SECTION I–MAINTENANCE

SUBJECT **PAGE NO.**

This section explains procedures unique to 1997 model S1 Lightnings. Any procedures not found in this supplement are covered in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y).

NOTES

SPECIFICATIONS

DIMENSIONS	IN.	MM
Wheel base	55	1397
Overall length	79.5	2019
Overall width	30	762
Road clearance	5.2	132
Seat height	29.5	749

CAPACITIES	U.S.	LITERS
Fuel tank (including reserve)	4.0 gallons	15.14
Reserve	0.6 gallons	2.27
Oil tank	2.0 quarts	1.89
Transmission	1.0 quart	0.95

WEIGHT	LBS.	KG
S1 shipping weight	446	202
GVWR	820	372
GAWR - Front	340	154
GAWR - Rear	480	218

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 front frame steering head.

ENGINE		
Number of cylinders	2	
Type	4-Cycle, 45 Degree V-Type	
Bore	3.498 in.	88.849 mm
Stroke	3.8125 in.	96.838 mm
Piston displacement	73.4 cu. in.	1203 cc
Compression ratio	10.0 to 1	
Horsepower @ RPM	91 @ 5800	
Torque ft-lb @ RPM	87 @ 5200	

IGNITION SYSTEM		
Spark plugs	No. 6R12	
Size	12 mm	
Gap	0.038-0.045 in.	0.97-1.14 mm

TRANSMISSION	
Type	Constant Mesh, Foot Shift
Speeds	5 Forward

NUMBER OF SPROCKET TEETH	
Engine	35
Clutch	56
Transmission	27
Rear wheel	61
Belt	128

TRANSMISSION GEAR RATIOS	FINAL*	OVERALL**
First (low) gear	2.69	9.717
Second gear	1.97	7.118
Third gear	1.43	5.180
Fourth gear	1.18	4.269
Fifth (high) gear	1.00	3.615

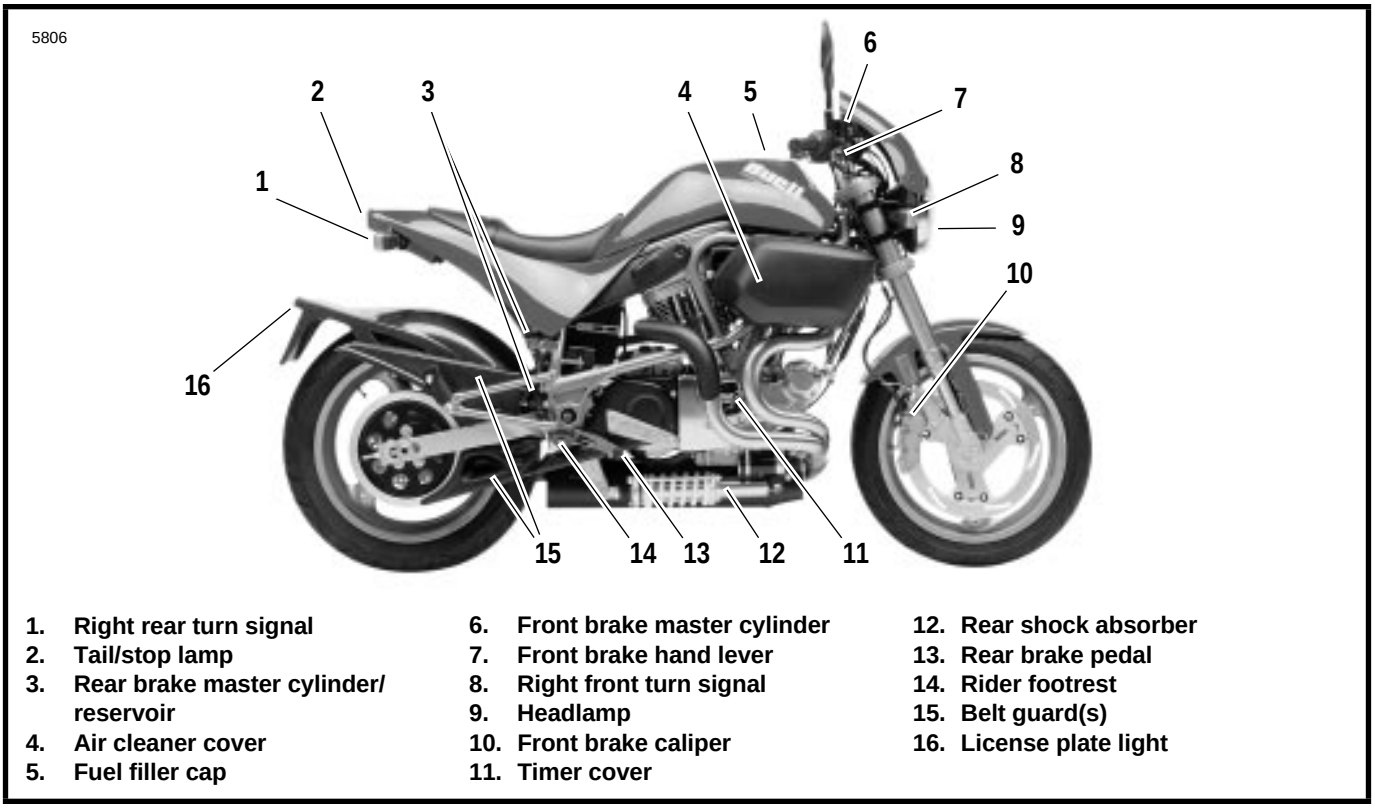
*Final gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.
**Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

TIRE AND POSITION	PRESSURE FOR SOLO RIDING	PRESSURE AT GVWR
Front-Dunlop Sportmax Radial II 120/70 ZR 17	32 PSI (2.2 bar)	36 PSI (2.5 bar)
Rear-Dunlop Sportmax Radial II 170/60 ZR 17	36 PSI (2.5 bar)	38 PSI (2.8 bar)

⚠WARNING

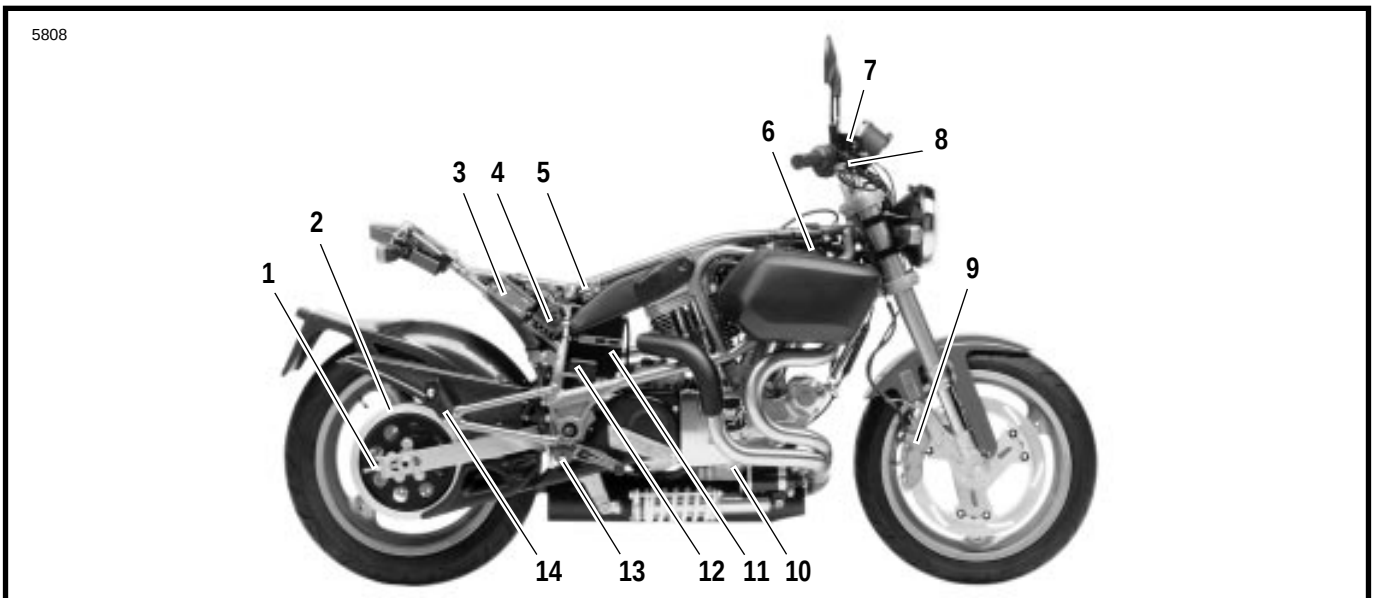
Do not inflate any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate leading to personal injury.

SIDE VIEWS



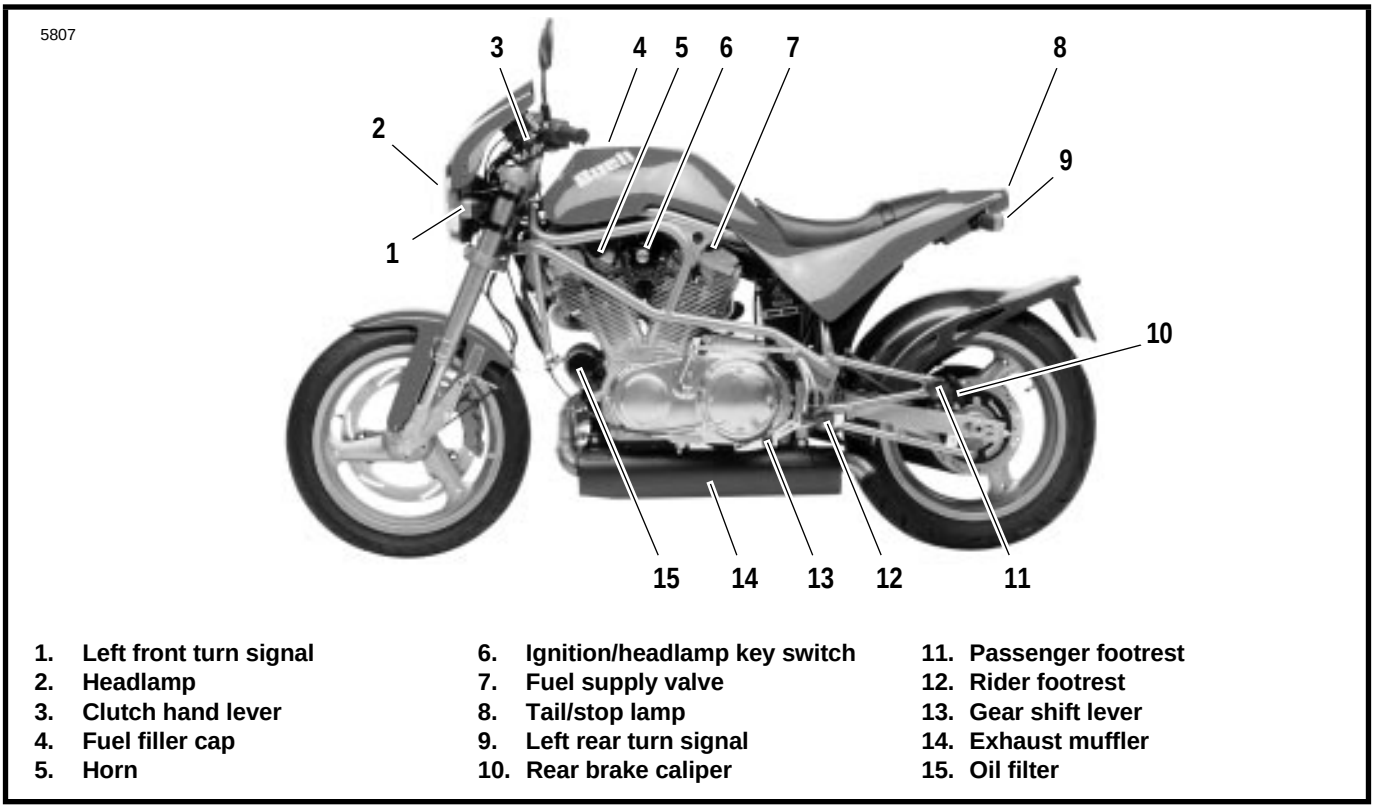
1. Right rear turn signal
2. Tail/stop lamp
3. Rear brake master cylinder/ reservoir
4. Air cleaner cover
5. Fuel filler cap
6. Front brake master cylinder
7. Front brake hand lever
8. Right front turn signal
9. Headlamp
10. Front brake caliper
11. Timer cover
12. Rear shock absorber
13. Rear brake pedal
14. Rider footrest
15. Belt guard(s)
16. License plate light

Figure 1. 1997 S1 Lightning, Right Side View



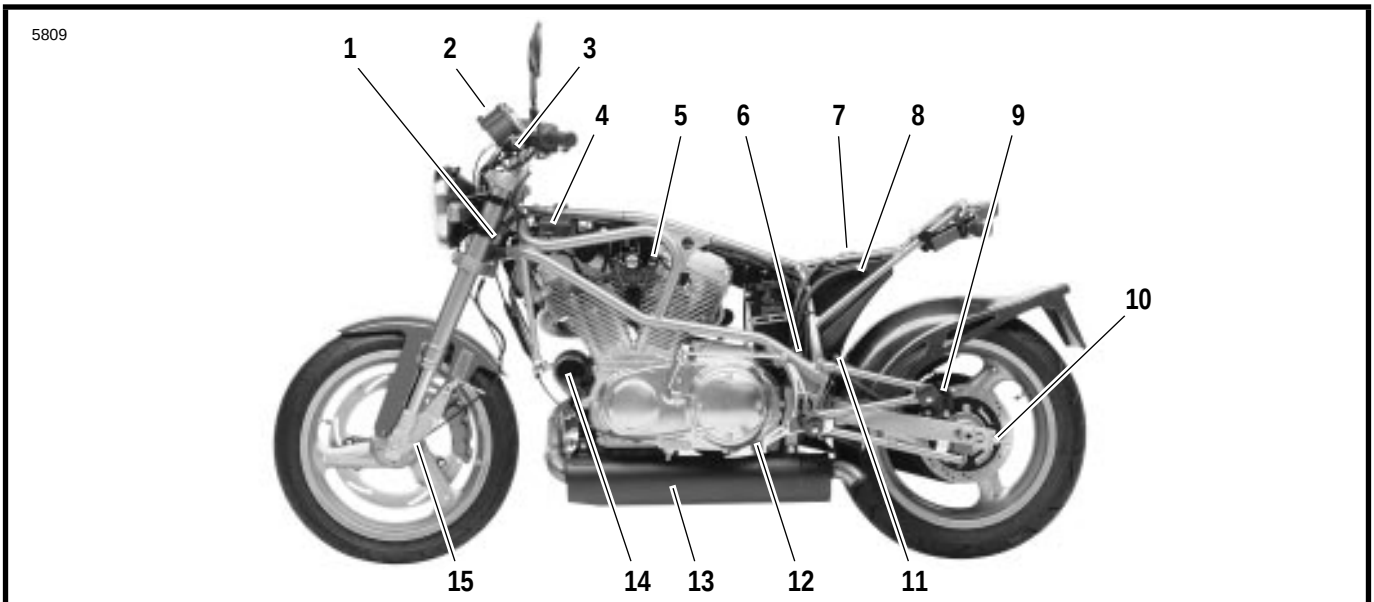
1. Rear axle adjuster nut
2. Rear sprocket and secondary drive belt
3. Ignition module
4. Fuse block and spare fuse
5. Turn signal flasher
6. Remote idle adjuster
7. Front brake master cylinder
8. Front brake hand lever
9. Front brake caliper
10. Oil pump
11. Battery
12. Voltage regulator
13. Rider footrest
14. Passenger footrest

Figure 2. 1997 S1 Lightning, Right Side View (Body Removed)



1. Left front turn signal
2. Headlamp
3. Clutch hand lever
4. Fuel filler cap
5. Horn
6. Ignition/headlamp key switch
7. Fuel supply valve
8. Tail/stop lamp
9. Left rear turn signal
10. Rear brake caliper
11. Passenger footrest
12. Rider footrest
13. Gear shift lever
14. Exhaust muffler
15. Oil filter

Figure 3. 1997 S1 Lightning, Left Side View



1. Steering head lock
2. Instruments
3. Clutch hand lever
4. Ignition coil
5. Enrichener knob
6. Starter relay
7. Oil filler plug/dipstick
8. Oil tank
9. Rear brake caliper
10. Rear axle adjuster nut
11. Oil tank drain hose
12. Gear shift lever
13. Exhaust muffler
14. Oil filter
15. Speedometer drive

Figure 4. 1997 S1 Lightning, Left Side View (Body Removed)

FLUID REQUIREMENTS

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. 5 SILICONE HYDRAULIC BRAKE FLUID can cause eye irritation. In case of contact with eyes, flush with plenty of water and get medical attention. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN!

Use only D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID (Part No. 99902-77).

FRONT FORK OIL

Use only WP FORK OIL, 5 WEIGHT.

FUEL

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

ENGINE OIL

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

Table 1. 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 240	Below 40°F (4°C)	Excellent
H.D. Multi-Grade	SAE 20W50	HD 240	Above 40° (4°C)	Good
H.D. Regular Heavy	SAE 50	HD 240	Above 60° (16°C)	Poor
H.D. Extra Heavy	SAE 60	HD 240	Above 80° (27°C)	Poor

PRIMARY DRIVE/TRANSMISSION LUBRICANT

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

MODEL YEAR CHANGE

See Figure 5. All 1997 model year motorcycles use the new style clutch release ramp introduced on late 1996 vehicles. The clutch adjustment and lever freeplay procedures remain the same. The change was made to provide additional clearance between the coupler and the primary cover.

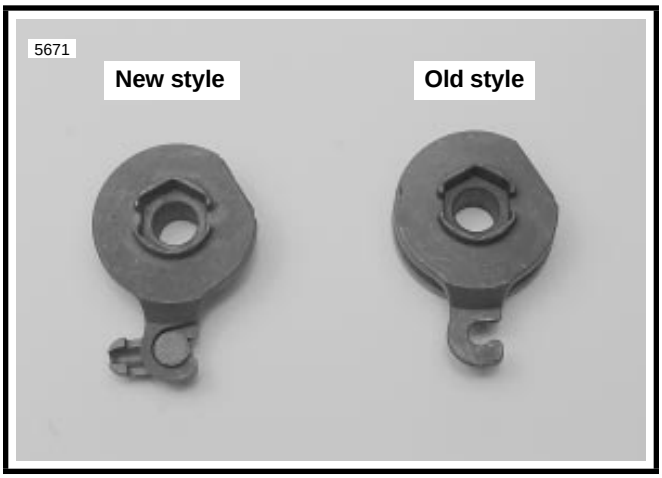


Figure 5. Ramp Change

REAR PRELOAD ADJUSTMENT

GENERAL

Rear suspension spring preload must be adjusted before any other adjustments can be attempted. This adjustment assures that the rear suspension has the proper amount of travel.

Spring preload is the most important suspension adjustment on the S1 Lightning. Improper preload will adversely affect both the handling and motorcycle ride. Correct preload setting will result in motorcycle handling that suits the rider's size and weight.

ADJUSTMENT

You will need three people to carry out this adjustment.

1. Verify correct front and rear tire pressure. See SPECIFICATIONS on page 3.
2. Remove all accessories from motorcycle including tank bag and/or saddlebags.
3. Take the motorcycle off the side stand and bounce the rear up and down a few times to be sure the suspension is free and not binding.
4. See Figure 6. Measure the distance from the center of the rear axle nut to the rear turn signal mounting bolt **without** rider/passenger/cargo/accessories on the motorcycle.
5. Install items removed in Step 2. Load all cargo.
6. Bounce a few times on the seat to be sure the suspension is free and not binding.
7. With the help of an assistant, take the same measurement with the vehicle fully loaded (rider/passenger/luggage/cargo). The assistant should help balance the motorcycle so the rider can keep both feet on the footrests.
8. Subtract the second measurement from the first. The difference, which is the squat, should be 0.25-0.75 in. (6.4-19.1 mm). If it is not, you will have to adjust the spring preload.

⚠CAUTION

- **Be sure to apply the same number of turns to each preload adjusting nut to ensure that the drawing rings do not become misaligned. Misaligned drawing rings will cause the shock absorber spring to bind against the adjustment rods**
- **Be sure the drawing rings are parallel within 1/64 in. (0.4 mm). Misaligned drawing rings will cause the shock absorber spring to bind against the adjustment rods.**

9. See Figure 7. Change the spring preload by adjusting both preload adjusting nuts (1) (metric) behind the rear drawing ring (2).
   a. Increase the preload by tightening the nuts.
   b. Decrease the preload by loosening the nuts.

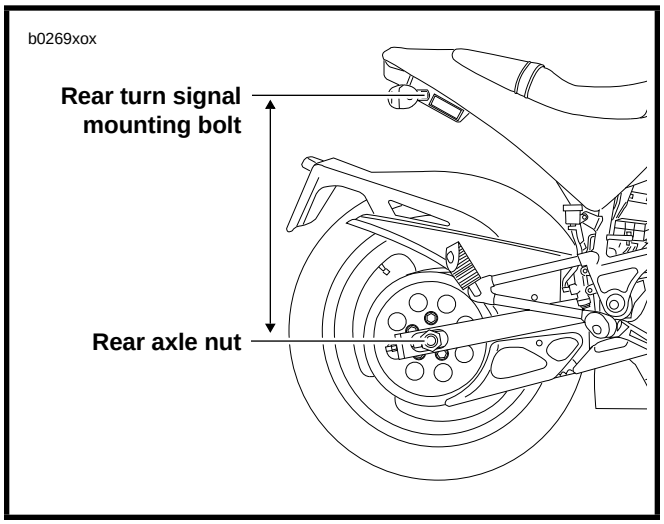
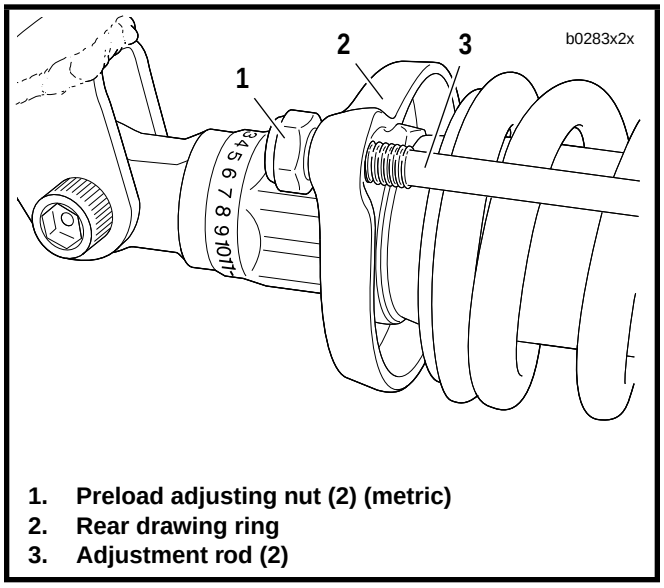


Figure 6. Checking Rear Preload



1. **Preload adjusting nut (2) (metric)**
2. **Rear drawing ring**
3. **Adjustment rod (2)**

Figure 7. Adjusting Rear Preload

IGNITION TIMING

MODEL YEAR CHANGE

See Figure 8. All 1997 model year motorcycles have the remote idle adjuster introduced on late 1996 vehicles. Using this adjuster, it is no longer necessary to use the CARBURETOR IDLE ADJUSTMENT TOOL (Part No. HD-33413) and TIP (SNAP-ON Part No. TMP23A) to adjust engine idle speed.

NOTE

The new idle adjuster changes Step 4 of IGNITION TIMING, INSPECTION in Section 1 the 1996 manual.

See REMOTE IDLE ADJUSTER on page 21 for more information.

Figure 8. Remote Idle Adjuster

NOTES

SECTION II–CHASSIS

This section explains procedures unique to 1997 model S1 Lightnings. Any procedures not found in this supplement are covered in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y).

NOTES

VEHICLE IDENTIFICATION NUMBER

MODEL YEAR CHANGE

See Figure 9. A 17-digit serial number, or Vehicle Identification Number (V.I.N.), is stamped on the right side of the steering head (ex., 4MZSS11J1V3200001). Also affixed to the steering head at this location is an information decal bearing the V.I.N. code.

An abbreviated V.I.N. is stamped on the front left side of the crankcase.

NOTE

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

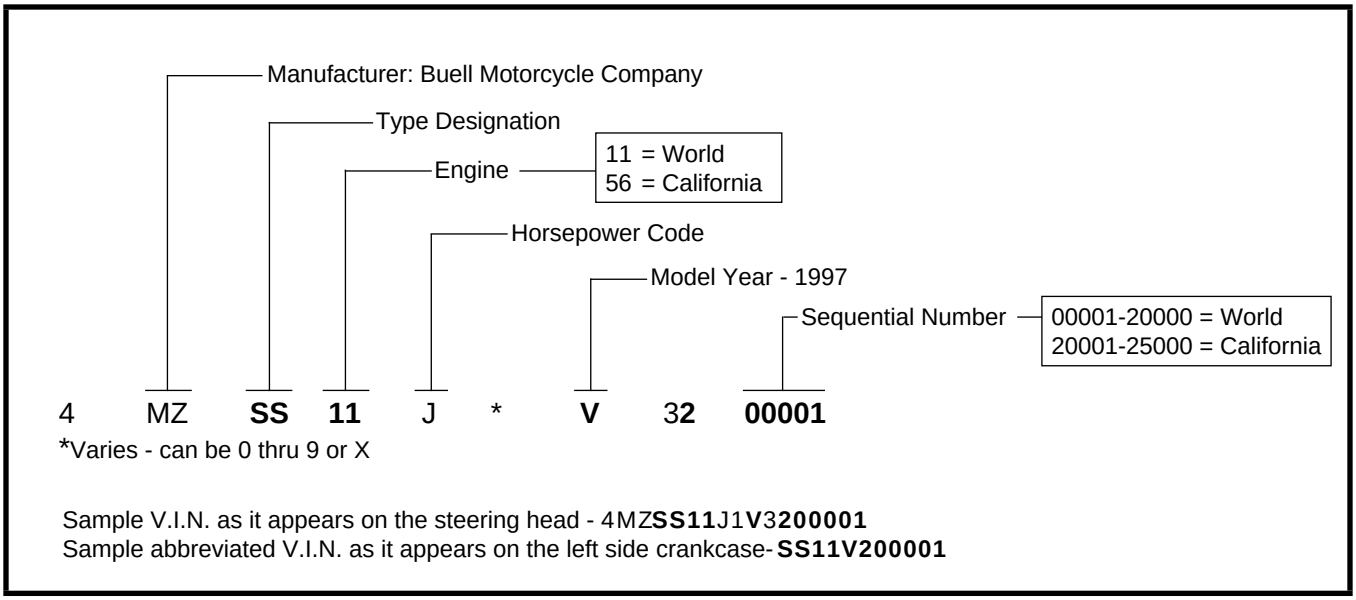


Figure 9. Vehicle Identification Number (V.I.N.)

FRONT WHEEL

MODEL YEAR CHANGE

See Figure 10. All 1997 model year motorcycles have new fasteners on the front brake rotor/carrier assembly.

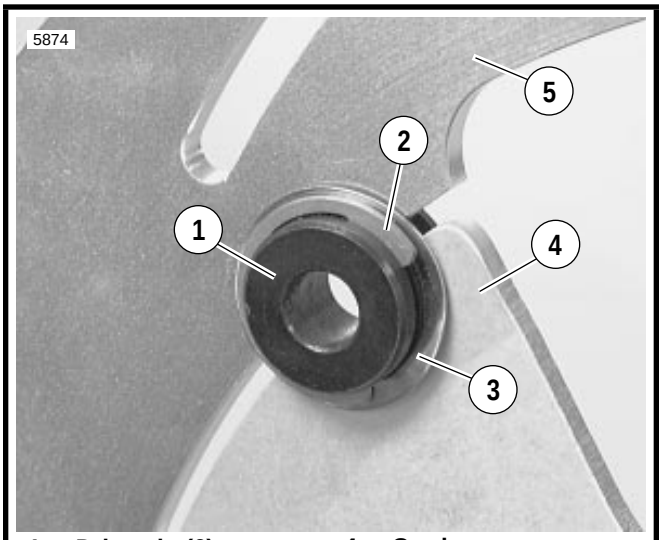
Separate the carrier from the rotor only when necessary. Use **new** clips when reassembling.

NOTE

The new rotor/carrier assembly changes Step 4 of FRONT WHEEL, REMOVAL and Step 2 of FRONT WHEEL, ASSEMBLY in the 1996 manual.

REMOVAL/INSTALLATION

1. See Figure 10. Remove and discard the clip (2).
2. Remove the wave washer (3).
3. Remove the drive pin (1). Repeat this procedure for the other five fasteners to separate the carrier (4) from the rotor (5).
4. Assemble in reverse order. Use **new** clips upon assembly.



1. Drive pin (6)
2. Clip (6)
3. Wave washer (6)
4. Carrier
5. Rotor

Figure 10. 1997 Rotor to Carrier Fastener

FRONT BRAKE CALIPER

TOOL INFORMATION

Use the BRAKE CALIPER PISTON REMOVER (Part No. B-42079) to simplify front caliper piston removal.

NOTE

The following instructions expand upon Step 9 of FRONT BRAKE CALIPER, REMOVAL/DISASSEMBLY in the 1996 manual.

1. Attach caliper half to tool.
   a. See Figure 11. Attach outside caliper half using two screws.
   b. See Figure 12. Attach inside caliper half using two screws and two nuts.

⚠WARNING

When using air pressure to remove pistons from caliper, pistons may be ejected with considerable force. Wear safety glasses and heavy gloves to prevent personal injury.

⚠CAUTION

Exercise care to avoid dropping piston on hard surface. Any damage requires piston replacement.

2. If removing pistons from outside caliper half, place a gloved finger over the banjo bolt hole.
3. See Figure 13. Apply low pressure air to force the pistons from the caliper bores.

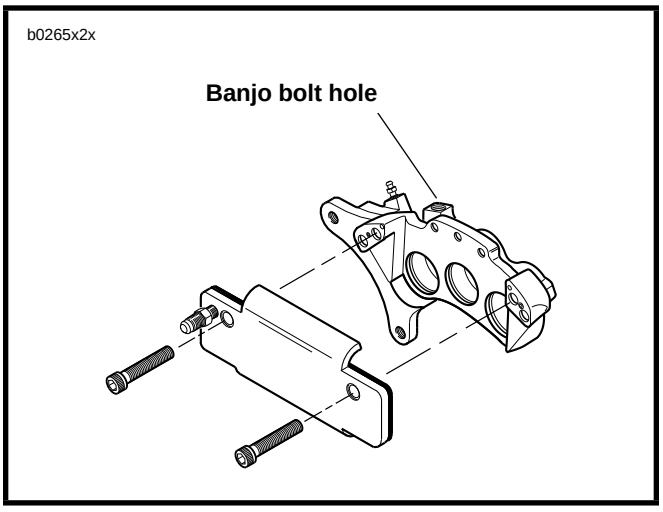


Figure 11. Outside Caliper Half

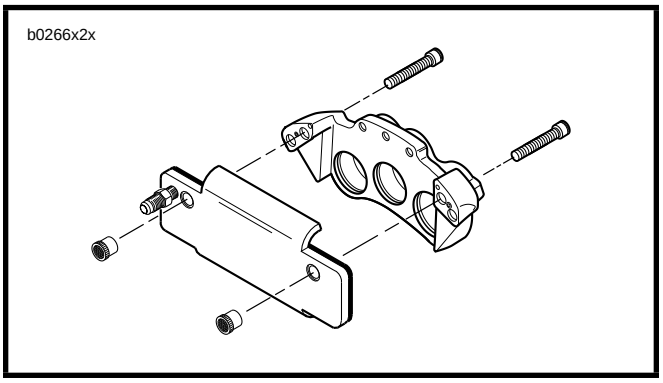


Figure 12. Inside Caliper Half

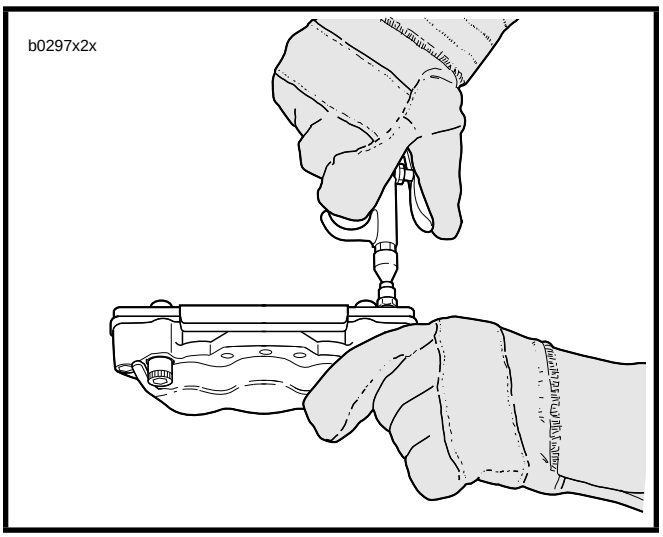


Figure 13. Using Air Pressure to Remove Pistons

SWINGARM

MODEL YEAR CHANGE

All 1997 model year motorcycles use a revised swingarm pivot assembly. The modifications allow preload to be adjusted without using the PIVOT SHAFT BEARING ADJUSTER (Part No. B-41175).

NOTE

See Figure 14. The threaded rod (1) replaces a pivot shaft used on 1996 models. This new part changes the SWINGARM, ASSEMBLY and SWINGARM, INSTALLATION procedures in the 1996 manual.

ASSEMBLY

1. See Figure 14. If necessary, draw **new** roller bearing cups (5) into swingarm using BEARING INSTALLATION BOLT (Part No. B-35316-5) and STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302).

NOTE

Timkin roller bearing assemblies should be replaced as a unit. Do not intermix components. Mark all components so they may be correctly installed.

2. Coat bearing components with WHEEL BEARING GREASE (Part No. HD-99855-89) and assemble.
3. Install a **new** swingarm seal (3) flush to the swingarm.
4. Slide swingarm assembly into position.

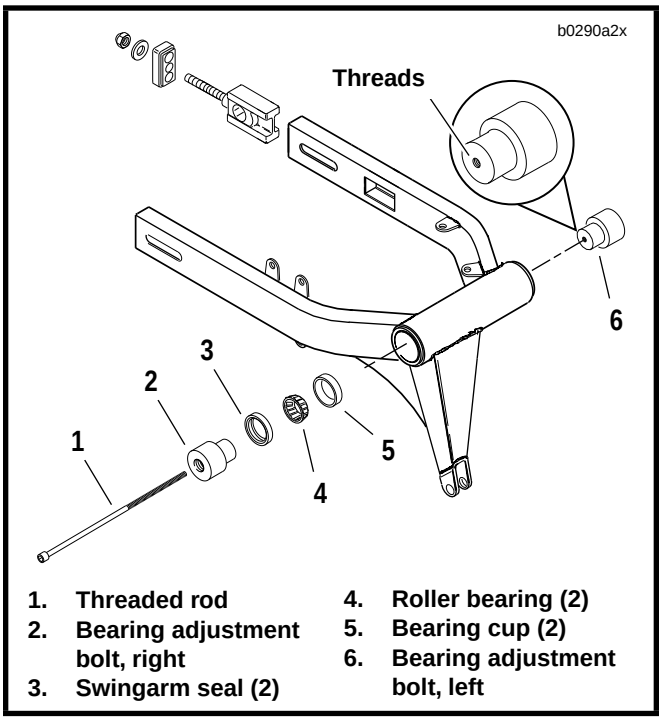
NOTE

See Figure 14. The left side bearing adjustment bolt (6) has additional internal threads.

5. Install both bearing adjustment bolts (2, 6) and the threaded rod (1). Insert the rod from the air cleaner side of the motorcycle.
6. Tighten the left pinch screw on the swingarm mount block. Do not tighten the right side pinch screw at this time.

INSTALLATION

1. See Figure 15. Adjust swingarm preload by tightening the threaded rod. Preload should measure 3.5-5.5 lbs (1.6-2.5 kg).
2. Follow the remaining installation instructions in the 1996 manual.



1. **Threaded rod**
2. **Bearing adjustment bolt, right**
3. **Swingarm seal (2)**
4. **Roller bearing (2)**
5. **Bearing cup (2)**
6. **Bearing adjustment bolt, left**

Figure 14. Swingarm

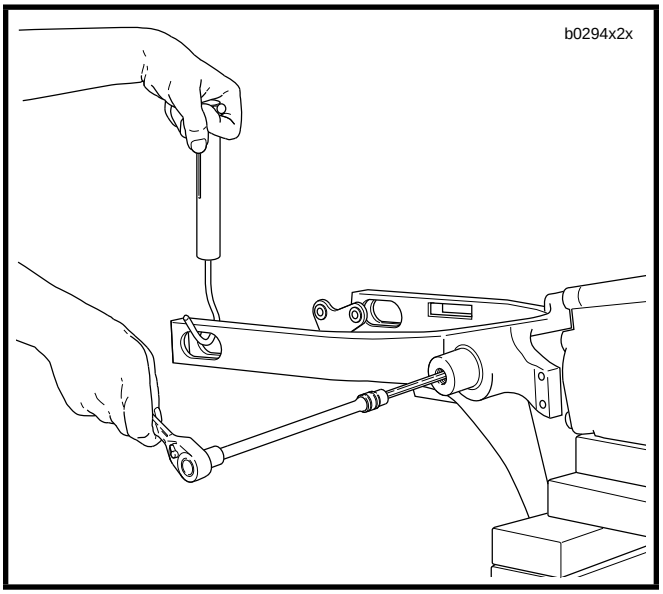


Figure 15. Adjusting Preload

SECTION III–ENGINE

All engine procedures in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y) apply to 1997 models.

NOTES

SECTION IV–FUEL SYSTEM

SUBJECT **PAGE NO.**

This section explains procedures unique to 1997 model S1 Lightnings. Any procedures not found in this supplement are covered in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y).

NOTES

REMOTE IDLE ADJUSTER

GENERAL

See Figure 16. The remote idle adjuster allows idle adjustments without use of tools. Idle speeds are listed in Table 2.

REMOVAL

1. Remove seat and fuel tank. See FUEL TANK, REMOVAL in Section 4 of the 1996 manual.
2. Remove cable strap holding adjuster to frame.
3. See Figure 17. Unthread adjuster assembly from bracket (4). Remove spring (3) and washer (2).

NOTE

If remote idle adjuster is permanently removed, install idle adjuster screw, spring and two washers. See the 1996 S1 LIGHTNING PARTS CATALOG (Part No. 99571-96Y).

INSTALLATION

1. See Figure 17. Thread remote adjuster (1), spring (3) and washer (2) into bracket (4). Adjuster shaft (5) must touch stop plate (6).
2. See Figure 18. Secure adjuster to frame with a figure-8 cable strap.
   a. Wrap cable strap around inside of frame, then up and through the slot.
   b. Contine cable strap over adjuster.
   c. Run cable strap through the other side of the slot. Strap should be tight enough that the adjuster turns easily.

⚠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 and personal injury.

3. Install fuel tank and seat. See FUEL TANK, INSTALLATION in Section 4 of the 1996 manual.
4. Start vehicle and warm engine to normal operating temperature.
5. See Figure 16. Set idle speed by turning adjuster. See Table 2.
   a. Turn clockwise to increase idle speed.
   a. Turn counterclockwise to decrease idle speed.

Table 2. Engine Idle Speed

MODEL	REGULAR IDLE	FAST IDLE
World Model	950-1050 RPM	2000 RPM
California	1150-1250 RPM	

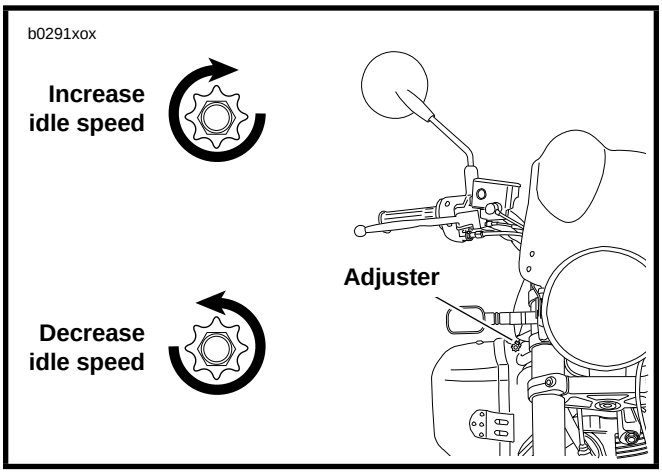
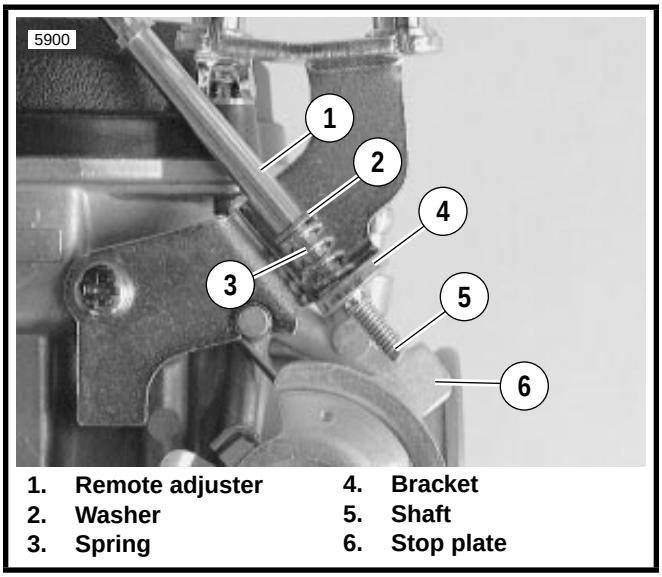


Figure 16. Idle Speed Adjuster



1. Remote adjuster
2. Washer
3. Spring
4. Bracket
5. Shaft
6. Stop plate

Figure 17. Removal/Installation

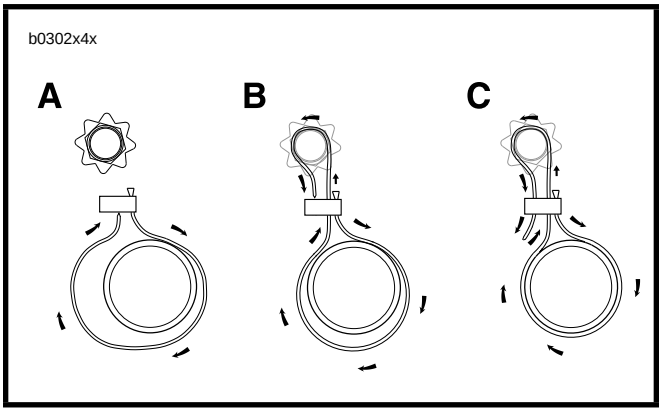


Figure 18. Cable Strap

AIR CLEANER

MODEL YEAR CHANGE

All 1997 model year motorcycles use a modified air cleaner assembly. The new design increases serviceability.

REMOVAL

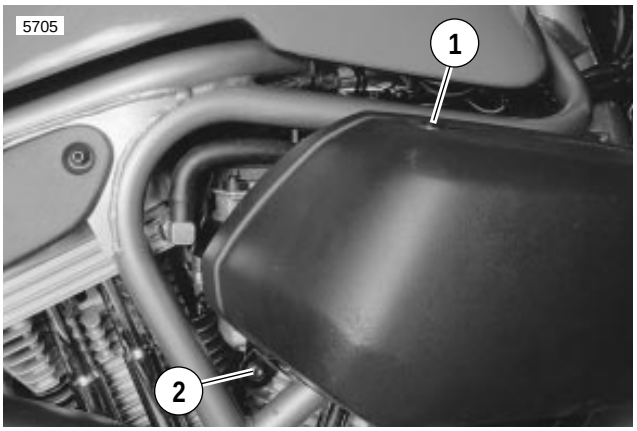
⚠CAUTION

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

1. See Figure 19. Remove screw and nylon washer (1) on top of air cleaner cover.
2. Remove screw and locknut (2) at rear of air cleaner cover.
3. See Figure 20. Remove cover (3) with attached filter box (2) and filter (1).
4. See Figure 21. Remove backplate hoses.
   a. Detach rear breather hose (4) from tee fitting (3).
   b. Detach snorkel breather hose (2) at snorkel (1).
   c. Remove hoses (2, 5) and tee fitting (3) from front breather bolt (6).
   d. On California models, slide fresh air hose from canister through backplate.
5. See Figure 22. Remove two screws and snorkel plate.
6. Remove snorkel.
7. See Figure 23. Remove screw with spacer and gasket.
8. Remove backplate.
   a. See Figure 24. Remove two bolts (1), washers (2) and nuts (3).
   b. Draw rear breather hose through backplate.
   c. Remove front breather bolt. Detach backplate from motorcycle.
9. If necessary, remove air cleaner support ring.
   a. Detach breather hose from rear cylinder head breather bolt.
   b. Loosen rear bolt.
   c. Slide air cleaner support ring upward and remove.

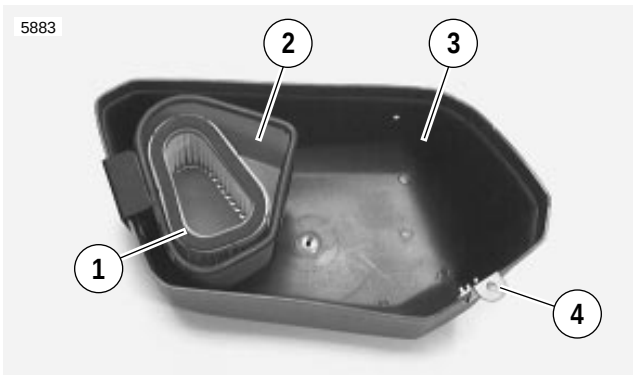
NOTE

Air cleaner support ring fits around breather bolts. Fitting on rear breather bolt may not clear the frame if bolt removal is attempted. Do not remove rear breather bolt unless absolutely necessary.



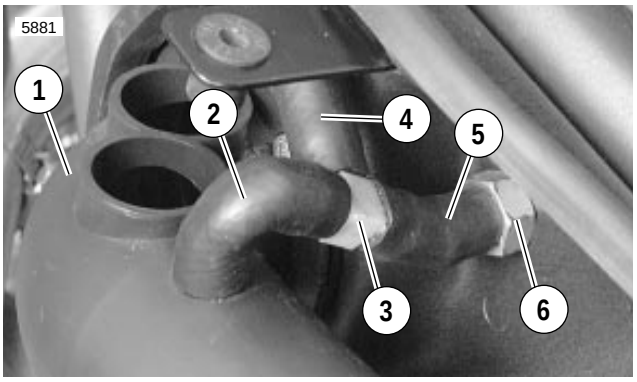
1. Screw and nylon washer
2. Screw and locknut

Figure 19. Air Cleaner Cover



1. Filter
2. Filter box
3. Cover
4. Rear mount

Figure 20. Inside of Air Cleaner Cover

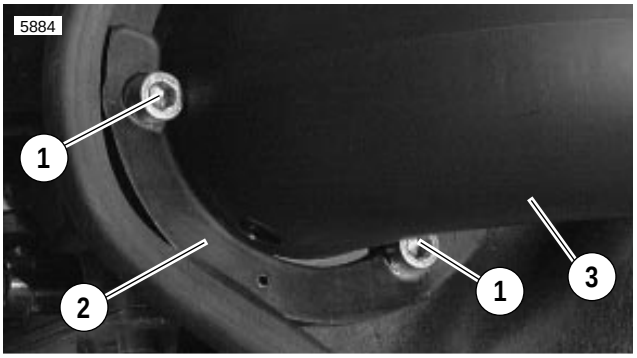


1. Snorkel
2. Snorkel breather
3. Tee fitting
4. Rear head breather
5. Front head breather
6. Front breather bolt

Figure 21. Breather Hoses

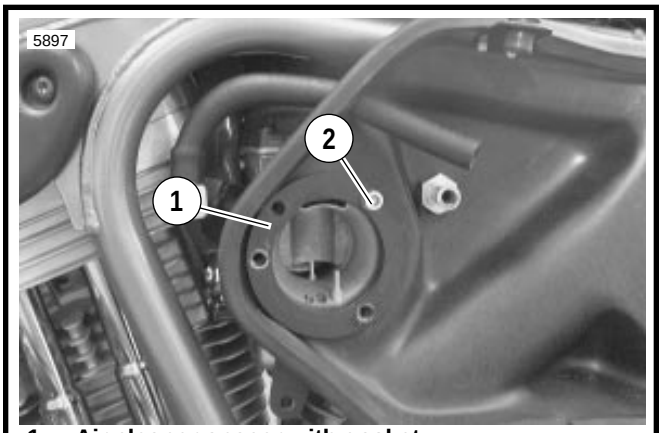
INSTALLATION

1. Install backplate.
   a. Apply HYLOMAR to threads of breather bolts.
   b. Install air cleaner support ring and backplate using breather bolts. Tighten breather bolts to 10-15 ft-lbs (13.6-20.3 Nm).
   c. Attach rear breather hose to rear breather bolt.
   d. See Figure 24. Install two bolts (1), washers (2) and nuts (3) through backplate into isolator mount.
2. See Figure 21. Install breather hoses.
   a. Slide rear breather hose through backplate.
   b. Attach front breather hose (5, with attached tee and snorkel breather hose) to front breather bolt (6).
   c. Connect rear breather hose (4) to tee fitting (3).
   d. On California models, insert fresh air hose from canister through backplate.
3. See Figure 23. Apply LOCTITE THREADLOCKER 242 (blue) to screw. Install ring with screw through backplate. Tighten to 7-9 ft-lbs (9.5-12.2 Nm).
4. See Figure 22. Apply LOCTITE THREADLOCKER 242 (blue) to screws. Fasten snorkel tube with ring and two screws. Tighten to 6-8 ft-lbs (8.1-10.8 Nm).
5. Connect snorkel hose to snorkel tube.
6. See Figure 20. Check air cleaner filter. Place filter inside filter box. Place cover assembly over backplate.
7. See Figure 19. Install screw and washer into top well nut.
8. Install screw and locknut at rear mount. Tighten to 6-8 ft-lbs (8.1-10.8 Nm).



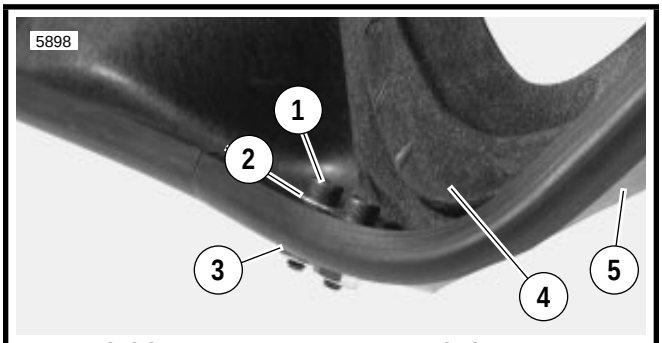
1. Screw (2)
2. Snorkel plate
3. Snorkel

Figure 22. Snorkel Ring



1. Air cleaner spacer with gasket
2. Screw

Figure 23. Air Cleaner Spacer



1. Bolt (2)
2. Washer (2)
3. Nut (2)
4. Backplate
5. Isolator mount

Figure 24. Front Isolator Mount Attachment

NOTES

SECTION V–ELECTRIC STARTER

SUBJECT **PAGE NO.**

This section explains procedures unique to 1997 model S1 Lightnings. Any procedures not found in this supplement are covered in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y).

NOTES

STARTING SYSTEM DIAGNOSIS

— BATTERY TESTS —
● VISUAL ● VOLTAGE ● LOAD

Check Connections at Battery and Starter Components.

Continued on Next Page

INOPERATIVE

Solenoid Clicks.

Perform Voltage Drop Tests Between Battery and "Relay" Terminal on Solenoid. Less Than 1 Volt?

YES

(2) Perform Voltage Drop Tests from Battery (Pos. +) to Starter "Motor" Terminal. Crank Engine. Is Voltage Greater than 1 Volt?

YES

(2) Perform Voltage Drop Tests from Battery (Pos. +) to Starter Motor "M" (Battery) Terminal. Crank Engine. Is Voltage Greater than 1 Volt?

YES

Repair Connection Between Battery and Starter.

NO

Repair or Replace Solenoid (Contacts).

NO

(2) Backtrack to Pinpoint Poor Connections or Relay Contact Problems Using Voltage Drop Tests.

NO

(2) Perform Voltage Drop Test Between Battery (Neg. -) and Starter Studs or Bolts. Is Voltage Greater than 1 Volt?

YES

Clean Ground Connections

NO

Relay Clicks.

Test for Voltage at Solenoid Terminal. Is 12V Present When Starter Button is Pressed?

YES

(1) Does Starter Motor Turn if Jumped?

YES

Replace Solenoid.

NO

Test Starter Motor for Opens, Shorts or Grounds.

NO

Test for Voltage to Relay. Is 12V Present on Relay Terminal

YES

Test for Voltage from Relay. Is 12V Present on Relay Terminal 87 When Starter Button is Pressed?

YES

Repair Open on GN Wire Between Relay and Solenoid.

NO

Replace Starter Relay.

NO

Repair Open on R/BK Wire Feeding Terminal 30 on Starter Relay.

Nothing Clicks.

Check for Battery Voltage at Relay Terminal 86 From Starter Button. Battery Voltage Present?

YES

Check for Ground at Relay Terminal 85. Ground Present?

YES

Substitute Good Relay or Test Relay.

NO (5)

Inspect Starter Interlock Circuit or Correct Relay Ground.

NO

Check for Battery Voltage from Starter Button BK/R Wire. Battery Voltage Present With Starter Button Pressed?

YES

Repair Wiring From Starter Button to Relay.

NO

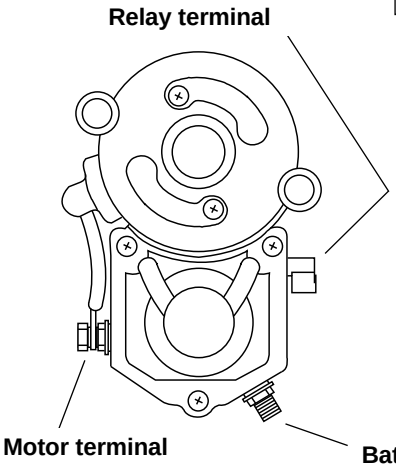
Check for Battery Voltage to Starter Button W/BK Wire. Battery Voltage Present?

YES

Replace Starter Button.

NO

Repair Wiring to Starter Button.



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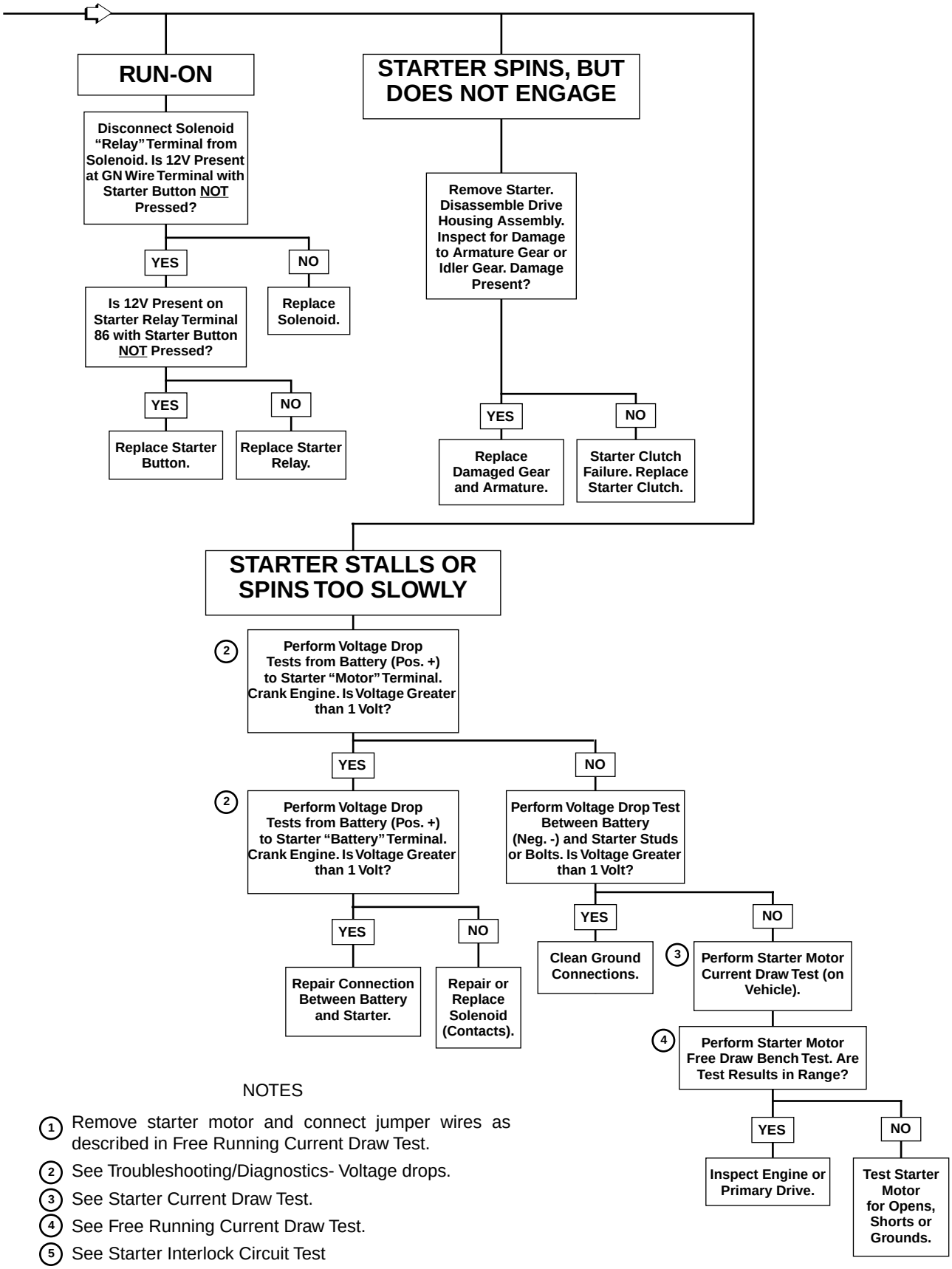


NOTES

1. Remove starter motor and connect jumper wires as described in Free Running Current Draw Test.
2. See Troubleshooting/Diagnostics- Voltage drops.
3. See Starter Current Draw Test.
4. See Free Running Current Draw Test.
5. See Starter Interlock Circuit Test

SECTION VI–DRIVE/TRANSMISSION

All drive/transmission procedures in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y) apply to 1997 models.

NOTES

SECTION VII–ELECTRICAL

SUBJECT **PAGE NO.**

This section explains procedures unique to 1997 model S1 Lightnings. Any procedures not found in this supplement are covered in the 1996 S1 Lightning Service Manual (Part No. 99490-96Y).

NOTES

HANDLEBAR SWITCHES

MODEL YEAR CHANGE

All 1997 model year motorcycles use new handlebar switches. The switches feature new icons, connectors and a different pin numbering sequence.

NOTE

All HANDLEBAR SWITCHES, REMOVAL and HANDLEBAR SWITCHES, INSTALLATION procedures remain the same. The new switch assemblies are interchangeable between 1996 and 1997 models if the corresponding connector on the wiring harness is changed.

See WIRING HARNESS on page 37 for more information.

Right Handlebar Switch

See Figure 25. The right handlebar switch [P1] contains:

- Engine stop switch (ignition ON or OFF)
- Electric starter switch

Left Handlebar Switch

See Figure 26. The left handlebar switch [P6] contains:

- Passing lamp switch
- Headlamp dimmer switch (headlamp HIGH or LOW beam)
- Turn signal switch
- Horn switch

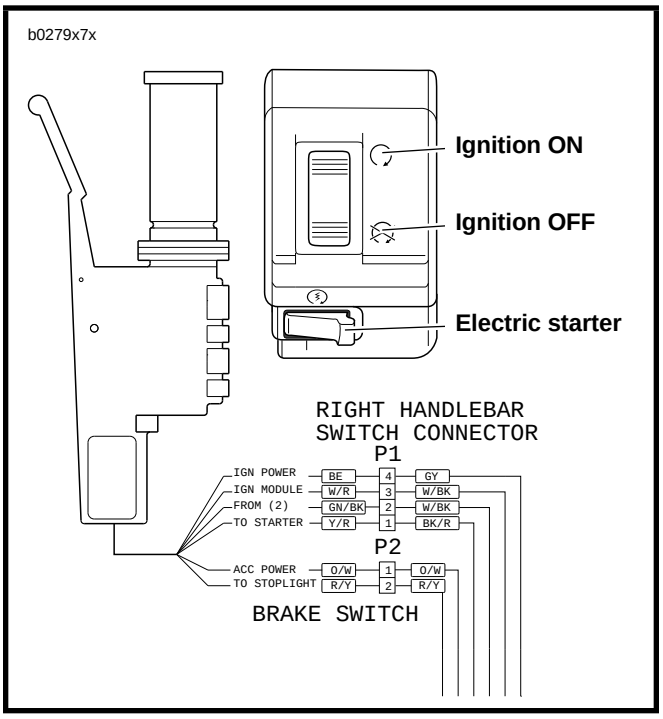


Figure 25. Right Handlebar Switch [P1]

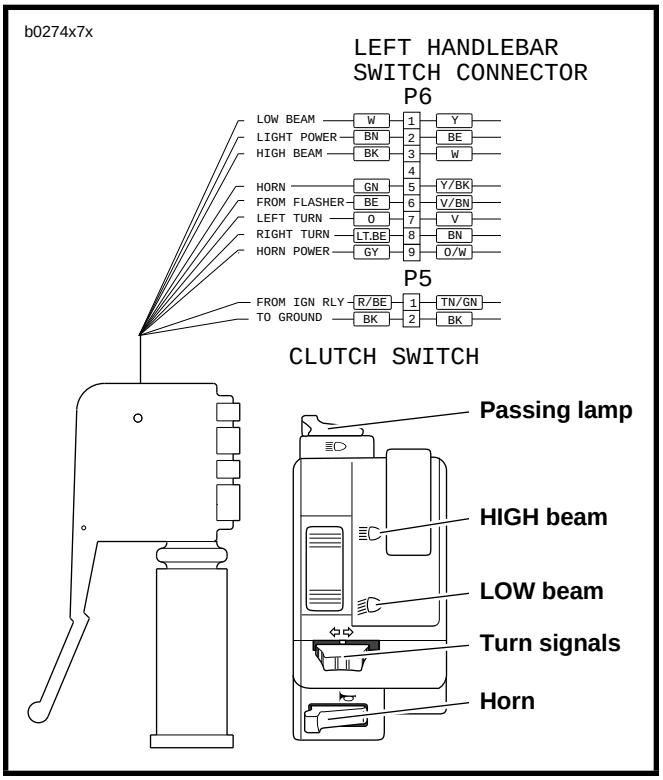


Figure 26. Left Handlebar Switch [P6]

STARTER INTERLOCK SYSTEM

INSPECTION

The starter interlock system is designed to prevent unintended start-up and/or forward motion of the motorcycle with the vehicle's side stand not retracted. Use the following two tests to check the system for proper operation.

NOTE

The STARTER CIRCUIT and IGNITION CIRCUIT tests should be performed in one continuous operation. Conduct both tests one after the other in the sequence given without interruption

Starter Circuit

Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).

Remove GN wire from starter motor.

Connect a test light or voltmeter to the vehicle in series.

a. Attach one end to starter wire terminal.
b. Attach the other end to vehicle ground.

Set engine stop switch to RUN.

Turn ignition switch to IGN.

Place motorcycle in neutral.

Press starter button on right handlebar.
Is current present? (Current is present if test light illuminates or if voltmeter shows 12 VDC± 1.0 VDC.)

YES ← → **NO** → Check neutral switch and circuit. See NEUTRAL INDICATOR SWITCH in Section 7 of the 1996 manual. Repeat entire interlock circuit test when finished.

Place motorcycle in first gear.

Press starter button on right handlebar.
Is current present?

→ **YES** → Check neutral switch. See NEUTRAL INDICATOR SWITCH in Section 7 of the 1996 manual. Repeat entire interlock circuit test when finished.

NO

Disengage clutch lever by pulling lever in fully.

Press starter button on right handlebar.
Is current present?

→ **NO** → Check clutch switch. See STARTER INTERLOCK in Section 7 of the 1996 manual. Repeat entire interlock circuit test when finished.

YES

Release clutch lever.

Press starter button on right handlebar.
Is current present?

→ **YES** → Check clutch switch. See STARTER INTERLOCK in Section 7 of the 1996 manual. Repeat entire interlock circuit test when finished.

No → Starter circuit operating properly.

a. Turn ignition switch to LOCK.
b. Remove test light or voltmeter.
c. Reattach starter motor wire.

→ Proceed to IGNITION CIRCUIT on page 35.

Ignition Circuit

Remove W/BK wire from ignition coil.

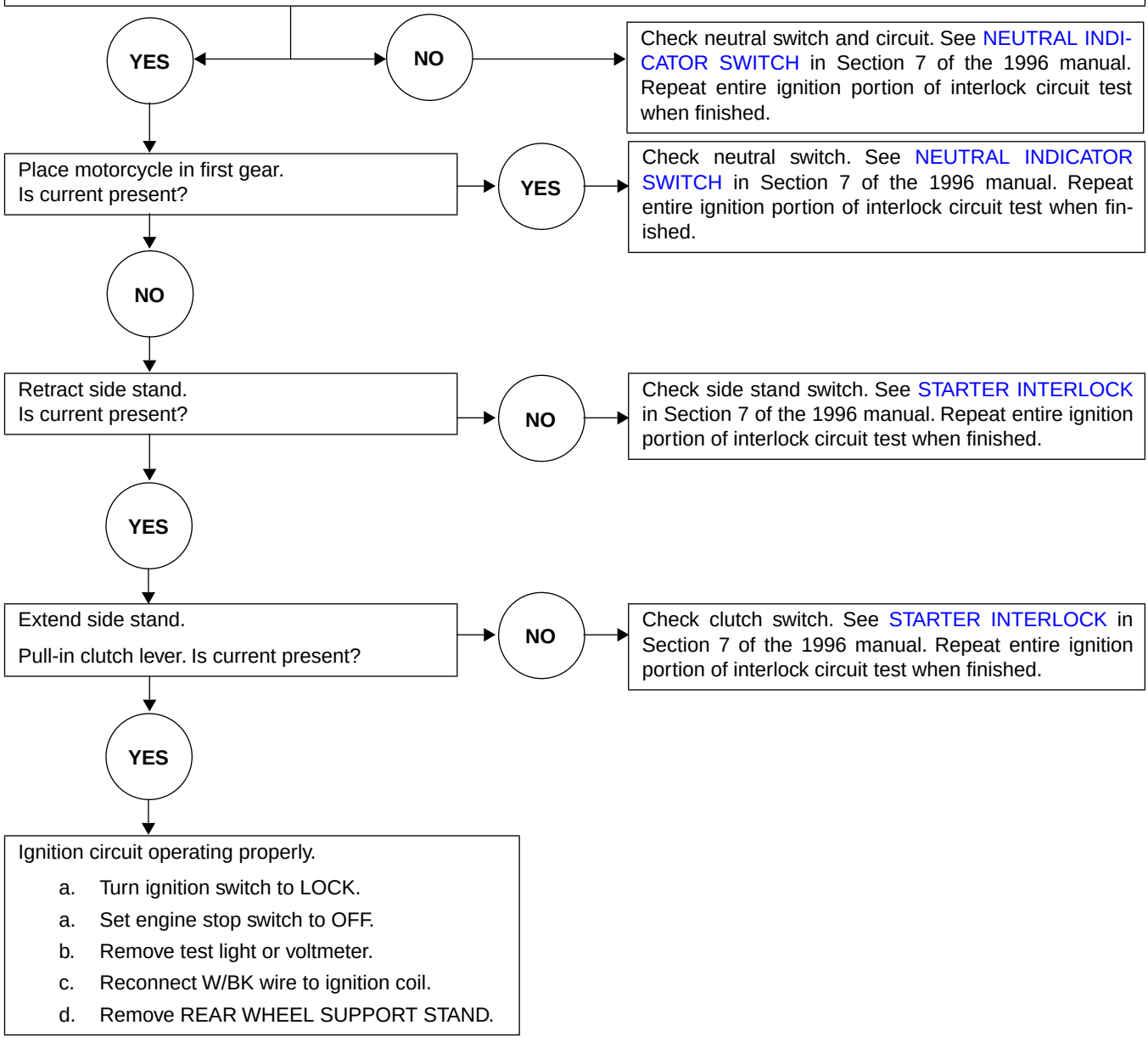
Connect a test light or voltmeter to the vehicle.

a. Attach one end to W/BK wire terminal.
b. Attach the other end to vehicle ground.

Turn ignition switch to IGN.

Set engine stop switch to RUN.

Place motorcycle in neutral. Is current present?



HORN

MODEL YEAR CHANGE

See Figure 27. All 1997 model year motorcycles have a new horn in a new location.

NOTE

For troubleshooting information, see HORN, TROUBLESHOOTING in Section 7 in the 1996 manual.

REMOVAL

1. Remove seat and fuel tank. See FUEL TANK, REMOVAL in Section 4 of the 1996 manual.
2. See Figure 28. Detach horn wires.
   a. Disconnect Y/BK power wire (5).
   b. Disconnect BK ground wire (6).
3. Remove bolt (1), lockwasher (2) and washer (3) to detach horn and bracket from frame.

INSTALLATION

1. See Figure 28. Attach horn assembly to frame using bolt (1), lockwasher (2) and washer (3).
2. Connect horn wires.
   a. Attach Y/BK power wire (5).
   b. Attach BK ground wire (6).

⚠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 and personal injury.

3. Install fuel tank and seat. See FUEL TANK, INSTALLATION in Section 4 of the 1996 manual.

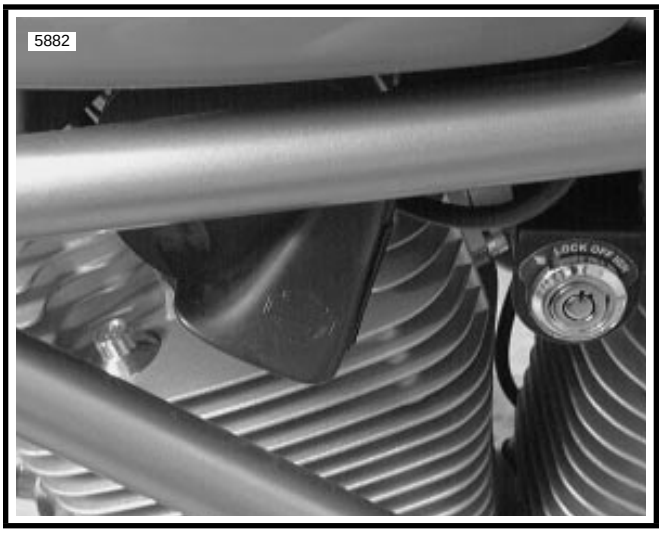
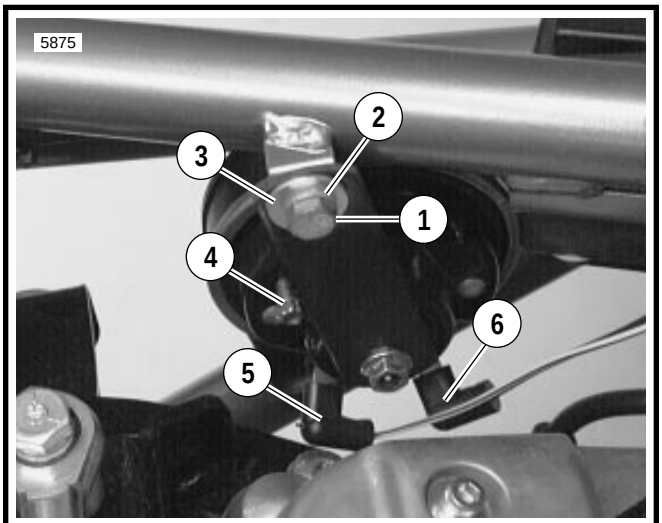


Figure 27. Horn Location



1.	**Bolt**	**4.**	**Adjuster**
2.	**Lockwasher**	**5.**	**Power wire (Y/BK)**
3.	**Washer**	**6.**	**Ground wire (BK)**

Figure 28. Horn Attachment

WIRING HARNESS

MODEL YEAR CHANGE

The following changes were made to the wiring harness for 1997 model year motorcycles.

- New connectors and a different pin numbering sequence for the right handlebar switch [P1] and the left handlebar switch [P6]. See HANDLEBAR SWITCHES on page 33.
- Longer wires leading to the horn to accommodate the new mounting position.

Table 3. Electrical Connectors

CONNECTOR NUMBER	DESCRIPTION	COMPONENT(S)
[P1]	4-place connector	right handlebar switch housing-ignition power, module and starter
[P2]	2-place Amp Multilock	front brake switch
[P3]	12-place Amp Multilock	instruments and indicator lamps
[P4]	4-place Amp Multilock	headlamp
[P5]	2-place Amp Multilock	clutch switch
[P6]	8-place connector	left handlebar switch housing-horn, turn signals, lights
[P7]	2-place Deutsch	vacuum-operated electric switch
[P8]	4-place PED	ignition/headlamp switch
[P9]	4-slot fuse block	four 15 amp fuses-ignition, instruments, lights and accessories
[P10]	8-place Deutsch	ignition module
[P11]	8-place Amp Multilock	tail lamp and rear turn signals
[P12]	4-place relay	ignition relay
[P13]	4-place relay	starter relay
[P14]	2-place Amp Multilock	side stand switch
[P15]	2-place Amp Multilock	license plate light
[P16]	3-place Deutsch	timer and pickup
[P17]	2-place plug	voltage regulator

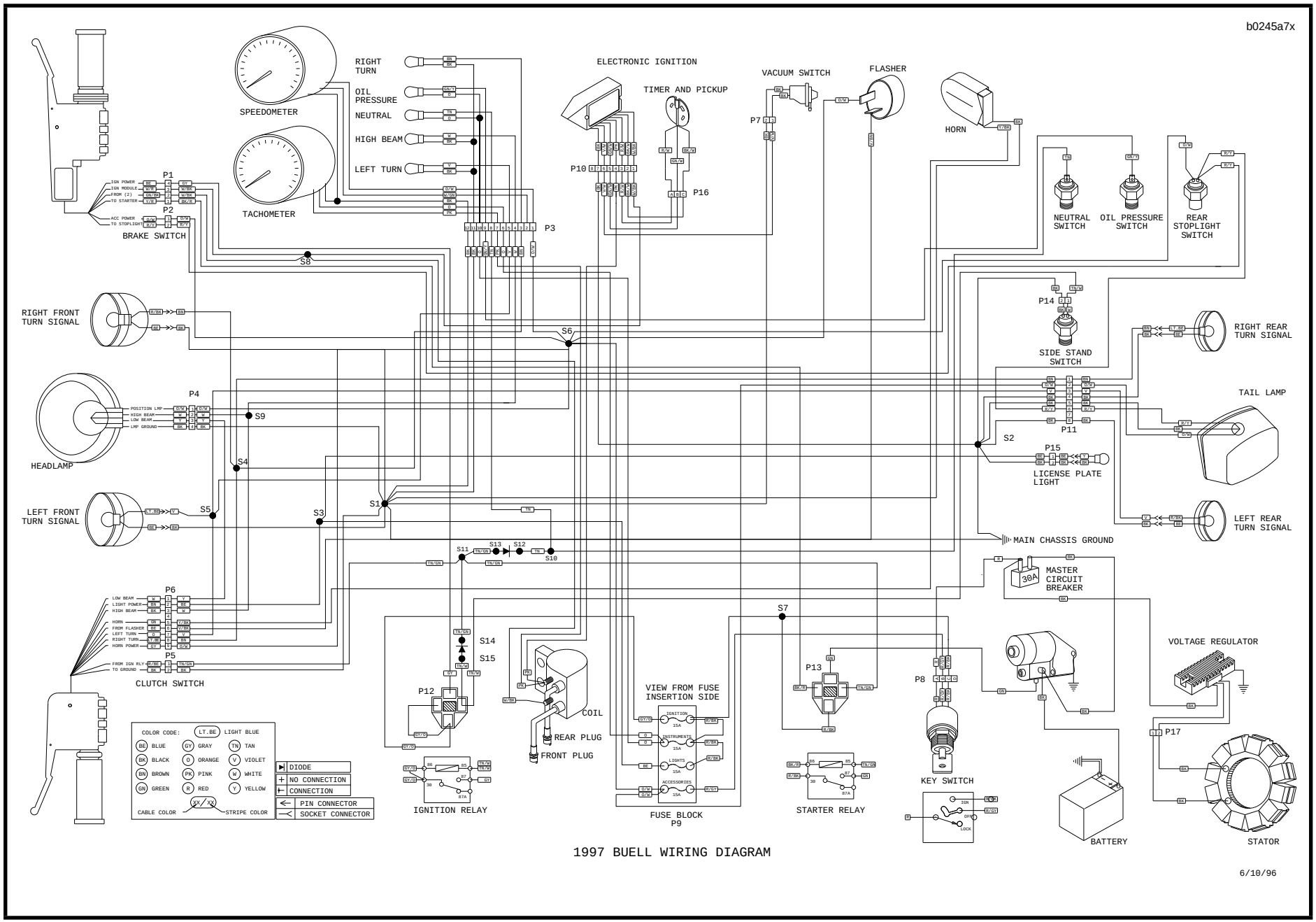


Figure 29. 1997 Wiring Diagram

FOREWORD

GENERAL

This Service Manual Supplement has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the 1997 Buell S1 Lightning and assist in the performance of basic maintenance and repair. Secondly, it will introduce to the professional Buell Technician the latest field-tested and factory-approved major repair methods. We sincerely believe that this Service Manual Supplement will make your association with Buell products more pleasant and profitable.

HOW TO USE YOUR SERVICE MANUAL SUPPLEMENT

1. Check the TABLE OF CONTENTS following this FORWORD to find the desired subject.

2. If the information you seek is not in this supplement, refer to the corresponding section in the Buell 1996 S1 Lightning Service Manual (Part No. 99490-96Y). Check the TABLE OF CONTENTS or INDEX to find the desired subject.

3. Information is presented in a definite order as follows:

   Specifications
   General/Model Year Change
   Adjustment/Testing
   Removal/Disassembly
   Cleaning, Inspection, and Repair
   Assembly/Installation

In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.

NOTE

To avoid needless disassembly, carefully read all relative service information before repair work is started.

PREPARATION FOR SERVICE

⚠WARNING

Gasoline is extremely flammable and highly explosive. Always stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near the work site. Inadequate safety precautions may result in personal injury.

Good preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and will reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts. Cleaning will occasionally uncover sources of trouble. Tools, instruments and any parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is an unnecessary distraction and causes needless delay.

SERVICE BULLETINS

In addition to the information presented in this Service Supplement, Buell Distribution Corporation will periodically issue Service Bulletins to Buell dealers. Service Bulletins cover interim engineering changes and supplementary information.

USE GENUINE REPLACEMENT PARTS

⚠WARNING

When replacement parts are required, use only genuine Buell parts or parts with equivalent characteristics (which include type, strength and material). Failure to do so may result in product malfunction and possible injury to the operator and/or passenger.

To ensure satisfactory and lasting repairs, carefully follow the instructions and use only genuine Buell replacement parts. This is your assurance that the parts you are using will fit right, operate properly and last longer.

PRODUCT REFERENCES

⚠WARNING

Follow the directions listed on all products. Carefully read all labels, warnings and cautions before use. Inadequate safety precautions may result in personal injury.

When reference is made in this Service Manual Supplement to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be substituted.

Kent-Moore Products

All tools mentioned in this supplement with an “HD”, “J” or “B” preface must be ordered through:

Kent-Moore
SPX Corporation
29784 Little Mack
Roseville, Michigan 48066-2298
Telephone: 1-800-345-2233

Sealing and Threadlocking Products

LOCTITE PRODUCTS

Some procedures call for the use of Loctite® products. If you have any questions regarding Loctite product usage or retailer/wholesaler locations, please call Loctite Corp. at 1-800-323-5106.

CONTENTS

All photographs and illustrations may not necessarily depict the most current model or component, but are based on the latest production information available at the time of publication.

Since product improvement is our continual goal, Buell reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

WARNINGS AND CAUTIONS

Statements in this supplement preceded by the word **“⚠WARNING” or “⚠CAUTION”** are very important. Since these items alert you to situations where the possibility of personal injury or vehicle damage exists, please take special notice of them.

⚠WARNING

A “WARNING” indicates the potential for personal injury, whether to yourself or others.

⚠CAUTION

A “CAUTION” indicates that vehicle damage can occur.

⚠WARNING

- **Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this Service Manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended. It is important to note that some warnings against the use of specific service methods, which could damage the motorcycle or render it unsafe, are stated in this Service Manual. However, please remember that these warnings are not all-inclusive.**
- **Since Buell could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Buell must first thoroughly satisfy himself that neither his nor the operator’s safety will be jeopardized as a result.**
- **Wear eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Be especially cautious when using pulling, pressing or compressing equipment. The forces involved can cause parts to fly outward with considerable force, possibly resulting in personal injury.**

Buell products are manufactured under one or more of the following patents: U.S. Patents – 2986161, 2987934, 2998809, 3116089, 3144531, 3144860, 3226994, 3229792, 3434887, 3559773, 3673359, 3709317, Des. 225 626.

GENERAL

SERVICING A NEW MOTORCYCLE

⚠WARNING

Always follow the listed service and maintenance recommendations, since they affect the safe operation of the motorcycle and the personal welfare of the rider. Failure to follow recommendations may cause personal 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, and again at 2500 mile intervals, a Buell dealer should perform the service operations listed in the REGULAR MAINTENANCE INTERVALS chart on page 1-9.

SAFE OPERATING MAINTENANCE

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.

⚠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 20W50 engine oil. Failure to use the recommended oil will result in improper break-in of the engine cylinders and piston rings.**
- **Do not lubricate the enrichment cable on C.V. carburetors. The cable requires friction to operate properly.**

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.

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.

Wash bearings in a non-flammable cleaning solution. Knock out packed lubricant inside by tapping the bearing against a wooden block. Wash bearings again. Cover bearings with clean material after setting them down to dry. Never use compressed air to dry bearings.

Coat bearings with clean oil. Wrap bearings in clean paper.

Be sure that the chamfered side of the bearing always faces the shoulder (when bearings installed against shoulders). Lubricate bearings and all metal contact surfaces before pressing into place. Only apply pressure on the part of the bearing that makes direct contact with the mating part.

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.

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

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.

1996 S1 LIGHTNING SPECIFICATIONS

DIMENSIONS	IN.	MM
Wheel base	55	1397
Overall length	79.5	2019
Overall width	30	762
Road clearance	5.2	132
Seat height	29.5	749

CAPACITIES	U.S.	LITERS
Fuel tank (including reserve)	4.0 gallons	15.14
Reserve	0.6 gallons	2.27
Oil tank	2.0 quarts	1.89
Transmission	1.0 quart	0.95

WEIGHT	LBS.	KG
S1 shipping weight	446	202
GVWR	820	372
GAWR - Front	340	154
GAWR - Rear	480	218

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 front frame steering head.

ENGINE		
Number of cylinders	2	
Type	4-Cycle, 45 Degree V-Type	
Bore	3.498 in.	88.849 mm
Stroke	3.8125 in.	96.838 mm
Piston displacement	73.4 cu. in.	1203 cc
Compression ratio	10.0 to 1	
Horsepower @ RPM	91 @ 5800	
Torque ft-lb @ RPM	87 @ 5200	

IGNITION SYSTEM		
Spark plugs	No. 6R12	
Size	12 mm	
Gap	0.038-0.045 in.	0.97-1.14 mm

TRANSMISSION	
Type	Constant Mesh, Foot Shift
Speeds	5 Forward

NUMBER OF SPROCKET TEETH	
Engine	35
Clutch	56
Transmission	27
Rear wheel	61
Belt	128

TRANSMISSION GEAR RATIOS	FINAL*	OVERALL**
First (low) gear	2.69	9.717
Second gear	1.97	7.118
Third gear	1.43	5.180
Fourth gear	1.18	4.269
Fifth (high) gear	1.00	3.615

*Final gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.
**Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

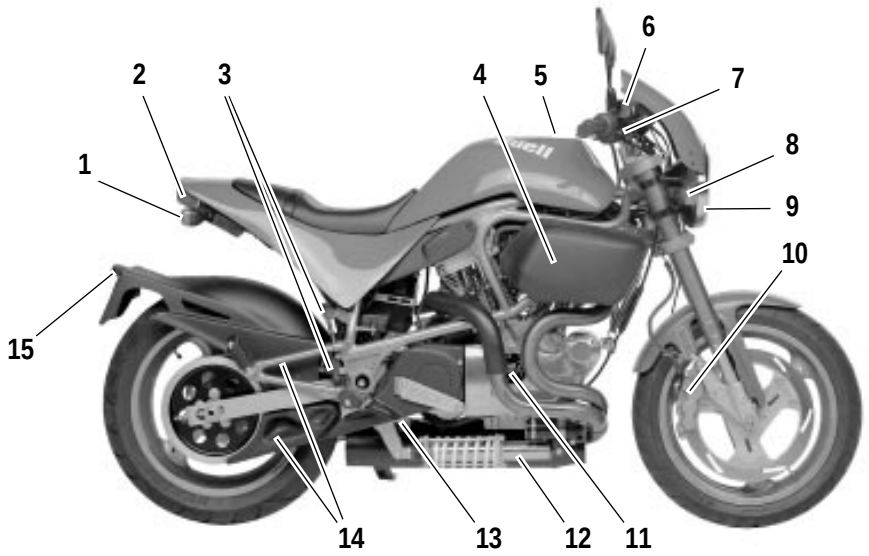
TIRE AND POSITION	PRESSURE FOR SOLO RIDING	PRESSURE AT GVWR
Front-Dunlop Sportmax Radial II 120/70 ZR 17	32 PSI (2.2 bar)	36 PSI (2.5 bar)
Rear-Dunlop Sportmax Radial II 170/60 ZR 17	36 PSI (2.5 bar)	38 PSI (2.8 bar)

⚠WARNING

Do not inflate any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate leading to personal injury.

SIDE VIEWS

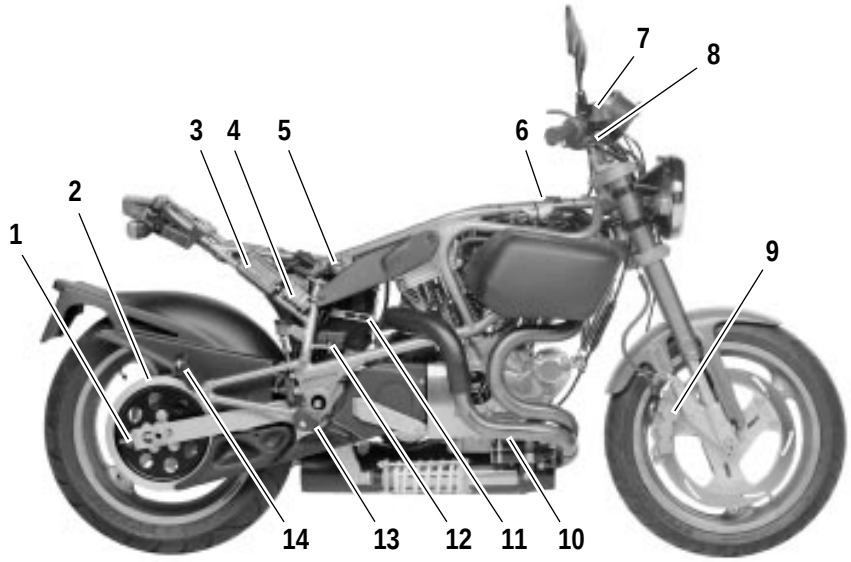
5745



1. Right rear turn signal
2. Tail/brake lamp
3. Rear brake master cylinder and reservoir
4. Air cleaner cover
5. Fuel filler cap
6. Front brake master cylinder
7. Front brake hand lever
8. Right front turn signal
9. Headlamp
10. Front brake caliper
11. Timer cover
12. Rear shock absorber
13. Rear brake pedal
14. Belt guard(s)
15. License plate light

Figure 1-1. 1996 S1 Lightning, Right Side View

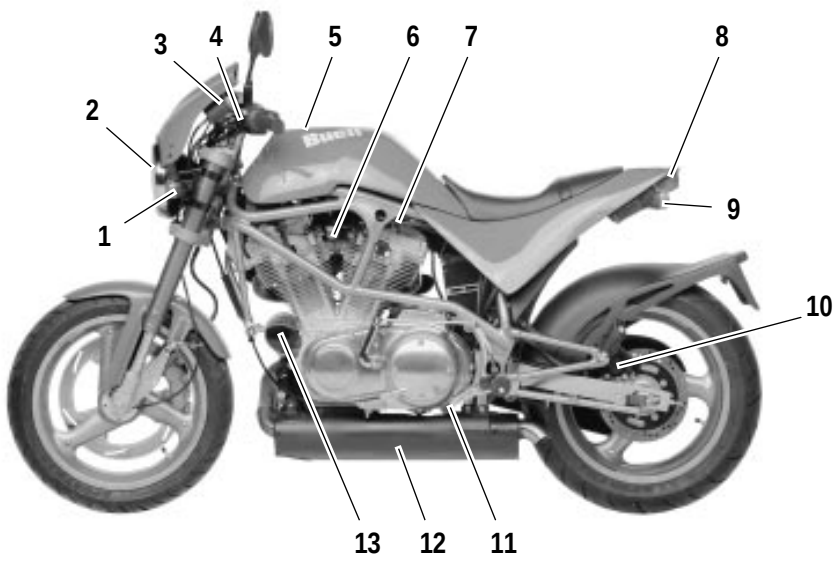
5746



1. Rear axle adjuster nut
2. Rear sprocket and secondary drive belt
3. Ignition module
4. Fuse block and spare fuse
5. Turn signal flasher
6. Horn
7. Front brake master cylinder
8. Front brake hand lever
9. Front brake caliper
10. Oil pump
11. Battery
12. Voltage regulator
13. Rider footrest
14. Passenger footrest

Figure 1-2. 1996 S1 Lightning, Right Side View (Body Removed)

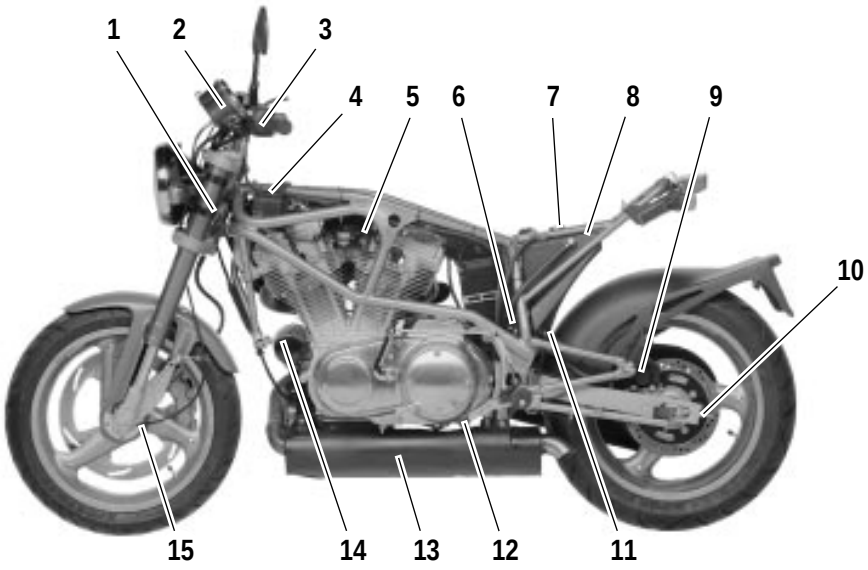
5747



1. Left front turn signal
2. Headlamp
3. Instruments
4. Clutch hand lever
5. Fuel filler cap
6. Ignition/headlamp key switch
7. Fuel supply valve
8. Tail/brake lamp
9. Left rear turn signal
10. Rear brake caliper
11. Gear shift lever
12. Exhaust muffler
13. Oil filter

Figure 1-3. 1996 S1 Lightning, Left Side View

5748



1. Steering head lock
2. Instruments
3. Clutch hand lever
4. Ignition coil
5. Enrichener knob
6. Starter relay
7. Oil filler plug/dipstick
8. Oil tank
9. Rear brake caliper
10. Rear axle adjuster nut
11. Oil tank drain hose
12. Gear shift lever
13. Exhaust muffler
14. Oil filter
15. Speedometer drive

Figure 1-4. 1996 S1 Lightning, Left Side View (Body Removed)

FLUID REQUIREMENTS

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. 5 SILICONE HYDRAULIC BRAKE FLUID can cause eye irritation. In case of contact with eyes, flush with plenty of water and get medical attention. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN!

Use only D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID (Part No. 99902-77).

FRONT FORK OIL

Use only WP FORK OIL, 5 WEIGHT.

FUEL

Use a good quality leaded or unleaded gasoline (91 pump octane or higher). Pump octane is the octane number usually shown on the gas pump. See ENGINE in Section 3 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.

Table 1-1. 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 240	Below 40°F (4°C)	Excellent
H.D. Multi-Grade	SAE 20W50	HD 240	Above 40° (4°C)	Good
H.D. Regular Heavy	SAE 50	HD 240	Above 60° (16°C)	Poor
H.D. Extra Heavy	SAE 60	HD 240	Above 80° (27°C)	Poor

PRIMARY DRIVE/TRANSMISSION LUBRICANT

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

Table 1-2. Regular Maintenance Intervals

SERVICE OPERATIONS AND SPECIAL TOOLS	Preride	5000 mi 8000 km	25000 mi 40000 km	50000 mi 80000 km	75000 mi 120000 km	100000 mi 160000 km	125000 mi 200000 km	150000 mi 240000 km	175000 mi 280000 km	200000 mi 320000 km	225000 mi 360000 km	250000 mi 400000 km	275000 mi 440000 km	300000 mi 480000 km	Annual	SERVICE DATA
Battery connections (page 1-13)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	**Torque** 30-40 **in-lbs** (3.4-4.5 Nm)-hold cables when tightening
Engine oil (page 1-15) OIL FILTER WRENCH (Part No. HD-41215)	I	R	I	R	I	R	I	R	I	R	I	R	I	R	R	See Recommended Oil Grades on page 1-15. **Checking oil level** Check with vehicle at operating temperature, engine off, motorcycle upright (not on side stand) on a level surface. **Oil level** Between upper and lower marks on dipstick (1/2 quart [0.47 liter] difference). **Oil capacity** 2.0 quarts (1.9 liters)
Oil filter (page 1-16)		R		R		R		R		R		R		R	R	Hand tighten filter 1/2-3/4 turn after gasket contacts surface.
Brake fluid level and condition (page 1-17)		I		I		I		I		I		I		I	I	**Fluid type** D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID **Front master cylinder level** Above LOW mark on sight glass or within 1/8 in. (3.2 mm) of molded boss when cover is removed. **Rear master cylinder level** Between upper and lower marks on reservoir.
Rear brake pedal height adjustment and freeplay (page 1-17)	I	I		I		I		I		I		I		I		**Maximum freeplay** 1/8 in. (3.2 mm) Pedal action should be smooth and not binding.
Brake pads and rotors for wear (page 1-17)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	**Minimum brake pad thickness** 1/16 in. (1.6 mm) **Minimum front rotor thickness** 0.17 in. (4.4 mm) **Minimum rear rotor thickness** 0.19 in. (4.8 mm)
Condition of rear brake caliper mounting pins and boots				IL		IL		IL		IL		IL		IL		

Table Code:
A - Adjust.
I - Inspect, and if necessary, correct, adjust, clean or replace.
L - Lubricate with specified lubricant.
R - Replace or change.
T - Tighten to proper torque.
X - Perform.

