

2001 BUELL S3/S3T

SERVICE MANUAL

Part Number 99489-01Y

Section 1: Maintenance

Section 2: Chassis

Section 3: Engine

Section 4: Fuel System

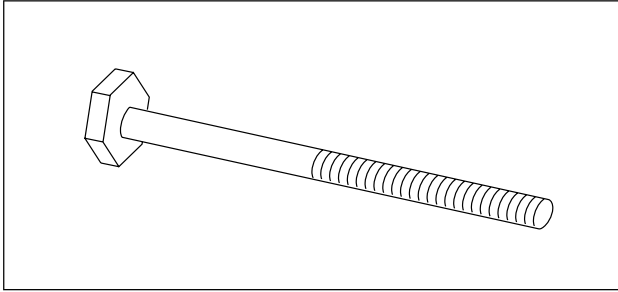
Section 5: Starter

Section 6: Drive/Transmission

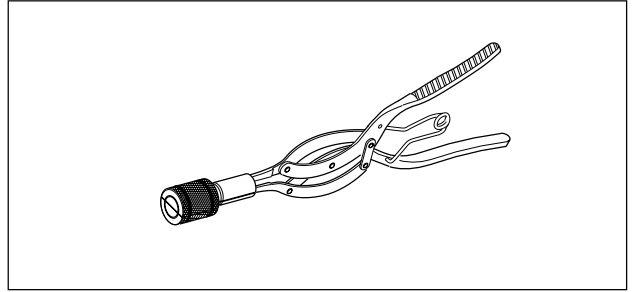
Section 7: Electrical

Appendix

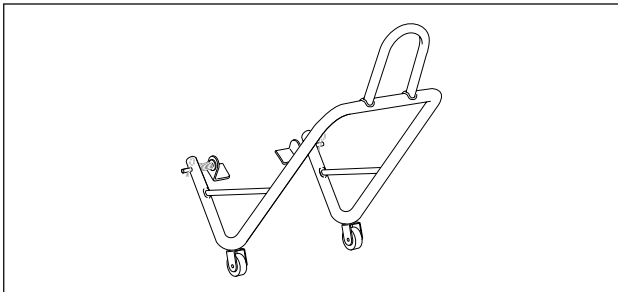
APPENDIX A—TOOLS



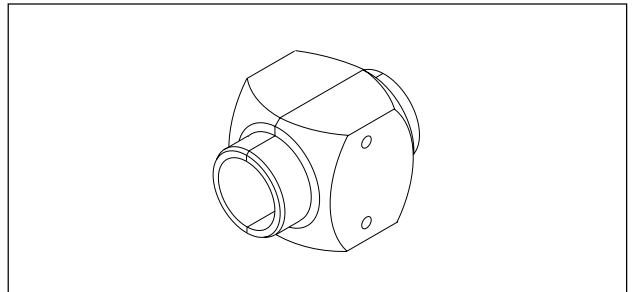
Part No. B-35316-5 12 Inch Bolt.
Used with Part No. HD-39302.



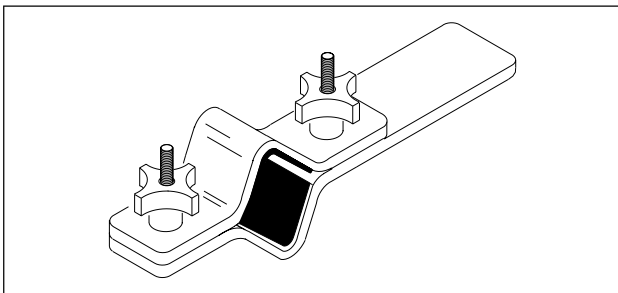
Part No. B-42887 Brake Caliper Piston Remover



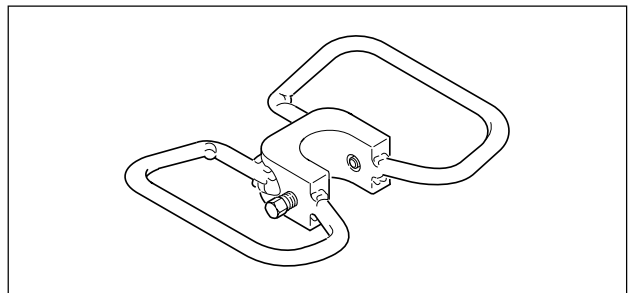
**Part No. B-41174 Rear Wheel Support Stand and
Part No. B-41174-2 Replacement Pad**



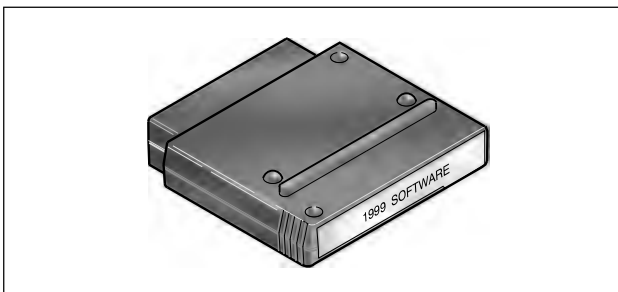
Part No. B-43721 Front Fork Seal Driver



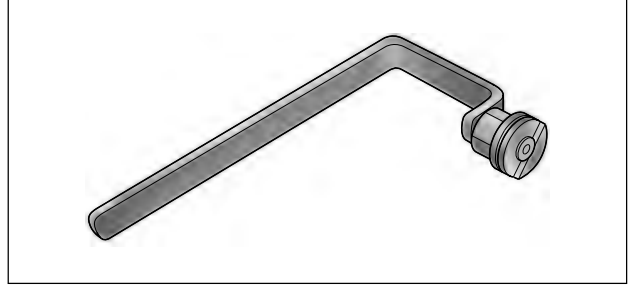
Part No. B-41177 Front Fork Holding Tool



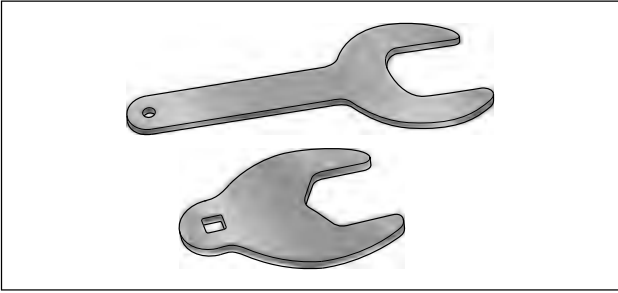
Part No. B-43875 Fork Spring Compressor



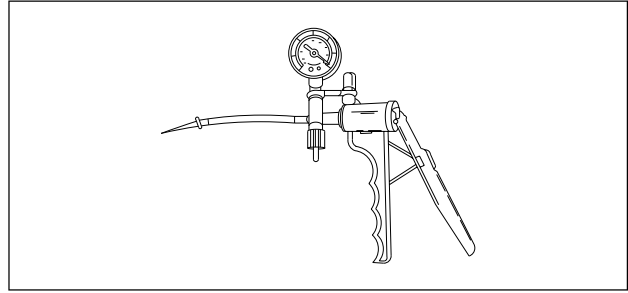
Part No. B-41325-99 Scanalyzer Software Cartridge



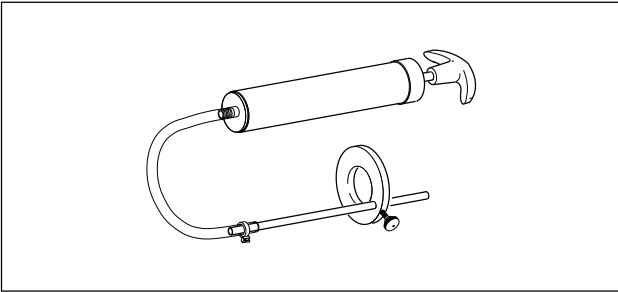
Part No. B-44623 Isolator Tool



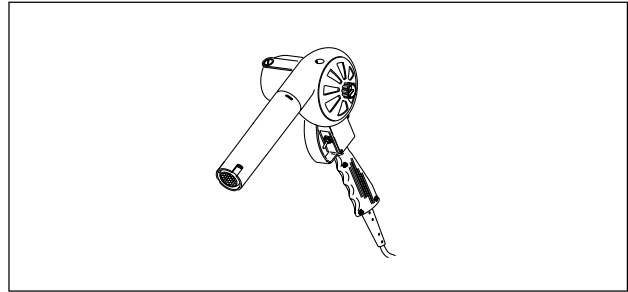
Part No. B-45110 Shock Preload Adjustment Tools



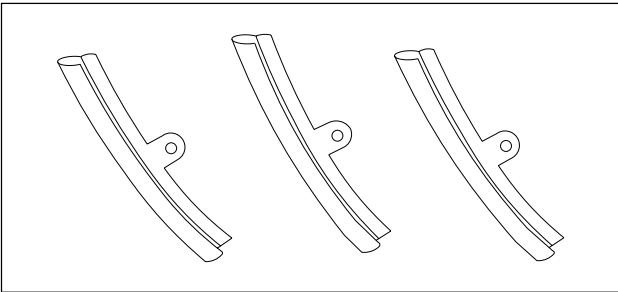
Part No. HD-23738 Vacuum Pump



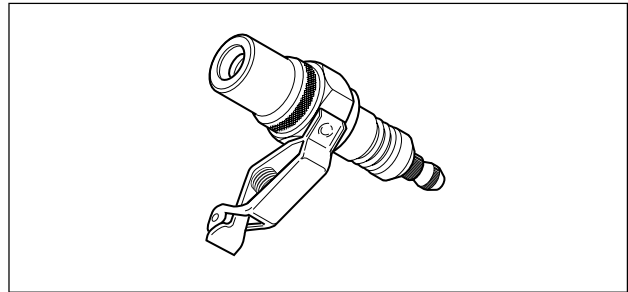
Part No. B-59000A Pro Level Oil Gauge



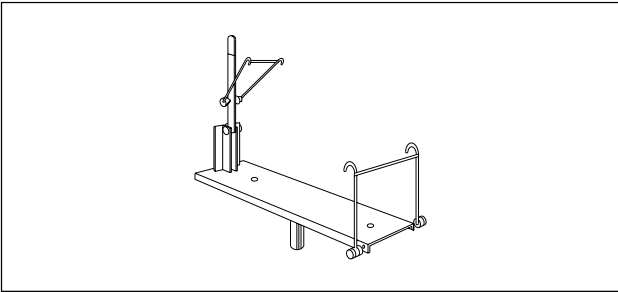
Part No. HD-25070 Robinair Heat Gun



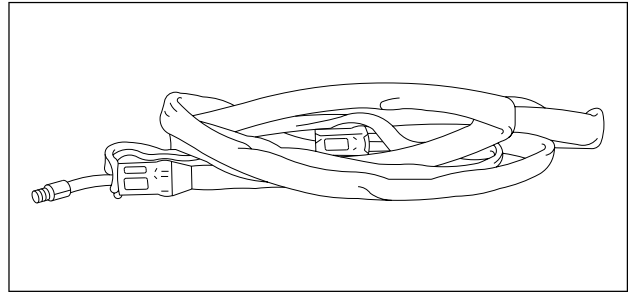
Part No. HD-01289 Rim Protectors



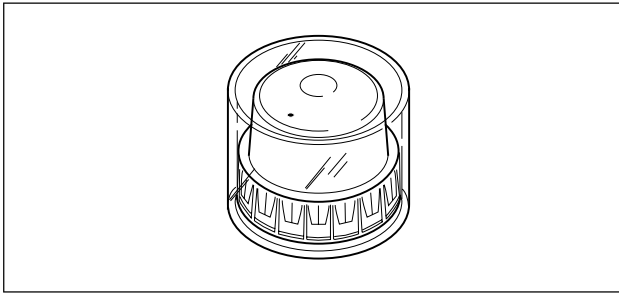
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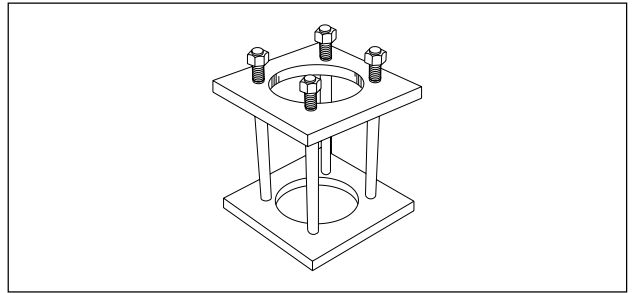
Part No. HD-21000 Tire Spreader



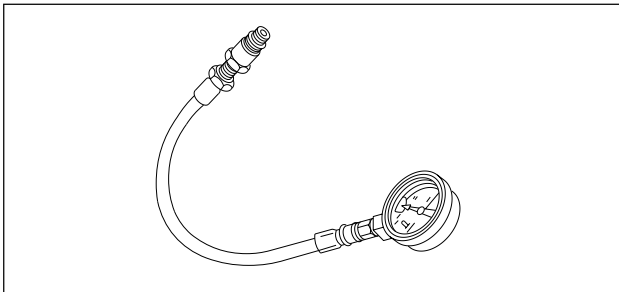
Part No. HD-28700 Tire Bead Expander



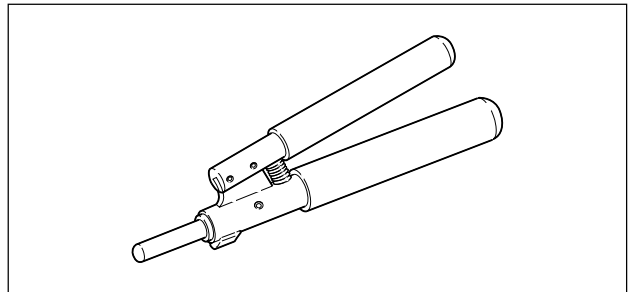
Part No. HD-33067 Wheel Bearing Packer



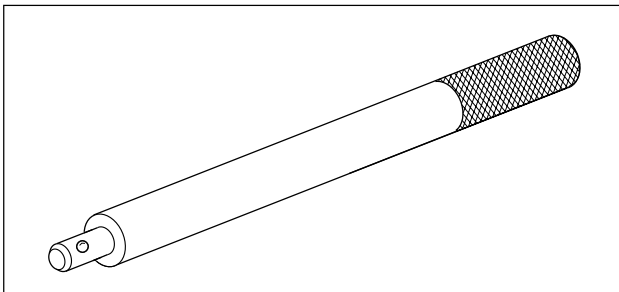
**Part No. HD-33446A Cylinder Torque Plates
and Torque Plate Bolts Part No. HD-33446-86**



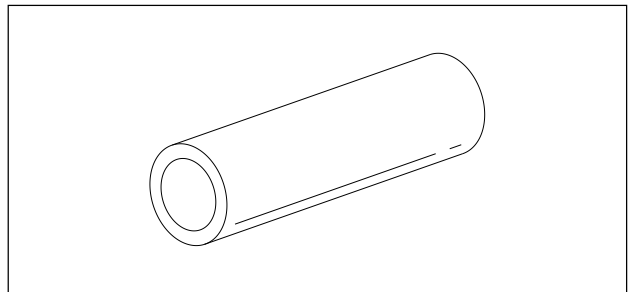
Part No. HD-33223-1 Cylinder Compression Gauge



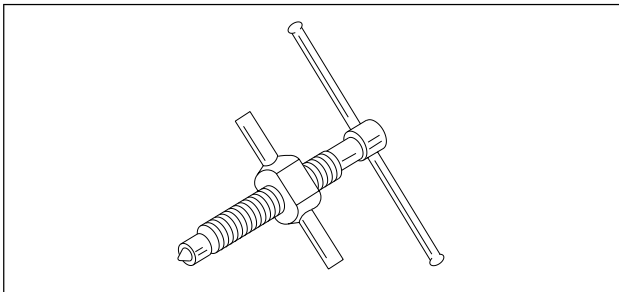
**Part No. HD-34623B Piston Pin
Retaining Ring Installer/Remover**



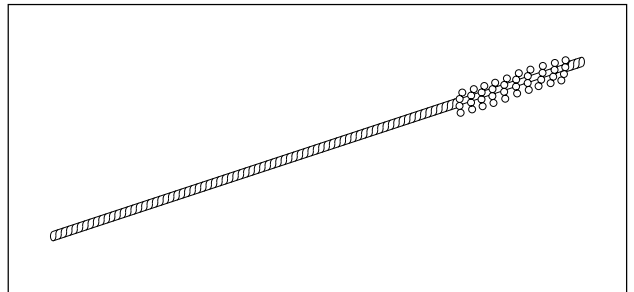
Part No. HD-33416 Universal Driver Handle



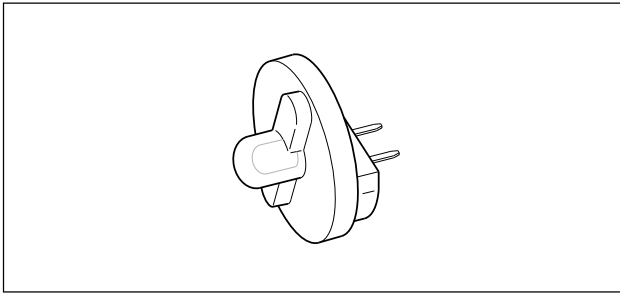
**Part No. HD-34643A Shoulderless Valve Guide
Seal Installer**



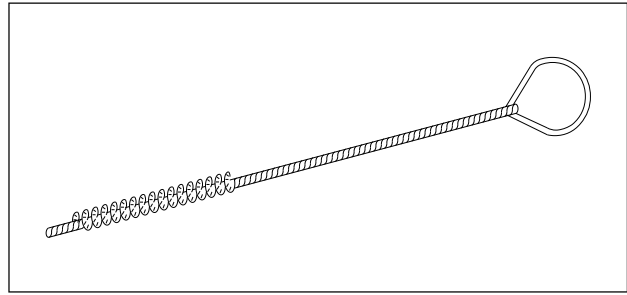
Part No. HD-33418 Universal Puller Forcing Screw



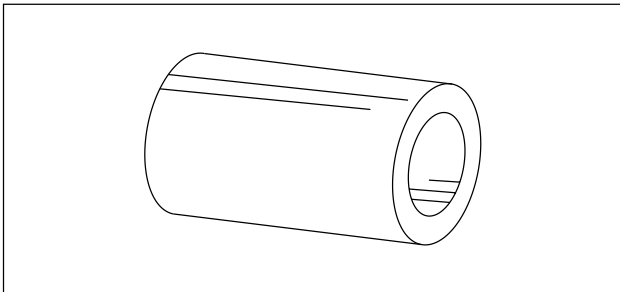
Part No. HD-34723 Valve Guide Hone (8 mm)



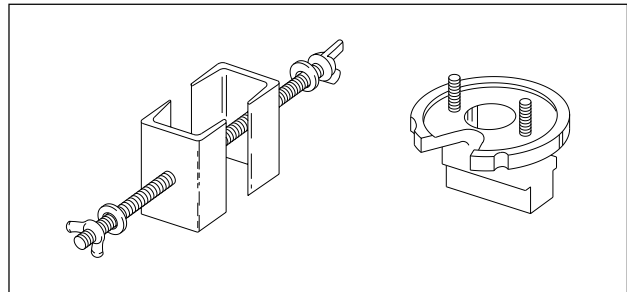
Part No. HD-34730-2C Fuel Injector Test Lamp



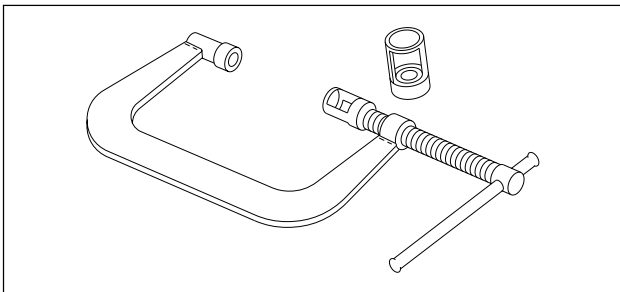
Part No. HD-34751 Nylon Valve Guide Brush



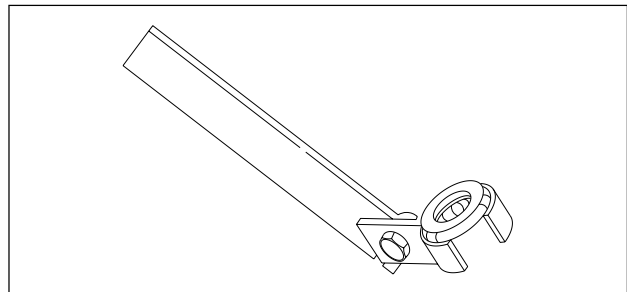
Part No. HD-34731 Shoulderless Valve Guide Installation Tool



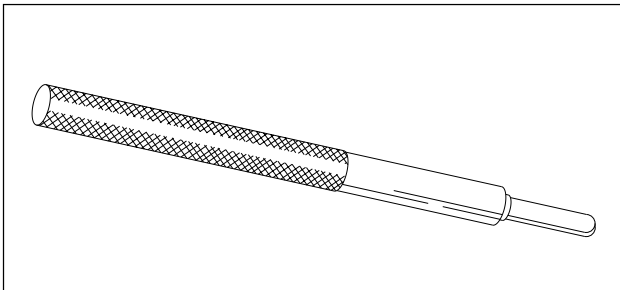
Part No. HD-34813 Rowe Flywheel Rebuilding Jig



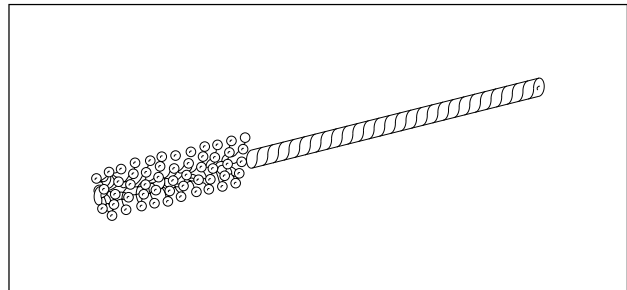
Part No. HD-34736B Valve Spring Compressor



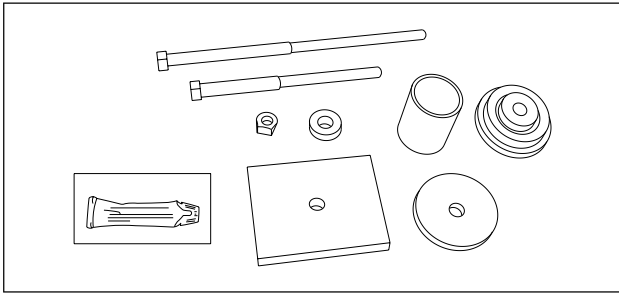
Part No. HD-34816 Oil Pressure Switch Wrench



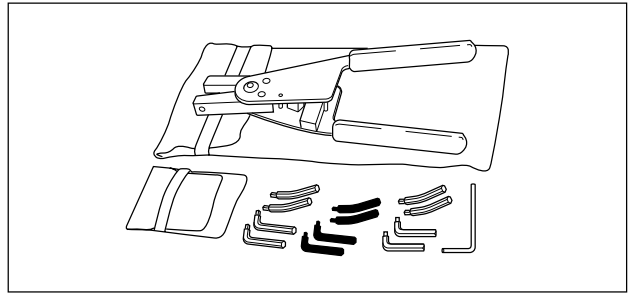
Part No. HD-34740 Driver Handle and Remover. Used with HD-34643A and HD-34731.



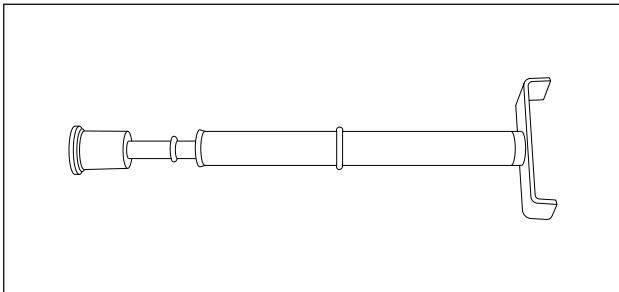
Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)



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



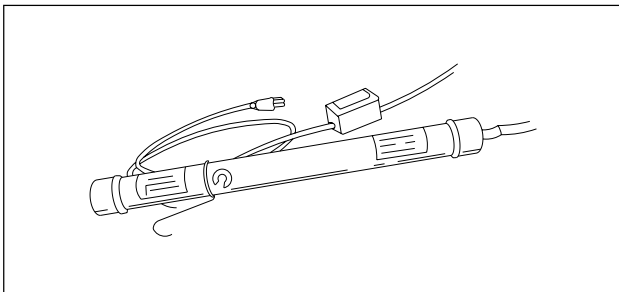
Part No. HD-35518 Internal/External Retaining Ring Pliers



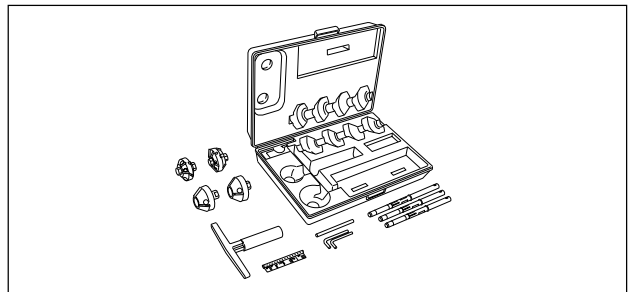
Part No. HD-35381 Belt Tension Gauge



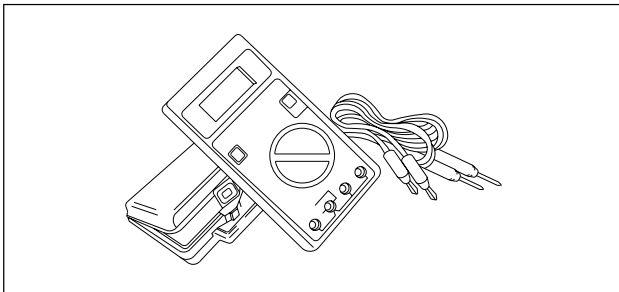
Part No. HD-35667A Cylinder Leakdown Tester



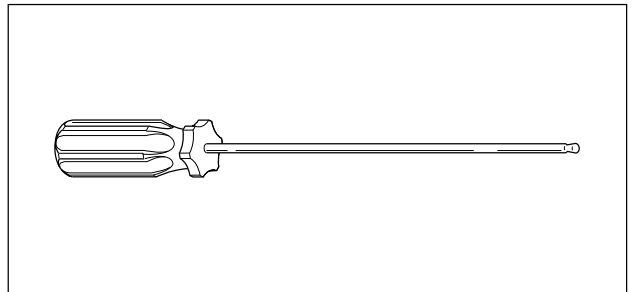
Part No. HD-35457 Black Light Leak Detector



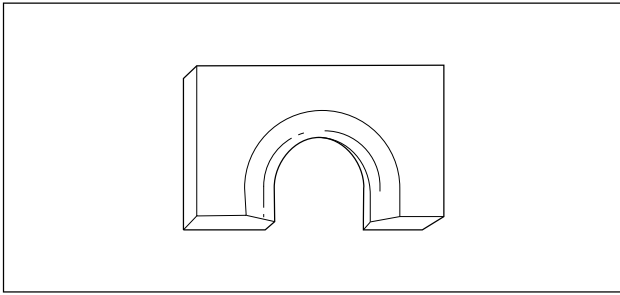
Part No. HD-35758A Neway Valve Seat Cutter Set



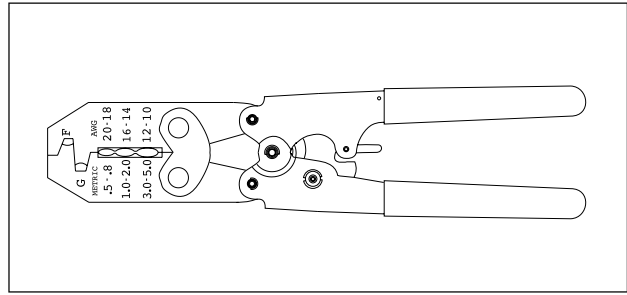
Part No. HD-35500A Digital Multi-Meter (FLUKE 23)



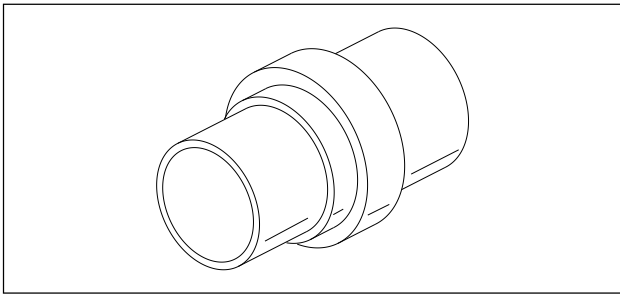
Part No. HD-35801 Intake Manifold Screw Wrench



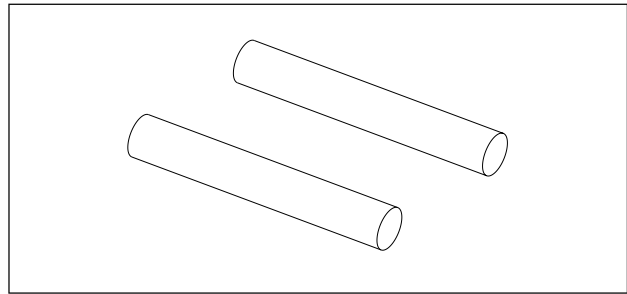
Part No. HD-37404 Countershaft Gear Support Plate



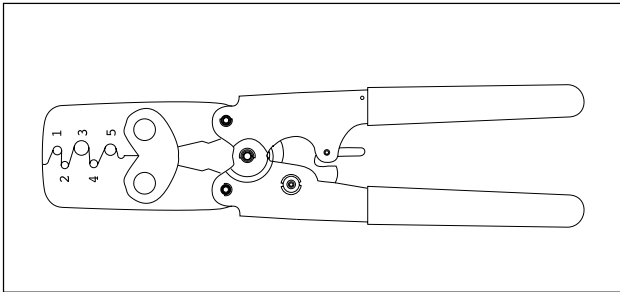
Part No. HD-38125-8 Packard Terminal Crimp Tool



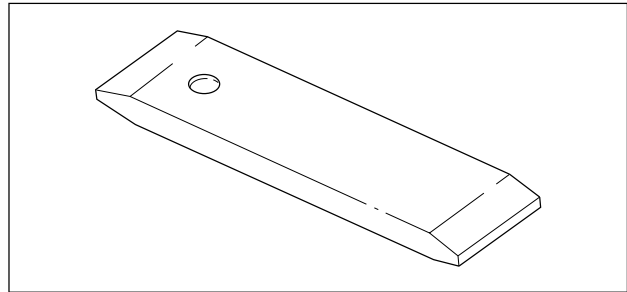
Part No. HD-37842A Inner/Outer Main Drive Gear Needle Bearing Installer



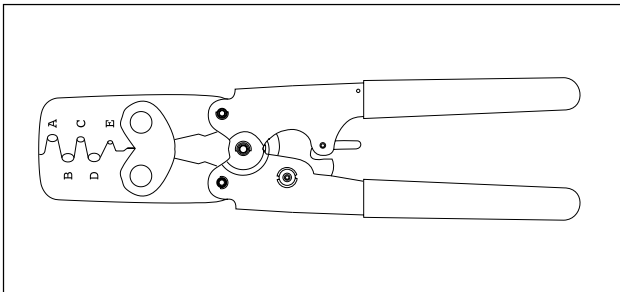
Part No. HD-38361 Cam Gear Gauge Pin Set (0.108 in. (2.74 mm) Diameter)



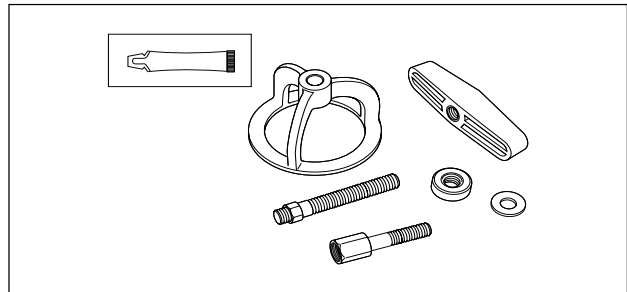
Part No. HD-38125-6 Packard Terminal Crimp Tool (Sealed and non-sealed connectors)



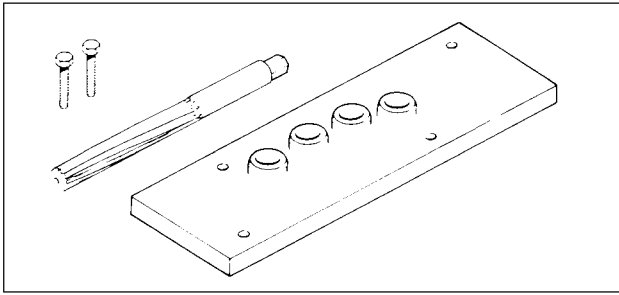
Part No. HD-38362 Sprocket Locking Link



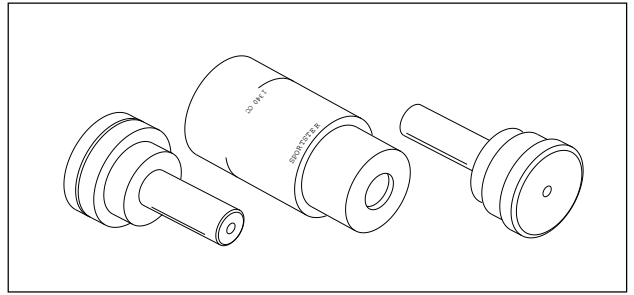
Part No. HD-38125-7 Packard Terminal Crimp Tool (Sealed connectors)



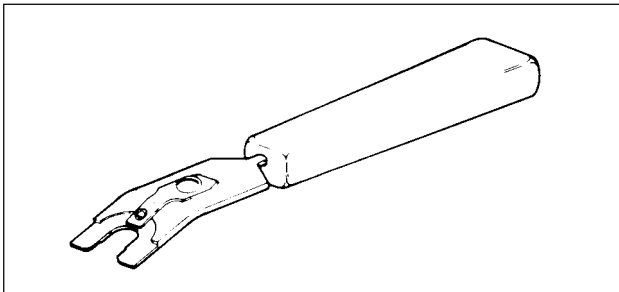
Part No. HD-38515-A Clutch Spring Compressing Tool and Part No. HD-38515-91 Forcing Screw



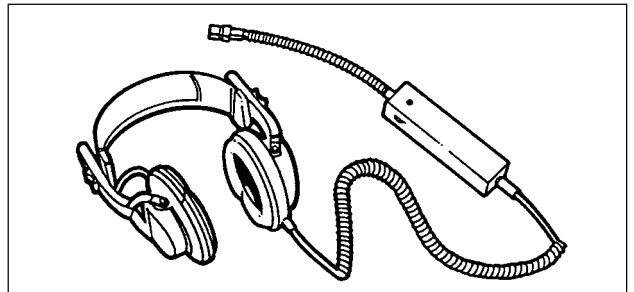
Part No. HD-38871 Camshaft Bushing Plate Pilot and Reamer



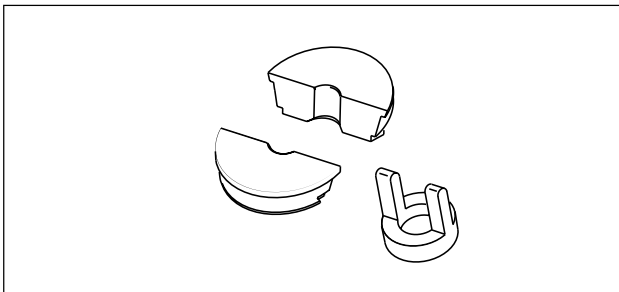
Part No. HD-39458 Sprocket Shaft Bearing Outer Race Installer



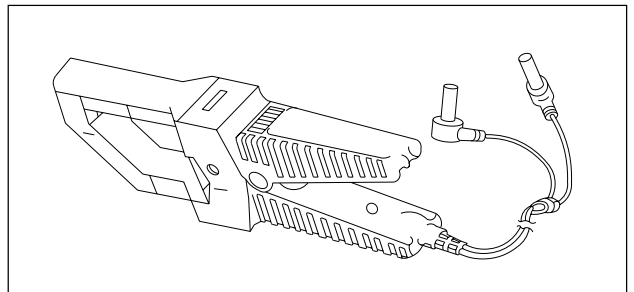
Part No. HD-39151 Shift Drum Retaining Ring Installer



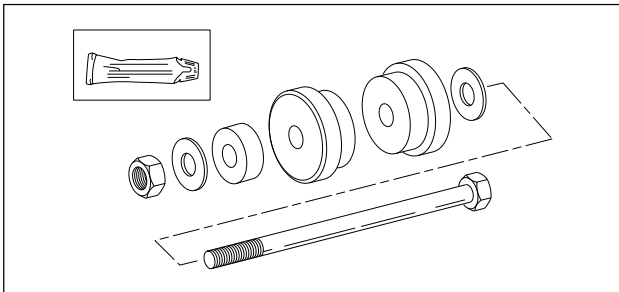
Part No. HD-39565 Engine Sound Probe



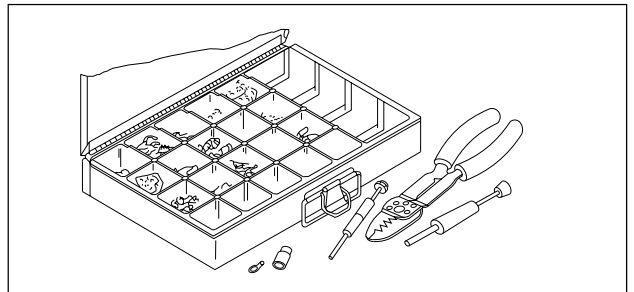
Part No. HD-39301A Steering Head Bearing Race Remover



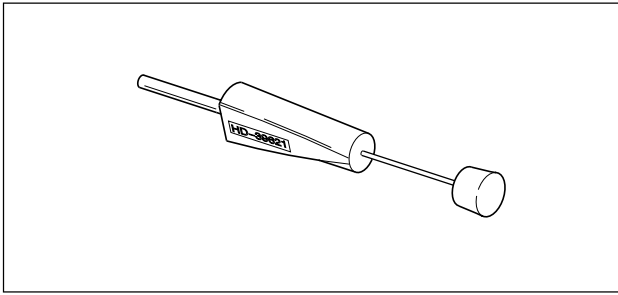
Part No. HD-39617 Inductive Amp Probe. Use with HD-35500A.



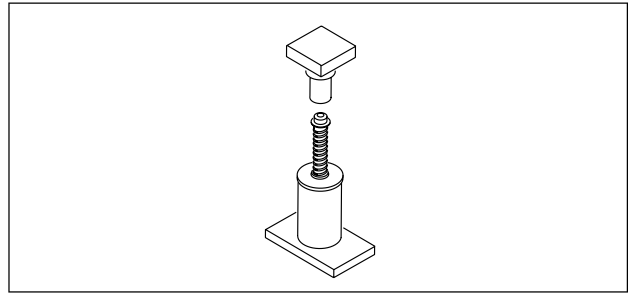
Part No. HD-39302 Steering Head Bearing Race Installer



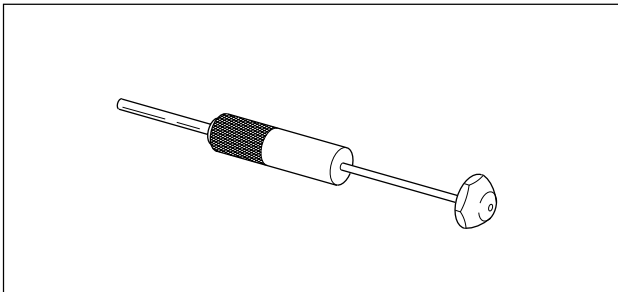
Part No. HD-39621 Electrical Terminal Repair Kit



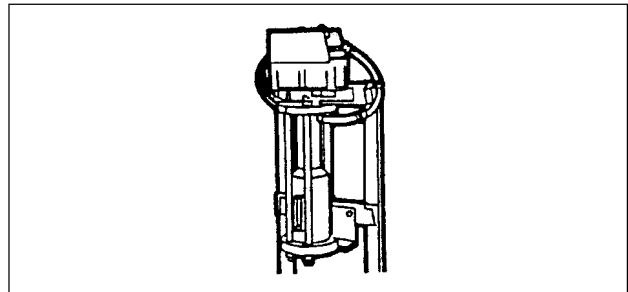
Part No. HD-39621-27 Socket Terminal Remover



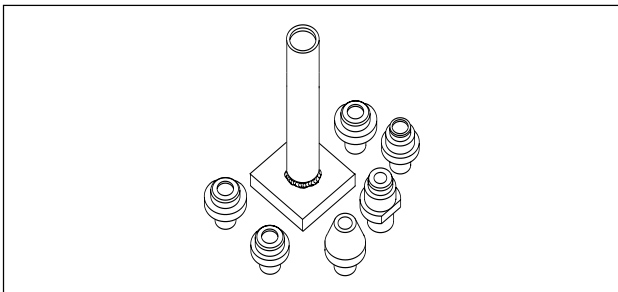
Part No. HD-39800 Oil Filter Crusher, Small



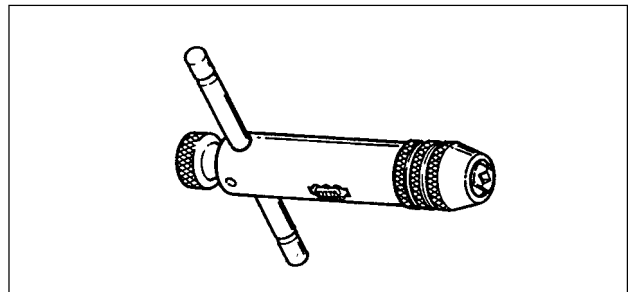
Part No. HD-39621-28 Pin Terminal Remover



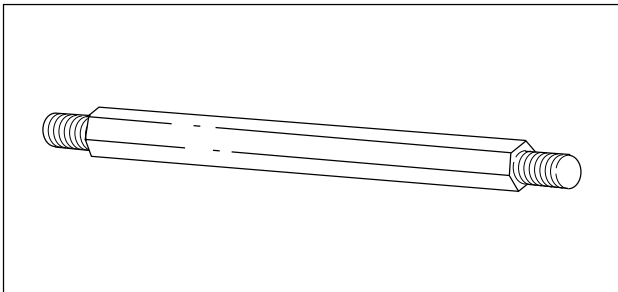
Part No. HD-39823 Oil Filter Crusher, Large



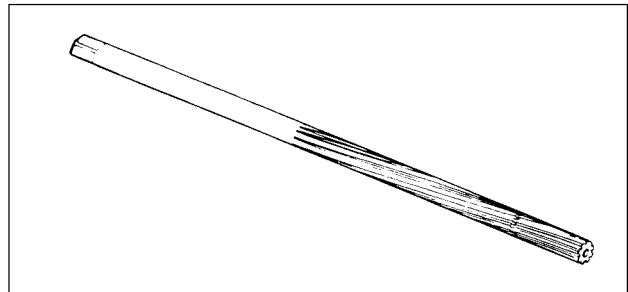
Part No. HD-39782 Cylinder Head Support



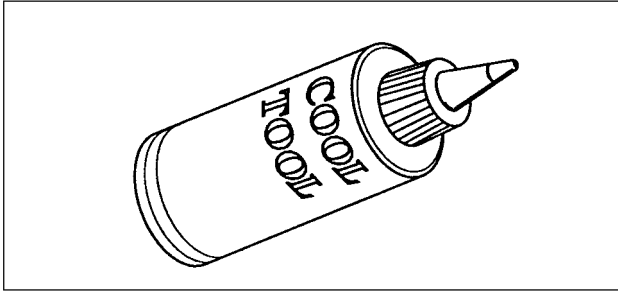
Part No. HD-39847 Universal Ratcheting Tap/
Reamer Handle



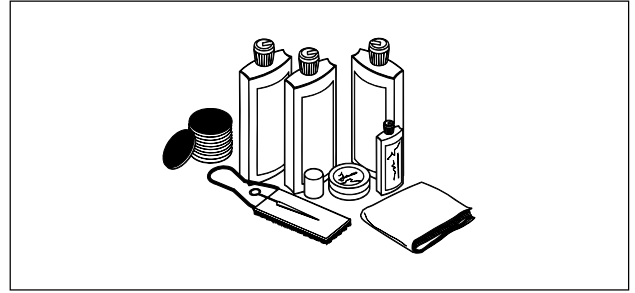
Part No. HD-39786 Cylinder Head Holding Fixture



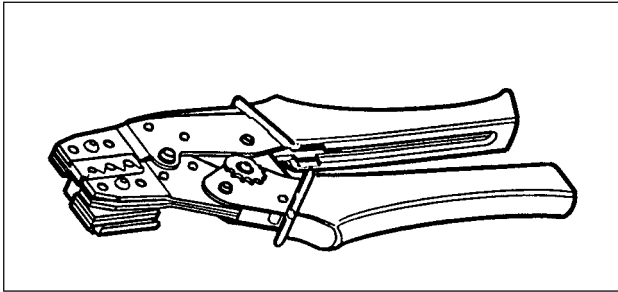
Part No. HD-39932 (Steel) or HD-39932-CAR (Carbide)
Intake and Exhaust Valve Guide Reamer



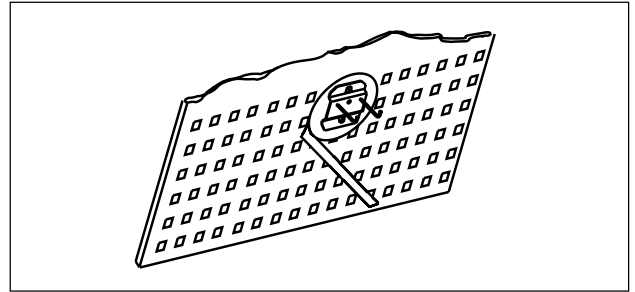
Part No. HD-39964 Reamer Lubricant (Cool Tool)



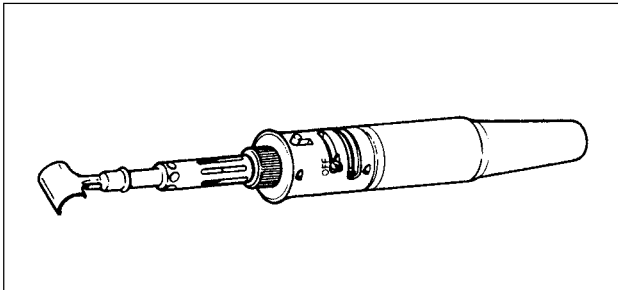
Part No. HD-39994 Paint Repair Kit



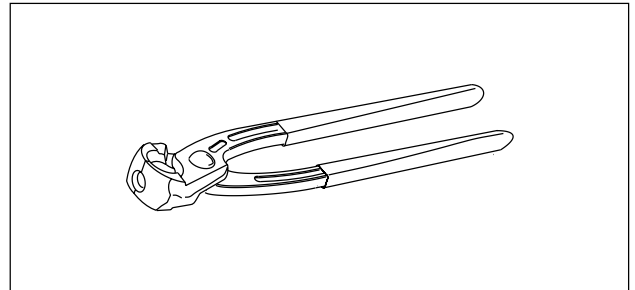
Part No. HD-39965 Deutsch Terminal Crimp Tool



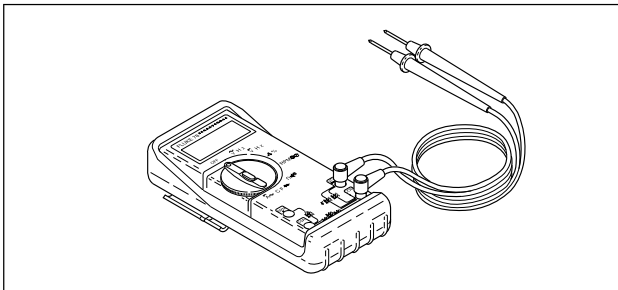
Part No. HD-41025 Tool Organizational System



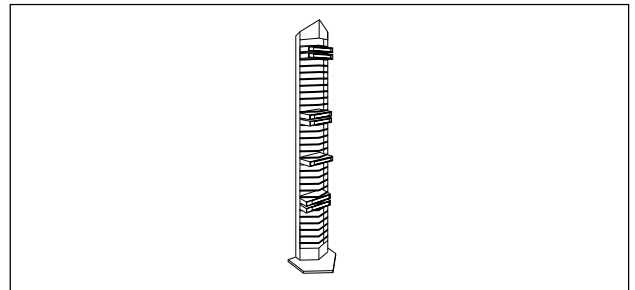
Part No. HD-39969 Ultra-Torch UT-100



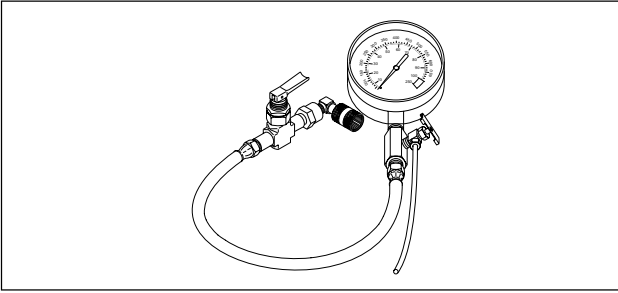
Part No. HD-41137 Hose Clamp Pliers



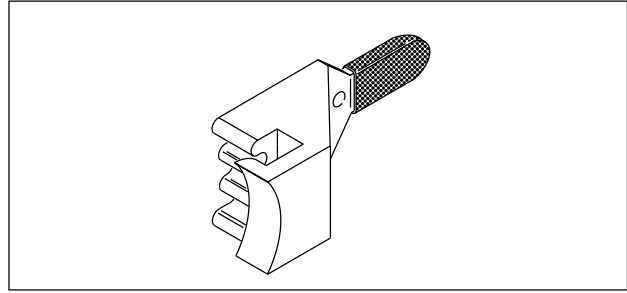
Part No. HD-39978 Fluke 78 Multimeter (DVOM)



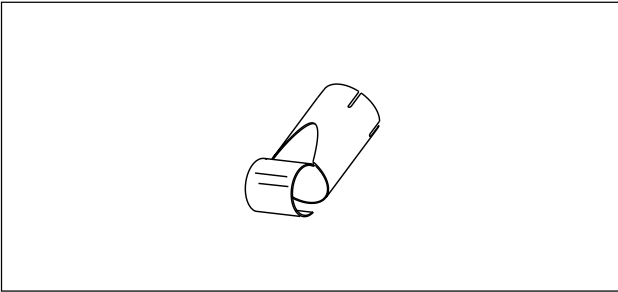
Part No. HD-41155 VHS Video Shelf



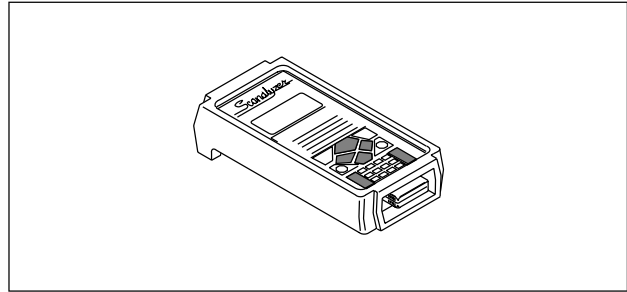
Part No. HD-41182 Fuel Pressure Gauge



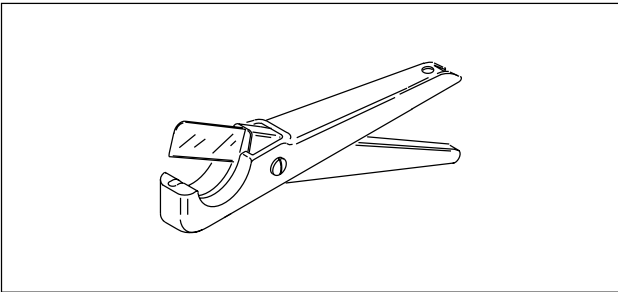
Part No. HD-41321 Sprocket Holding Tool



Part No. HD-41183 Heat Shield Attachment
Use with Part No. HD-25070.



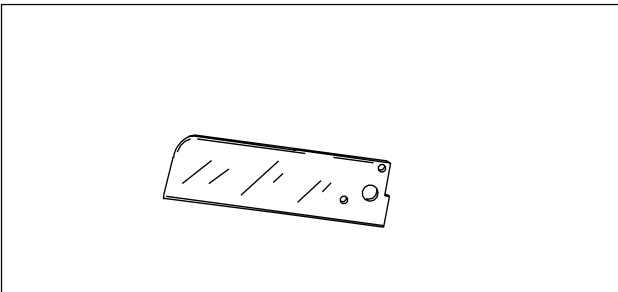
Part No. HD-41325 Scanalyzer



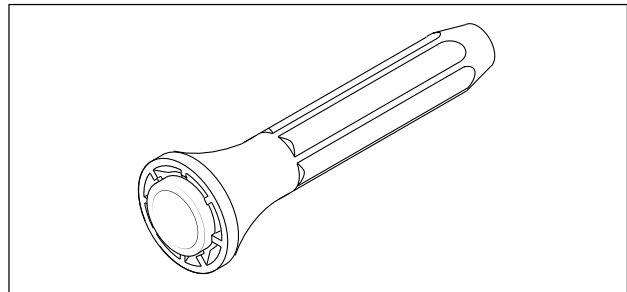
Part No. HD-41185 Hose Cutting Tool



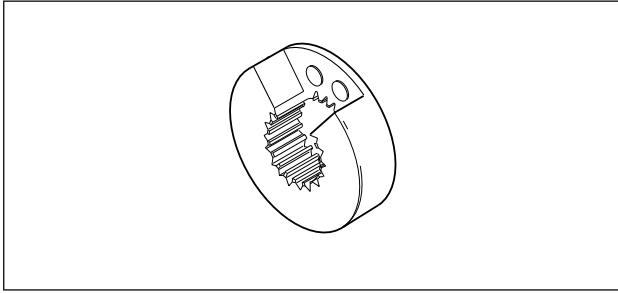
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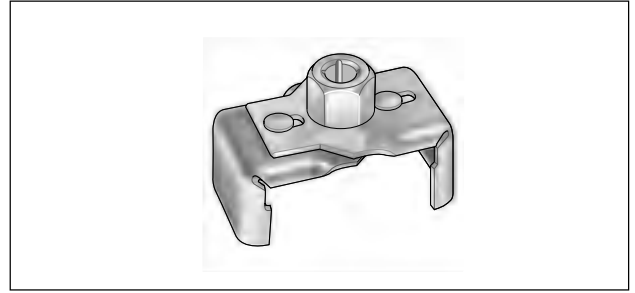
Part No. HD-41185-1 Oil Hose Cutter



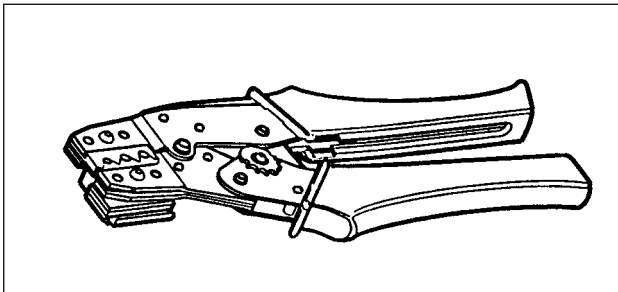
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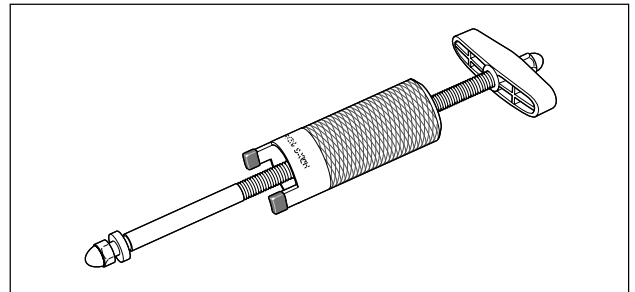
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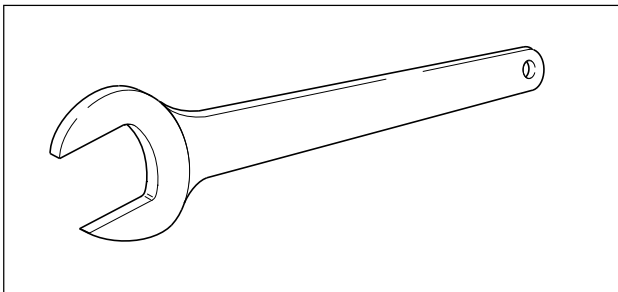
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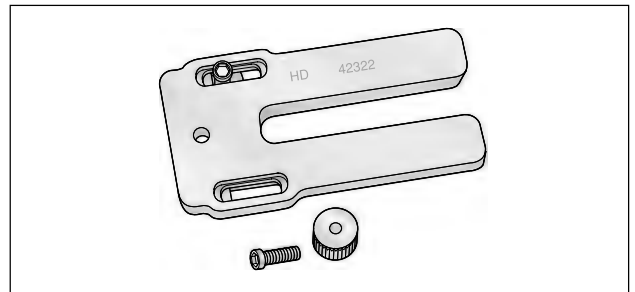
Part No. HD-41609 Amp Terminal Crimp Tool



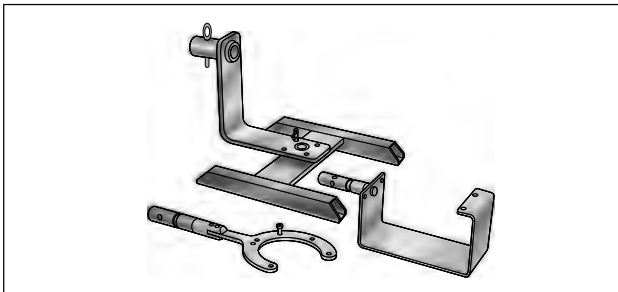
Part No. HD-42320 Piston Pin Remover/Installer



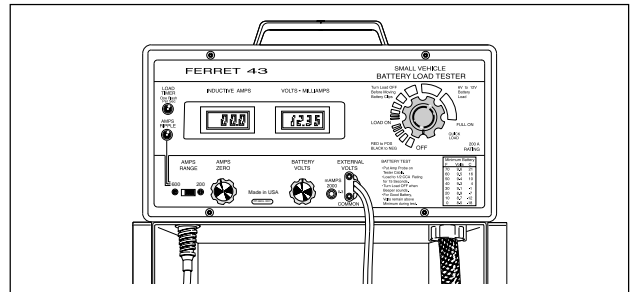
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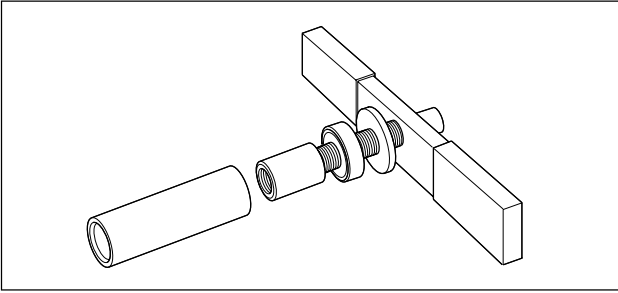
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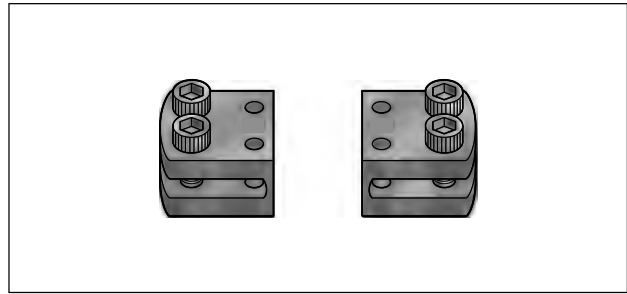
Part No. HD-42310 Engine/Transmission Stand



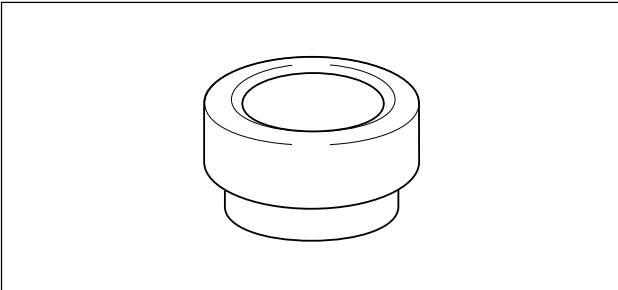
Part No. HD-42376 Battery/Charging System Load Tester



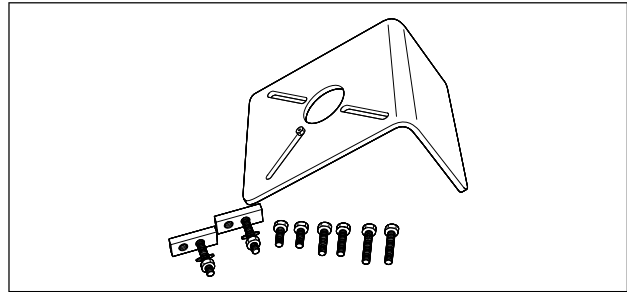
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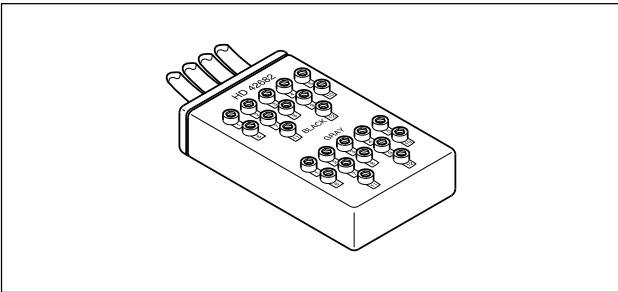
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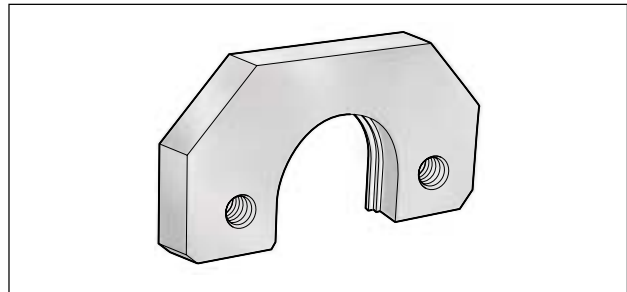
Part No. HD-42774 Sprocket Shaft Seal Installer



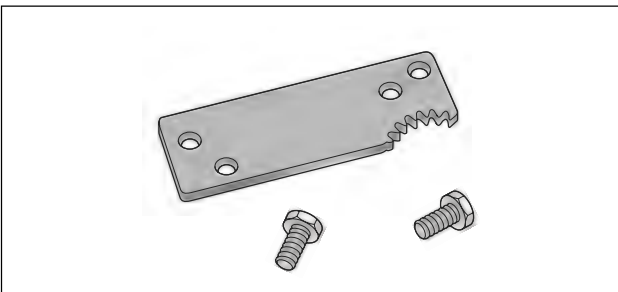
Part No. HD-44358 Flywheel Fixture (2000 Models)



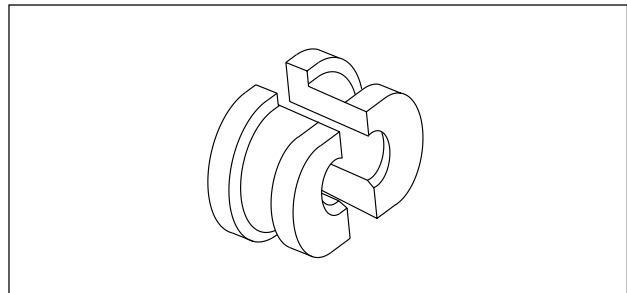
Part No. HD-42682 Breakout Box



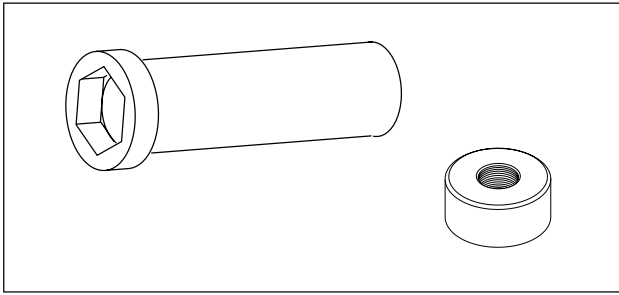
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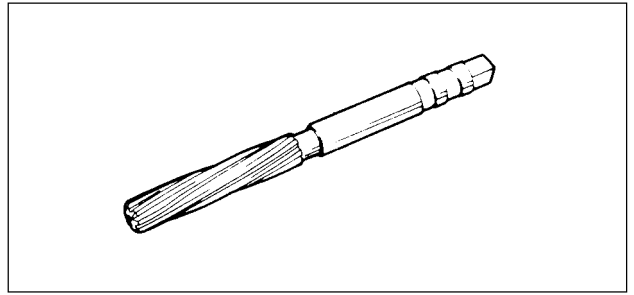
Part No. HD-43894 Crankshaft Locking Tool



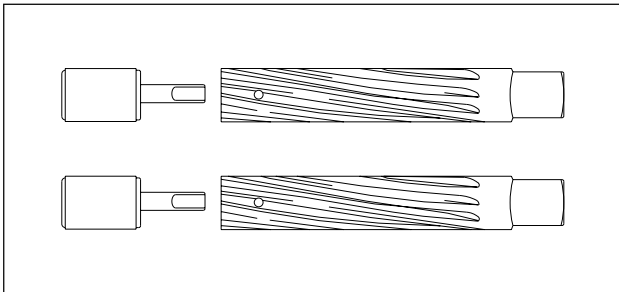
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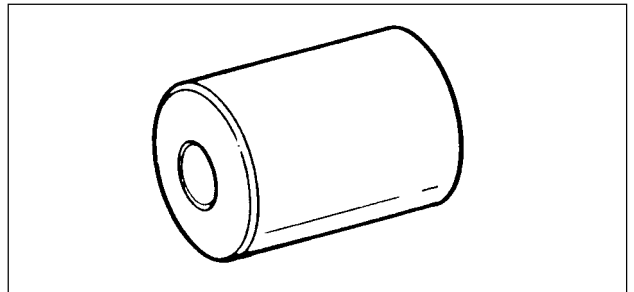
Part No. HD-94660-37B Mainshaft Locknut Wrench



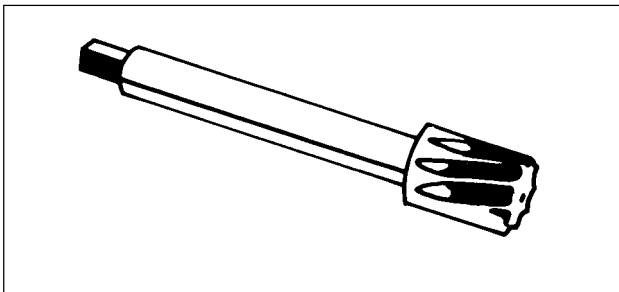
Part No. HD-94812-1 Pinion Shaft Bushing Reamer.
Use with HD-94812-87.



