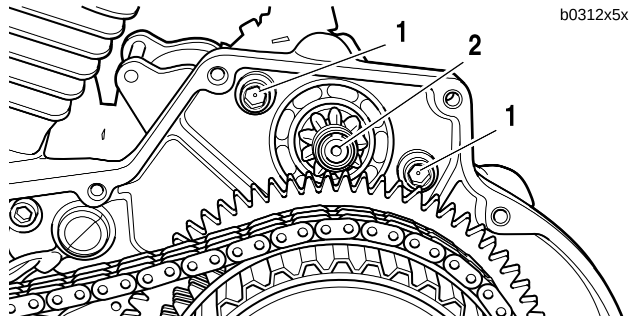
Always disconnect the negative battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion which could result in death or serious injury.

1. Remove primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
2. See Figure 5-9. Remove both starter mounting bolts and washers (1).

NOTE

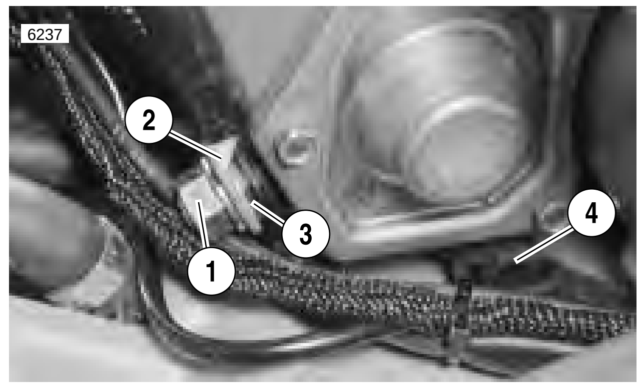
A ball hex driver may be required to gain access to the starter mounting bolts.

3. See Figure 5-10. Remove nut with washer (1) (metric).
   a. Remove positive battery cable ring terminal (2).
   b. Remove circuit breaker wire ring terminal (3).
   c. Remove protective boot (if equipped) and detach solenoid wire (4).
4. Remove starter and gasket from the gearcase cover side.



1. **Mounting Bolts and Washers**
2. **Starter**

Figure 5-9. Starter Mounting



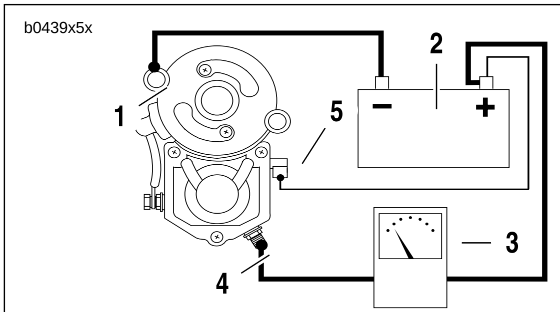
1. **Nut with Washer (metric)**
2. **Positive Battery Cable Ring Terminal**
3. **Circuit Breaker Wire Ring Terminal**
4. **Solenoid Wire**

Figure 5-10. 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 5-11. 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.



1. **Mounting Flange**
2. **Battery**
3. **Induction Ammeter**
4. **Battery Terminal**
5. **Relay Terminal**

Figure 5-11. Free Running Current Draw Test

Starter Solenoid

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in Figure 5-12.

CAUTION

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

NOTE

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.

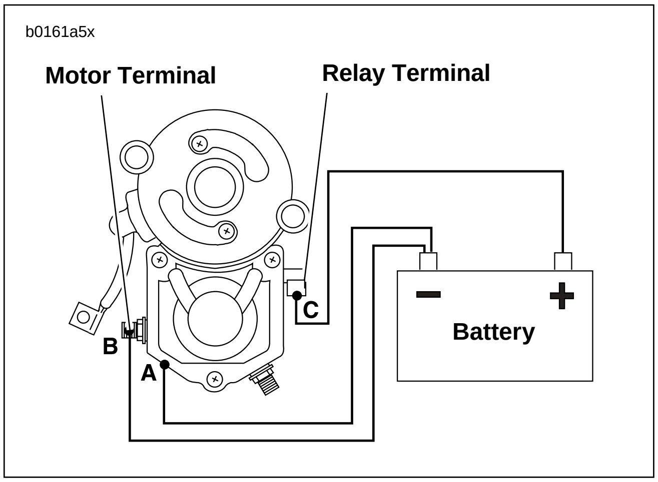


Figure 5-12. Pull-In Test

Solenoid Pull-in Test

1. See Figure 5-12. 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.

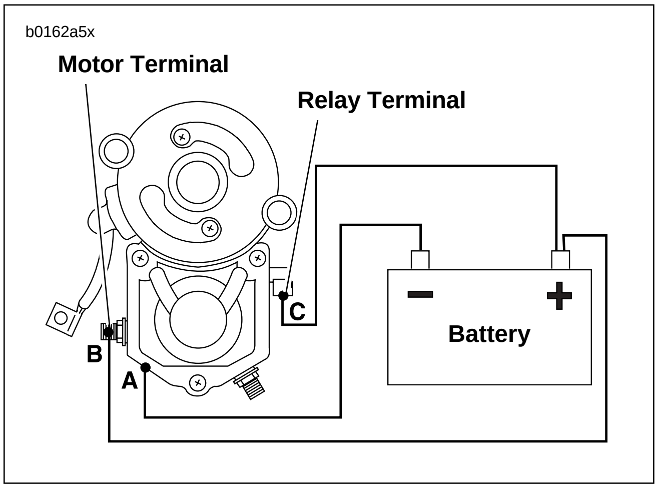


Figure 5-13. Hold-In Test

Solenoid Hold-in Test

1. See Figure 5-13. 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.

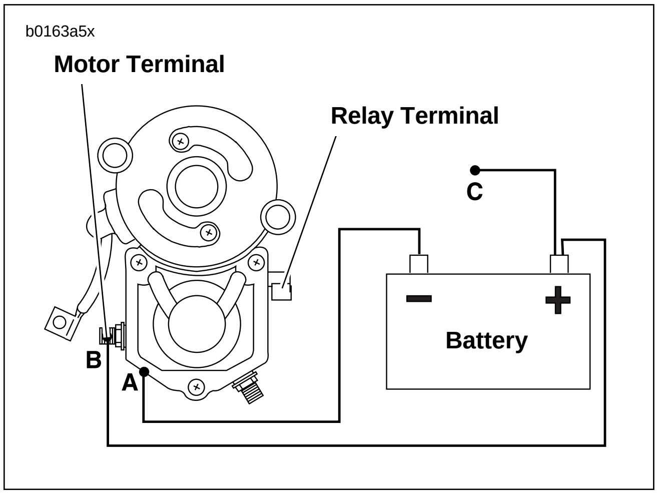


Figure 5-14. Return Test

Solenoid Return Test

1. See Figure 5-14. 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.

DISASSEMBLY, INSPECTION AND REPAIR

1. See Figure 5-15. Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).

2. See Figure 5-16. Remove both thru-bolts (1, 3).

3. Remove both end cover screws with O-rings (2) and end cover (4).

4. See Figure 5-17. 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.

CAUTION

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.

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.

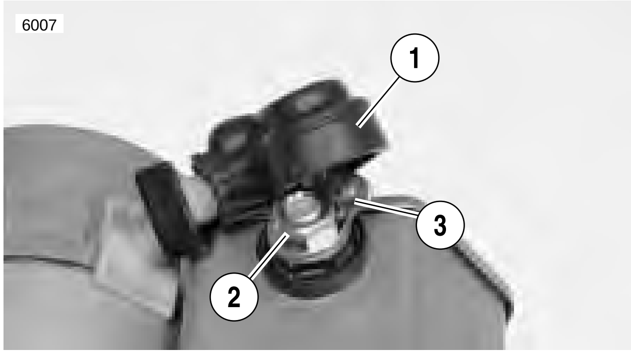
   See Figure 5-18. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.

9. See Figure 5-19. Check for SHORTED ARMATURE with a growler.

   a. Place armature on growler (1).

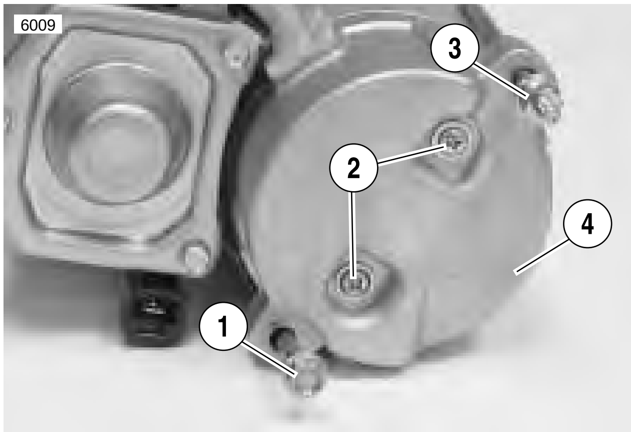
   b. Hold a thin steel strip (2) (hacksaw blade) against armature core and slowly turn armature.

   c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace shorted armatures.



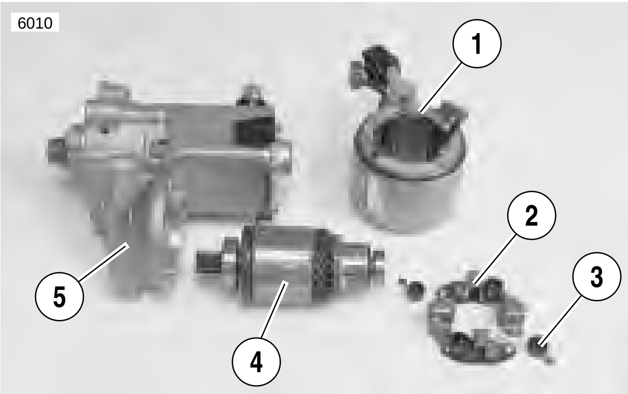
1. **Rubber Boot**
2. **Field Wire Nut with Washer (metric)**
3. **Field Wire**

Figure 5-15. Field Wire



1. **Lower Thru-Bolt**
2. **Screw and O-Ring (2)**
3. **Upper Thru-Bolt**
4. **End Cover**

Figure 5-16. Removing the Thru-Bolts



1. **Field Frame**
2. **Brush Holder**
3. **Brush Spring (4)**
4. **Armature**
5. **Solenoid Housing**

Figure 5-17. Starter Components

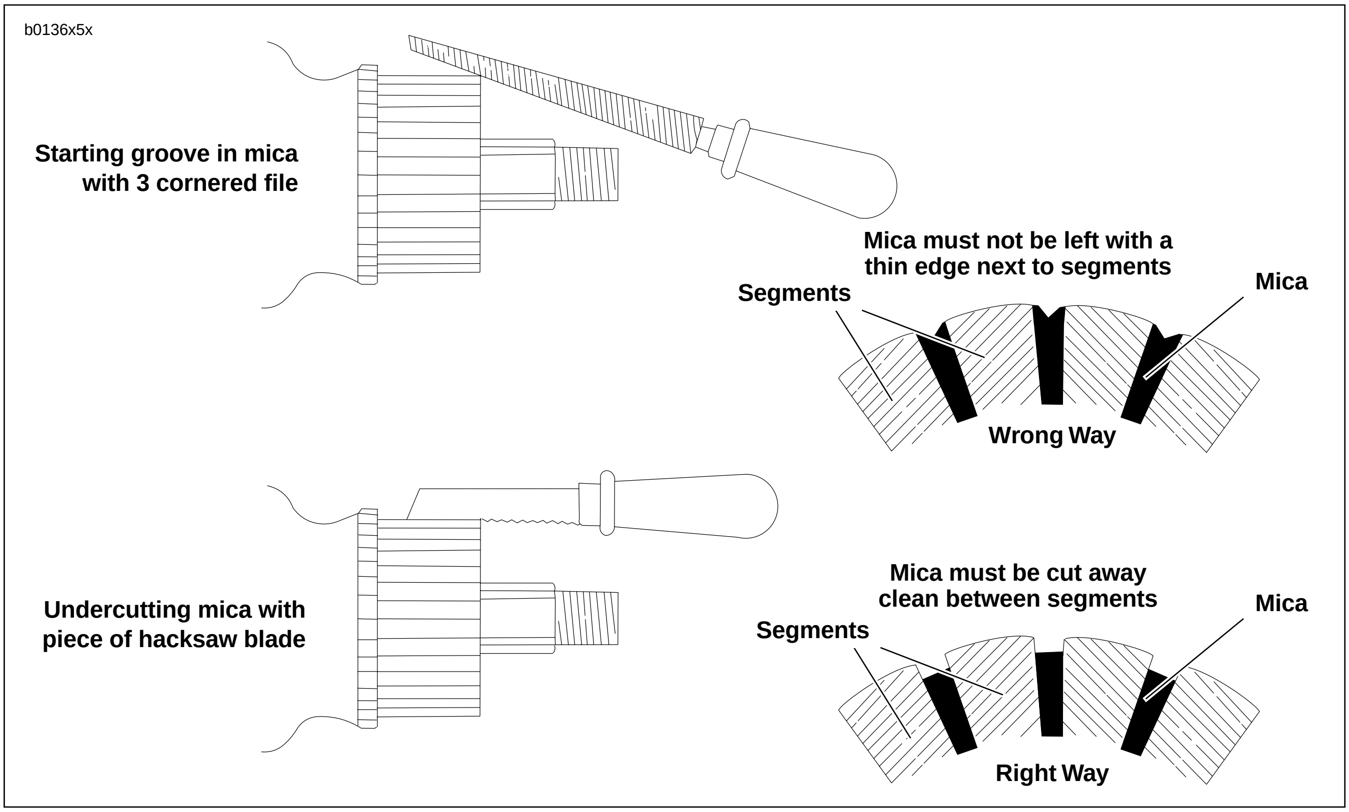


Figure 5-18. Undercutting Mica Separators

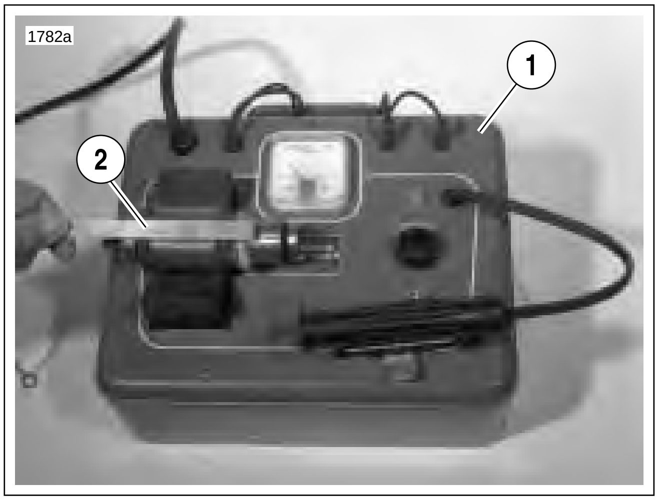


Figure 5-19. Shorted Armature Test Using Growler

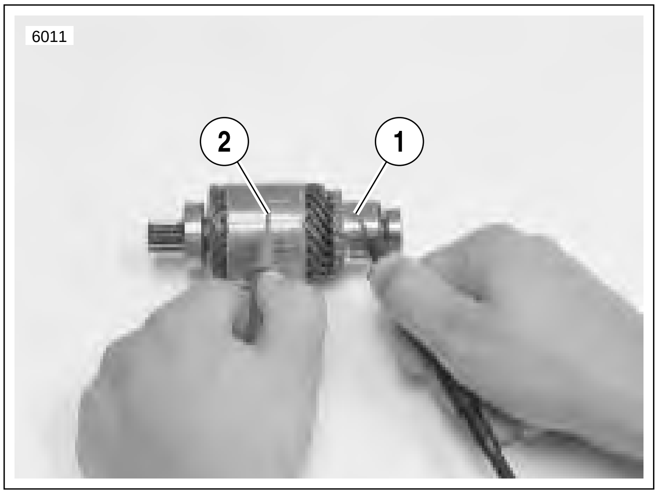


Figure 5-20. Grounded Armature Test

10. See Figure 5-20. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
    a. Touch one probe to any commutator segment (1).
    b. Touch the other probe to the armature core (2).
    c. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace grounded armatures.

11. See Figure 5-21. Check for OPEN ARMATURE with an ohmmeter or continuity tester.

    a. Check for continuity between all commutator segments (1).

    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.

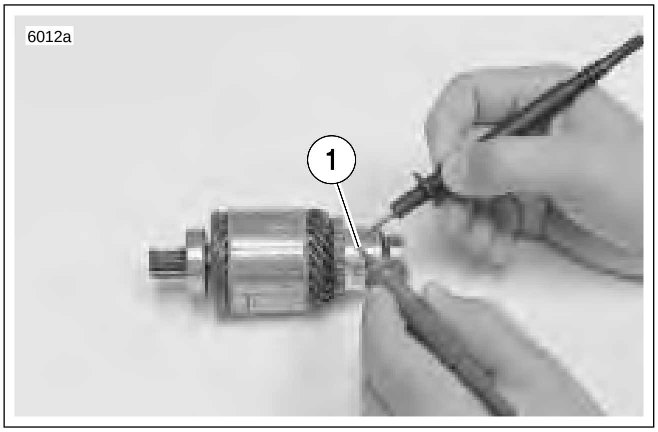


Figure 5-21. Open Armature Test

12. See Figure 5-22. Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester.

    a. Touch one probe to the frame (1).

    b. Touch the other probe to each of the brushes (2) 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 5-23. Check for OPEN FIELD COILS with an ohmmeter or continuity tester.

    a. Touch one probe to the field wire (1).

    b. Touch the other probe to each of the brushes attached to the field coil(s) (2).

    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 5-24. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.

    a. Touch one probe to holder plate (1).

    b. Touch the other probe to each of the positive (insulated) brush holders (2).

    c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.

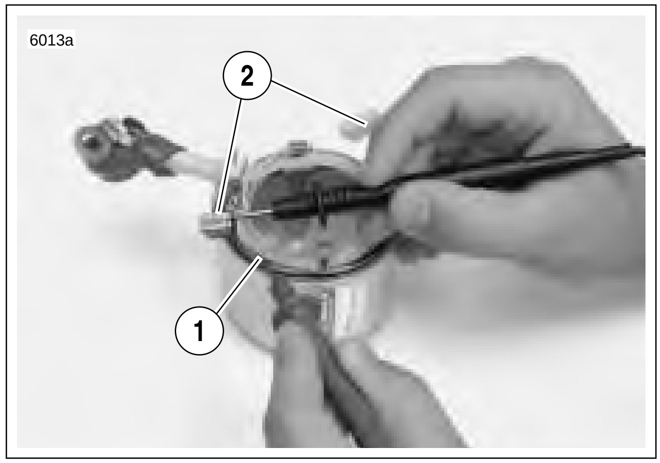


Figure 5-22. Grounded Field Test

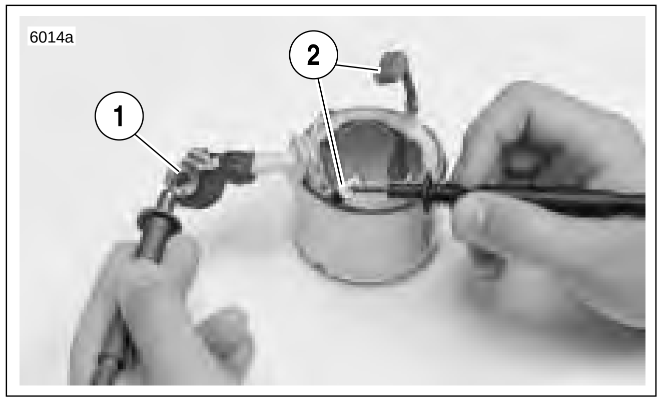


Figure 5-23. Open Field Test

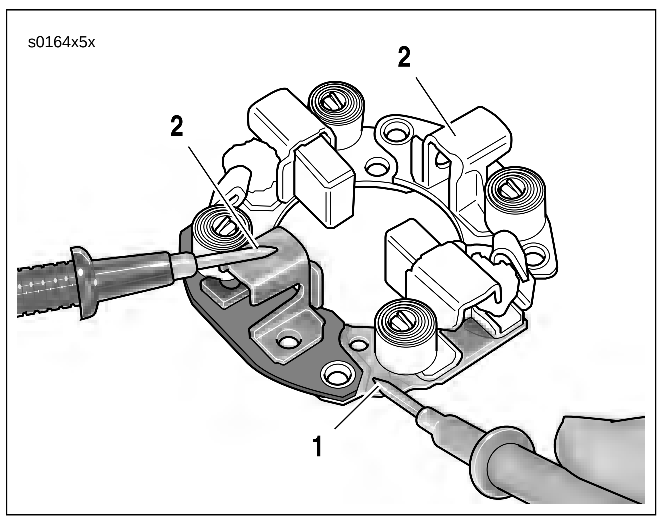


Figure 5-24. Brush Holder Insulation Test

15. See Figure 5-25. Remove two drive housing mounting screws (6). Remove drive housing (5) from solenoid housing.

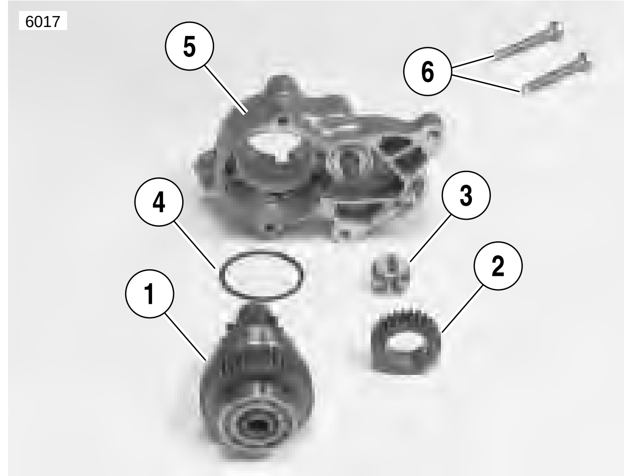
16. Remove drive (1), idler gear (2), idler gear bearing (3), and O-ring (4) from drive housing (O-ring is located in drive housing groove).

ASSEMBLY

1. See Figure 5-25. Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.

2. See Figure 5-26. 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).



1. Drive
2. Idler Gear
3. Idler Gear Bearing
4. O-Ring
5. Drive Housing
6. Screws

Figure 5-25. Starter Drive Assembly

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)

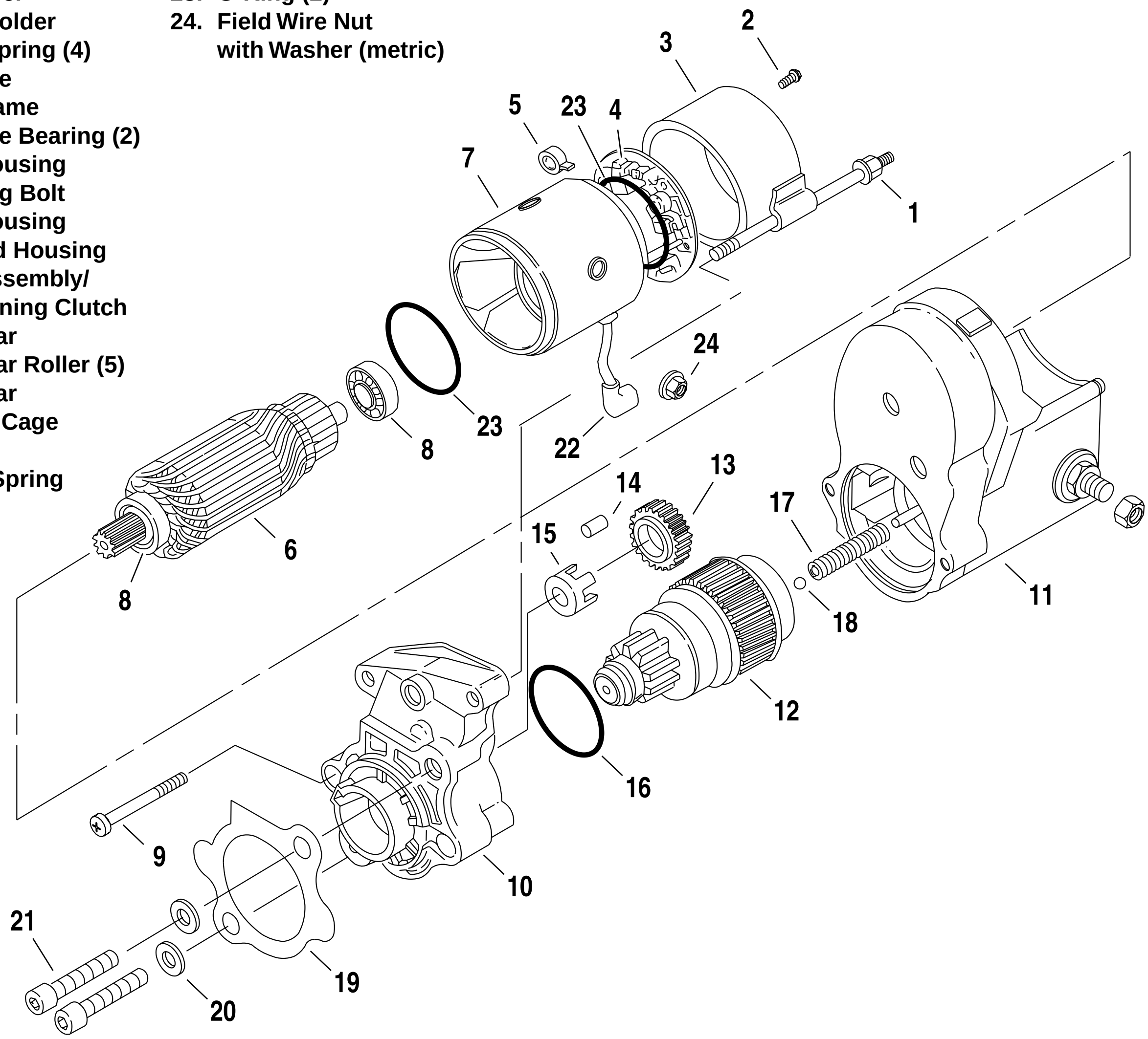


Figure 5-26. Starter Assembly

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 5-10. Connect wiring to starter.
   a. Connect solenoid wire (4).
   b. Attach circuit breaker wire ring terminal (3).
   c. Attach positive battery cable ring terminal (2).
   d. Install nut with washer (1) (metric). Tighten to 60-85 **in-lbs** (7-10 Nm).
   e. Replace protective boot (if equipped).
3. See Figure 5-9. Install both starter mounting bolts and washers. Tighten to 13-20 ft-lbs (18-27 Nm).
4. Install primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
5. Fill transmission to proper level with fresh lubricant. See 1.9 CLUTCH.

⚠WARNING

Always connect 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.

6. Connect battery cables, positive cable first. Tighten terminal hardware to 60-96 **in-lbs** (7-11 Nm).

STARTER SOLENOID 5.8

GENERAL

CAUTION

See Figure 5-27. Do not tighten nut (7) without removing items 1-5. Movement will cause damage to the contact.

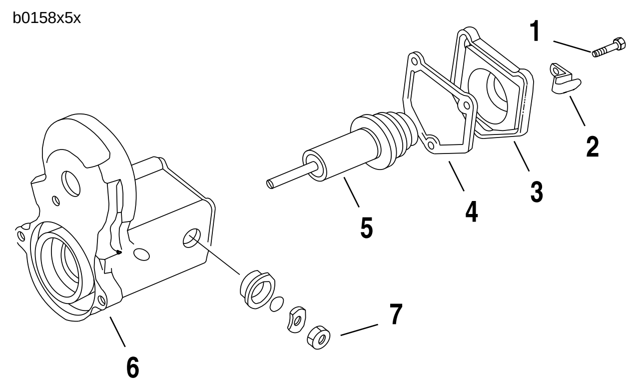
The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See Figure 5-27. 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 5-27. 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 5-27. Starter Solenoid

NOTES

Table Of Contents

DRIVE/TRANSMISSION 6

SUBJECT	PAGE NO.
6.1 Specifications	6-1
6.2 Primary Chain	6-3
6.3 Drive Belt	6-6
6.4 Clutch Release Mechanism	6-8
6.5 Primary Drive/Clutch	6-10
6.6 Transmission	6-17
6.7 Transmission Case	6-19
6.8 Shifter Forks and Drum	6-21
6.9 Mainshaft and Countershaft	6-23
6.10 Main Drive Gear	6-29
6.11 Access Door Bearings	6-31
6.12 Right Transmission Case Bearings	6-32
6.13 Transmission Installation and Shifter Pawl Adjustment	6-33

SPECIFICATIONS 6.1

TRANSMISSION		
Transmission Type	5 forward speed, foot shift	
Clutch Type	Wet – multiple disc	
Clutch Fluid Capacity	1.0 quart	0.95 liter
Fluid Part No.-Quart	98854-96	
Fluid Part No.-Gallon	98855-96	

PRIMARY DRIVE (ENGINE-TO-TRANSMISSION)	
Engine Sprocket	35 teeth
Clutch Sprocket	56 teeth
Ratio	1.60: 1

TRANSMISSION GEAR RATIOS	FINAL*	OVERALL**
First (Low) Gear	2.69	9.047
Second Gear	1.85	6.687
Third Gear	1.43	4.823
Fourth Gear	1.18	3.973
Fifth (High) Gear	1.00	3.366

*Final gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.
**Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

FINAL DRIVE (TRANSMISSION-TO-REAR WHEEL)	
Transmission Sprocket	27 teeth
Rear Wheel Sprocket	61 teeth
Drive Belt	128 teeth
Ratio	2.10:1

CLUTCH PLATE THICKNESS	NUMBER REQUIRED	NEW COMPONENTS		SERVICE WEAR LIMITS	
		IN.	MM	IN.	MM
Friction Plate (Fiber)	8	0.0866 + 0.0031	2.1996 + 0.0787	0.006	0.152
Steel Plate	6	0.0629 + 0.0020	1.5977 + 0.0508	0.006	0.152
Clutch Pack				0.661 minimum	16.789 minimum

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.*

TORQUE VALUES

ITEM	TORQUE		NOTES
Access Door Mounting Bolts	13-17 ft-lbs	18-23 Nm	LOCTITE THREADLOCKER 243 (blue)
Clutch Inspection Cover TORX Screws with Washers	7-9 ft-lbs	10-12 Nm	
Clutch Mainshaft Nut	70-80 ft-lbs	95-109 Nm	LOCTITE THREADLOCKER 262 (red), **left hand threads**
Countershaft Retainer TORX Screw	13-17 ft-lbs	18-23 Nm	LOCTITE THREADLOCKER 243 (blue)
Engine Sprocket Nut	190-210 ft-lbs	258-285 Nm	LOCTITE THREADLOCKER 262 (red)
Isolator TORX Bolts (Rear)	63-70 ft-lbs	85-95 Nm	LOCTITE THREADLOCKER 262 (red), LOCTITE ANTI-SEIZE under bolt heads
Primary Chain Adjuster Locknut	15-18 ft-lbs	20-24 Nm	on interior of chaincase
Primary Chain Adjuster Locknut	20-25 ft-lbs	27-34 Nm	on exterior of chaincase
Primary Chain Inspection Cover Screws	40-60 **in-lbs**	5-7 Nm	
Primary Cover Screws	100-120 **in-lbs**	11-14 Nm	3 lengths
Large primary cover screws	16-28 ft-lbs	22-38 Nm	
Rear Shock Mounting Bolt (Front)	40-45 ft-lbs	54-61 Nm	metric
Rear Shock Mounting Bolt (Rear)	30-33 ft-lbs	41-45 Nm	metric
Shifter Lever Pinch Screw	59-66 **in-lbs**	7-8 Nm	
Shifter Lever Mounting Bolt	27-29 ft-lbs	37-39 Nm	
Shifter Shaft Assembly Locknuts	90-110 **in-lbs**	10-12 Nm	bottom nut first, same torque for top
Tie Bar Bolts	30-33 ft-lbs	40.7-44.7 Nm	
Transmission Detent Plate Nut	13-17 ft-lbs	17.6-23.0 Nm	
Transmission Drain Plug	14-21 ft-lbs	19.0-28.5 Nm	remove debris from end
Transmission Sprocket Nut	See note		LOCTITE THREADLOCKER 262 (red), **left hand threads**, special torque turn method
Transmission Sprocket Screws	90-110 **in-lbs**	10.2-12.4 Nm	replace after 3 removals

PRIMARY CHAIN 6.2

GENERAL

An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both compartments.

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, it must be replaced. Remove and install the chain following the procedure under 6.5 PRIMARY DRIVE/CLUTCH.

ADJUSTMENT/LUBRICATION

See 1.12 PRIMARY CHAIN for inspection and adjustment procedures.

See 1.9 CLUTCH for complete lubrication service on the primary chain.

REMOVAL

Primary Cover

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative cable from battery terminal.
2. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
3. Remove left fairing lower. See 2.38 FAIRING LOWERS.
4. Remove muffler. See 2.27 EXHAUST SYSTEM.
5. See Figure 6-1. Place a drain pan under the engine. Remove drain plug (9) and drain lubricant from primary drive.
6. Carefully remove lower shifter lever mounting bolt, washer, plastic bushings and spacer.

1. TORX Screw with Washers (4)
2. Clutch Inspection Cover
3. Spring
4. Lockplate
5. Wellnut
6. Coupling
7. Ramp Assembly
8. Quad Ring
9. Drain Plug and O-ring
10. Locknut
11. Chain Adjuster Screw
12. Primary Cover
13. Primary Chain Inspection Cover
14. Clutch Adjusting Screw
15. Oil Seal

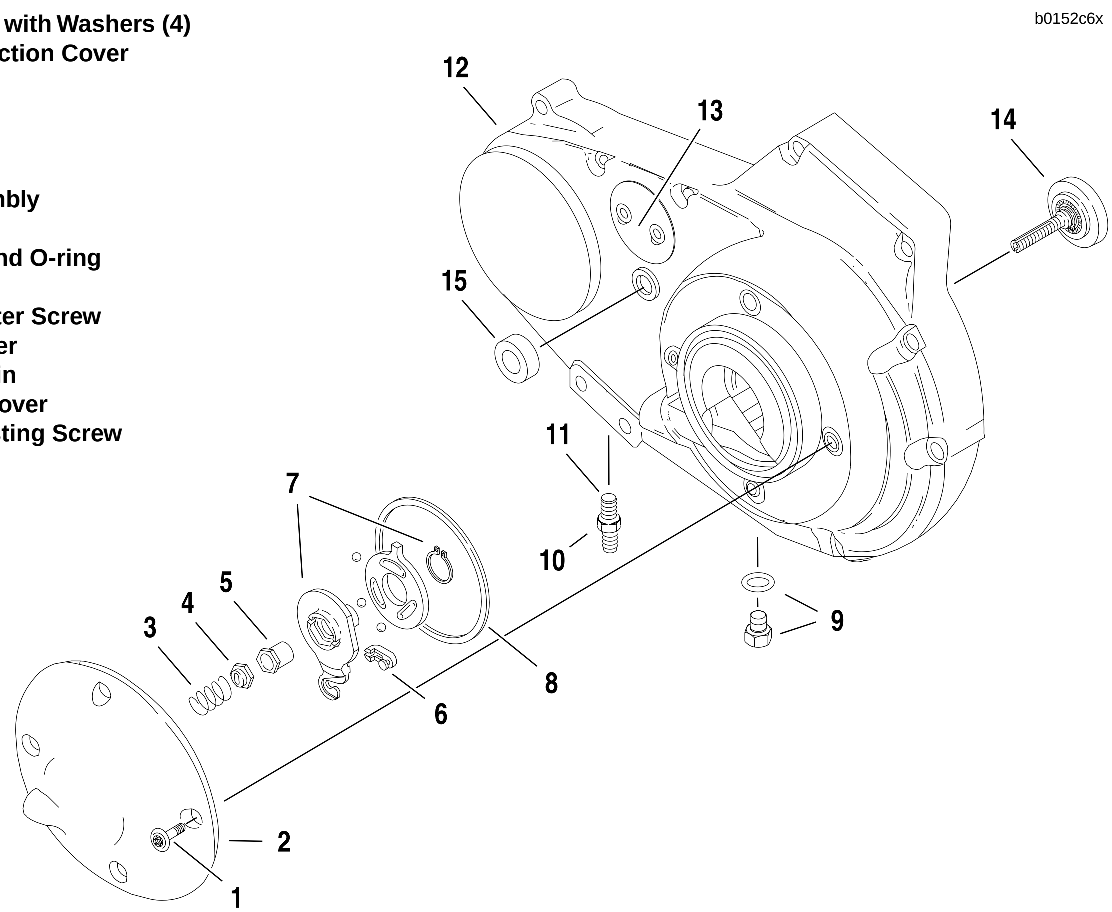


Figure 6-1. Primary Cover

7. Add freeplay to clutch cable. See 1.9 CLUTCH.
8. Loosen locknut (10). Turn chain adjuster screw (11) counterclockwise (outward) to relax primary chain tension.
9. Remove four TORX screws with washers (1) and clutch inspection cover (2). Remove and discard Quad ring (8) from groove in primary cover.
10. Slide spring (3) with attached hex lockplate (4) from flats of clutch adjusting screw (14).
11. Turn clutch adjusting screw (14) clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly (7) moves forward. Unscrew wellnut (5) from end of adjusting screw.
12. Remove hook of ramp from button to the rear of cable end coupling (6). Remove cable end from slot in coupling. Remove coupling and ramp assembly.
13. Remove screws which secure primary cover. Remove cover and gasket. Discard gasket.
14. Remove and discard shifter lever oil seal (15).

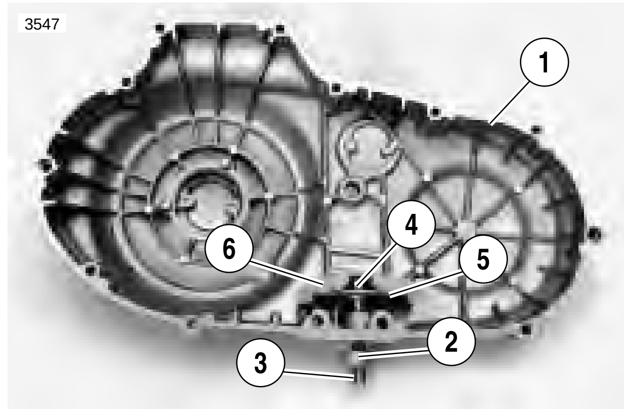
Primary Chain Adjuster

1. See Figure 6-2. Remove primary cover (1).
2. Remove locknut (2) from chain adjuster screw (3). Turn adjuster screw out of threaded boss in primary cover.
3. Slide shoe (6) off plate (5) (shoe must be slid off plate toward closed or blind side of shoe). Remove locknut (4) and plate (5).

INSTALLATION

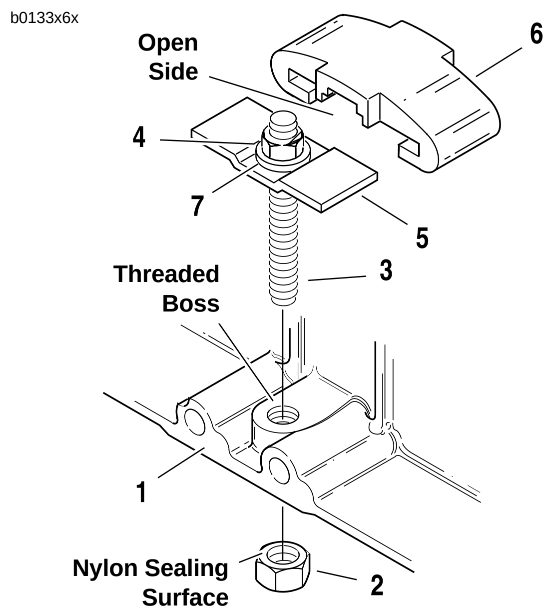
Primary Chain Adjuster

1. See Figure 6-3. If shoe (6) is badly worn, replace it or adjust assembly.
2. Install plate (5) over top of chain adjuster screw (3). Place spacer (7) over top of adjuster screw next to plate. Secure plate and spacer to adjuster screw by threading on locknut (4). Tighten locknut to 15-18 ft-lbs (20-24 Nm).
3. Place plate into slots at open end of shoe (6). Slide shoe over plate until locknut at top end of adjuster screw is against closed (blind) side of shoe.
4. Position adjuster inside primary cover (1) with closed side of shoe against cover. Thread adjuster screw into tapped boss at bottom of primary cover. At outside of cover, install locknut (2) onto adjuster screw with nylon sealing surface toward cover. Tighten to 20-25 ft-lbs (27-34 Nm).
5. Install primary cover.