SERVICE OPERATIONS AND SPECIAL TOOLS	Pre ride	5000 mi 8000 km	25000 mi 40000 km	50000 mi 80000 km	75000 mi 120000 km	100000 mi 160000 km	125000 mi 200000 km	150000 mi 240000 km	175000 mi 280000 km	200000 mi 320000 km	225000 mi 360000 km	250000 mi 400000 km	275000 mi 440000 km	300000 mi 480000 km	Annual	SERVICE DATA
Tire pressure and inspect tire for wear/damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I		See Tire Pressures on page 1-18.
Wheel bearings (page 1-18)						I				I				I	I	Check for wear and corrosion. Replace in sets only.
Primary chaincase/transmission lubricant (page 1-19) REAR WHEEL SUPPORT STAND (Part No. B-41174)		R	I	R	I	R	I	R	I	R	I	R	I	R		**Fluid type and amount** 1.0 quart (0.95 liter) of SPORT-TRANS FLUID (Part No. 98854-96) **Fluid level** Lubricant should reach bottom of clutch spring with motorcycle upright (not on side stand). **Drain plug torque** 14-21 ft-lbs (19-28 Nm)
Clutch adjustment (page 1-20)		A		A		A		A		A		A		A		**Hand lever freeplay** 1/16-1/8 in. (1.6-3.2 mm) **Clutch inspection cover screw torque** 7-9 ft-lbs (9-12 Nm)
Rear belt deflection (page 1-21) BELT TENSION GAUGE (Part No. HD-35381)	I	A		I		I		I		I		I		I		**Belt deflection with 10 lbs (4.5 kg) of upward force** 7/8-1 in. (22.2-25.4 mm) **Rear axle nut torque** 68-73 ft-lbs (89.5-98.9 Nm)
Primary chain (page 1-22)		I		I		I		I		I		I		I		**Chain freeplay with hot engine** 1/4-3/8 in. (6.4-9.5 mm) **Chain freeplay with cold engine** 3/8-1/2 in. (9.5-12.7 mm) **Inspection screws torque** 40-60 **in-lbs** (4.5-6.8 Nm)
Rear shock absorber (page 1-24)		I		I		I		I		I		I		I		Check for bushing wear and loose mounting hardware.
Steering head bearing adjustment (page 1-25) FRONT WHEEL SUPPORT STAND (Part No. B-41395) & S1 ADAPTER (B-41686)		I		I		IL		I		IL		I		IL		**Force to pull front wheel to center** 3.5-5.5 ft-lbs (1.6-2.5 kg) **Lubricant** WHEEL BEARING GREASE (Part No. HD99855-89)

Table Code:

A - Adjust.
I - Inspect, and if necessary, correct, adjust, clean or replace.
L - Lubricate with specified lubricant.
R - Replace or change.
T - Tighten to proper torque.
X - Perform.

SERVICE OPERATIONS AND SPECIAL TOOLS	Pre ride	5000 mi 8000 km	25000 mi 40000 km	50000 mi 80000 km	75000 mi 120000 km	100000 mi 160000 km	125000 mi 200000 km	150000 mi 240000 km	175000 mi 280000 km	200000 mi 320000 km	225000 mi 360000 km	250000 mi 400000 km	275000 mi 440000 km	300000 mi 480000 km	Annual	SERVICE DATA
Front fork oil (page 1-26) FRONT WHEEL SUPPORT STAND (Part No. B-41395) & S1 ADAPTER (B-41686) PRO-LEVEL OIL GAUGE (Part No. B-59000A)						R				R				R		**Fluid type** WP FORK OIL, 5 weight **Fluid level** 4.33 in. (110 mm) from top with fork fully compressed
Spark plugs (page 1-27)				I		R		I		R		I		R		**Spark plug type** No. 6R12 **Spark plug gap** 0.038-0.045 in. (0.96-1.14 mm) **Lubricant** LOCTITE ANTI-SEIZE LUBRICANT **Torque** 11-18 ft-lbs (15-24 Nm)
Air cleaner filter (page 1-28)		I		R		R		R		R		R		R		Check more often in dusty conditions.
Throttle control grip sleeve, cables and speedometer cable (Section 2)	I			L		L		L		L		L		L		Check for damage and freeplay.
Front brake hand lever, throttle control cables, clutch control cable and hand lever (Section 2)		L		L		L		L		L		L		L		Check for damage and freeplay.
Operation of throttle and enrichener controls (page 1-29)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		Controls must be smooth and not binding. **DO NOT** lubricate the enrichener cable.
Engine idle speed (page 1-30) CARBURETOR IDLE ADJUSTMENT TOOL (Part No. HD-33413) TIP (Snap-on Part No. TMP23A)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		**Fast idle-all models** 2000 RPM **Regular idle-49 state models** 950-1050 RPM **Regular idle-California models** 1150-1250 RPM
Ignition timing (page 1-30) TIMING MARK VIEW PLUG (Part No. HD-96295-65D) INDUCTIVE TIMING LIGHT (Part No. HD-33813)				I		I		I		I		I		I		Ignition timing set at regular engine idle speed (listed above).
Vacuum-operated electric switch (V.O.E.S.) (page 1-32)				I		I		I		I		I		I		

Table Code:

A - Adjust.
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L - Lubricate with specified lubricant.
R - Replace or change.
T - Tighten to proper torque.
X - Perform.

SERVICE OPERATIONS AND SPECIAL TOOLS	Pre ride	5000 mi 8000 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	Annual	SERVICE DATA
Fuel supply valve, hoses and fittings for leaks (Section 4)		I	I	I	I	I	I	I	I	I	I	I	I	I		
Fuel tank filter screen (Section 4)				I		I		I		I		I		I		
Swingarm pivot bolt (Section 2)				I		I		I		I		I		I		**Lubricant** LOCTITE ANTI-SEIZE LUBRICANT
Swingarm bearings (Section 2)				I		IL		I		IL		I		IL		**Lubricant** WHEEL BEARING GREASE (Part No. HD99855-89)
Oil and brake lines (Section 2 and 3)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		Check for leaks and loose connections.
Side stand (Section 2)		I		L		L		L		L		L		L		
Engine mounts (Section 3)		I		I		I		I		I		I		I		
Operation of all electrical equipment and switches (Section 7)	I	I	I	I	I	I	I	I	I	I	I	I	I	I		
All fasteners except engine head bolts		T		T		T		T		T		T		T		
Road test	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

Table Code:

A - Adjust.
I - Inspect, and if necessary, correct, adjust, clean or replace.
L - Lubricate with specified lubricant.
R - Replace or change.
T - Tighten to proper torque.
X - Perform.

BATTERY

GENERAL

⚠WARNING

- **Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes or clothing.**
- **Batteries produce explosive hydrogen gas at all times, especially when being charged. Keep cigarettes, open flame and sparks away from the battery at all times. Ventilate area when charging battery. Always protect hands and protect eyes with shield or goggles when working near a battery or acid. KEEP BATTERIES AND ACID OUT OF THE REACH OF CHILDREN!**

The battery is below the seat in the center of the vehicle. The battery can be removed from the left side of the motorcycle without removing the tail section or fuel tank.

The battery requires no additional fluid at any time.

Check the battery:

- At every scheduled service interval.
- When storing or removing the motorcycle for the season.

CHARGING

The sealed, low maintenance battery has a very slow discharge rate. See Figure 1-6. If you suspect a battery problem, test as described below.

1. Remove battery from motorcycle. See BATTERY, REMOVAL on page 1-14.
2. Test battery voltage using a multimeter.
3. If battery voltage is below 12.66 Volts, use a 1-100 Amp, 12 Volt charger on battery. See Table 1-3.

⚠DANGER - EXPLOSIVE GASES

Cigarettes, flames or sparks could cause battery to explode resulting in personal injury. Always shield eyes and face from battery. Do not charge without proper instruction and training. Securely connect cables to the proper terminals.

POISON - CAUSES SEVERE BURNS

Contains sulfuric acid. Avoid contact with skin, eyes, and clothing. In event of accident, flush with water and call a physician immediately.

KEEP OUT OF REACH OF CHILDREN

Figure 1-5. Battery Warnings

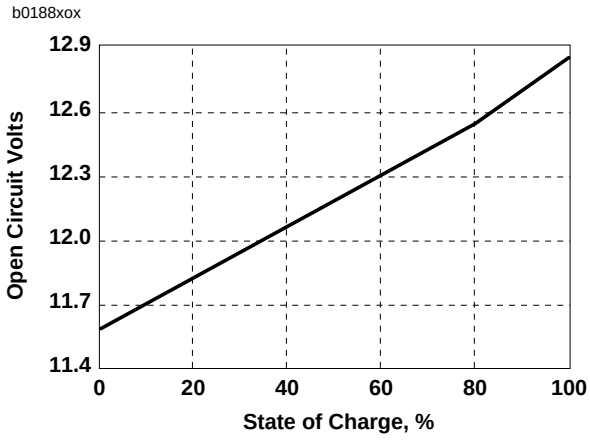


Figure 1-6. Open Circuit Voltage vs. State of Charge (No Charge Last 24 Hours)

Table 1-3. Charging Rates

CHARGER OUTPUT CURRENT RATE	OPEN CIRCUIT VOLTAGE		
	12.00 to 12.66 Volts	11.40 to 11.99 Volts	Less than 11.40 Volts
1 Amp	32 hours	48 hours	96 hours
2-5 Amps	16 hours	24 hours	48 hours
6-10 Amps	8 hours	12 hours	24 hours

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

⚠CAUTION

See Figure 1-8. Hold battery cable when loosening battery terminal hardware. Failure to hold cable will cause battery damage.

1. Disconnect battery cables, negative cable first.
2. Remove battery strap locknut using 7/16 in. flex socket (SNAP-ON Part No. TMU141) and handle (SNAP-ON Part No. TM62B).

NOTE

On California models, detach carbon canister from bracket before removing battery.

3. Remove battery from left side.

INSTALLATION

1. Clean cable connectors and battery terminals using a wire brush or sandpaper to remove any oxidation.

⚠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 resulting in personal injury.

⚠CAUTION

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

2. Connect positive cable to positive (+) battery terminal. Then, after positive cable has been connected to positive terminal, connect negative cable to negative (-) battery terminal.

⚠CAUTION

See Figure 1-8. Hold battery cable when tightening battery terminal hardware. Failure to hold cable will cause battery damage.

3. Tighten battery hardware to 30-40 **in-lbs** (3.4-4.5 Nm).
4. Apply light coat of petroleum jelly or corrosion-retardant material to both terminals.

NOTE

On California models, attach carbon canister to bracket after installing battery.

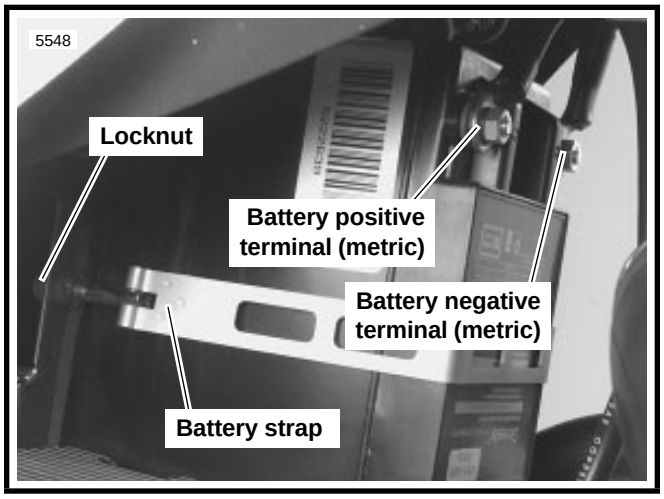


Figure 1-7. Battery

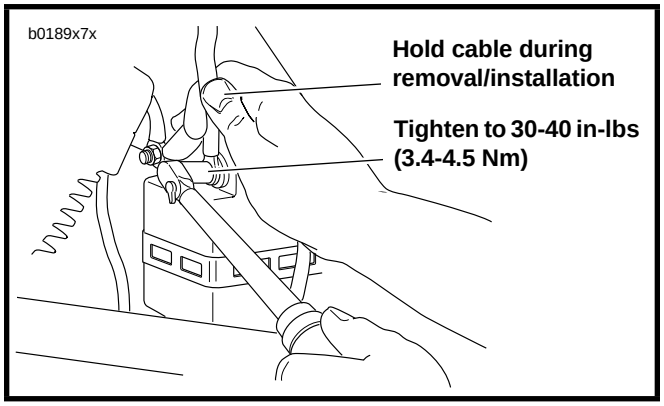


Figure 1-8. Checking Battery Terminals

ENGINE LUBRICATION SYSTEM

CHECKING ENGINE OIL LEVEL

Check engine oil level:

- At least once every 500 miles (800 km).
- At every 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.
2. See Figure 1-10. 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.

   Oil level should be between lower and upper dipstick level marks. If oil level in tank is below lower mark of dipstick, add oil to tank. Install filler cap/dipstick.

   Recommended viscosity depends upon ambient temperature. See Table 1-4.

NOTE

Difference between upper and lower dipstick marks is 0.5 quart (0.47 liter).

⚠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 and personal injury.

5. Install seat.

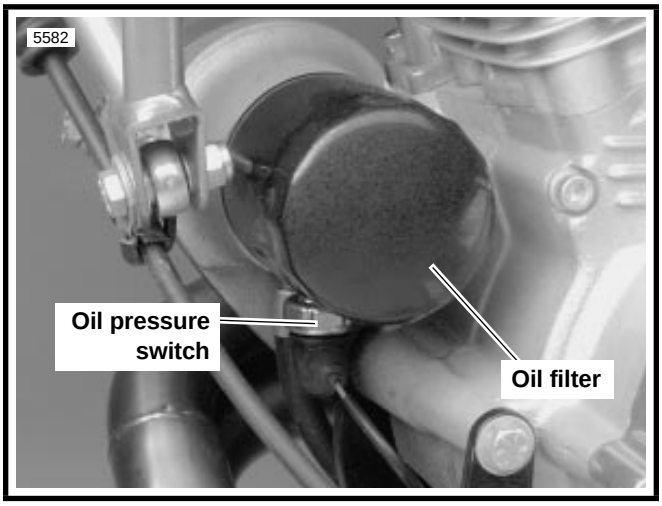


Figure 1-9. Oil Filter and Mount

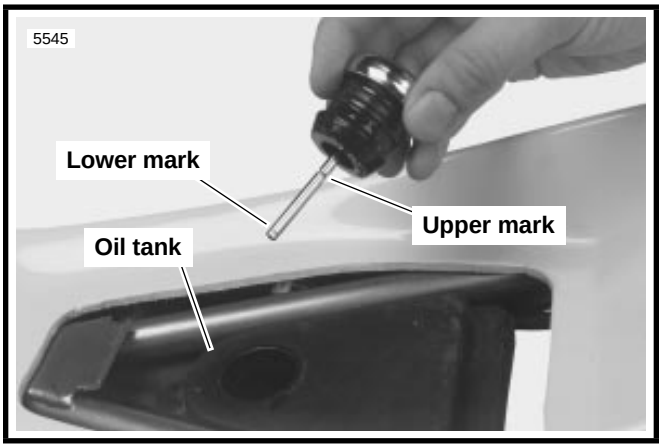


Figure 1-10. Checking Oil Tank Level

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 240	Below 40°F (4°C)	Excellent
H.D. Multi-Grade	SAE 20W50	HD 240	Above 40° (4°C)	Good
H.D. Regular Heavy	SAE 50	HD 240	Above 60° (16°C)	Poor
H.D. Extra Heavy	SAE 60	HD 240	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 1-11. Compress clamp. Remove hose from drain plug by pulling hose forward. Direct hose to container and completely drain oil tank.
3. Install drain hose on drain plug. Tighten clamp.
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 1-12. Apply a thin film of oil to gasket contact surface on crankcase mounting plate 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 gasket contacts mounting plate surface. Apply another 1/2-3/4 turn by hand.

⚠WARNING

Be sure no oil gets on tires when changing oil and filter. Traction will be adversely affected which may lead to a loss of control and personal injury.

9. Fill oil tank with an oil from Table 1-4. Oil tank capacity is 2.0 quarts (1.90 liters) plus the 4.0 ounces (0.12 liter) added in Step 7.
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 and personal injury.

11. Install seat.
12. 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 as described on page 1-15.

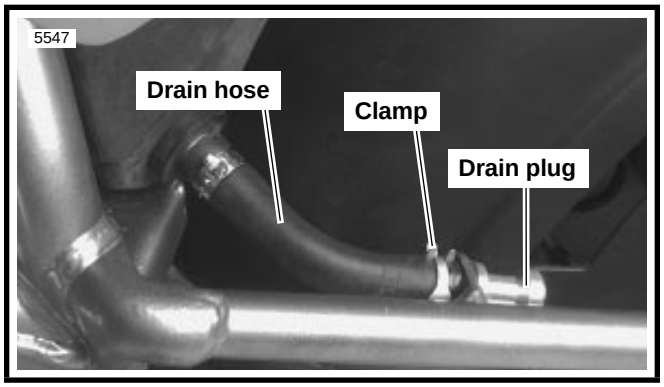


Figure 1-11. Oil Tank Drain Line

Figure 1-12. Oil Filter

BRAKES

GENERAL

⚠WARNING

Brake fluid can cause irritation of eyes and skin, and may be harmful if swallowed. If 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.

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.

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

BLEEDING BRAKES

NOTE

Hydraulic brake fluid bladder-type pressure equipment can be used to fill brake master cylinder through the bleeder valve. Remove master cylinder reservoir cover so that system cannot pressurize. Do not use pressure bleeding equipment when the hydraulic system is sealed with master cylinder reservoir cover and gasket in place.

1. 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-Figure 1-13.
   b. Rear brake caliper-Figure 1-14.
2. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID to master cylinder reservoir. Do not reuse brake fluid.
   a. Bring fluid level to within 1/8 in. (3.2 mm) of molded boss for front master cylinder reservoir.
   b. Bring fluid level between upper and lower marks for rear master cylinder reservoir.
3. Depress and 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 1/2-3/4 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 bleeder valves.
   a. Front bleeder valve to 4-6 ft-lbs (5.4-8.1 Nm).
   b. Rear bleeder valve to 6-9 ft-lbs (8.1-12.2 Nm).
7. Verify master cylinder fluid level as described in Step 2.
8. Tighten master cylinder reservoir cover screws to 9-13 **in-lbs** (1.0-1.5 Nm). Install cover on rear reservoir.

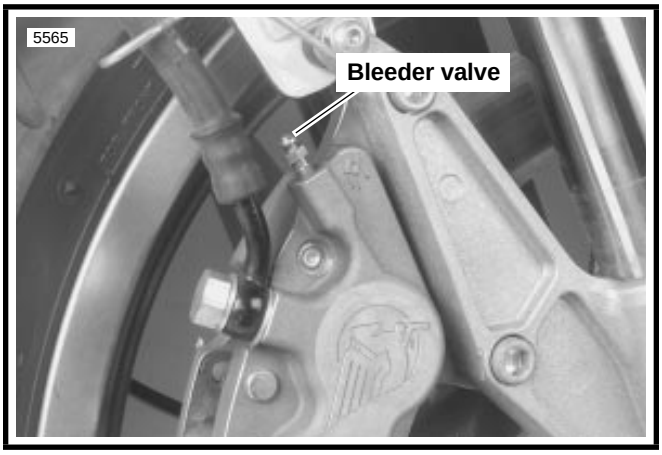


Figure 1-13. Front Brake Caliper Bleeder Valve

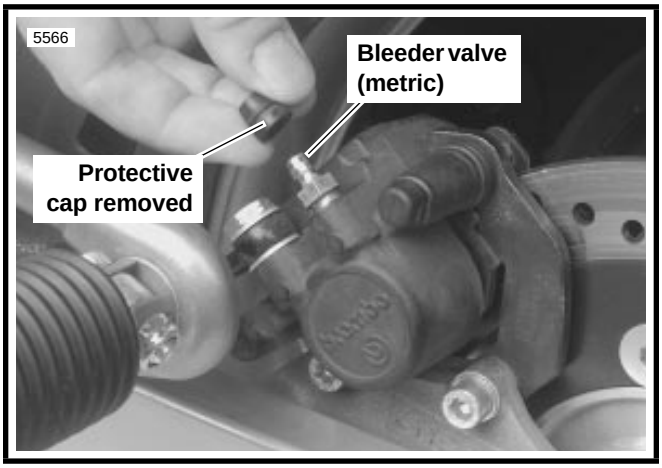


Figure 1-14. Rear Brake Caliper Bleeder Valve

PADS, ROTORS AND LINKAGE

Check brake pads and rotors for minimum thickness. See Table 1-5. See Section 2 for replacement procedures.

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

Check rear brake pedal height and freeplay. See Table 1-5. See Section 2 for adjustment procedures.

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

Table 1-5. Brake System Components

SPECIFICATION	FRONT	REAR
Minimum rotor thickness	0.17 in. (4.4 mm)	0.19 in. (4.8 mm)
Minimum pad thickness	1/16 in. (1.6 mm)	
Hand lever/pedal freeplay	1/8 in. (3.2 mm) maximum	

TIRES AND WHEELS

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 leading to personal injury.

Check tire pressure and tread:

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

Check for proper front and rear tire pressures when tires are cold. Compare pressure against Table 1-6.

Table 1-6. Tire Pressures

TIRE AND POSITION	PRESSURE FOR SOLO RIDING	PRESSURE AT GVWR
Front-Dunlop Sportmax Radial II 120/70 ZR 17	32 PSI (2.2 bar)	36 PSI (2.5 bar)
Rear-Dunlop Sportmax Radial II 170/60 ZR 17	36 PSI (2.5 bar)	38 PSI (2.8 bar)

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.

SPEEDOMETER CABLE

Check speedometer cable:

- Inspect before every ride.
- Lubricate at every 5000 mile (8000 km) service interval.

Examine speedometer cable housing (outer sheath) for kinks or other damage. Replace entire cable assembly if any damage is noted.

Lubricate inner cable with a good quality graphite grease. Wipe off excess grease.

CLUTCH

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.

Primary chaincase lubricant capacity is approximately 1.0 quart (0.95 liter). For best results, drain lubricant while hot.

1. Raise rear of vehicle off the floor using REAR WHEEL SUPPORT STAND (Part No. B-41174) to prevent chaincase lubricant from draining out of clutch cover opening when refilled.
2. Remove muffler. See EXHAUST SYSTEM in Section 2.
3. See Figure 1-15. Position a suitable container under transmission lubricant drain plug. Remove drain plug and drain lubricant.
4. Remove foreign material from magnetic drain plug. Reinstall plug and tighten to 14-21 ft-lbs (19-28 Nm).
5. Remove four TORX screws with washers from clutch inspection cover. Remove clutch inspection cover from primary cover. Do not damage or dislodge Quad ring from primary cover.

⚠CAUTION

Do not overfill the primary chaincase with lubricant. Overfilling may cause rough clutch engagement and incomplete disengagement (or clutch drag).

6. Add SPORT-TRANS FLUID (Part No. 98854-96 quart size; Part No. 98855-96 gallon size) as required until lubricant is even with bottom of clutch diaphragm spring. See Figure 1-16.
7. Install clutch inspection cover using four TORX screws with washers. Tighten screws in a crosswise pattern to 7-9 ft-lbs (9-12 Nm).
8. Install muffler. See EXHAUST SYSTEM in Section 2.

PRODUCTION CHANGE

See Figure 1-17. Beginning with motorcycles built in early January 1996, the outer clutch release ramp has been changed. The clutch adjustment and lever freeplay procedures remain the same. The change was made to prevent any possible contact between the coupler and the primary cover.

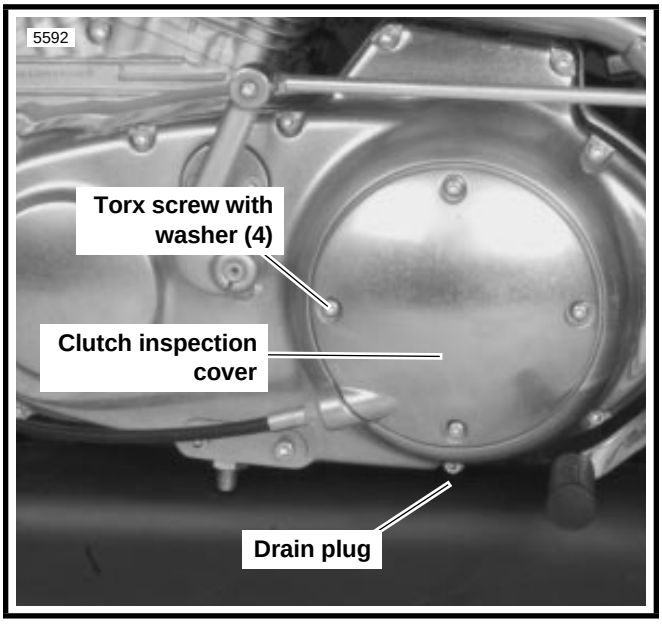


Figure 1-15. Primary Cover

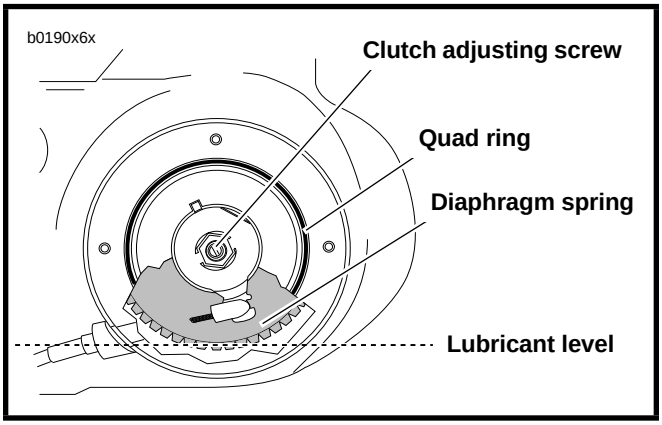


Figure 1-16. Lubricant Level

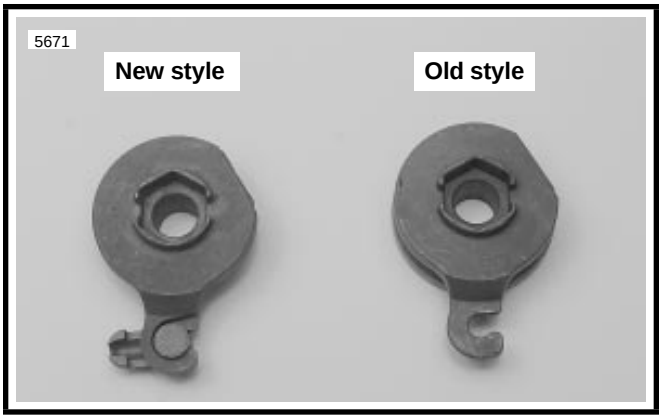


Figure 1-17. Ramp Change

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.

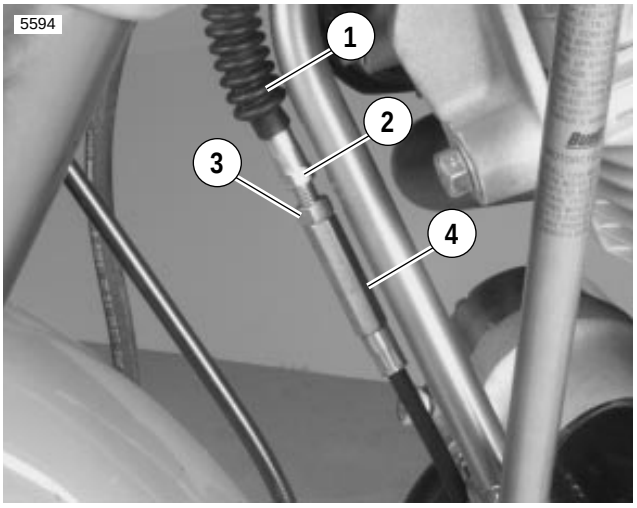
When necessary, lubricate cable with LUBIT-8 TUFOIL® CHAIN AND CABLE LUBE (Part No. HD-94968-85TV).

1. Raise rear of vehicle off the floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 1-18. Slide rubber boot (1) upward to expose adjuster mechanism. Loosen jam nut (3) from adjuster (4). Turn adjuster to shorten cable housing until there is a large amount of freeplay at clutch hand lever.
3. See Figure 1-19. Remove TORX screws with washers (1) from clutch inspection cover (2). Remove clutch inspection cover from primary cover, but leave Quad ring (3) in place.

NOTE

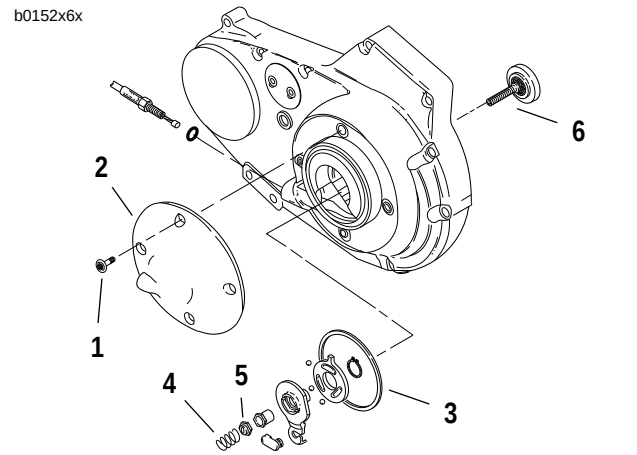
Quad ring removed from primary cover for illustrative purposes only in Figure 1-19.

4. Remove spring (4) and adjusting screw lockplate (5). Turn adjusting screw counterclockwise until it lightly bottoms.
5. Turn clutch 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 lever to maximum limit three times to set 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 hand lever. Adjust as follows.
   a. See Figure 1-20. Pull clutch cable ferrule (end of cable housing) away from clutch hand lever bracket. Gap between ferrule and bracket should be 1/16-1/8 in. (1.6-3.2 mm).
   b. See Figure 1-18. Adjust freeplay by turning cable adjuster (4).
   c. Tighten jam nut (3) against adjuster (4).
   d. Slide boot (1) over cable adjuster mechanism.
7. Change or add transmission fluid if necessary.
8. Install clutch inspection cover (2). Tighten TORX screws with washers (1) in a crosswise pattern to 7-9 ft-lbs (9-12 Nm).
9. Check clutch cable freeplay. See Step 6 above.



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

Figure 1-18. Clutch Cable Adjuster Mechanism



1. **Torx screw with washer**
2. **Clutch inspection cover**
3. **Quad ring**
4. **Spring**
5. **Lockplate**
6. **Adjusting screw**

Figure 1-19. Clutch Release Mechanism

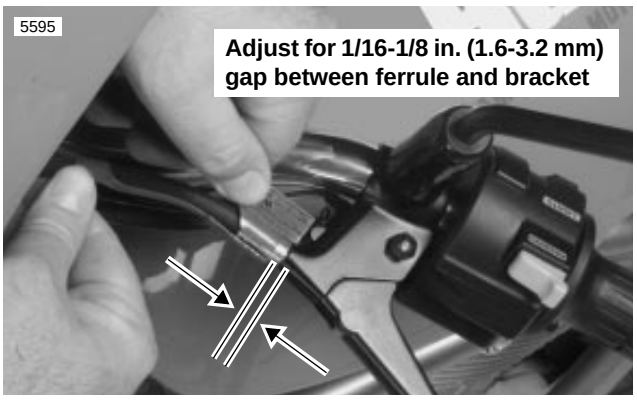


Figure 1-20. Adjusting Clutch Freeplay

REAR BELT DEFLECTION

INSPECTION

Check rear belt deflection:

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

The secondary drive belt should be checked for unusual wear, cracking or loss of teeth. Check the belt sprocket for unusual wear, broken teeth or damaged flange. 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. See Figure 1-21. At the lower strand, position “A”, midway between transmission sprocket and rear wheel sprocket, apply 10 lbs (4.5 kg) of upward force on lower span of rear belt using BELT TENSION GAUGE (Part No. HD-35381).
2. Measure belt deflection “B” several times, each time with belt moved (by rotating rear wheel) to a different position on sprockets. With sprockets rotated to tightest belt position, belt deflection “B” (measured at position “A”) should be 7/8-1 in. (22.2-25.4 mm).

ADJUSTMENT

1. Adjust shock absorber spring preload. See REAR PRELOAD ADJUSTMENT on page 1-23.
2. See Figure 1-22. Loosen rear axle nut (metric), if not already performed.

NOTE

After you loosen the axle nut, turn the axle and nut so the rearmost flat on each side is parallel with the ends of the swingarm.

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

3. See Figure 1-23. Measure each side from the flat to the end of the swingarm, to be sure rear axle is correctly located.
4. Turn axle adjuster nuts (metric) on **each** side of swingarm to adjust belt deflection.
   a. Turn clockwise to decrease deflection (increase tension).
   b. Turn counterclockwise to increase belt deflection (decrease tension).

   Turn each adjuster nut exactly the same number of turns to maintain rear wheel alignment
5. Tighten axle nut (metric) to 66-73 ft-lbs (89.5-98.9 Nm).

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets. Clean the belt with a rag which is slightly damp with light cleaning agent.

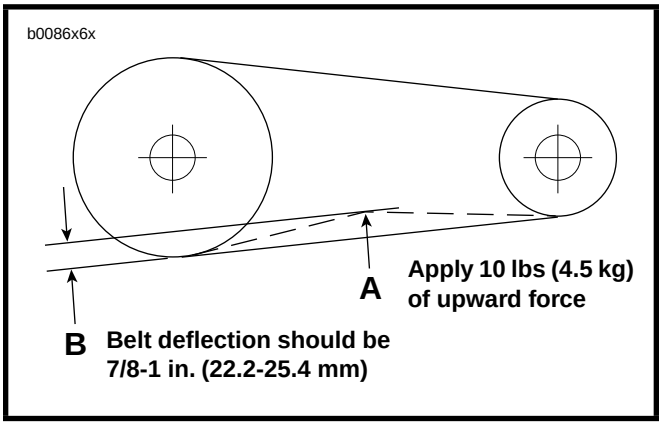


Figure 1-21. Checking Belt Deflection

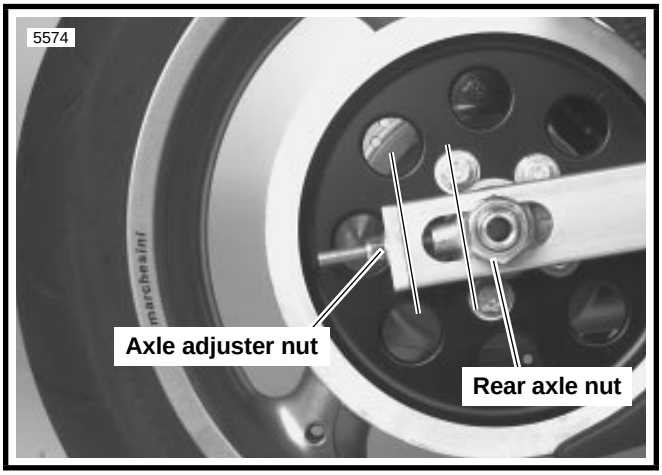


Figure 1-22. Rear Axle

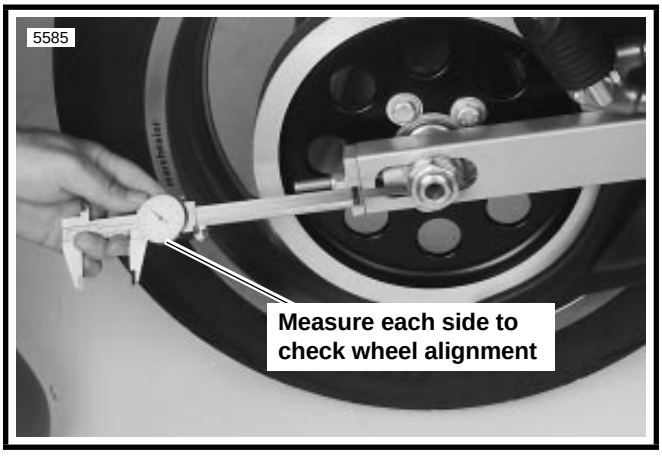


Figure 1-23. Checking Rear Wheel Alignment, Right Side Shown

PRIMARY CHAIN

INSPECTION

Check primary chain:

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

Check primary chain for correct tension by measuring its vertical freeplay through the primary chain inspection cover opening located near the top of the primary cover.

1. See Figure 1-24. Remove two screws from primary chain inspection cover.
2. Remove primary chain inspection cover.
3. See Figure 1-25. Check primary chain tension by measuring vertical freeplay (measuring midway between sprockets) several times, each time with primary chain moved (by rotating engine) to a different position on sprockets.
4. Check primary chain tension against Table 1-7. If necessary, adjust as described below.

NOTE

- *Measurements are taken with sprockets rotated to tightest chain position.*
- *The initial primary chain vertical freeplay specification used at the assembly plant is 1/4-1/2 in. (6.3-12.7 mm) with a cold engine. The 1/4 in. (6.3 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. 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.*

Table 1-7. Primary Chain Tension

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

5. Install primary chain inspection cover. Tighten screws to 40-60 **in-lbs** (4.5-6.8 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 1-26. Loosen locknut and turn adjusting screw:
   a. Turn clockwise (inward) to reduce freeplay.
   b. Turn counterclockwise (outward) to increase freeplay.
2. Tighten locknut to 20-25 ft-lbs (27.1-33.9 Nm).

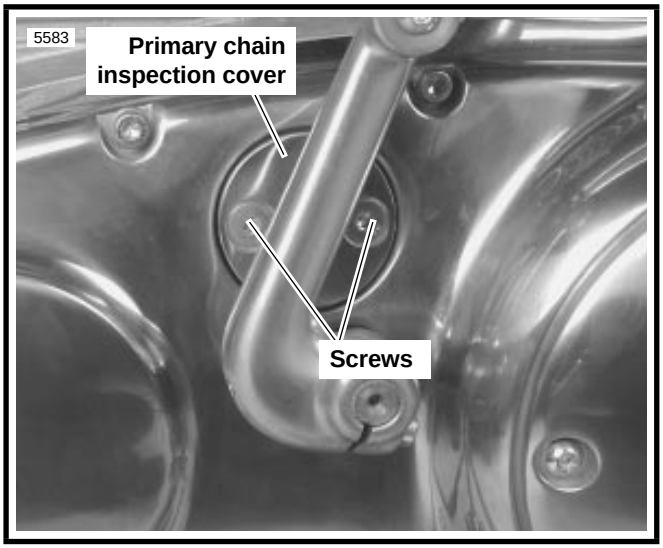


Figure 1-24. Primary Chain Inspection Cover

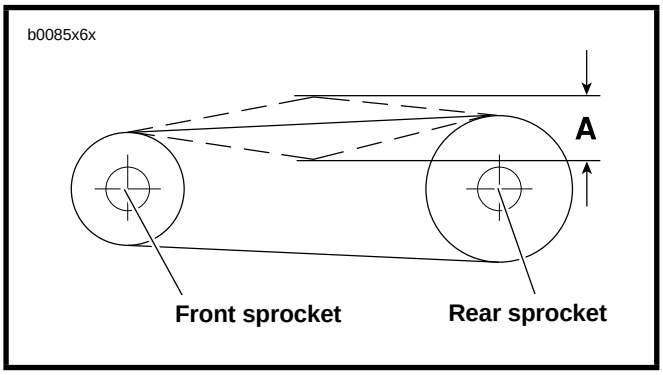


Figure 1-25. Measuring Primary Chain Tension

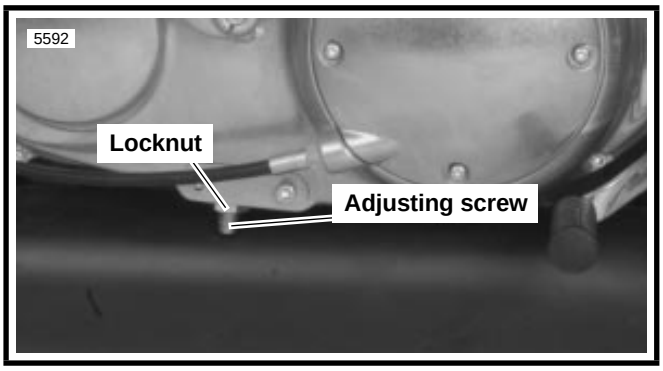


Figure 1-26. Primary Chain Adjustment

REAR PRELOAD ADJUSTMENT

GENERAL

Adjust rear preload:

- When a new rider buys the motorcycle.
- When there is a change in load (luggage, etc.)
- Before changing front fork or rear shock suspension settings.

Rear suspension spring preload assures that the rear suspension has the proper amount of travel.

Spring preload is the most important suspension adjustment on the S1 Lightning. Improper preload will adversely affect both the handling and motorcycle ride. Correct preload setting will result in motorcycle handling that suits the rider's size and weight.

ADJUSTMENT

You will need three people to carry out this adjustment.

1. Verify correct front and rear tire pressure. See TIRES AND WHEELS on page 1-18.
2. Remove all accessories from motorcycle including tank bag and/or saddlebags.
3. Take the motorcycle off the side stand and bounce the rear up and down a few times to be sure the suspension is free and not binding.
4. See Figure 1-27. Measure the distance from the center of the rear axle nut to the rear turn signal mounting bolt without rider/passenger/cargo/accessories on the motorcycle.
5. Install items removed in Step 2. Load all cargo.
6. Bounce a few times on the seat to be sure the suspension is free and not binding.
7. With the help of an assistant, take the same measurement with the vehicle fully loaded (rider/passenger/luggage/cargo). The assistant should help balance the motorcycle so the rider can keep both feet on the footrests.
8. Subtract the second measurement from the first. The difference, which is the squat, should be 0.25-0.75 in. (6.4-19.1 mm). If it is not, you will have to adjust the spring preload.

⚠CAUTION

- **Be sure to apply the same number of turns to each mechanical preload adjusting nut to ensure that the end plates do not become misaligned. Misaligned end plates will cause the shock absorber spring to bind against the adjustment rods.**
- **Be sure the plates are parallel within 1/64 in. (0.4 mm). Misaligned end plates will cause the shock absorber spring to bind against the adjustment rods.**

9. See Figure 1-28. Change the spring preload by adjusting the mechanical preload adjusting nuts (metric) on the rods that connect the end plates.
   a. Increase the preload by tightening the nuts.
   b. Decrease the preload by loosening the nuts.

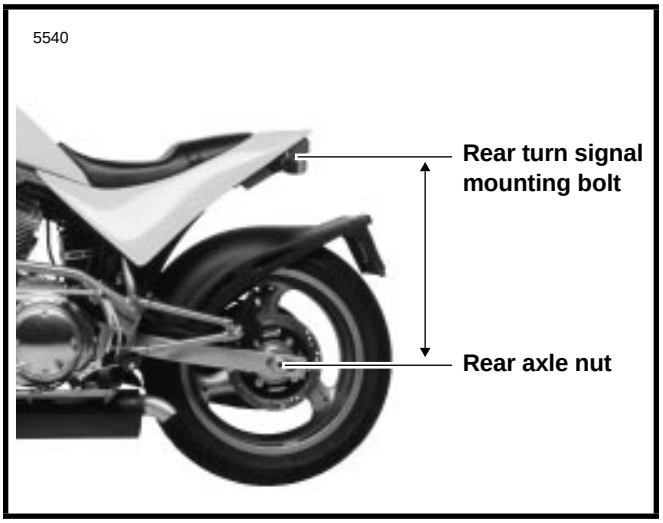


Figure 1-27. Checking Rear Preload

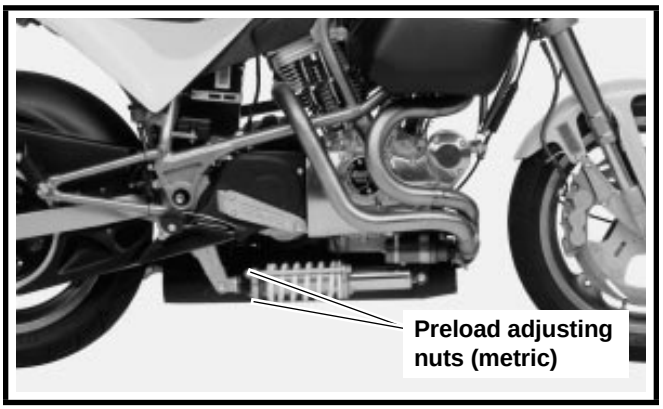


Figure 1-28. Adjusting Rear Preload

ADJUSTMENT

Adjust front forks by first turning the slotted dial clockwise with a screwdriver until it stops. Then turn the dial counterclockwise the recommended 12 or 20 positions. A higher number of clicks increases damping.

NOTE

Rear spring preload must be set before adjusting any other suspension settings. See REAR PRELOAD ADJUSTMENT on page 1-23.

Table 1-8. Suspension Settings

ADJUSTMENT	RANGE IN CLICKS	FACTORY SETTING	SEE FIGURE
Front fork compression	28	20	1-29
Front fork rebound	28	12	1-29
Rear shock rebound	7	3	1-30
Rear shock compression	11	5	1-31

REAR SHOCK

Check rear shock:

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

Inspect the rear shock absorber for loose mounting hardware, leaks or rod-to-spring contact. Tighten the front and rear mounts 40-45 ft-lbs (54.2-61.0 Nm).

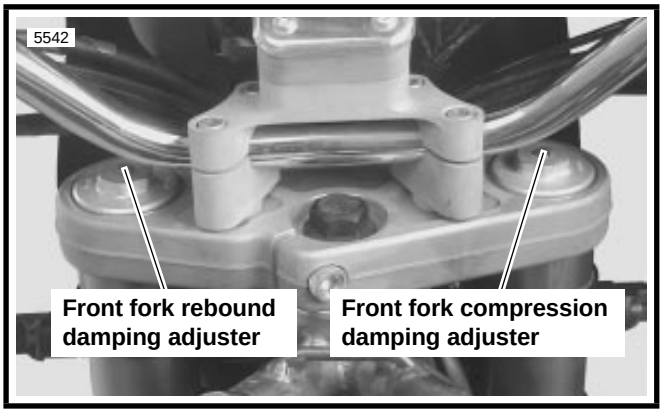


Figure 1-29. Front Fork Adjustments

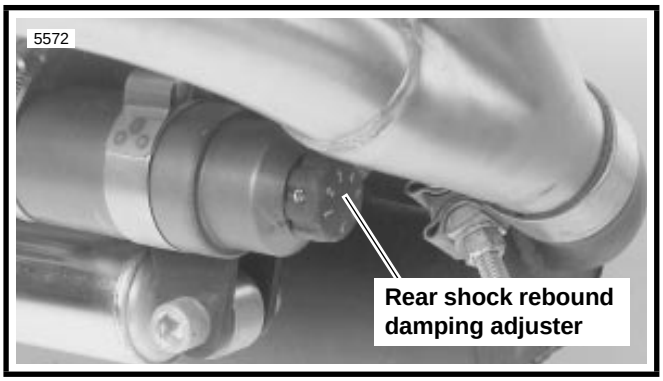


Figure 1-30. Rear Shock Rebound Adjuster

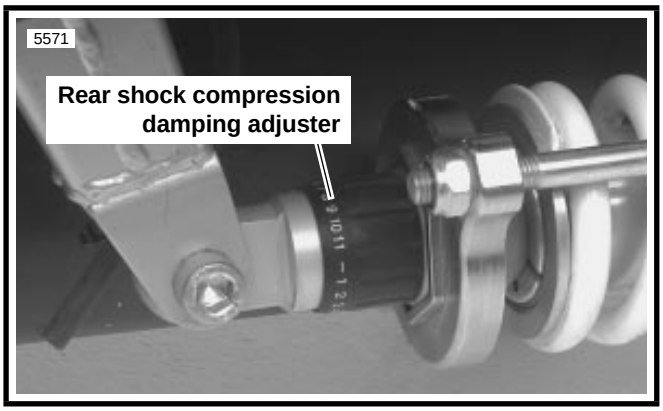


Figure 1-31. Rear Shock Compression Adjuster

STEERING HEAD BEARINGS

Check steering head bearings:

- At the 500 mile (800 km) service interval.
- At every 5000 mile (8000 km) service interval thereafter.
- Lubricate every 10,000 mile (16,000 km) service interval.

1. See Figure 1-32. Lift motorcycle using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and S1 LIFT ADAPTER (Part No. B-41686) so front wheel is off the ground.
2. Turn front wheel to full right lock.
3. Hook a spring scale into the axle hole and pull front wheel to center position.

   It should take 3.5-5.5 lbs (1.6-2.5 kg) to pull front wheel to center.

NOTE

Check that clutch and throttle cables do not bind when measuring bearing resistance.

Lubrication

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

See FORK STEM AND BRACKET ASSEMBLY in Section 2 for lubrication procedure.

ADJUSTMENT

1. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and S1 LIFT ADAPTER (Part No. B-41686).
2. Turn front wheel to full right lock.
3. See Figure 1-32. Hook spring scale into front axle hole. Pull front wheel to center position. It should take 3.5-5.5 lbs (1.6-2.5 kg) to pull front wheel to center.
4. Loosen pinch screws (7) on upper and lower triple clamps.
5. See Figure 1-33. Tighten or loosen fork stem bolt (1) to set proper tension.
6. Recheck tension using spring scale. See Step 3.
7. Tighten triple clamp pinch screws (7) to 18-20 ft-lbs (24.4-27.1 Nm).

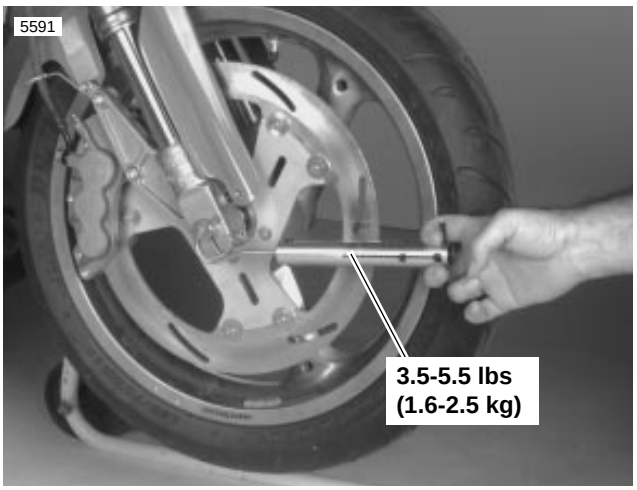
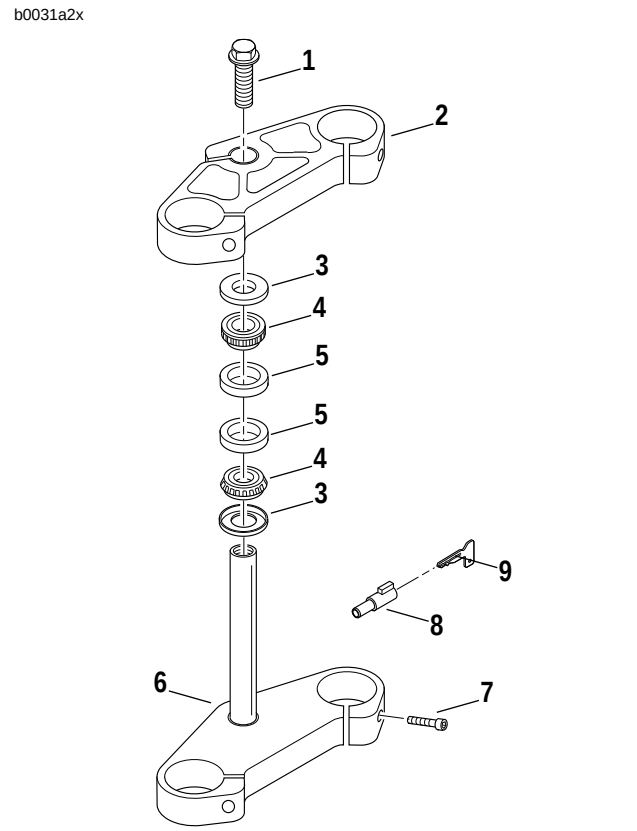


Figure 1-32. Checking Steering Head Bearings



1. **Fork stem bolt**
2. **Upper triple clamp**
3. **Dust shield (2)**
4. **Roller bearing (2)**
5. **Bearing cup (2)**
6. **Lower triple clamp**
7. **Screw (5)**
8. **Steering head lock**
9. **Steering lock key**

Figure 1-33. Steering Head Assembly

FORK OIL CHANGE

Replace fork oil:

- At every 10,000 mile (16,000 km) service interval.
- If fork should be submerged in water.

1. Remove and disassemble front forks. See FRONT FORK in Section 2.

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.

2. Drain forks of oil.
3. With fork in fully compressed stage, add WP FORK OIL, 5 WEIGHT to above red retaining cap.

⚠CAUTION

See Figure 1-34. Raise outer tube no higher than 9 in. (229 mm) or fluid loss will occur.

4. See Figure 1-35. Grasp damper assembly by the adjuster. Pull damper assembly through several full strokes to bleed air from the fork.
5. With front fork fully compressed, clamp vertically in FRONT FORK HOLDING TOOL (Part No. B-41177).
6. Measure distance from fork oil surface to top of tube using PRO-LEVEL OIL GAUGE (Part No. B-59000A). Add or drain fork oil as needed until distance from top of fork tube to oil surface measures 4.33 in. (110 mm). See Figure 1-36.
7. Assemble front fork and install. See FRONT FORK in Section 2.

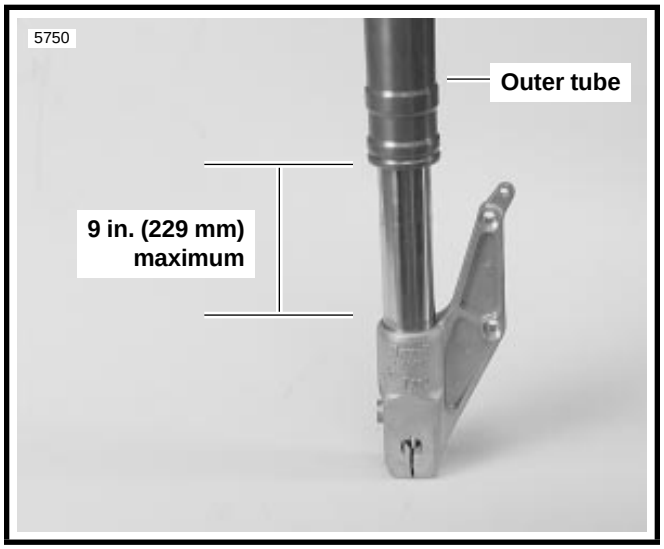


Figure 1-34. Maximum Outer Tube Lift

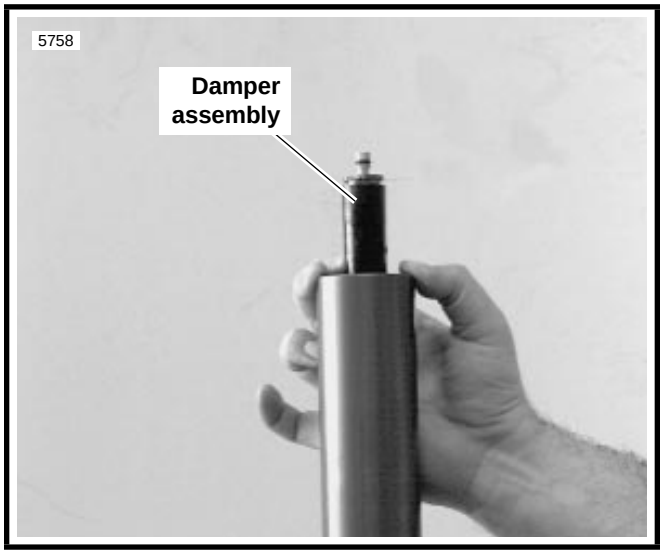


Figure 1-35. Bleeding Fork

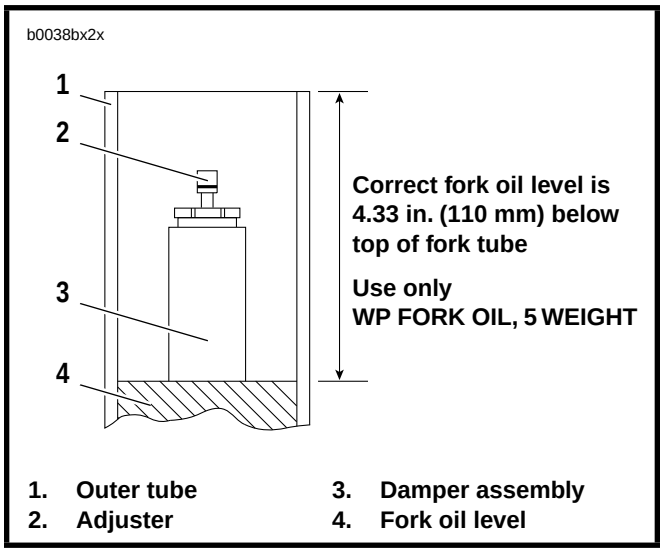


Figure 1-36. Correct Fork Oil Level

SPARK PLUGS

INSPECTION

Check spark plugs:

- Inspect at every 5000 mile (8000 km) service interval.
- Replace every 10,000 mile (16,000 km) service interval.

1. Disconnect cables from both spark plugs.
2. Remove spark plugs.
3. See Figure 1-37. Compare your observations of the plug deposits with the descriptions provided below.
   a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
   b. A dry, fluffy or sooty black deposit indicates 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, 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. 6R12 spark plugs.
6. Check electrode gap with a wire-type feeler gauge. Gap should be 0.038-0.045 in. (0.96-1.14 mm).
7. See Figure 1-38. Apply LOCTITE ANTI-SEIZE to plugs. Install and tighten spark plugs to 11-18 ft-lbs (15-24 Nm).
8. Connect spark plug cables. Verify that cables are securely connected to coil and spark plugs.

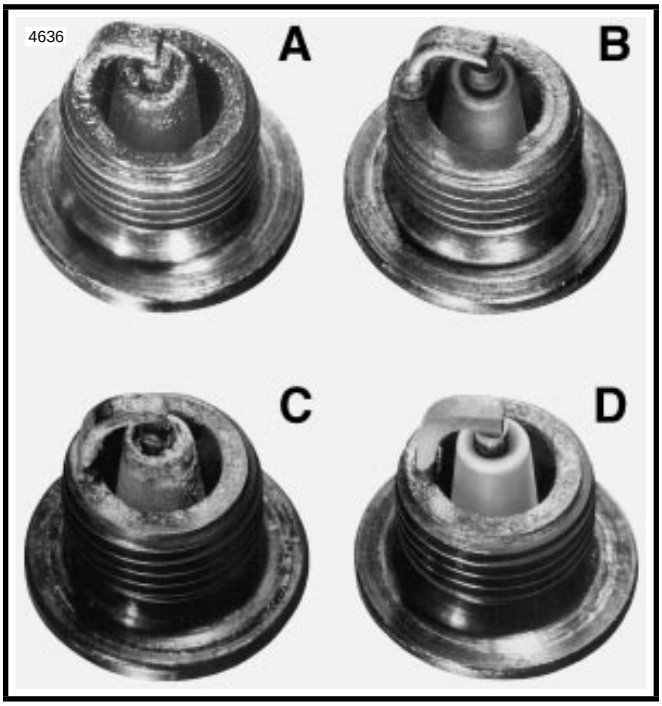


Figure 1-37. Typical Spark Plug Deposits

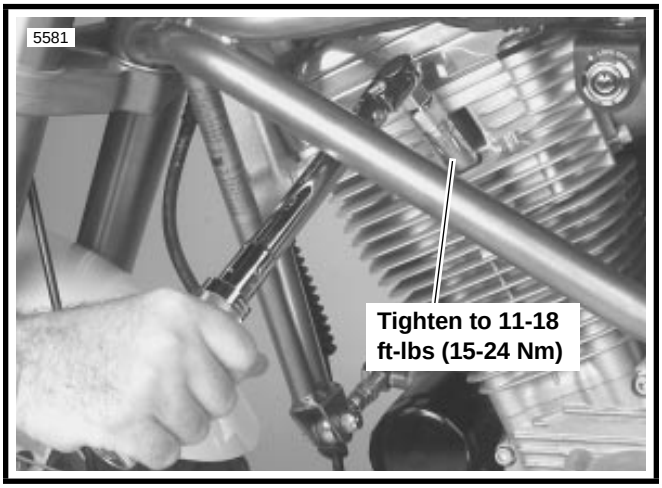


Figure 1-38. Spark Plugs

AIR CLEANER FILTER

REMOVAL

Check air cleaner filter:

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

NOTE

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

⚠CAUTION

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

1. See Figure 1-39. Remove screw and nylon washer on top of air cleaner cover.
2. Remove screw, nylon washer and locknut at rear of air cleaner cover. Remove cover.
3. See Figure 1-40. Remove filter box from snorkel tube.
4. Remove filter from filter box.

INSTALLATION

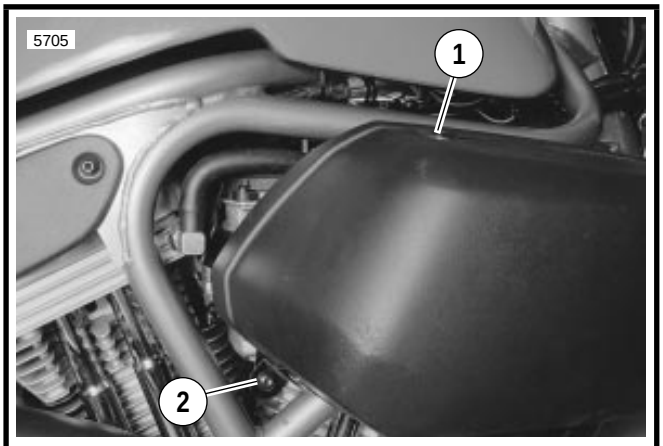
1. Replace filter element if damaged or if filter media cannot be adequately cleaned.

⚠WARNING

- **Low pressure air can blow debris in your face and eyes. Not wearing eye protection or a face shield when using pressurized air may result in personal injury.**
- **Do not use gasoline or solvents to clean the filter element. Volatile/flammable cleaning agents may cause an intake system fire which may result in personal injury.**

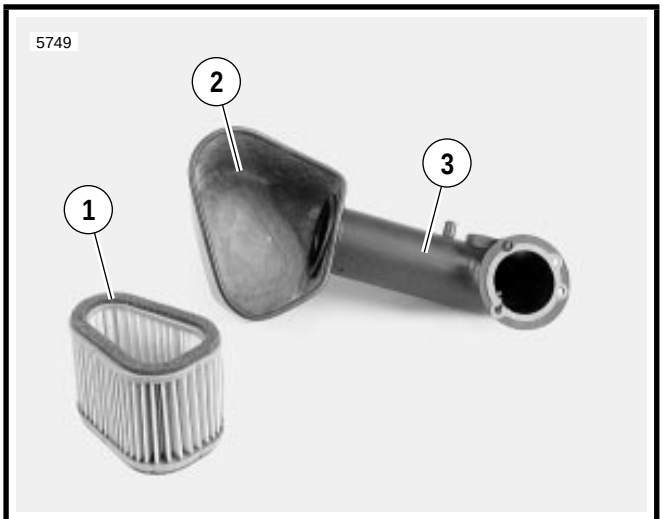
2. Wash element in luke warm water with a mild detergent. Dry the filter element using low-pressure (32 psi/221 kPa maximum) compressed air. Rotate element while moving air nozzle up and down the element interior. Do not rap the element on a hard surface.

   Hold filter element up to strong light source. The element can be considered sufficiently clean if light is uniformly visible through the element.
3. Thoroughly clean backplate, filter box and inside of cover.
4. See Figure 1-40. Place filter in filter box. Attach filter box to snorkel tube.
5. See Figure 1-39. Place cover over backplate assembly. Install top screw and nylon washer.
6. Install screw, nylon washer and locknut on rear mount. Tighten to 6-8 ft-lbs (8.1-10.8 Nm).



1. Screw and nylon washer
2. Screw, nylon washer and locknut

Figure 1-39. Air Cleaner Cover



1. Filter element
2. Filter box
3. Snorkel tube

Figure 1-40. Snorkel Tube

CABLE ADJUSTMENT

⚠WARNING

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

Check throttle cable adjustment:

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

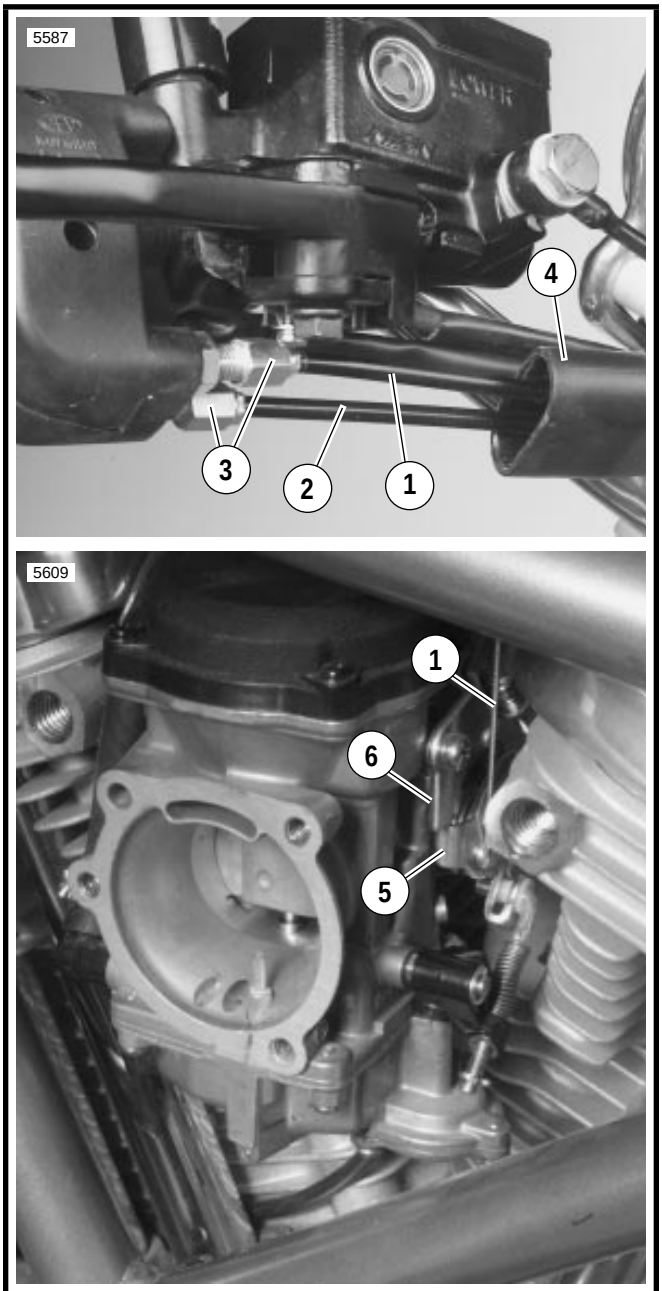
Check throttle cable adjustment with engine running. Turn handlebars through full range of travel. If engine speed changes during this maneuver, adjust throttle cables as follows:

1. Remove air cleaner. See AIR CLEANER, REMOVAL in Section 4.
2. See Figure 1-41. Slide rubber boot (4) off cable adjusters (3).
3. Loosen jam nut on each adjuster.

NOTE

Cable adjusters (3) and jam nuts are metric.

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. Turn adjuster (3) on throttle control cable (1) until throttle cam stop (5) touches carburetor stop plate (6). Tighten jam nut on throttle control cable (1) adjuster (3); release throttle control grip.
7. Turn handlebars fully to right. Turn adjuster (3) on idle control cable (2) until end of cable housing just touches the carburetor cable guide.
8. Twist and release throttle control grip a few times. Carburetor throttle must return to idle position each time throttle grip is released. If this is not the case, turn adjuster (3) on idle control cable (2) (shortening cable housing) until throttle control functions properly.
9. Tighten jam nut on idle control cable (2) adjuster (3). Recheck operation of throttle control (Step 7).
10. Slide rubber boot (4) over each cable adjuster (3). Recheck engine slow idle speed; adjust if required.
11. Install air cleaner. See AIR CLEANER, INSTALLATION in Section 4.



1.	**Throttle control cable**	**4.**	**Rubber boot**
2.	**Idle control cable**	**5.**	**Throttle cam stop**
3.	**Cable adjuster**	**6.**	**Carburetor stop plate**

Figure 1-41. Carburetor

IDLE ADJUSTMENT

Check idle adjustment:

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

See IGNITION TIMING on page 1-30.

IGNITION TIMING

INSPECTION

Check ignition timing:

- At every 5000 mile (8000 km) service interval.

Check for proper RPM and ignition timing as follows:

1. See Figure 1-42. Thread TIMING MARK VIEW PLUG (Part No. HD 96295-65D) into timing inspection hole. Be sure view plug does not touch flywheel.
2. Connect leads of INDUCTIVE TIMING LIGHT (Part No. HD-33813) to front spark plug cable, to battery positive terminal and to ground.
3. Be sure vacuum hose is properly installed at carburetor and at vacuum-operated electric switch (V.O.E.S.).
4. Start engine. Set engine speed by turning idle adjustment screw clockwise to increase speed or counterclockwise to decrease speed. Use CARBURETOR IDLE ADJUSTMENT TOOL (Part No. HD-33413) and TIP (SNAP-ON Part No. TMP23A) as shown in Figure 1-43.
   a. On world models, idle speed is 950-1050 RPM.
   b. On California models, idle speed is 1150-1250 RPM.
5. Timing light will flash each time ignition spark occurs. Aim timing light into timing inspection hole. Front cylinder advance timing mark should be centered in timing inspection hole. If not, see ADJUSTMENT on page 1-31.
6. Set engine slow idle speed as described in Step 4 with engine running at normal operating temperature and with enrichener control knob pushed in fully.

NOTE

- *Buells have an enrichener circuit that will cause the engine to idle at approximately 2000 RPM with the engine at normal operating temperature and the enrichener knob pulled out fully. The increase in idle speed is intended to alert the rider that the engine is warmed up to normal operating temperature and that the enrichener knob should be pushed in all the way. Continuing to use the enrichener circuit when the engine is at normal operating temperature will cause fouled plugs.*
- *Be sure the engine is warmed up to normal operating temperature and the enrichener knob is pushed all the way in before adjusting engine idle speed. Be aware that, because there are variations in individual components, it is possible for a properly warmed-up engine to idle at 2000 RPM with the enrichener knob pulled out partially.*

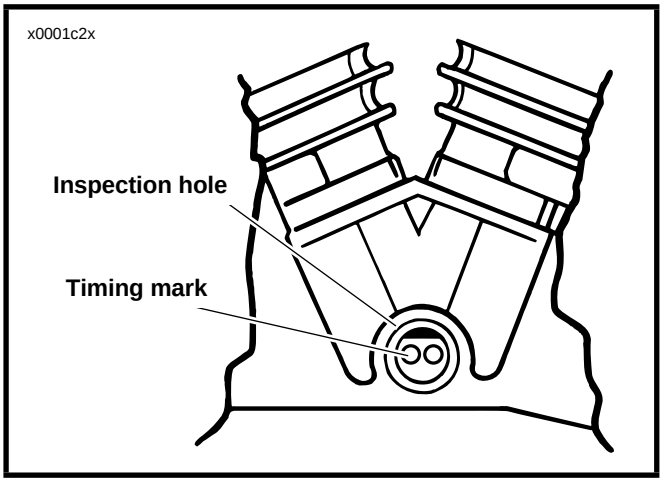
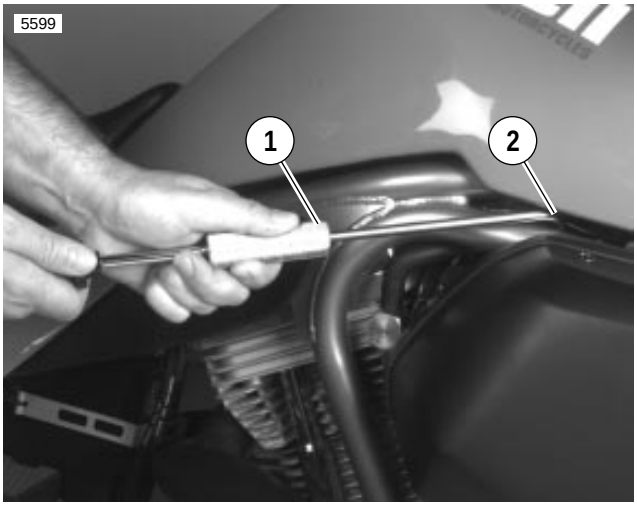


Figure 1-42. Timing Inspection Hole



1. Carburetor idle adjustment tool (Part No. HD-33413)
2. Tip (Snap-On Part No. TMP23A)

Figure 1-43. Adjusting Idle Speed

1. Pop rivet (2)
2. Timer cover
3. Screw (2)
4. Inner cover
5. Ignition gasket
6. Timer plate stud (2)
7. Bolt
8. Sensor assembly
9. Trigger rotor
10. Seal
11. Gearcase cover
12. Spark plug (2)
13. Ignition coil
14. Front spark plug cable
15. Rear spark plug cable
16. V.O.E.S. connector [P7]
17. V.O.E.S.
18. Cable strap
19. Terminal pin
20. Timer connector [P16]
21. Secondary lock
22. Ignition module connector [P10]
23. Ignition module
24. Washer (2)
25. Screw (2)

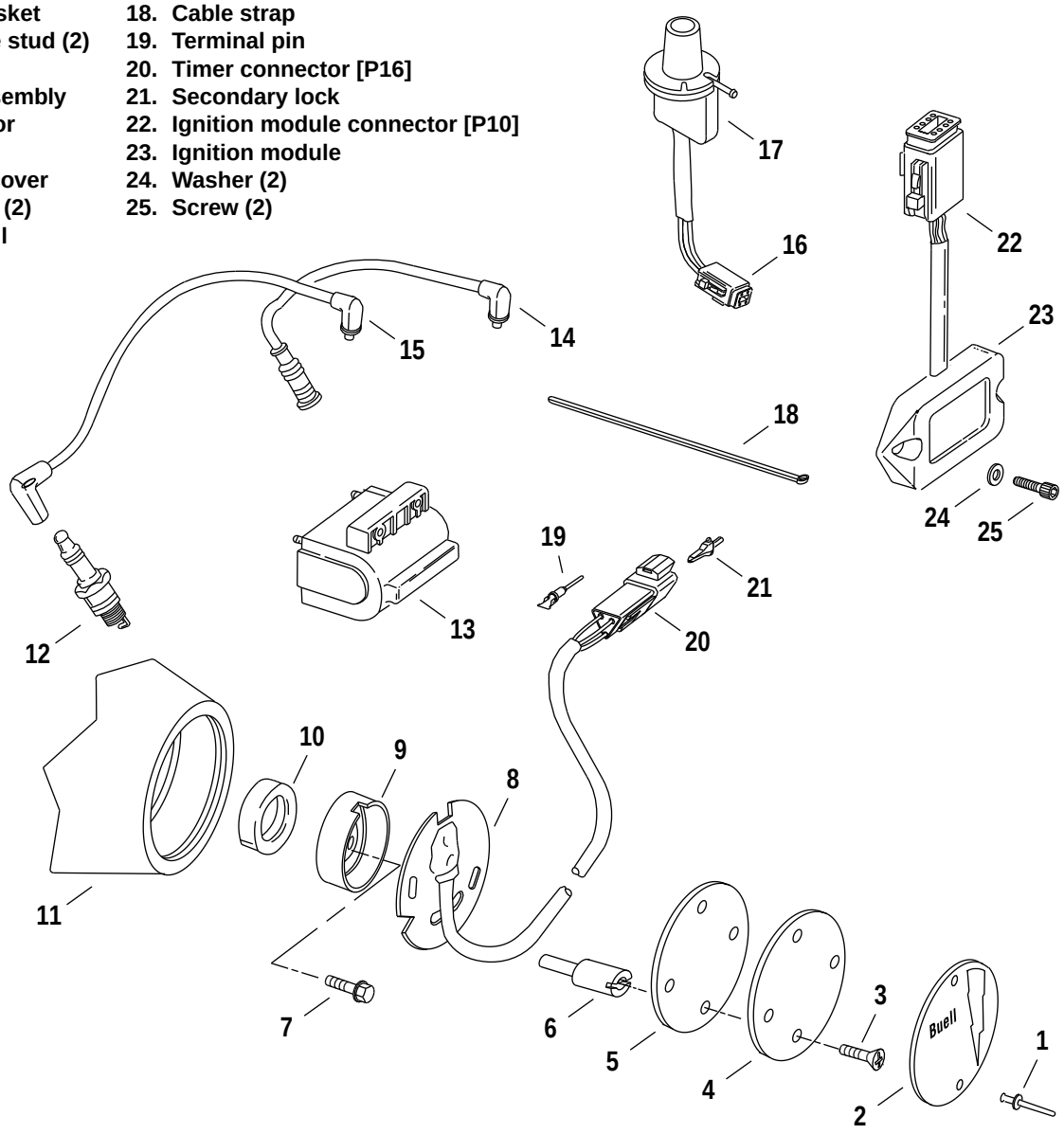


Figure 1-44. Ignition System Components

ADJUSTMENT

1. See Figure 1-44. Remove outer cover pop rivets (1), outer timer cover (2), inner cover screws (3), inner cover (4) and gasket (5).
2. Loosen timer plate studs (6) just enough to allow sensor assembly (8) to be rotated using a screwdriver in the plate's notch.
3. With timing light aimed into inspection hole, rotate sensor assembly (8) until front cylinder advance timing mark is centered in timing inspection hole.
4. Tighten timer plate studs (6).
5. Install gasket (5), inner cover (4), inner cover screws (3), timer cover (2) and **new** outer cover rivets (1).
6. Remove TIMING MARK VIEW PLUG from timing inspection hole. Install hex socket timing plug.

VACUUM-OPERATED ELECTRIC SWITCH (V.O.E.S)

ADJUSTMENT/TESTING

Timing Mark Method

Verify engine ignition timing. See IGNITION TIMING on page 1-30. Adjust ignition timing, if necessary, and then perform the following V.O.E.S. check:

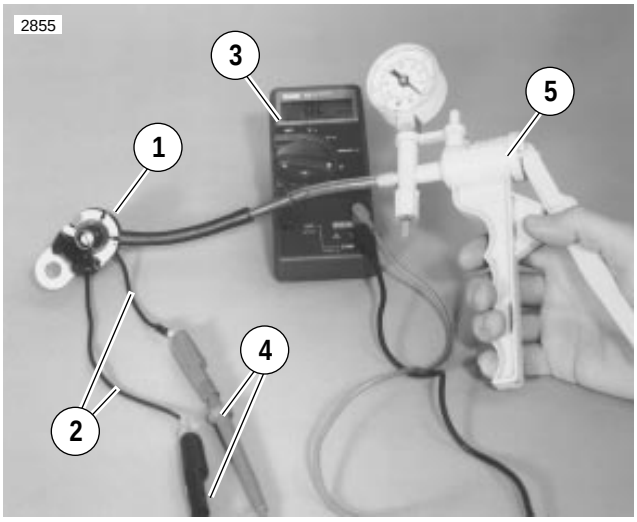
1. Run engine at regular idle. Disconnect V.O.E.S. vacuum hose from carburetor fitting. See VACUUM-OPERATED ELECTRIC SWITCH (V.O.E.S) in Section 7.
   a. On world models, idle speed is 950-1050 RPM.
   b. On California models, idle speed is 1150-1250 RPM.
2. Temporarily plug the open carburetor fitting. Ignition timing should retard (front cylinder advance timing mark disappears from view in timing inspection hole) and engine RPM should decrease.
3. Connect V.O.E.S. vacuum hose to carburetor fitting. Timing mark should reappear and engine speed should increase to previous RPM.

If speed does not first decrease and then increase as described, check V.O.E.S. wire connection to ignition module.

Ohmmeter and Vacuum Pump Method

The V.O.E.S. can also be checked using an ohmmeter and a VACUUM PUMP (Part No. HD-23738).

1. Remove V.O.E.S. from vehicle. See VACUUM-OPERATED ELECTRIC SWITCH (V.O.E.S) in Section 7.
2. See Figure 1-45. Connect two ohmmeter leads to the two V.O.E.S. leads.
3. Connect vacuum pump to V.O.E.S. vacuum fitting.
4. Slowly squeeze vacuum pump handle. Observe vacuum gauge and ohmmeter readings. Ohmmeter should indicate switch closed (zero ohms) with an applied vacuum of 5.0-6.0 in. (127.0-152.4 mm) mercury (Hg). If a vacuum reading of more than 6.0 in. (152.4 mm) Hg or less than 5.0 in. (127.0 mm) Hg is required to close the switch, then the switch must be replaced.
5. Install V.O.E.S. See VACUUM-OPERATED ELECTRIC SWITCH (V.O.E.S) in Section 7.



1. V.O.E.S.
2. V.O.E.S. leads
3. Ohmmeter
4. Ohmmeter probes
5. Vacuum pump

Figure 1-45. Checking V.O.E.S. Using Ohmmeter and Vacuum Pump

HANDLEBARS

INSPECTION

Check handlebar adjustment:

- Before every ride.

1. See Figure 1-46. Check steering motion range to both fork stops. Each handlebar should be spaced equally between the windscreen and fuel tank and parts should not make contact.
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.

NOTE

Windscreen and instrument support must be removed to access front clamp screws.

1. Remove windscreen. See WINDSCREEN in Section 2.
2. Remove instrument support. See SPEEDOMETER AND TACHOMETER in Section 2.
3. See Figure 1-47. Loosen clamp screws.
4. Move handlebar to desired position.
5. Tighten clamp screws to 10-12 ft-lbs (13.6-16.2 Nm).

NOTE

Tighten front clamp screws first.

6. Install instrument support. See SPEEDOMETER AND TACHOMETER in Section 2.
7. Install windscreen. See WINDSCREEN in Section 2.
8. Check steering motion range to both fork stops. Each handlebar should be spaced equally between windscreen and fuel tank and parts should not make contact.

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

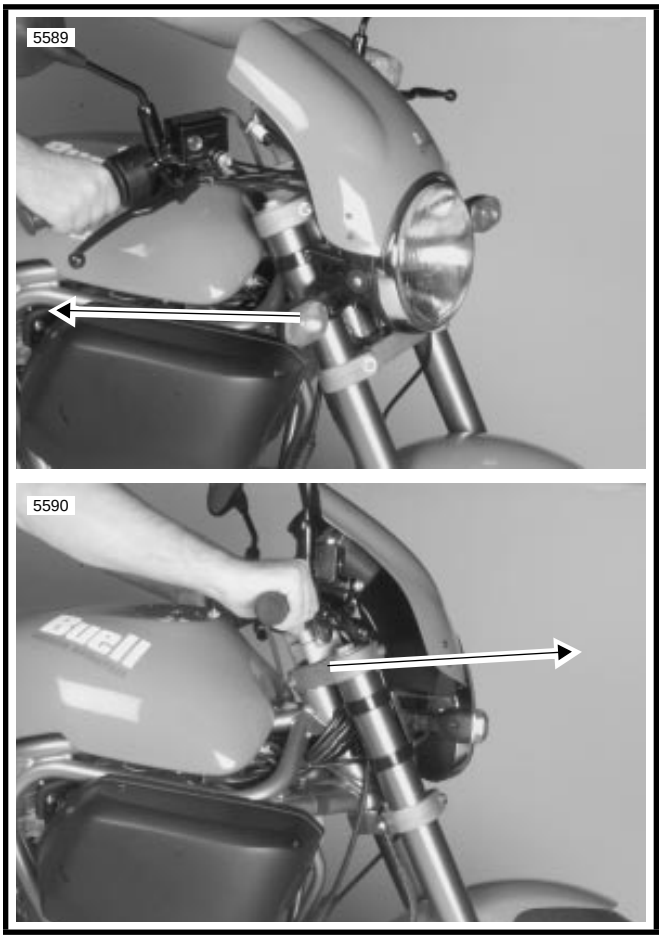


Figure 1-46. Testing Handlebars

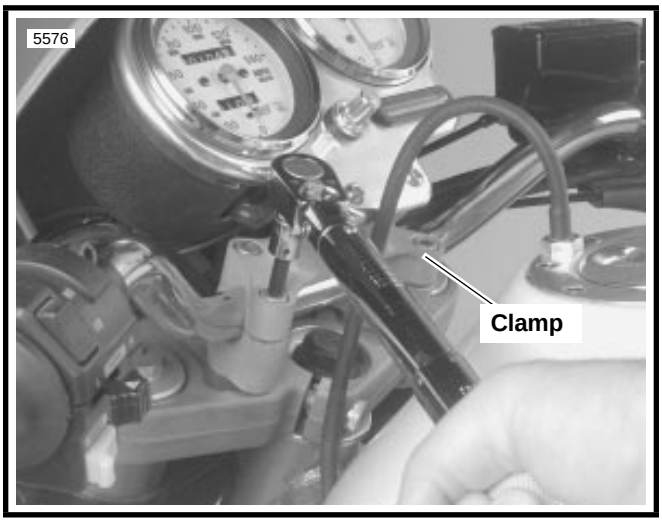


Figure 1-47. Adjusting Handlebars

HEADLAMP

INSPECTION

⚠WARNING

Do not modify ignition wiring to permit motorcycle operation with headlamp off. Operating with headlamp off may reduce your visibility to other motorists and could cause an accident resulting in personal injury.

Check headlamp alignment:

- When a new rider buys the motorcycle.
- When there is a change in load (luggage, etc.)

Check headlamp beam for proper height and lateral alignment as follows:

1. Verify correct front and rear tire inflation pressure. See TIRES AND WHEELS on page 1-18.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. See Figure 1-48. Point front of motorcycle toward a screen or wall which is 25 ft (7.62 M) away from front tire contact patch on floor (i.e., directly below front axle).
4. Draw a horizontal line, on screen or wall, which is 35 in. (889 mm) above floor.
5. Have a person whose weight is roughly the same as that of the principal rider sit on motorcycle seat. Weight of rider 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 proper height alignment. Main beam of light (broad, flat pattern of light) should be centered on horizontal line on screen or wall (i.e. equal area of light above and below line).
9. Check light beam for proper lateral alignment. Main beam of light should be directed straight ahead (i.e. equal area of light to right and left of center).

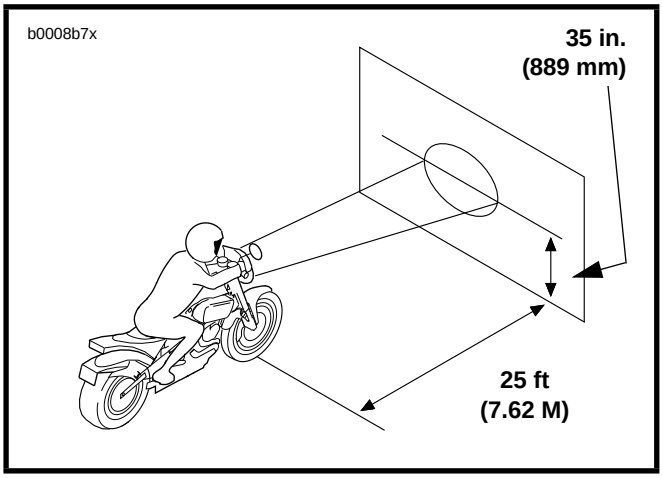


Figure 1-48. Checking Headlamp Alignment

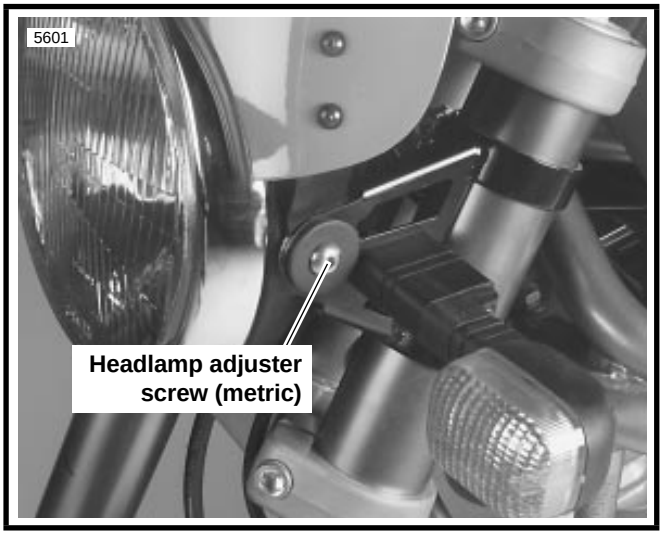


Figure 1-49. Adjusting Headlamp

ADJUSTMENT

If headlamp requires adjustment, perform the following:

1. See Figure 1-49. Loosen both adjuster screws (metric).
2. See Figure 1-48. Tilt headlamp up or down to aim it in relation to the horizontal line. At the same time, turn headlamp right or left to direct light beam straight ahead.
3. Tighten both adjuster screws (metric) to 6-8 ft-lbs (8.1-10.8 Nm).

STORAGE

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 carburetor.

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 cause an accident resulting in personal 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 carburetor float bowl. Turn fuel supply valve OFF.
2. Fill the oil tank. Pinch off (or remove and plug) the line leading from the oil tank bottom to the oil pump feed fitting. This prevents oil from seeping past the check ball into the oil pump and filling the engine flywheel compartment.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
4. Adjust primary chain.
5. Adjust secondary drive belt.
6. Check tire inflation. 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 can result in an accident causing personal injury.

7. Wash painted and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.
8. 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 could result in personal injury.

1. Remove and inspect spark plugs. Replace if necessary.
2. Clean air filter element and lubricate if necessary.
3. If fuel tank was drained, fill fuel tank with fresh gasoline.
4. If oil feed line was pinched off or plugged, unplug it and reconnect.
5. Start the engine and run until it reaches normal operating temperature. Check fluids and refill to proper levels if required.
   a. Check engine oil level.
   b. Check the transmission lubricant level.
6. Perform all of the checks in the PRE-RIDING CHECK LIST in the Owner's Manual.

TROUBLESHOOTING

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. Fuel supply valve turned OFF.
3. Fuel supply valve or filter clogged.
4. Discharged battery, loose or broken battery terminal connections.
5. Fouled spark plugs.
6. Loose or shorting spark plug cables or connections.
7. Ignition timing badly out of adjustment.
8. Loose wire connection at coil or battery connection or plug between ignition sensor and module.
9. Ignition coil not functioning.
10. Ignition module not functioning.
11. Ignition sensor not functioning.
12. Sticking or damaged valve or valves.
13. Engine flooded with gasoline as a result of overchoking.
14. 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. Carburetor controls not adjusted correctly.
6. Ignition coil not functioning.
7. Engine oil too heavy (winter operation).
8. Ignition not timed properly. See dealer.
9. Vapor vent valve plugged or carburetor fuel line closed off restricting fuel flow.
10. Water or dirt in fuel system and carburetor.
11. Enrichener valve inoperative.
12. Air leak at intake manifold.
13. Valves sticking.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Spark plug gap too close or too wide.
4. Ignition coil not functioning.
5. Ignition module not functioning.
6. Ignition sensor not functioning.
7. Battery nearly discharged.
8. Damaged wire or loose connection at battery terminals or coil.
9. Intermittent short circuit due to damaged wire insulation.
10. Water or dirt in fuel system and carburetor or filter.
11. Fuel tank filler cap vent plugged or carburetor float bowl vent closed off.
12. Carburetor controls improperly adjusted.
13. Air leak at intake manifold or air filter.
14. Damaged intake or exhaust valve.
15. Weak or broken valve springs.
16. Incorrect valve timing.

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 BLACK LIGHT LEAK DETECTOR (Part No. HD-35457).
3. Restricted oil return line to tank.
4. Restricted breather passage(s) to air cleaner.

ELECTRICAL SYSTEM

Alternator Does Not Charge

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

Alternator Charge Rate Is Below Normal

1. Regulator-rectifier module not functioning.
2. Stator not functioning.
3. Rotor not functioning.
4. Weak battery.
5. Loose connections.

FUEL

Carburetor Floods

1. Excessive “pumping” of throttle control grip.
2. Inlet valve sticking.
3. Inlet valve and/or valve seat worn or damaged.
4. Dirt or other foreign matter between valve and its seat.
5. Float misadjusted or filled with fuel.

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 (1/16 in. (1.6 mm) 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. Check TIRES AND WHEELS on page 1-18. Do not overinflate.
2. Loose wheel axle nuts. Tighten front nut to 48-53 ft-lbs (65.1-71.9 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. Correct adjustment and replace pitted or worn bearings and races. See FORK STEM AND BRACKET ASSEMBLY in Section 2.
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.

SPECIFICATIONS

DIMENSIONS	IN.	MM
Wheel Base	55	1397
Overall Length	79.5	2019
Overall Width	30	762
Seat Height	29.5	749

CHASSIS	IN.	MM
Road Clearance	5.2	132
Front Wheel Travel	4.7	119.4
Rear Wheel Travel	4.9	124.5
Trail	3.9	99
Rake	25 degrees	

WEIGHT	LBS.	KG
S1 Shipping weight	446	202
GVWR	820	372
GAWR - Front	340	154
GAWR - Rear	480	218

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 front frame steering head.

CAPACITIES	U.S.	LITERS
Fuel Tank (including reserve)	4.0 gallons	15.14
Reserve	0.6 gallons	2.27
Oil Tank	2.0 quarts	1.89
Transmission	1.0 quart	0.95

TIRE AND POSITION	PRESSURE FOR SOLO RIDING	PRESSURE AT GVWR
Front-Dunlop Sportmax Radial II 120/70 ZR 17	32 PSI (2.2 bar)	36 PSI (2.5 bar)
Rear-Dunlop Sportmax Radial II 170/60 ZR 17	36 PSI (2.5 bar)	38 PSI (2.8 bar)

⚠WARNING

Do not inflate any tire beyond its maximum inflation pressure as specified on tire sidewall. Overinflation may cause tire to suddenly deflate leading to personal injury.