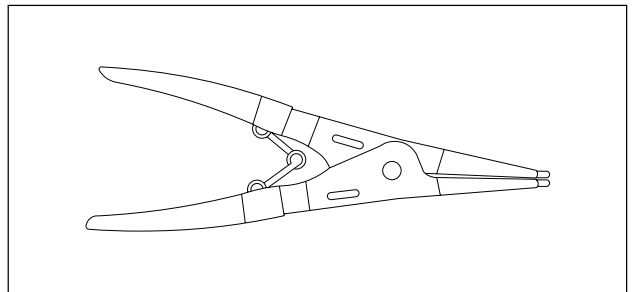
Part No. HD-94800-26A Connecting Rod Bushing
Reamers and Pilots



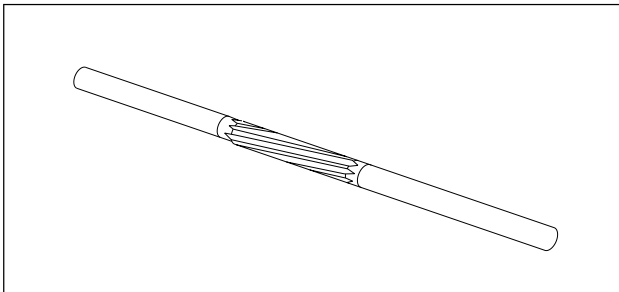
Part No. HD-94812-87 Pinion Shaft Reamer Pilot.
Use with HD-94812-1.



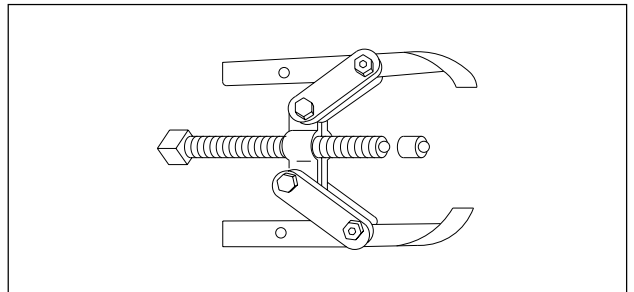
Part No. HD-94803-67 Rear Intake Camshaft
Bushing Reamer



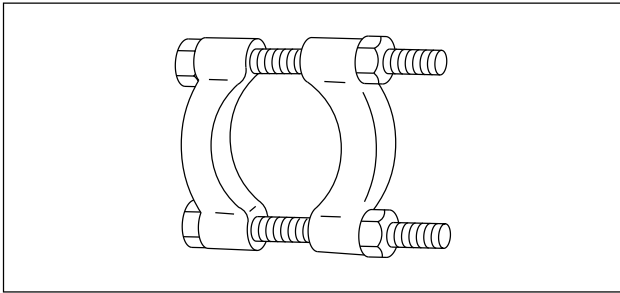
Part No. HD-95017-61 Large External Retaining
Ring Pliers



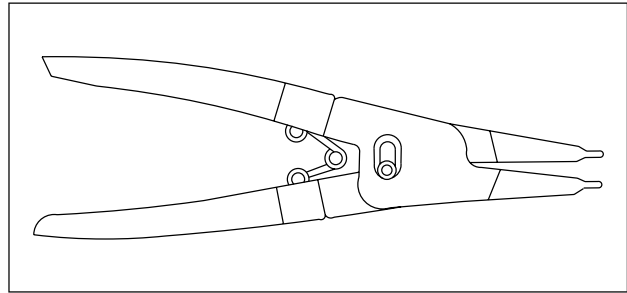
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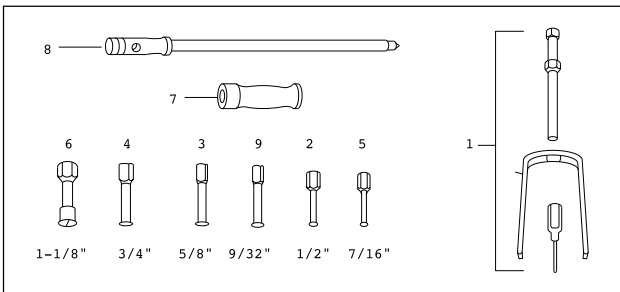
Part No. HD-95635-46 All-Purpose Claw Puller



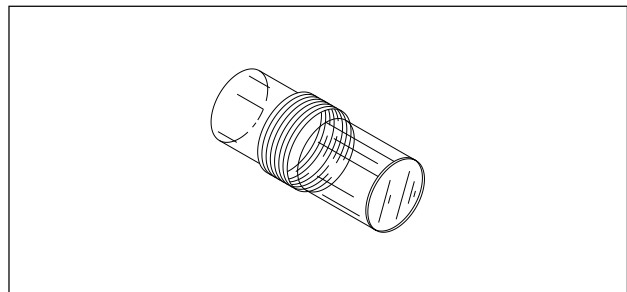
Part No. HD-95637-46A Wedge Attachment for Claw Puller. Use with HD-95635-46.



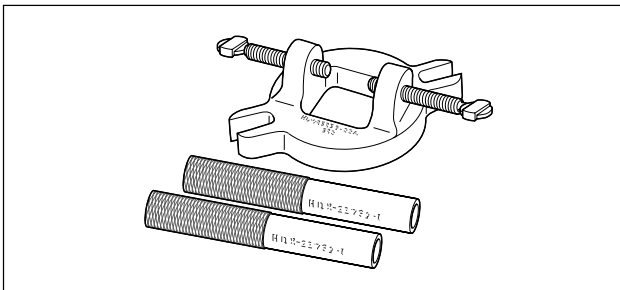
Part No. HD-96215-49 Small Internal Retaining Ring Pliers



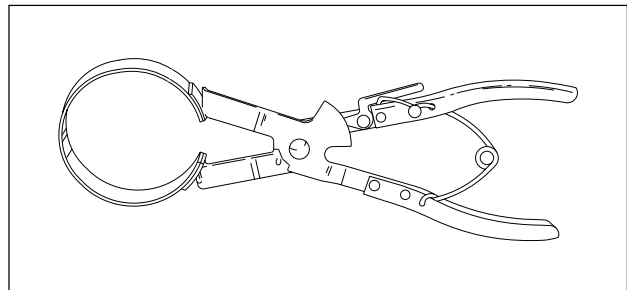
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-7. Items 8 (HD-95769-69), 9 (HD-95770-69) and 10 (HD-95771-69) are optional.



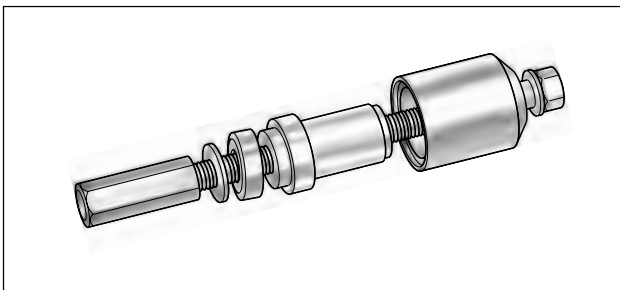
Part No. HD-96295-65D Timing Mark View Plug. Use with HD-33813.



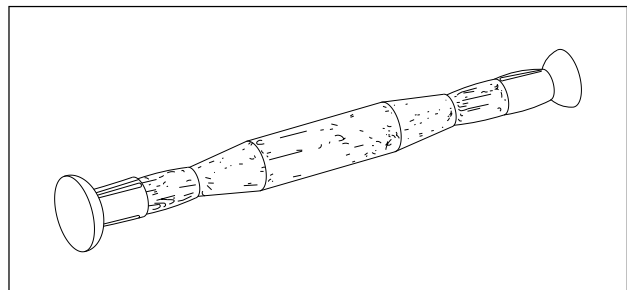
Part No. HD-95952-33B Connecting Rod Clamping Tool



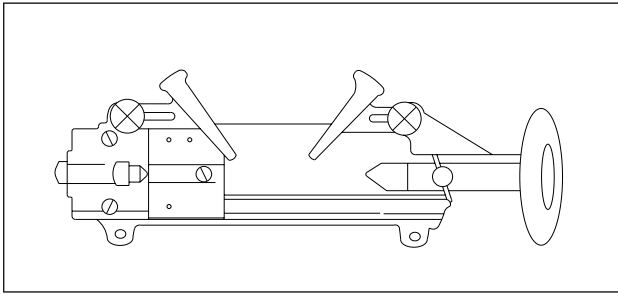
Part No. HD-96333-51C Piston Ring Compressor



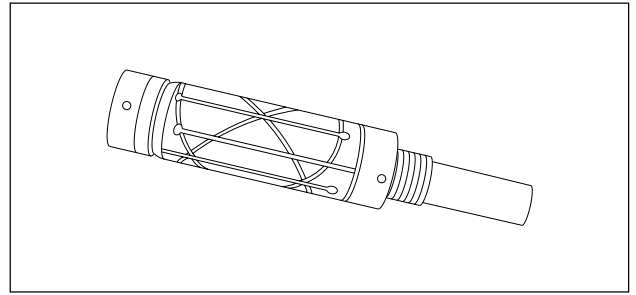
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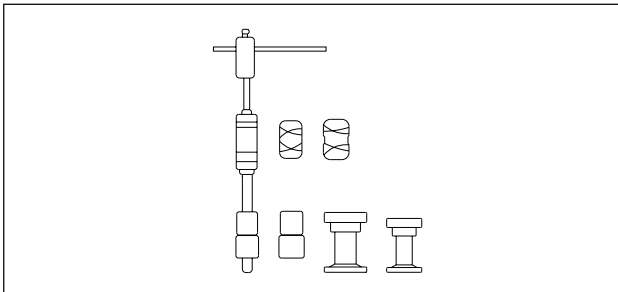
Part No. HD-96550-36A Valve Lapping Tool



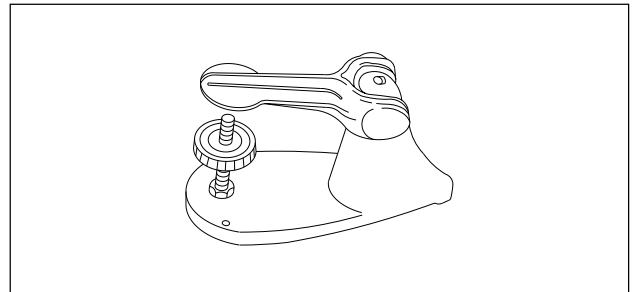
Part No. HD-96650-80 Flywheel Truing Stand



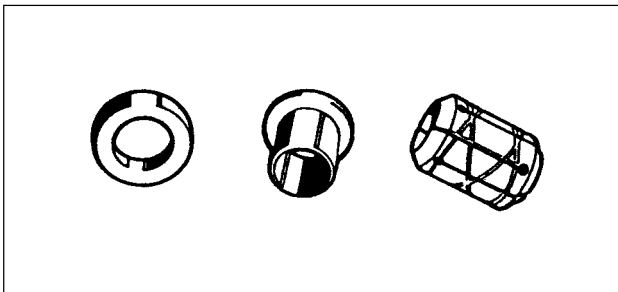
Part No. HD-96740-36 Connecting Rod Lapping Arbor



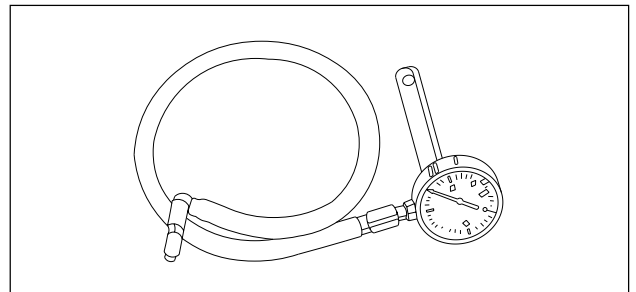
Part No. HD-96710-40B Crankcase Main Bearing Lapping Tool



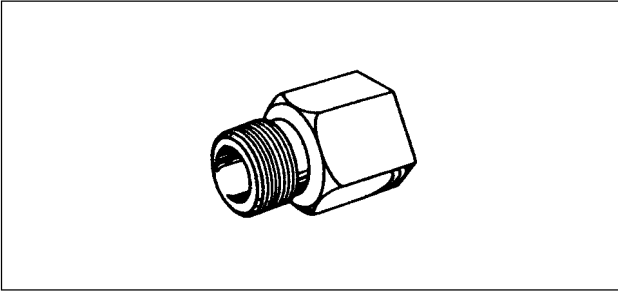
Part No. HD-96796-47 Valve Spring Tester



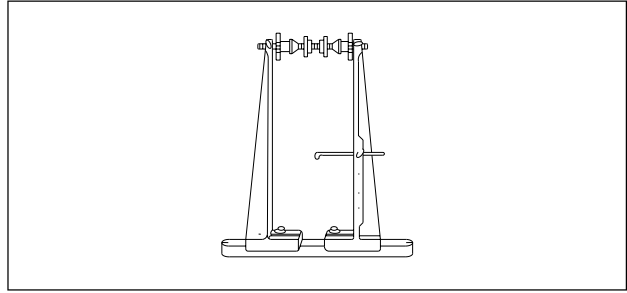
Part No. HD-96718-87 Pinion Bearing Outer Race Lapping Kit



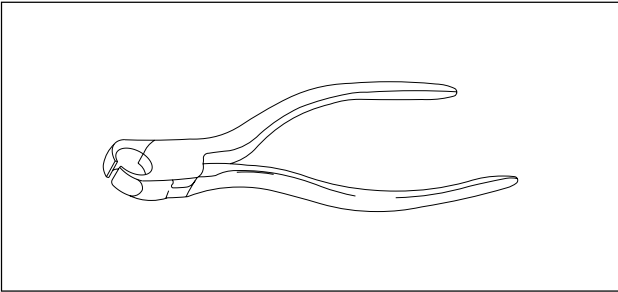
Part No. HD-96921-52A Oil Pressure Gauge



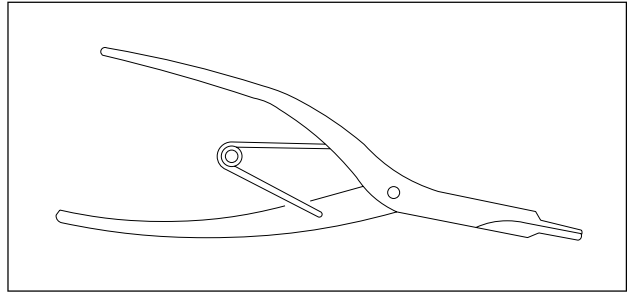
**Part No. HD-96940-52A Oil Pressure Gauge Adapter.
Use with HD-96921-52A.**



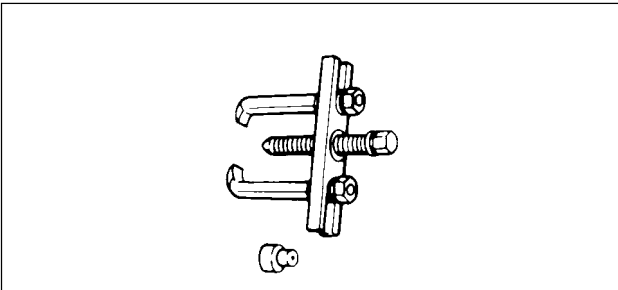
**Part No. HD-99500-80 Wheel Truing
and Balancing Stand**



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



**Part No. J-5586 Transmission Shaft
Retaining Ring Pliers**



Part No. HD-97292-61 Two Claw Puller

GENERAL

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

The following table provides a brief description of the connectors found on the S3/S3T Thunderbolt.

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.

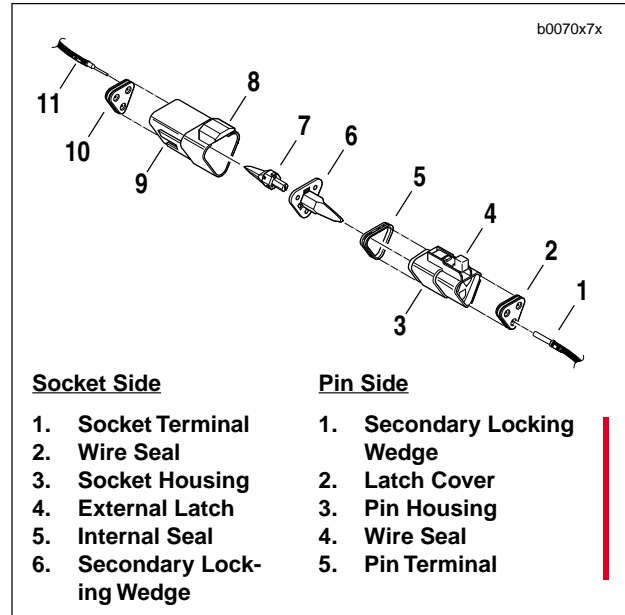


Figure B-1. 3-Pin Connector

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.

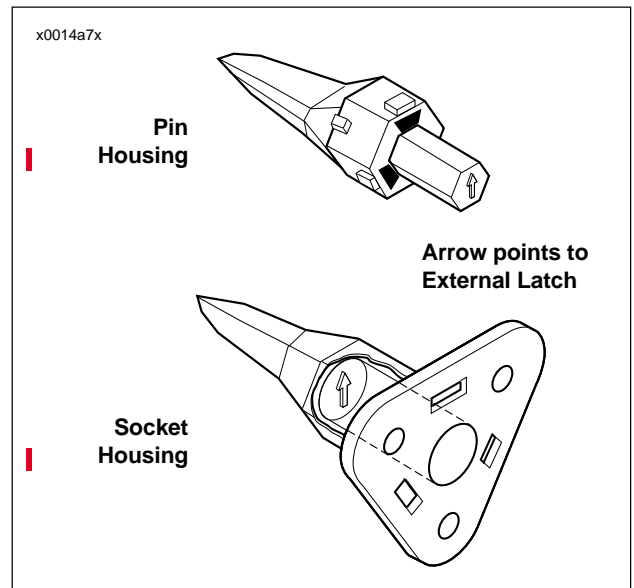


Figure B-2. 3-pin Locking Wedge Orientation

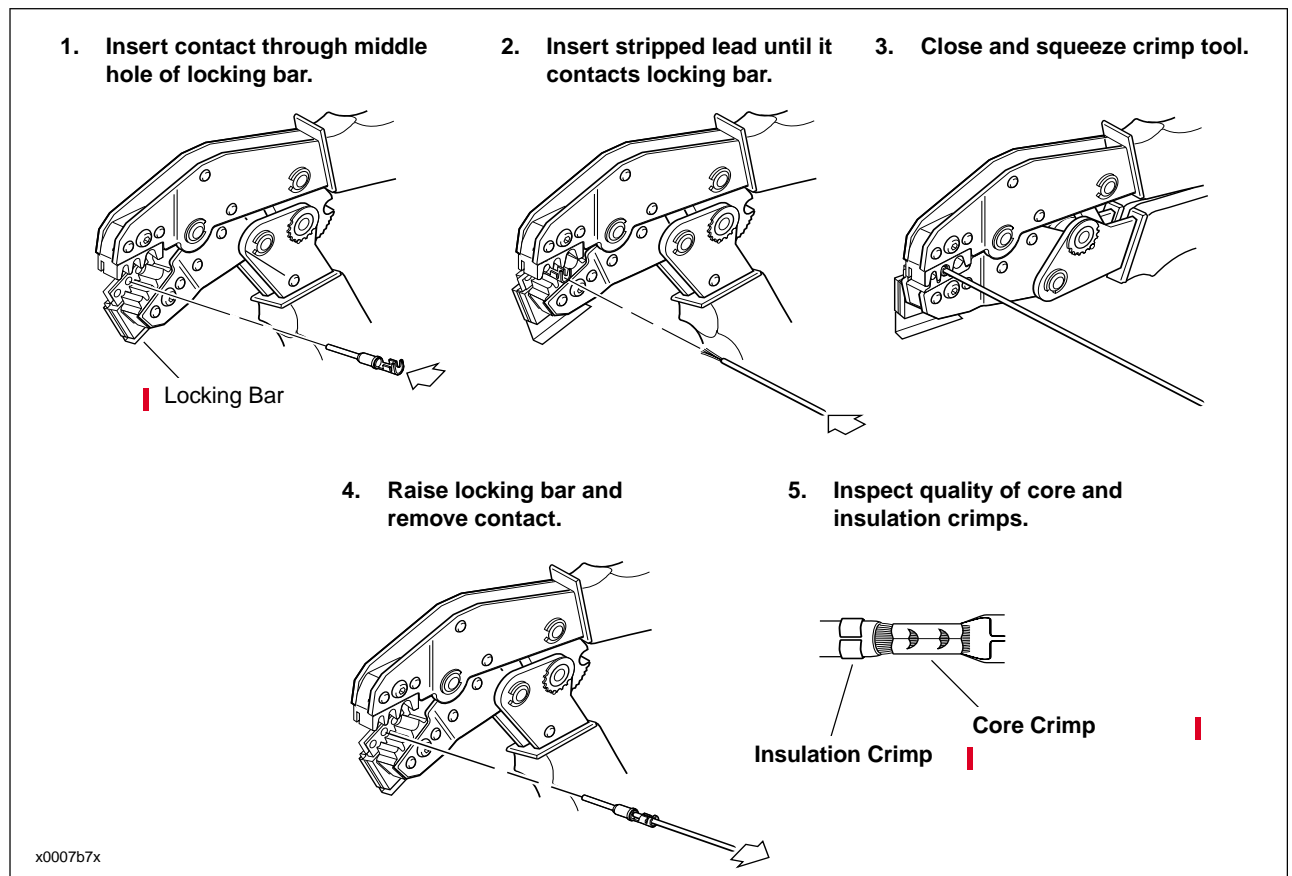


Figure B-3. Deutsch Crimping Procedure

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](#).

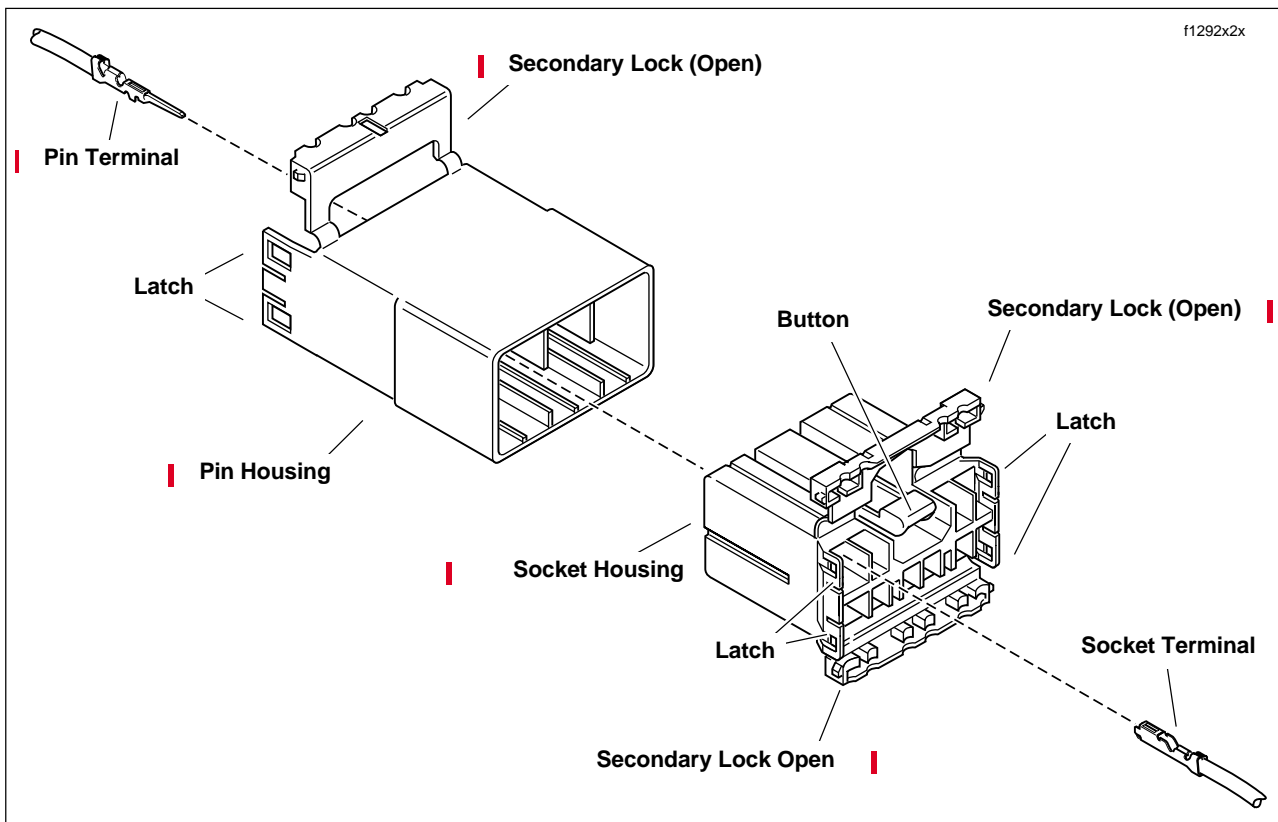


Figure B-4. Amp Multilock Connector (Exploded View)

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.

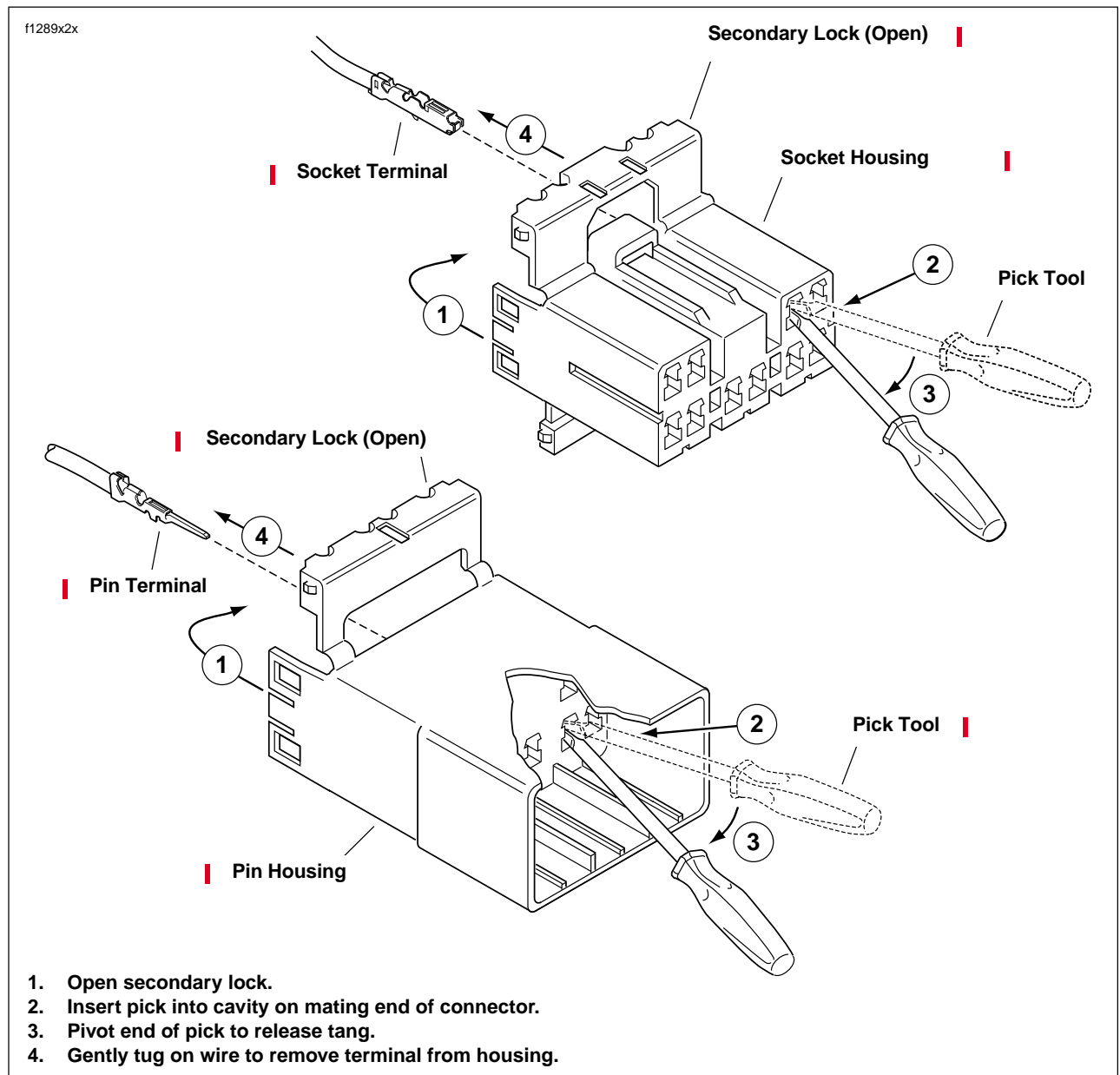


Figure B-5. Release Tang and Back Out Terminals

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.

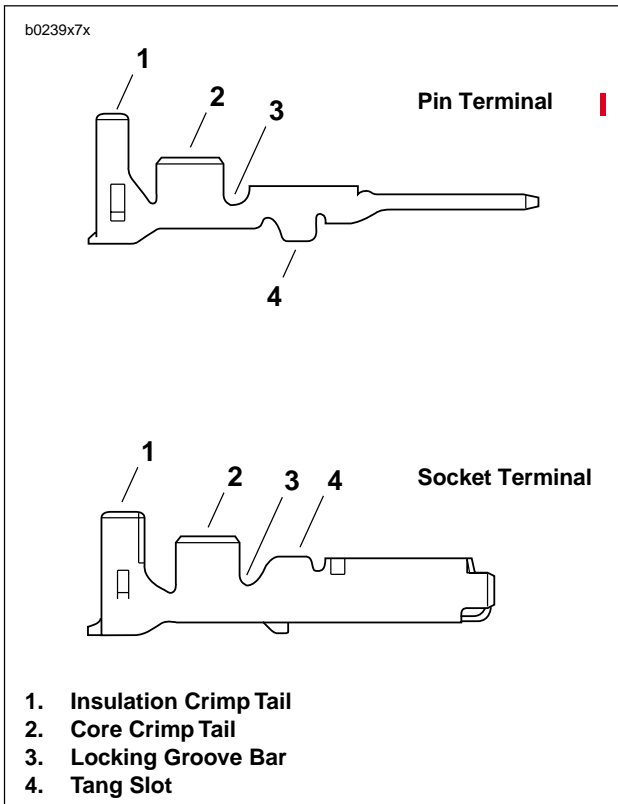


Figure B-6. Crimps

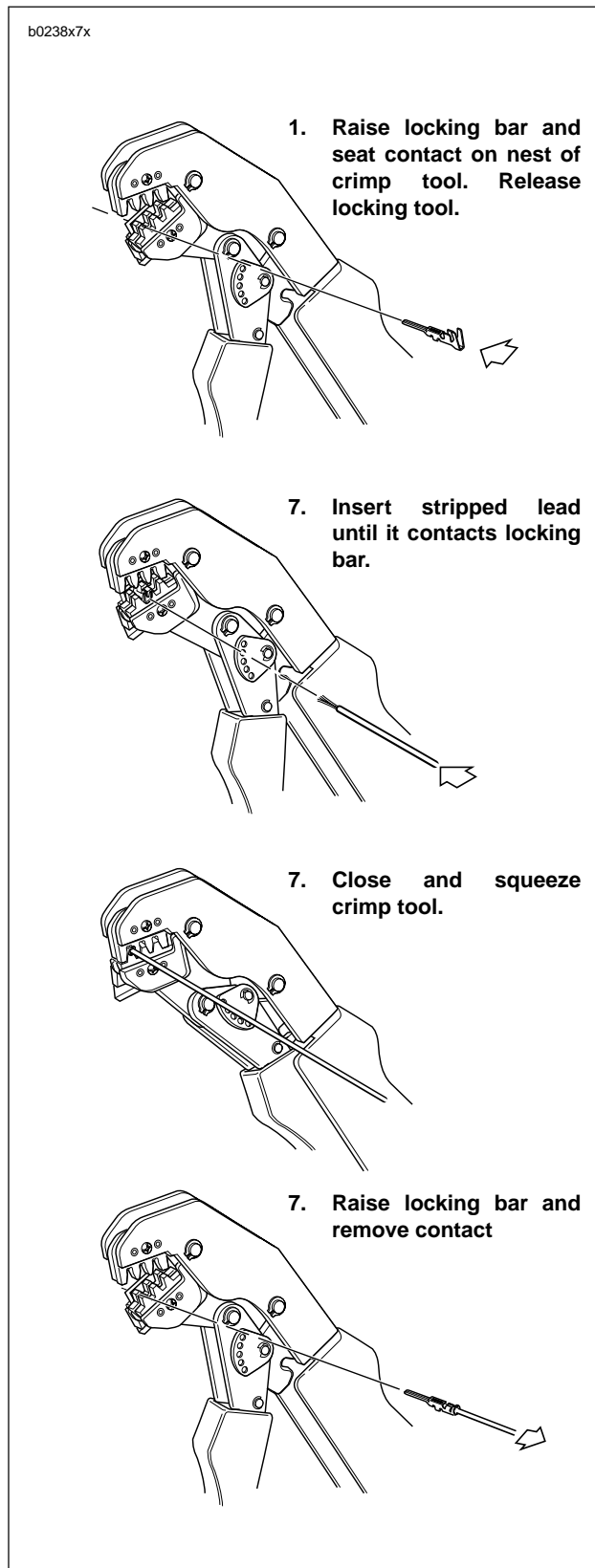


Figure B-7. Amp Multilock Crimping Procedure

APPENDIX C—METRIC CONVERSIONS

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








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)

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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.

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. S3/S3T Fork Oil

PROPERTY	SPECIFICATION	
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).

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.

BATTERY TESTING

Voltmeter Test

See Table 1-4. The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.8V or above, perform the load test described in Section 7.

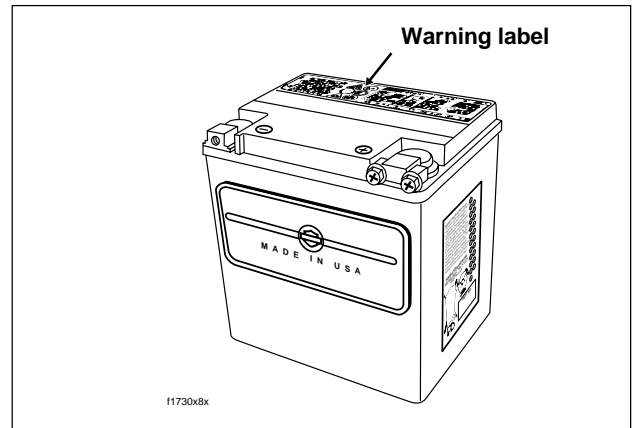


Figure 1-1. Maintenance-Free Battery (Typical)

ANTIDOTE

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.

Contents are Corrosive.	Wear Safety Glasses.	Contents are Explosive.	Keep Flames Away.	Read Instructions.	Keep Away From Children.

<p>NON-SPILLABLE</p> <p>This is a ready filled, activated, SEALED BATTERY. NEVER remove strip. Refer to owner's manual for charging instructions.</p> <p>If battery is put into service after date shown, charge for minimum of 1 hour at 6-10 amps. (See side of battery for date.)</p>			<p>3-4425</p> <p>! DANGER/POISON</p> <p>SHIELD EYES.</p> <p>EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.</p> <p>NO SPARKS • FLAMES • SMOKING</p> <p>SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.</p> <p>FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.</p> <p>KEEP OUT OF REACH OF CHILDREN. DO NOT OPEN BATTERY.</p>

f1733x8x

Figure 1-2. Battery Label

Table 1-4. 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.
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.

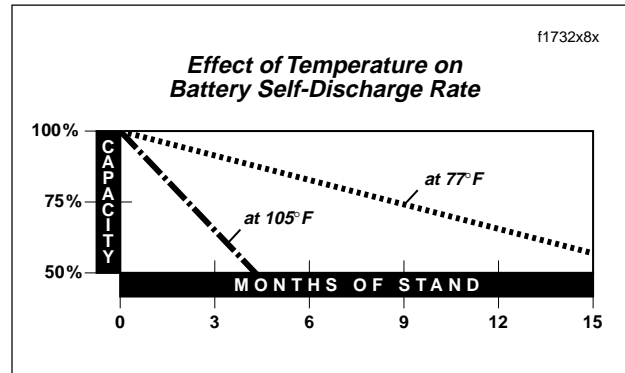


Figure 1-3. Battery Self-Discharge Rate

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 (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, 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 1-4. 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.

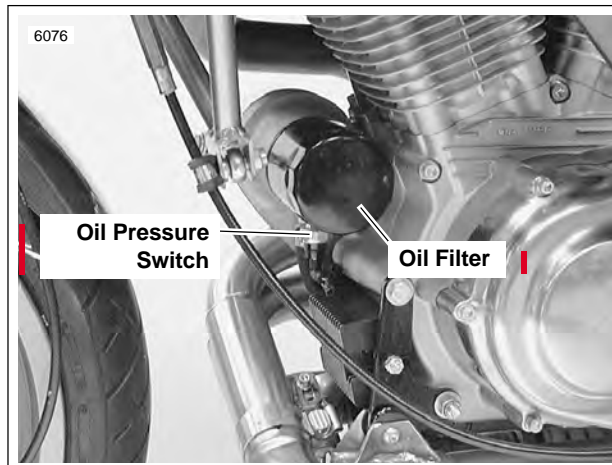


Figure 1-4. Oil Filter and Mount (Typical)

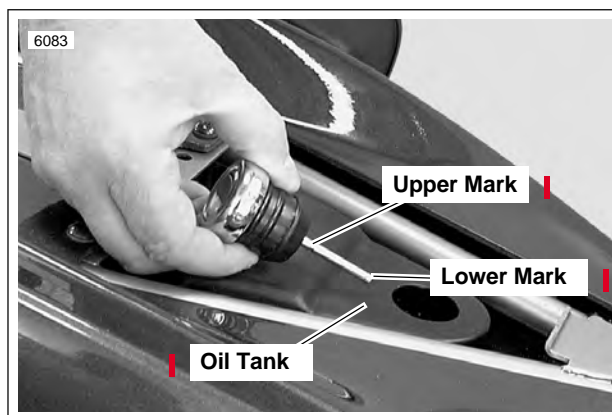


Figure 1-5. Checking Oil Tank Level

Table 1-4. 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 1-4](#). 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](#).

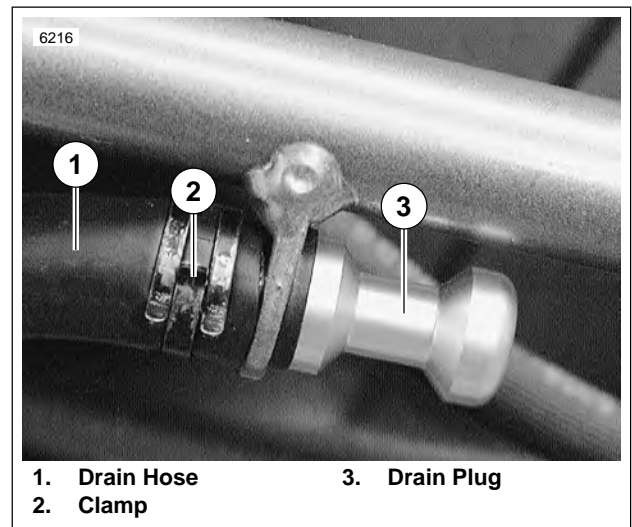


Figure 1-6. Oil Tank Drain Line

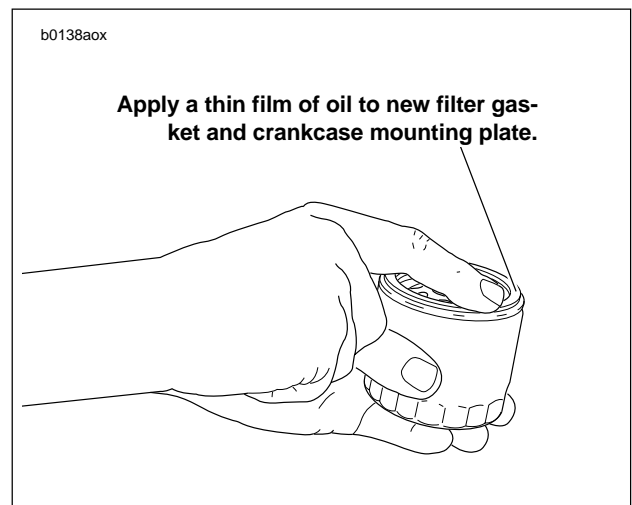


Figure 1-7. Oil Filter

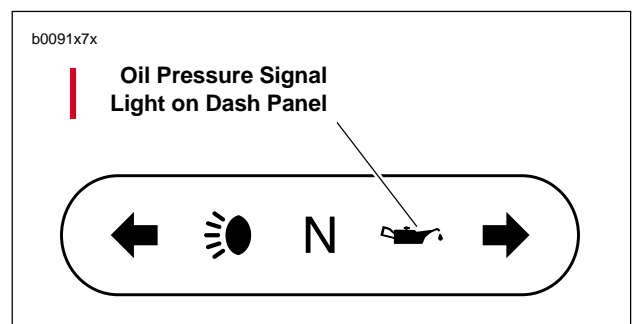


Figure 1-8. Oil Pressure Signal Light

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.

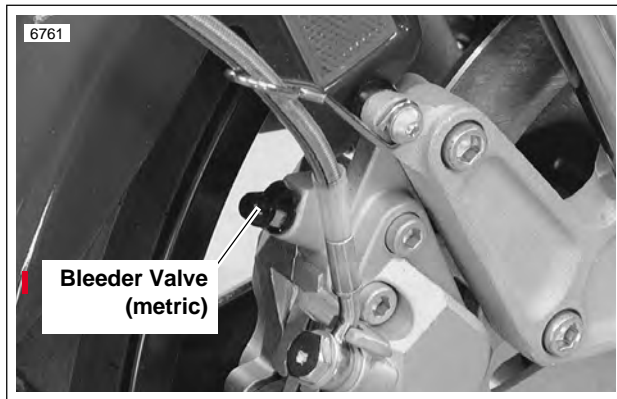


Figure 1-9. Front Brake Caliper Bleeder Valve

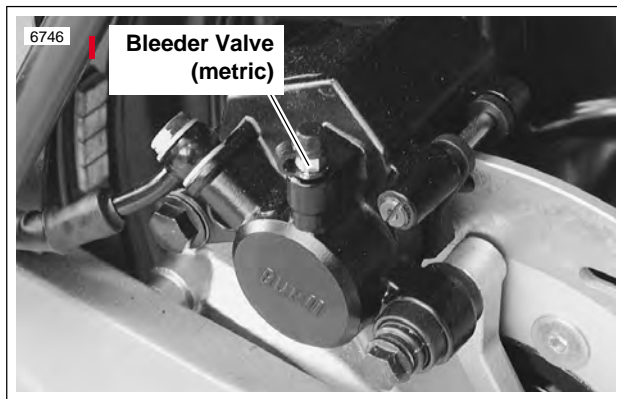


Figure 1-10. Rear Brake Caliper Bleeder Valve

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.

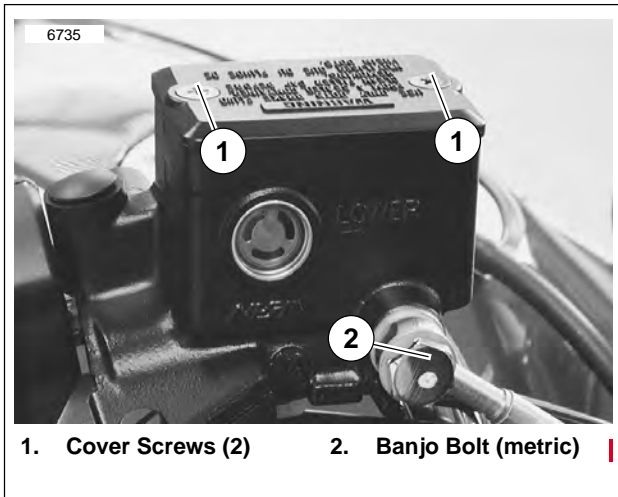


Figure 1-11. Front Master Cylinder

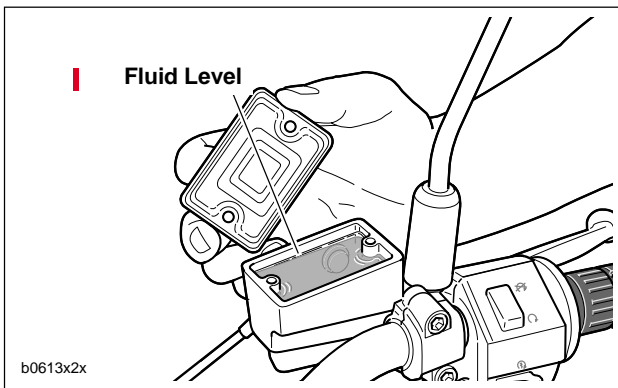


Figure 1-12. Checking Brake Fluid (Switch shown uncovered for clarity)

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.

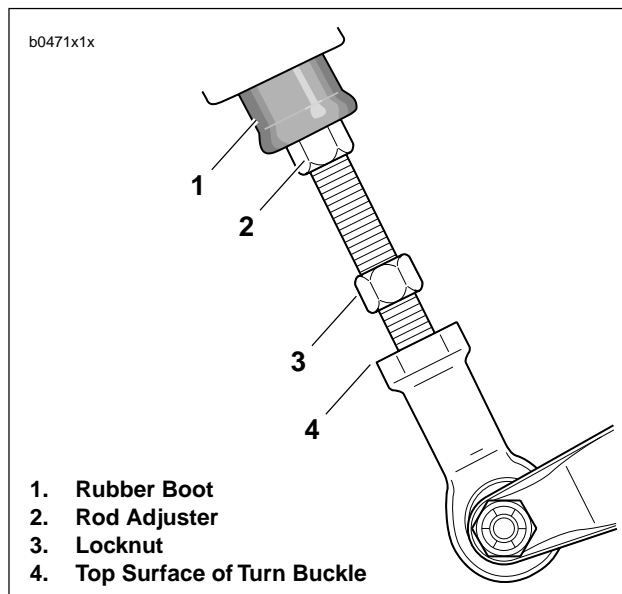


Figure 1-13. Pushrod Adjustment

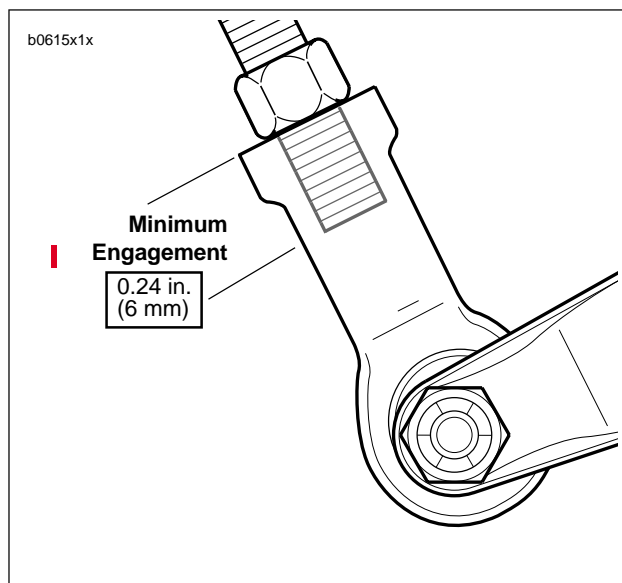


Figure 1-14. Minimum Thread Engagement

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 1-15](#). 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](#).

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

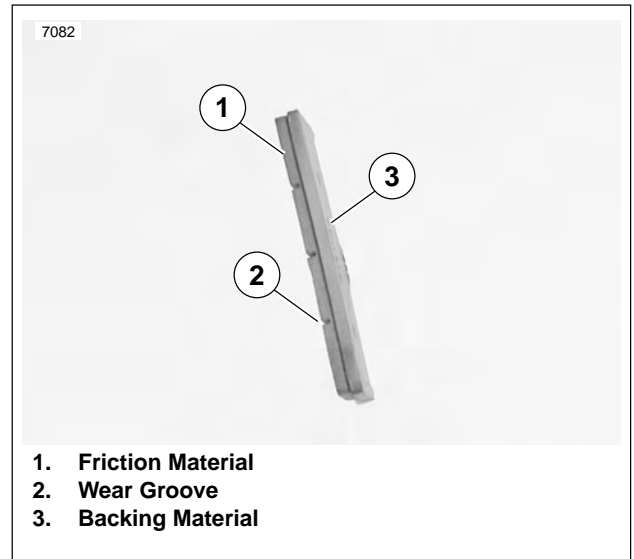


Figure 1-15. Brake Pad Thickness



Figure 1-16. Front Brake Rotor

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 1-5](#).

Table 1-5. Tire Pressures

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

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 1-17](#). 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 14-21 ft-lbs (19-29 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 1-18](#). 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 1-17](#). Install clutch inspection cover (2) using four TORX screws with washers (1). Tighten in a cross-wise pattern to 7-9 ft-lbs (10-12 Nm).
8. Install muffler. See [2.27 EXHAUST SYSTEM](#).

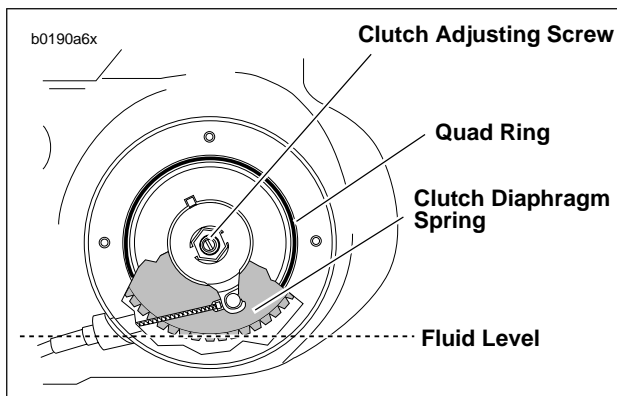


Figure 1-18. Fluid Level

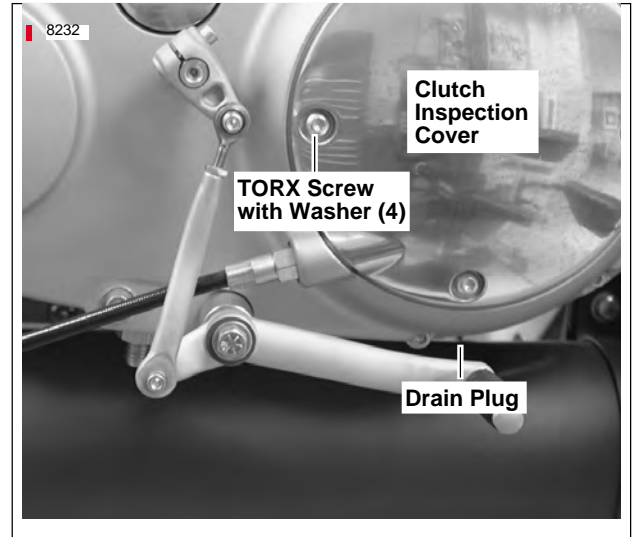


Figure 1-17. Primary Cover

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 1-19](#). 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 1-20](#). 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 1-20](#).

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 1-21](#). 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 1-19](#). 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 1-20](#). Install clutch inspection cover (2) using four TORX screws with washers (1). Tighten in a cross-wise pattern to 7-9 ft-lbs (10-12 Nm).
 9. Check clutch cable freeplay. See Step 6 above.

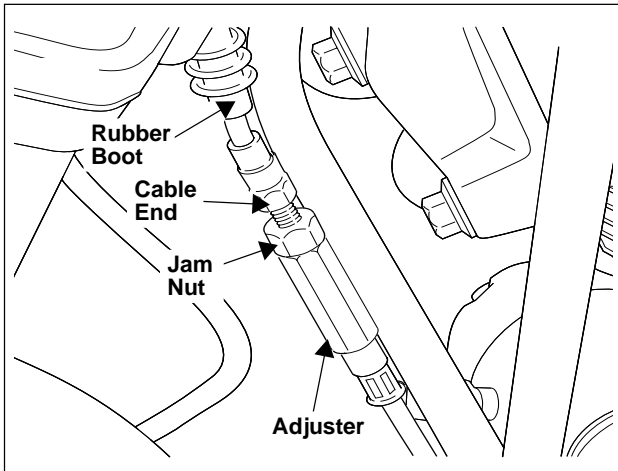


Figure 1-19. Clutch Cable Adjuster Mechanism

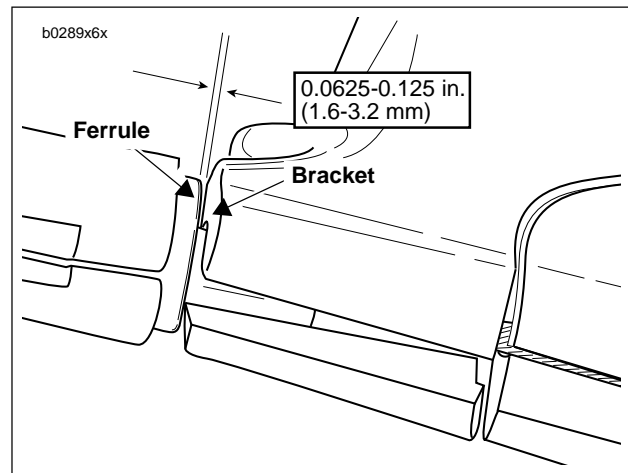


Figure 1-21. Adjusting Clutch Freeplay

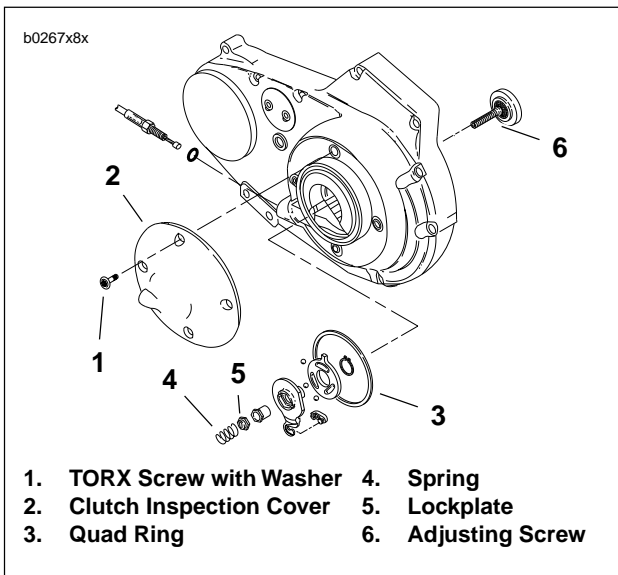


Figure 1-20. Clutch Release Mechanism

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.

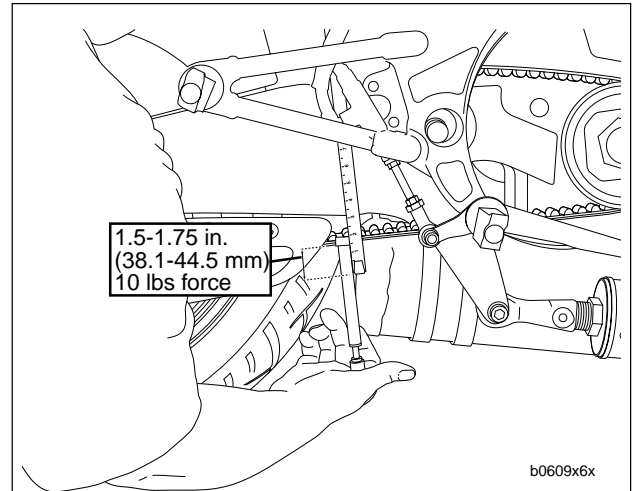
When checking deflection, have:

- 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.

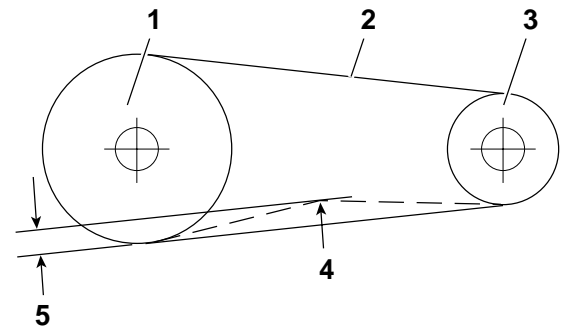
NOTE

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 1-22](#). 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).



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

Figure 1-22. Checking Belt Deflection

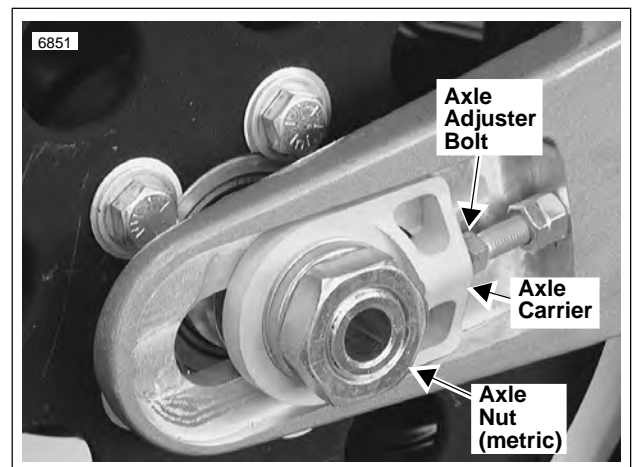


Figure 1-23. Rear Axle Adjuster

ADJUSTMENT

Axle Alignment

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

1. See [Figure 1-24](#). 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 1-23](#). Loosen rear axle nut (metric), if not already loose.

NOTE

See [Figure 1-25](#). 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 1-25](#). 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.