1.	Primary Cover	4.	Locknut (Interior)
2.	Locknut (Exterior)	5.	Plate
3.	Chain Adjuster Screw	6.	Shoe

Figure 6-2. Removing Primary Chain Adjuster

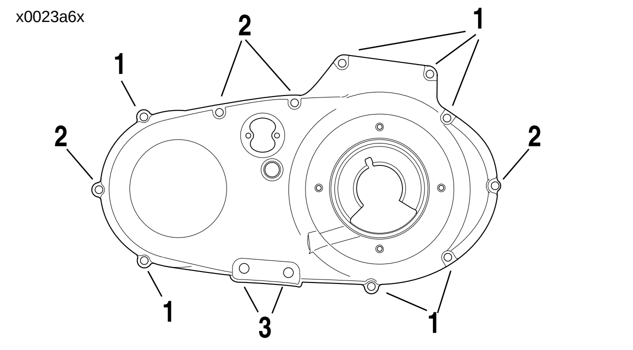


1.	Primary Cover	4.	Locknut (Interior)
2.	Locknut (Exterior)	5.	Plate
3.	Chain Adjuster Screw	6.	Shoe
		7.	Spacer

Figure 6-3. Primary Chain Adjuster

Primary Cover

1. Remove foreign material from magnetic drain plug. Install plug and tighten to 14-30 ft-lbs (19-41 Nm).
2. Wipe gasket surface clean. Install **new** gasket on primary cover.
3. See Figure 6-4. Install primary cover and gasket onto left crankcase half using mounting screws. Tighten screws to 100-120 **in-lbs** (11-14 Nm).
4. See Figure 6-1. Install **new** shifter lever oil seal (15).
5. Fit coupling (6) over cable end with rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp (7) around coupling button and rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover.
6. Thread wellnut (5) on adjusting screw (14) until slot of screw is accessible with a screwdriver. Fit wellnut hex into recess of outer ramp and turn adjusting screw counterclockwise.
7. Fill transmission to proper level with fresh lubricant. See 1.9 CLUTCH.
8. Adjust clutch. See 1.9 CLUTCH.
9. Adjust primary chain tension. See 1.12 PRIMARY CHAIN.
10. See Figure Figure 6-5. Apply LOCTITE THREADLOCKER 243 (Blue) to shift lever mounting bolt.
11. Install shifter lever assembly with mounting bolt, washer and plastic bushings and spacer. Do not tighten mounting bolt.
12. Install rubber washer and upper shift lever assembly to splined shaft.
13. See Figure 6-6. Position upper clamp on splined shaft pointing just below front clutch inspection cover bolt. (Shift linkage rod in figure is disconnected for clarity.)
14. Apply LOCTITE THREADLOCKER 243 (Blue) to pinch screw.
15. Install pinch screw to upper clamp and tighten to 59-66 **in-lbs** (7-8 Nm).
16. Adjust shift linkage rod length. See 1.6 SHIFT LINKAGE ROD ADJUSTMENT.
17. Tighten mounting bolt to 27-29 ft-lbs (37-39 Nm).
18. Install muffler. See 2.27 EXHAUST SYSTEM.
19. Install left fairing lower. See 2.38 FAIRING LOWERS.
20. Connect negative cable to battery.



1. **1/4-20 x 1-3/4 in. Bolt with Washers (7)**
2. **1/4-20 x 2-1/4 in. Bolt with Washers (4)**
3. **5/16-18 x 3-1/2 in. Bolt with Washers (2)**

Figure 6-4. Install Primary Cover Bolts

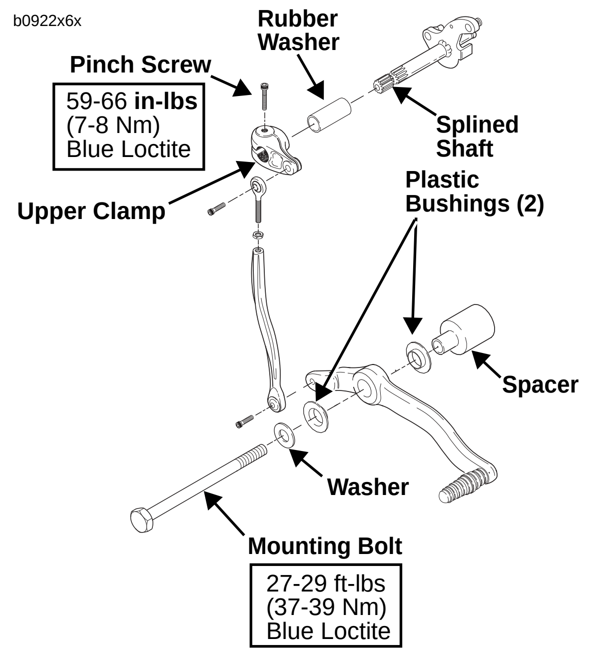


Figure 6-5. Shifter Lever

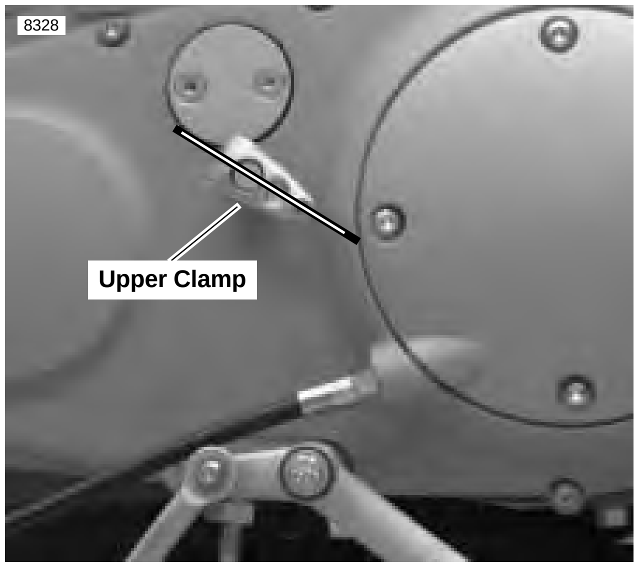


Figure 6-6. Upper Clamp Position

DRIVE BELT 6.3

GENERAL

The drive belt should be checked for unusual wear, cracking or loss of teeth. Check the belt sprocket for unusual wear, broken teeth or damaged flange.

See 1.10 DRIVE BELT DEFLECTION for adjustment information.

See 1.11 DRIVE BELT AND SPROCKET for inspection and cleaning procedures.

REMOVAL

NOTE

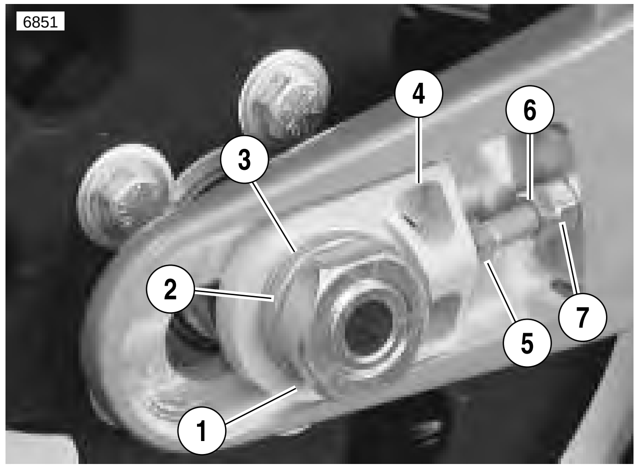
Mark all hardware as it is removed so that it may be returned to its original location.

1. Place vehicle on a lift and anchor front wheel in place.

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

2. Disconnect negative battery cable from battery.
3. Remove seat and attach lifting straps to motorcycle. Insert lifting straps under frame tubes. It is not necessary to remove tail section. See 2.35 SEAT.
4. Attach lifting straps to a floor hoist placed behind the lift. Raise motorcycle off lift until rear suspension is unloaded.
5. Remove the stone guard and lower belt guard. See 2.30 STONE GUARD.
6. Remove sprocket cover. See 2.29 SPROCKET COVER.
7. Remove rear fender. See 2.32 REAR FENDER.
8. See Figure 6-7. Remove rear wheel.
   a. Remove rear axle nut (1) (metric), lockwasher (2), washer (3) and right side axle carrier (4).
   b. Hold axle adjuster bolt (5) with a 5/16 in. wrench. Loosen locknut (6) and axle adjuster screws (7). Repeat on left side.
   c. From left side, slowly pull rear axle from swingarm. As axle is removed, remove right side spacer, rear brake caliper mount, left side axle carrier and washer. Suspend rear brake caliper mount from frame with a piece of rope. Push rear wheel forward and slip off belt.
9. Remove right rear isolator. See 2.20 REAR ISOLATORS.
10. Slide the drive belt from the sprockets between the frame and the swingarm mount block.



1. **Axle nut**
2. **Lockwasher**
3. **Washer**
4. **Axle Carrier**
5. **Adjuster Bolt**
6. **Locknut**
7. **Adjuster Screw**

Figure 6-7. Rear Axle, Right Side

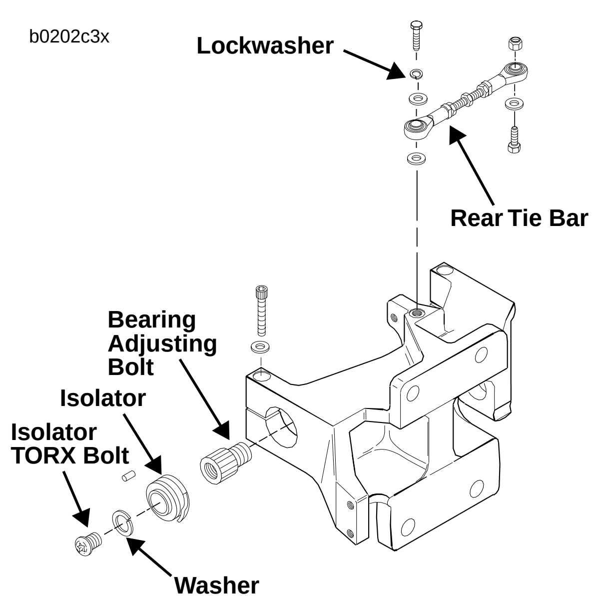


Figure 6-8. Rear Isolators

HOME

INSTALLATION

1. Slide a **new** belt over the sprockets.

CAUTION

- **Use caution when installing isolator bolts. Make sure isolator bolt hole is aligned with threaded hole in bearing adjusting bolt to avoid cross-threading bolt.**
- **Observe seam on rubber isolator after isolator bolt is tightened. If seam twists, apply more LOCTITE ANTI-SEIZE to underside of isolator bolt heads. Failure to comply will result in damage to rubber isolators. See Figure 6-9.**

2. See Figure 6-8. Install right rear isolator. See 2.20 REAR ISOLATORS.
3. See Figure 6-9. After tightening isolator bolt, verify that seam on isolator is perpendicular to swingarm mount block.
4. Install rear fender. See 2.32 REAR FENDER.
5. Align the **new** belt and rear wheel. See 1.10 DRIVE BELT DEFLECTION.
6. Install sprocket cover. See 2.29 SPROCKET COVER.
7. Install the stone guard and lower belt guard. See 2.30 STONE GUARD.
8. Connect negative battery cable to battery.

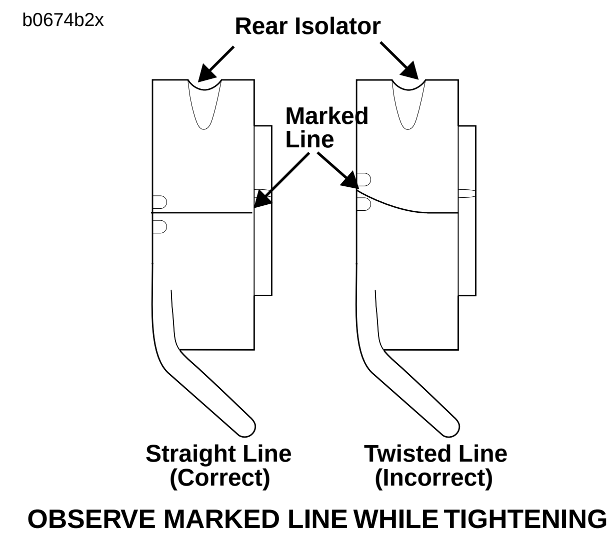


Figure 6-9. Isolator Alignment

CLUTCH RELEASE MECHANISM 6.4

DISASSEMBLY

NOTE

For adjustment procedure, see 1.9 CLUTCH.

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Pull clutch cable ferrule (end of cable housing) away from clutch hand lever bracket. Gap between ferrule and bracket should be 1/16-1/8 (1.6-3.2 mm). Adjust freeplay by turning cable adjuster.
3. See Figure 6-10. Remove four TORX screws with washers (1) and clutch inspection cover (2).
4. Slide spring (3) with attached screw lockplate (4) from flats of adjusting screw (12).
5. Turn adjusting screw (12) clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (5) from end of adjusting screw.
6. Remove hook of ramp from cable end coupling (16). Remove cable end (10) from slot in coupling.
7. Remove and discard retaining ring (13) from ramp assembly to separate inner and outer halves. Remove three balls (7) from ramp sockets.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in cleaning solvent.
2. See Figure 6-10. Inspect three balls (7) 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 (15) and outer (6) 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 1.9 CLUTCH.

1. TORX Screw with Washer (4)
2. Clutch Inspection Cover
3. Spring
4. Lockplate
5. Wellnut
6. Outer Ramp
7. Ball (3)
8. O-Ring
9. Cable End Fitting
10. Clutch Cable End
11. Primary Cover
12. Clutch Adjusting Screw
13. Retaining Ring
14. Quad Ring
15. Inner Ramp
16. Coupling

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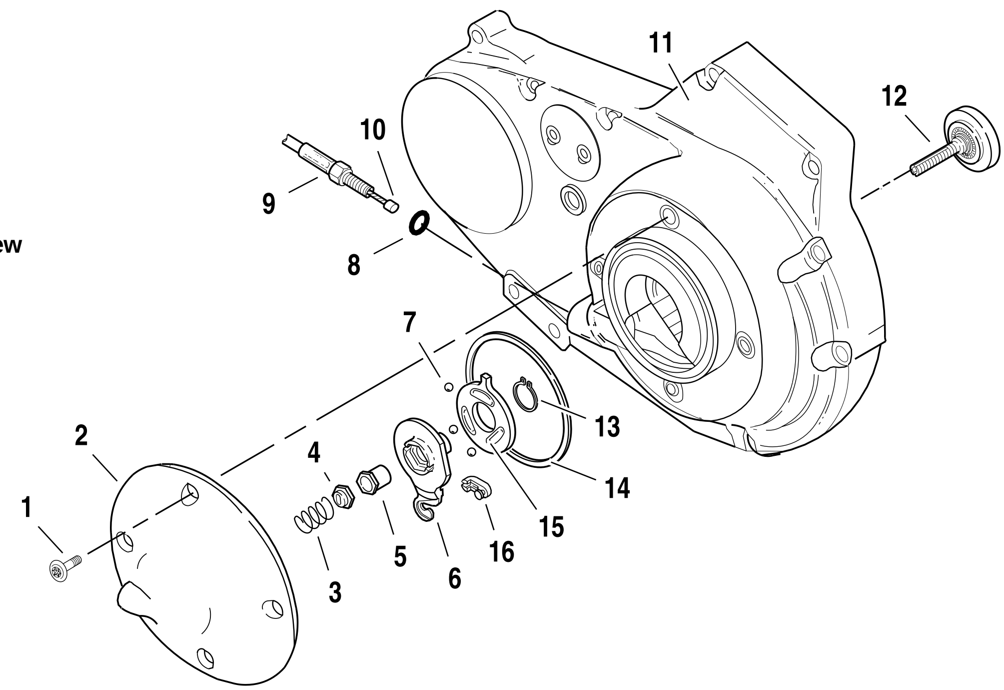
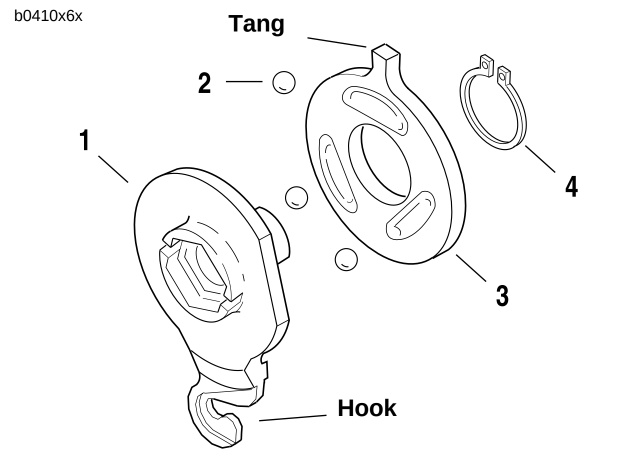


Figure 6-10. Clutch Release Mechanism

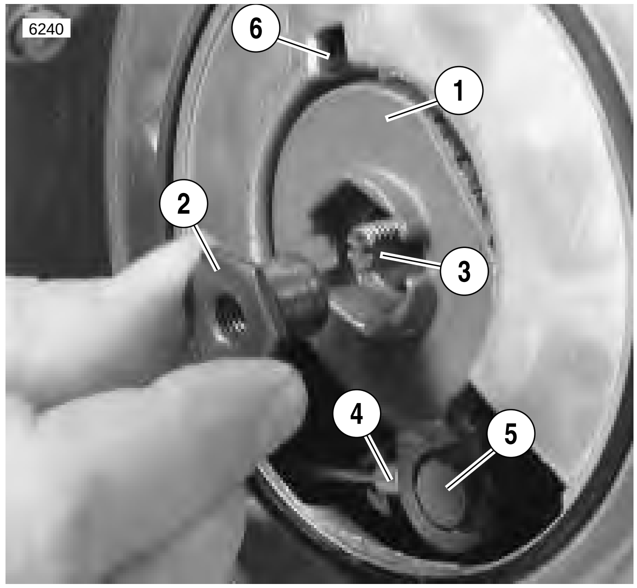
ASSEMBLY

1. See Figure 6-11. Assemble inner and outer ramp.
   a. Apply multi-purpose grease to balls (2) and ramps (1, 3).
   b. Insert balls in sockets of outer ramp (1).
   c. Install inner ramp (3) on hub of outer ramp (1) with tang 180° from hook of outer ramp.
   d. Install **new** retaining ring (4) in groove of outer ramp hub.
2. See Figure 6-12. Install ramp assembly.
   a. Fit coupling (5) over cable end (4) 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 (6).
3. Secure assembly in place.
   a. Thread wellnut (2) on adjusting screw (3) until slot of screw is accessible with a screwdriver.
   b. Fit nut hex into recess of outer ramp (1).
   c. Turn adjusting screw counterclockwise until resistance is felt.
4. Adjust clutch release mechanism. See 1.9 CLUTCH.
5. Connect negative battery cable to battery terminal.



1. **Outer Ramp**
2. **Balls (3)**
3. **Inner Ramp**
4. **Retaining Ring**

Figure 6-11. Inner and Outer Ramp



1. **Outer Ramp**
2. **Wellnut**
3. **Adjusting Screw**
4. **Cable End**
5. **Coupling**
6. **Slot of Primary Cover**

Figure 6-12. Nut and Outer Ramp

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 6-13. The clutch is a wet, multiple-disc clutch with six steel plates (1), one spring plate (2) and eight fiber (friction) plates (3) stacked alternately in the clutch shell (4). The order of plate assembly, from inboard to outboard, is as follows:

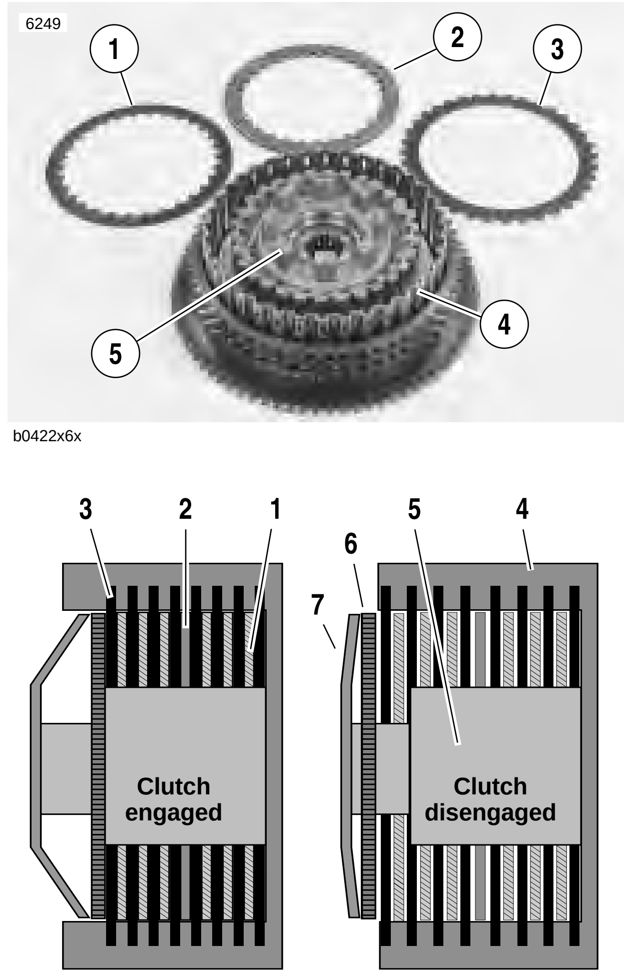
F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

(F = Fiber plate, St = Steel plate, **Sp** = Spring plate)

The fiber plates (clutch driving plates) are keyed to the clutch shell (4), which is driven by the engine through the primary chain. The steel plates (clutch driven plates) and the centrally located spring plate (also a clutch driven plate) are keyed to the clutch hub (5), which drives the rear wheel through the transmission and secondary drive belt.

When the clutch is engaged (clutch lever released), the diaphragm spring (7) applies strong inward force against the pressure plate (6). The pressure plate then presses the clutch plates (1, 2 and 3) together, allowing no slippage between the plates and causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell (4) is fully transmitted through the “locked” clutch plates to the clutch hub (5). 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 (6) is pulled outward (by clutch cable action) against the diaphragm spring (7), thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates (1, 2 and 3) together. The fiber plates (3) are now free to rotate at a different relative speed than that of the steel (1) and spring (2) plates (i.e. – slippage between the clutch plates occurs). The result is that the rotational force of the clutch shell (4) is no longer fully transmitted through the “unlocked” clutch plates to the clutch hub (5). The engine is free to rotate at a different speed than the rear wheel.



1. **Steel Plate (6)**
2. **Spring Plate**
3. **Fiber Plate (8)**
4. **Clutch Shell**
5. **Clutch Hub**
6. **Pressure Plate**
7. **Diaphragm Spring**

Figure 6-13. Clutch Plates and Hub/Shell Assembly

Table 6-1. Clutch Troubleshooting

SYMPTOM	CAUSE (CHECK IN FOLLOWING ORDER)	REMEDY
Clutch slips.	Incorrect clutch release adjustment. Worn clutch plates.	Check and adjust clutch release mechanism. Check service wear limits. Replace plates.
Clutch drags.	Incorrect clutch release adjustment. Worn clutch release ramps or balls. Warped clutch steel plates. Blade worn or damaged clutch gear splines. Overfilled primary.	Check and adjust clutch release mechanism. Replace release ramps and/or balls. Replace clutch steel plates. Replace clutch gear or hub as required. Drain lubricant to correct level.

REMOVAL/DISASSEMBLY

Clutch Pack

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect the negative battery cable from the battery.
2. Remove primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
3. Remove the left fairing lower. See 2.38 FAIRING LOWERS.

WARNING

Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL (Part No. HD-38515-A), CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) and proper eye protection. Otherwise, the highly compressed diaphragm spring could fly out with great force, which could result in death or serious injury.

4. See Figure 6-14. Attach tools to compress clutch diaphragm spring.
   a. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (1) onto the clutch adjusting screw.
   b. Place the bridge (2) of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring (6).
   c. Install bearing (3) and washer (4).
   d. Thread the tool handle (5) onto end of forcing screw.

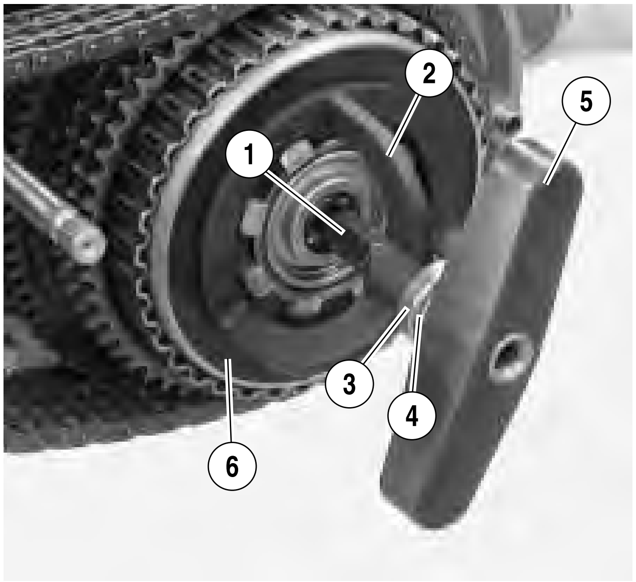
WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

CAUTION

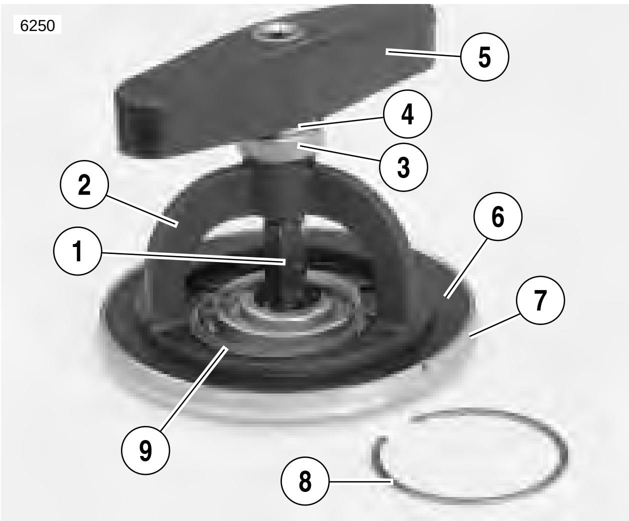
See Figure 6-15. Turn compressing tool handle (5) only the amount required to release spring seat (9) and remove snap ring (8). Excessive compression of diaphragm spring (6) could damage clutch pressure plate (7).

5. Remove pressure plate assembly.
   a. Place a wrench on the clutch spring forcing screw (1) flats to prevent the forcing screw from turning.
   b. Turn compressing tool handle (5) clockwise until tool relieves pressure on snap ring (8) and spring seat (9). Remove and discard snap ring (8).
   c. Unseat spring seat (9) from the groove in clutch hub prongs.
   d. Remove pressure plate assembly.
6. See Figure 6-16. Remove the clutch pack from the hub/shell assembly. The pack consists of eight fiber plates (18), six steel plates (19) and a spring plate (20).



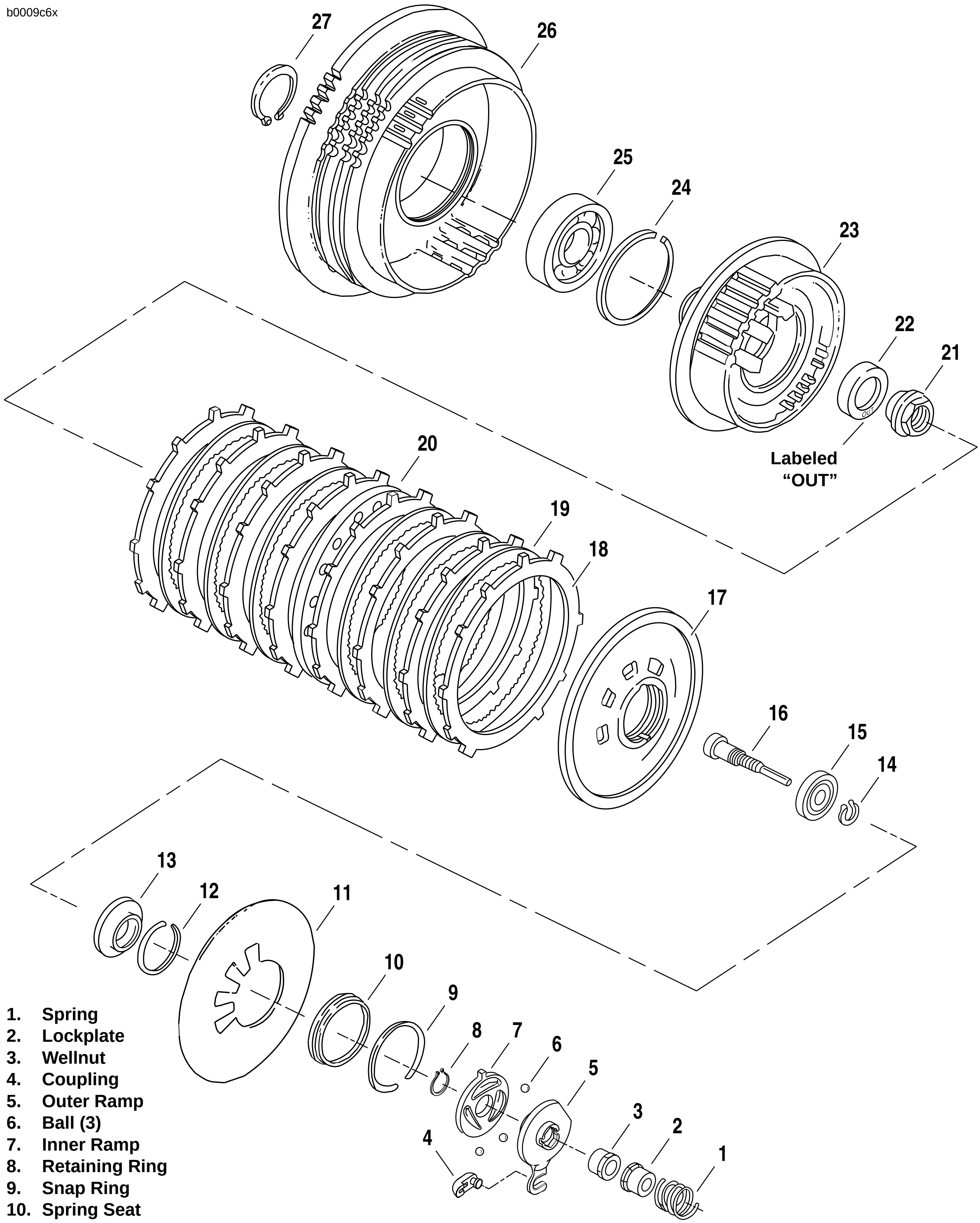
1. Clutch Spring Forcing Screw
2. Bridge
3. Bearing
4. Washer
5. Tool Handle
6. Diaphragm Spring

Figure 6-14. Compressing Clutch Diaphragm Spring



1. Clutch Spring Forcing Screw
2. Bridge
3. Bearing
4. Washer
5. Tool Handle
6. Diaphragm Spring
7. Pressure Plate
8. Snap Ring
9. Spring Seat

Figure 6-15. Pressure Plate Assembly



1. Spring
2. Lockplate
3. Wellnut
4. Coupling
5. Outer Ramp
6. Ball (3)
7. Inner Ramp
8. Retaining Ring
9. Snap Ring
10. Spring Seat
11. Diaphragm Spring
12. Retaining Ring
13. Release Plate
14. Retaining Ring
15. Bearing
16. Adjusting Screw
17. Pressure Plate
18. Fiber Plate (8)
19. Steel Plate (6)
20. Spring Plate
21. Mainshaft Nut
22. Washer
23. Clutch Hub
24. Retaining Ring
25. Bearing
26. Clutch Shell
27. Retaining Ring

Figure 6-16. Clutch Assembly

Primary Chain/Drive

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Remove the negative battery cable from the battery.
2. Remove primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
3. Install the left fairing lower. See 2.38 FAIRING LOWERS.
4. Loosen engine sprocket.
   a. 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 6-17. Remove adjusting screw assembly.

⚠WARNING

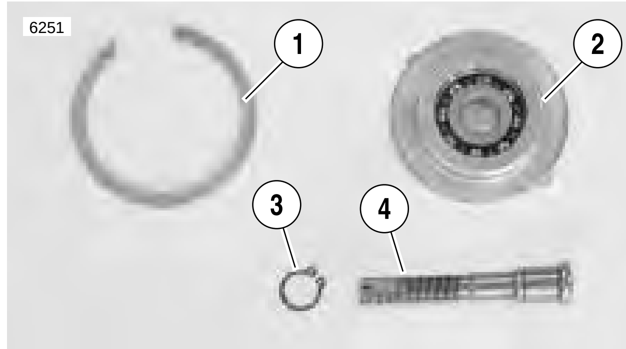
Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

   a. Remove large retaining ring (1).
   b. Remove adjusting screw assembly (2, 3 and 4) from pressure plate.

CAUTION

See Figure 6-16. Mainshaft nut (21) has left-hand threads. To prevent damage, turn nut clockwise to loosen and remove from mainshaft.

6. Remove mainshaft nut (21) and washer (22).
7. Remove the clutch assembly, primary chain and engine sprocket as a unit.
   a. Inspect primary chain and sprockets for damage or excessive wear.
   b. Inspect stator and rotor. See 7.9 ALTERNATOR.
   c. Replace damaged parts as necessary.
8. Install adjusting screw assembly into pressure plate.
   a. See Figure 6-18. Align two tabs on perimeter of release plate with corresponding recesses in pressure plate.
   b. See Figure 6-17. Secure the adjusting screw assembly with large retaining ring (1).
9. Attach tools to compress clutch diaphragm spring. See Step 2 of CLUTCH PACK under 6.5 PRIMARY DRIVE/CLUTCH.
10. Remove clutch pack components. See Steps 4-5 of CLUTCH PACK under 6.5 PRIMARY DRIVE/CLUTCH.



1. **Retaining Ring**
2. **Bearing and Release Plate**
3. **Retaining Ring**
4. **Adjusting Screw**

Figure 6-17. Adjusting Screw Assembly

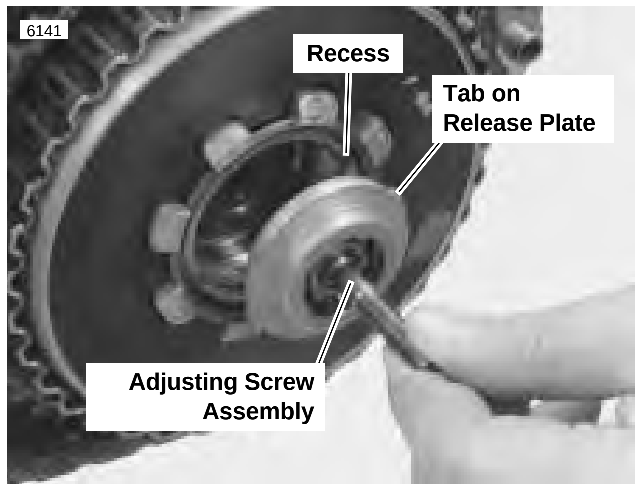


Figure 6-18. Aligning Tabs

11. See Figure 6-15. Disassemble pressure plate.
    a. Place a wrench on the clutch spring forcing screw (1) flats to prevent the forcing screw from turning.
    b. Turn the compressing tool handle (5) counterclockwise until the handle spins off.
    c. Remove washer (4), bearing (3) and bridge (2).
    d. Remove clutch spring forcing screw (1) from clutch adjusting screw.
    e. Remove spring seat (9) and diaphragm spring (6) from pressure plate (7).
12. See Figure 6-17. Remove and disassemble adjusting screw assembly.

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

   a. Remove large retaining ring (1).
   b. Remove adjusting screw assembly (2, 3 and 4) from pressure plate.

c. If necessary, disassemble adjusting screw assembly. Remove and discard small retaining ring (3) and then separate the adjusting screw (4) from the bearing and release plate (2). Remove bearing from release plate.

CAUTION

See Figure 6-16. Due to the possible damage to the bearing (25), the clutch hub (23) and shell (26) assembly should not be disassembled unless the bearing, hub or shell require replacement. If the assembly is pressed apart, the bearing must be replaced.

13. Disassemble clutch hub and clutch shell if necessary.

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

a. Remove retaining ring (27) from inboard end of clutch hub (23).

b. Using an arbor press, separate clutch hub (23) from assembly of clutch shell (26), bearing (25) and retaining ring (24).

c. Remove retaining ring (24) from groove in clutch shell (26).

d. Press on the inboard side of bearing (25) outer race to remove bearing from clutch shell.

INSPECTION/REPAIR

1. See Figure 6-16. Wash all parts, except fiber (friction) plates (18) and bearing (25), in cleaning solvent. Blow dry with compressed air. Examine the clutch components as follows:

   a. Check all clutch plates for wear and discoloration.

   b. Inspect each steel (drive) plate (19) 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. (0.152 mm).

2. Check the diaphragm spring (11) for cracks or bent tabs. Install a **new** spring if either condition exists.

3. See Figure 6-19. Check fiber plates for thickness.

   a. Wipe the lubricant from the eight fiber plates 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.

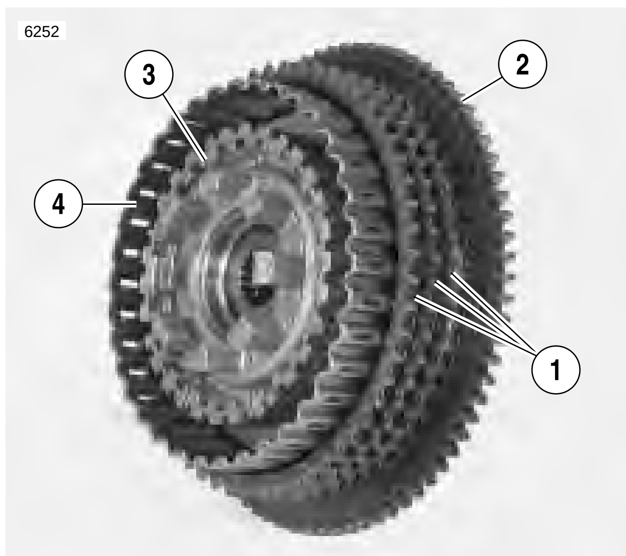
4. See Figure 6-20. Check the clutch shell.

   a. Inspect primary chain sprocket (1) and the starter ring gear (2) on the clutch shell. If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.

   b. Check the slots that mate with the clutch plates on both clutch shell (4) and hub (3). If slots are worn or damaged, replace shell and/or hub.

   c. If clutch shell was removed from motorcycle, check the bearing for smoothness. Rotate the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced.

Figure 6-19. Measuring Friction Plates



1. **Primary Chain Sprocket**
2. **Starter Ring Gear**
3. **Slots on Clutch Hub**
4. **Slots on Clutch Shell**

Figure 6-20. Checking Clutch Shell

ASSEMBLY

Clutch Pack

1. See Figure 6-16. Install the clutch pack, which consists of eight fiber plates (18), six steel plates (19) and a spring plate (20), into the clutch hub (23). The order of plate assembly, from inboard to outboard, is as follows:

   F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

   (F = Fiber plate, St = Steel plate, **Sp** = Spring plate)

CAUTION

See Figure 6-15. Turn compressing tool handle (5) only the amount required to install spring seat (9) and snap ring (8). Excessive compression of diaphragm spring (6) could damage clutch pressure plate (7).

2. Place assembly of spring seat, **new** snap ring, diaphragm spring, pressure plate, adjusting screw components and compressing tool onto clutch hub and against clutch pack.

   a. See Figure 6-21. Align square openings of pressure plate and diaphragm spring (1) so that the assembly can be installed over prongs (2) of clutch hub.

   b. Position spring seat (5) with its larger O.D. side toward diaphragm spring (1).

   c. See Figure 6-15. Place a wrench on the clutch spring forcing screw (1) flats to prevent the forcing screw from turning.

   d. Turn compressing tool handle (5) clockwise until diaphragm spring (6) compresses just enough to install spring seat (9) and **new** snap ring (8) into the groove in clutch hub prongs.

   e. With snap ring positioned against outboard side of spring seat, and fully seated in groove of clutch hub, carefully loosen and remove compression tool.

Primary Drive

1. See Figure 6-22. Assemble clutch hub and shell if necessary.

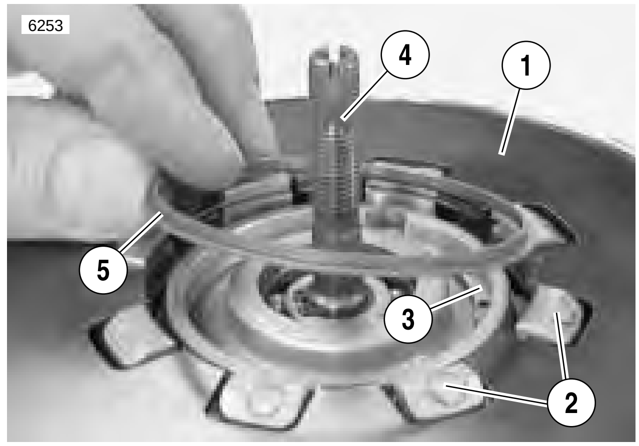
   a. Press **new** bearing (3) in clutch shell (4). Secure bearing with a **new** retaining ring (2).

   b. Press inboard end of clutch hub (1) into shell bearing (3). Secure with **new** retaining ring (5) on end of hub.