BRAKE ROTORS	IN.	MM
Front rotor minimum thickness	0.17	4.3
Rear rotor minimum thickness	0.19	4.8

ITEM	TORQUE		NOTES
Clutch cable, primary cover fitting	3-5 ft-lbs	4-6.87 Nm	turn clockwise to install, page 2-45
Clutch clamp screw	30-33 **in-lbs**	3.4-4.0 Nm	metric, page 2-45
Drive support fastener	30-35 ft-lbs	40.7-47.4 Nm	page 2-53
Exhaust manifold nuts	6-8 ft-lbs	8.1-10.8 Nm	page 2-50
Fender mounting screw, lower	10-15 **in-lbs**	1.1-1.7 Nm	page 2-54
Fender mounting screw, upper	20-25 **in-lbs**	2.3-2.8 Nm	metric, page 2-54
Front axle nut	48-53 ft-lbs	65.1-71.9 Nm	LOCTITE THREADLOCKER 242 (blue), metric, page 2-6, page 2-10
Front axle pinch screw	13-15 ft-lbs	17.6-20.3 Nm	metric, page 2-10
Front brake caliper screw	26-28 ft-lbs	35.2-38.0 Nm	2 sizes, page 2-21
Front brake carrier screw	7.5-8.5 ft-lbs	10.2-11.5 Nm	LOCTITE THREADLOCKER 242 (blue), page 2-9
Front brake line clamp screw	30-35 **in-lbs**	3.4-4.0 Nm	page 2-22
Front brake master cylinder clamp screw	80-90 **in-lbs**	9.0-10.2 Nm	metric, page 2-19
Front brake rotor carrier screw	20-22 ft-lbs	27.1-29.8 Nm	LOCTITE THREADLOCKER 242 (blue), page 2-9
Front caliper banjo bolt	16-20 ft-lbs	21.7-27.1 Nm	page 2-21, page 2-22
Front caliper bleeder valve	4-6 ft-lbs	5.4-8.1 Nm	page 2-22
Front caliper center bolt	11-13 ft-lbs	14.9-17.6 Nm	page 2-21
Front caliper mounting bolt	30-33 ft-lbs	40.7-44.7 Nm	page 2-21
Front fork triple clamp screw	18-20 ft-lbs	24.4-27.1 Nm	LOCTITE ANTI-SEIZE, page 2-31
Front master cylinder banjo bolt	17-20 ft-lbs	23.0-27.1 Nm	metric, page 2-19, page 2-22
Front master cylinder cover screw	9-13 **in-lbs**	1.0-1.5 Nm	page 2-19, page 2-21
Fuel tank screw	9-11 ft-lbs	12.2-14.9 Nm	page 2-55
Handlebar bolt, lower clamp	30-33 ft-lbs	40.7-44.7 Nm	page 2-49
Handlebar screw, upper clamp	10-12 ft-lbs	13.6-16.2 Nm	page 2-49
Header tiebar screw	5-7 ft-lbs	6.8-9.5 Nm	page 2-50
Headlamp adjusting screw	6-8 ft-lbs	8.1-10.8 Nm	metric, page 2-56
Instrument support screw	7-9 ft-lbs	9.5-12.2 Nm	page 2-46
Muffler clamp	50-55 ft-lbs	67.8-74.6 Nm	discard after use, page 2-50
Muffler mounting bolt, front	22-25 ft-lbs	29.8-33.9 Nm	page 2-50
Muffler mounting bolt, rear	22-25 ft-lbs	29.8-33.9 Nm	page 2-50
Muffler support mounting bolt, front	30-33 ft-lbs	40.7-44.7 Nm	page 2-50
Muffler support mounting bolt, rear	12-15 ft-lbs	16.3-20.3 Nm	page 2-50

ITEM	TORQUE		NOTES
Rear axle nut	66-73 ft-lbs	89.5-98.9 Nm	metric, page 2-6, page 2-13
Rear brake caliper banjo bolt	9.5-12.5 ft-lbs	12.9-17.0 Nm	metric, page 2-26, page 2-27
Rear brake caliper bleeder valve	6-9 ft-lbs	8.1-12.2 Nm	metric, page 2-26, page 2-27
Rear brake caliper mounting screw	18-22 ft-lbs	24.4-29.8 Nm	metric, page 2-26
Rear brake lamp switch	7-8 ft-lbs	9.5-10.8 Nm	LOCTITE SEALANT WITH TEFLON, page 2-27
Rear brake line clamp screw	10-12 ft-lbs	13.6-16.2 Nm	page 2-27
Rear brake reservoir mounting screw	12-15 **in-lbs**	1.4-1.7 Nm	page 2-24
Rear brake rotor screw	35-40 ft-lbs	47.5-54.2 Nm	LOCTITE THREADLOCKER 242 (blue), metric, page 2-12
Rear master cylinder banjo bolt	10-12 ft-lbs	13.6-16.2 Nm	metric, page 2-24, page 2-27
Rear master cylinder mounting screw	8-10 ft-lbs	10.8-13.6 Nm	page 2-24
Rear master cylinder rod to brake pedal screw	10-12 ft-lbs	13.6-16.2 Nm	page 2-24
Rear shock mounting screw	40-45 ft-lbs	54.2-61.0 Nm	metric, page 2-37
Sprocket bolt	55-65 ft-lbs	74.6-88.1 Nm	LOCTITE THREADLOCKER 272 (red), page 2-12
Sprocket cover mounting screw	12-17 **in-lbs**	1.4-1.9 Nm	page 2-53
Sprocket cover screw	4-6 ft-lbs	5.4-8.6 Nm	page 2-53
Swingarm pinch screw	27-30 ft-lbs	36.6-40.7 Nm	LOCTITE THREADLOCKER 242 (blue), page 2-34
Swingarm/drive support screw	20-25 ft-lbs	27.1-33.9 Nm	page 2-53
Switchgear housing screws, left side	25-33 **in-lbs**	2.8-3.7 Nm	metric, page 2-45
Switchgear housing screws, right side	12-17 **in-lbs**	1.4-1.9 Nm	metric, page 2-43
Tie bar bolt	30-33 ft-lbs	40.7-44.7 Nm	page 2-34
Valve stem nut	42-44 **in-lbs**	4.7-5.0 Nm	page 2-16

TIRE SPECIFICATIONS

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 may result in personal 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. The **3.5** is the width of the bead seat measured in inches. The **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 Marchesini Wheels

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

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

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

VEHICLE IDENTIFICATION NUMBER

GENERAL

A 17-digit serial number, or Vehicle Identification Number (V.I.N.), is stamped on the right side of the steering head (ex., 4MZSS11J1T3200001). Also affixed to the steering head at this location is an information plate bearing the V.I.N. code.

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

NOTE

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

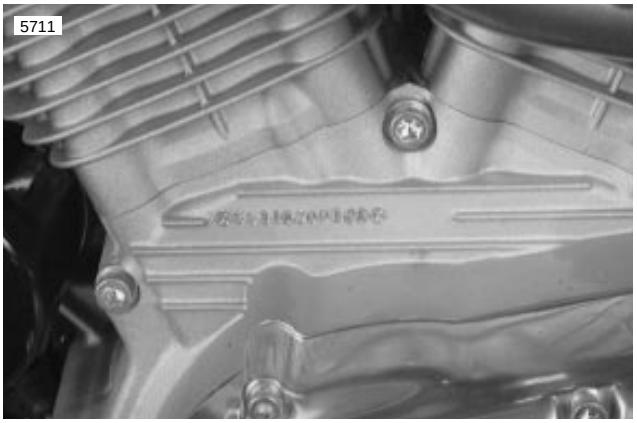
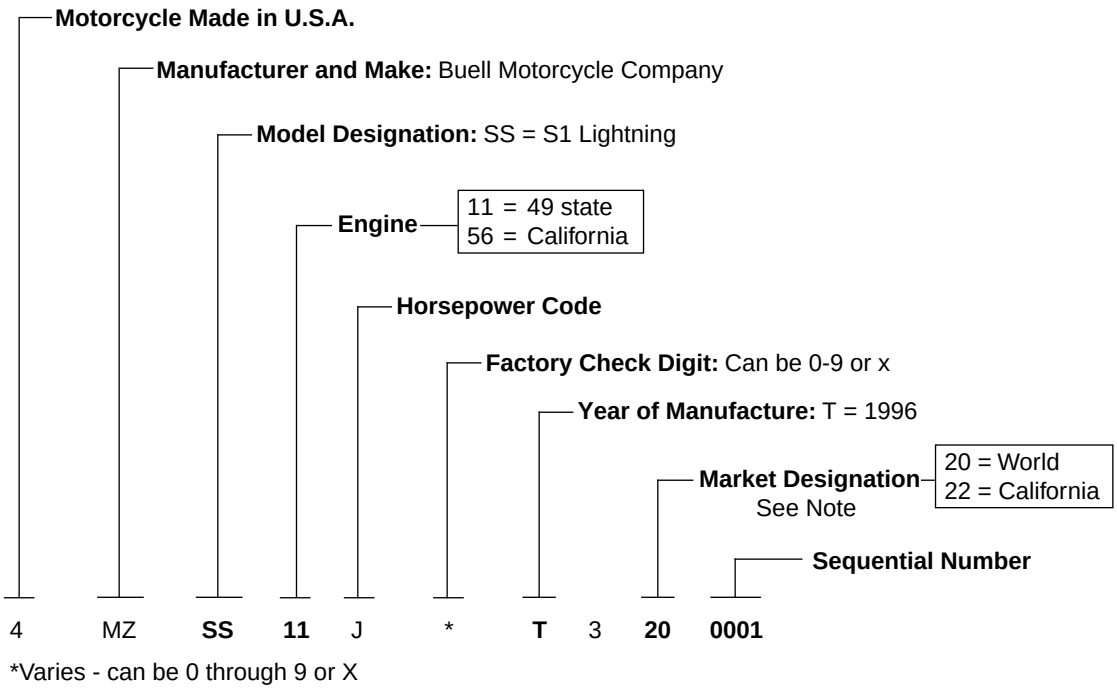


Figure 2-1. Abbreviated V.I.N. Location



Sample V.I.N. as it appears on the steering head - 4MZ**SS11**J1**T**3**200001**

Sample abbreviated V.I.N. as it appears on the left side crankcase- **SS11T200001**

NOTE

Two market destination characters have been used beginning with sequential number 38.

Figure 2-2. Vehicle Identification Number (V.I.N.)

WHEELS

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, check the TROUBLESHOOTING guide in Section 1 or see the table below for a list of probable causes.

See TIRES AND WHEELS in Section 1. 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 leading to personal injury.

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.

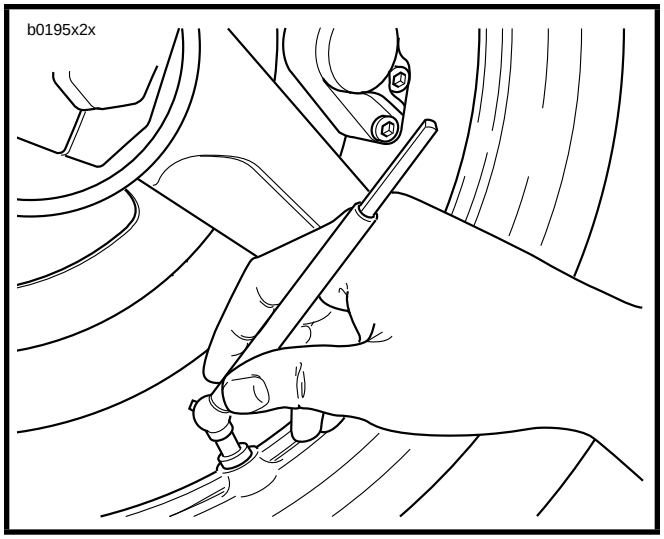


Figure 2-3. Checking Tire Inflation Pressure

Table 2-3. Wheel Service

CHECK FOR	REMEDY
1. Loose axle nuts.	Tighten front axle nut (metric) to 48-53 ft-lbs (65.1-71.9 Nm). Tighten rear axle nut (metric) to 66-73 ft-lbs (89.5-98.9 Nm).
2. Excessive side-play or radial (up-and-down) play in wheel hubs.	Replace wheel hub bearings.
3. Alignment of rear wheel in frame or with front wheel.	Check WHEEL BALANCING on page 2-17 or repair swingarm as described under SWINGARM on page 2-33.
4. Rims and tires out-of-true sideways; should not be more than 0.080 in. (2.03 mm).	Replace rims. See TIRES, INSTALLATION on page 2-16.
5. Rims and tires out-of-round or eccentric with hub; should not be more than 0.090 in. (2.29 mm).	See Item 4 above.
6. Irregular or peaked front tire wear.	Replace as described under FRONT WHEEL (page 2-8), REAR WHEEL (page 2-11) and TIRES (page 2-15).
7. Correct tire inflation.	Inflate tires to correct pressure. See SPECIFICATIONS on page 2-1.
8. Correct tire and wheel balance.	Static balance may be satisfactory if dynamic balancing facilities are not available. However, dynamic balancing is strongly recommended.
9. Steering head bearings.	Correct adjustment and replace pitted or worn bearings. See FORK STEM AND BRACKET ASSEMBLY on page 2-32.
10. Damper tubes.	Check for leaks. See FRONT FORK on page 2-28.
11. Shock absorbers.	Check damping action and mounts. See SWINGARM on page 2-33.
12. Swingarm bearings.	Check for looseness. See SWINGARM on page 2-33.

⚠WARNING

To prevent personal injury, use the following guidelines when installing a new tire or repairing a flat:

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

⚠WARNING

Excessively worn tires adversely affect motorcycle traction, steering and handling and could result in personal 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.

FRONT WHEEL

REMOVAL

1. See Figure 2-4. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and S1 LIFT ADAPTER (Part No. B-41686).
2. Remove front brake caliper. See FRONT BRAKE CALIPER, REMOVAL/DISASSEMBLY on page 2-20.

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 2-5. Insert screwdriver/rod through hole in axle (1) and loosen front axle nut (4) (metric).
4. Loosen pinch screws (2) (metric).
5. Remove front axle nut (4) and washer (3). Pull front axle out of hub while supporting front wheel.
6. See Figure 2-6. Detach speedometer drive spacer (3) and speedometer drive (4) from left side of wheel. Remove front wheel.

DISASSEMBLY

1. See Figure 2-6. Move wheel to bench area. On the side of the wheel opposite the brake rotor, remove left axle spacer (5).
2. On brake rotor side of wheel, remove right axle spacer (12).
3. Remove wheel bearings (6, 11) using BUSHING AND BEARING PULLER (Part No. HD-95760-69A) and 3/4 in. COLLET (Part No. HD-95767-69A).
4. Remove six locknuts (14), washers (21), spring washers (20), screws (19) and brake drive pins (18). Remove brake rotor (17).
5. Remove five screws (16) and front brake carrier (15).
6. Remove tire. See TIRES, REMOVAL on page 2-15.

CLEANING, INSPECTION AND REPAIR

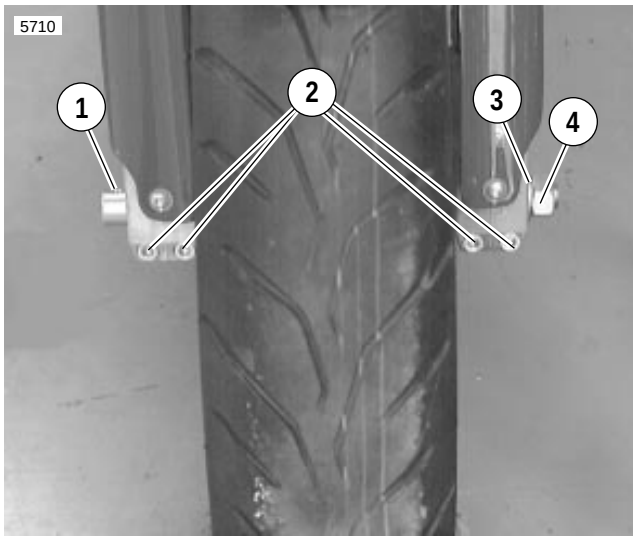
1. Thoroughly clean all parts in solvent.

⚠WARNING

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

2. Inspect all parts for damage or excessive wear.
3. Inspect brake rotor. Replace rotor if warped or badly scored. Measure rotor thickness for excessive wear. Minimum rotor thickness is 0.17 in. (4.4 mm).

Figure 2-4. Front Wheel Support Stand (Part No. B-41395) with S1 Lift Adapter (Part No. B-41686)



1. **Hole in front axle**
2. **Pinch screws (4) (metric)**
3. **Washer**
4. **Front axle nut (metric)**

Figure 2-5. Front Wheel Mounting

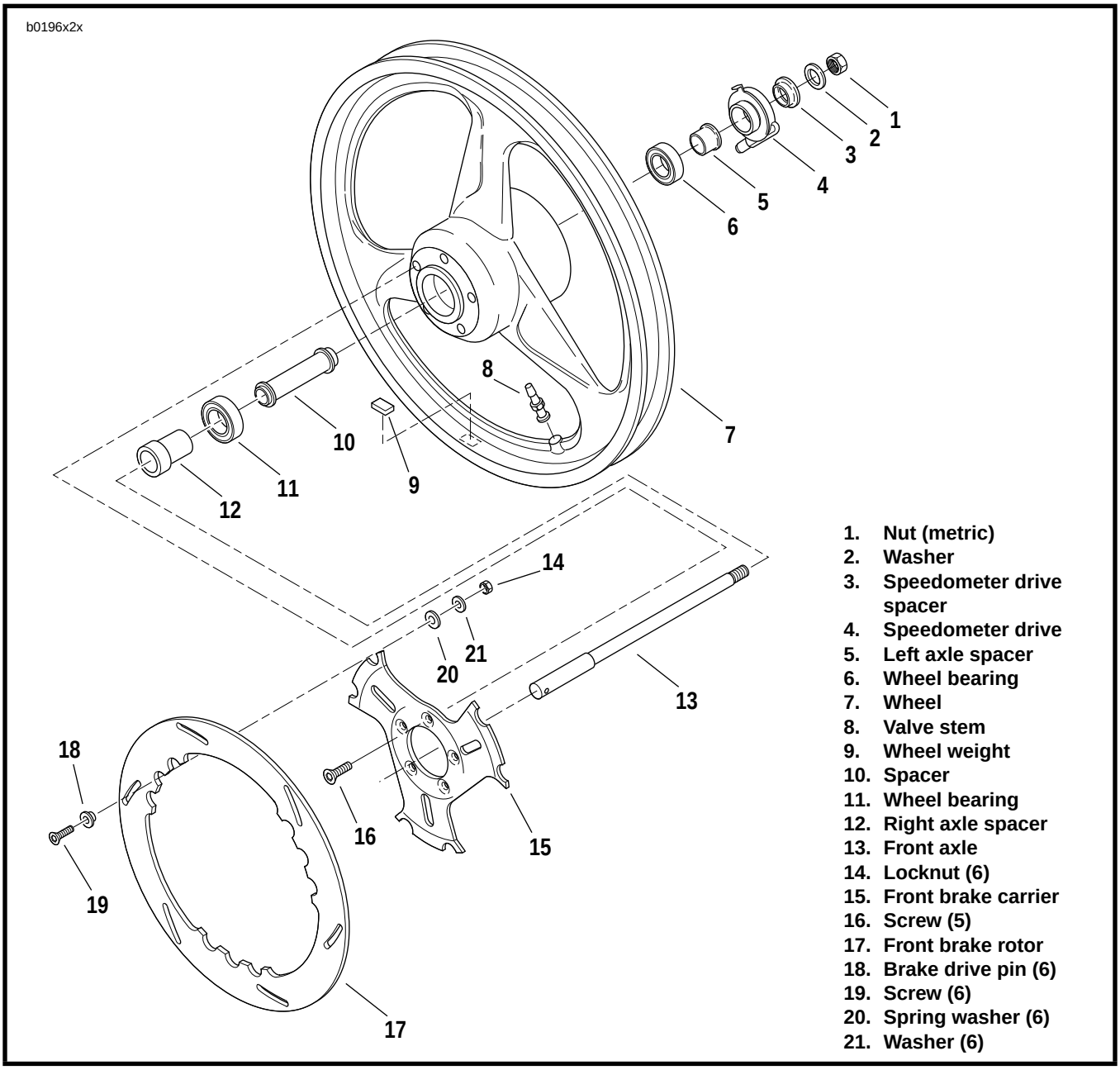


Figure 2-6. Front Wheel

ASSEMBLY

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake rotor or reduced braking ability will occur, possibly resulting in personal injury.

1. See Figure 2-6. Verify that the front brake carrier is thoroughly clean. Apply LOCTITE THREADLOCKER 242 (blue) to each screw (16). Install carrier (15) on hub with five screws. Tighten to 20-22 ft-lbs (27.1-29.8 Nm).
2. Verify that the brake rotor is thoroughly clean. Apply LOCTITE THREADLOCKER 242 (blue) to each screw (19). Install rotor on front brake carrier with six screws, brake drive pins (18), spring washers (20), washers (21) and locknuts (14). Tighten to 7.5-8.5 ft-lbs (10.2-11.5 Nm).
3. Install spacer (10).
4. Install **new** wheel bearings (6, 10) into hub using suitable driver. Press on outer race only.
5. On the side of the wheel opposite the brake rotor insert left axle spacer (5) into hub until it seats in bore. Spacer sleeve must not be cocked or tilted in bore.
6. On the right side of the wheel insert right axle spacer (12) into hub until it seats in bore. Spacer sleeve must not be cocked or tilted in bore.
7. Install tire, if removed. See TIRES, INSTALLATION on page 2-16.
8. Verify that wheel and tire are true. See CHECKING CAST RIM RUNOUT on page 2-14.

INSTALLATION

1. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle.

2. Position wheel between forks with brake rotor on right side of vehicle. With pinch screws (metric) loose, insert threaded end of axle through right side fork. Push axle through fork and wheel hub until axle begins to emerge from left side of hub.

⚠CAUTION

Speedometer drive tab must be properly inserted or damage to the unit will occur. If drive tab is damaged, it must be replaced.

3. See Figure 2-7. Align speedometer drive tab and wheel hub. Push axle through speedometer drive, speedometer drive spacer and left fork leg.

4. Compress the front suspension to make sure it is free and not binding.

5. See Figure 2-6. Apply LOCTITE THREADLOCKER 242 (blue) to axle nut. Install washer (2) and axle nut (1) (metric) over threaded end of axle. Insert screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 48-63 ft-lbs (65.1-71.9 Nm).

6. See Figure 2-5. Tighten the four front axle pinch screws (2) (metric) to 13-15 ft-lbs (17.6-20.3 Nm).

7. Install front brake caliper. See FRONT BRAKE CALIPER, INSTALLATION on page 2-21.

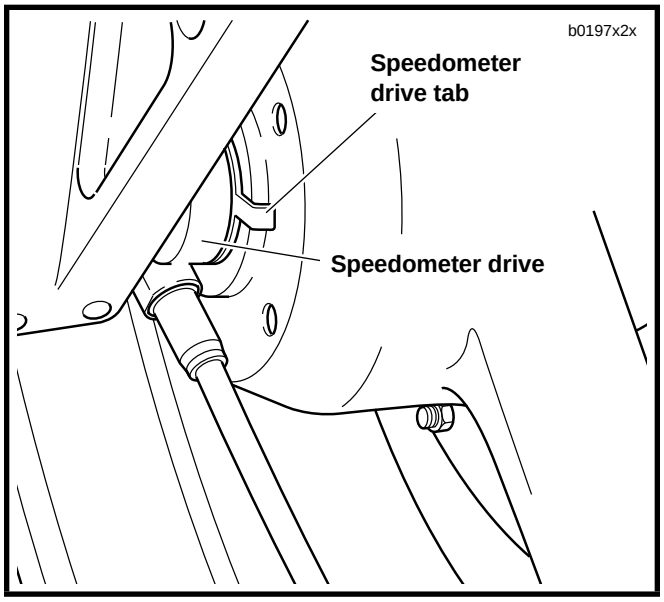


Figure 2-7. Speedometer Drive

REAR WHEEL

REMOVAL

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove rear fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.
3. Remove rear brake caliper. See REAR BRAKE CALIPER, REMOVAL/DISASSEMBLY on page 2-25.

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 2-8. Loosen rear axle nut (metric).
5. Loosen rear axle adjuster nuts. Push wheel as far forward as possible.
6. Slip secondary drive belt from bottom of rear wheel sprocket and remove.
7. See Figure 2-9. Remove rear axle nut (14) (metric), lockwasher (13), and washer (12). Pull axle (3) and washer (4) out from left side and remove wheel.

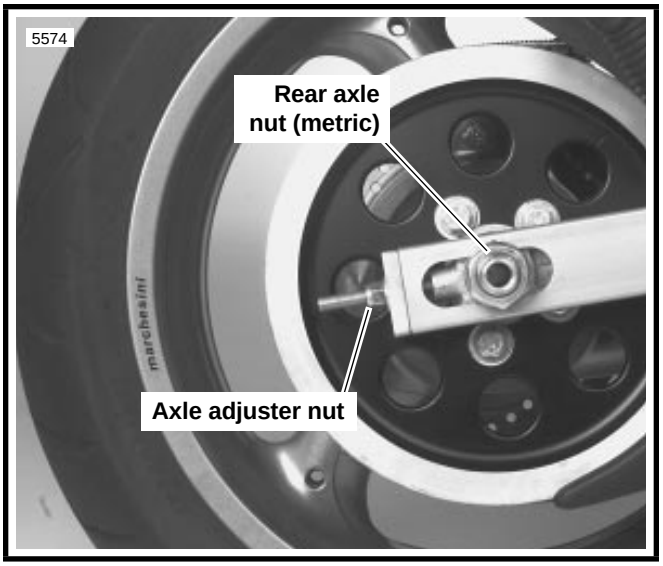


Figure 2-8. Rear Wheel Mounting

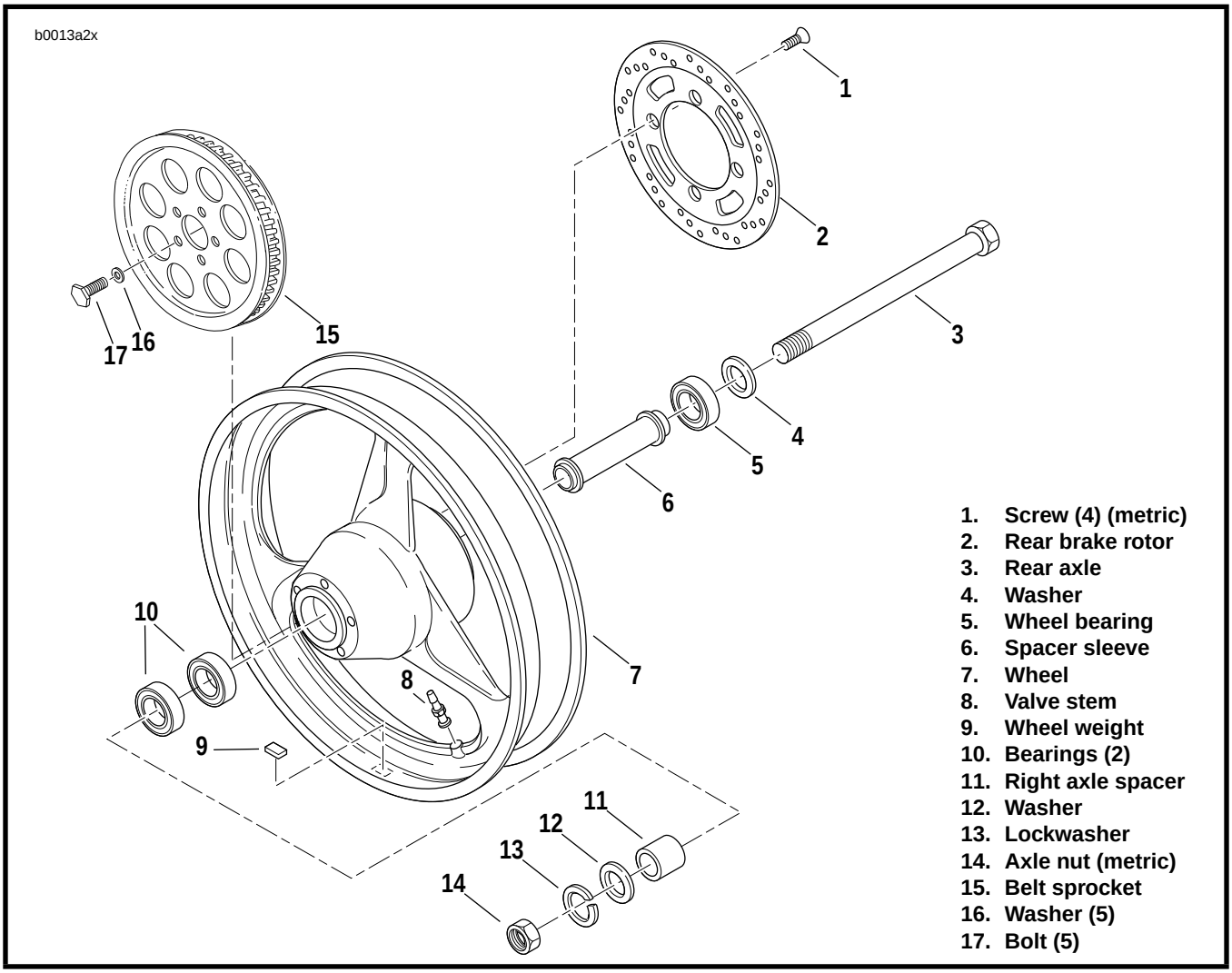


Figure 2-9. Rear Wheel

DISASSEMBLY

1. See Figure 2-10. 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. See Figure 2-9. Remove four screws (1) (metric) to remove rear brake rotor (2) from hub.
4. Remove five bolts (17) and washers (16) on belt sprocket (15). Remove belt sprocket from wheel.

CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean all parts in solvent.

⚠WARNING

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

2. Inspect all parts for damage or excessive wear.
3. Inspect brake rotor. Replace rotor if warped or badly scored. Measure rotor thickness for excessive wear. Minimum acceptable thickness (0.19 in. (4.8 mm)) is stamped on side of rotor.

ASSEMBLY

⚠WARNING

Do not allow brake fluid, bearing grease, lubricants, etc. to contact brake rotor or reduced braking ability will occur, possibly resulting in personal injury.

1. See Figure 2-9. Verify that brake rotor (2) is thoroughly clean. Apply LOCTITE THREADLOCKER 242 (blue) to each screw (1) (metric). Fasten rotor to hub with four screws. Tighten to 35-40 ft-lbs (47.5-54.2 Nm).

NOTE

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

2. Apply two drops of LOCTITE THREADLOCKER 272 (red) to threads of each sprocket bolt (17). Install belt sprocket (15) using five bolts (17) and washers (16). Tighten bolts to 55-65 ft-lbs (74.6-88.1 Nm).

Figure 2-10. Removing Wheel Bearing Using Bushing/ Bearing Puller (Part No. HD-95760-69A) and 1 1/8 in. Collet (Part No. HD-95769-69)

3. On the sprocket side of the wheel, insert two bearings (10) into hub until they contact shoulder for spacer sleeve. Press bearings in separately, pressing on outer race only.
4. Insert spacer sleeve (6) into hub.
5. On the brake rotor side of the wheel, insert bearing (5) into hub until it contacts end of spacer sleeve. Press on outer race only.
6. Install tire, if removed. See TIRES, INSTALLATION on page 2-16.
7. Verify that wheel and tire are true. See CHECKING CAST RIM RUNOUT on page 2-14.

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. See Figure 2-9. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle (3).
3. Insert axle (3) through washer (4), left side of swingarm, rear brake caliper mount, wheel assembly, spacer (11) and right side of swingarm.
4. Install washer (12), lockwasher (13), and axle nut (14) (metric) on right side of axle. Do not fully tighten rear axle nut at this time.
5. Install rear brake caliper. See REAR BRAKE CALIPER, INSTALLATION on page 2-26.
6. Check for proper belt tension and wheel alignment. See REAR BELT DEFLECTION in Section 1.
7. Tighten rear axle nut (14) (metric) to 66-73 ft-lbs (89.5-98.9 Nm).
8. Install rear fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.

CHECKING CAST RIM RUNOUT

GENERAL

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

Rim Lateral Runout

1. See Figure 2-11. 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 2-12. 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 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 Marchesini	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)

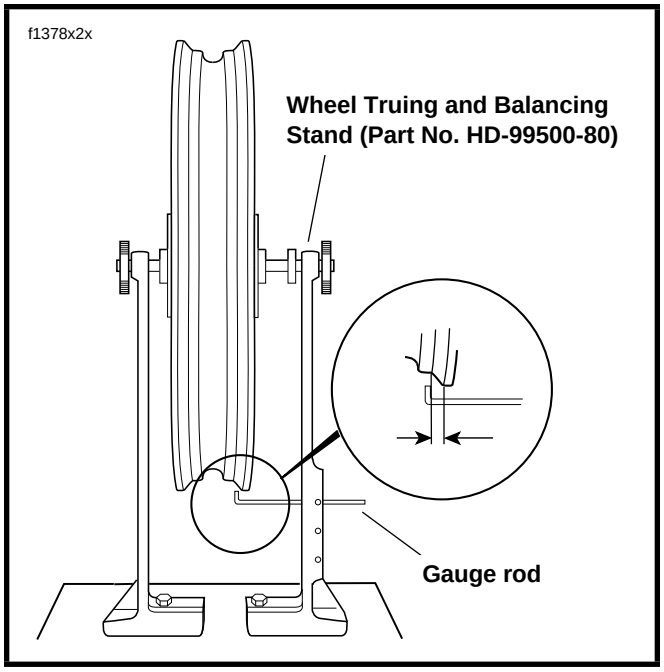


Figure 2-11. Checking Cast Rim Lateral Runout

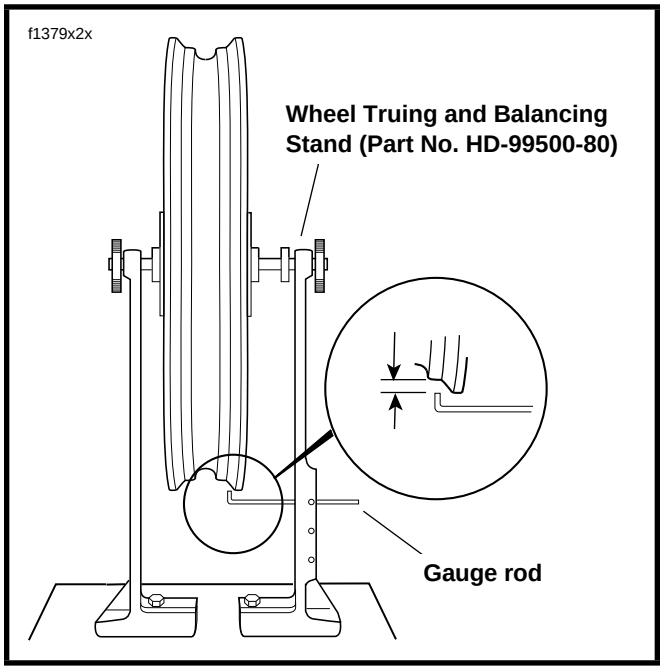


Figure 2-12. Checking Cast Rim Radial Runout

TIRES

GENERAL

Tires should be inspected 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 personal 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 FRONT WHEEL, REMOVAL on page 2-8 or REAR WHEEL, REMOVAL on page 2-11.
2. Deflate tire.
3. See Figure 2-13. 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 resulting in personal 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 2-14. 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, INSPECTION AND REPAIR

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. Use TIRE REPAIR KIT (Part No. HD-20000) for tire repair. Follow the kit manufacturer's instructions.

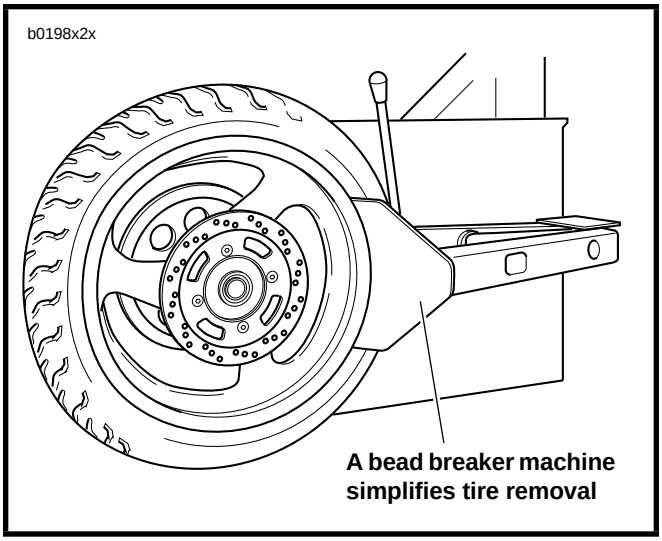


Figure 2-13. Loosening Beads from Rim Flange

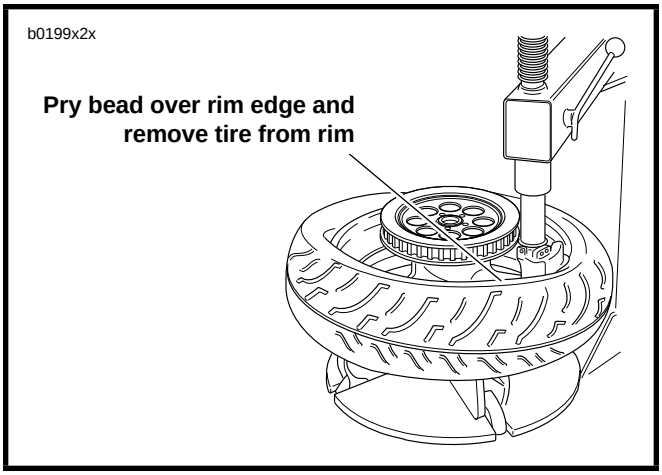


Figure 2-14. Starting Tire Off RIm

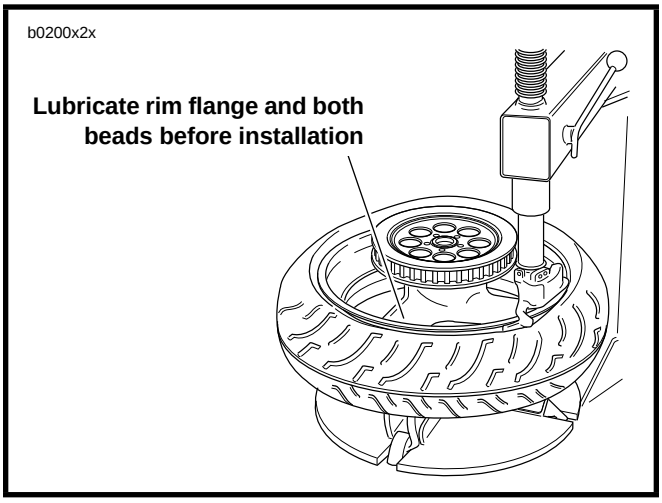


Figure 2-15. Starting Bead on Rim

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 and personal injury.**
- **Also, 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 and personal 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 2-15. 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 over 40 psi (2.8 bars) to seat the beads. Inflating the tire beyond 40 psi (2.8 bars) to seat the beads can cause the tire rim assembly to burst with force sufficient to cause personal injury. If the beads fail to seat to 40 psi (2.8 bars), deflate and relubricate the bead and rim and reinflate to seat the beads, but do not exceed 40 psi (2.8 bars).

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 2-16. 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 CHECKING CAST RIM RUNOUT on page 2-14. Replace rims not meeting specifications.
4. Install tire and check again for tire tread lateral runout.

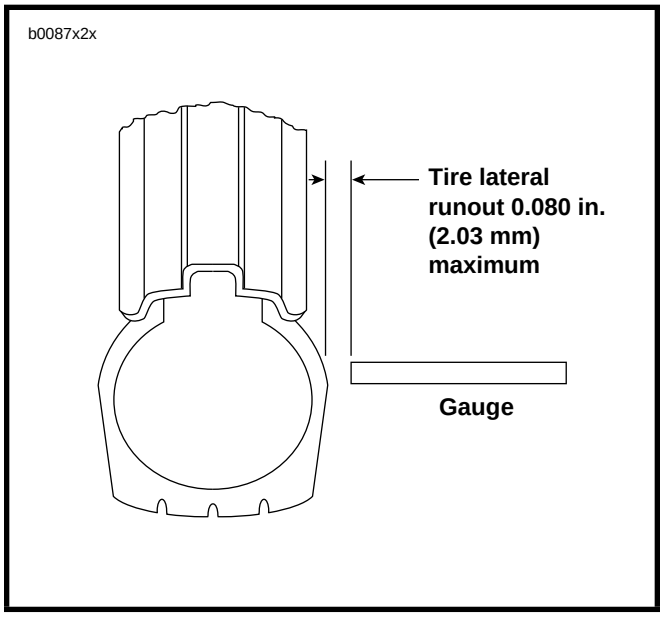


Figure 2-16. Checking Tire Lateral Runout

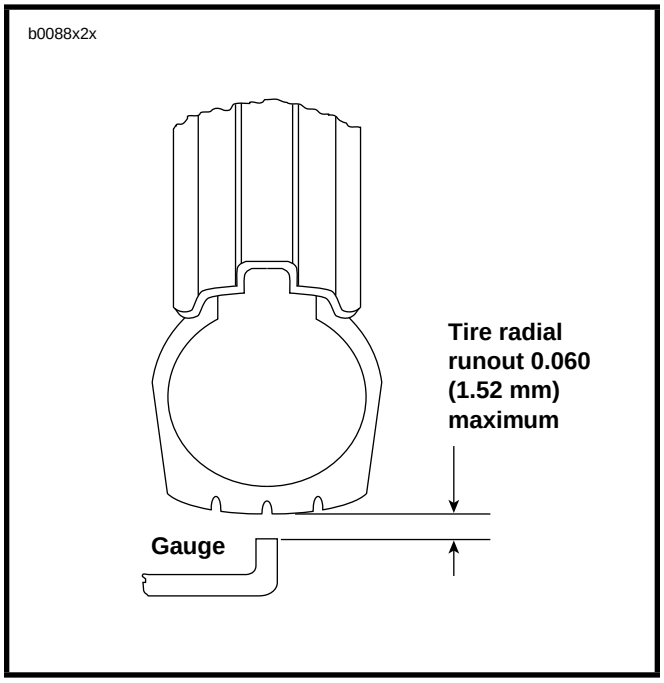


Figure 2-17. Checking Tire Radial Runout

Checking Tire Radial Runout

1. See Figure 2-17. 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 CHECKING CAST RIM RUNOUT on page 2-14. 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 best high-speed handling characteristics. Follow the instructions supplied with the balance machine you are using.

WEIGHTS FOR CAST WHEELS

Buell specifies WHEEL WEIGHTS (Part No. 43692-94Y) which have special self-adhesive backings.

The maximum weight permissible to accomplish balance is 1 oz. (28 g) (total weight applied to the rim). Wheels should be balanced to within 1/4 oz. (7 g) at 60 MPH (97 KM/H).

These weights are applied to the flat surface of the wheel rim according to the following procedures.

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. Place weight on flat surface of wheel rim. Press weight firmly in place and hold for ten seconds.

3. Allow eight hours for adhesive to cure completely before using wheel.

BRAKES

GENERAL

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 every 5000 miles (8000 km). See BRAKES in Section 1.

Check brake pads and rotors for wear every 2500 miles (4000 km). Replace brake pads if friction material is worn to 1/16 in. (1.6 mm) or less. Replace brake rotors not meeting minimum rotor thickness. See BRAKES in Section 1.

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 could result in improper and unsafe brake operation which may cause personal injury.**
- **Always test motorcycle brakes at low speed after servicing or bleeding system. To prevent personal injury, Buell recommends that all brake repairs be performed by a Buell dealer or other qualified mechanic.**
- **Exercise caution when handling brake fluid. Brake fluid can cause irritation of eyes and skin and may be harmful or fatal if swallowed. If swallowed, administer two tablespoons of salt in a glass of warm water to induce vomiting. Call a doctor immediately. 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.**

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.
Chattering sound when brake is applied.	Worn pads. Loose mounting bolts. Warped rotor.	Replace brake pads. Tighten bolts. Replace rotor.
Ineffective brake – lever/pedal travels to limit.	Low fluid level. Piston cup not functioning.	Fill master cylinder with approved brake fluid, and bleed system. Rebuild cylinder.
Ineffective brake – lever/pedal travel normal.	Distorted or glazed rotor. Distorted, glazed or contaminated brake pads.	Replace rotor. Replace pads.
Brake pads drag on rotor – will not retract.	Cup in master cylinder not uncovering relief port. Rear brake pedal linkage out of adjustment.	Inspect master cylinder. Adjust linkage.

FRONT BRAKE MASTER CYLINDER

REMOVAL

NOTE

The front master cylinder contains no user serviceable parts. Do not remove the master cylinder unless problems are being experienced. Replace the entire assembly when necessary.

1. Remove mirror mounting hardware (metric, left hand threads).
2. Open bleeder nipple cap on front caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake hand lever to drain brake fluid.
3. See Figure 2-18. Remove banjo bolt (6) (metric) and two gaskets (4) to disconnect brake line from master cylinder. Discard gaskets.
4. 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.

5. Remove two screws (1) (metric) and clamp to free master cylinder assembly from handlebar.

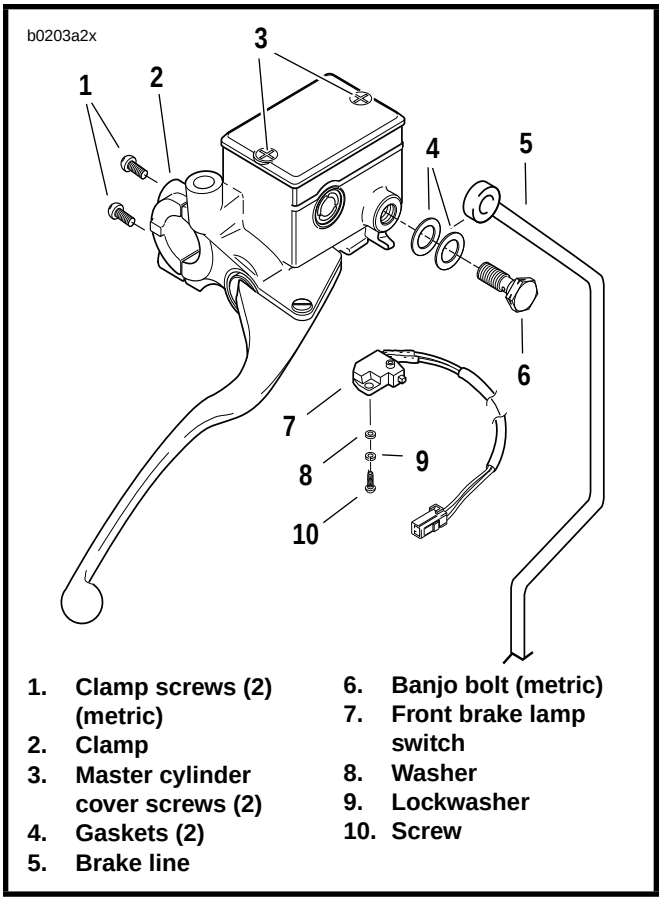
INSTALLATION

1. See Figure 2-18. Fasten master cylinder to handlebar by installing clamp (2) and screws (1) (metric). Tighten screws to 80-90 **in-lbs** (9.0-10.2 Nm).

⚠CAUTION

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

2. Place **new** gaskets on each side of the hydraulic brake line. Install banjo bolt through gaskets and brake line fitting into master cylinder. Tighten banjo bolt (6) (metric) to 17-20 ft-lbs (23.0-27.1 Nm).
3. Attach brake lamp switch (7) with screw (10), lockwasher (9) and washer (8).
4. Remove both master cylinder cover screws (3) and cover.
5. With the master cylinder in a level position, add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID. Bring fluid level to within 1/8 in. (3.2 mm) of molded boss inside front master cylinder reservoir.



1. **Clamp screws (2) (metric)**
2. **Clamp**
3. **Master cylinder cover screws (2)**
4. **Gaskets (2)**
5. **Brake line**
6. **Banjo bolt (metric)**
7. **Front brake lamp switch**
8. **Washer**
9. **Lockwasher**
10. **Screw**

Figure 2-18. Front Master Cylinder Banjo Bolt

⚠WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible personal 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. Install master cylinder cover screws (3) and cover. Tighten cover screws to 9-13 **in-lbs** (1.0-1.5 Nm).
8. Bleed brake system. See BRAKES in Section 1.
9. Install mirror parallel to handlebars. Mirror mount has metric, left hand threads.
10. Test brake lamp operation with the brake hand lever applied and the ignition/headlamp switch turned to IGN.

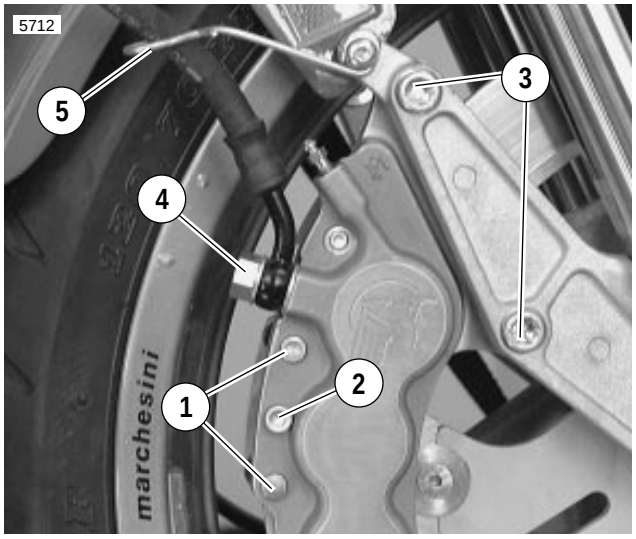
FRONT BRAKE CALIPER

REMOVAL/DISASSEMBLY

NOTE

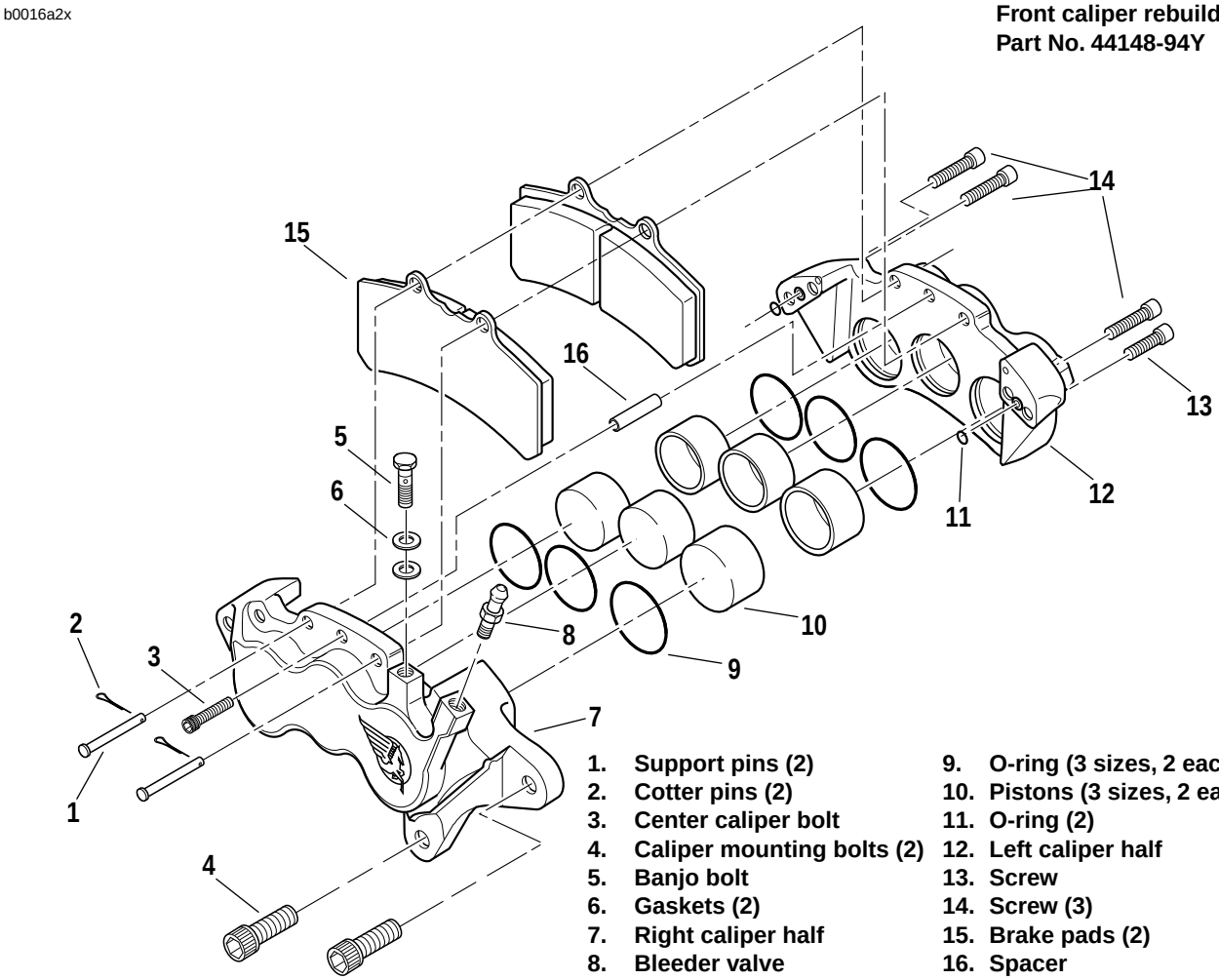
Step 1 (draining fluid) is not required for caliper removal. Drain brake fluid only when disassembling caliper.

1. See Figure 2-19. Remove banjo bolt (4) and gaskets to disconnect brake line from caliper. Drain brake fluid into a clean, suitable container. Discard gaskets.
2. Remove cotter and support pins (1).
3. Remove center caliper bolt (2) and spacer.
4. Remove brake pads from front brake caliper. Pads must be removed in order to remove caliper from rotor.
5. Remove both caliper mounting bolts (3).
6. Free caliper from front brake rotor.
7. Move caliper assembly to bench area.
8. See Figure 2-20. Remove screws (13, 14) to separate caliper halves (7, 12). Remove O-rings (11) and discard.



1. Cotter and support pins
2. Center caliper bolt
3. Caliper mounting bolts
4. Banjo bolt
5. Wire guide

Figure 2-19. Front Brake Caliper Mounts



1. Support pins (2)
2. Cotter pins (2)
3. Center caliper bolt
4. Caliper mounting bolts (2)
5. Banjo bolt
6. Gaskets (2)
7. Right caliper half
8. Bleeder valve
9. O-ring (3 sizes, 2 each)
10. Pistons (3 sizes, 2 each)
11. O-ring (2)
12. Left caliper half
13. Screw
14. Screw (3)
15. Brake pads (2)
16. Spacer

Figure 2-20. Front Brake Caliper

⚠WARNING

When using air pressure to remove pistons from caliper, pistons may be ejected with considerable force. Wear safety glasses, heavy gloves and hold caliper with heavy towel to prevent personal injury.

⚠CAUTION

Exercise care to avoid dropping piston on hard surface. Any damage requires piston replacement.

9. See Figure 2-21. Use BRAKE CALIPER PISTON REMOVER (Part No. B-42079) to remove caliper pistons.
10. See Figure 2-20. Pry O-rings (9) out of their respective grooves on each side of caliper. Discard O-rings.

CLEANING, INSPECTION AND REPAIR

⚠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 and unsafe brake operation which may cause personal injury.

1. Thoroughly clean brake system components using denatured alcohol. Blow dry using compressed air. Carefully inspect all components. Replace any parts that appear damaged or worn. Do not hone caliper piston bore.
2. Inspect brake rotor. Replace if warped or badly scored. Measure rotor thickness for excessive wear. Replace rotors less than 0.17 in. (4.3 mm) thick.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Never replace just one brake pad. Failure to install brake pads as a set may cause personal injury.

3. Inspect brake pads for damage or wear. Replace both pads as a set if the friction material of either pad is worn to 1/16 in. (1.6 mm) or less.

ASSEMBLY

1. See Figure 2-20. Install **new** O-rings (11) in groove of each caliper half (7, 12). Install **new** O-rings (9) in groove of piston bores.
2. Install pistons (10) in each caliper piston bore.
3. Tighten caliper halves together with four screws (13, 14). Smallest screw (13) is placed on top next to bleeder valve (8). Tighten screws to 26-28 ft-lbs (35.2-38.0 Nm).

INSTALLATION

1. Fit caliper on front brake rotor without brake pads.
2. See Figure 2-20. Tighten both caliper mounting bolts (4) to 30-33 ft-lbs (40.7-44.7 Nm).
3. Insert brake pads (15) from top.

Figure 2-21. Removing Brake Caliper Pistons Using Brake Caliper Piston Remover (Part No. B-42079)

4. Install center caliper bolt (3) and spacer (16). Tighten center caliper bolt to 11-13 ft-lbs (14.9-17.6 Nm).
5. Install two support pins (1) and **new** cotter pins (2).
6. Connect brake line to caliper using **new** gaskets. Tighten banjo bolt (5) to 16-20 ft-lbs (21.7-27.1 Nm).
7. 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. 5 SILICONE HYDRAULIC BRAKE FLUID if necessary.

⚠WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible personal injury.

8. Verify proper operation of the master cylinder relief port. Actuate the brake lever with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
9. Install cover gasket, cover and screws. Tighten screws to 9-13 **in-lbs** (1.0-1.5 Nm).
10. Depress front brake lever several times to set brake pads to proper operating position within caliper. Bleed brake system. See BRAKES in Section 1.
11. Test brake lamp operation with the brake hand lever applied and the ignition/headlamp switch turned to IGN.

NOTE

*To allow **new** brake pads to "wear in" properly with the brake rotor, avoid making hard stops for the first 100 miles (160 km).*

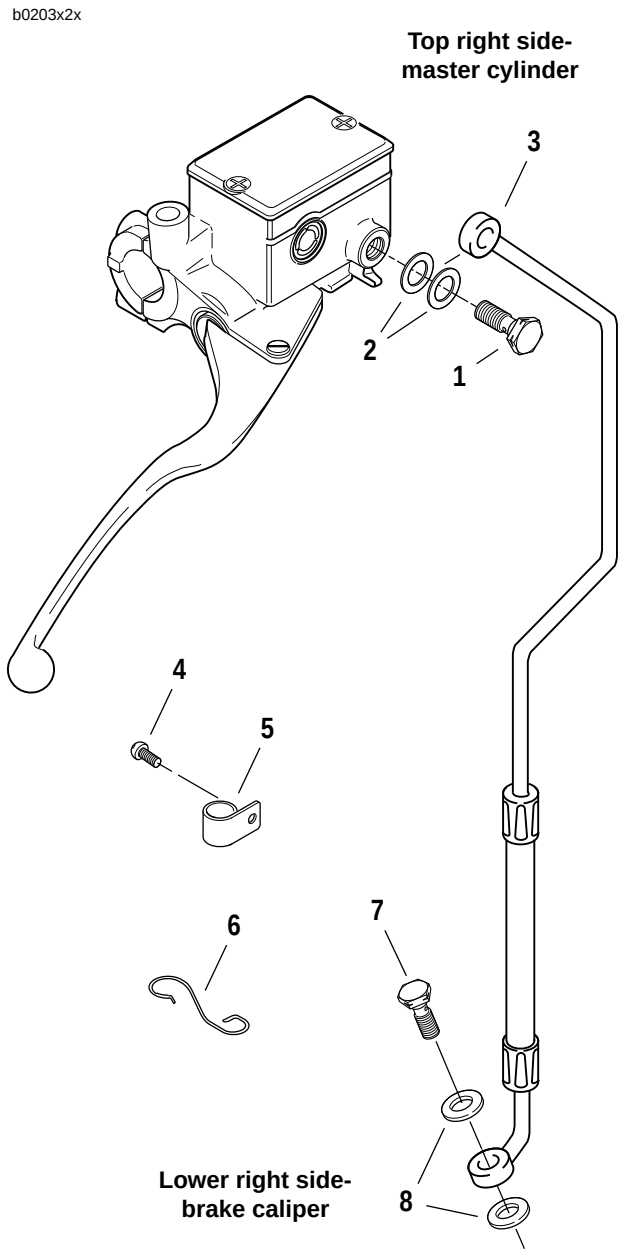
FRONT BRAKE LINE

REMOVAL

1. Open bleeder nipple cap on front brake caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake hand lever to drain brake fluid.
2. See Figure 2-22. Remove screw (4) to detach brake line clamp (5) from lower triple clamp (right side).
3. Slide brake line out of wire guide (6) on front fender.
4. Remove master cylinder banjo bolt (1) (metric) and two gaskets (2) to detach brake line from master cylinder body. Discard gaskets.
5. Remove caliper banjo bolt (7) and two gaskets (8) to detach brake line from front brake caliper. Discard gaskets.
6. Carefully inspect the brake line for dents, cuts or other defects. Replace the brake line if any damage is noted.

INSTALLATION

1. See Figure 2-22. Position **new** master cylinder gaskets (2) on each side of the banjo fitting. Insert banjo bolt (1) (metric) through gaskets and banjo fitting. Loosely install bolt into master cylinder.
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 (5), and screw (4) to attach front brake line to right side of lower triple clamp.
3. Place brake line inside wire guide (6) on front fender.
4. Position **new** gaskets (8) on each side of banjo fitting at free end of brake line. Insert caliper banjo bolt (7) through gaskets. Loosely install bolt into caliper.
5. Tighten clamp screw (4) on lower triple clamp to 30-35 **in-lbs** (3.4-4.0 Nm).
6. Tighten master cylinder banjo bolt (1) (metric) to 17-20 ft-lbs (23.0-27.1 Nm).
7. Tighten brake caliper banjo bolt (7) to 16-20 ft-lbs (21.7-27.1 Nm).
8. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See BRAKES in Section 1.
9. Test operation of brake lever.
10. Tighten front bleeder valve to 4-6 ft-lbs (5.4-8.1 Nm). Install bleeder cap.
11. Test brake lamp operation with the brake hand lever applied and ignition/headlamp switch turned to IGN.



1.	**Master cylinder banjo bolt (metric)**	**4.**	**Screw**
		5.	**Clamp**
2.	**Master cylinder gasket (2)**	**6.**	**Wire guide**
		7.	**Caliper banjo bolt**
3.	**Brake line**	**8.**	**Caliper gasket (2)**

Figure 2-22. Front Brake Line

REAR BRAKE MASTER CYLINDER

ADJUSTMENT

Brake Pedal

1. See Figure 2-23. Brake pedal must have 1/8 in. (3.2 mm) pushrod freeplay. If adjustment is necessary, hold pushrod (1) and loosen locknut (2) (metric).
2. Rotate pushrod to increase or decrease freeplay.
3. Tighten locknut.

NOTE

If you alter pedal height, always check pushrod freeplay.

REMOVAL/DISASSEMBLY

NOTE

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

1. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve (metric) about 1/2-turn. Pump brake pedal to drain brake fluid.
2. See Figure 2-23. Remove screw and locknut (3) to detach male end of push rod (4) from brake pedal. Remove push rod.

⚠CAUTION

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

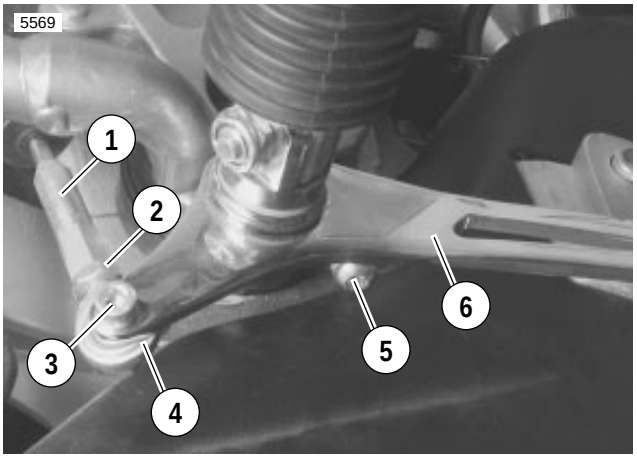
3. See Figure 2-24. Remove banjo bolt (metric) (3) and two gaskets (4) from rear master cylinder. Discard gaskets.
4. Remove two screws and locknuts (5) holding the rear brake master cylinder to frame.
5. Remove reservoir hose clamp from rear master cylinder.
6. Remove screw on reservoir assembly.

CLEANING, INSPECTION AND REPAIR

⚠WARNING

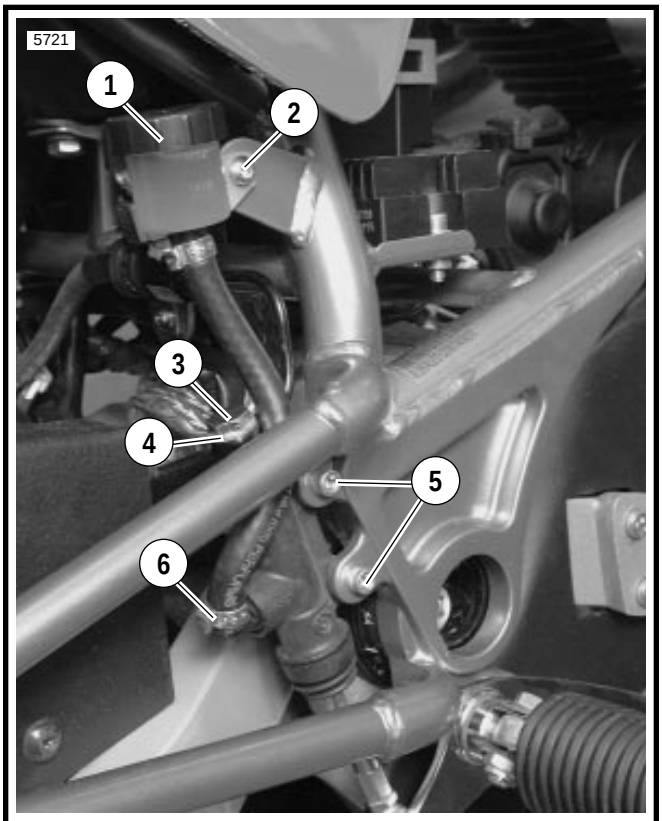
Clean brake system components using denatured alcohol. Do not use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly. This could result in improper and unsafe brake operation which may cause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

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



1. **Pushrod**
2. **Locknut (metric)**
3. **Screw and locknut**
4. **Male end of pushrod**
5. **Pedal height adjustment screw**
6. **Brake pedal**

Figure 2-23. Brake Pedal



1. **Master cylinder reservoir**
2. **Screw**
3. **Banjo bolt (metric)**
4. **Gaskets (2)**
5. **Screws and locknuts**
6. **Hose clamp**

Figure 2-24. Rear Master Cylinder

ASSEMBLY/INSTALLATION

1. See Figure 2-24. Mount reservoir assembly on frame with screw. Tighten screw to 12-15 **in-lbs** (1.4-1.7 Nm). Clamp reservoir hose to rear master cylinder with a **new** clamp and HOSE CLAMP PLIERS (Part No. HD-41137).

2. Attach rear master cylinder to frame with two screws and locknuts. Tighten to 8-10 ft-lbs (10.8-13.6 Nm).

⚠CAUTION

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

3. Position **new** gaskets on each side of rear brake line at master cylinder. Insert banjo bolt (metric) through gaskets and brake line. Thread banjo bolt (metric) into rear brake master cylinder and tighten to 10-12 ft-lbs (13.6-16.2 Nm).

4. See Figure 2-23. Place push rod into rear master cylinder. Install male rod end behind brake pedal with screw and locknut. Tighten screw to 10-12 ft-lbs (13.6-16.2 Nm).

5. Adjust brake pedal freeplay.

6. See Figure 2-25. With the master cylinder in a level position, check that the brake fluid level is between the upper and lower marks on reservoir. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID if necessary. Be sure cap is securely screwed on.

⚠WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible personal injury.

7. Bleed brake system. See BRAKES in Section 1.

8. Test brake lamp operation with the rear brake pedal applied and the ignition/headlamp switch turned to IGN.

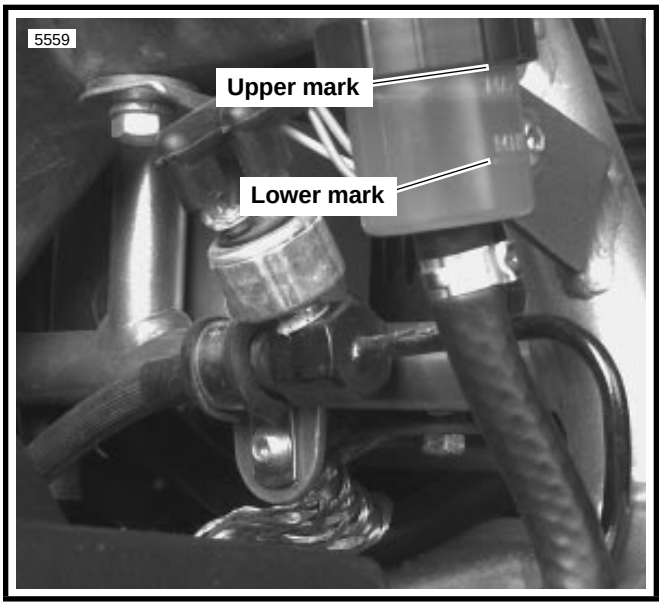


Figure 2-25. Proper Rear Brake Fluid Level

REAR BRAKE CALIPER

REMOVAL/DISASSEMBLY

NOTE

Step 1 (draining fluid) is not required for caliper removal. Drain brake fluid only when disassembling caliper.

1. See Figure 2-26. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve (2), while placing free end in a suitable container. Open bleeder valve (metric) about 1/2-turn. Pump brake pedal to drain brake fluid.
2. Remove both caliper mounting screws (11) (metric) and washers (10) to free caliper from caliper mount.
3. Pump brake pedal until piston reaches its full travel. Remove banjo bolt (1) (metric) and two gaskets (3) to disconnect brake line from caliper. Discard gaskets.
4. Remove slave pad from rear pad bracket (9).
5. Remove rear pad bracket and dust boots (12, 13) from rear caliper assembly (4).
6. Remove master brake pad (7) from piston (6).

NOTE

Do not remove piston from caliper unless there are signs of hydraulic fluid leakage or piston is not operating properly. If piston must be removed, proceed to Step 7.

⚠WARNING

When using air pressure to remove piston from caliper, piston may be ejected with considerable force. Wear safety glasses, heavy gloves and hold caliper with heavy towel to prevent personal injury.

⚠CAUTION

Exercise care to avoid dropping piston on hard surface. Any damage requires piston replacement.

7. Hold caliper with piston facing downward. Place a clean shop towel under piston. Apply low air pressure to hydraulic brake line inlet hole until piston is forced out caliper bore. If piston is tight in bore, tap lightly around caliper while applying air pressure.
8. Remove and discard O-ring (5) from groove within piston bore.

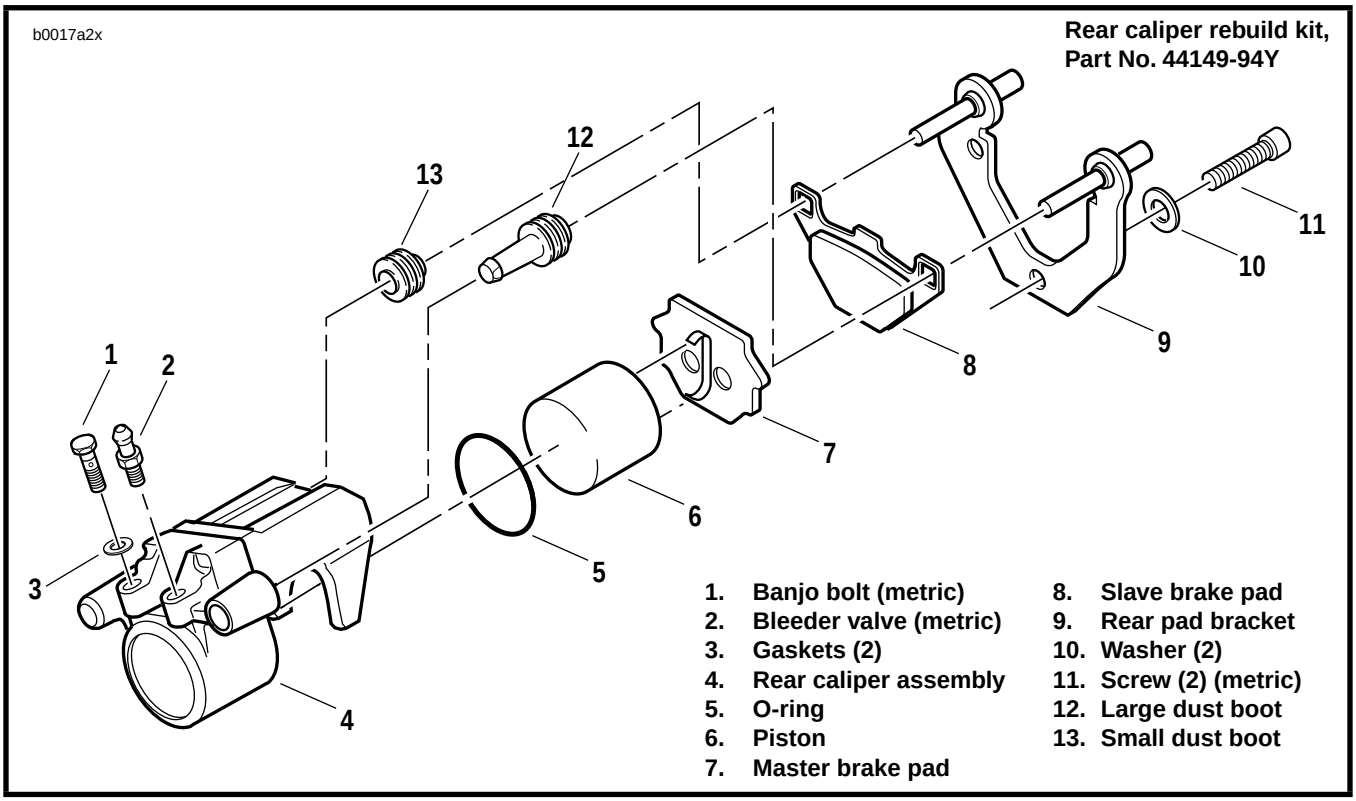


Figure 2-26. Rear Brake Pads and Caliper

CLEANING, INSPECTION AND REPAIR

⚠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 and unsafe brake operation which may cause personal injury.

1. Clean brake system components using denatured alcohol. Blow dry using compressed air. Carefully inspect all components. Replace any parts that appear damaged or worn. Replace rubber dust boots (12, 13) if damaged or worn. Do not hone caliper piston bore.
2. Inspect brake rotor. Replace rotor if warped or badly scored. Measure rotor thickness for excessive wear. Replace rotors less than 0.19 in. (4.8 mm) thick.

⚠WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Never replace just one brake pad. Failure to install brake pads as a set may cause personal injury.

3. Inspect brake pads for damage or excessive wear. Replace both pads as a set if friction material of either pad is worn to 1/16 in. (1.6 mm) or less.

ASSEMBLY

1. See Figure 2-26. Install **new** O-ring (5) within groove in piston bore of rear caliper assembly (4).
2. Apply light coat of D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID to piston OD, including chamfer. Apply a light coat to caliper piston bore (6) and ID of installed piston O-ring (5). Install piston into caliper piston bore. Use a “C” clamp to press in piston, if necessary.

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.*

3. Install master brake pad (7) on piston (6).
4. Install dust boots (12, 13) and rear pad bracket (9) into rear caliper assembly.
5. Install slave brake pad (8).

INSTALLATION

1. With friction material facing brake rotor, align rear caliper assembly on mounting bracket.
2. See Figure 2-26. Install washers and screws (metric) to fasten rear caliper assembly to mounting bracket. Tighten screws to 18-22 ft-lbs (24.4-29.8 Nm).
3. Install bleeder valve (metric) if removed. Tighten valve to 6-9 ft-lbs (8.1-12.2 Nm). Install bleeder cap.
4. Position **new** gaskets on each side of banjo fitting. Insert banjo bolt (metric) through gaskets and banjo fitting into caliper. Tighten banjo bolt (metric) to 9.5-12.5 ft-lbs (12.9-17.0 Nm).
5. With the master cylinder in a level position, check that the brake fluid level is between the upper and lower marks on reservoir. See Figure 2-25. Add D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID if necessary. Be sure cap is securely screwed on.

⚠WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible personal injury.

6. Depress rear brake pedal several times to set brake pads to proper operating position within caliper. Bleed brake system. See BRAKES in Section 1.
7. Verify proper reservoir fluid level as described in Step 5.
8. Test brake lamp operation with the rear brake pedal applied and the ignition/headlamp switch turned to IGN.

NOTE

*To allow **new** brake pads to “wear in” properly with the brake rotor, avoid making hard stops for the first 100 miles (160 km).*

REAR BRAKE LINE AND SWITCH

REMOVAL

1. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve (metric) about 1/2-turn. Pump rear brake pedal to drain brake fluid.

2. See Figure 2-27. Remove banjo bolt (metric) and two gaskets to detach brake line from rear brake caliper. Discard gaskets.

3. See Figure 2-28. Remove banjo bolt (metric) and two gaskets to detach brake line from rear master cylinder. Discard gaskets.

4. See Figure 2-29. Remove screw and clamp to detach brake line clamp from frame.

5. Remove brake line from clamp under oil tank.

6. Pull terminal sockets from spade connections at top of brake lamp switch. Unthread switch from tee nut.

INSTALLATION

1. See Figure 2-29. Coat brake lamp switch threads with LOCTITE PIPE SEALANT WITH TEFLON. Thread brake lamp switch to tee nut of brake line. Tighten switch assembly to 7-8 ft-lbs (9.5-10.8 Nm). Install terminal sockets on switch spade connections.

2. From left side of vehicle, feed **new** brake line from rear brake caliper mount forward to frame mount. Thread brake line right to rear master cylinder.

3. Install screw and clamp to secure rear brake line to frame. Tighten clamp screw to 10-12 ft-lbs (13.6-16.2 Nm).

4. Attach brake line to clamp under oil tank.

5. See Figure 2-28. Position **new** gaskets on each side of master cylinder banjo fitting. Insert banjo bolt (metric) through gaskets and banjo fitting. Thread bolt into master cylinder and tighten to 10-12 ft-lbs (13.6-16.2 Nm).

6. See Figure 2-27. Position **new** gaskets on each side of caliper banjo fitting. Insert banjo bolt (metric) through gaskets and banjo fitting into caliper. Tighten banjo bolt to 9.5-12.5 ft-lbs (12.9-17.0 Nm). Install bleeder valve if removed. Refill master cylinder and bleed brakes. See BRAKES in Section 1.

7. Tighten bleeder valve (metric) to 6-9 ft-lbs (8.1-12.2 Nm). Install bleeder cap.

8. Test brake lamp operation with the rear brake pedal applied and the ignition/headlamp switch turned to IGN.

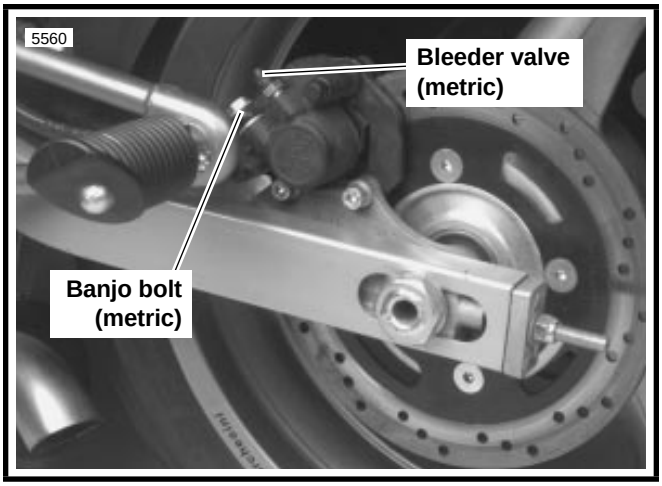


Figure 2-27. Rear Brake Caliper Banjo Bolt

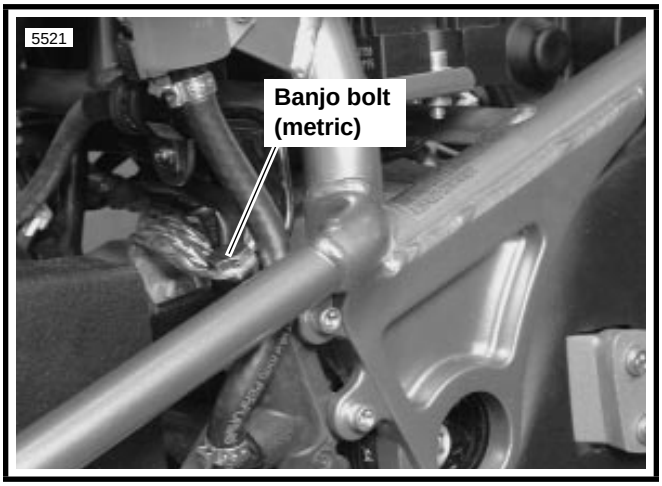


Figure 2-28. Rear Master Cylinder Banjo Bolt

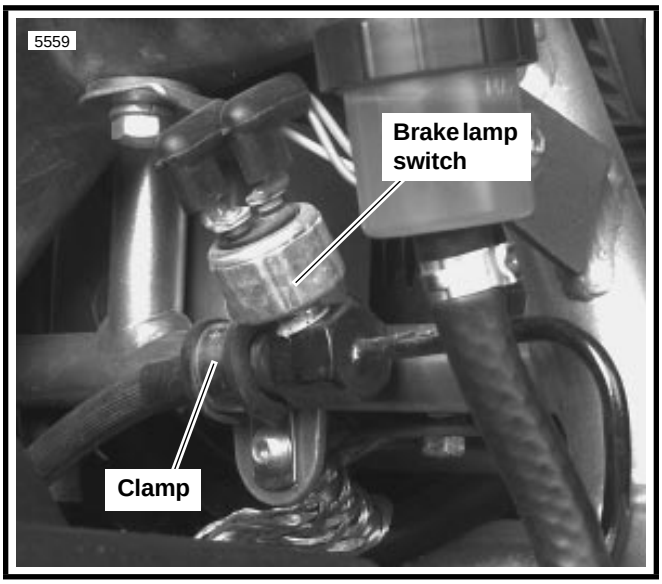


Figure 2-29. Brake Line and Switch

FRONT FORK

GENERAL

The front fork consists of two telescoping outer tube/inner slider assemblies. Each tube/slider assembly has an internal compression spring which supports the forward weight of the vehicle/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 FRONT FORK in Section 1 for fork oil change procedure.

REMOVAL

1. Raise front wheel off floor using FRONT WHEEL SUPPORT STAND (Part No. B-41395) and S1 LIFT ADAPTER (Part No. B-41686).
2. Remove front brake caliper. See FRONT BRAKE CALIPER, REMOVAL/DISASSEMBLY on page 2-20.
3. Remove front wheel. See FRONT WHEEL, REMOVAL on page 2-8.
4. Remove front fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.
5. Loosen left and right headlamp brackets. See HEADLAMP, REMOVAL in Section 7.
6. Loosen all five pinch screws on both the upper and lower triple clamps.
7. Remove front forks.

DISASSEMBLY

1. See Figure 2-30. Clamp the fork vertically in a vise using FRONT FORK HOLDING TOOL (Part No. B-41177).
2. See Figure 2-31. Turn adjuster to full slow position (completely clockwise).
3. See Figure 2-32. Remove fork cap (2) (metric), O-ring (3) and washer (4).
4. Reduce spring pressure and remove both retaining clips (5).
5. Remove preload shim(s) (6) and steel washer (7).
6. Remove fork spring (8).
7. Invert fork and drain fork oil.
8. Clamp fork outer tube (9) horizontally using FRONT FORK HOLDING TOOL (Part No. B-41177). Loosen fork seal retaining ring (14) and spacer ring (13).
9. Using ROBINAIR HEAT GUN (Part No. HD-25070) heat bottom of outer tube. When the tube has sufficiently expanded, drive inner tube (18) from outer tube with a slide hammer action. Inner tube will retain fork oil seal (12) and support ring (11) in place.
10. Spread red retaining cap (15) and remove. Remove upper DU bushing (16) and washer (17).
11. Remove retaining ring (14) and spacer ring (13).

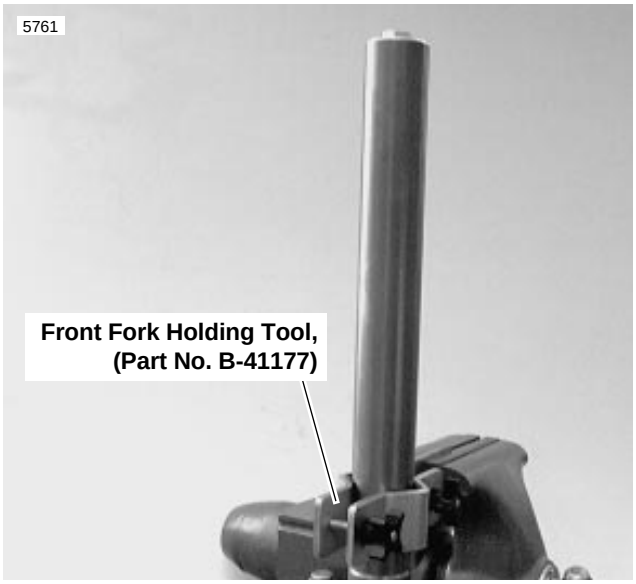


Figure 2-30. Front Fork Holding Tool

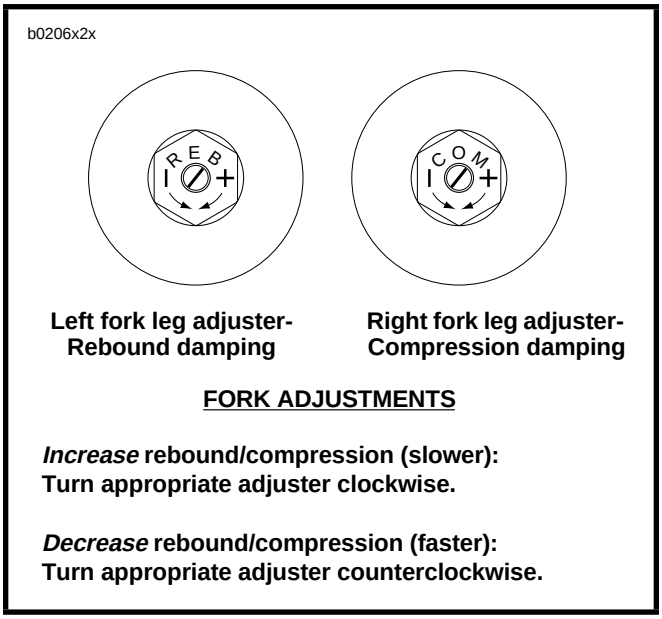


Figure 2-31. Fork Adjusters

12. Remove lower DU bushing (10), support ring (11) and fork oil seal (12). Discard fork oil seal and support ring.
13. Invert fork. Hold damper assembly and remove bolt (20) (metric) and copper washer (19). Discard copper washer.
14. Remove damper assembly (22).

NOTE

The damper assembly (22) contains no user serviceable parts.

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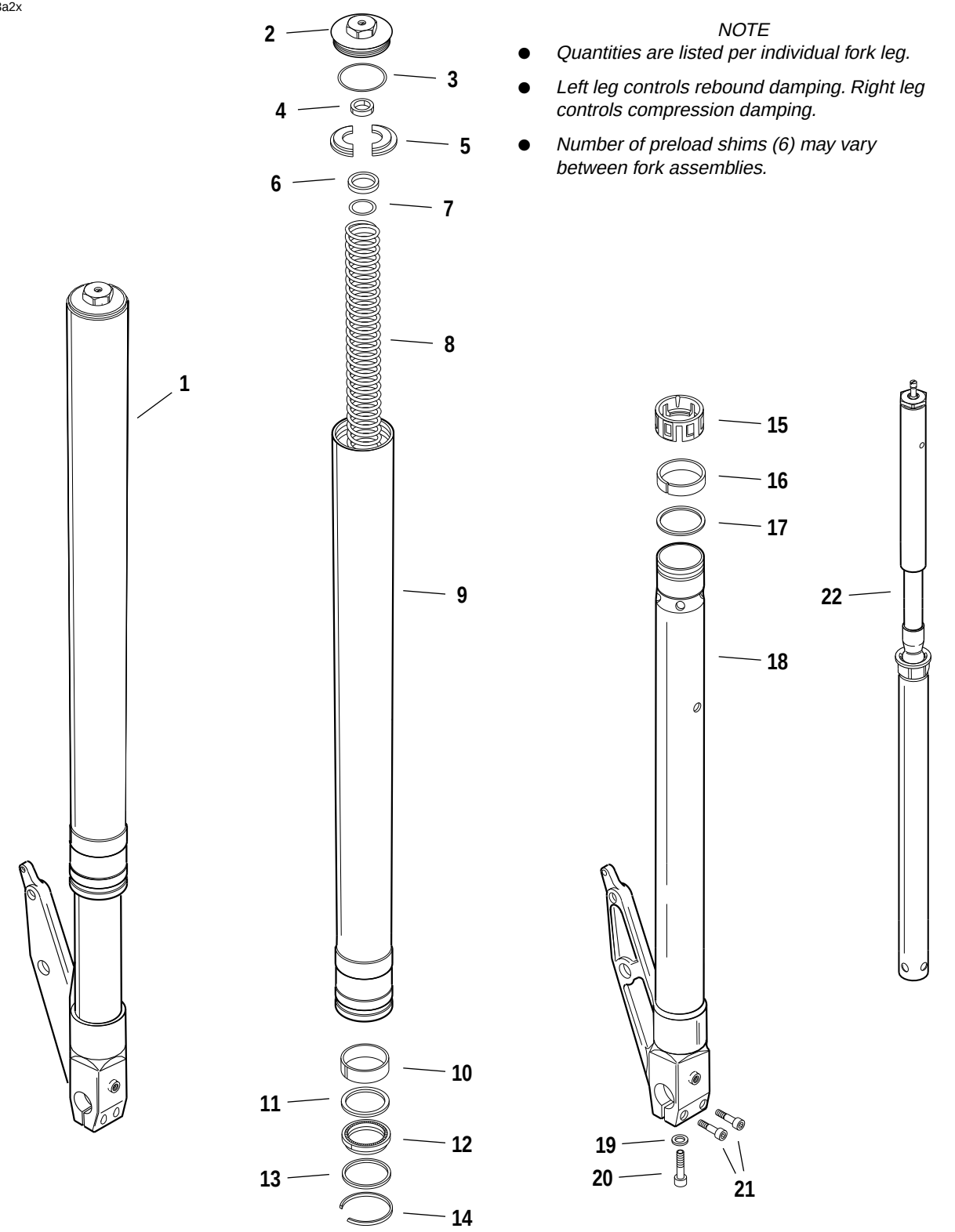


NOTE

- *Quantities are listed per individual fork leg.*
- *Left leg controls rebound damping. Right leg controls compression damping.*
- *Number of preload shims (6) may vary between fork assemblies.*

1. Front fork assembly
2. Fork cap
3. O-ring
4. Washer
5. Retaining clip (2)
6. Preload shim
7. Steel washer
8. Spring
9. Outer tube
10. DU bushing (lower)
11. Support ring
12. Fork oil seal
13. Spacer ring
14. Retaining ring
15. Retaining cap (red)
16. DU bushing (upper)
17. Washer
18. Inner tube
19. Copper washer
20. Bolt (metric)
21. Bolt (2) (metric)
22. Damper assembly

Figure 2-32. Front Forks

CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.
2. Inspect the O-rings for damage, wear or general deterioration; replace as necessary. Replace all other removed seals.
3. See Figure 2-32. Check inner tube (18). Tube surface should be shiny, smooth and free of scoring or abrasions.

ASSEMBLY

1. Install **new** fork seal retaining ring (14) and spacer ring (13) on inner tube.
2. See Figure 2-33. Using FRONT FORK BUSHING/SEAL INSTALLER (Part No. B-41176), install **new** fork oil seal on inner tube. External spring on fork oil seal faces bottom of fork leg.
3. See Figure 2-32. Install **new** support ring (11).
4. Install upper DU bushing (16) with large end towards the bottom of the fork leg. Install washer (17) and lower DU bushing (10). Install red retaining cap (15).

NOTE

Inspect both DU bushings upon assembly. Bushings are bronze with a Teflon layer. A DU bushing should be replaced when 20-30% of the Teflon layer has been worn through. In this circumstance, a visual inspection will show 20-30% of the bronze base. Also replace bushings if bushing interiors show any small grooves. Such grooves will damage the outside surface of the inner tubes.

5. Clamp outer tube (9) upside down using FRONT FORK HOLDING TOOL (Part No. B-41177).
6. See Figure 2-34. Place inner tube assembly inside outer tube. Using **bushing** side of FRONT FORK BUSHING/SEAL INSTALLER (Part No. B-41176), drive in DU bushings until fully seated.
7. Reverse FRONT FORK BUSHING/SEAL INSTALLER. (Part No. B-41176). Seat fork oil seal with **seal** side of tool. Drop seal retaining ring in place. Fully seat retaining ring.
8. See Figure 2-32. Clamp fork in a horizontal position. Install damper assembly (22) using bolt (20) (metric) and a **new** copper washer (19). Tighten bolt to 18-23 ft-lbs (24.4-31.2 Nm).
9. Clamp fork upright in the fully compressed stage.
10. Fill fork with oil. See FRONT FORK in Section 1.
11. Install fork spring (8).
12. Pull damper assembly above fork spring. Place steel washer (7) and preload shim(s) (6) on top of spring.
13. Installing the retaining clips (5) requires two people. Have one person compress the spring, steel washer and preload shim(s). At the same time, have the second person install both retaining clips.
14. Install washer (4), **new** O-ring (3) and fork cap (2) (metric).

Figure 2-33. Installing New Fork Seal Using Front Fork Bushing/Seal Installer (Part No. B-41176)

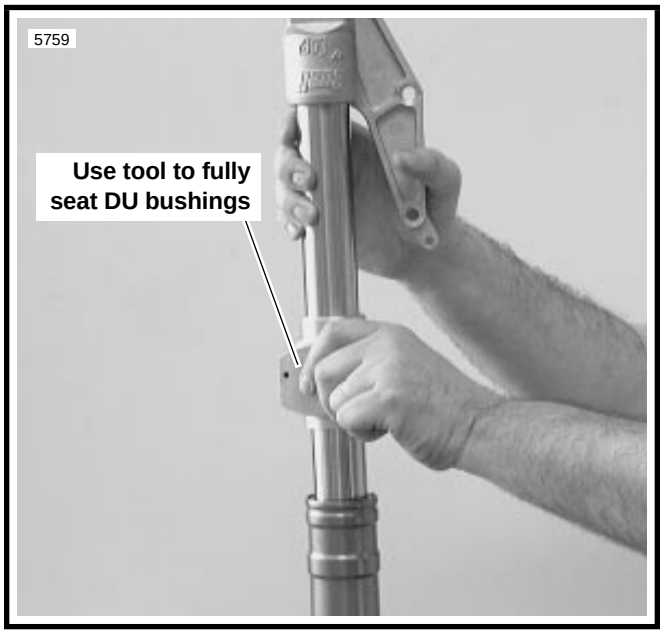


Figure 2-34. Installing Bushings and Seals Using Front Fork Bushing/Seal Installer (Part No. B-41176)

INSTALLATION

1. Insert fork assembly through front fork triple clamps and headlamp brackets.

NOTE

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

2. See Figure 2-35. Position fork tubes so that top of each fork cap fits flush with the top surface of upper triple clamp.

3. Spread LOCTITE ANTI-SEIZE on the last three threads of all five front fork triple clamp pinch screws. Tighten screws to 18-20 ft-lbs (24.4-27.1 Nm).

4. Position headlamp bracket 2.375 in. (60.3 mm) above lower triple clamp. Tighten headlamp bracket screws.

5. Install front fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.

6. Install front wheel. See FRONT WHEEL, INSTALLATION on page 2-10.

7. Install front brake caliper. See FRONT BRAKE CALIPER, INSTALLATION on page 2-21.

8. Set rebound and compression adjusters to the desired settings.

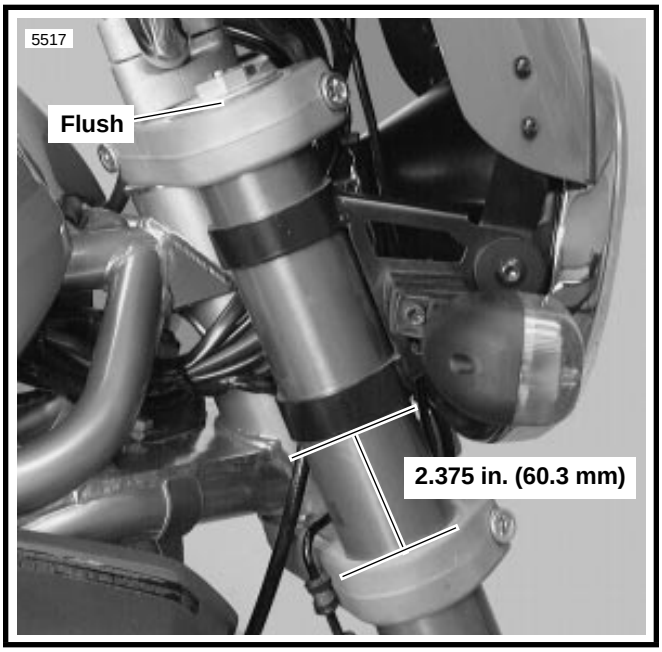


Figure 2-35. Aligning Front Forks

FORK STEM AND BRACKET ASSEMBLY

REMOVAL/DISASSEMBLY

1. Remove fork assemblies. See FRONT FORK, REMOVAL on page 2-28.
2. See Figure 2-36. Remove fork stem bolt (1) and upper triple clamp (2).
3. Remove upper dust shield (3) and upper roller bearing (4).
4. Lower the lower triple clamp (6). The lower bearing cone is a press fit on fork stem. Chisel through outer bearing cage to allow rollers to fall free. Apply heat to remove the remaining portion of bearing cone. Continuously move flame around its entire circumference until bearing falls free. Remove lower dust shield (3).
5. 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).