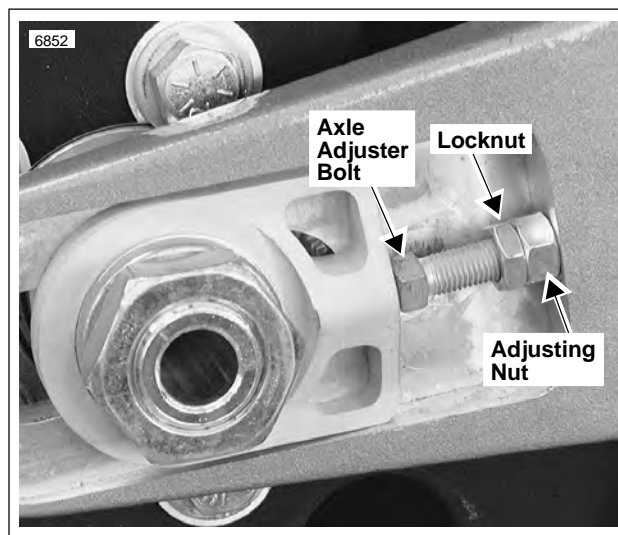


Figure 1-25. Axle Adjuster Bolt, Right Side Shown

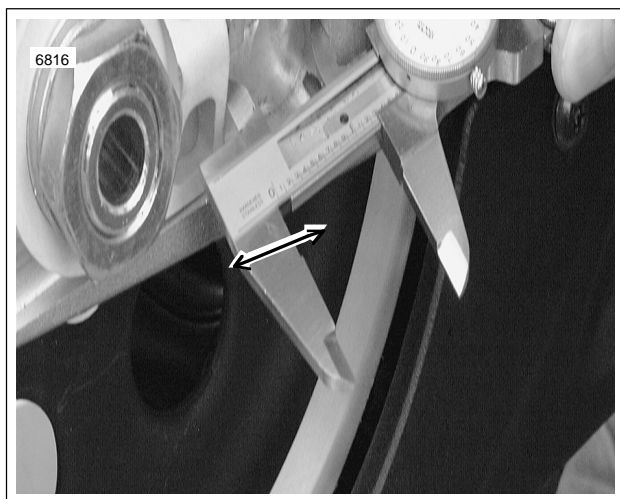


Figure 1-24. Checking Rear Wheel Alignment, Right Side Shown

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 1-26](#). 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.

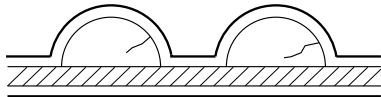
NOTE

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.

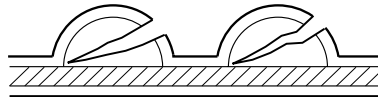
CLEANING

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.

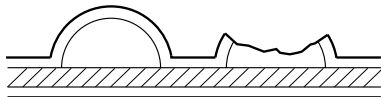
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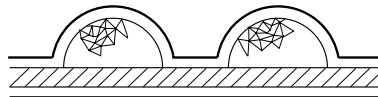
#1 Internal Tooth Crack (Hairline)
OK to Run, but monitor condition



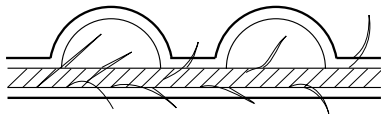
#2 Pac Man Cracks
Replace Belt



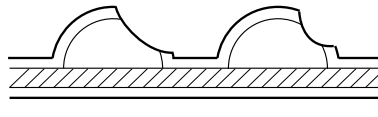
#3 Missing Teeth
Replace Belt



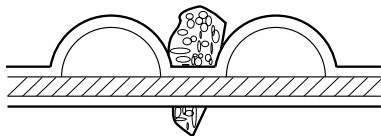
#4 Chipping (Not Serious)
OK to Run, but monitor condition



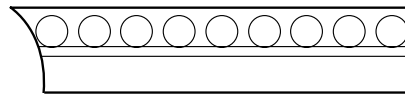
#5 Fuzzy Edge Cord (Not Serious)
OK to Run, but monitor condition



#5 Hook Wear
Replace Belt



#7 Stone Damage
Replace Belt if damage is on edge



#8 Bevel Wear (Outboard Edge Only)
OK to Run, but monitor condition

Figure 1-26. Drive Belt Wear Patterns

INSPECTION

Check primary chain tension:

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

See [Figure 1-27](#). Measure primary chain tension through the inspection cover (3) opening. Adjust primary chains not meeting vertical freeplay specifications.

1. See [Figure 1-27](#). Remove two screws (1) and O-rings (2).
2. Remove inspection cover (3) and O-ring (4) from primary cover (6).
3. See [Figure 1-28](#). 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 1-6](#). If necessary, adjust as described under [ADJUSTMENT](#).

NOTE

The initial primary chain vertical freeplay specification used at the assembly plant is 1/4-1/2 in. (6.4-12.7 mm) with a cold engine. The 1/4 in. (6.4 mm) minimum is only allowed at the absolute tightest point in the drive, as measured with specialized factory equipment. If a chain has less than 1/4 in. (6.4 mm) vertical 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 1-27](#). 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 1-29](#). 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)

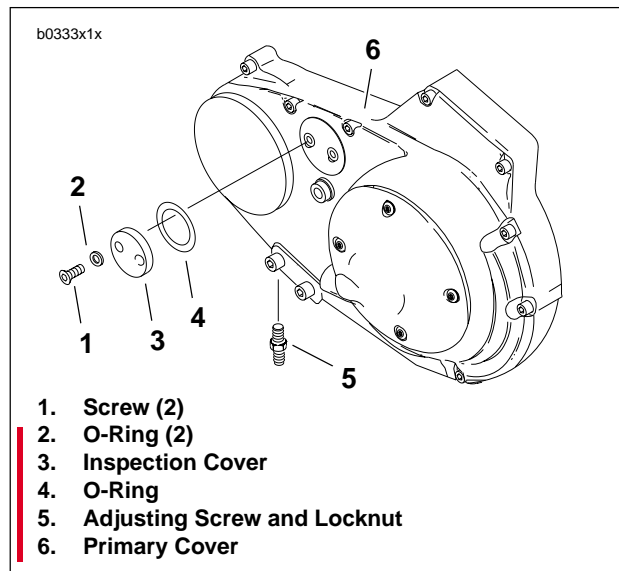


Figure 1-27.

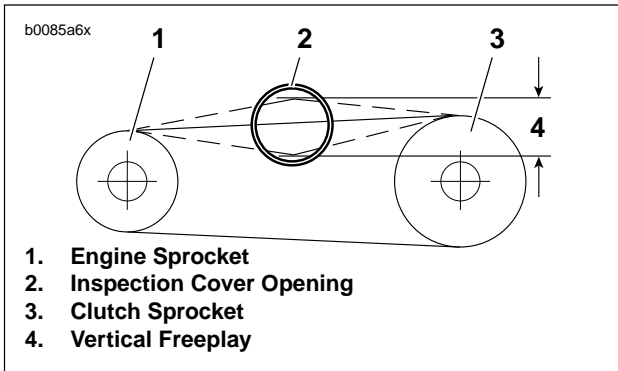


Figure 1-28. Measuring Primary Chain Tension

Table 1-6. Primary Chain Tension

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

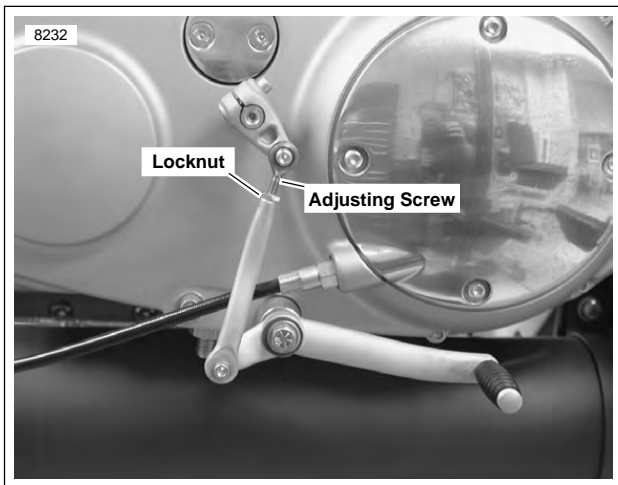


Figure 1-29. Primary Chain Adjustment

GENERAL

Adjust rear preload:

- When the new owner takes delivery of the motorcycle.
- When there is a change in load (adding luggage, etc.).
- Before 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 of the motorcycle will adversely affect both the handling and ride. Correct preload setting will result in motorcycle handling that suits the rider's size and weight.

ADJUSTMENT

Rear Shock

1. See [Figure 1-30](#). Check and adjust rear shock preload.
 - a. With rider seated on motorcycle, the preload is determined by measuring the distance between the centers of the front and rear shock eye and adjusting until the measurement is within specification.
 - b. See below for optimum preload measurement:
 - **S3/S3T Models:** 15.2-15.5 in. (386-394 mm)

NOTE:

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

2. See [Figure 1-31](#). To adjust shock preload, loosen the locknut and turn the preload adjuster at the end of the shock to move the canister towards the front or rear of the motorcycle.
 - a. Move canister towards **rear** of motorcycle to increase preload.
 - b. Move canister towards **front** of motorcycle to decrease preload.
3. See [Figure 1-32](#). When finished, 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.
4. Thread locknut back into place.

NOTE

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

5. Using SHOCK PRELOAD ADJUSTING TOOLS (Part No. B-45110), hold adjusting nut in place with 60 mm ADJUSTING NUT WRENCH and tighten locknut to 65-72 ft-lbs (88-98 Nm) with 52 mm LOCKNUT CROW'S FOOT set at 90 degrees to the torque wrench.
6. Wipe excess grease off of shock absorber.

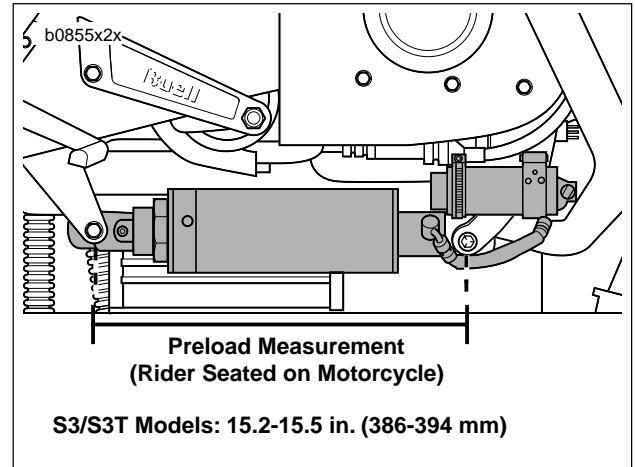


Figure 1-30. Measuring Preload

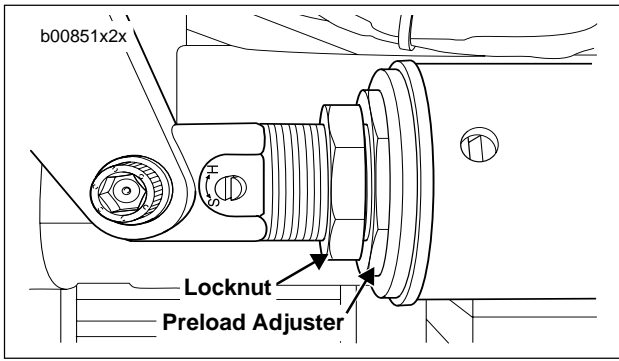


Figure 1-31. Rear Shock Preload Adjustment

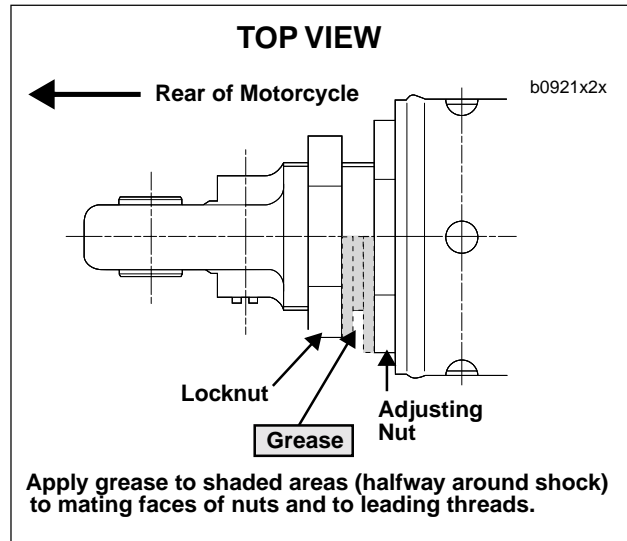


Figure 1-32. Locknut Tightening Procedure

NOTE

When preload is increased, compression damping should be increased. If preload is decreased, compression damping should be decreased.

ADJUSTMENT

Front Fork Adjustment

⚠ 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.

Verify that all suspension settings are adjusted to the factory recommended standards.

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 (dots). This is the factory recommended setting.

Front Fork Rebound Damping

- See Figure 1-33. Factory setting = maximum damping minus 1 turn.

Front Fork Compression Damping

- See Figure 1-33. Factory setting = maximum damping minus 2.5 turns.

Rear Shock Rebound Damping

- See Figure 1-34. Adjust rebound damping using the slotted dial on the remote reservoir at the front of the shock. Factory setting = maximum damping minus 1 turn.

Rear Shock Compression Damping

See Figure 1-34. Adjust compression damping using the slotted dial on the shaft at the end of the shock. Factory setting = maximum damping minus 2.5 turns.

Rear Shock Adjustment

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.

Recommended Damping Settings (S3/S3T)

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

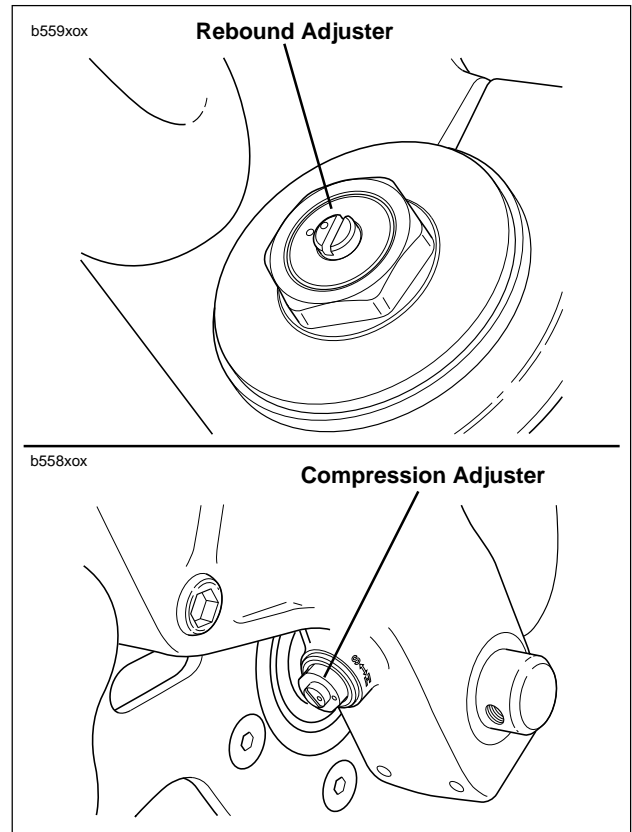


Figure 1-33. Front Forks

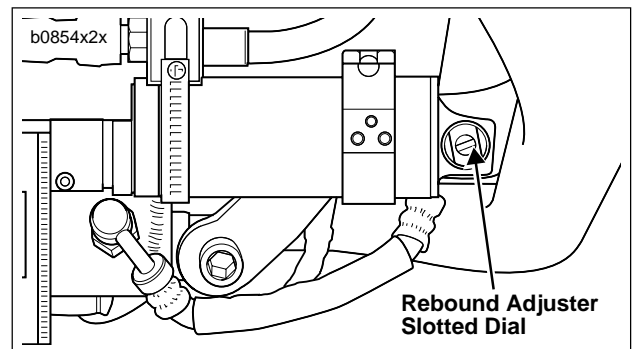


Figure 1-34. Rear Shock Rebound Damping

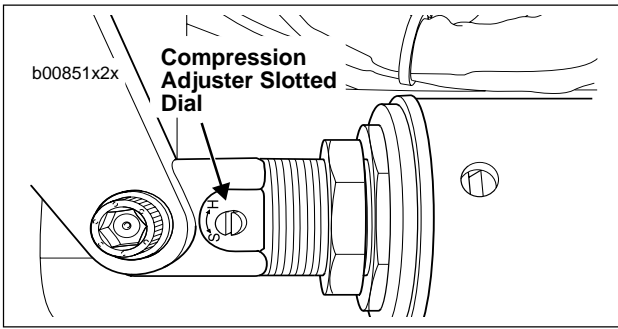


Figure 1-35. Rear Shock Compression Damping

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 1-7](#). 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 1-7](#).
 - 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](#).

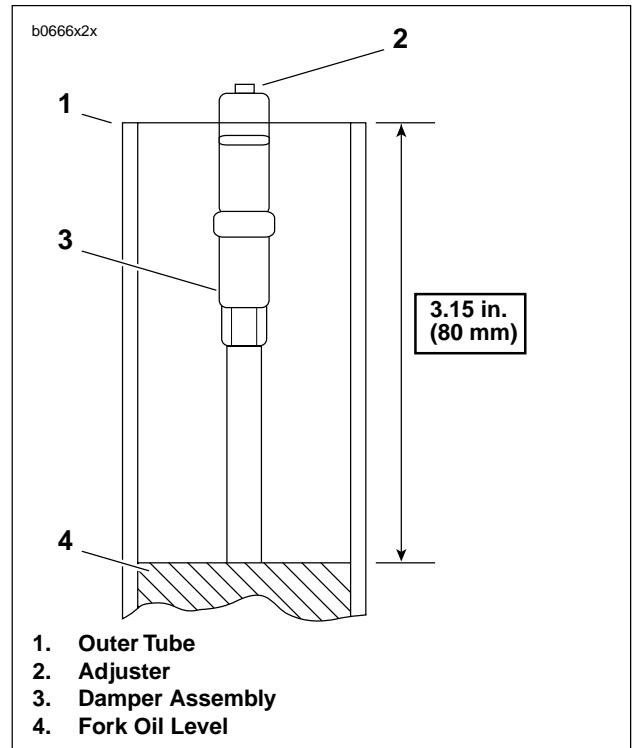


Figure 1-36. Correct Fork Oil Level

Table 1-7. 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

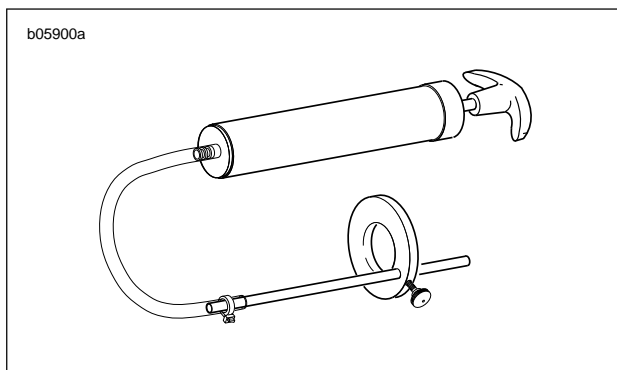


Figure 1-37. Pro Level Oil Gauge

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 LIFT ADAPTER (Part No. B-43426-1)
 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).

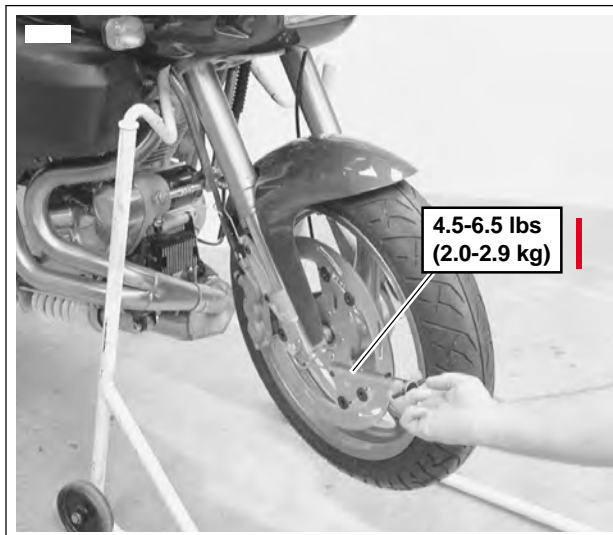


Figure 1-38. Checking Steering Head Bearings (Typical)

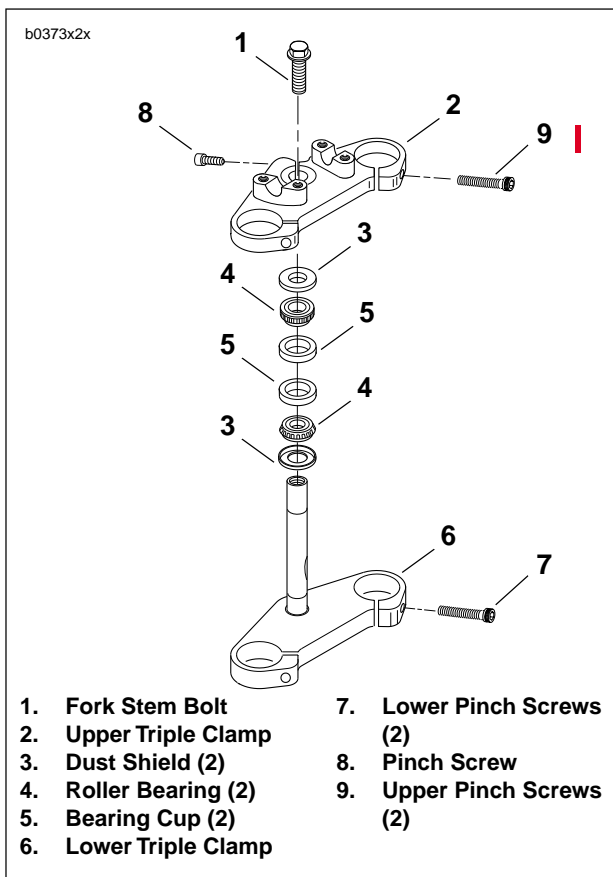


Figure 1-39. Steering Head Assembly

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

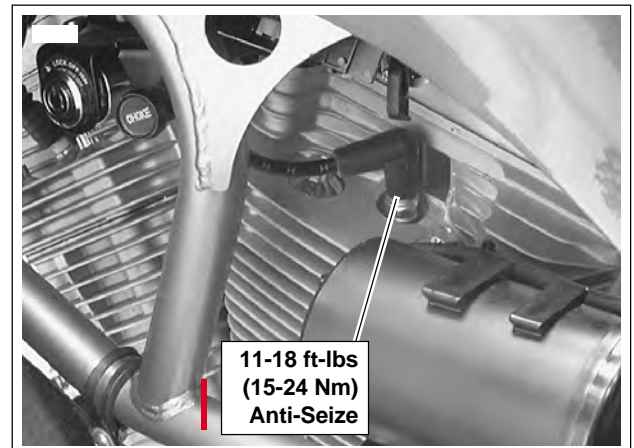


Figure 1-41. Spark Plugs (Typical)

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. On S3T models, 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. See Figure 1-43. Apply LOCTITE THREADLOCKER 243 (blue) to bolts (3). Fasten filter box to backplate with bolts and washers (3).
5. See Figure 1-42. Place cover (3) over backplate assembly. Install both rear screws and nylon washers (1).
6. Install both front screws and nylon washers (2).
7. On S3T models, install bolt and washer to fasten right fairing lower to bracket on swingarm/drive support.

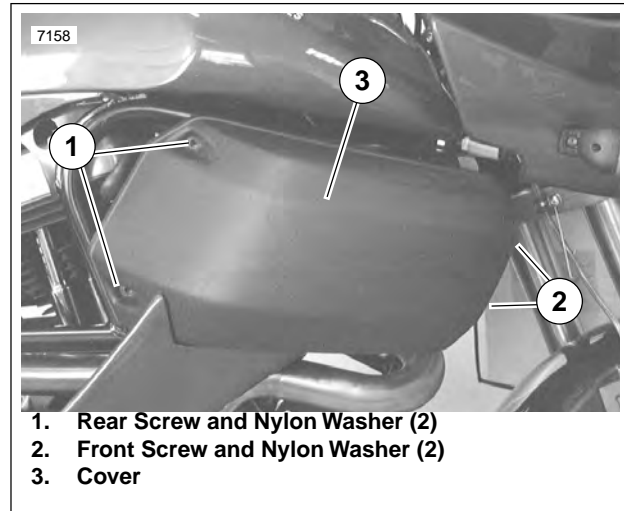


Figure 1-42. Air Cleaner Cover

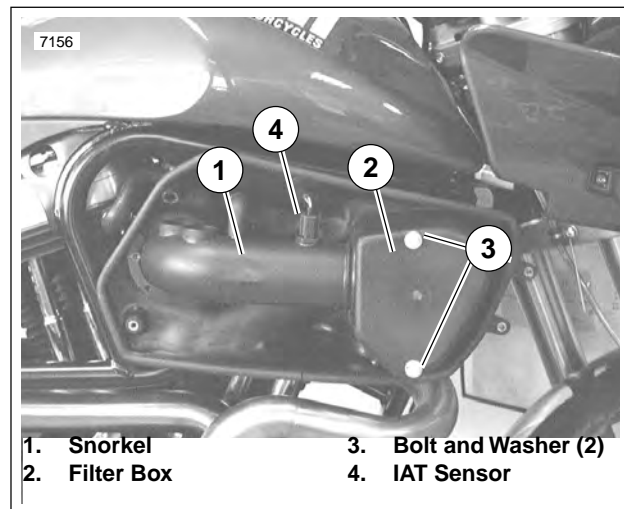


Figure 1-43. Filter Box

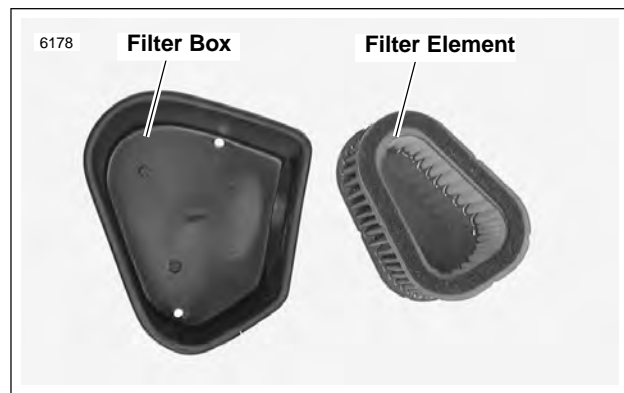


Figure 1-44. Filter Element

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.

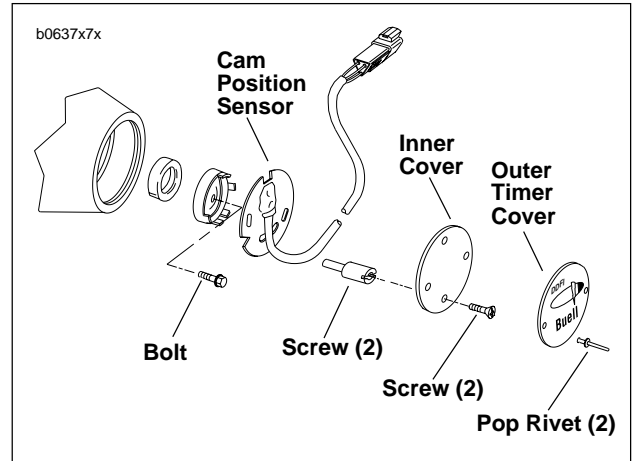


Figure 1-45. Timing Cover

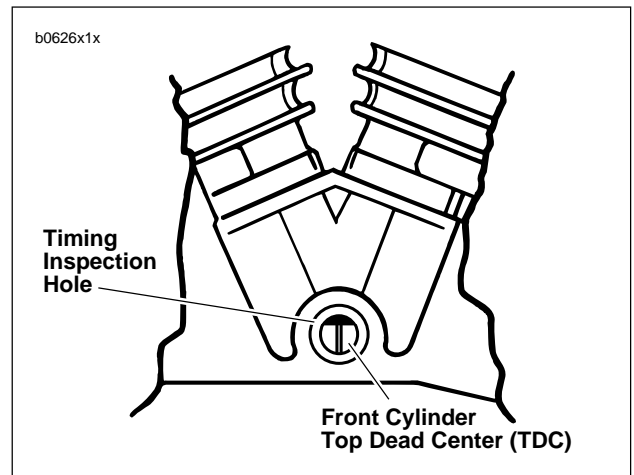


Figure 1-46. Timing Marks

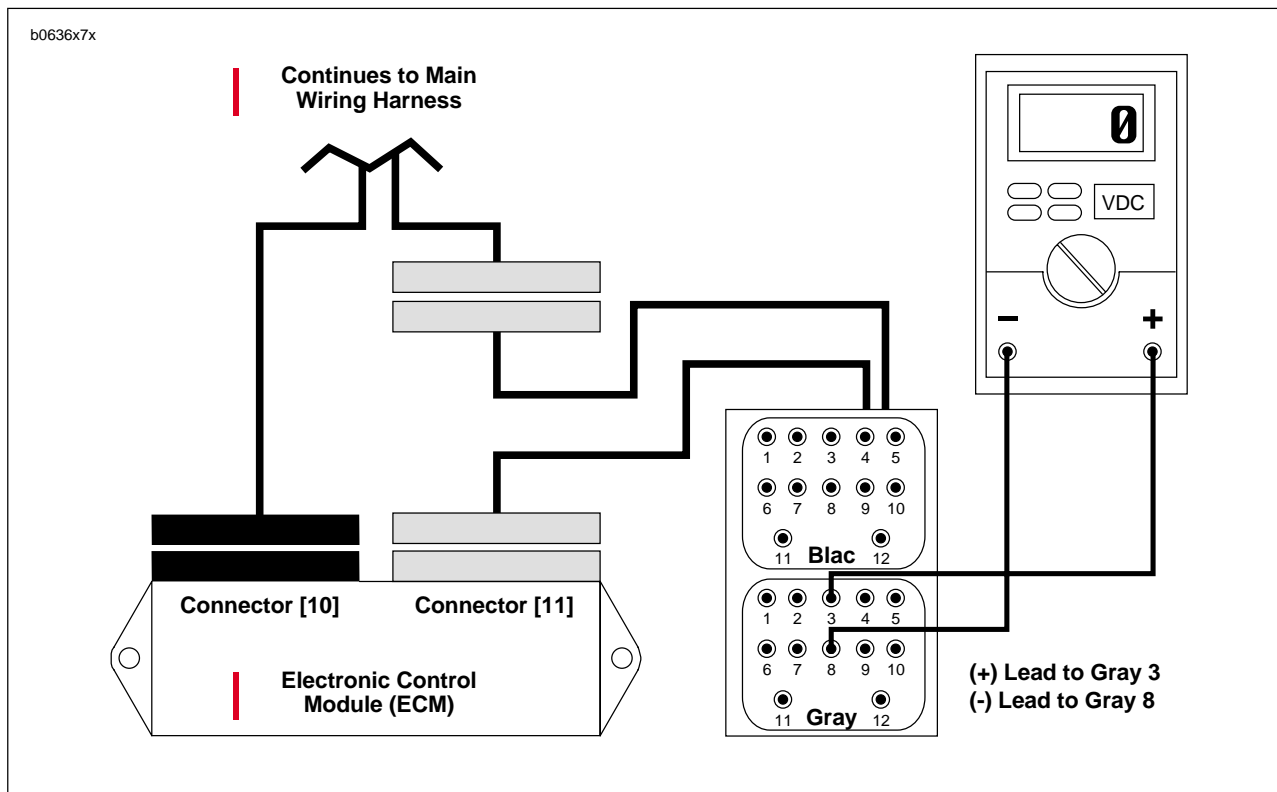
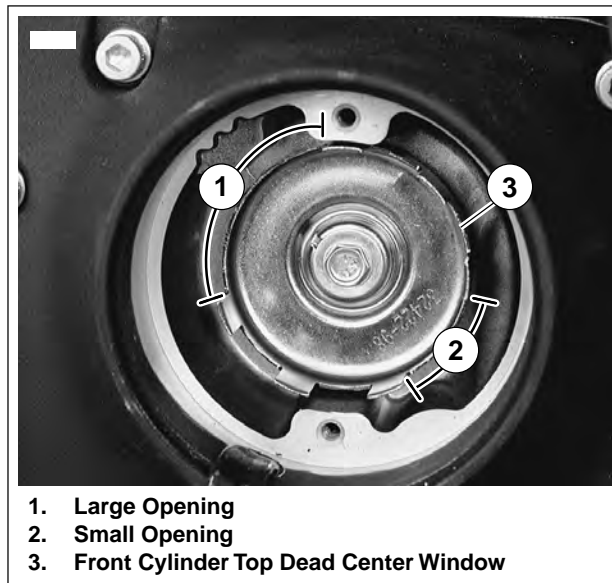


Figure 1-47. Static Timing Connections

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 15-30 in-lbs (2-3 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].

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

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.

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.

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.

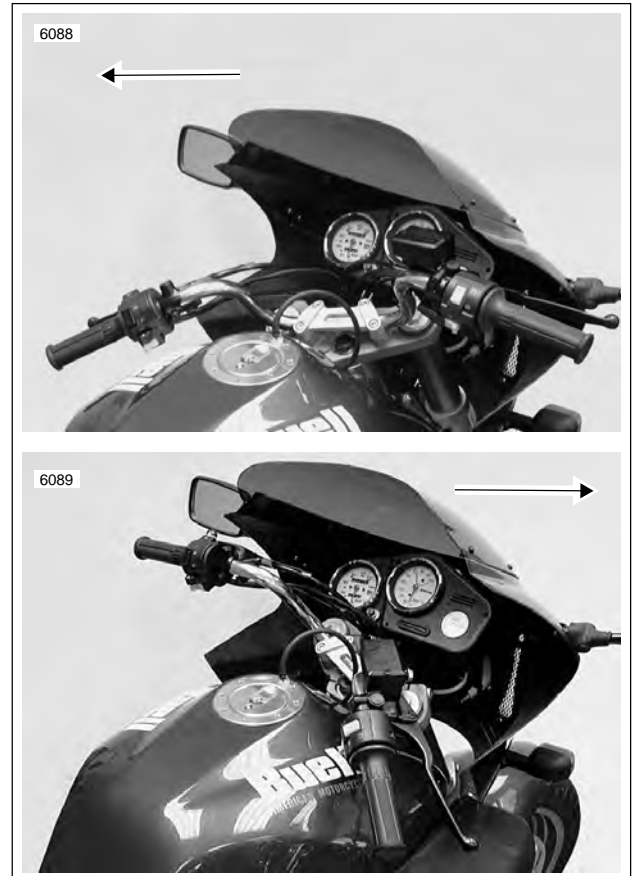
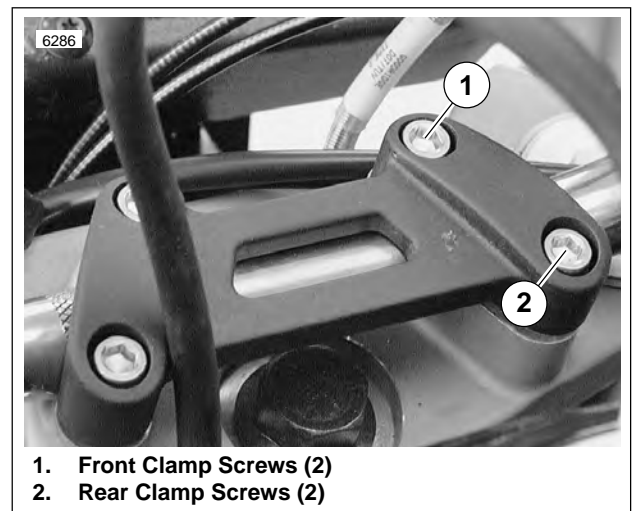


Figure 1-49. Testing Handlebars (Typical)



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:

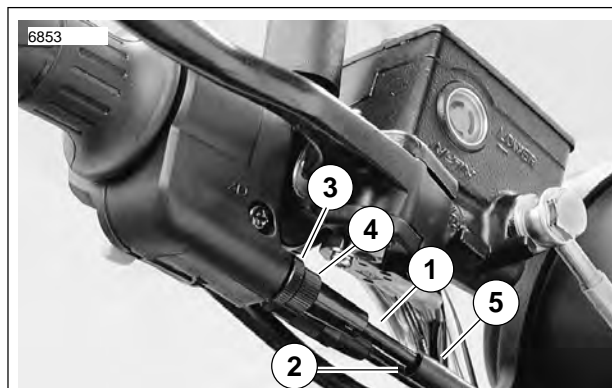
1. Remove air cleaner cover and backplate. See 4.41 AIR CLEANER.
2. See Figure 1-51. Slide rubber boot (5) off each cable adjuster (4).
3. Loosen cable adjuster lock (3) on each cable (1, 2).
4. Turn adjusters in direction which will shorten cable housings to minimum length.
5. Point front wheel straight 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.

IDLE ADJUSTMENT

Check idle adjustment:

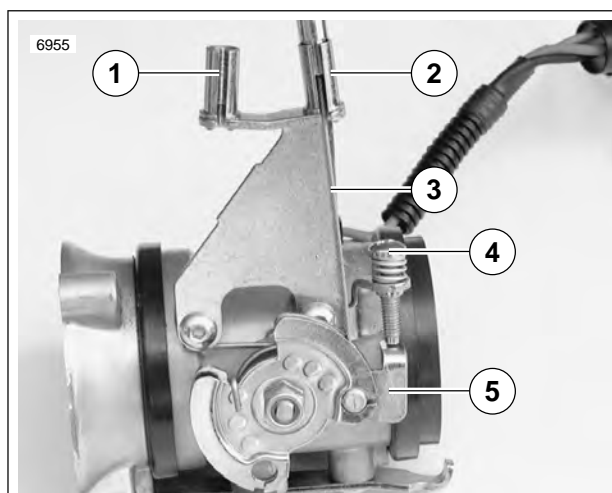
- Before every ride.
- At every scheduled service interval.

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



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)

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 [1.7 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

If headlamp requires adjustment, perform the following:

1. Change height alignment by tilting headlamp up or down to aim it in relation to the horizontal line in [Figure 1-53](#).
 - a. See [Figure 1-54](#). Turn headlamp adjuster clockwise to raise beam.
 - b. Turn headlamp adjuster counterclockwise to lower beam.
2. See [Figure 1-55](#). Change lateral alignment by adjusting the right side headlamp mounting stud with a nut driver.
 - a. Turn stud clockwise to shift headlamp beam to the right.
 - b. Turn stud counterclockwise to shift headlamp beam to the left.

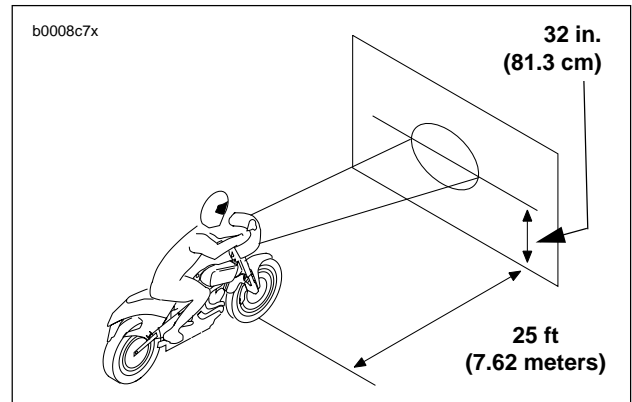


Figure 1-53. Checking Headlamp Alignment

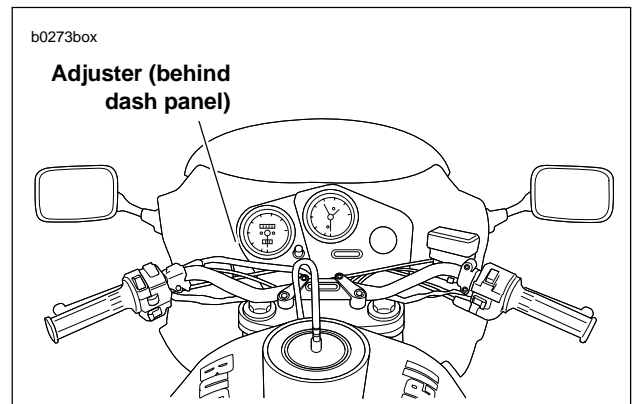


Figure 1-54. Headlamp Height Adjustment (Typical)



Figure 1-55. Headlamp Lateral 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 fly-wheel 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 [1.16 SPARK PLUGS](#).
5. Adjust rear drive belt deflection. See [1.9 DRIVE BELT DEFLECTION](#).
6. Adjust primary chain. See [1.11 PRIMARY CHAIN](#).
7. Check tire inflation. See [1.7 TIRES AND WHEELS](#). If the motorcycle will be stored for an extended period of time, securely support the motorcycle 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 [1.16 SPARK PLUGS](#).
3. Inspect air filter element. Replace if necessary. See [1.17 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 [1.8 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 over-running 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 [1.7 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 [1.15 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.

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SPECIFICATIONS

DIMENSIONS	IN.	CM
Wheel Base	55	139.7
Seat Height	29.5	74.93
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:		
- S3	496	225
- S3T	518	235
GVWR (S3/S3T)	915	415
GAWR - Front (S3/S3T)	330	150
GAWR - Rear (S3/S3T)	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	3-5 ft-lbs	4-7 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	

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

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.

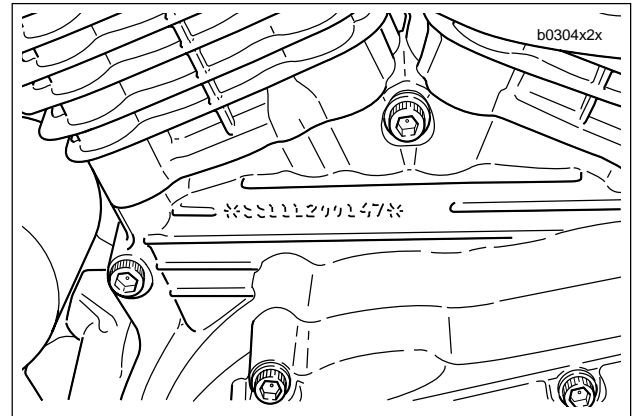


Figure 2-1. Abbreviated V.I.N. Location

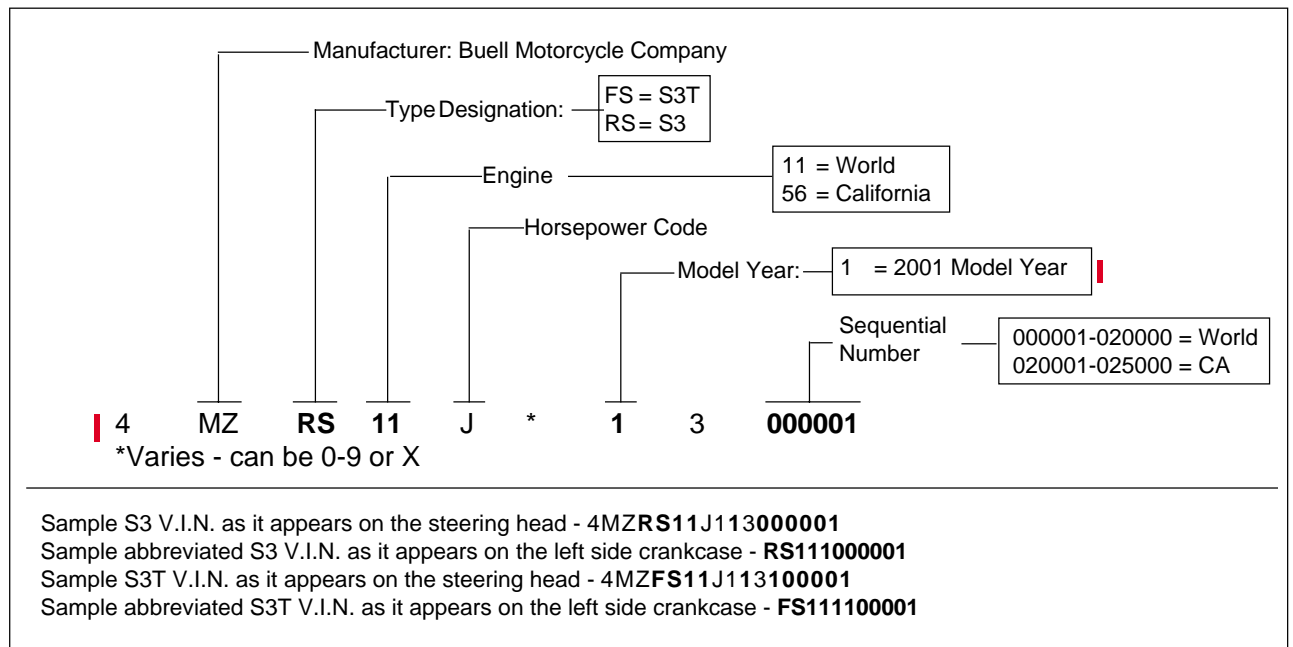


Figure 2-2. 2001 Model Year Thunderbolt S3/S3T V.I.N.s

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 [1.23 TROUBLESHOOTING](#) or [Table 2-3](#).

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

WARNING

Do not inflate 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.

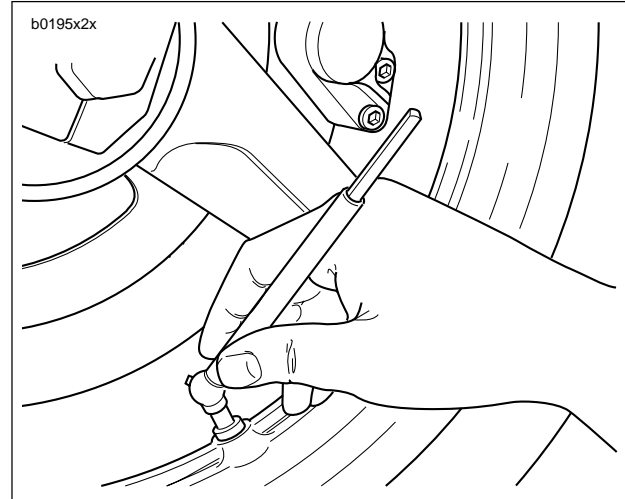


Figure 2-3. Checking Tire Inflation Pressure

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 1.9 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 1.7 TIRES AND WHEELS .
Correct tire and wheel balance.	Static balance may be satisfactory if dynamic balancing facilities are not available. However, dynamic balancing is strongly recommended.
Steering head bearings.	Correct adjustment and replace pitted or worn bearings. See 1.15 STEERING HEAD BEARINGS .
Damper tubes.	Check for leaks. See 2.16 FRONT FORK .
Shock absorbers.	Check damping action and mounts. See 1.13 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 LIFT ADAPTER (1) (Part No. B-42577).
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.

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 1.6 BRAKE PADS AND ROTORS.
 - b. Check rotor surface. Replace if warped or badly scored.

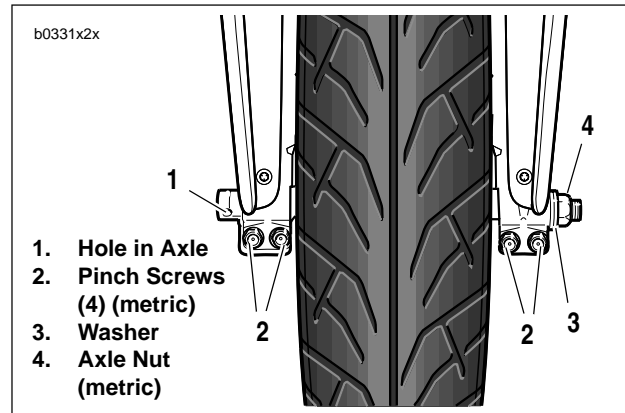


Figure 2-4. Front Wheel Mounting

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).
 - d. Install nut (1). Torque nut (1) to 7.5-10 ft-lbs (10-14 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.

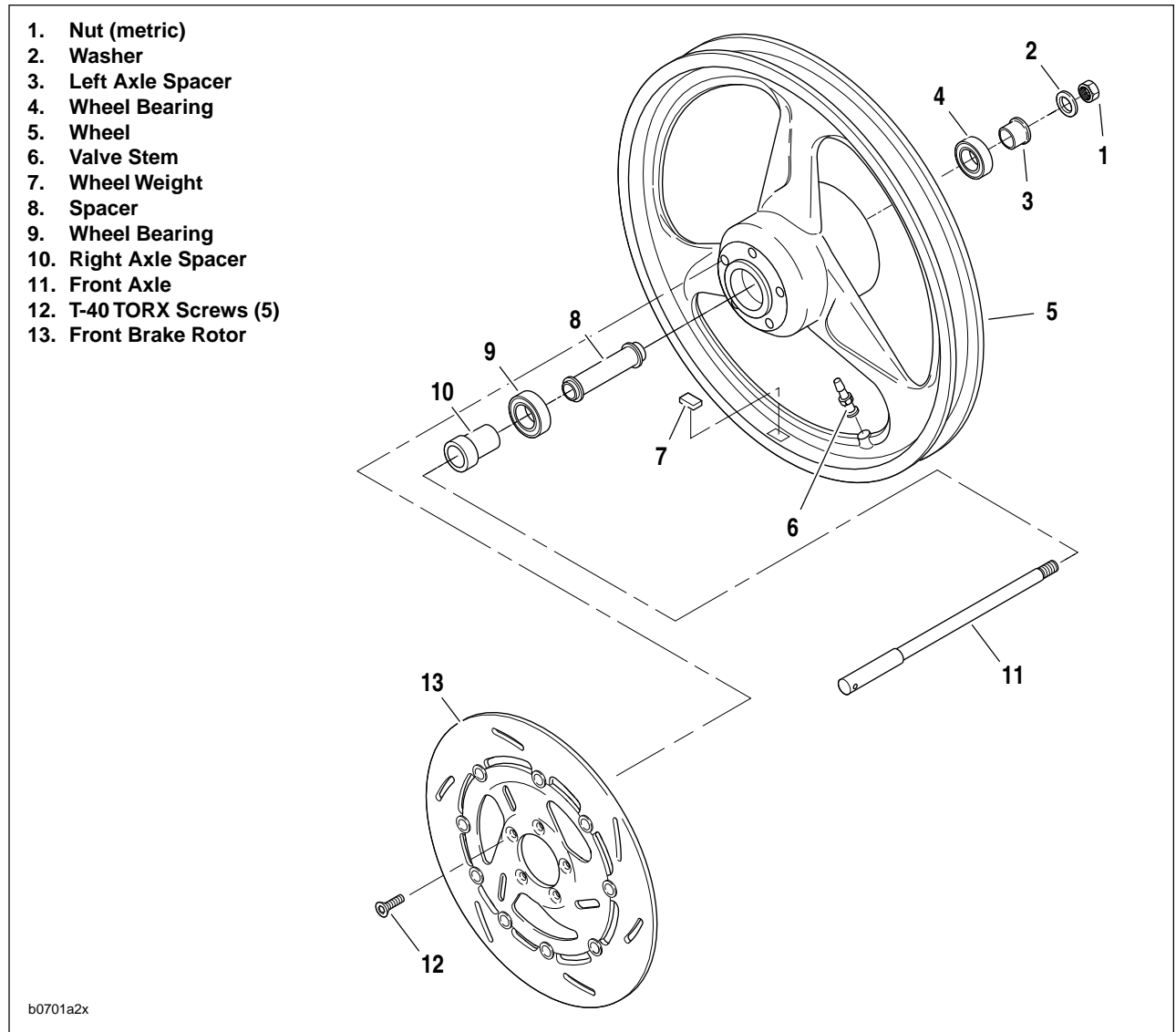


Figure 2-5. Front Wheel

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](#).

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 (S3T).
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 2-10. 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 2-11. 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.

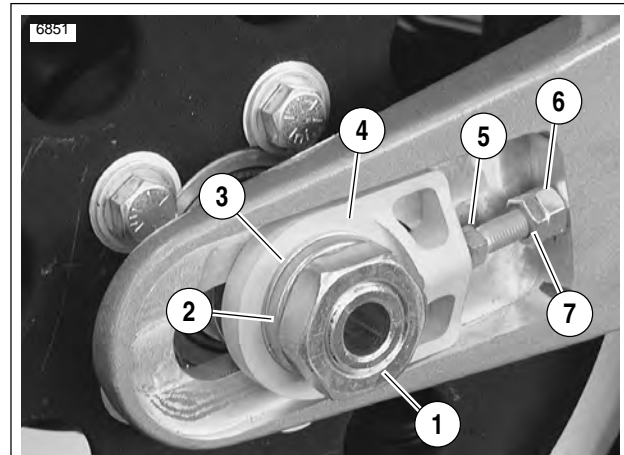
CLEANING AND INSPECTION

1. Thoroughly clean all parts in solvent.

CAUTION

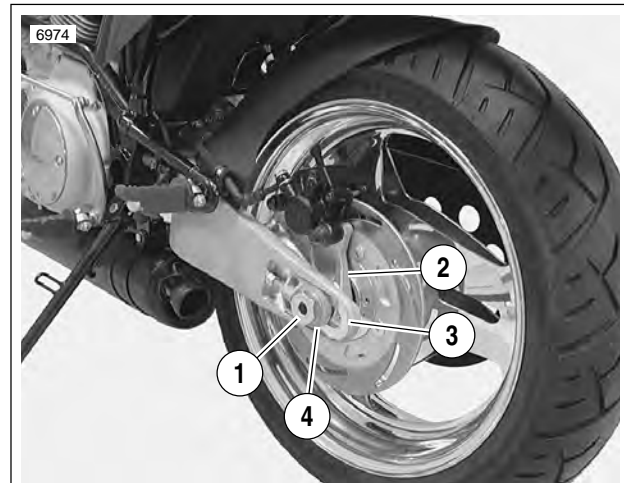
Never use compressed air to “spin-dry” bearings. Very high bearing speeds can damage unlubricated bearings. Spinning bearings with compressed air can also cause a bearing to fly apart, which may result in minor or moderate injury.

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 1.6 BRAKE PADS AND ROTORS.
 - b. Check rotor surface. Replace if warped or badly scored.



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)



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

Figure 2-10. Rear Wheel With Axle Carrier (Left Side)

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](#).

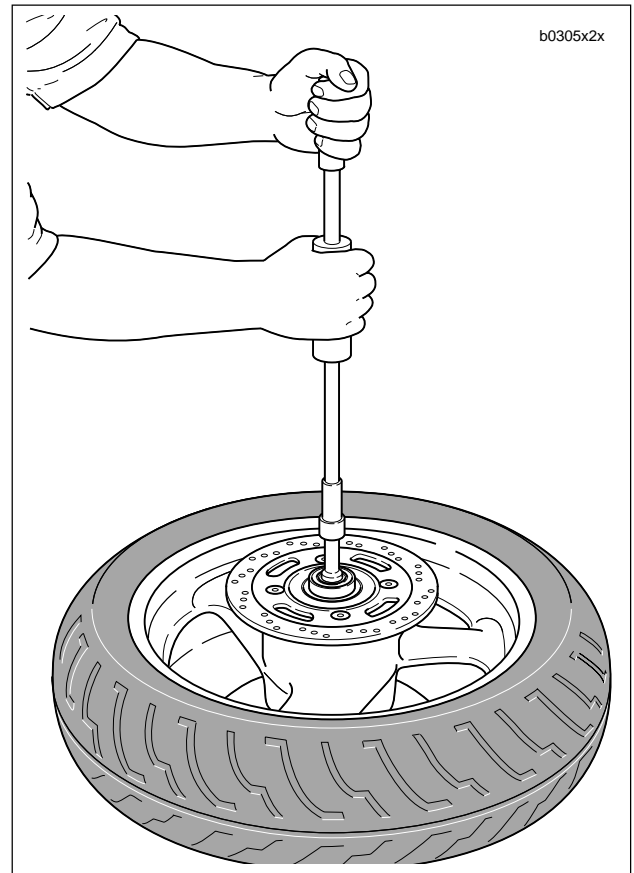


Figure 2-11. Removing Wheel Bearing

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 [1.9 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 \(S3T\)](#).

GENERAL

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

Rim Lateral Runout

1. See Figure 2-12. 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 2-13. 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)

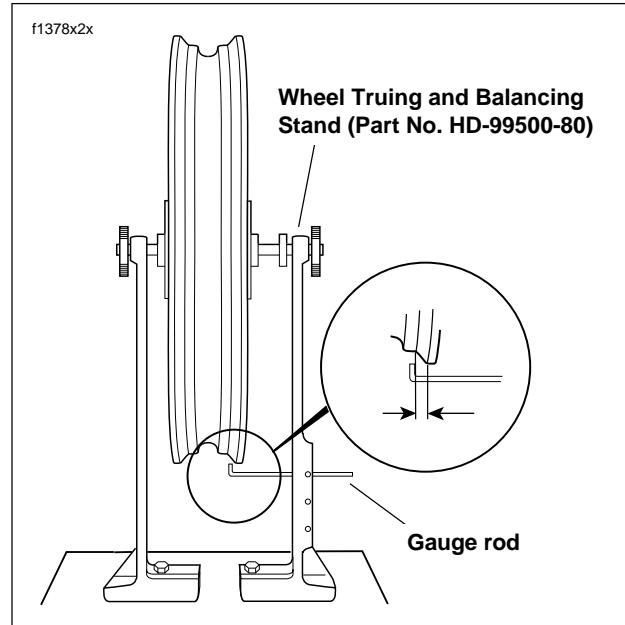


Figure 2-12. Checking Cast Rim Lateral Runout

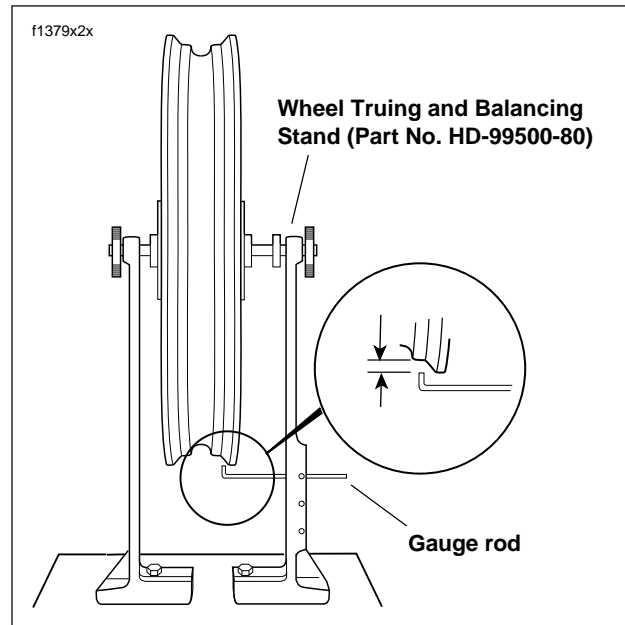


Figure 2-13. Checking Cast Rim Radial Runout

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 2-14](#). 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 2-15](#). 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.

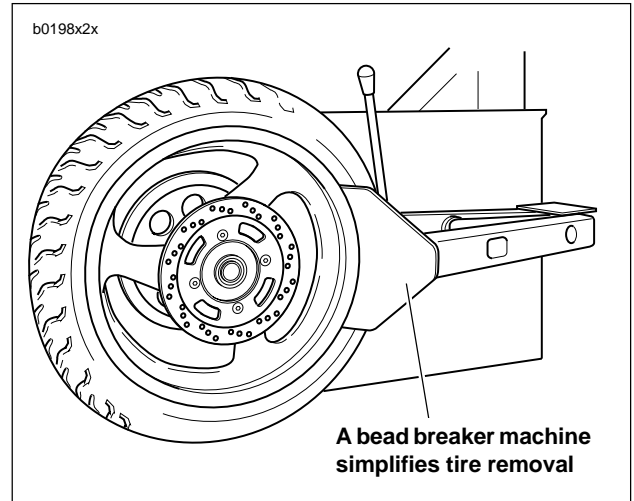


Figure 2-14. Loosening Beads from Rim Flange

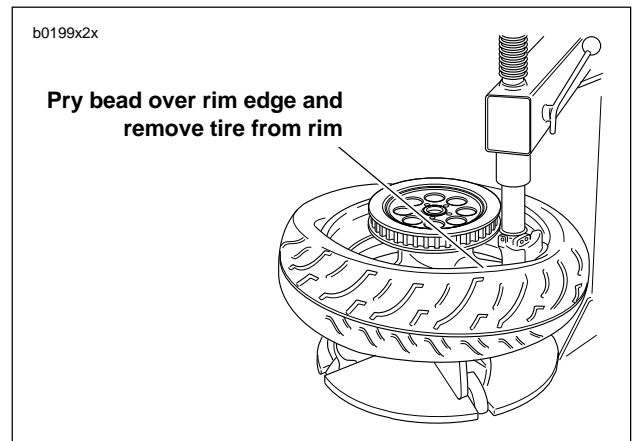


Figure 2-15. Starting Tire Off Rim

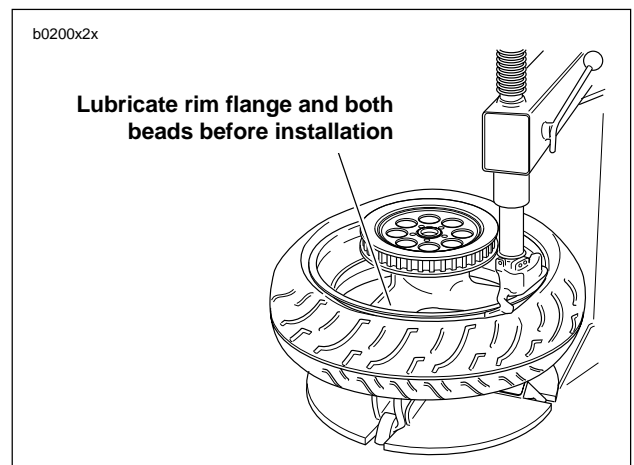


Figure 2-16. Starting Bead on Rim

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 2-16](#). 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 2-17](#). 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.

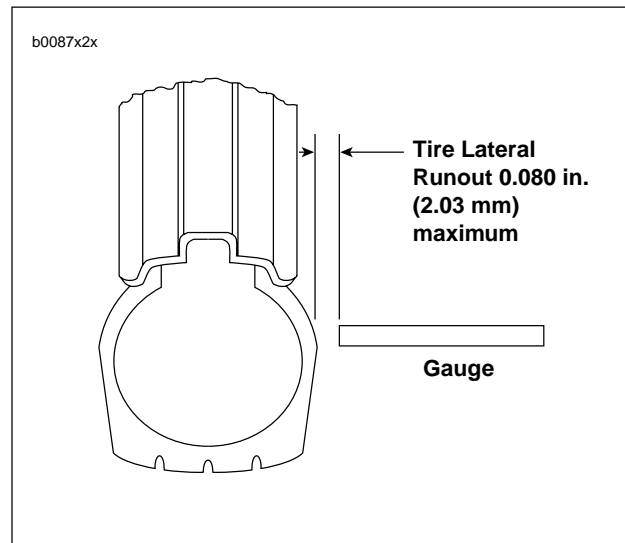


Figure 2-17. Checking Tire Lateral Runout

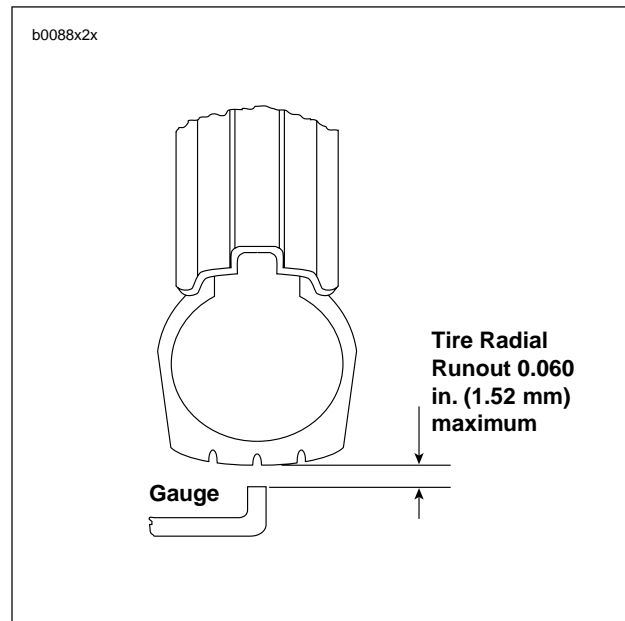


Figure 2-18. Checking Tire Radial Runout

Checking Tire Radial Runout

1. See [Figure 2-18](#). 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 2-19](#). 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.