2. Assemble pressure plate hardware.

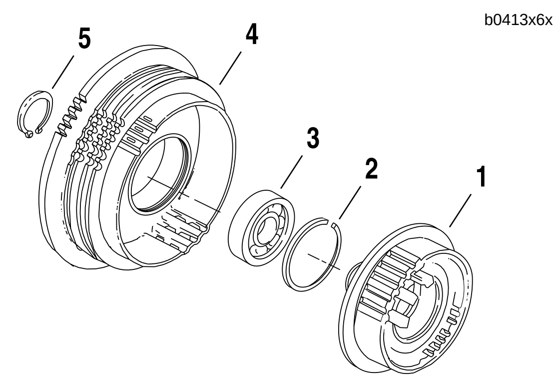
   a. See Figure 6-17. Place bearing inside release plate. Insert adjusting screw (4) through bearing and release plate (2). Secure with **new** retaining ring (3).

   b. See Figure 6-21. Position diaphragm spring (1) with its concave side facing toward pressure plate onto pressure plate assembly.



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. **Clutch Hub**
2. **Retaining Ring**
3. **Bearing**
4. **Clutch Shell**
5. **Retaining Ring**

Figure 6-22. Clutch Hub and Shell Assembly

   c. Insert adjusting screw assembly (4) into pressure plate. Secure with large retaining ring (3).

   d. Position spring seat (5) with its larger O.D. side toward diaphragm spring.

3. Attach tools to compress clutch diaphragm spring. See Step 2 of CLUTCH PACK under 6.5 PRIMARY DRIVE/CLUTCH. Do not tighten compressing tool against diaphragm spring at this time.

4. Install the clutch pack. Follow all instructions of CLUTCH PACK under 6.5 PRIMARY DRIVE/CLUTCH.

INSTALLATION

NOTE

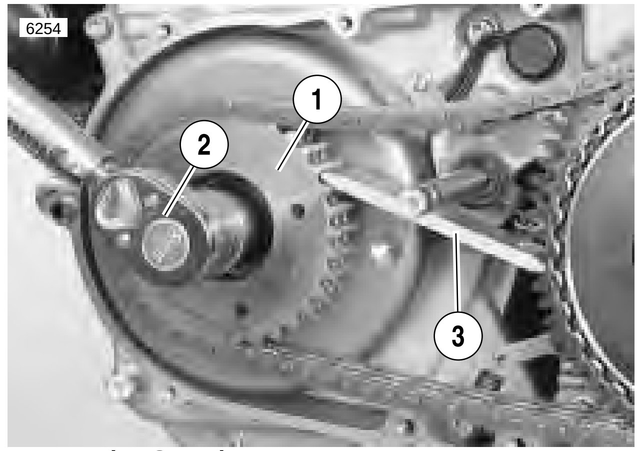
If clutch pack replacement was the only service work performed, start with Step 5.

1. Install the engine sprocket, clutch assembly and primary chain as a unit into primary chaincase.
2. See Figure 6-23. Install the engine sprocket nut.
   a. Place SPROCKET LOCKING LINK (3) (Part No. HD-38362) between primary chain and engine sprocket.
   b. Apply two or three drops of LOCTITE THREADLOCKER 262 (red) onto threads of sprocket shaft.
   c. Install engine sprocket nut. Tighten to 190-210 ft-lbs (258-285 Nm).

CAUTION

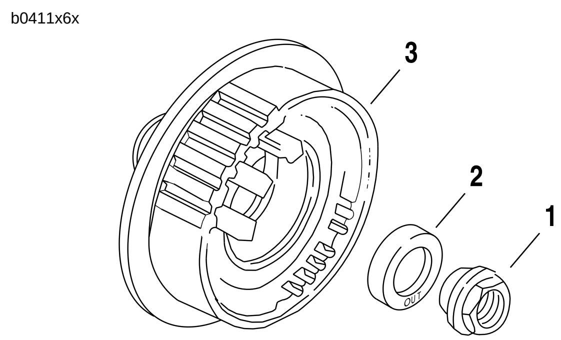
See Figure 6-24. Washer (2) must be installed with the word "out" facing the mainshaft nut (1) or transmission may be damaged.

3. Install mainshaft nut and washer.
   a. Apply two or three drops of LOCTITE THREADLOCKER 262 (red) onto threads on end of mainshaft.
   b. Place washer (2) on mainshaft with the word "out" facing away from clutch hub (3).
   c. Install nut (1) **(left-hand threads)**. Tighten to 70-80 ft-lbs (95-109 Nm).
4. Remove SPROCKET LOCKING LINK.
5. Install adjusting screw assembly into pressure plate.
   a. See Figure 6-18. Align two tabs on perimeter of release plate with corresponding recesses in pressure plate.
   b. See Figure 6-17. Secure the adjusting screw assembly with retaining ring.
6. Install primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
7. Install the left fairing lower. See 2.38 FAIRING LOWERS.
8. Connect negative battery cable to battery.



1. **Engine Sprocket**
2. **Torque Wrench**
3. **Sprocket Locking Link (Part No. HD-38362)**

Figure 6-23. Sprocket Locking Link



1. **Mainshaft Nut**
2. **Washer**
3. **Clutch Hub**

Figure 6-24. Mainshaft Nut and Washer

TRANSMISSION 6.6

GENERAL

See Figure 6-25. 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 shift 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 clutch gears, on the mainshaft and countershaft, into and out of mesh with the other gears.

LUBRICATION

Drain transmission and refill to correct level with fresh, clean lubricant at least once each year or every 5000 miles (8000 km), whichever comes first. For best results, drain lubricant while hot.

See 1.9 CLUTCH for more information.

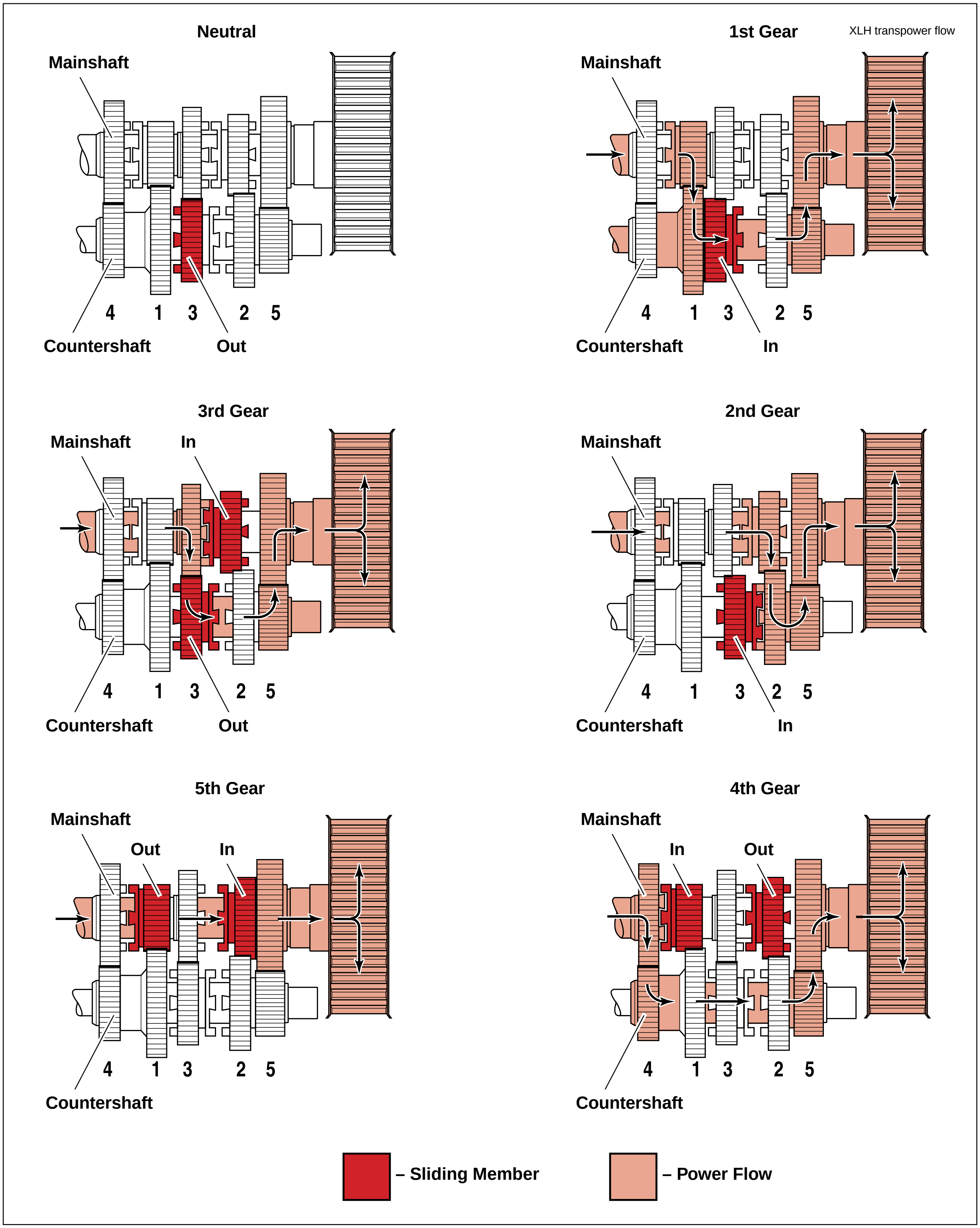


Figure 6-25. Transmission Power Flow

TRANSMISSION CASE 6.7

GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. An access cover (door) allows removal of transmission components without removing the engine or disassembling (splitting) the crankcase.

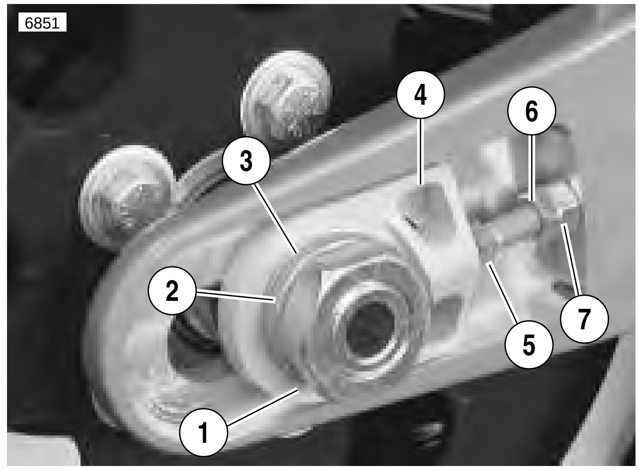
REMOVAL

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove muffler and drain primary drive/transmission. See 1.9 CLUTCH.
3. Remove sprocket cover. See 2.29 SPROCKET COVER.
4. Remove the left fairing lower. See 2.38 FAIRING LOWERS.
5. Remove rear fender. See 2.32 REAR FENDER.
6. See Figure 6-26. Loosen rear axle nut (2) (metric). Reduce tension on secondary drive belt by turning axle adjuster nuts (1) on each side of swingarm an equal number of turns counterclockwise. Move rear wheel as far forward as possible.
7. See Figure 6-27. Place transmission in first gear. Remove four socket head screws (5) and lockplate (4).

CAUTION

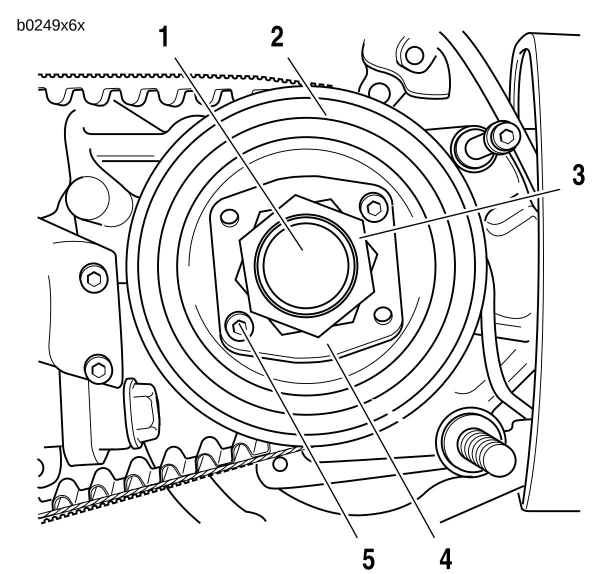
Transmission sprocket nut has left-hand threads. To prevent damage, turn nut clockwise to loosen and remove from main drive gear shaft.

8. Remove transmission sprocket nut (3) from main drive gear shaft (1).
9. Remove secondary drive belt from transmission sprocket (2). Remove transmission sprocket from main drive gear shaft (1).
10. Remove primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
11. Remove the left fairing lower. See 2.38 FAIRING LOWERS.
12. Remove clutch assembly, primary chain and engine sprocket. See PRIMARY CHAIN/DRIVE under 6.5 PRIMARY DRIVE/CLUTCH.



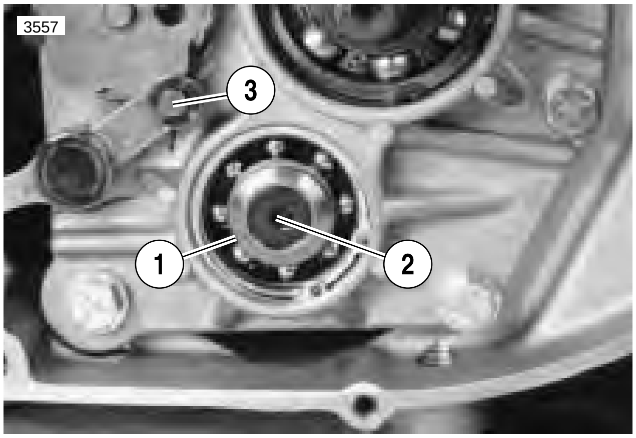
1. **Axle nut**
2. **Lockwasher**
3. **Washer**
4. **Axle Carrier**
5. **Adjuster Bolt**
6. **Locknut**
7. **Adjuster Screw**

Figure 6-26. Secondary Drive Belt Adjustment



1. **Main Drive Gear Shaft**
2. **Transmission Sprocket**
3. **Transmission Sprocket Nut (left-hand threads)**
4. **Lockplate**
5. **Socket Head Screw (4)**

Figure 6-27. Transmission Sprocket



1. **Retention Collar**
2. **TORX Screw**
3. **Detent Roller Arm**

Figure 6-28. Countershaft Retainer

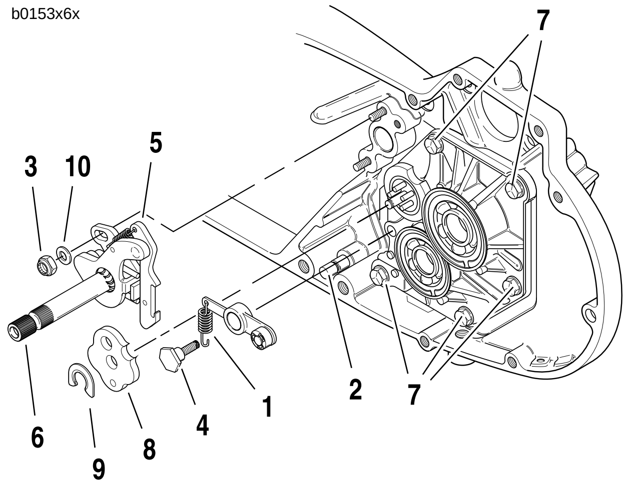
13. See Figure 6-28. Lock transmission in gear. Remove countershaft TORX screw (2) and retention collar (1).
14. See Figure 6-29. Detach spring (1) from groove in post (2).
15. Remove retaining ring (9) and detent plate (8). You will need to use a **new** retaining ring for installation.
16. Remove two locknuts (3) and washers (10) which attach shifter shaft assembly (6) to studs at transmission case. Remove shifter shaft assembly.
17. Remove five access door bolts with captive washers (7). Remove transmission assembly by pulling it straight outward, away from transmission case.

CLEANING AND INSPECTION

Thoroughly clean transmission compartment with cleaning solvent. Blow parts dry with compressed air. Inspect parts to determine if any must be replaced. Replace all parts that are badly worn or damaged.

Neutral Indicator Switch

See Figure 6-30. The neutral indicator switch is threaded into the transmission portion of the right crankcase half. See 7.7 NEUTRAL INDICATOR SWITCH for testing, removal and installation procedures.



1. **Spring**
2. **Post**
3. **Locknut (2)**
4. **Detent Screw**
5. **Pawl**
6. **Shifter Shaft Assembly**
7. **Bolt w/Captive Washer (5)**
8. **Detent Plate (Typical)**
9. **Retaining Ring**
10. **Washer (2)**

Figure 6-29. Shifter Shaft Assembly

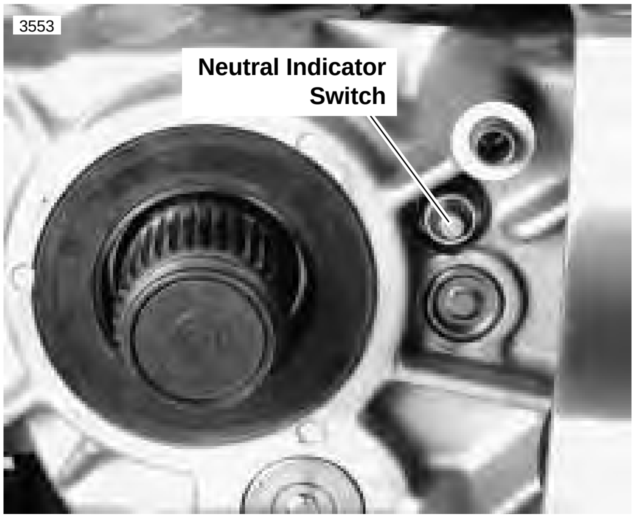


Figure 6-30. Neutral Indicator Switch

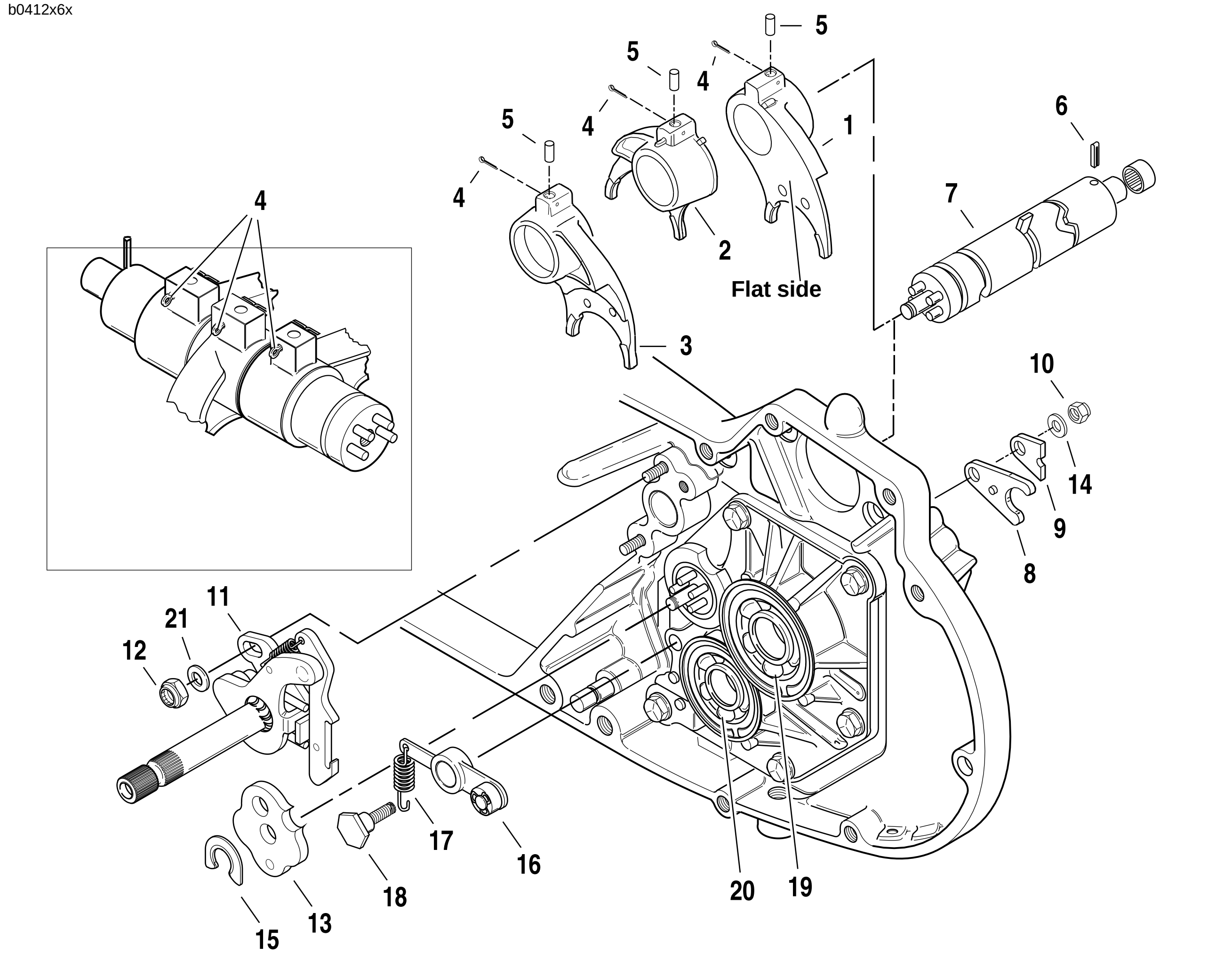
SHIFTER FORKS AND DRUM 6.8

DISASSEMBLY

1. Remove transmission assembly. See 6.7 TRANSMISSION CASE. Mount transmission assembly in vise with protected jaws.
2. See Figure 6-31. Remove nut (10), washer (14), detent screw (18), plates (8, 9), detent arm (16) and spring (17).
3. Remove and discard the three fork cotter pins (4).
4. Remove three shifter fork pins (5). A small magnet is useful in freeing the fork pins (5).
5. Slide shifter fork drum (7) away from access door, through shifter forks. The neutral indicator pin prevents removal in the other direction.
6. Remove shifter forks (1, 2 and 3).

CLEANING AND INSPECTION

1. See Figure 6-31. Clean all parts except bearings (19, 20) with solvent.



1.	**Shifter Fork 3rd and 5th Gear**	**8.**	**Shifter Drum Plate**	**15.**	**Retaining Ring**
2.	**Shifter Fork 1st and 2nd Gear**	**9.**	**Reinforcing Plate**	**16.**	**Detent Arm**
3.	**Shifter Fork 4th Gear**	**10.**	**Nut (2)**	**17.**	**Spring**
4.	**Cotter Pin (3)**	**11.**	**Shifter Shaft Assembly**	**18.**	**Detent Screw**
5.	**Shifter Fork Pin (3)**	**12.**	**Locknut (2)**	**19.**	**Mainshaft Bearing**
6.	**Neutral Indicator Pin**	**13.**	**Detent Plate (Typical)**	**20.**	**Countershaft Bearing**
7.	**Shifter Fork Drum**	**14.**	**Washer (2)**	**21.**	**Washer (2)**

Figure 6-31. Shifter Mechanism

2. Inspect bearings (19, 20) and shifter drum ends. If ends of shifter drum are pitted or grooved, replace the shifter drum and bearings. If replacing bearings, see 6.11 ACCESS DOOR BEARINGS.

3. Inspect shifter fork drum (7) for cracks or wear. Replace if necessary.

ASSEMBLY

1. See Figure 6-32. Identify all shifter forks before assembly. Note shape of fork and location of fork pin holes.

2. Install shifter forks.

   a. Lubricate the shaft bore in of all three shifter forks (1, 2 and 3) with SPORT-TRANS FLUID.

   b. Place 3rd and 5th gear shifter fork (1) in the fork groove of mainshaft 2nd gear. Be sure the flat side of fork is facing the access cover.

   c. Place 1st and 2nd gear shifter fork (2) in the fork groove of countershaft 3rd gear. Be sure the flat side of fork is facing away from the access door.

   d. Place 4th gear shifter fork (3) in the fork groove of mainshaft 1st gear. Be sure the flat side of fork is facing away from the access door.

3. See Figure 6-31. Install shifter shaft drum.

   a. Position the shifter drum shaft so that the neutral indicator pin (6) is upward. The shaft is then in the neutral position.

   b. Insert the pin end of shifter drum shaft (7) through the hubs of shifter forks (1, 2 and 3) and through the bearing in access cover.

   c. Align the hole through the top of each shifter fork with the appropriate cam groove in the shifter drum.

CAUTION

The cotter pins must be inserted through the shifter forks as shown in Figure 6-32. This will prevent possible damage to the cotter pins.

4. See Figure 6-31. Secure shifter mechanism.

   a. Lubricate the three shifter fork pins (5) with SPORT-TRANS FLUID.

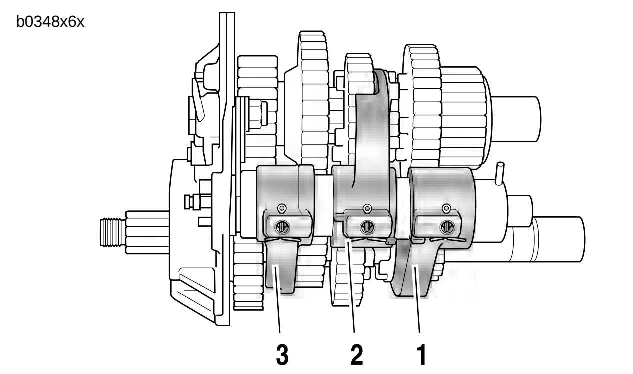
   b. Drop fork pins (5) through the holes in shifter forks.

   c. With a small screwdriver press on the pins while manipulating the forks back and forth until the pin seats in the drum groove.

   d. Secure shifter fork pins with **new** cotter pins (4).

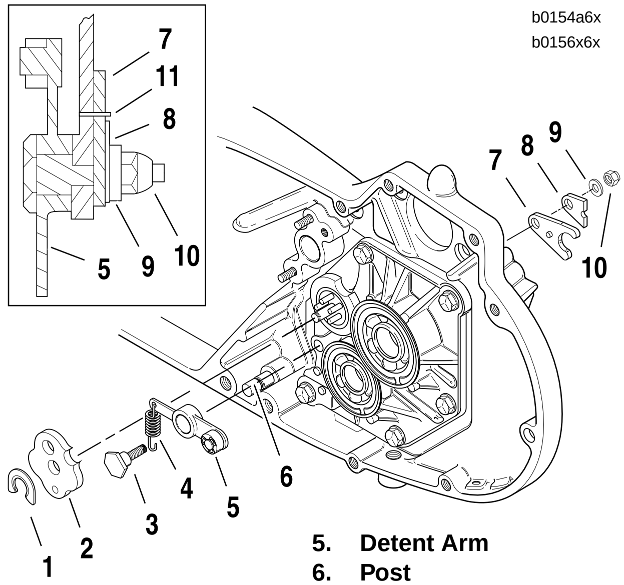
NOTE

See Figure 6-33. Detent plate (2) and retaining ring (1) are not installed at this time. These parts are installed during transmission installation after the final shifter pawl adjustment is made. See 6.13 TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT.



1. **Shifter Fork 3rd and 5th Gear**
2. **Shifter Fork 1st and 2nd Gear**
3. **Shifter Fork 4th Gear**

Figure 6-32. Shifter Fork Identification



1. **Retaining Ring**
2. **Detent Plate (Typical)**
3. **Detent Screw**
4. **Spring**
5. **Detent Arm**
6. **Post**
7. **Shifter Drum Plate**
8. **Reinforcing Plate**
9. **Washer**
10. **Nut**
11. **Pin**

Figure 6-33. Detent Plate Mounting

5. Install detent plate hardware.

   a. At the inside of the access door, place the shifter drum plate (7) in the groove of the drum shaft. See inset Figure 6-33.

   b. Correctly align reinforcement plate (8) with the pin pressed in the shifter drum plate (7).

   c. Insert detent screw (3) through detent arm (5), access door, shifter drum plate (7), reinforcing plate (8) and washer (9).

   d. Thread nut (10) on detent screw. Tighten to 13-17 ft-lbs (18-23 Nm).

NOTE

See Figure 6-28. Install detent arm roller (3) between countershaft bearing and detent plate.

DISASSEMBLY

1. Remove transmission assembly. See 6.7 TRANSMISSION CASE. See Figure 6-34. Clamp transmission assembly in a vise, with protective jaws, to work on disassembly.
2. Remove shifter forks and drum as described under 6.8 SHIFTER FORKS AND DRUM.

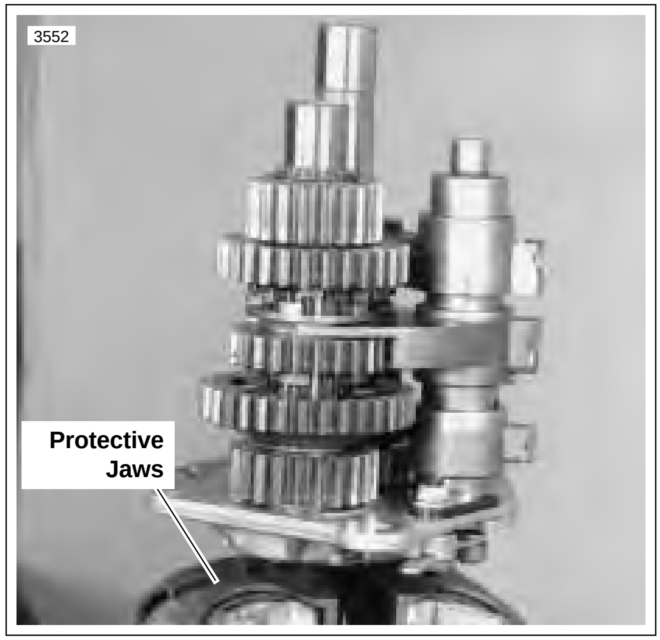


Figure 6-34.

NOTE

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.

3. See Figure 6-35. As each component is removed, place it on a clean surface in the exact order of removal.

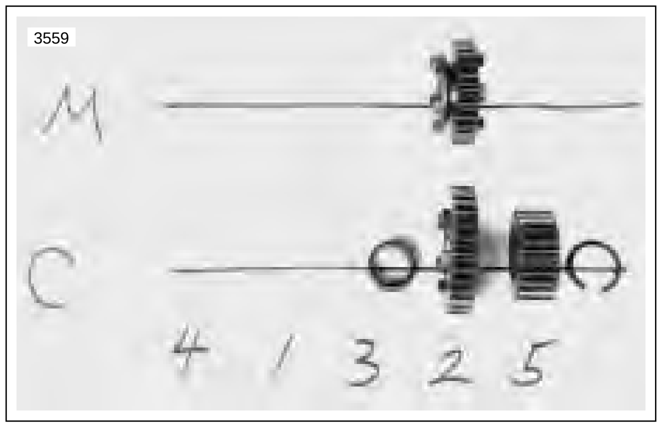


Figure 6-35.

WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

See Figure 6-36. Using RETAINING RING PLIERS (Part No. J-5586) remove and discard retaining ring (5) next to countershaft 5th gear (12). Slide countershaft 5th (12), mainshaft 2nd (22) and countershaft 2nd (11) off end of shafts.

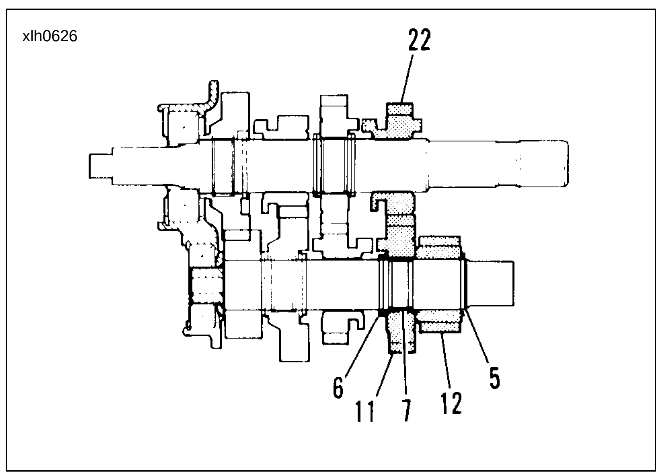
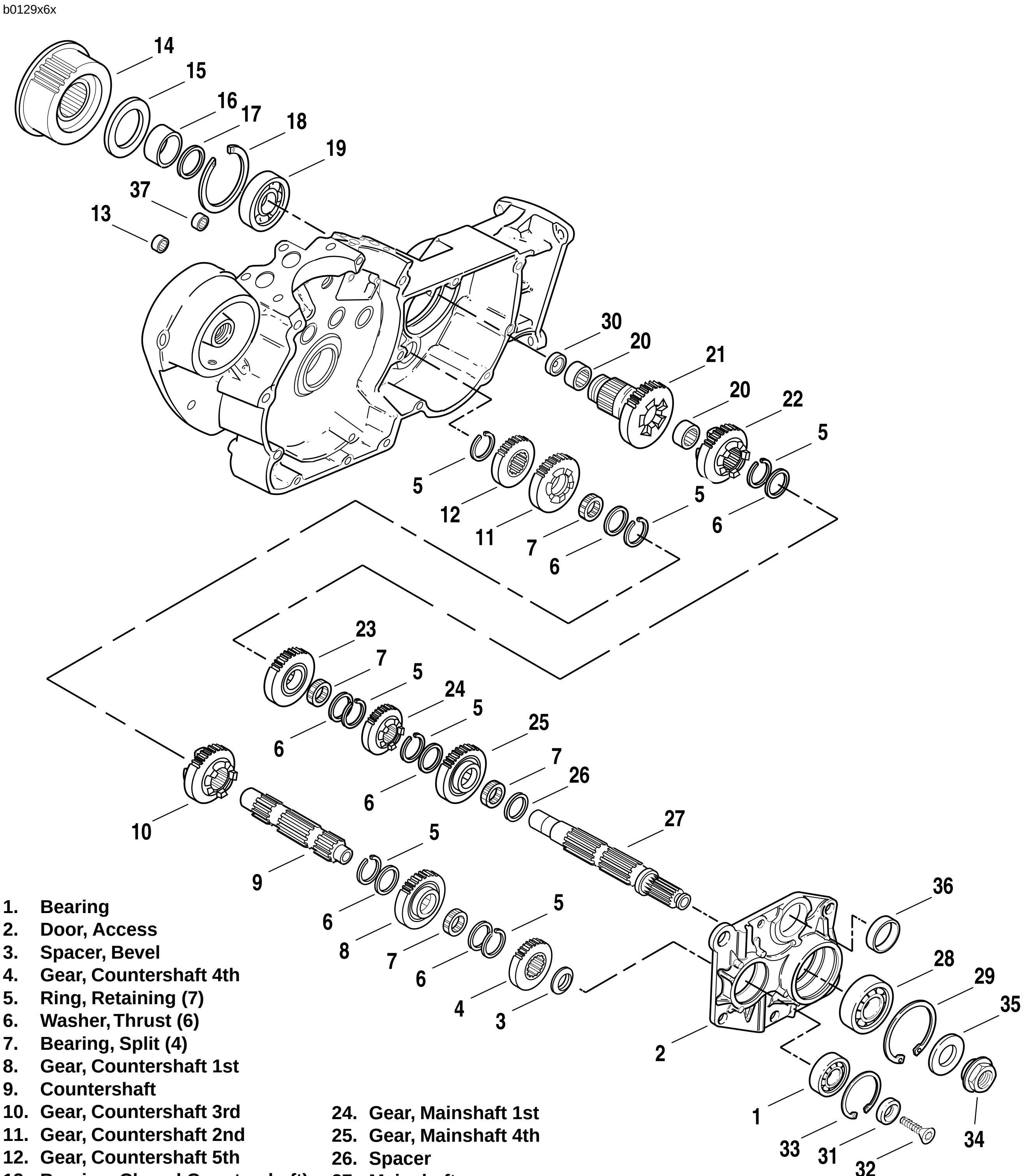


Figure 6-36.



1. Bearing
2. Door, Access
3. Spacer, Bevel
4. Gear, Countershaft 4th
5. Ring, Retaining (7)
6. Washer, Thrust (6)
7. Bearing, Split (4)
8. Gear, Countershaft 1st
9. Countershaft
10. Gear, Countershaft 3rd
11. Gear, Countershaft 2nd
12. Gear, Countershaft 5th
13. Bearing, Closed Countershaft)
14. Sprocket, Belt
15. Seal, Oil
16. Spacer (Belt Drive)
17. Ring, Quad
18. Ring, Retaining
19. Bearing, Ball
20. Bearing, Needle
21. Gear, Mainshaft 5th
22. Gear, Mainshaft 2nd
23. Gear, Mainshaft 3rd
24. Gear, Mainshaft 1st
25. Gear, Mainshaft 4th
26. Spacer
27. Mainshaft
28. Bearing
29. Ring, Retaining
30. Seal
31. Retention Collar
32. TORX Screw
33. Ring, Retaining
34. Nut, Mainshaft
35. Washer, Spring
36. Bushing
37. Bearing Closed (Shifter Shaft)

Figure 6-37. Transmission Assembly

4. Remove split bearing (7) that was under gear (11) and thrust washer (6) on the countershaft. See Figure 6-38. Remove retaining ring (5) next to countershaft 3rd gear (10). Slide countershaft 3rd gear (10) off free end of shaft.
5. At mainshaft, between mainshaft 1st gear (24) and mainshaft 3rd gear (23), expand retaining ring (5) and move next to mainshaft 1st gear along with thrust washer (6). Move mainshaft 3rd gear as far as possible toward mainshaft 1st gear (24). Expand retaining ring (5) at opposite side of mainshaft 3rd gear and slide off end of shaft. Remove mainshaft 3rd gear (23) and its split bearing (7).
6. Slide thrust washer (6) off end of mainshaft. Expand retaining ring (5), which is next to mainshaft 1st gear (24), and slide off end of shaft.

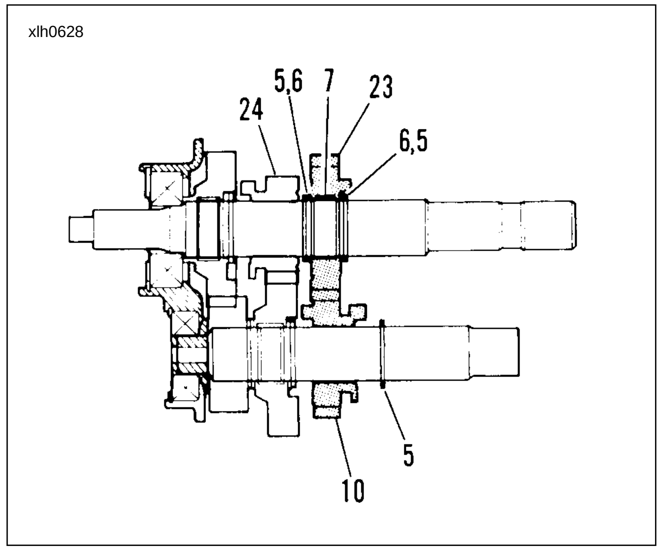


Figure 6-38.

7. See Figure 6-39. Place COUNTERSHAFT GEAR SUPPORT PLATE (Part No. HD-37404) under countershaft 4th gear (4). Place assembly on press with suitable metal blocks under the support plate. Place a socket or mandrel, smaller than inside diameter of bearing, and press countershaft free of access cover. Slide mainshaft 1st gear (24) off mainshaft.
8. See Figure 6-40. Remove beveled spacer (3) and countershaft 4th gear (4).

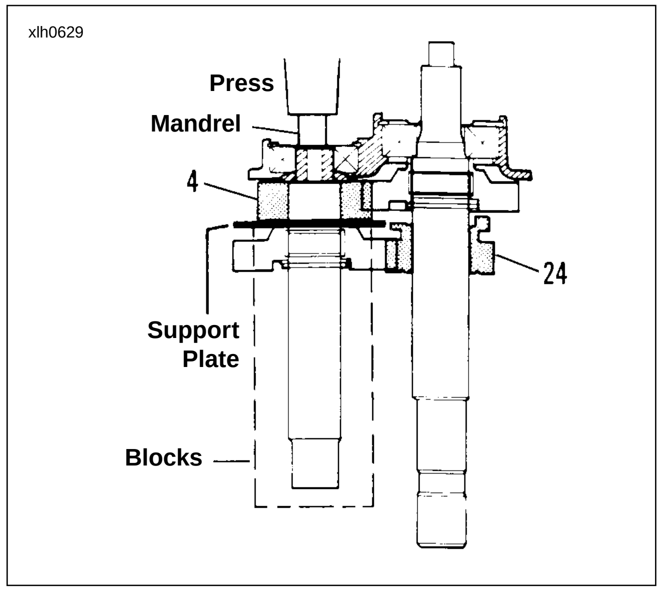


Figure 6-39.

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

9. Expand retaining ring (5) located next to countershaft 1st gear (8). Remove retaining ring (5) and thrust washer (6). Slide countershaft 1st gear off end of shaft. Remove split bearing (7).

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

10. Remove thrust washer (6). Expand remaining retaining ring (5) and slide off shaft. This completes disassembly of countershaft.