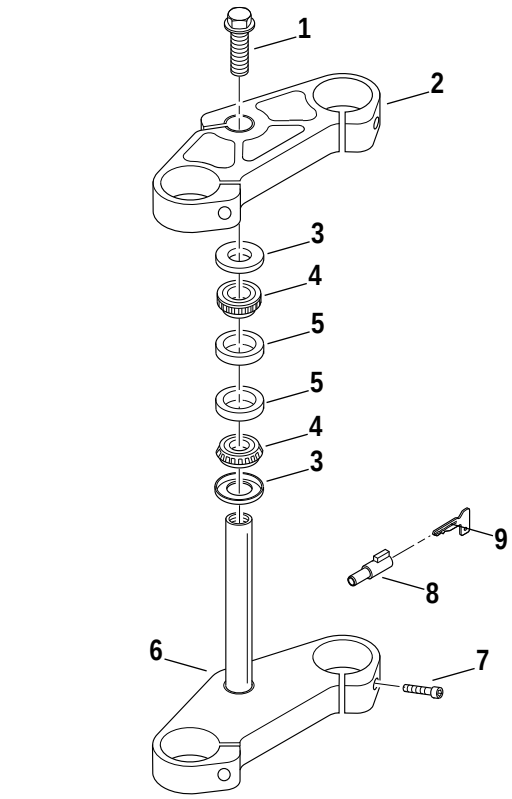
CLEANING, INSPECTION AND REPAIR

See FRONT FORK in Section 1 for adjustment procedures.

1. See Figure 2-36. 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 bearing as a set.
3. Check the fork stem and lower triple clamp (6) for damage. Replace damaged fork stem.

ASSEMBLY/INSTALLATION

1. See Figure 2-36. 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. Place lower bearing dust shield (3) over fork stem. Find a section of pipe having an inside diameter slightly larger than the outside diameter of the fork stem. Press bearing cone (4) onto fork stem and bracket (1) using the pipe as a press on tool.
4. Insert lower triple clamp (6) through the steering head. Install the upper bracket bearing (4) and dust shield (3) onto fork stem.



1.	**Fork stem bolt**	**6.**	**Lower triple clamp**
2.	**Upper triple clamp**	**7.**	**Screw (5)**
3.	**Dust shield (2)**	**8.**	**Steering head lock**
4.	**Roller bearing (2)**	**9.**	**Steering lock key**
5.	**Bearing cup (2)**		

Figure 2-36. Bearing Cup Removal

5. Install the upper triple clamp (2) and loosely install fork stem bolt (11).
6. Install fork assemblies. See FRONT FORK, INSTALLATION on page 2-31.
7. Tighten the fork stem bolt (1) until the bearings have no freeplay. Make sure the fork stem turns freely, then tighten the fork stem clamp screw (rearmost pinch screw on upper triple clamp).
8. Check bearing adjustment. See FRONT FORK, ADJUSTMENT in Section 1.

SWINGARM

REMOVAL

NOTE

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

1. Swingarm removal requires motorcycle to be supported in several areas. First, secure front wheel and then raise rear wheel off ground with REAR WHEEL SUPPORT STAND (Part No. B-41174).

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

⚠CAUTION

Hold battery cable when loosening battery terminal hardware. Failure to hold cable may cause battery damage.

2. Disconnect **both** battery cables, negative cable first.
3. Remove seat, fuel tank and tail section. See TAIL SECTION, REMOVAL on page 2-55.
4. Drain oil tank and remove filter. Detach feed, vent and return hoses from oil tank. See ENGINE LUBRICATION SYSTEM in Section 1.
5. Support motorcycle frame with a floor hoist such as the CENTRAL HYDRAULICS FOLDING CRANE (Model T-5466).
6. Remove rear fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.
7. Remove rear brake caliper assembly from swingarm. See REAR BRAKE CALIPER, REMOVAL/DISASSEMBLY on page 2-25.
8. Remove rear wheel. See REAR WHEEL, REMOVAL on page 2-11.
9. Remove rear shock. See REAR SHOCK ABSORBER, REMOVAL on page 2-36.
10. Remove rider footrests. See FOOTRESTS, REMOVAL on page 2-52.
11. Remove air cleaner assembly. See AIR CLEANER, REMOVAL in Section 4.
12. Remove carburetor. See CARBURETOR, REMOVAL in Section 4.
13. Remove muffler and exhaust header. See EXHAUST SYSTEM, REMOVAL/DISASSEMBLY on page 2-50.
14. Support engine under crankcase. Avoid pushing tie bar assembly upward.
15. Place a crating strap between the engine cylinders and around the lift. Tighten crating strap until snug.
16. Detach tie bars from frame mounts in the following sequence. Do not remove tie bars from engine.
    a. Rear tie bar. Use a swivel socket.
    b. Top tie bar.
    c. Front tie bar and clutch cable clamp.
17. See Figure 2-37. Remove isolator screws (9) and washers on each side.
18. Slowly raise floor hoist until rubber isolators (10) can be removed. Frame will rise while engine and swingarm remain secured to lift by crating strap.
19. Loosen one pinch screw (8) on the swingarm mount block (7).
20. Remove bearing adjusting bolt (1) on that side with PIVOT SHAFT BEARING ADJUSTER (Part No. B-41175).
21. Loosen the remaining pinch screw. Extract pivot shaft (5) and second adjuster as an assembly.
22. Remove swingarm.

DISASSEMBLY

⚠CAUTION

Carefully mark all bearing components as they are removed, so that they may be returned to their original locations. Do not intermix bearing components.

1. See Figure 2-37. Remove and discard swingarm seal (2).
2. Remove roller bearings (3).

NOTE

Remove roller bearing cups (4) only if replacement is required. The complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.

3. See Figure 2-38. Carefully press roller bearing cups (4) from swingarm using STEERING HEAD BEARING RACE REMOVER (Part No. HD-39301A) and UNIVERSAL DRIVER HANDLE (Part No. HD-33416).

CLEANING/INSPECTION

1. Clean all components in solvent and blow dry. Carefully inspect all bearing components for wear and/or corrosion. Replace complete bearing assembly if any component is damaged.
2. Check that swingarm is not bent or twisted. Replace if damaged.

ASSEMBLY

1. See Figure 2-39. If necessary, draw **new** roller bearing cups (4) into swingarm using BEARING INSTALLATION BOLT (Part No. B-35316-5) and STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302).

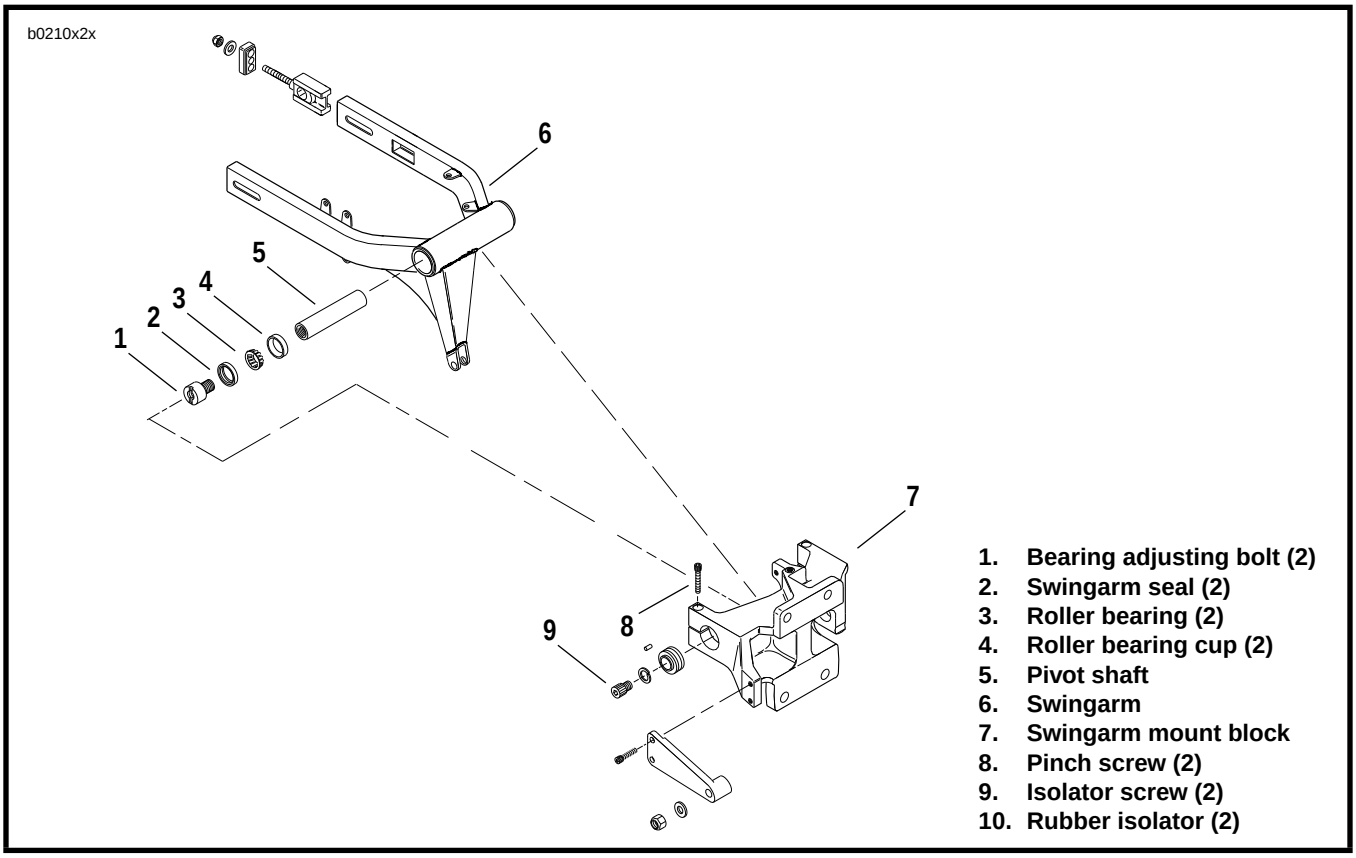


Figure 2-37. Swingarm Assembly and Swingarm Mount Block

NOTE

Timkin roller bearing assemblies should be replaced as a unit. Do not intermix components. Mark all components so they may be correctly installed.

2. Coat bearing components with WHEEL BEARING GREASE (Part No. HD-99855-89) and assemble.

⚠CAUTION

Pivot shaft (5) must be installed between inner races (3) or bearing failure can result.

3. Install a **new** swingarm seal (2) flush to the swingarm.
4. Apply LOCTITE ANTI-SEIZE LUBRICANT to pivot shaft threads.
5. Install one bearing adjustment bolt (1) into pivot shaft (5). Bottom out the adjustment bolt.
6. Slide swingarm assembly into position.
7. Slide pivot shaft assembly through mount block and swingarm. Install the opposing bearing adjustment bolt (1) using PIVOT SHAFT BEARING ADJUSTER (Part No. B-41175).
8. Tighten one pinch screw (8) into swingarm mount block. Do not tighten the other pinch screw (8) at this time.

INSTALLATION

1. Adjust swingarm preload. Using a scale as shown in Figure 2-40. Preload should measure 3.5-5.5 lbs (1.6-2.5 kg).
2. Remove both pinch screws (8). Apply LOCTITE THREADLOCKER 242 (blue) to pinch screw threads.
3. Check that swingarm is centered between mounts. Torque pinch screws (8) to 27-30 ft-lbs (36.6-40.7 Nm).
4. Install rubber isolators and bolts. See SECONDARY DRIVE BELT in Section 6.
5. Attach tie bars to the frame in the following order. Torque to 30-33 ft-lbs (40.7-44.7 Nm)
   a. Front tie bar. Clutch cable clamp holds cable on air cleaner side of motor.
   b. Top tie bar.
   c. Rear tie bar. Tie bar must be horizontal and below frame tab.
6. Install carburetor. See CARBURETOR, INSTALLATION in Section 4.
7. Install muffler and exhaust header. See EXHAUST SYSTEM, ASSEMBLY/INSTALLATION on page 2-50.
8. Install air cleaner. See AIR CLEANER, INSTALLATION in Section 4.

Figure 2-38. Removing Roller Bearing Cups

Figure 2-39. Installing Bearings into Swingarm

9. Install rear shock. See REAR SHOCK ABSORBER, INSTALLATION on page 2-37.
10. Install rear brake caliper assembly. See REAR BRAKE CALIPER, INSTALLATION on page 2-26.
11. Install rear wheel. See REAR WHEEL, INSTALLATION on page 2-13.
12. Install rider footrests. See FOOTRESTS, INSTALLATION on page 2-52.
13. Install rear fender. See FENDERS, REMOVAL/INSTALLATION on page 2-54.
14. Connect and fill lubrication system. See ENGINE LUBRICATION SYSTEM in Section 1.

⚠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 resulting in personal injury and/or property damage.

⚠CAUTION

Hold battery cable when tightening battery terminal hardware. Failure to hold cable may cause battery damage.

15. Connect battery cables, positive cable first.

⚠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 and personal injury.

16. Install tail section, fuel tank and seat. See TAIL SECTION, INSTALLATION on page 2-55.

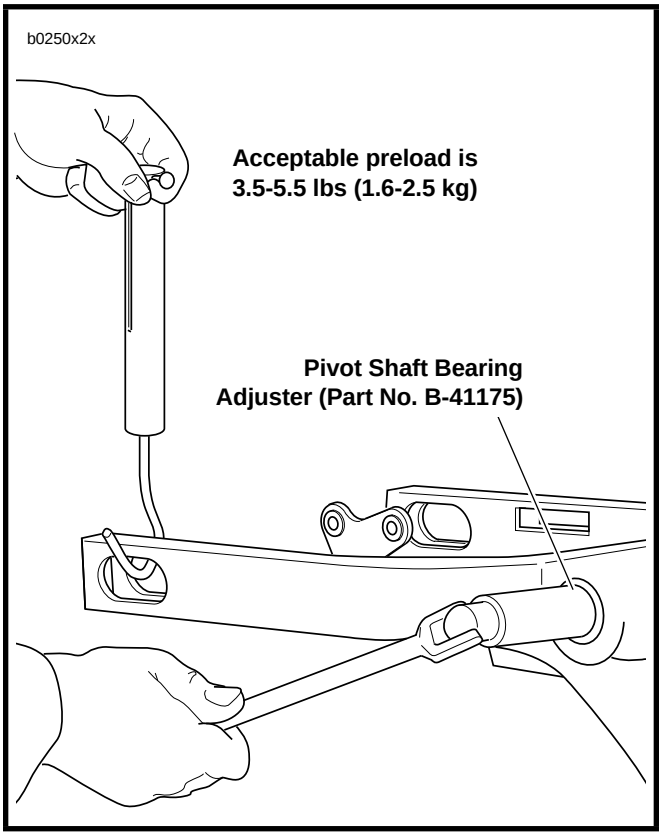


Figure 2-40. Adjusting Swingarm Preload

REAR SHOCK ABSORBER

GENERAL

See Figure 2-41. The rear suspension features a WP Suspension shock absorber. The shock adjusts for compression and rebound damping as well as spring preload.

The most important rear shock adjustment is the preload setting. Before making any suspension adjustments, set the proper preload. This procedure can be found under SUSPENSION ADJUSTMENTSon page 2-39.

NOTE

Rear shock absorber contains no user serviceable parts.

REMOVAL

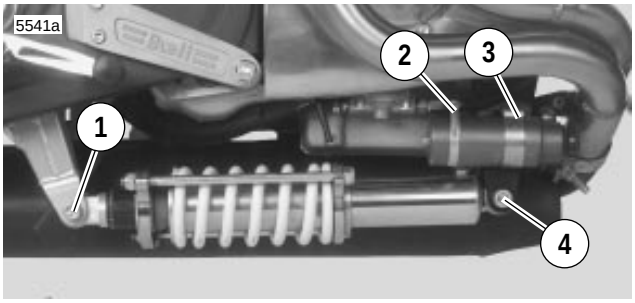
1. Lift rear wheel off ground using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove seat, fuel tank and tail section. See TAIL SECTION, REMOVAL on page 2-55.
3. Support motorcycle frame with a floor hoist such as the CENTRAL HYDRAULICS FOLDING CRANE.
4. See Figure 2-41. Use a flex socket and extension to remove allen screw on front reservoir clamp (3).
5. Remove allen screw and locknut (4) (metric) on front mounting point.
6. Remove allen screw and locknut (1) (metric) on rear mount while supporting shock absorber.
7. Loosen rear reservoir clamp (2).
8. Remove shock absorber assembly.

DISASSEMBLY

⚠WARNING

The following steps require using a press. Wear eye protection and make certain set-up is stable. The force involved could cause parts to "flyout" at great speeds causing personal injury.

1. See Figure 2-42. Place rear shock absorber in a hydraulic press with REAR SHOCK COMPRESSING TOOL (Part No. B-41178-A) on rear drawing ring.
2. Apply pressure to compress shock spring. Loosen and remove preload adjusting nuts (metric).
3. Release pressure. Remove REAR SHOCK COMPRESSING TOOL (Part No. B-41178-A) and shock from press.
4. See Figure 2-43. Remove rear drawing ring (2).
5. Remove support ring (3) and bump rubber (4).
6. Remove circlip (5) on end of shock cartridge.
7. Remove steel spring retainer (6).
8. Remove spring (7).



1. **Rear allen screw and locknut (metric)**
2. **Rear reservoir clamp**
3. **Front reservoir clamp**
4. **Front allen screw and locknut (metric)**

Figure 2-41. Rear Shock Mounting Hardware

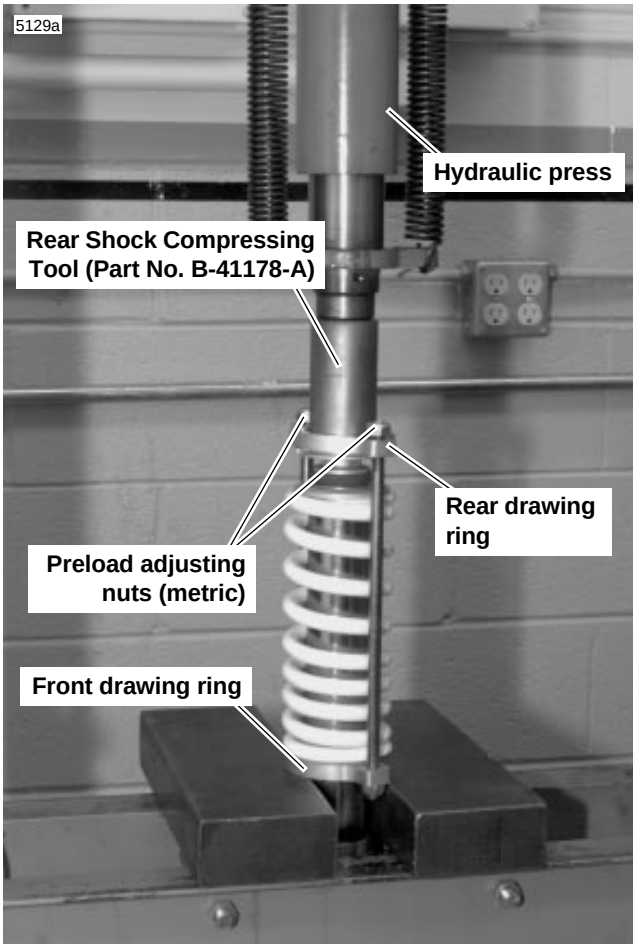


Figure 2-42. Compressing Rear Shock

ASSEMBLY

1. See Figure 2-43. Install spring (7).
2. Install steel spring retainer (6).
3. Install circlip (5) on end of shock cartridge.
4. Install bump rubber (4) and support ring (3).

⚠WARNING

The following steps require using a press. Wear eye protection and make certain set-up is stable. The force involved could cause parts to "flyout" at great speeds causing personal injury.

5. See Figure 2-42. Place rear shock absorber in a hydraulic press with REAR SHOCK COMPRESSING TOOL (Part No. B-41178-A) on rear drawing ring.
6. Apply pressure to compress shock spring. Install rear preload adjusting nuts (metric).
7. Release pressure. Remove REAR SHOCK COMPRESSING TOOL (Part No. B-41178-A) and shock from press.

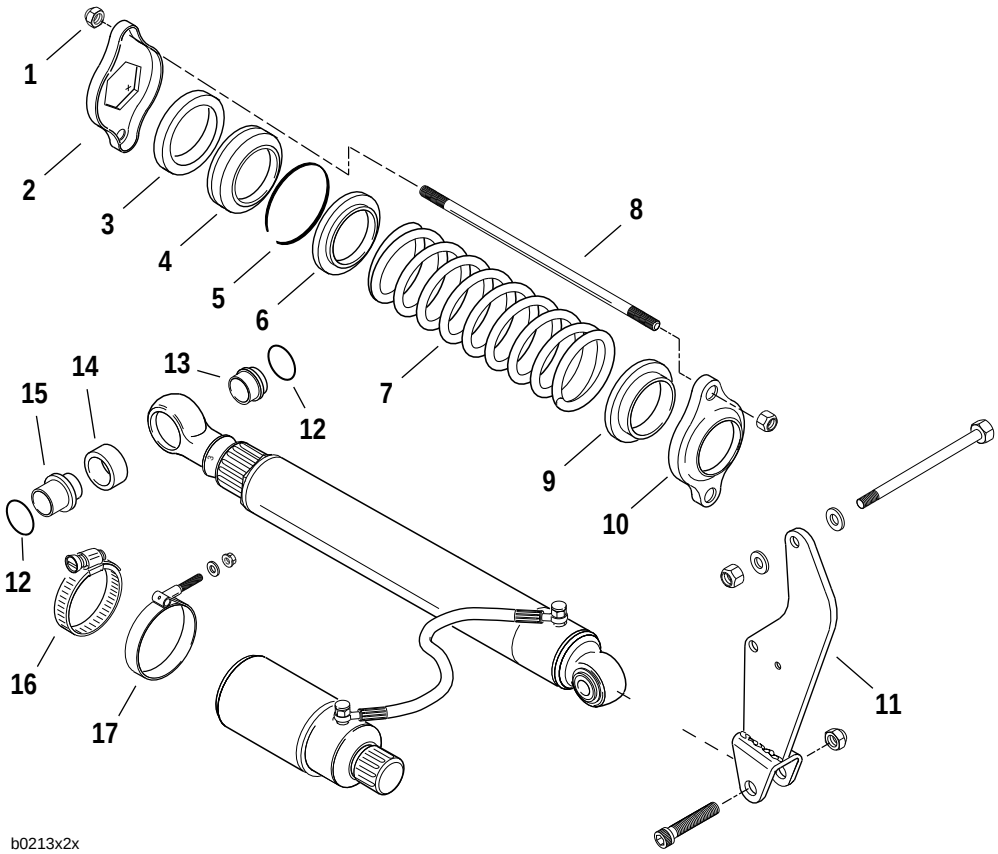
INSTALLATION

1. See Figure 2-41. Loosely install reservoir clamps (2, 3).
2. With banjo bolt facing upward, place shock in mounts and loosely install front allen screw and locknut (4) (metric).
3. Loosely install rear allen screw and locknut (1) (metric). Tighten reservoir clamp hardware (2, 3).
4. Tighten front and rear allen screws (1, 4) (metric) to 40-45 ft-lbs (54.2-61.0 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 and personal injury.

5. Install tail section, fuel tank and seat. See TAIL SECTION, INSTALLATION on page 2-55.
6. Check rear shock preload. See SUSPENSION ADJUSTMENTS on page 2-39.



1. **Preload adjusting nut (2) (metric)**
2. **Drawing ring, rear**
3. **Support ring**
4. **Bump rubber**
5. **Circlip**
6. **Spring retainer (steel)**
7. **Spring**
8. **Rod (2)**
9. **Spring retainer (nylon)**
10. **Drawing ring, front**
11. **Shock mount and hardware**
12. **Seal (4)**
13. **Bushing (2)**
14. **Heim joint (2)**
15. **Adaptor bushing (2)**
16. **Clamp**
17. **Clamp w/nut and washer**

Figure 2-43. Rear Shock

DEFINITIONS

- **Compression:** Suspension is compressed when the wheel moves upward.
- **Damping:** Resistance to movement. Damping affects how easily the suspension can move and limits oscillation of the system once movement has begun.
- **Preload:** The spring is compressed somewhat during assembly. This initial compression provides a “loaded” condition in the spring. This compression is referred to as preload.
- **Rebound:** The suspension is rebounding when it is moving back from being compressed.

GENERAL

⚠WARNING

Before evaluating and adjusting suspension settings, check the motorcycle’s tires. Tires must be in good condition and properly inflated. Failure to check the tires may cause personal injury.

See Figure 2-44 and Figure 2-45. The rear suspension features a WP Suspension shock absorber that adjusts for compression and rebound damping as well as spring preload.

See Figure 2-46. The front suspension uses WP Suspension inverted forks that adjust for compression and rebound damping. These forks offer strength and stiffness for improved sliding action, better shock absorption and compliance with the road.

If the 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. Changes should be approached carefully.

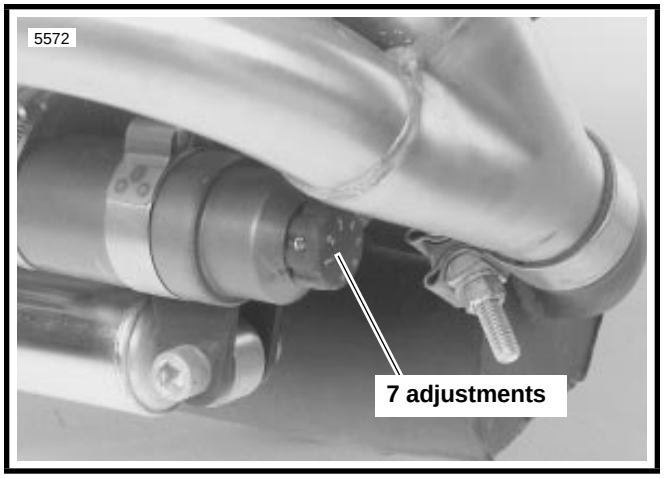


Figure 2-44. Rear Shock Rebound Adjuster

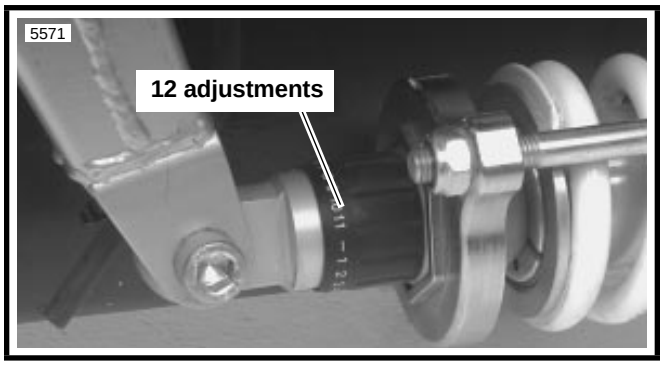


Figure 2-45. Rear Shock Compression Adjuster

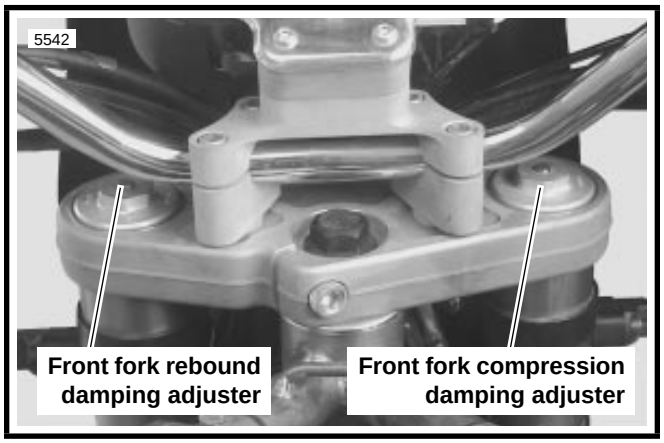


Figure 2-46. Front Fork Adjusters

REAR SHOCK PRELOAD

Rear shock spring preload must be adjusted before any other adjustments can be attempted. This adjustment assures the rear suspension has the proper amount of travel for the rider's weight. This setting should be made before the motorcycle is ridden any distance. Your Buell dealer can assist you with rear shock spring preload settings.

Improper preload will adversely affect both the handling and the ride of the motorcycle. Correct setting of preload will result in a motorcycle that suits the rider's size and weight.

You will need three people to carry out this adjustment.

1. Verify correct front and rear tire pressure. See SPECIFICATIONS on page 2-1.
2. Remove all accessories from motorcycle including tank bag and/or saddlebags.
3. Take the motorcycle off the side stand and bounce the rear up and down a few times to be sure the suspension is free and not binding.
4. See Figure 2-47. Measure the distance from the center of the rear axle nut to the rear turn signal mounting bolt without rider/passenger/cargo/accessories on the motorcycle.
5. Install items removed in Step 2. Load all cargo.
6. Bounce a few times on the seat to be sure the suspension is free and not binding.
7. With the help of an assistant, take the same measurement with the vehicle fully loaded (rider/passenger/luggage/cargo). The assistant should help balance the motorcycle so the rider can keep both feet on the footrests.
8. Subtract the second measurement from the first. The difference, which is the squat, should be 0.25-0.75 in. (6.4-19.1 mm). If it is not, you will have to adjust the spring preload.

⚠CAUTION

- **Be sure to apply the same number of turns to each mechanical preload adjusting nut to ensure that the end plates do not become misaligned. Misaligned end plates will cause the shock absorber spring to bind against the adjustment rods.**
- **Be sure the plates are parallel within 1/64 in. (0.4 mm). Misaligned end plates will cause the shock absorber spring to bind against the adjustment rods.**

9. See Figure 2-48. Change the spring preload by adjusting the mechanical preload adjusting nuts (metric) on the rods that connect the end plates.
   a. Increase the preload by tightening the nuts.
   b. Decrease the preload by loosening the nuts.

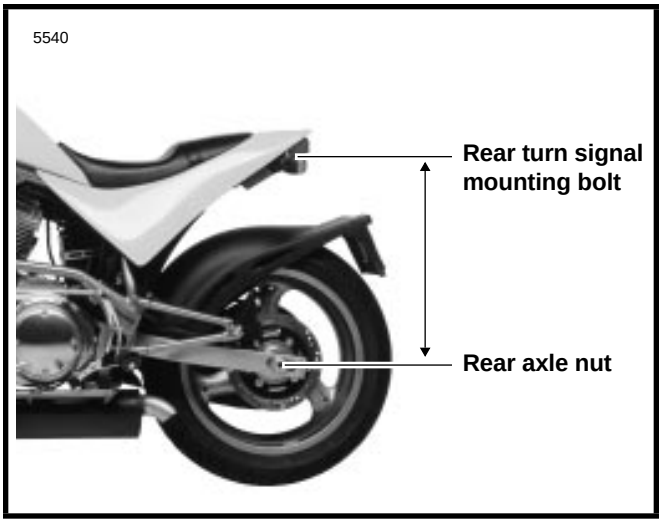


Figure 2-47. Checking Rear Preload

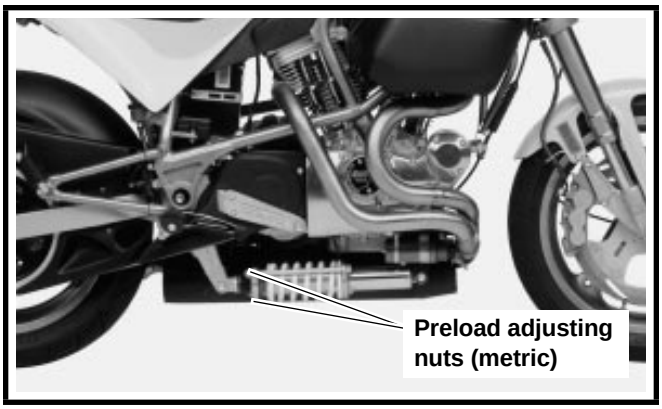


Figure 2-48. Adjusting Rear Preload

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 Suspension Adjustments

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

See Table 2-6. The compression damping adjuster has 11 possible settings. Adjust compression damping by using the black dial at the rear of the shock. Position #1 sets the minimum amount of compression damping. This is the softest setting. Position #11 maximizes compression damping. The factory recommended setting is Position #5.

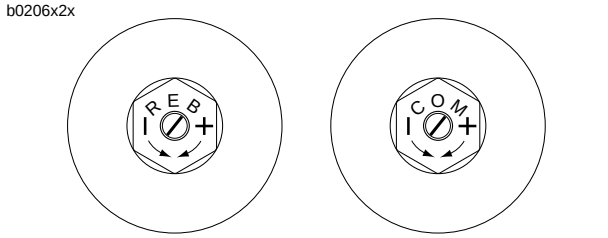
The rebound damping adjuster has 7 possible settings. Changes are made using the dial on the remote nitrogen reservoir. When set to Position #1, the rear shock exhibits minimum rebound damping. At this setting, the shock will have a very fast rebound. Position #7 sets the rear shock to maximum rebound damping. The factory recommended setting is Position #3.

Front Suspension Adjustments

See Table 2-6. The fork compression damping adjuster on right fork leg has 28 positions. Position #20 is the factory recommended setting.

The fork rebound adjuster on the left fork leg has 28 positions. Position #12 is the factory recommended setting.

See Figure 2-49. To set the forks to their factory recommended setting, turn the adjusters clockwise until they lock. Then turn the knobs counterclockwise the recommended 12 or 20 positions. A higher number of clicks increases damping.



**Left fork leg adjuster-
Rebound damping**

**Right fork leg adjuster-
Compression damping**

FRONT FORK ADJUSTMENTS

***Increase* rebound/compression (slower):
Turn appropriate adjuster clockwise.**

***Decrease* rebound/compression (faster):
Turn appropriate adjuster counterclockwise.**

Figure 2-49. Fork Adjustments

TROUBLESHOOTING

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

When making adjustments, remember there are two mediums in setting up a bike, geometry and suspension. Both components work together because suspension is a part of geometry. In order to solve handling problems, it is important to diagnose the problem's true nature. Chattering, sliding or an uncomfortable feeling are suspension problems. Handling and a swinging fork are geometric problems, but often these problems can be solved by suspension adjustments.

⚠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 and personal injury.

Table 2-6. Factory Recommended Suspension Settings

PART	RANGE IN CLICKS	FACTORY SETTING	SEE FIGURE
Rear shock rebound	7	3	Figure 2-44.
Rear shock compression	11	5	Figure 2-45.
Front fork rebound	28	12	Figure 2-46.
Front fork compression	28	20	Figure 2-46.

Table 2-7. General Suspension Problems

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

Table 2-8. Rear Suspension Problems

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

Table 2-9. Front Suspension Problems

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

Table 2-10. Rider Suspension Preferences

NOTE

All adjustments require rear shock preload to be properly adjusted for the rider's size and weight. For information on setting rear shock preload, see SUSPENSION ADJUSTMENTS, REAR SHOCK PRELOAD in this section.

DATE	FRONT FORK REBOUND	FRONT FORK COMPRESSION	REAR SHOCK COMPRESSION	REAR SHOCK REBOUND	RESULTS
	Position #12	Position #20	Position #5	Position #3	Factory recommended settings.

THROTTLE CONTROL

REMOVAL/DISASSEMBLY

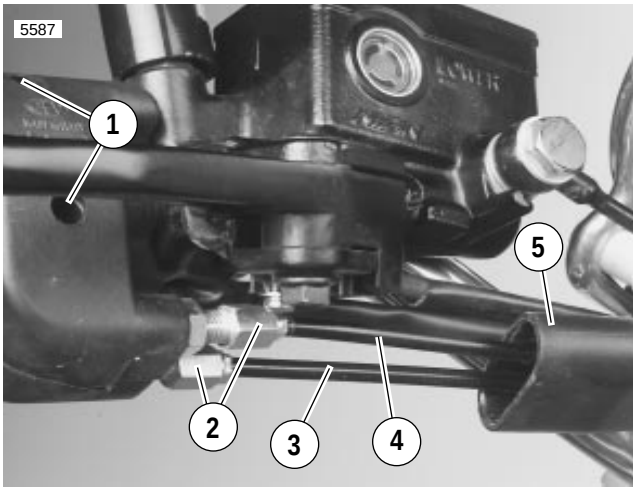
1. See Figure 2-50. Slide rubber boot (5) off the cable adjusters (2). Loosen jam nut (metric) on each adjuster.
2. Remove two screws (1) (metric). Separate housings from handlebar.
3. See Figure 2-51. Unhook ferrules (7) from cable wheel (8).
4. Remove cables from under cable guide (6).
5. Remove cables from housings (5, 9) by loosening cable adjusters (2) (metric).
6. Remove air cleaner assembly. See AIR CLEANER, REMOVAL in Section 4.
7. Disconnect cables from carburetor.
8. Remove cables from motorcycle.

CLEANING, INSPECTION AND REPAIR

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

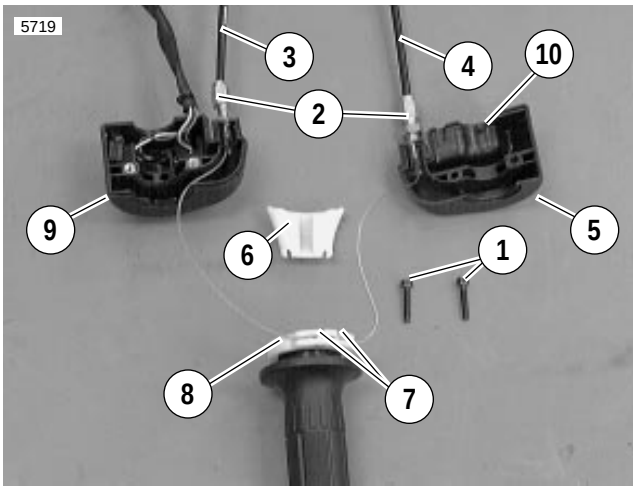
ASSEMBLY/INSTALLATION

1. See Figure 2-51. Screw cable assemblies (3, 4) into housings (5, 9). Throttle control cable (4) has a larger 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 in grooves on cable guide (6).
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 screws (1) (metric). Tighten to 12-17 **in-lbs** (1.4-1.9 Nm).
5. Route idle and throttle control cables.
   a. Cables must be routed forward from throttle control grip, forward of upper triple clamp and down and to the left.
   b. Continue between side of frame steering head and left frame tube. Cables should be above and to the left of the D-shaped washer behind the steering head.
   c. Route cables below the fuel tank and above the horn mount. Continue downward to carburetor.
6. Install idle control cable into longer, inboard cable guide on carburetor.
7. Install throttle control cable into shorter, outboard cable guide on carburetor.
8. Adjust throttle cables. See CARBURETOR, CABLE ADJUSTMENT in Section 1.
9. Install air cleaner. See AIR CLEANER, INSTALLATION in Section 4.



1. Screws (2) (metric)
2. Cable adjusters (2)
3. Idle control cable
4. Throttle control cable
5. Rubber boot

Figure 2-50. Throttle Control Cables



1. Screws (2) (metric)
2. Cable adjusters (2)
3. Idle control cable
4. Throttle control cable
5. Front housing
6. Cable guide
7. Ferrules
8. Cable wheel
9. Rear housing
10. Locating pin

Figure 2-51. Cable Connections

CLUTCH CONTROL

ADJUSTMENT

See CLUTCH in Section 1.

REMOVAL/DISASSEMBLY

Clutch Cable – Lower

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. See Figure 2-52. 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

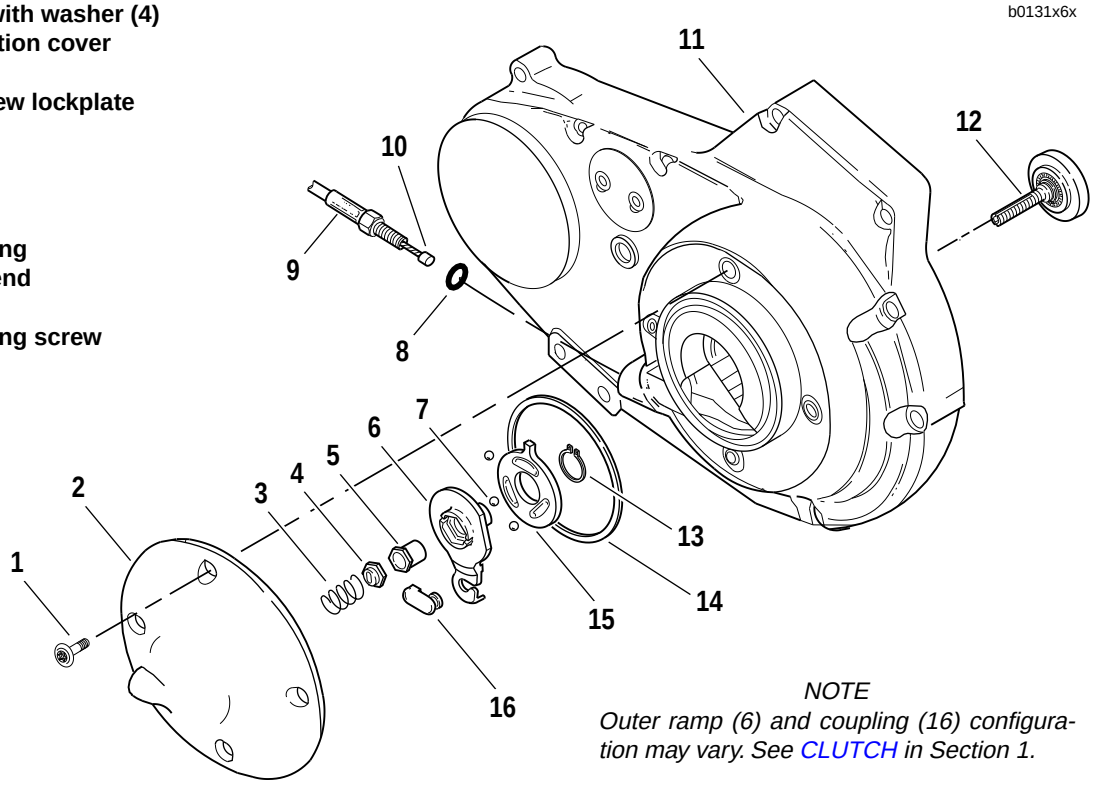
1. See Figure 2-53. Detach clutch switch (7) as follows.
   a. Remove screw (8).
   b. Depress clutch lever and hold.
   c. Detach switch by depressing switch trigger button and pulling switch towards the end of the handlebar.

NOTE

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

2. Remove bolt (2) (metric) and nut (6) (metric).
3. Remove handlever from clutch clamp (5). Detach clutch cable from handlever.
4. Slide clutch cable out of wire guide (10) on right fork leg.
5. Remove clutch cable clamp (11) from frame.
6. Remove clutch clamp as follows.
   a. Cut off left handgrip.
   b. Remove left handlebar switch housing. See HANDLEBAR SWITCHES in Section 7.
   c. Detach mirror mounting hardware (metric, left hand threads).
   d. Remove clamp screw (4) (metric). Slide clamp off the end of the handlebar.

1. **TORX screw with washer (4)**
2. **Clutch inspection cover**
3. **Spring**
4. **Adjusting screw lockplate**
5. **Nut**
6. **Outer ramp**
7. **Ball (3)**
8. **O-ring**
9. **Cable end fitting**
10. **Clutch cable end**
11. **Primary cover**
12. **Clutch adjusting screw assembly**
13. **Retaining ring**
14. **Quad ring**
15. **Inner ramp**
16. **Coupling**



NOTE

Outer ramp (6) and coupling (16) configuration may vary. See CLUTCH in Section 1.

Figure 2-52. Clutch Release Mechanism

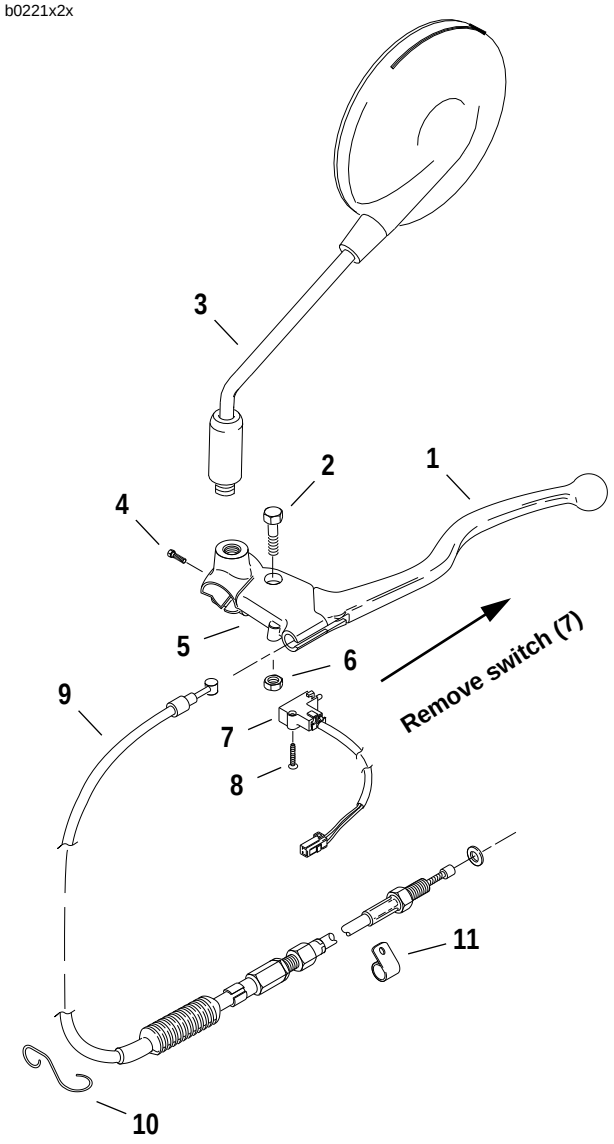
ASSEMBLY/INSTALLATION

Clutch Cable – Lower

1. See Figure 2-52. Install O-ring (8) over cable end fitting (9) of clutch cable lower section. Turn fitting clockwise to install into primary cover (11). Tighten fitting to 3-5 ft-lbs (4.0-6.8 Nm).
2. Fit coupling (16) over cable end. Place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp (15) fits in slot of primary cover (11).
3. Thread nut (5) on adjusting screw (12) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (6) and turn adjusting screw counter-clockwise.
4. If not yet performed, route clutch cable from hand grip across front of upper triple clamp to right side, down between right fork leg and steering neck above lower triple clamp. Continue down to left side of bike through clamp along primary chaincase to clutch.
5. With clutch cable upper section connected to clutch lever, adjust primary chain tension. See PRIMARY CHAIN in Section 1.
6. Adjust clutch. See CLUTCH in Section 1.

Clutch Hand Control

1. See Figure 2-53. Attach clutch clamp (5) as follows.
   a. Slide clamp over handlebar.
   b. Install left switchgear housing. See HANDLEBAR SWITCHES in Section 7.
   c. Place clamp next to switchgear housing. Fasten to handlebar with screw (4) (metric). Tighten screw to 30-35 **in-lbs** (3.4-4.0 Nm).
   d. Install mirror parallel to handlebars. Mirror mount has metric, left hand threads.
   e. Install a **new** left handgrip. See HANDLEBAR, INSTALLATION on page 2-49.
2. Connect end of clutch cable upper section to clutch handlever. Position lever within clutch clamp.
3. Apply small amount of LOCTITE ANTI-SEIZE LUBRICANT to bolt (2). Secure handlever with bolt (2) (metric) and nut (6) (metric).
4. Attach clutch switch (7) with screw (8).
5. If not yet performed, route clutch cable from hand grip across front of upper triple clamp to right side, down between right fork leg and steering neck above lower triple clamp. Continue down to left side of bike through clamp along primary chaincase to clutch.
6. With clutch cable lower section connected to primary cover, adjust clutch. See CLUTCH in Section 1.



1. **Clutch handlever**
2. **Bolt (metric)**
3. **Mirror assembly**
4. **Screw (metric)**
5. **Clutch clamp**
6. **Nut (metric)**
7. **Clutch switch**
8. **Screw**
9. **Clutch cable**
10. **Wire guide**
11. **Cable clamp**

Figure 2-53. Clutch Hand Control

SPEEDOMETER AND TACHOMETER

GENERAL

Replace the speedometer or tachometer if the unit is not working properly. These instruments are not repairable. However, before replacing the instrument check that the problem is not caused by a faulty cable or loose wire connection.

REMOVAL

Speedometer

1. Detach windscreen from mounts. See WINDSCREEN, REMOVAL on page 2-56.
2. See Figure 2-54. Loosen and remove the speedometer cable (5) from the speedometer.
3. Remove nuts and lockwashers (4) from speedometer cover (1).
4. Straighten reset cable cotter pin and remove. Discard pin. Detach reset cable assembly from speedometer.
5. Remove cover. Remove wires from clamp inside cover.
6. Detach ground wire.
7. See Figure 2-55. Disconnect wire terminals from back of speedometer. Pull bulbs (3) from bores.
8. Remove speedometer (1) through front of instrument support (8).

Tachometer

1. Detach windscreen from mounts. See WINDSCREEN, REMOVAL on page 2-56.
2. See Figure 2-54. Remove nut and lockwasher (4) from tachometer cover (2).
3. Remove nut on windscreen mount (3). Remove windscreen mount from tachometer cover.
4. Remove tachometer cover.
5. Remove ground wires from bottom stud.
6. See Figure 2-55. Disconnect wire terminals from back of tachometer. Pull bulbs (3) from bores.
7. Remove tachometer (2) through front of instrument support (8).

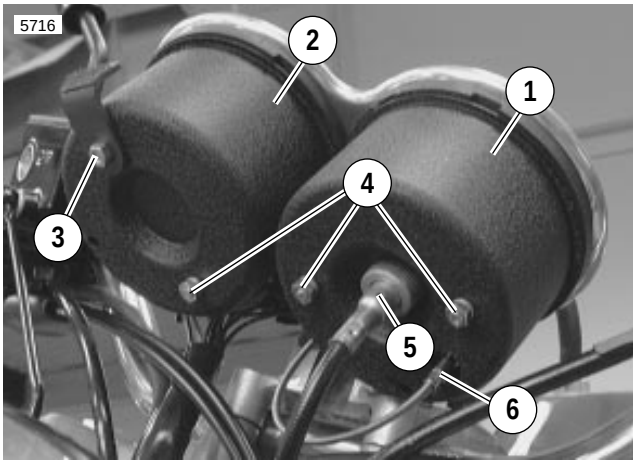
Instrument Support

1. Remove speedometer and tachometer.
2. See Figure 2-55. Remove knurled nut (5), washer (6) and odometer reset cable.
3. Pull indicator lights assembly (4) out towards the headlamp. Pull bezel (19) out towards the tail lamp.
4. Remove two screws (7).
5. Remove instrument support.

INSTALLATION

Speedometer

1. See Figure 2-55. If removed, install instrument support (8). Slide speedometer into instrument support.



1.	**Speedometer cover**	**4.**	**Nut and lockwasher (3)**
2.	**Tachometer cover**	**5.**	**Speedometer cable**
3.	**Windscreen mount**	**6.**	**Odometer reset cable**

Figure 2-54. Instruments

2. Attach ground wire with screw and lockwasher.
3. Connect wire terminals on back of speedometer. Insert bulbs into bores at back of speedometer.
4. See Figure 2-54. Using a **new** cotter pin, connect reset cable assembly (6) to speedometer.
5. Place speedometer cover over speedometer. Tighten nuts and lockwashers (4).
6. Connect speedometer cable (5) to speedometer.
7. Attach windscreen. See WINDSCREEN, INSTALLATION on page 2-56.

Tachometer

1. See Figure 2-55. If removed, install instrument support (8). Slide tachometer into instrument support (8).
2. Connect wire terminals on back of tachometer. Insert bulbs into bores.
3. Attach ground wire.
4. See Figure 2-54. Slide tachometer cover (2) over tachometer. Install nut and lockwasher (4).
5. Install windscreen mount (3) with nut.
6. Attach windscreen. See WINDSCREEN, INSTALLATION on page 2-56.

Instrument Support

1. See Figure 2-55. Attach instrument support to mounts using two screws (7). Tighten screws to 7-9 ft-lbs (9.5-12.2 Nm).
2. Install odometer reset cable using washer (6) and knurled nut (5).
3. Insert bezel (19) through instrument support. Attach indicator lights assembly (4) to bezel.

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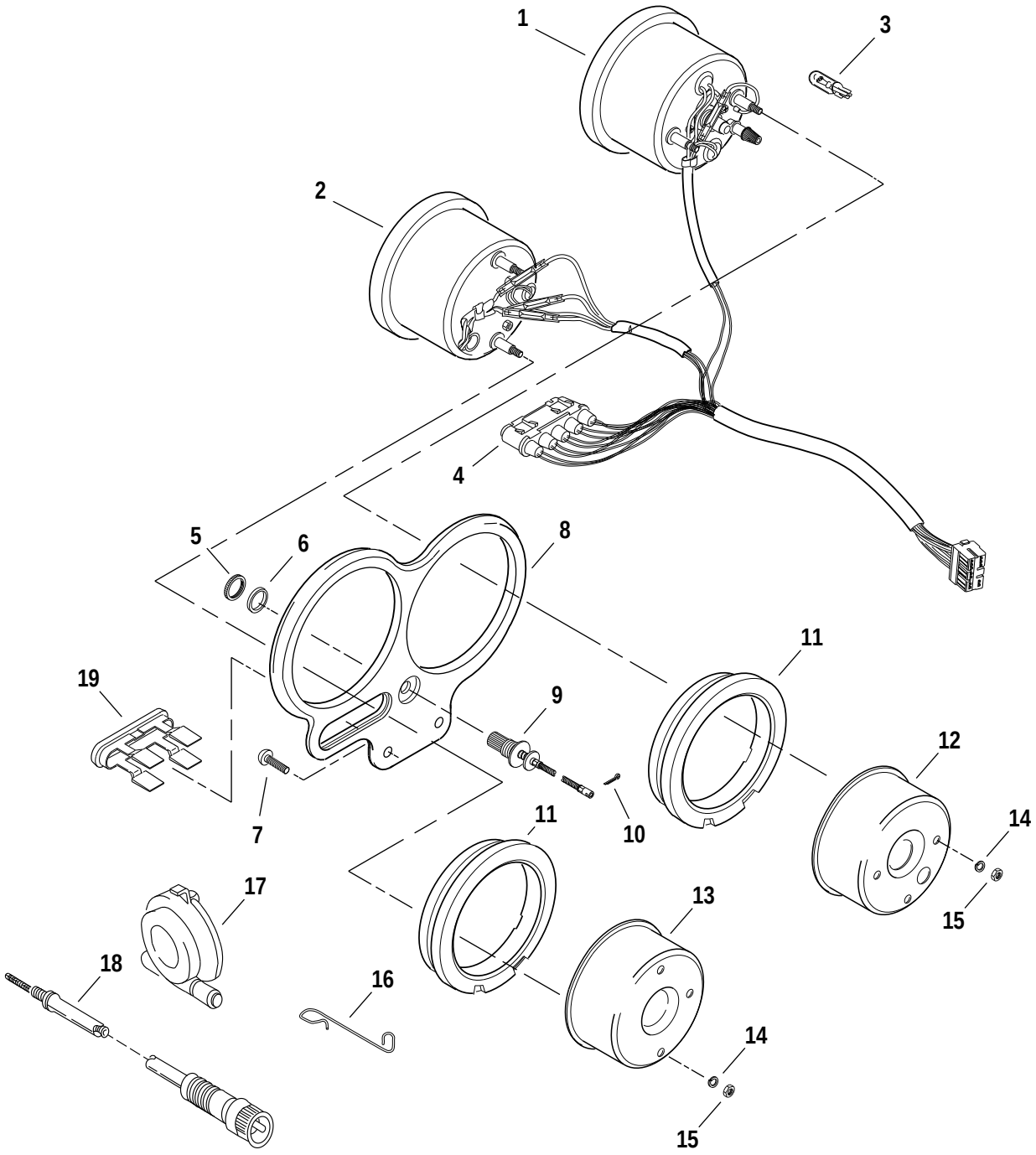


1. Speedometer
2. Tachometer
3. Bulb
4. Indicator light assembly
5. Knurled nut
6. Washer
7. Screw (2)
8. Instrument support
9. Odometer reset cable
10. Cotter pin
11. Rubber cushion (2)
12. Speedometer cover
13. Tachometer cover
14. Lockwasher (3)
15. Nut (2)
16. Wire guide
17. Speedometer drive
18. Speedometer cable
19. Indicator lamp bezel

Figure 2-55. Speedometer and Tachometer

SPEEDOMETER CABLE

Cable Cleaning, Inspection and Lubrication

Clean, inspect and lubricate speedometer cable every 5000 miles (8000 km). Proceed as follows:

1. See Figure 2-56. Examine speedometer cable housing (outer sheathing) for kinks or other damage. Replace entire cable assembly if any damage is noted.
2. Detach windscreen from mounts. See WINDSCREEN, REMOVAL on page 2-56.
3. Loosen and remove the speedometer cable assembly from the speedometer.
4. Carefully withdraw inner speedometer cable from its housing. Exercise caution to avoid stretching coils of inner cable. Outer cable housing remains attached to speedometer drive unit.
5. Carefully wipe off old lubricant from inner cable. Inspect cable coils for bends, bulges, discoloration or other defects. Replace entire cable assembly if any damage or defect is noted.
6. Apply a good quality graphite grease to entire length of inner cable. Wipe off excess grease.
7. Insert inner cable fully into its housing, rotating inner cable somewhat to allow its lower end to engage with speedometer drive unit. Inner cable will no longer rotate once engaged with drive unit.
8. Insert pin of speedometer cable into receptacle at back of speedometer. Tighten to secure cable.
9. Attach windscreen. See WINDSCREEN, INSTALLATION on page 2-56.

Speedometer Drive Unit

See the procedures listed under FRONT WHEEL starting on page 2-8.

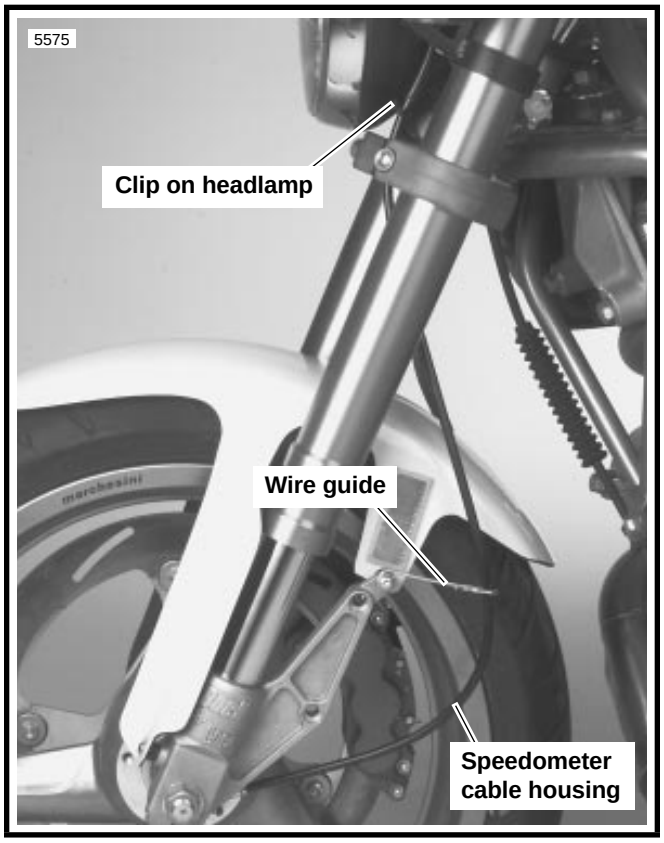


Figure 2-56. Speedometer Cable

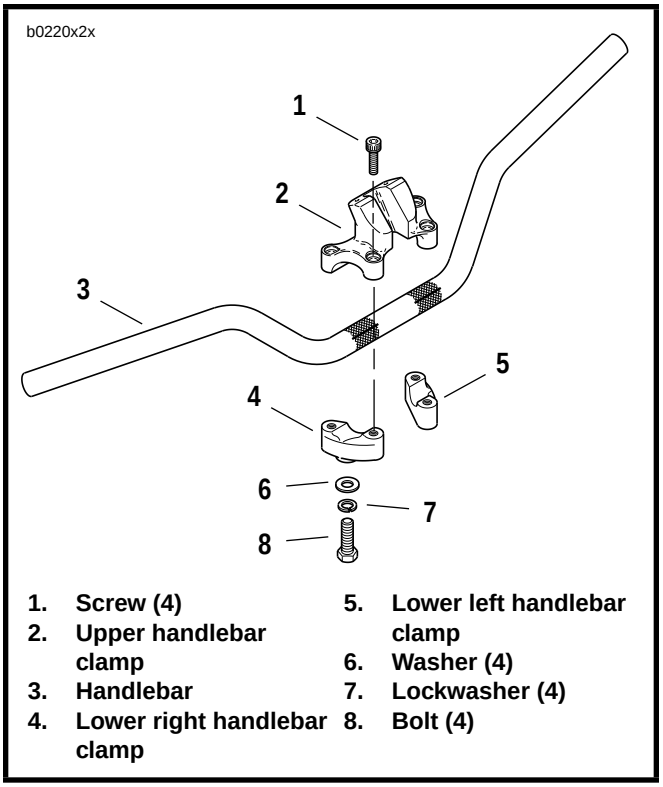
HANDLEBAR

REMOVAL

1. Remove front brake master cylinder. See FRONT BRAKE MASTER CYLINDER, REMOVAL on page 2-19.
2. Remove left and right handlebar switch housings. See HANDLEBAR SWITCHES in Section 7.
3. Cut left handlebar grip and remove.
4. Remove instrument support. See SPEEDOMETER AND TACHOMETER on page 2-46.
5. Loosen four screws (1) on upper handlebar clamp (2).
6. Move handlebar towards the air cleaner to increase clutch cable freeplay. Remove clutch control. See CLUTCH CONTROL, REMOVAL/DISASSEMBLY on page 2-44.
7. Remove four screws (1), upper handlebar clamp (2) and handlebars (3).
8. Remove four bolts (8), lockwashers (7) and washers (6) to detach lower handlebar clamps (4, 5) from upper triple clamp.

INSTALLATION

1. Install lower handlebar clamps (4, 5) with four bolts (8), lockwashers (7) and washers (6). Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
2. Install clutch control. See CLUTCH CONTROL, ASSEMBLY/INSTALLATION on page 2-45.
3. Install handlebar (3) using upper handlebar clamp (2) and four screws (1). Tighten screws to 10-12 ft-lbs (13.6-16.2 Nm).
4. Install instrument support. See SPEEDOMETER AND TACHOMETER on page 2-46.
5. Install left and right handlebar switch housings. See HANDLEBAR SWITCHES in Section 7.
6. 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.
7. Install front brake master cylinder. See FRONT BRAKE MASTER CYLINDER, INSTALLATION on page 2-19.



1.	**Screw (4)**	**5.**	**Lower left handlebar clamp**
2.	**Upper handlebar clamp**	**6.**	**Washer (4)**
3.	**Handlebar**	**7.**	**Lockwasher (4)**
4.	**Lower right handlebar clamp**	**8.**	**Bolt (4)**

Figure 2-57. Handlebars

EXHAUST SYSTEM

REMOVAL/DISASSEMBLY

Muffler

1. See Figure 2-58. Remove bolts (2), locknuts (9) and washers (6) from rear muffler supports (19).
2. Remove bolt (3) and locknut (9) from muffler support (15).
3. Loosen muffler clamp (14).
4. Loosen screw (1) on header tiebar (26).
5. Remove muffler (13) and muffler clamp. Discard clamp.
6. Remove muffler/header supports (15, 19) as follows:
   a. Remove bolts (4), locknuts (9) and washers (21).
   b. Remove rear muffler mounts (24) and mount spacers (20).
   c. Remove bolts (5), locknuts (10) and washers (7).
   d. Remove muffler support (15). Remove front muffler mounts (25) and mount spacer.

Exhaust Header

1. See Figure 2-58. Remove muffler as described above.
2. Remove screw (1), locknut (11) and washers (27) from header tiebar (26).
3. Using a SNAP-ON SWIVEL SOCKET (Part No. PFSX916), remove nuts (8) from front and rear cylinder head exhaust studs.
4. Remove exhaust header clamps (18), exhaust clamp retaining rings (17) and exhaust port gaskets (16).
5. Remove exhaust header (12).
6. Remove heat shield clamps (23) and heat shield (22) from exhaust header.

ASSEMBLY/INSTALLATION

Muffler

1. See Figure 2-58. If removed, install exhaust header (12).
2. If removed, install muffler/header supports (15, 19).
   a. Hold rear muffler mounts (24), mount spacers (20) and muffler supports (19) in place. Fasten with bolts (4), locknuts (9), washers (21). Tighten to 12-15 ft-lbs (16.3-20.3 Nm).
   b. Fasten muffler support (15) to crankcase with bolts (5), washers (7) and locknuts (10). Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
   c. Install front muffler mounts (25) and mount spacer.
3. Coat inside of muffler inlet with PERMATEX ULTRA-COPPER HIGH TEMP RTV SILICON GASKET material.
4. Place a **new** muffler clamp (14) over slotted end of muffler. Place muffler and clamp on end of exhaust header. Loosely tighten clamp.

NOTE

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

5. Install bolt (3) and locknut (9). Tighten to 22-25 ft-lbs (29.8-33.9 Nm).

⚠WARNING

Before tightening muffler hardware, position muffler to provide adequate clearance from rear shock absorber and side stand spring post. Failure to provide adequate clearance may cause personal injury during motorcycle operation.

6. Install rear mounting bolts (2), washers (6), and locknuts (9). Tighten to 22-25 ft-lbs (29.8-33.9 Nm).
7. Tighten muffler clamp (13) to 50-55 ft-lbs (67.8-74.6 Nm).

Exhaust Header

1. See Figure 2-58. Install **new** exhaust port gaskets (16), exhaust clamp retaining rings (17), exhaust header clamps (18), and nuts (8). Loosely tighten nuts with SNAP-ON SWIVEL SOCKET (Part No. PFSX916).
2. Install screw (1) with washers (27) and locknut (11). Tighten to 5-7 ft-lbs (6.8-9.5 Nm).
3. Place a **new** muffler clamp (14) over slotted end of muffler. Place muffler and clamp on end of exhaust header (20). Loosely tighten clamp.
4. Tighten manifold nuts (8) to 6-8 ft-lbs (8.1-10.8 Nm).
5. Tighten muffler clamp (13) to 50-55 ft-lbs (67.8-74.6 Nm).
6. If removed, install heat shield (22) with heat shield clamps (23).

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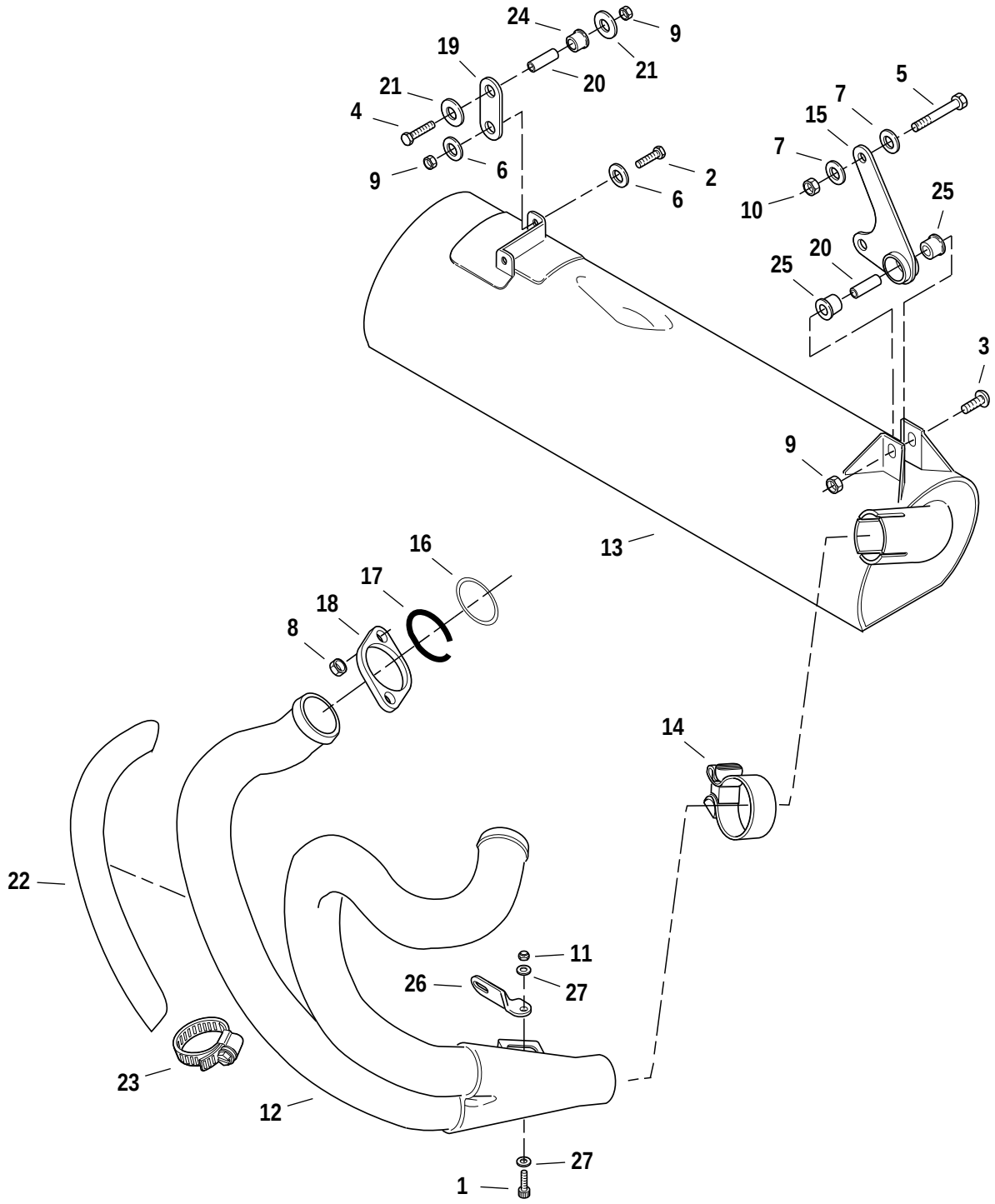


1. Screw
2. Bolt (2)
3. Bolt
4. Bolt (2)
5. Bolt (2)
6. Washer (4)
7. Washer (5)
8. Nut (4)
9. Locknut (5)
10. Locknut (2)
11. Locknut
12. Exhaust header
13. Muffler
14. Muffler clamp
15. Muffler support
16. Exhaust port gasket (2)
17. Exhaust clamp retaining ring (2)
18. Exhaust header clamp (2)
19. Muffler support (2)
20. Mount spacer (3)
21. Washer (4)
22. Heat shield
23. Heat shield clamp (2)
24. Rear muffler mount (2)
25. Front muffler mount (2)
26. Header tiebar
27. Washer (2)

Figure 2-58. Exhaust System

FOOTRESTS

REMOVAL

1. See Figure 2-59. Remove locknut (1) and bolt (2).
2. Remove footrest.
   a. Detach passenger footrests (3) from frame.
   b. Detach rider footrests (4) from footrest mounts (5).
3. If necessary, remove bolts (10) and washers (9) to remove footrest mounts from frame.

NOTE

Brake pedal and shift lever must be removed with footrest mounts. See REAR BRAKE MASTER CYLINDER in this section and PRIMARY COVER in Section 6 or more information.

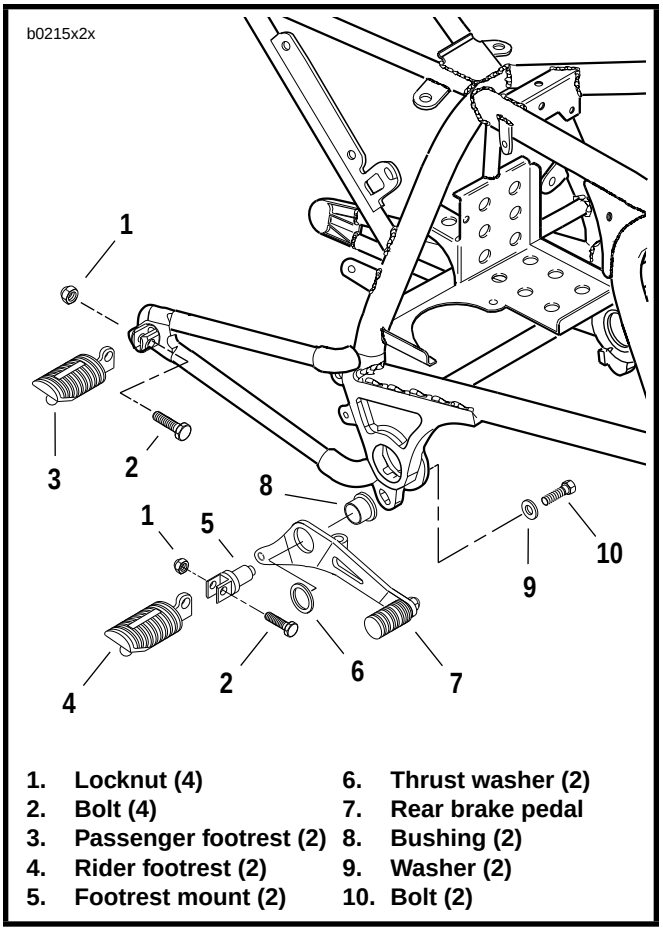
INSTALLATION

1. See Figure 2-59. Install passenger footrests with bolts (2) and locknuts (1). Tighten securely.

NOTE

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

2. If removed, install footrest mounts (5).
   a. Assemble brake pedal with bushing (8) on the inside and thrust washer (6) on the outside. Fasten brake pedal to frame with bolt (10), washer (9) and footrest mount.
   b. Assemble shift lever with bushing on the inside and thrust washer on the outside. Fasten shift lever to frame with bolt, washer and footrest mount.
3. Install rider footrests with bolts (2) and locknuts (1). Tighten securely.
4. Adjust shift lever and brake pedal for smooth operation.



1.	**Locknut (4)**	**6.**	**Thrust washer (2)**
2.	**Bolt (4)**	**7.**	**Rear brake pedal**
3.	**Passenger footrest (2)**	**8.**	**Bushing (2)**
4.	**Rider footrest (2)**	**9.**	**Washer (2)**
5.	**Footrest mount (2)**	**10.**	**Bolt (2)**

Figure 2-59. Footrests, Right Side

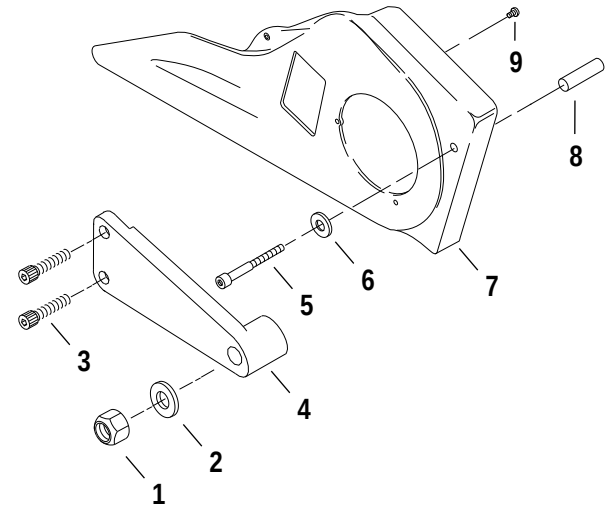
SPROCKET COVER

REMOVAL/DISASSEMBLY

1. See Figure 2-60. Remove nut (1) and washer (2).
2. Remove two screws (3).
3. Remove sprocket cover screw (5), washer (6) and spacer (8).
4. Remove swingarm drive/support (4) and sprocket cover (7) as an assembly.
5. Remove two screws (9) to separate sprocket cover from swingarm/drive support.

ASSEMBLY/INSTALLATION

1. See Figure 2-60. If removed, attach sprocket cover to swingarm/drive support with two screws (9). Tighten screws to 12-17 in-lbs (1.4-1.9 Nm).
2. Install sprocket cover assembly with screw (5), washer (6) and spacer (8). Tighten screw to 4-6 ft-lbs (5.4-8.6 Nm).
3. Install screws (3). Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
4. Install nut (1) and washer (2). Tighten nut to 30-35 ft-lbs (40.7-47.4 Nm).



1.	**Nut**	**5.**	**Sprocket cover crew**
2.	**Washer**	**6.**	**Washer**
3.	**Screw (2)**	**7.**	**Sprocket cover**
4.	**Swingarm/drive support**	**8.**	**Spacer**
		9.	**Screw (2)**

Figure 2-60. Sprocket Cover

FENDERS

REMOVAL/INSTALLATION

Front Fender

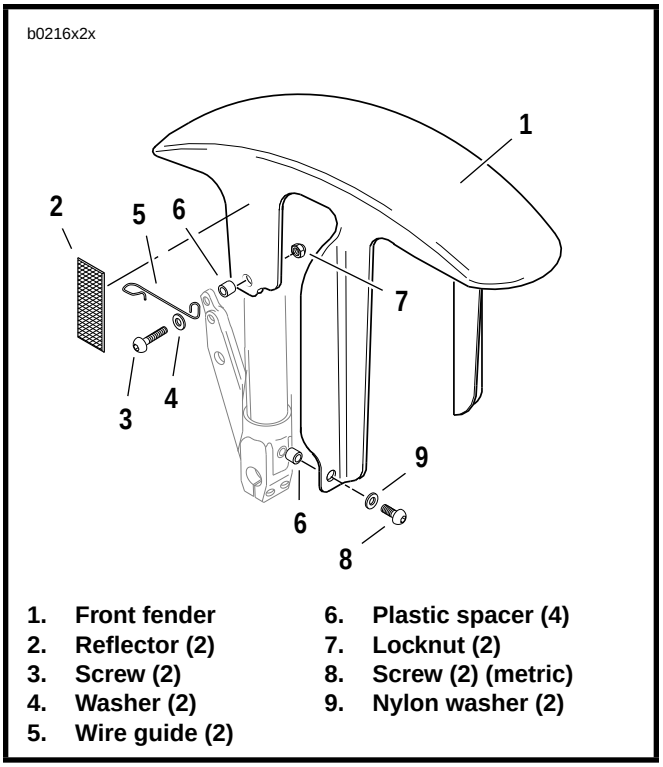
1. Raise front wheel off ground with FRONT WHEEL SUPPORT STAND (Part No. B-41395) and S1 LIFT ADAPTER (Part No. B-41686).
2. Remove front brake caliper. See FRONT BRAKE CALIPER, REMOVAL/DISASSEMBLY on page 2-20.
3. See Figure 2-61. Remove lower fender mounting screws (8) (metric), washers (9) and plastic spacers (6).
4. Remove upper fender mounting screws (3), washers (4), wire guides (5), plastic spacers (6) and locknuts (7).
5. Carefully remove fender (1) from between front forks.
6. Install in reverse order.
   a. Tighten upper fender mounting screws (3) to 20-25 **in-lbs** (2.3-2.8 Nm).
   b. Tighten lower fender mounting screws (8) (metric) to 10-15 **in-lbs** (1.1-1.7 Nm).

Rear Fender/Lower Belt Guard

1. See Figure 2-62. Unplug connector (10)
2. Remove screws (13) and nylon washers (2) on right side to detach lower belt guard (11).
3. Remove shoulder bolts (7), washers (8) and grommets (9) on left side.
4. Remove rear fender (6) from swingarm.
5. Install in reverse order.

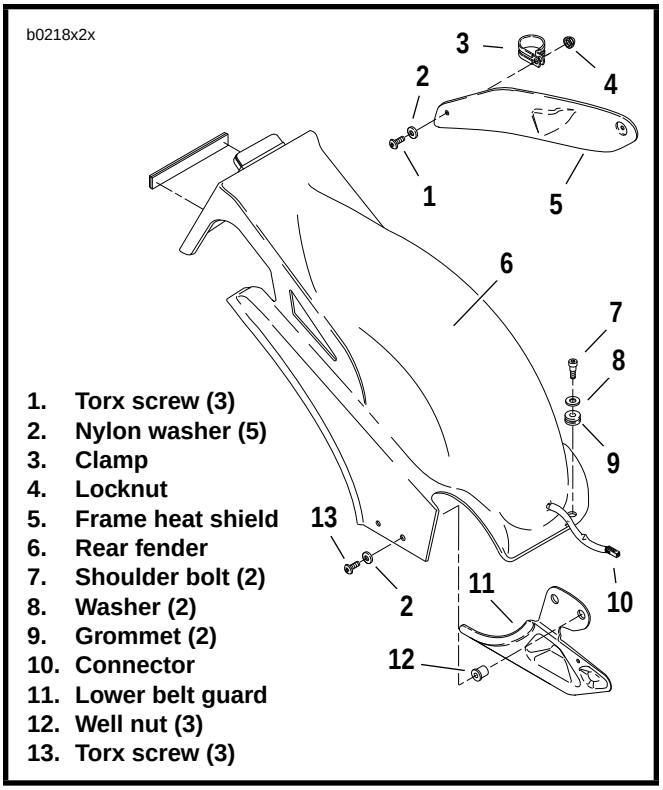
Frame Heat Shield

1. Remove seat and tail section. See TAIL SECTION, REMOVAL on page 2-55.
2. See Figure 2-62. Remove screws (1), nylon washers (2) and locknut (4).
3. Remove frame heat shield (5).
4. If necessary, remove clamp (3).
5. Install in reverse order.



1. **Front fender**
2. **Reflector (2)**
3. **Screw (2)**
4. **Washer (2)**
5. **Wire guide (2)**
6. **Plastic spacer (4)**
7. **Locknut (2)**
8. **Screw (2) (metric)**
9. **Nylon washer (2)**

Figure 2-61. Front Fender



1. **Torx screw (3)**
2. **Nylon washer (5)**
3. **Clamp**
4. **Locknut**
5. **Frame heat shield**
6. **Rear fender**
7. **Shoulder bolt (2)**
8. **Washer (2)**
9. **Grommet (2)**
10. **Connector**
11. **Lower belt guard**
12. **Well nut (3)**
13. **Torx screw (3)**

Figure 2-62. Rear Fender, Lower Belt Guard and Heat Shield

TAIL SECTION

REMOVAL

1. See Figure 2-63. Loosen seat wing screw (1). Remove seat by pulling up and back.
2. Remove two screws (4) and nylon washers (3).
3. Loosen fuel tank screw (6).
4. Lift fuel tank (8) and withdraw tail section.

NOTE

See FUEL TANK, REMOVAL in Section 4 for information on removing fuel tank from frame.

INSTALLATION

1. Place tail section on frame so mounting holes align with holes on frame.
2. See Figure 2-63. Install two screws (4) and nylon washers (3).

NOTE

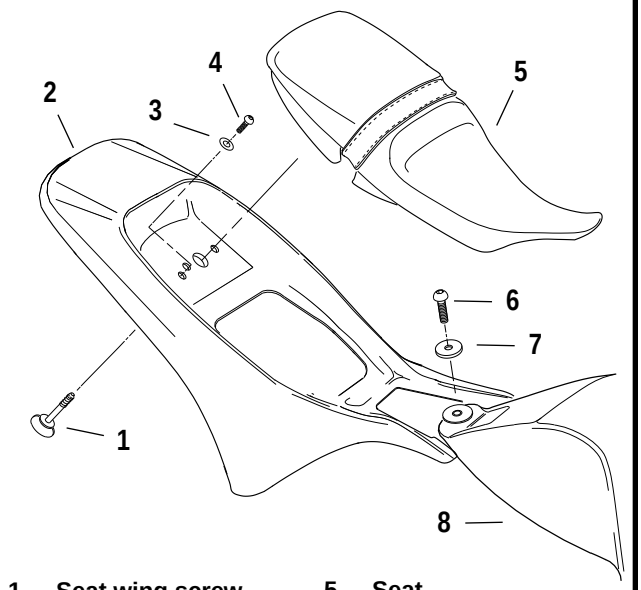
If fuel tank was removed, see FUEL TANK, INSTALLATION in Section 4.

3. Tighten screw (6) to 9-11 ft-lbs (12.2-14.9 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 and personal injury.

4. Place seat on tail section. Tighten wing screw.



1.	**Seat wing screw**	**5.**	**Seat**
2.	**Tail section**	**6.**	**Screw**
3.	**Nylon washer (2)**	**7.**	**Washer**
4.	**Torx screw (2)**	**8.**	**Fuel tank**

Figure 2-63. Tail Section

WINDSCREEN

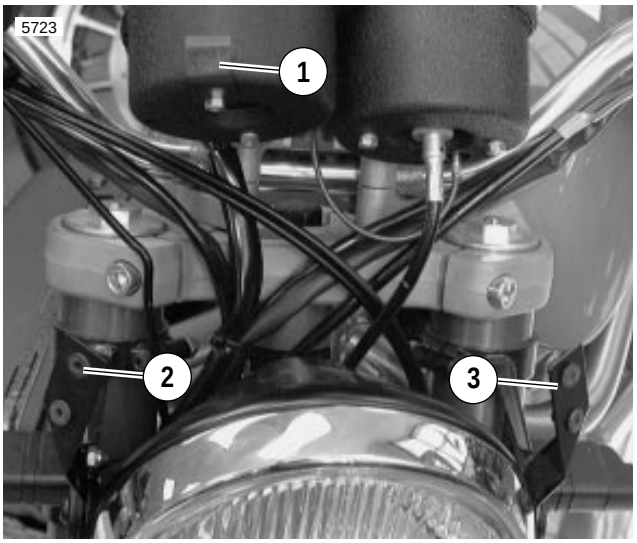
REMOVAL

1. See Figure 2-64. Remove two screws and nylon washers on each side.
2. Detach windscreen from center bracket on tachometer cover. Remove windscreen.
3. If necessary, remove the three windscreen brackets.
   a. See Figure 2-65. Remove center windscreen bracket by removing nut on tachometer cover.
   b. While holding headlamp, remove left and right headlamp adjusting screws (metric). Slide windscreen brackets from between headlamp housing and headlamp brackets.

INSTALLATION

1. If removed, install the three windscreen brackets.
   a. See Figure 2-65. Install center bracket using nut.
   b. Install left and right brackets between headlamp housing and headlamp brackets. Tighten headlamp adjusting screws (metric) 6-8 ft-lbs (8.1-10.8 Nm).
2. Align windscreen on right, left and center brackets. Attach windscreen to center bracket velcro strip.
3. See Figure 2-64. Install two screws and nylon washers on each side.

Figure 2-64. Windscreen, Right Side



1. Center bracket with nut and velcro strip
2. Right bracket
3. Left bracket

Figure 2-65. Windscreen Brackets

SEAT

REMOVAL

1. See Figure 2-66. Detach seat from frame by loosening the wing screw underneath the tail section.

2. Remove seat by pulling up and back.

INSTALLATION

1. See Figure 2-67. Install seat by sliding the metal locating tab on the underside of the seat into the opening on the motorcycle.

⚠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 and personal injury.

2. See Figure 2-66. Fasten seat to frame with wing screw. Tighten securely.

Figure 2-66. Seat Wing Screw

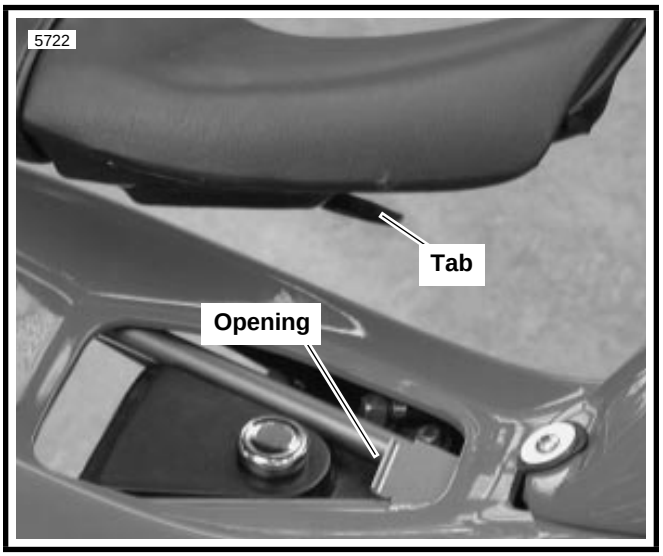


Figure 2-67. Seat Mount

SIDE STAND

GENERAL

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

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.

REMOVAL/DISASSEMBLY

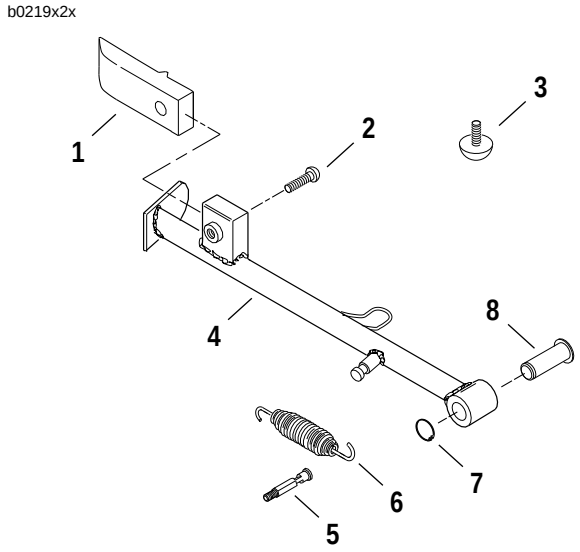
1. See Figure 2-68. Remove spring (6) from side stand and spring pin (5).
2. Remove retaining clip (7) and pivot pin (8). Detach side stand from frame.
3. Remove screw (2) and side stand dragger (1).
4. Remove bumper (3) from frame.

ASSEMBLY/INSTALLATION

1. See Figure 2-68. Attach bumper (3) to frame.
2. Attach side stand dragger (1) to side stand with screw (2).
3. Install side stand using pivot pin (8) and retaining clip (7).
4. Connect spring (6) to side stand and spring pin (5).

⚠WARNING

- **If the side stand is not in the full forward position when vehicle weight is rested on it, the vehicle could fall over, possibly causing personal injury.**
- **Always park motorcycle on a level, firm surface. Vehicle weight could cause motorcycle to fall over, possibly causing personal injury.**
- **Be sure side stand is fully retracted before riding the motorcycle. If side stand is not fully retracted during vehicle operation, it could contact the road surface causing a momentary disturbance before retracting. This momentary disturbance could distract the rider, possibly causing loss of vehicle control and personal injury.**



1.	**Side stand dragger**	**5.**	**Spring pin**
2.	**Screw**	**6.**	**Spring**
3.	**Bumper**	**7.**	**Retaining clip**
4.	**Side stand**	**8.**	**Pivot pin**

Figure 2-68. Side Stand

SPECIFICATIONS

GENERAL		
Number of cylinders	2	
Type	4-cycle, 45°V Twin	
Horsepower	91 @ 5800 RPM	
Torque (foot-pounds)	87 @ 5200 RPM	
Compression ratio	10.0 to 1	
Bore	3.500 in.	88.9 mm
Stroke	3.812 in.	96.82 mm
Piston displacement	73.4 $in.^3$	1203 cc
Oil tank capacity with filter	2.1 quarts	1.90 liters

ENGINE IGNITION SPECIFICATIONS		
Timing during engine cranking	5° BTDC	
Timing with engine at RPM listed below and V.O.E.S. connected	20° BTDC	
Regular idle	950-1050 RPM (49 State)	1150-1250 RPM (Calif.)
Fast idle (all models)	2000 RPM	
Spark plug gap	0.038-0.045 in.	0.96-1.14 mm

NOTE

Service wear limits are given as a guideline for measuring components that are not new. For measurements 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.	0.038-0.084 mm	0.0040 in.	0.102 mm
	Intake	0.008-0.0026 in.	0.020-0.066 mm	0.0035 in.	0.089 mm
Seat width		0.040-0.062 in.	1.02-1.57 mm	0.090 in.	2.29 mm
Stem protrusion from cylinder valve pocket		1.975-2.011 in.	50.17-51.08 mm	2.031 in.	51.59 mm
OUTER VALVE SPRING					
Free length		2.105-2.177 in.	53.47-55.30 mm	2.105 in. (min)	53.47 mm (min)
Intake	1.751-1.848 in. (closed)	72-92 lbs	32.6-41.7 kg		
	1.286-1.383 in. (open)	183-207 lbs	82.9-93.8 kg		
Exhaust	1.751-1.848 in. (closed)	72-92 lbs	32.6-41.7 kg		
	1.332-1.429 in. (open)	171-195 lbs	77.5-88.3 kg		
INNER VALVE SPRING					
Free length		1.926-1.996 in.	48.92-50.70 mm	1.926 in. (min)	48.92 mm (min)
Intake	1.577-1.683 in. (closed)	38-49 lbs	17.2-22.2 kg		
	1.112-1.218 in. (open)	98-112 lbs	44.4-50.7 kg		
Exhaust	1.577-1.683 in. (closed)	38-49 lbs	17.2-22.2 kg		
	1.158-1.264 in. (open)	91-106 lbs	41.2-48.0 kg		

ITEM		NEW COMPONENTS		SERVICE WEAR LIMITS	
ROCKER ARM					
Shaft fit in bushing (loose)		0.0005-0.0020 in.	0.013-0.051 mm	0.0035 in.	0.089 mm
End clearance		0.003-0.013 in.	0.08-0.33 mm	0.025 in	0.64 mm
Bushing fit in rocker arm (tight)		0.004-0.002 in.	0.10-0.05 mm		
ROCKER ARM SHAFT					
Shaft fit in rocker cover (loose)		0.0007-0.0022 in.	0.018-0.056 mm	0.0035 in.	0.089 mm
PISTON					
Compression ring gap (top and 2nd)		0.007-0.020 in.	0.18-0.51 mm	0.032 in.	0.81 mm
Oil control ring rail gap		0.009-0.052 in.	0.23-1.32 mm	0.065 in	1.65 mm
Compression ring side clearance	Top	0.0020-0.0045 in.	0.051-0.114 mm	0.0065 in.	0.165 mm
	2nd	0.0016-0.0041 in.	0.041-0.104 mm	0.0065 in.	0.165 mm
Oil control ring side clearance		0.0016-0.0076 in.	0.041-0.193 mm	0.0094 in.	0.239 mm
Pin fit (loose, at room temperature)		0.00005-0.00045 in.	0.0013-0.0114 mm	0.00100 in.	0.0254 mm
CYLINDER HEAD					
Valve guide in head (tight)		0.0033-0.0020 in.	0.084-0.051 mm		
Valve seat in head (tight)		0.0035-0.0010 in.	0.089-0.025 mm		
Head gasket surface (flatness)		0.006 in. total	0.15 mm total	0.006 in. total	0.15 mm total
CYLINDER					
Taper				0.002 in.	0.05 mm
Out of round				0.003 in.	0.08 mm
Warpage (gasket surfaces)	Top			0.006 in.	0.15 mm
	Base			0.008 in.	0.20 mm
Bore diameter ± 0.0002 in. OS=over size	Standard	3.4978 in.	88.844 mm	3.5008 in.	88.920 mm
	0.005 OS	3.502 in.	88.95 mm	3.505 in.	89.03 mm
	0.010 OS	3.507 in.	89.08 mm	3.510 in.	89.15 mm
	0.020 OS	3.517 in.	89.33 mm	3.520 in.	89.41 mm
	0.030 OS	3.527 in.	89.59 mm	3.530 in.	89.66 mm
CONNECTING ROD					
Piston pin fit (loose)		0.00125-0.00175 in.	0.0318-0.0445 mm	0.00200 in.	0.0508 mm
Side play between flywheels		0.005-0.025 in.	0.13-0.64 mm	0.030 in.	0.76 mm
Fit on crankpin (loose)		0.0004-0.0017 in.	0.010-0.043 mm	0.0027 in.	0.069 mm
TAPPET					
Fit in guide		0.0008-0.0023 in.	0.020-0.058 mm	0.003 in.	0.08 mm
Roller fit		0.0006-0.0013 in.	0.015-0.033 mm		
Roller end clearance		0.008-0.022 in.	0.203-0.599 mm	0.026 in.	0.660 mm
OIL PUMP					
Oil pressure at normal operating temperature	1000 RPM	7-12 PSI	0.5-0.8 kN/cm^2		
	2500 RPM	10-17 PSI	0.7-1.2 kN/cm^2		
Shaft to pump clearance		0.0025 in.	0.064 mm		
Feed/scavenge inner/outer gerotor clearance		0.003 in.	0.08 mm	0.004 in.	0.10 mm

ITEM		NEW COMPONENTS		SERVICE WEAR LIMITS	
GEARCASE					
Cam gear shaft in bushing (loose)		0.0007-0.0022 in.	0.018-0.056 mm	0.003 in.	0.08 mm
Cam gear shaft end play (min) (except rear intake)		0.005-0.024 in.	0.13-0.61 mm	0.025 in.	0.64 mm
Rear intake cam gear shaft end play (min)		0.006-0.024 in.	0.15-0.61 mm	0.040 in.	1.02 mm
FLYWHEEL					
Runout	Flywheels at rim	0.000-0.010 in.	0.00-0.25 mm	0.010 in.	0.25 mm
	Shaft at flywheel end	0.000-0.002 in.	0.00-0.05 mm	0.002 in.	0.05 mm
End play		0.001-0.005 in.	0.025-0.13 mm	0.005 in.	0.13 mm
SPROCKET SHAFT BEARING					
Outer race fit in crankcase (tight)		0.0004-0.0024 in.	0.010-0.061 mm		
Bearing inner race fit on shaft (tight)		0.0002-0.0015 in.	0.005-0.038 mm		
PINION SHAFT BEARINGS					
Pinion shaft jounal diameter		1.2496-1.2500 in.	31.740-31.750 mm	1.2496 in. (min)	31.375 mm (min)
Outer race diameter in right crankcase		1.5646-1.5652 in.	39.741-39.756 mm	1.5672 in. (max)	39.807 mm (max)
Bearing running clearance		0.00012-0.00088 in.	0.0030-0.0224 mm		
Fit in cover bushing (loose)		0.0023-0.0043 in.	0.058-0.109 mm	0.0050 in.	0.127 mm

ITEM	TORQUE		NOTES
Crank pin nut	150-185 ft-lbs	203-251 Nm	LOCTITE 620 RETAINING COMPOUND, page 3-59
Crankcase 1/4 in. screws	70-110 **in-lbs**	7.9-12.4 Nm	page 3-63
Crankcase 5/16 in. screws	15-18 ft-lbs	20-24 Nm	page 3-63
Crankcase cover screws	80-110 **in-lbs**	9.0-12.4 Nm	special pattern to tighten, page 3-46
Cylinder head screws	See note		special pattern to tighten, page 3-20
Cylinder studs	10 ft-lbs	13.6 Nm	install shoulder end down, page 3-63
Front isolator to cylinder head bolt	73-78 ft-lbs	98.9-105.7 Nm	LOCTITE THREADLOCKER 262 (red), page 3-19
Front sprocket nut	150-165 ft-lbs	203-224 Nm	LOCTITE THREADLOCKER 262 (red), page 3-63
Isolator bolt, front	100-110 ft-lbs	135.6-149.1 Nm	page 3-10
Isolator bolts, side	100-110 ft-lbs	135.6-149.1 Nm	LOCTITE THREADLOCKER 262 (red), page 3-10
Oil filter adapter	8-12 ft-lbs	11-16 Nm	LOCTITE THREADLOCKER 242 (blue), page 3-37
Oil pressure signal light switch	5-7 ft-lbs	7-9 Nm	page 3-37
Oil pressure switch wire nut	4-10 **in-lbs**	0.4-1.1 Nm	page 3-37
Oil pump cover screws	125-150 **in-lbs**	14.1-16.9 Nm	page 3-36
Oil pump mounting screws	125-150 **in-lbs**	14.1-16.9 Nm	page 3-36
Pinion shaft nut	35-45 ft-lbs	47-61 Nm	LOCTITE THREAD-LOCKER 262 (red), page 3-46
Rocker box bolts	10-13 ft-lbs	13.6-18 Nm	page 3-21
Rocker box cover screws	10-13 ft-lbs	13.6-18 Nm	page 3-21
Rocker box screws	90-120 **in-lbs**	10.2-13.6 Nm	page 3-21
Rocker box to head bolts	15-18 ft-lbs	20-24 Nm	2 sizes, page 3-21
Swingarm mount block bolts, lower	68-75 ft-lbs	92.2-101.7 Nm	page 3-10
Swingarm mount block bolts, upper	41-45 ft-lbs	55.6-61.0 Nm	page 3-10
Tappet plate screw	80-110 **in-lbs**	9.0-12.4 Nm	page 3-20, page 3-39
Tappet retainer screw	11-15 ft-lbs	20-24 Nm	page 3-20, page 3-39
Tie bar bolts	30-33 ft-lbs	40.7-44.7 Nm	front tie bar uses LOCITITE PST SEALANT, page 3-10

ENGINE

GENERAL

The V^2 Evolution^{TM} 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.