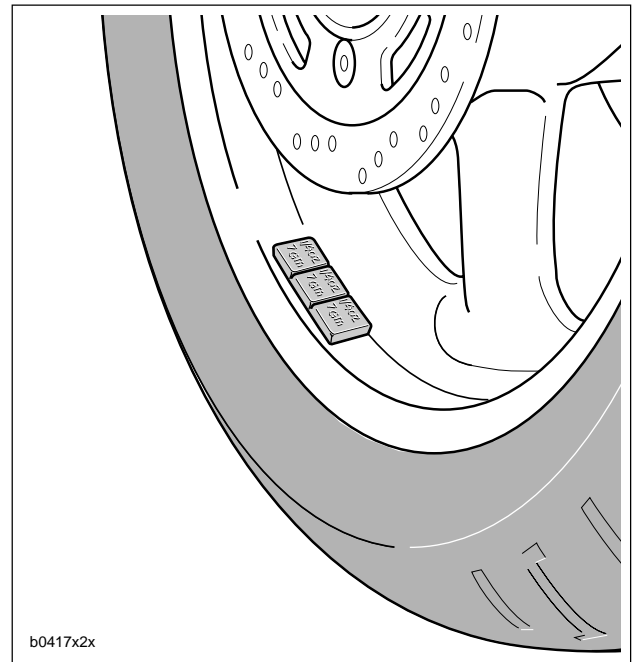


Figure 2-19. Wheel Weights (Typical)

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 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

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.

REMOVAL

NOTE

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

1. See Figure 2-20. 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 2-21. 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.

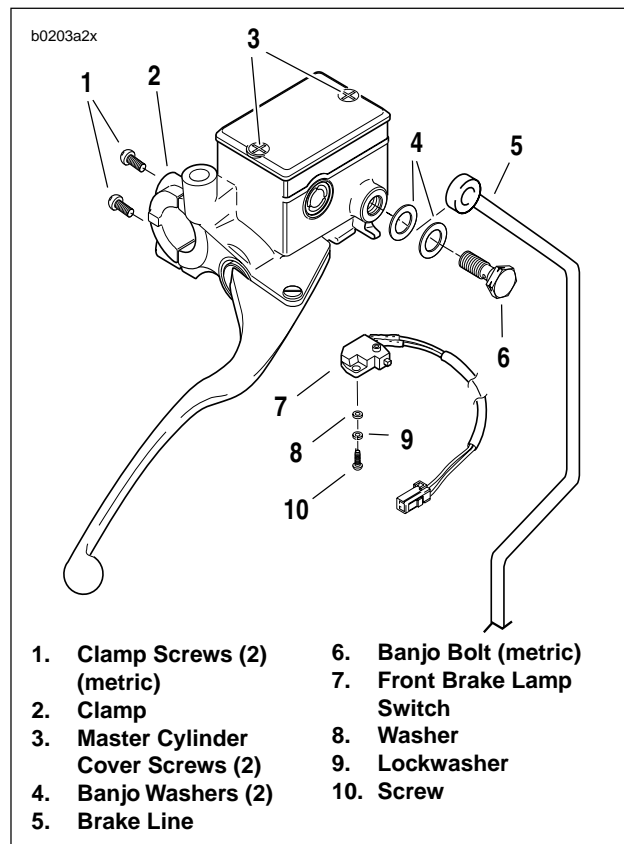
4. Remove two screws (1) (metric) and clamp (2) to detach master cylinder assembly from handlebar.

DISASSEMBLY

1. See Figure 2-22. 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 2-23. Remove screw, lockwasher and washer (1) holding front brake switch (2) to master cylinder assembly. Remove switch.
3. See Figure 2-24. Compress piston (2) and remove boot (1).
4. Depress piston assembly and remove internal snap ring (3). Discard snap ring.
5. See Figure 2-25. Remove piston assembly (1-4) from front master cylinder.



Figure 2-20. Draining Front Brake System (Typical)



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

Figure 2-21. Front Master Cylinder

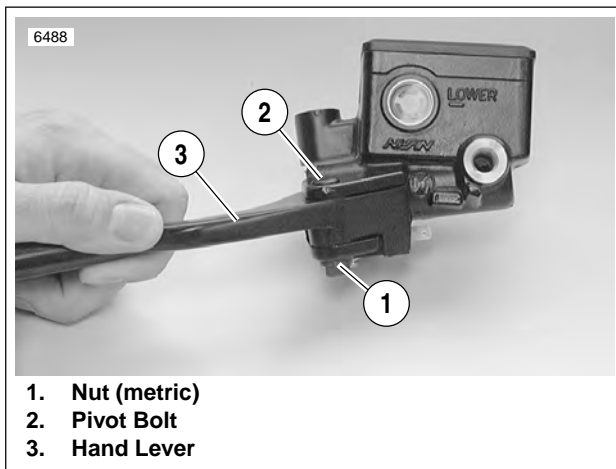


Figure 2-22. Hand Lever

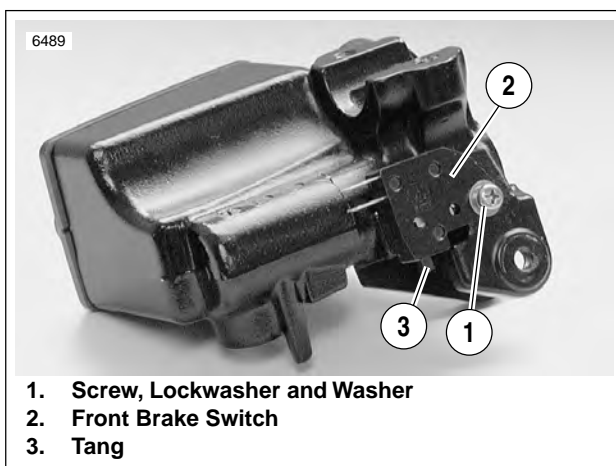


Figure 2-23. Front Brake Switch

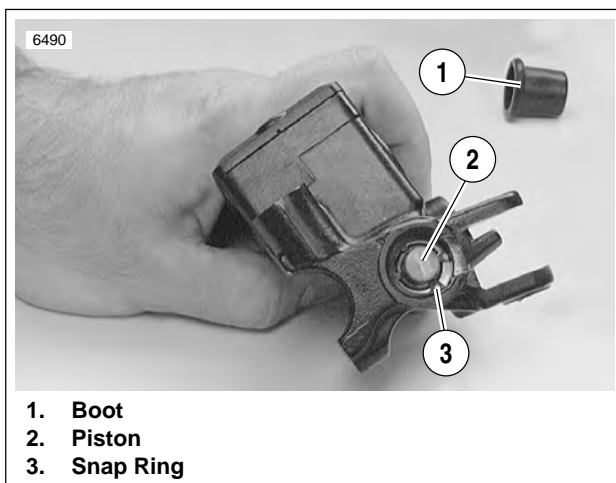


Figure 2-24. Snap Ring

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 2-26](#). 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 2-26](#). 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 2-22](#). 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 2-27](#). 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.

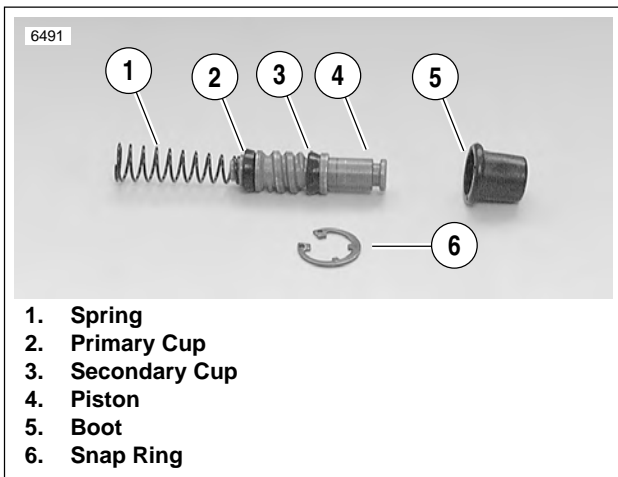


Figure 2-25. Piston Assembly

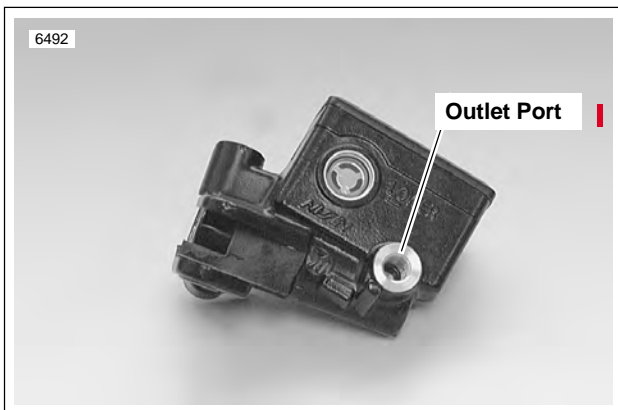


Figure 2-26. Master Cylinder Body

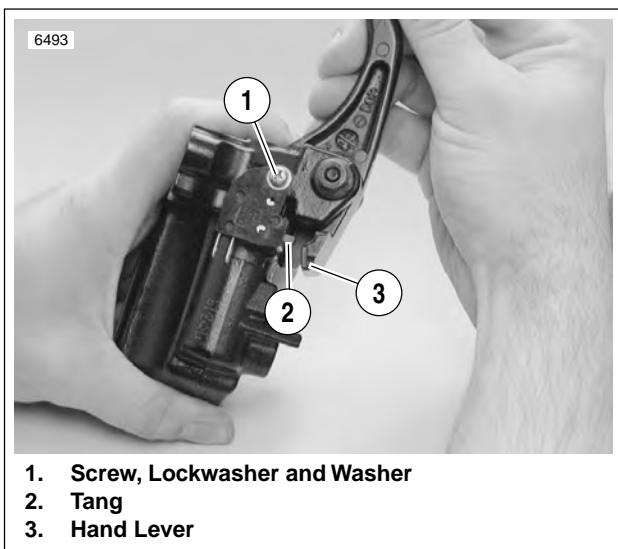


Figure 2-27. Testing Hand Lever

INSTALLATION

1. See [Figure 2-21](#). 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 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.

⚠ 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 2-28](#). 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.

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.

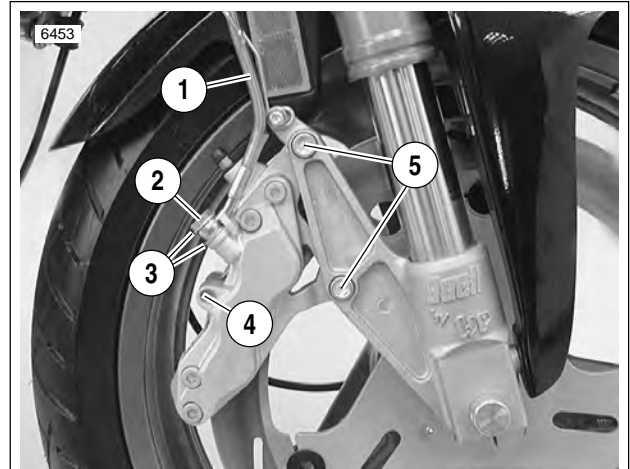
WARNING

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 2-28](#). 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 2-29](#). Remove pad hanger pin (1) (metric).
 - c. Remove pad spring (2).
 - d. Remove brake pads from caliper.
4. See [Figure 2-28](#). 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.

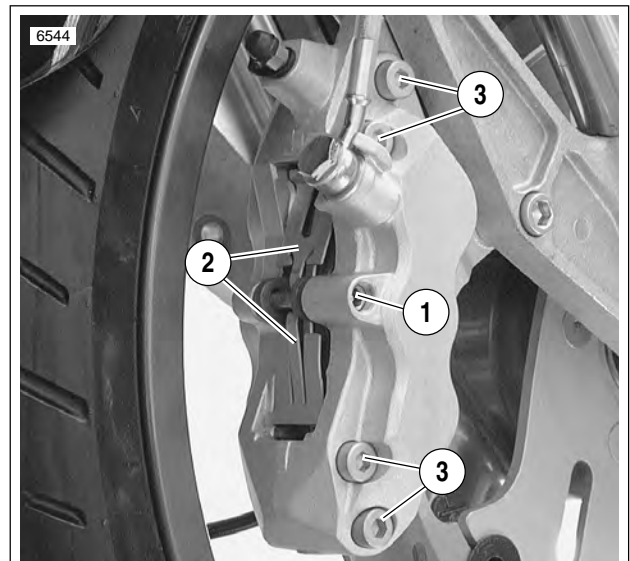
DISASSEMBLY

1. See [Figure 2-29](#). Remove four screws (3) (metric) to separate caliper halves.
2. Remove two O-rings from between caliper halves and discard.
3. See [Figure 2-30](#). Use BRAKE CALIPER PISTON REMOVER (Part No. B-42887) without adaptor to pull the six pistons from caliper bores.
4. See [Figure 2-31](#). 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 2-28. Front Brake Caliper Mounts (Typical)



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

Figure 2-29. 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.

- 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.
- Carefully inspect all components. Replace any parts that appear damaged or worn. Do not hone caliper piston bore.
- Inspect brake rotor.
 - Measure rotor thickness. Replace if minimum thickness is less than 0.18 in. (4.5 mm).
 - 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.

- 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

- See [Figure 2-31](#). Install pistons and O-rings.
 - Apply a light coat of **D.O.T. 4 BRAKE FLUID** to O-rings, pistons and caliper piston bores.
 - Install two **new** O-rings (6) in grooves of each piston bore.
 - Install pistons (5) in each piston bore.
- Install two **new** O-rings (3) between caliper halves.
- Attach caliper halves together with four screws (7) (metric). Tighten to 14.5-18 ft-lbs (20-24 Nm).
- Install a **new** bleeder valve (4) (metric) if necessary. Tighten to 3-5 ft-lbs (4-7 Nm).

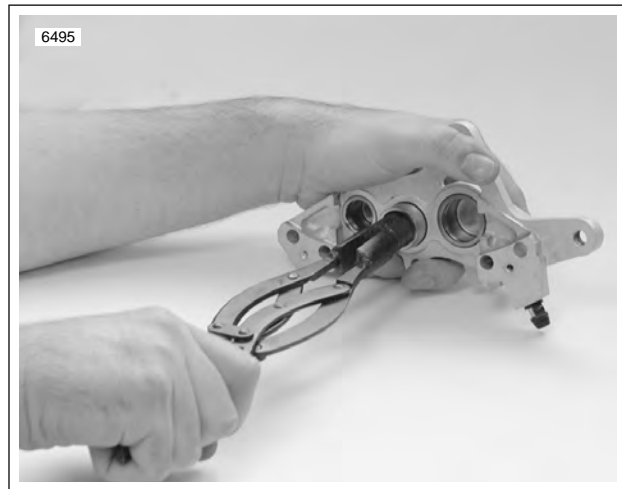
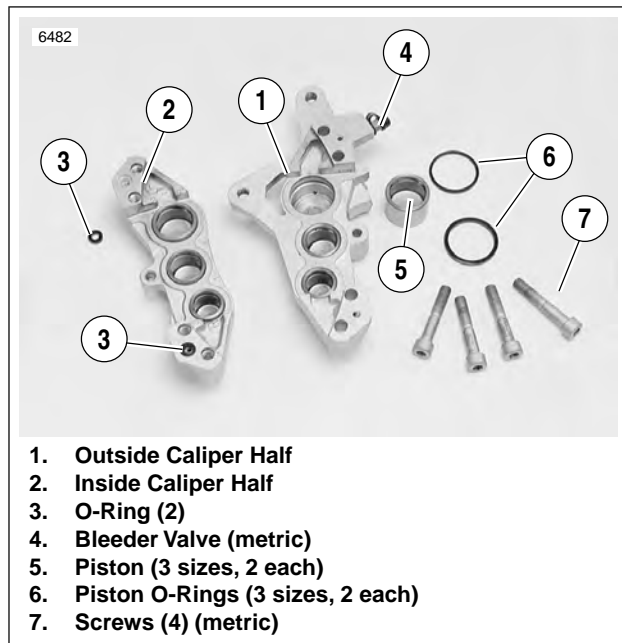


Figure 2-30. Removing Pistons



- Outside Caliper Half
- Inside Caliper Half
- O-Ring (2)
- Bleeder Valve (metric)
- Piston (3 sizes, 2 each)
- Piston O-Rings (3 sizes, 2 each)
- Screws (4) (metric)

Figure 2-31. Caliper O-rings and Pistons

INSTALLATION

- Fit front brake caliper on rotor.
 - Check rotor attachment to carrier. Inspect all six brake drive pins for missing hardware.
 - Make sure rotor is centered on carrier. Use two clamps on rotor and carrier to reduce freeplay and center rotor.
 - Slide caliper over front brake rotor without brake pads installed.
- See [Figure 2-28](#). Apply **LOCTITE THREADLOCKER 272** (red) to both caliper mounting screws (5). Install and tighten to 22-25 ft-lbs (30-34 Nm).
- Install brake pads.
 - See [Figure 2-32](#). Insert brake pads from behind.
 - See [Figure 2-29](#). 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 2-28](#). Install pin plug (4). Tighten to 1.5-2.1 ft-lbs (2-3 Nm).

⚠ 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.

⚠ 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 2-33](#). 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.

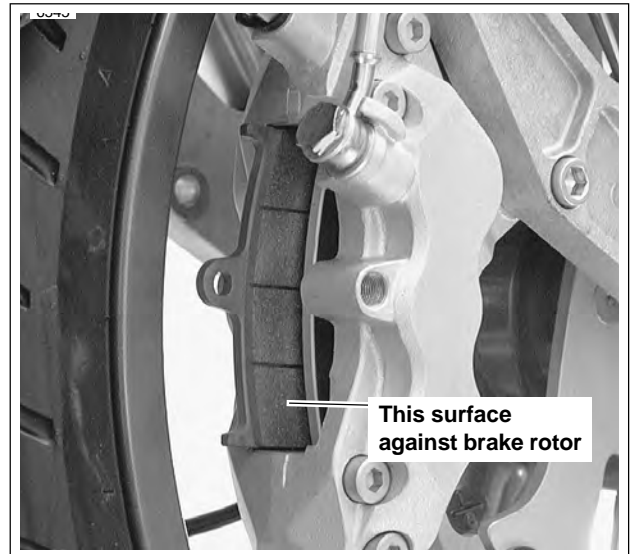


Figure 2-32. Installing Brake Pads

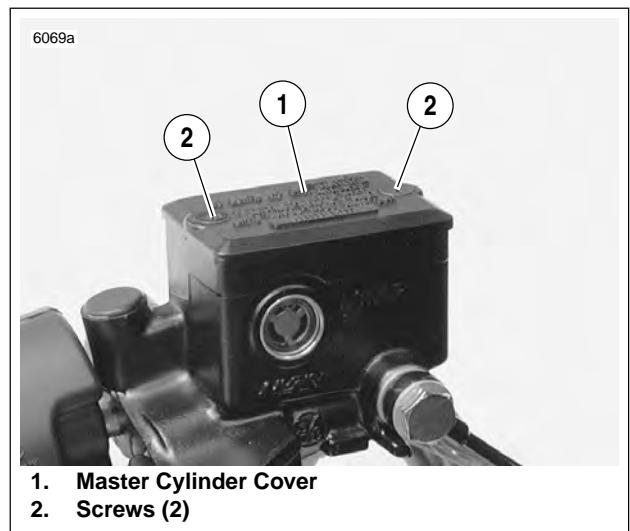


Figure 2-33. Master Cylinder Cover

REMOVAL

1. Drain and discard brake fluid. See Step 1 under 2.11 FRONT BRAKE CALIPER.
2. See Figure 2-34. 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 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

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

1. See Figure 2-34. 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.

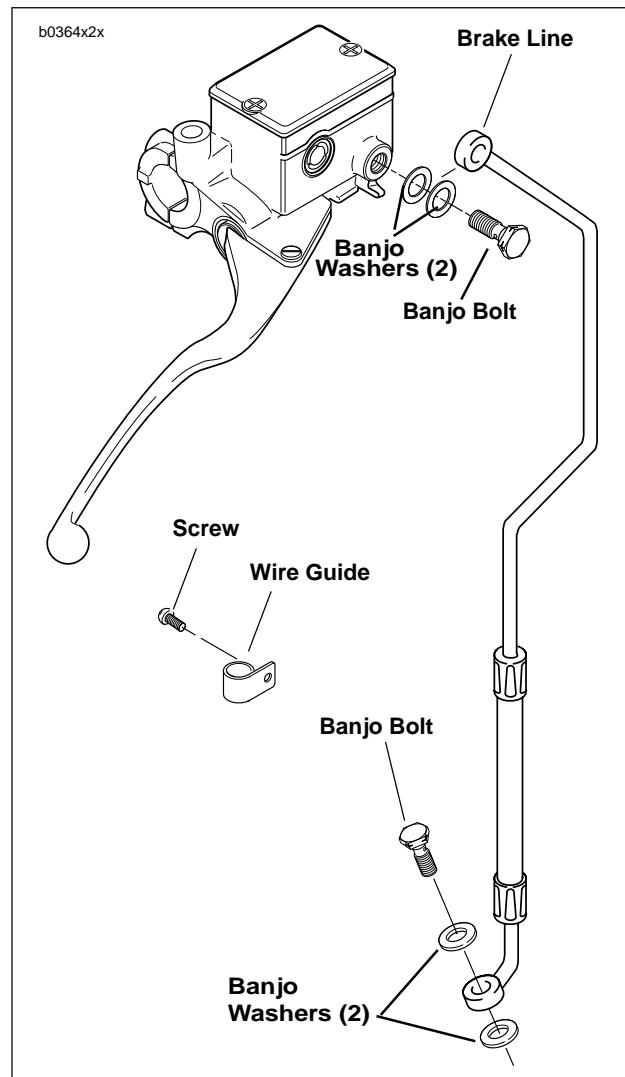


Figure 2-34. Front Brake Line

REMOVAL

1. See Figure 2-35. 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.

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 2-36. 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 2-37. 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 2-38. Remove two screws (2) (metric) to detach master cylinder (3) from frame.
5. See Figure 2-39. 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.

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 2-40. 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.

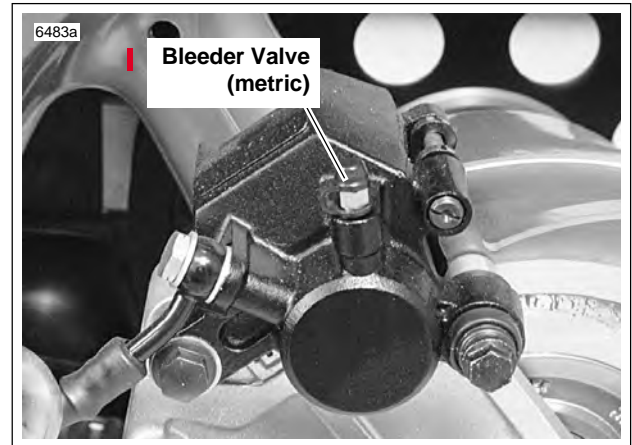


Figure 2-35. Rear Caliper Bleeder Valve (Metric)

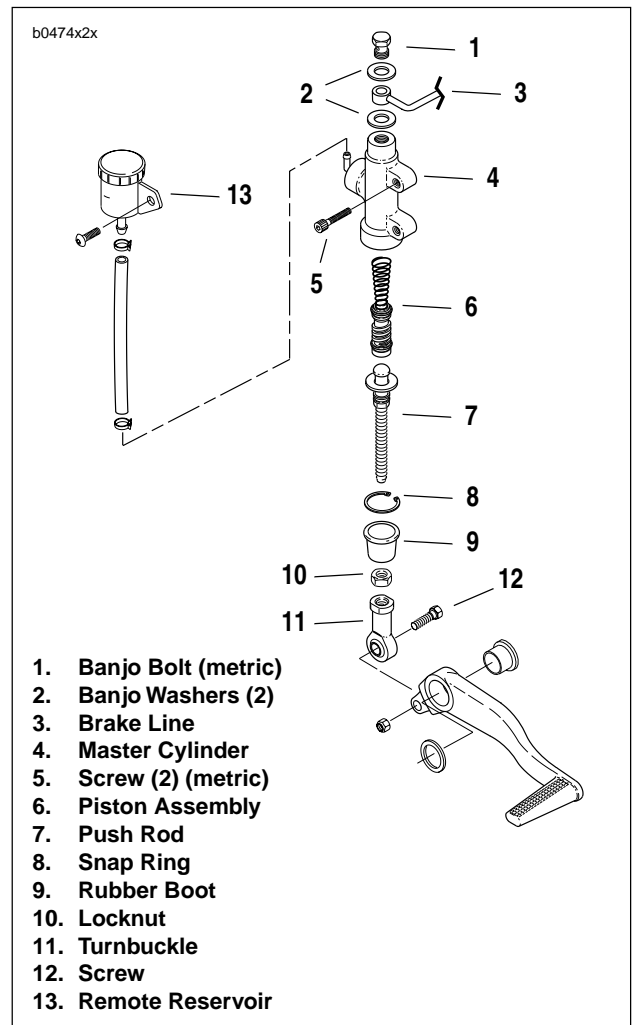


Figure 2-36. Rear Master Cylinder Assembly

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.

ASSEMBLY

1. See [Figure 2-40](#). 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 2-39](#). 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 2-38](#). Attach master cylinder (3) to frame using two screws (2) (metric). Tighten to 8-10 **ft-lbs** (11-14 Nm).

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.

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 2-36](#). 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).

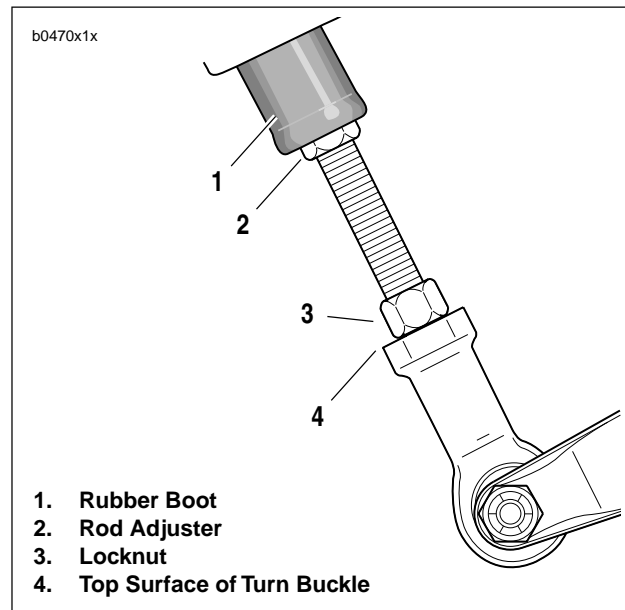


Figure 2-37. Brake Push Rod

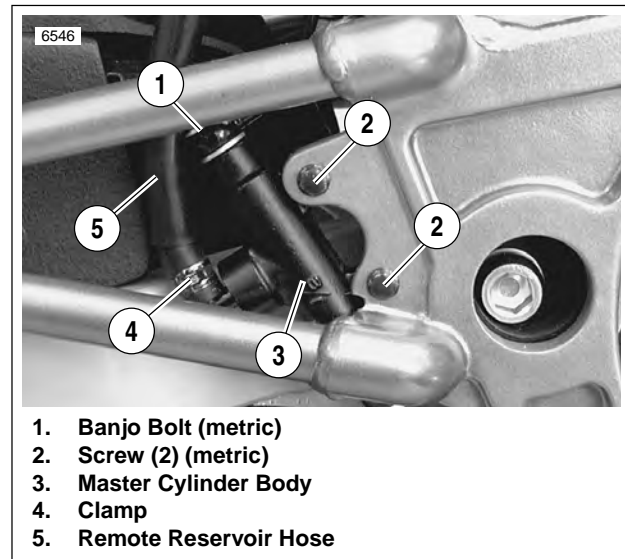


Figure 2-38. Master Cylinder Mounting

4. See [Figure 2-37](#). 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 2-39](#). 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.

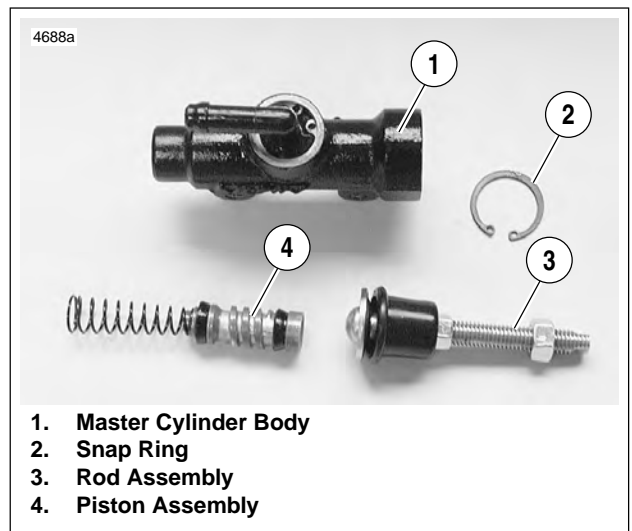
WARNING

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 2-39. Remote Reservoir



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

Figure 2-40. 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 2-41. 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 2-42. Remove clip (1) from rear caliper mount (2) if necessary.

DISASSEMBLY

1. See Figure 2-41. Remove pin plug and pad hanger (5) (metric) to free brake pads.
2. See Figure 2-43. Remove clip (1) from caliper body.
3. See Figure 2-44. 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.

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.

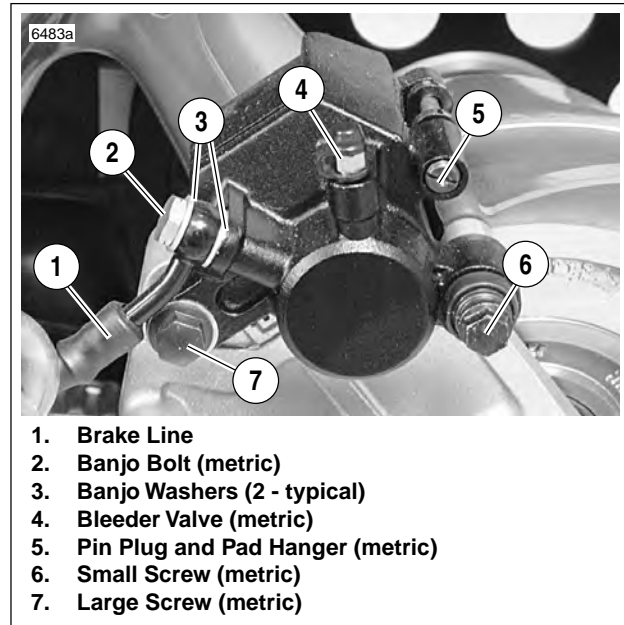


Figure 2-41. Rear Brake Caliper (Typical)

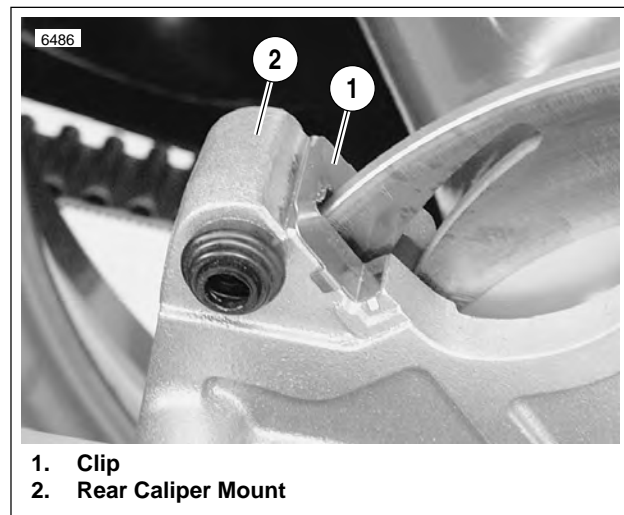


Figure 2-42. Caliper Mount Clip

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.

- 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

- See [Figure 2-43](#). 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.

- See [Figure 2-44](#). Install pistons and O-rings.
 - Apply a light coat of **D.O.T. 4 BRAKE FLUID** to O-rings, piston and caliper piston bore.
 - Place **two** new O-rings inside grooves of piston bore.
 - Install piston (3) inside caliper body.
- See [Figure 2-43](#). Install brake pads (3) using pad hanger and pin plug (1).
 - Install pad hanger pin (metric). Tighten to 11-14.5 ft-lbs (15-20 Nm).
 - Install pin plug. Tighten to 1.5-2.1 ft-lbs (2-3 Nm).
- Install a **new** bleeder valve (metric) if necessary. Tighten to 3-5 ft-lbs (4-7 Nm).

INSTALLATION

- See [Figure 2-42](#). Install caliper mount clip (1) if removed.
- See [Figure 2-41](#). Install caliper assembly on caliper mount. Brake pad surfaces must face rear brake rotor.
 - Apply **LOCTITE THREADLOCKER 272** (red) to both caliper mounting screws (6, 7) (metric).
 - Install large caliper screw (7) (metric). Tighten to 18-22 ft-lbs (24-30 Nm)
 - Install small caliper screw (6) (metric). Tighten to 14.5-18 ft-lbs (20-24 Nm).

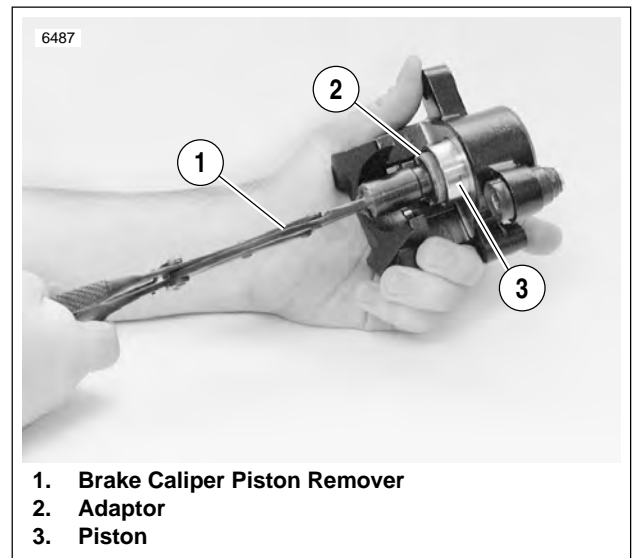
⚠ WARNING

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.

⚠ WARNING

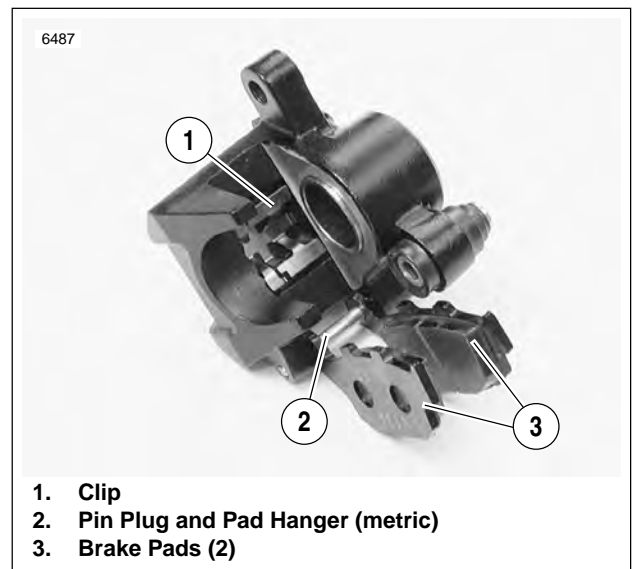
Any leak in brake system will adversely affect brake operation. To avoid leakage, verify that gaskets, banjo bolt, hydraulic brake line and caliper bore are completely clean. Failure to comply could result in death or serious injury.

- 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).



- Brake Caliper Piston Remover
- Adaptor
- Piston

Figure 2-44. Removing Rear Brake Caliper Piston



- Clip
- Pin Plug and Pad Hanger (metric)
- Brake Pads (2)

Figure 2-43. Brake Pads

- Depress rear brake pedal several times to set brake pads to proper operating position within caliper. Bleed brake system. See [1.5 BRAKES](#).
- 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.

- 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.

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.

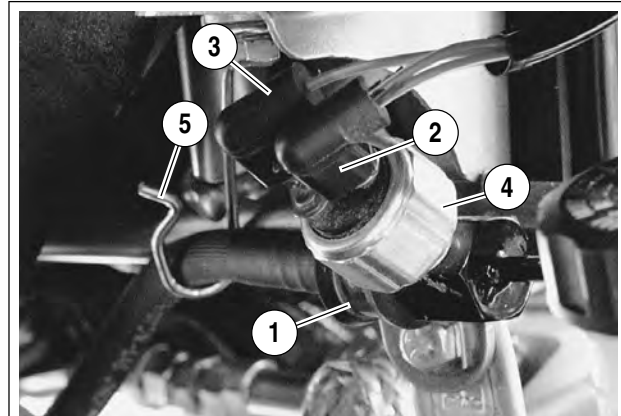
2. See Figure 2-45. Remove banjo bolt (2) (metric) and two banjo washers (3) to disconnect brake line (1) from rear brake caliper. Discard banjo washers.
3. Remove banjo bolt and two banjo washers to disconnect brake line from rear master cylinder. Discard banjo washers.
4. Remove screw and clamp to detach brake line clamp from frame.
5. See Figure 2-47. 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

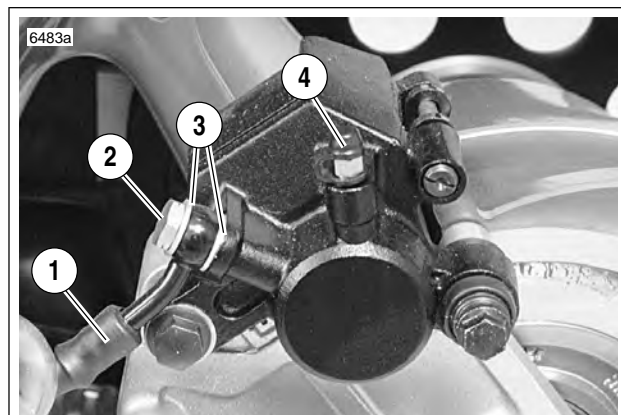
If rear brake line must be replaced, use only the brake line with the olive drab coating on the metal portion of the line (See Parts Catalog for Part No.) with DOT 4 brake systems. The previous black metal brake line is NOT compatible with DOT 4 brake fluid. Failure to comply may adversely affect braking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

1. See Figure 2-48. 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 2-45. 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 2-47. 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 2-45. Rear Brake Line and Switch



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

Figure 2-46. Rear Brake Caliper Banjo Bolt (Typical)

⚠ 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.

⚠ 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 2-46. 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 2-45. 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.

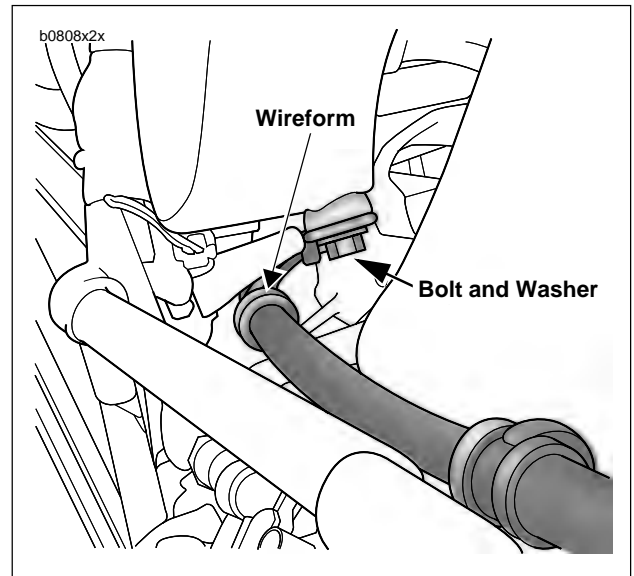


Figure 2-47. Rear Brake Line Wireform

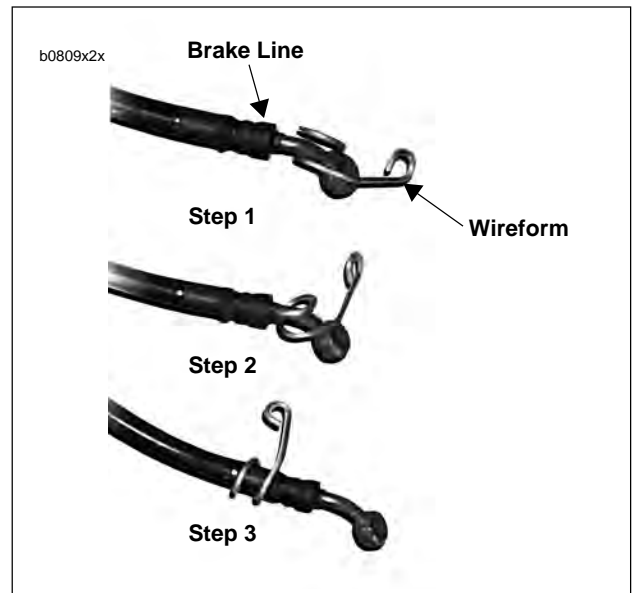


Figure 2-48. Wireform Installation

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 [1.13 SUSPENSION DAMPING ADJUSTMENTS](#) for more information.

REMOVAL

1. Raise front wheel off floor using procedure under [1.15 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 2-49](#). 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 2-50](#). 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 2-51](#). 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)

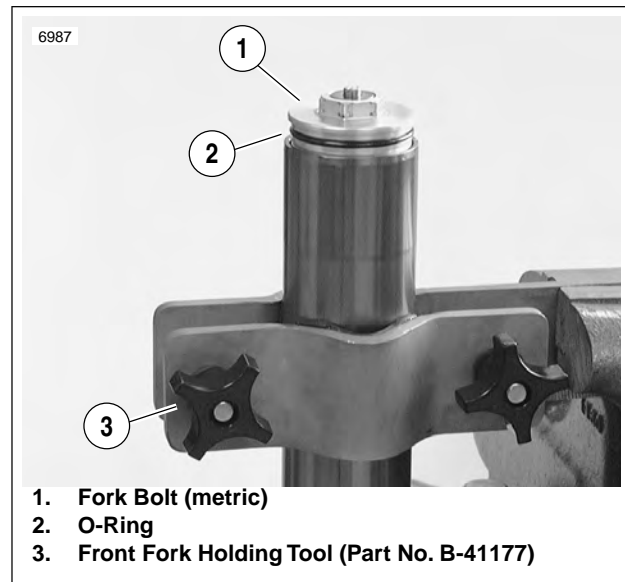


Figure 2-49. Fork Bolt

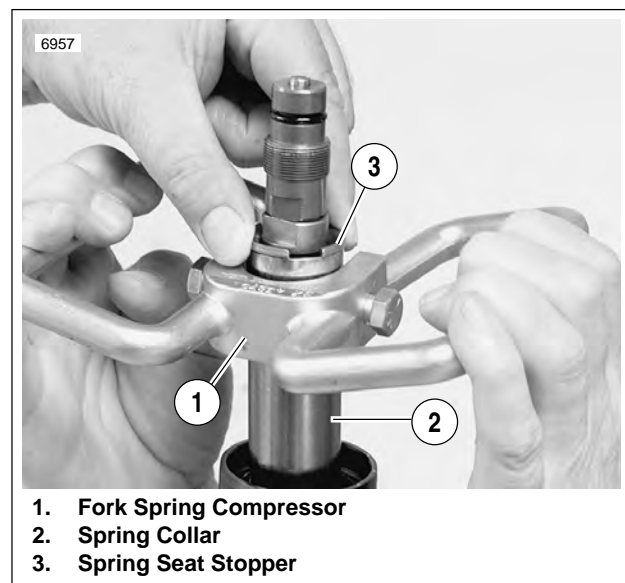
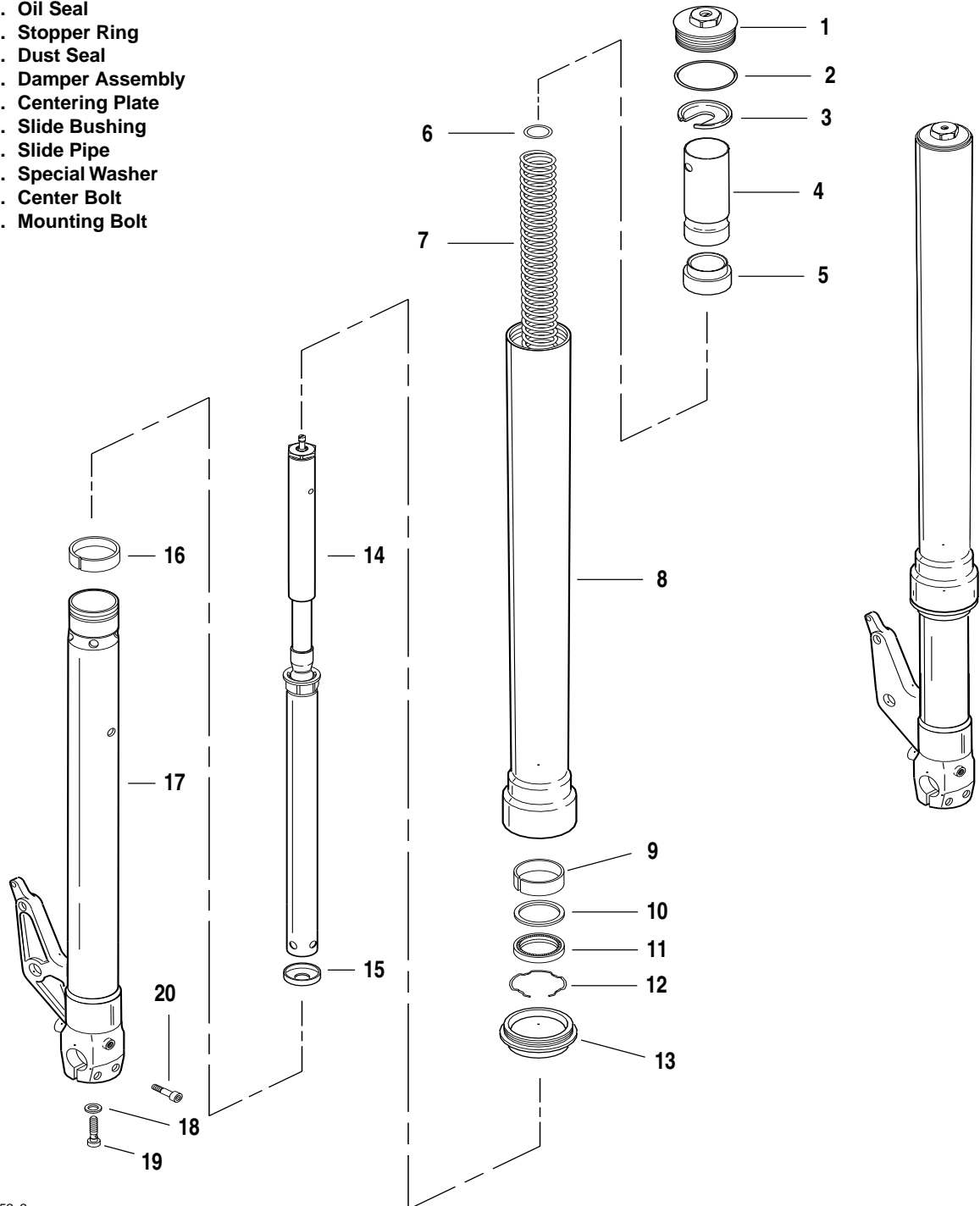


Figure 2-50. Front Fork Spring Compressor

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



b0652x2x

Figure 2-51. Front Fork Assembly

CLEANING AND INSPECTION

1. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.
2. See [Figure 2-51](#). 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 2-53](#). Measure slide pipe runout. Replace pipe if runout exceeds the service wear limit of 0.008 in. (0.2 mm).

ASSEMBLY

1. See [Figure 2-54](#). 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 2-52](#). 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 2-51](#). 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 2-55](#).
9. See [Figure 2-51](#). 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.

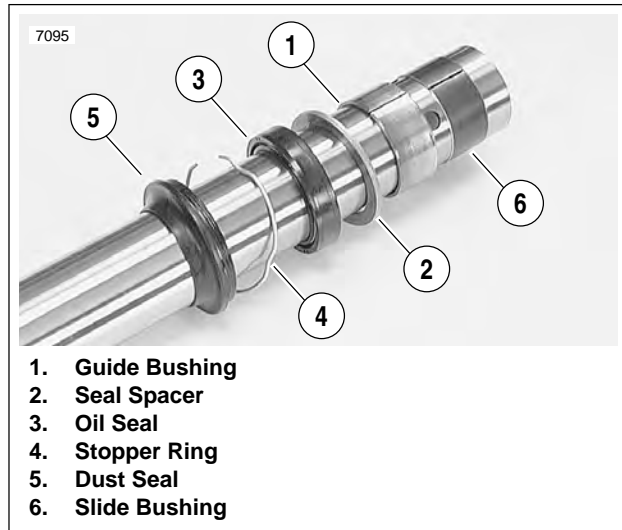


Figure 2-52. Slide Pipe Components

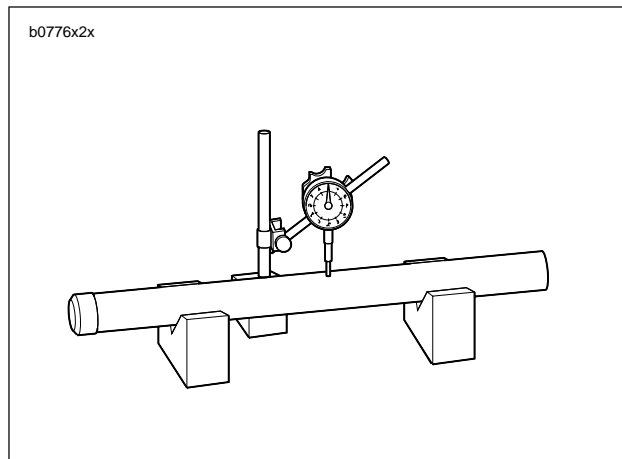


Figure 2-53. Pipe Runout



Figure 2-54. 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 2-56](#). 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 [1.14 FRONT FORK](#).
16. See [Figure 2-57](#). Install the spring, with the taper side at top, and the spring collar and spring joint.
17. See [Figure 2-50](#). Place FRONT FORK SPRING COMPRESSOR (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 2-49](#). 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 [1.13 SUSPENSION DAMPING ADJUSTMENTS](#).

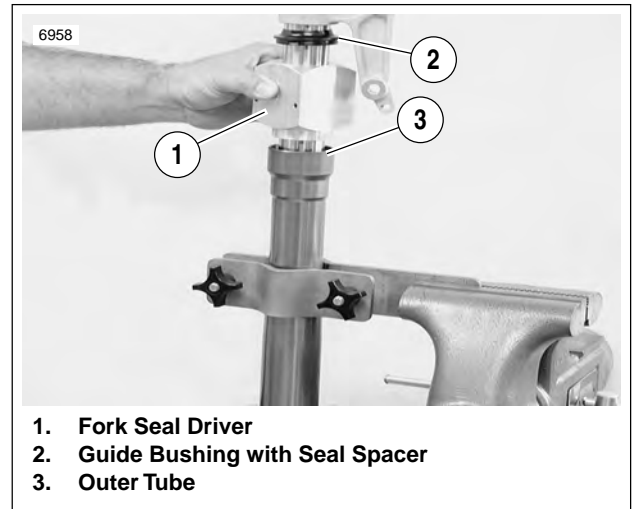


Figure 2-55. Fork Seal Driver

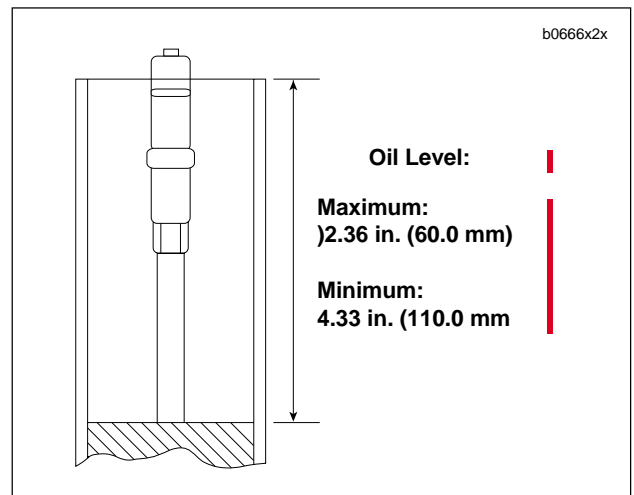


Figure 2-56. Oil Level Measurement

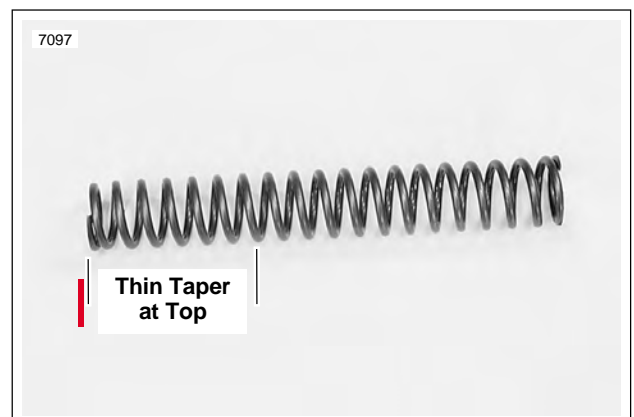


Figure 2-57. Spring Installation

INSTALLATION

1. Insert fork tubes through triple clamps.

NOTE

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

2. See [Figure 2-58](#). 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 [1.14 FRONT FORK](#).

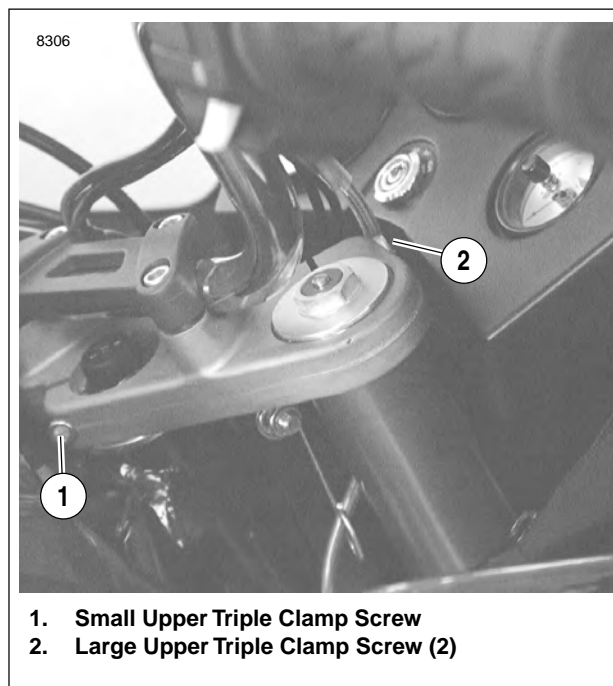


Figure 2-58. Front Fork

REMOVAL/DISASSEMBLY

1. Remove fork assemblies. See 2.16 FRONT FORK.
2. Remove handlebar clamp. See 2.26 HANDLEBARS.
3. See Figure 2-59. 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 1.14 FRONT FORK for adjustment procedures.

1. See Figure 2-59. 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 2-59. 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.

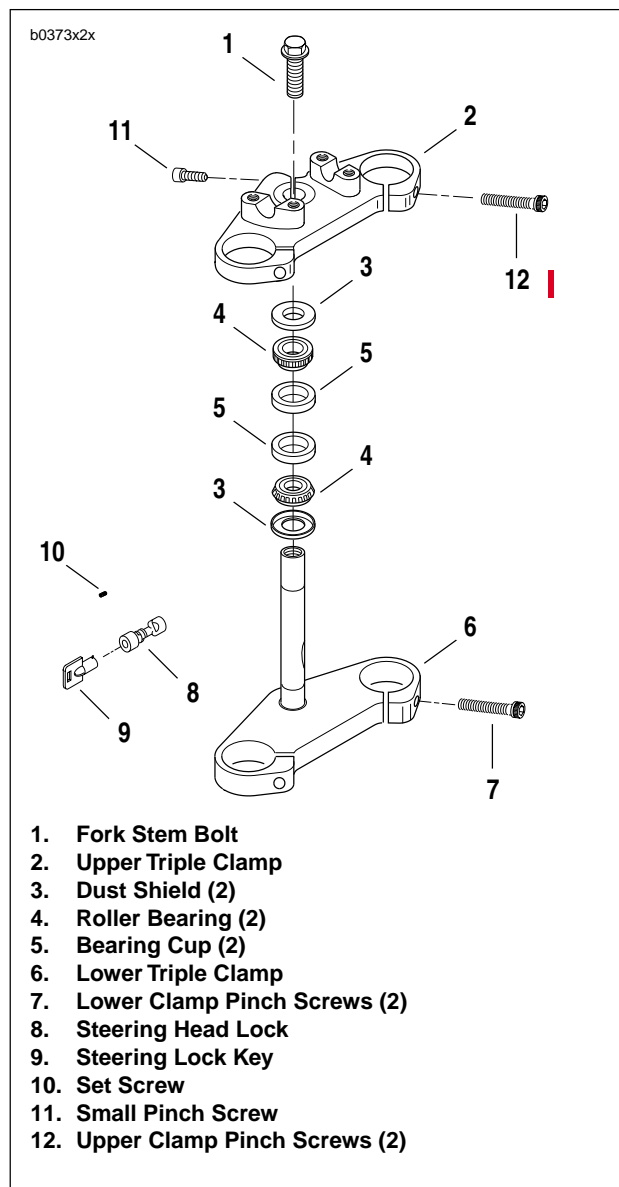


Figure 2-59. Fork Stem

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 1.15 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.

REMOVAL

1. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and LIFT ADAPTER (Part No. B-42577).
2. See Figure 2-60. 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 2-61. 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 2-62. Dished area of steering head lock faces front wheel.
 - b. Lift front wheel upward.
 - c. See Figure 2-61. Lock must be in the unlocked position to install. Insert lock with key openings positioned as shown.
 - d. Release front wheel.
2. See Figure 2-60. 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 1.19 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

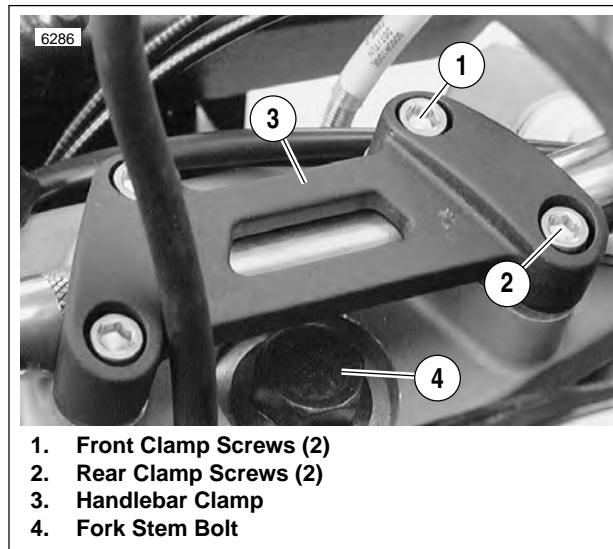


Figure 2-60. Loosening Handlebars

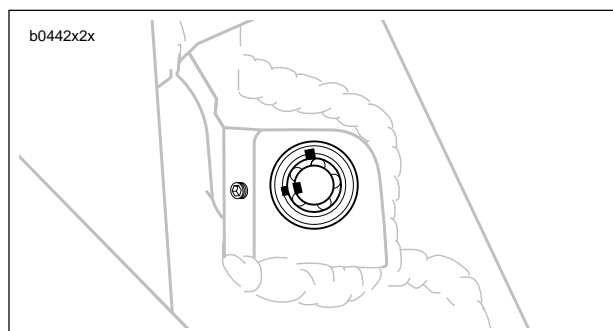


Figure 2-61. Set Screw



Figure 2-62. 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 2-63](#). 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.
8. Remove cap from oil tank. See [Figure 2-64](#). 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.

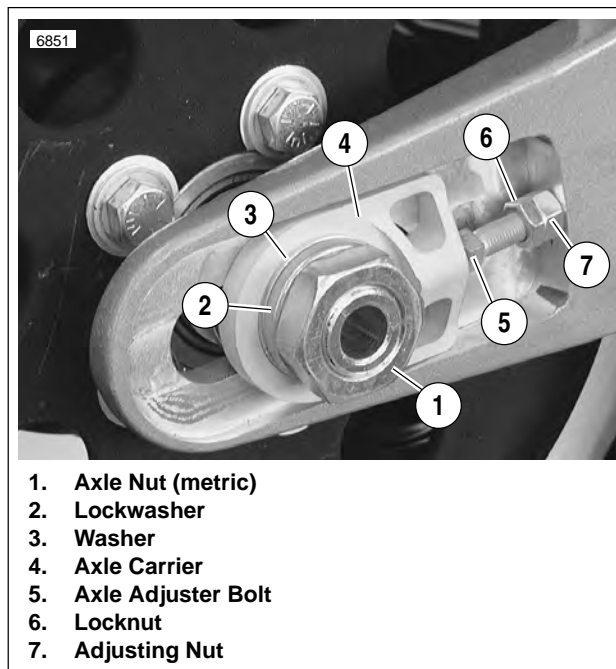


Figure 2-63. Rear Axle, Right Side

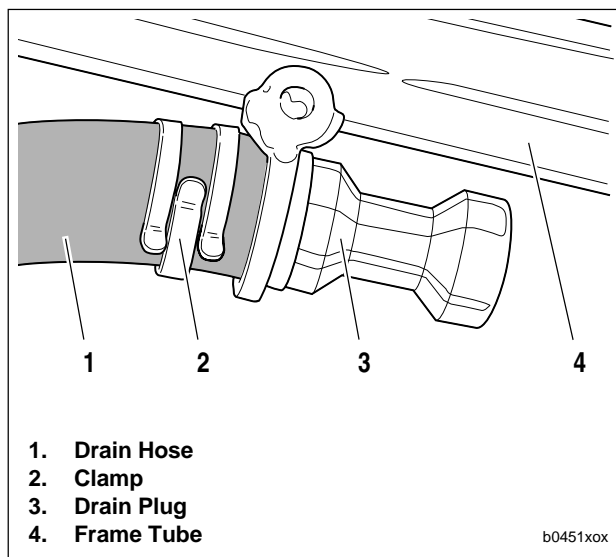


Figure 2-64. Oil Tank Drain, Typical

5. See [Figure 2-65](#). Place a jack under the crankcase.
6. Detach rear tie bar from swingarm.
7. See [Figure 2-66](#). 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.