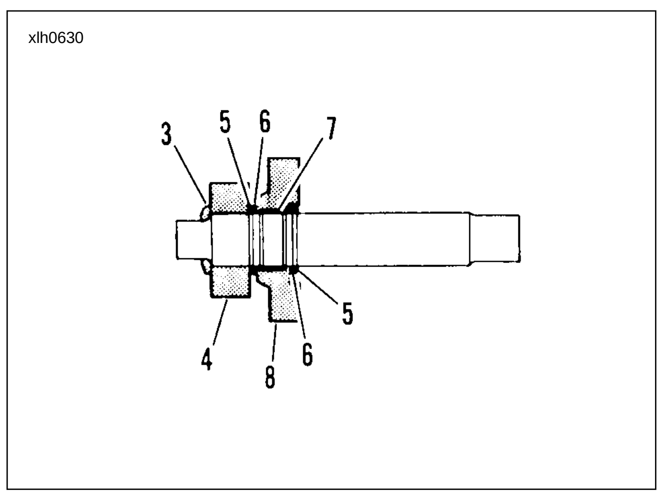


Figure 6-40.

11. See Figure 6-41. Place mainshaft and access door assembly on arbor press with support under mainshaft 4th gear (25). Press on end of shaft until mainshaft is free of access door bearing. Remove spacer (26), mainshaft 4th gear (25) and split bearing (7).

WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

12. Remove thrust washer (6). Expand and remove remaining retaining ring (5).

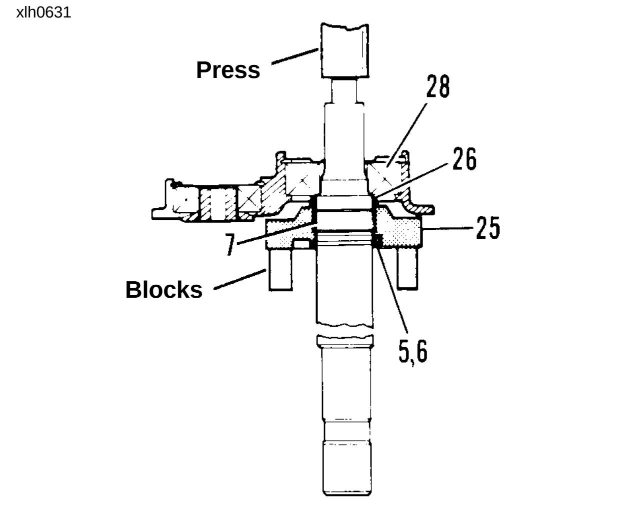


Figure 6-41.

CLEANING AND INSPECTION

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.
4. Discard all retaining rings that were removed.

ASSEMBLY

CAUTION

During assembly, the split bearings (7) and the internal bores of the gears must be lubricated with SPORT-TRANS FLUID prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. Find a section of pipe that matches the inner race of mainshaft bearing (28). See Figure 6-42. Place the door assembly, outside downward, on a press with the inner race of bearing (28) resting on the section of pipe. Insert the splined end of the shaft through the bearing and hold in a vertical position. Press the shaft into the bearing until the bearing bottoms against the shaft shoulder.

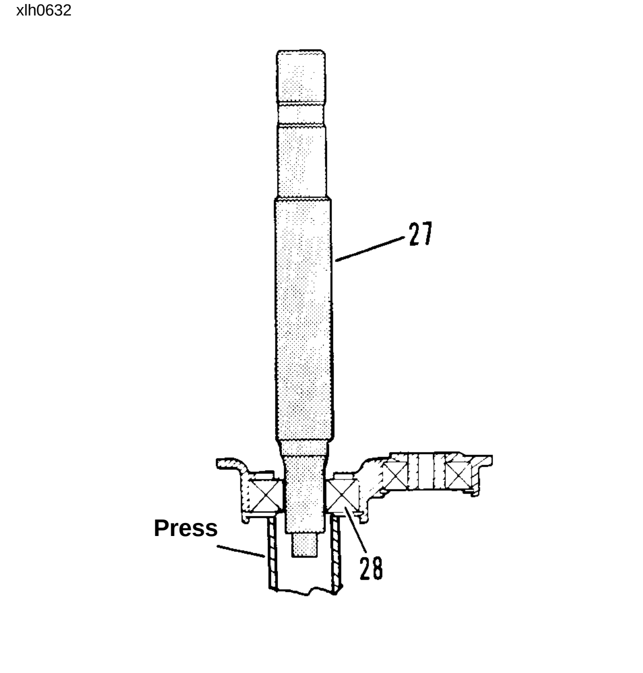


Figure 6-42.

2. See Figure 6-43. Place spacer (26) over mainshaft and position next to bearing (28). Position split bearing (7) into machined seat next to spacer (26). Locate mainshaft 4th gear (25), which can be identified by the two radial grooves at one side. Slide gear (25) onto shaft with radial grooves facing door. Position gear over bearing next to spacer (26).
3. Install thrust washer (6) and retaining ring (5) next to gear (25). It will be necessary to push the retaining ring into final position with a screwdriver.
4. Slide mainshaft 1st gear (24) onto mainshaft with the locking dogs facing gear (25). The shifter fork groove must face the access door.

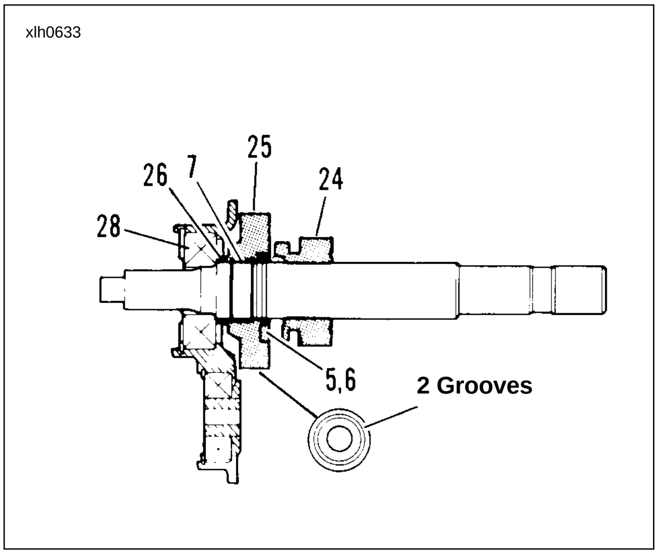


Figure 6-43.

5. See Figure 6-44. Install retaining ring (5) on countershaft. Position retaining ring in the second ring groove from the end with internal threads. Install thrust washer (6) next to retaining ring. Install split bearing (7) in seat next to washer (6).
6. Locate countershaft first gear (8). Gear (8) has a radial groove at one side of the gear. Install gear (8) over split bearing (7) with radial groove facing access door.
7. Install thrust washer (6) and retaining ring (5) next to gear (8).
8. Locate countershaft 4th gear (4). This flat, shoulderless gear is splined and has a single radial groove at one side. Position gear next to retaining ring (5). Place beveled washer (3) over end of shaft with beveled side away from gear (4).

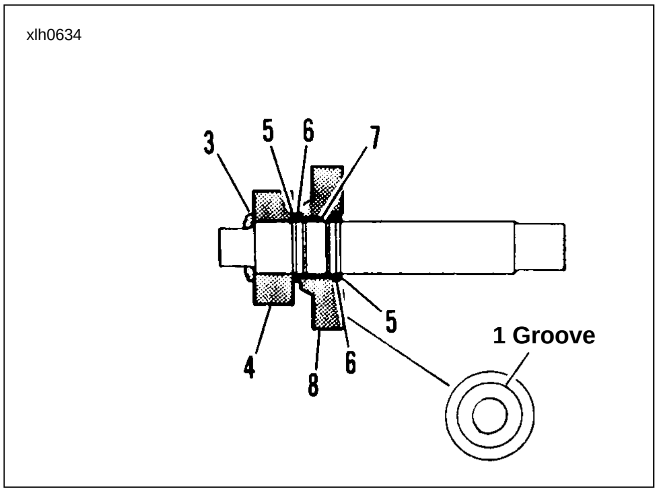


Figure 6-44.

9. See Figure 6-45. Stand countershaft assembly on press with beveled washer upward. Place access cover and mainshaft assembly on top of countershaft with bearing (1) in access cover over end of countershaft. Place a socket or section of pipe on inner race of bearing (1). Hold assembly straight, making sure gear teeth on countershaft are engaged with gear teeth on mainshaft, and press bearing onto shaft until beveled spacer bottoms against bearing.

NOTE

When correctly installed, countershaft 4th gear should have zero end play.

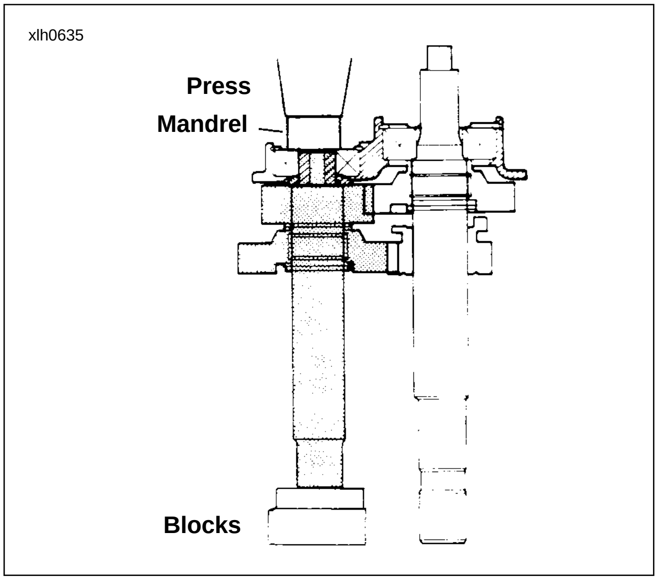


Figure 6-45.

10. See Figure 6-46. At mainshaft, install retaining ring (5) and thrust washer (6). Install split bearing (7) in seat next to thrust washer (6).
11. Install mainshaft 3rd gear (23) onto shaft over bearing (7).
12. Install thrust washer (6) and retaining ring (5) next to gear (23).
13. Install countershaft 3rd gear (10) onto shaft. The shifter fork groove must face away from the access door.

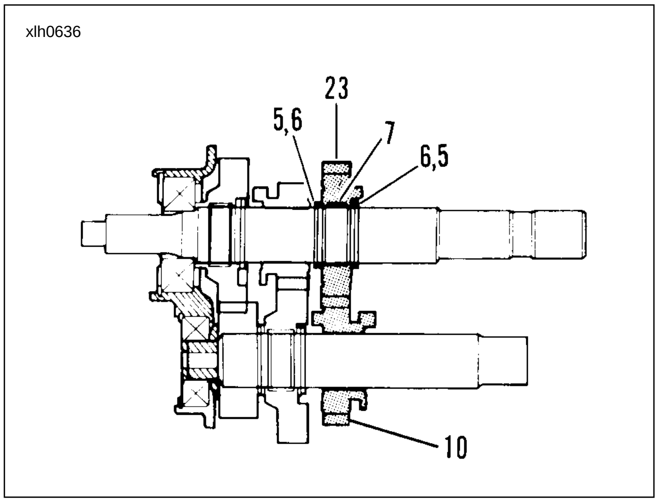


Figure 6-46.

14. See Figure 6-47. Install retaining ring (5) and thrust washer (6) on countershaft. Install split bearing (7) into seat next to thrust washer (6).
15. Install countershaft 2nd gear (11) over bearing (7).
16. Install mainshaft 2nd gear (22) onto shaft. The shifter fork groove must face the access door.
17. Install shouldered countershaft 5th gear (12). The single radial groove must face away from the access door.
18. Expand retaining ring (5) and slide into groove next to countershaft 5th gear (12).

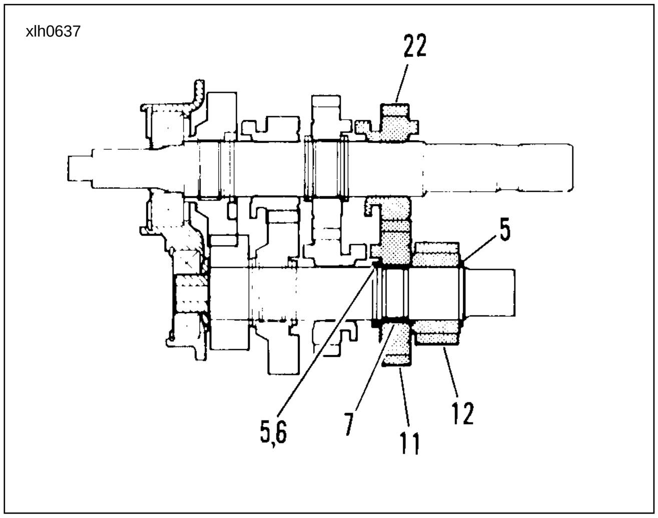


Figure 6-47.

19. See Figure 6-48. At outside of access door, position retention collar (31) next to end of countershaft with beveled side facing outward. Apply a few drops of LOCTITE THREADLOCKER 243 (blue) to the threads of TORX screw (32). Insert TORX screw (32) through retention collar and thread into end of shaft. Place transmission in gear and tighten TORX screw to 13-17 ft-lbs (18-23 Nm).
20. Install shifter forks and drum. See 6.8 SHIFTER FORKS AND DRUM.

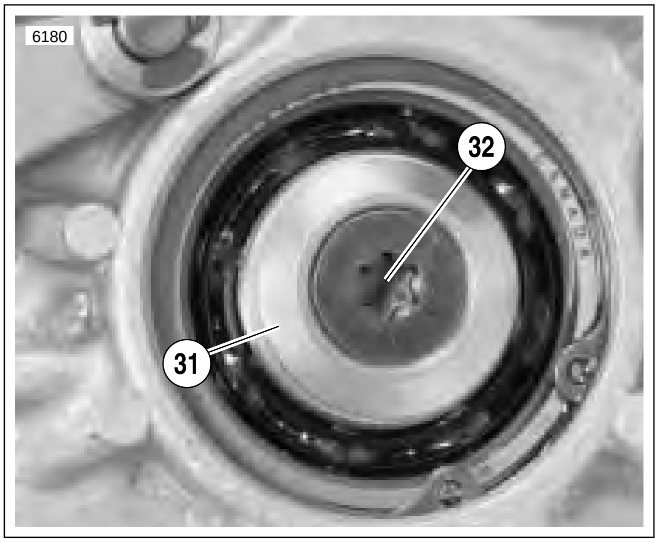


Figure 6-48.

MAIN DRIVE GEAR 6.10

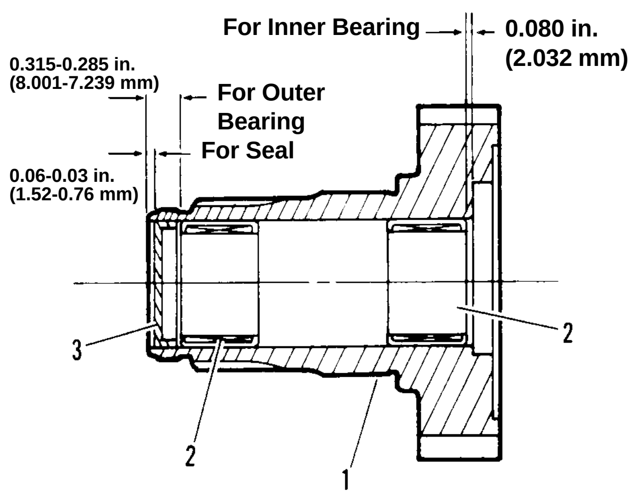
REMOVAL

1. Remove transmission. See 6.7 TRANSMISSION CASE.
2. See Figure 6-49. From inside case tap out seal (3) at end of mainshaft 5th gear (1). Discard seal (3).
3. See Figure 6-50. Use MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-A) with CROSS PLATE (Part No. HD-35316-91). Take support bracket and insert pins, at one side, into holes which are now exposed under access cover.
4. See Figure 6-51. Insert bolt (2) through support bracket (1) and 5th gear (3).

CAUTION

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.

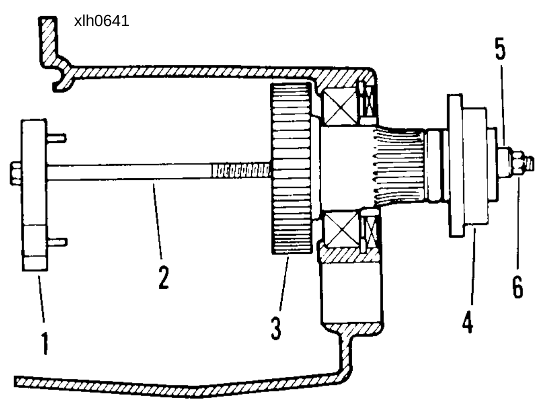
5. At outside of case, place driver (4) and thrust washer (5) over end of bolt (2). Install and tighten nut (6) until 5th gear (3) is free.



1. **Main Drive Gear**
2. **Needle Bearing**
3. **Seal**

Figure 6-49. Main Drive Gear Assembly

Figure 6-50. Support Bracket Mounting



1. **Support Bracket**
2. **Bolt**
3. **5th Gear**
4. **Driver**
5. **Thrust Washer**
6. **Nut**

Figure 6-51. Removing Main Drive Gear

DISASSEMBLY

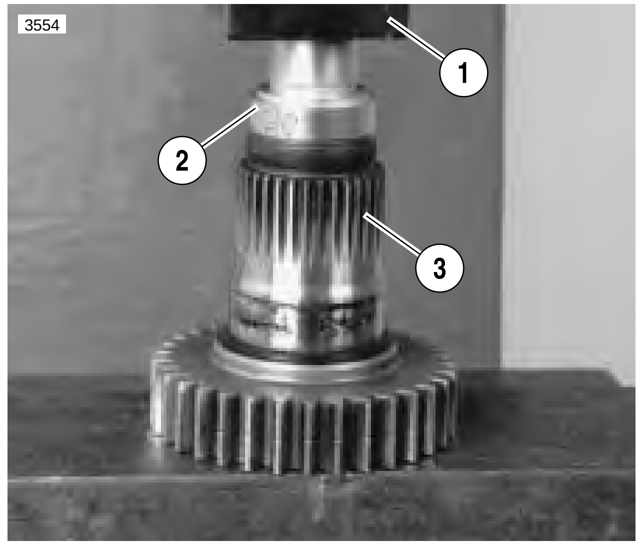
Drive out needle bearings from inside bore of main drive gear. Do not reuse bearings after removal.

ASSEMBLY

1. See Figure 6-52. Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL (Part No. HD-37842A) for assembly. Select which end of tool to use.
   a. The end stamped 0.080 in. (2.032 mm) is for driving the bearing into the inner end.
   b. The end stamped 0.315 in. (8.001 mm) is for the outer end bearing.
2. Assemble parts. The installation tool will automatically bottom on the gear when the correct depth is reached.
   a. Place main drive gear on a press.
   b. Press in the outer bearing to a depth of 0.315-0.285 in. (8.001-7.239 mm).
   c. Press in the inner bearing to a depth of 0.080 in. (2.032 mm).

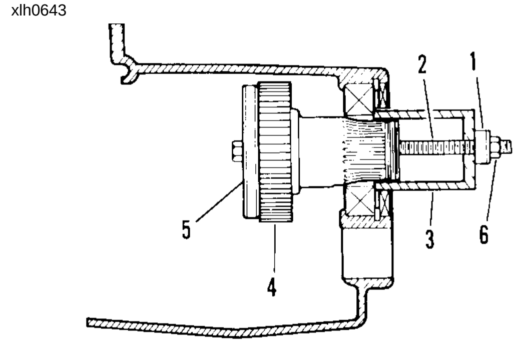
INSTALLATION

1. Replace main drive gear bearing. See 6.11 ACCESS DOOR BEARINGS.
2. See Figure 6-53. Use MAIN DRIVE GEAR REMOVER AND INSTALLER TOOL for assembly.
   a. Take bolt (2) and place washer (5) followed by main drive gear (4) over end of bolt.
   b. From inside of case insert bolt and main drive gear through inner race of ball bearing.
   c. Insert threaded end of bolt (2) through installer cup (3) and thrust washer (1).
   d. Thread nut (6) onto end of bolt (2). Tighten nut (6) until shoulder on gear (4) bottoms against inner race of bearing.
3. See Figure 6-49. Tap in **new** seal (3) at threaded end of 5th gear.



1. Ram on End of Press
2. Needle Bearing Installation Tool
3. Main Drive Gear

Figure 6-52. Needle Bearing Installation Tool



1. Thrust Washer	**4. 5th Gear**
2. Bolt	**5. Washer**
3. Installer Cup	**6. Nut**

Figure 6-53. Main Drive Gear Installation

ACCESS DOOR BEARINGS 6.11

REMOVAL

Mainshaft and Countershaft Bearings

1. Remove transmission assembly. See 6.7 TRANSMISSION CASE.
2. Remove shifter forks and drum. See 6.8 SHIFTER FORKS AND DRUM.
3. Remove countershaft and mainshaft. See 6.9 MAINSHAFT AND COUNTERSHAFT.
4. Inspect the mainshaft and countershaft ball bearings for pitting, scoring, discoloration or other damage.

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

5. See Figure 6-54. If bearing replacement is required, remove retaining rings (1, 2). Press out bearings (3, 4) from the inside of the door.

Shift Drum Bushing

1. Inspect the shifter drum bushing for pitting, scoring, discoloration or excessive wear. If bushing requires replacement press bushing out of door from either side.

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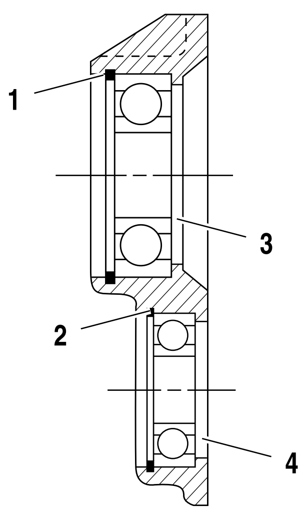

1. **Retaining Ring**
2. **Retaining Ring**
3. **Bearing, Mainshaft**
4. **Bearing, Countershaft**

Figure 6-54. Ball Bearing Assembly

INSTALLATION

Mainshaft and Countershaft Bearings

1. Lay access door on press with inside surface of door downward.
2. Lay bearing squarely over bore with printed side of bearing upward. Place section of pipe or tubing (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. Lay access door on press with outside surface of door downward.
2. See Figure 6-55. Lay bushing squarely over bore. Locate socket or pipe that is slightly larger than diameter of bushing. Place socket or pipe on bushing and press into bore until bushing is flush with or 0.020 in. (0.508 mm) below inside surface. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against door when bushing is flush with top surface.

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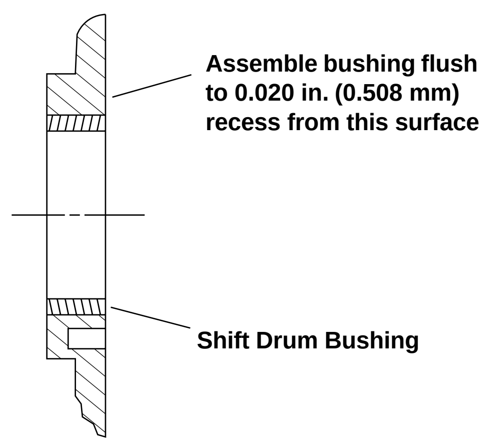


Figure 6-55. Shift Drum Bushing Assembly

RIGHT TRANSMISSION CASE BEARINGS 6.12

REMOVAL

1. Remove transmission assembly. See 6.7 TRANSMISSION CASE. Remove main drive 5th gear. See 6.10 MAIN DRIVE GEAR.

⚠WARNING

Retaining rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Always wear safety glasses or goggles while removing or installing retaining rings. Failure to comply could result in death or serious injury.

2. At outside of case remove seal next to 5th gear bearing retainer. Remove retaining ring.
3. From inside transmission case drive bearings (5th gear, countershaft or shifter shaft) out of bores. Carefully tap bearings free by working around bearing diameter to keep bearing from skewing.

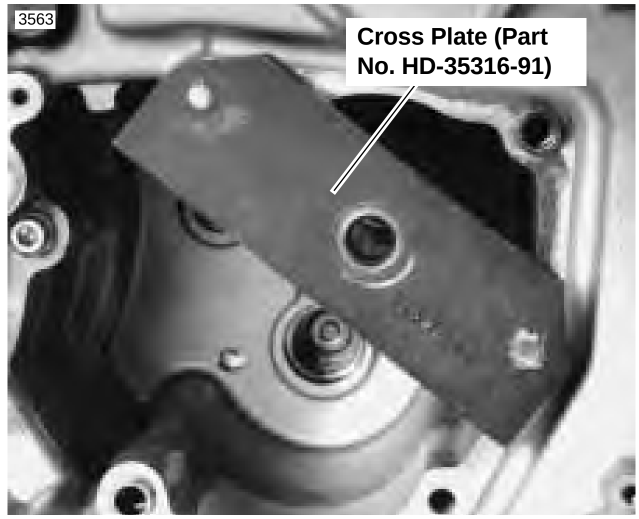
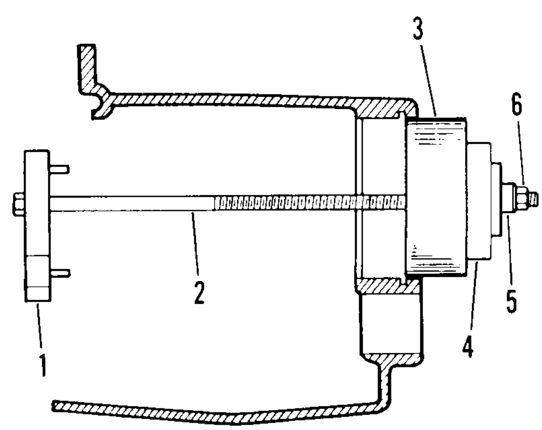


Figure 6-56. Cross Plate Mounting

INSTALLATION

Mainshaft 5th Gear Ball Bearing

1. Locate MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-A). See Figure 6-56. Place support bracket pins in appropriate holes in transmission case.
2. See Figure 6-57. Insert bolt (2) through support bracket (1), **new** bearing (3), driver (4) and thrust bearing (5). Thread nut (6) on end of bolt. Tighten nut carefully until bearing is started in bore squarely. Tighten nut (6) until bearing is seated against shoulder in bore.
3. At outside of case install beveled retaining ring in groove inside bearing bore with beveled side facing outside of case.
4. Lubricate bearing with SPORT-TRANS FLUID.



1.	**Support Bracket**	**4.**	**Driver**
2.	**Bolt**	**5.**	**Thrust Bearing**
3.	**Bearing**	**6.**	**Nut**

Figure 6-57. Installing Mainshaft Ball Bearing

Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. (31.75 mm) in diameter.
2. From the outside of the case place the needle bearing 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 inward flush or 0.030 in. (0.762 mm) below the outside surface of the case.
3. Lubricate bearing with SPORT-TRANS FLUID.

Shift Drum Needle Bearing

1. Find a suitable bearing driver 13/16 in. (20.64 mm) in diameter.
2. From the outside of the case place the needle bearing, 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 driven inward flush or 0.030 in. (0.762 mm) below the outside surface.
3. Lubricate bearing with SPORT-TRANS FLUID.

TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT 6.13

Verify that all parts have been properly installed, as described earlier in this section under:

- 6.12 RIGHT TRANSMISSION CASE BEARINGS
- 6.10 MAIN DRIVE GEAR
- 6.9 MAINSHAFT AND COUNTERSHAFT
- 6.8 SHIFTER FORKS AND DRUM

1. Carefully insert transmission into case opening. Position the assembly so that the mainshaft enters fifth gear, and so that the countershaft and drum shifter shaft enter their respective bearings.
2. See Figure 6-58. Install access door.
   a. Apply a few drops of LOCTITE THREADLOCKER 243 (blue) to the five access door mounting bolts with captive washers (7).
   b. Insert the bolts with captive washers (7) through access door into tapped holes in right transmission case.
   c. Tighten to 13-17 ft-lbs (18-23 Nm).
3. Lift pawl (5) over drum pins and place shifter shaft assembly (6) on studs at transmission case. Loosely install a washer (11) and locknut (3) on each stud.
4. Attach loop of spring (1) over and into groove in post (2).
5. Install detent plate.
   a. Place detent plate (8) over drum pins.
   b. Rotate plate until blind holes in plate align with pins in end of shifter fork drum.
   c. Install **new** retaining ring (9) using SHIFT DRUM RETAINING RING INSTALLER (Part No. HD-39151).
   d. Verify that retaining ring is fully engaged with drum groove.
6. See Figure 6-59. Align shifter shaft.
   a. Place transmission in third gear.
   b. Place a No. 32 drill bit (0.116 in. dia.) through hole in detent plate (3), and between pawl (2) and drive pin at end of shifter drum shaft.
   c. Push down top of crank (4) to remove all clearance between pawl and drill bit; this will correctly align pawl to shift drum pins (do not push down with too great a force, as this might cause the shifter drum to rotate).
   d. With bit in place, tighten shifter shaft assembly bottom locknut (1) first to 90-110 **in-lbs** (10-12 Nm). Then, tighten shifter shaft assembly top locknut (1) to the same torque.
   e. **Remove drill bit**.
7. See Figure 6-37. Place **new** quad ring (17) over threaded end of fifth gear (21), and position next to the gear taper. Install spacer (16) over threaded end of fifth gear with chamfered end toward quad ring. Slide spacer up against bearing (19).

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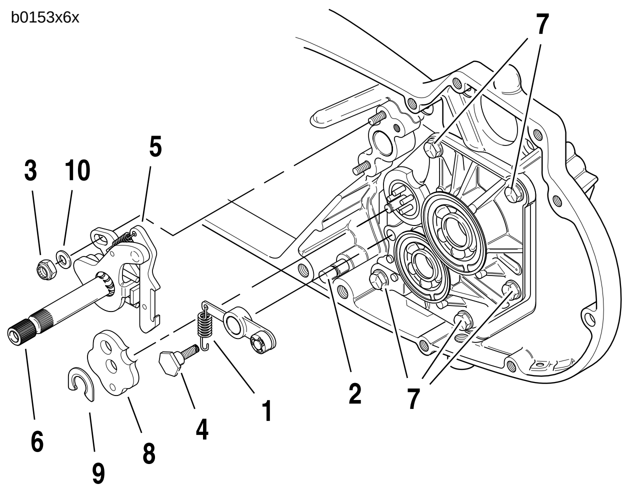

1. Spring
2. Post
3. Locknut (2)
4. Detent Screw
5. Pawl
6. Shifter Shaft Assembly
7. Bolt with Captive Washer (5)
8. Detent Plate (Typical)
9. Retaining Ring
10. Washer (2)

Figure 6-58. Installing Access Door

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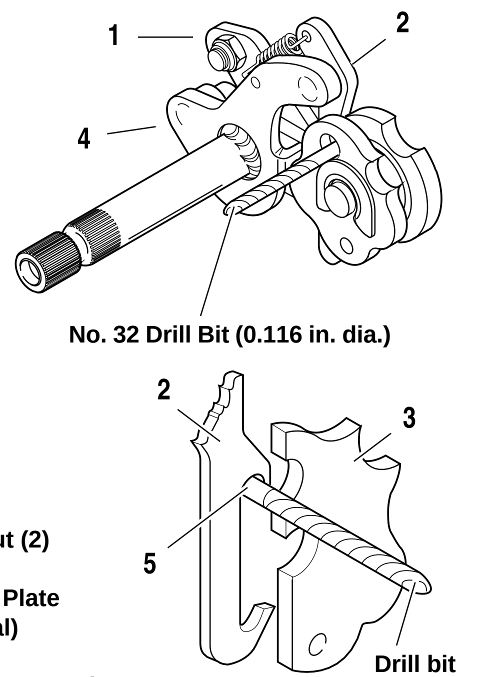


1. Locknut (2)
2. Pawl
3. Detent Plate (Typical)
4. Crank
5. Shifter Drum Pin

Figure 6-59. Shifter Shaft Assembly Alignment

8. Install seal.
    a. Coat lips of seal (15) with SPORT-TRANS FLUID.
    b. Position seal over spacer (16) with lips of seal toward case.
    c. Gently tap seal into bore of case until the outside of seal is flush with outer edge of bore.

NOTE

It is acceptable to recess seal to about 0.030 in. (0.762 mm) below outer edge of bore. Seal recession will be limited by seal bottoming against retaining ring (18).

9. See Figure 6-60. Increase belt deflection by loosing rear axle and moving rear wheel forward. Install transmission sprocket (2) with secondary drive belt onto main drive gear shaft (1).
10. Place transmission in neutral.
11. Apply a few drops of LOCTITE THREADLOCKER 262 (red) to the **left-hand threads** of transmission sprocket nut (3). Position nut with washer-faced side facing transmission sprocket. Turn the nut **counterclockwise** to install it onto main drive gear shaft.
    a. See Figure 6-61. Install SPROCKET HOLDING TOOL (1) (Part No. HD-41321) as shown. Use MAINSHAFT LOCKNUT WRENCH (2) (Part No. HD-94660-37B) and a torque wrench to tighten sprocket nut to 50 ft-lbs (68 Nm) INITIAL torque, ONLY.
    b. See Figure 6-62. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.
    c. Tighten the transmission sprocket nut an additional 30°-40°.
    d. See Figure 6-60. Install lockplate (4) over nut (3) so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's (2) two tapped holes.

NOTE

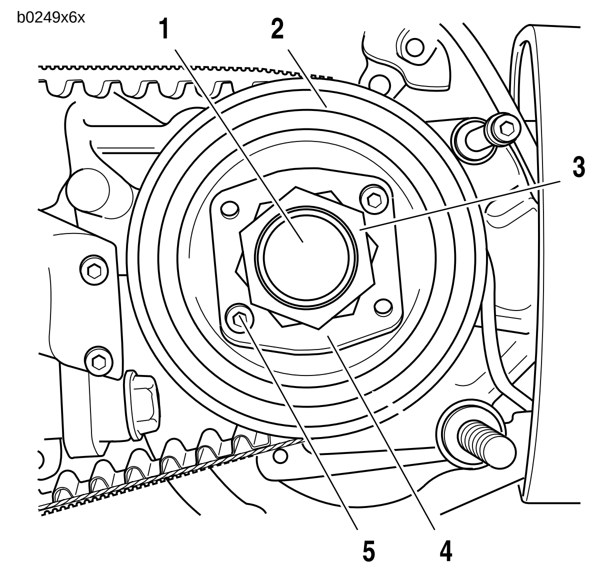
The lockplate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally TIGHTENED until the screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

    e. See Figure 6-62. If lockplate will not align with holes, tighten nut to 45° maximum.

WARNING

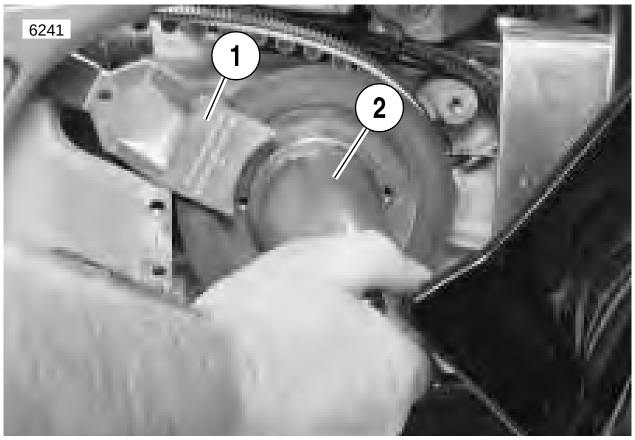
Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs. Do not loosen sprocket nut while attempting to align the screw holes. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened 45° as specified above. Tightening too much or too little may cause the nut to come loose during vehicle operation which may cause an accident which could result in death or serious injury.

12. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened until screw holes align.



1. Main Drive Gear Shaft
2. Transmission Sprocket
3. Transmission Sprocket Nut (Left-Hand Threads)
4. Lockplate
5. Socket Head Screw (4)

Figure 6-60. Transmission Sprocket



1. Sprocket Holding Tool (Part No. HD-41321)
2. Mainshaft Locknut Wrench (Part No. HD-94660-37B)

Figure 6-61. Transmission Sprocket Tightening

13. See Figure 6-60. Install four socket head screws (5) through aligned holes of lockplate and into tapped holes of sprocket. Tighten to 90-110 **in-lbs** (10-12 Nm).

NOTE

The original equipment socket head screws (5) 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.*

14. Install the remaining removed components in the reverse order of the removal procedures. See the procedures listed in the respective component sections.
15. Adjust drive belt tension. See 1.10 DRIVE BELT DEFLECTION.
16. Fill transmission to proper level with fresh lubricant. See 1.9 CLUTCH.

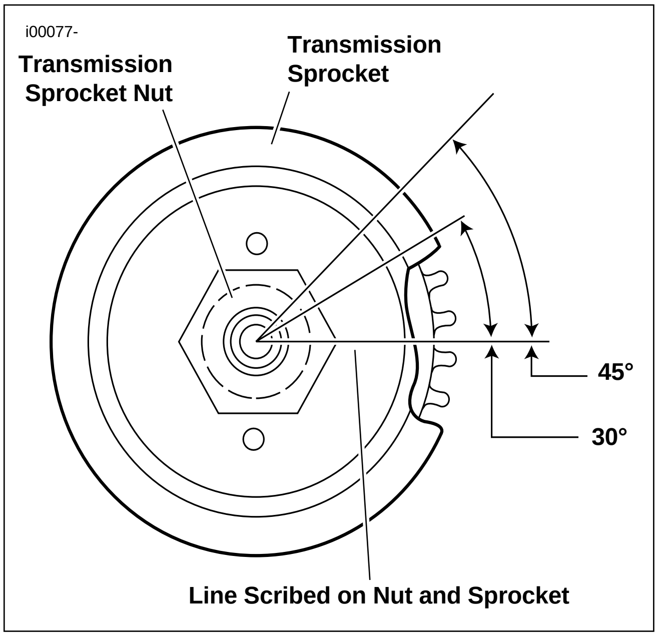


Figure 6-62. Aligning Transmission Sprocket

NOTES

SUBJECT	PAGE NO.
7.1 Specifications	7-1
7.2 Ignition System	7-3
7.3 Ignition/Headlamp Key Switch	7-5
7.4 Ignition Coil	7-7
7.5 Spark Plug Cables	7-9
7.6 Starter Interlock	7-10
7.7 Diodes	7-17
7.8 Charging System	7-19
7.9 Alternator	7-26
7.10 Voltage Regulator	7-28
7.11 Battery	7-29
7.1 Headlamp	7-34
7.2 Tail Lamp	7-36
7.3 Turn Signals	7-37
7.4 Turn Signal Flasher	7-39
7.5 Handlebar Switches	7-40
7.6 Horn	7-42
7.7 Neutral Indicator Switch	7-43
7.8 Fuses and Circuit Breakers	7-44
7.9 Relay Block	7-45
7.10 Speedometer	7-46
7.11 Speedometer Sensor	7-48
7.12 Speedometer Performance Check	7-49
7.13 Tachometer	7-54
7.14 Tachometer Performance Check	7-56
7.15 Clock	7-57

ELECTRICAL 7

SPECIFICATIONS 7.1

BATTERY	
Size	12 VDC, 18 amp hour
Type	Sealed

REGULATOR	
Voltage Output @ 75°F	13.8-15 VDC
Amperes @ 3600 RPM	22 Amps

SPARK PLUGS		
Size	12 mm	
Style	10R12	
Gap	0.038-0.043 in.	0.97-1.09 mm
Torque Value	11-18 ft-lbs	15-24 Nm

IGNITION COIL RESISTANCE	
Primary Winding	0.5-0.7 ohms
Secondary Winding	5,500-7,500 ohms

ALTERNATOR	
AC Voltage Output	19-26 VAC per 1000 engine RPM
Stator Coil Resistance	0.2-0.4 Ohms

ELECTRICAL SYSTEM	AMPERES
Main Circuit Breaker	30
Ignition Fuse	20
Light Fuse	15
Accessory Fuse	15
Instrument Fuse	15
Clock/Odometer Fuse	15

BULB CHART					
LAMP DESCRIPTION		BULBS REQUIRED	WATTS	AMPS	PART NUMBER
Headlamp	High/Low Replaceable Bulb	1	60/55	5.0/4.58	67969-96Y
	Position Lamp (European models only)	1	5	0.42	67968-96Y
Marker Lamps	Tail/Stop Lamp	2	5/21	0.42/1.75	68075-94Y
	Turn Signal Lamp-Front and Rear, 1 Bulb per Lamp	4	10	0.83	68073-94Y
Indicator Lamps on Instrument Support	High Beam Indicator	1	2.1	0.15	68024-94
	Turn Signal Indicator	2	2.1	0.15	68024-94
	Oil Pressure Indicator	1	2.1	0.15	68024-94
	Neutral Indicator	1	2.1	0.15	68024-94
Instruments	Speedometer Illumination	1	1.7	0.14	67421-99Y
	Tachometer Illumination	1	1.7	0.14	68073-99Y
	Low Fuel Lamp (Tachometer)	1	1.7	0.14	68073-99Y
	Check Engine Lamp (Tachometer)	1	1.7	0.14	68073-99Y

TORQUE VALUES

ITEM	TORQUE		NOTES
Battery Terminal Hardware	60-96 **in-lbs**	7-11 Nm	metric
Ignition Coil Mounting Screws	4-6 ft-lbs	5-8 Nm	
Inner Cover Screws	12-20 **in-lbs**	1.4-2.3 Nm	
Neutral Indicator Switch	3-5 ft-lbs	4-7 Nm	LOCTITE THREADLOCKER 243 (blue)
Rotor Mounting Bolts	90-110 **in-lbs**	10-12 Nm	LOCTITE THREADLOCKER 243 (blue)
Spark Plugs	11-18 ft-lbs	15-24 Nm	
Starter Battery Positive Cable Nut	60-85 **in-lbs**	7-10 Nm	metric
Stator Mounting Screws	30-40 **in-lbs**	3.4-3.5 Nm	T-27 TORX with retaining compound, replace after removal
Switchgear Housing Screws (Left Side)	25-33 **in-lbs**	3-4 Nm	metric
Switchgear Housing Screws, (Right Side)	12-17 **in-lbs**	1-2 Nm	metric

IGNITION SYSTEM 7.2

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, 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 7-3

The scan tool can access the information received by and stored in the electronic control module.