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 tappets, push rods and rocker arms. Hydraulic lifters, located in the tappets, automatically compensate for heat expansion to maintain the no-lash fit of valve train components. Tappets 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 ignition module, ignition coil, and spark plugs. Spark timing is determined by a trigger rotor, magnetic sensing unit and vacuum-operated electric switch.

The trigger rotor has two openings which time the cylinders.

Both spark plugs fire simultaneously each crankshaft revolution. The spark plug in the front cylinder will fire at the end of that cylinder’s compression stroke, igniting the air/fuel mixture in the front cylinder. At the same instant, however, the spark in the rear cylinder will fire ineffectually during the end of that cylinder’s exhaust stroke. During the next engine revolution, the simultaneous firing of the spark plugs will occur during the middle of the front cylinder’s exhaust stroke and at the end of the rear cylinder’s compression stroke (igniting the air/fuel mixture in the rear cylinder).

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 tappets. 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 tappet 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 LUBRICATION SYSTEM on page 3-28 for further 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 DISASSEMBLING ENGINE FOR CYLINDER HEAD REPAIR on page 3-8 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 REMOVING ENGINE CRANKCASE OR COMPLETE ENGINE on page 3-8.

⚠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 TROUBLESHOOTING in Section 1. 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 (8.4 kgN/cm^2) or more and do not indicate more than a 10 psi (0.7 kgN/cm^2) variance between cylinders. See Table 3-1.
8. Inject approximately 1/2 oz. (15 ml) of SAE 30 oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

Table 3-1. Compression Test Results

DIAGNOSIS	TEST RESULTS
Ring trouble.	Compression low on first stroke; tends to build up on the following strokes but does not reach normal; improves considerably when oil is added to cylinder.
Valve trouble.	Compression low on first stroke; does not build up much on following strokes; does not improve considerably with the addition of oil.
Head gasket leak.	Same reaction as valve trouble.

Cylinder Leakage Test

The cylinder leakage test pinpoints engine problems including leaking valves, worn, broken or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume, and measures the percent of leakage from the cylinder.

Use a CYLINDER LEAKDOWN TESTER (Part No. HD-35667) 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
Carburetor intake.	Intake valve leaking.
Exhaust pipe.	Exhaust valve leaking.
Timing inspection hole.	Piston rings leaking. Worn or broken piston. Worn cylinder.
Head gasket.	Leaking gasket.

Diagnosing Smoking Engine or High Oil Consumption

Perform Compression or Cylinder Leakdown Test as described previously. If further testing is needed, remove suspect head(s) and inspect the following:

- Valve guide seals.
- Valve guide-to-valve stem clearance.
- Gasket surface of both head and cylinder.
- Oil return passages for clogging.

STRIPPING MOTORCYCLE FOR ENGINE REPAIR

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 avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

⚠CAUTION

Hold battery cable when loosening battery terminal hardware. Failure to hold cable may cause battery damage.

2. Disconnect both battery cables, negative cable first.
3. Remove seat and fuel tank. See FUEL TANK in Section 4.
4. Remove air cleaner assembly. See AIR CLEANER, REMOVAL in Section 4.
5. Remove exhaust header. See EXHAUST SYSTEM in Section 2.
6. Remove carburetor and manifold. See CARBURETOR, REMOVAL in Section 4.
7. If removing front cylinder, remove ignition coil and horn. See IGNITION COIL in Section 7.
8. Disconnect spark plug cables.

NOTE

At this stage, the lower rocker boxes, the cylinder heads and the cylinders may be removed. See CYLINDER HEAD on page 3-11.

REMOVING ENGINE CRANKCASE OR COMPLETE ENGINE

1. Perform the steps listed above.
2. Remove tail section. See TAIL SECTION, REMOVAL in Section 2.
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 handgrip.
5. Remove REAR FENDER/LOWER BELT GUARD and SPROCKET COVER. See Section 2.
6. Remove rear caliper. See REAR BRAKE CALIPER in Section 2.
7. Detach belt from rear sprocket and remove rear wheel. See REAR WHEEL in Section 2.

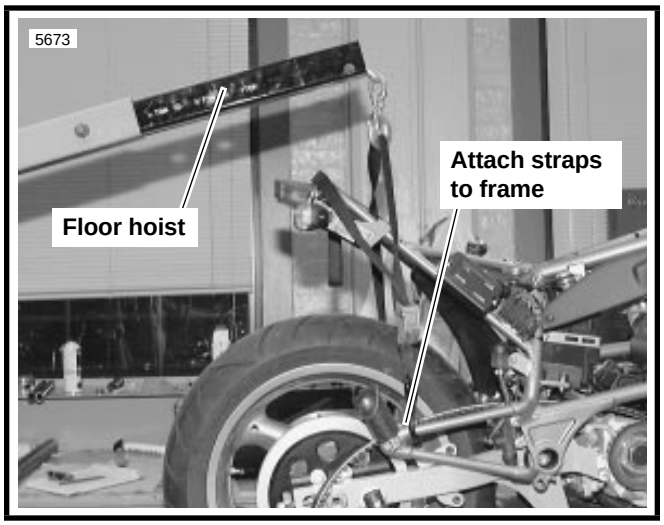


Figure 3-1. Floor Hoist

8. Drain oil tank and remove oil filter. See ENGINE LUBRICATION SYSTEM in Section 1.
9. Disconnect wire to oil pressure signal light switch. See OIL PRESSURE SIGNAL LIGHT SWITCH on page 3-31.
10. Detach feed, vent and return hoses from oil tank. See OIL TANK on page 3-30.
11. Remove both rider footrests from frame. See FOOTRESTS in Section 2.
12. Remove rear shock mounting bolt (metric) from swingarm. Allow rear shock to hang from front mount.
13. Disconnect wiring. See Section 7.
    a. Disconnect neutral switch wire from crankcase.
    b. Unplug ignition timer plate wires from wiring harness.
    c. Disconnect 18-gauge green wire from starter motor.
    d. Disconnect regulator/rectifier from the alternator stator at the plug near the regulator. See VOLTAGE REGULATOR in Section 7.
    e. Disconnect V.O.E.S. wire from ignition module.
14. Remove muffler. See EXHAUST SYSTEM in Section 2.
15. See Figure 3-2. Place a wooden cradle underneath the crankcase.
16. Place a crating strap between the engine cylinders and around the lift. Tighten crating strap until snug.
17. See Figure 3-3. Remove engine ground strap (1) from swingarm mount block.
18. Detach tie bars from frame mounts.
    a. Remove rear tie bar using a swivel socket.
    b. See Figure 3-4. Remove front tie bar (1) and clutch cable clamp.
19. Remove front isolator bolt (6), nut (9), D-washer (8) and washers (7).

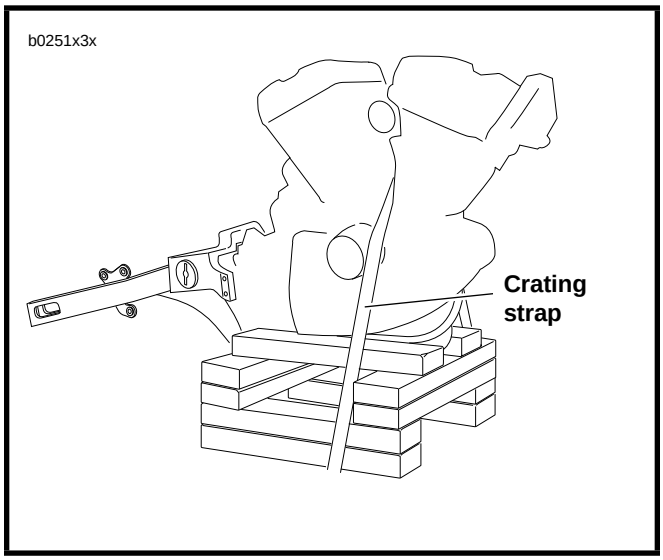


Figure 3-2. Supporting the Engine

20. See Figure 3-3. Remove isolator bolt (7) and lockwasher (6) on each side.

21. 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.

22. Raise frame and walk forward over and away from the engine.

23. If necessary, remove rear swingarm. See SWINGARM in Section 2.

24. If necessary, detach swingarm mount block from power-train by removing bolts (3, 4), washers and locknuts.

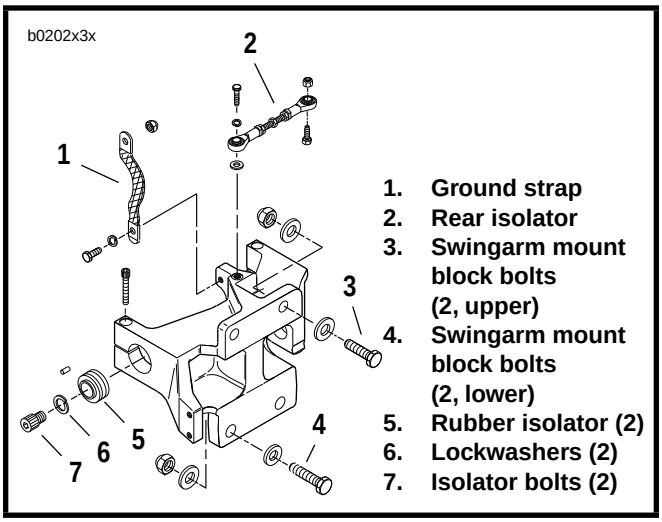


Figure 3-3. Rear Tie Bar Assembly

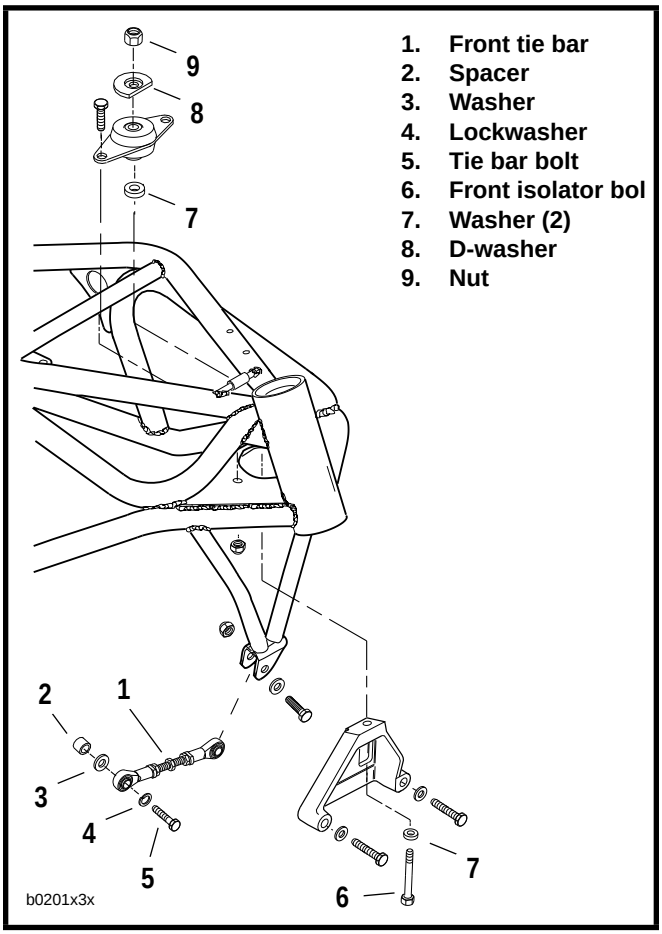


Figure 3-4. Front Tie Bar Assembly

INSTALLING THE ENGINE

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 (55.6-61.0 Nm) and lower bolts to 68-75 ft-lbs (92.2-101.7 Nm).
3. If removed, install swingarm. Adjust swingarm bearing preload. See SWINGARM in Section 2.
4. Remove oil filter (if installed). Walk frame over powertrain.
5. See Figure 3-4. Install front isolator bolt. Attach front isolator mount with bolt (6), washers (7), D-washer (8) and locknut (9). Tighten bolt finger tight.

⚠CAUTION

Isolator bolts must be tightened within 30 minutes of applying LOCTITE THREADLOCKER. Failure to tighten bolts within 30 minutes may cause LOCTITE to set.

6. See Figure 3-3. Apply LOCTITE THREADLOCKER 262 (red) to side isolator bolts (7). Align pins on frame into holes in rubber isolators. Install bolts (7) and lockwashers (6) finger tight.

⚠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.

7. See Figure 3-3. Attach rear tie bar assembly (2). Install bolt, lockwasher, and washer on swingarm mount block. Install bolt and locknut on frame. Tighten bolts to 30-33 ft-lbs (40.7-44.7 Nm).
8. Attach top center tie bar assembly. Install bolt, washer, front tie bar spacer and locknut on ignition mount. Install bolt and locknut on frame. Tighten bolts to 30-33 ft-lbs (40.7-44.7 Nm).
9. See Figure 3-4. Attach front tie bar assembly to engine. Install bolt (5), lockwasher (4), washer (3) and front tie bar spacer (2).
10. See Figure 3-3. Tighten the two side isolator bolts (7) to 100-110 ft-lbs (135.6-149.1 Nm).
11. See Figure 3-4. Tighten front isolator bolt (6) to 100-110 ft-lbs (135.6-149.1 Nm).
12. Connect feed, return and vent lines to oil tank. See OIL HOSE ROUTING on page 3-29. Use **new** hose clamps.
13. Attach battery ground strap to swingarm mount block.
14. Attach clutch cable to handlebar lever.
15. Remove strap from between engine cylinders. Using a floor hoist, lift motorcycle by the frame and remove the wooden cradle from underneath the crankcase.
16. Install rear shock. See REAR SHOCK ABSORBER, INSTALLATION in Section 2. Remove floor hoist straps.
17. Install rear wheel and attach secondary drive belt. See REAR WHEEL, INSTALLATION in Section 2.
18. Install rear brake caliper. See REAR BRAKE CALIPER in Section 2.
19. Attach disconnected wires. See Section 7.
    a. Connect 18-gauge green wire to starter motor.
    b. Plug ignition switch assembly into main harness plug.
    c. Plug regulator/rectifier into stator connection.
    d. Attach ignition sensor to wire harness.
    e. Connect V.O.E.S. to ignition module.
    f. Connect neutral switch.
    g. Connect oil pressure switch wire.
20. Install REAR FENDER/LOWER BELT GUARD and SPROCKET COVER. See Section 2.
21. Install footrests. See FOOTRESTS in Section 2.
22. Continue with the steps listed below.

ENGINE INSTALLATION AFTER CYLINDER HEAD REPAIR

1. Install **new** oil filter, engine oil, and primary chaincase lubricant as necessary. See Section 1.
2. Install carburetor with intake manifold. See CARBURETOR, INSTALLATION in Section 4.
3. Install exhaust system as described under EXHAUST SYSTEM in Section 2.
4. Install air cleaner assembly. See AIR CLEANER, INSTALLATION in Section 4.
5. If removed, install horn and ignition coil. See Section 7.
6. Connect spark plug cables. See SPARK PLUG CABLES in Section 7.

⚠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 producing personal injury.

⚠CAUTION

Hold battery cable when tightening battery terminal hardware. Failure to hold cable may cause battery damage.

7. Install battery. Connect battery cables, positive first.
8. Install tail section, fuel tank and seat. See TAIL SECTION in Section 2.
9. If engine crankcase installation was performed:
    a. Adjust belt according to REAR BELT DEFLECTION in Section 1.
    b. Adjust rear shock spring preload. See REAR PRELOAD ADJUSTMENT in Section 1.
    c. Adjust clutch lever. See CLUTCH in Section 1.
    d. Check rear brake pedal freeplay. See BRAKES in Section 1.
10. Check all electrical components for proper operation.

CYLINDER HEAD

REMOVAL

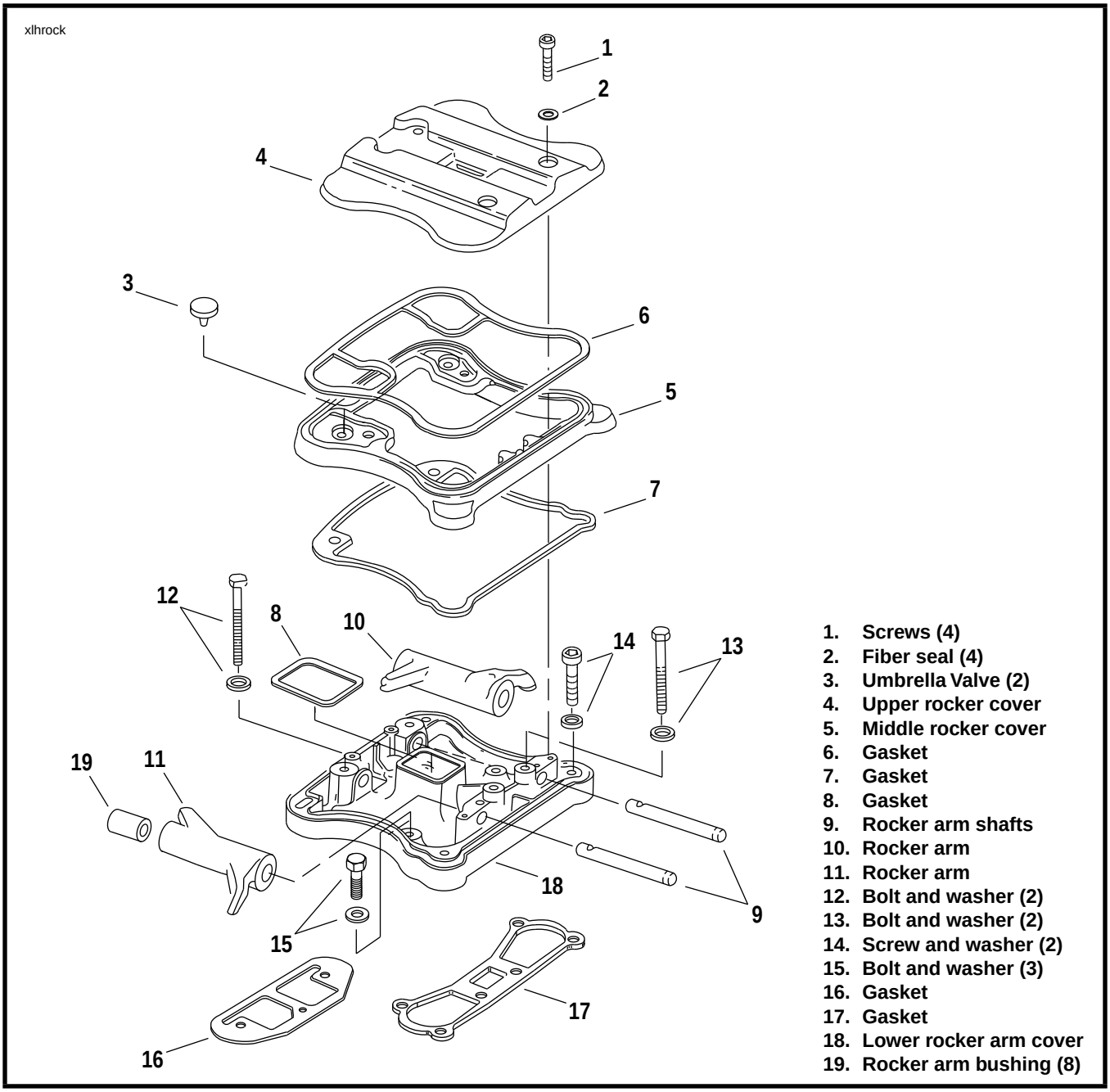
Before removing the cylinder head assembly, see DISASSEMBLING ENGINE FOR CYLINDER HEAD REPAIR on page 3-8. The rocker arm covers and internal components must be removed before removing cylinder heads.

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

CAUTION

All washers and fasteners used in the V^2_{TM} 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 top (4) and middle (5) sections of rocker box. Remove and discard gaskets (6, 7 and 8).



1. Screws (4)
2. Fiber seal (4)
3. Umbrella Valve (2)
4. Upper rocker cover
5. Middle rocker cover
6. Gasket
7. Gasket
8. Gasket
9. Rocker arm shafts
10. Rocker arm
11. Rocker arm
12. Bolt and washer (2)
13. Bolt and washer (2)
14. Screw and washer (2)
15. Bolt and washer (3)
16. Gasket
17. Gasket
18. Lower rocker arm cover
19. Rocker arm bushing (8)

Figure 3-5. Rocker Arm Cover

3. Rotate crankshaft until both valves are closed on head being repaired.
4. Remove two 5/16 in. rocker arm retaining bolts (12) at push rod end.
5. Remove remaining fasteners and washers (13, 14 and 15) holding lower rocker arm cover to cylinder head.
6. Remove lower rocker cover (18).

NOTE

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

⚠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 3-8.

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

⚠CAUTION

See Figure 3-7. 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.

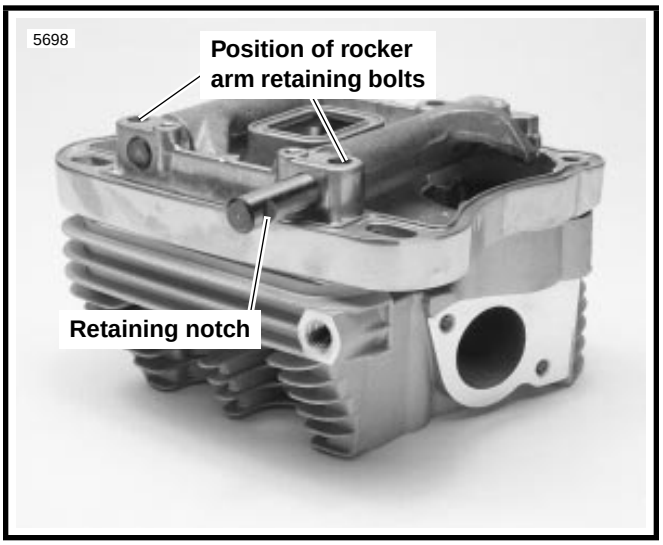


Figure 3-6. Removing Rocker Arm Shafts

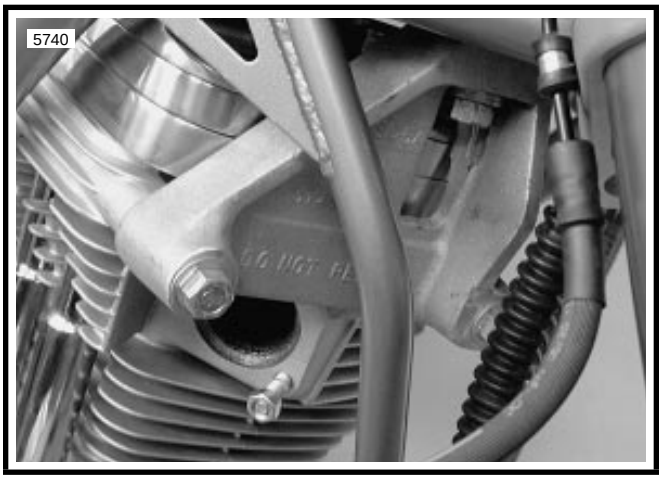


Figure 3-7. Front Isolator Mount Warning

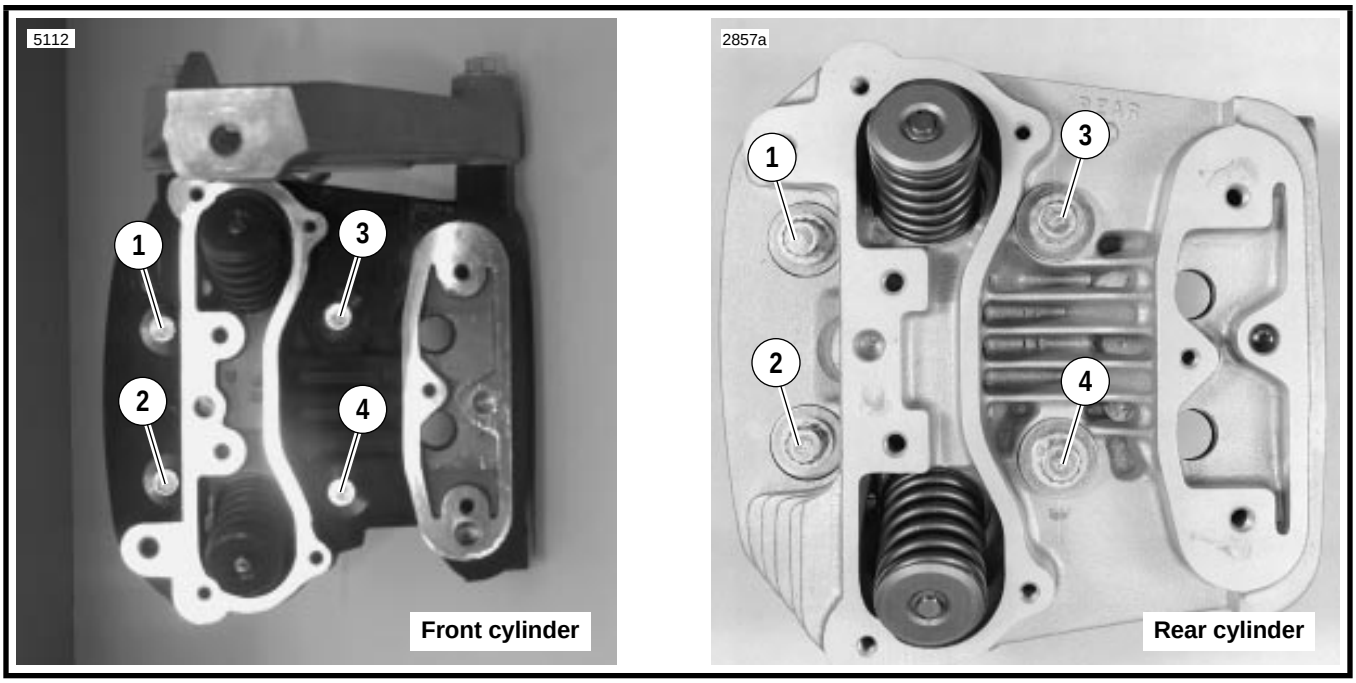


Figure 3-8. Head Screw Loosening/Tightening Sequence

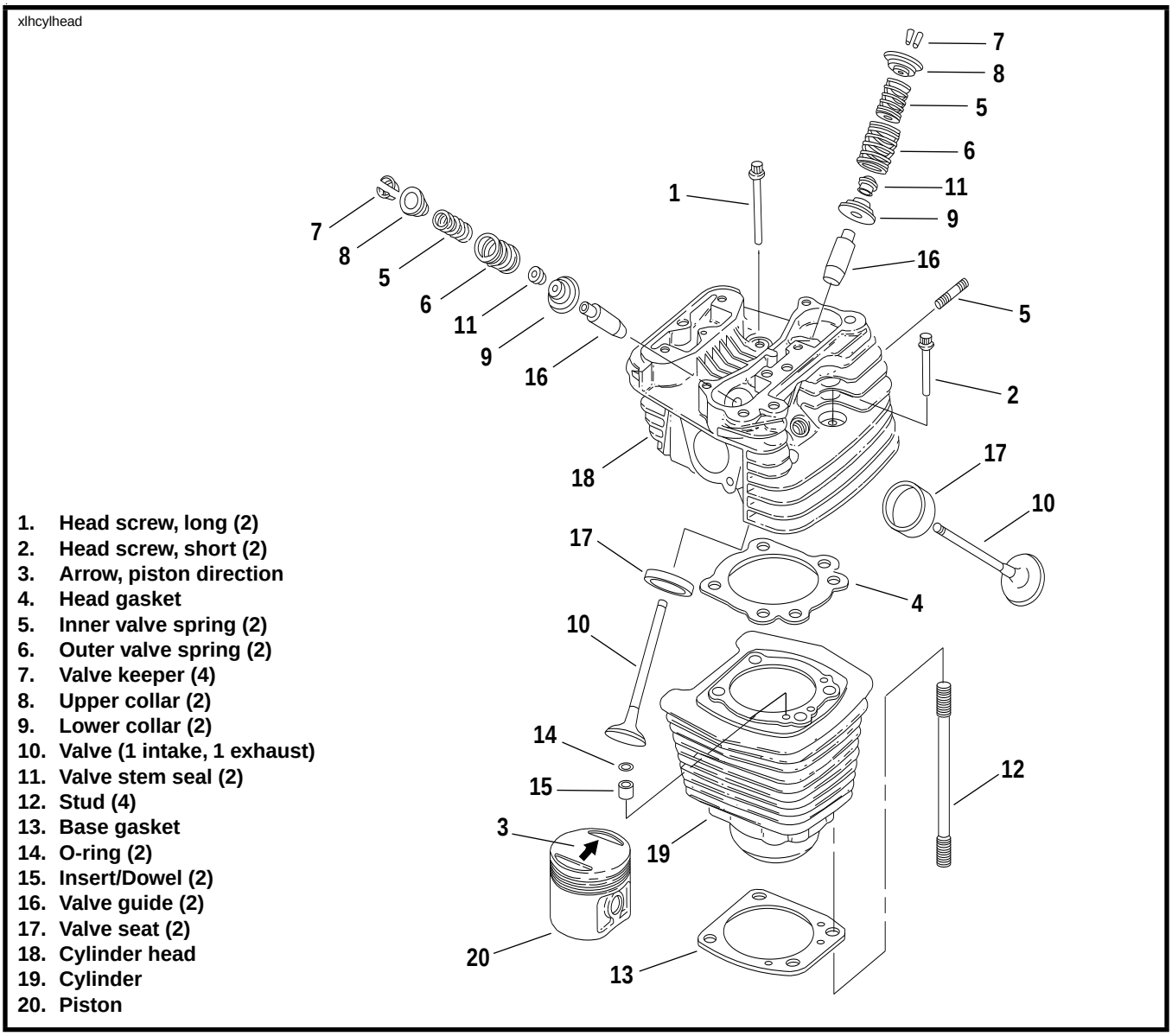


Figure 3-9. Cylinder Head, Cylinder and Piston

10. Support motorcycle under front header mount. Do not allow engine to drop when performing Step 11.
11. Continue loosening in 1/8-turn increments until screws are loose. Remove screws and thick washers.
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.

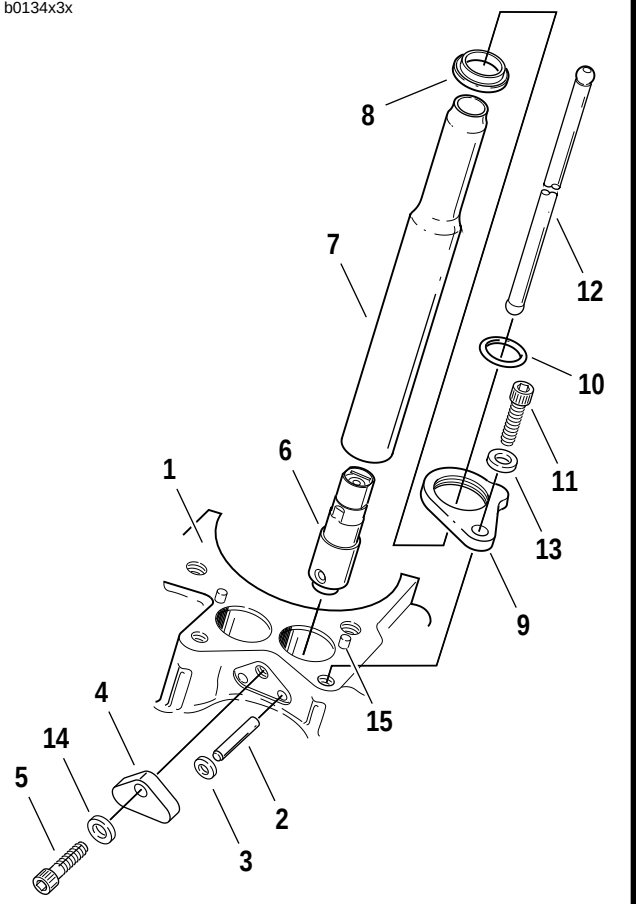
13. See Figure 3-10. Remove socket screws (11), washers (13), and retainers (9). Remove push rod covers (7), seals (8), O-rings (10) and push rods (12). Mark the location and orientation (top and bottom) of each push rod.
14. Remove socket screw (5), washer (14) and plate (4). Remove O-rings (3) from ends of pins (2). Grasp pins (2) and pull from crankcase. Use a pliers if necessary. Remove lifter from crankcase bore.
15. Repeat Steps 1-13 for the other head.

DISASSEMBLY

NOTE

Disassembly of front cylinder exhaust valve components requires front isolator mount removal.

1. See Figure 3-9. Compress valve springs (5, 6) with VALVE SPRING COMPRESSOR (Part No. HD-34736B) (as shown in Figure 3-11.)
2. Remove keepers (7), upper collar (8) and springs (5, 6). Mark keepers for reassembly in original position.
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 Steps 1-5 for the other valve.
6. Disassemble the other head following Steps 1-6.



1.	Right crankcase half	8.	Seal (2)
2.	Pin (2)	9.	Retainer (2)
3.	O-ring (2)	10.	O-ring (2)
4.	Plate	11.	Screw (2)
5.	Screw	12.	Push rod (2)
6.	Tappet lifter (2)	13.	Washer (2)
7.	Push rod cover (2)	14.	Washer
		15.	Locating pin (2)

Figure 3-10. Middle Valve Train Components (Quantities per Engine Cylinder)

CLEANING, INSPECTION AND REPAIR

1. Bead blast or scrape carbon from head, top of cylinder and valve ports. Be careful to avoid scratching or nicking cylinder head and cylinder joint faces. Blow off loosened carbon or dirt with compressed air.
2. Soak cylinder head in an aluminum-compatible cleaner/solvent to loosen carbon deposits.
3. Wash all parts in non-flammable solvent, followed by a thorough washing with hot, soapy water. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem using a wire wheel. Never use a file or other hardened tool which could scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool.
4. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.

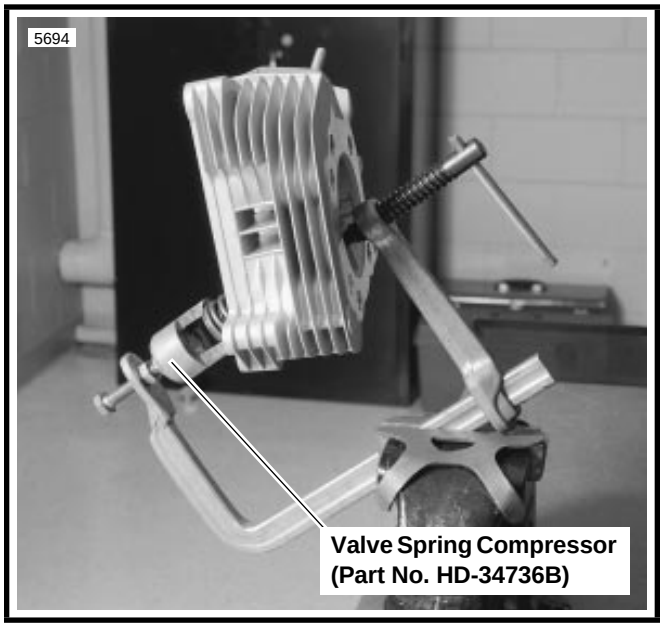


Figure 3-11. Compressing Valve Springs

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

5. See Figure 3-12 and Figure 3-13. Measure rocker arm shaft diameter at the positions where shaft fits in lower rocker arm cover and where rocker arm bushings ride. Record the measurements.
6. See Figure 3-14 and Figure 3-15. Measure rocker arm shaft bore diameter in lower rocker cover and rocker arm bushing inner diameter. Record the measurements.
7. Check the clearances and measurements obtained in Steps 5 and 6 against the SERVICE WEAR LIMITS. Repair or replace parts exceeding the SERVICE WEAR LIMITS.
8. Assemble rocker arms and rocker arm shafts into lower rocker cover.

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

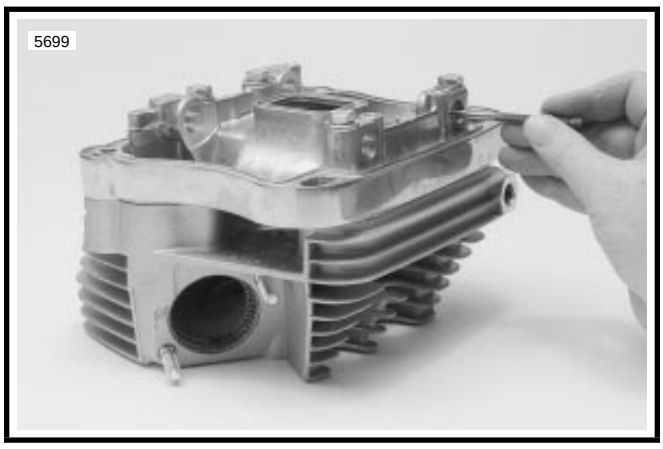


Figure 3-14. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover

9. Check end play of rocker arm with feeler gauge.
10. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.63 mm).
11. Valve heads should have a seating surface width of 0.040-0.062 in. (1.02-1.57 mm), and should be free of pit marks and burn spots. The color of carbon on exhaust valves should be black or dark brown. White or light buff carbon indicates excessive heat and burning.
12. Valve seats are also subject to wear, pitting, and burning. They should be resurfaced whenever valves are refinished.
13. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).
14. Scrub guides with VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water. Measure valve stem outer diameter and valve guide inner diameter. Check measurements against SERVICE WEAR LIMITS.

Figure 3-15. Measuring Rocker Arm Bushing Inner Diameter

15. Inspect spark plug threads for damage. If threads in head are damaged, a special plug type insert can be installed using a 12 mm spark plug repair kit.
16. Inspect valve springs for broken or discolored coils.
17. See Figure 3-16. Check free length and compression force of each spring. Compare with SPECIFICATIONS. If spring length is shorter than specification, or if spring compression force is below specification, replace spring.
18. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored, or broken.
19. See Figure 3-17. Check head gasket surface on head for flatness. Machine or replace any head which exceeds SERVICE WEAR LIMIT of 0.006 in. (0.15 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.

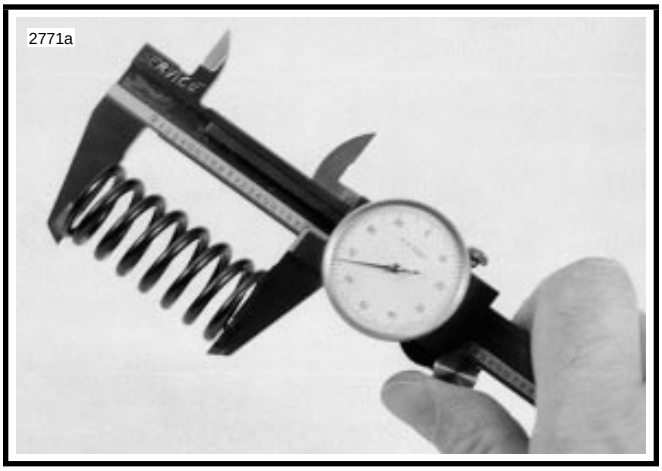


Figure 3-16. Checking Spring Free Length

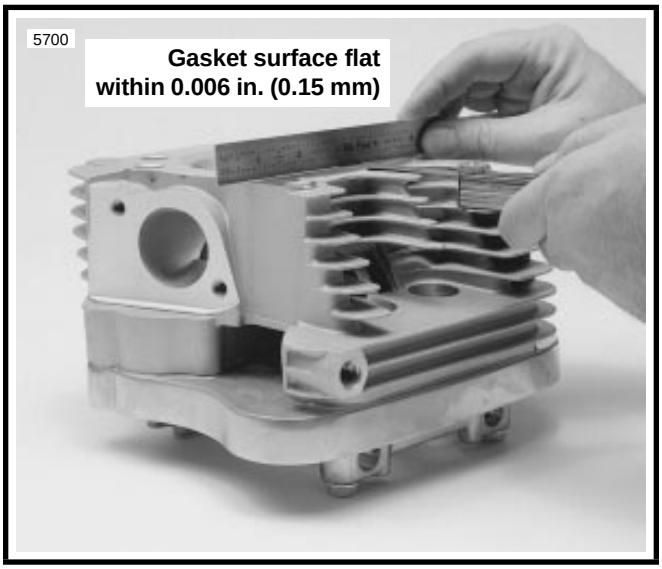


Figure 3-17. Checking Gasket Surface

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 service wear 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.	0.0040 in.
Intake	0.008-0.0026 in.	0.0035 in.

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

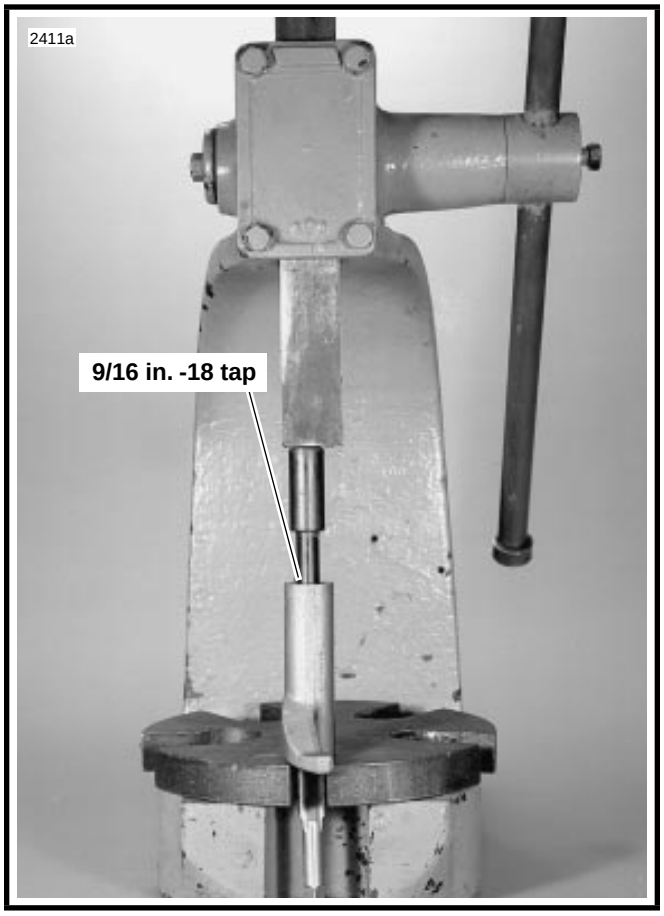


Figure 3-18. Removing Rocker Arm Bushing

3. Measure outer diameter of a new standard valve guide. The guide diameter should be 0.0020-0.0033 in. (0.051-0.084 mm). larger than bore in head. If it is not, select one of the following oversizes: +0.001 in., +0.002 in., or +0.003 in. (+0.025, +0.05 +0.08 mm) (intake and exhaust).
4. See Figure 3-19. Install shoulderless guides using VALVE GUIDE INSTALLATION TOOL (Part No. HD-34731) and DRIVER HANDLE (Part No. HD-34740). Press or drive guide until the tool touches the machined surface surrounding the guide. At this point, the correct guide height has been reached.
5. Ream guides to final size or within 0.0010 in. (0.025 mm) of final size using VALVE GUIDE REAMER (Steel, Part No. HD-39932 or Carbide, Part No. HD-39932-CAR). Use REAMER LUBRICANT (Part No. HD-39964) or liberal amounts of suitable cutting oil to prevent reamer chatter.
6. See Figure 3-20. Apply the proper surface finish to the valve guide bores using the VALVE GUIDE HONE (Part No. HD-34723). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60°.

NOTE

The hone is not intended to remove material.

7. Thoroughly clean valve guide bores using VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water.

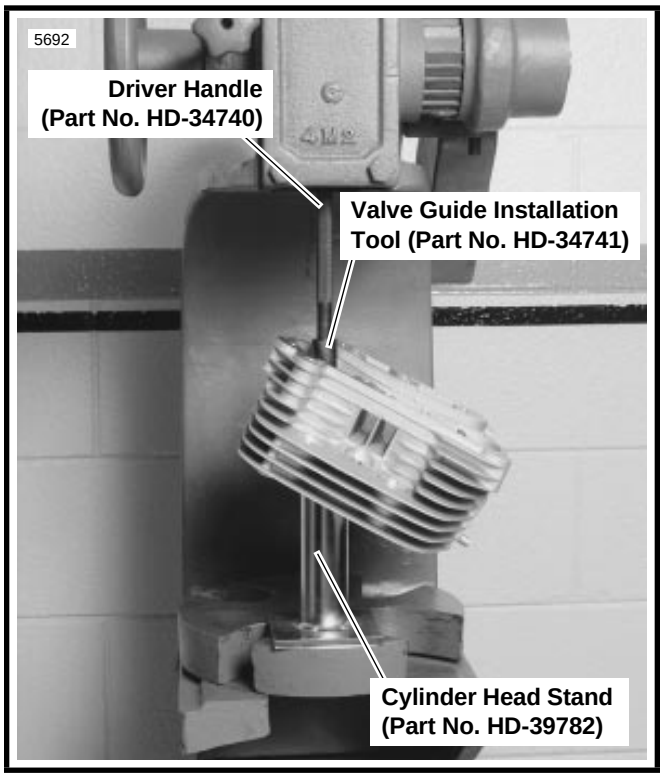


Figure 3-19. Installing Shoulderless Valve Guide

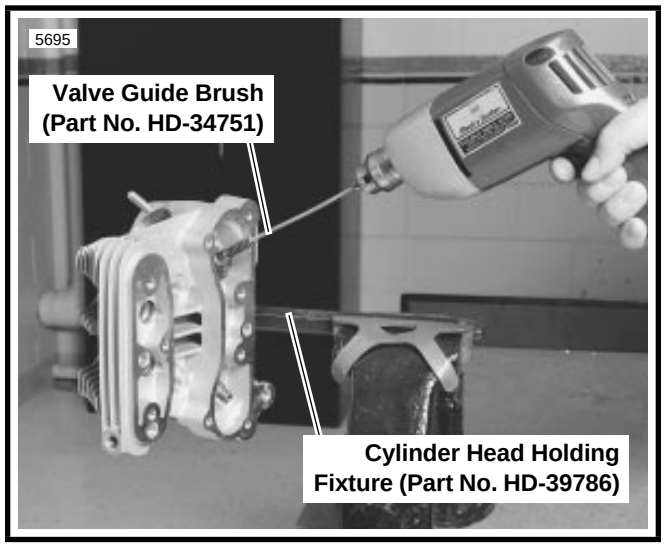


Figure 3-20. Honing Valve Guides

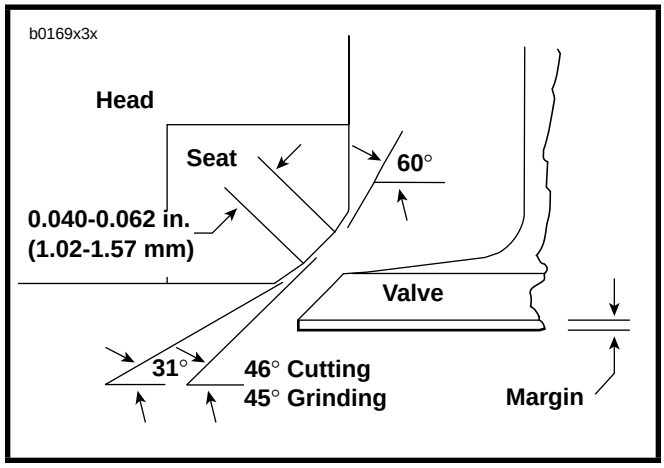


Figure 3-21. Valve Seat Angles

Grinding Valve Faces and Seats

After installing valve guides, valve seats must be refaced 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 a NEWAY VALVE SEAT CUTTER (Part No. 444-HDF; part of 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. (1.02-1.57 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. (1.02-1.57 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 3-22. Wipe valve seats and valve faces clean. Measure valve stem protrusion. If valve stem protrudes more than 2.034 in. (51.66 mm), replace valve seat or cylinder head. If valve stem protrusion is within the acceptable range, valves and seats are ready for lapping.

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 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 3-23. Apply a light coat of fine lapping compound to valve face. Insert valve in guide. Position one rubber cup end of VALVE LAPPING TOOL (Part No. HD-96550-36A) onto head of valve. Holding lapping tool as shown, apply only very light pressure against valve head, and 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 with a **new**, clean cloth or towel.
5. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated. If lapped finish is not complete, further lapping (or grinding and lapping) is necessary.

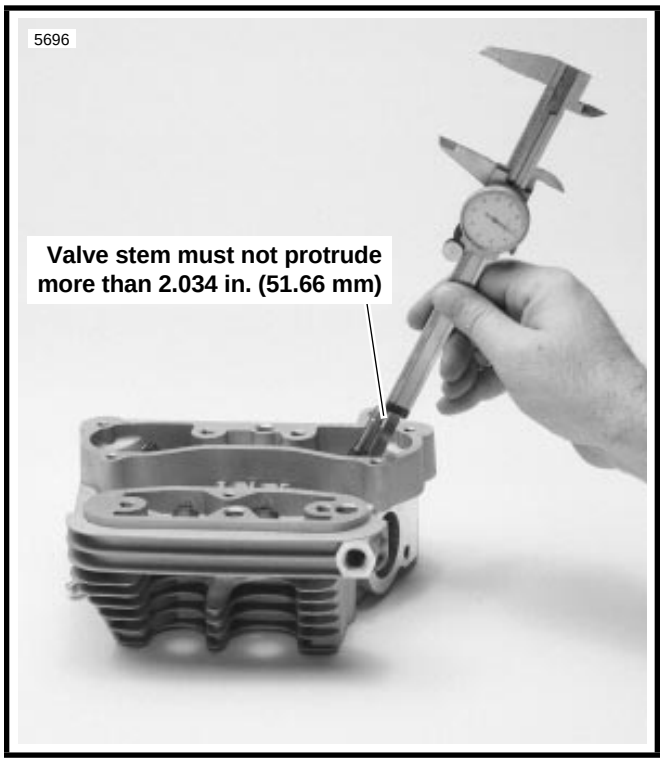


Figure 3-22. Measuring Valve Stem Protrusion

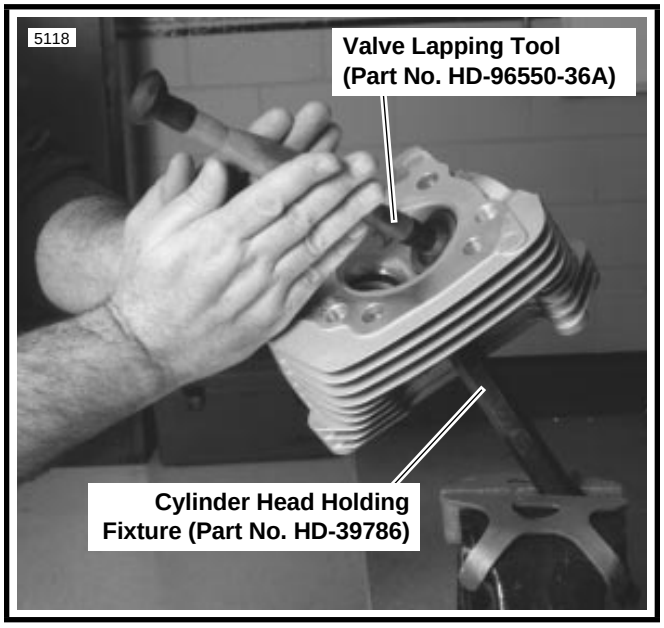


Figure 3-23. Lapping Valves

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 3-24. Insert valve into guide and install lower collar (4).
6. See Figure 3-25. 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

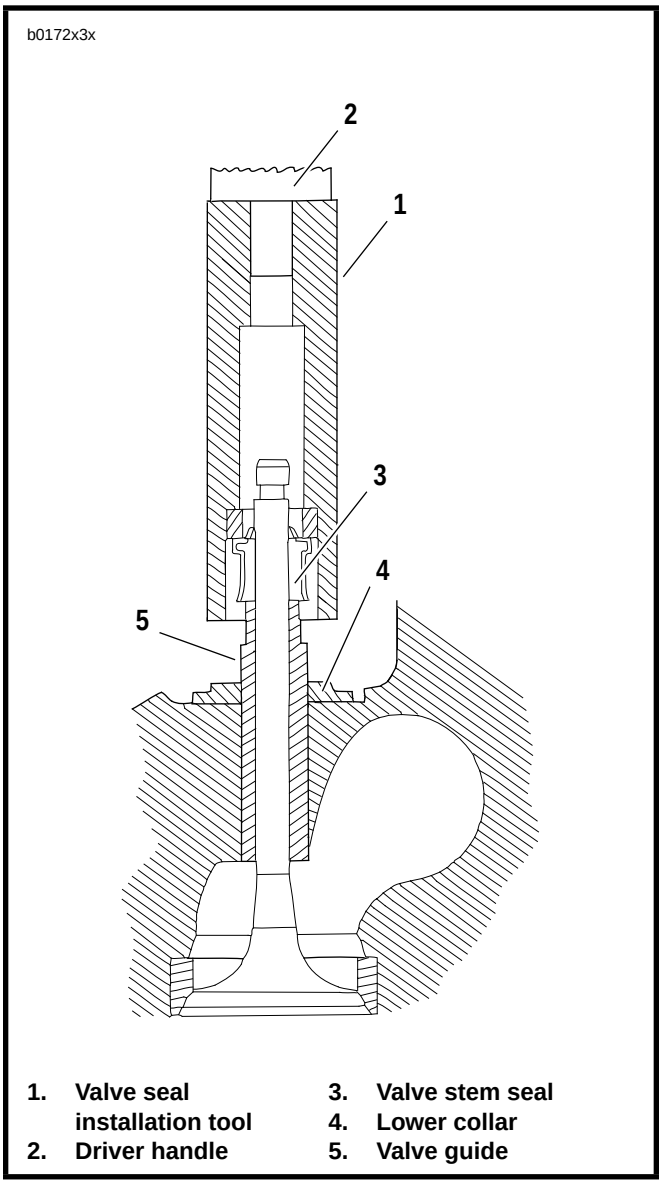
- **Always use a protective sleeve on the valve stem keeper groove when installing valve stem seal. If the seal is installed without using the protective sleeve, the seal will be damaged.**
- **Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.**

7. See Figure 3-24. Tap the seal onto the guide 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 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).

NOTE

If front isolator mount was removed from front cylinder, reinstall in the following manner.

13. Coat **new** bolts with LOCTITE THREADLOCKER 262 (red). Tighten bolts to 73-78 ft-lbs (98.9-105.7 Nm).



1. **Valve seal installation tool**
2. **Driver handle**
3. **Valve stem seal**
4. **Lower collar**
5. **Valve guide**

Figure 3-24. Valve Seal Installation

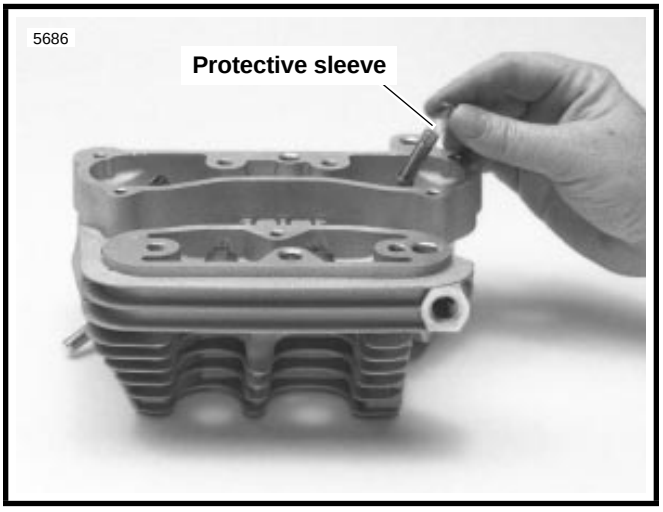


Figure 3-25. Valve Guide Seal Protector Sleeve

INSTALLATION

If only cylinder head work was needed, reinstall cylinder head following these instructions. If further repair is required, see CYLINDER AND PISTON on page 3-22.

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).

⚠CAUTION

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.
10. Install head screws (1, 2) finger tight.

⚠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.

11. See Figure 3-8. For each cylinder head, start with screw numbered one, as shown. In increasing numerical sequence (i.e. – 1, 2, 3 and 4), tighten head screws in three stages:

FIRST STAGE: Tighten each screw to 7-9 ft-lbs (9-12 Nm).

SECOND STAGE: Tighten each screw to 12-14 ft-lbs (16-19 Nm).

THIRD STAGE: See Figure 3-26. Mark cylinder head and head screw shoulder with a line as shown (View A). Tighten each screw a 1/4-turn (90°) (View B).

12. See Figure 3-10. Rotate engine so that both tappets (6), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.

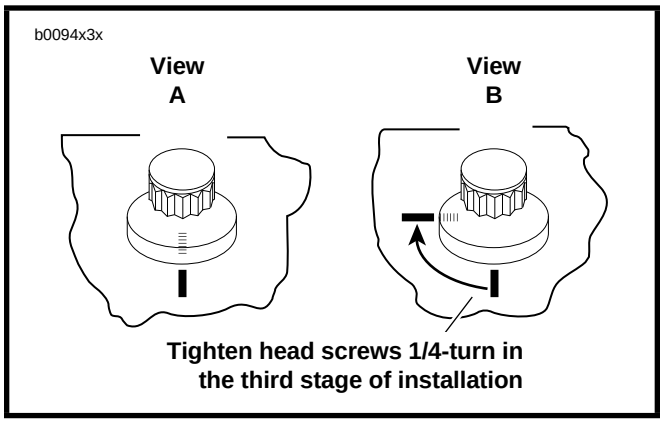


Figure 3-26. Tightening Head Screws

13. Apply a liberal amount of engine oil to tappet assembly (especially roller needles) for smooth initial operation.
14. Insert tappet (6) into bore in crankcase (1). Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, pins (2) cannot be inserted.
15. Insert pins (2) in the holes in crankcase. Place **new** O-rings (3) over ends of pins. Install plate (4) using screw (5) with washer (14). Tighten screw (5) to 80-110 **in-lbs**. (9.0-12.4 Nm).
16. Slide **new** seal (8), and place retainer (9), over top of push rod cover (7). Position **new** O-ring (10) at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer (9) with seal (8) onto crankcase, aligning locating pin (15) with hole in retainer.
17. Insert screw (11) with washer (13) through hole in retainer (9), and thread into tapped hole in crankcase. Tighten screw (11) to 15-18 ft-lbs (20-24 Nm).
18. Identify push rod color coding, length and respective push rod positions in engine. See Table 3-4. Place intake and exhaust push rods (1, 2) onto seat at top of tappet (6).

Table 3-4. Push Rod Selection Table

POSITION	COLOR CODE, PART NUMBER, LENGTH
Exhaust (Front & Rear)	3 Band - Pink, 17904-89, 10.800 in.
Intake (Front & Rear)	1 Band - Brown, 17897-89, 10.746 in.

19. 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.

20. See Figure 3-5. 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. Tighten screws (14) to 90-120 **in-lbs** (10.2-13.6 Nm). Tighten bolts (15) to 10-13 ft-lbs (13.6-18 Nm). Tighten bolts (12, 13) to 15-18 ft-lbs (20-24 Nm). See Table 3-5.

Table 3-5. Rocker Arm Cover Hardware

ITEM (NUMBER)	QTY	SIZE	TORQUE
Bolt (12)	2	5/16-18 X 2-3/4	15-18 ft-lbs (20-24 Nm)
Bolt (13)	2	5/16-18 X 2-1/2	
Screw (14)	2	1/4-20 X 1-1/2	90-120 **in-lbs** (10.2-13.6 Nm)
Bolt (15)	3	1/4-20 X 1-1/4	10-13 ft-lbs (14-18 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 (Part No. SS-306G) to correctly assemble.

21. Place **new** gasket (7), middle rocker cover (5), (with breather valve on intake side) **new** gasket (6) and upper rocker cover (4) on lower rocker box. Install screws (1) with **new** fiber seals (2). Tighten screws (1) to 10-13 ft-lbs (14-18 Nm).

Repeat above procedures for other cylinder.

CYLINDER AND PISTON

REMOVAL/DISASSEMBLY

1. Strip motorcycle as described under DISASSEMBLING ENGINE FOR CYLINDER HEAD REPAIR on page 3-8.
2. Remove cylinder head as described under CYLINDER HEAD, REMOVAL on page 3-11.
3. Clean crankcase around base of cylinder to prevent dirt and debris from entering crankcase while removing cylinder.
4. See Figure 3-27. Turn engine over until one piston (3) is at bottom of its stroke.
5. Carefully raise cylinder just enough to permit placing clean towel under piston to prevent any foreign matter from falling into crankcase.

NOTE

If cylinder does not come loose, tap lightly with plastic hammer. Never try to pry cylinder up.

6. Carefully lift cylinder over piston and studs. Do not allow piston to fall against cylinder studs. Discard cylinder base gasket (5).

⚠CAUTION

With cylinder removed, be careful not to bend the studs. The slightest bend could cause a stress riser and lead to stud failure.

7. Install a 6 in. (150 mm) length of 1/2 in. (12.7 mm) ID plastic or rubber hose over each stud. This will protect the studs and the pistons.

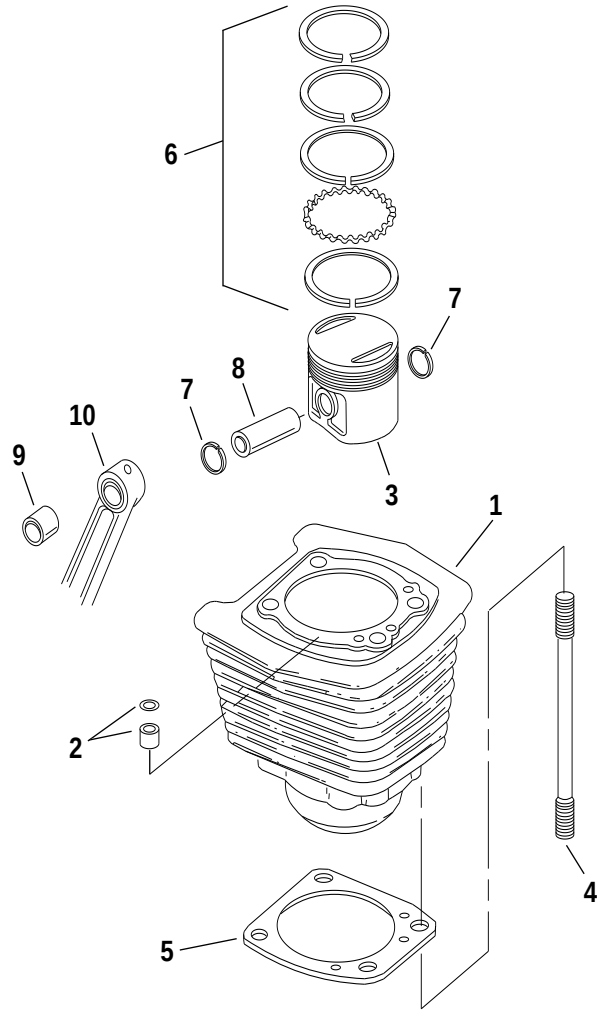
⚠WARNING

The next step covers removing the piston pin retaining rings. These rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove. Safety glasses or goggles must be worn while removing or installing retaining rings or personal injury may occur.

⚠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.



1. Cylinder
2. Dowel (2) and O-ring (2)
3. Piston
4. Stud (4)
5. Gasket
6. Ring set
7. Retaining ring (2)
8. Piston pin
9. Piston pin bushing
10. Connecting rod

Figure 3-27. Cylinder and Piston

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 3-28. 1200cc piston pins are stamped with a V-groove at one end.

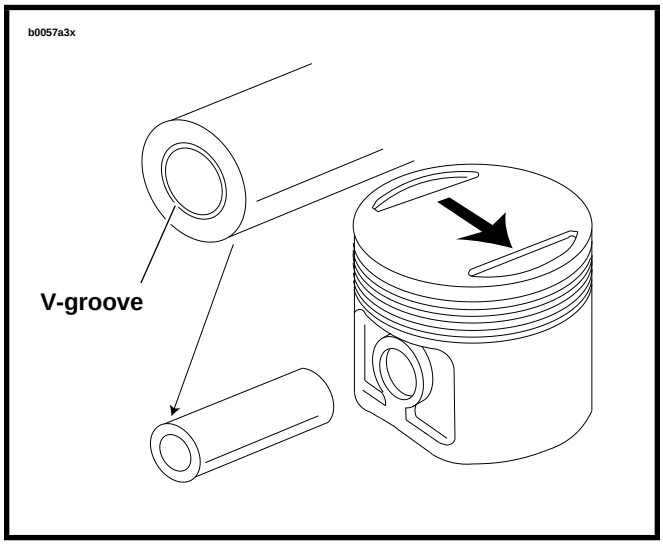


Figure 3-28. Piston Pin and Piston Identification

9. Mark each pin boss with either an “F” or an “R” to indicate front or rear cylinder, respectively. See Figure 3-28. The arrow at the top of 1200cc 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. Spread piston rings (6) outward until they clear grooves in piston (3) and lift off.

CLEANING, INSPECTION AND REPAIR

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 piston pin properly fitted to upper connecting rod bushing has a 0.00125 to 0.00175 in. (0.0317-0.0444 mm) clearance in bushing. If piston pin-to-bushing clearance exceeds 0.00200 in. (0.0508 mm), replace worn parts. See CONNECTING ROD BUSHING on page 3-26.
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 3-29. Check that cylinder top (head) gasket surface is flat within 0.006 in. (0.15 mm). Lay a straight edge across the surface, then try to insert a feeler gauge between the straightedge and the gasket surface.
2. Check that the cylinder base gasket surface is flat within 0.008 in. (0.20 mm). Lay a straightedge across the surface, then try to insert a feeler gauge between the straightedge and the gasket surface.

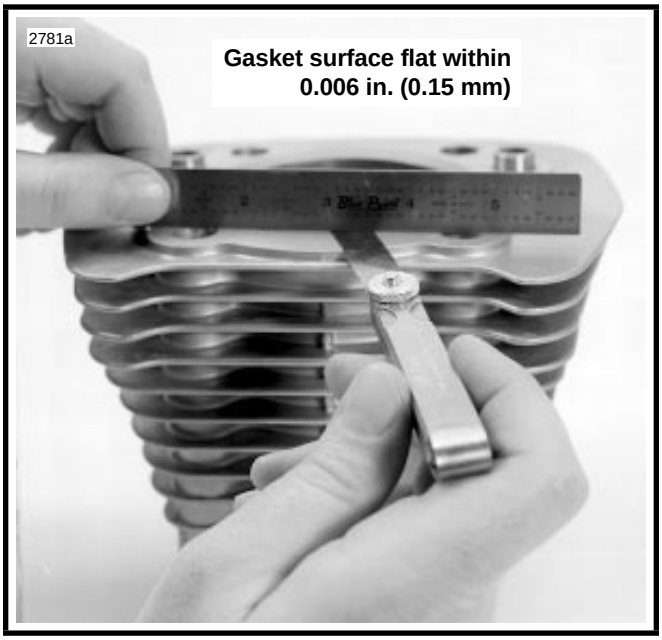


Figure 3-29. Checking Gasket Surfaces

Measuring Cylinder Bore

1. Remove any burrs from the cylinder gasket surfaces.

2. See Figure 3-30. Install a head and base gasket, and CYLINDER TORQUE PLATES (Part No. HD-33446A) and TORQUE PLATE BOLTS (Part No. HD-33446-86). Tighten the bolts using the same method used when installing the cylinder head screws. See CYLINDER HEAD, INSTALLATION on page 3-20.

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. (13 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 3-25.

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. (0.018 mm) See SPECIFICATIONS.

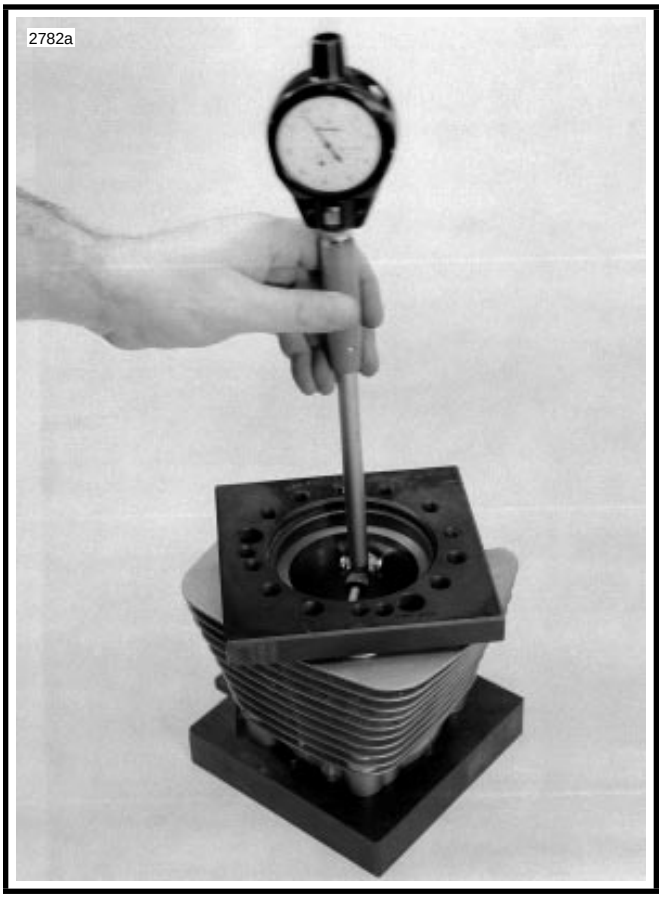


Figure 3-30. Measuring Cylinder Bore Using Torque Plates (Part No. HD-33446A)

Table 3-6. 1200cc Cylinder Bore Service Wear Limits

BORE SIZES	IN.	MM
Standard Bore	3.5008	88.920
0.005 in. OS bore (0.13 mm)	3.5050	89.027
0.010 in. OS bore (0.25 mm)	3.5100	89.154
0.020 in. OS bore (0.51 mm)	3.5200	89.408
0.030 in. OS bore (0.76 mm)	3.5300	89.662

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. (0.13 mm) oversize piston will have the proper clearance with a bore size of 3.502 in. ± 0.0002 in. (88.95 mm ± 0.005 mm) for the 1200cc engine.

Boring and Honing Cylinder

1. The cylinder must be bored with gaskets and torque plates attached. Bore the cylinder to 0.003 in. (0.08 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.

Table 3-7. Final Cylinder Bore Sizes

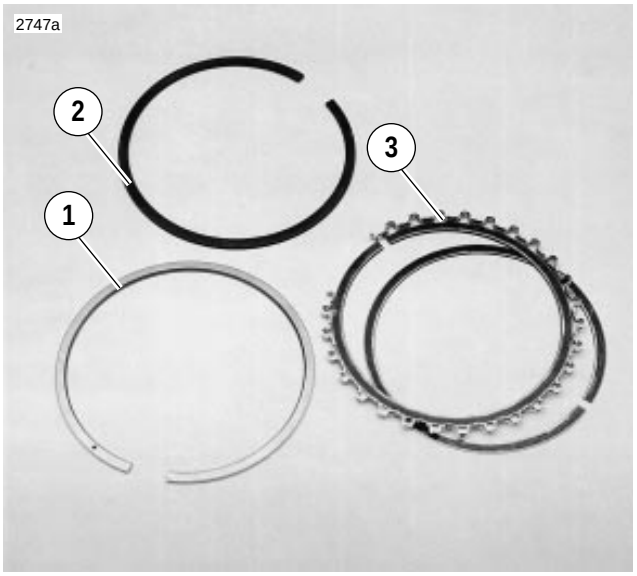
BORE SIZES	IN.	MM
Standard bore*	3.4978 in.	88.844 mm
0.005 in. OS bore (0.13 mm)	3.502 in.	88.95 mm
0.010 in. OS bore (0.25 mm)	3.507 in.	89.08 mm
0.020 in. OS bore (0.51 mm)	3.517 in.	89.33 mm
0.030 in. OS bore (0.76 mm)	3.527 in.	89.59 mm

*All bore sizes + 0.0002 in. (0.005 mm)

When cylinder requires oversize reboring to beyond 0.30 in. (0.76 mm), the oversize limit has been exceeded and cylinder must be replaced.

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.



1. **Top compression ring – Install either side up**
2. **Second compression ring – Install dot toward top**
3. **Oil control rings**

Figure 3-31. Piston Rings

Fitting Piston Rings

NOTE

Ring sets and pistons, 0.040 in. (1.02 mm) oversize, are not available on 1200cc engines.

See Figure 3-31. Piston rings are of two types: compression and oil control. The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward. Ring sets are available to fit standard and oversize pistons.

Piston ring sets must be properly fitted to piston and cylinder:

1. See Figure 3-32. 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 SPECIFICATIONS for tolerance.

NOTE

See SERVICE WEAR LIMITS for end gap dimensions. Do not file rings to obtain proper gap.

2. See Figure 3-33. Apply engine oil to piston grooves. Use TRANSMISSION SHAFT RETAINING RING PLIERS (Part No. J-5586) to slip compression rings over piston into their respective grooves. Be extremely careful not to over expand, twist rings, or damage piston surface when installing rings.

NOTE

Install second compression ring with dot towards top.

3. See Figure 3-34. 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 3-35. Check for proper side clearance with thickness gauge, as shown. See 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.

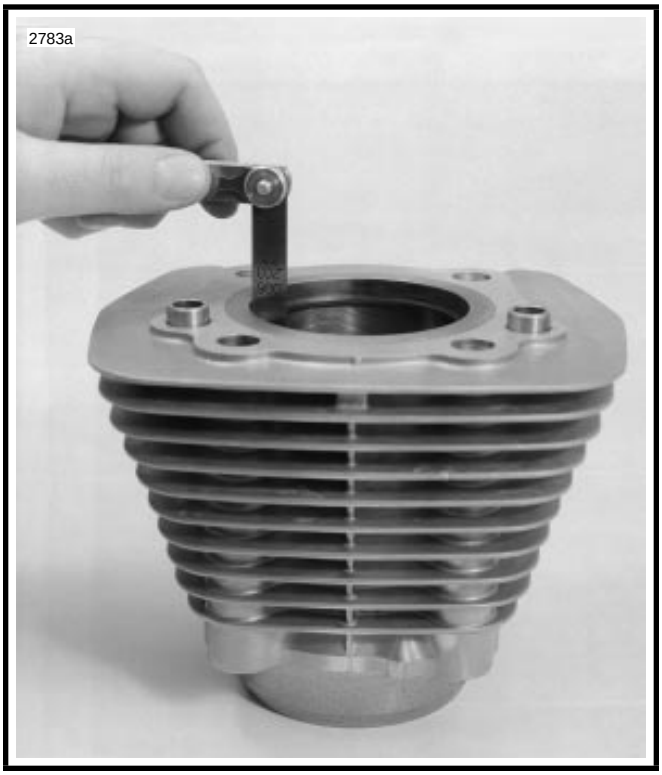


Figure 3-32. Measuring Ring End Gap

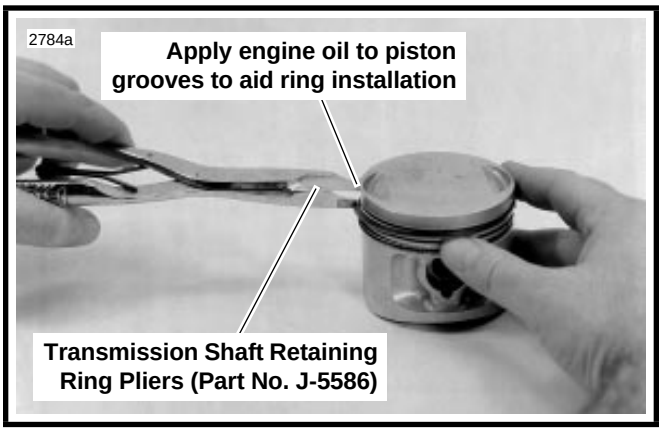


Figure 3-33. Installing Piston Rings

Connecting Rod Bushing

REMOVAL/INSTALLATION

When connecting rod bushing is worn to excessive pin clearance (0.002 in. or more) (0.05 mm) it must be replaced.

1. See Figure 3-37. Install plastic hoses over studs.
2. Secure connecting rod with CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33A).

NOTE

If CONNECTING ROD CLAMPING TOOL holes are too small, enlarge the holes in the tool.

3. See Figure 3-36. Attach PISTON PIN BUSHING TOOL (Part No. HD-95970-32C) to the connecting rod (receiver cup on one side of the rod and the driver on the opposite side) as shown.

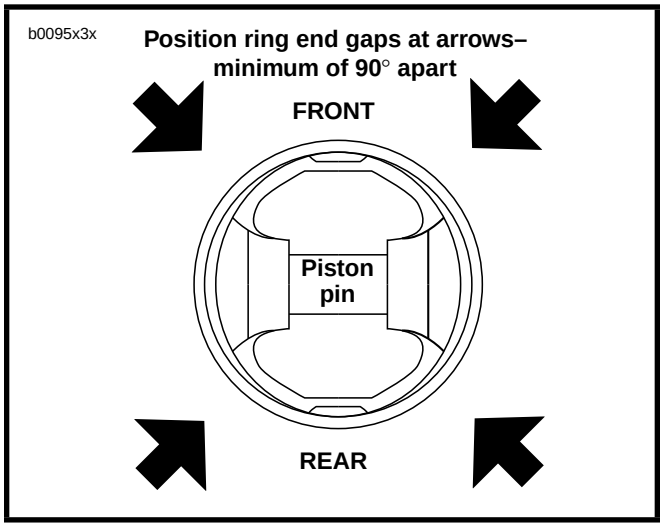


Figure 3-34. Ring End Gap Position

Figure 3-35. Measuring Ring Clearance in Groove

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. See Figure 3-37. 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. (0.025-0.013 mm) undersize using REAMER (Part No. HD-94800-26A). Sizing bushing with less than 0.00125 in. (0.0317 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.

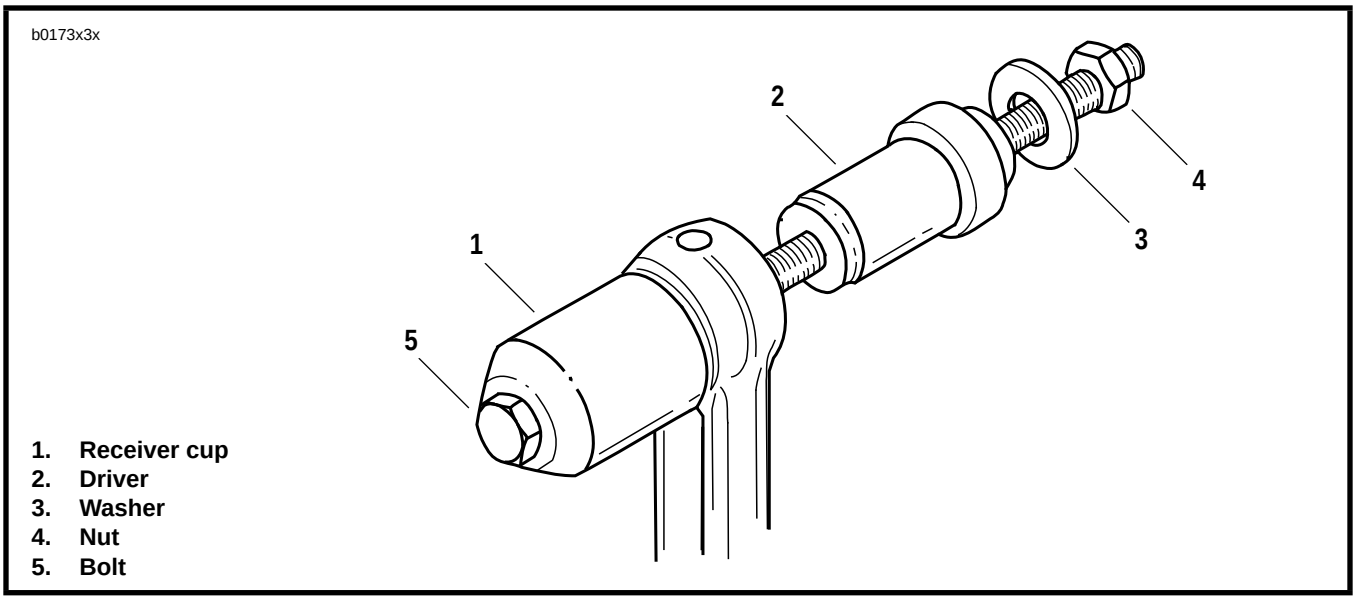


Figure 3-36. Piston Pin Bushing Tool Assembly for Bushing Removal

REPAIR

⚠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.

ASSEMBLY/INSTALLATION

1. Install piston assembly over connecting rod.

NOTE

New 1200cc pistons must be installed with the arrow, at the top of the piston, pointing towards the front of the engine.

2. Install piston pin.

⚠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.

3. Install **new** piston pin retaining rings with the PISTON PIN RETAINING RING INSTALLER (Part No. HD-34623A). Make sure the ring groove is clean and that the ring is fully seated in the groove with the gap away from the slot at the bottom.
4. See Figure 3-34. Make sure the piston ring end gaps are properly positioned as shown.
5. Lubricate cylinder wall, piston, pin and rod bushing with engine oil.
6. Turn engine until piston is at top dead center.

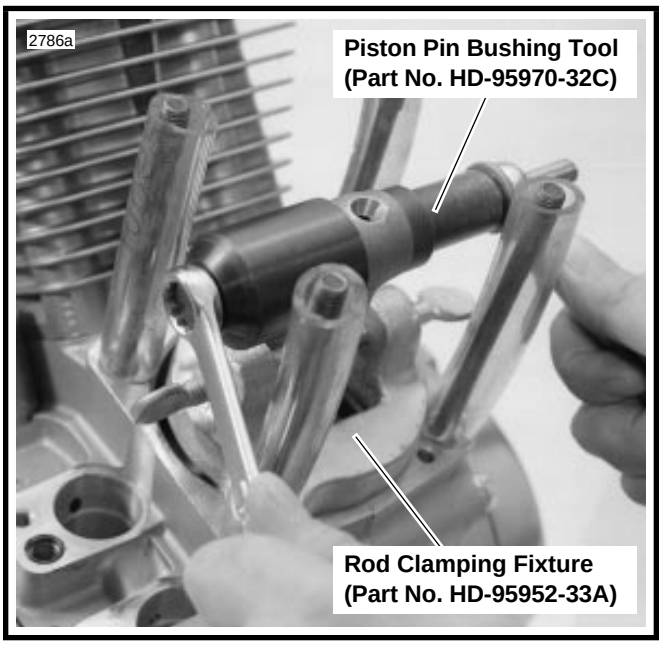


Figure 3-37. Installing New Piston Pin Bushing

7. Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51B).
8. Remove cylinder stud sleeves. Install a **new** cylinder base gasket. Make sure the piston does not bump the studs or crankcase.
9. Install cylinder over piston.
10. Remove piston ring compressor.
11. Assemble and install cylinder head. See CYLINDER HEAD, ASSEMBLY starting on page 3-19.
12. Install assembled engine. See INSTALLING THE ENGINE on page 3-10.

LUBRICATION SYSTEM

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 is 2.0 quarts (1.9 liters).

See ENGINE LUBRICATION SYSTEM in Section 1 for more information.

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.

See ENGINE LUBRICATION SYSTEM in Section 1 for more information.

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 accumulates in the oil tank. This is especially true if the vehicle is operated in cold weather. In freezing weather, an accumulation of water in the engine oil may become slush or ice, which can block oil lines and lead to severe engine damage. Water remaining in the engine oil for long periods of time can form an acidic sludge that is corrosive to metal engine parts and causes accelerated wear of moving components.

In winter the oil change interval should be shorter than normal. The colder the weather, the shorter the recommended oil change interval. A vehicle used only for short runs in cold weather must have the engine oil drained frequently.

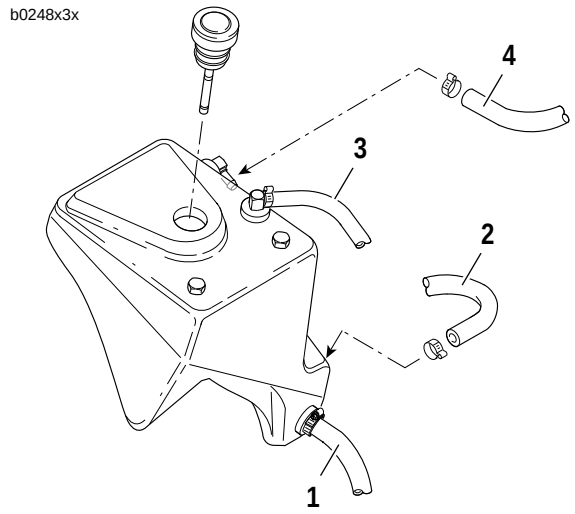
OIL HOSE ROUTING

GENERAL

See Figure 3-38. The oil tank has four hoses. The drain hose (2) attaches to a fitting on the left side of the frame. From the top of the tank, the vent hose (3) and the return hose (4) join the bottom feed hose (1) near the battery tray. Cable straps secure the hoses in place.

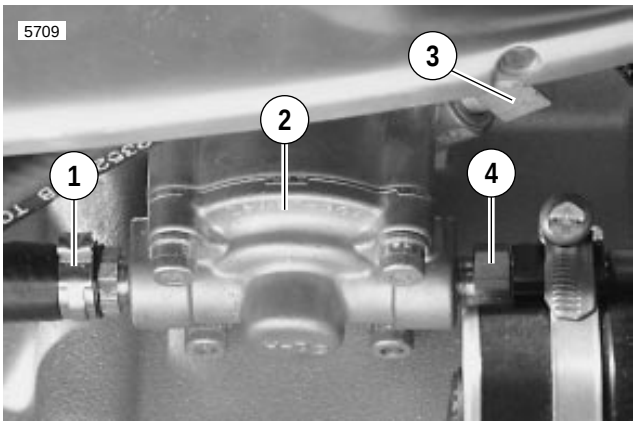
See Figure 3-39. The feed (1) and return hoses (3) run together between the swingarm mount block and crankcase, beneath the engine and forward to the oil pump. The feed hose attaches to the rear most oil pump fitting; the return hose connects forward and above.

After diverging from the feed and return hoses, the vent hose is routed beneath the starter. The vent hose continues on to the right side of the motorcycle and goes behind the gearcase cover assembly where it connects to an elbow fitting.



1. **Feed hose (3/8 in. ID by 5/8 in. OD)**
2. **Drain hose (3/8 in. ID by 5/8 in. OD)**
3. **Vent hose (1/4 in. ID by 1/2 in. OD)**
4. **Return hose (3/8 in. ID by 5/8 in. OD)**

Figure 3-38. Oil Tank Hoses



1. **Feed hose**
2. **Oil pump**
3. **Return hose**
4. **Oil filter connection**

Figure 3-39. Oil Pump Connections

OIL TANK

REMOVAL/DISASSEMBLY

1. Remove seat, fuel tank and tail section. See TAIL SECTION, REMOVAL in Section 2.
2. Remove rear fender. See FENDERS in Section 2.
3. Drain oil tank. See ENGINE LUBRICATION SYSTEM, CHANGING ENGINE OIL AND FILTER in Section 1. The oil filter need not be removed unless it is due to be replaced.
4. See Figure 3-40. Disconnect hoses from oil tank. Label each hose upon removal.
   a. Remove worm clamp (3) from feed hose (4).
   b. Remove clamp (5) from drain hose (6).
   c. Remove clamp (8) from vent hose (7).
   d. Remove clamp (10) from return hose (9)
5. Remove bolts and lockwashers from well nuts.
6. Detach oil tank from frame.

ASSEMBLY/INSTALLATION

1. See Figure 3-40. 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

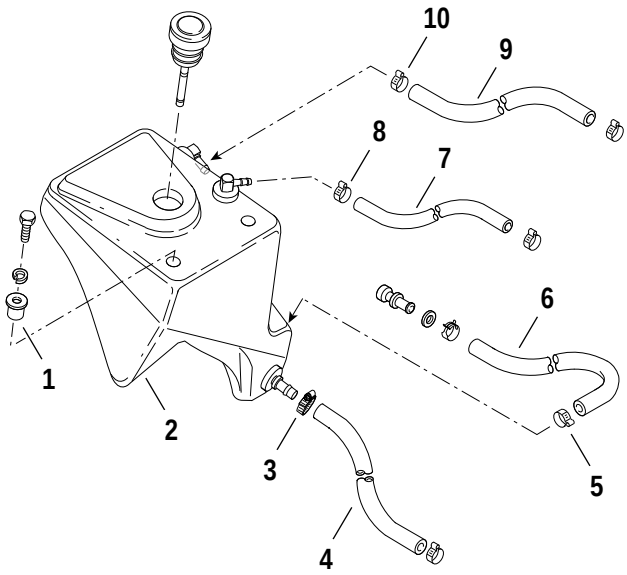
Worm clamp (3) may be reused on feed hose (4).

3. Fill oil tank. See ENGINE LUBRICATION SYSTEM, CHANGING ENGINE OIL AND FILTER in Section 1.
4. Install rear fender. See FENDERS in Section 2.

⚠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 and personal injury.

5. Install tail section, fuel tank and seat. See TAIL SECTION in Section 2.



1.	**Bolt, lockwasher and well nut (4)**	**6.**	**Drain hose**
2.	**Oil tank**	**7.**	**Vent hose**
3.	**Worm clamp, 3/8 in.**	**8.**	**Hose clamp, 1/4 in.**
4.	**Feed hose**	**9.**	**Return hose**
5.	**Hose clamp, 3/8 in.**	**10.**	**Hose clamp, 3/8 in.**

Figure 3-40. Oil Tank

OIL PRESSURE SIGNAL LIGHT SWITCH

GENERAL

The oil pressure signal light 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 3-41. 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 switch and insert pressure gauge fitting. See Figure 3-42.

Run engine until oil reaches normal operating temperature (motorcycle should be driven at least 20 miles (32 km) at or above 50 MPH (80 KM/H)). At 2500 RPM, oil pressure will vary from 10-17 psi (69-117 kN/m^2). At idle speed (950-1050 RPM), oil pressure will vary from 7-12 psi (48-83 kN/m^2).