8. Place a drip pan under the oil filter. Remove oil filter.

9. Using floor hoist, raise frame enough to remove both rubber isolators (6) from frame mounted pins.
10. Loosen swingarm pinch screw (4) on right side.
11. Remove threaded rod (1) from between bearing adjusting bolts (2, 3).
12. Loosen remaining swingarm pinch screw.
13. See [Figure 2-67](#). 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, apply leverage between frame and mount block using a plastic hammer wrapped in clean shop towels.

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

INSTALLATION

1. See [Figure 2-66](#). 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. 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 2-68](#). 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.

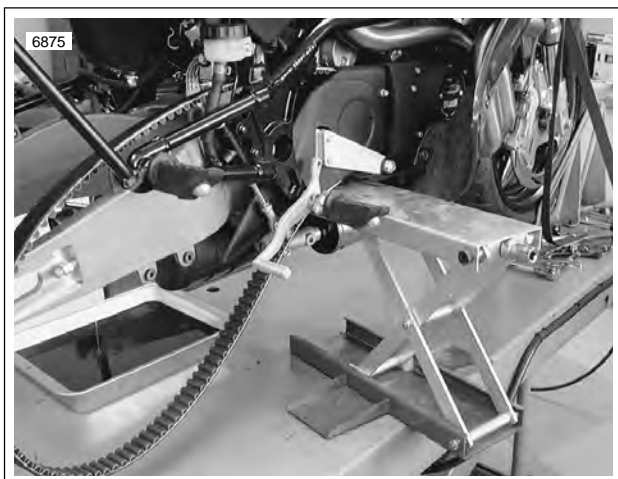


Figure 2-65. Scissors Jack

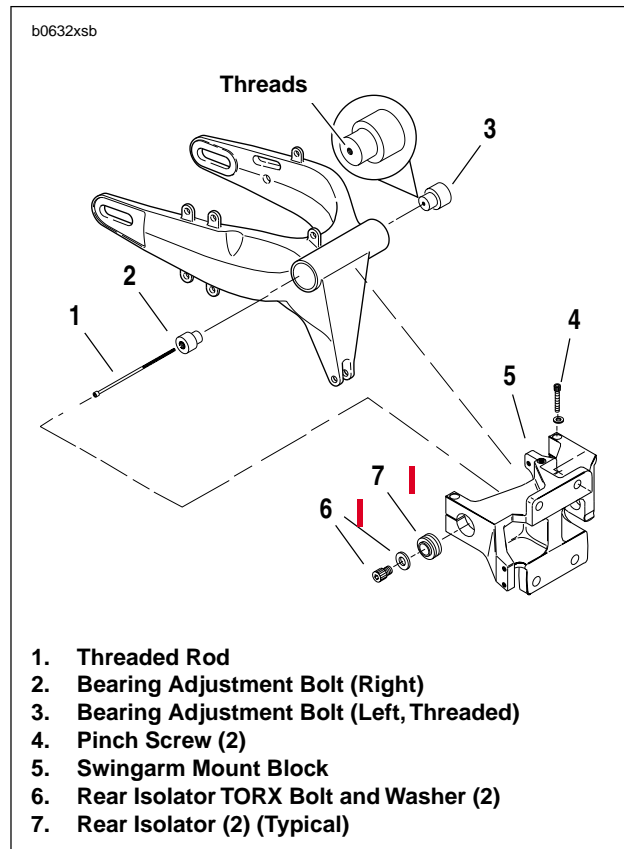


Figure 2-66. Swingarm Assembly

6. See [Figure 2-66](#). Secure swingarm in place.
 - a. Remove both pinch screws (1).
 - b. Apply LOCTITE THREADLOCKER 243 (blue) to threads of pinch screws.
 - c. Verify that swingarm is centered between mounts.
 - d. 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](#) for complete procedure.
 - a. Apply LOCTITE THREADLOCKER 271 (red) to threads of both isolator bolts. Apply LOCTITE ANTI-SEIZE to underside of TORX bolt head.
 - b. Install isolator TORX bolts and washers (7) through rubber isolators and into bearing adjustment bolts (2, 3).
 - c. Tighten isolator TORX bolts to 63-70 ft-lbs (85-95 Nm).
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.
 - a. Wipe any grease or dust from rear axle. Apply LOC-TITE ANTI-SEIZE LUBRICANT to axle.
 - b. See [Figure 2-69](#). Insert axle (1) through washer (2) so that rounded side of washer will face swingarm. Continue through left side of swingarm, rear brake caliper mount (3) and wheel assembly.
 - c. See [Figure 2-63](#). Place spacer between wheel hub and right side of swingarm. Slide axle through spacer and swingarm.
 - d. Place washer (3) on axle with rounded side facing swingarm. Install lockwasher (2) and axle nut (1) (metric). Do not fully tighten rear axle nut at this time.

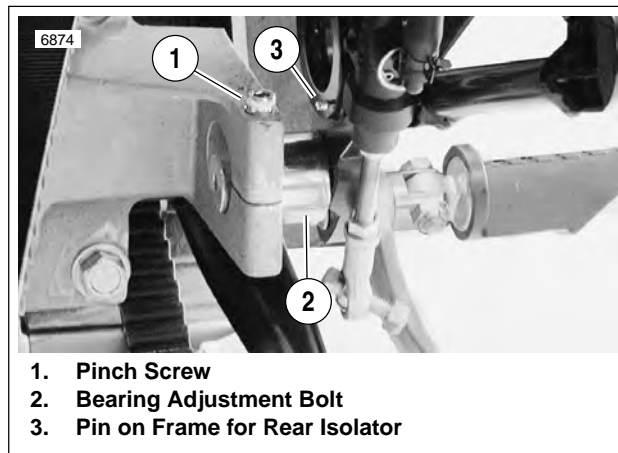


Figure 2-67. Swingarm Mount Block, Right Side

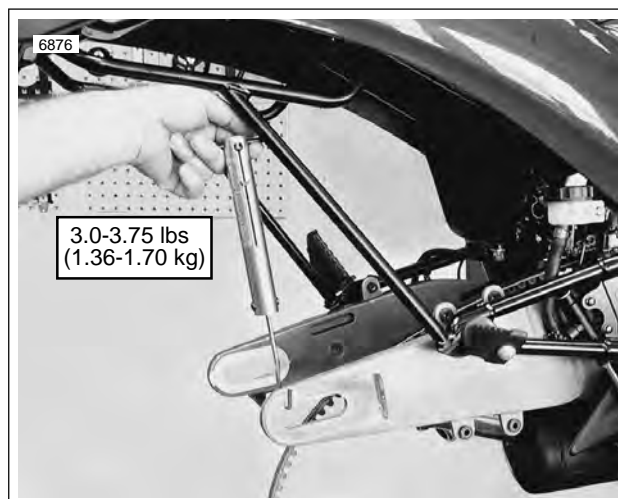


Figure 2-68. Checking Preload

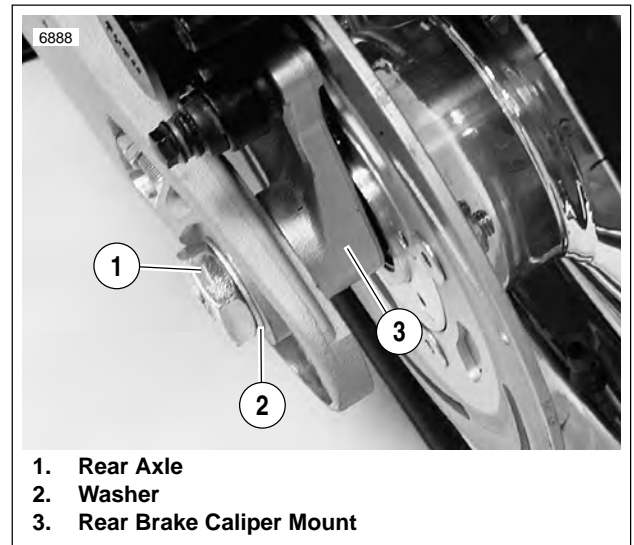


Figure 2-69. Rear Axle, Left Side

17. Set axle alignment and belt deflection. See [1.9 DRIVE BELT DEFLECTION](#).
 - a. See [Figure 2-70](#). Check rear axle alignment.
 - b. See [Figure 2-71](#). Check belt deflection.
 - c. Proceed to the next step when both axle alignment and belt deflection are correct.
18. See [Figure 2-72](#). 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.

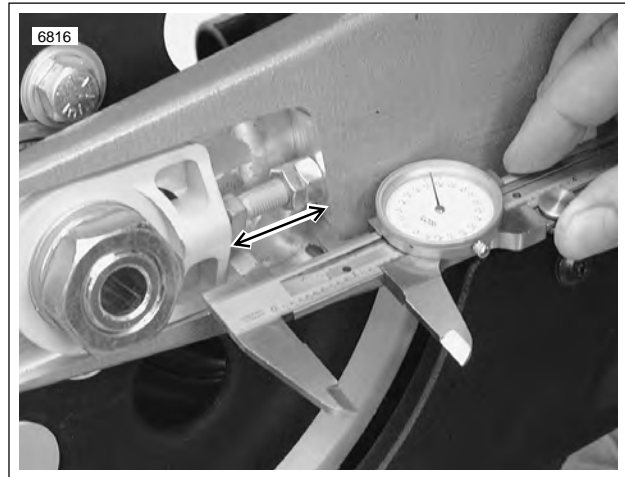


Figure 2-70. Checking Rear Wheel Alignment, Right Side Shown

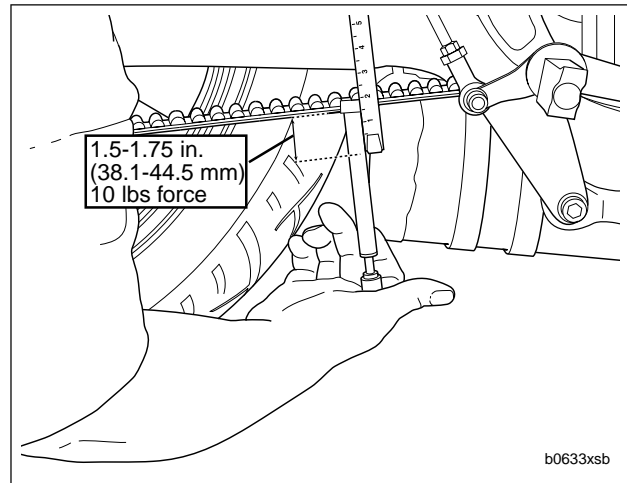


Figure 2-71. Belt Deflection



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

Figure 2-72. Axle Adjuster Bolt, Right Side Shown

MODEL YEAR CHANGE

All 2001 Air Twin Buell Models have **new** isolators with snubbers to reduce isolator shear. The sprocket cover has been modified from previous years to allow clearance for the snubber.

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 2-73](#). On the right side of the motorcycle, remove the front sprocket cover assembly.
5. See [Figure 2-73](#). Remove two screws that attach sprocket cover to the backside of the swingarm/drive support. Retain screws. Discard sprocket cover.

NOTE

See [Figure 2-74](#). 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 2-74](#). Strap tail section of frame to overhead beam or hoist and put slight tension on strap to secure frame assembly.
7. See [Figure 2-75](#). 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 2-75](#). Remove rear tie bar bolt, lockwasher and washers from mount block. Discard lockwasher.
9. See [Figure 2-75](#). Loosen left side isolator bolt from swing arm bearing adjusting bolt. Do not remove.
10. See [Figure 2-75](#). Remove right side isolator bolt and washer from swingarm bearing adjustment bolt. Discard isolator bolt, but retain washer.

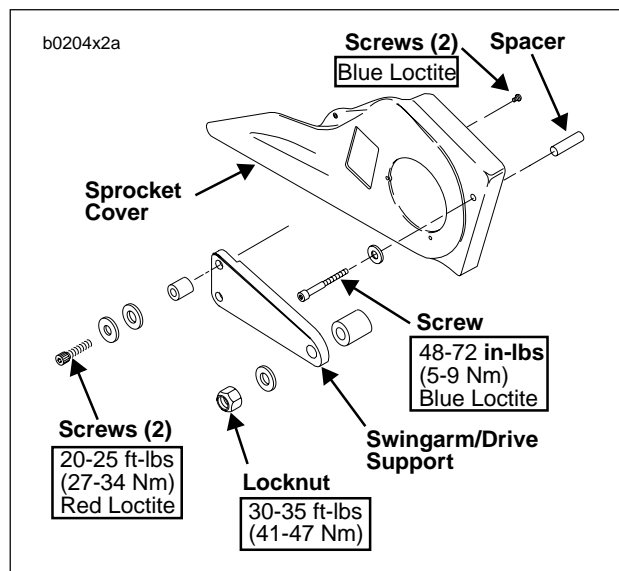


Figure 2-73. Sprocket Cover

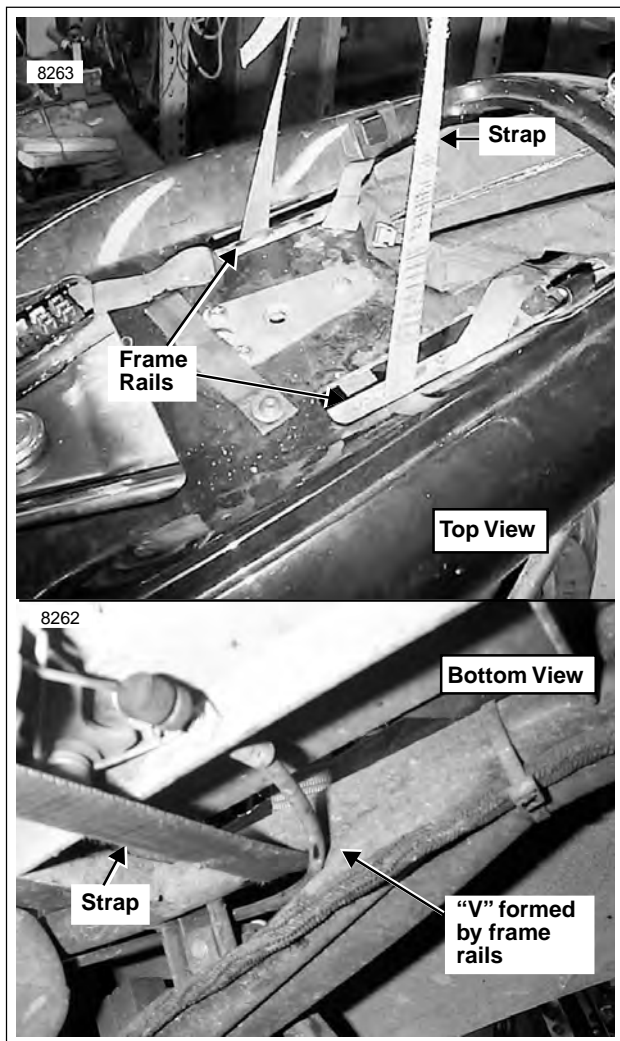


Figure 2-74. Floor Hoist

- See Figure 2-76. 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.

- 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.
- 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. Discard rear isolator.
- Remove rear isolator replacement tool by turning nut counterclockwise.
- Remove left side isolator bolt and washer from bearing adjusting bolt. Discard isolator bolt, but retain washer.
- Remove nut and back out bolt (until flush with the mount block) from upper rear of muffler Z bracket and swingarm mount block.

- Pull frame to left and remove left side isolator from 6:00 or 7:00 position. Discard isolator.

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 2-77. 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

- On left side of motorcycle, align locator hole with roll pin and install **new** left rear isolator provided in kit. The left isolator backing plate has an "L" stamped on it.
- Move to right side of motorcycle. Lower the frame approximately two inches with the hoist to allow clearance between isolator replacement tool and the **new** larger isolator.
- See Figure 2-76. 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.

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

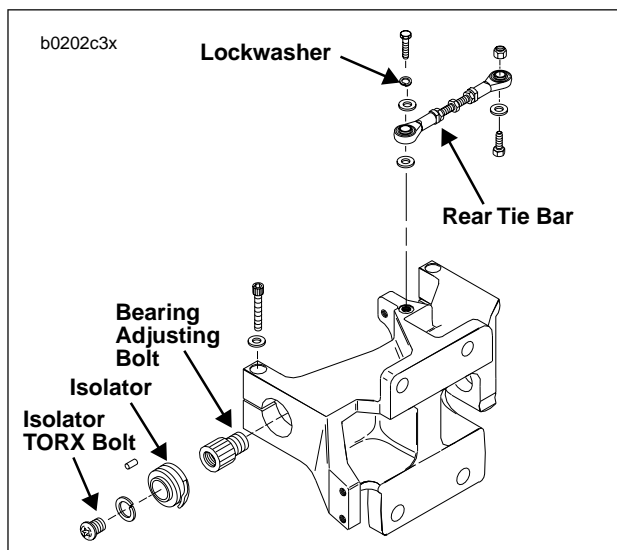


Figure 2-75. Mount Block

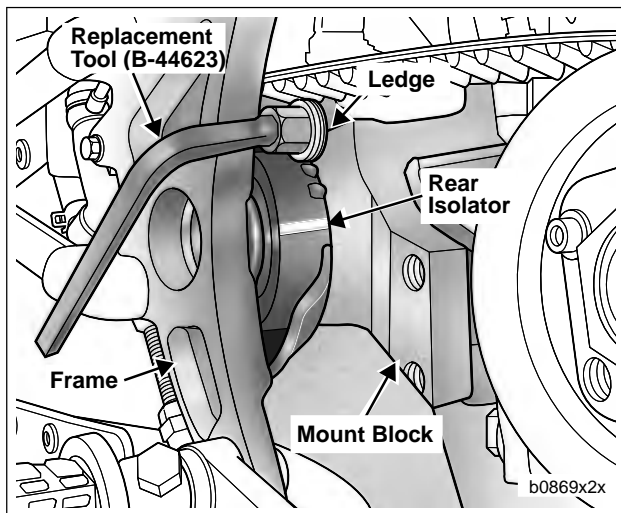


Figure 2-76. Rear Isolator Replacement Tool In Use

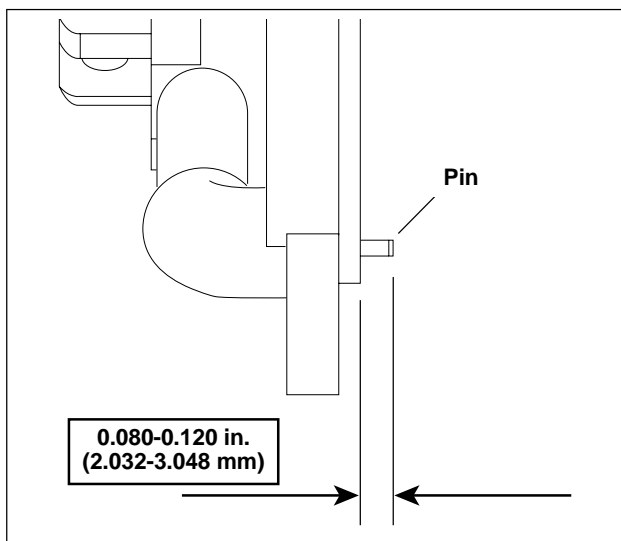


Figure 2-77. Measuring Roll Pin Protrusion

5. On right side of motorcycle, align locator hole with roll pin and install **new** 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 **new** isolator bolt heads.

CAUTION

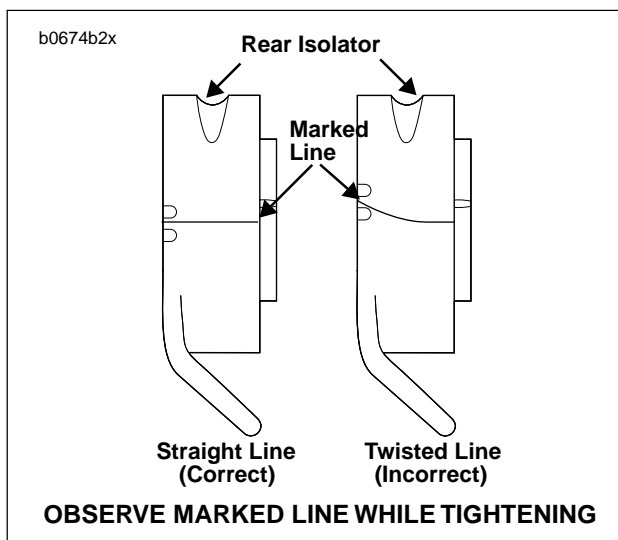
Use caution when installing isolator bolts. Make sure isolator bolt hole is aligned with threaded hole in bearing adjusting bolt to avoid cross-threading bolt.

10. See Figure 2-75. Install **new** isolator TORX bolts and washers through both rubber isolators into bearing adjustment bolts on each side.

CAUTION

See Figure 2-78. 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 **new** 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 2-73. 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 2-73. Install **new** 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).



OBSERVE MARKED LINE WHILE TIGHTENING

Figure 2-78. 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.

MODEL YEAR CHANGE

All 2001 Air Twin Buell Motorcycles have a **new** rear shock absorber and a **new** front shock mount. The **new** 2001 front shock mount must be used with the **new** rear shock to fit properly. The **new** shock absorber has a remote reservoir that allows for rebound damping adjustment.

GENERAL

See [Figure 2-80](#). 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 [1.12 PRELOAD ADJUSTMENT](#).

NOTE

The rear shock absorber contains no user serviceable parts.

REMOVAL

- Lift rear wheel off ground using REAR WHEEL SUPPORT STAND (Part No. B-41174).
- Remove seat and attach lifting straps to motorcycle. Insert lifting straps under frame tubes. It is not necessary to remove tail section.
- Attach lifting straps to a floor hoist placed behind the motorcycle. Raise motorcycle off lift until rear suspension is unloaded.
- Use a flex socket and extension to remove locknut and washer from front reservoir clamp. Discard clamp and locknut.
- Loosen rear reservoir clamp. Slide reservoir and mount block out of clamp. Remove and discard clamp.
- See [Figure 2-79](#). Remove allen screw (metric) and locknut on front mount. Discard locknut.
- While supporting the shock absorber, remove the allen screw (metric) and locknut from the rear mount. Discard locknut.
- Remove shock absorber assembly.
- Inspect and replace bushings as required.

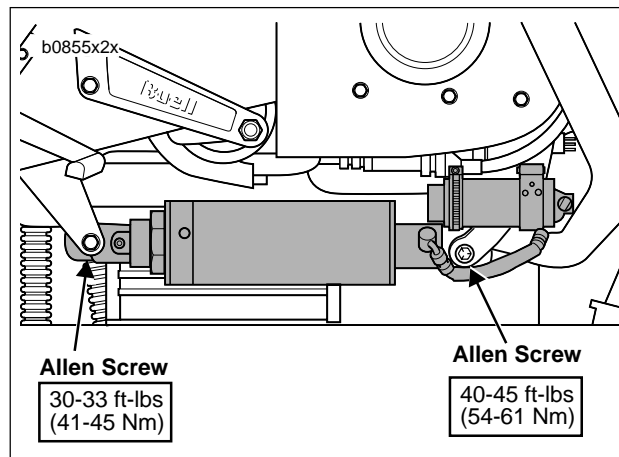


Figure 2-79. Shock Mounting Hardware

INSTALLATION

- See [Figure 2-80](#). Place **new** bushings into mounting holes of shock absorber (if only replacing bushings).
- See [Figure 2-79](#). Loosely install rear allen screw (metric) and **new** locknut.
- Loosely install front allen screw (metric) and **new** locknut.
- Install rear clamp over front oil pump fitting.
- Slide reservoir through rear clamp.
- Position front clamp over reservoir and loosely install front reservoir clamp to front shock mount with washer and nylon locknut.
- Install reservoir mount block between oil pump fitting and remote reservoir.
- Tighten clamps around reservoir.

NOTE

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

- Tighten front allen screw to 40-45 ft-lbs (54-61 Nm).
- 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.

- Remove lifting straps and install seat. See [2.35 SEAT](#).
- Check rear shock preload. See [1.12 PRELOAD ADJUSTMENT](#).

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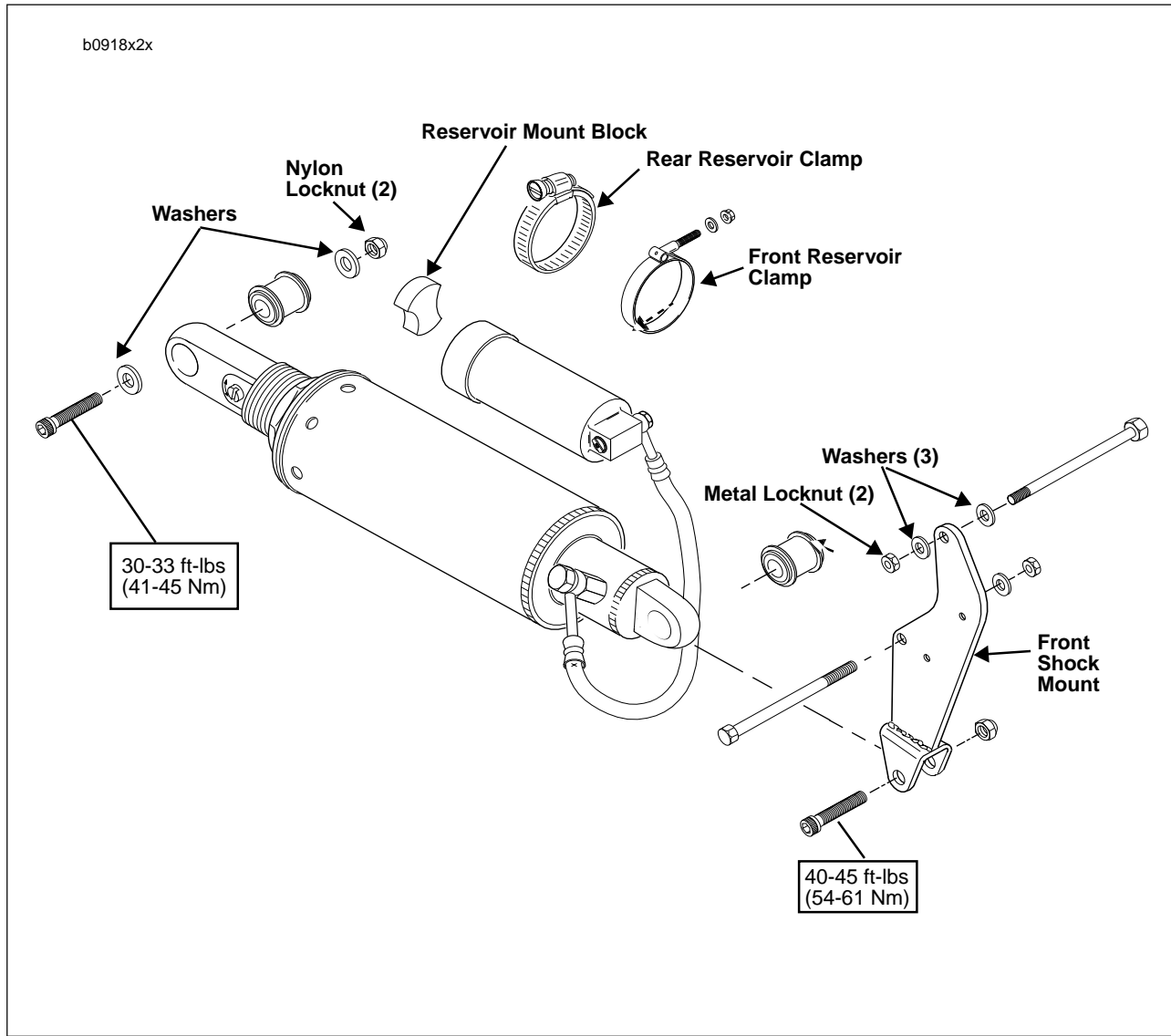


Figure 2-80. Rear Shock Absorber

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 2-81. See Figure 2-82. The rear suspension adjusts for compression and rebound damping and spring preload.

See Figure 2-83. 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 2-9.

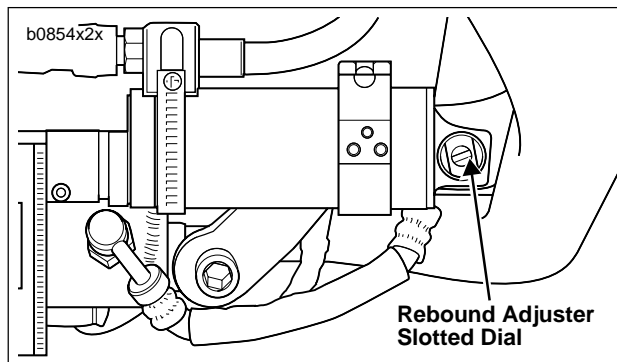


Figure 2-81. Rear Shock Rebound Damping Adjustment

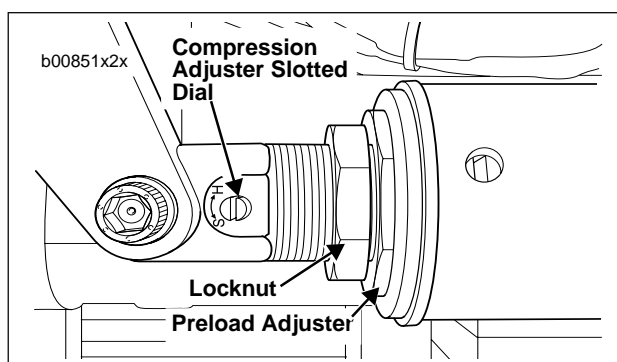


Figure 2-82. Preload and Compression Damping Adjustment

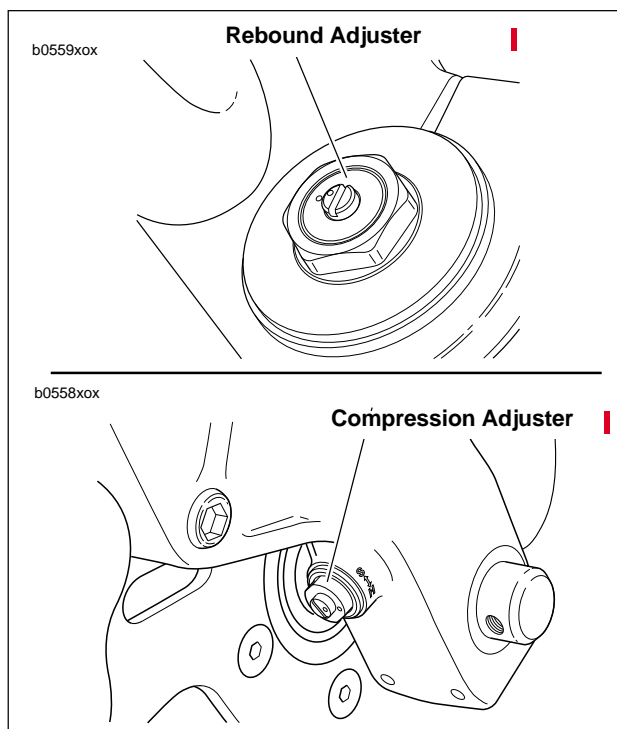


Figure 2-83. Front Fork Adjusters

SPRING PRELOAD

Adjust rear spring preload before attempting any other adjustments. See [1.12 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 2-81](#). 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 2-82](#). 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.

Recommended Rear Shock Damping Settings (S3/S3T)

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 2-83](#). Adjust **rebound** damping using the slotted dial on the top of each fork leg.

- Factory setting-full damping minus 0.5 turn.

See [Figure 2-83](#). 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 adjustments. and a swinging fork are geometry-related, but often these unwanted characteristics can be solved by suspension

Table 2-6. 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 2-7. Rear Suspension Problems

TROUBLESHOOTING CONDITION	ADJUSTMENT SOLUTION
“Pumping on the Rear” occurs when you are accelerating out of a corner. This problem 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 2-8. 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.

REMOVAL/DISASSEMBLY

1. See [Figure 2-85](#). Slide rubber boot (5) off the cable adjusters (4). Loosen cable adjuster lock (3) on each adjuster.
2. See [Figure 2-86](#). 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: On S3T models, this includes removing the right fairing lower.
6. See [Figure 2-84](#). Remove screw and throttle cable clamps from cables by throttle body.
7. Disconnect cables from throttle body manifold to remove.

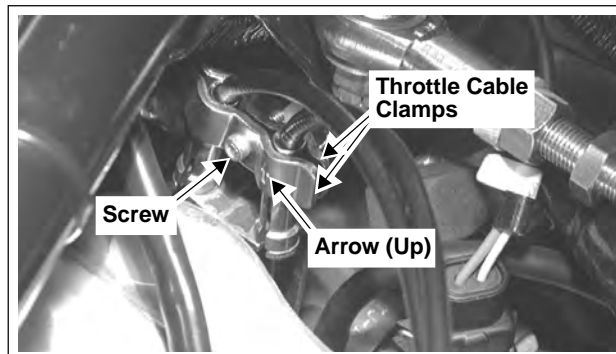


Figure 2-84. Throttle Cable Clamps

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 2-86](#). 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 [1.20 THROTTLE CABLES](#).
6. See [Figure 2-84](#). Attach throttle cable clamp to ferrules with screw (arrow on clamp points up).
7. Install air cleaner assembly. See [4.41 AIR CLEANER](#). On S3T models, also install the right fairing lower.

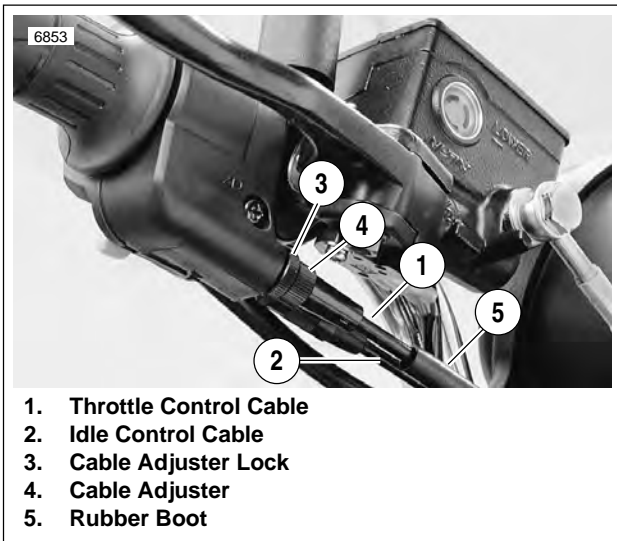


Figure 2-85. Throttle Control Cables

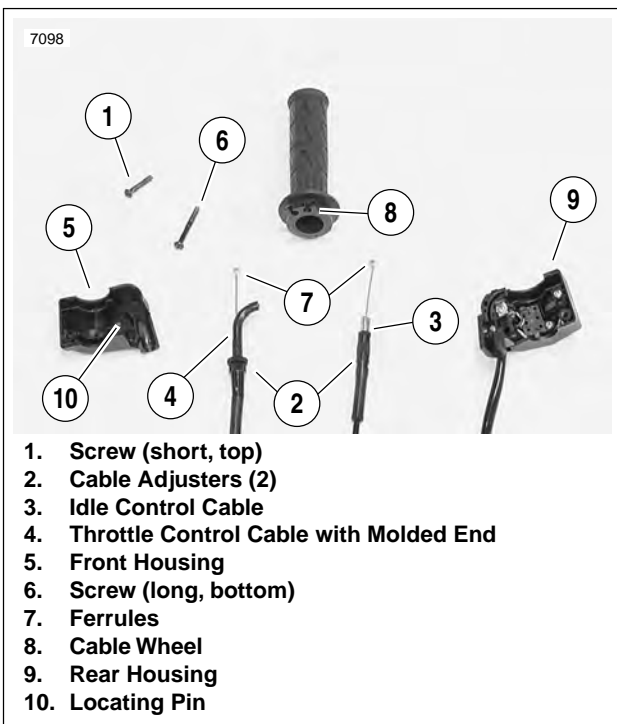


Figure 2-86. Cable Connections

REMOVAL/DISASSEMBLY

NOTE

For information on clutch adjustment, see 1.8 CLUTCH.

Clutch Cable-Lower

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 2-87. 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 2-88. 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 handlebar from clutch clamp (5). Detach clutch cable from handlebar.
4. Remove clutch cable clamp (10) from frame.
5. Remove clutch clamp.
 - a. Cut off left handgrip.
 - b. Remove left handlebar switch housing. See 7.16 HANDLEBAR SWITCHES.
 - c. Remove clamp screw (4) (metric). Slide clamp off the end of the handlebar.

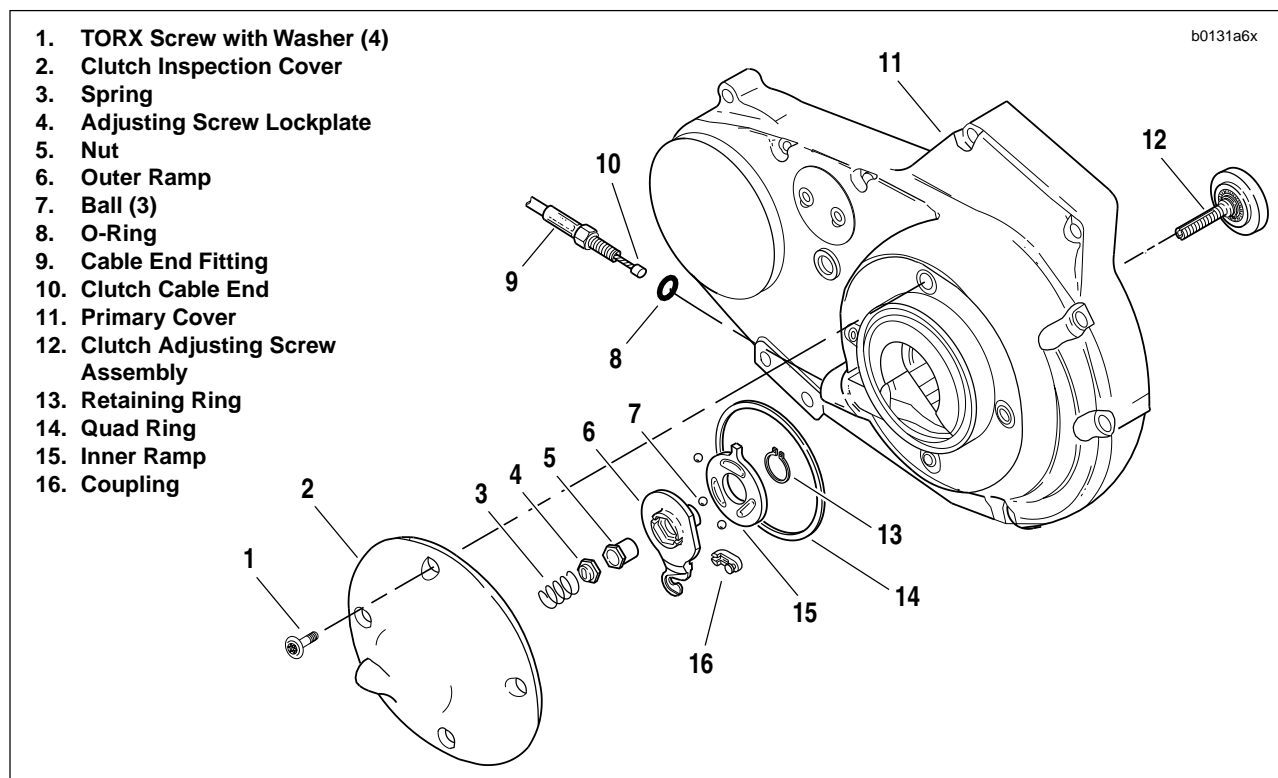


Figure 2-87. Clutch Release Mechanism

ASSEMBLY/INSTALLATION

Clutch Cable-Lower

- See [Figure 2-87](#). 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 3-5 ft-lbs (4-7 Nm).
- 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).
- 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.
- If not yet performed, route clutch cable to hand control.
 - See [Figure 2-89](#). Route cable along left side of primary chaincase and up through clamp on front isolator tie bar.
 - Continue above and behind lower triple clamp, between left fork leg and steering neck.
 - Route cable across front of upper triple clamp to hand grip.
- With clutch cable upper section connected to clutch lever, check primary chain tension. Adjust if necessary. See [1.11 PRIMARY CHAIN](#).
- Adjust clutch. See [1.8 CLUTCH](#).

Clutch Hand Control

- See [Figure 2-88](#). Attach clutch clamp (5) as follows.
 - Slide clamp over handlebar.
 - Install left switchgear housing. See [7.16 HANDLE-BAR SWITCHES](#).
 - Place clamp next to switchgear housing. Fasten to handlebar with screw (4) (metric). Tighten to 30-35 in-lbs (3-4 Nm).
 - Install a **new** left handgrip. See [2.26 HANDLE-BARS](#).
- Connect end of clutch cable upper section to clutch handlebar. Position lever within clutch clamp.
- Apply small amount of LOCTITE ANTI-SEIZE LUBRICANT to bolt (2). Attach handlebar with bolt (2) (metric) and nut (6) (metric).
- Attach clutch switch (7) with screw (8).
- If not yet performed, route clutch cable to primary cover.
 - Route cable from hand grip across front of upper triple clamp.
 - Continue to left side, down between left fork leg and steering neck, above lower triple clamp.
 - See [Figure 2-89](#). Route cable down left side of bike, through clamp, along primary chaincase to clutch.
- With clutch cable lower section connected to primary cover, adjust clutch. See [1.8 CLUTCH](#).

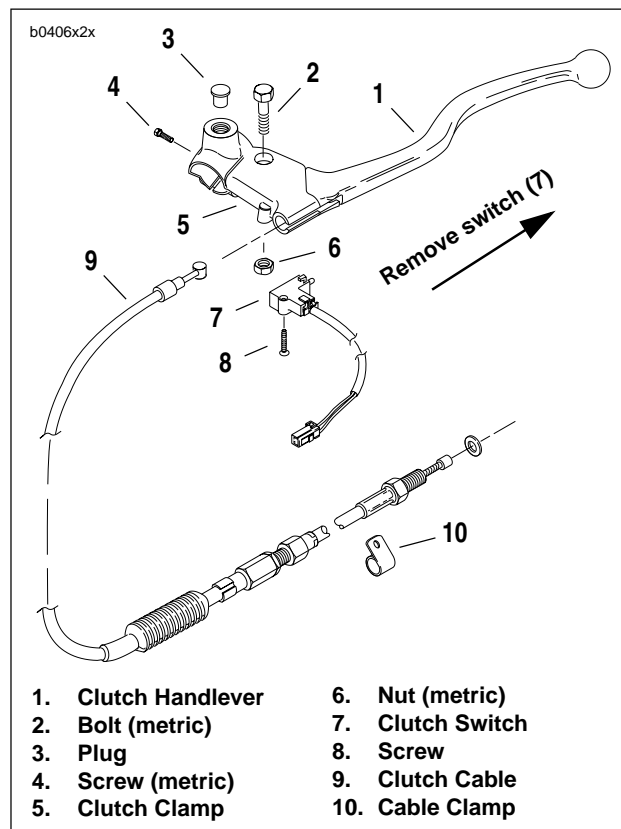


Figure 2-88. Clutch Hand Control

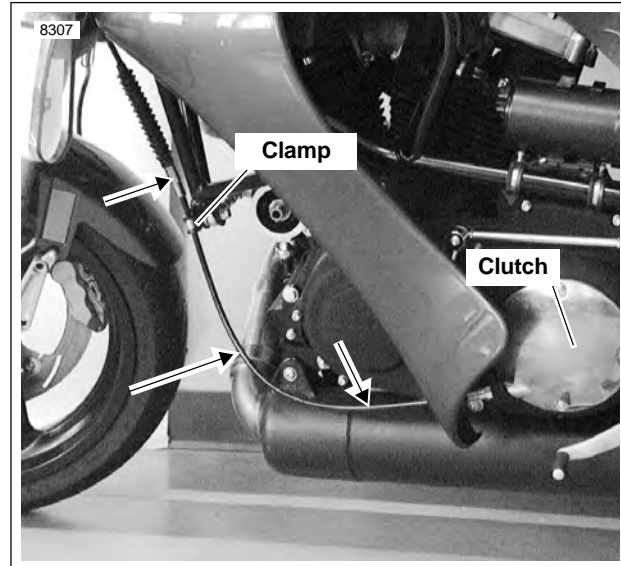
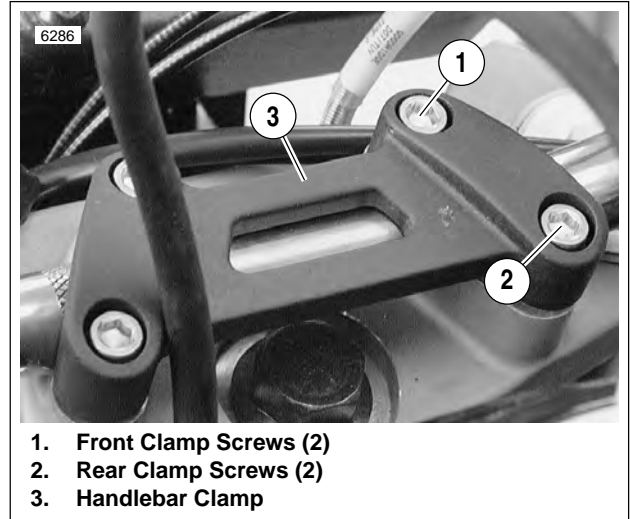


Figure 2-89. Clutch Cable Routing, Lower

REMOVAL

1. Remove front brake master cylinder. See [2.10 FRONT BRAKE MASTER CYLINDER](#).
2. Remove left handlebar switch housing. See [7.16 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 2-90](#). Remove four screws (1, 2) from handlebar clamp (3).
6. Slide handlebars out of throttle grip assembly to remove.

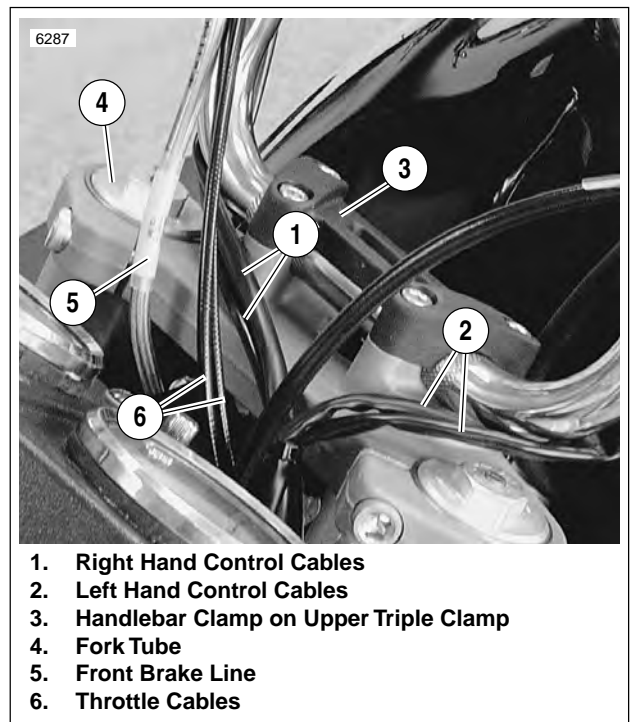


1. Front Clamp Screws (2)
2. Rear Clamp Screws (2)
3. Handlebar Clamp

Figure 2-90. Handlebar Clamp

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 2-91](#). 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 2-90](#). 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 [7.16 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 [1.15 STEERING HEAD BEARINGS](#).



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 2-91. Routing Hand Control Wires

MODEL YEAR CHANGE

All 2001 S3/S3T Models have **new** front and rear exhaust mounts.

REMOVAL/DISASSEMBLY

Muffler

NOTE

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

1. On S3T models, remove right side fairing lower. See [2.38 FAIRING LOWERS \(S3T\)](#).
2. See [Figure 2-92](#). Remove bolts, lockwashers and washers securing muffler to Z-bracket.
3. See [Figure 2-93](#). 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 2-94](#). 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.

Exhaust Header

1. Remove muffler.
2. See [Figure 2-95](#). 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 2-96](#). Remove exhaust header by swiveling and lifting exhaust header as shown. Slide exhaust header from behind frame.
5. See [Figure 2-97](#). Remove exhaust header clamps (22), exhaust clamp retaining rings (23) and exhaust port gaskets (24) from exhaust header.

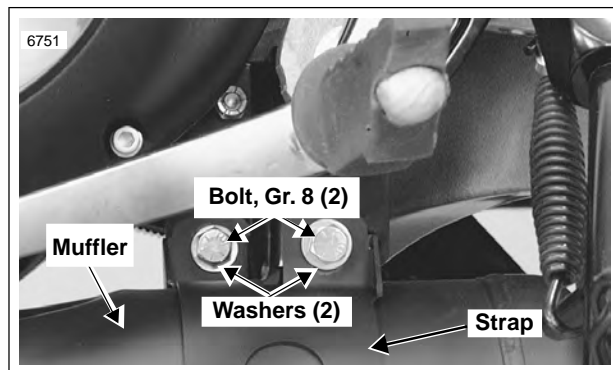


Figure 2-92. Rear Muffler Mounts

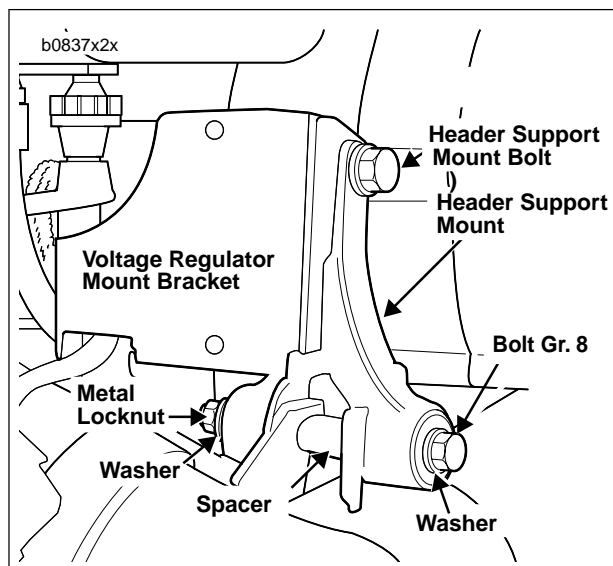


Figure 2-93. Header Support Mount

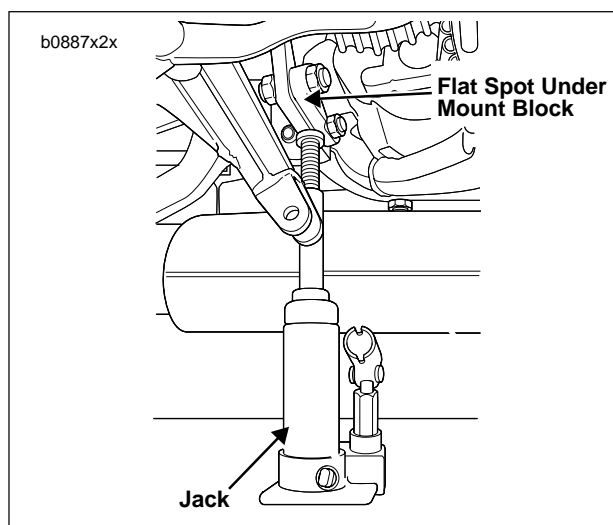


Figure 2-94. Supporting Motorcycle with Jack

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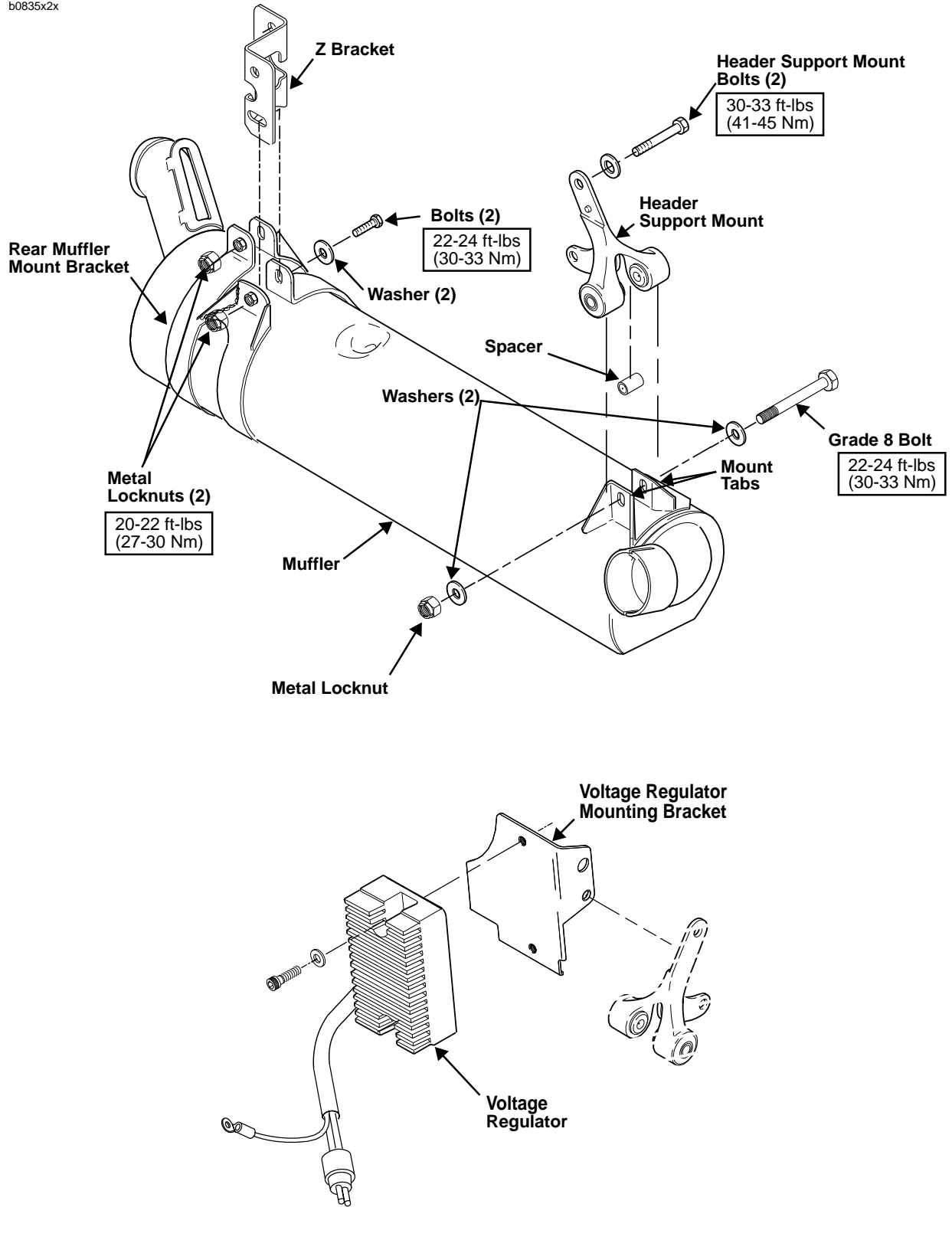


Figure 2-95. Exhaust System

ASSEMBLY/INSTALLATION

Muffler

1. If removed, install exhaust header.
2. See [Figure 2-95](#). 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 2-93](#). 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 2-92](#). 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 2-93](#). 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 2-97](#). 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 2-96](#). Slide exhaust header under frame by positioning as shown, threading oxygen sensor wire under frame.



Figure 2-96. Exhaust Header Positioning (Typical)

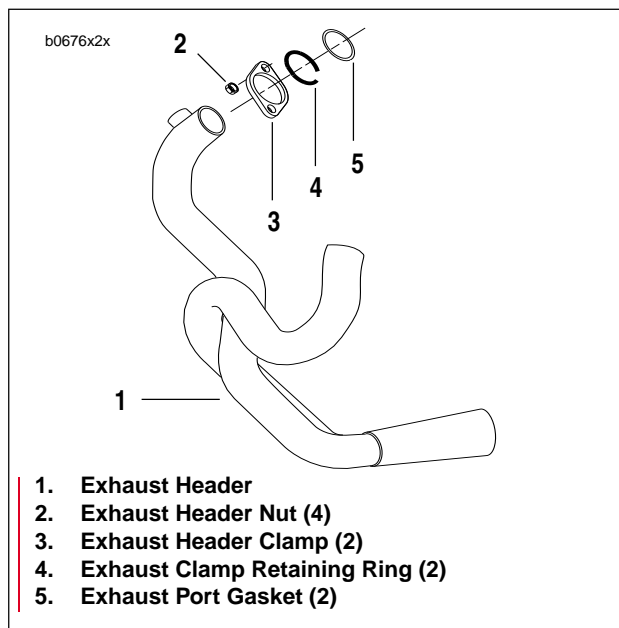


Figure 2-97. Exhaust Header

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 2-97](#). 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 LOC-TITE 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. On S3T models, install right fairing lower. See [2.38 FAIRING LOWERS \(S3T\)](#).

REMOVAL

1. See [Figure 2-98](#). 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 on S3T models 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 2-98](#). 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.

INSTALLATION

1. See [Figure 2-98](#). 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.

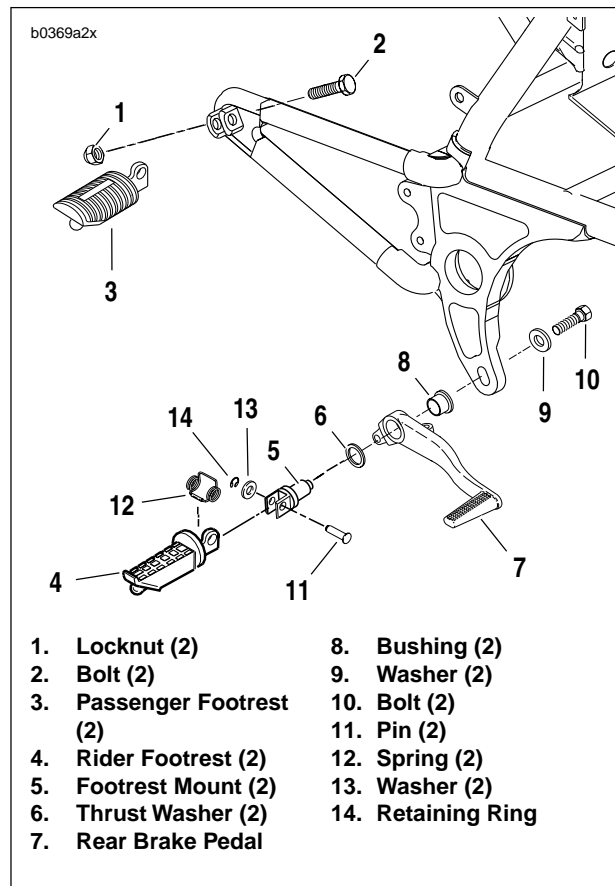


Figure 2-98. Footrests, Right Side

MODEL YEAR CHANGE

The sprocket cover on 2001 Buell Air Twin Models has been modified from previous years to allow for more clearance with the **new** rear isolators.

REMOVAL/DISASSEMBLY

1. See [Figure 2-99](#). On S3 models, remove locknut and washer from swingarm/drive support.
2. See [Figure 2-100](#). On S3T models, remove screw on fairing lower. Remove bracket from stud.
3. See [Figure 2-99](#). Remove two screws from swingarm/drive support.
4. Remove sprocket cover forward screw, washer and spacer.
5. Remove swingarm drive/support and sprocket cover as an assembly.
6. Remove two screws to separate sprocket cover from swingarm/drive support.

ASSEMBLY/INSTALLATION

1. See [Figure 2-99](#). 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 2-100](#). On S3T models, place fairing lower bracket on stud. Fasten fairing lower to bracket using screw.
5. See [Figure 2-99](#). On S3 models, install locknut and washer. Tighten locknut to 30-35 ft-lbs (41-47 Nm).

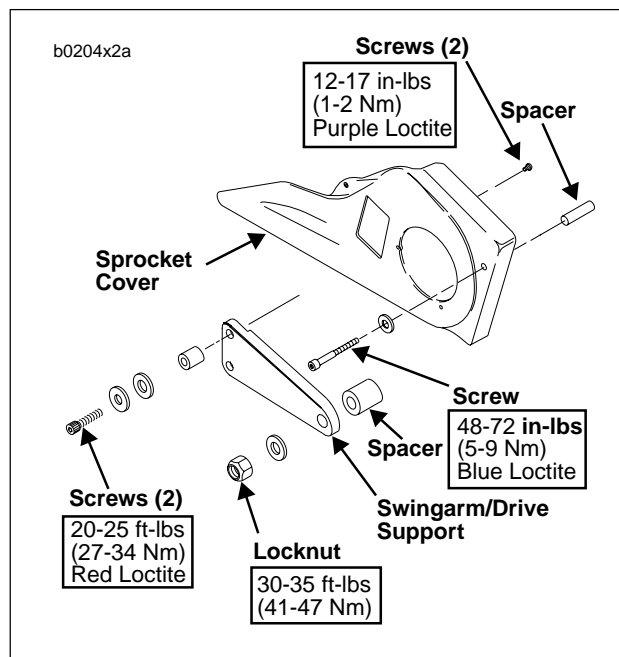
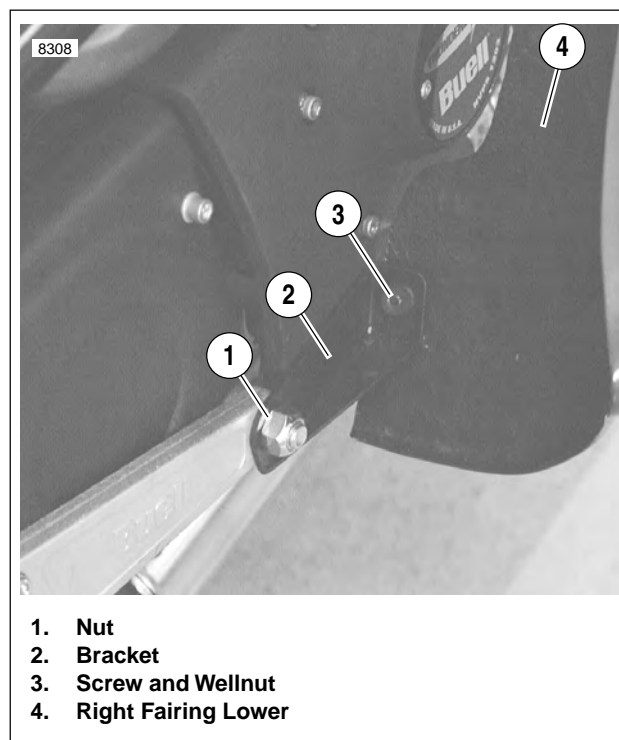


Figure 2-99. Sprocket Cover



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

Figure 2-100. S3T Fairing Lower Mount

REMOVAL

1. See [Figure 2-101](#). 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 well-nuts (5) from swing arm.

INSTALLATION

1. See [Figure 2-101](#). Position stone guard (4) with wellnuts (5) and lower belt guard (3) on swing arm.
2. Secure with two screws (1) and washers (2).