The electronic control module (ECM) attaches to the vehicle frame next to the fuse block. 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.

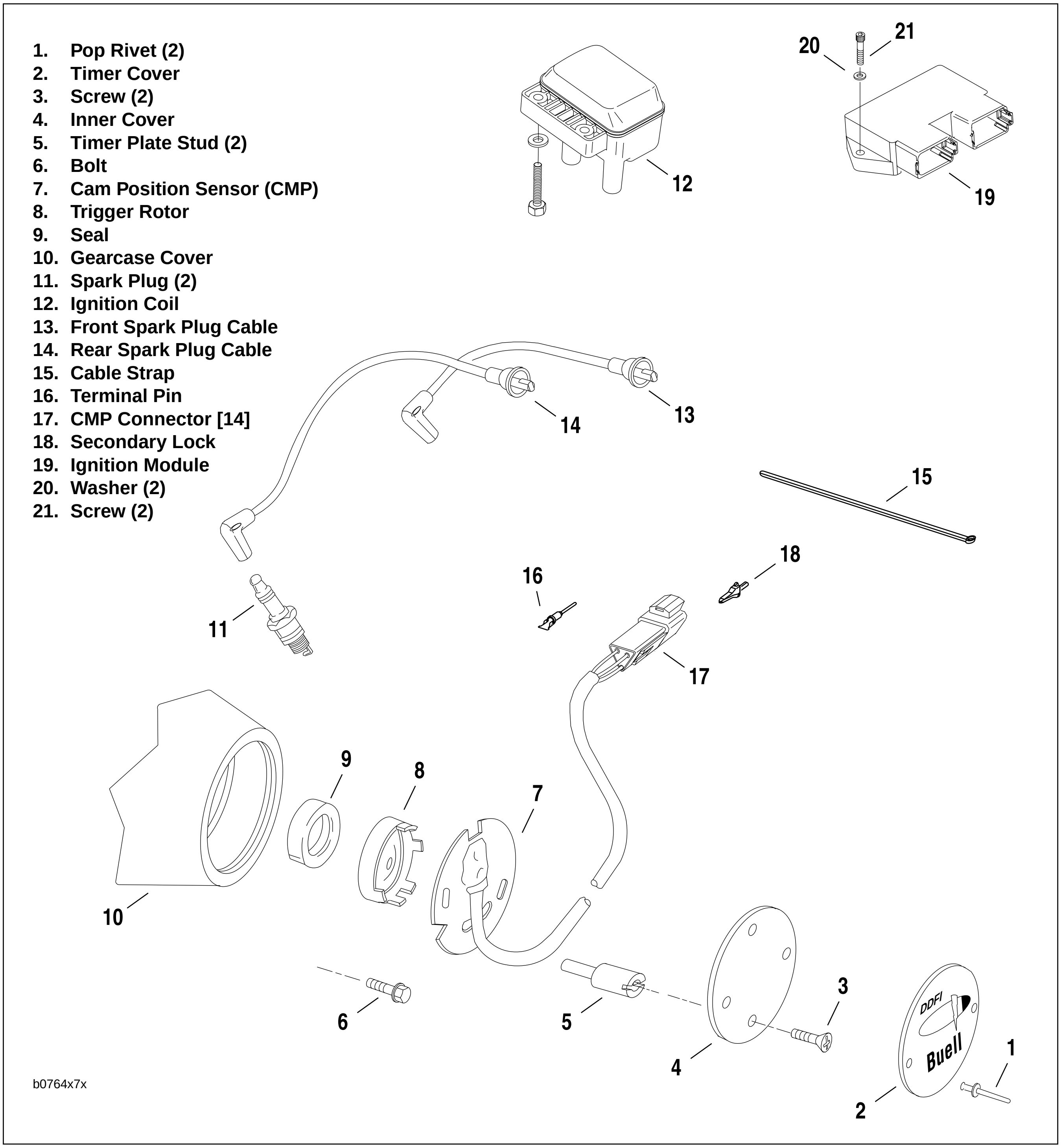


Figure 7-1. Ignition System Components

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)

The ECM uses the information provided by the TP and CMP sensors to calculate how much air is entering the engine.The TP 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 CMP 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.

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 (14.6:1) 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 55 degrees. As long as lean angle does not exceed 55 degrees fuel supply and ignition operation are unaffected. If the vehicle exceeds a 55 degree lean angle, the BAS will interrupt the operation of the ignition system and fuel supply.

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 CMP 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 at the end of this section for additional information on ignition system circuits.

TROUBLESHOOTING

See Section 4 Fuel System for troubleshooting information.

IGNITION/HEADLAMP KEY SWITCH 7.3

GENERAL

⚠WARNING

DO NOT modify the ignition/headlamp switch wiring to circumvent the automatic-on headlamp feature. Riding without an operating headlamp could cause an accident. Failure to comply could result in death or serious injury.

See Figure 7-5 The three-position combination ignition/headlamp key switch is not repairable. Replace the unit if it fails.

Switch positions are explained in Figure 7-3

CAUTION

When turning off the ignition, verify that the key is removed in the OFF position and that the lights are not left on. If the rider stops the engine and inadvertently removes the key in the PARK position, the battery will be drained of its charge if the vehicle is left standing too long.

NOTE

The key locks the ignition system and is removable in both the OFF and PARK positions. The PARK position is located between the OFF and IGNITION positions and allows the rider to remove the key while leaving the lights on. When the key is placed in the PARK position, several indicator markers are or can be activated. See Figure 7-5

REMOVAL

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Detach turn signals and mirrors (metric) to remove front fairing.
3. See Figure 7-5 Disconnect ignition key switch connector [33] from main wiring harness.
4. Remove ignition switch face nut. Remove ignition key switch from behind dash panel.

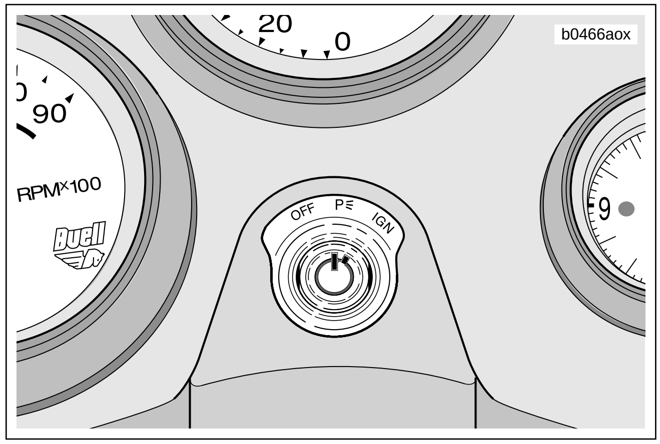


Figure 7-2. Ignition Key Switch

Table 7-1. Ignition Key Switch Position

LABEL	NAME	IGN.	LAMPS	REMOVE KEY
OFF	Locked	off	off	yes
P	Markers	off	See note & Figure 7-5	yes
IGN	Ignition	on		no

Table 7-2. Indicator Markers

ITEM	PARK	IGN
Headlamp Position Marker (European models only)	on	on
Headlamp High/Low Beam	off	on
Speedometer Illumination Lamp	on	on
Stop Lamp	can be activated	
Front and Rear Turn Signals	can be activated	
Horn	can be activated	

INSTALLATION

1. Install ignition key switch.
   a. Insert ignition key switch into hole of dash panel. The word “TOP” stamped on the switch body should face upward toward the lettering on the switch position decal.
   b. Apply LOCTITE THREADLOCKER 243 (blue) to ignition key switch face nut.
   c. Loosely install face nut.
2. See Figure 7-6 Attach ignition key switch connector [33] to main wiring harness.
3. Tighten face nut to secure switch within dash panel.
4. Install negative battery cable to battery.
5. Check ignition key switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.
6. Install front fairing, mirrors and turn signals. See the appropriate instructions in Section 2.

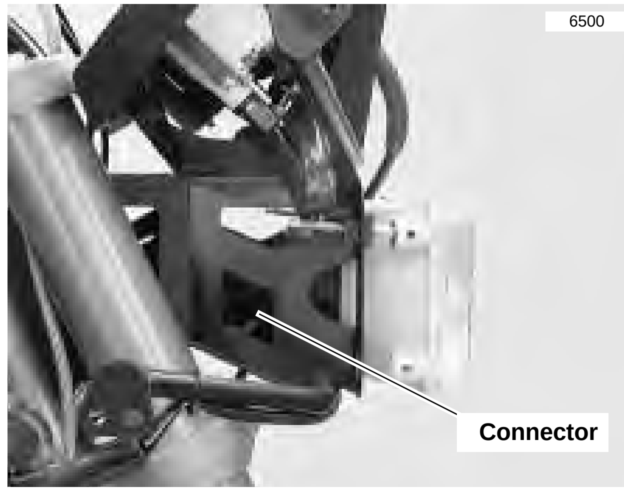


Figure 7-3. Ignition Headlamp Key Switch Connector

IGNITION COIL 7.4

GENERAL

See Figure 7-7 The ignition coil is mounted on the frame underneath the fuel tank and behind the steering neck.

See Figure 7-7 The ignition coil (12) is a pulse-type transformer. Internally, the coil consists of primary and secondary windings with a laminated iron core. The contents are sealed in a waterproof insulating compound. The ignition coil is not repairable. Replace the unit if it fails.

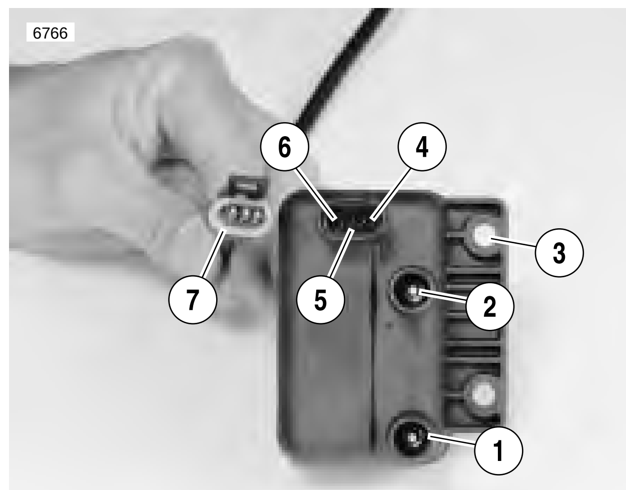
The low-voltage ignition primary circuit consists of the coil primary winding, ignition module (22) and battery. When the circuit is closed, current flows through the coil primary winding creating a strong magnetic field in the iron core of the ignition coil.

When the ignition module receives a signal from the cam position sensor (7) and trigger rotor (8), the ignition module interrupts (opens) the ignition primary circuit, which causes the magnetic field in the coil core to collapse suddenly.

The collapsing magnetic field induces a high-voltage electrical discharge in the ignition secondary circuit, which consists of the coil secondary winding, spark plug cables and spark plugs (11). The high-voltage discharge produces a spark to bridge the electrode gap of each spark plug.

The ignition coil fires each spark plug independently on the compression stroke of each cylinder.

Figure 7-4. Ignition Coil Location



1. **Rear Cylinder Post**
2. **Front Cylinder Post**
3. **Screw and Washer Location**
4. **Coil Pin A (Rear Cylinder)**
5. **Coil Pin B (12 VDC)**
6. **Coil Pin C (Front Cylinder)**
7. **Connector [83]**

Figure 7-5. Ignition Coil

REMOVAL

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Remove seat. See 2.35 SEAT.

⚠WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

3. Purge fuel line and remove fuel tank.
4. See Figure 7-7 Disconnect the spark plug cables from the coil plug posts (1, 2).
5. Detach connector (7) [83].
6. Remove two screws and washers to drop coil from frame.

TROUBLESHOOTING

When the engine will not start or when hard starting or missing indicates a faulty ignition system, see 4.16 MISFIRE. If the problem persists, check primary and secondary resistance of ignition coil with a coil tester. See Figure 7-8

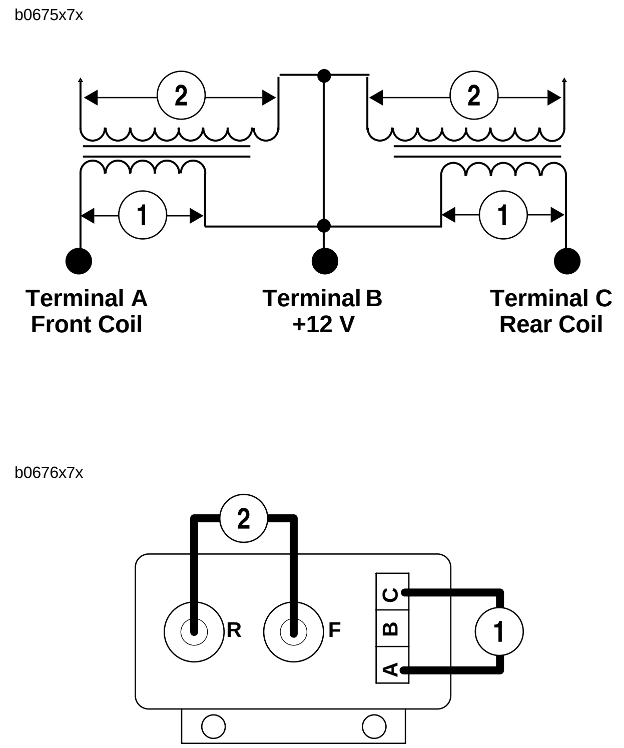
- Primary resistance (1) should be 0.5-0.7 ohms.
- Secondary resistance (2) should be 5.5-7.5K ohms.

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 terminal wires to **new** coil.
2. Attach **new** spark plug cables to coil and plugs.
3. Test system. If ignition trouble is eliminated by the temporary installation of a **new** coil, careful 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.



1. **Primary resistance should be 0.5-0.7 ohms.**
2. **Secondary resistance should be 5.5-7.5K ohms.**

Figure 7-6. Ignition Coil Wiring Diagram

INSTALLATION

1. Attach coil to frame with screws and washers. Tighten to 4-6 ft-lbs (5-8 Nm).
2. See Figure 7-7 Attach connector (7) [83].
3. Connect front spark plug cable to connector (2) and rear spark plug cable to connector (1).
4. Install fuel tank. See 4.36 FUEL TANK.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

5. Install seat. See 2.35 SEAT.
6. Connect negative battery cable to battery.

SPARK PLUG CABLES 7.5

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. Failure to comply could result in death or serious injury.

CAUTION

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.

Disconnect spark plug cables from ignition coil and spark plug terminals. Inspect all removed cables for damage.

INSPECTION

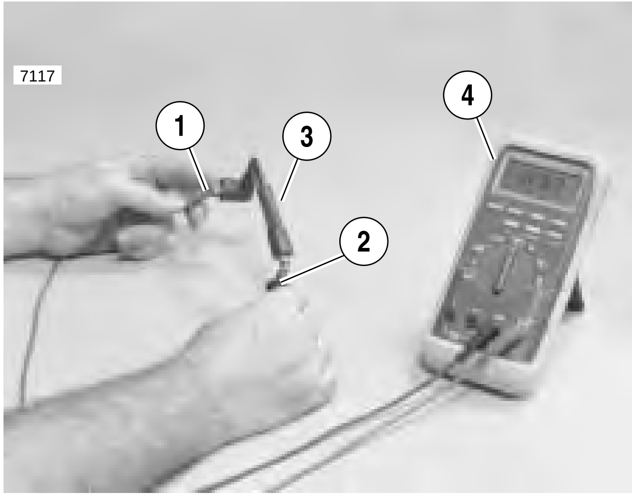
1. Inspect spark plug cables. Replace cables that are worn or damaged.
   a. Check for cracks or loose terminals.
   b. Check for loose fit on ignition coil and spark plugs.
2. Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.
3. See Figure 7-9 Check spark plug cable resistance with an ohmmeter. Replace cables not meeting resistance specifications.
   a. 4750-11,230 ohms for 19 in. (483 mm) cable.
   b. 1812-4375 ohms for 7.25 in. (184 mm) cable.

INSTALLATION

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.

NOTE

See 1.17 SPARK PLUGS for spark plug information.



1. Ohmmeter Positive Lead
2. Ohmmeter Negative Lead
3. Spark Plug Cable (7.25 in. shown)
4. Ohmmeter

Figure 7-7. Testing Resistance

STARTER INTERLOCK 7.6

GENERAL

The starter interlock system is designed to prevent unintended start-up and/or forward motion of the motorcycle with the vehicle's side stand not retracted.

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.

Ignition Circuit

The ignition circuit prevents the motorcycle from operating unless a ground is established at the ignition relay. If this ground is not established, the ignition system will be not turned on and the motorcycle will not run. Grounds may be established three ways.

- By retracting the side stand and grounding through the side stand switch.
- By placing the motorcycle in neutral and grounding through the neutral switch.
- By disengaging the clutch and grounding through the clutch lever switch.

Note that the ignition circuit allows operation in gear with the side stand extended if the clutch is disengaged. However, if the motorcycle is in gear with the side stand extended, and the clutch is released, the ignition ground is lost and the ignition system is turned off. This system will prevent vehicle operation if forward motion is attempted with the side stand down.

See Figure 7-14

PROBLEM	CHECK FOR	CORRECTION
Electric starter will not crank.	Battery problems.	See *1.3 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.
Electric starter cranks, but vehicle will not start.	Side stand not retracted.	Retract side stand.
Motorcycle will not start with side stand retracted.	Clutch lever not disengaged.	Pull in clutch lever.
Motorcycle will not start with side stand retracted or clutch disengaged.	Ignition relay problems.	Listen for relay “click”. If click is not heard, perform ignition system tests.
Motorcycle will not start after starter relay tests.	No spark at spark plug.	Check for 12 VDC at coil W/BK wire.
		Follow ignition system troubleshooting

HOME

INSPECTION

The starter interlock system is designed to prevent unintended start-up and/or forward motion of the motorcycle with the vehicle's side stand not retracted. Use the following tests to check the system for proper operation.

The reference numbers below correlate with the circled numbers in the 7.6 STARTER INTERLOCK flow charts.

1. Check diode with an ohmmeter as shown in Figure 7-11
2. Check diode polarity as shown in Figure 7-11

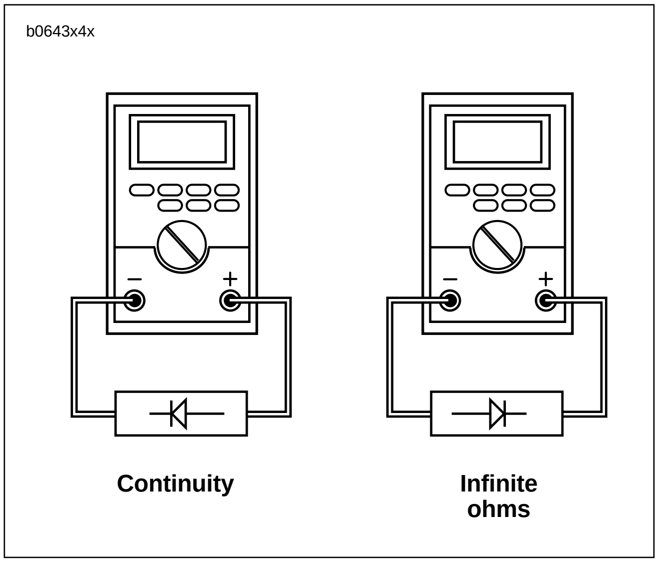


Figure 7-8. Ohmmeter Diode Test

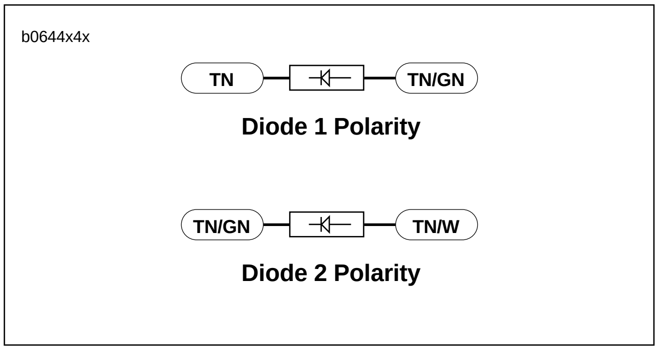


Figure 7-9. Diode Polarity

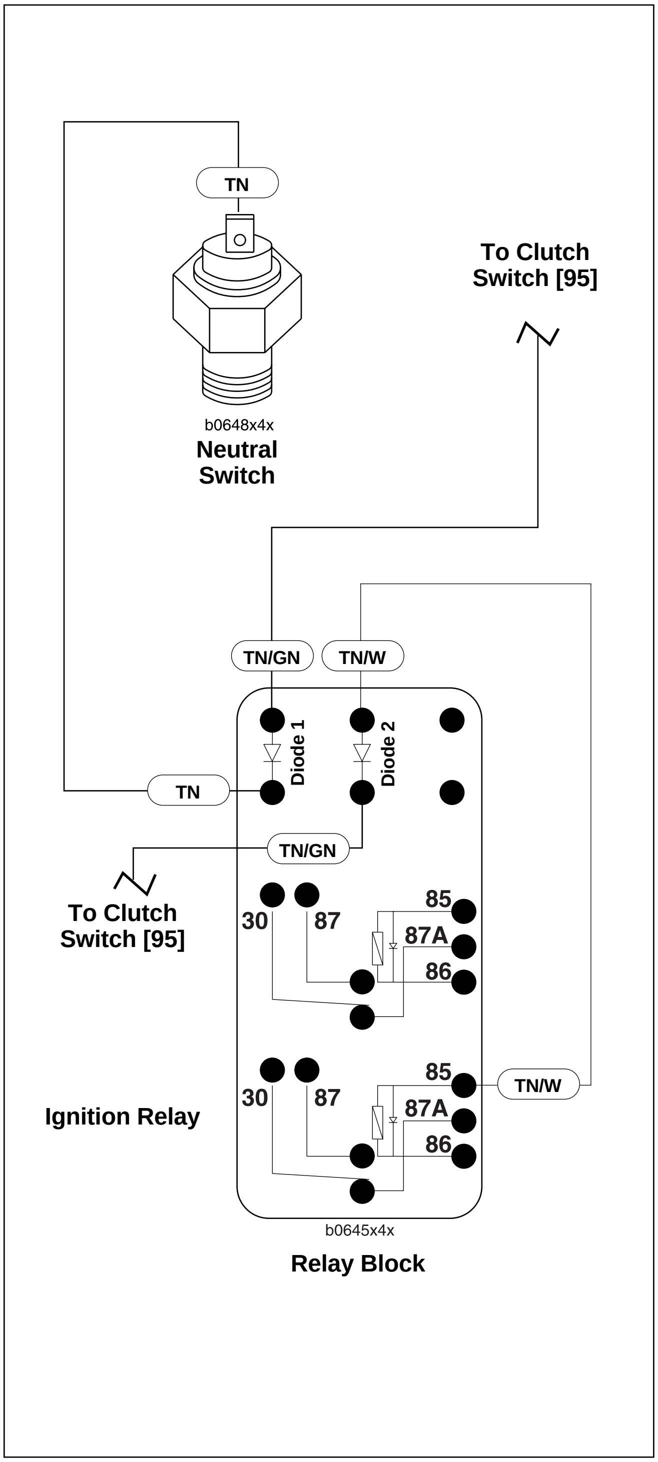
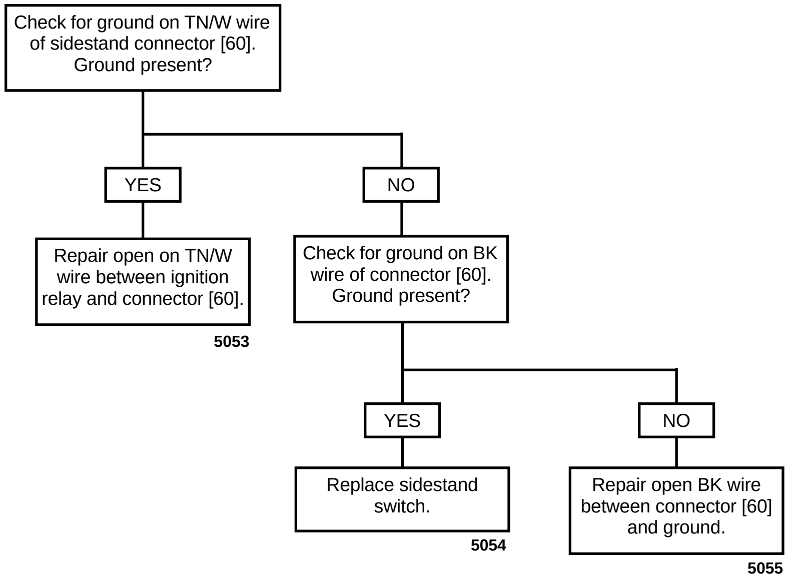


Figure 7-10. Diode Wiring

HOME

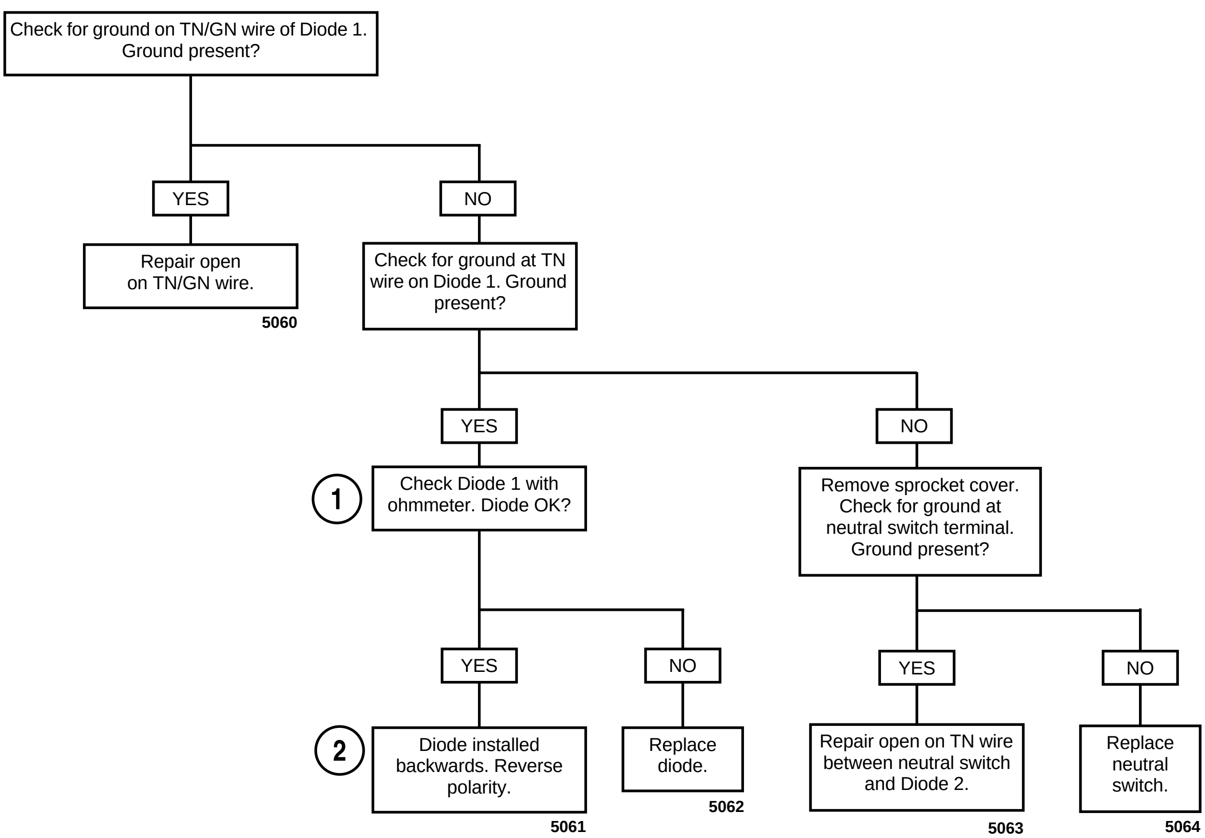
Ignition Test

CONDITION: Sidestand up and key ON, transmission in neutral and clutch engaged



Starter Test (Part 1 of 2)

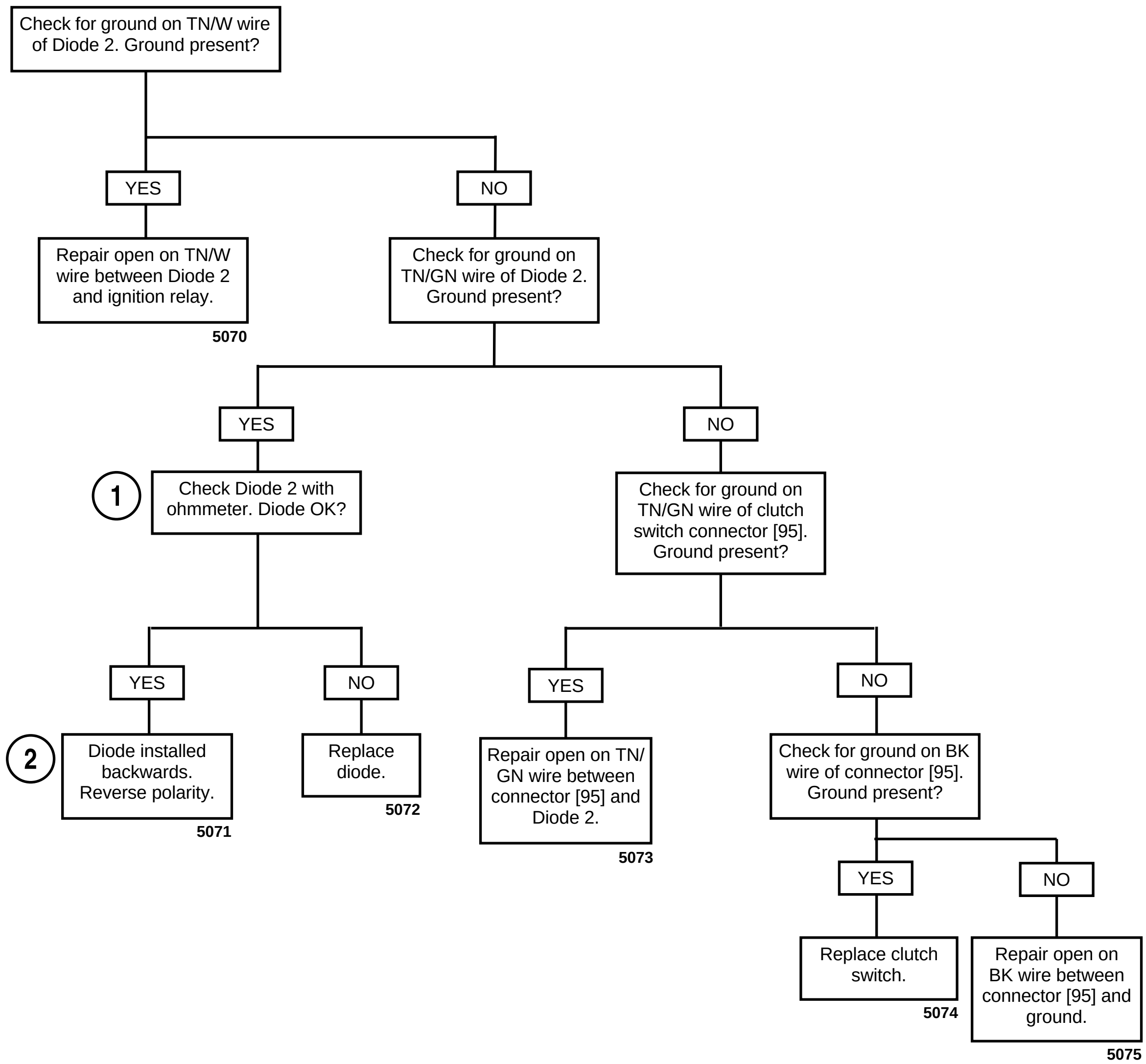
CONDITION: Sidestand down, key ON, transmission in neutral and clutch engaged



HOME

Starter Test (Part 2 of 2)

CONDITION: Sidestand down, key ON, transmission in gear and clutch disengaged



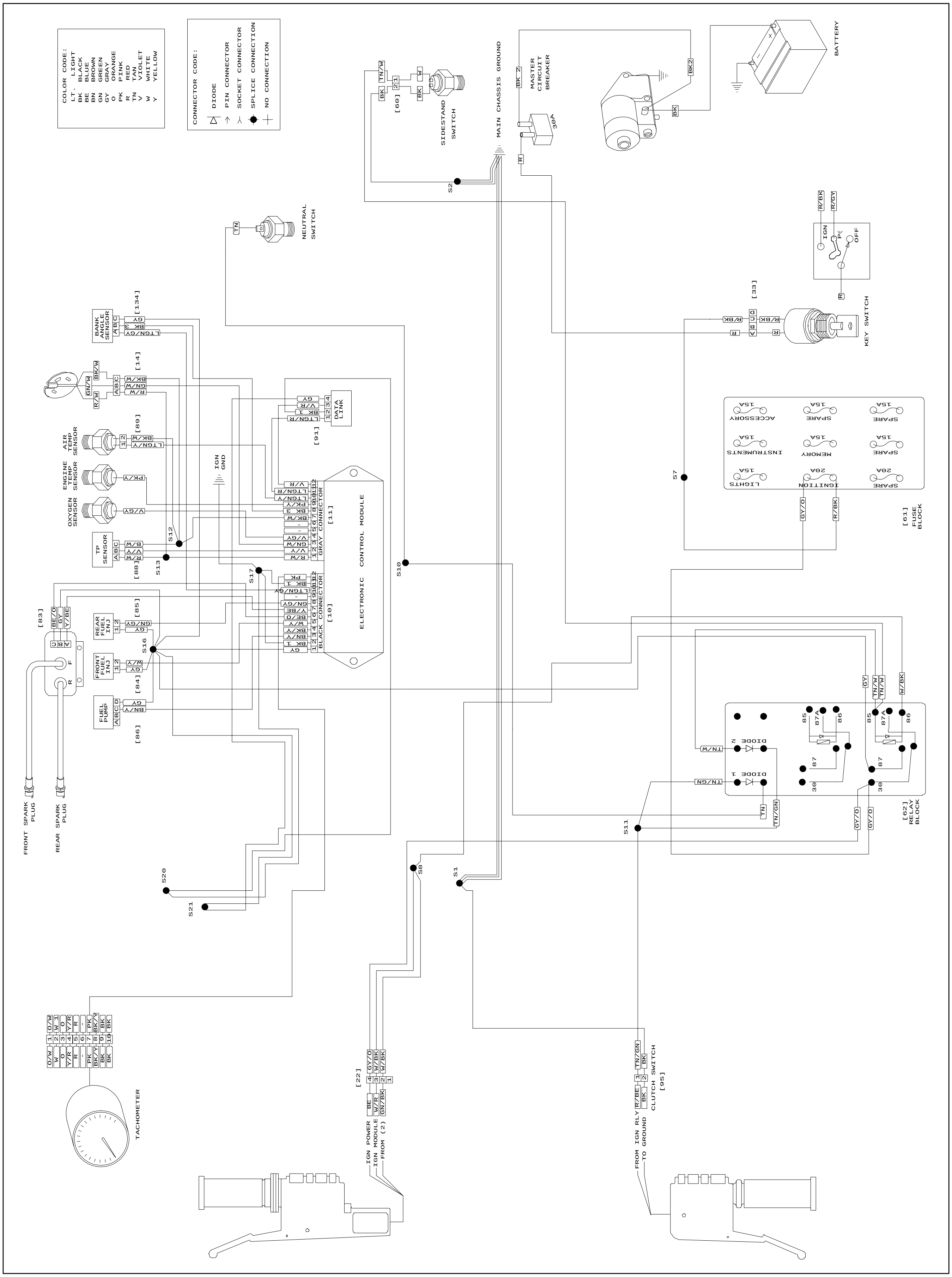


Figure 7-11. Starter/Ignition Interlock System

TESTING/REPLACEMENT

Side Stand Switch

See Figure 7-15 The side stand switch is a simple spring loaded plunger. The switch completes a path to ground for the ignition relay when the side stand is in the retracted position. Test the switch as follows:

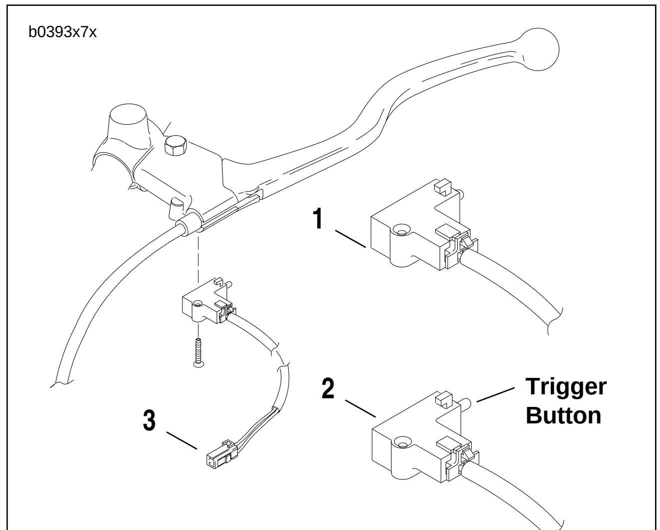
1. Unplug the 2-place side stand switch connector [60].
2. Test the switch using an ohmmeter.
   a. With side stand down (1) (switch open), the switch should show ∞ ohms (infinite ohms).
   b. With side stand up (2) (switch closed), the switch should show 0 ohms or little resistance.
3. Replace the assembly with a **new** switch if necessary. Remove side stand switch from frame by removing two nuts.

Clutch Switch

See Figure 7-15 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.
   a. Remove small Phillips screw.
   b. Depress clutch lever and hold.
   c. Detach switch by depressing switch trigger button and pulling switch towards the end of the handlebar.
   d. Install **new** switch.

Figure 7-12. Side Stand Switch and Bracket



1. **Clutch Engaged (Switch Open)**
2. **Clutch Disengaged (Switch Closed)**
3. **Connector [95]**

Figure 7-13. Clutch Switch

HOME

Ignition Relay

See Figure 7-16 The ignition relay (1) is on the relay block under the tail section along the right side frame tube. Test the relay as follows:

1. Test the relay in the same fashion as the starter relay. See Section 5.
2. Replace the relay with a **new** relay if necessary.

Starter Relay

See Figure 7-16 The starter relay (2) is on the relay block under the tail section along the right side frame tube. See 5.3 STARTING SYSTEM DIAGNOSIS.

Ignition Fuse

See Figure 7-16 The ignition fuse is in the fuse block under the right side of the tail section. Always replace the fuse with another 20 ampere fuse.

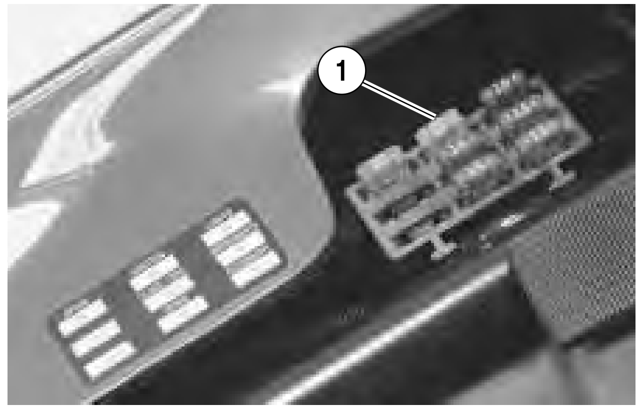
Diodes

1. See Figure 7-16 Remove seat and locate diodes within relay block.
2. Test diodes using Starter Test flow charts under DIAGNOSTICS.
3. Identify the diode which must be replaced. Replace both diodes if necessary.
4. Replace the diodes by pulling them straight out. The spare diode may be used in either circuit as long as it is installed in the correct direction.

Main Circuit Breaker

See Figure 7-16 Attached to the frame above the battery, the main circuit breaker (1) is between the ignition key switch and the battery. Remove the main circuit breaker as follows:

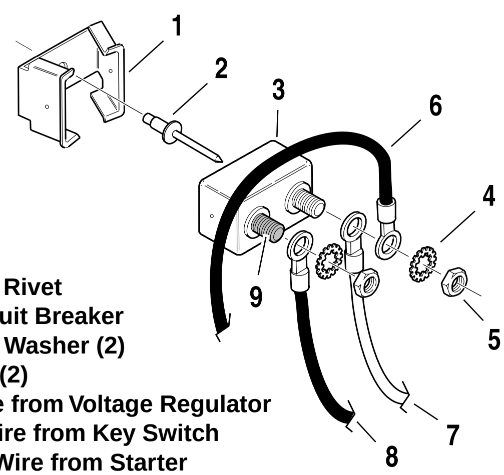
1. Remove seat and fuel tank. See 4.36 FUEL TANK.
2. Remove battery negative cable (3) from frame.
3. See Figure 7-16 Remove nuts (5), star washers (4) and wire leads (6, 7 and 8) from circuit breaker studs.
4. Remove circuit breaker (3) from circuit breaker clip (1).
5. Install in the reverse order.