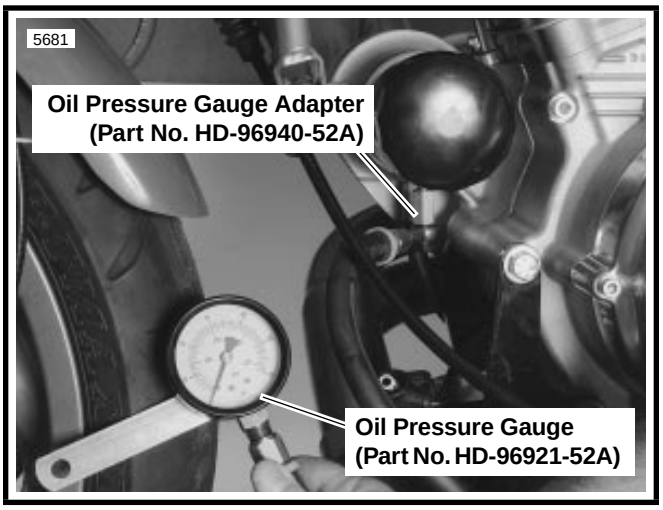


Figure 3-41. Checking Oil Pressure

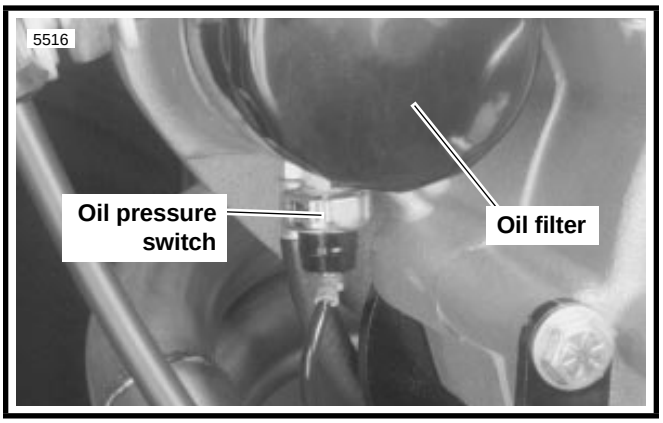


Figure 3-42. Oil Pressure Signal Light Switch

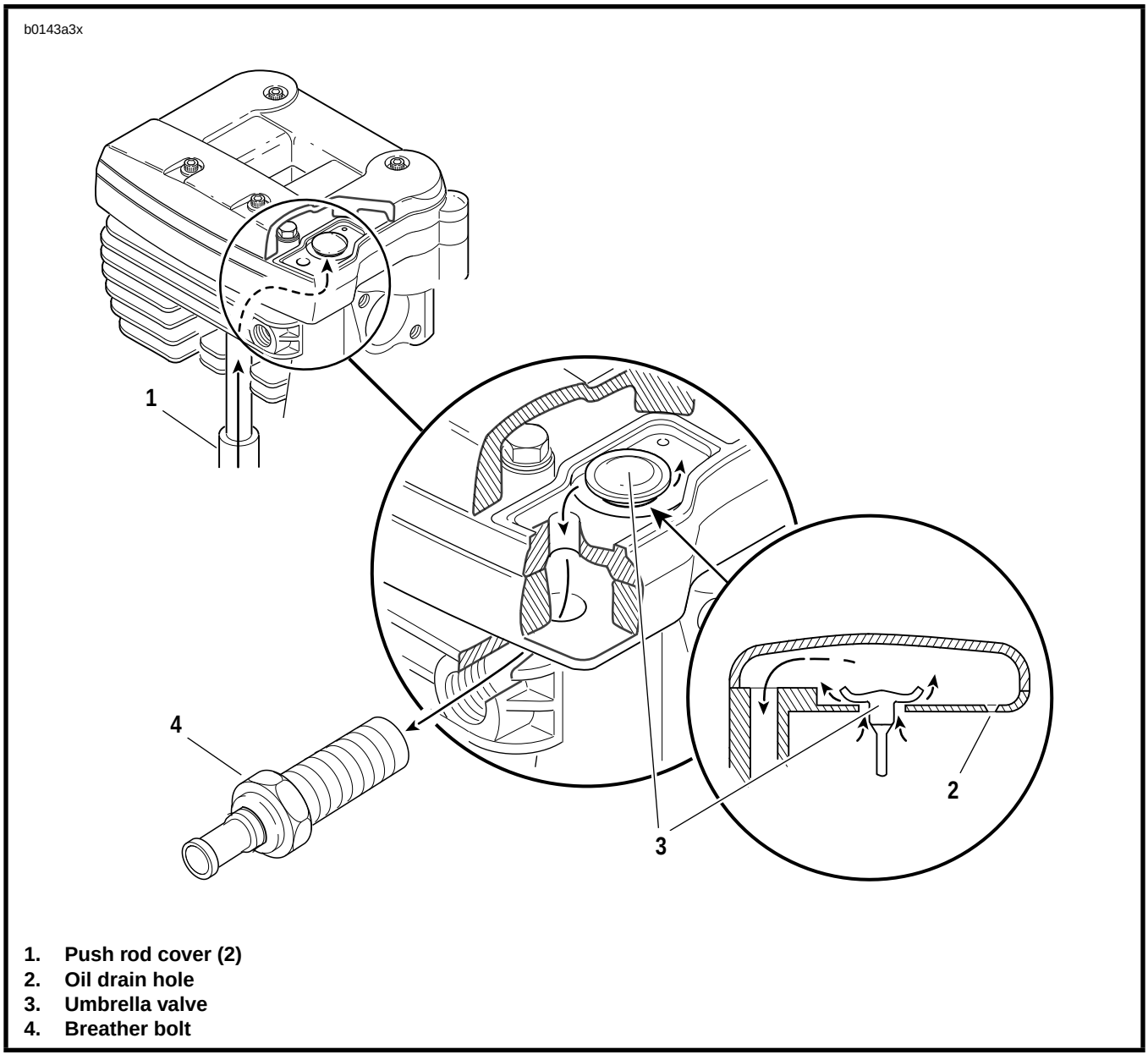
Table 3-8. Troubleshooting Oil Pressure Signal Light

OIL PRESSURE SIGNAL LIGHT	PROBABLE CAUSES
Stays on at speeds above idle.	● Empty oil tank. ● Clogged feed line (ice and sludge, freezing temperatures). ● Air-bound oil line. ● Grounded oil switch wire. ● Malfunctioning signal switch. ● Diluted oil. ● Malfunctioning check valve (see OIL FILTER MOUNT on page 3-37).
Flickers at idle.	● Incorrect idle speed. Malfunctioning or improperly installed check valve (see OIL FILTER MOUNT).
Does not glow when ignition is turned on (prior to operating engine).	● Malfunctioning signal switch. ● Malfunction in wiring. ● Burned-out signal bulb. ● Dead battery (see NOTE above).

CRANKCASE BREATHING SYSTEM

GENERAL

See Figure 3-43. 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 crankcase air then travels through each air cleaner breather bolt (4) into a hose leading into the air cleaner.



1. **Push rod cover (2)**
2. **Oil drain hole**
3. **Umbrella valve**
4. **Breather bolt**

Figure 3-43. Crankcase Breathing System – Typical Cylinder

OILING SYSTEM (COLOR FOLDOUT)

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

A complete explanation of the gerotor pump is given under OIL PUMP.

2. The feed pump transfers oil from the inlet cavity through the **feed hose** to the oil filter mount.
3. Oil flows through the **filter mount cavity** to the oil filter.
4. Oil enters the peripheral cavity of the **oil filter,** passes through the filtering medium into the central cavity of the oil filter, and flows into the filter adapter (fitting which connects filter to filter mount).
5. Adequate oil pressure in the filter mount cavity activates the **oil pressure signal light switch** and shuts off the oil pressure signal light.
6. Oil flowing from the filter adapter opens the **check ball.** The check ball opens at 4-6 psi (28-41 kN/m^2) oil pressure.
7. With the check ball open, oil flows into the **crankcase feed galley.**
8. Oil flows through the feed galley in the crankcase to the tappet 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 **tappet 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.

OIL PUMP

GENERAL

See Figure 3-44. The oil pump consists of two gerotor gear sets, feed and scavenge (return), housed in one pump body. The feed pump distributes oil to the engine, the scavenge pump returns oil to the tank.

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

In a gerotor gear set, oil is transferred from inlet to outlet as it is trapped between the rotating inner and outer gerotors. The illustration below shows the principle of gerotor operation:

1. During the first 180° of rotation, the cavity between inner and outer gerotors gradually increases in size until it reaches its maximum size, equivalent to the full volume of the "missing tooth." The gradually enlarging cavity creates a vacuum into which oil flows from the inlet.
2. During the next 180° of rotation, the size of the cavity decreases forcing oil into the outlet. See Figure 3-46. Gravity-fed oil from the oil tank enters the pump through fitting (5). It is forced by gerotor 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 gerotor 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.

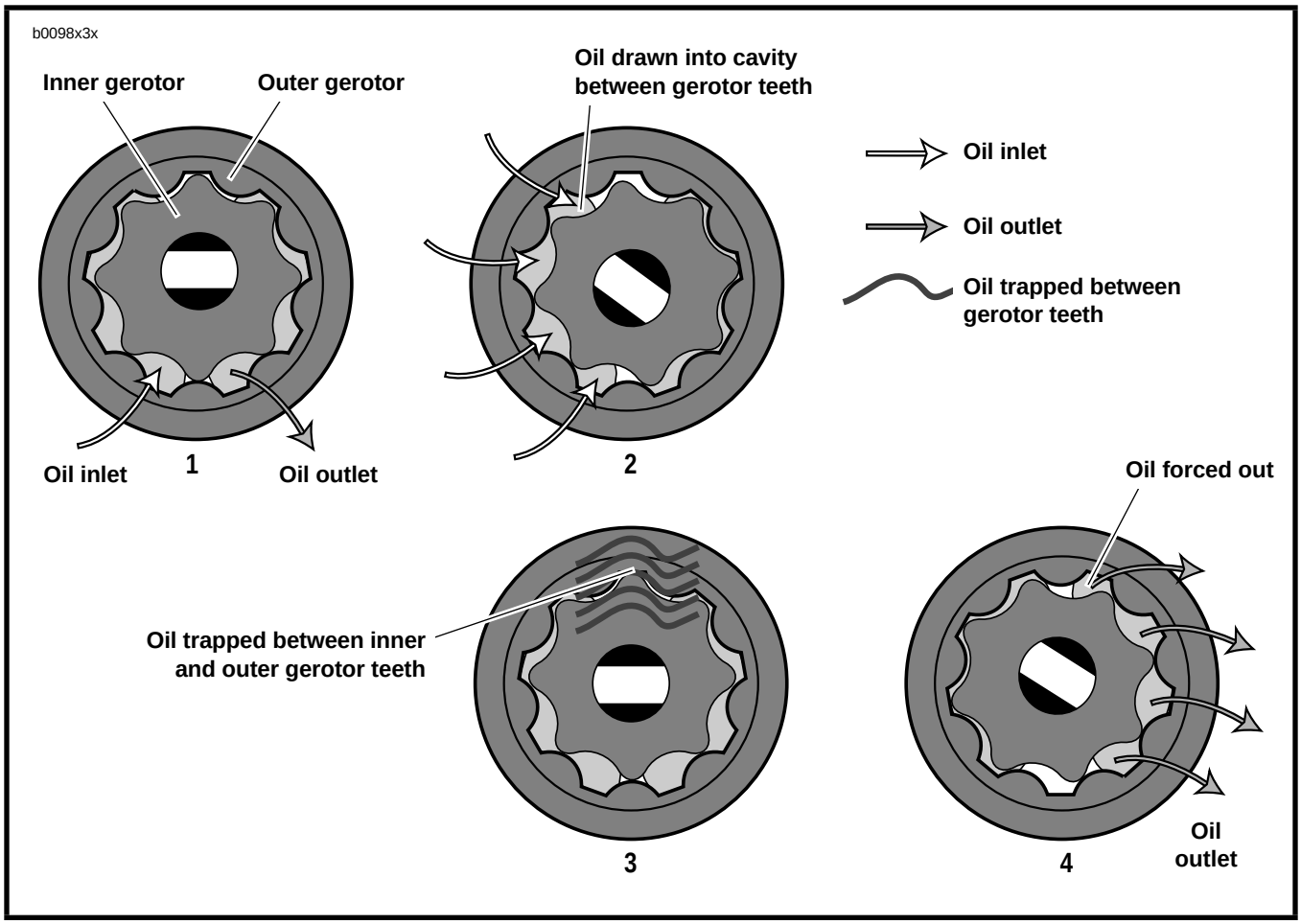


Figure 3-44. Principle of Gerotor Operation

REMOVAL/DISASSEMBLY

NOTE

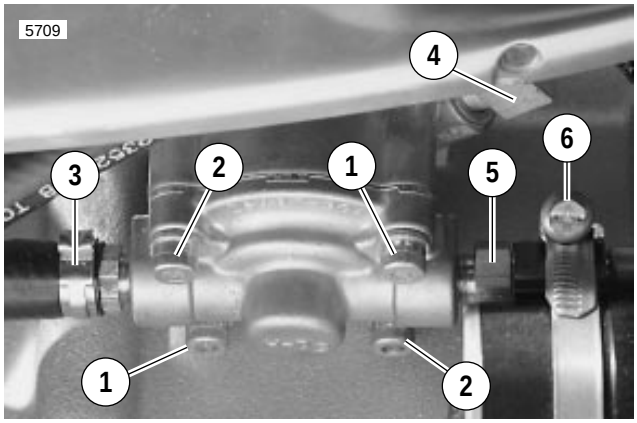
Oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil from oil tank.
2. See Figure 3-45. Detach clamp (6) from oil hose. Move rear shock rebound canister aside.
3. Disconnect feed hose (3) and oil filter mount connection (5).

NOTE

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

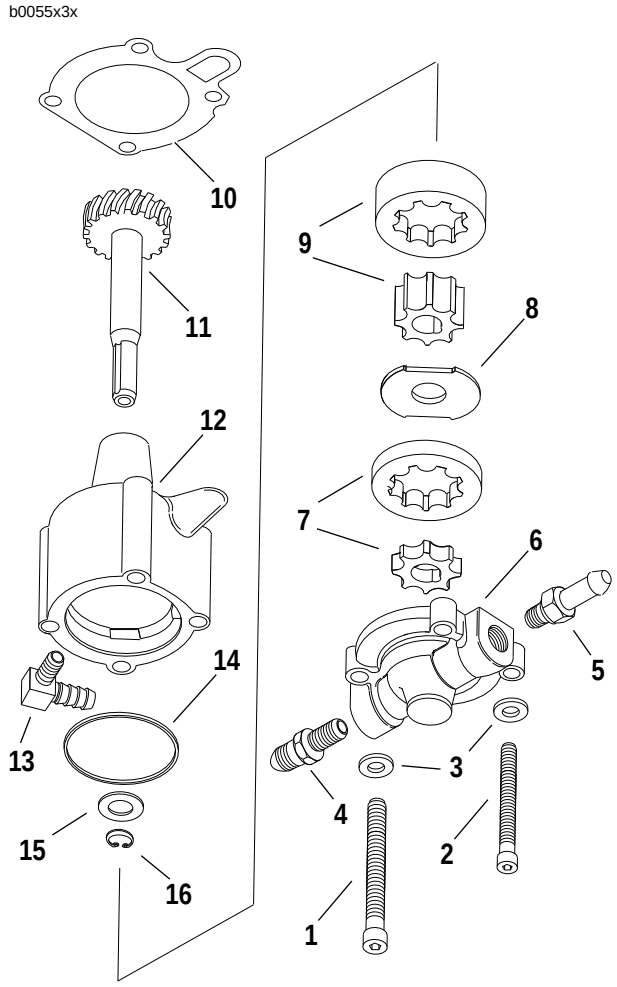
4. Carefully remove screws (1) and washers that secure pump to crankcase. Pump will drop with screws removed. Discard mounting gasket.
5. Remove clamp and return hose connection (4).



1.	Mounting screw and washer (2)	4.	Return hose connection
2.	Cover screw and washer (2)	5.	Oil filter mount connection
3.	Feed hose connection	6.	Clamp

Figure 3-45. Oil Pump Hardware

6. See Figure 3-46. Remove cover screws (2) and washers (3). Lift cover (6) off body (12). Remove and discard O-ring (14).
7. Slide both pieces of feed gerotor set (7), separator plate (8) and both pieces of scavenge gerotor set (9) off gear shaft (11).
8. Remove and discard retaining ring (16). Remove thrust washer (15) and gear shaft (11).



1.	Mounting screw, long (2)	9.	Gerotor assembly, scavenge pump
2.	Cover screw, short (2)	10.	Mounting gasket
3.	Washer (4)	11.	Gear shaft
4.	Connector	12.	Body, oil pump
5.	Hose fitting	13.	Elbow
6.	Cover, oil pump	14.	O-ring
7.	Gerotor assembly, feed pump	15.	Washer, thrust
8.	Gerotor separator plate	16.	Retaining ring

Figure 3-46. Oil Pump

CLEANING, INSPECTION AND REPAIR

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
2. See Figure 3-47. Inspect both gerotor sets for wear. Mesh pieces of each set together as shown. Use a feeler gauge to determine clearance.

NOTE

The maximum allowable clearance between gerotors is 0.004 in. (0.10 mm). Replace gerotors as a set if clearance exceeds this dimension.

3. Measure thickness of feed gerotors with a micrometer. If they are not the same thickness, replace as a set.
4. Check gear shaft (11) teeth for damage or wear. Replace if necessary.

ASSEMBLY/INSTALLATION

1. See Figure 3-46. Install gear shaft (11) through body (12). Position thrust washer (15) over end of shaft. Install **new** retaining ring (16) into groove in shaft.

NOTE

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

2. Insert inner gerotor of the scavenge gerotor set (9) over gear shaft.
3. Place outer gerotor over inner to complete scavenge set (9).
4. Position separator plate (8) into case and line up slots on perimeter with tabs inside oil pump body (12).
5. Place feed gerotor set (7) over gear shaft (11).
6. Install a **new** O-ring (14) into groove in cover (6). Place cover onto pump body. Install cover screws (2) with washers (3). Tighten cover screws (2) to 125-150 **in-lbs** (14.1-16.9 Nm).

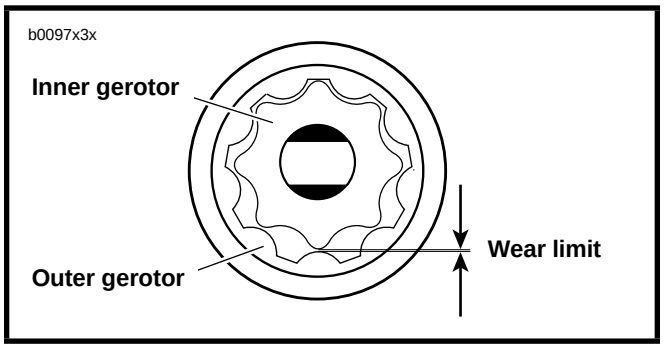


Figure 3-47. Gerotor Wear Limits

7. Place **new** mounting gasket (10) in position.
8. See Figure 3-45. Attach return hose (4) to oil pump.
9. Secure pump to crankcase with screws (1) and washers. Tighten mounting screws to 125-150 **in-lbs** (14.1-16.9 Nm).
10. Connect feed hose (3) and oil filter mount connection (5) to oil pump.

NOTE

*Use **new** hose clamps. If fittings were removed, use TEFLON® PIPE SEALANT or HYLOMAR® on fitting threads.*

11. Attach clamp (6) and canister to oil hose.
12. Prime oil pump. Loosen feed hose connection and start engine. Operate at idle and allow about 2.0 ounces (0.06 liter) of engine oil to be forced through hose connection. Stop engine and tighten hose connection.
13. Check engine oil level in tank. Add oil to correct level if needed. See ENGINE LUBRICATION SYSTEM in Section 1.

OIL FILTER MOUNT

GENERAL

See Figure 3-48. Oil is pressure-fed from the oil pump to the oil filter mount (4) via a hose connection (5). Oil travels through the filter mount into the filter via outer filter holes.

Adequate oil pressure activates the oil pressure signal light switch (6) in the filter mount, which turns off the oil pressure indicator lamp.

The check ball (2) in the filter adapter (1) “opens” at 4-6 psi (28-41 kN/m^2) oil pressure. Filtered oil leaves the filter, flowing past the check ball.

DISASSEMBLY

1. Remove oil filter adapter (1) from oil filter mount (4). Remove check ball (2) and spring (3).
2. Remove oil pressure signal light switch (6).

CLEANING/INSPECTION

Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

ASSEMBLY

NOTE

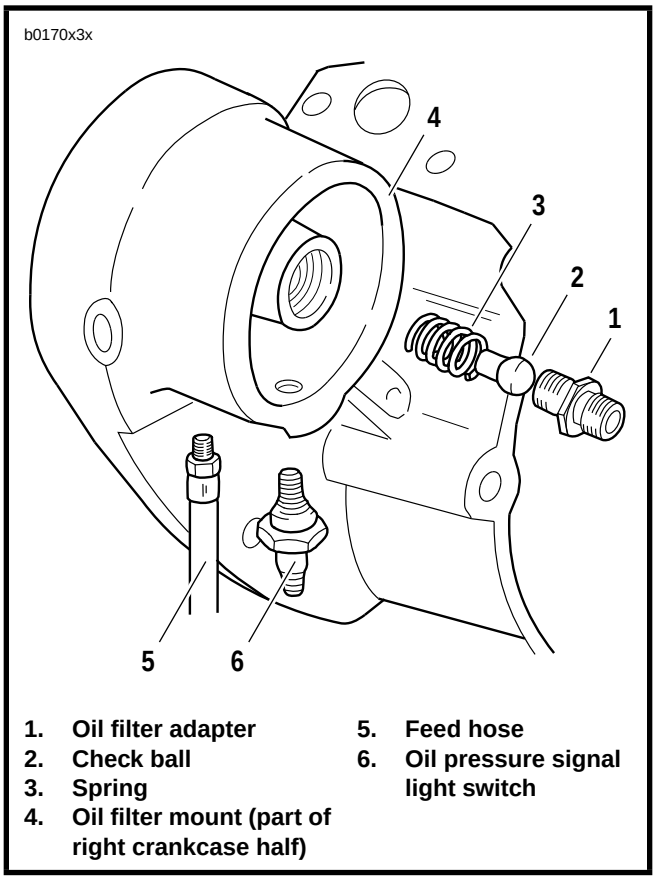
Use TEFLON PIPE SEALANT or HYLOMAR on all fittings installed to oil filter mount.

1. Install oil pressure signal light switch (6). Tighten to 5-7 ft-lbs (7-9 Nm).
2. Apply LOCTITE THREADLOCKER 242 (blue) to the threads on that end of the oil filter adapter (1) which is installed into oil filter mount (4). Do not apply LOCTITE to adapter threads on oil filter element side.

NOTE

The oil filter adapter (1) has identical ends; either end may be installed into the oil filter mount.

3. Place spring (3) and check ball (2) into threaded hole at center of mount (4). Push adapter (1) against ball to compress spring. Install threaded end (with LOCTITE) into threaded hole at center of mount (4). Tighten adapter to 8-12 ft-lbs (11-16 Nm).



1. Oil filter adapter
2. Check ball
3. Spring
4. Oil filter mount (part of right crankcase half)
5. Feed hose
6. Oil pressure signal light switch

Figure 3-48. Oil Filter Mount

4. Connect pressure switch wire. Tighten nut which secures wire to 4-10 **in-lbs** (0.4-1.1 Nm).
5. Pour about 4.0 ounces (0.12 liter) of clean engine oil into filter. Apply a light coat of oil to oil filter gasket. Install oil filter onto oil filter mount/adapter assembly; tighten filter an additional 1/2-3/4 turn after gasket contacts filter mount surface.
6. Fill oil tank with proper oil. See ENGINE LUBRICATION SYSTEM, CHANGING ENGINE OIL AND FILTER in Section 1.

VALVE TAPPETS

GENERAL

See Figure 3-49. The tappet assembly consists of tappet and roller. The tappet 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 tappet 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 tappet is functioning properly, the assembly operates with minimal tappet clearance. The unit automatically compensates for heat expansion to maintain a no-clearance condition.

It is normal for tappets to click when engine is started after standing for some time. Tappets have a definite leakdown rate which permits the oil in the tappets to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain correct clearance operation. Tappets are functioning properly if they become quiet after a few minutes of engine operation.

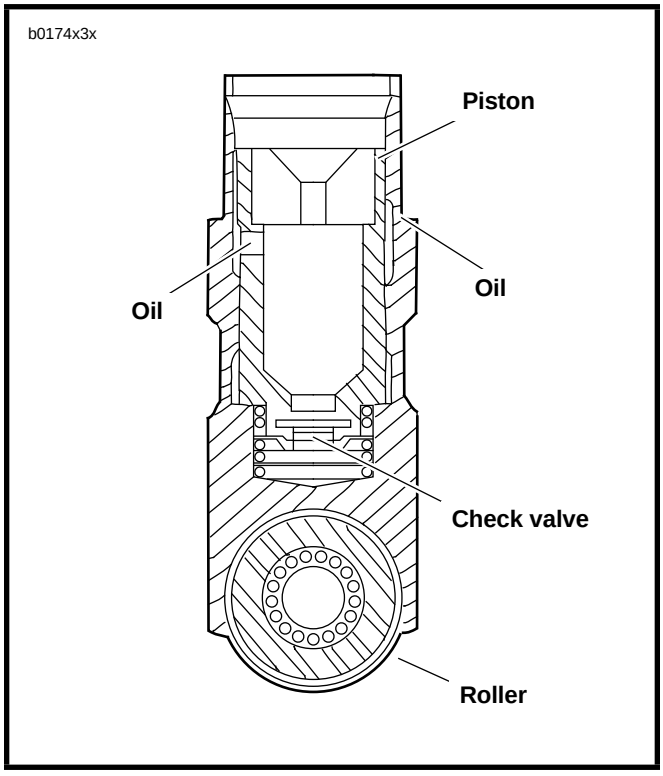


Figure 3-49. Tappet Assembly

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 CYLINDER HEAD, REMOVAL on page 3-11. Pull the push rod upward through top of cylinder head.

3. See Figure 3-50. Remove screw (11) and washer (13). Lift retainer (9) and seal (8) upward a few inches on push rod cover (7). Push upward on push rod cover while pulling bottom of cover (7) clear of crankcase. Remove cover (7).

4. Remove screw (5), washer (14), and plate (4). Pull O-rings (3) off ends of pins (2) and discard. Grasp ends of pins (2) and pull outward free of crankcase. A pliers is a handy tool to free pins (2). With a thin-bladed screwdriver in the retainer groove at the top of the tappet, pry upward on the tappet until it extends above the gearcase and can be pulled out by hand.

CLEANING/INSPECTION

1. Clean all parts, except roller/tappet assembly, thoroughly in solvent. Blow dry with compressed air.

2. Inspect valve tappets for excessive clearance in guide. Clearance should be 0.0008-0.0020 in. (0.020-0.051 mm). Accurately measure tappet bore inner diameter with a gauge. Service wear limit is 0.0030 in. (0.076 mm). Excessive tappet guide clearance is corrected by fitting a **new** tappet and/or replacing crankcases.

NOTE

Inside and outside micrometers used for measuring tappets and tappet guides must be calibrated to ensure accurate readings.

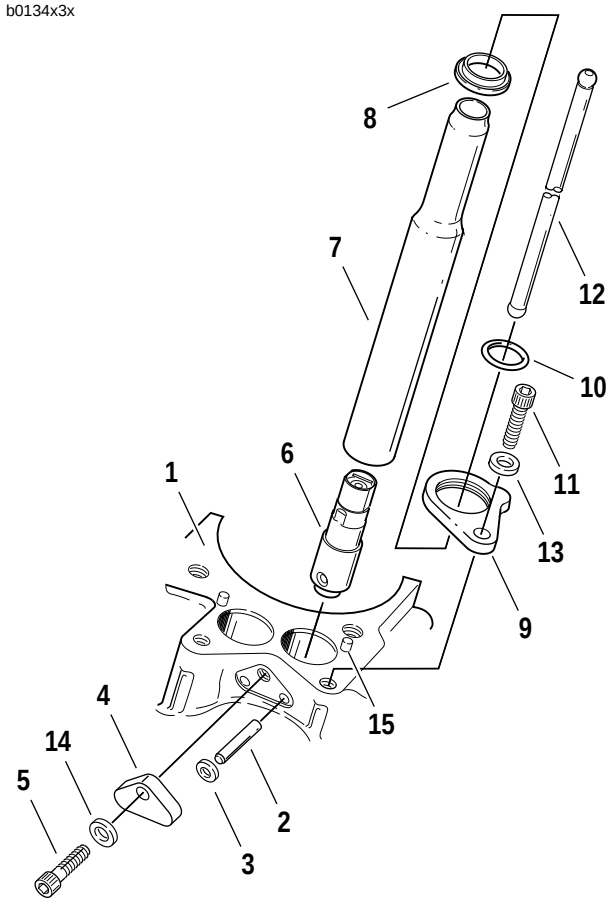
3. Check tappet roller freeplay. Roller clearance on pin should be within 0.0006-0.0010 in. (0.015-0.025 mm). Recommended service practice is tappet replacement. Service wear limit is 0.0015 in. (0.038 mm).

4. Check tappet roller end clearance. Clearance should be 0.008-0.022 in. (0.203-0.559 mm). Service wear limit is 0.026 in. (0.660 mm).

5. Tappets should be soaked in clean engine oil and kept covered until assembly.

INSTALLATION

1. See Figure 3-50. Rotate engine so that both tappets (6), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.
2. Apply a liberal amount of engine oil to tappet assembly, especially the roller needles, to ensure smooth initial operation.
3. Insert tappet (6) into bore in crankcase (1). Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, pins (2) cannot be inserted.
4. Insert pins (2) in the holes in crankcase. Place **new** O-rings (3) over ends of pins. Install plate (4) using screw (5) with washer (14). Tighten screw (5) to 80-110 **in-lbs** (9.0-12.4 Nm).
5. Slide **new** seal (8) and place retainer (9), over top of push rod cover (7). Position **new** O-ring (10) at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer (9) with seal (8) onto crankcase, aligning locating pin (15) with hole in retainer.
6. Insert screw (11) with washer (13) through hole in retainer (9), and thread into tapped hole in crankcase. Tighten screw (11) to 15-18 ft-lbs (20-24 Nm).
7. Install rocker covers. See CYLINDER HEAD, INSTALLATION starting on page 3-20.



1.	Right crankcase half	8.	Seal (2)
2.	Pin (2)	9.	Retainer (2)
3.	O-ring (2)	10.	O-ring (2)
4.	Plate	11.	Screw (2)
5.	Screw	12.	Push rod (2)
6.	Tappet lifter (2)	13.	Washer (2)
7.	Push rod cover (2)	14.	Washer
		15.	Locating pin (2)

Figure 3-50. Valve Tappet Service

GEARCASE COVER AND CAM GEARS

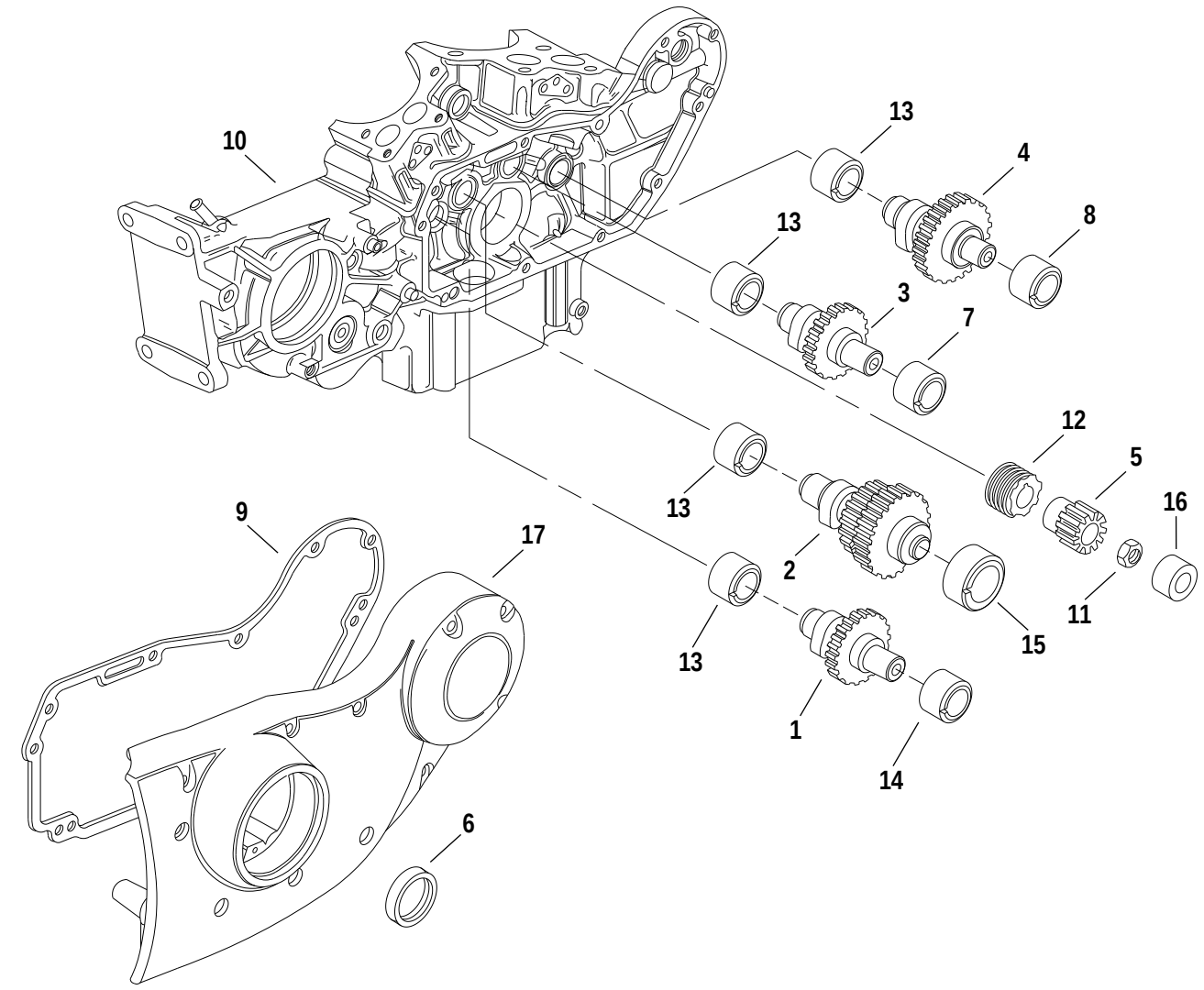
GENERAL

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.

REMOVAL/DISASSEMBLY

1. See Figure 3-51. Thoroughly clean area around gearcase cover (17) and tappets. Blow loose dirt from crankcase with compressed air.
2. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust header, footrest, air cleaner, etc.).
3. Remove push rods as described under CYLINDER HEAD, REMOVAL on page 3-11.
4. Remove tappets. See VALVE TAPPETS, REMOVAL on page 3-38.



1. Rear exhaust cam gear
2. Rear intake cam gear
3. Front intake cam gear
4. Front exhaust cam gear
5. Pinion gear
6. Seal
7. Front intake cam gear bushing
8. Front exhaust cam gear bushing
9. Gearcase cover gasket
10. Right crankcase half
11. Nut
12. Oil pump drive gear
13. Cam gear bushing (4)
14. Rear exhaust cam gear bushing
15. Rear intake cam gear bushing
16. Pinion shaft bushing
17. Gearcase cover

Figure 3-51. Gearcase and Valve Train Components

5. Check for minimum cam gear end play. See page 3-46. Record readings.
6. Remove ignition system. See Section 7.
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, INSPECTION AND REPAIR

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, Inspection, and Selection

See Figure 3-52. 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:

15-1 = rear exhaust
15-2 = rear intake
15-3 = front intake
15-4 = front exhaust

Use only “15” cams on 1996 models.

See Figure 3-53. Measure the gear diameter with a micrometer over 0.108 in. (2.74 mm) diameter gauge pins on opposite sides of the gear. The pins are of the proper size to fit between the contacting surfaces of the gear teeth. Gear diameter should be measured in at least two places 90° apart. Use GAUGE PIN SET (Part No. HD-38361) when measuring pinion and cam gear sizes.

Cam and pinion gears are individually selected for each specific gear cover through sophisticated computer-aided measuring techniques in a controlled environment. Each gear is assigned an individual color code based on its diameter (measured with gauge pins). When cam and/or pinion gears are replaced, always use the same color code as found on gears being replaced to ensure that the gear operation remains as quiet as possible. For location of cam and pinion gear color codes, see Figure 3-54.

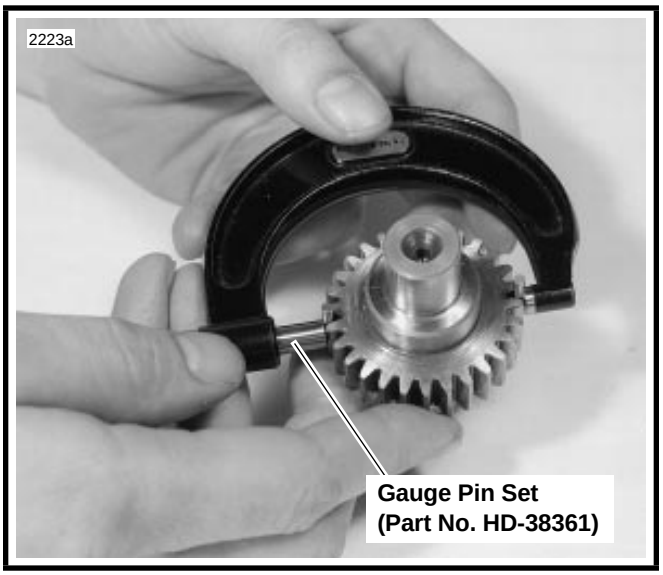


Figure 3-52. Measuring Gear Size

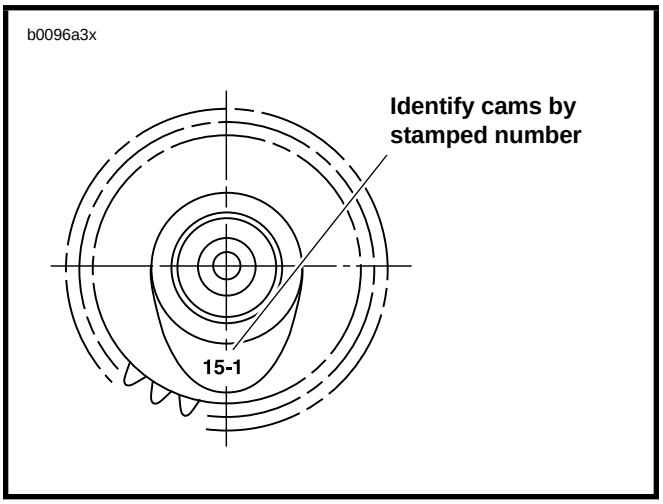
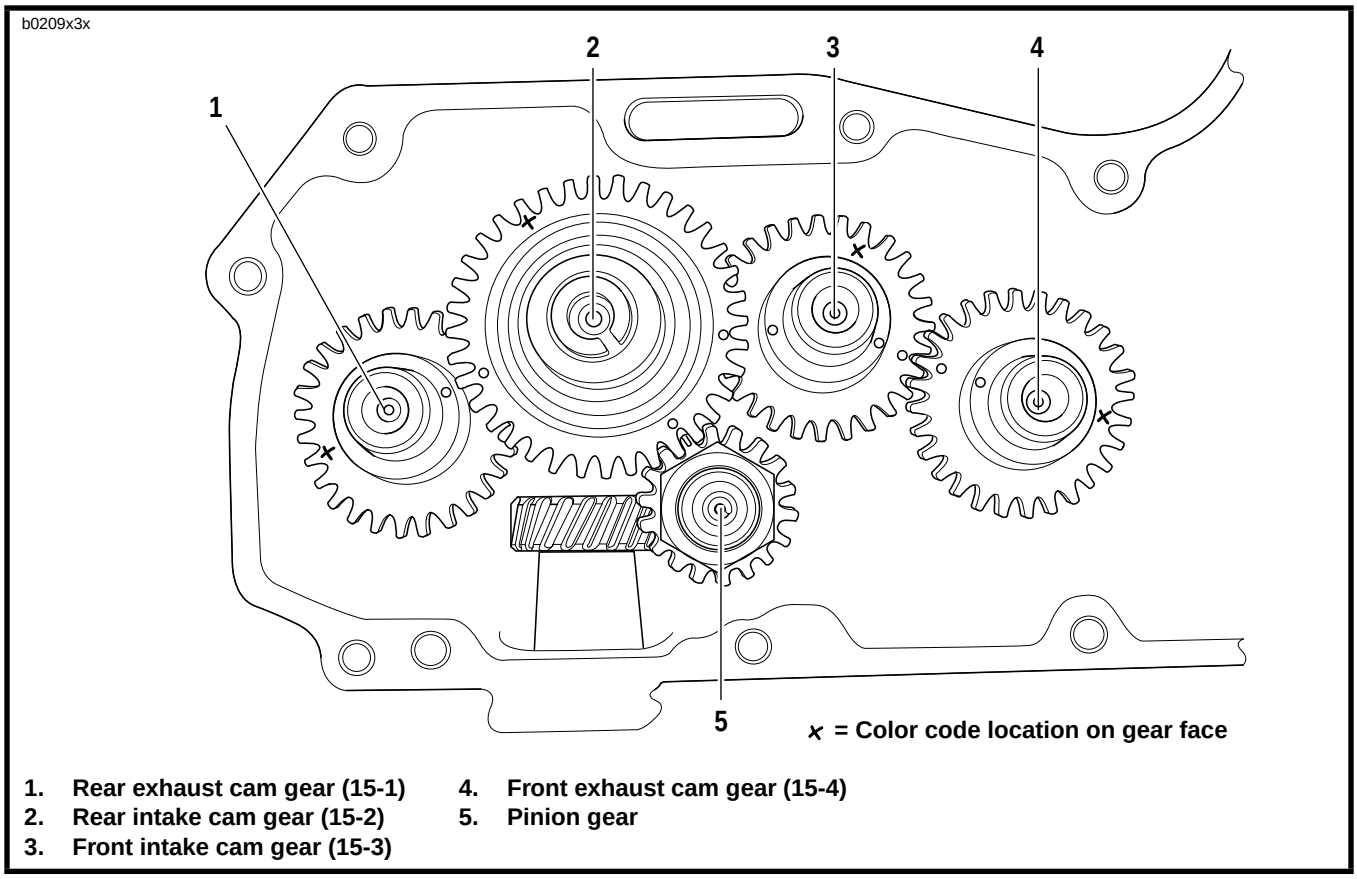


Figure 3-53. Cam Identification

NOTE

On flywheel pinion shaft, a paint dot is located on the shaft perimeter near the centerline of the keyway. This dot identifies the pinion shaft inner race size. Do not use this dot to select pinion gear size.

See Table 3-9. Compare the previously measured diameter of each gear with the specifications (listed in inches) shown in the table to determine amount of wear on gear teeth.



1. **Rear exhaust cam gear (15-1)**
2. **Rear intake cam gear (15-2)**
3. **Front intake cam gear (15-3)**
4. **Front exhaust cam gear (15-4)**
5. **Pinion gear**

Figure 3-54. Cam and Pinion Gear Color Code Location and Timing Mark Indexing

NOTE

Prior to changing any cam gears, check gear shaft fit within corresponding bushings. Worn bushings can cause excessive backlash.

Table 3-9. Cam and Pinion Gear Color Code and Diameter

GEAR NO. & POSITION	1	2 INBOARD	2 OUTBOARD	3	4	5
COLOR CODE (1 paint dot)	Rear Exhaust	Rear Intake	Rear Intake	Front Intake	Front Exhaust	Pinion
BROWN	1.9005-1.9009 (48.272-48.283)	1.9035-1.9039 (48.349-48.359)	2.4021-2.4025 (61.013-61.023)	1.9005-1.9009 (48.272-48.283)	1.9035-1.9039 (48.349-48.359)	1.2753-1.2756 (32.393-32.400)
BLUE	1.9010-1.9014 (48.285-48.295)	1.9030-1.9034 (48.336-48.346)	2.4026-2.4030 (61.026-61.036)	1.9010-1.9014 (48.285-48.295)	1.9030-1.9034 (48.336-48.346)	1.2749-1.2752 (32.382-32.390)
RED	1.9015-1.9019 (48.298-48.308)	1.9025-1.9029 (48.323-48.333)	2.4031-2.4035 (61.038-61.049)	1.9015-1.9019 (48.298-48.308)	1.9025-1.9029 (48.323-48.333)	1.2745-1.2748 (32.372-32.380)
WHITE	1.9020-1.9024 (48.310-48.321)	1.9020-1.9024 (48.310-48.321)	2.4036-2.4040 (61.051-61.061)	1.9020-1.9024 (48.310-48.321)	1.9020-1.9024 (48.310-48.321)	1.2741-1.2744 (32.362-32.369)
GREEN	1.9025-1.9029 (48.323-48.333)	1.9015-1.9019 (48.298-48.308)	2.4041-2.4045 (61.064-61.074)	1.9025-1.9029 (48.323-48.333)	1.9015-1.9019 (48.298-48.308)	1.2737-1.2740 (32.352-32.359)
YELLOW	1.9030-1.9034 (48.336-48.346)	1.9010-1.9014 (48.285-48.295)	2.4046-2.4050 (61.076-61.087)	1.9030-1.9034 (48.336-48.346)	1.9010-1.9014 (48.285-48.295)	1.2733-1.2736 (32.341-32.349)
BLACK	1.9035-1.9039 (48.349-48.359)	1.9005-1.9009 (48.272-48.283)	2.4051-2.4055 (61.089-61.099)	1.9035-1.9039 (48.349-48.359)	1.9005-1.9009 (48.272-48.283)	1.2729-1.2732 (32.331-32.339)

Bushing Inspection and Removal

1. See Figure 3-51. 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 3-10.

Table 3-10. Gear Shaft Specifications

GEAR SHAFT	CORRECT CLEARANCE	SERVICE WEAR LIMIT
Cam	0.0007-0.0022 in. (0.018-0.056 mm)	0.003 in. (0.08 mm)
Pinion	0.0023-0.0043 in. (0.058-0.109 mm)	0.005 (0.13 mm)

2. See Figure 3-55. Use a BUSHING AND BEARING PULLER (Part No. HD-95760-69A) to remove bushings from gearcase cover and crankcase.

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 3-57. 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 on page 3-44.

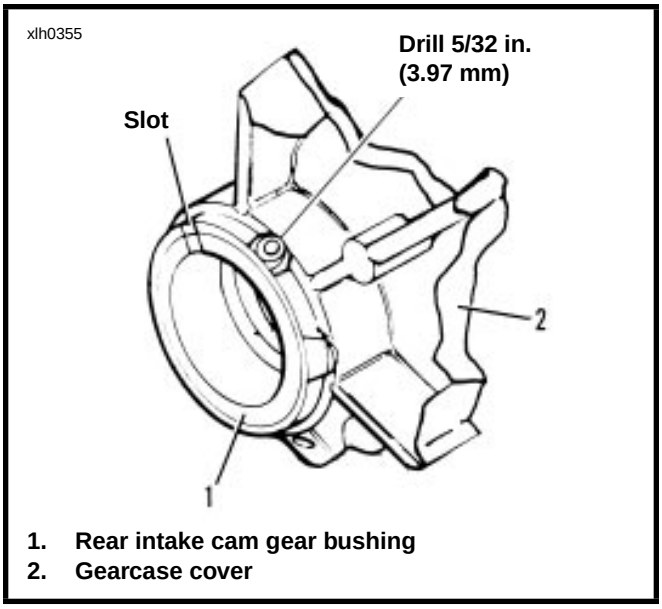
CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

1. See Figure 3-51. Using an arbor press, install each bushing (7, 8 and 14) in its gearcase cover (17) bore so that bushing shoulder contacts cover boss. There is no need to orient these particular bushings in any specific position of rotation within gearcase cover bores.
2. After you install a **new** bushing in gearcase cover, line-ream the bushing to correct size. See BUSHING REAMING on page 3-44.

REAR INTAKE CAM GEAR BUSHING IN GEARCASE COVER.

1. See Figure 3-51. 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

Figure 3-55. Removing Bushing



1. **Rear intake cam gear bushing**
2. **Gearcase cover**

Figure 3-56. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

2. See Figure 3-56. 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 on page 3-44.

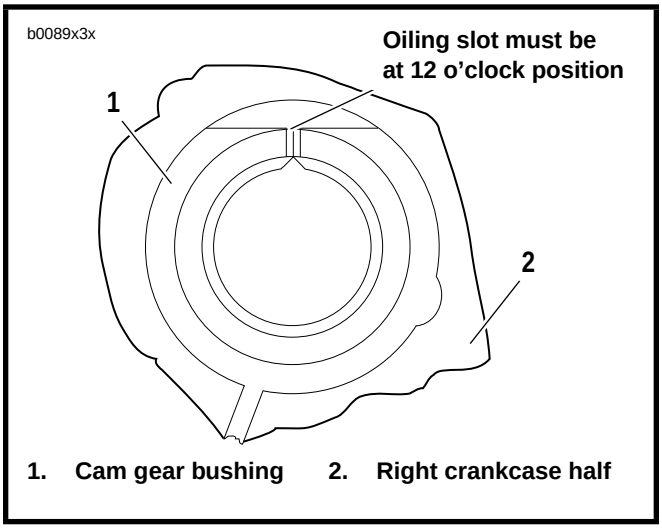


Figure 3-57. Cam Gear Bushing Installed in Crankcase

PINION SHAFT BUSHING IN GEARCASE COVER

1. See Figure 3-51. 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 3-58. Drill a No. 31 hole, 0.281 in. (7.14 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. (5.1 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.*

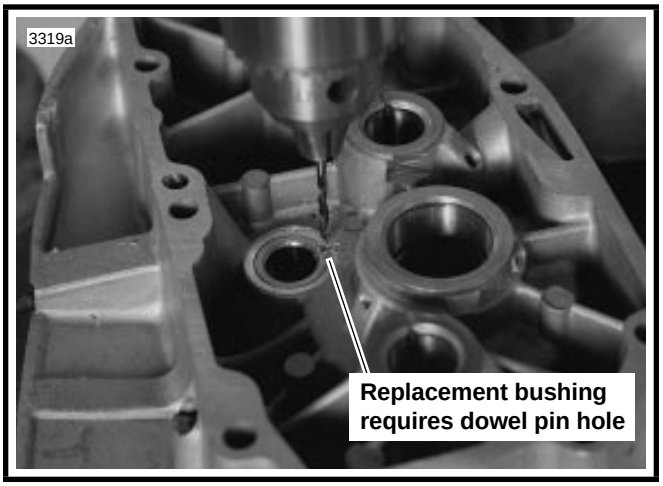


Figure 3-58. Drilling Dowel Pin Hole

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 3-57.
2. See Figure 3-59. 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 3-51. Bushings (7, 8 and 14) to be reamed must be installed in gearcase cover (17) as described in BUSHING INSTALLATION on page 3-43. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.

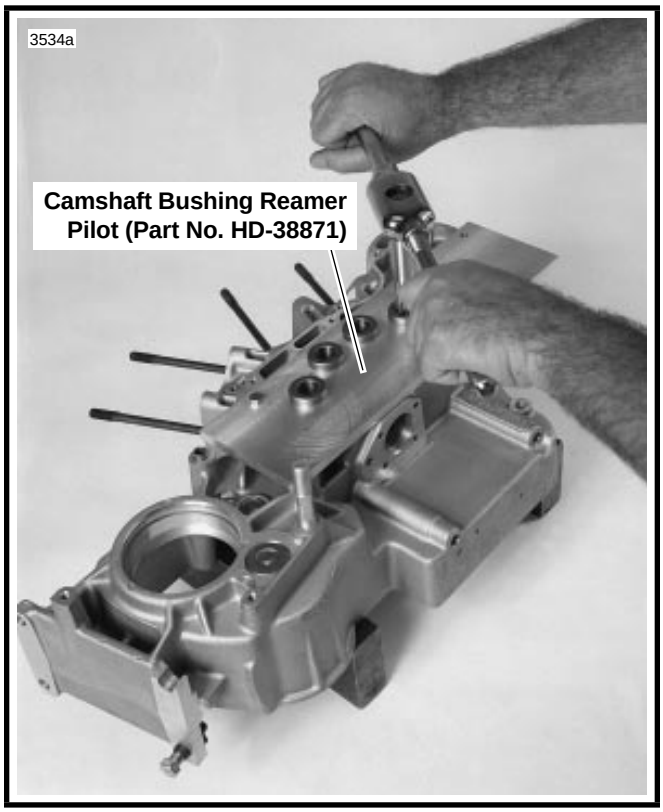


Figure 3-59. Reaming Cam Gear Bushing in Right Crankcase Half

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 3-51. Rear intake cam gear bushing (15) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION on page 3-43.
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.

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 3-51. Pinion shaft bushing (16) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION on page 3-43. 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 3-60. 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.

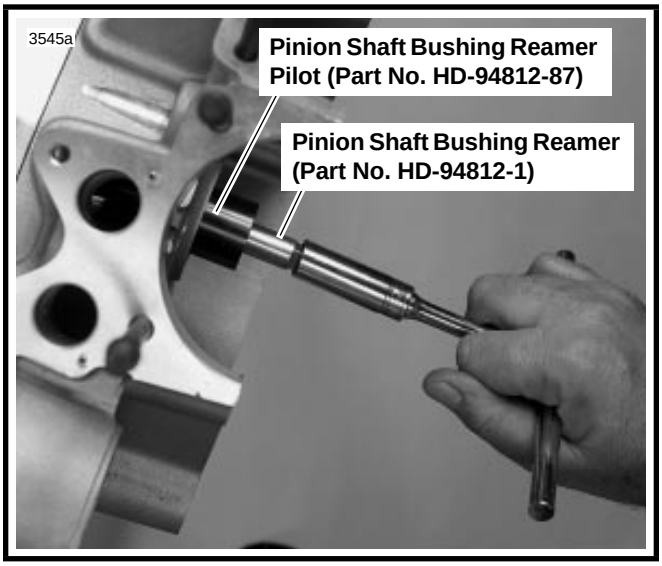


Figure 3-60. Line Reaming Pinion Shaft Bushing

ASSEMBLY/INSTALLATION

1. See Figure 3-51. Install oil pump drive gear (12) and pinion gear (5) to pinion shaft. Note that timing mark on pinion gear tooth is aligned with keyway in ID of pinion gear, as shown in Figure 3-61. See Figure 3-62. The timing mark will allow you to easily position pinion gear (1) over shaft key (2) and against oil pump drive gear (3) on pinion shaft (4).

2. See Figure 3-51. Clean pinion shaft threads and nut (11) threads. Apply several drops of LOCTITE THREADLOCKER 262 (red) to threads of nut. Install nut to pinion shaft, tightening to 35-45 ft-lbs (47-61 Nm).

3. See Table 3-9 and Figures 3-53 and 3-54. 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 as shown in Figure 3-54.

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.

4. See Figure 3-51. Install a **new** seal (6) and **new** dry gasket (9) on gearcase cover (17).

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** (9.0-12.4 Nm) according to the torque sequence shown in Figure 3-63.

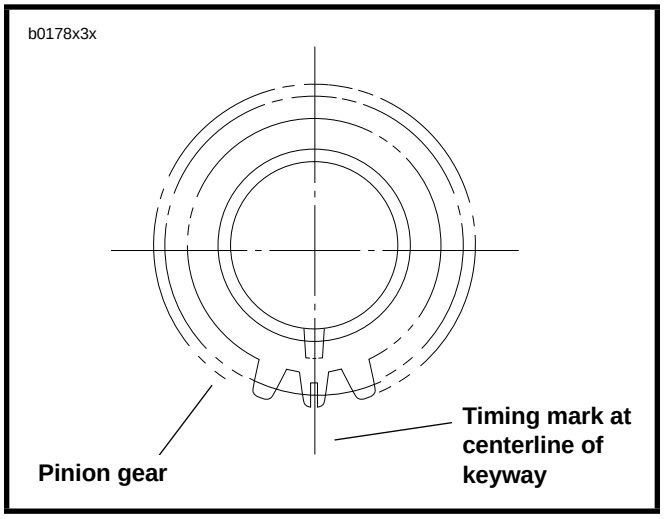


Figure 3-61. Pinion Gear Timing Mark and Keyway

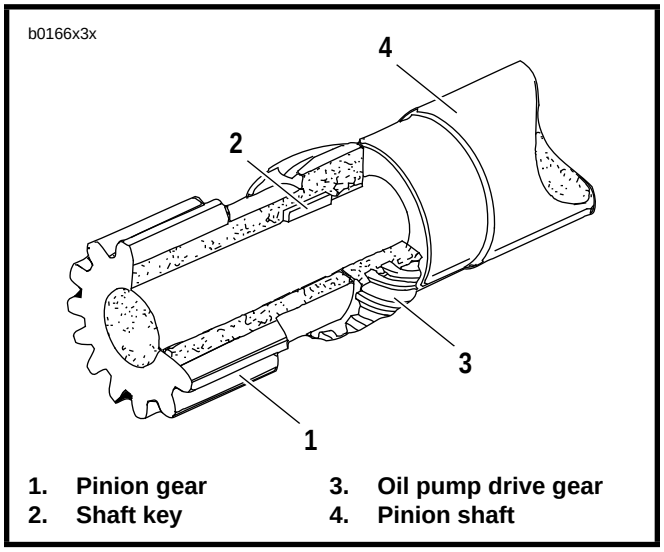


Figure 3-62. Oil Pump Drive Gear and Pinion Gear Installed on Pinion Shaft

6. Check cam gear end play for each cam gear as follows:
   a. Turn engine over until lobe of cam gear being checked is pointing toward its respective tappet guide hole.
   b. Using a flat blade screwdriver, gently pry the cam gear toward gearcase cover.
   c. Using a feeler gauge, measure gap between bushing (in crankcase half) and cam gear shaft thrust face (shoulder). This is cam gear end play.
   d. Compare your cam gear end play measurements with the SPECIFICATIONS on page 3-3. Make repairs as required if end gap is less than the minimum specified, or greater than the maximum specified (Service Wear Limits).

7. Install valve tappets and push rods. See VALVE TAPPETS, INSTALLATION on page 3-39.
8. Install ignition system. See Section 7.
9. Install any components removed to gain access to gearcase (i.e. exhaust system components, air cleaner, etc.).

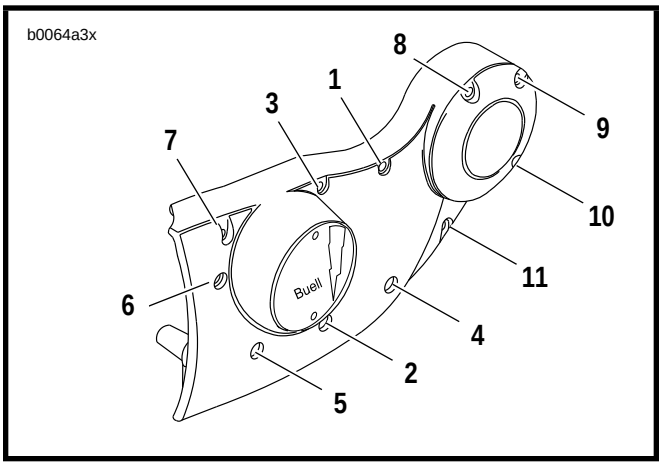


Figure 3-63. Gearcase Cover Mounting Screw Torque Sequence

CRANKCASE

GENERAL

When rod bearings, pinion shaft bearing or sprocket shaft bearing are in need of repair, the engine must be removed from the chassis. See REMOVING ENGINE CRANKCASE OR COMPLETE ENGINE on page 3-8. It is recommended procedure to check and make repairs to cylinder heads, cylinders, gearcase and transmission at the same time (perform entire engine overhaul).

⚠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.

ADJUSTMENT/TESTING

Flywheel End Play

See Figure 3-64. Before completely disassembling crankcases, check flywheel end play.

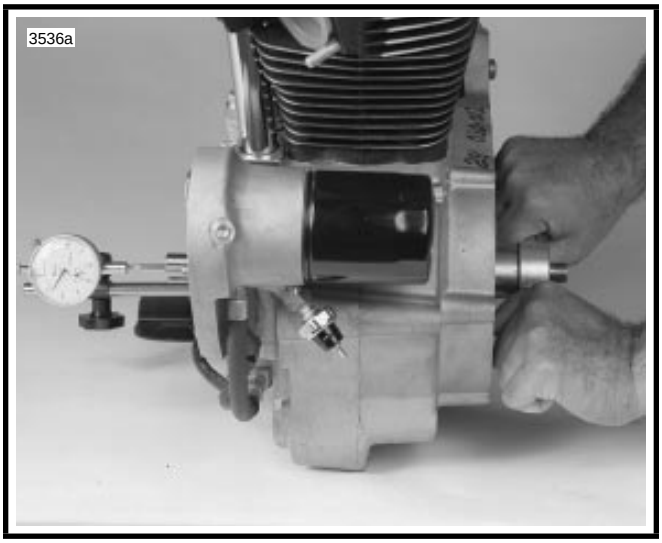


Figure 3-64. Checking Flywheel End Play

1. After engine has been removed from chassis, securely fasten it to a stand or workbench.
2. Remove gearcase cover. Attach a dial indicator to gear side crankcase with indicator stem on end of gearshaft.
3. Sprocket shaft bearings must be preloaded to obtain an accurate flywheel end play reading. A suitable tool can be made by welding two handles to an old sprocket shaft nut. Install the nut and sprocket. Tighten nut to 150-165 ft-lbs (203-224 Nm).
4. Rotate and push on sprocket shaft while reading dial indicator. Then rotate and pull on sprocket shaft while reading dial indicator. If difference (end play) in indicator readings is not 0.001-0.005 in. (0.025-0.13 mm), bearing inner spacer (shim) (item 6, Figure 3-68.) must be replaced. Choose spacer from Table 3-11. Use a thinner spacer for less end play; use a thicker spacer for more end play.

Table 3-11. Flywheel End Play Spacers (Shims)

PART NUMBER	THICKNESS	
	IN.	MM
9155	0.0975-0.0985	2.476-2.502
9142	0.0995 - 0.1005	2.527-2.553
9143	0.1015-0.1025	2.578-2.603
9144	0.1035 - 0.1045	2.629-2.654
9145	0.1055 - 0.1065	2.680-2.705
9146	0.1075 - 0.1085	2.730-2.756
9147	0.1095 - 0.1105	2.781-2.807
9148	0.1115 - 0.1125	2.832-2.857
9149	0.1135 - 0.1145	2.883-2.908

DISASSEMBLY

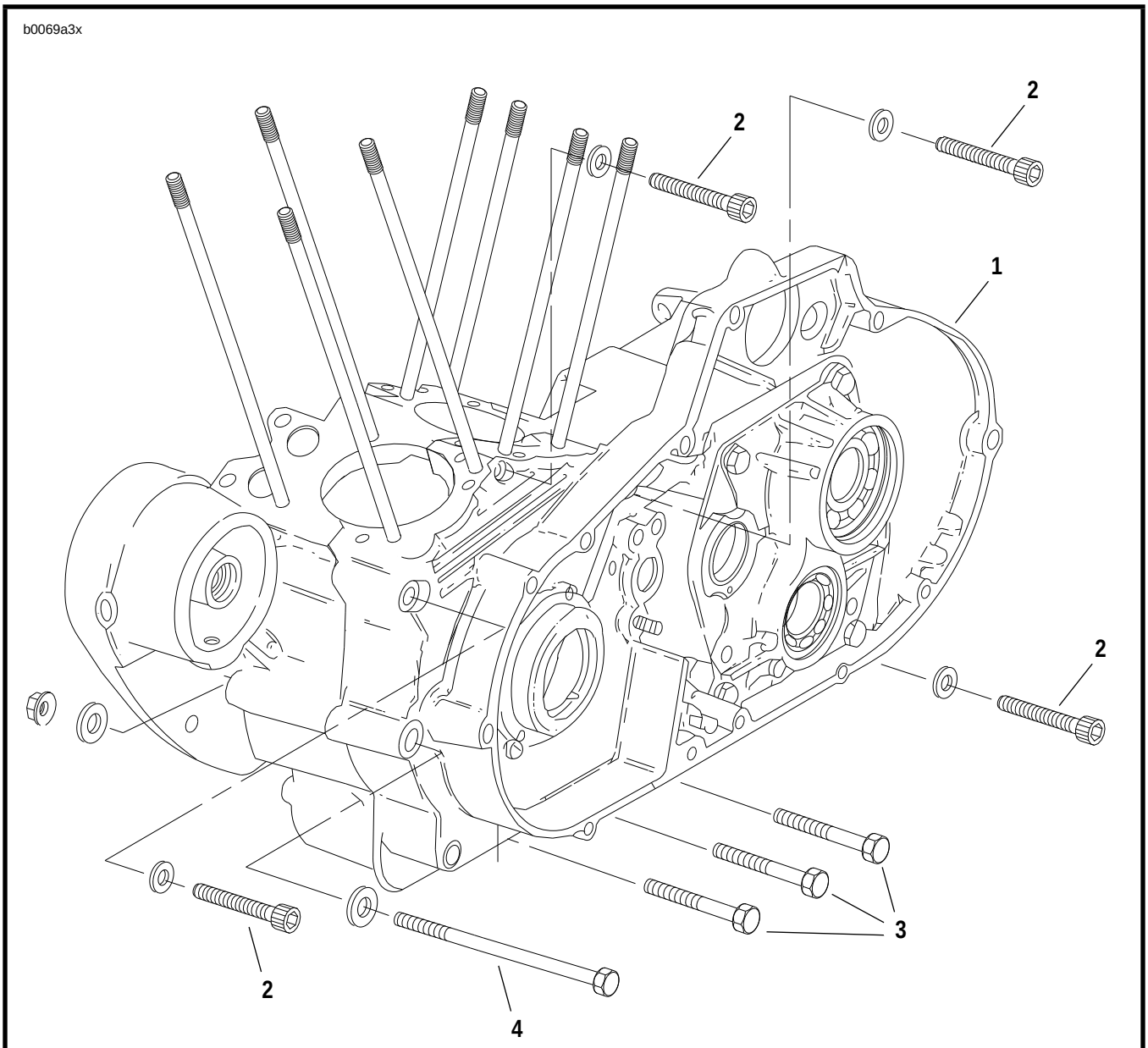
Crankcase Halves

1. Remove cylinder heads as described under CYLINDER HEAD, REMOVAL on page 3-11.

⚠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 CYLINDER AND PISTON, REMOVAL/DISASSEMBLY on page 3-22.
3. Remove oil pump as described under OIL PUMP, REMOVAL/DISASSEMBLY on page 3-35.
4. Remove gearcase components. See GEARCASE COVER AND CAM GEARS, REMOVAL/DISASSEMBLY on page 3-40.
5. Remove clutch and primary drive components. See PRIMARY DRIVE/CLUTCH in Section 6.



1. **Crankcase**
2. **Upper case hex socket head screw – 5/16-18 X 2-1/2 in. long (4)**
3. **Bottom case hex head bolt – 1/4-20 X 3/4 in. long (3)**
4. **Muffler mount bolt – 3/8-16 X 5-1/2 in. long (2, with washers and locknuts)**

Figure 3-65. Crankcase Hardware

6. Remove starter motor as described under STARTER, REMOVAL in Section 5.

7. Remove transmission. See TRANSMISSION CASE in Section 6.

8. See Figure 3-65. Remove screws (2) 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.

⚠WARNING

The following step requires using a press. Wear eye protection and make certain set-up is stable. The force involved could cause parts to "fly out" and cause personal injury.

10. See Figure 3-66. Mount the left case 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 case half. Do not drive flywheel assembly from case half as flywheels may be knocked out of alignment.

NOTE

See Figure 3-68. If it is necessary to remove either the pinion shaft bearing (11) or sprocket shaft bearing (4 and 9), proceed as follows:

11. Pinion bearing (11) will remain on pinion shaft. Remove retaining ring (10), and bearing (11) may be slipped off pinion shaft.
12. See Figure 3-69. Pull sprocket shaft bearing with WEDGE ATTACHMENT FOR CLAW PULLER (Part No. HD-95637-46A) and ALL PURPOSE CLAW PULLER (Part No. HD-95635-46) using bolts in place of jaws.
13. See Figure 3-67. Use CRANKSHAFT BEARING TOOL (Part No. HD-94547-101) to remove sprocket shaft outer races.

NOTE

See Figure 3-68. Do not remove retaining ring (7); the crankcase can easily be damaged during the removal process. Removal of the retaining ring is not necessary for the removal or installation of the outer bearing races.

Flywheels

1. See Figure 3-70. Place flywheel assembly in holding fixture. Remove crank pin nut (1). Strike left flywheel with soft metal mallet at about 90° from crank pin hole on wheel periphery to loosen. Lift left flywheel (2) off crank pin.
2. Hold down crank pin bearing assembly (4) with a short length of pipe or tubing so connecting rods (3) may be slipped off bearings, then remove bearing assembly. Secure bearings (4) together in set until they are washed and refitted to crank pin.
3. Remove crank pin nut (9), then tap crank pin (6) out of flywheel and remove key (7).

CLEANING/INSPECTION

1. Wash all parts in solvent and blow dry with compressed air. Examine crank pin for wear, grooving and pitting. If the surface is at all worn, replace with **new** pin. Examine flywheel washers. If either washer is worn or grooved, it should be replaced. See REPLACING FLYWHEEL WASHERS on page 3-51.
2. Examine connecting rod lower races. If they appear slightly grooved or shouldered where edge of bearing rollers ride, they may be lapped out, and an oversize crank pin and new bearing installed. If they appear badly worn, grooved or pitted, **new** rods should be installed, preferably as an assembly with **new** bearings and crank pin.
3. Inspect bearing for wear, pitting and heat discoloration. Replace as required.
4. Inspect crank pin, crank pin roller and connecting rods for correct freeplay.

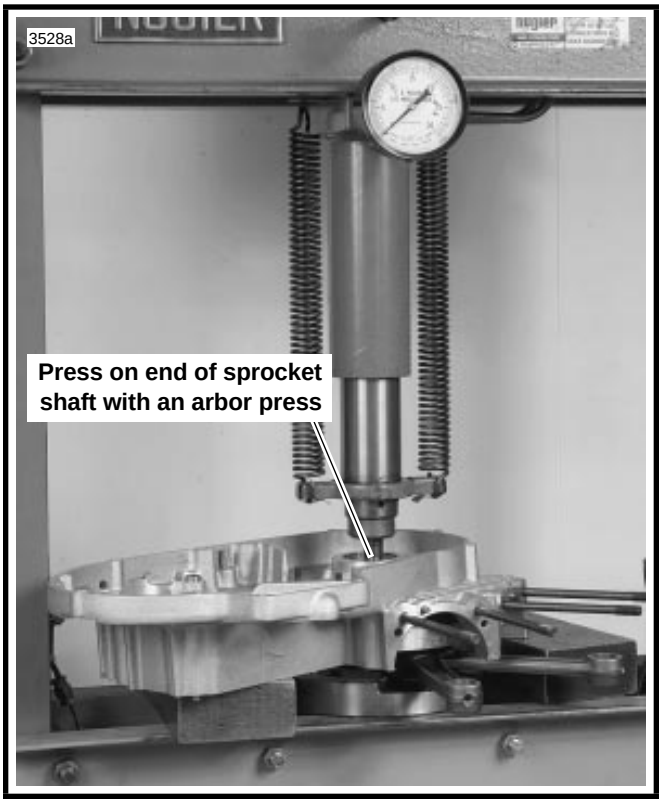


Figure 3-66. Pressing Flywheel from Crankcase

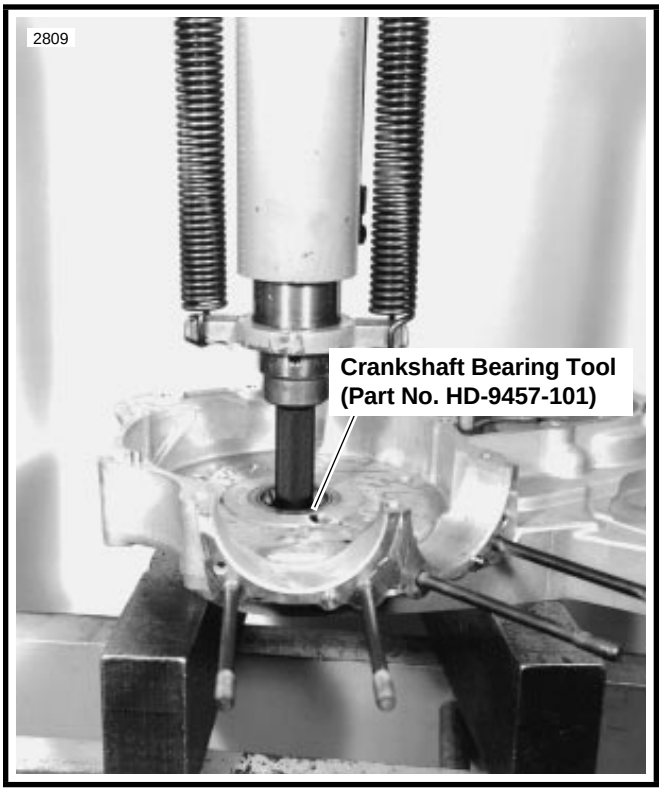
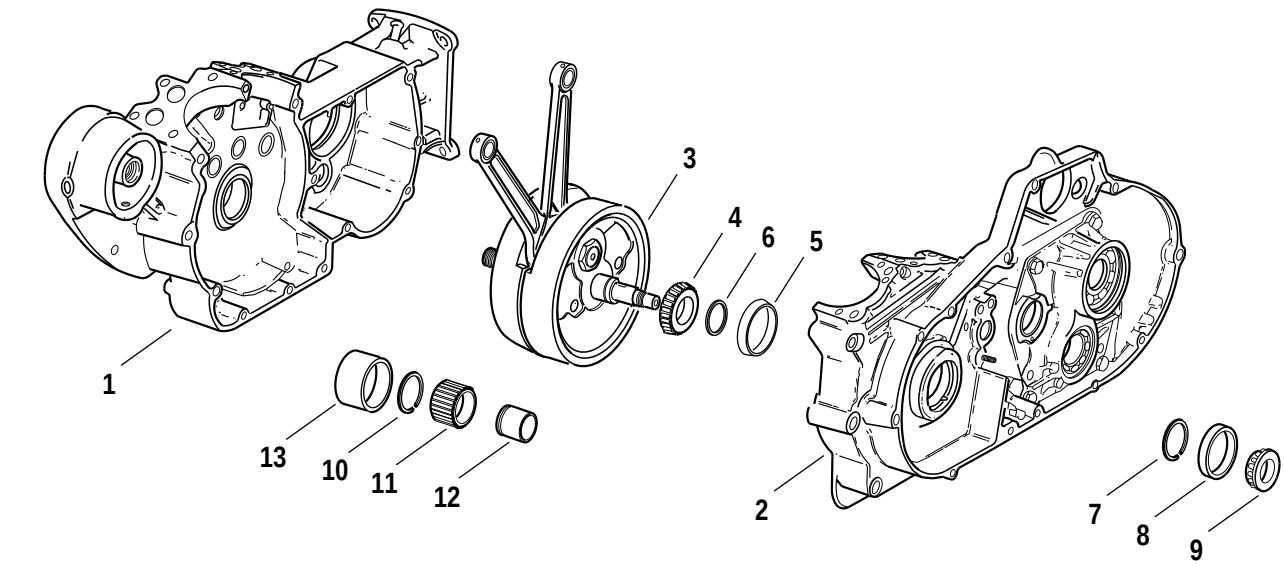


Figure 3-67. Sprocket Shaft Outer Race Removal



1. **Right crankcase half**
2. **Left crankcase half**
3. **Connecting rod and flywheel assembly**
4. **Sprocket right bearing**
5. **Sprocket right outer race**
6. **Spacer**
7. **Retaining ring**
8. **Sprocket left outer race**
9. **Sprocket left bearing**
10. **Retaining ring**
11. **Pinion shaft bearing**
12. **Pinion shaft bearing inner race**
13. **Pinion shaft bearing outer race**

Figure 3-68. Crankcase and Flywheel Assembly

Replacing Flywheel Washers

Replace worn flywheel washers as follows:

1. See Figure 3-70. The washer (10) is a close fit in flywheel recess and is secured originally by punching flywheel metal tight against the washer at several points. It is usually necessary to drill a small hole (1/8 in. (3.2 mm) or smaller) at the outer edge of the washer to permit prying with a pointed tool.

NOTE

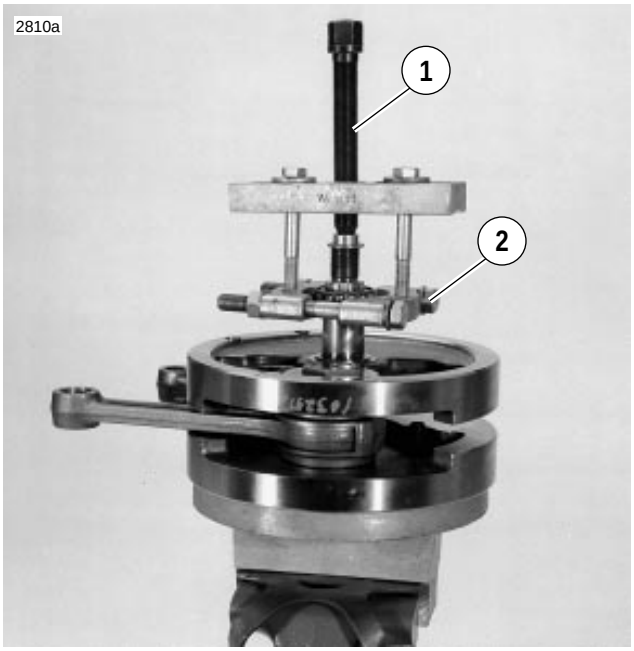
Drill hole only slightly deeper than thickness of washer. Avoid removing more material than necessary.

2. Before installing a **new** washer, scrape outer edge of recess, where metal was punched against original washer, so **new** washer will seat fully against recess bottom. If washer does not seat fully, forked rod will not have necessary clearance (side play).

⚠CAUTION

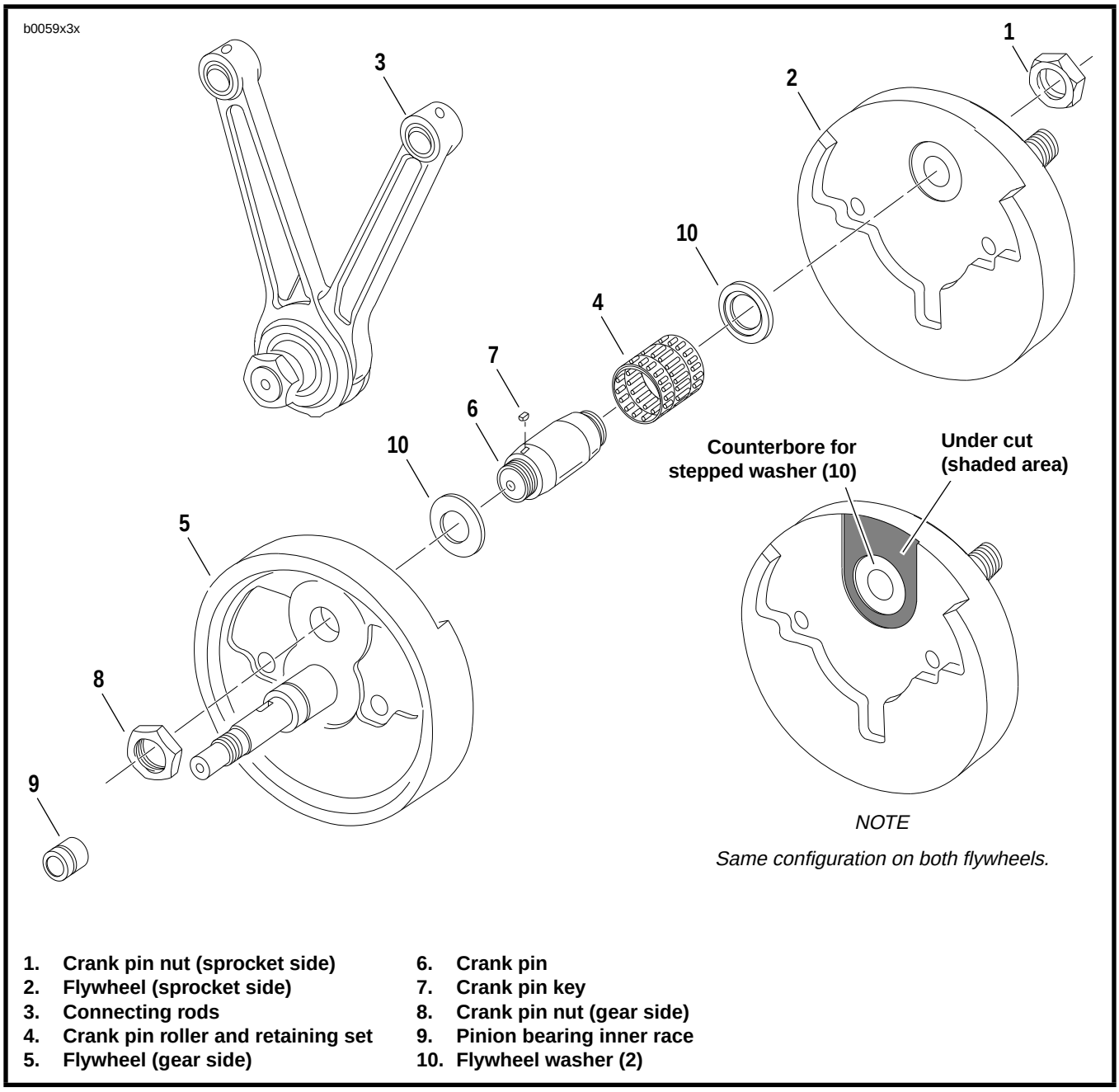
Be sure stepped thrust washers are installed with step facing crank pin bearing. Improper installation will damage washer and bearing set and cause accelerated wear and increased noise.

3. Carefully tap **new** washers into place and using a punch, peen metal over edge to retain washer.



1. **All purpose claw puller (Part No. H-D 95637-46)**
2. **Wedge attachment (Part No. H-D 95637-46A)**

Figure 3-69. Removing Sprocket Shaft Roller Bearing



1. **Crank pin nut (sprocket side)**
2. **Flywheel (sprocket side)**
3. **Connecting rods**
4. **Crank pin roller and retaining set**
5. **Flywheel (gear side)**
6. **Crank pin**
7. **Crank pin key**
8. **Crank pin nut (gear side)**
9. **Pinion bearing inner race**
10. **Flywheel washer (2)**

Figure 3-70. Flywheel and Connecting Rod Assembly

Lapping Connecting Rod Races

Connecting rod lower races that are likely to clean up within range of oversize bearing rollers and are otherwise in serviceable condition, should be trued and sized with CONNECTING ROD LAPPING ARBOR (Part No. HD-96740-36).

1. Clean lap before using.
2. See Figure 3-71. Clamp lap into lathe chuck, carefully load lap with #220 grit grinding compound, mixed with oil. Adjust lathe to turn at approximately 150-200 RPM.
3. Carefully slide connecting rod over lap. Adjust lap to a dragging, but free, fit in rod race.

NOTE

A loose lap will BELL MOUTH bearing races, so lap must be kept adjusted at all times.

4. Start lathe and work rod back and forth, over full length of lap. Hold rod as near race end as possible.
5. Check rod frequently. When rod is lapped true and all traces of pit marks or grooves are cleaned up, wash and blow rod dry.
6. Repeat lapping procedure for other rod race.
7. Bearing races should have a soft velvety appearance and be free of shiny spots.

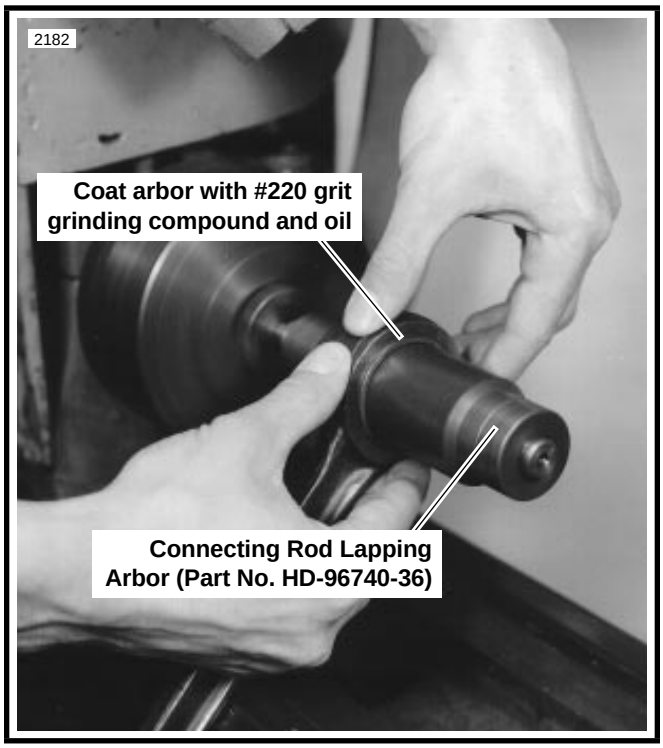


Figure 3-71. Lapping Connecting Rod Races

Fitting Rod Bearings

See Figure 3-72. The **new** crank pin bearing set packages are color coded with either a red or blue identification. This color coding is used by the bearing manufacturer only. The color coding DOES NOT indicate size selection for crank pin bearing replacement.

⚠CAUTION

Either a red or a blue coded bearing set may be used. DO NOT intermix bearings from a red and a blue bearing set because this may cause excessive loading on one bearing, resulting in premature bearing failure.

The bearings consist of rollers retained in steel cages. The wide bearing (male/front rod) retains rollers both internally and externally. The two narrow bearings (female/rear rod) only retain the rollers externally, so care must be taken to slide the bearing set directly from the inner sleeve onto the crank pin; this will prevent the rollers from dropping out of the cage.

Only one size replacement bearing set (standard, either red or blue coding) is sold. Oversize bearings are not available. Bearing clearance or fit is controlled by the connecting rod race inside diameters and the crank pin diameter. Two oversize crank pins are available.

1. See Figure 3-73. Measure inside diameter (ID) of lapped connecting rod races with a dial bore gauge that has 0.0001 in. (0.0025 mm) graduations. Measure the ID at four places as shown. Record the four measurements. If any race ID exceeds Service Wear Limit of 1.6270 in. (41.326 mm), replace races or connecting rod set. If race ID measurements are less than 1.6270 in. (41.326 mm), continue procedure as follows:

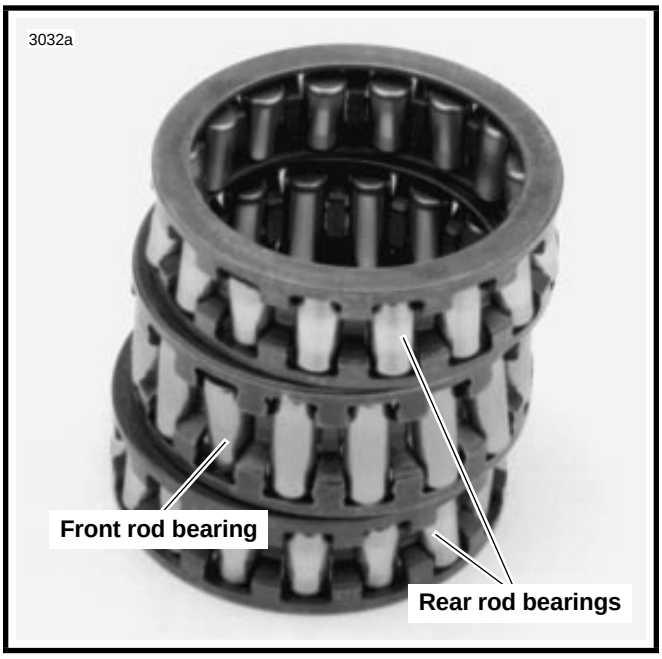


Figure 3-72. Crank Pin Bearing Set

Figure 3-73. Measuring Connecting Rod Race Inside Diameter

2. Compare the measurements recorded in Step 1 with the ranges given in Table 3-12. If the four measurements taken in each race differ, use the smallest measurements.

NOTE

Front and rear rod race ID must be within the same tolerance range given in the above table. The following example will illustrate the procedure necessary if the lapped connecting rod races on both rods do not fall in the same range.

Table 3-12. Race Diameter and Crank Pin Size

CONNECTING ROD RACE ID REQUIRED	CRANK PIN REQUIRED
1.6245-1.6250 in. (41.262-41.275 mm)	Standard
1.6255-1.6260 in. (41.288-41.300 mm)	0.0010 in. oversize (0.025 mm)
1.6265-1.6270 in. (41.313-41.326 mm)	0.0020 in. oversize (0.051 mm)
Greater than 1.6270 in. (41.326 mm)	Service Wear Limit exceeded. Replace races or connecting rod set.

3. As an example, assign the following values to the measurements taken in Step 1.

   Front connecting rod race diameter: 1.6255 in. (41.288 mm)

   Rear connecting rod race diameter: 1.6250 in. (41.275 mm)

See Table 3-12. For the above example measurements, the front connecting rod would require a 0.0010 in. (0.025 mm) oversize crank pin, while the rear connecting rod could use the standard sized crank pin. The rear connecting rod races must be lapped so they have the same ID (within 0.0002 in. (0.005 mm)) as the front rod.

4. See Figure 3-74. Oversize (OS) crank pins are available in two oversizes: 0.0010 and 0.0020 in. (0.025 and 0.051 mm) OS crank pins will have a blue or red paint dot applied to the ends of the pins. A blue dot indicates 0.0010 in. (0.025 mm) OS, a red dot indicates 0.0020 in. (0.051 mm) OS. Standard size crank pins will not be marked.

5. Before assembling the flywheel assembly, recheck connecting rods as follows:

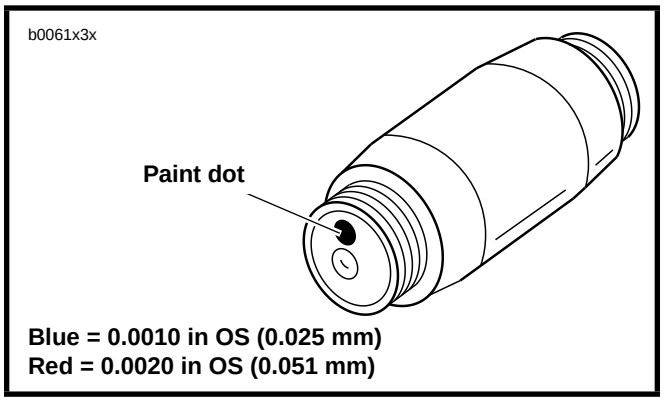


Figure 3-74. Oversize Crank Pin Identification

⚠CAUTION

After the appropriate connecting rod race ID range specified in RACE DIAMETER AND CRANK PIN SIZE table has been achieved, verify that the following CONNECTING ROD SPECIFICATIONS are also met:

CONNECTING ROD SPECIFICATION

Rear . . . . . Difference in ID of two races must not exceed 0.0001 in. (0.0025 mm).

Front and rear . . . . . Difference in ID of races in front and rear connecting rods must not exceed 0.0002 in. (0.005 mm).

Front and rear . . . . . Races must be round within 0.00025 in. (0.0064 mm). (Difference between largest and smallest ID measurement in any race must not exceed 0.00025 in. (0.0064 mm)).

NOTE

*Always use **new** bearings and crank pin after resizing (lapping) connecting rods to insure proper running clearance.*

⚠CAUTION

Fitting components tighter than recommended may result in seizing and bearing damage when heat expands the parts. Such damage requires component replacement.

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.

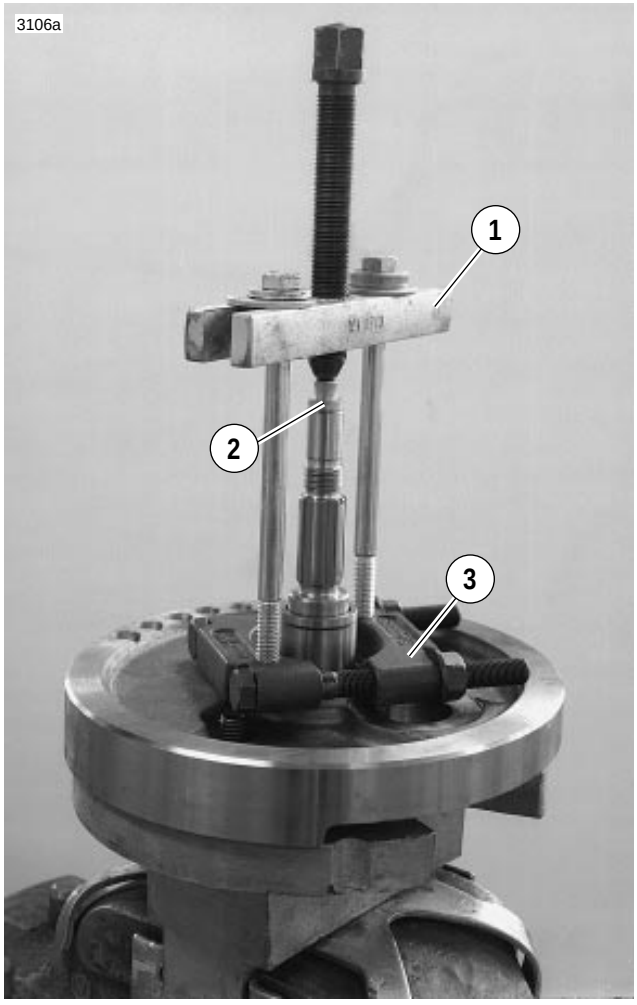
Fitting Pinion Bearings

See Figure 3-68. A pressed-in bushing in the right crankcase half is the outer race (13). The inner race (12) is pressed on the pinion shaft.

See Figure 3-75. 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. (0.005-0.020 mm) is established during crankcase set or flywheel assembly replacement and engine rebuild.

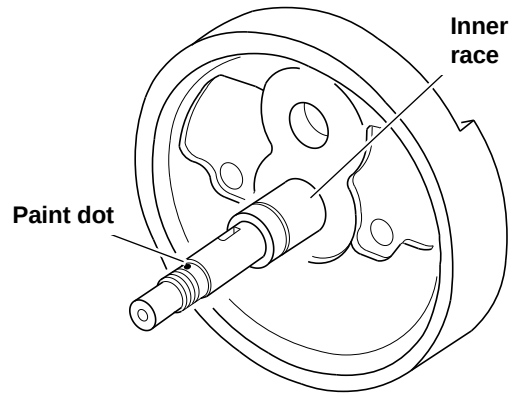
See Figure 3-76. Installed inner races are identified at the factory as shown.

See Figure 3-77. Outer races are identified at the factory 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 3-75. Pulling Pinion Shaft Inner Race

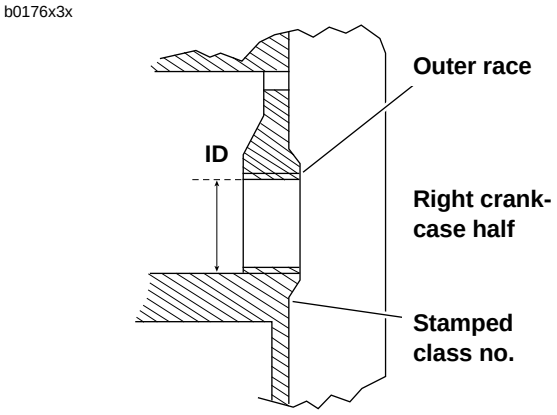


RACE OD	CLASS	IDENTIFICATION*
1.2498-1.2500 in. (31.745-31.750 mm)	A	White
1.2496-1.2498 in. (31.740-31.745 mm)	B	Green

*** Paint dot on end of spline**

Service Wear Limit: 1.2492 in.

Figure 3-76. Factory Inner Race Sizes



RACE ID	CLASS NO.	STAMPED IDENTIFICATION*
1.5646-1.5648 in. (39.741-39.746 mm)	1	1
1.5648-1.5650 in. (39.746-39751 mm)	2	2
1.5650-1.5652 in. (39.751-39756 mm)	3	3

*** Stamped number inside crankcase near race**

Service Wear Limit: 1.5672 in.

Figure 3-77. Factory Outer Race Sizes

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 3-78. Pinion bearings are identified as shown.

BEARING SELECTION

Select bearings using the identification information given for inner and outer races and bearings. See Table 3-13.

NOTE

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

1. Measure ID of outer race at four places with a dial bore gauge. Take measurement on ID where bearing rollers ride. Record the four measurements.
2. If the largest measurement is larger than 1.5672 in. (39.807 mm) or the required lapping to remove wear marks would enlarge bore beyond 1.5672 in., continue at Step 8.
3. If the largest measurement is 1.5672 in. (39.807 mm) or less, cover the cam bearings with masking tape to prevent debris from entering bearings. Assemble crankcase halves.