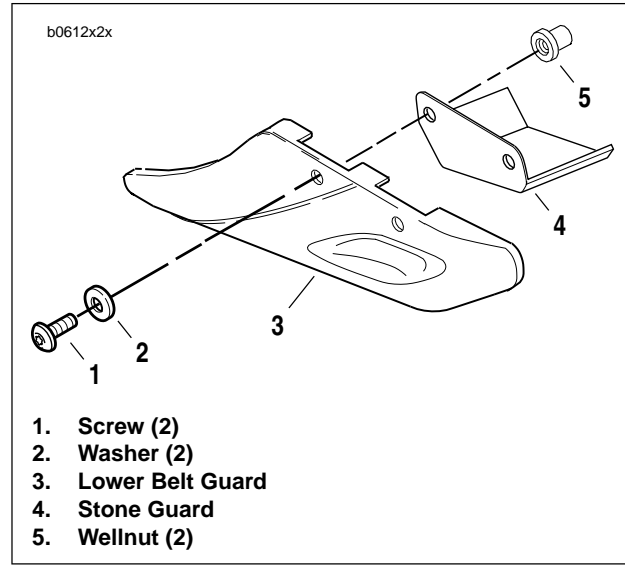


Figure 2-101. Stone Guard

REMOVAL

1. Remove front wheel. See [2.5 FRONT WHEEL](#).
2. See [Figure 2-102](#). 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 2-102](#). 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](#).

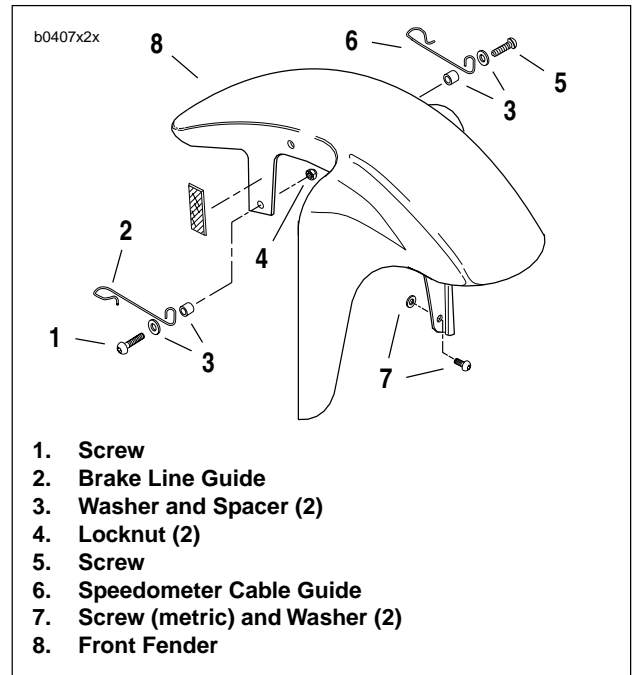


Figure 2-102. Front Fender

REMOVAL

1. Have someone sit on the vehicle to compress the motorcycle's suspension.
2. See [Figure 2-103](#). 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 2-104](#). Position fender over tire, making sure that the brake hose is on the outside of the fender as shown.
2. See [Figure 2-103](#). 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).

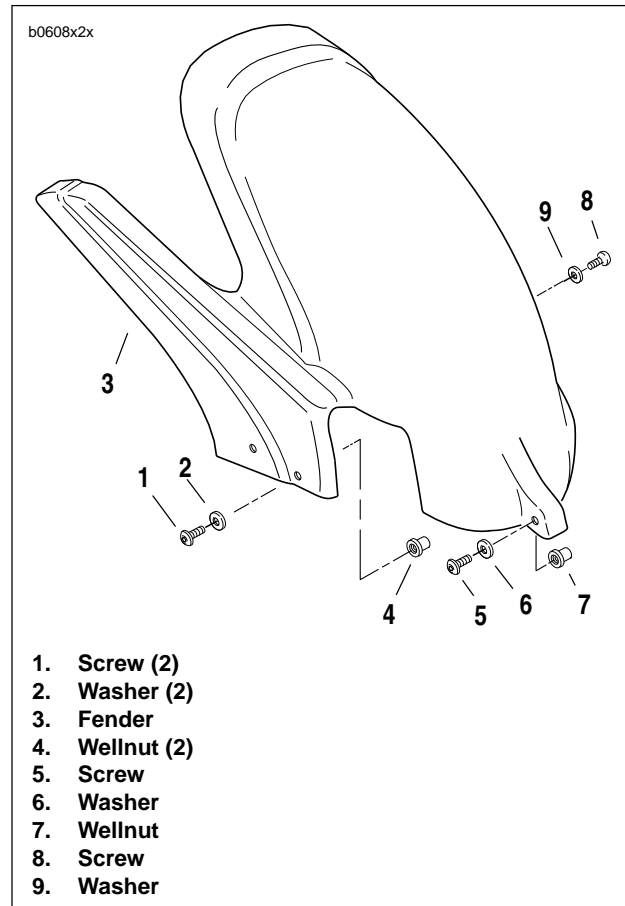


Figure 2-103. Rear Fender

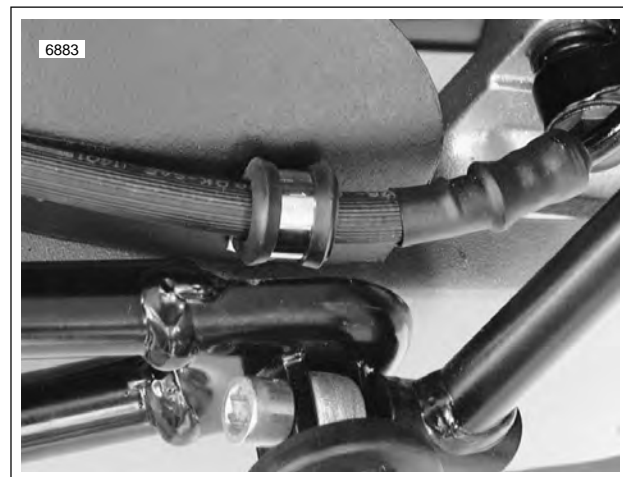


Figure 2-104. Rear Fender With Brake Hose

REMOVAL

Tail Section

1. Remove both saddlebags from S3T models.
 - 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 2-105](#). 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.

Glove Box and License Plate Holder

1. Remove tail section.
2. Unplug tail lamp/brake light connections and remove tail lamp mount. See [7.13 TAIL LAMP](#).
3. Remove rear turn signals. See [7.14 TURN SIGNALS](#).
4. See [Figure 2-106](#). 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 2-107](#). On S3T models, you may remove bolts, washers and nuts (2) to detach rear saddlebag support bracket (3) from turn signal support bracket (1).

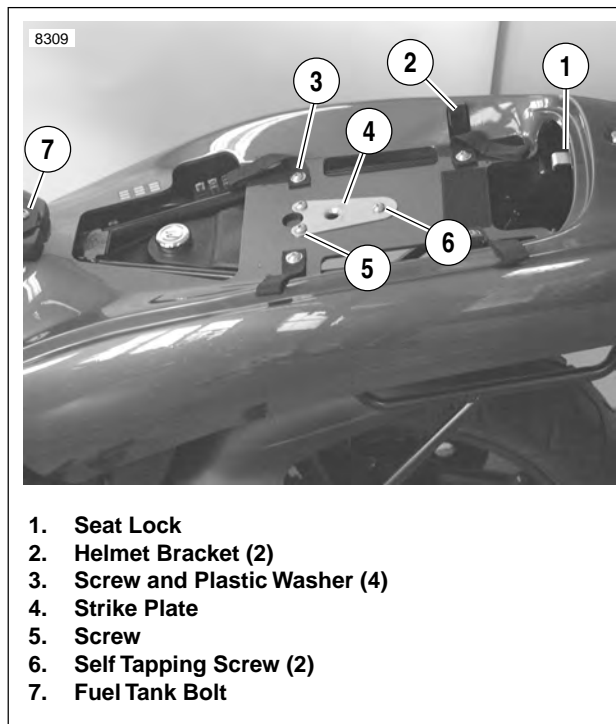


Figure 2-105. Tail Section Hardware

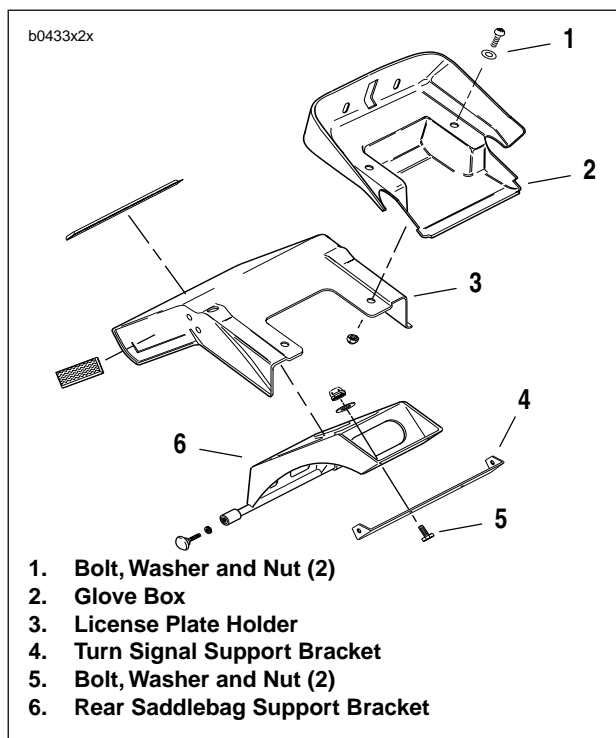


Figure 2-106. Glove Box

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 2-105](#). 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 to S3T models. See [2.37 SADDLEBAGS \(S3T\)](#).

Glove Box and License Plate Holder

1. See [Figure 2-107](#). Install turn signal support bracket (1) and rear saddlebag support bracket (3) (S3 models equipped with touring package) using bolts, washers and nuts (2).
2. See [Figure 2-108](#). Place license plate holder (3) on frame. Install turn signals. See [7.14 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 [7.13 TAIL LAMP](#).

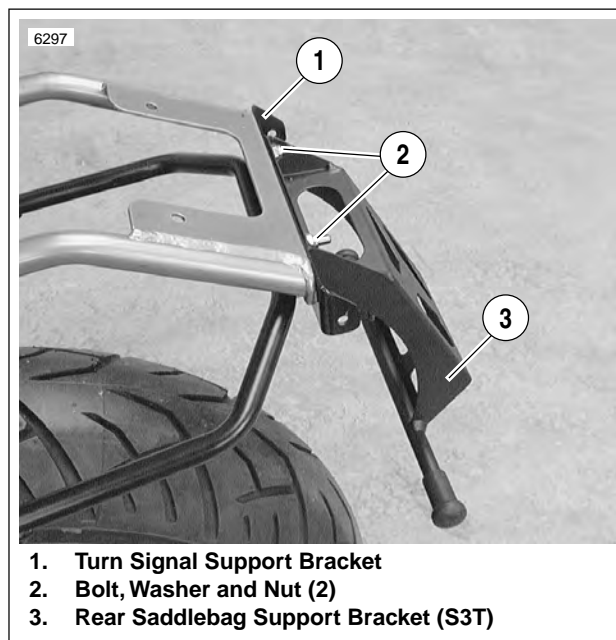


Figure 2-107. Saddlebag Brackets

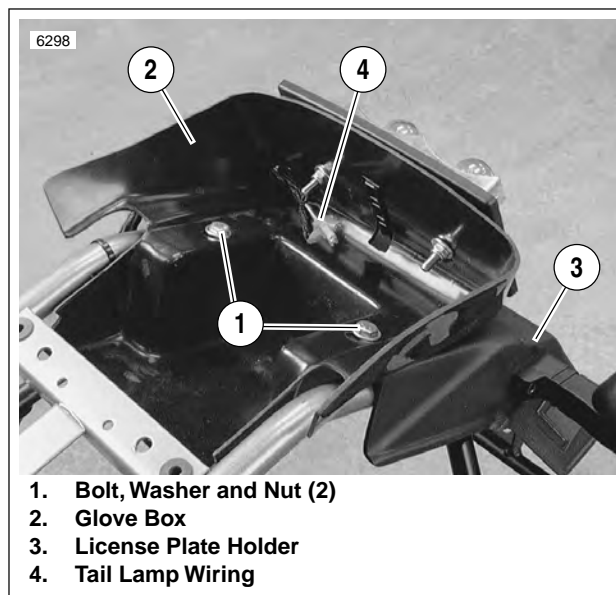


Figure 2-108. Assembled Glove Box/License Plate Holder

REMOVAL

Front Fairing

1. See [Figure 2-109](#). Remove both fairing bags (4) from S3T models.
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 HANDLE-BARS](#).
3. Detach headlamp connector from bulb. See [7.12 HEAD-LAMP](#).

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 2-110](#). Remove two locknuts (1), washers (2) and bolts (3) to detach front fairing mount from steering head.

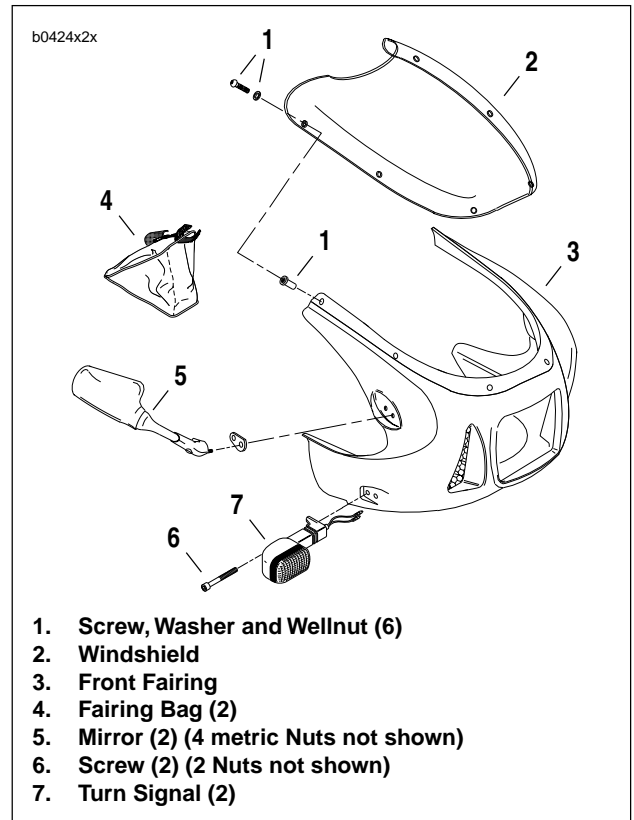


Figure 2-109. Front Fairing

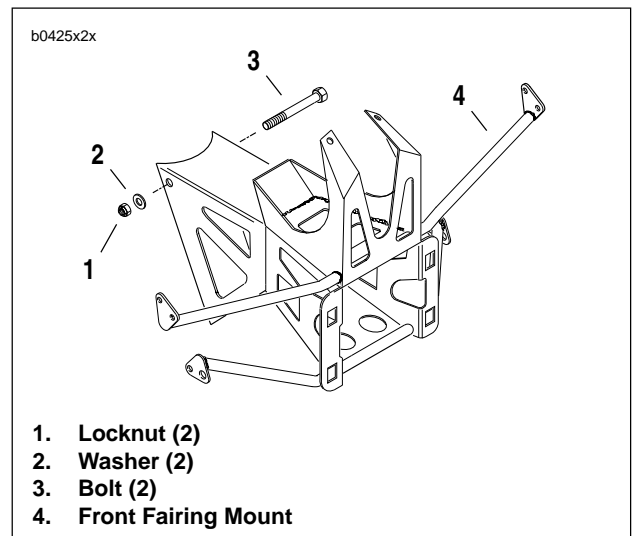


Figure 2-110. Front Fairing Mount

INSTALLATION

Front Fairing Mount

1. Align and install front fairing mount on frame.
 - a. See [Figure 2-111](#). 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 2-110](#). 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 [7.12 HEADLAMP](#).
3. See [Figure 2-112](#). Use **new** cable straps (3) to secure wires (1, 2) to front fairing mount.
4. Install dash panel and both gauges. See [2.26 HANDLE-BARS](#).
5. Install front fairing.

Front Fairing

1. See [Figure 2-109](#). 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 [7.14 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) on S3T models.

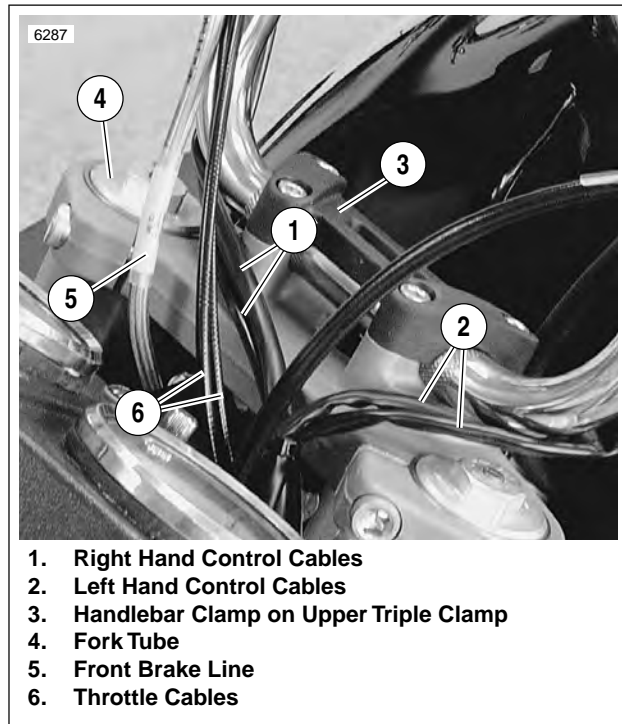


Figure 2-111. Front Fairing Mount Alignment

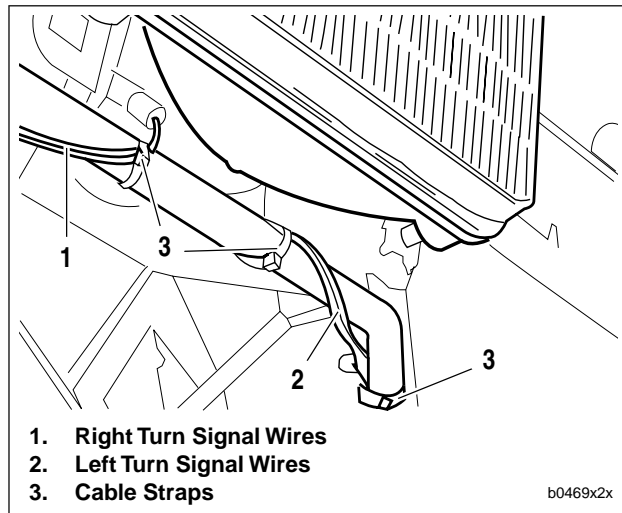


Figure 2-112. Cable Straps

REMOVAL

Seat

1. See [Figure 2-113](#). 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 2-114](#). 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 2-115](#). 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 2-116](#). 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 2-113](#). 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 2-116](#). 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 2-113. Removing Seat

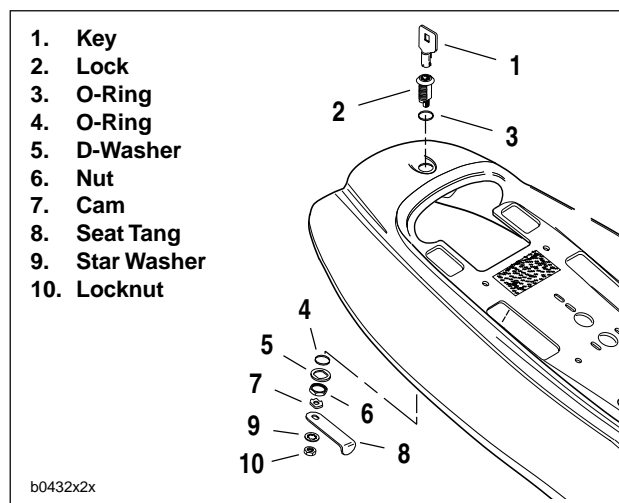


Figure 2-114. Seat Lock

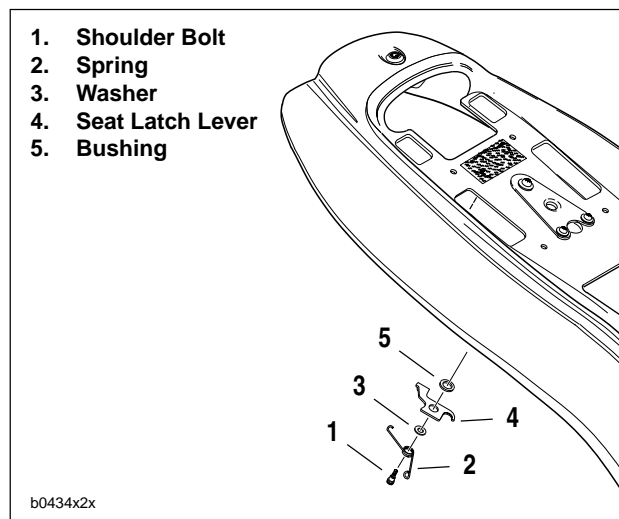


Figure 2-115. Seat Release

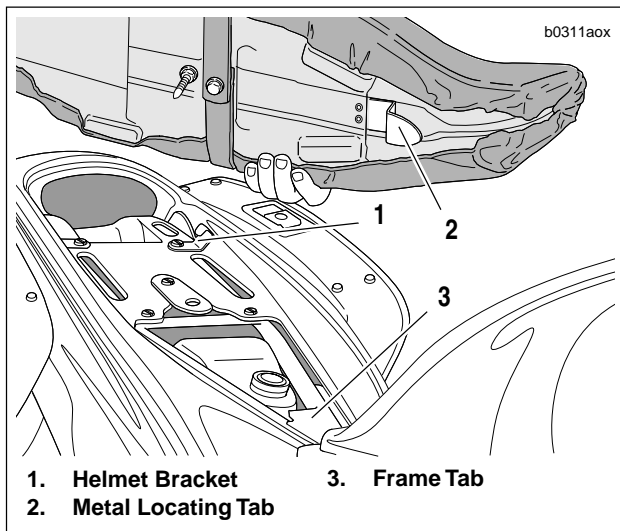


Figure 2-116. Seat

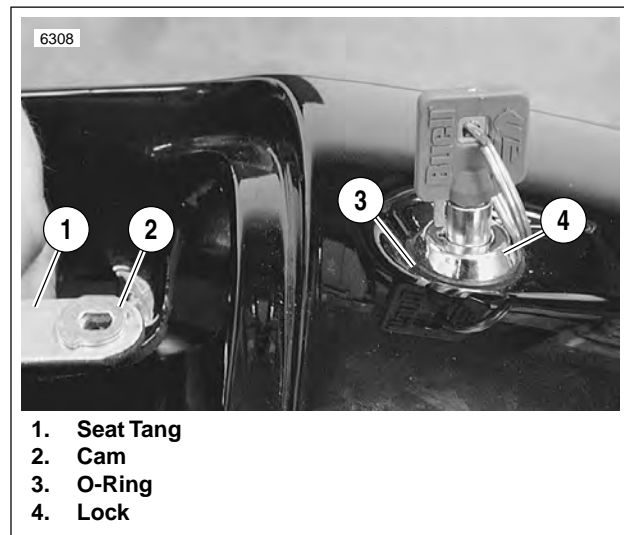


Figure 2-117. Installing Seat Lock

Seat Lock

1. See Figure 2-117. Place O-ring (3) and lock (4) in tail section as shown.
2. See Figure 2-114. 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 2-117. Position cam (2) on seat tang (1). Install assembly on lock.
4. See Figure 2-114. 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.

Seat Release

1. See Figure 2-115. Place bushing (5) on top of seat latch lever (4).
2. See Figure 2-118. 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.

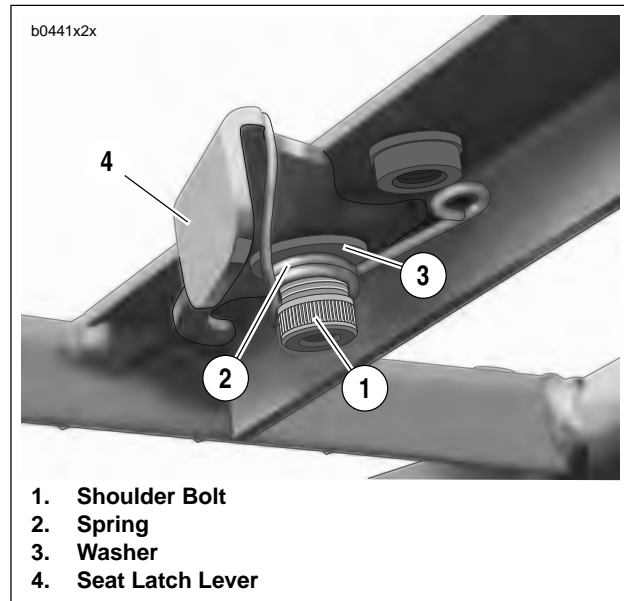


Figure 2-118. Installing Seat Release

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 on S3T models.

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.

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 2-119](#). The side stand activates the side stand switch which is part of the starter interlock system. See [7.6 STARTER INTERLOCK](#) for more information.

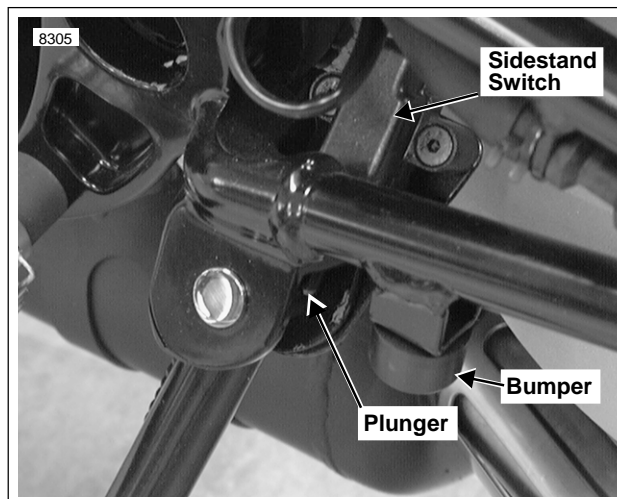


Figure 2-119. Side Stand Switch

REMOVAL/DISASSEMBLY

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See [Figure 2-120](#). 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 2-121](#).
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 2-120](#). 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.

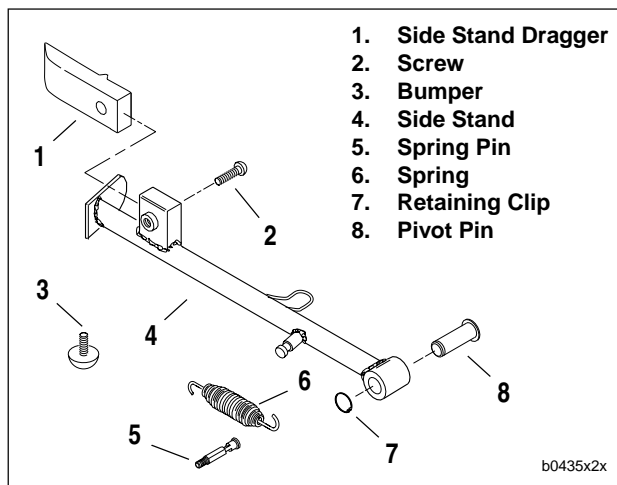


Figure 2-120. Side Stand

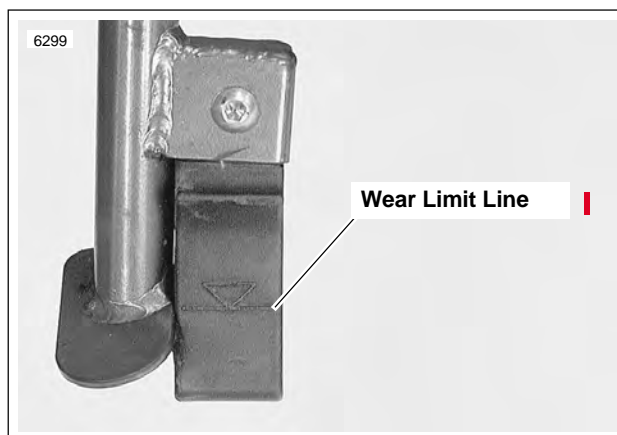


Figure 2-121. Side Stand Dragger Wear Limit

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 2-122. Each saddlebag features a barrel-style lock and a removable saddlebag liner.

See Figure 2-123. 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.

OPERATION

1. See Figure 2-122. 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 2-122. 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.

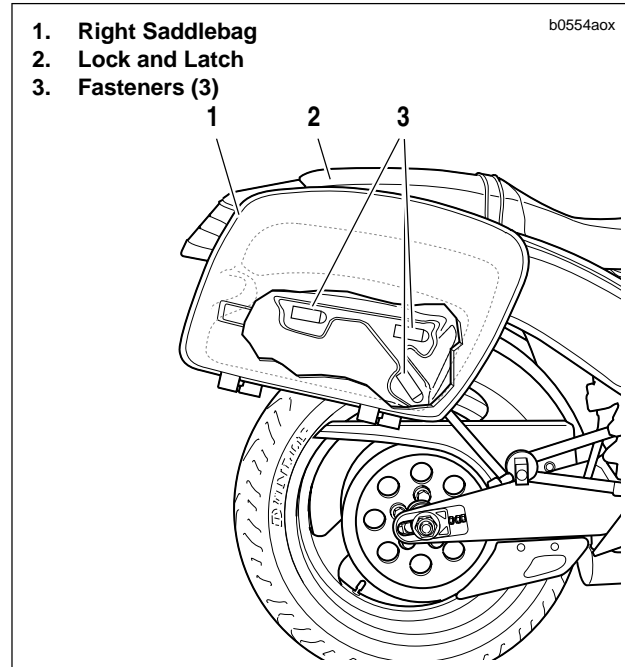


Figure 2-122. S3T Saddlebags

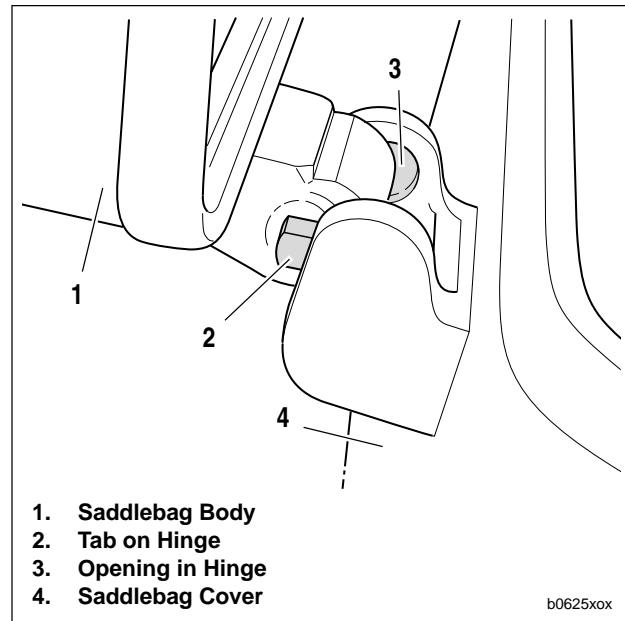


Figure 2-123. S3T Saddlebag Cover Hinge

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 2-124](#). 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 2-125](#). 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.

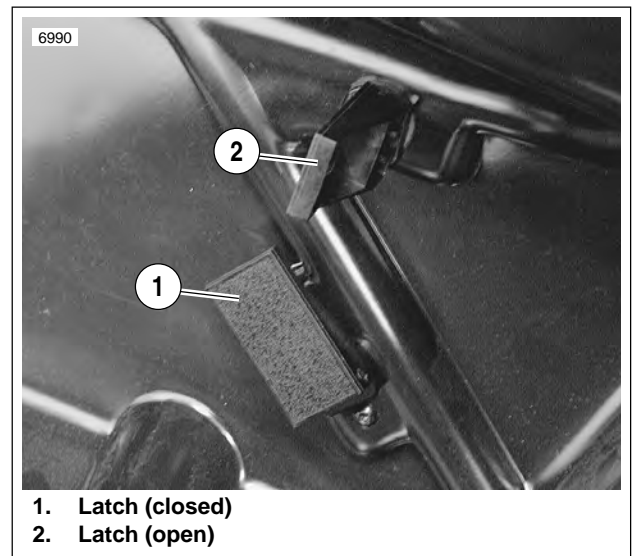


Figure 2-124. Saddlebag Latches

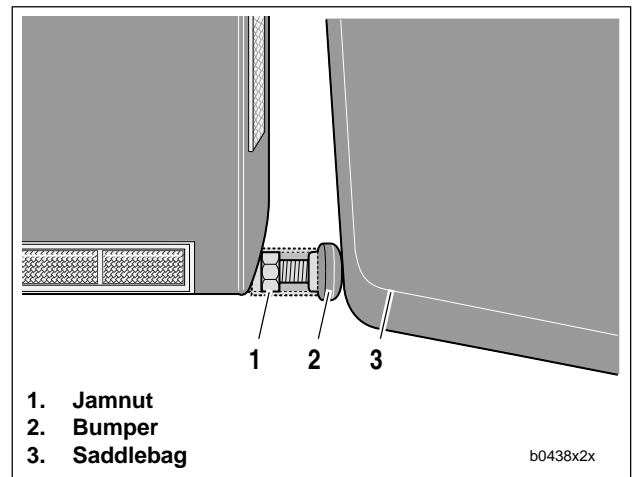


Figure 2-125. S3T Saddlebag Alignment

REMOVAL

Right Side

1. See [Figure 2-126](#). 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 2-126](#). 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.

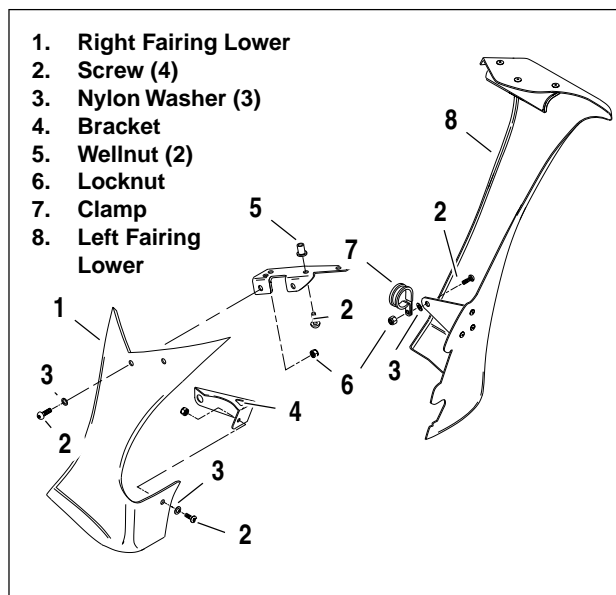


Figure 2-126. Fairing Lower

INSTALLATION

Right Side

1. See [Figure 2-126](#). 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 2-127](#). 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).

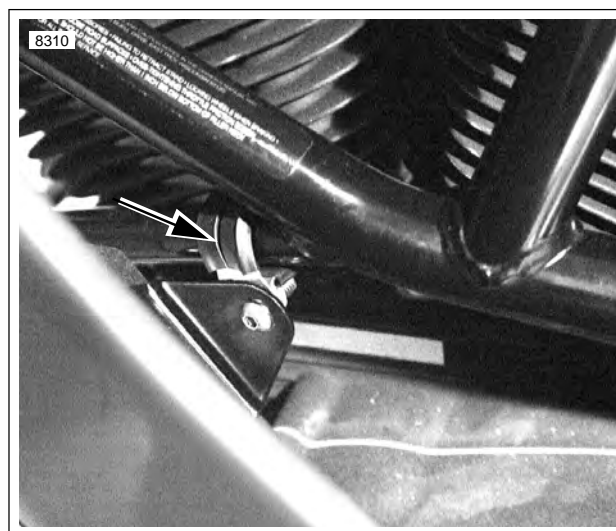


Figure 2-127. Left Fairing Lower Clamp

⚠ 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](#).

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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°	

CAMSHAFT SPECIFICATIONS	
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
Bushings 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
	0.020 OS	3.517 in.	89.332 mm	3.5200 in.	89.4080 mm
OS=over size	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 journal diameter		1.2496-1.2500 in.	31.7398-31.7500 mm	1.2496 in. (min)	31.7398 mm (min)
Outer race diameter in right crankcase		1.5646-1.5652 in.	39.7408-39.7561 mm	1.5672 in. (max)	39.8069 mm (max)
Bearing running clearance		0.00012-0.00088 in.	0.00305-0.02235 mm		
Fit in cover bushing (loose)		0.0023-0.0043 in.	0.0584-0.1092 mm	0.0050 in.	0.1270 mm

TORQUE VALUES

ITEM	TORQUE		NOTES
Anti-Rotation Screws	80-110 in-lbs	9-12 Nm	
Crankcase 1/4 in. Screws	70-110 in-lbs	8-12 Nm	
Crankcase 5/16 in. Screws	15-18 ft-lbs	20-24 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	4-6 ft-lbs	5-8 Nm	
Oil Pump Cover Screws	125-150 in-lbs	14-17 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	130-150 in-lbs	15-17 Nm	
Rocker Box to Head Bolts	15-19 ft-lbs	20-26 Nm	2 sizes
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	

MODEL YEAR CHANGE

All 2001 Model Year Thunderstorm™ engines are equipped with a **new** oil pump with increased scavenging ability, high contact ratio cam gears and Harley-Davidson No. 10R12 spark plugs. Cylinders on M2/M2L models, clutch covers and clutch inspection covers are now powder-coated black. Push-rod tubes and starters are now painted black. The two-piece intake manifold seals remain for the model year.

GENERAL

The Thunderstorm™ 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/m²) or more and do not indicate more than a 10 psi (69 kN/m²) 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.

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.
3. Remove seat and fuel tank. See [4.36 FUEL TANK](#).
4. Remove left and right fairing lower from S3T models. See [2.38 FAIRING LOWERS \(S3T\)](#).
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 ([7.17 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.

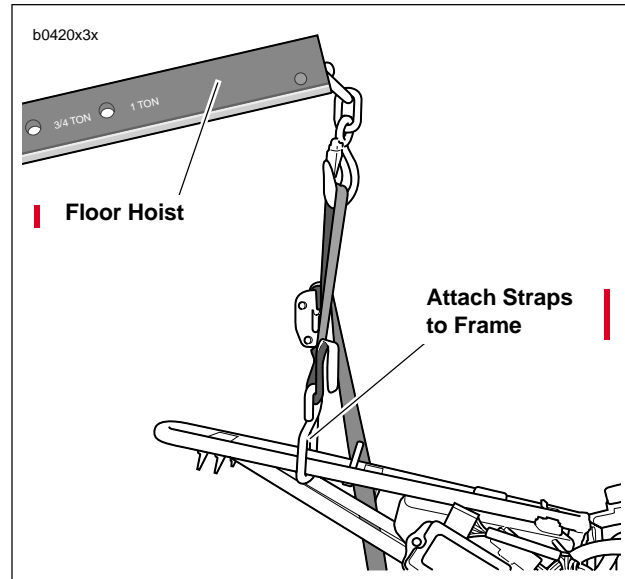


Figure 3-1. Floor Hoist (Typical)

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 swing-arm. 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](#).

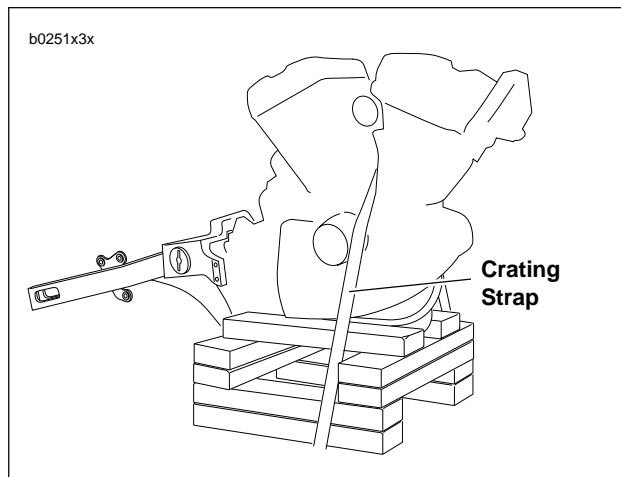


Figure 3-2. Supporting the Engine

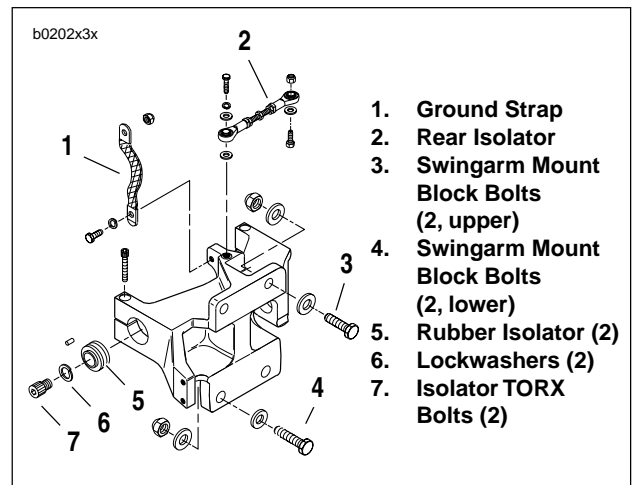


Figure 3-3. Rear Tie Bar Assembly

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 SWING-ARM](#).
23. If necessary, detach swingarm mount block from powertrain by removing bolts (3, 4), washers and locknuts.

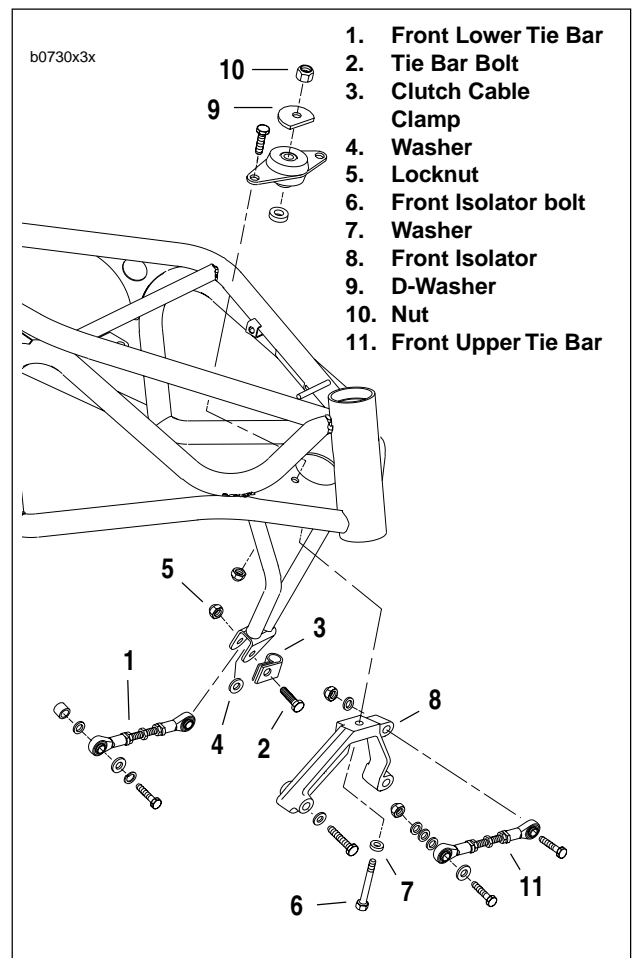


Figure 3-4. Front Tie Bar Assembly

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. Install rear isolators but do not tighten isolator bolts at this time. See [2.20 REAR ISOLATORS](#).

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 ([7.17 HORN](#)) and ignition coil ([7.4 IGNITION COIL](#)).
6. Install spark plugs and connect cables. See [1.16 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 on S3T models. See [2.38 FAIRING LOWERS \(S3T\)](#).
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 [1.9 DRIVE BELT DEFLECTION](#).
 - b. Adjust rear shock spring preload. See [1.12 PRE-LOAD ADJUSTMENT](#).
 - c. Adjust clutch lever. See [1.8 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.

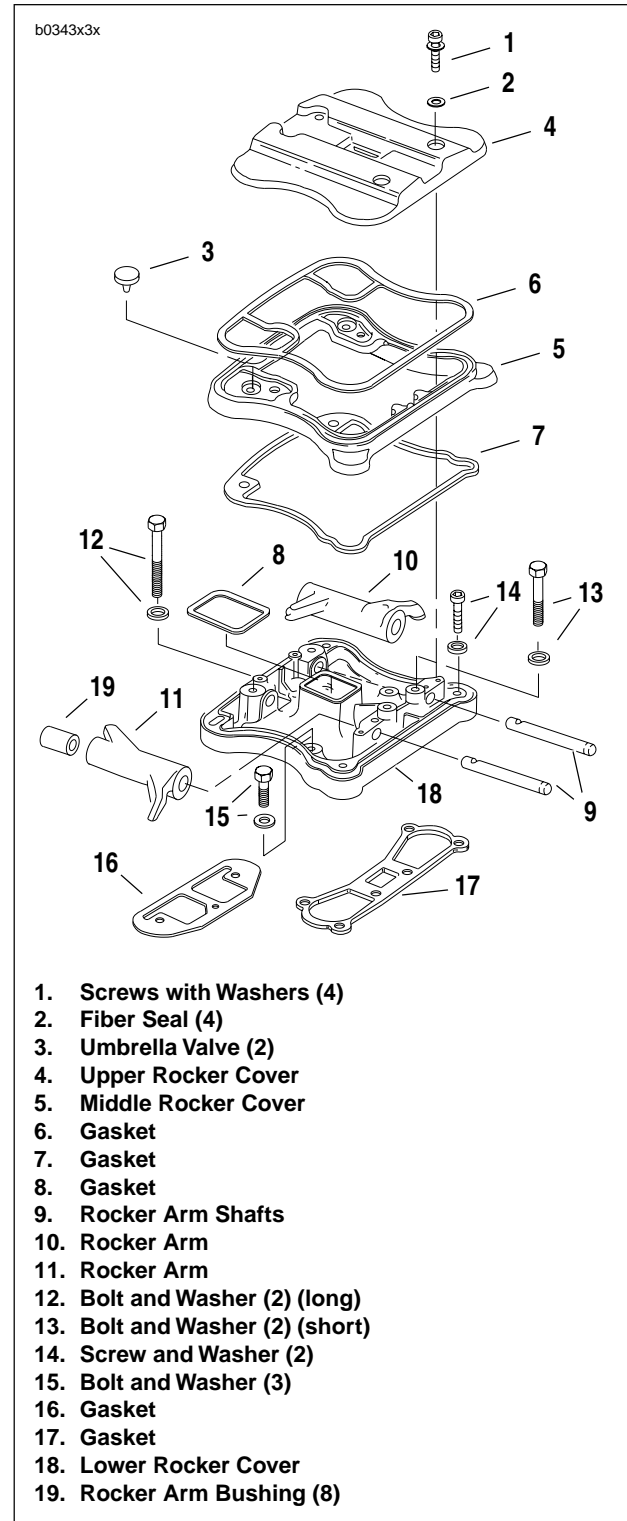


Figure 3-5. Rocker Arm Cover

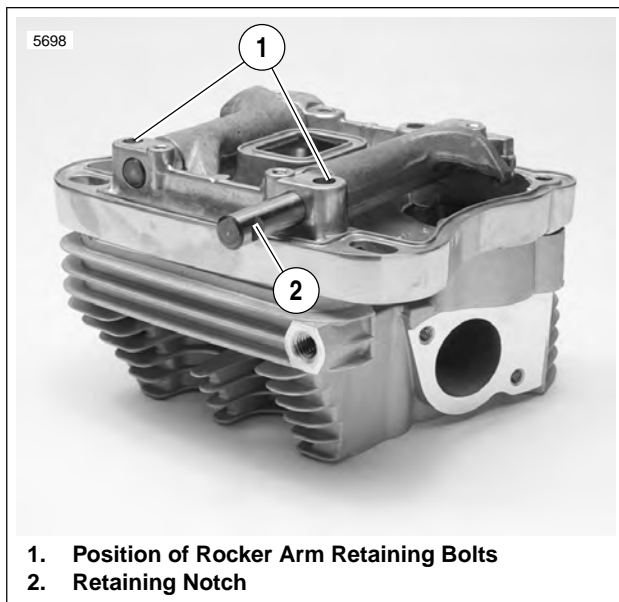


Figure 3-6. Removing Rocker Arm Shafts

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.

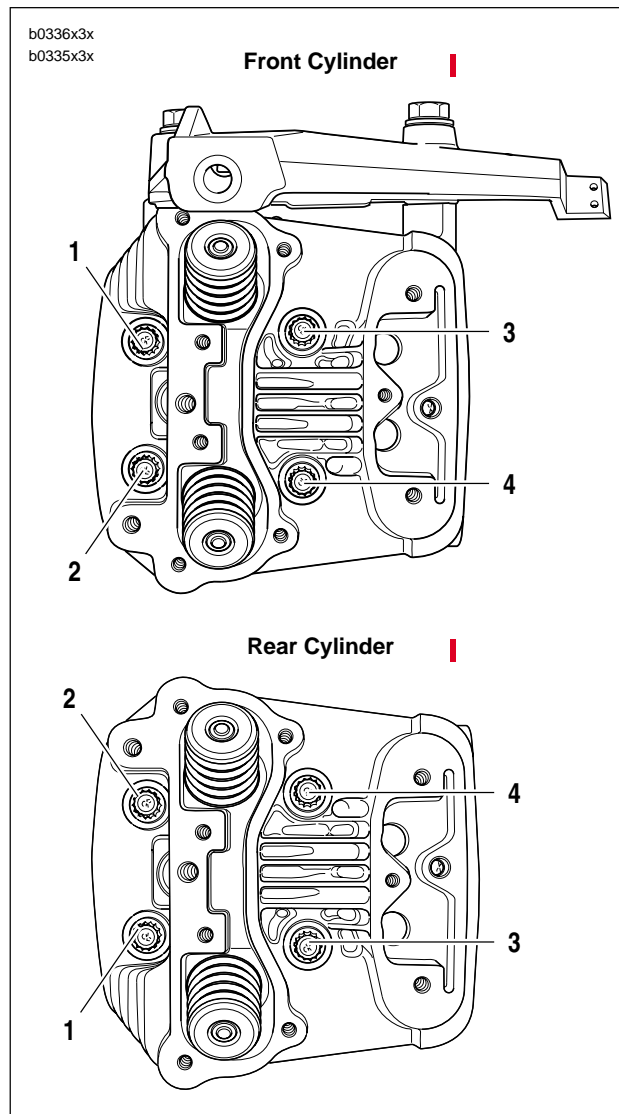


Figure 3-7. Head Screw Loosening/Tightening Sequence

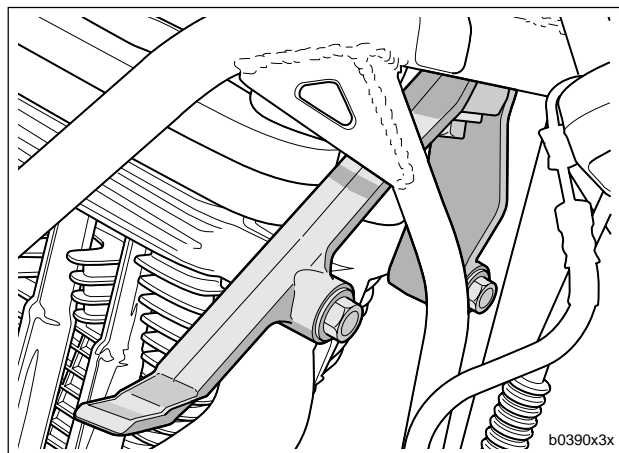
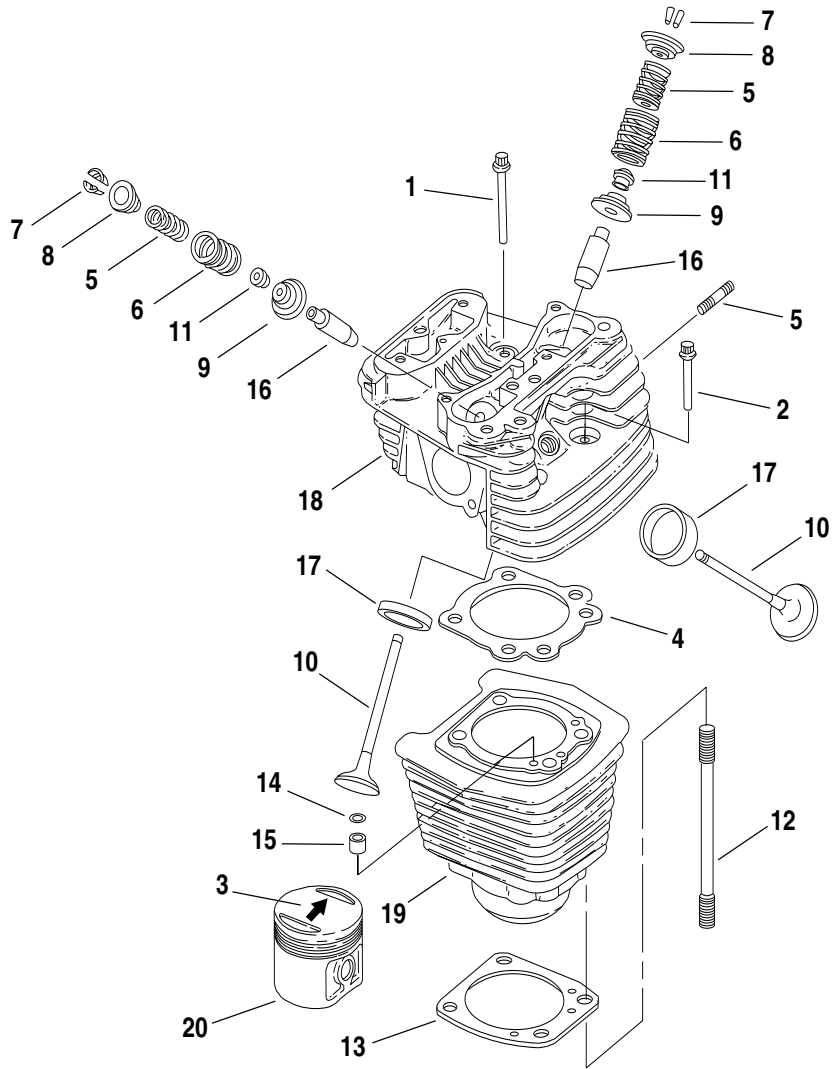


Figure 3-8. Front Isolator Mount (4th Tie Bar Not Shown)

xlhcyhead



- | | | |
|----------------------------|---------------------------------|----------------------|
| 1. Head Screw, Long (2) | 8. Upper Collar (2) | 15. Insert/Dowel (2) |
| 2. Head Screw, Short (2) | 9. Lower Collar (2) | 16. Valve Guide (2) |
| 3. Arrow, Piston Direction | 10. Valve (1 Intake, 1 Exhaust) | 17. Valve Seat (2) |
| 4. Head Gasket | 11. Valve Stem Seal (2) | 18. Cylinder Head |
| 5. Inner Valve Spring (2) | 12. Cylinder Stud (4) | 19. Cylinder |
| 6. Outer Valve Spring (2) | 13. Base Gasket | 20. Piston |
| 7. Valve Keeper (4) | 14. O-Ring (2) | |

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.

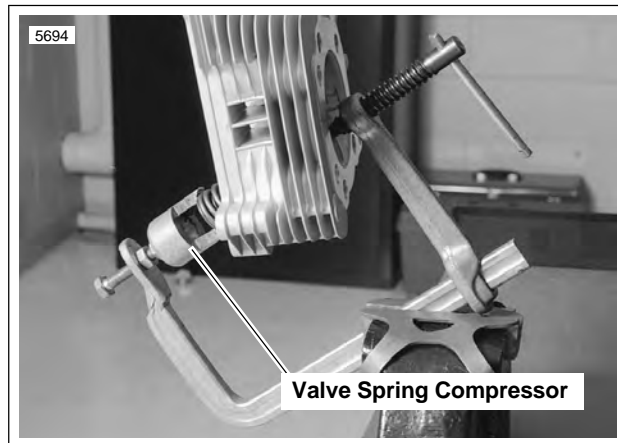


Figure 3-10. Valve Spring Compressor (Part No. HD-34736B)

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.
2. 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.
3. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.
4. Soak cylinder head in an aluminum-compatible cleaner/ 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.
5. 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.
6. Check the measurements obtained in Steps 5-6 against the SERVICE WEAR LIMITS. Repair or replace parts exceeding limits.
7. Assemble rocker arms and rocker arm shafts into lower rocker cover.
8. Check end play of rocker arm with feeler gauge.

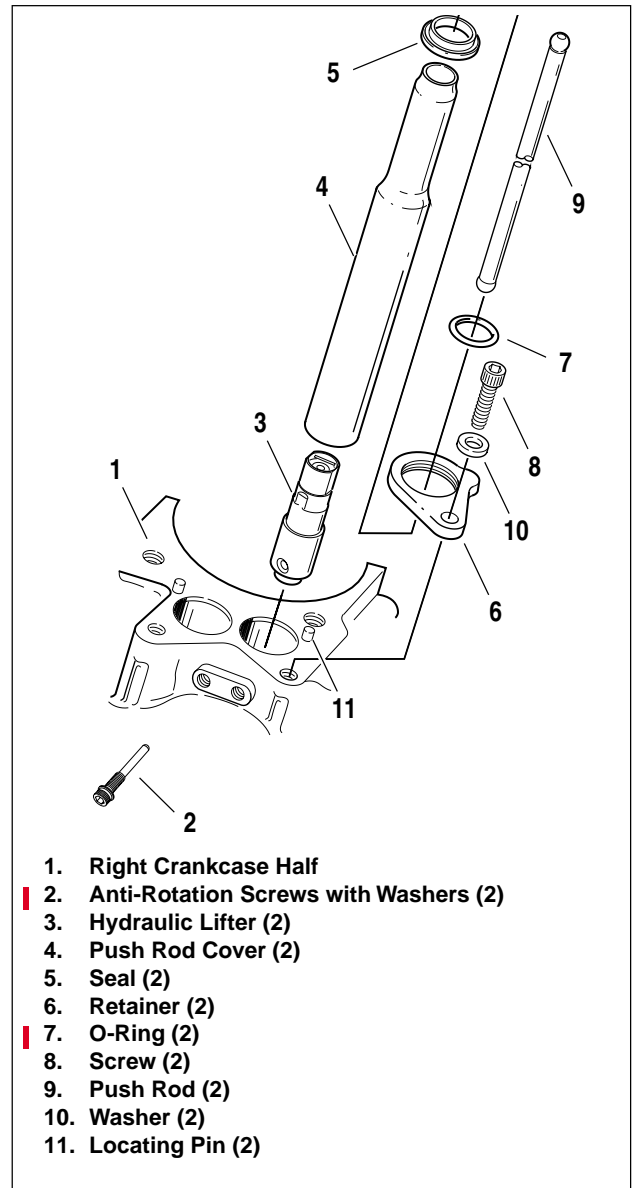


Figure 3-11. Middle Valve Train Components (Quantities per Engine Cylinder)



Figure 3-12. Measuring Rocker Arm Shaft Diameter (Rocker Cover Position)



Figure 3-13. Measuring Rocker Arm Shaft Diameter (Rocker Arm Bushing Position)

9. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.635 mm).
10. 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.
11. Valve seats are also subject to wear, pitting, and burning. Resurface valve seats whenever valves are refinished.

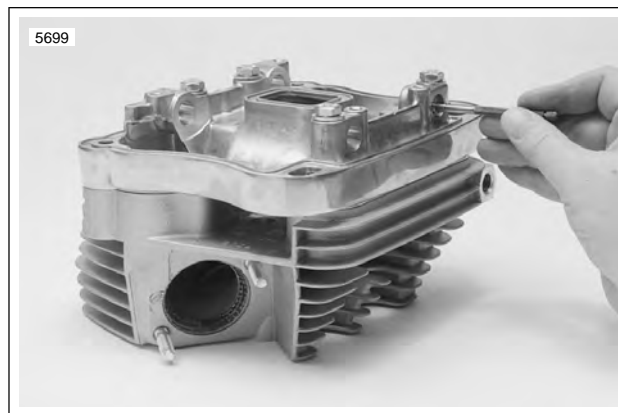


Figure 3-14. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover



Figure 3-15. Measuring Rocker Arm Bushing Inner Diameter

12. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).
13. 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.
14. 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.
15. Inspect valve springs for broken or discolored coils.

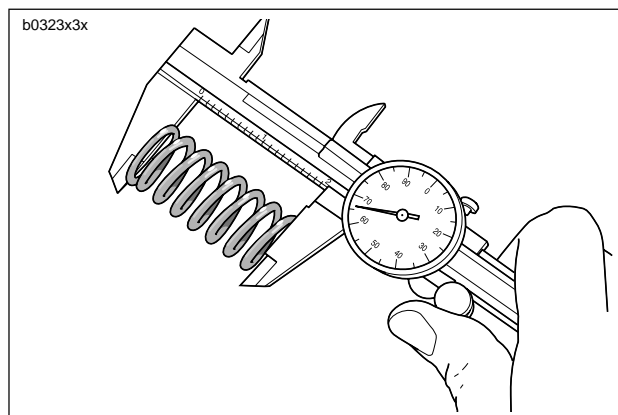


Figure 3-16. Checking Spring Free Length

16. 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.
17. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored or broken.
18. 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.