1. Ignition Fuse (20A)

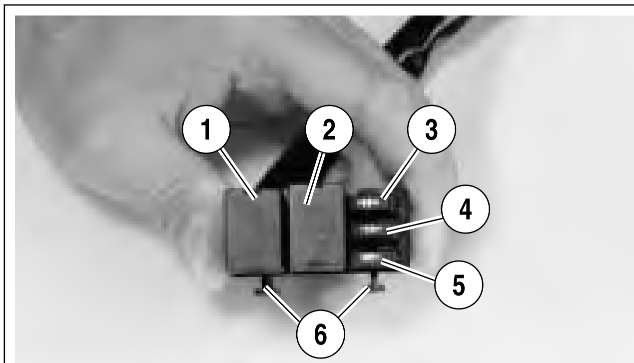
Figure 7-14. Fuse Block

b0401x7x



1. **Clip**
2. **Pop Rivet**
3. **Circuit Breaker**
4. **Star Washer (2)**
5. **Nut (2)**
6. **Wire from Voltage Regulator**
7. **R Wire from Key Switch**
8. **BK Wire from Starter**
9. **Circuit Breaker Gold Post**

Figure 7-15. Circuit Breaker Installation



1. **Ignition Relay**
2. **Starter Relay**
3. **Starter Circuit Diode**
4. **Ignition Circuit Diode**
5. **Spare Diode**
6. **Mounting Tabs**

Figure 7-16. Relay Block

DIODES 7.7

GENERAL

See Figure 7-17 Both user replaceable diodes (1, 2) are mounted on the relay block under the tail section. One spare diode (3) is attached to the relay block.

See 7.6 STARTER INTERLOCK and 4.13 NO ECM POWER for troubleshooting information. The spare diode may be used in either circuit as long as it is installed in the correct direction.

REPLACEMENT

⚠WARNING

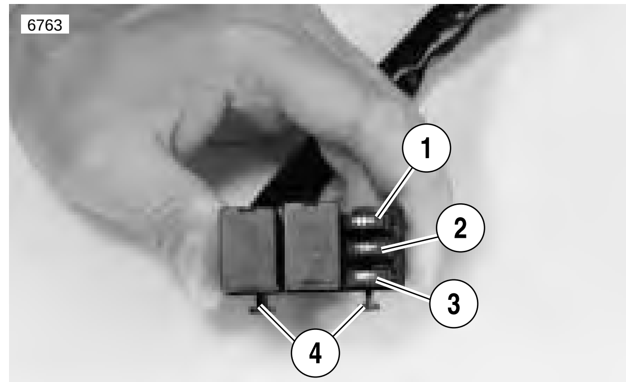
To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Remove seat and tail section. See 2.33 TAIL SECTION.
3. Replace the diodes by pulling them straight out from relay block.
4. Install new diode by plugging into slot on relay block.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

5. Install tail section and seat. See 2.33 TAIL SECTION.
6. Reconnect negative battery cable to battery.
7. Test interlock for proper operation.



1. **Starter Circuit Diode**
2. **Ignition Circuit Diode**
3. **Spare Diode**
4. **Mounting Tabs**

Figure 7-17. Diodes

NOTES

CHARGING SYSTEM 7.8

GENERAL

The charging system consists of the alternator and regulator. Charging system circuits are shown in Figure 7-18.

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 7-18. The voltage regulator is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

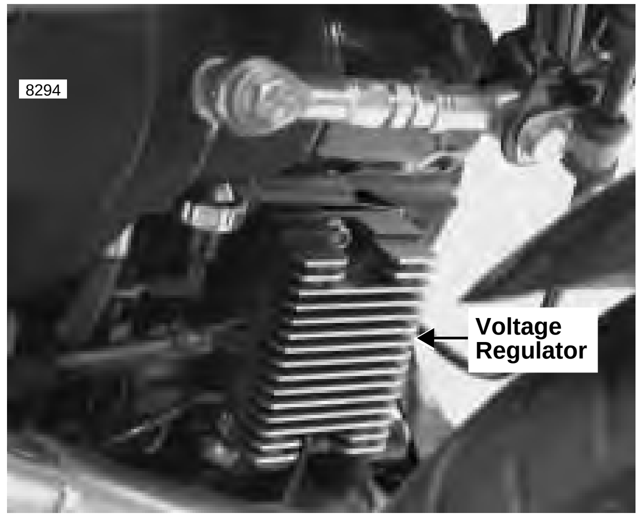


Figure 7-18. Voltage Regulator

TROUBLESHOOTING

When the charging system fails to charge or does not charge at a satisfactory rate, make the following recommended checks.

Battery

Check for a weak or dead battery. See 1.3 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 7-18.

Voltage Regulator Inspection

See Figure 7-18. The voltage regulator base must have a clean, tight connection for proper grounding. Check by using an ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator base.

Connector plug to stator must be clean and tight.

TESTING

Voltage Regulator Bleed Test

1. Be sure regulator is connected to battery. Check BK charging wire on gold terminal of master circuit breaker.
2. Locate voltage regulator connector [46] near the oil pump. Disconnect from alternator stator wiring.
3. Check regulator connector using a trouble light.
   a. Touch one probe to a suitable ground.
   b. Touch the other to the regulator pins, one at a time.
   c. If light glows, replace regulator.

Milliampere Draw Test

CAUTION

Make 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 7-21. 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 3 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.

HOME

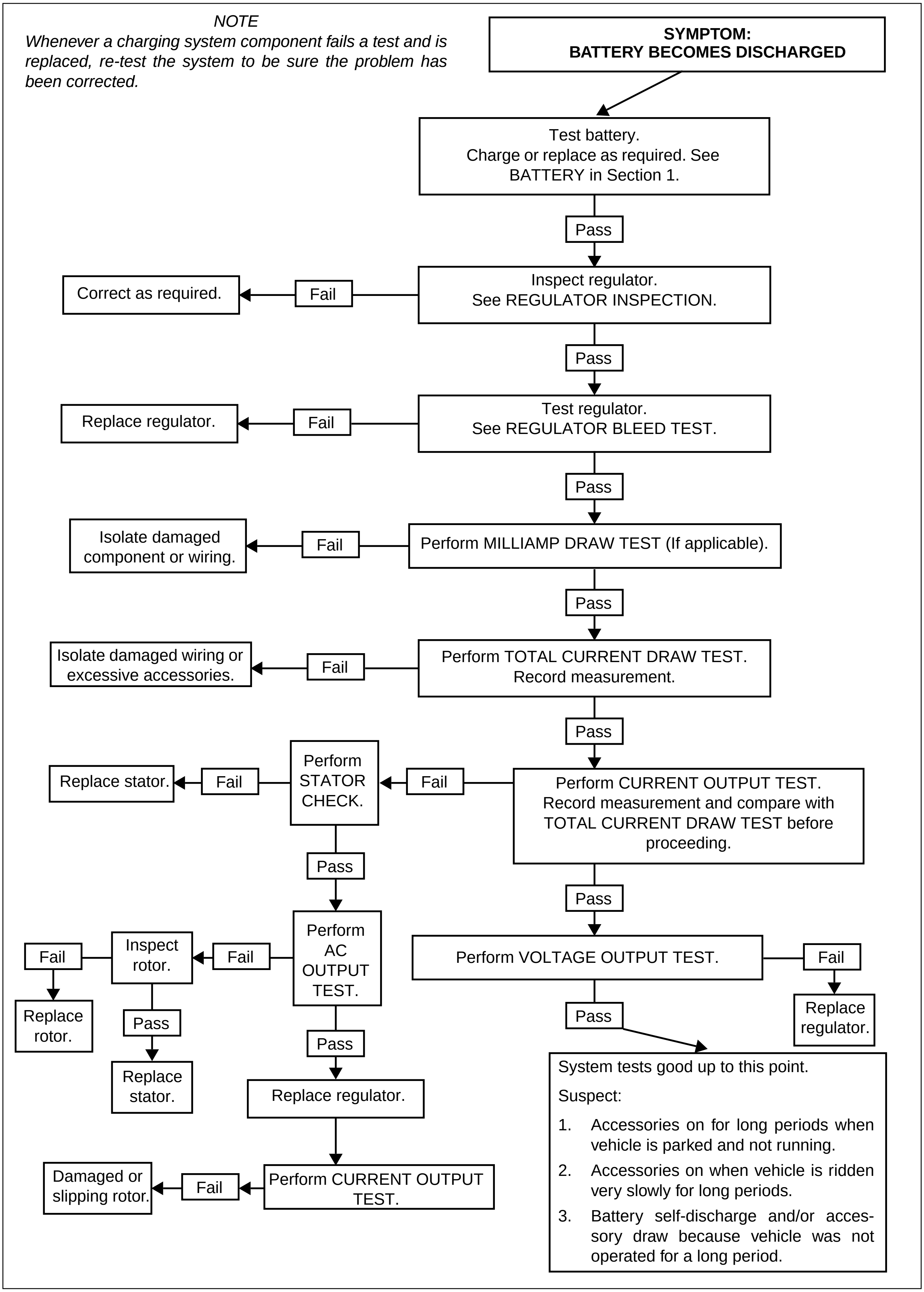


Figure 7-19. Charging System Troubleshooting

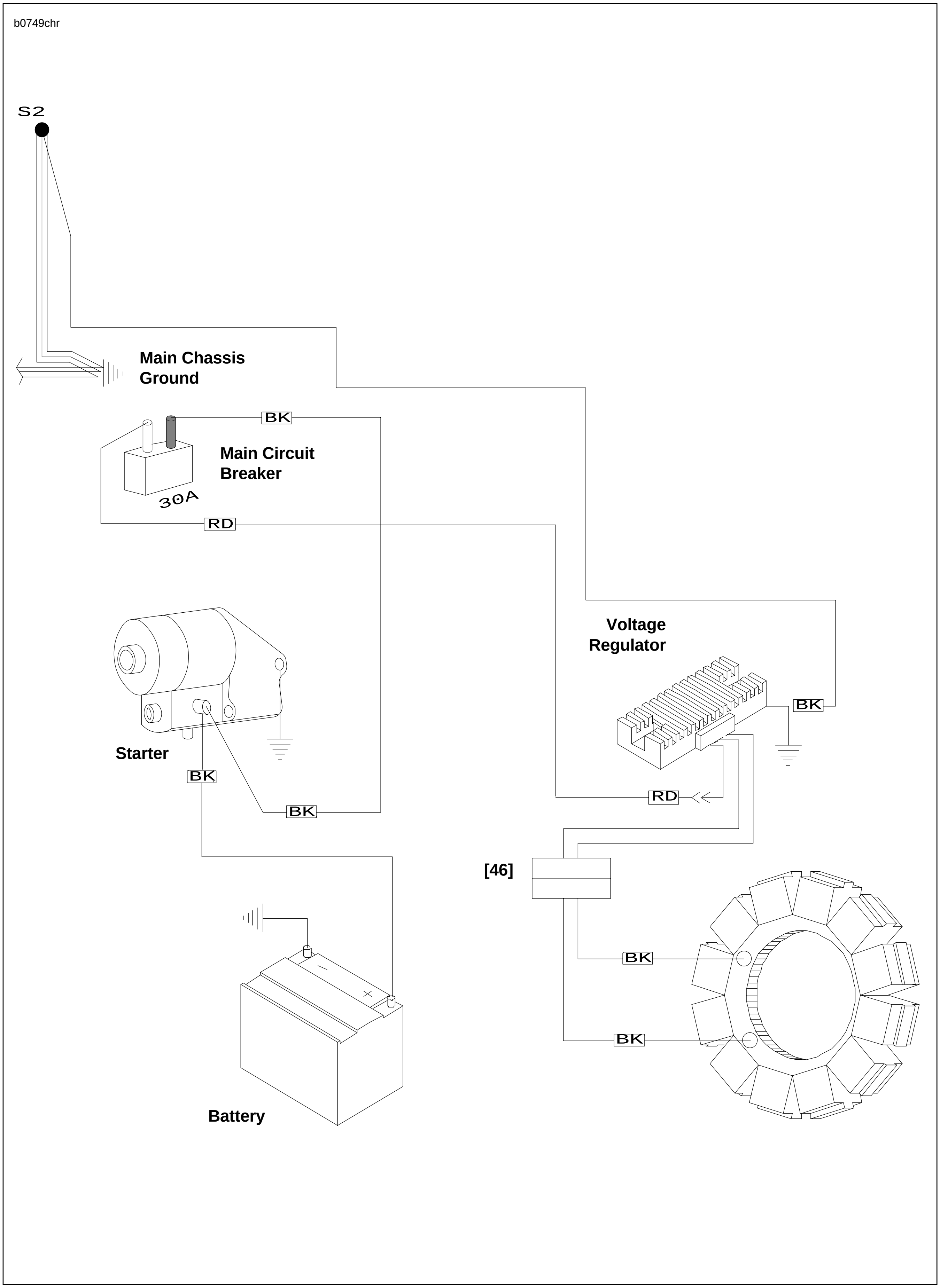


Figure 7-20. Charging System Circuit

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.

1. See Figure 7-22. 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] near the oil pump. Start the motorcycle and run the engine at 2000 RPM.
3. With ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw.
4. Compare this reading to the reading obtained after performing the CURRENT AND VOLTAGE OUTPUT TEST.
   a. The current output should exceed current draw by 3.5 amps minimum.
   b. If output does not meet specifications, there may be too many accessories for the charging system to handle.
5. Reconnect regulator after testing.

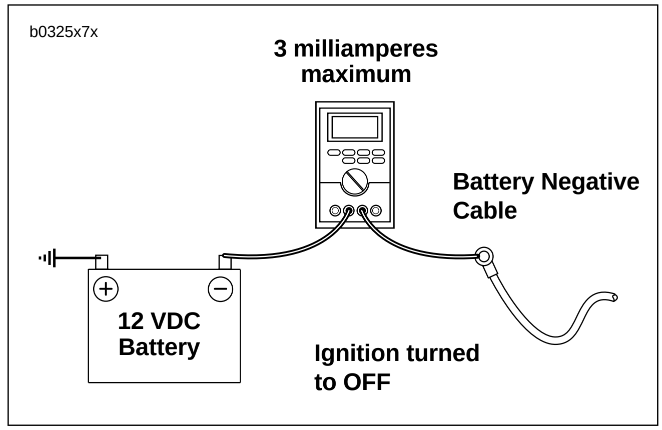


Figure 7-21. Milliampere Draw Test

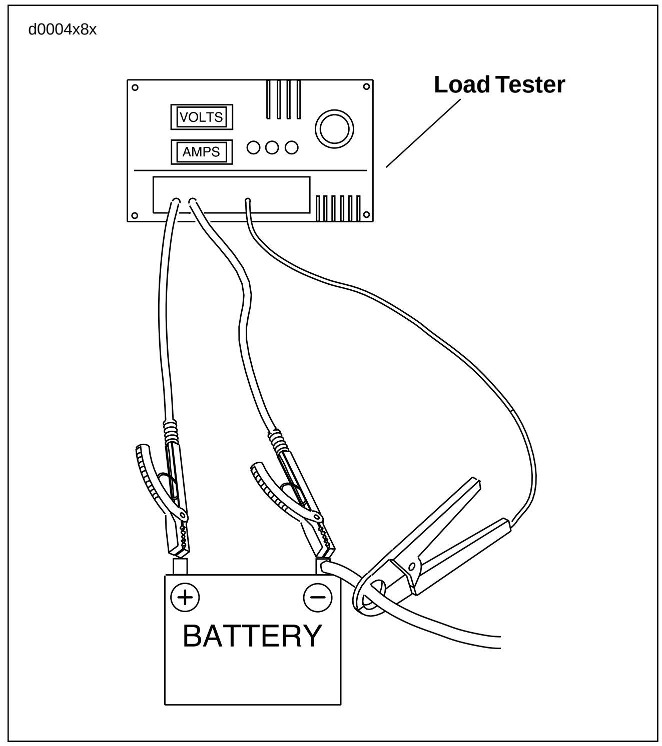


Figure 7-22. Check Current Draw (Ignition Switch On)

Current and Voltage Output Test

1. See Figure 7-23. Connect load tester.
   a. Connect negative and positive leads to battery terminals.
   b. Place load tester induction pickup over positive regulator cable.

CAUTION

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

2. Run the engine at 2000 RPM. Increase the load as required to obtain a constant 13.0 VDC.
3. The current output should be 19-23 amps. Make note of measurement for use in TOTAL CURRENT DRAW TEST.

NOTE

Rider's habits may require output test at lower RPM.

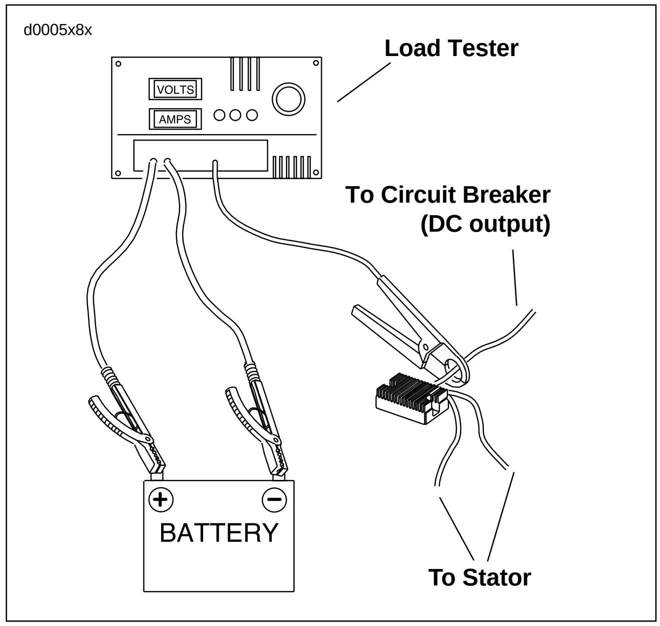


Figure 7-23. Current and Voltage Output Test

Voltage Output Test

1. See Figure 7-23. 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 Figure 7-19.
   b. If voltage is higher, regulator is not functioning properly or connections are loose or dirty.

Stator Check

1. Turn ignition key switch to OFF.
2. See Figure 7-24. Connect an ohmmeter.
   a. Locate voltage regulator connector [46] near the oil pump. Disconnect from alternator stator wiring.
   b. Insert one ohmmeter lead into either 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 either stator socket.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 7-25. Remove ground lead. Insert lead into the remaining stator socket.
5. Test for resistance with ohmmeter set on the RX1 scale.
   a. Resistance across the stator sockets should be 0.2-0.4 ohms.
   b. If the resistance is lower, the stator is damaged and must be replaced.

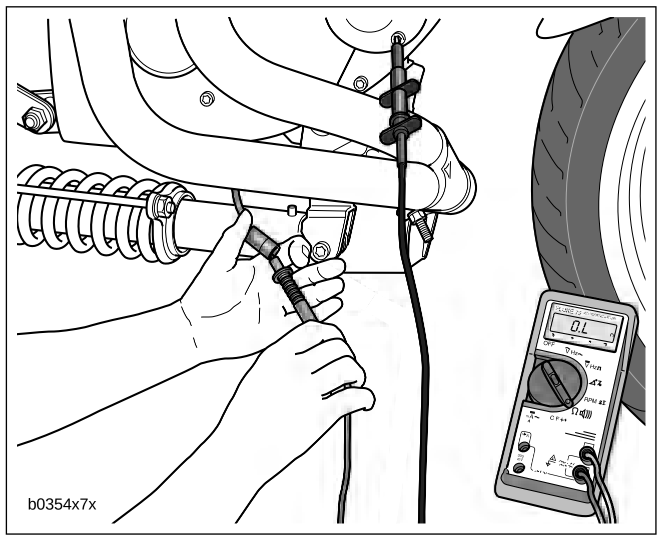


Figure 7-24. Test for Grounded Stator (Typical)

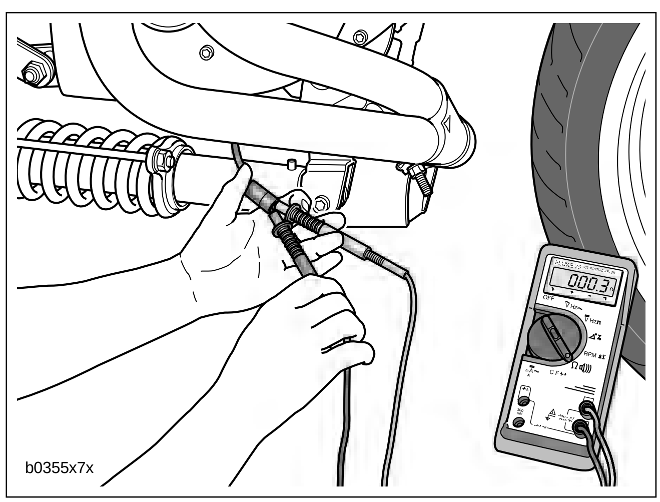


Figure 7-25. Check for Stator Resistance (Typical)

HOME

AC Output Check

1. See Figure 7-26. Test AC output.
   a. Locate voltage regulator connector [46] near the oil pump. Disconnect from alternator stator wiring.
   b. Connect an AC voltmeter across both stator sockets.
   c. Run the engine at 2000 RPM. The AC output should be 38-52 volts AC.
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 5-24.

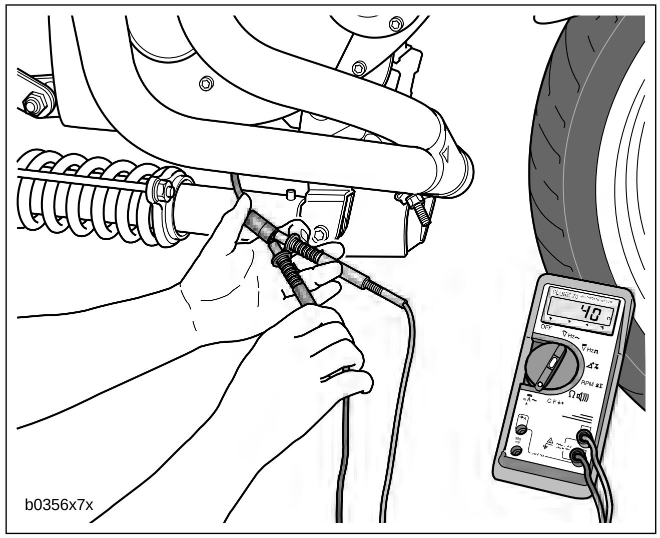


Figure 7-26. Check Stator AC Voltage Output

REMOVAL/DISASSEMBLY

⚠WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.
2. Remove primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
3. Removing the left fairing lower. See 2.38 FAIRING LOWERS.
4. Remove clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See PRIMARY CHAIN/DRIVE under 6.5 PRIMARY DRIVE/CLUTCH.
5. Remove/disassemble rotor and/or stator, as required. Refer to the following procedures.

Rotor

1. See Figure 7-27. Remove the eight bolts which secure alternator rotor to engine sprocket.
2. See Figure 7-27. 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.

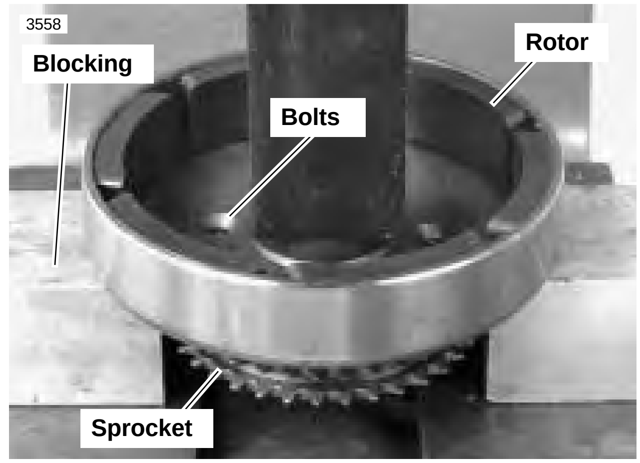


Figure 7-27. Removing Rotor From Sprocket

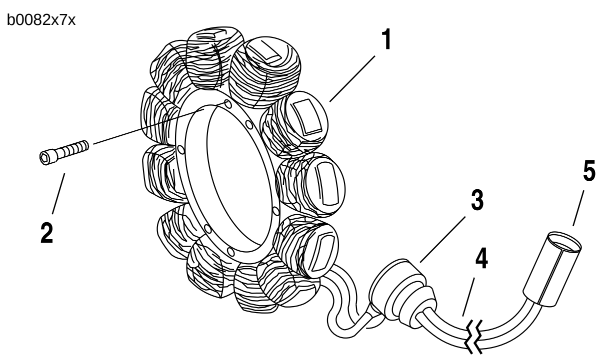
Stator

1. See Figure 7-28. Disconnect stator wiring (4) from voltage regulator wiring at connector (5) [46] near the oil pump.
2. Remove cable straps holding stator wire to oil filter hose.
3. Withdraw stator wiring (4) from behind the gearcase cover.
4. Remove and discard the four TORX screws (2) which secure stator (1) to left crankcase half.

CAUTION

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.

5. Remove stator wiring grommet (3) from left crankcase half.
6. Withdraw stator wiring (4) from grommet hole in left crankcase half. Remove stator (1).



1. Stator
2. TORX Screw (4)
3. Grommet
4. Stator Wiring
5. Connector [46]

Figure 7-28. 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 7-28. 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.

CAUTION

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 (1) on left crankcase half. Secure stator using four **new** TORX screws (2). Tighten screws to 30-40 **in-lbs** (3.4-3.5 Nm).
4. Route stator wiring (4) in front of starter, behind gearcase cover and outboard of oil pump.

NOTE
Temporarily attach a thin flexible “feed” or mechanic’s wire to the connector end of the stator wiring to assist in the routing of the wiring.

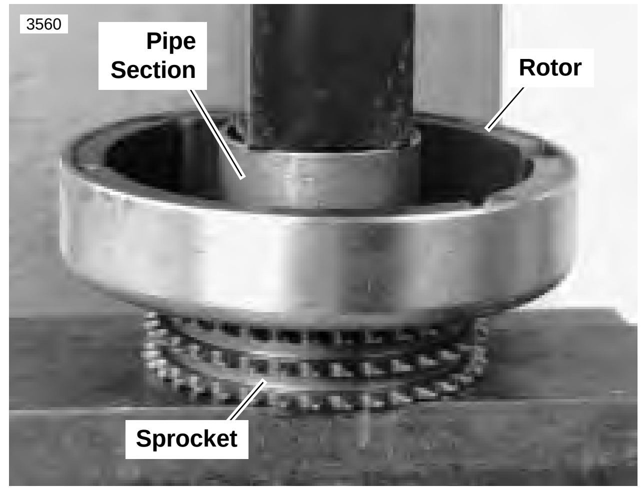


Figure 7-29. Pressing Rotor onto Sprocket

5. Connect alternator stator wiring to voltage regulator connector [46]. Bundle excess wiring in front of oil pump. Secure bundle to oil filter hose using a **new** cable strap.
6. See Figure 7-29. Attach rotor to sprocket.
   a. Position rotor on sprocket. Align holes in sprocket with holes in rotor.
   b. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to threads of each mounting bolt. Insert the four mounting bolts through rotor and start bolts into tapped holes in sprocket.
   c. Position a section of pipe with an inside diameter larger than the sprocket mounting hub over center of rotor. Press rotor onto sprocket. Tighten bolts 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 DRIVE/CLUTCH.
8. Install primary cover. See PRIMARY COVER under 6.2 PRIMARY CHAIN.
9. Install the left fairing lower. See 2.38 FAIRING LOWERS.
10. Connect negative battery cable to battery.
11. Test charging system. See 7.8 CHARGING SYSTEM.

VOLTAGE REGULATOR 7.10

GENERAL

The voltage regulator attaches to a mounting plate at the front of the crankcase. The voltage regulator is not repairable. Replace the unit if it fails.

Positive Lead

A red wire with a female bullet connector leads from the AUX terminal of the main circuit breaker to beneath the oil pump. Here it connects with a male bullet connector from the voltage regulator. The two joined wires are cable strapped to the oil pump.

Negative Lead

A **new** 18 gauge ground wire is spliced at one end to SPL2 and terminated at the other end by a star-washer type ring terminal. The ring terminal attaches to the bottom of the voltage regulator.

REMOVAL

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

1. Disconnect negative battery cable from battery.

CAUTION

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.

2. See Figure 7-30. Locate voltage regulator connector [46] near the oil pump. Disconnect from alternator stator wiring.

NOTE

The black charging wire, formerly loose, is now part of the harness and connector [46].

3. Remove screws and washers.
4. Remove and discard voltage regulator.
5. If necessary, detach mounting bracket by removing screw, washers and nut.

INSTALLATION

1. See Figure 7-31. Attach **new** voltage regulator to bracket using screws and washers.
2. Connect voltage regulator connector [46] to alternator stator wiring. Bundle excess wiring in front of oil pump. Secure bundle to oil pump using a **new** cable strap.

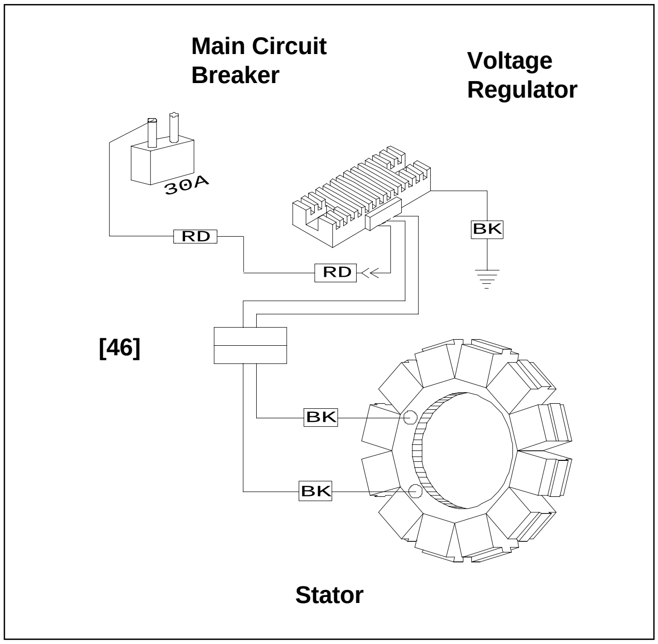


Figure 7-30. Voltage Regulator Wiring

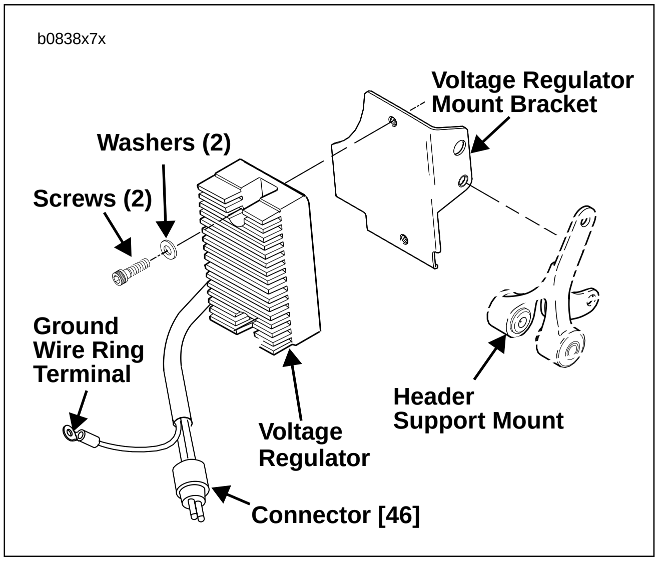


Figure 7-31. Voltage Regulator

3. Route ground wire to gold post on main circuit breaker. Secure wire to frame with **new** cable straps.
4. Install tail section, fuel tank bolt and seat. See 2.33 TAIL SECTION.
5. Connect negative battery cable to battery.
6. Test charging system. See 7.8 CHARGING SYSTEM.

GENERAL

All 2002 Model Year 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

All batteries contain electrolyte. Electrolyte is a sulfuric acid solution that is highly corrosive and can cause severe chemical burns. Avoid contact with skin, eyes, and clothing. Avoid spillage. Always wear protective face shield, rubberized gloves and protective clothing when working with batteries. A warning label is attached to the top of the battery. See Figures 7-33 and 7-34. Never remove warning label from battery. Failure to read and understand all precautions contained in warning label before performing any service on batteries could result in death or serious injury.

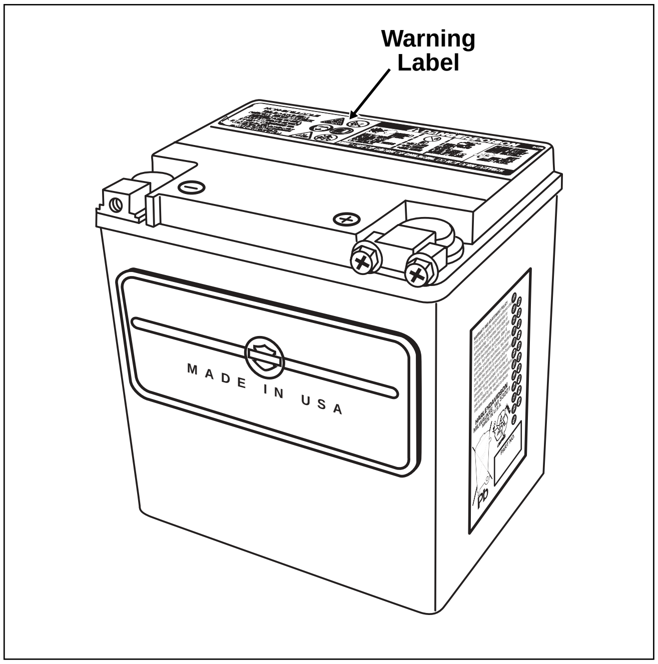


Figure 7-32. Maintenance-Free AGM Battery

BATTERY TESTING

Voltmeter Test

See Table 7-4. 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.

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.

Figure 7-33.

Table 7-4. Voltmeter Test

BATTERY CHARGE CONDITIONS	
Voltage (OCV)	**State of Charge**
12.8	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

DISCONNECTION AND REMOVAL

1. Remove seat. See 2.35 SEAT.

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

WARNING

Always disconnect the negative 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.

2. Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal.
3. Unthread bolt and remove battery positive cable (red) from battery positive (+) terminal.
4. Remove battery strap locknut (metric). Unhook battery strap from frame near negative terminal.
5. Cut any cable straps holding oxygen sensor connector to battery tray.
6. Remove battery from right side.

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.

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

Charge the battery in a well ventilated area. Explosive hydrogen gas escapes from the battery during charging. Keep open flames, electrical sparks and smoking materials away from the battery at all times. Inadequate safety precautions could result in death or serious injury.

CAUTION

If the battery releases an excessive amount of gas during charging, decrease the charging rate. If the battery gets hotter than 110°F. (43°C) during charging, discontinue 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, VOLTMETER TEST, on the previous page. If battery needs to be charged, proceed to step 2.

CAUTION

Always remove the battery from the motorcycle before charging. Accidental electrolyte leakage will damage motorcycle parts.

The figures listed 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.

2. Remove the battery from the motorcycle. See BATTERY, DISCONNECTION AND REMOVAL. Place the battery on a level surface.

⚠WARNING

Always unplug or turn OFF the battery charger before connecting the charger clamps to the battery. Connecting clamps with the charger ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

CAUTION

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 the 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 7-5.

⚠WARNING

Always unplug or turn OFF the battery charger before disconnecting the charger clamps from the battery. Disconnecting clamps with the charger ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

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, LOAD TEST.

Table 7-5. Battery Charging Rates/Times

Battery Amp-Hour	State of Charge		3 Amp Charger	6 Amp Charger	10 Amp Charger	20 Amp Charger
	Voltage Reading	% of Charge				
SPORT 19	12.8 V	100%	-	-	-	-
	12.6 V	75%	1.75 hours	50 minutes	30 minutes	15 minutes
	12.3 V	50%	3.5 hours	1.75 hours	1 hour	30 minutes
	12.0 V	25%	5 hours	2.5 hours	1.5 hours	45 minutes
	11.8 V	0%	6 hours, 40 minutes	3 hours, 20 minutes	2 hours	1 hour

BATTERY LOAD TESTING

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:

CAUTION

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 CHARGING BATTERY. 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

Always turn the battery load tester OFF before connecting the tester cables to the battery terminals. Connecting tester cables with the load tester ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

3. Connect tester leads to battery posts and place induction pickup over negative (black) cable. See Figure 7-42.

CAUTION

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

4. Referencing Table 7-7, load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 70°F. (21°C).

⚠WARNING

Always turn the battery load tester OFF before disconnecting the tester cables from the battery terminals. Disconnecting tester cables with the load tester ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

1. Install the battery on the motorcycle. See BATTERY, INSTALLATION AND CONNECTION.

Table 7-6. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
SPORT	270	135

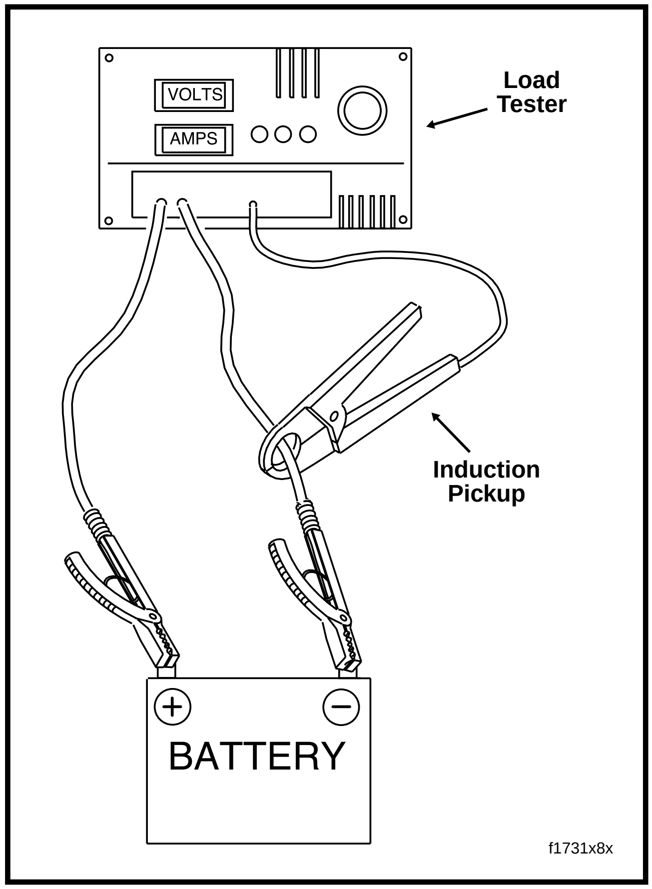


Figure 7-34. Load Test Battery

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 7-35.

HOME

BATTERY INSTALLATION AND CONNECTION

1. Place the fully charged battery into the battery box, terminal side forward.

CAUTION

Connect the cables to the correct battery terminals or damage to the motorcycle electrical system will occur.

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.

CAUTION

Overtightening bolts can damage battery terminals.

2. Insert bolt through battery positive cable (red) into threaded hole of battery positive (+) terminal. Tighten bolt to 60-96 **in-lbs** (7-11 Nm).
3. Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten bolt to 60-96 **in-lbs** (7-11 Nm).
4. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.
5. Install battery strap.
   a. Insert tab on right side of battery tray. Place battery strap around top side of battery.
   b. Hook edge of strap into frame tab.
   c. Insert threaded shaft on strap through frame tab.
   d. Install battery strap locknut on threaded shaft. Tighten to 40 **in-lbs** (4.5 Nm).
6. Apply light coat of petroleum jelly or corrosion-retardant material to both battery terminals.
7. Secure oxygen sensor connector with **new** cable straps to battery tray.

WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

8. Install seat. See 2.35 SEAT.

STORAGE

WARNING

Always store batteries where they cannot be reached by children. Contact with the battery's sulfuric acid could result in death or serious injury.

CAUTION

The electrolyte in a discharged battery will freeze if exposed to freezing temperatures. Freezing may crack the battery case and buckle battery plates.

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 CHARGING BATTERY.

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 7-37.

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 CHARGING BATTERY.

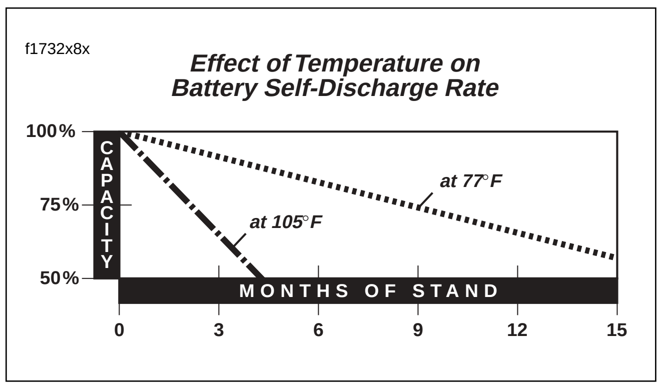


Figure 7-35. Battery Self-Discharge Rate

REMOVAL/DISASSEMBLY

1. Remove front fairing. See 2.34 FRONT FAIRING.
2. See Figure 7-36. Remove headlamp from front fairing mount.
   a. Hold jam nut (6) with a wrench. Twist adjusting knob counterclockwise to remove. Remove jam nut.
   b. Compress clamps (3) on mounting studs (5). Pull headlamp assembly forward when clamps slide through front fairing mount.
3. Detach headlamp connector (8) [4].
4. Remove rubber boot (1).