NOTE

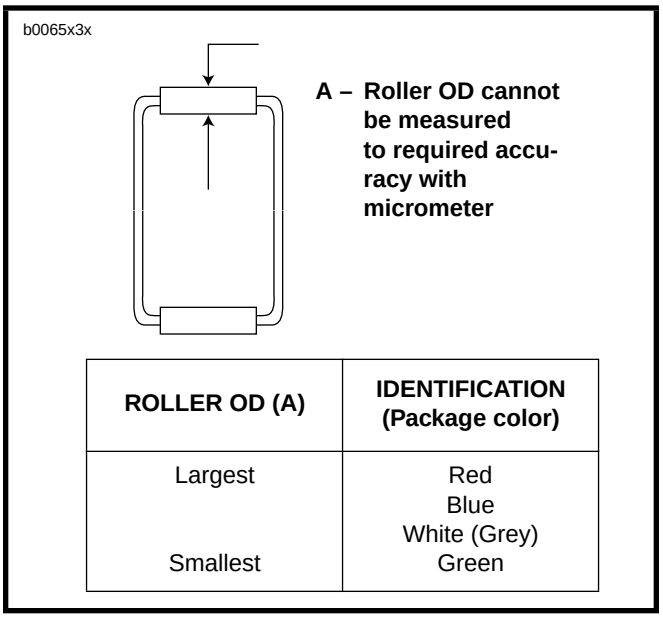
The next step requires lapping the outer race. To keep sprocket shaft and pinion shaft bearings aligned the lap must be supported by an adaptor or pilot in the left crankcase half.

4. See LAPPING ENGINE MAIN BEARING RACES on page 3-58. Race must be lapped until all wear marks are removed.
5. Measure ID of race at four places and record the measurements.
6. Check measurements against these specifications:

   Largest ID measured: 1.5672 in. (39.807 mm) or less
   Roundness of ID: within 0.0002 in. (0.005 mm)
   Taper: within 0.0002 in. (0.005)
7. If lapping increased bore ID to larger than 1.5672 in. (39.807 mm), go to Step 8. If roundness or taper do not meet specifications, continue lapping until specifications are met. If all specifications are met, continue at Step 10 to remove and size inner race.
8. Press the outer race from the right crankcase. Press **new** outer race into crankcase flush with inside edge of cast-in insert.

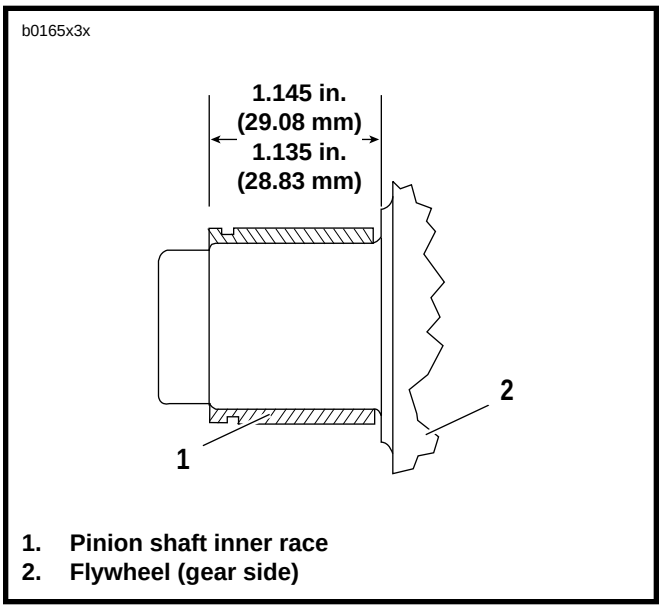
   See Figure 3-80. Dimensions are shown for fabrication of tools used in pressing the outer race into or out of crankcase.
9. The **new** outer race must be lapped slightly to true and align with left case bearing and to meet the following specifications. See LAPPING ENGINE MAIN BEARING RACES on page 3-58.

   ID: 1.5646 - 1.5652 in. (39.741 - 39.756 mm)
   Roundness: within 0.0002 in. (0.005 mm)
   Taper: within 0.0002 in. (0.005 mm)
   Surface finish: 16 RMS



ROLLER OD (A)	IDENTIFICATION (Package color)
Largest	Red
	Blue
	White (Grey)
Smallest	Green

Figure 3-78. Bearing Identification



1. **Pinion shaft inner race**
2. **Flywheel (gear side)**

Figure 3-79. Inner Race Location

Table 3-13. Pinion Shaft Bearing Selection

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

10. See Figure 3-75. 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.

11. See Figure 3-79. Press **new** inner race on pinion shaft as shown. The **new** inner race must be ground by a competent machinist to OD dimension range given in the PINION SHAFT BEARING SELECTION TABLE, for the finished lapped ID of the outer race. The finished inner race must meet these specifications. For necessary dimensions for constructing a press-on tool see Figure 3-80. When the tool bottoms against the flywheel, correct inner race location is automatically established.

    Roundness: within 0.0002 in.
    Taper: within 0.0002 in. (0.005 mm)
    Surface finish: 16 RMS

12. The following example illustrates how to determine the required inner race OD.

EXAMPLE:

a. If smallest measured ID of outer race is 1.5651 in. (39.754 mm) Table 13 indicates an inner race OD range of 1.2496-1.2504 in. (31.740 - 31.760 mm) is required.

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 and check that specifications in Step 11 are met.

c. For example purposes, the largest measured OD of inner race after grinding is 1.2499 in. (31.747 mm) OD.

d. See Table 3-13. With a 1.5651 in. ID outer race and a 1.2499 in. (31.747 mm) OD inner race, a blue bearing is required.

NOTE

Always use the smallest outer race ID measurement and the largest OD inner race measurement when selecting bearings.

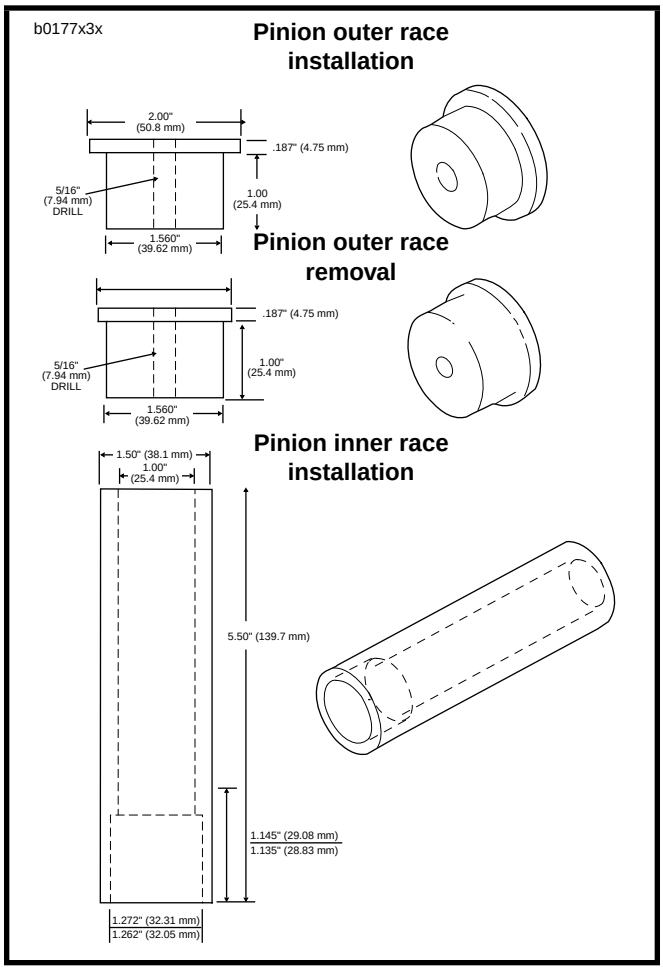


Figure 3-80. Pinion Shaft Bearing Tools

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 3-81. 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. (3.96 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.
5. 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.

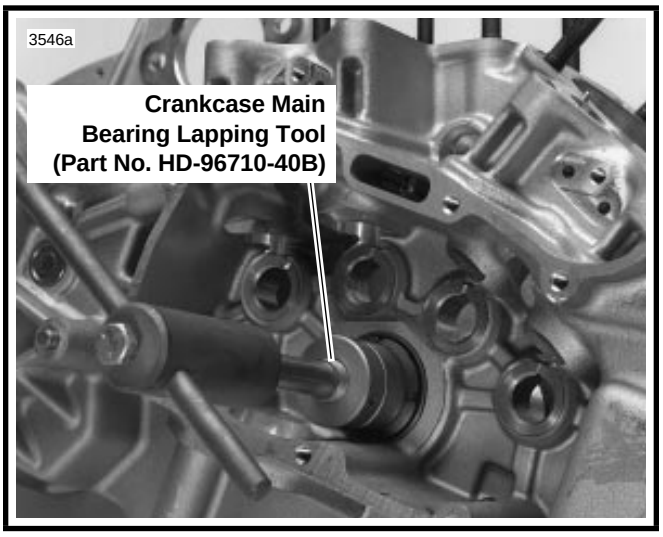


Figure 3-81. Lapping Pinion Shaft Main Bearing

ASSEMBLY

Flywheels

After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

1. Carefully clean all flywheel components using a non-petroleum-based solvent, such as LOCTITE CLEANING SOLVENT or electrical contact cleaner. Thoroughly dry all components.
2. See Figure 3-70. Apply two drops of LOCTITE 620 RETAINING COMPOUND to the crank pin threads, and apply no more than two drops to the nut bearing faces.

⚠CAUTION

Do not apply any LOCTITE THREADLOCKER COMPOUND or RETAINING COMPOUND to shaft tapers. Any material on shaft tapers will cause component damage.

3. Assemble crank pin (6) to gear-side flywheel (5) making sure that key (7) is in proper position. Tighten crank pin nut. See SPECIFICATIONS for proper torque.
4. Position gear-side flywheel assembly in a flywheel fixture with crank pin pointing up. Wipe crank pin taper clean.
5. See Figure 3-82. Slip bearings, and connecting rods over crank pin. Assemble angular boss of the female rod adjacent to large radius side of the male rod as shown. The side of the male rod with the larger radius is narrower in the area where it fits between the forks of the female rod.
6. Verify that oil passages through pinion shaft, gear-side flywheel and crank pin are clear by blowing compressed air into oil galley at end of pinion shaft.
7. Install sprocket-side flywheel. Lightly tighten nut.
8. See Figure 3-83. Hold steel straightedge along outer face of wheel rims at 90° from crank pin as shown. Tap outer

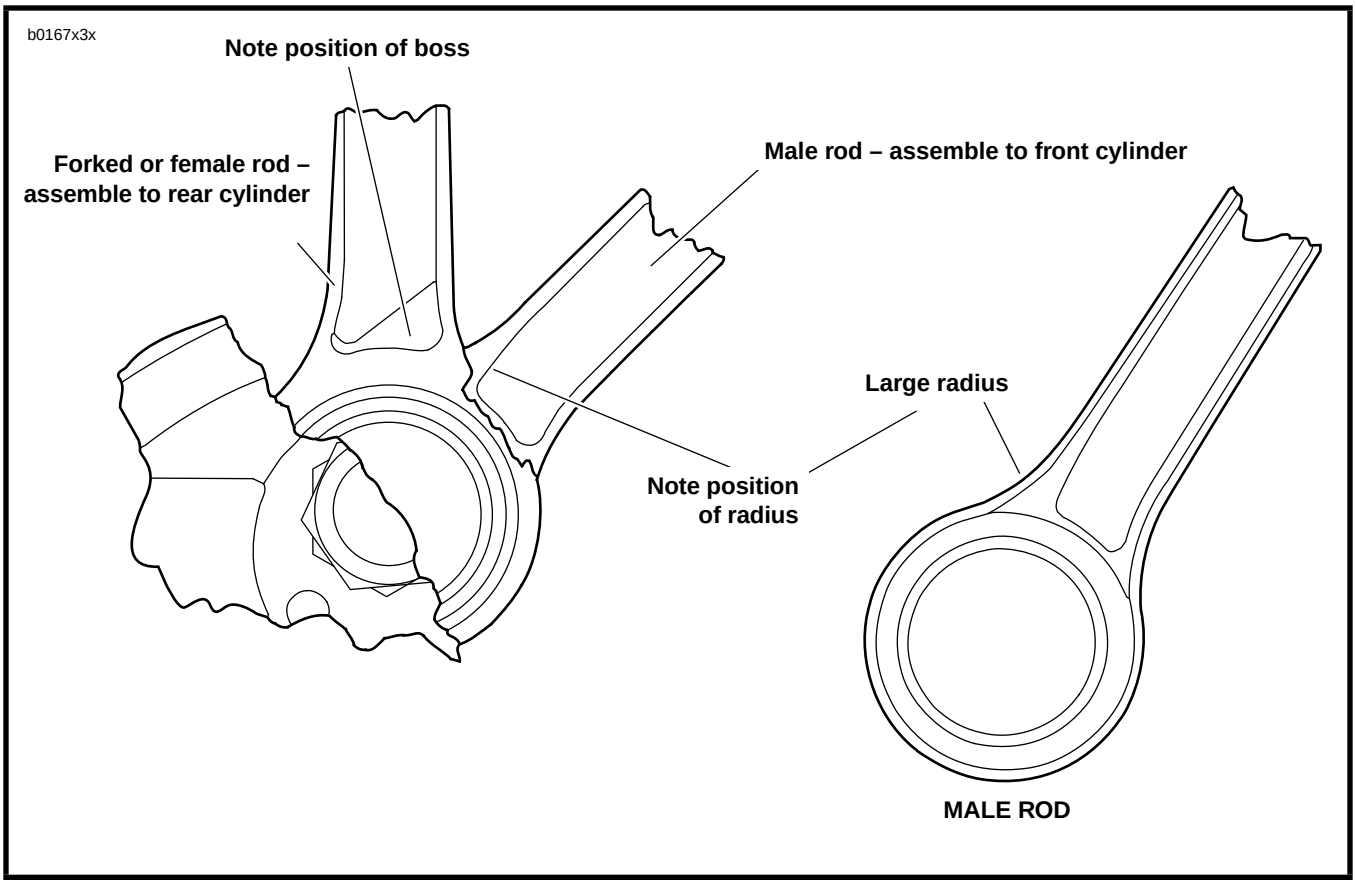


Figure 3-82. Installing Connecting Rods

rim of top wheel until wheels are concentric. Tighten nut, recheck with straightedge at frequent intervals.

NOTE

Use soft metal hammer to realign wheels.

9. Tighten crank pin nut to 150-185 ft-lbs (203-251 Nm). See Figure 3-85. Install flywheel assembly in FLYWHEEL TRUING STAND (Part No. HD-96650-80) as shown. Adjust so centers are snug. Wheels must turn freely; however, shafts must not be loose in centers. If flywheel assembly is either loose or squeezed, indicators will not indicate accurately. Adjust indicators to take reading as near to flywheels as possible, so pointers read at about the middle of the scales.
10. Turn flywheels slowly and observe the movement of indicator pointers. Movement toward flywheels indicate high points of shafts. Find highest point of each shaft and chalk-mark flywheel rims at those points. Remove flywheel from stand and make corrections as follows:
11. See Figure 3-84. Flywheel may be out of true three ways, A, B and C or a combination of two of the three ways.
12. When wheels are both out of true as indicated in A, tighten C-clamp on rims or wheels opposite crank pin and lightly tap the rim at the crank pin with lead or copper mallet.
13. When wheels are both out of true as indicated in B, drive a hardwood wedge between the wheels opposite the crank pin and lightly tap the rims near the crank pin with a lead or copper mallet.
14. When wheels are out of true as indicated in C, strike the rim of the wheel a firm blow at about 90° from crank pin on high side.

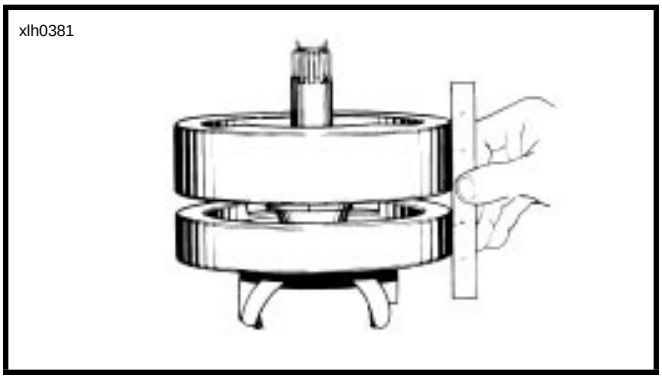


Figure 3-83. Squaring Flywheel Faces

15. When wheels are out of true in a combination of any of the conditions shown, correct C first, tapping rim of offending wheel only, and then correct condition A or B.

NOTE

The number of blows required and how hard they should be struck depends on how far shafts are out of true and how tight nuts are drawn. Always remove the flywheels from the stand, and strike the flywheel rim only at 90° to the crank pin. Use only a soft metal mallet. Never strike wheels a hard blow near crank pin. This could result in a broken crank pin.

16. See Figure 3-85. Readjust centers, revolve wheels and take reading from indicator. Repeat truing operation until indicated shaft runout does not exceed 0.001 in. (0.025 mm) (each graduation on indicator is 0.002 in. (0.05 mm)).

17. If it is impossible to true wheels, check for a cracked flywheel, damaged or enlarged tapered hole or a sprocket or pinion shaft worn out-of-round at surface where indicator reading is being taken.

18. See Figure 3-86. When wheels are true, check connecting rod side play with thickness gauge as shown. If it is greater than tolerance shown in SPECIFICATIONS, CONNECTING ROD draw up crank pin nuts until within tolerance. Insufficient play between rods and flywheel face is caused by one of the following conditions:

    a. Flywheels and crank pin assembled with oil on tapers and nut over-tightened. Disassemble, clean and reassemble.

    b. **New** flywheel washers installed and not fully seated. Disassemble, inspect, replace deepest seating flywheel or crank pin. As last resort, grind down width of forked rod.

    c. Taper holes enlarged as a result of having been taken apart several times. Replace deepest seating wheel.

    d. Cracked flywheel at tapered hole. Replace flywheel.

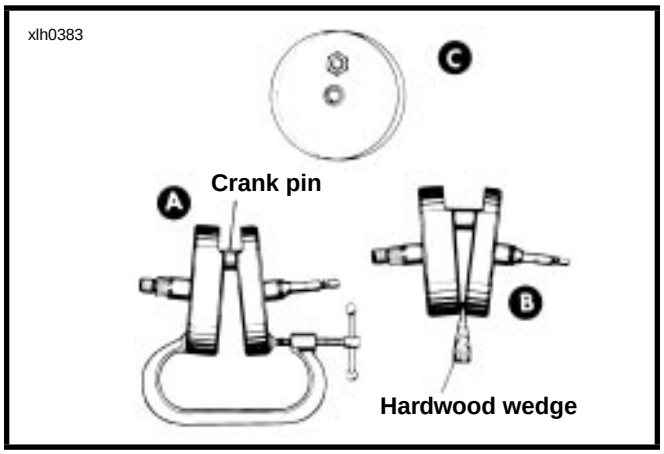


Figure 3-84. Correcting Flywheel Alignment

19. After rod side play is checked and adjusted, check that crank pin nut is tightened to specified torque, again check wheel trueness on truing device. Correct any runout as above.

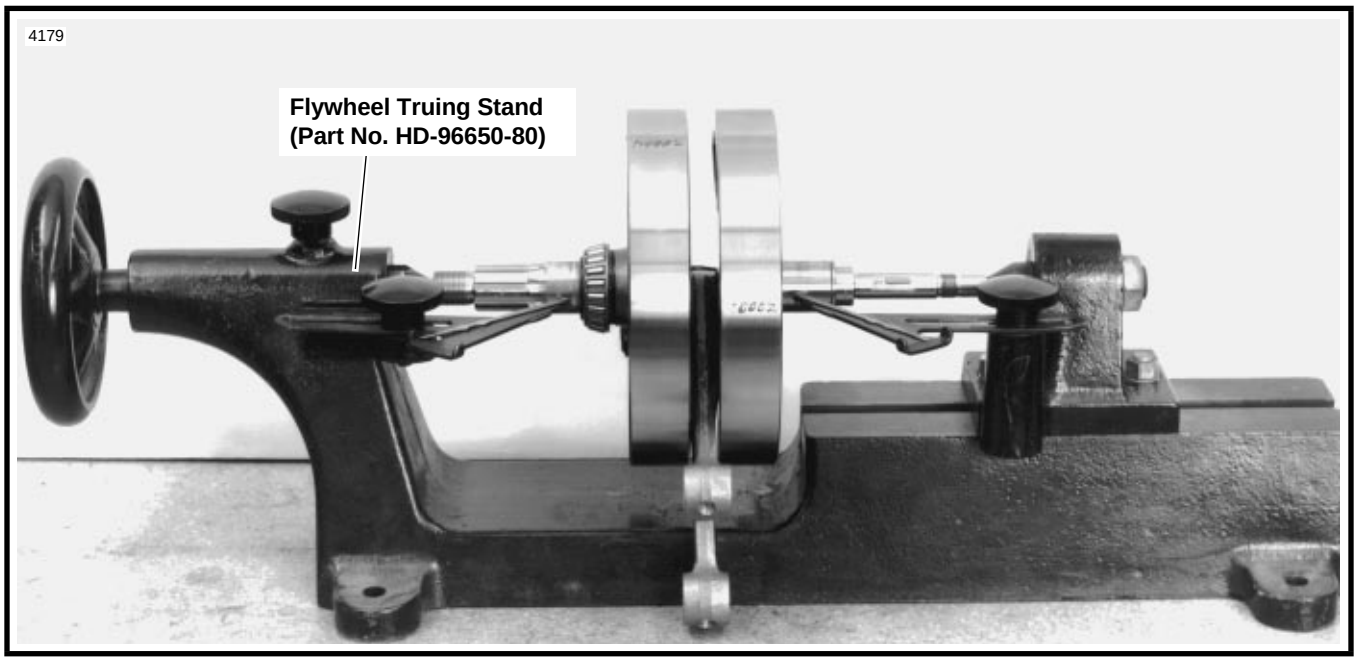


Figure 3-85. Truing Flywheel

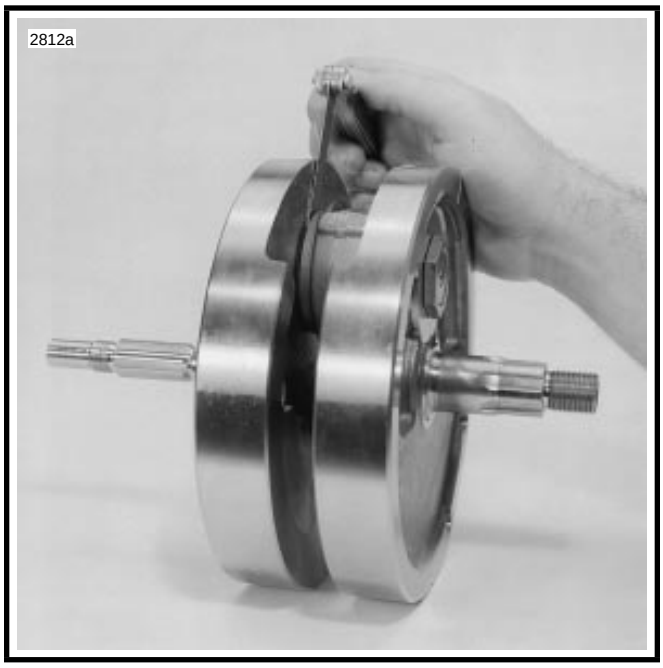


Figure 3-86. Checking Connecting Rod Sideplay

Crankcase Halves

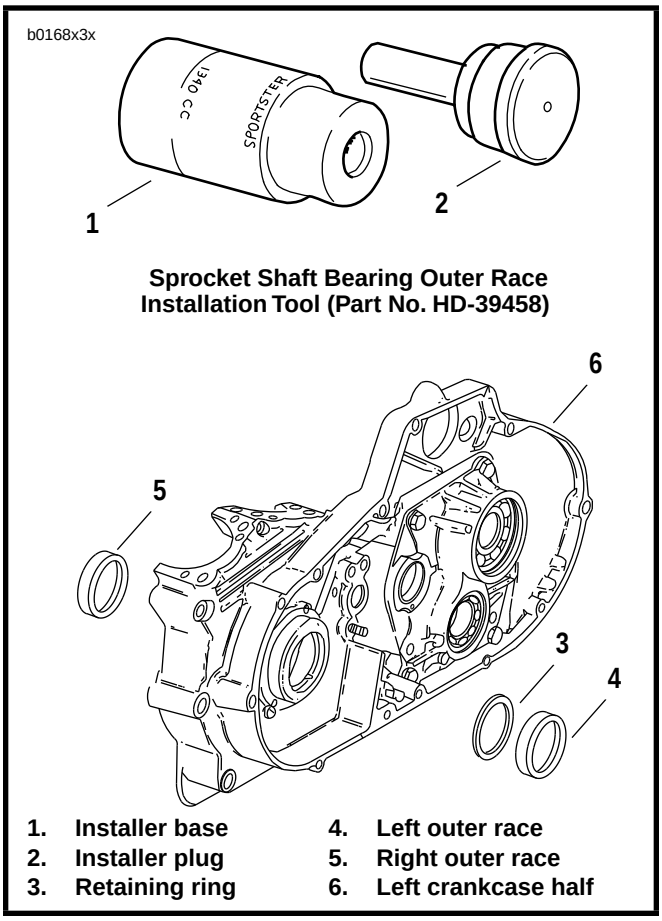
Lubricate all parts with Harley-Davidson 20W50 engine oil, and proceed as follows:

1. See Figure 3-87. The original retaining ring (3) is left in place to avoid damaging the bearing bore of the left crankcase half (6). Verify that gap in retaining ring is aligned with oil supply hole in bearing bore of left crankcase half.

NOTE

See Figure 3-87. USE SPROCKET SHAFT BEARING OUTER RACE INSTALLATION TOOL (1-2 Part No. HD-39458) to install left and right outer races (4, 5) of sprocket shaft tapered roller bearings into left crankcase half (6). Always install left outer race (4) prior to installing right outer race (5); the installer base (1) is usable only when you follow this sequence of race installation.

2. Insert “SPORTSTER” end of installer base (1) into inboard side of left crankcase half (6) bearing bore until base contacts installed retaining ring (3).
3. Position left outer race (4) over bearing bore on outboard side of left crankcase half (6).
4. Insert shaft of installer plug (2) through left outer race (4) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).
5. Insert “SPORTSTER” end of installer base (1) into outboard side of left crankcase half (6) bearing bore until base contacts outboard surface of installed left outer race (4).
6. Position right outer race (5) over bearing bore on inboard side of left crankcase half (6).
7. Insert shaft of installer plug (2) through right outer race (5) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).



Sprocket Shaft Bearing Outer Race Installation Tool (Part No. HD-39458)

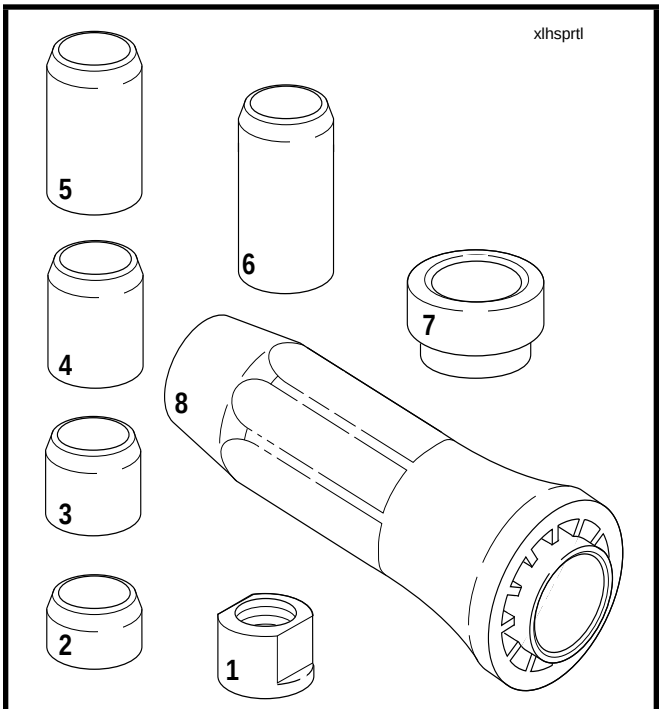
1.	**Installer base**	**4.**	**Left outer race**
2.	**Installer plug**	**5.**	**Right outer race**
3.	**Retaining ring**	**6.**	**Left crankcase half**

Figure 3-87. Installing Sprocket Shaft Bearing Outer Races

NOTE

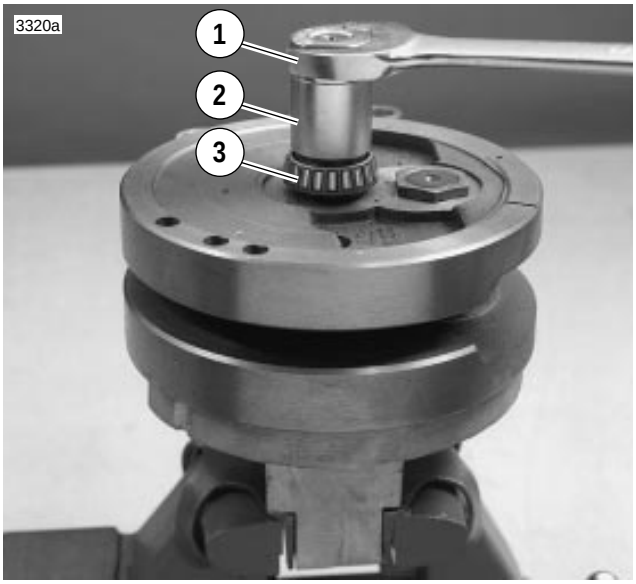
See Figure 3-88. Use SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (1 - 8, Part No. HD-37047A) to install sprocket shaft tapered roller bearings and seal.

8. See Figure 3-89. Place bearing cone (3), small end upward, over end of sprocket shaft. Position spacer (2) over sprocket shaft with (radius) rounded end downward. Thread nut driver (1) on sprocket shaft. Turn nut driver onto shaft until nut bottoms at end of threads. Remove nut driver and spacer (2).
9. See Figure 3-88. Repeat procedure using spacers (3, 4, 5 and 6) until bearing cone bottoms against the shaft shoulder.
10. See Figure 3-90. Position left crankcase over sprocket shaft so that the shaft is through the bearing cups in the bearing bore. Place the spacer that determines end play (item 6 in Figure 3-68.) over sprocket shaft. Position left bearing cone over end of shaft with small end downward. Place spacer (2) over sprocket shaft with flat end downward. Thread nut driver (1) on sprocket shaft. Turn nut driver onto shaft until threads bottom. Remove nut driver and spacer. See Figure 3-88. Install spacers (3, 4 and 5) and nut driver (1) in same manner, and tighten until bearing cones and spacer are drawn together.
11. Remove nut driver and spacer.



1. Nut driver
2. Spacer (0.75 in.)
3. Spacer (1.2 in.)
4. Spacer (1.6 in.)
5. Spacer (2.06 in.)
6. Spacer (2.5 in.)
7. Seal/spacer driver
8. Driver handle

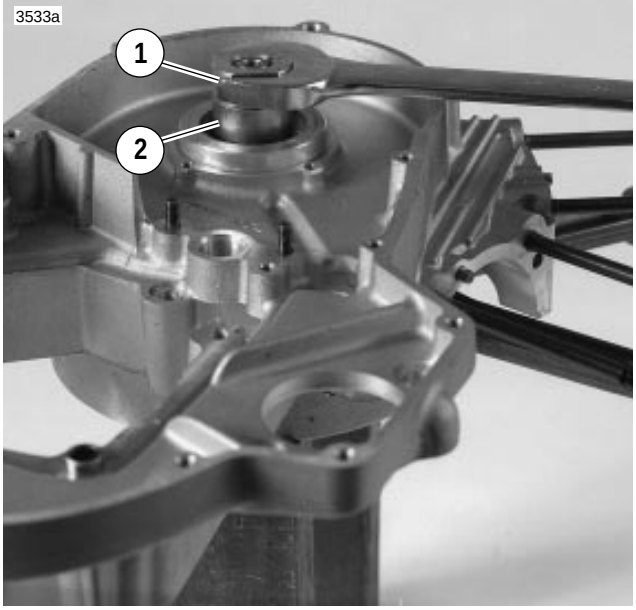
Figure 3-88. Sprocket Shaft Bearing/Seal Installation Tool



1. Nut driver
2. Spacer
3. Bearing cone

Figure 3-89. Installing Bearing Cone

12. See Figure 3-91. Install spacer in seal ID. With the open (lipped) side facing outward, center seal/spacer assembly over bearing bore.



1. Nut driver
2. Spacer

Figure 3-90. Installing Left Crankcase

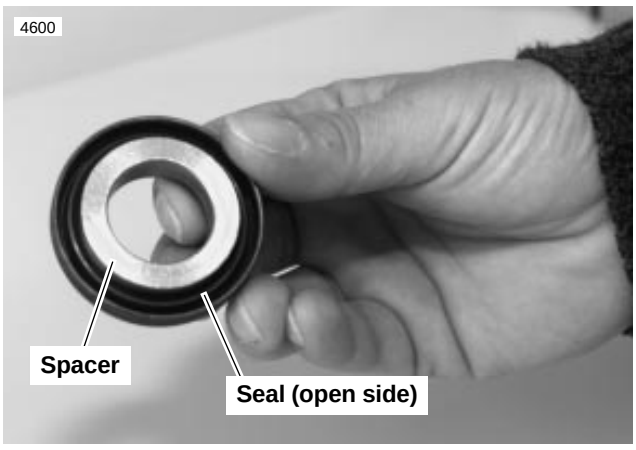


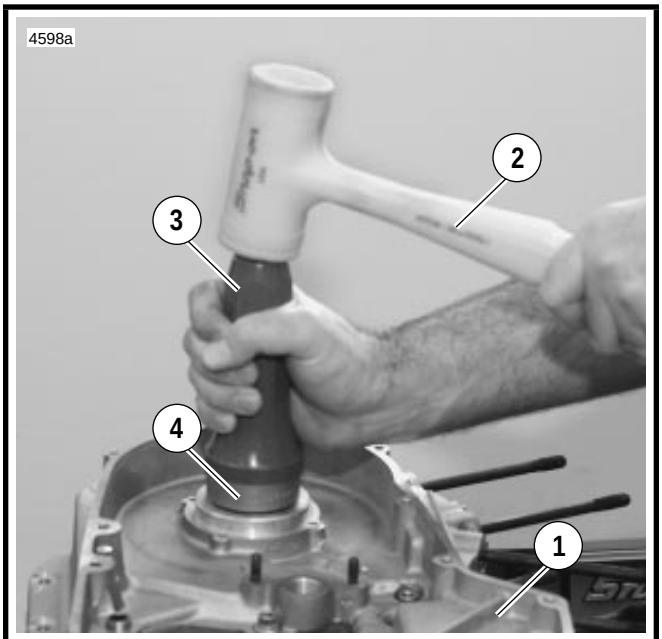
Figure 3-91. Install Spacer in Seal

13. See Figure 3-92. Center seal/spacer driver over seal, so that the sleeve (smaller OD) seats between seal wall and garter spring. Fit the sleeve of the driver handle into the recess at the top of the seal/spacer driver. Using a rubber or plastic mallet, drive the seal and spacer simultaneously into the bore until the spacer makes solid contact with the Timken bearing cage. Remove the driver handle and seal/spacer driver.

⚠CAUTION

Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

14. Apply a thin coat of DOW CORNING SILASTIC or 3-M 800 sealant to crankcase joint faces.



1. Crankcase
2. Rubber mallet
3. Driver handle
4. Seal/spacer driver

Figure 3-92. Install Bearing Seal/Spacer

15. Assemble crankcase halves together. See Figure 3-65. Install hardware to secure crankcase halves. Tighten 1/4-in. fasteners to 70-110 **in-lbs** (7.9-12.4 Nm), and 5/16-in. fasteners to 15-18 ft-lbs (20-24 Nm).
16. See Figure 3-68. Lubricate pinion shaft bearing (11) with engine oil. Slip bearing (11) on pinion shaft and into outer race in right crankcase. Install **new** retaining ring (10) in groove of pinion shaft bearing inner race (12).
17. See Figure 3-93. The cylinder studs have a shoulder at the lower end.
18. Pack clean towels into crankcase opening.
19. Place a steel ball into a head bolt, then place the unpainted end of the stud into the head bolt.
20. See Figure 3-94. Install the stud in the crankcase with the shoulder end down. Tighten to 10 ft-lbs (13.6 Nm).
21. See Figure 3-65. Install crankcase in chassis using hardware shown.
22. Install transmission mainshaft sprocket. See TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT in Section 6.
23. Install starter. See STARTER, INSTALLATION in Section 5.
24. Install primary drive components, clutch and clutch release mechanism. See PRIMARY DRIVE/CLUTCH in Section 6.
25. Apply two or three drops of LOCTITE THREADLOCKER 262 (red) on threads of sprocket shaft. Tighten front sprocket nut to 150-165 ft-lbs (203-224 Nm).

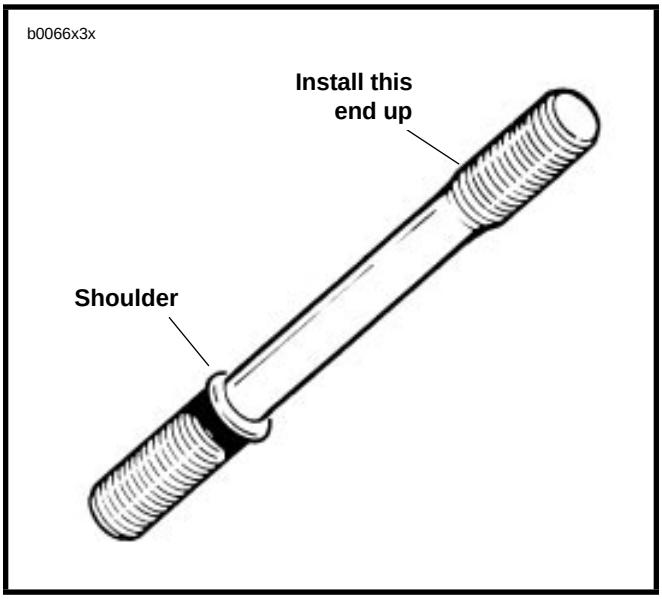


Figure 3-93. Cylinder Studs

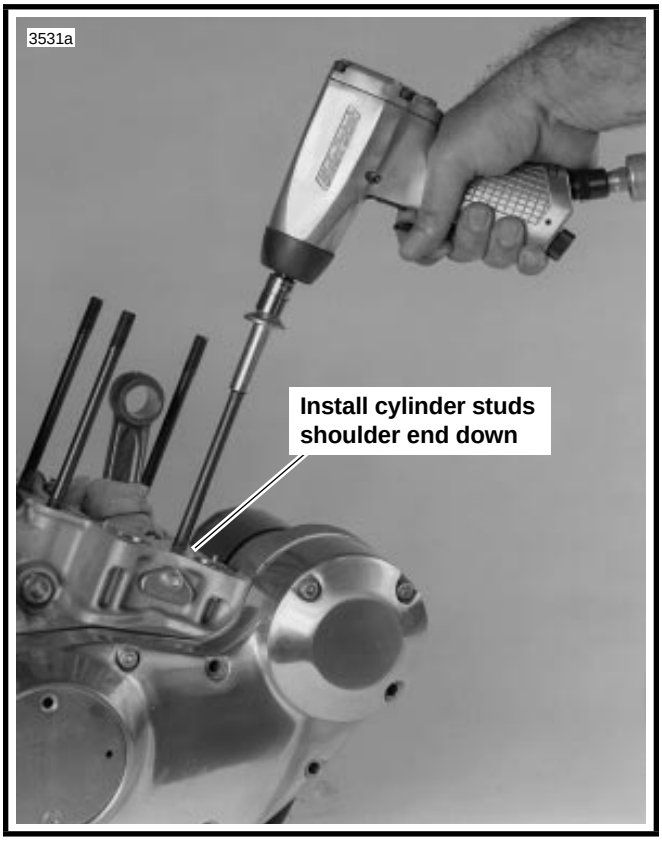


Figure 3-94. Install Cylinder Stud

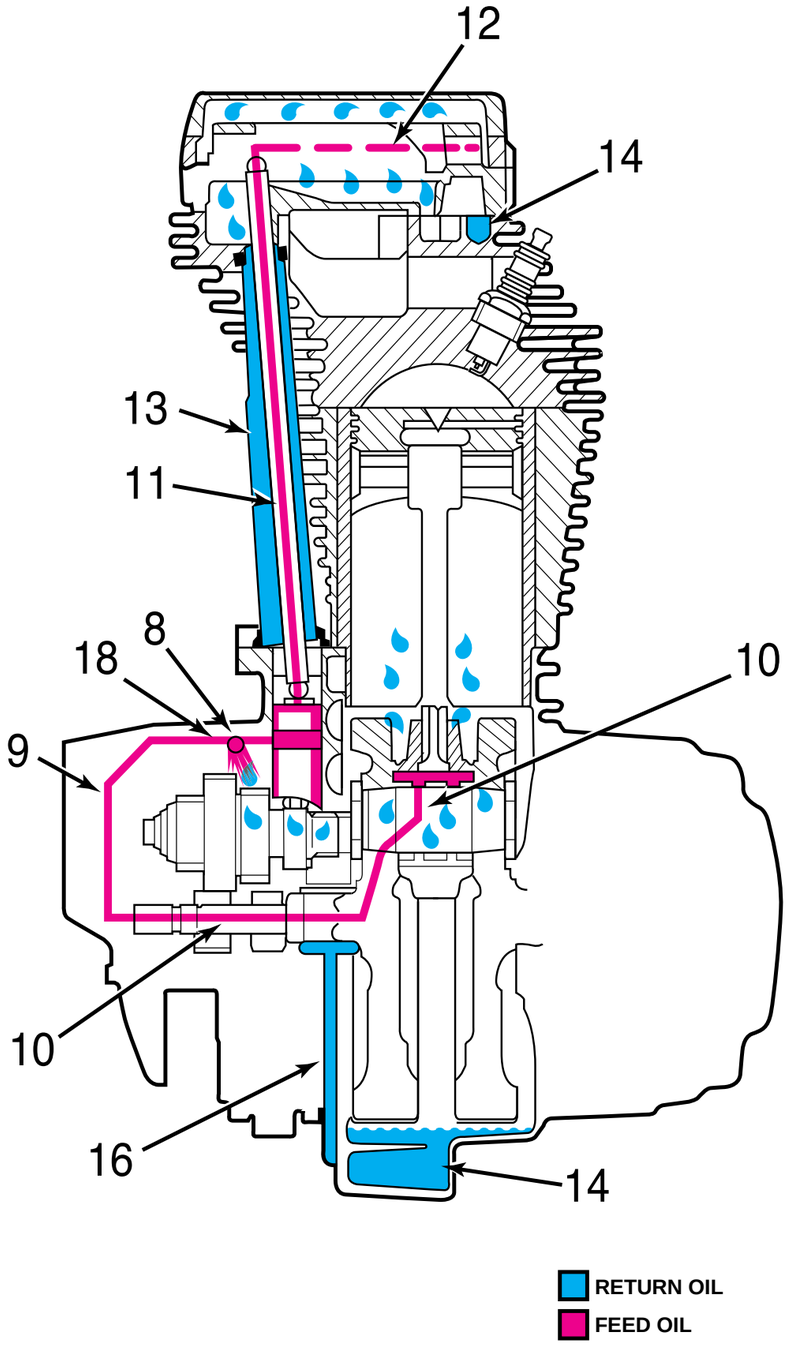
NOTE

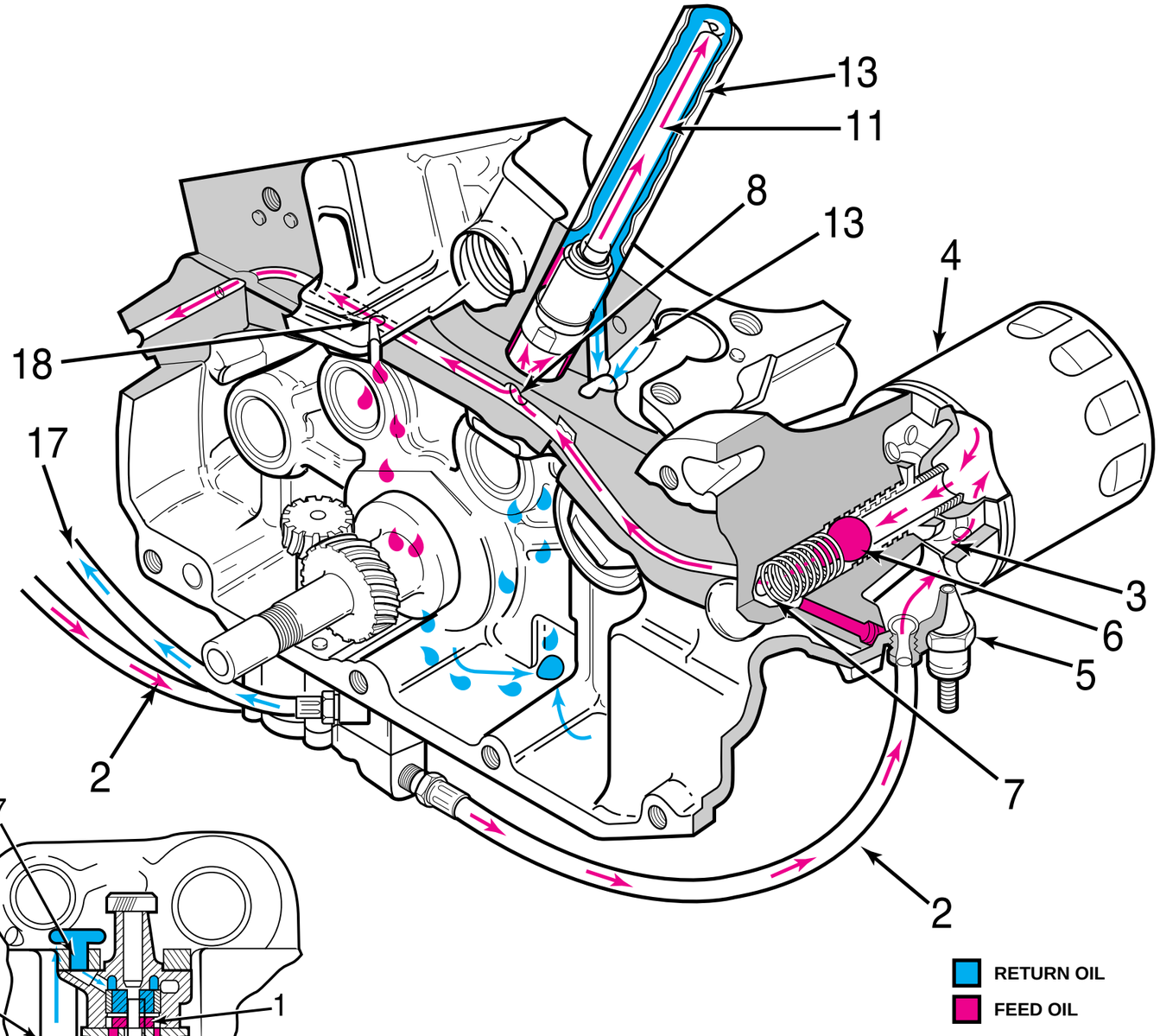
Be sure to refill transmission with lubricant. See CLUTCH, TRANSMISSION FLUID in Section 1.

26. Install transmission. See TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT in Section 6.

27. Install oil pump. See OIL PUMP, ASSEMBLY/INSTALLATION on page 3-36.
28. Install cylinders and pistons. See CYLINDER AND PISTON, ASSEMBLY/INSTALLATION on page 3-27.
29. Install cylinder heads. See CYLINDER HEAD, INSTALLATION on page 3-20.
30. Install cam gears, gearcase cover, tappet guides and tappets. See GEARCASE COVER AND CAM GEARS, ASSEMBLY/INSTALLATION on page 3-46.
31. Refer to INSTALLING THE ENGINE on page 3-10 and perform the applicable steps.
32. Install ignition system and check/adjust engine ignition timing. See IGNITION SYSTEM in Section 7.

INTERNAL ENGINE PASSAGES





SPECIFICATIONS

CARBURETOR JET SIZES	
Main jet	195
Slow jet	42

FUEL TANK CAPACITY	GALLONS	LITERS
Total (including reserve)	4.0	15.14
Reserve	0.6	2.27

CARBURETOR ADJUSTMENTS	
Engine fast idle speed (using enrichener circuit)	2000 RPM
Engine speed for setting ignition timing-world models	950-1050 RPM
Engine speed for setting ignition timing-California models	1150-1250 RPM

ITEM	TORQUE		NOTES
Air cleaner backplate screw	7-9 ft-lbs	9.5-12.2 Nm	LOCTITE THREADLOCKER 242 (blue), page 4-19
Air cleaner cover rear screw	6-8 ft-lbs	8.1-10.8 Nm	page 4-19
Air cleaner front support screw	3-5 ft-lbs	4.1-6.8 Nm	LOCTITE THREADLOCKER 242 (blue), page 4-19
Canister clamp screws	6-8 ft-lbs	8.1-10.8 Nm	page 4-25
Cylinder head breather bolts	10-15 ft-lbs	13.6-20.3 Nm	HYLOMAR, page 4-19
Fuel cap flange screws	22-25 **in-lbs**	2.5-2.8 Nm	special pattern to tighten, page 4-21
Fuel supply valve screws	34-37 **in-lbs**	3.8-4.2 Nm	page 4-22
Fuel tank screw	9-11 ft-lbs	12.2-14.9 Nm	page 4-21
Intake manifold screws	6-10 ft-lbs	8.1-13.6 Nm	page 4-17
Snorkel tube screw	6-8 ft-lbs	8.1-10.8 Nm	LOCTITE THREADLOCKER 242 (blue), page 4-19
Tie bar bolts	30-33 ft-lbs	40.7-44.7 Nm	page 4-17
Torx ignition bracket screw	25-30 ft-lbs	33.9-40.7 Nm	page 4-17

CARBURETOR

GENERAL

See Figure 4-1. Buell motorcycles use a constant-velocity, gravity-fed carburetor. This carburetor features a float-operated inlet valve, a variable venturi, a throttle stop screw (for idle speed adjustment) and a fuel enrichment system (for starting).

Idle and transfer ports provide a balanced fuel mixture during the transition period from stop to mid-range. A vacuum piston controls venturi opening.

The carburetor is specifically designed to control exhaust emissions. All jets are fixed. The idle mixture has been preset at the factory. The idle mixture screw is recessed in the carburetor casting. The opening is sealed with a plug because it is intended that the idle mixture be non-adjustable.

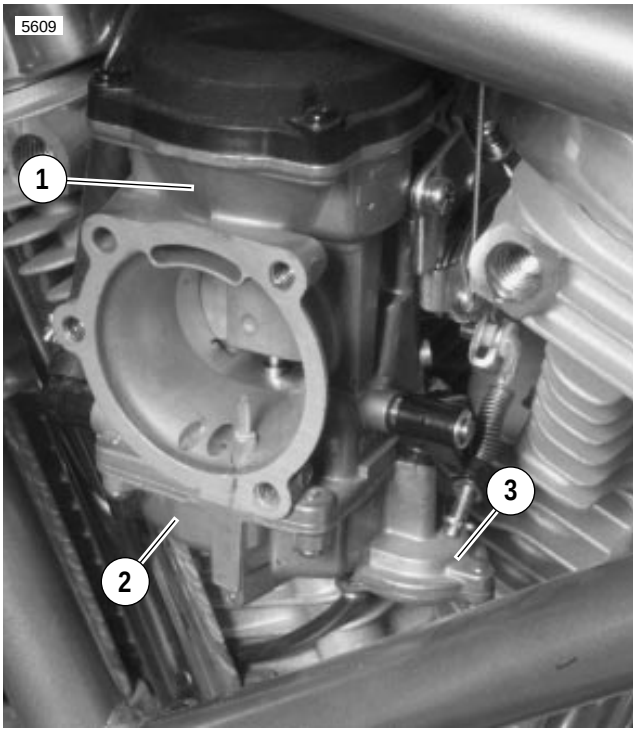
NOTE

Adjusting mixture setting by procedures other than specified in this section may be in violation of Federal or State regulations.

This system partially compensates for changes in the mixture that are normally caused by changes in altitude. Because atmospheric pressures drop as altitude increases, the pressure difference in the upper and lower chambers is reduced; this results in less fuel being delivered to the engine, thereby maintaining the correct air/fuel ratio for better engine performance and reduced exhaust emissions.

The carburetor has a drain for emptying the float chamber during seasonal or extended periods of storage.

The carburetor is equipped with an accelerator pump. The accelerator pump system uses sudden throttle openings (rapid accelerations) to quickly inject raw fuel into the carburetor venturi; this provides extra fuel for smooth acceleration.



1. Vacuum piston chamber
2. Float chamber
3. Accelerator pump

Figure 4-1. Carburetor

Table 4-1. Fuel System Troubleshooting

Check for:	Remedy:
OVERFLOW	
1. Restricted fuel tank vent system.	1. Correct restricted hose. Replace vapor vent valve.
2. Loose float bowl screws.	2. Tighten screws.
3. Damaged float bowl O-ring.	3. Replace O-ring.
4. Damaged or leaking float assembly.	4. Replace float assembly.
5. Particle contamination in fuel inlet fitting cavity.	5. Clean and clear cavity and fuel supply tract.
6. Worn or dirty inlet valve or seat.	6. Clean or replace valve and clean seat.
7. Improper fuel level in float bowl.	7. Adjust float tab for correct fuel level.
POOR IDLING	
1. Idle speed improperly adjusted.	1. Adjust operating idle speed.
2. Inlet system air leak (faster idling).	2. Correct as required.
3. Loose low speed jet.	3. Tighten jet.
4. Contaminated or plugged low speed system.	4. Clean, clear and correct as required.
5. Enrichener valve not seated or leaking.	5. Adjust, clean or replace.
6. Leaking accelerator pump.	6. Repair.
POOR FUEL ECONOMY	
1. Excessive use of enrichener system.	1. Limit system use.
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Dirty air cleaner filter element.	3. Clean or replace as required.
4. Restricted fuel tank vent system.	4. Correct restricted hose. Replace vapor vent valve.
5. High speed riding style.	5. Modify riding habits.
6. Idle speed improperly adjusted.	6. Adjust operating idle speed.
7. Loose jets.	7. Tighten jets.
8. Fuel level too high.	8. Adjust float tab for correct fuel level.
9. Plugged or restricted bowl vent.	9. Clean and clear passages.
10. Worn or damaged needle or needle jet.	10. Replace needle or needle jet.
11. Vacuum piston assembly malfunction.	11. See Vacuum Piston Troubleshooting on page 4-4.
12. Plugged air jets or passages.	12. Clean, clear and correct as required.
13. Excessive accelerator pump output.	13. Check and clean accelerator pump bypass orifice.
POOR ACCELERATION	
1. Throttle cables misaligned.	1. Adjust throttle cables.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor vent valve.
4. Restricted fuel supply passages.	4. Correct and clear restriction.
5. Plugged bowl vent or overflow.	5. Clean and clear passages.
6. Enrichener valve not seated or leaking.	6. Adjust, clean or replace.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston malfunction.	8. See Vacuum Piston Troubleshooting on page 4-4.
9. Plugged jets or passages.	9. Clean and clear as required.
10. Fuel level too low.	10. Adjust float tab for correct fuel level.
11. Accelerator pump leaking or no output.	11. Repair as necessary.
HARD STARTING	
1. Enrichener system plugged, not properly functioning or improperly operated.	1. Clean, adjust or replace; or read Owner's Manual.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel supply.	3. Correct fuel supply or passages.
4. Fuel overflow.	4. See Overflow Troubleshooting on page 4-3.
5. Plugged slow jet or passages.	5. Clean, clear and correct as required.

Table 4-1. Fuel System Troubleshooting (cont.)

POOR PERFORMANCE ON ROAD	
Check for:	**Remedy:**
1. Idle speed improperly adjusted.	1. Adjust operating idle speed.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor vent valve.
4. Dirty or damaged air cleaner element.	4. Clean or replace.
5. Enrichener valve not seated or leaking.	5. Adjust, clean or replace.
6. Restricted fuel supply tract.	6. Correct and clear restriction.
7. Plugged bowl vent or overflow.	7. Clean and clear passages.
8. Loose or plugged fuel and air jets or passages.	8. Clean, clear and correct as required.
9. Worn or damaged needle or needle jet.	9. Replace assembly.
10. Vacuum piston assembly malfunction.	10. See Vacuum Piston Troubleshooting below.
11. Accelerator pump inoperative.	11. Repair as required.
POOR HIGH-SPEED PERFORMANCE	
Check for:	**Remedy:**
1. Inlet system air leak.	1. Clean or replace.
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Restricted fuel tank vent system.	3. Correct restricted hose. Replace vapor vent valve.
4. Restricted fuel supply tract.	4. Correct and clean restriction.
5. Dirty or damaged air cleaner element.	5. Clean or replace.
6. Plugged bowl, vent or overflow.	6. Clean and clear passages.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston assembly malfunction.	8. See Vacuum Piston Troubleshooting below.
9. Loose or plugged main jets or passages.	9. Clean, clear and correct as required.
10. Improper fuel level.	10. Adjust float level.
11. Accelerator pump inoperative.	11. Repair as required.

Table 4-2. Vacuum Piston Assembly Troubleshooting

PISTON DOES NOT RISE PROPERLY	
Check for:	**Remedy:**
1. Piston atmosphere vent blocked.	1. Clear vent.
2. Diaphragm cap loose, damaged or leaking.	2. Tighten or replace cap.
3. Spring binding.	3. Correct or replace spring.
4. Diaphragm pinched at lip groove.	4. Reposition diaphragm lip.
5. Torn diaphragm.	5. Replace piston diaphragm assembly.
6. Piston binding.	6. Clean piston slides and body or replace piston.
7. Piston vacuum passage plugged.	7. Clean and clear passage.
PISTON DOES NOT CLOSE PROPERLY	
Check for:	**Remedy:**
1. Spring damaged.	1. Replace spring.
2. Piston binding.	2. Clean piston slides and body or replace piston.
3. Piston diaphragm ring dirty or damaged.	3. Clean or replace piston.

OPERATION

Enrichener

The enrichener knob, next to the ignition switch, controls the opening and closing of the enrichener valve at the carburetor.

⚠CAUTION

Avoid idling with the enrichener knob in the full out position for periods longer than 30 seconds. Such operation may cause poor performance, erratic idle, poor fuel economy and spark plug fouling.

NOTE

The 1996 C.V. carburetor has an enrichener circuit that will cause the engine to idle at approximately 2000 RPM with the engine at normal operating temperature and the enrichener knob pulled fully out.

The increase in idle speed is intended to alert the rider that the engine is warmed up to normal operating temperature and the enrichener knob should be pushed all the way in.

Continuing to use the enrichener when the engine is at full operating temperature WILL CAUSE FOULED PLUGS.

IMPORTANT NOTE

This motorcycle features a starter interlock. All the following conditions must be met to operate the engine starter.

- ***Engine stop switch on right handlebar control group must be in the RUN (ignition ON) position.***
- ***Clutch must be disengaged before starting motorcycle in gear. Note that it is not necessary to disengage clutch before starting the vehicle in neutral.***
- ***Side stand must be retracted before the clutch is engaged if the motorcycle is in gear.***

See STARTER INTERLOCK in Section 7 for troubleshooting information.

COOL ENGINE
OUTSIDE TEMPERATURE COOLER THAN 50° F

1. Set engine stop switch to RUN.
2. Raise side stand.
3. Turn fuel supply valve ON.
4. Turn ignition key switch to IGN.
5. BE SURE THROTTLE IS CLOSED. Pull enrichener knob to full out position.
6. Press electric starter switch to operate starter.

After starting the motorcycle, proceed as follows:

1. After initial 15-30 second warm-up, ride for 5 minutes or 3 miles with enrichener knob in full out position.
2. After 5 minutes or 3 miles, push enrichener knob in to the 1/2 way position. Ride 2 minutes or 2 miles.
3. After 2 minutes or 2 miles, push enrichener knob fully in.

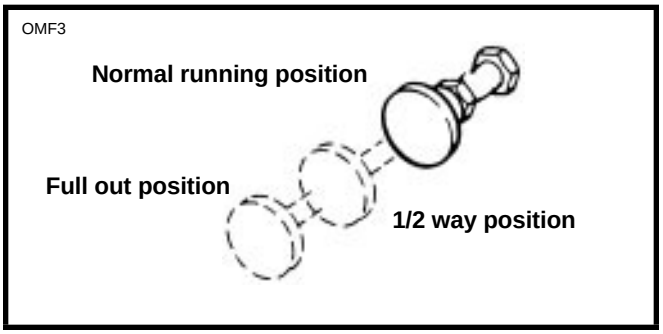


Figure 4-2. Enrichener Knob Positions

COOL ENGINE
OUTSIDE TEMPERATURE WARMER THAN 50° F

1. Set engine stop switch to RUN.
2. Raise side stand.
3. Turn fuel supply valve ON.
4. Turn ignition key switch to IGN.
5. BE SURE THROTTLE IS CLOSED. Pull enrichener knob to full out position.
6. Press electric starter switch to operate starter.

After starting the motorcycle, proceed as follows:

1. After initial 15-30 second warm-up, ride for 3 minutes or 2 miles with enrichener knob in full out position.
2. After 3 minutes or 2 miles, push enrichener knob in to the 1/2 way position. Ride 2 minutes or 2 miles.
3. After 2 minutes or 2 miles, push enrichener knob fully in.

WARM OR HOT ENGINE

1. Set engine stop switch to RUN.
2. Raise side stand.
3. Turn fuel supply valve ON.
4. Turn ignition key switch to IGN.
5. DO NOT USE ENRICHENER. Open throttle 1/8-1/4.
6. Press electric starter switch to operate starter.

NOTE

If the engine does not start after a few turns or if one cylinder fires weakly but engine does not start, it is usually because of an over-rich (flooded) condition. This is especially true of a hot engine. If the engine is flooded, push the enrichener knob fully in, turn ignition key switch to IGN and operate starter with throttle wide open. Do not "pump" the throttle while starting.

Fuel Supply System

See Figure 4-3. Fuel from the fuel tank passes through the carburetor inlet valve into the carburetor float chamber. The rising fuel level in the float chamber lifts the float, which in turn lifts the attached inlet valve closer to the valve seat. When the fuel reaches the level predetermined by the float level setting, the float will lift the inlet valve into its seated position, thereby closing the valve and stopping fuel flow to the float chamber.

When fuel is used by the running engine, the fuel level in the float chamber drops; this lowers the float and inlet valve, thereby causing the valve to open and the fuel flow to resume.

The float chamber is vented to atmosphere through an air passage in the carburetor body. The opening for the float chamber vent passage is next to the carburetor main venturi inlet, on the carburetor body surface to which the air cleaner backplate is mounted.

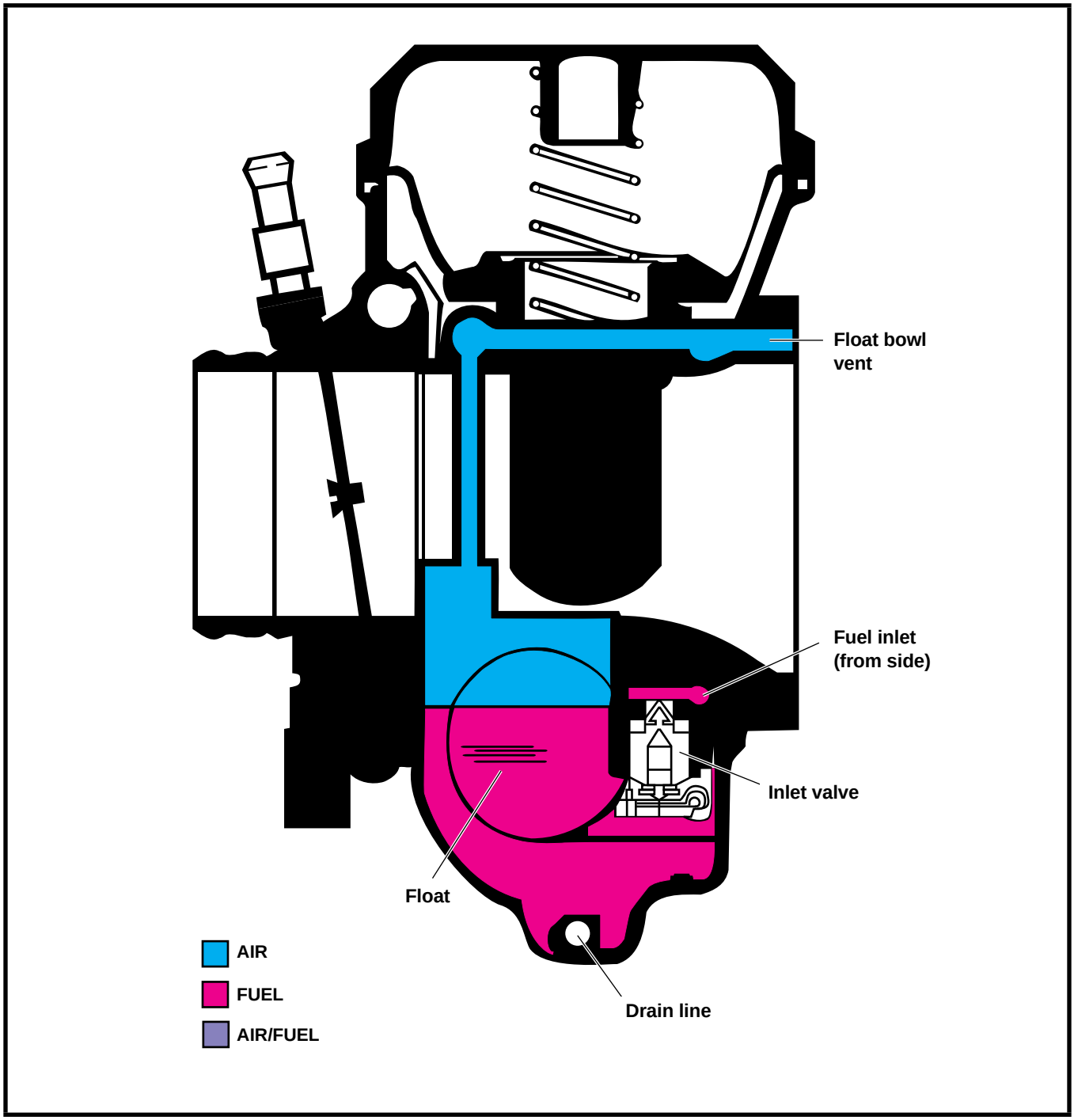


Figure 4-3. Fuel Supply System

Starting Circuit

See Figure 4-4. The starting circuit consists of a cable-actuated enrichener valve and converging fuel and air passages in the carburetor body.

The enrichener air/fuel passage opens to the carburetor venturi, where low pressure exists when the engine is running. Fuel in the carburetor float bowl and air in the enrichener air inlet are vented to atmosphere and are at atmospheric pressure (greater pressure than in the carburetor venturi).

When the enrichener knob is pulled outward, the enrichener valve opens the air/fuel passage to the low pressure carburetor venturi. Fuel in the float bowl, at atmospheric pressure, flows upward through a metering enrichener jet and then through a passage to the lower pressure enrichener valve chamber. Air in the enrichener air inlet, at atmospheric pressure, also flows into the lower pressure enrichener valve chamber and mixes with the incoming fuel. The resulting air/fuel mixture flows through the air/fuel passage into the carburetor venturi, effectively increasing the amount of fuel delivered to the combustion chambers.

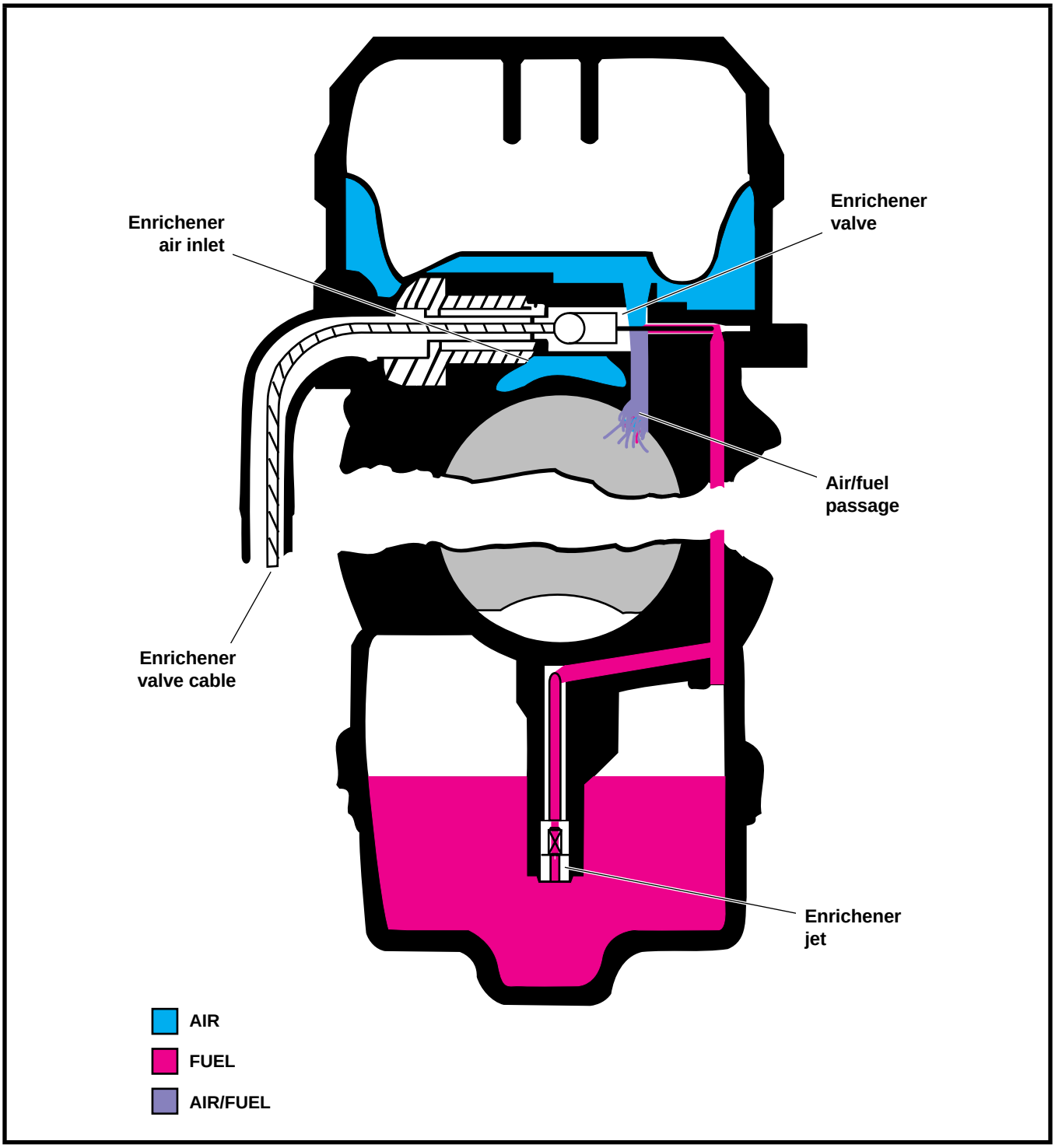


Figure 4-4. Starting Circuit

Idle- and Low-Speed Circuit

See Figure 4-5. At idle (with the throttle plate closed and the main air stream obstructed), engine idle speed is maintained by fuel metered through the slow jet. Air from the slow air jet mixes with the fuel and is delivered to the idle port at the low pressure side of the throttle plate.

At low-speed (with the throttle plate slightly open), the transfer ports are exposed to the low pressure side of the throttle plate, and additional fuel is directed to the barrel of the carburetor.

During the transition period from idle speed to mid-range, the idle and transfer ports also supply some fuel to the carburetor barrel; this allows for a smoother transition.

The venturi opening is reduced by the low position of the vacuum piston. This enables initial air stream velocities to be higher than normally attainable with fixed-venturi carburetors. The higher air stream velocities provide improved atomization of fuel necessary for good acceleration and driveability.

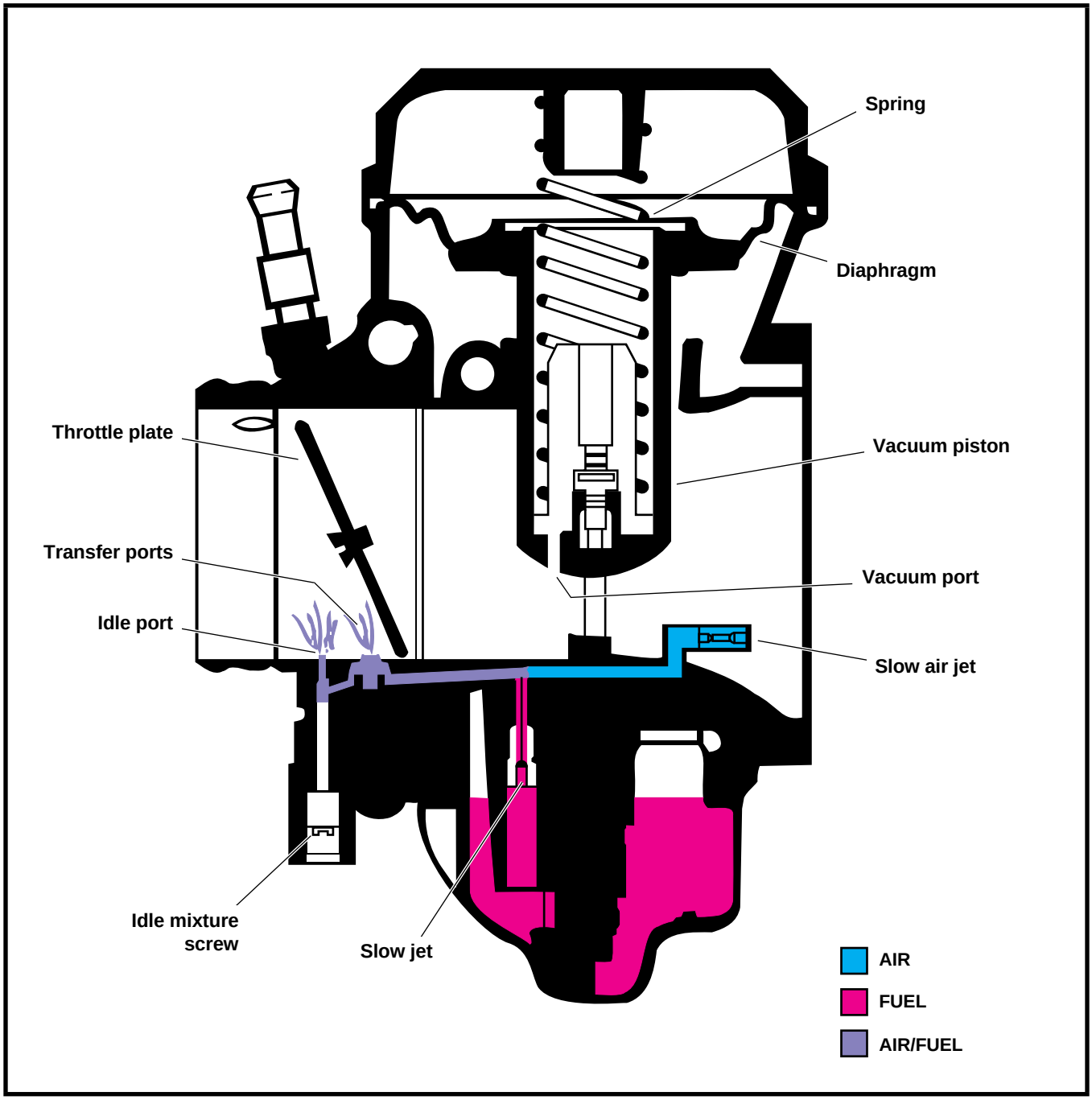


Figure 4-5. Idle- and Low-Speed Circuit

Mid-Range Slide Position

See Figure 4-6. As the throttle plate is opened, air flow increases through the carburetor; this causes air pressure to decrease in the carburetor venturi (near the needle jet) and in the chamber above the diaphragm (which is vented to the venturi through a vacuum port and passage in the vacuum piston).

The chamber beneath the diaphragm is vented to higher atmospheric pressure by a passage to the carburetor inlet. The higher air pressure at the underside of the diaphragm overcomes spring pressure and moves the vacuum piston upward in proportion to the pressure difference between the chambers.

The tapered needle moves upward with the vacuum piston, thereby opening the needle jet. With the needle jet open, the main bleed tube is exposed to the lower pressure of the carburetor venturi. This causes fuel in the float bowl (at atmospheric pressure) to flow through the main jet and into the main bleed tube. Air from the main air jet (at atmospheric pressure) flows through the main bleed tube openings and mixes with the incoming fuel. The air/fuel mixture is then delivered through the needle jet into the main air stream of the venturi.

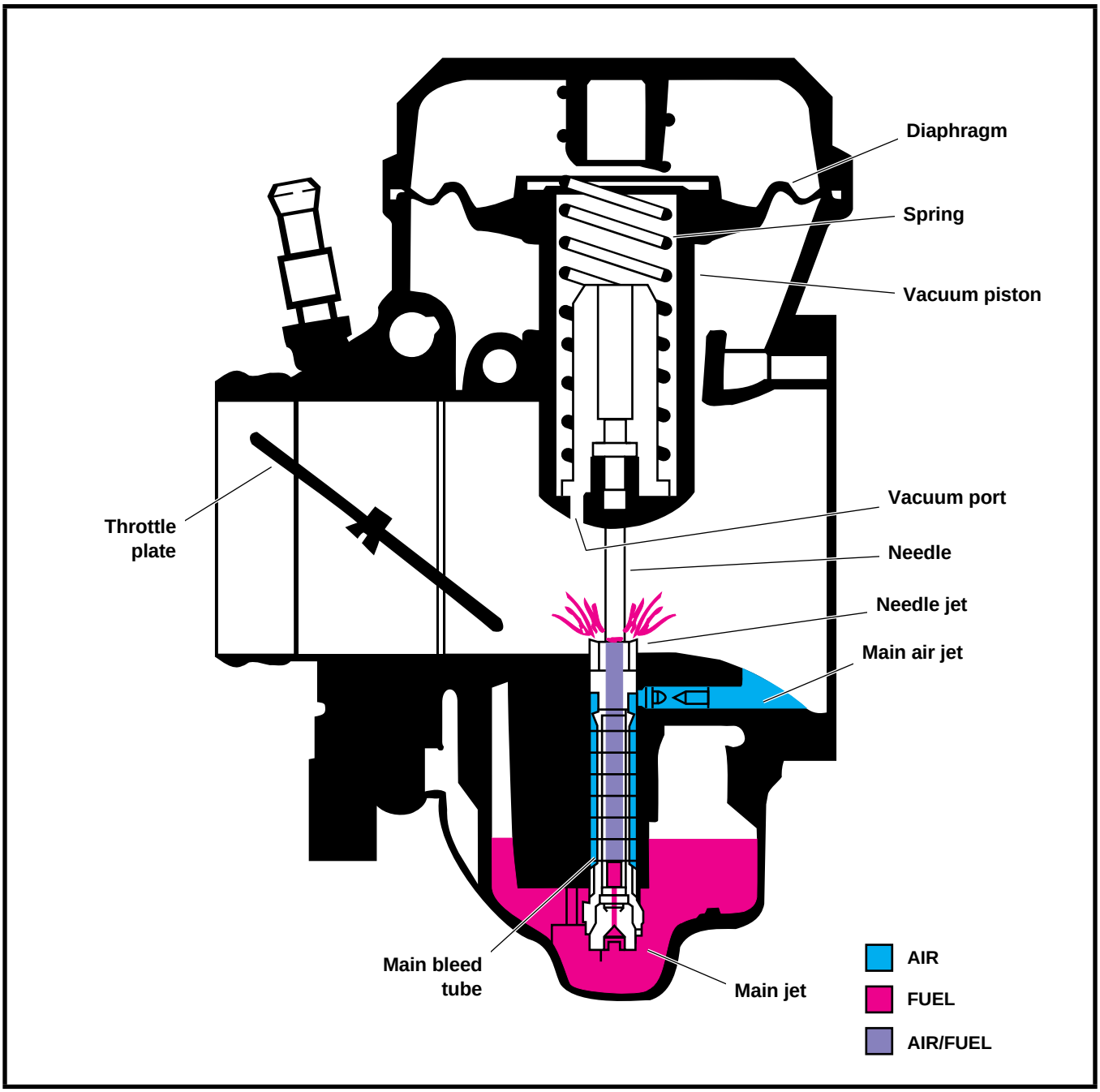


Figure 4-6. Mid-Range Slide Position

High-Speed Circuit Slide Position

See Figure 4-7. As the throttle plate is opened, the pressure difference between the chambers above and below the diaphragm increases and the vacuum piston moves further upward.

The venturi opening increases and the needle is lifted further out of the needle jet. The quantity of fuel and the volume of air are simultaneously increased and metered to the proportions of engine demand by the variable venturi and needle lift. With the vacuum piston fully upward, the venturi opening is fully enlarged and the needle jet opening exposure to the air stream is at its maximum. Air and fuel supplies are now available in quantities sufficient to meet maximum engine demand.

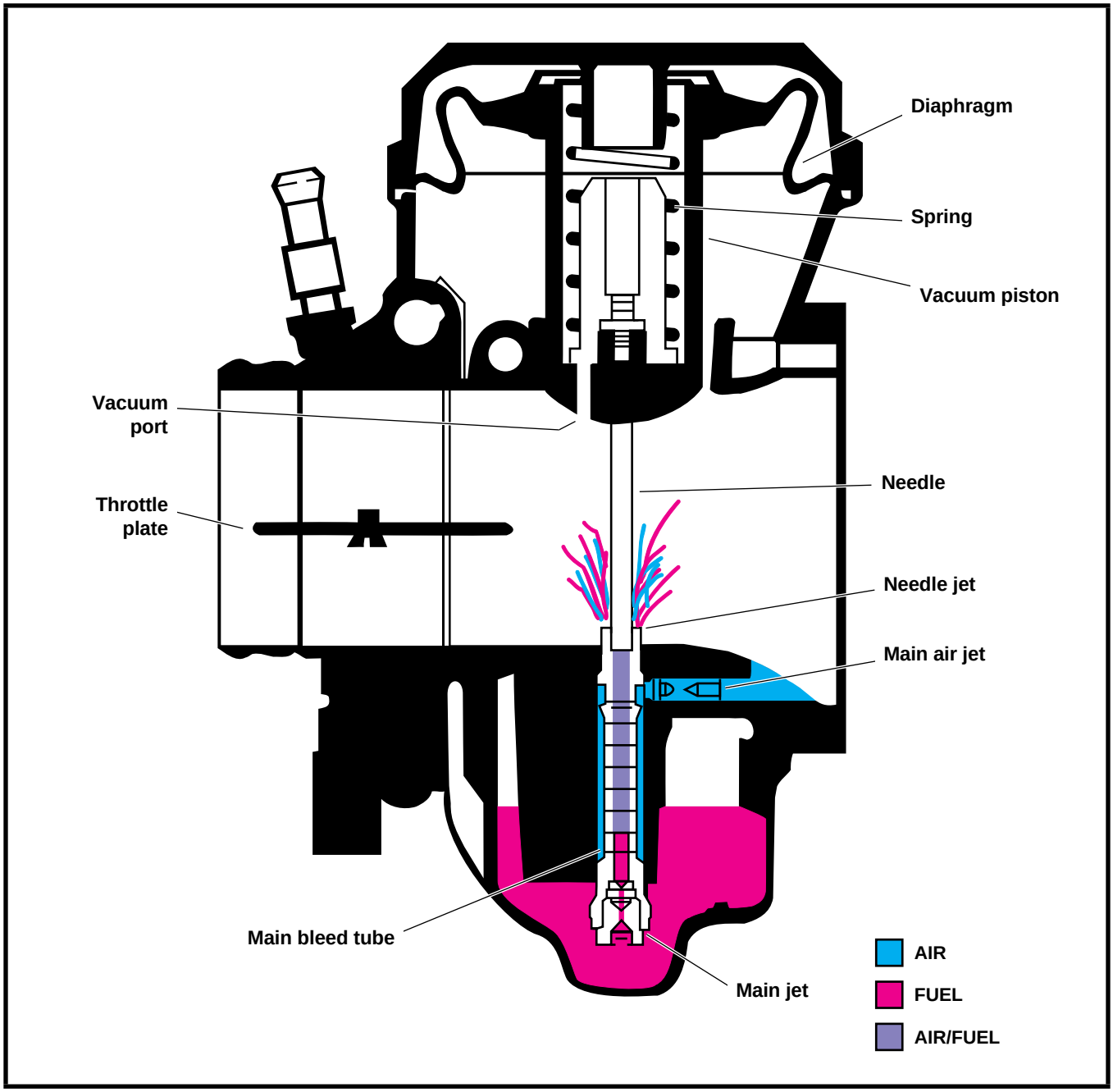


Figure 4-7. High-Speed Circuit

Accelerator Pump System

See Figure 4-8. The accelerator pump system uses sudden throttle openings (rapid acceleration) to quickly inject fuel into the carburetor venturi; the extra fuel provides for smooth acceleration. This fuel also assists engine operation during cold engine warm-up when the enrichener is turned off prematurely.

Rapid throttle action, during the first third of throttle travel, causes the accelerator pump rod to depress the accelerator pump diaphragm. This forces fuel in the pump to flow through a fuel passage (which has a “one-way” check valve), through the pump nozzle, and then into the venturi. When the throttle closes, the pump rod lifts up and away from the pump diaphragm; a spring below the diaphragm pushes the diaphragm upward, thereby causing the lower pump cavity to refill with fuel from the float bowl. The check valve prevents backflow of fuel from the pump nozzle/fuel passage during this refilling phase.

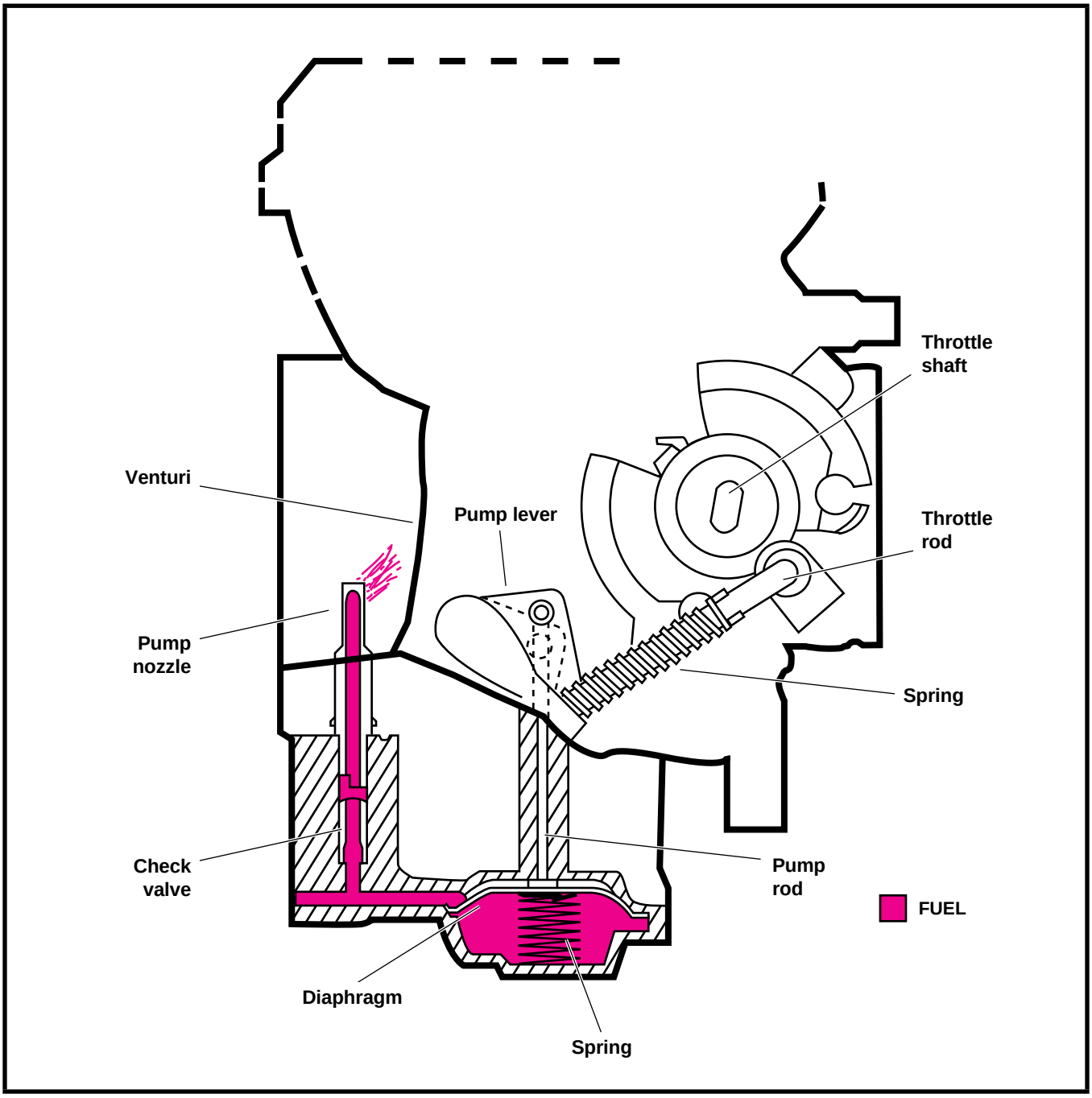


Figure 4-8. Accelerator Pump System

ADJUSTMENT

Idle

See IGNITION TIMING in Section 1.

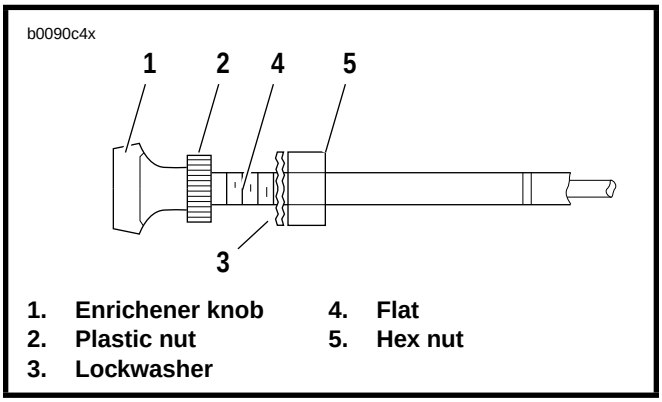
Enrichener Control

See Figure 4-9. Check enrichener operation. Enrichener knob (1) should open (and remain open) and close without binding. Plastic nut (2), next to the enrichener knob, controls the sliding resistance of the enrichener control cable within the cable conduit. If adjustment is needed, perform the following:

1. Loosen hex nut (5) at backside of mounting bracket.
2. Move cable assembly free of slot in mounting bracket.
3. Hold cable assembly at flats (4) with a wrench. Adjust resistance until knob slides outward and remains fully open without assistance. Knob must also slide inward unaided.
   a. Turn plastic nut (2) by hand counterclockwise (reducing sliding resistance).
   b. Turn plastic nut clockwise (increasing sliding resistance).
4. Position cable assembly into slot in mounting bracket. Tighten hex nut at backside of bracket.

NOTE

Do not lubricate the cable or inside of conduit. The cable must have friction to work properly.



1. Enrichener knob
2. Plastic nut
3. Lockwasher
4. Flat
5. Hex nut

Figure 4-9. Fuel Enrichener Control

Float Level

1. Remove carburetor and place on a flat, clean surface on engine manifold side. This is the “base.” Tilt carburetor counterclockwise 15˚ to 20˚ from base until float comes to rest. See Figure 4-11.

NOTE

If carburetor is tilted less than 15˚ or more than 20˚, your measurements will be inaccurate.

2. Use a vernier or dial caliper depth gauge to measure from the carburetor flange face to the perimeter of the float. Be careful not to push on float while measuring. The measurement must be 0.413-0.453 in. (10.49-11.51 mm). If measurement is not within given dimension, remove float and carefully bend tab in order to reposition float at proper level.
3. Install float and recheck setting.
4. Install float bowl. Install carburetor as described in CARBURETOR, INSTALLATION on page 4-17.

OPERATION CHECK – VACUUM PISTON

Opening Malfunction

⚠WARNING

While observing piston slide movement, be sure to maintain a safe distance from the carburetor and to wear suitable eye protection. An unexpected engine backfire could cause personal injury.

1. See Figure 4-10. Test vacuum piston as follows.
   a. Remove air cleaner cover and snorkel.
   b. Start engine running.
   c. Twist throttle control partially open and closed several times.

   Observe whether or not vacuum piston has upward movement. If piston does not rise, see VACUUM PISTON ASSEMBLY TROUBLESHOOTING on page 4-4.
2. With engine not running, lift vacuum piston with finger. Feel whether piston lifts fully and smoothly or whether there is a binding condition.

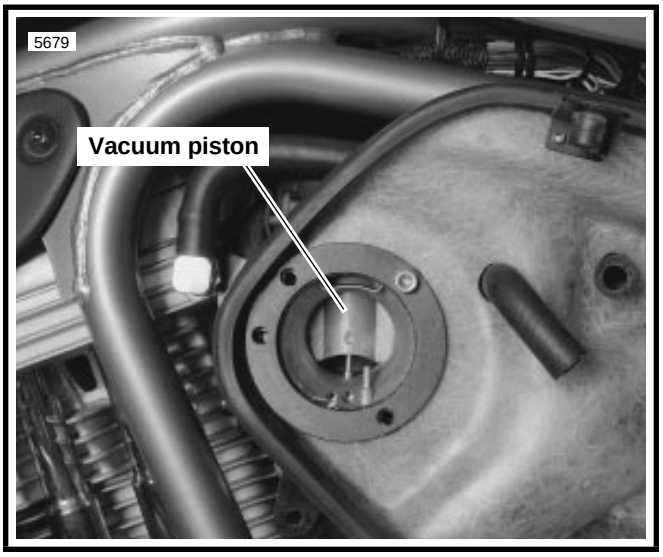


Figure 4-10. Vacuum Piston

Closing Malfunction

1. See Figure 4-10. With engine not running, lift vacuum piston to full open position, then release. Observe whether piston slides downward smoothly and fully to stop.
2. Observe position of piston slide at its lowest downward point. Lower edge of slide should rest at horizontal groove at lower end of slide track. See VACUUM PISTON ASSEMBLY TROUBLESHOOTING on page 4-4 if problems are noted.

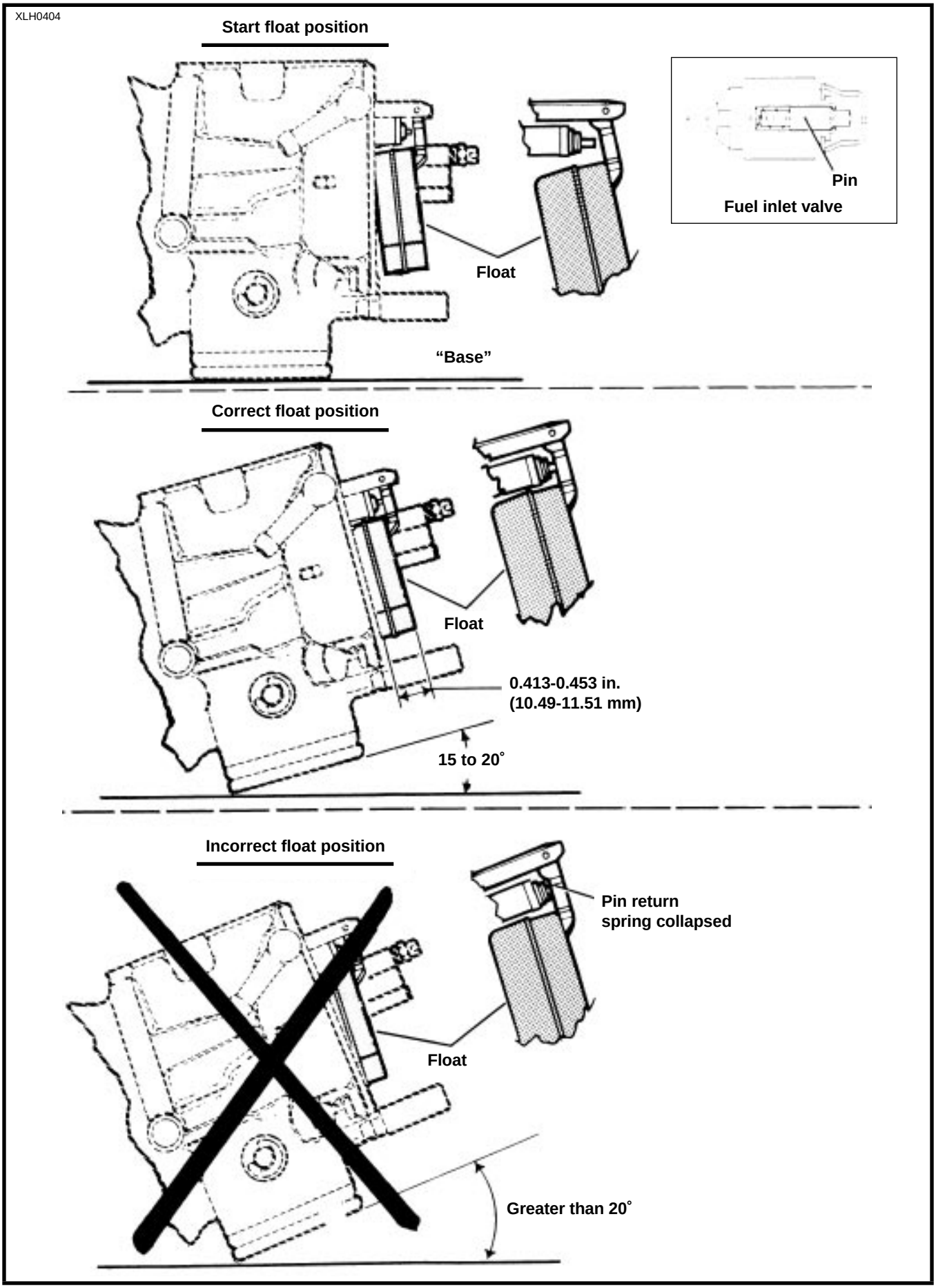


Figure 4-11. Carburetor Float Adjustment

REMOVAL

Carburetor

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury.