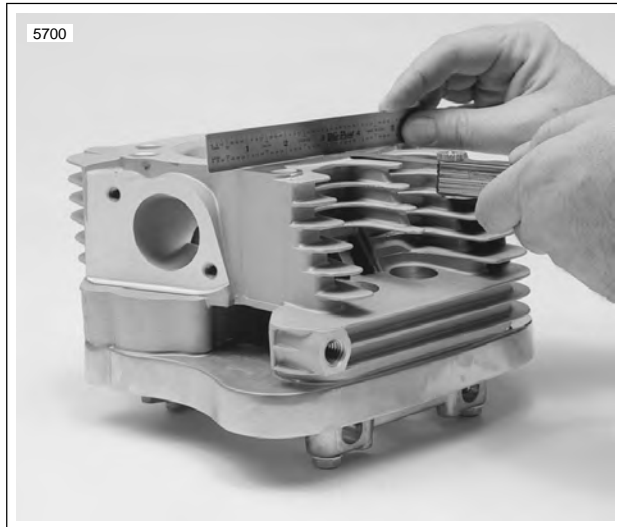


Figure 3-17. Checking Gasket Surface

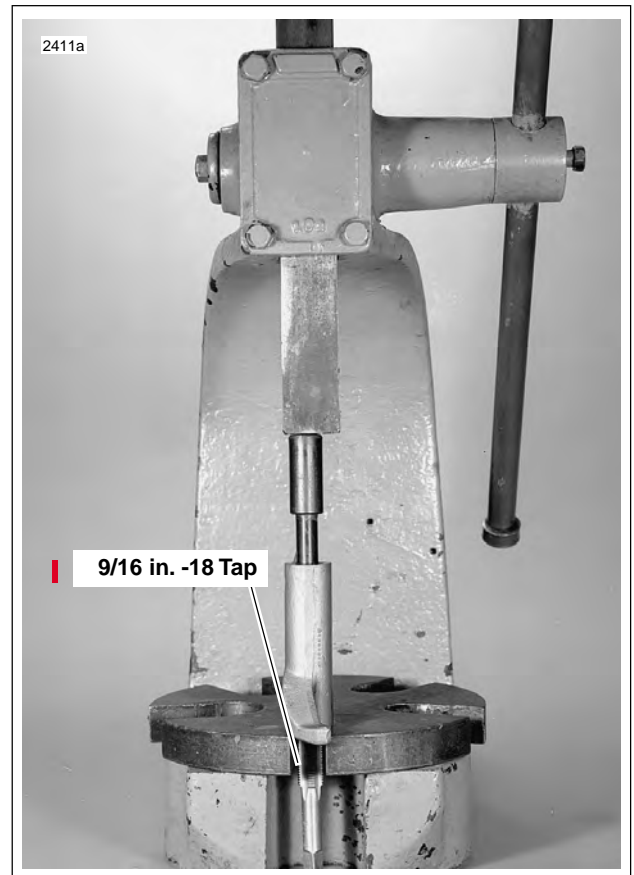


Figure 3-18. Removing Rocker Arm Bushing

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

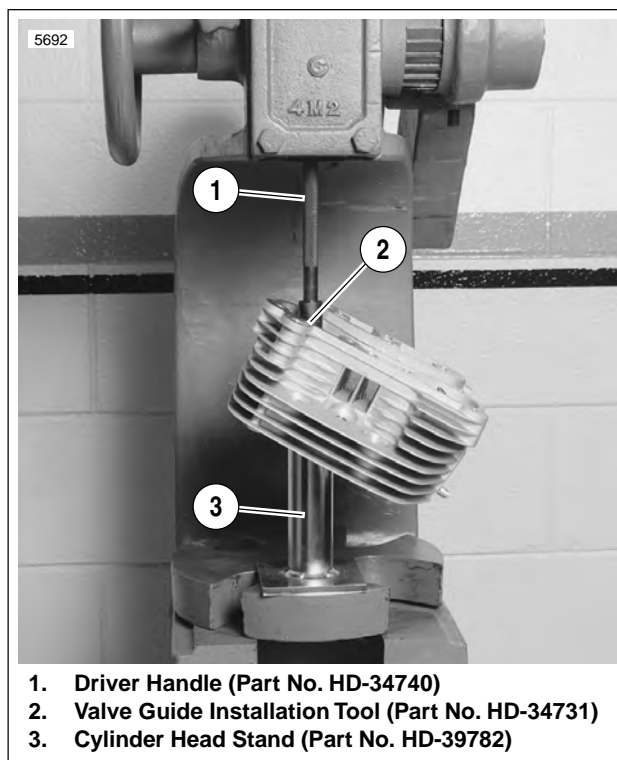
VALVE	CLEARANCE	SERVICE WEAR LIMIT
Exhaust	0.0015-0.0033 in. (0.0381-0.0838 mm)	0.0040 in. (0.1016 mm)
Intake	0.008-0.0026 in. (0.203-0.0660 mm)	0.0035 in. (0.0889 mm)

- To remove shoulderless guides, press or tap guides toward combustion chamber using **DRIVER HANDLE AND REMOVER** (Part No. HD-34740).
- Clean and measure valve guide bore in head.
- 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).
- 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.
- 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.
- 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

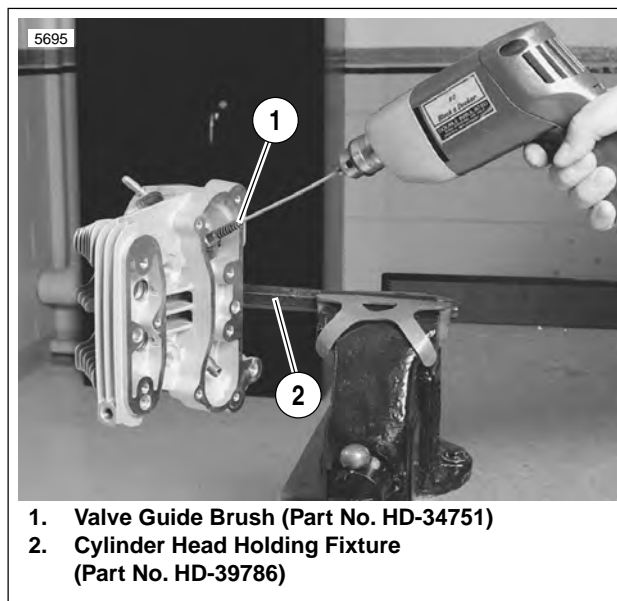
The hone is not intended to remove material.

- See [Figure 3-20](#). Thoroughly clean valve guide bores using **VALVE GUIDE BRUSH** (1) (Part No. HD-34751) and hot soapy water.



- Driver Handle (Part No. HD-34740)**
- Valve Guide Installation Tool (Part No. HD-34731)**
- Cylinder Head Stand (Part No. HD-39782)**

Figure 3-19. Installing Shoulderless Valve Guide



- Valve Guide Brush (Part No. HD-34751)**
- 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.

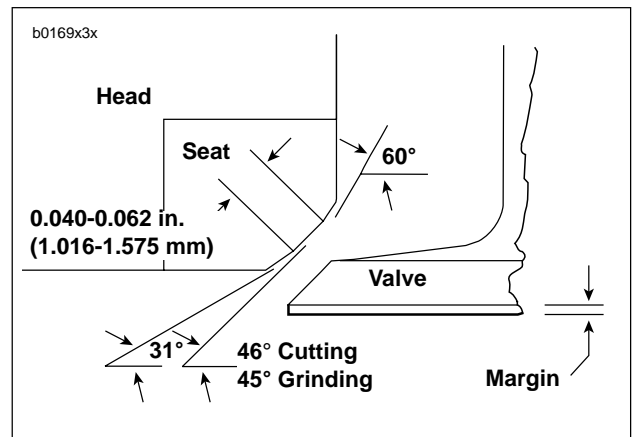


Figure 3-21. Valve Seat Angles

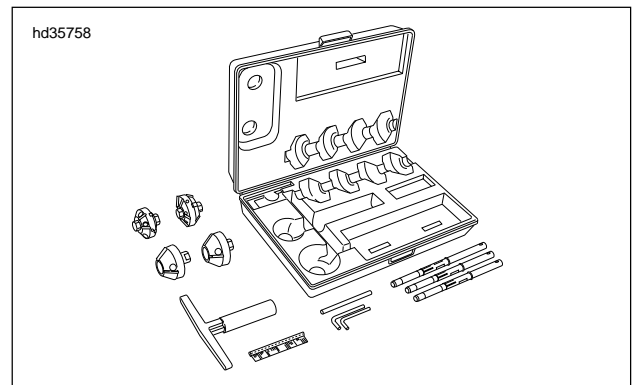


Figure 3-22. Valve Seat Cutter

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

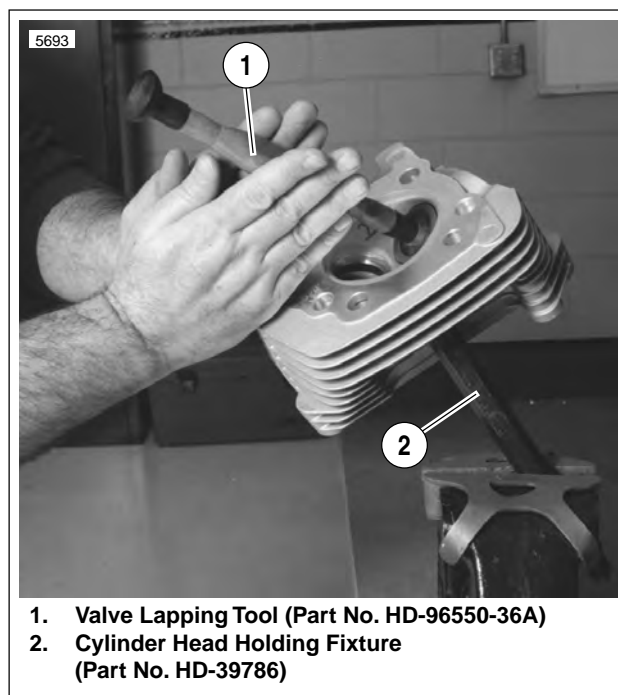
NOTE

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).

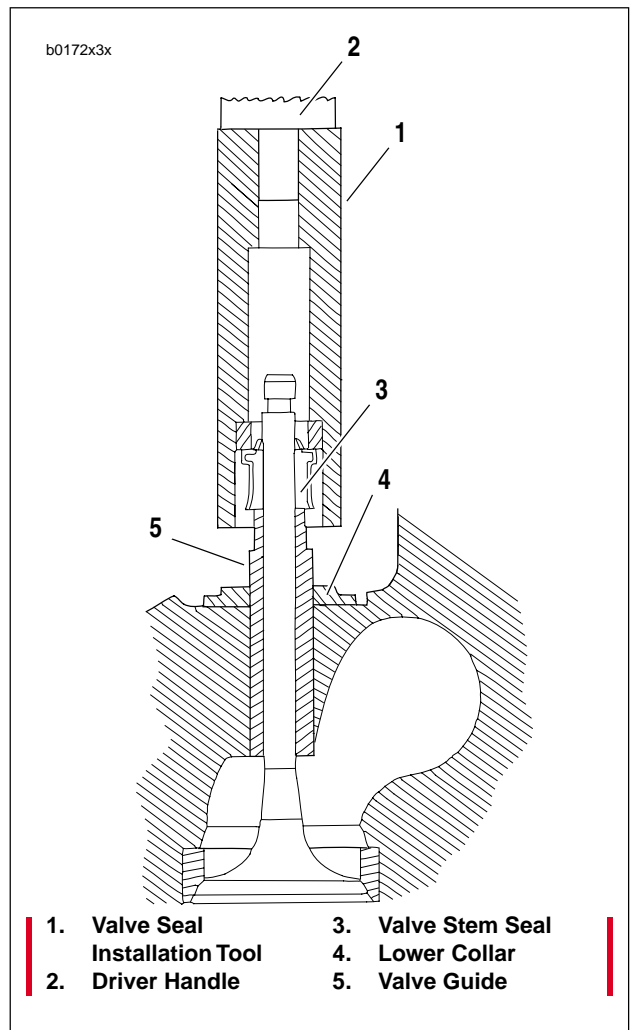


Figure 3-25. Valve Seal Installation



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 7-9 ft-lbs (10-12 Nm).
 - b. Tighten each screw to 12-14 ft-lbs (16-19 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 7-9 ft-lbs (10-12 Nm).
 - b. Tighten each screw to 12-14 ft-lbs (16-19 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 (90°) (View B).

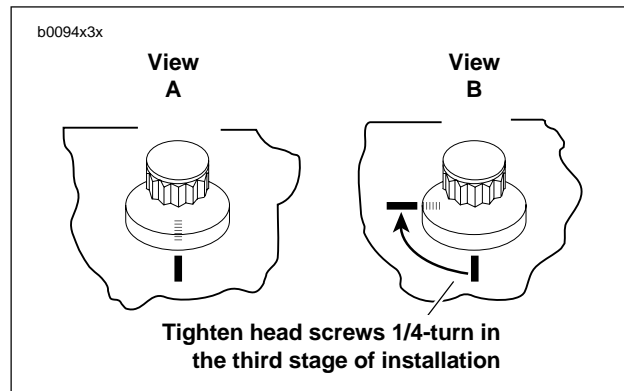


Figure 3-27. Tightening Head Screws

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.
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. Secure lifters in place.
 - a. Insert pins (2) in the holes in crankcase.
 - b. Place **new** O-rings (3) over ends of pins.
 - c. Install plate (4) using screw (5) with washer (14). Tighten to 80-110 **in-lbs** (9-12 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

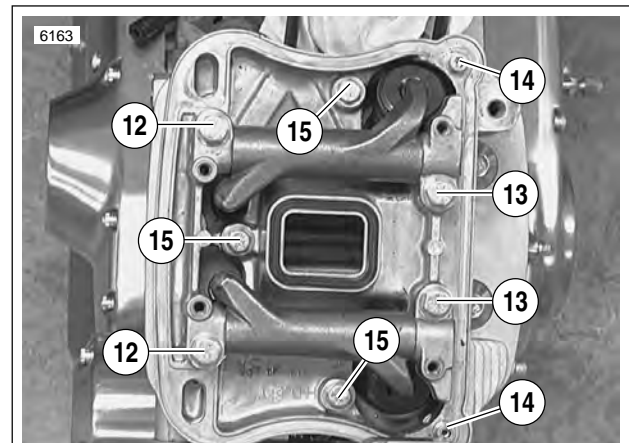
Do not turn engine over until both push rods can be turned with fingers. Otherwise, damage to push rods or rocker arms may result.

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

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.

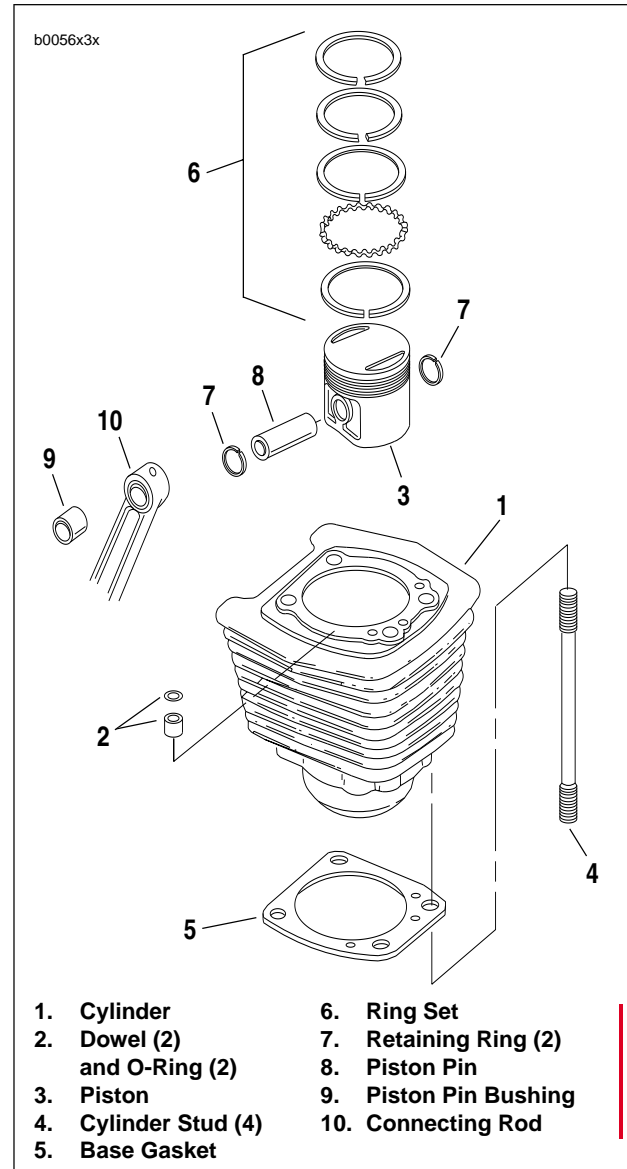


Figure 3-29. Cylinder and Piston

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.

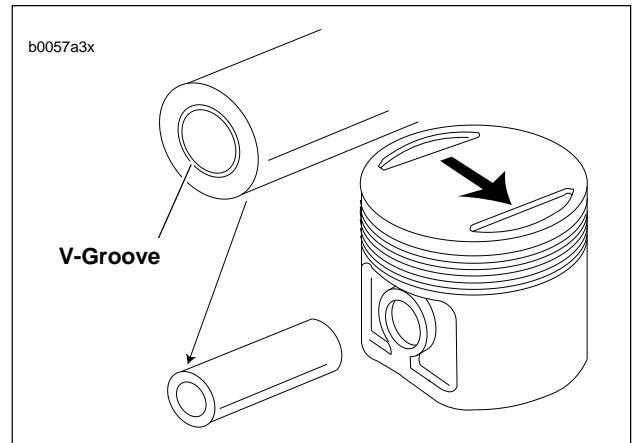


Figure 3-30. Piston Pin and Piston Identification



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](#).

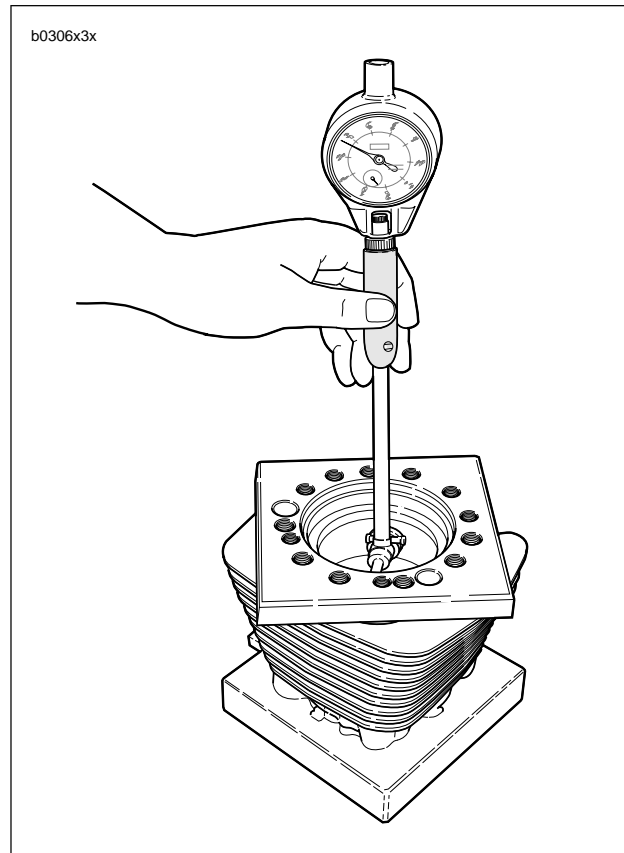


Figure 3-32. Measuring Cylinder Bore Using Torque Plates (Part No. HD-33446A)

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. \pm 0.0002 in. (88.951 mm \pm 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.

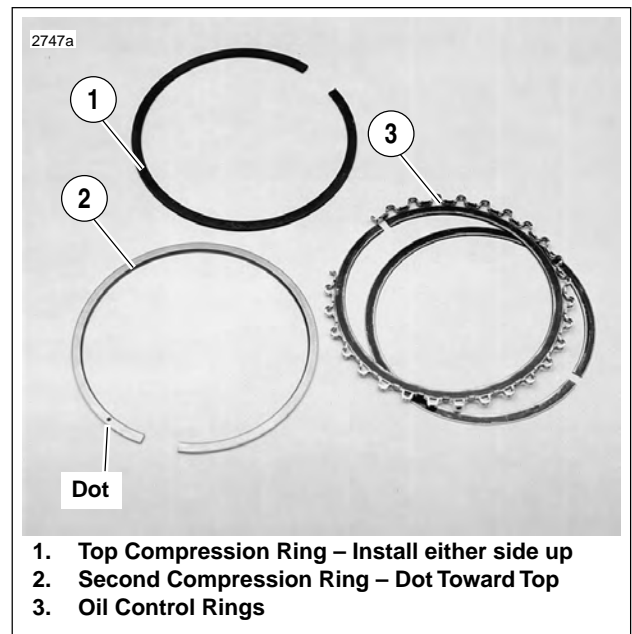


Figure 3-33. Piston Rings

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)

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.

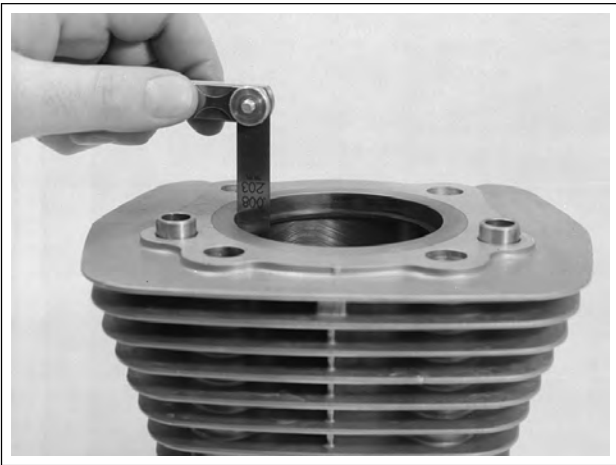


Figure 3-34. Measuring Ring End Gap

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.

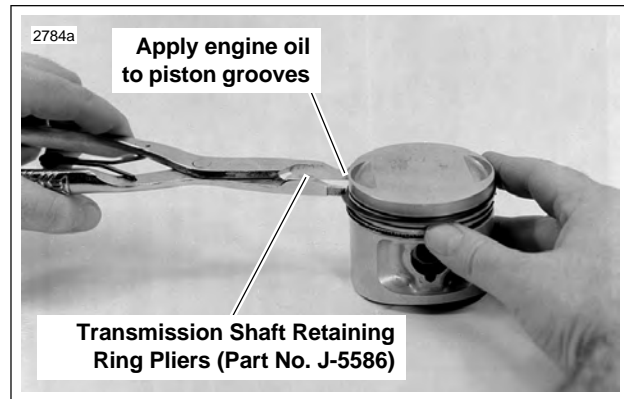


Figure 3-35. Installing Piston Rings

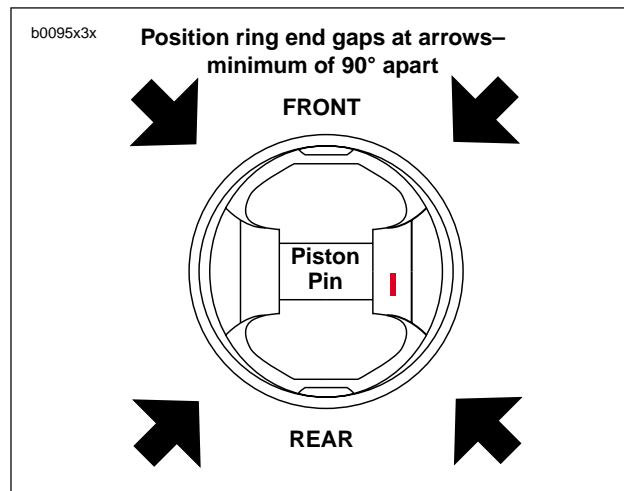


Figure 3-36. Ring End Gap Position

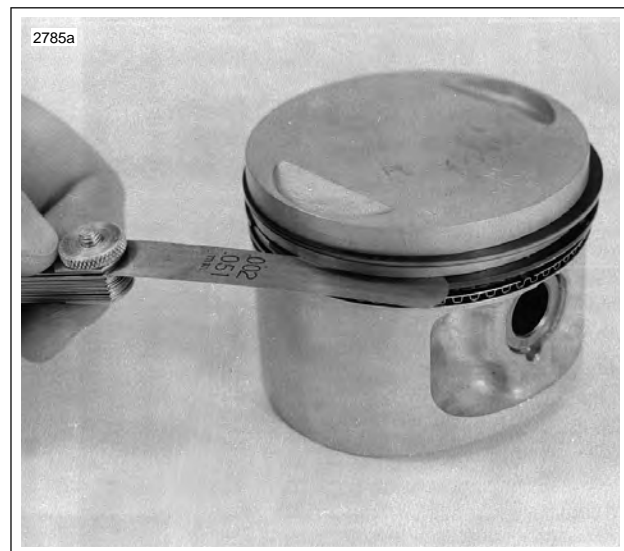


Figure 3-37. Measuring Ring Clearance in Groove

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 (Part No. HD-95970-32C) 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.

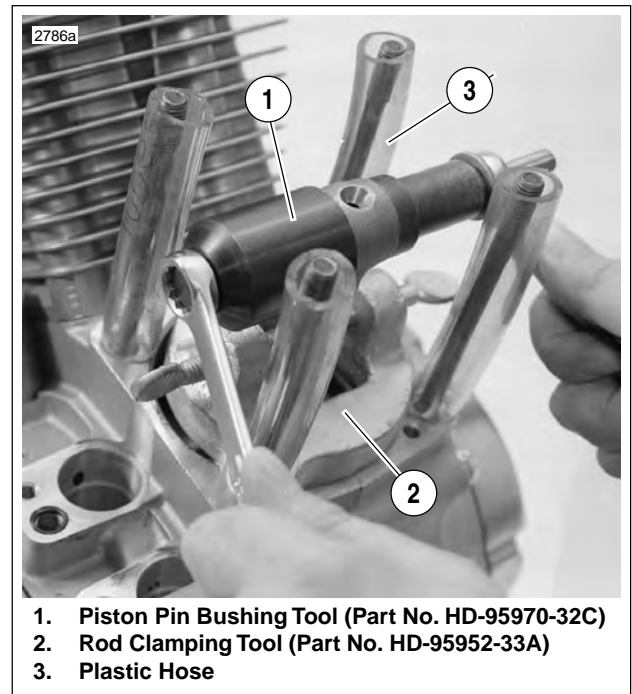


Figure 3-38. Installing New Piston Pin Bushing

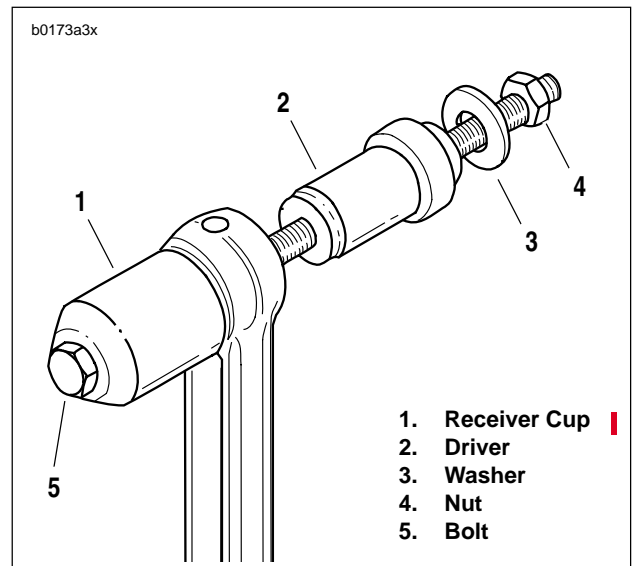


Figure 3-39. Piston Pin Bushing Tool Assembly for Bushing Removal

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

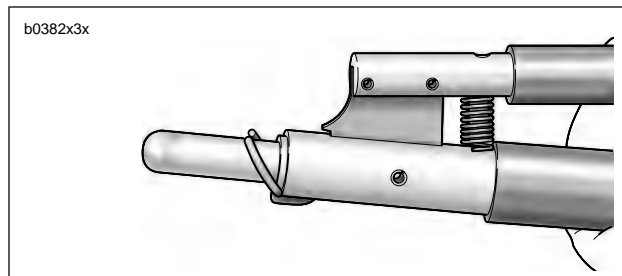


Figure 3-41. Aligning Retaining Ring



1. Piston Ring Compressor (Part No. HD-96333-51C)

Figure 3-42. Compressing Piston Rings

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.

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).

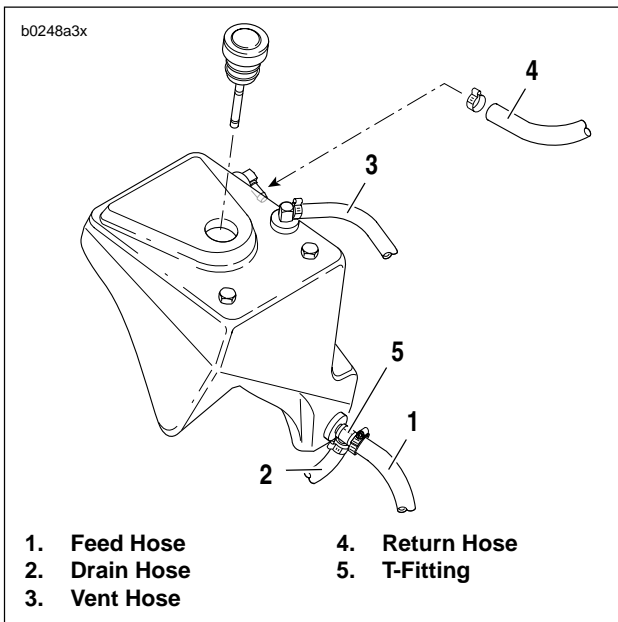


Figure 3-43. Oil Tank Hoses

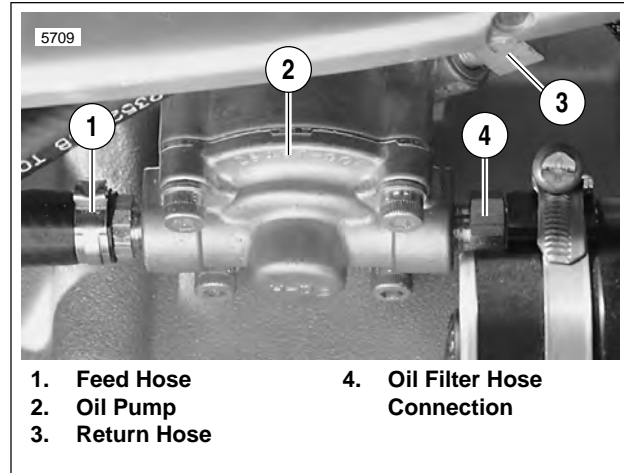


Figure 3-44. Oil Pump Connections

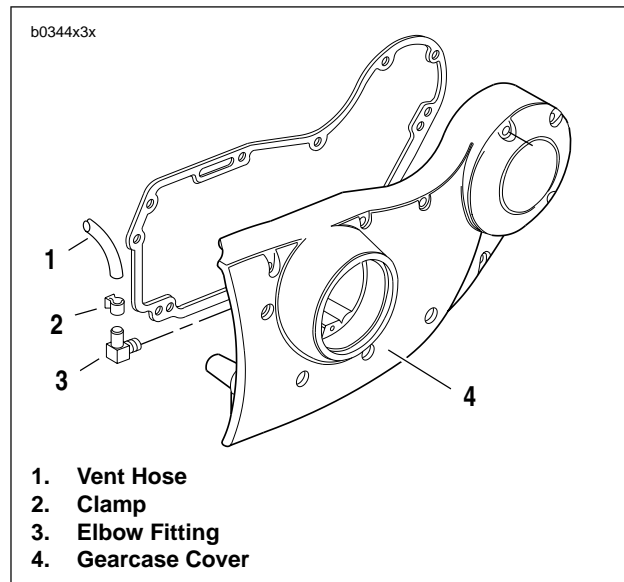


Figure 3-45. Vent Hose Connection (Typical)

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.

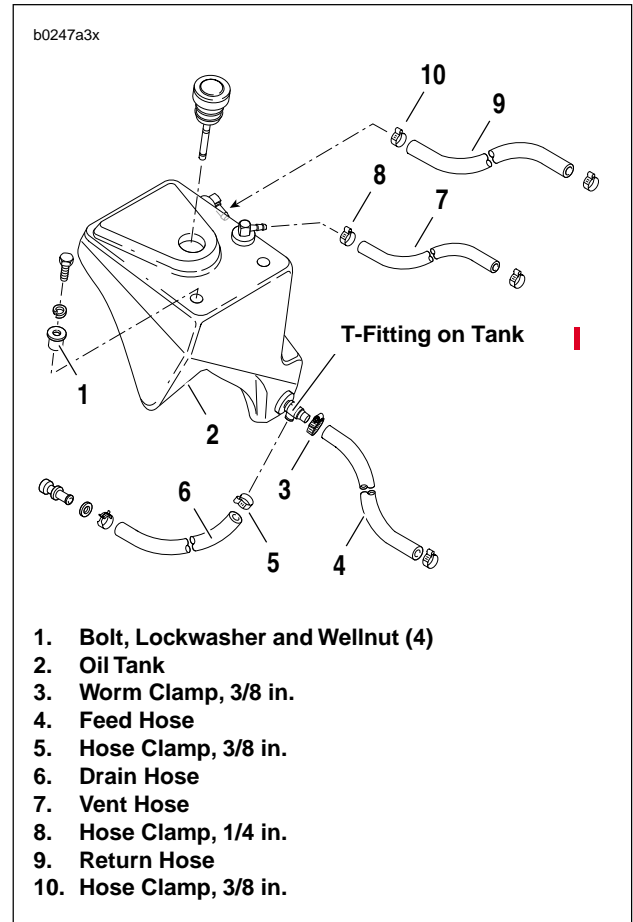


Figure 3-46. Oil Tank

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/m²). At idle speed (950-1050 RPM), oil pressure will vary from 7-12 psi (48-83 kN/m²).

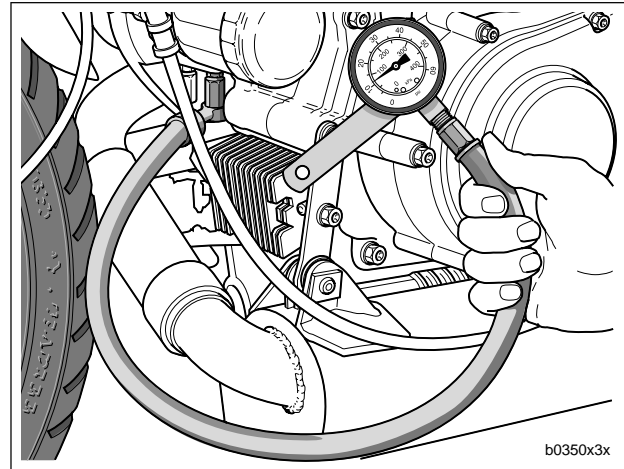


Figure 3-47. Checking Oil Pressure (Typical)

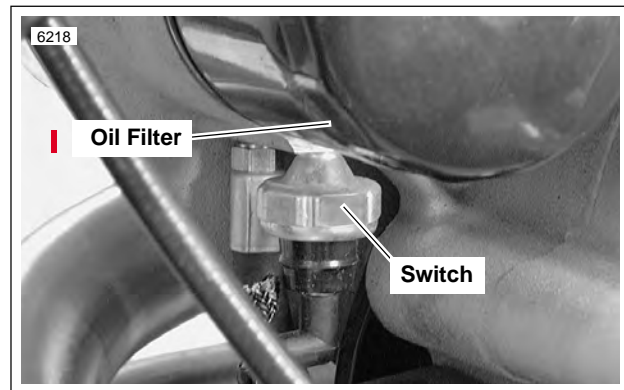


Figure 3-48. Oil Pressure Indicator Switch

Table 3-8. Troubleshooting Oil Pressure Signal Light

LIGHT	PROBABLE CAUSES
Stays on at speeds above idle.	<ul style="list-style-type: none"> ● 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.	<ul style="list-style-type: none"> ● 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).	<ul style="list-style-type: none"> ● Malfunctioning signal switch. ● Malfunction in wiring. ● Burned-out signal bulb. ● Dead battery (see NOTE above).

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.

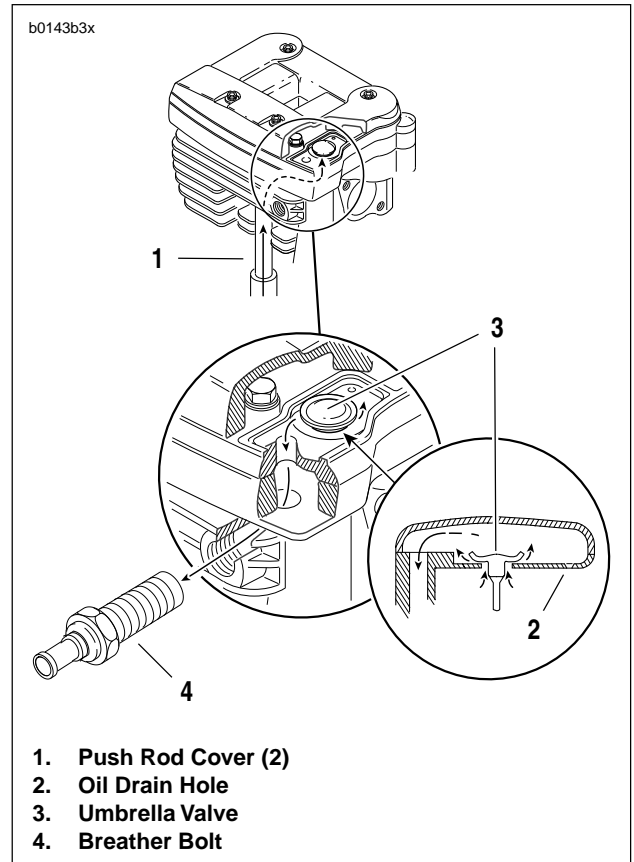


Figure 3-49. Crankcase Breathing System, Typical Cylinder

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.

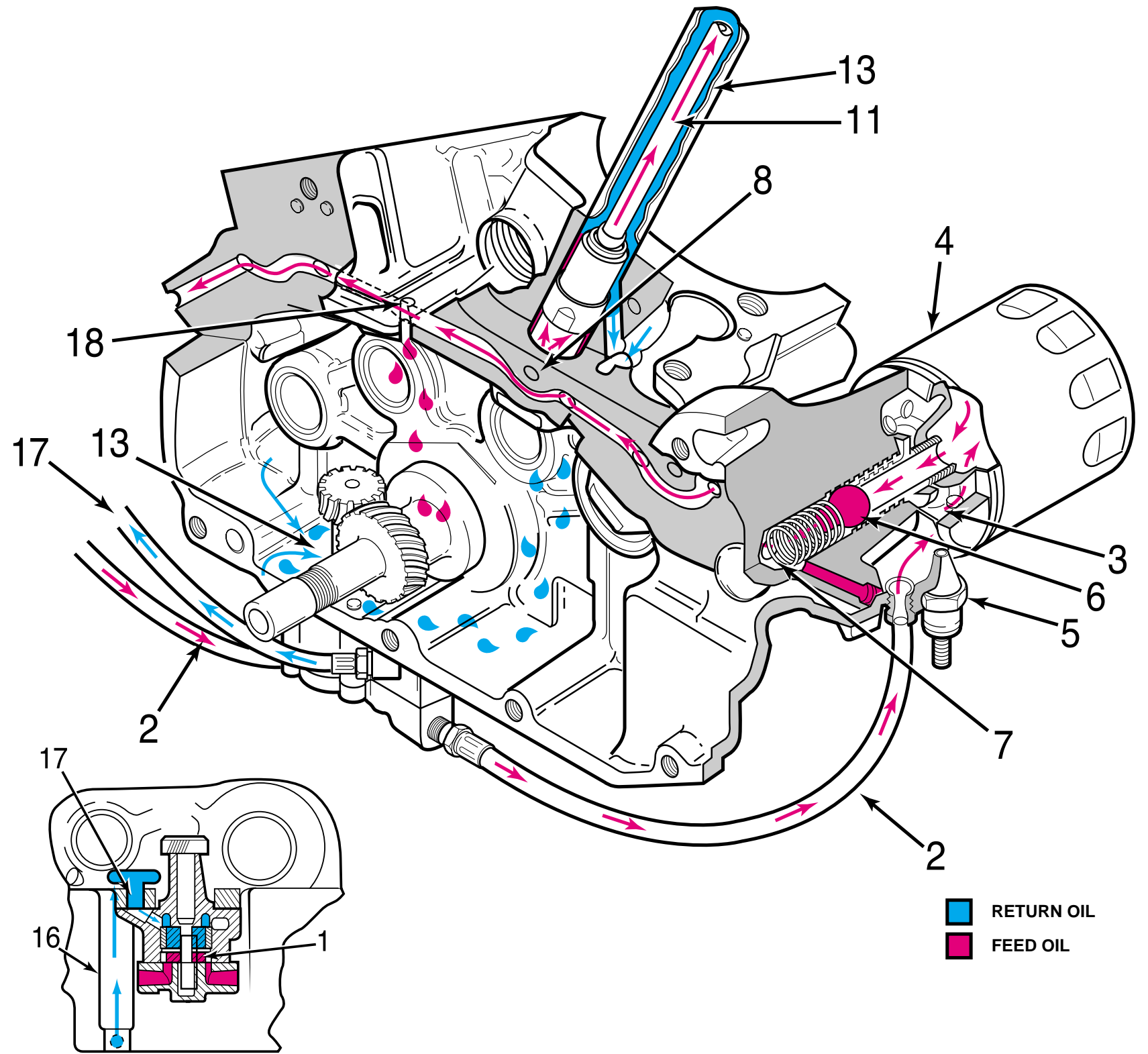
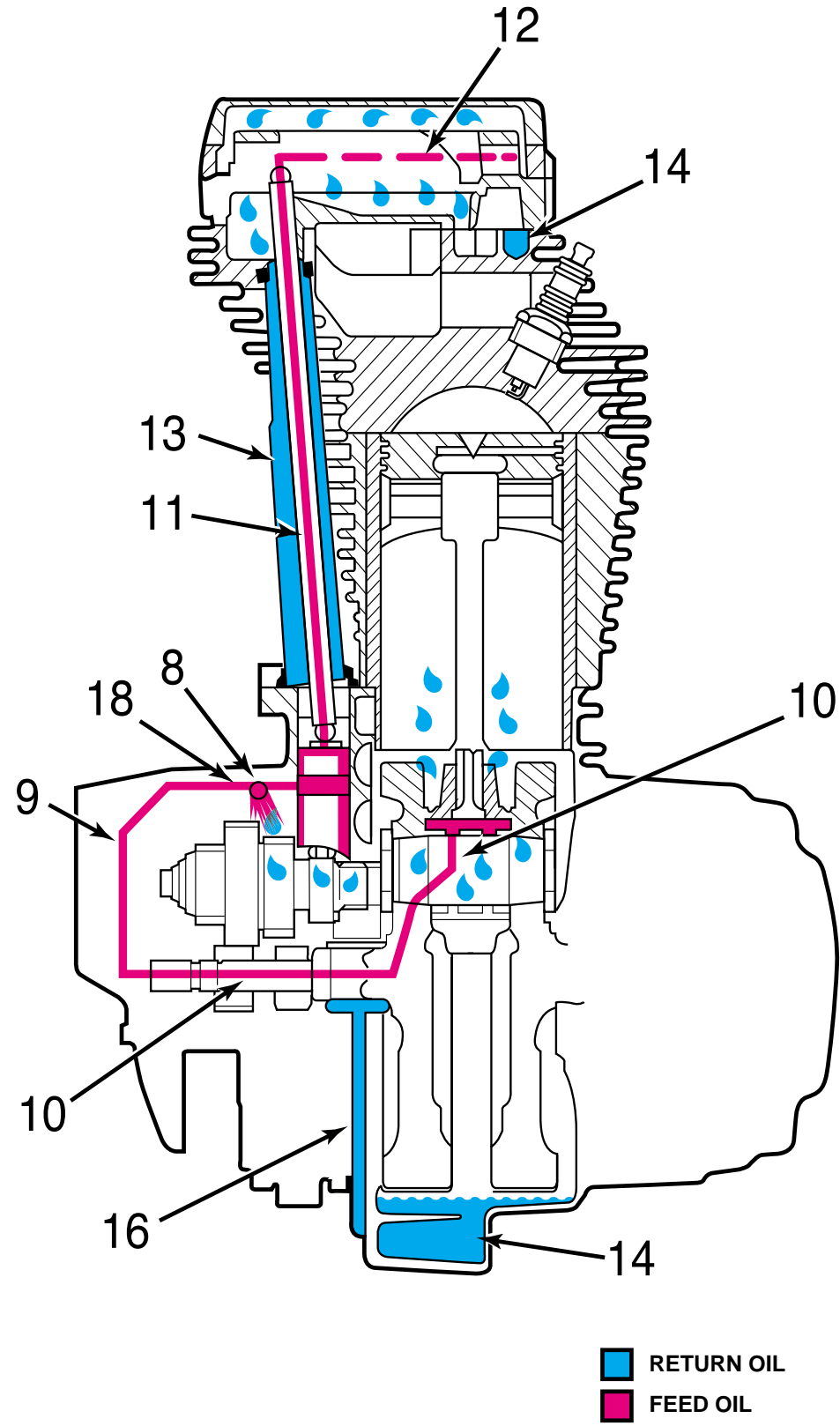
NOTE

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/m²) 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.

INTERNAL ENGINE PASSAGES



MODEL YEAR CHANGE

All 2001 Buell Air Twin Models have a **new** oil pump with a modified casting that allows for better scavenging. All wear limits and specifications remain the same as previous years.

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 off-set 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.

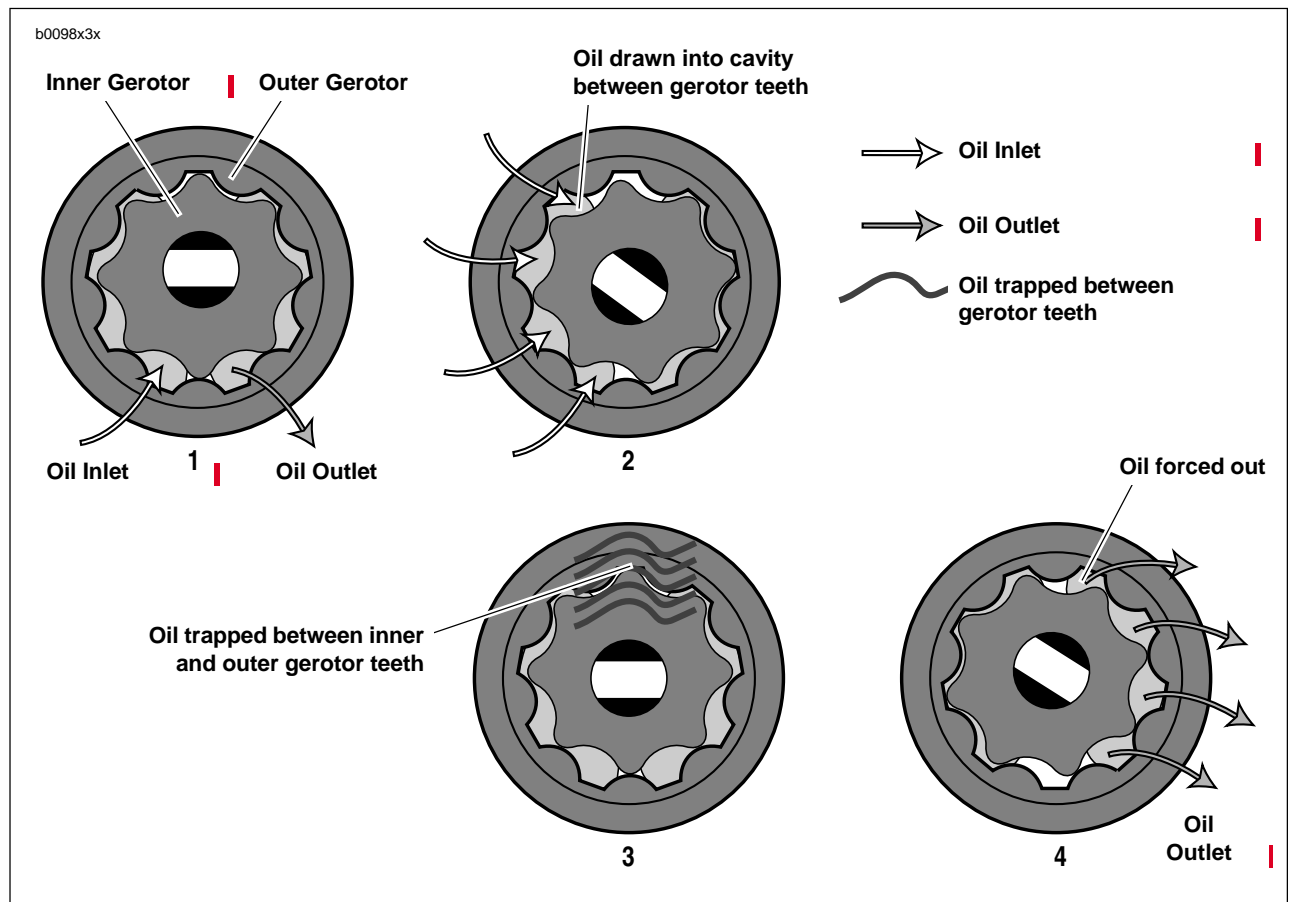


Figure 3-50. Principle of Gerotor Operation

REMOVAL/DISASSEMBLY

NOTE

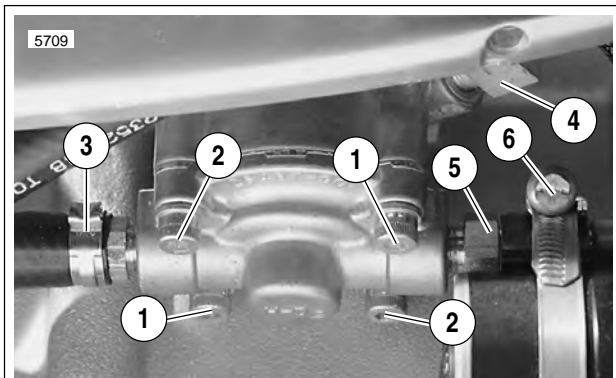
Oil pump can be removed with engine in frame and without removing gearcase cover.

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

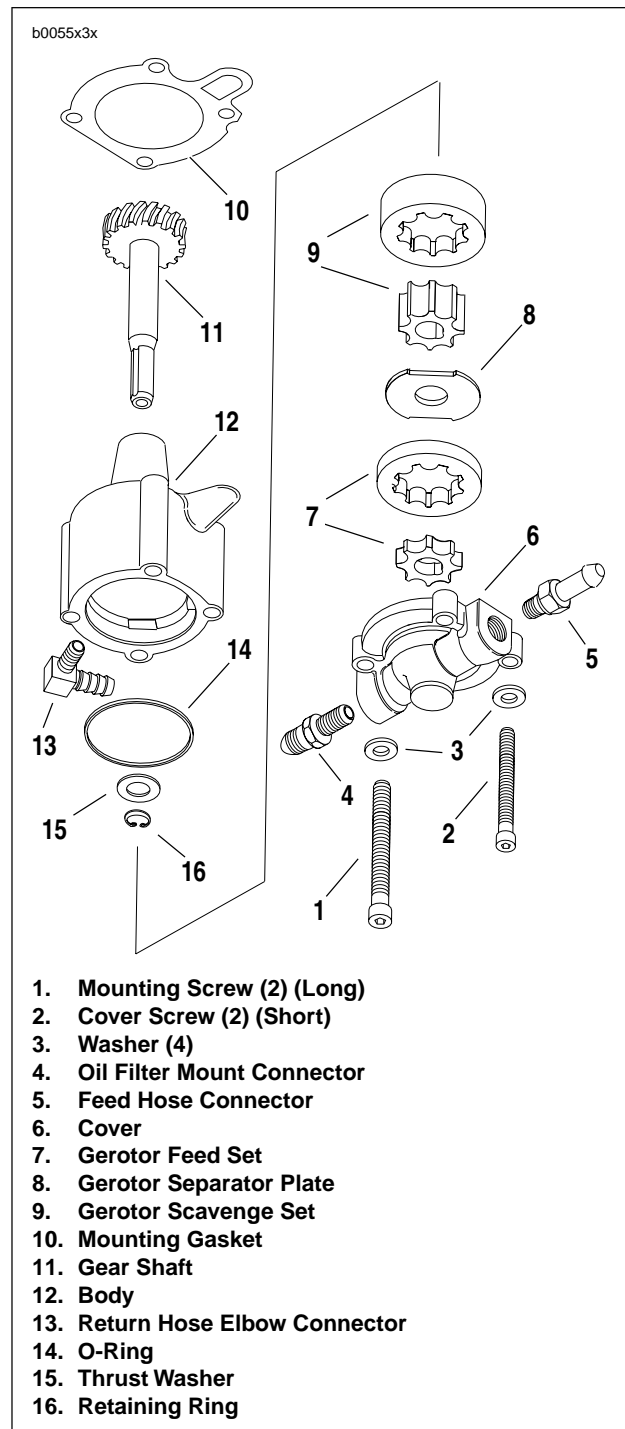
Loosen nut on oil filter hose connection (5) and then remove pressurized hose.

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) (Long)
2. Cover Screw (2) (Short)
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

- Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
- See Figure 3-53. Inspect both gerotor sets for wear.
 - Mesh pieces of each set together as shown.
 - Use a feeler gauge to determine clearance.
 - The SERVICE WEAR LIMIT between gerotors is 0.004 in. (0.102 mm). Replace gerotors as a set if clearance exceeds this dimension.
 - Measure thickness of feed gerotors with a micrometer. Replace gerotors as a set if they are not the same thickness.
- Check gear shaft (11) teeth for damage or wear. Replace if necessary.

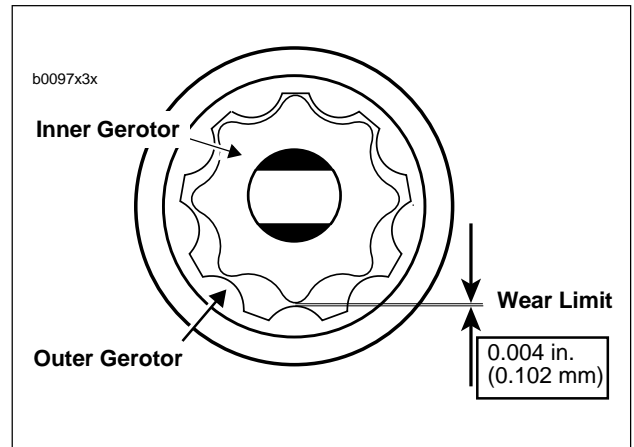


Figure 3-53. Gerotor Wear Limits

ASSEMBLY/INSTALLATION

NOTE

Liberalily coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

- 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.
- Insert inner gerotor of the gerotor scavenge set (9) over gear shaft.
- Place outer gerotor over inner to complete scavenge set (9).
- See Figure 3-54. Position gerotor separator plate into case and line up slots on perimeter with tabs inside oil pump body.
- Place gerotor feed set (7) over gear shaft (11).
- 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 125-150 **in-lbs** (14-17 Nm).
- 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.*

- See Figure 3-51. Attach return hose connection (4).
- Secure pump to crankcase with mounting screws (1) and washers. Tighten to 125-150 **in-lbs** (14-17 Nm).
- Attach feed hose (3) and oil filter hose connection (5).
- Attach clamp (6) and canister to hose.
- 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.
- Check engine oil level. Add oil to correct level if needed. See 1.4 ENGINE LUBRICATION SYSTEM.

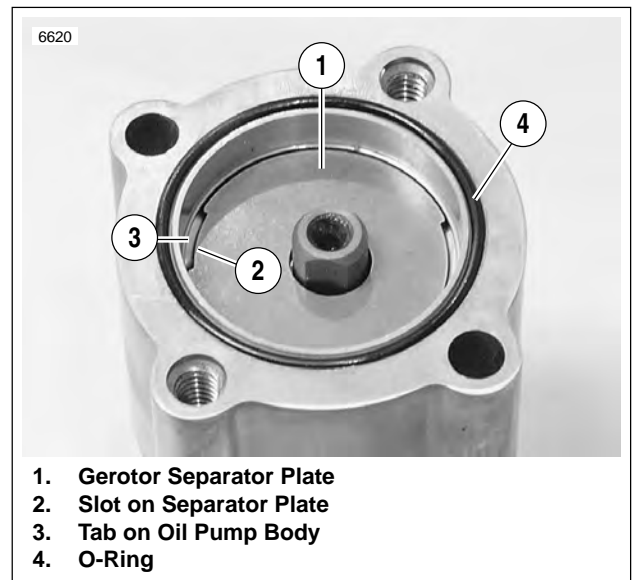


Figure 3-54. Separator Plate Slots

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/m²) 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/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.

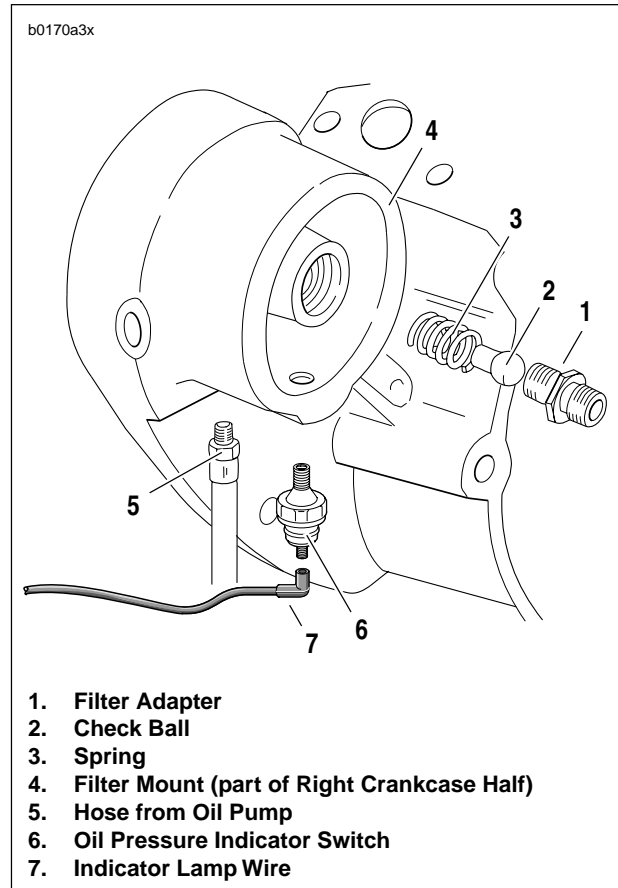


Figure 3-55. Oil Filter Mount

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.

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/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.

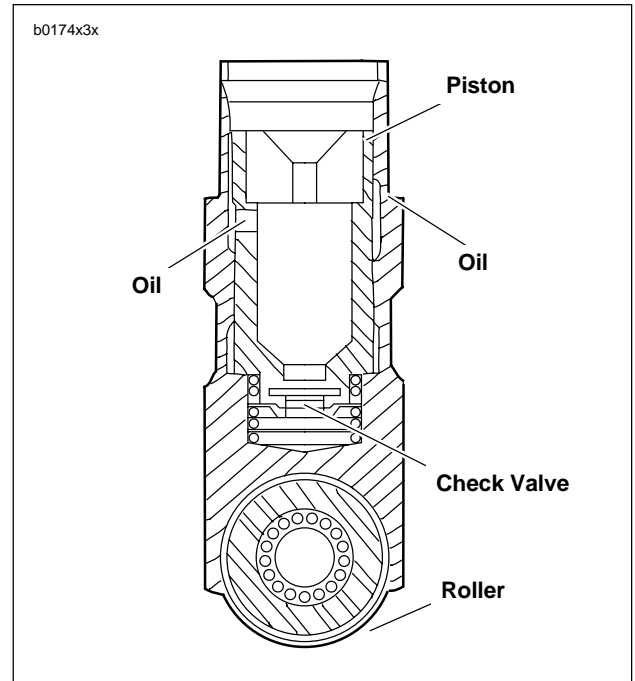


Figure 3-56. Lifter Assembly (Typical)

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).
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.

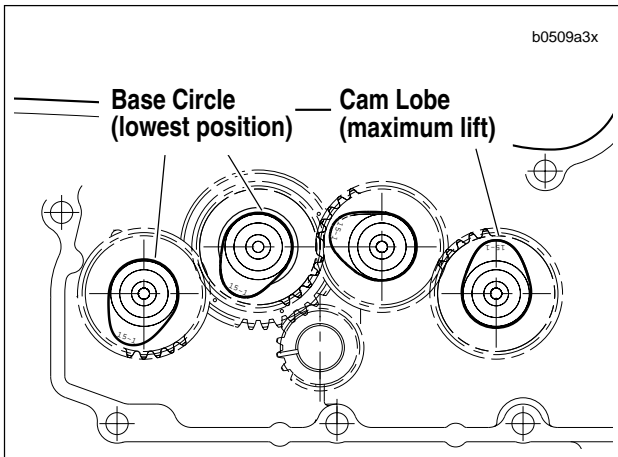


Figure 3-57. Base Circle

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 80-110 **in-lbs** (9-12 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](#).

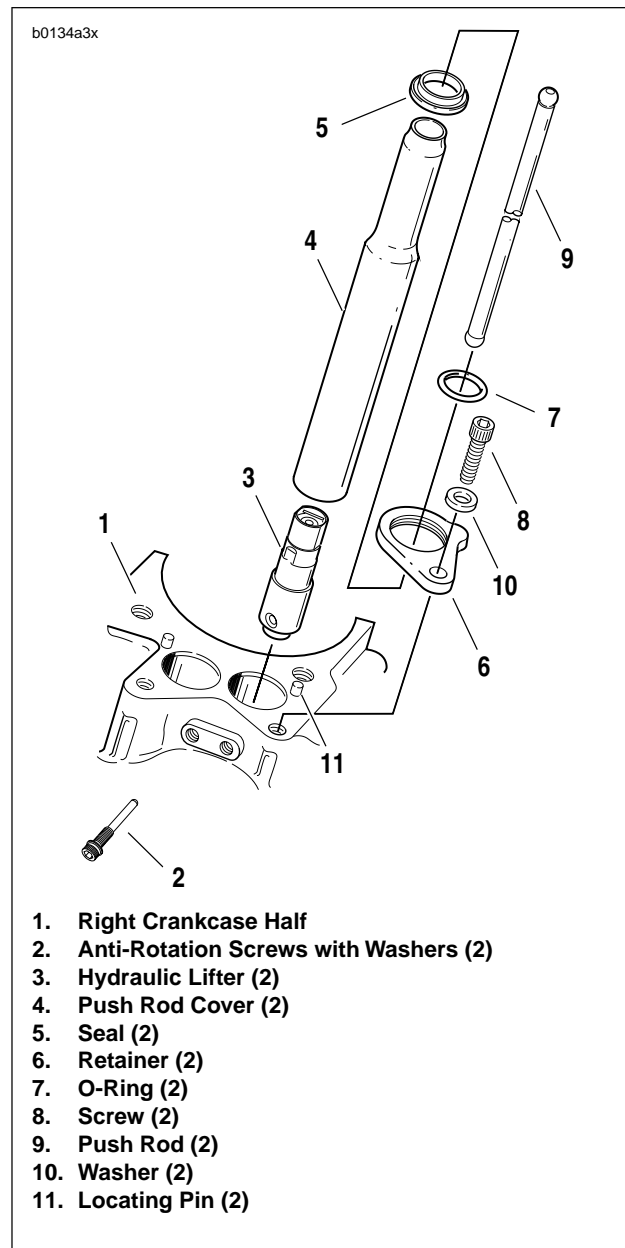


Figure 3-58. Hydraulic Lifter Service

MODEL YEAR CHANGE

All 2001 Model Year Thunderstorm™ engines have **new** high contact ratio cam gears. Cam gears are no longer color-coded and must be ordered/replaced in complete sets (which include camshafts).