CAUTION

The bulb contains Halogen gas under pressure. Handle bulb carefully and wear eye protection. Failure to comply may result in minor or moderate injury.

CAUTION

Never touch the bulb with your fingers. Fingerprints will etch the glass and cause the bulb to fail prematurely. Always wrap the bulb in paper or a clean, dry cloth during handling.

5. See Figure 7-37. Remove headlamp bulb.
   a. Twist plastic collar (1) counterclockwise to remove.
   b. Pull bulb (2) from headlamp housing (3).

ASSEMBLY/INSTALLATION

NOTE

When replacement is required, see your Buell dealer. Not using the specified bulb may cause charging system problems.

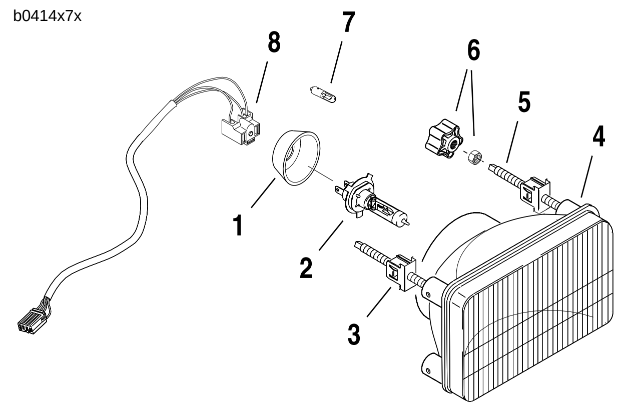
CAUTION

The bulb contains Halogen gas under pressure. Handle bulb carefully and wear eye protection. Failure to comply may result in minor or moderate injury.

CAUTION

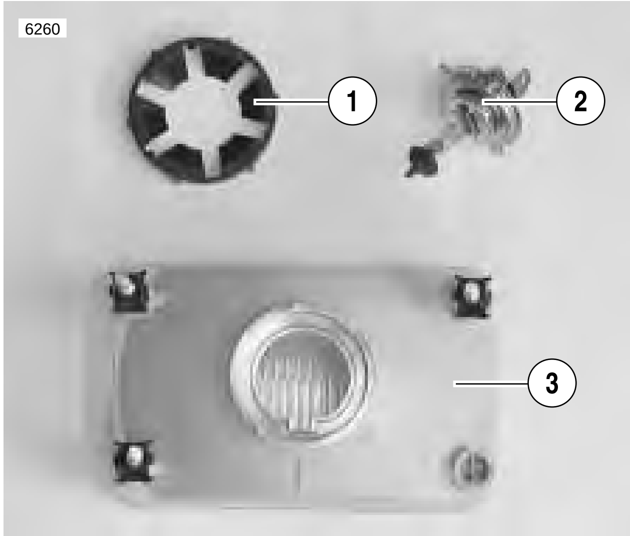
Never touch the bulb with your fingers. Fingerprints will etch the glass and cause the bulb to fail prematurely. Always wrap the bulb in paper or a clean, dry cloth during handling.

1. See Figure 7-37. Install headlamp bulb.
   a. Insert bulb (2) into headlamp housing (3). Metal tab on bulb must fit slot on headlamp housing.
   b. Align tabs on plastic collar (1) with slots on headlamp housing (3). Install collar by turning clockwise.



1. **Rubber Boot**
2. **Bulb**
3. **Clamp (3)**
4. **Headlamp Housing**
5. **Mounting Stud (3)**
6. **Adjusting Knob and Jam Nut**
7. **Position Lamp (Europe only)**
8. **Connector [4]**

Figure 7-36. Headlamp Assembly



1. **Plastic Collar**
2. **Bulb**
3. **Headlamp Housing**

Figure 7-37. Headlamp Bulb

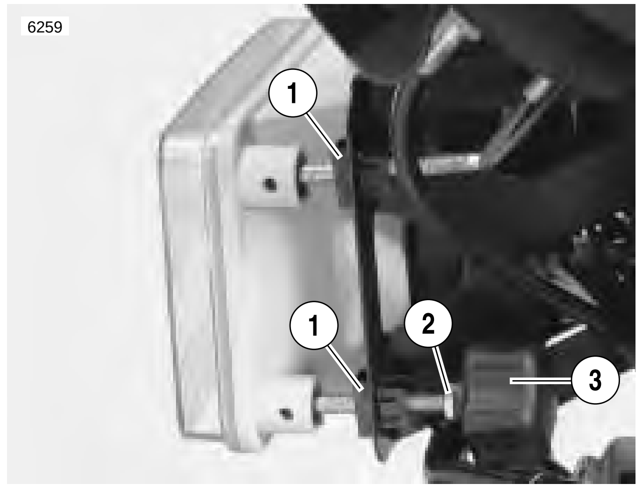
2. See Figure 7-36. Install rubber boot (1).
3. Attach headlamp bulb connector (8) [4].

4. Install headlamp.
   a. Align headlamp with front fairing mount. On U.S. models, text on headlamp lens must be upright.
   b. See Figure 7-38. Compress clamps (1) on headlamp mounting studs. Insert each clamp through front fairing mount.
   c. Place jam nut (2) on lower left mounting stud. Install adjusting knob (3) next to jam nut.
5. Install front fairing. See 2.34 FRONT FAIRING.

WARNING

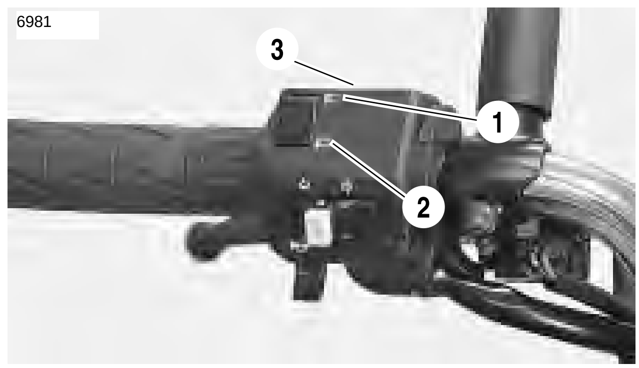
Check for proper headlamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper headlamp operation could result in death or serious injury.

6. Check headlamp for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to IGN.
   b. See Figure 7-39. Check headlamp LOW (2) and HIGH beam (1) settings.
   c. Set headlamp to LOW beam (2). Press passing lamp switch (3). Headlamp should flash HIGH beam for as long as the switch is pressed.
   d. Turn ignition key switch to OFF.
7. Align headlamp. See 1.22 HEADLAMP.



1. **Clamp (3)**
2. **Jam Nut**
3. **Adjusting Knob**

Figure 7-38. Installing Headlamp



1. **HIGH Beam**
2. **LOW Beam**
3. **Passing Lamp Switch**

Figure 7-39. Passing Lamp Switch

TAIL LAMP 7.2

REMOVAL/DISASSEMBLY

1. See Figure 7-40. Remove two screws (1) to detach tail lamp lens.
2. If necessary, remove tail lamp bulbs (3). Push bulbs inward and turn counterclockwise to remove.
3. Remove seat and tail section. See 2.33 TAIL SECTION.
4. See Figure 7-41. Disconnect the three tail lamp wires (2, 3 and 4).
5. Remove two locknuts (metric) and washers (1).
6. Remove tail lamp mount from glove box.

ASSEMBLY/INSTALLATION

1. See Figure 7-41. Attach tail lamp mount to glove box with two locknuts (metric) and washers (1).

NOTE

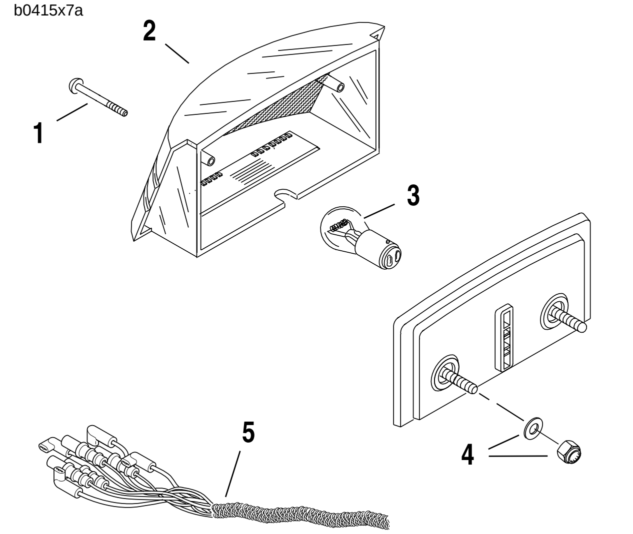
Slots on glove box allow adjustment of tail lamp mount. As a general rule, install tail lamp mount as high as possible within slots.

2. Attach the three tail lamp wires (2, 3 and 4).
3. See Figure 7-40. If removed, install tail lamp bulbs (3). Push bulb in and turn clockwise to install.
4. Install seat and tail section. See 2.33 TAIL SECTION.
5. Install tail lamp lens with two screws (1).

WARNING

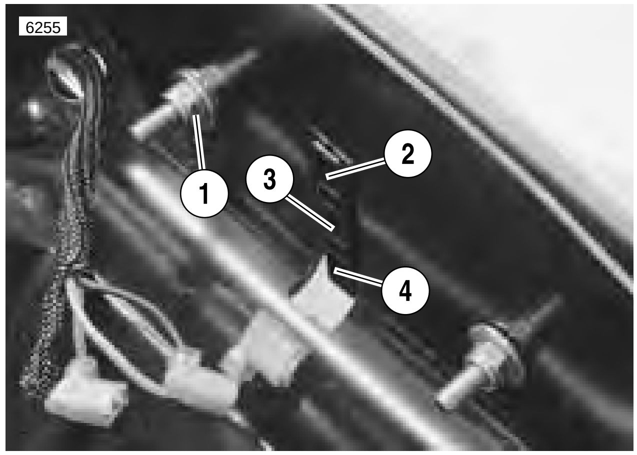
Check for proper brake lamp operation before riding motorcycle (see Step 6). Visibility is a major concern for motorcyclists. Failure to have proper brake lamp operation could result in death or serious injury.

6. Check tail lamp for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to IGN.
   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.



1. **Screw (2)**
2. **Tail Lamp**
3. **Tail Lamp Bulb (2)**
4. **Locknut (metric) and Washer (2)**
5. **From Main Harness**

Figure 7-40. Tail Lamp



1. **Locknut (metric) and Washer (2)**
2. **R/Y Stop Lamp Wire**
3. **B Ground Wire**
4. **O/W Tail Lamp Wire**

Figure 7-41. Tail Lamp Wiring

TURN SIGNALS 7.3

REMOVAL

NOTE

*Remove screw on turn signal lens to install **new** turn signal bulbs.*

Front

1. See Figure 7-42. Disconnect bullet connectors on turn signal wires.
2. See Figure 7-43. Remove screws (1) and nuts (5).
3. Remove turn signals (3).

Rear

1. Detach saddlebags from brackets. See 2.37 SADDLEBAGS.
2. Cut cable straps from turn signal wires under tail section.
3. See Figure 7-44. Disconnect bullet connectors on turn signal wires.
4. See Figure 7-45. Remove screws (1) and nuts (4).
5. Remove turn signals (2) from tail section.

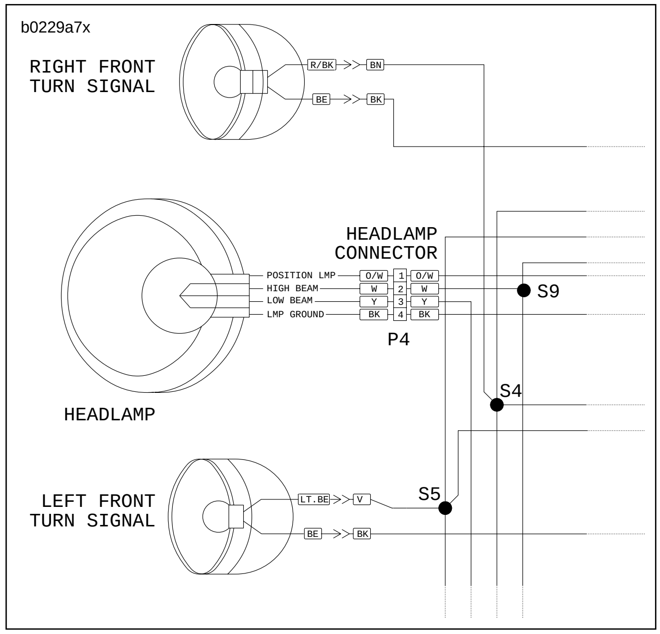
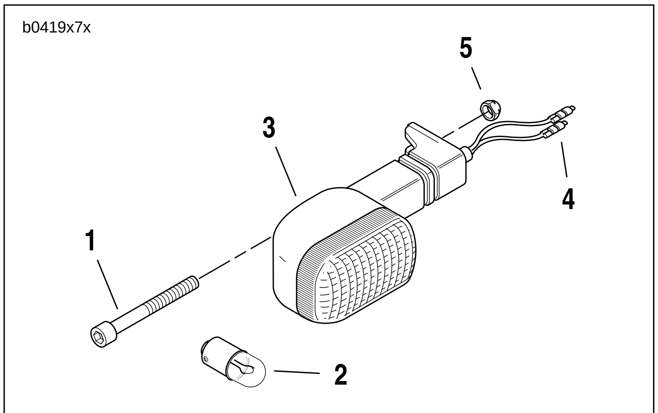


Figure 7-42. Front Turn Signal Connections



1. **Screw (2)**
2. **Bulb (2)**
3. **Turn Signal**
4. **Bullet Connectors (2 per Signal)**
5. **Nut (2)**

Figure 7-43. Front Turn Signals

INSTALLATION

Front

1. See Figure 7-43. Insert bullet connectors (4) through forward hole in front fairing. Attach turn signals (3) using screws (1) through rear hole and nuts (5).

NOTE

Install turn signal with lens drain hole facing downward.

2. Attach bullet connectors on turn signal wires as shown in Figure 7-42.

⚠WARNING

Check for proper turn signal operation before riding motorcycle. Failure to have proper turn signal operation could result in death or serious injury.

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 IGN.
   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.

Rear

1. See Figure 7-45. Insert bullet connectors (3) through rear hole in license plate bracket. Attach turn signals (2) using screws (1) through front hole and nuts (4).

NOTE

Install turn signal with lens drain hole facing downward.

2. Attach bullet connectors on turn signal wires as shown in Figure 7-44.
3. Use **new** cable straps (5) to bundle turn signal wires beneath tail section.
4. Attach saddlebags to bracket. See 2.37 SADDLEBAGS.

WARNING

Check for proper turn signal operation before riding motorcycle. Failure to have proper turn signal operation could result in death or serious injury.

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 IGN.
   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.

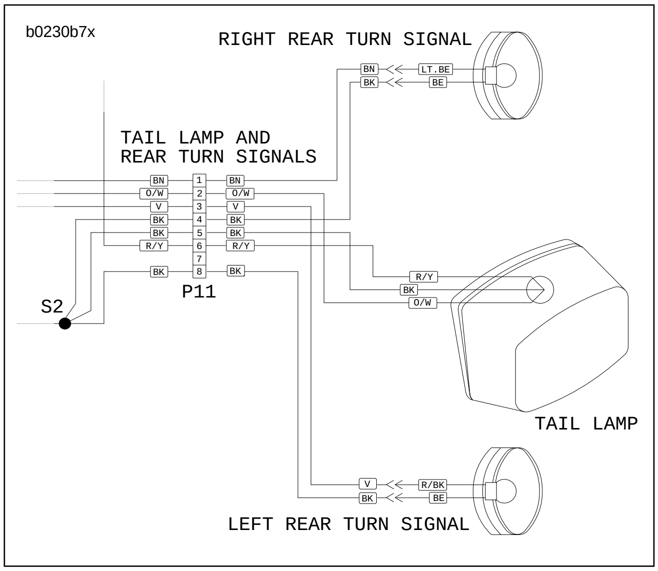
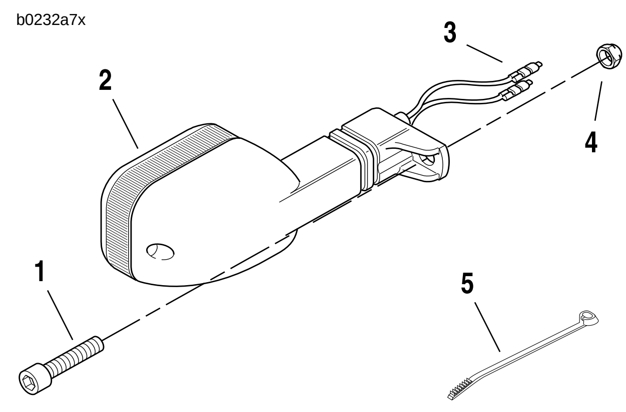


Figure 7-44. Rear Turn Signal Connections



1. **Screw (2)**
2. **Turn Signal**
3. **Bullet Connectors (2 per Signal)**
4. **Nut (2)**
5. **Cable Strap**

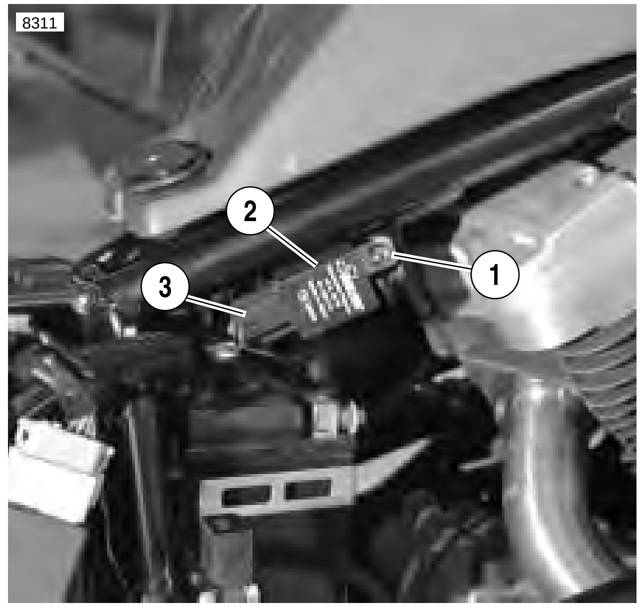
Figure 7-45. Rear Turn Signals

TURN SIGNAL FLASHER

REMOVAL

NOTE
The turn signal flasher is not repairable. Replace the unit if it fails.

1. Remove seat and tail section. See 2.33 TAIL SECTION.
2. See Figure 7-46. Locate turn signal flasher (2) on right side frame tube.
3. Remove screw (1) and flasher (2) from frame.
4. Remove connector [30] (3) from turn signal flasher (2).



1. **Screw**
2. **Turn Signal Flasher**
3. **Connector [30]**

Figure 7-46. Turn Signal Flasher

INSTALLATION

1. See Figure 7-46. Install connector [30] (3) to turn signal flasher (2).
2. Install turn signal flasher (2) to frame with screw (1).

⚠WARNING

Check for proper turn signal operation before riding motorcycle. Failure to have proper turn signal operation could result in death or serious injury.

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 IGN.
   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 locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

4. Install tail section and seat. See 2.33 TAIL SECTION.

REMOVAL

NOTE
The individual handlebar switches are not repairable. Replace switch assembly upon switch failure.

Right Side

1. Detach throttle cables.
2. Remove seat.

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

3. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.
4. See Figure 7-47. Cut as many cable straps as necessary to access right handlebar switch connector [22] along right side frame tube. Detach connector [22] from wiring harness.
5. Cut as many cable straps as necessary to access brake switch connector [21] along right side frame tube. Detach connector [21] from wiring harness.

Left Side

1. Remove three screws (metric) from handlebar switch.
2. Separate switch housings and remove from handlebar.
3. Remove seat.

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (49 psi [338 kPa]). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

4. Purge fuel line and remove fuel tank. See 4.36 FUEL TANK.
5. Cut as many cable straps as necessary to access left handlebar switch connector [24] along right side frame tube. Detach connector [24] from wiring harness.
6. Cut as many cable straps as necessary to access clutch switch connector [95] along right side frame tube. Detach connector [95] from wiring harness.

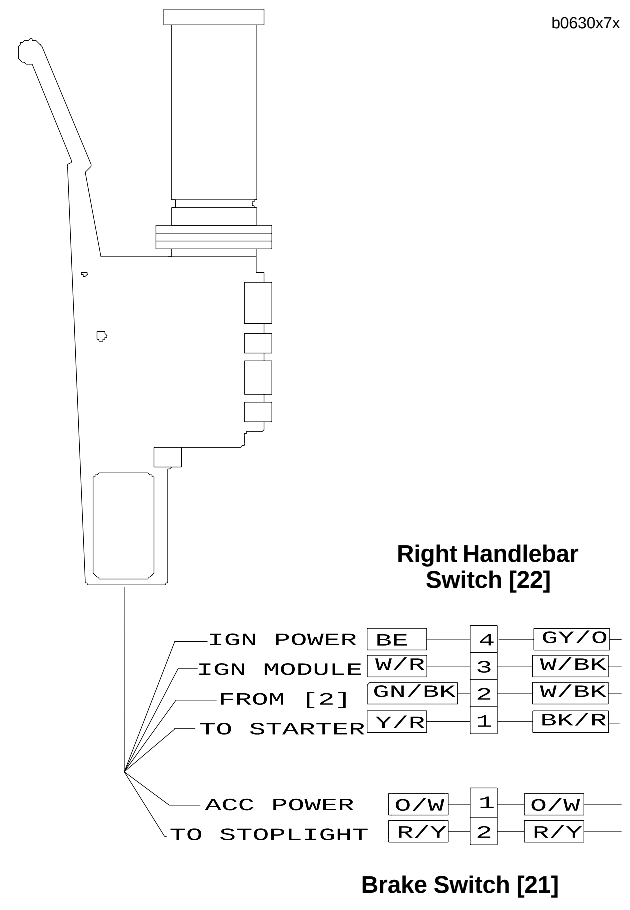
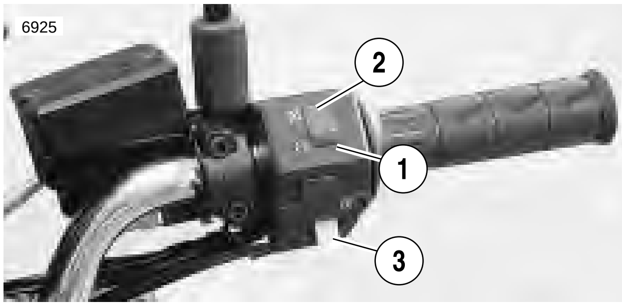


Figure 7-47. Right Handlebar Switch Connection



1. **Ignition ON**
2. **Ignition OFF**
3. **Electric Starter Switch**

Figure 7-48. Right Handlebar Switches

INSTALLATION

Right Side

1. Attach throttle cables to hand control.
2. Position housings on right handlebar by engaging stud on front housing with hole in handlebar. Fasten housings with two screws (metric). Tighten to 12-17 **in-lbs** (1-2 Nm).
3. See Figure 7-47. Route switch housing wiring harness between front forks and along right side frame tube. Attach connector [22] and, if necessary, connector [21] to wiring harness. Fasten wiring harness to frame with **new** cable straps.
4. Install fuel tank. See 4.36 FUEL TANK.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

5. Install seat. See 2.35 SEAT.
6. Adjust throttle cables. See 1.21 THROTTLE CABLES.

⚠WARNING

Check all handlebar switches for proper operation before riding motorcycle. Failure to have operating handlebar switches could result in death or serious injury.

7. Check handlebar switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.
   a. Turn ignition key switch to IGN.
   b. Start motorcycle.
   c. Turn ignition key switch to LOCK.

Left Side

1. Attach switch housing to handlebar with three screws (metric). Tighten screws to 25-33 **in-lbs** (3-4 Nm).
2. Route switch housing wiring harness between front forks and along right side frame tube. Attach connector [24] and, if necessary, connector [95} to wiring harness. Fasten wiring harness to frame with **new** cable straps.
3. Install fuel tank. See 4.36 FUEL TANK.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, which could result in death or serious injury.

4. Install seat. See 2.35 SEAT.

⚠WARNING

Check all handlebar switches for proper operation before riding motorcycle. Failure to have operating handlebar switches could result in death or serious injury.

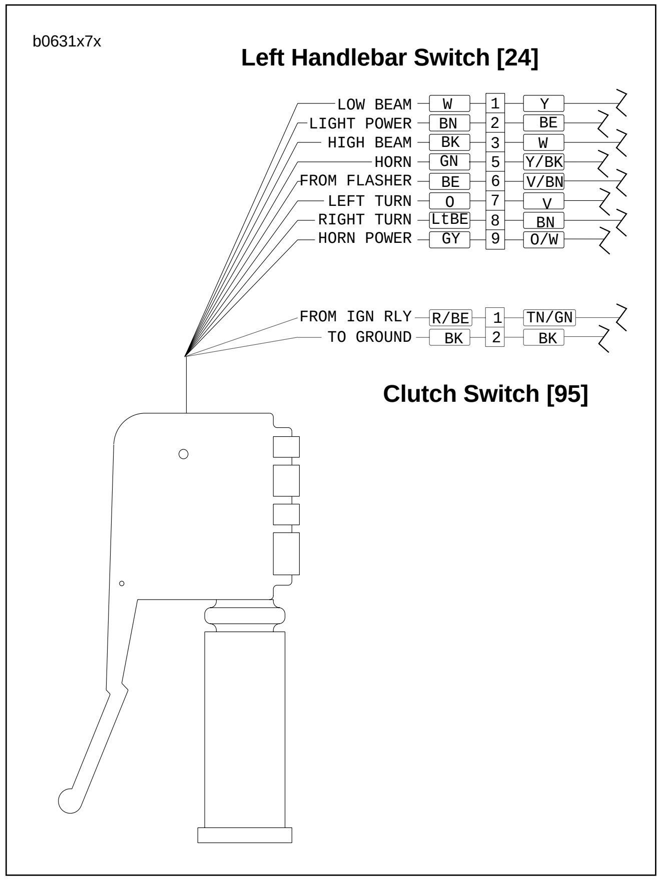


Figure 7-49. Left Handlebar Switch Connection

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 IGN.
   b. Check headlamp LOW and HIGH beam settings.
   c. Set headlamp to LOW beam. Press passing lamp switch. Headlamp 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.
   f. Turn ignition key switch to LOCK.

HORN 7.6

REMOVAL

1. Remove seat and fuel tank bolt. Move fuel tank aside. See 4.36 FUEL TANK.
2. See Figure 7-50. Remove bolt and washer (1).
3. Remove horn (2) from frame. Detach Y/BK power wire (3) and BK ground wire (4) from terminal clips.

INSTALLATION

1. See Figure 7-50. Connect Y/BK power wire (3) and BK ground wire (4) to terminal clips.
2. Attach horn (2) to frame using bolt and washer (1).

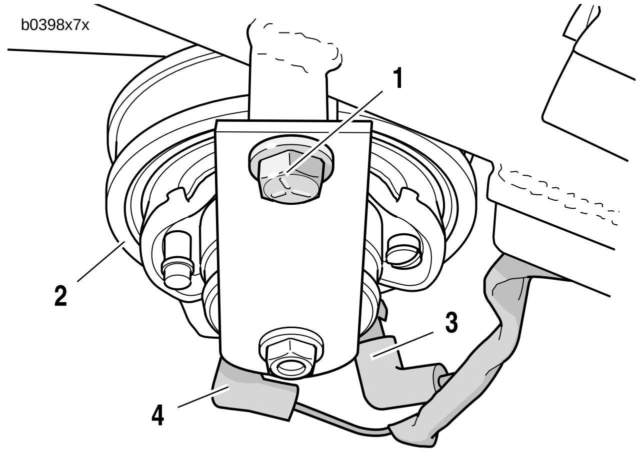
WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

3. Install fuel tank and seat. See 4.36 FUEL TANK.
4. Check horn operation. If horn does not sound or fails to function satisfactorily, see TROUBLESHOOTING.
   a. Turn ignition key switch to IGN.
   b. Press horn switch to activate horn.
   c. Turn ignition key switch to OFF.

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 7-50. Remove Y/BK power (3) and BK ground (4) wires from terminal clips.
   b. Connect voltmeter positive (+) lead to Y/BK (3) wire.
   c. Connect voltmeter negative (–) lead to ground.
   d. Turn ignition key switch to IGN.
3. See Figure 7-51. 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 7.5 HANDLEBAR SWITCHES.



1. **Bolt and Washer**
2. **Horn**
3. **Y/BK Power Wire**
4. **BK Ground Wire**

Figure 7-50. Horn Assembly

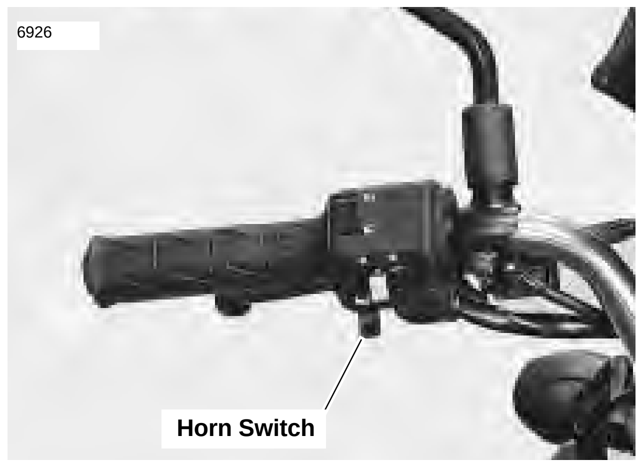


Figure 7-51. Horn Switch Location

NEUTRAL INDICATOR SWITCH 7.7

GENERAL

See Figure 7-52. The neutral indicator switch is threaded into the transmission portion of the right crankcase half; it is immediately forward of the main drive gear shaft. The sprocket cover must be removed to test the switch. If switch requires replacement, secondary drive belt and transmission sprocket must also be removed; there is not enough clearance to allow the removal of the switch without first removing the transmission sprocket.

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.

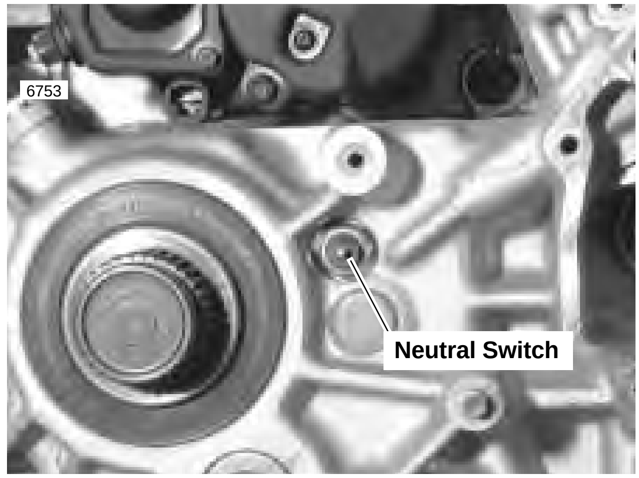


Figure 7-52. Neutral Indicator Switch

TESTING

1. Remove sprocket cover. See 2.29 SPROCKET COVER.
2. Remove the right fairing lower. See 2.38 FAIRING LOWERS.
3. See Figure 7-52. Disconnect wire lead from neutral indicator switch.
4. Turn ignition key switch to IGN. 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.
5. Install sprocket cover. See 2.29 SPROCKET COVER.
6. Install the right fairing lower. See 2.38 FAIRING LOWERS.

REMOVAL/INSTALLATION

1. Verify that the ignition key switch is turned to OFF.
2. Remove sprocket cover. See 2.29 SPROCKET COVER.
3. Remove the right fairing lower. See 2.38 FAIRING LOWERS.
4. See Figure 7-52. Place transmission in first gear. Remove two socket head screws (7) and lockplate (6).

CAUTION

Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft. Transmission sprocket nut will be damaged if turned counterclockwise to remove.

5. Remove transmission sprocket nut (5) from main drive gear shaft (3).
6. Decrease secondary drive belt tension by loosening axle adjusting nuts. See 1.10 DRIVE BELT DEFLECTION. Remove transmission sprocket (4) (with secondary drive belt) from main drive gear shaft (3).
7. Remove wire lead from neutral indicator switch (1). Remove switch from right crankcase half (2).
8. Install **new** neutral indicator switch.
   a. Apply a light coating of LOCTITE THREADLOCKER 243 (blue) to **new** neutral indicator switch (1) threads.
   b. Install switch in crankcase. Tighten to 3-5 ft-lbs (4-7 Nm).
   c. Connect wire lead to switch.
9. Install transmission sprocket (4) (with secondary drive belt) onto main drive gear shaft (3). See 6.13 TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT.
10. Install sprocket cover. See 2.29 SPROCKET COVER.
11. Install the right fairing lower. See 2.38 FAIRING LOWERS.
12. Adjust drive belt tension. See 1.10 DRIVE BELT DEFLECTION.

GENERAL

Buell motorcycles feature two components which protect the electrical system; fuses and circuit breakers.

WARNING

To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

Fuse Block

See Figure 7-53. The fuse block contains five fuses and two spares. Two additional spares may be added at the rider's discretion.

The fuse block is located on the right side of the vehicle, under the tail section.

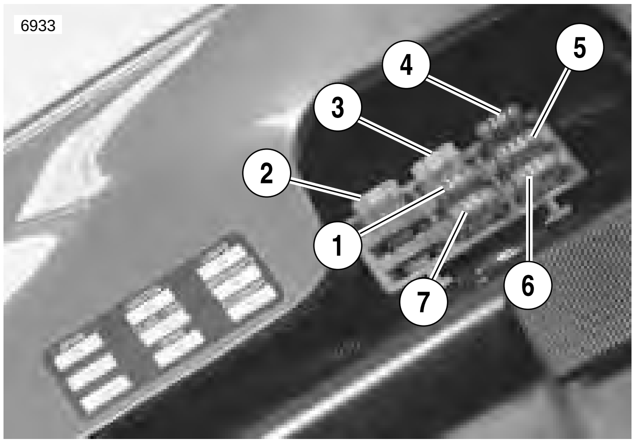
Always investigate the cause of blown fuses before replacing them. See your Buell dealer for more information.

Circuit Breakers

See Figure 7-54. The 30 ampere main circuit breaker is on the frame beneath the tail section.

Circuit breakers prevent electrical overload of a circuit. The circuit breaker electrical contacts remain closed (completing the circuit) as long as current (amperage) flowing through the circuit does not exceed the ampere rating of the breaker. If the circuit current exceeds the breaker ampere rating, then the circuit breaker contacts open and the current flow in the circuit is interrupted.

Since the circuit breaker is the automatic-reset type, the bimetallic breaker contacts automatically close (completing the circuit) once they have cooled down from the initial overload. If the overload condition still exists, the breaker contacts will again open to interrupt current flow. This opening and closing of the breaker contacts continues as long as the current circuit overload condition exists.



1. **Clock/Odometer 15A**
2. **Spare 20A**
3. **Ignition 20A**
4. **Lights 15A**
5. **Instruments 15A**
6. **Accessory 15A**
7. **Spare 15A**

Figure 7-53. Fuse Block

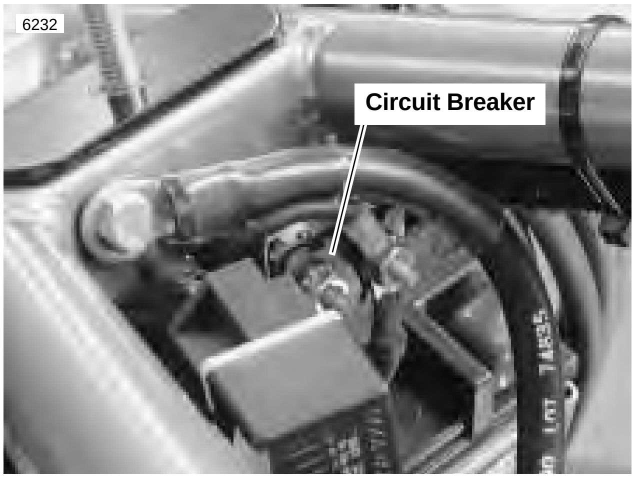


Figure 7-54. Circuit Breaker (Typical)

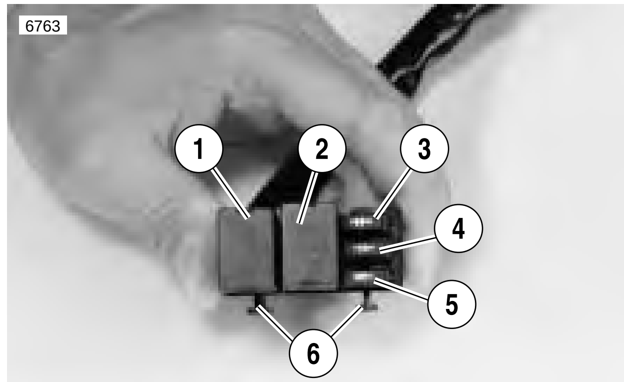
RELAY BLOCK 7.9

GENERAL

See Figure 7-55. The block contains two relays (1, 2), two diodes (3, 4) and one space for a replacement diode (5).

The relay block is located on the right side of the vehicle, under the tail section.

Relay block wiring is shown in Figure 7-56.



1. Ignition Relay
2. Starter Relay
3. Starter Circuit Diode
4. Ignition Circuit Diode
5. Spare Diode
6. Mounting Tabs

Figure 7-55. Relay Block

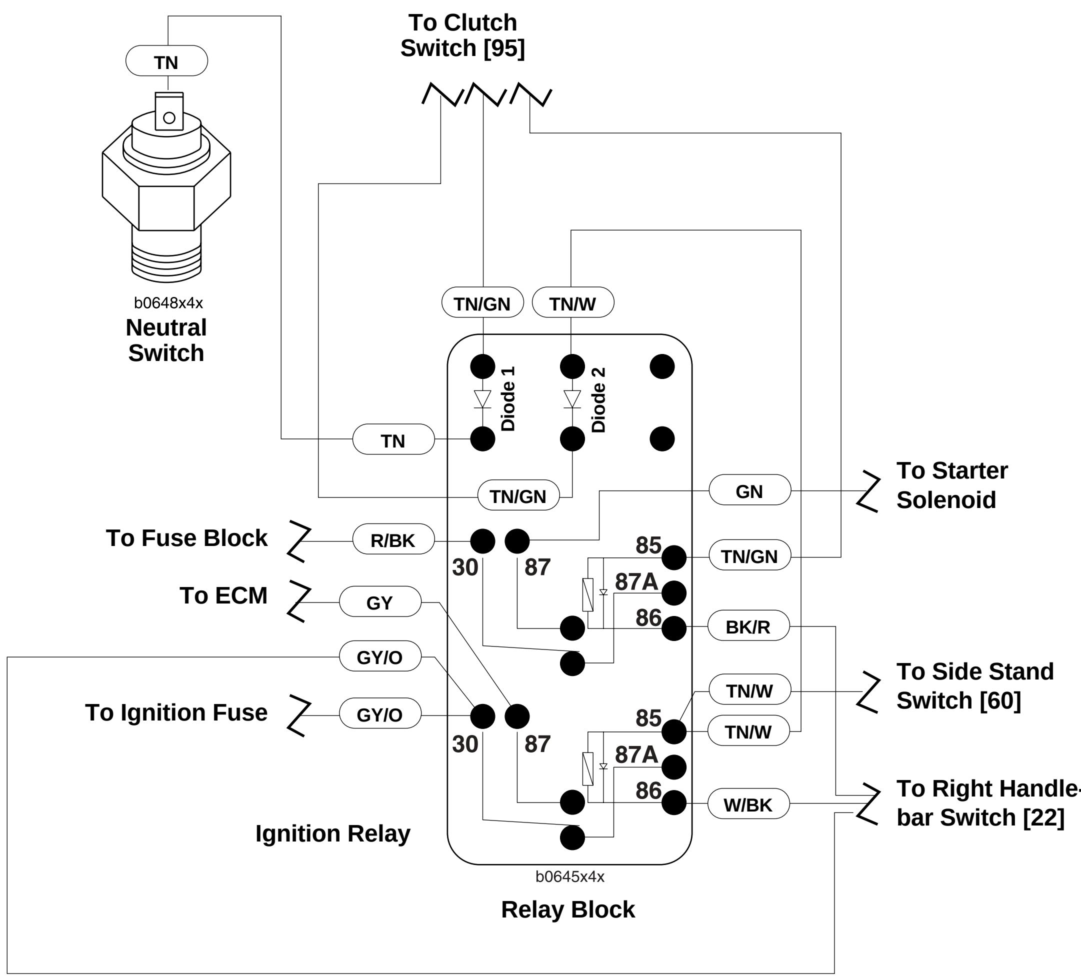


Figure 7-56. Relay Wiring

SPEEDOMETER 7.10

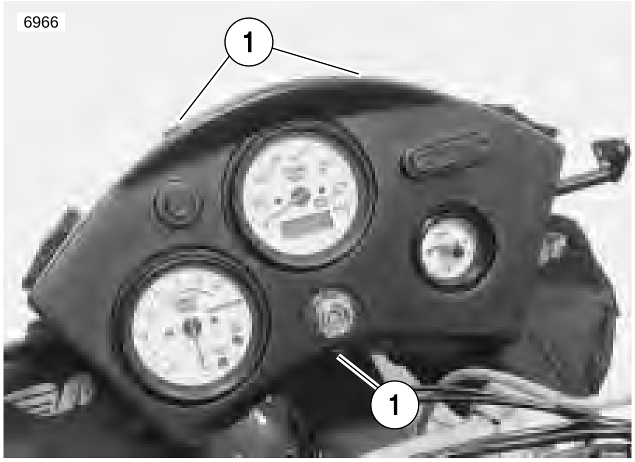
GENERAL

Replace the speedometer if the unit is not working properly. The instrument is not repairable. However, before replacing a component, check that the problem is not caused by a loose wire connection.