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.

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.

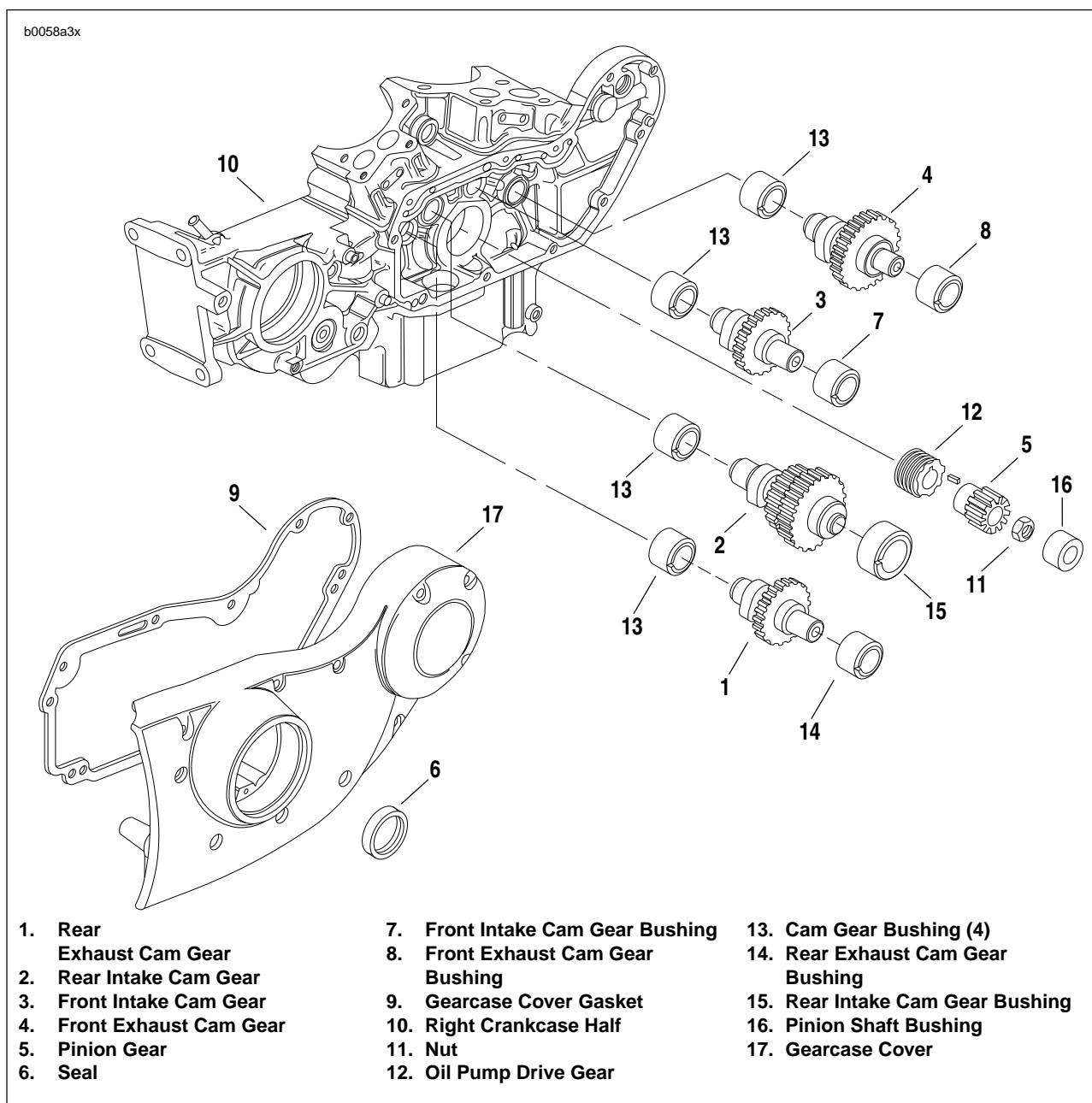


Figure 3-59. Gearcase and Valve Train Components

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.

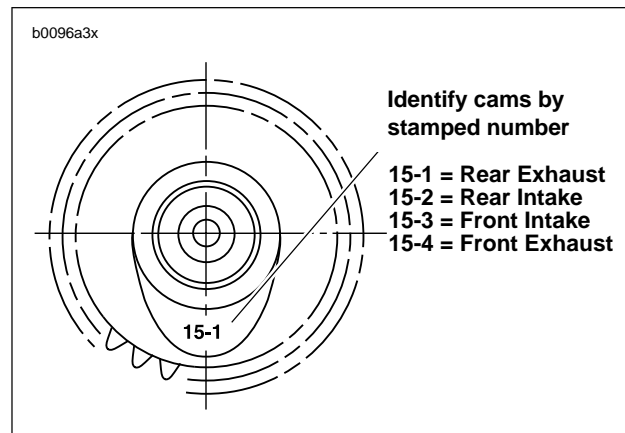


Figure 3-60. Cam Identification

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

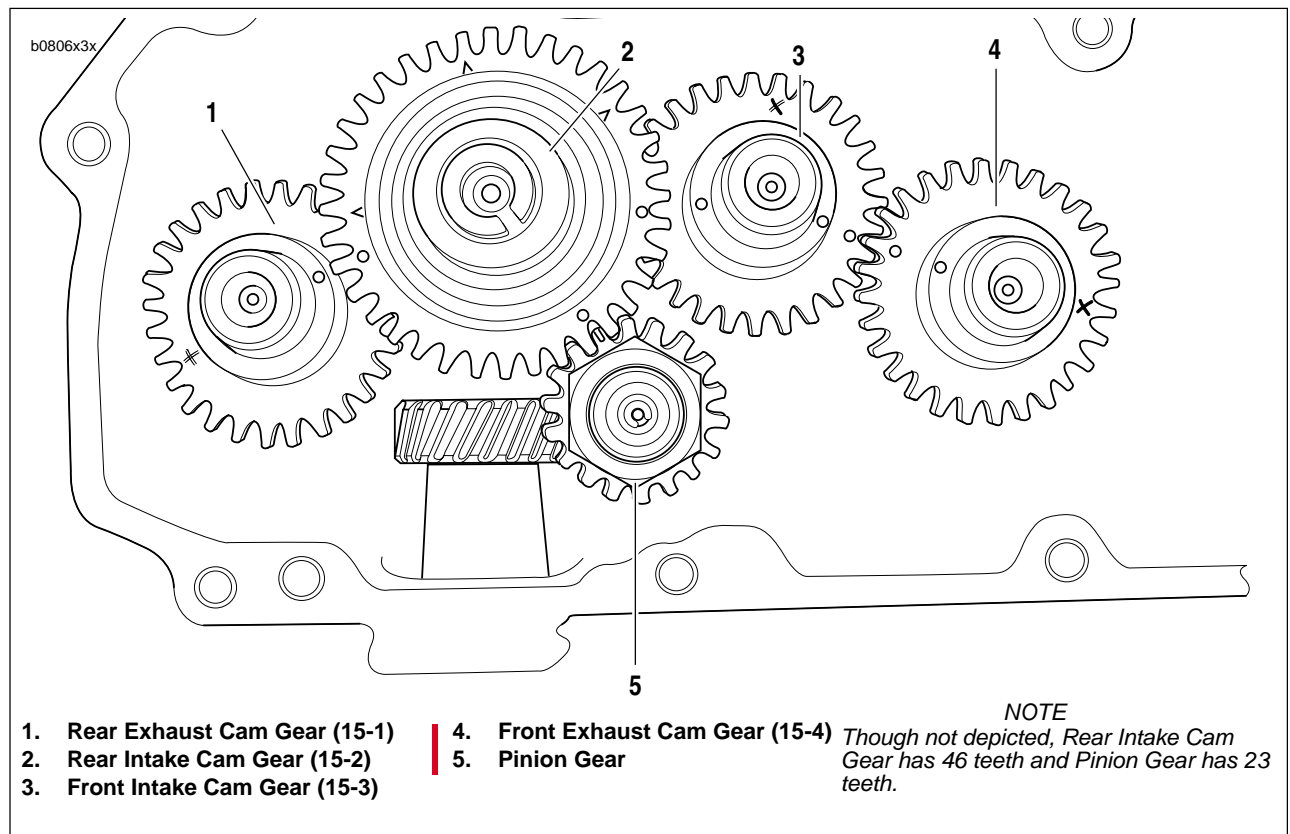


Figure 3-62. Cam and Pinion Gear Timing Mark Indexing

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.*

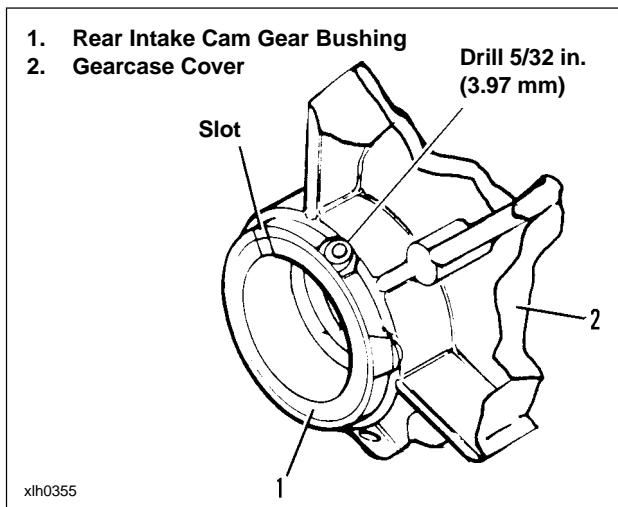


Figure 3-63. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

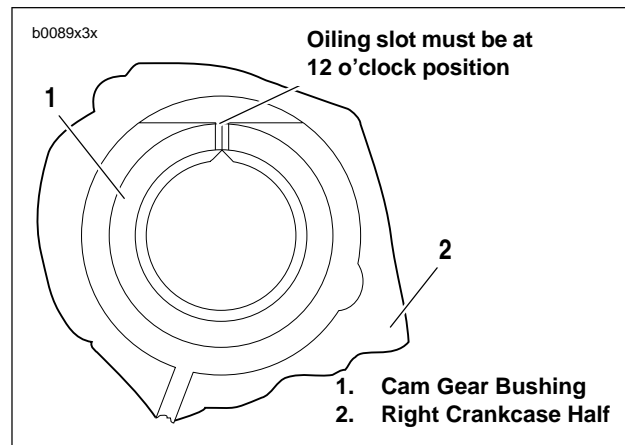


Figure 3-64. Cam Gear Bushing Installed in Crankcase

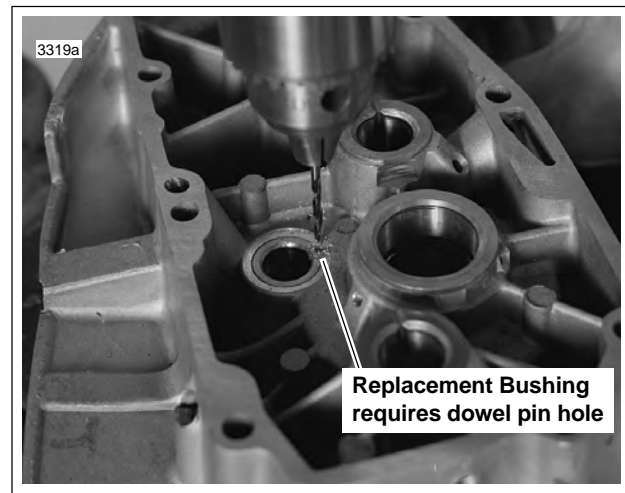


Figure 3-65. Drilling Dowel Pin Hole

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.

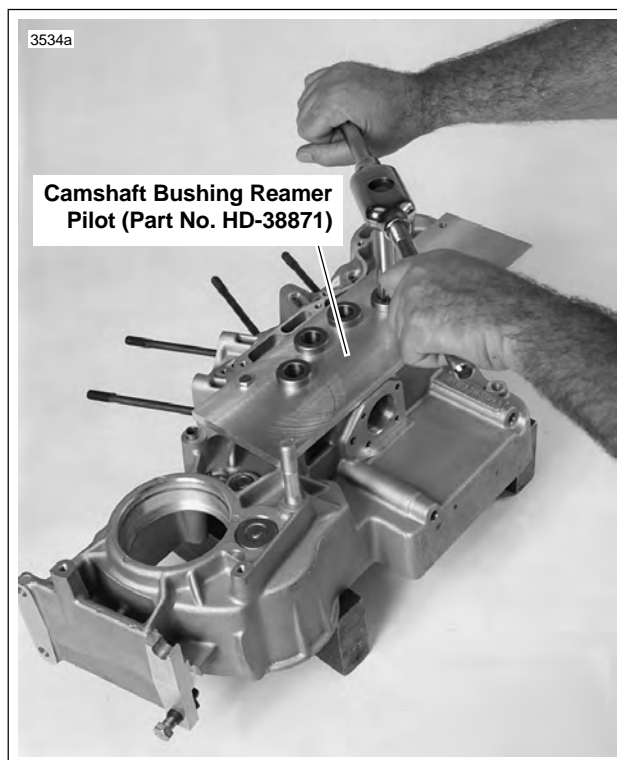


Figure 3-66. Reaming Cam Gear Bushing in Right Crankcase Half

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).

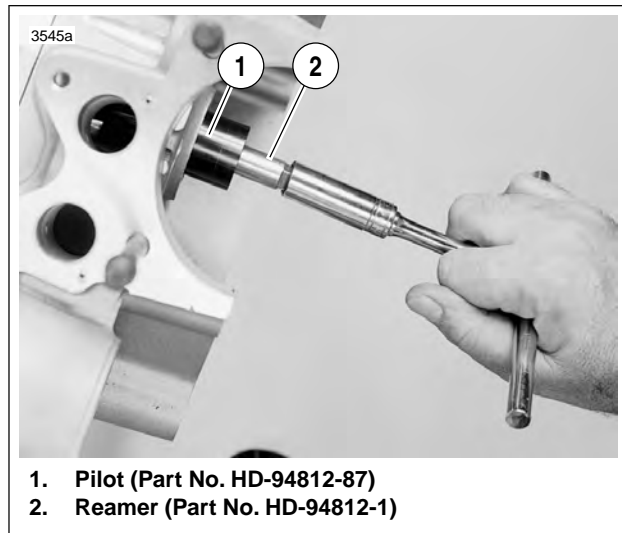


Figure 3-67. Line Reaming Pinion Shaft Bushing

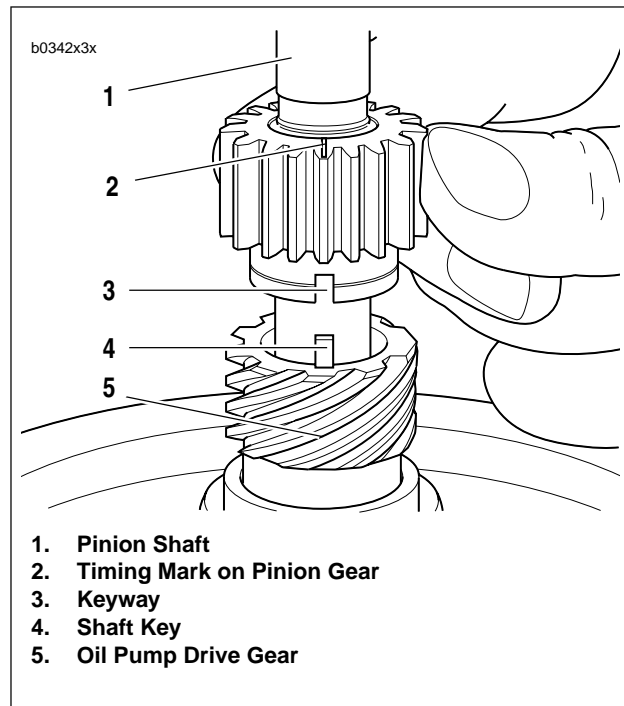


Figure 3-68. Aligning Pinion Gear

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.).

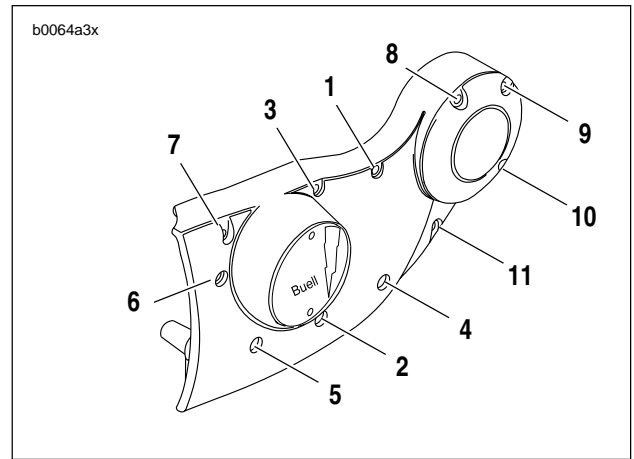


Figure 3-70. Gearcase Cover Mounting Screw Torque Sequence

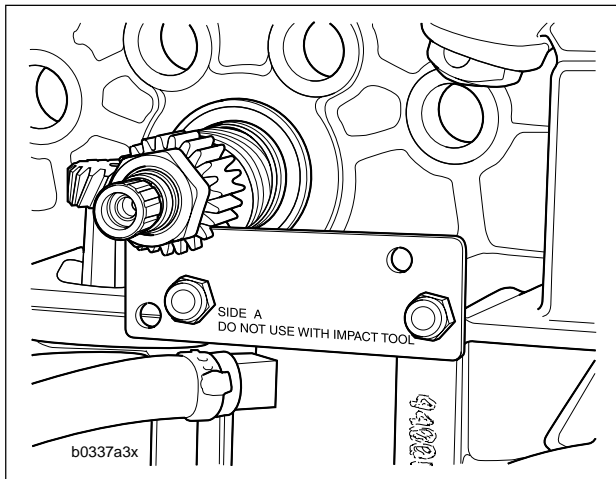


Figure 3-69. Crankshaft Locking Tool (HD-43984)

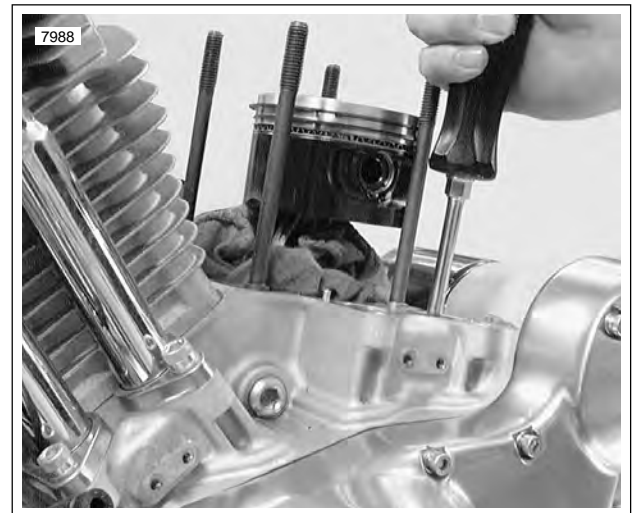


Figure 3-71. Checking Cam Gear End Play

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.

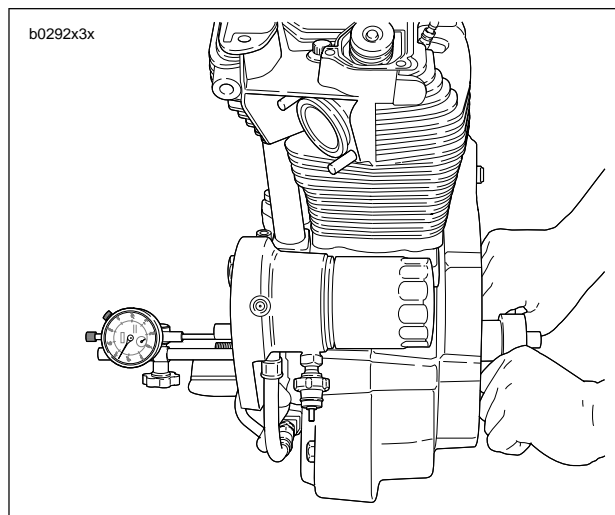


Figure 3-72. Checking Flywheel End Play

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.

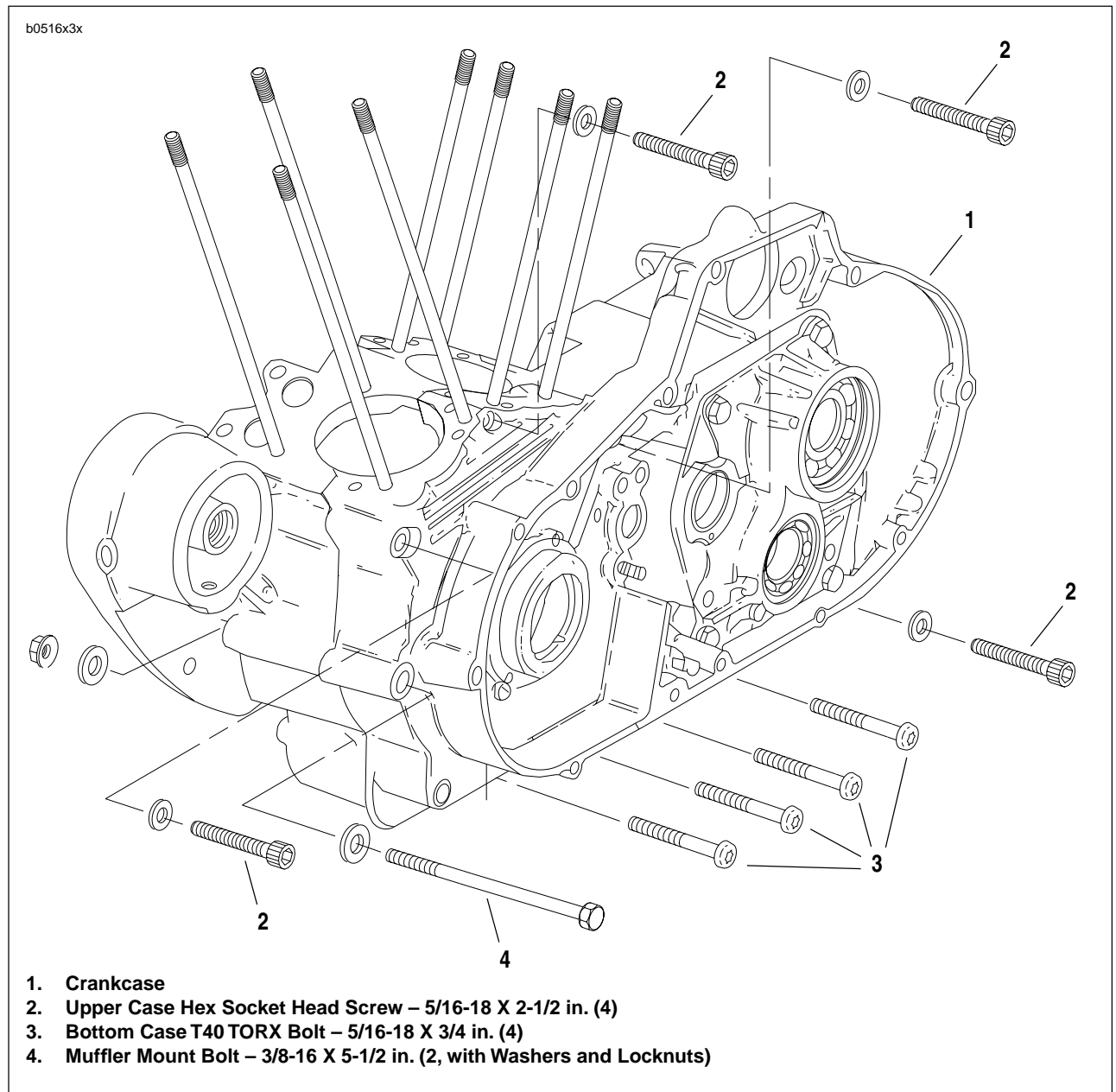


Figure 3-73. Crankcase Hardware (Typical)

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.

- 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:

- Gearshaft bearing will remain on flywheel pinion shaft. Remove retaining ring, and bearing may be slipped off pinion shaft.
- See Figure 3-76. Place flywheel assembly in FLYWHEEL FIXTURE (Part No. HD-44385). 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.
- See Figure 3-77. Use CRANKSHAFT BEARING TOOL (Part No. HD-94547-101) to remove sprocket shaft outer races.

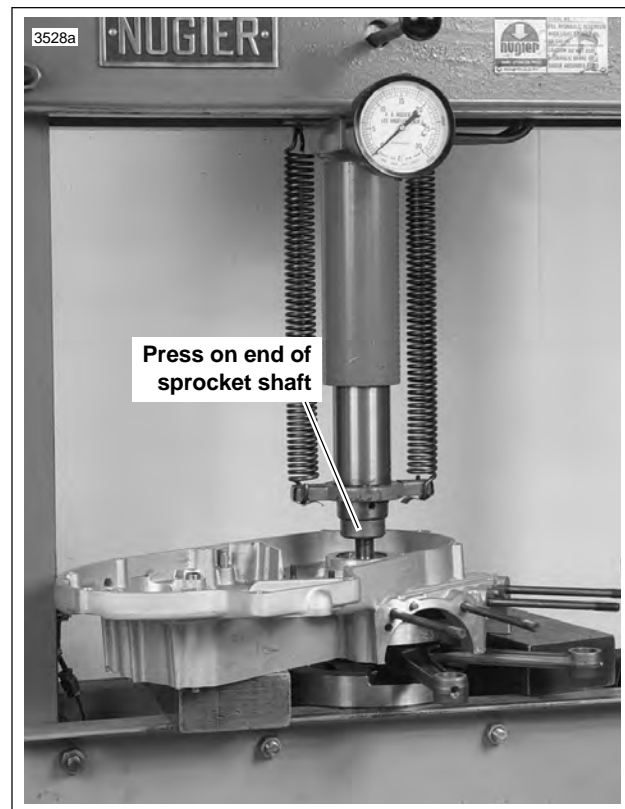


Figure 3-74. Pressing Flywheel from Crankcase

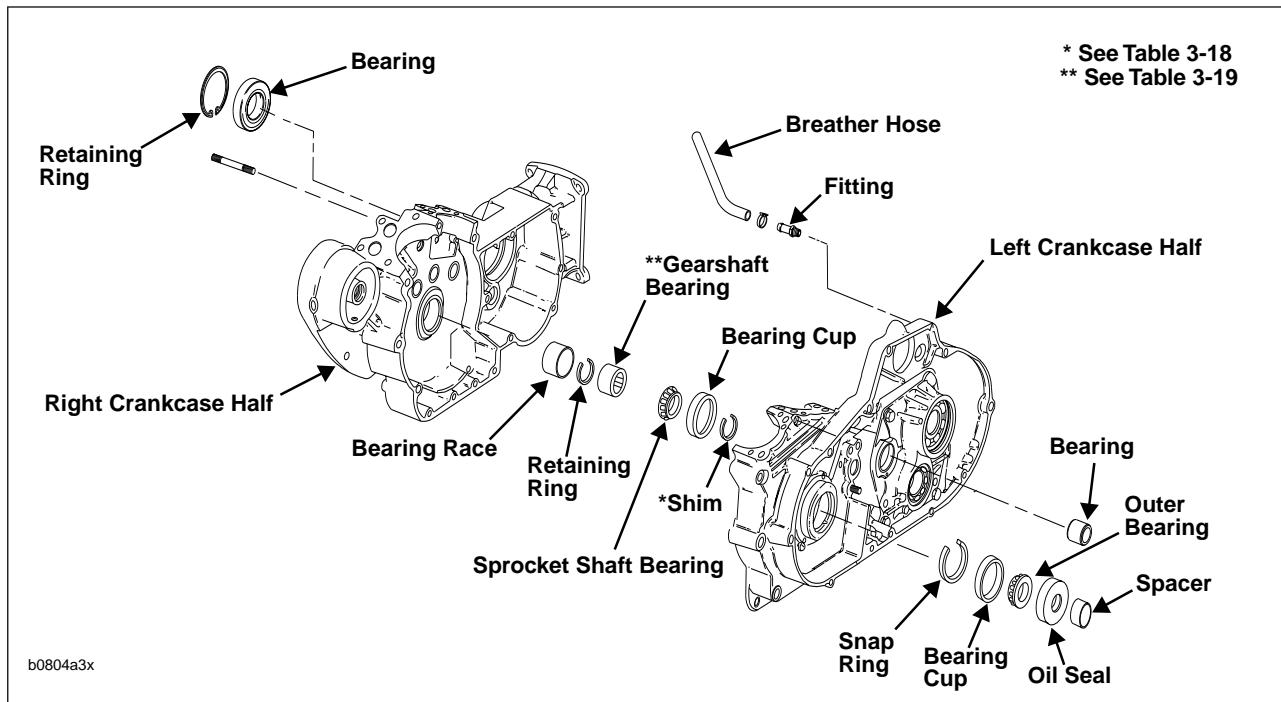


Figure 3-75. Crankcase Assembly

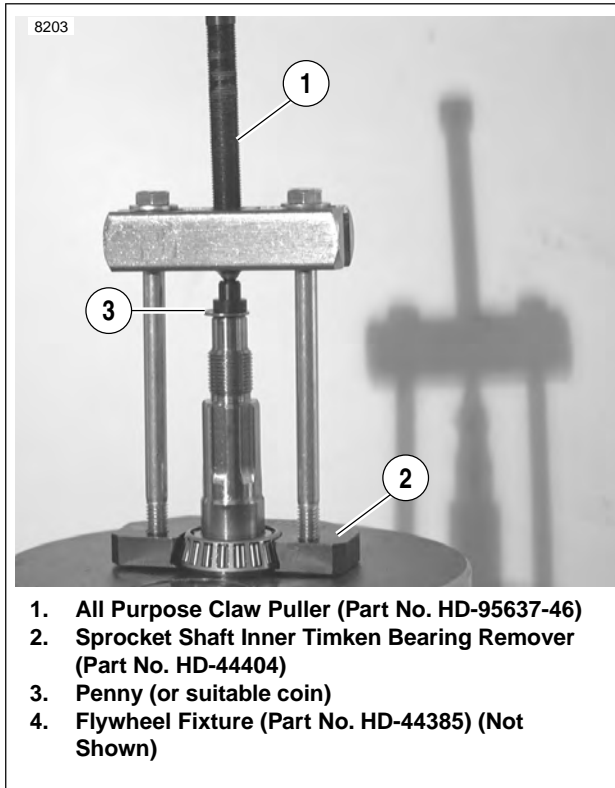


Figure 3-76. Removing Sprocket Shaft Inner Timken Bearing (Typical)



Figure 3-77. Sprocket Shaft Outer Race Removal

14. Remove crankcase retaining ring from crankcase bore.
 - a. Place 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.

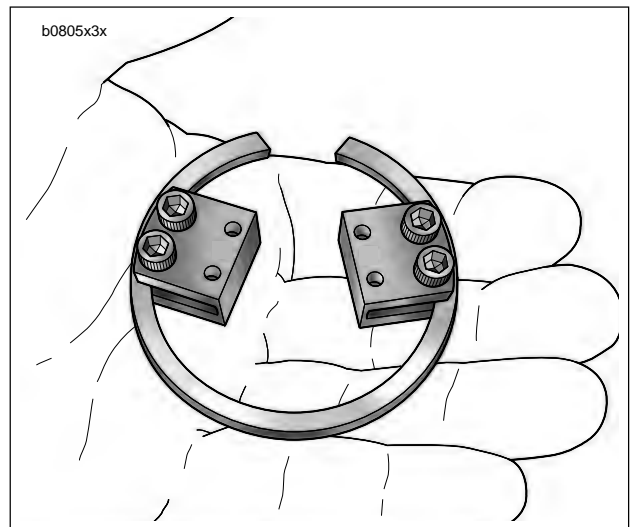


Figure 3-78. Install Claws on Snap Ring

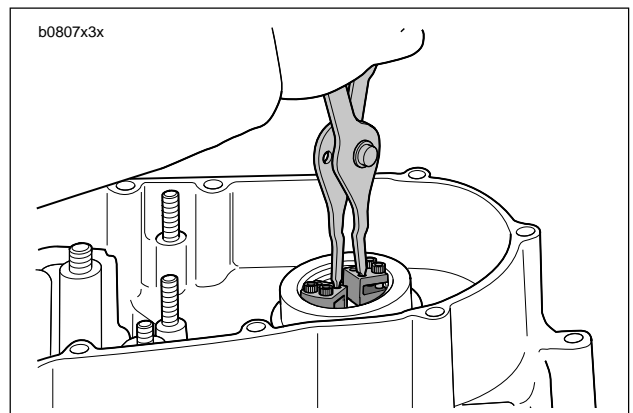


Figure 3-79. Remove Snap-Ring From Crankcase Bore

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 if 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 bur-nelled, burnt, scored, blued or damaged.
2. Inspect connecting rods for correct free play.
 - a. 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.
 - a. 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.

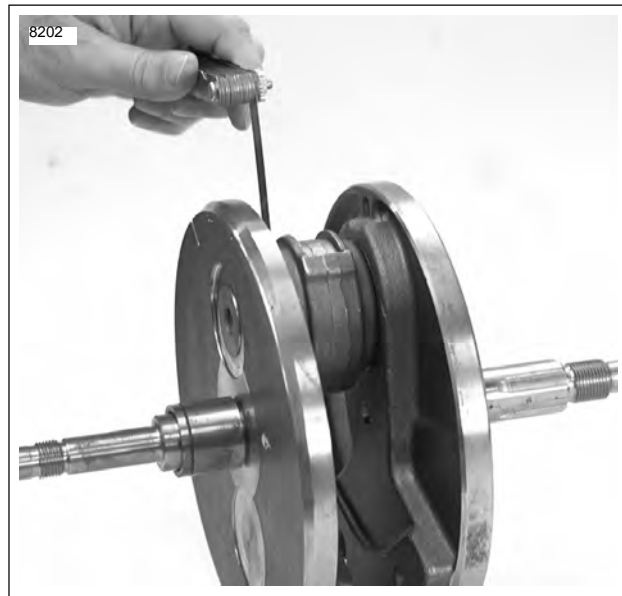


Figure 3-80. Checking Connecting Rod Side Play

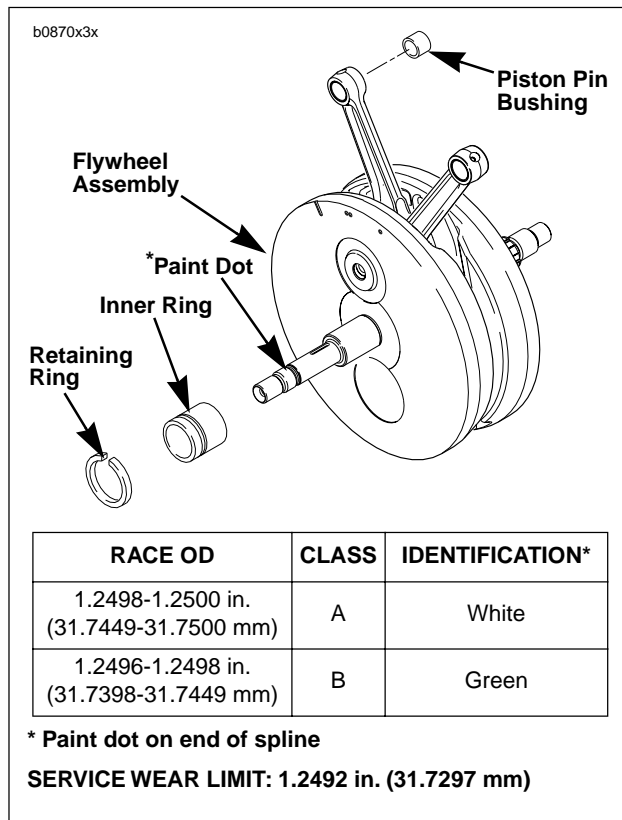


Figure 3-81. Low Inertia Flywheel and Connecting Rod Assembly/Factory Inner Race Sizes

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.

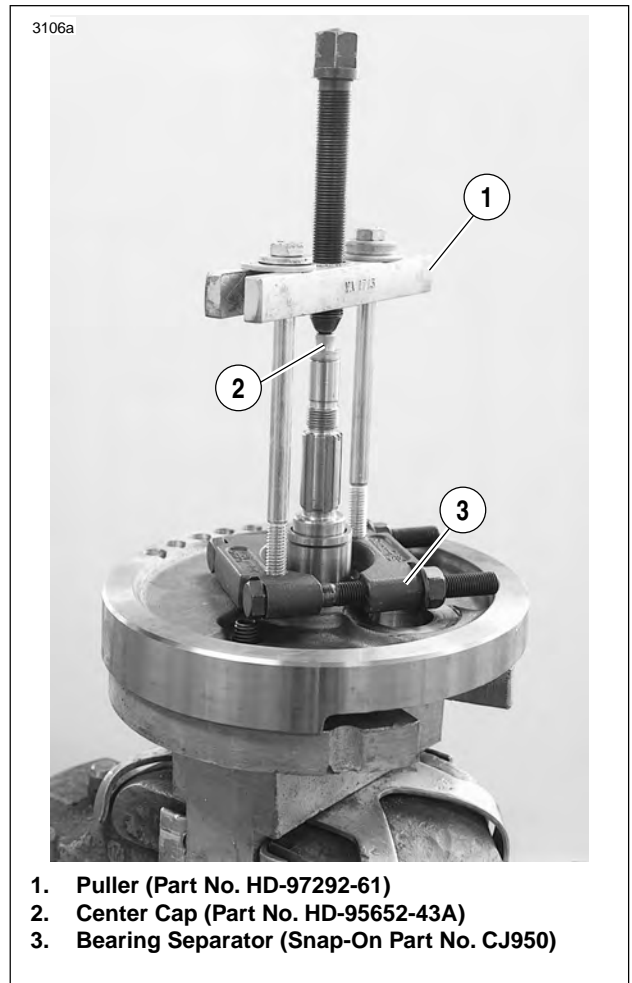
See Figure 3-81. Installed inner races are identified at the factory as shown.

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.



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)

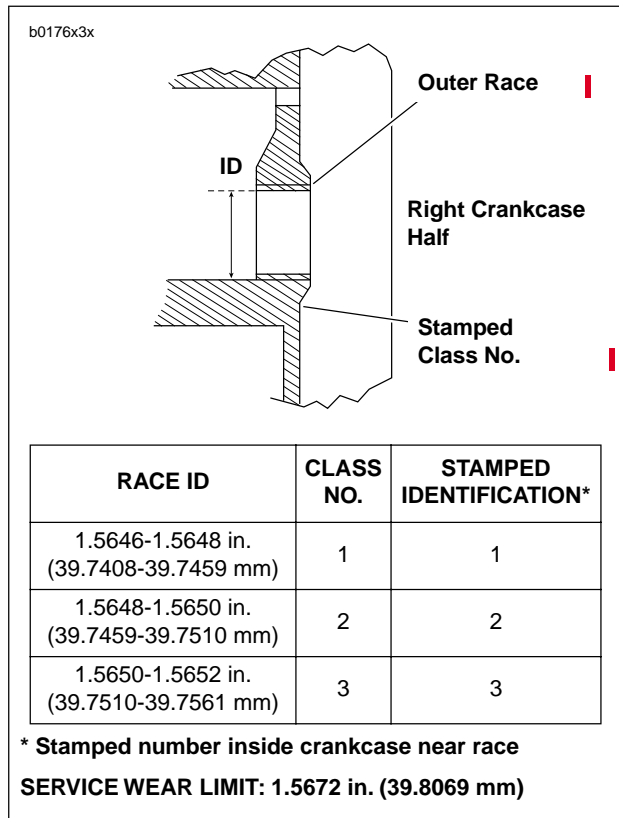


Figure 3-82. Factory Outer Race Sizes

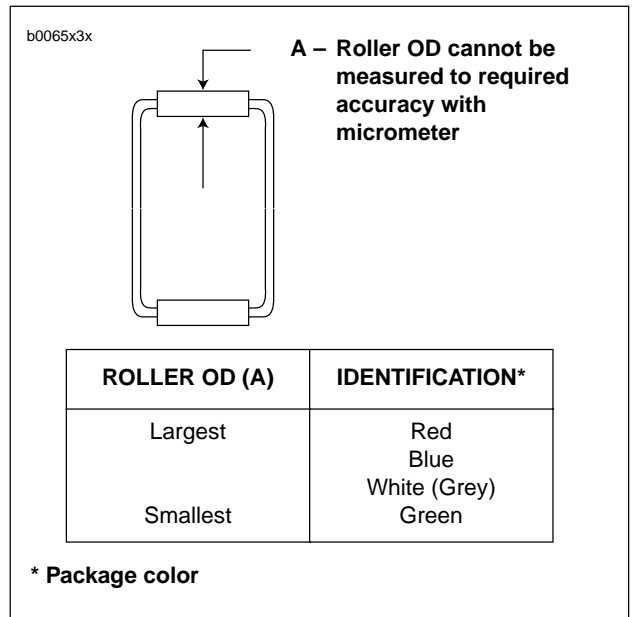


Figure 3-84. Bearing Identification

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 3-131.](#) 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.
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

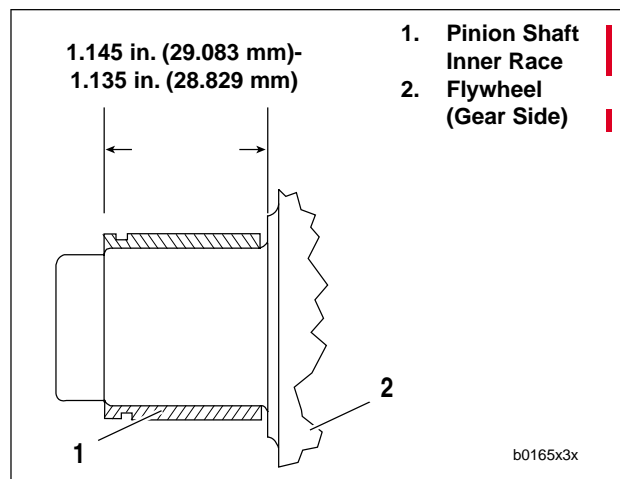


Figure 3-85. Inner Race Location

inner race must meet these specifications. For necessary dimensions for constructing a press-on tool see [Figure 3-131.](#) 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.

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 3-132. 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.

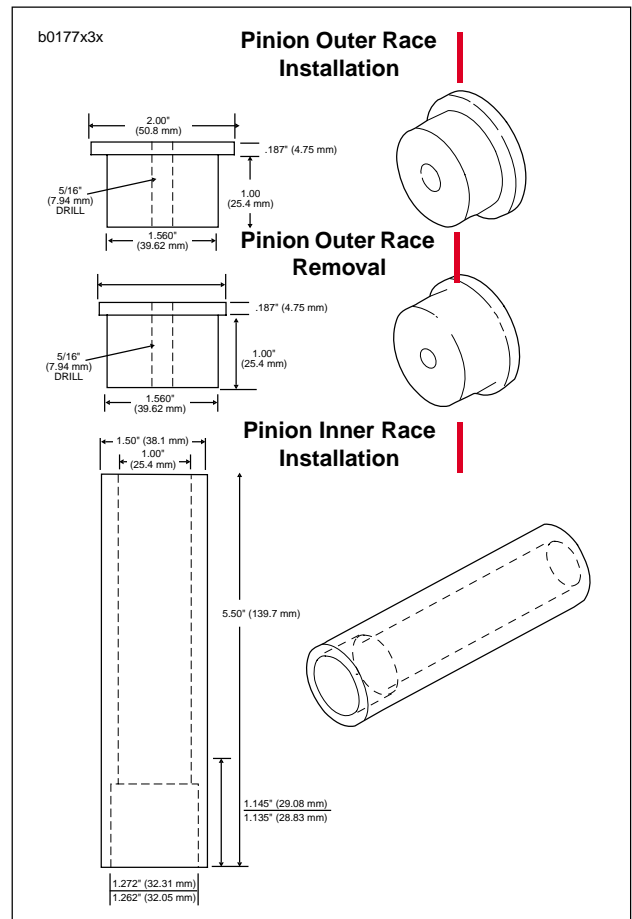


Figure 3-131. Pinion Shaft Bearing Tools



Figure 3-132. Lapping Pinion Shaft Main Bearing

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 3-135](#). Use **SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL** (Part No. HD-42579) to install sprocket shaft tapered roller bearings and seal.

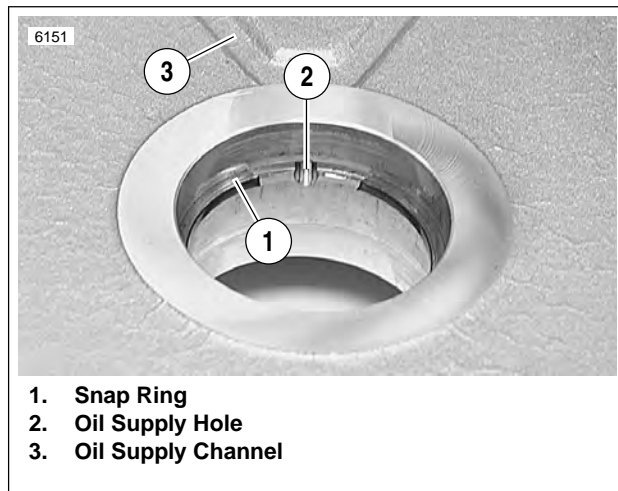


Figure 3-133. Snap Ring

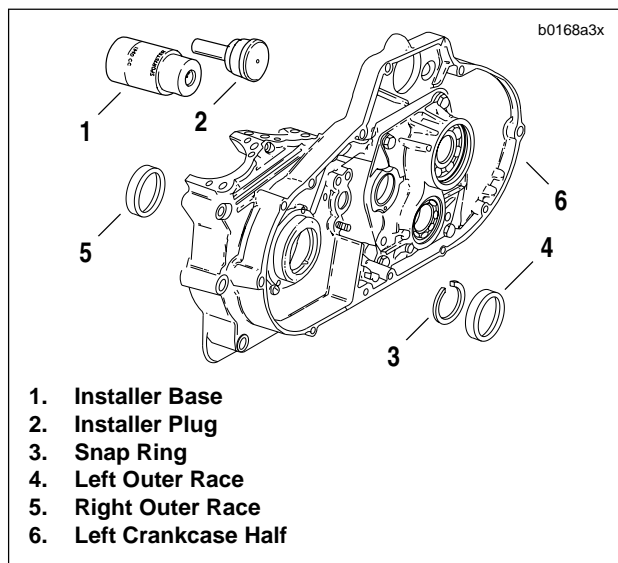


Figure 3-134. Installing Sprocket Shaft Bear Outer Races

8. 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 3-136](#). 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 3-137](#). 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 3-138](#). 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-42774) 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.

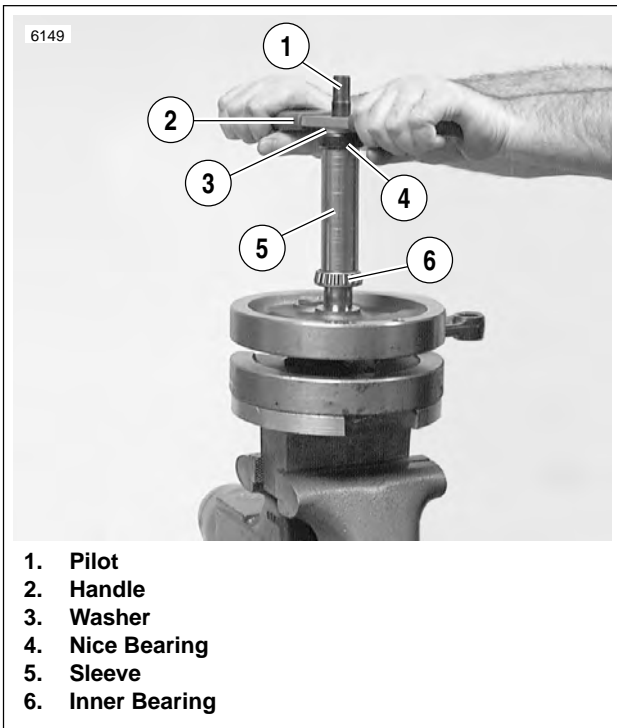


Figure 3-135. Inner Bearing Installation (Typical)

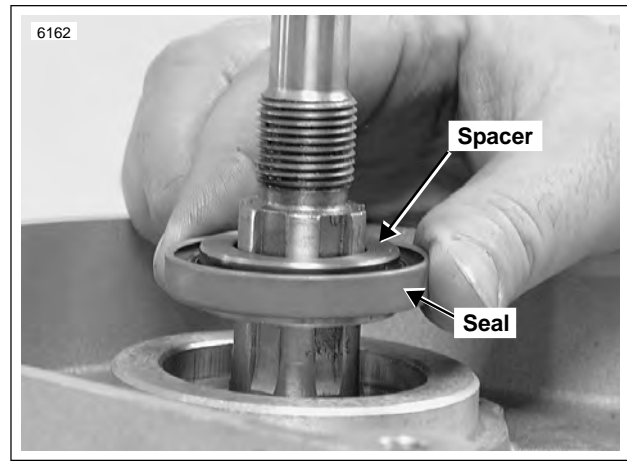


Figure 3-137. Install Spacer in Seal

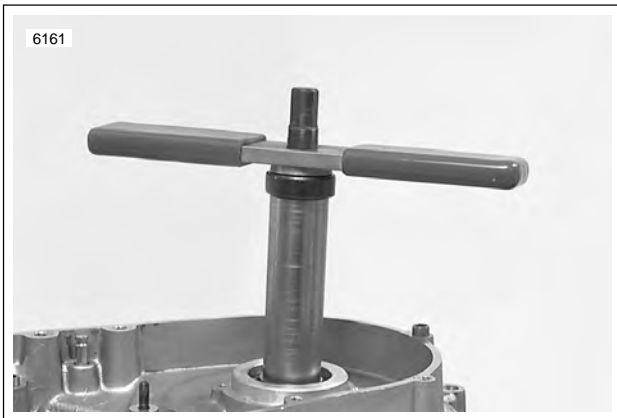


Figure 3-136. Installing Flywheel Spacer and Outer Bearing

12. See [Figure 3-139](#). 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 1/4-in. fasteners to 70-110 **in-lbs** (8-12 Nm)
 - e. Tighten the 5/16-in. fasteners to 15-19 **ft-lbs** (20-26 Nm).
14. See [Figure 3-140](#). 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 [1.8 CLUTCH](#).

23. See [3.4 INSTALLING THE ENGINE](#) and perform the applicable steps.

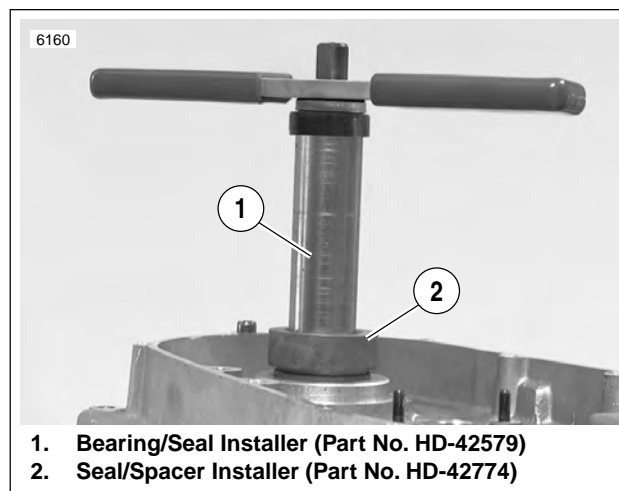


Figure 3-138. Install Bearing Seal/Spacer

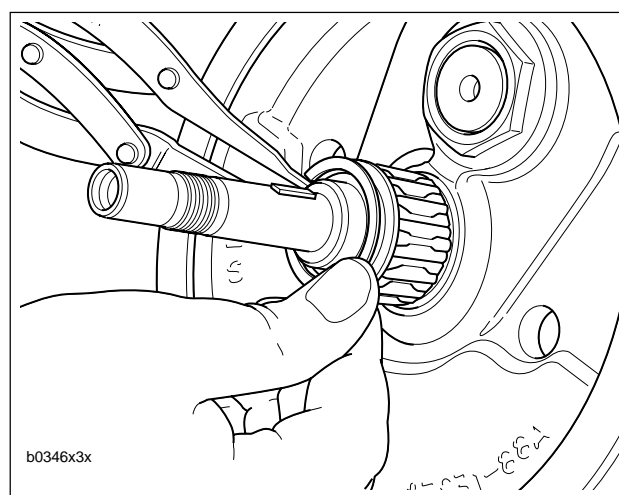


Figure 3-139. Pinion Shaft Bearing

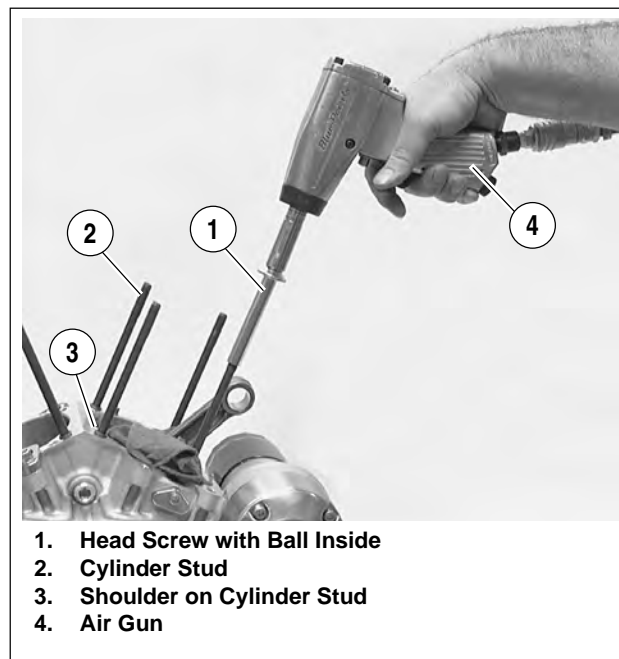


Figure 3-140. Cylinder Studs

INTERNAL ENGINE PASSAGES

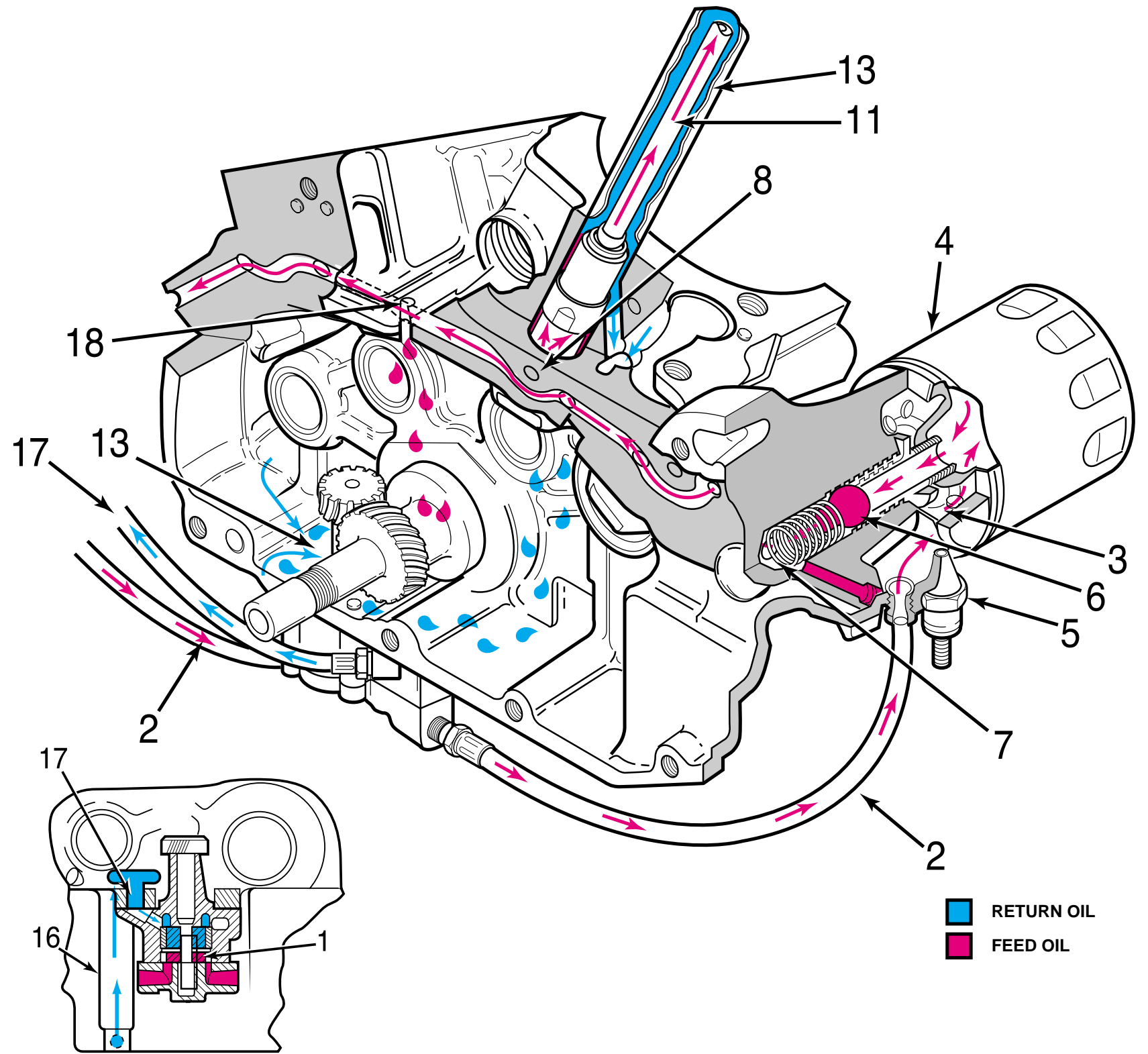
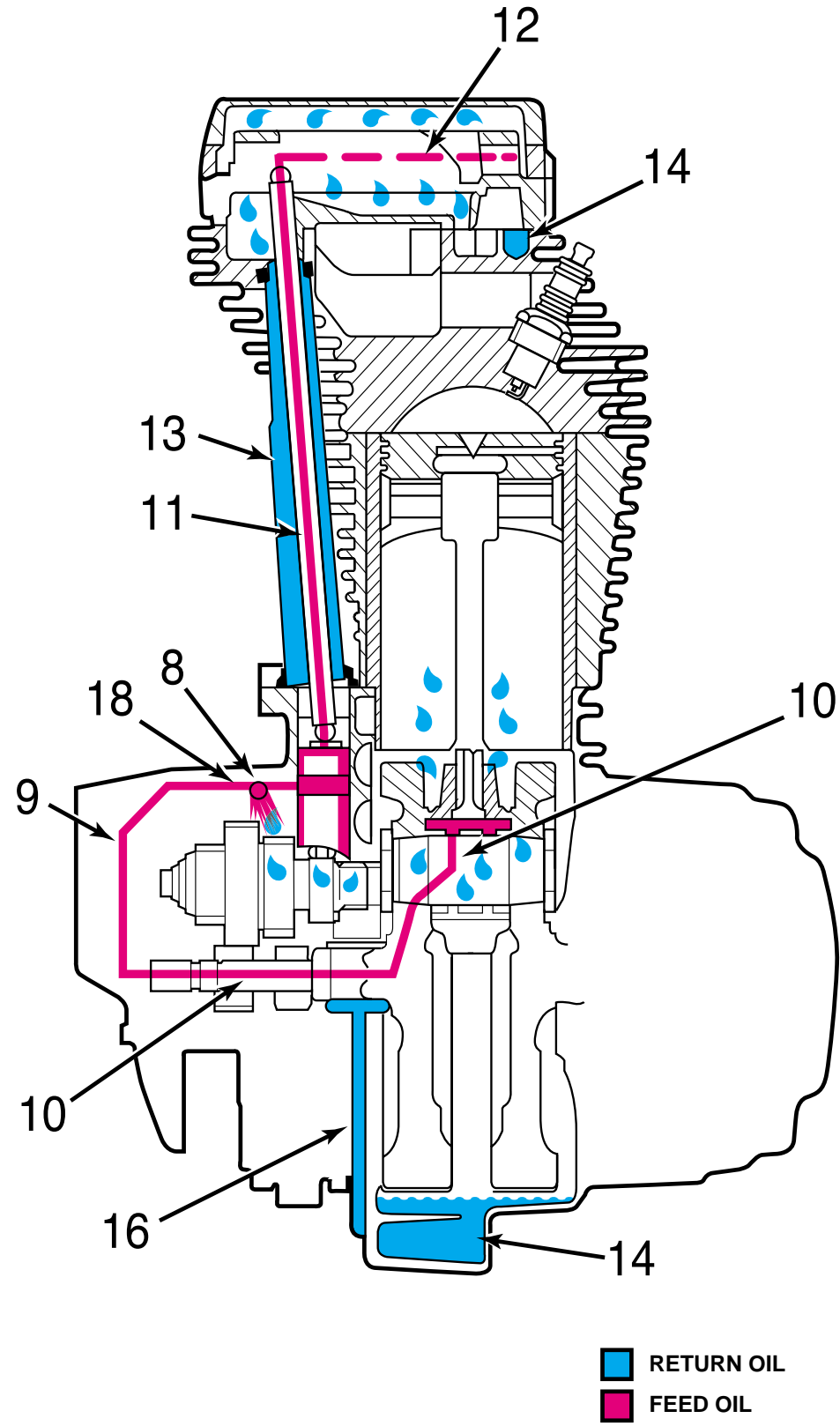


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FUEL TANK CAPACITY	GALLONS	LITERS
Total (including Reserve)	5.4	20.44
Reserve	0.4	1.51
Low Fuel Indicator Light at	0.4	1.51

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	

NOTES