REMOVAL

1. Gain access to the back side of the dash panel. Detach turn signals and mirrors (metric) from front fairing. Remove fairing.
2. Remove odometer reset button from dash panel.
   a. See Figure 7-57. Pry off plastic grommet from front of odometer reset button.
   b. See Figure 7-58. Remove odometer reset (3) from back side of dash panel.
3. See Figure 7-59. Remove three screws and plastic washers (1) holding dash panel to front fairing bracket. Pull dash panel upward, but do not damage wiring.
4. See Figure 7-57. Remove two nuts (metric) and lock-washers (1) from speedometer cover (3).
5. Slide speedometer cover (3) away from speedometer.
6. See Figure 7-60. Remove wires from speedometer. Pull lamp (5) from bore.
7. Pull speedometer and attached odometer reset button from front of dash panel.
8. Remove mounting gasket.
9. If necessary, replace speedometer wiring.
   a. Remove fuel tank.
   b. Cut cable straps on wiring harness. Detach wires at plug connector. See Figure 7-61.

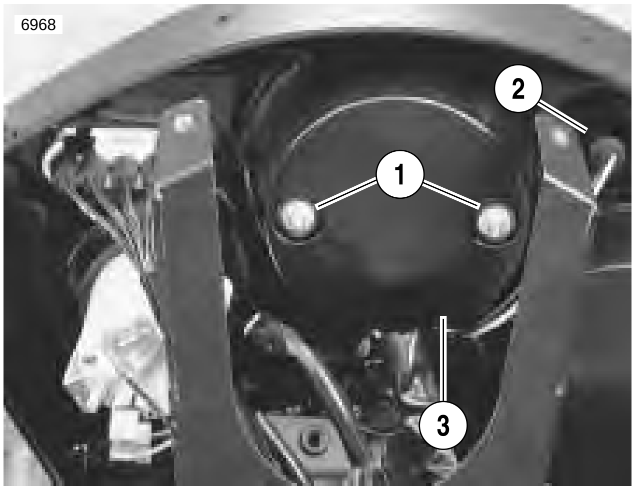
NOTE
Tachometer and speedometer wiring share a common connector on the wiring harness.



1. **Screws and Washers (3)**

Figure 7-57. Dash Panel (Front)

Figure 7-58. Odometer Reset Button



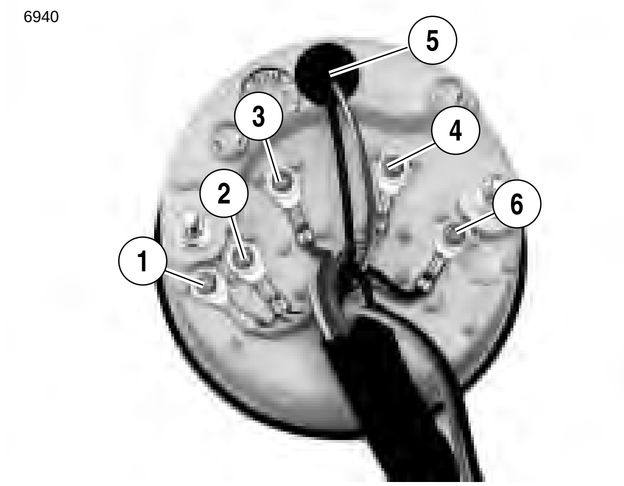
1. **Nuts and Washers (2)**
2. **Odometer Reset Button**
3. **Speedometer Cover**

Figure 7-59. Dash Panel (Back)

HOME

INSTALLATION

1. If replacing speedometer wiring:
   a. See Figure 7-61. Attach wires at plug connector.
   b. Feed wiring through to dash panel. Route wiring to outside of clutch cable. Pull slack to front, behind windscreen and secure with ties on electrical cabling.
   c. Install fuel tank. See 4.36 FUEL TANK.
2. Install odometer reset.
   a. See Figure 7-59. Install odometer reset button (2) from back side of dash panel.
   b. See Figure 7-58. Secure odometer reset button on front of dash panel with plastic grommet.
3. Install rubber mounting gasket.
   a. Apply 2 drops of Permabond 105 at each end of notches in gasket.
   b. Apply 1 drop of Permabond 105 at top of gasket and bottom of gasket.
   c. Position mounting gasket in dash panel.
4. Install speedometer in dash panel.
   a. Feed wires through opening in speedometer cover.
   b. Using alcohol or window cleaner to lubricate rubber gasket, slide speedometer into rubber mounting gasket.
   c. See Figure 7-60. Insert lamp (5).
   d. Attach wires to speedometer as shown.
5. See Figure 7-59. Install speedometer cover (3).
   a. Place speedometer cover over speedometer. Align posts on back of speedometer with holes in cover. Drain hole must be at the bottom of cover.
   b. Apply LOCTITE THREADLOCKER 243 (blue) to both nuts (metric).
   c. Fasten cover (3) to speedometer using two nuts (metric) and lockwashers (1).
6. See Figure 7-57. Position dash panel on front fairing bracket.
7. Attach dash panel using three screws and washers (1). Tighten screws to 7-9 ft-lbs (10-12 Nm).
8. Install front fairing by attaching turn signals and mirrors (metric).



1. **Silver Blue/White**
2. **White/Green**
3. **Red**
4. **Orange/White**
5. **Lamp**
6. **Black**

Figure 7-60. Speedometer Wiring

Figure 7-61. Speedometer Wiring Connector Locations (Approximate)

REMOVAL

1. See Figure 7-62. Remove bolt (1) to detach speedometer sensor (2) from crankcase.
2. See Figure 7-63. Disconnect 3-place Deutsch connector [65] for speedometer sensor.
   a. Remove seat and tail section. See 2.33 TAIL SECTION.
   b. Locate connector [65] near battery negative terminal (-) and disconnect.

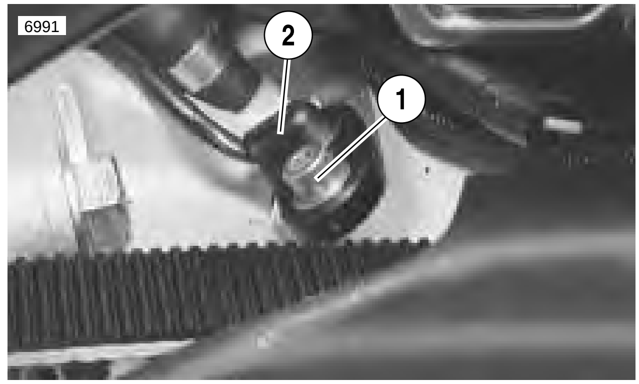
INSTALLATION

1. See Figure 7-62. Install bolt (1) to attach speedometer sensor (2) to crankcase.
2. Connect speedometer sensor connector [65] to wiring harness.

⚠WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

3. Install tail section and seat. See 2.33 TAIL SECTION.



1. **Bolt**
2. **Speedometer Sensor**

Figure 7-62. Speedometer Sensor

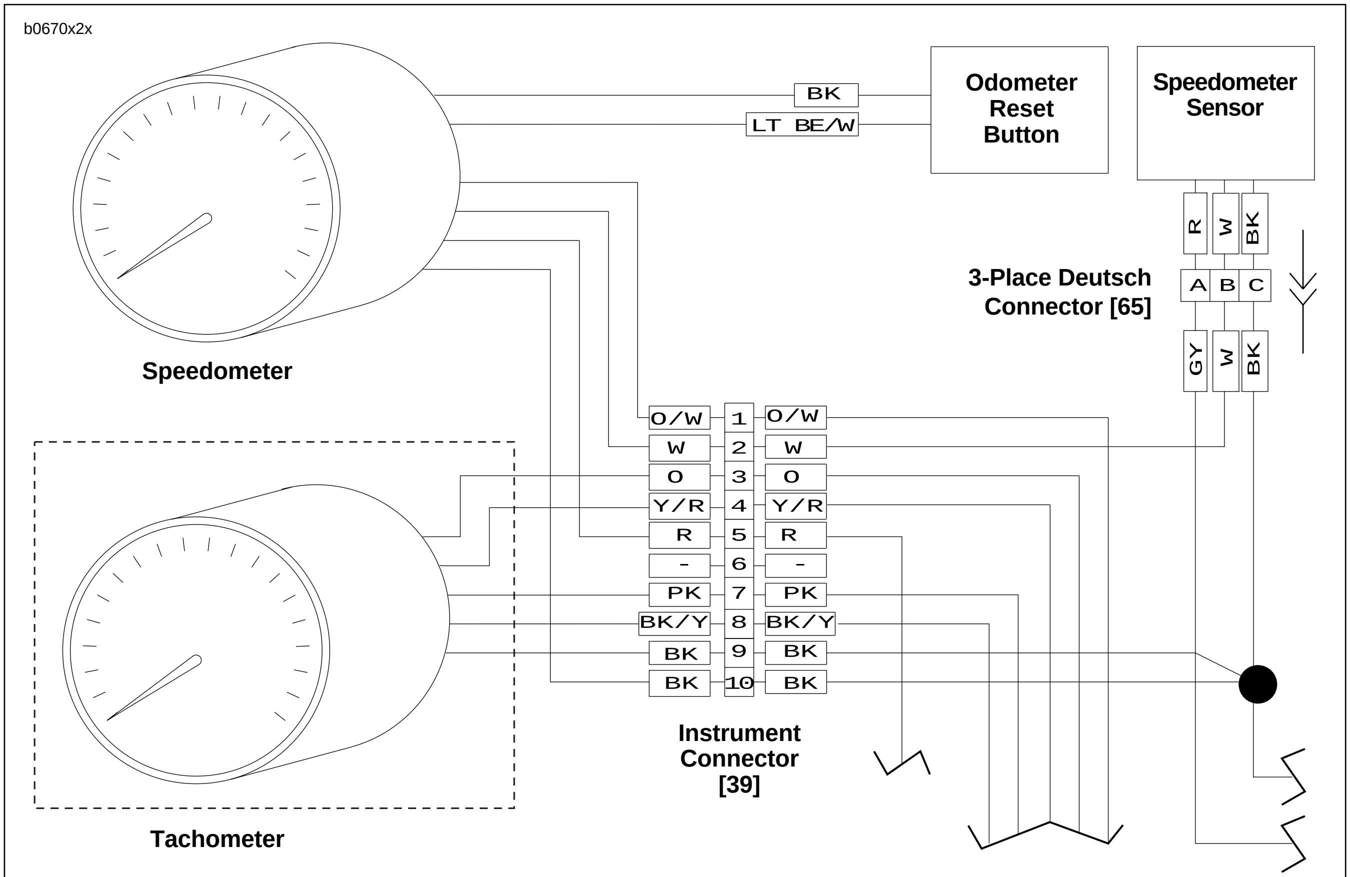


Figure 7-63. Speedometer Sensor Wiring

GENERAL

See Figure 7-64. 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.*

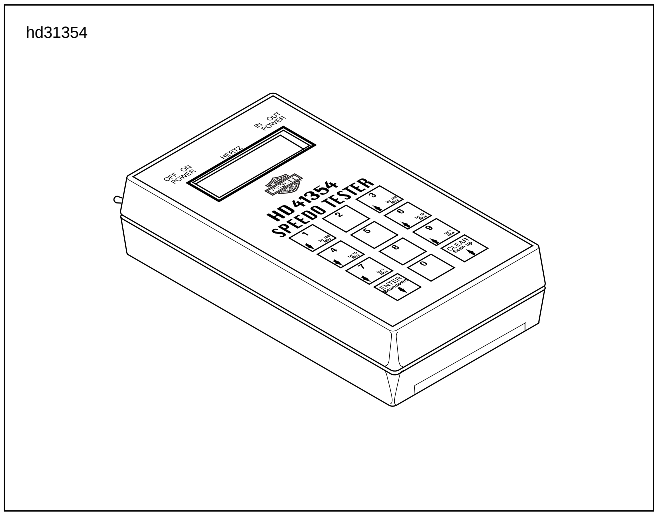


Figure 7-64. Speedometer Tester

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

1. See Figure 7-65. Locate and disconnect the 3-place Deutsch connector [65] for the speedometer sensor. Attach speedometer tester connector to speedometer sensor connector.
   a. Connector [65] is located above battery negative (-) terminal.
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 7-7. 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 0-4 MPH (0-6.5 KPH).

Figure 7-65. Speedometer Sensor Connector

Table 7-7. Market Frequencies

MARKET	20 MPH (30 KPH)	40 MPH (60 KPH)	60 MPH (100 KPH)	80 MPH (130 KPH)
USA	432	864	1296	1728
ENG	362	725	1088	1454
AUS, EUR	340	680	1134	1474
CAN, JPN, NZ	405	810	1350	1755

Speedometer Needle Sweep Test

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 7-65. Disconnect speedometer sensor connector. Attach speedometer tester connector to speedometer 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 7-66. 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).
- Deutsch 3-place pin housing (Part No. 72103-94BK).
- Six lengths of 18 gauge wire, each 6.0 in. (15 cm) long.

1. Deutsch Socket Housing (2)
2. Deutsch Pin Housing

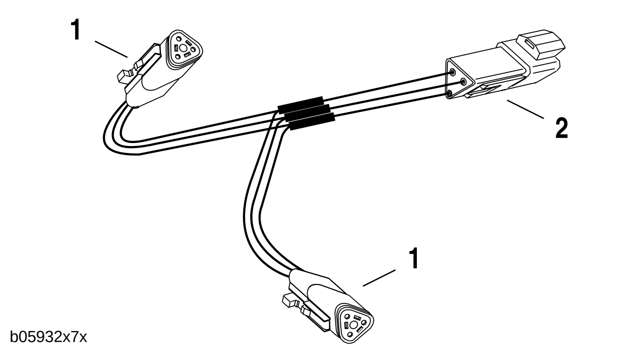


Figure 7-66. Test Harness

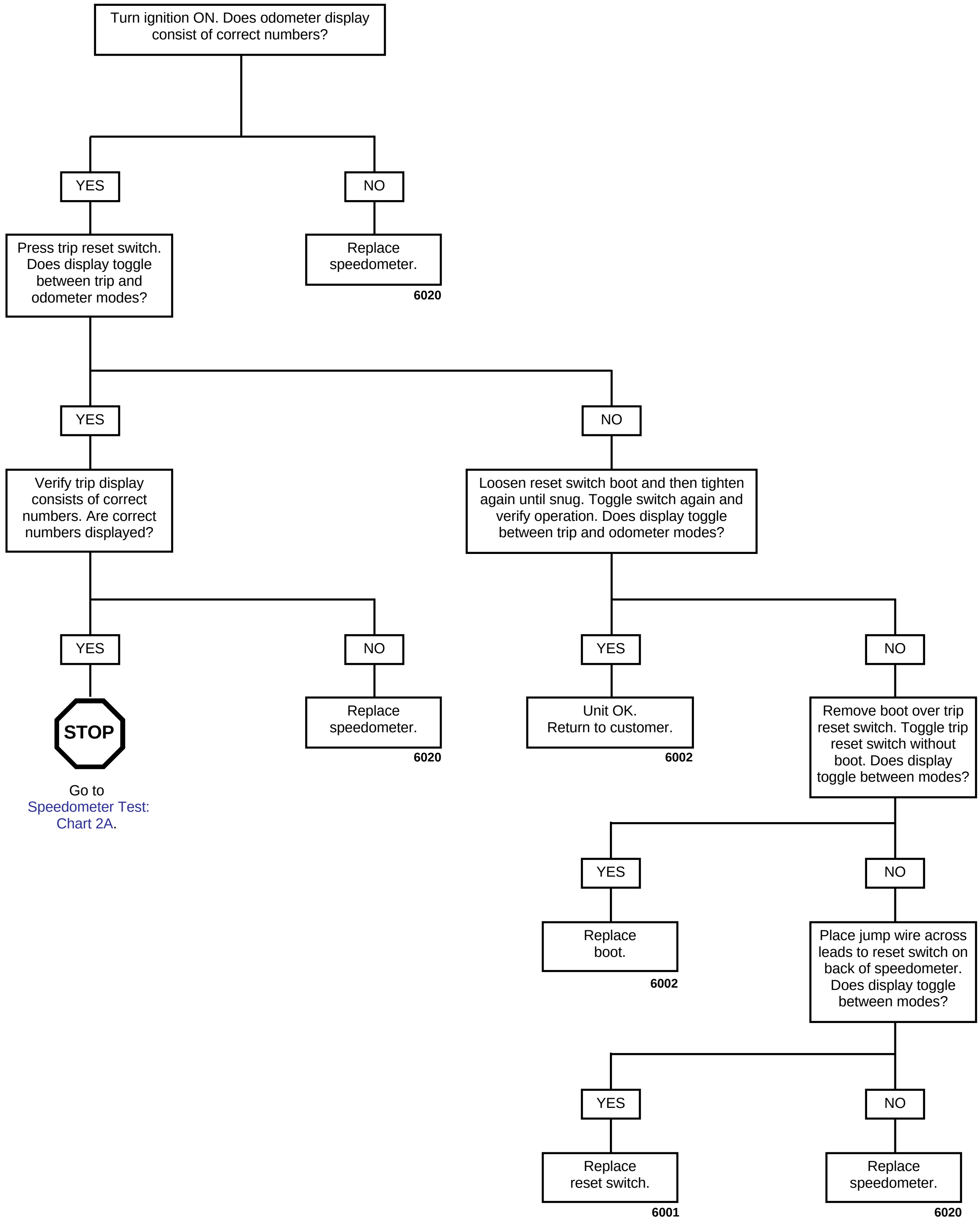
- Test for voltage to sensor by checking for 8-12 VDC on red wire in connector [65].
- Then check for continuity to ground on black wire in connector [65].

1. Install the test harness between the speedometer sensor connector [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, speedometer sensor is suspect. Install a known, good speedometer sensor and test again.

HOME

Speedometer Test: Chart 1

ODOMETER, TRIP ODOMETER AND RESET SWITCH TESTING



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Speedometer Test: Chart 2A

INOPERATIVE, INACCURATE OR ERRATIC SPEEDOMETER

Problem #2: Speedometer inoperative, reading high/low, or needle sticking/intermittent/erratic. Check Accessory Fuse. Fuse OK? No, replace Fuse. Yes, Turn ignition ON. Is speedometer backlighting on?

- YES: Hook up speedometer tester. See TESTING. Verify that tester battery is OK.
  - Perform speed sweep function and specified inputs with tester and observe output speed and odometer/trip odometer change on speedometer.

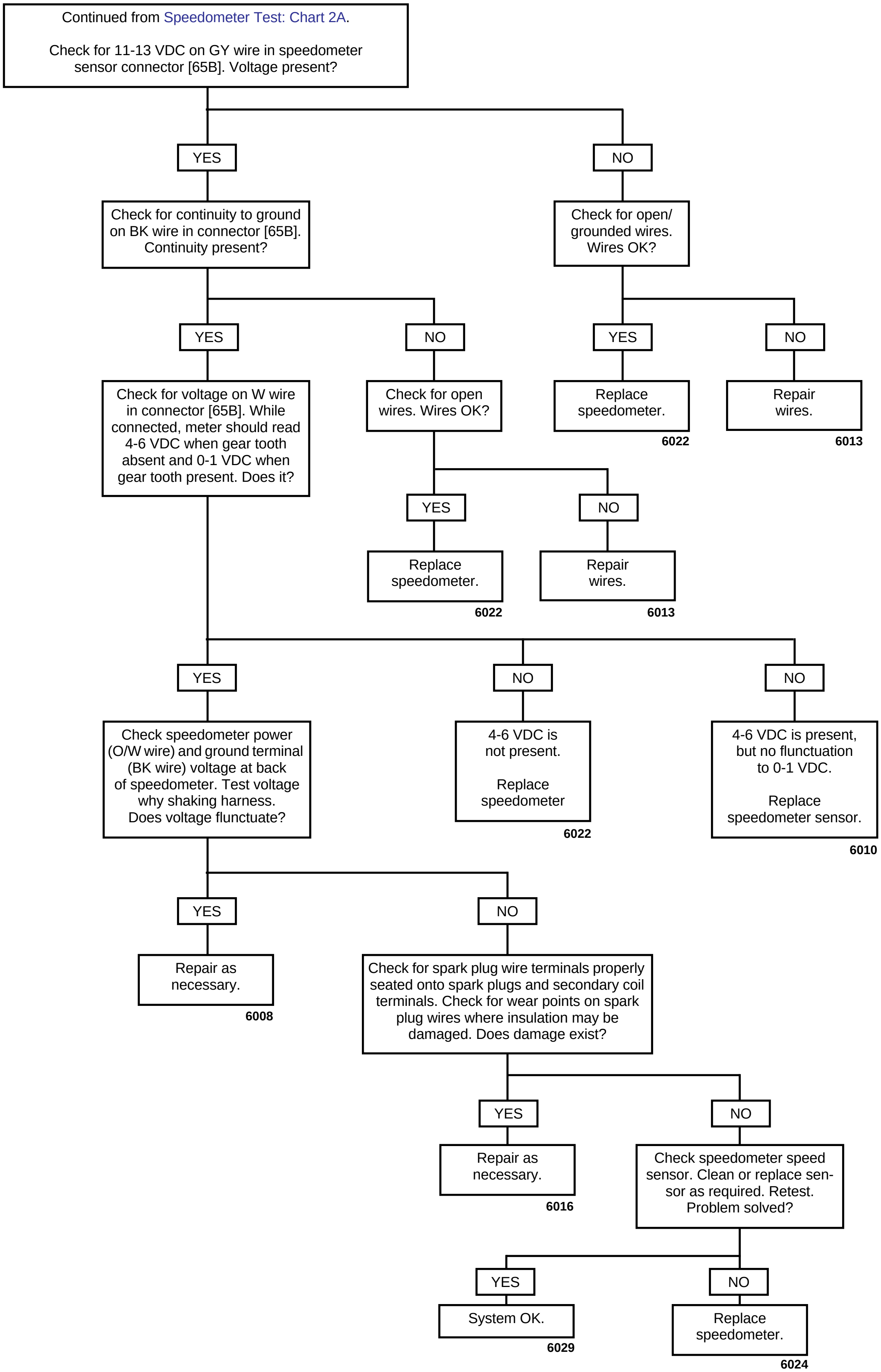
    Does speedometer appear to function normally and follow sweeping frequency input?
    - YES: Program steady input frequency on tester and observe output speed on speedometer while moving/shaking vehicle harness connections. Output erratic?
      - YES: Bad connection found. Repair connector or harness. **6008**
      - NO: STOP. Go to Speedometer Test: Chart 2B.
    - NO: Check 3-pin vehicle speed connector and wires for damage. Connector or wire damage found?
      - YES: Repair as necessary. **6004**
      - NO: Replace speedometer. **6006**
- NO: Remove speedometer back cover. Check speedometer bulb. Bulb failed?
  - YES: Replace bulb. **6014**
  - NO: If speedometer backlighting is not on, check for 9-12 VDC on O/W wire at terminal on back of speedometer. Voltage present?
    - YES: Check for continuity to ground on BK wire at terminal on back of speedometer. Continuity present?
      - YES: Replace bulb **6014**
      - NO: Locate and repair open in O/W wire. **6008**
    - NO: Locate and repair open in O/W wire. **6008**

DIAGNOSTIC NOTES

- *Low battery voltage on speedometer tester may cause inaccurate test results. Make sure speedometer tester battery is fully charged.*
- *If necessary, remove speedometer 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



TACHOMETER 7.13

GENERAL

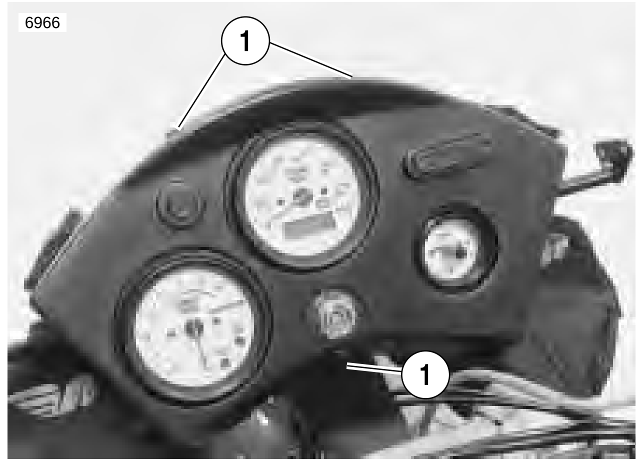
Replace the tachometer if the unit is not working properly. The instrument is not repairable. However, before replacing a component, check that the problem is not caused by a loose wire connection.

REMOVAL

1. Gain access to the back side of the dash panel. Detach and remove turn signals and mirrors (metric) from front fairing. Remove fairing.
2. See Figure 7-67. Remove three screws and plastic washers (1) holding dash panel to front fairing bracket. Pull dash panel upward, but do not damage wiring.
3. See Figure 7-68. Remove two nuts (metric) and lock-washers (1) from tachometer cover (2).
4. Slide tachometer cover (2) away from tachometer.
5. See Figure 7-69. Remove wires from tachometer.
   a. Remove three lamps (1, 2, and 3) and attached wires.
   b. Loosen screws and remove wires (4, 5 and 6).
6. Pull tachometer from front of dash panel.
7. Remove rubber mounting gasket.
8. If necessary, replace tachometer wiring.
   a. Remove fuel tank.
   b. Cut cable straps on wiring harness. See Figure 7-70. Detach wires at plug connector.

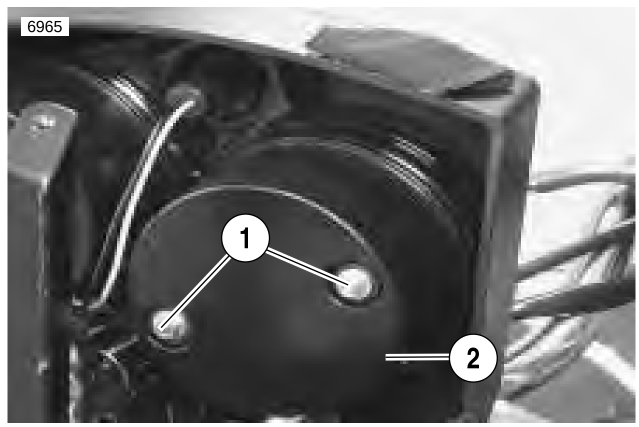
NOTE

Tachometer and speedometer wiring share a common connector on the wiring harness.



1. **Screws and Washers (3)**

Figure 7-67. Front Dash Panel

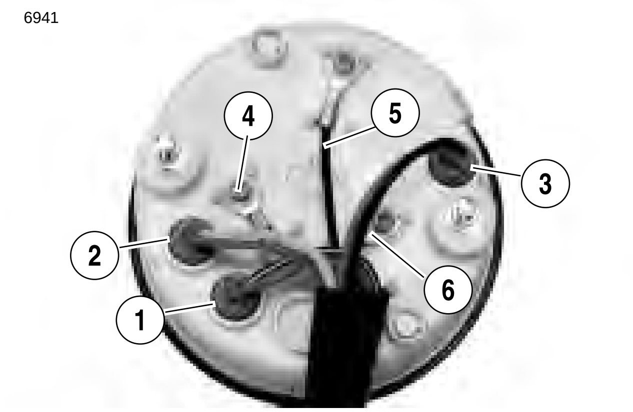


1. **Nut and Washer (metric) (2)**
2. **Tachometer Cover**

Figure 7-68. Back Dash Panel

INSTALLATION

1. If replacing tachometer wiring:
   a. See Figure 7-70. Attach wires at plug connector.
   b. Feed wiring through wiring harness to dash panel. Secure with cable straps.
   c. Install fuel tank.
2. Install rubber mounting gasket.
   a. Apply 2 drops of Permabond 105 at each end of notches in gasket.
   b. Apply 1 drop of Permabond 105 at top of gasket and bottom of gasket.
   c. Position mounting gasket in dash panel.
3. Install tachometer in dash panel.
   a. Feed wires through opening in tachometer cover.
   b. Slide tachometer into rubber mounting gasket.
   c. See Figure 7-69. Insert lamps (1, 2 and 3) into their appropriate bores.
   d. Attach wires (4, 5, 6) to tachometer as shown.
4. See Figure 7-68. Install tachometer cover (5).
   a. Place tachometer cover over tachometer. Align posts on back of tachometer with holes in tachometer cover. Drain hole must be at the bottom of cover.
   b. Apply LOCTITE THREADLOCKER 243 (blue) to both nuts (metric).
   c. Fasten cover (2) to tachometer using two nuts (metric) and lockwashers (1).
5. See Figure 7-67. Position dash panel on instrument support clamp.
6. Attach dash panel using three screws and washers (1). Tighten screws to 7-9 ft-lbs (10-12 Nm).
7. Install front fairing by attaching turn signals and mirrors (metric).



1. **Check Engine Lamp (BK/Y and O)**
2. **Low Fuel Lamp (Y and O)**
3. **Illumination Lamp (O and BK)**
4. **Signal (PK)**
5. **Ground (BK)**
6. **Power (O)**

Figure 7-69. Tachometer Wiring

Figure 7-70. Tachometer Wiring Connector Locations (Approximate)

TACHOMETER PERFORMANCE CHECK 7.14

GENERAL

See Figure 7-64. Use the SPEEDOMETER TESTER (Part No. HD-41354) for tachometer diagnostics. These diagnostics may include:

- Checking tachometer operation.
- Testing tachometer needle sweeping action.

The tester can be connected to the vehicle's cam position sensor connector. This connection introduces a signal to the ignition module that simulates the signal from the cam position sensor. The ignition module will use this simulated signal to open and close circuits to fire the spark plugs. This allows you to simulate the engine running and therefore generate tachometer readings.

TESTING

Operation Test

1. See Figure 7-71. Connect the speedometer tester to the cam position sensor Deutsch socket housing.
2. Convert the desired test RPM to a tester frequency in Hertz. Several conversions are listed in the table below
   a. Select a desired tachometer reading for testing. This example will use 2000 RPM.
   b. Divide the desired tachometer reading by 60. For example, 2000/60=33.3.
3. Enter the result (33.3 for 2000 RPM) into the speedometer tester.
   a. The tachometer should respond by moving its needle to the desired RPM.
   b. Test the tachometer at several different RPM readings to verify proper operation.

Table 7-8. Tachometer Accuracy Tolerances

READING	2000 RPM	4000 RPM	6000 RPM	7500 RPM
Tolerance (+/- RPM)	100	120	210	320
Conversion factor	33.3	66.7	100	125

NOTE

All tachometer accuracy tolerances were taken at 68°-77° F (20-25° C).

1. **Deutsch Socket Housing Test Connector**
2. **Deutsch Socket Housing**
3. **Deutsch Pin Housing**
4. **Cam Position Sensor**

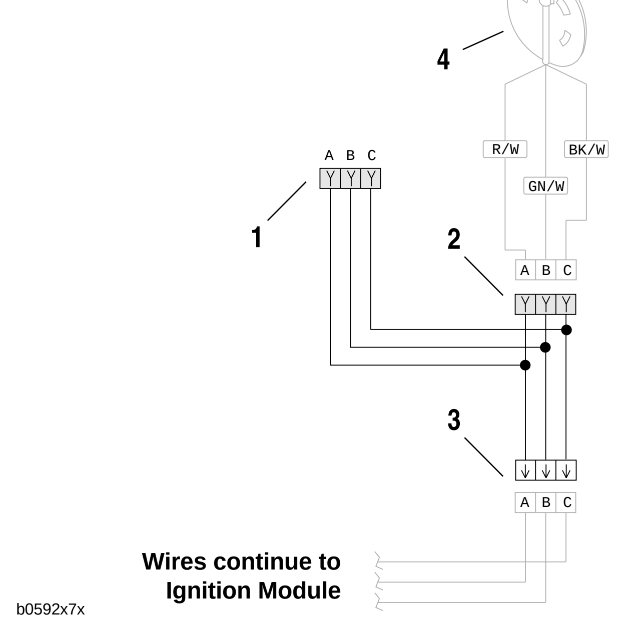


Figure 7-71. Testing Tachometer

Sweep Test

1. See Figure 7-71. Connect the speedometer tester to the cam position sensor Deutsch socket housing.
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.
   b. Press 5 to select CEN range.
   c. Press 8 to select HI range.
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.

CLOCK 7.15

GENERAL

See Figure 7-72. An illuminated clock is on the right side of the dash panel. The clock runs continuously as long as there is battery power.

OPERATION

Set clock using knob on clock face. Press knob inward to engage clock hands. Turn knob clockwise to set the desired time.

If clock fails, replace it as a unit. With the exception of a replaceable light bulb (Part No. 68868-98Y) the clock contains no user serviceable parts.

NOTE

Remember to reset clock after disconnecting battery.

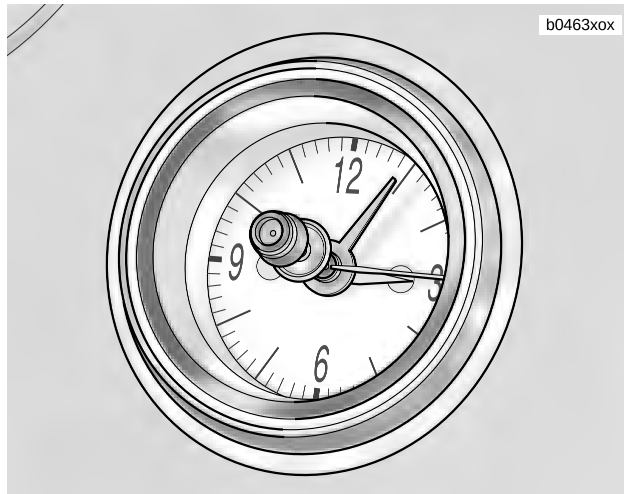


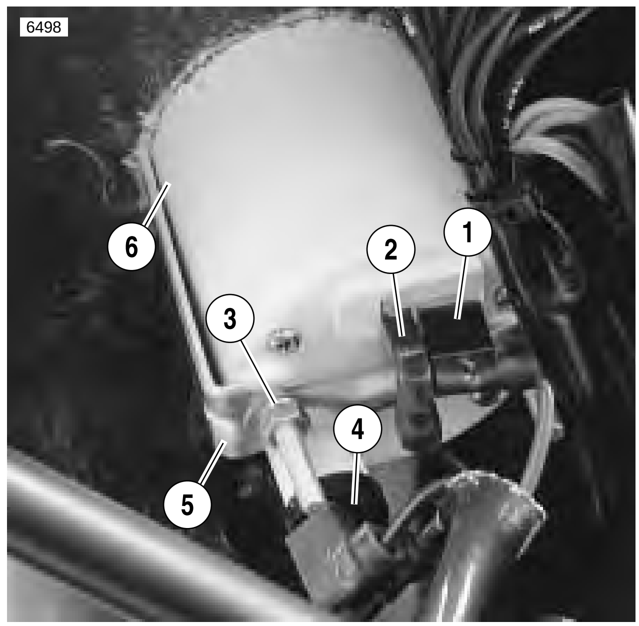
Figure 7-72. Clock

REMOVAL

1. Detach turn signals and mirrors (metric) to remove front fairing.
2. See Figure 7-73. Unplug red wire (1) and black wire (2).
3. Pull bulb housing (4) from back of clock.
4. Remove two nuts and lockwashers (3) to free clock housing (6) from mounting bracket (5).
5. From front of dash panel, remove clock housing (6).

INSTALLATION

1. See Figure 7-73. Slide clock housing (6) through front of dash panel.
2. Place mounting bracket (5) on threaded shafts of clock housing (6). Secure with two nuts and lockwashers (3).
3. Attach red wire (1) and black wire (2) as shown.
4. Insert bulb housing (4) into clock housing (6).
5. Attach front fairing, mirrors and turn signals. Refer to installation instructions under 2.34 FRONT FAIRING.



1. **Red Wire**
2. **Black Wire**
3. **Nut and Lockwasher (2)**
4. **Bulb Housing**
5. **Mounting Bracket**
6. **Clock Housing**

Figure 7-73. Clock Wiring

NOTES

HOME

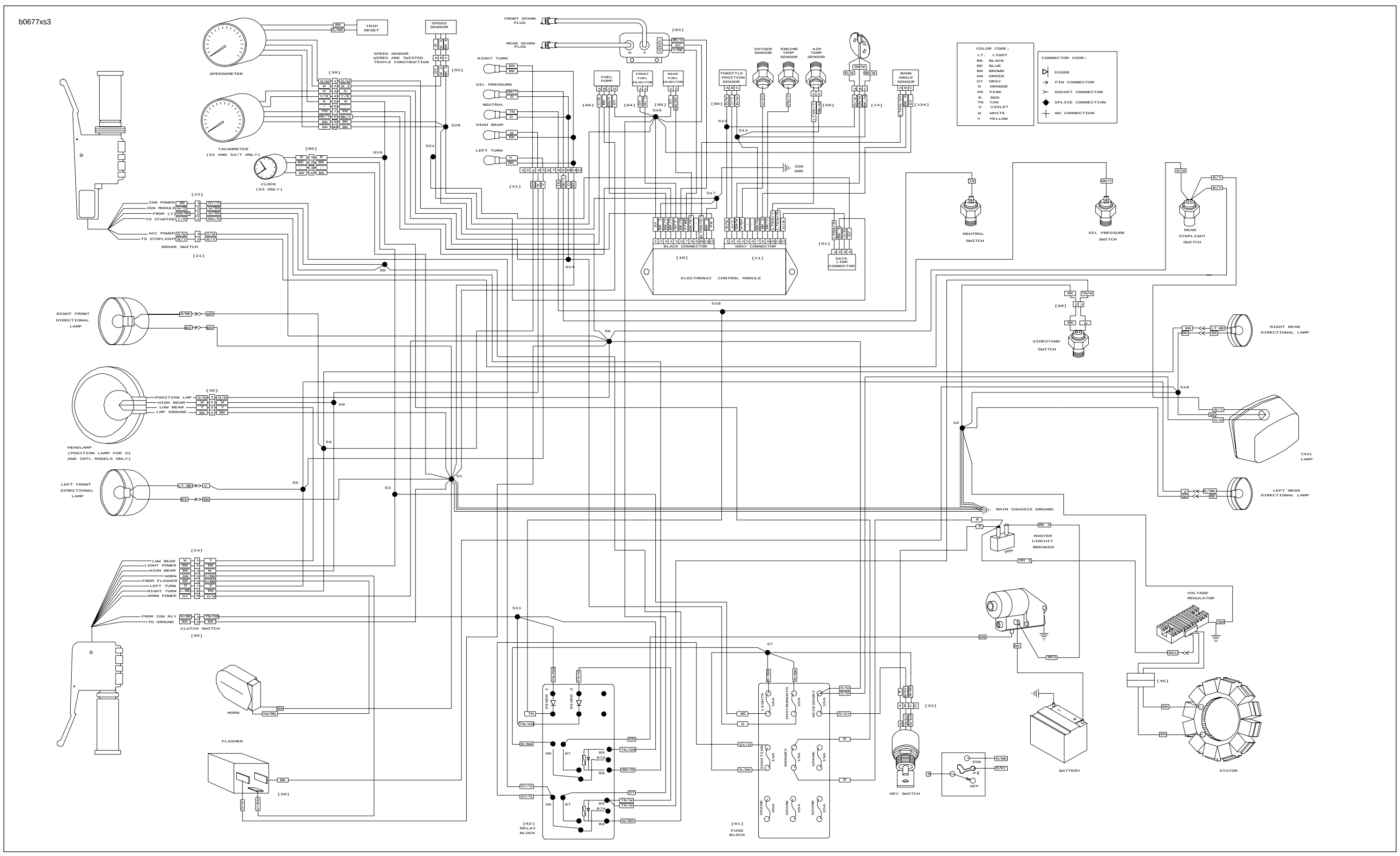


Figure 7-84. 2001 S3 Wiring Diagram

Table Of Contents

SUBJECT **PAGE NO.**

Appendix A - Tools A-1
Appendix B - Electrical Connectors B-1
Appendix C - Metric Conversions C-1

APPENDICES