1. Turn fuel supply valve OFF.
2. Remove air cleaner cover and backplate. See AIR CLEANER, REMOVAL on page 4-18.
3. Loosen rear breather bolt. Remove front breather bolt and washer. Remove air cleaner support ring.

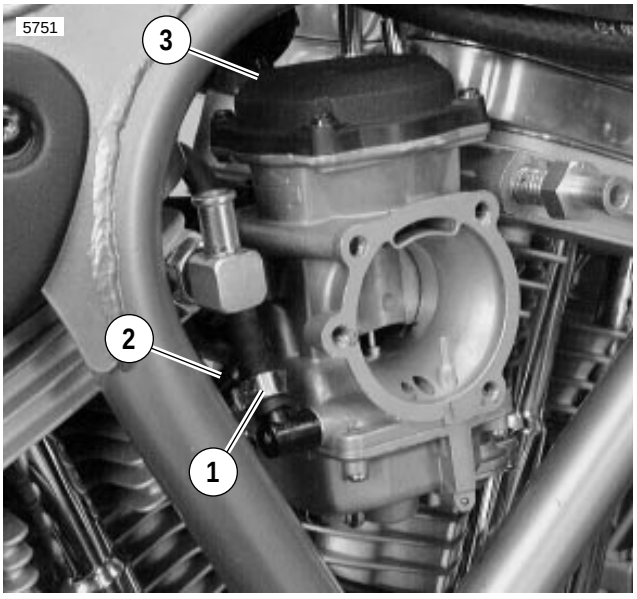
⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury.

4. See Figure 4-12. Disconnect fuel hose from carburetor. Discard fuel hose clamp.
5. Detach enrichener cable from bracket near ignition key switch.
6. Disconnect vacuum hose from carburetor V.O.E.S. fitting.
7. Add freeplay to throttle cable adjusters (metric). Remove throttle cables at carburetor.
8. Pull carburetor free of intake manifold.
9. Disconnect fuel drain hose from drain fitting. On California models, disconnect canister vent hose.

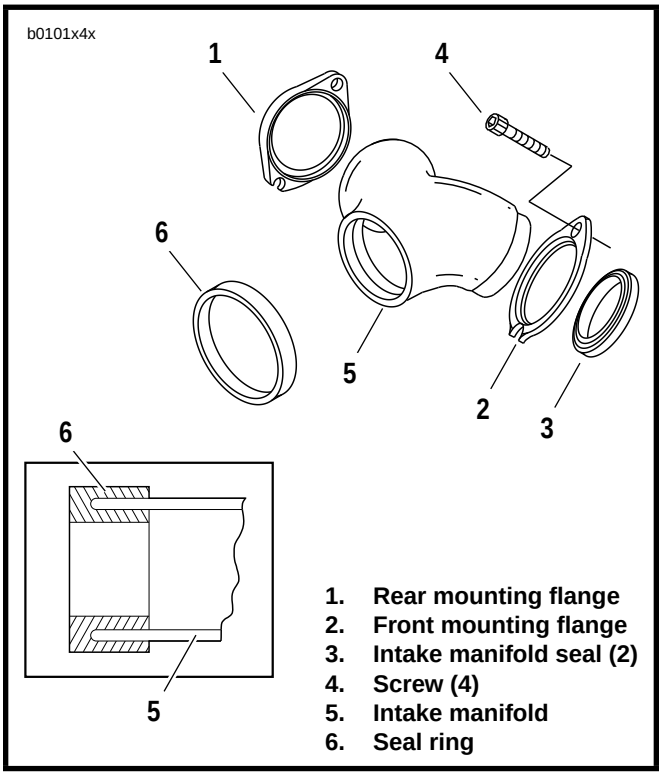
Carburetor Manifold

1. Remove carburetor as described above.
2. Remove fuel tank. See FUEL TANK, REMOVAL on page 4-20.
3. Remove ignition key switch bracket.
   a. Remove bolt and locknut to detach top tie bar from ignition key switch bracket.
   b. Cut cable strap holding ignition wires to main wiring harness.
   c. Remove two TORX screws and washers from cylinder heads.
   d. Place bracket to the side.
4. See Figure 4-13. Loosen two intake manifold screws (4) on primary side of engine. Do not remove.
5. Remove two manifold mounting screws (4) on gearcase side of engine.
6. Remove intake manifold (5) and seal ring (6). Slide both mounting flanges (1, 2) over primary side screws (4). Remove intake manifold seals (3).



1. **Fuel hose**
2. **Canister vent hose (California models only)**
3. **V.O.E.S. connection (on back of carburetor)**

Figure 4-12. Carburetor Hoses



1. **Rear mounting flange**
2. **Front mounting flange**
3. **Intake manifold seal (2)**
4. **Screw (4)**
5. **Intake manifold**
6. **Seal ring**

Figure 4-13. Intake Manifold

DISASSEMBLY

Vacuum Piston Chamber

1. See Figure 4-14. Remove screws (26, 25) and throttle cable bracket (24).
2. Remove three shouldered screws (2). Remove top cover (1) and spring (3).
3. Lift out vacuum piston (4) with jet needle (6) and spring seat (5). Remove loose parts from vacuum piston.

Carburetor Body

1. See Figure 4-14. Remove four screws and lockwashers (18). Remove float bowl assembly (38).
2. Remove pin (14), float (16) and fuel inlet valve (13).
3. Back out main jet (11) and needle jet holder (10). Needle jet (9) is free to be removed from bottom end of passage.
4. Insert thin-bladed screwdriver into slow jet passage to remove slow jet (12).

Accelerator Pump

1. Remove three screws (49), lockwashers (48), accelerator pump housing (42), spring (43) and diaphragm (44). Remove O-ring (45) from housing.

CLEANING, INSPECTION AND REPAIR

Vacuum Piston Components

1. See Figure 4-14. Hold vacuum piston up to strong light. Examine diaphragm at top of vacuum piston (4) for evidence of pinching, holes or tears. Replace if damaged.
2. Examine vacuum passage through bottom of piston (4). Clean passage if restricted.
3. Examine spring (3) for stretching, crimping, distortion or damage. Replace if necessary.
4. Examine slide on sides of piston (4) to be sure surface is smooth and clean. Clean or buff out any rough surfaces.
5. Examine jet needle (6) for evidence of bending or damage. Needle should be straight; surface of taper should be smooth and even.
6. Check float bowl O-ring (53) for any distortion or damage. Replace if seating surfaces are damaged.
7. Examine fuel inlet valve (13) and inlet valve seat. Clean with carburetor cleaner. Replace if seating surfaces are damaged.
8. Clean slow jet (12) with carburetor cleaner. Check to be sure all orifices are open.
9. Check enrichener valve (22). Be sure needle guide is clean, straight and undamaged. Check composition seating surface for wear or damage. Replace if damaged.
10. Check enrichener valve chamber. Clean with carburetor cleaner. Check that all passages are open and free of obstruction.
11. Clean needle jet (9). Replace if damaged.
12. Clean all internal fuel/air passages and jets. Check that all passages and jets are open and free of obstruction.
13. Check needle jet holder (10). Clean bleed tube orifices. Replace holder if damaged.
14. Check float (16) for cracks or other leaks. Replace if damaged.
15. Clean main jet (11) with carburetor cleaner and inspect for damage. Replace if damaged.

Accelerator Pump

1. See Figure 4-14. Inspect the accelerator pump diaphragm (44) for holes, cracks or deformation. Replace as necessary.
2. Replace the accelerator pump rod (51) if it is bent; replace the boot (50) if cracked.

ASSEMBLY

Vacuum Piston Chamber

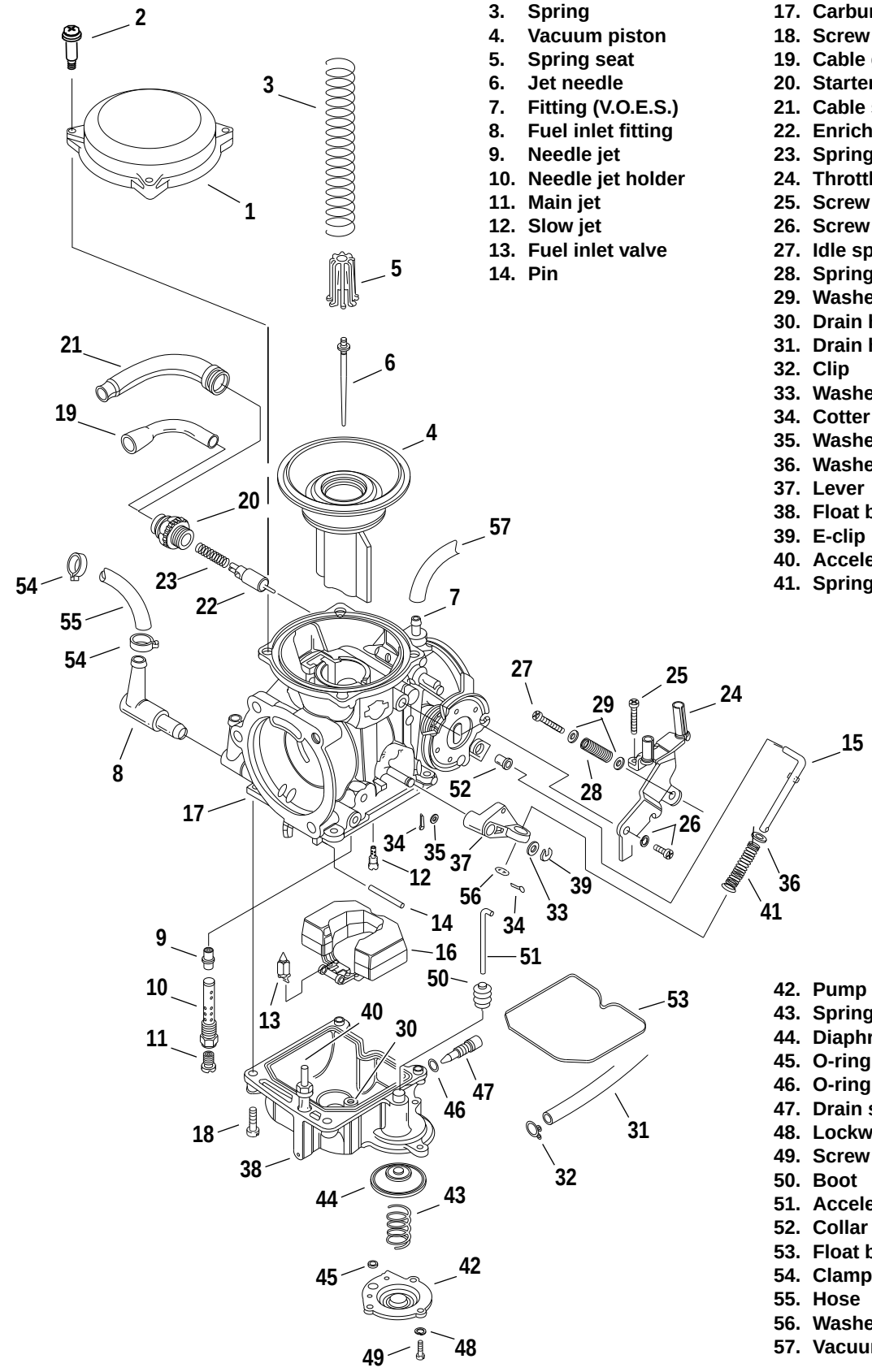
1. See Figure 4-14. Place jet needle (6) through center hole in vacuum piston (4). Place spring seat (5) over top of needle.
2. Insert vacuum piston (4) into carburetor body. The slides on the piston are off-center and the piston will fit into the slide track grooves one way only. If piston does not fit, rotate 180°.
3. Check to be sure diaphragm is seated evenly into groove at top of carburetor body. Place spring (3) over spring seat (5), and carefully lower top cover (1). Keep spring straight while lowering top cover.
4. After top cover (1) is seated, hold top cover while lifting vacuum piston (4) upward. Piston should raise to top smoothly. If piston movement is restricted, spring (3) is cocked; lift up top cover, then lower carefully, keeping spring coils straight.
5. Once top cover is installed correctly, install three shouldered screws (2). Place throttle cable bracket (24) in position with idle screw (27), resting on top of throttle cam stop. Install body screw and washer (26) first, then top screw (25) to prevent bending bracket or throttle cam.

Carburetor Body

⚠CAUTION

Slow jets from fixed-venturi carburetors look the same as the slow jet of the C.V. carburetor. However, the air bleed hole sizes are different on fixed-venturi carburetors and they must not be installed on C.V. carburetors.

1. See Figure 4-14. Thread slow jet (12) into slow jet passage with narrow-bladed screwdriver.
2. Turn carburetor upside down. Place needle jet (9) in main jet passage with needle passing through center hole. Be sure end of jet with larger opening and chamfered surface enters passage first.



1. Top cover
2. Shouldered screw (3)
3. Spring
4. Vacuum piston
5. Spring seat
6. Jet needle
7. Fitting (V.O.E.S.)
8. Fuel inlet fitting
9. Needle jet
10. Needle jet holder
11. Main jet
12. Slow jet
13. Fuel inlet valve
14. Pin
15. Pump linkage
16. Float
17. Carburetor body
18. Screw w/ lockwasher (4)
19. Cable guide
20. Starter cap
21. Cable sealing cap
22. Enrichener valve
23. Spring
24. Throttle cable bracket
25. Screw
26. Screw and lockwasher
27. Idle speed adj. screw
28. Spring
29. Washer (2)
30. Drain hole
31. Drain hose
32. Clip
33. Washer
34. Cotter pin (2)
35. Washer (3)
36. Washer
37. Lever
38. Float bowl
39. E-clip
40. Accelerator pump nozzle
41. Spring
42. Pump housing
43. Spring
44. Diaphragm
45. O-ring
46. O-ring
47. Drain screw
48. Lockwasher (3)
49. Screw (3)
50. Boot
51. Accelerator pump rod
52. Collar
53. Float bowl O-ring
54. Clamp (2)
55. Hose
56. Washer
57. Vacuum hose

Figure 4-14. Constant-Velocity (C.V.) Carburetor

3. Insert needle jet holder (10) into main jet passage with needle inserted into center of holder. Thread holder into passage and tighten. Thread and tighten main jet (11) in tapped hole in needle jet holder (10).
4. Place float assembly (16) into position with fuel inlet valve (13) inserted into valve seat and with pivot arm aligned with holes in mounting posts (at bottom of carburetor body). Insert pin (14) through float pivot arm and float mounting posts.
5. Check float level setting and adjust if necessary. See FLOAT LEVEL on page 4-12.
6. Place float bowl (38) over float and onto carburetor body flange. Bowl will only fit in one position. Install and tighten screws and lockwashers (18).

Accelerator Pump

Install diaphragm (44), spring (43), O-ring (45) and pump housing (42). Secure with screws (49) and lockwashers (48).

INSTALLATION

Carburetor Manifold

1. See Figure 4-13. Place mounting flanges (1, rear and 2, front) on aluminum manifold (5).
2. Place intake manifold seals (3) on each spigot of manifold with chamfered edge against mounting flanges (1, 2).
3. Place channel of seal ring (6) over inlet end of manifold.
4. Position manifold against intake ports of cylinder head, with slotted and round holes in flanges (1, 2) aligned with holes in cylinder head. Manifold should slide over screws on primary side of engine. Insert two screws (4) through manifold flanges on gearcase side and loosely thread into tapped holes in cylinder head. Tighten intake manifold screws (4) to 6-10 ft-lbs (8.1-13.6 Nm).
5. Install ignition key switch bracket.
   a. Fasten bracket to cylinder heads with two TORX screws and washers. Tighten to 25-30 ft-lbs (33.9-40.7 Nm).
   b. Attach top tie bar to bracket. Tighten locknut to 30-33 ft-lbs (40.7-44.7 Nm).
   c. Secure ignition wires to main wiring harness using a **new** cable strap.

Carburetor

1. Attach throttle cables to carburetor.
   a. Install idle control cable into longer, inboard cable guide on carburetor.
   b. Install throttle control cable into shorter, outboard cable guide on carburetor.

NOTE

The fit between the carburetor and the seal ring is tight. For ease of installation, lubricate the mating surfaces, carburetor body and seal ring with liquid dish soap or tire mounting lube prior to assembly.

2. See Figure 4-12. Connect fuel drain hose to drain fitting. Connect vacuum hose to V.O.E.S. fitting. On California models, connect canister hose to carburetor.
3. Lubricate only the inside surface of seal ring that will be in contact with the carburetor. Also apply a light coat of lubricant to the spigot of the carburetor body. Push carburetor body into seal ring.
4. Attach fuel hose to carburetor with a **new** clamp.
5. Install enrichener cable on bracket and adjust. See ENRICHENER CONTROL on page 4-12.
6. Adjust throttle cables. See CARBURETOR in Section 1.
7. Install air cleaner components. See AIR CLEANER, INSTALLATION on page 4-19.
8. Install fuel tank. See FUEL TANK, INSTALLATION on page 4-21.

Carburetor Drain Hose Routing

Route fuel drain hose from the carburetor drain fitting downward and forward through the space between the engine rear cylinder and the rear cylinder push rod covers (intake and exhaust), and then downward through the space between the engine crankcase and the oil pump.

AIR CLEANER

GENERAL

The air cleaner prevents foreign material from entering the carburetor and engine by trapping airborne dust and dirt in the filter element.

Service air cleaner filter element every 5000 miles (8000 km) or more often if the motorcycle is run in a dusty environment. See AIR CLEANER FILTER in Section 1 for more information.

REMOVAL

⚠CAUTION

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

1. See Figure 4-15. Remove screw and nylon washer on top of air cleaner cover.
2. Remove screw, nylon washer and locknut at rear of air cleaner cover. Remove cover.
3. See Figure 4-16. Detach backplate hoses.
   a. Detach cylinder head breather hoses from tee fitting.
   b. Detach snorkel breather hose at snorkel.
   c. On California models, slide fresh air hose from canister through backplate.
4. See Figure 4-17. Remove two screws and snorkel plate.
5. Remove snorkel and filter box.
6. See Figure 4-18. Remove screw with spacer and gasket.
7. See Figure 4-19. Remove screw under air cleaner support.

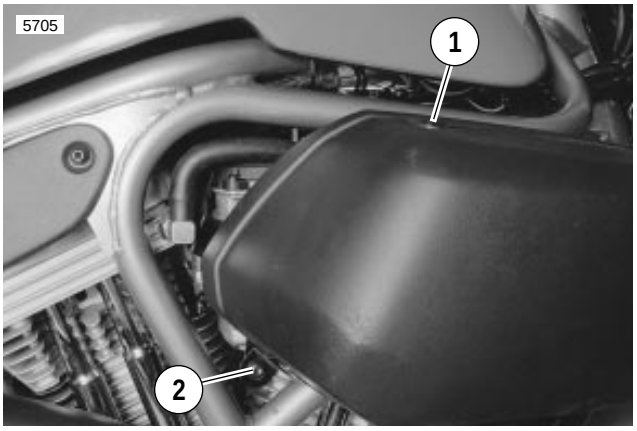
NOTE

Step 7 may require a cut down allen wrench.

8. Draw breather hoses through backplate. Remove backplate.
9. If necessary, remove air cleaner support ring.
   a. Detach breather hoses from cylinder head breather bolts.
   b. Remove front breather bolt.
   c. Loosen rear bolt.
   d. Slide air cleaner support ring upward and remove.

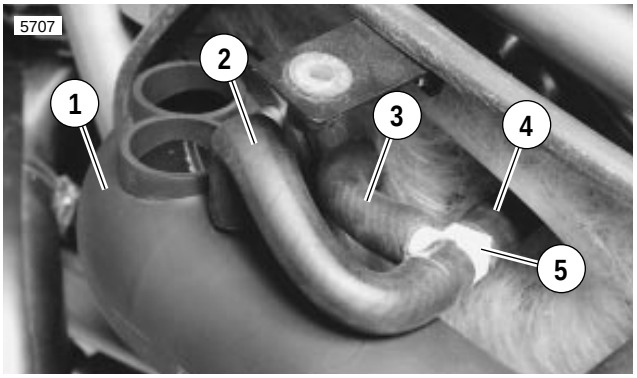
NOTE

See Figure 4-20. Air cleaner support ring fits around breather bolts. Fitting on rear breather bolt may not clear the frame if bolt removal is attempted. Do not remove rear breather bolt unless absolutely necessary.



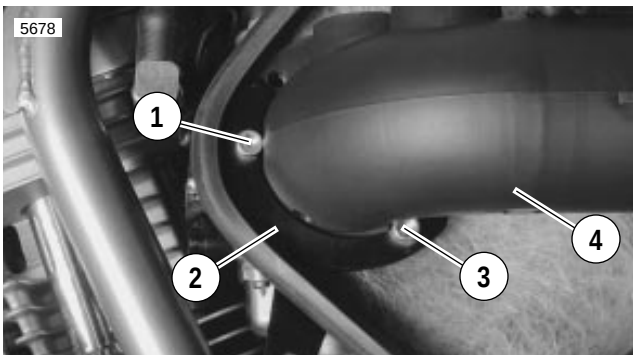
1. Screw and nylon washer
2. Screw, nylon washer and locknut

Figure 4-15. Air Cleaner Cover



1. Snorkel
2. Snorkel breather
3. Rear head breather
4. Front head breather
5. Tee fitting

Figure 4-16. Breather Hoses



1. Screw (2)
2. Snorkel plate
3. Screw
4. Snorkel tube

Figure 4-17. Snorkel Ring

INSTALLATION

1. See Figure 4-20. If removed, apply HYLOMAR to threads of breather bolts. Install air cleaner support ring using breather bolts and washer. Tighten breather bolts to 10-15 ft-lbs (13.6-20.3 Nm).

2. See Figure 4-16. Attach breather hoses.

   a. If removed, attach hoses to breather bolts in cylinder heads.

   b. Slide hoses through backplate.

   c. Connect hoses to tee fitting.

   d. On California models, insert fresh air hose from canister through backplate.

3. See Figure 4-19. Apply LOCTITE THREADLOCKER 242 (blue) to air cleaner front support screw. Install support/backplate and tighten screw to 3-5 ft-lbs (4.1-6.8 Nm).

NOTE

Step 3 may require a cut down allen wrench.

4. See Figure 4-18. Apply LOCTITE THREADLOCKER 242 (blue) to screw. Install ring with screw through backplate. Tighten to 7-9 ft-lbs (9.5-12.2 Nm).

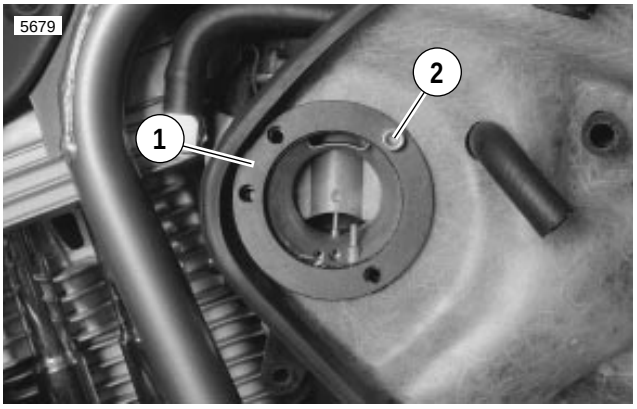
5. See Figure 4-17. Apply LOCTITE THREADLOCKER 242 (blue) to screws. Fasten snorkel tube with ring and two screws. Tighten to 6-8 ft-lbs (8.1-10.8 Nm).

6. Check air cleaner filter. See AIR CLEANER FILTER in Section 1. Attach filter box with filter to snorkel tube.

7. Connect breather hose to snorkel tube.

8. See Figure 4-15. Place cover over backplate assembly. Install screw and washer into top well nut.

9. Install screw, nylon washer and locknut at rear mount. Tighten to 6-8 ft-lbs (8.1-10.8 Nm).



1. Air cleaner spacer with gasket
2. Screw

Figure 4-18. Air Cleaner Spacer

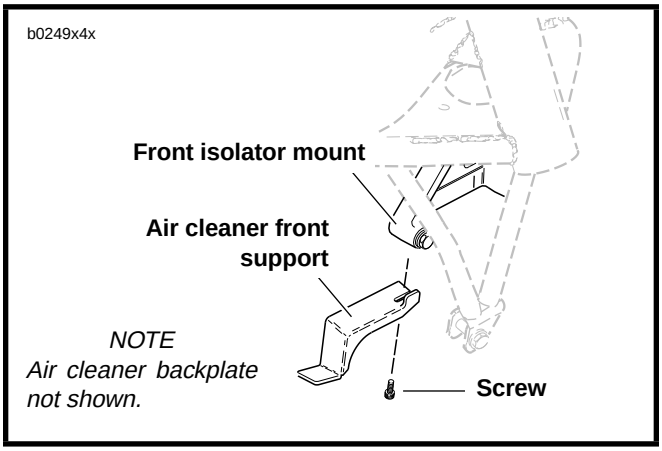


Figure 4-19. Air Cleaner Front Support

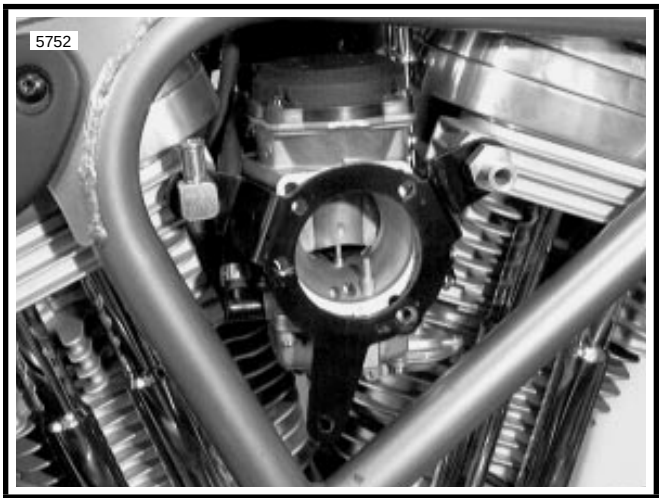


Figure 4-20. Breather Bolts

FUEL TANK

GENERAL

⚠WARNING

Verify that the fuel tank vent hose does not contact hot exhaust or engine parts. The hose contains flammable vapors that can be ignited if damaged, thereby resulting in personal injury.

See Figure 4-21. The fuel tank is vented through a vent valve assembly within the tank. A vent hose connects to the vent valve fitting at the top of the fuel tank. The vent hose is then cable strapped to the left side of the vehicle frame.

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury.

1. Turn fuel supply valve OFF.

⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury.

2. Remove fuel hose and hose clamp from fuel supply valve.

NOTE

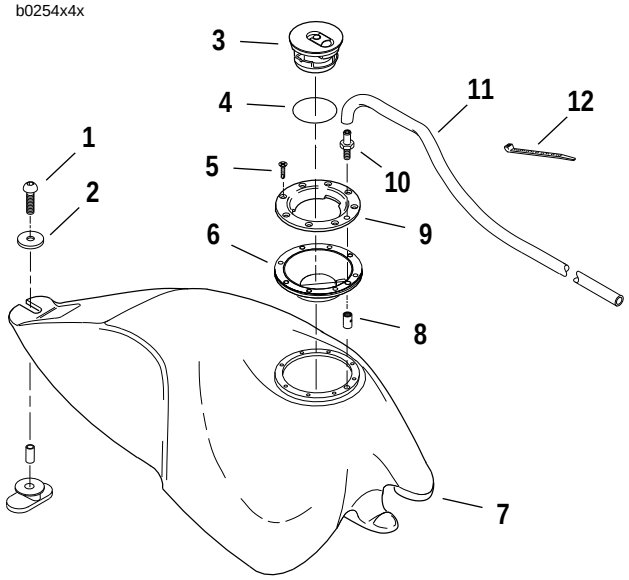
Fuel tank can be removed from motorcycle without being drained. Drain tank only when necessary.

3. Drain fuel from tank.
   a. Attach an additional length of hose to fuel supply valve. Place free end of drain hose into a proper, clean container of adequate size.
   b. Turn supply valve to reserve (RES). Drain gasoline from tank into container. Remove temporary drain hose.
4. See Figure 4-21. Remove cable strap (12) holding vent hose (11) to vent valve fitting (10). Disconnect vent hose from vent valve fitting.
5. Remove seat.
6. Remove fuel tank screw (1) and washer (2).

⚠CAUTION

Use caution when removing fuel tank. If tank should contact other chassis parts, tank finish may be damaged.

7. Lift rear of tank from frame and remove.



1.	Screw	7.	Fuel tank
2.	Washer	8.	Vent valve
3.	Fuel cap	9.	Fuel cap flange
4.	O-ring	10.	Vent valve fitting
5.	Screw (8)	11.	Vent hose
6.	Fuel cap boot	12.	Cable strap

Figure 4-21. Fuel Tank

DISASSEMBLY/ASSEMBLY

⚠WARNING

Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury.

1. If the fuel supply valve requires cleaning or repair, see FUEL SUPPLY VALVE, REMOVAL on page 4-22.
2. See Figure 4-21. Remove fuel filler cap (3) and O-ring (4).
3. Remove vent valve fitting (10) and vent valve (8).
4. Remove self-tapping screws (5) from fuel cap flange (9).
5. Remove fuel cap flange and fuel cap boot (6).
6. Assemble in reverse order.
   a. Apply HYLOMAR to fuel cap boot, fuel cap flange and top of fuel tank.
   b. See Figure 4-22. Tighten screws to 22-25 **in-lbs** (2.5-2.8 Nm) in the order shown.

CLEANING, INSPECTION AND REPAIR

⚠WARNING

An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Inadequate safety precautions may result in personal injury.

Clean tank interior with commercial cleaning solvent or a soap and water solution. Plug fuel tank openings. Shake tank to agitate the cleaning agent. Thoroughly flush fuel tank after cleaning. Allow tank to air dry. Carefully inspect fuel hose for damage, wear or general deterioration. Replace as necessary.

INSTALLATION

1. See Figure 4-21. Place fuel tank on frame. Install fuel tank screw (1) and washer (2). Tighten to 9-11 ft-lbs (12.2-14.9 Nm).

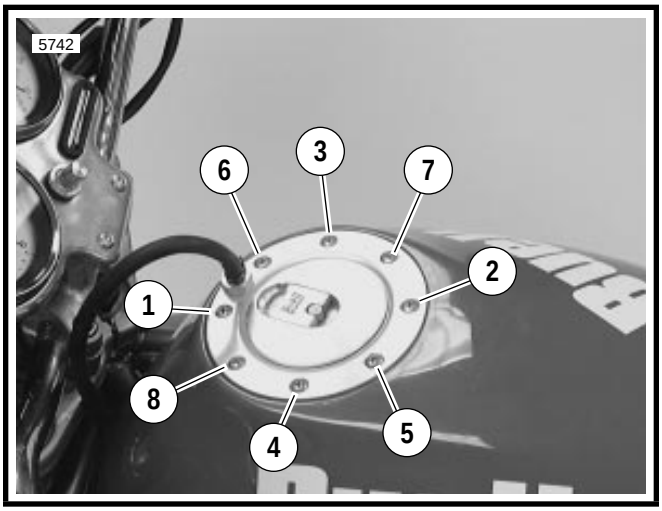


Figure 4-22. Tightening Flange

⚠CAUTION

Avoid pinching wiring harness and vent hose between fuel tank and frame during tank installation. Pinched hoses will negatively affect vehicle operation.

2. Connect vent hose (11) to vent valve fitting (10). Clamp hose to fitting with a **new** cable strap (12).
3. Connect fuel hose to fuel supply valve with a **new** clamp and HOSE CLAMP PLIERS (Part No. HD-41137)

⚠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 and personal injury.

4. Install seat. See SEAT, INSTALLATION in Section 2.
5. Fill fuel tank with fuel supply valve turned OFF.
6. Open fuel supply valve and carefully inspect for leaks. Turn valve OFF after the inspection is performed.

FUEL SUPPLY VALVE

GENERAL

The fuel supply valve is located on the left side, below the fuel tank. The gasoline supply to the carburetor is shut OFF when the handle is in the vertical position. For gasoline main supply, turn the handle to the 3 o'clock position (horizontal rearward). For gasoline reserve supply, turn the handle to the 9 o'clock position (horizontal forward). Turn valve to OFF position (vertical) when engine is not running.

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in personal injury.

1. See Figure 4-23. Turn fuel supply valve OFF.

⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury.

2. Remove fuel hose and clamp from fuel supply valve.
3. Attach an additional length of hose to fuel supply valve. Place free end of drain hose into a proper, clean container of adequate size. Turn supply valve to reserve (RES). Drain gasoline from tank into container. Remove temporary drain hose.

⚠WARNING

Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilt fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury.

4. Remove two screws and fuel supply valve assembly.

CLEANING, INSPECTION AND REPAIR

1. Clean or replace filter strainer (located inside fuel tank above fuel supply valve). Filter strainer threads into valve body.
2. Flush fuel tank to remove all dirt.

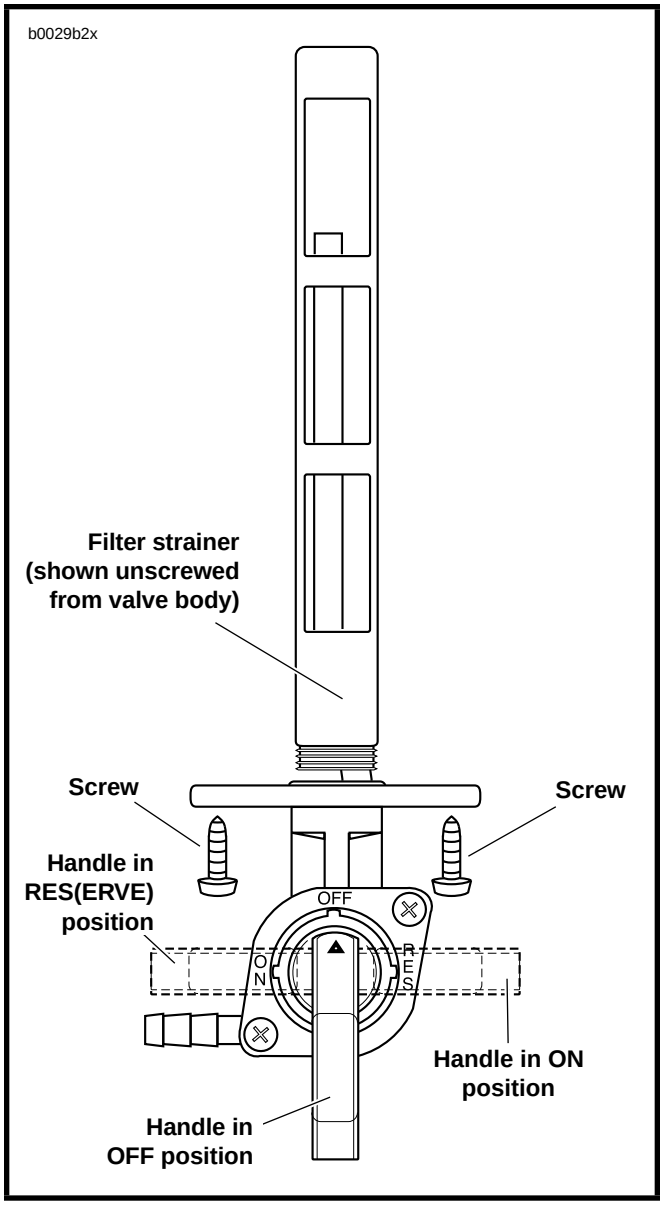


Figure 4-23. Fuel Supply Valve

INSTALLATION

1. See Figure 4-23. Attach fuel supply valve to tank with two screws. Tighten to 34-37 **in-lbs** (3.8-4.2 Nm).

⚠CAUTION

Screws thread directly into plastic fuel tank. Overtightening screws will strip the tank threads and require a replacement fuel tank to be installed upon subsequent removal of the fuel supply valve.

2. Connect fuel hose with a **new** clamp and HOSE CLAMP PLIERS (Part No. HD-41137).

EVAPORATIVE EMISSIONS CONTROL CALIFORNIA MODELS

GENERAL

Buell motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

- See Figure 4-24. Hydrocarbon vapors in the fuel tank are directed through the vent valve and stored in the carbon canister. If the vehicle is tipped at an abnormal angle, the vent valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vapor vent hose.
- See Figure 4-25. When the engine is running, carburetor venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the carbon canister through the vent hose. These vapors pass through the carburetor and are burned as part of normal combustion in the engine. The large diameter canister-to-air cleaner hose (canister clean air inlet hose) supplies the canister with fresh air from the air cleaner.

TROUBLESHOOTING

⚠WARNING

Verify that the evaporative emissions vent hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in personal injury.

The system has been designed to operate with a minimum of maintenance. Check that all hoses are properly routed and connected and are not pinched or kinked.

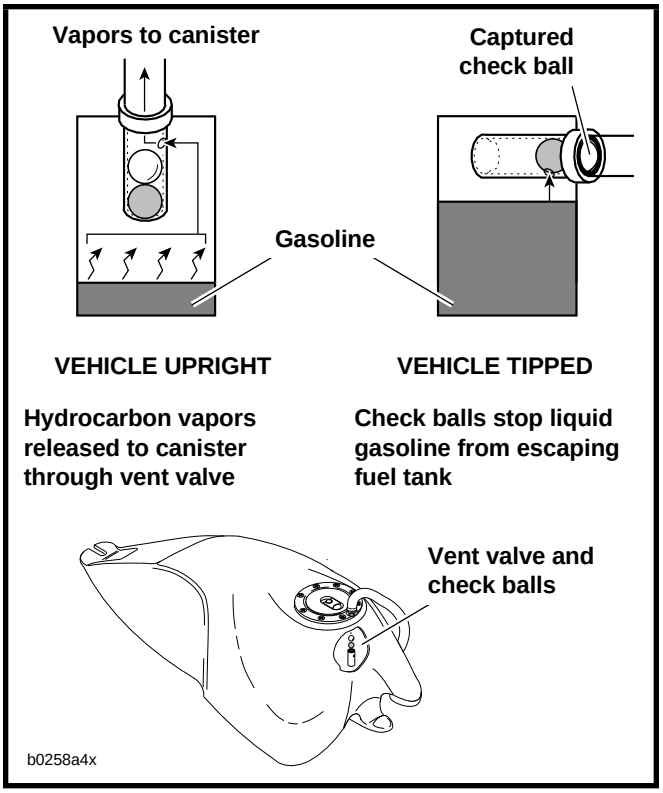
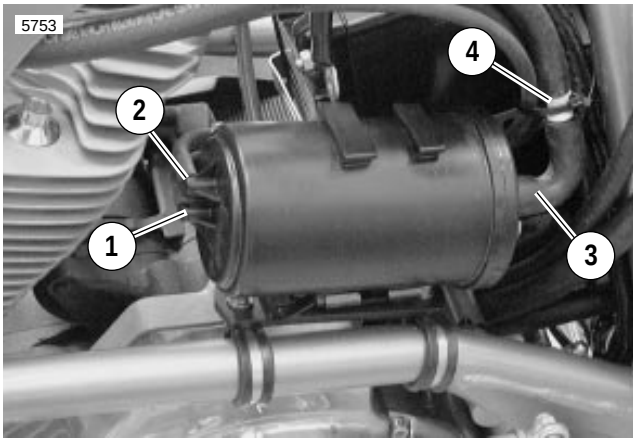


Figure 4-24. Vent Valve Operation



1. Overflow vent hose from fuel tank
2. Vent hose to carburetor
3. Fresh air inlet from air cleaner backplate
4. Cable strap around all three hoses

Figure 4-25. Carbon Canister

REMOVAL

Vent Valve

1. See Figure 4-26. The vent valve fitting (5) is screwed into the top of the fuel tank.
2. Remove vent hose cable strap. Disconnect hose (6) from fitting. Remove fitting.
3. Remove check balls (4, 3) from vent valve.
4. Remove fuel filler cap and O-ring. Remove vent valve.
5. If necessary, label overflow vent hose connected to canister and remove from canister fitting.

Canister

1. See Figure 4-25. The canister assembly mounts on a frame tube along the left side of the motorcycle.
2. Label the three hoses connected to canister. Disconnect hoses from canister.
3. Depress locking tab at the front end of the canister mounting bracket. Slide canister towards the front wheel until it disengages from the bracket and remove.
4. See Figure 4-27. Remove screws, washers and locknuts (5) to detach mounting plate (2) from clamps (1).
5. Remove countersunk screws and locknuts (4) to separate bracket (3) from mounting plate (2).

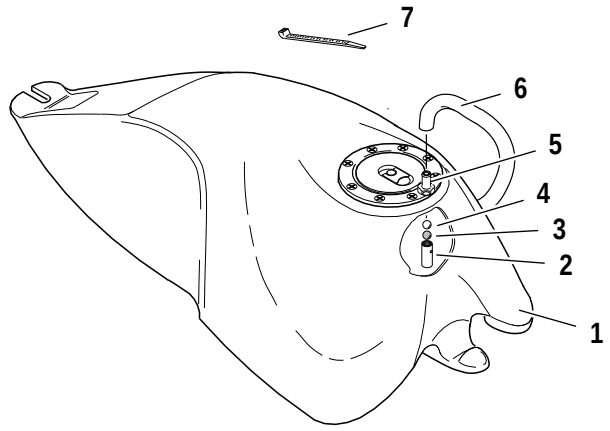
INSTALLATION

Vent Valve

⚠WARNING

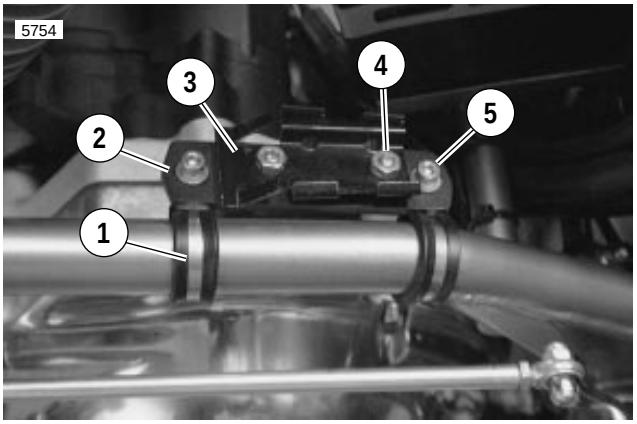
Verify that the fuel tank vapor vent hose does not contact hot exhaust or engine parts. The hose contains flammable vapors that can be ignited if damaged, thereby resulting in personal injury.

1. See Figure 4-26. Screw vent valve (2) into fuel tank.
2. Drop check balls (3, 4) into vent valve.
3. Attach vent valve fitting (5).
4. Install fuel cap and **new** O-ring.
5. Attach overflow vent hose to fitting with a **new** cable strap.
6. Attach overflow vent hose to bottom fitting on canister if disconnected.



1. **Fuel tank**
2. **Vent valve**
3. **Steel check ball**
4. **Plastic check ball**
5. **Vent valve fitting**
6. **Vent hose**
7. **Cable strap**

Figure 4-26. Vapor Vent Valve



1. **Clamp (2)**
2. **Mounting plate**
3. **Canister mounting bracket**
4. **Countersunk screw and locknut (2)**
5. **Screw, washer and locknut (2)**

Figure 4-27. Carbon Canister Mounting

Canister

1. See Figure 4-27. Install canister bracket (3) on mounting plate (2) with countersunk screws and locknuts (4).

2. Install mounting plate assembly on frame by attaching mounting clamps (1) using screws, washers and locknuts (2). Tighten to 6-8 ft-lbs (8.1-10.8 Nm).

3. See Figure 4-25. Depress locking tab and slide canister into locked position on canister bracket. Clip on canister bracket must engage canister; bend clip outward somewhat if canister is not held securely.

4. Connect the three marked hoses to the canister.

HOSE ROUTING

Carburetor

See Figure 4-28. Route the evaporative emissions control hoses at the carburetor as shown. To gain access to the V.O.E.S. and hoses, remove the fuel tank and/or air cleaner/backplate assembly if necessary.

Canister Hose Routings

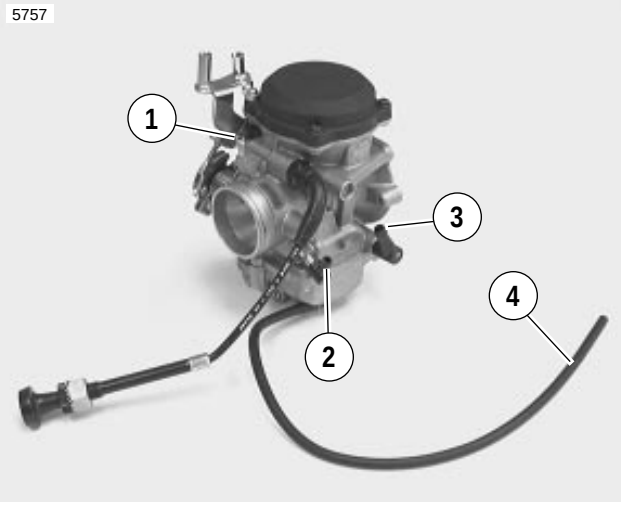
1. See Figure 4-25. Connect one end of the canister clean air inlet hose to the carbon canister.

2. Connect overflow vent hose and canister vent hose to fittings on carbon canister. Canister vent hose attaches to top fitting. Route both hoses towards fresh air hose on rear of canister.

3. Cable strap the three hoses where the hose connector attaches the two pieces of fresh air hose.

4. Route the smaller hoses forward along the top left frame tube. The vent and overflow hoses run together until the vent hose turns between the cylinders. Connect vent hose to elbow fitting on carburetor. Connect overflow vent hose to vent valve fitting using a **new** cable strap.

5. Route fresh air hose upward and forward along the left frame tube. Continue running hose to air cleaner backplate fitting. Secure hose using **new** cable straps.



1. V.O.E.S. hose
2. Canister vent hose
3. Fuel hose
4. Drain hose

Figure 4-28. Emissions Hose Routing at Carburetor

SPECIFICATIONS

STARTER	
Free speed	3000 RPM (min.) @ 11.5 V
Free current	90 amp (max.) @ 11.5 V
Stall current	400 amp (max.) @ 2.4 V
Stall torque	8.1 ft-lbs (11.0 Nm) (min.) @ 2.4 V

SERVICE WEAR LIMITS	IN.	MM
Brush length minimum	0.433	11.0
Commutator diameter minimum	1.141	28.98

ITEM	TORQUE		NOTES
Battery terminal hardware	30-40 **in-lbs**	3.4-4.5 Nm	hold cable when loosening/tightening, page 5-17
Starter mounting bolts	13-20 ft-lbs	17.6-27.1 Nm	page 5-17

ELECTRIC STARTER SYSTEM

GENERAL

The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear and a clutch gear in the drive housing. The idler gear is supported by rollers. The clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagram at the end of Section 7, ELECTRICAL.

Starter Relay

The starter relay is a non-repairable part that must be replaced as a unit if it fails.

OPERATION

See Figure 5-1. The starter relay is activated when the starter switch is pushed. This allows battery current to flow into the pull-in winding and also into the hold-in winding to ground. The magnetic forces of the pull-in and hold-in windings in the solenoid push the plunger causing it to shift to the left. This action engages the pinion gear with the clutch ring gear. At the same time, the main solenoid contacts are closed, so battery current flows directly through the field windings to the armature and to ground. Simultaneously, the pull-in winding is shorted. The current continues flowing through the hold-in winding keeping the main solenoid contacts closed. At this point, the starter begins to crank the engine. After the engine has started, the pinion gear turns freely on the pinion shaft through the action of the overrunning clutch. The overrunning clutch prevents the clutch ring gear (which is now rotating under power from the engine) from turning the armature too fast.

When the starter switch is released, the current of the hold-in winding is fed through the main solenoid contacts and the direction of the current in the pull-in winding is reversed. The solenoid plunger is returned to its original position by the return spring, which causes the pinion gear to disengage from the clutch ring gear.

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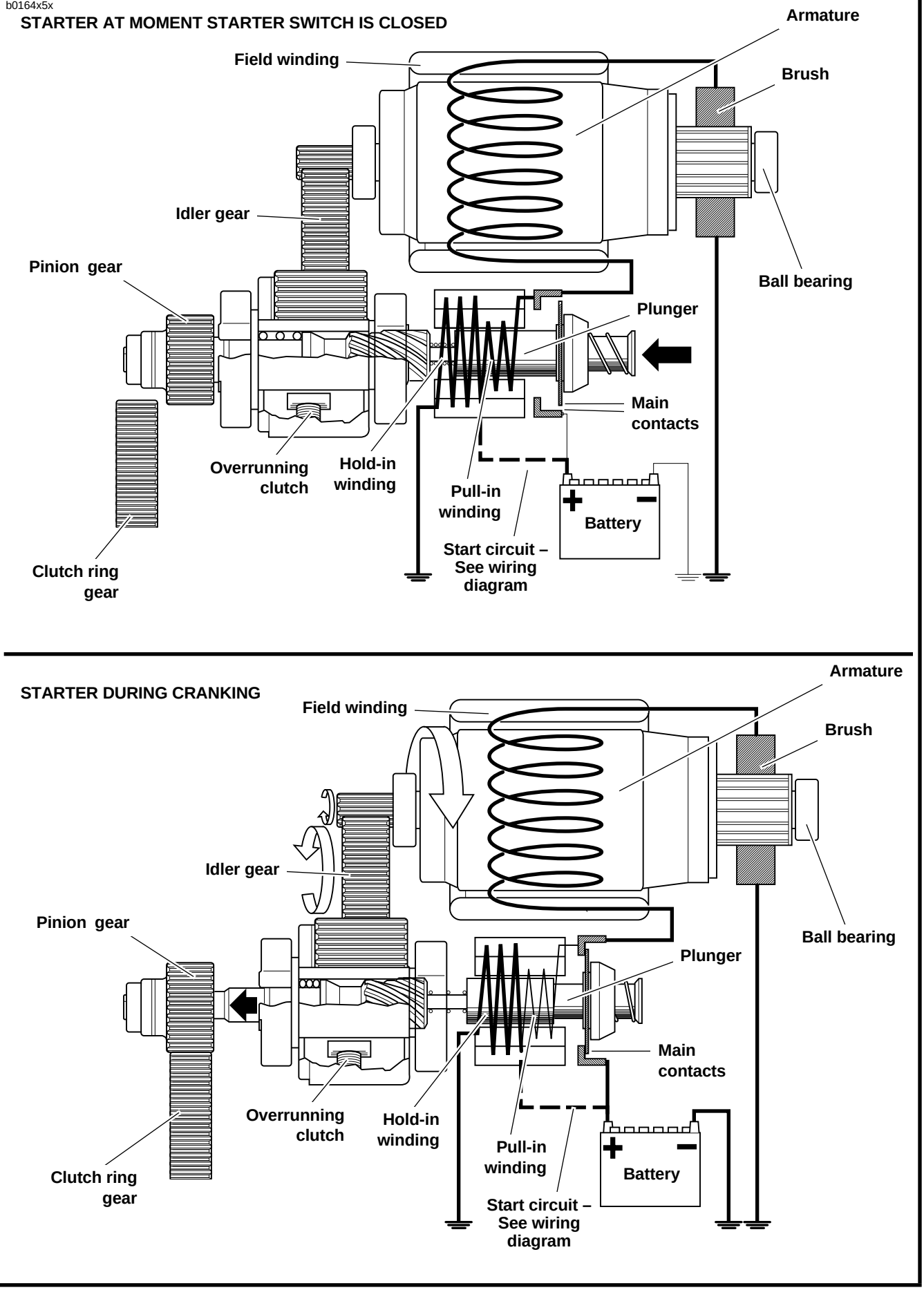


Figure 5-1. Starter Operation

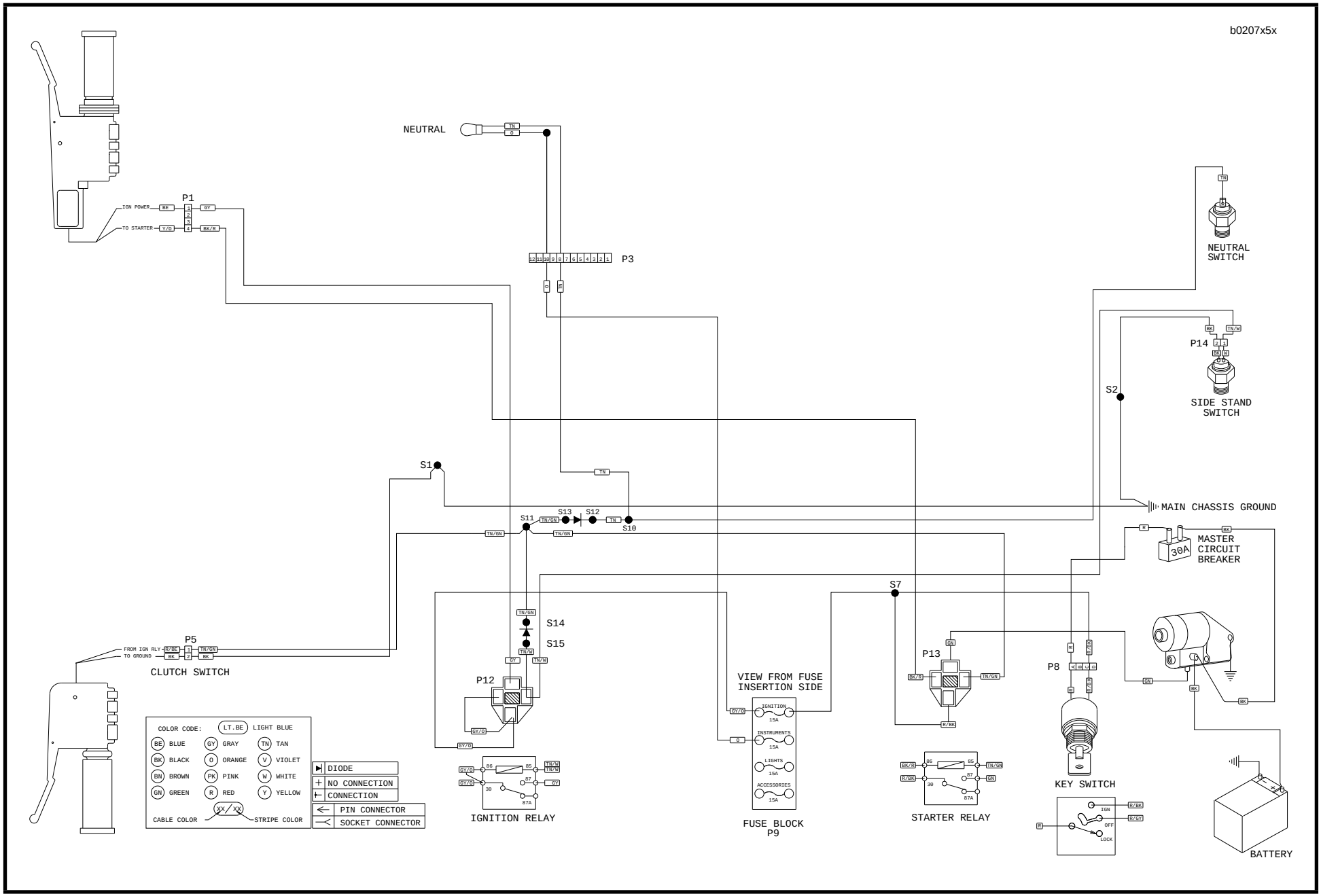


Figure 5-2. Electric Starting System Circuit

Table 5-1. Troubleshooting

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
1. Starter does not run or runs at very low speeds.	1.1 Battery.	1.1.1 Voltage drop due to discharged battery.	1.1.1 Charge battery.
		1.1.2 Short-circuited or open between electrodes.	1.1.2 Replace battery.
		1.1.3 Poor contact condition of battery terminal(s).	1.1.3 Clean and retighten.
	1.2 Wiring.	1.2.1 Disconnection between starter switch and solenoid terminal.	1.2.1 Repair or replace wire.
	1.3 Starting switch or starter relay.	1.3.1 Poor contact condition or poor connection.	1.3.1 Replace.
	1.4 Solenoid.	1.4.1 Poor contact condition. caused by burnt contact.	1.4.1 Polish contact surface or replace solenoid assembly.
		1.4.2 Contact plate removed.	1.4.2 Repair.
		1.4.3 Pull-in winding open or short-circuited.	1.4.3 Replace solenoid assembly.
		1.4.4 Hold-in winding open.	1.4.4 Replace solenoid assembly.
	1.5 Starting motor.	1.5.1 Poor contact condition of brushes.	1.5.1 Check brush spring tension.
		1.5.2 Commutator burnt.	1.5.2 Correct on lathe or replace.
		1.5.3 Commutator high mica.	1.5.3 Correct by undercutting.
		1.5.4 Field winding grounded.	1.5.4 Replace.
		1.5.5 Armature winding grounded or short-circuited.	1.5.5 Replace.
		1.5.6 Reduction gears damaged.	1.5.6 Replace.
		1.5.7 Insufficient brush spring tension.	1.5.7 Replace.
		1.5.8 Disconnected lead wire between solenoid and field windings.	1.5.8 Repair or replace lead wire.
		1.5.9 Ball bearing sticks.	1.5.9 Replace bearing.

Table 5-1. Troubleshooting (Continued)

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
2. Pinion does not engage with ring gear while starter is running or engine cannot be cranked.	2.1 Battery.	2.1.1 Voltage drop due to discharged battery.	2.1.1 Charge battery.
		2.1.2 Short-circuited or open between electrodes.	2.1.2 Replace battery.
		2.1.3 Poor contact condition of battery terminal(s).	2.1.3 Clean and retighten.
	2.2 Wiring.	2.2.1 Disconnection between starter switch and solenoid terminal.	2.2.1 Repair or replace wire.
	2.3 Overrunning clutch.	2.3.1 Overrunning clutch malfunction (rollers or compression spring).	2.3.1 Replace overrunning clutch.
		2.3.2 Pinion teeth worn out.	2.3.2 Replace overrunning clutch.
		2.3.3 Pinion does not run in overrunning direction.	2.3.3 Replace overrunning clutch.
		2.3.4 Poor sliding condition of spline teeth.	2.3.4 Remove foreign materials, dirt, or replace overrunning clutch.
		2.3.5 Reduction gears damaged.	2.3.5 Replace overrunning clutch and idler gear.
	2.4 Ring gear.	2.4.1 Excessively worn teeth.	2.4.1 Replace ring gear.
3. Starter does not stop running.	3.1 Solenoid.	3.1.1 Return spring worn.	3.1.1 Replace solenoid.
		3.1.2 Coil layer shorted.	3.1.2 Replace solenoid.
		3.1.3 Contact plate melted and stuck.	3.1.3 Replace solenoid.
	3.2 Starting switch or starter relay.	3.2.1 Unopened contacts.	3.3.1 Replace starting switch or starter relay.
		3.2.2 Poor returning.	3.3.1 Replace starting switch or starter relay.

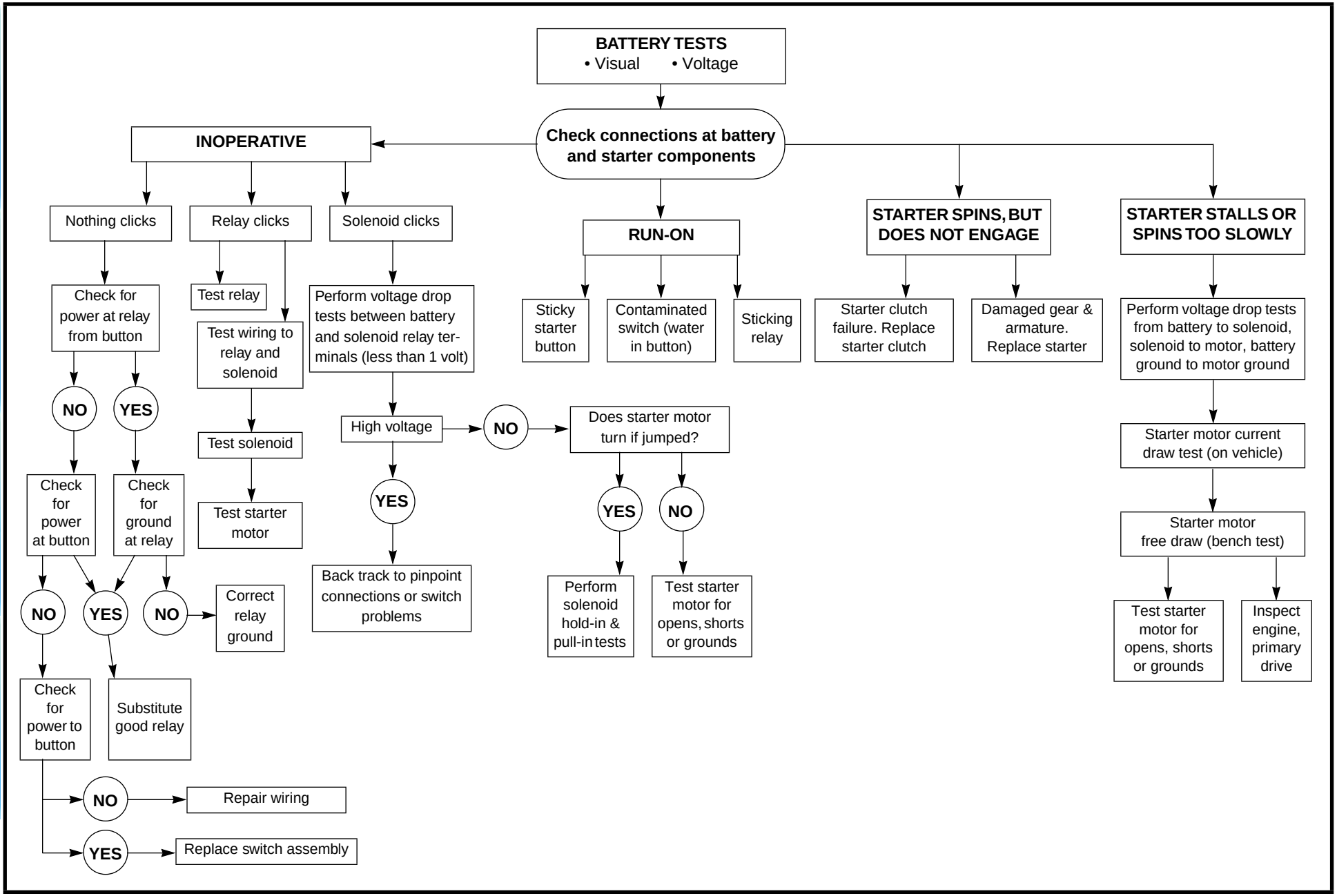


Figure 5-3. Electric Starting System Diagnosis

STARTER ACTIVATION CIRCUITS

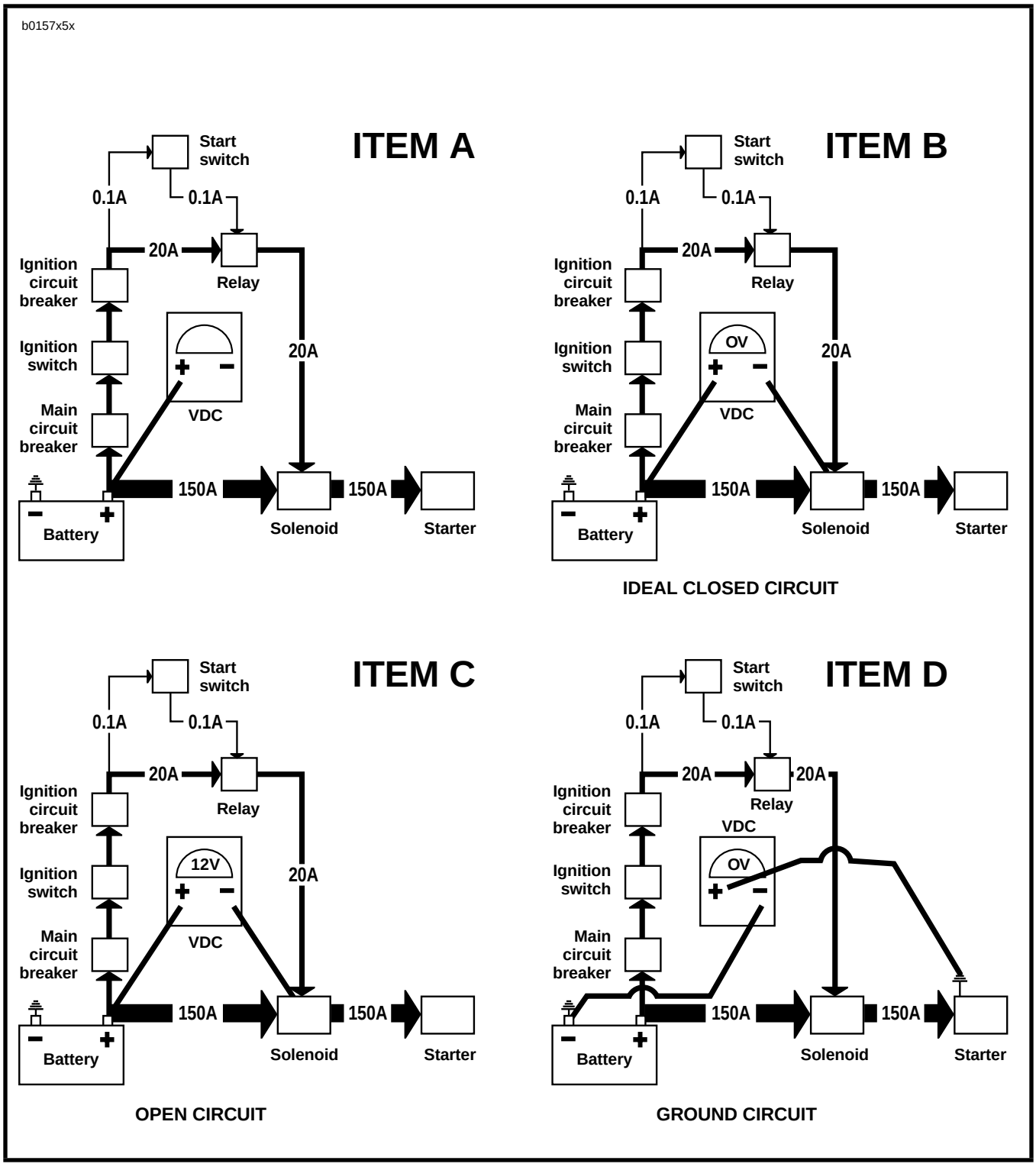


Figure 5-4. Typical circuity. Refer to wiring diagrams for more information.

DIAGNOSTICS/TROUBLESHOOTING

GENERAL

The TROUBLESHOOTING table, starting on page 5-5, contains detailed procedures to solve and correct problems. Follow the ELECTRIC STARTING SYSTEM DIAGNOSIS diagram on page 5-7 to diagnose starting system problems. The VOLTAGE DROPS procedure below will help you to locate poor connections or components with excessive voltage drops.

VOLTAGE DROPS

Check the integrity of all wiring, switches, circuit breakers and connectors between the source and destination.

The voltage drop test measures the difference in potential or the actual voltage dropped between the source and destination.

1. See ITEM A in Figure 5-4. Attach your red meter lead to the most positive part of the circuit, which in this case would be the positive post of the battery.
2. See ITEM B in Figure 5-4. Attach the black meter lead to the final destination or component in the circuit (solenoid terminal from relay).
3. Activate the starter and observe the meter reading. The meter will read the voltage dropped or the difference in potential between the source and destination.
4. An ideal circuit's voltage drop would be 0 volts or no voltage dropped, meaning no difference in potential.
5. See ITEM C in Figure 5-4. An open circuit should read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.
6. Typically, a good circuit will drop less than 1 volt.
7. If the voltage drop is greater, back track through the connections until the source of the potential difference is found.

The benefit of doing it this way is speed.

   a. Readings aren't as sensitive to real battery voltage.

   b. Readings show the actual voltage dropped, not just the presence of voltage.

   c. This tests the system as it is actually being used. It is more accurate and will display hard to find poor connections.

   d. This approach can be used on lighting circuits, ignition circuits, etc. Start from most positive and go to most negative (the destination or component).

8. See ITEM D in Figure 5-4. The negative or ground circuit can be checked as well. Place the negative lead on the most negative part of the circuit (or the negative battery post). Remember, there is nothing more negative than the negative post of the battery. Place the positive lead to the ground you wish to check.
9. Activate the circuit. This will allow you to read the potential difference or voltage dropped on the negative or ground circuit. This is very effective for identifying poor grounds due to powdered paint. Even the slightest connection may cause an ohmmeter to give a good reading. However, when sufficient current is passed through, the resistance caused by the powdered paint will cause a voltage drop, or potential difference in the ground circuit.

STARTER SYSTEM TESTING

"ON-MOTORCYCLE" TESTS

Starter Relay Test

1. See Figure 5-5. Locate starter relay. The relay is attached to the frame near the oil tank's feed hose. Unplug relay connector.

2. To test relay, proceed to Step 3. If installing a **new** starter relay, remove old relay. Secure **new** relay to frame using screw and washer. Attach relay connector plug.

3. See Figure 5-6. Obtain a 12 volt battery and a continuity tester or ohmmeter. Connect positive battery lead to the 86 terminal. Connect negative battery lead to the 85 terminal to energize relay. Check for continuity between the 30 and 87 terminals. A good relay shows continuity, continuity tester lamp "on" or a zero ohm reading on the ohmmeter. A malfunctioning relay will not show continuity and must be replaced.

4. If starter relay is functioning properly, proceed to STARTER CURRENT DRAW TEST.

Starter Current Draw Test

NOTE

- *Engine temperature should be stable and at room temperature.*

- *Battery should be fully charged.*

Check starter current draw with an induction ammeter before disconnecting battery. Proceed as follows:

1. See Figure 5-7. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.

2. Clamp induction ammeter over positive battery cable next to starter.

3. With ignition key switch ON, turn engine over by pressing starter switch while taking a reading on the ammeter. Disregard initial high current reading which is normal when engine is first turned over.

   - Typical starter current draw will range between 140-180 amperes.

4. If starter current draw exceeds 180 amperes, then the problem may be in the starter or starter drive. Remove starter for further tests. See STARTER, REMOVAL on page 5-11.

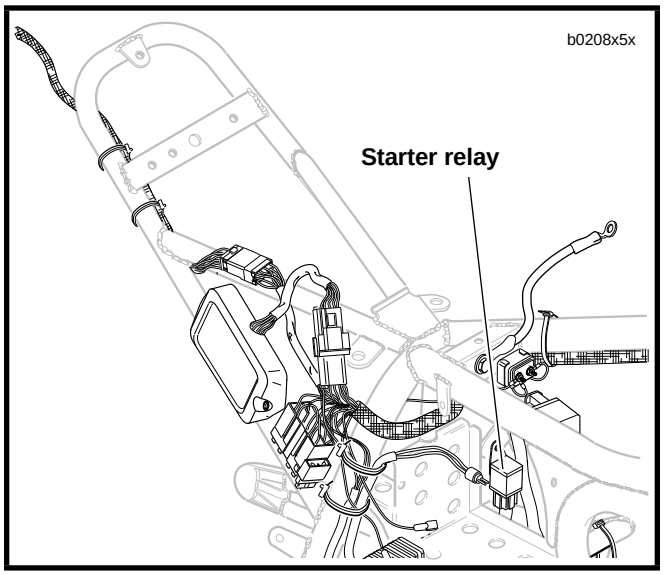
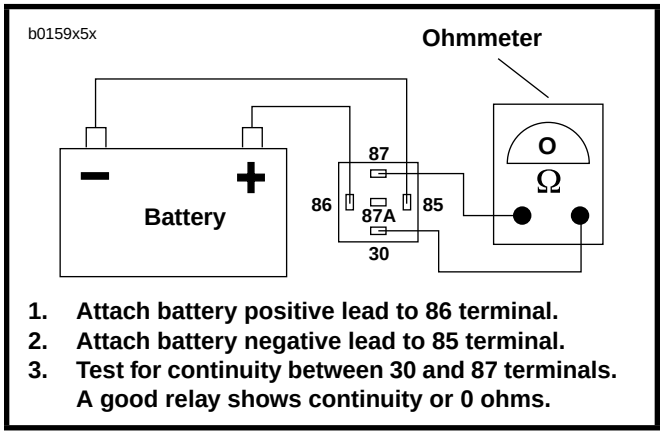
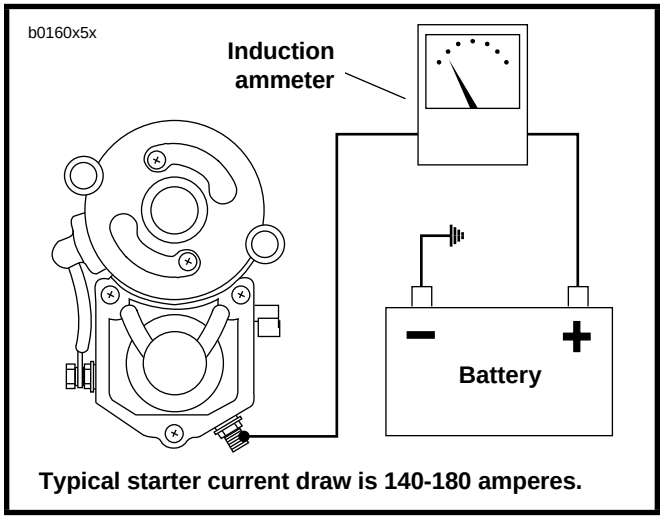


Figure 5-5. Starter Relay Location



1. Attach battery positive lead to 86 terminal.
2. Attach battery negative lead to 85 terminal.
3. Test for continuity between 30 and 87 terminals. A good relay shows continuity or 0 ohms.

Figure 5-6. Starter Relay Test



Typical starter current draw is 140-180 amperes.

Figure 5-7. Starter Draw Test

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before performing any of the following procedures. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

⚠CAUTION

Hold battery cable when loosening battery terminal hardware. Failure to hold cable will cause battery damage.

1. Remove primary cover. See PRIMARY CHAIN in Section 6.
2. See Figure 5-8. Remove the starter mounting bolts and washers.

NOTE

A ball hex driver may be required to gain access to the starter mounting bolts.

3. Remove positive battery lead and solenoid wire from starter.
4. Remove starter and gasket from right side of motorcycle.

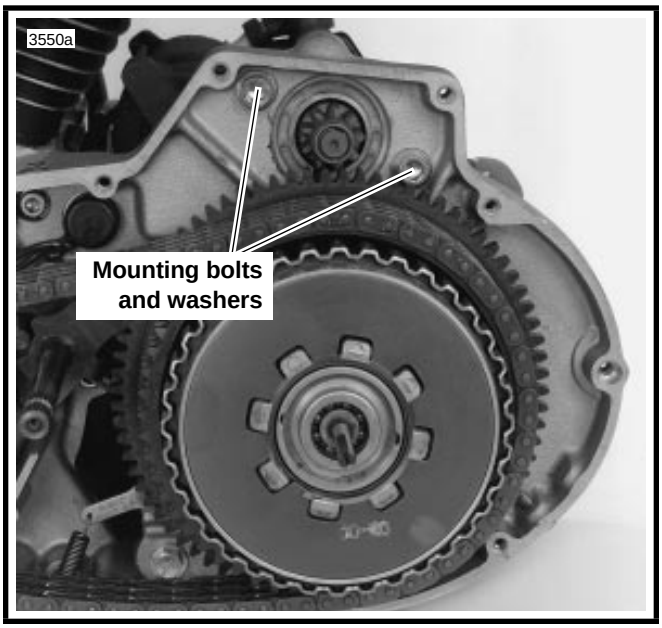


Figure 5-8. Starter Mounting

TESTING ASSEMBLED STARTER

Starter Solenoid

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from terminal "C," as shown in Figure 5-9.

⚠CAUTION

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

NOTE

The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. All three tests are conducted one after the other in the sequence given without interruption.

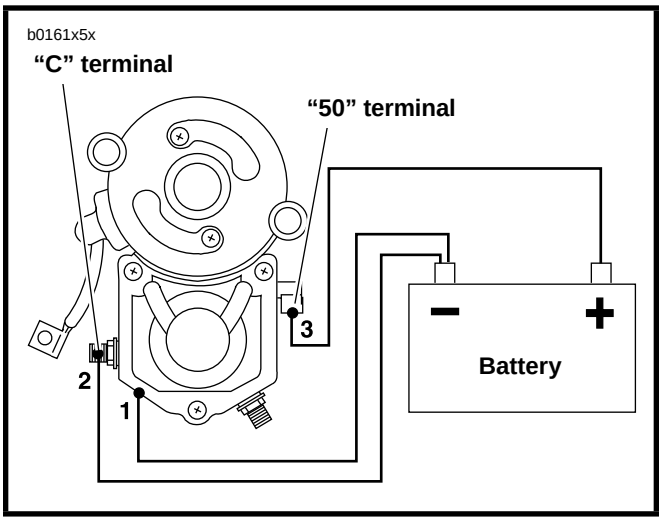


Figure 5-9. Pull-In Test

Solenoid Pull-in Test

See Figure 5-9. Using a 12 volt battery, connect three separate test leads as follows:

a. Solenoid housing to battery negative.
b. Solenoid "C" terminal to battery negative.
c. Solenoid "50" terminal to battery positive.

Starter pinion should pull in strongly if solenoid is working properly. If pinion does not pull in, solenoid should be replaced.

Solenoid Hold-in Test

See Figure 5-10. With test leads still connected in the manner specified in the previous SOLENOID PULL-IN TEST, **disconnect solenoid "C" terminal/battery negative test lead at battery negative end only; reconnect loose end of this test lead to battery positive, instead.** If pinion remains in pull-in position, solenoid is working properly. If pinion does not remain in pull-in position, solenoid should be replaced.

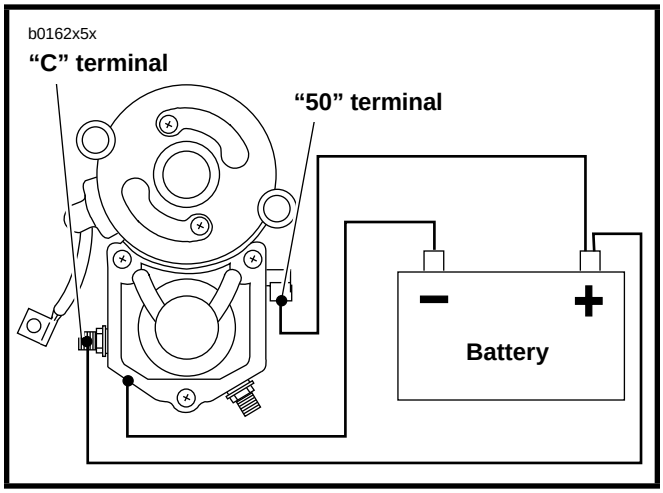


Figure 5-10. Hold-In Test

Solenoid Return Test

See Figure 5-11. With test leads still connected in the manner specified at the end of the previous SOLENOID HOLD-IN TEST, **disconnect solenoid "50" terminal/battery positive test lead at either end.** If pinion returns to its original position, the solenoid is working properly. If pinion does not return to its original position, solenoid should be replaced.

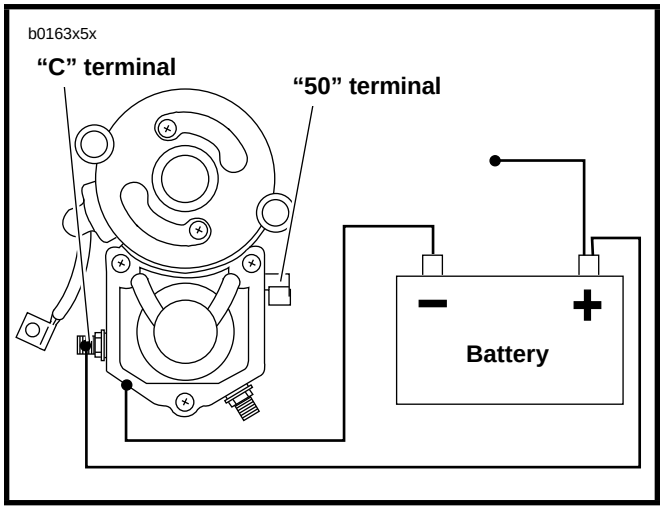


Figure 5-11. Return Test

DISASSEMBLY, INSPECTION AND REPAIR

1. See Figure 5-14. Remove field wire (22).

2. See Figure 5-12. Remove thru-bolts.

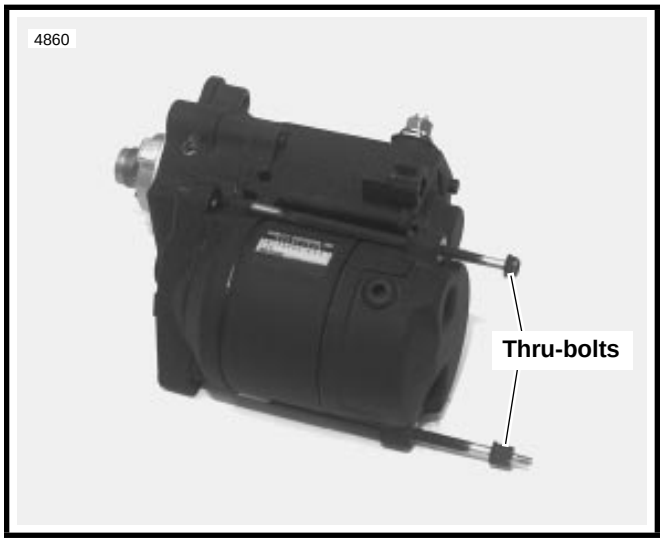


Figure 5-12. Removing the Thru-Bolts

3. See Figure 5-13. Remove two end cover screws, O-rings, and end cover.

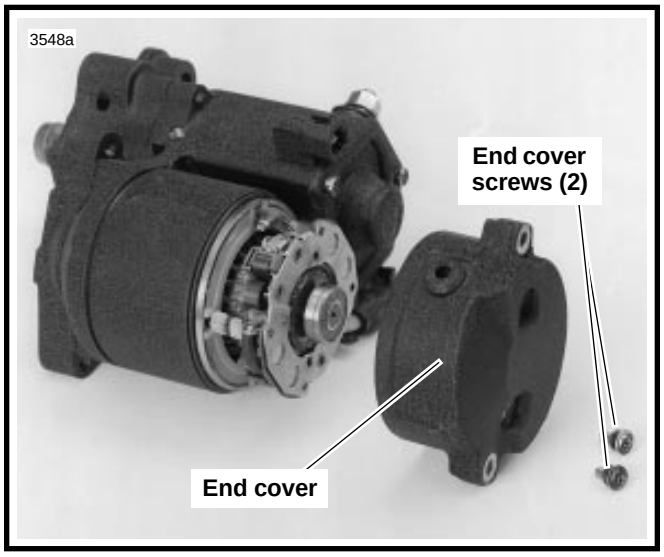
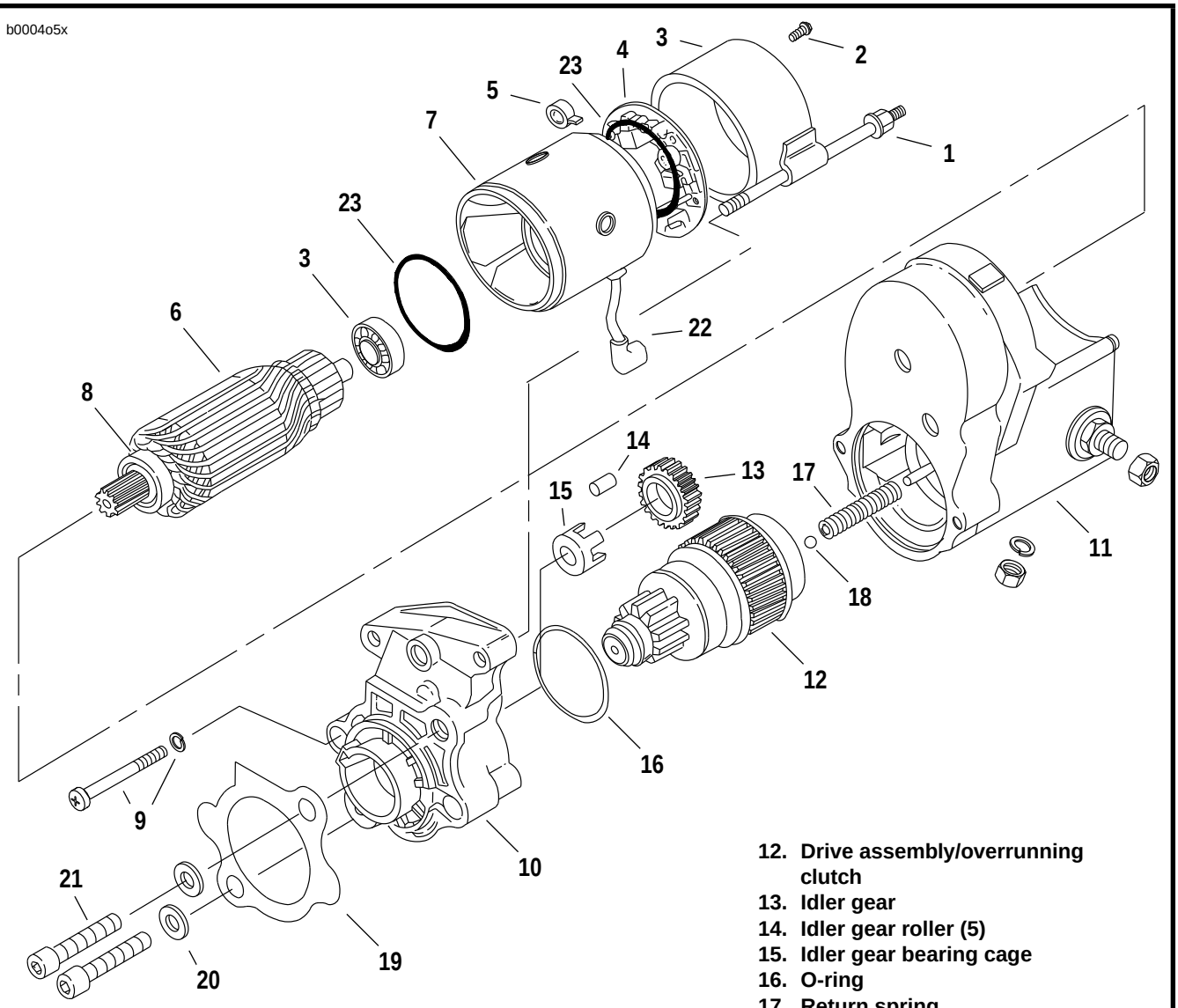


Figure 5-13. Removing End Cover



1. Thru-bolt (2)
2. End cover screw (2)
3. End cover
4. Brush holder
5. Brush spring (4)
6. Armature
7. Field frame
8. Armature bearings
9. Drive housing mounting bolt and lockwasher (2)
10. Drive housing
11. Solenoid housing
12. Drive assembly/overrunning clutch
13. Idler gear
14. Idler gear roller (5)
15. Idler gear bearing cage
16. O-ring
17. Return spring
18. Ball
19. Gasket
20. Washer (2)
21. Mounting bolt (2)
22. Field wire
23. O-ring (2)

Figure 5-14. Starter Assembly

4. See Figure 5-15. Use a wire hook to pull upward on brush springs, and lift brushes out of holder. Remove brush holder.
5. Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm).

   Replace brushes in sets of four only.
6. See Figure 5-14. Remove armature (6) and field frame (7).
7. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.016 in. (0.41 mm) of runout should be replaced, or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (28.98 mm).

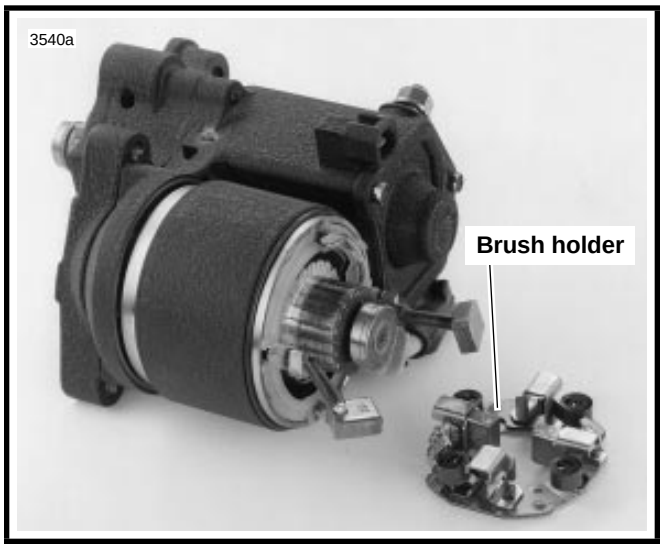


Figure 5-15. Removing Brush Holder

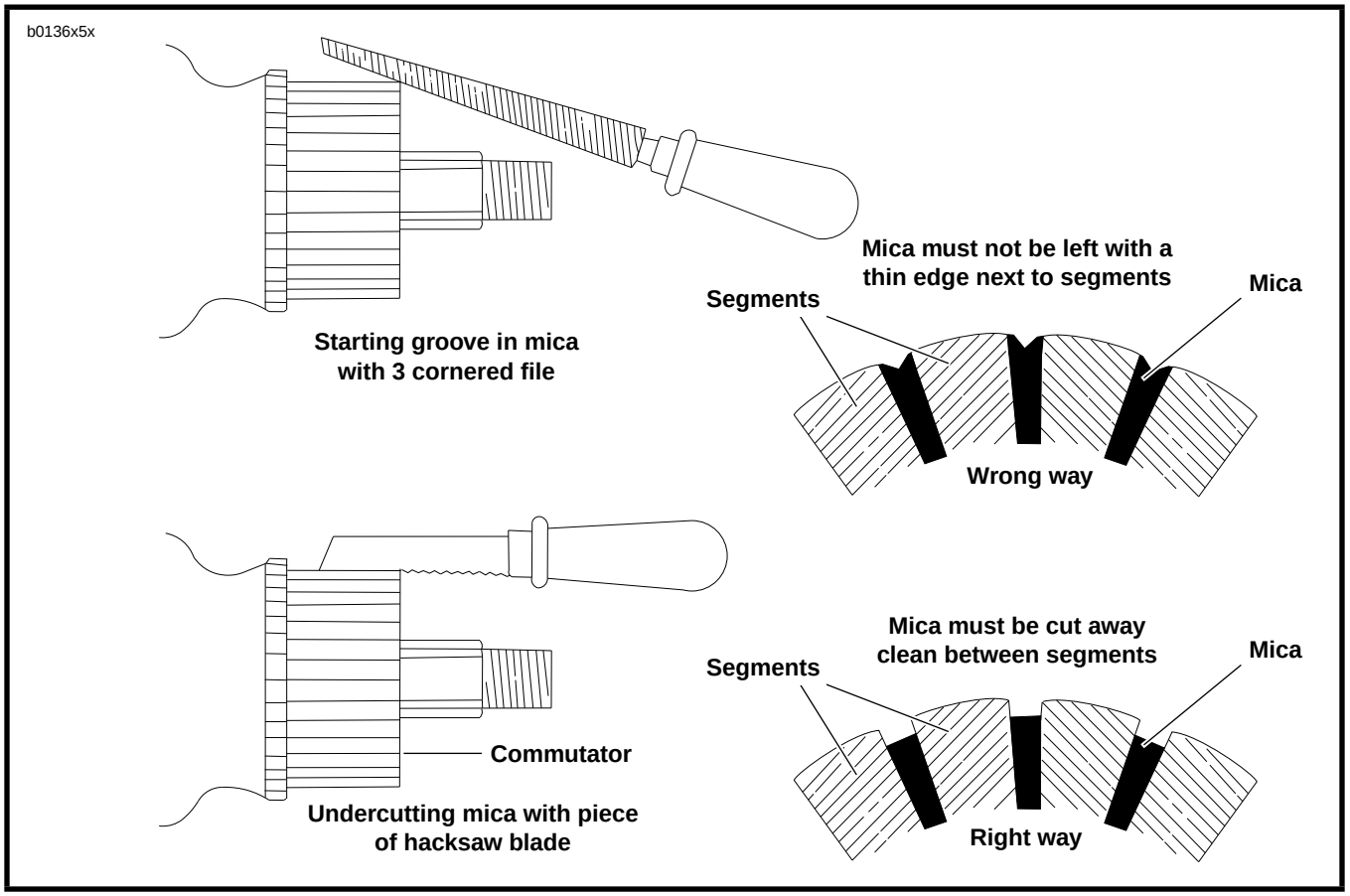


Figure 5-16. Undercutting Mica Separators

⚠CAUTION

Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.

8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.20 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.79 mm) deep. The slots should then be cleaned to remove any dirt or copper dust. See Figure 5-16. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.
9. See Figure 5-17. Check for SHORTED ARMATURE with a growler. Place armature on growler. Hold a thin steel strip (hacksaw blade) against armature core and slowly turn armature. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace armatures if shorted.

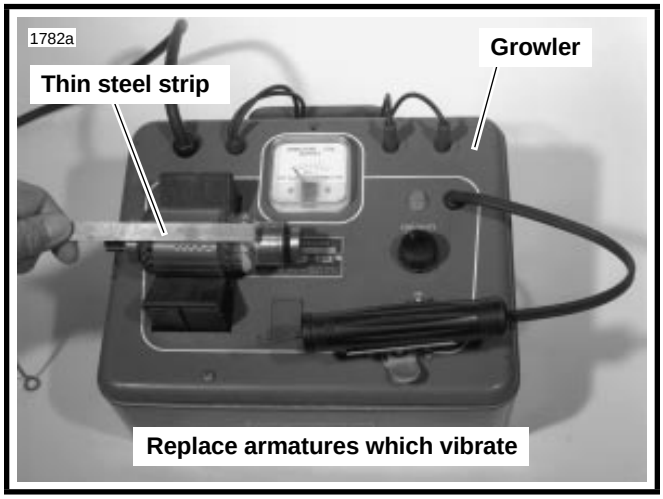


Figure 5-17. Shorted Armature Test Using Growler

10. See Figure 5-18. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester. Touch one probe to any commutator segment. Touch the other probe to the armature core. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace grounded armatures.
11. See Figure 5-19. Check for OPEN ARMATURE with an ohmmeter or continuity tester. Check for continuity between all commutator segments. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.
12. See Figure 5-20. Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester. Touch one probe to the frame. Touch the other probe to each of the brushes attached to the field coil. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field coil(s) are grounded and the field frame must be replaced.

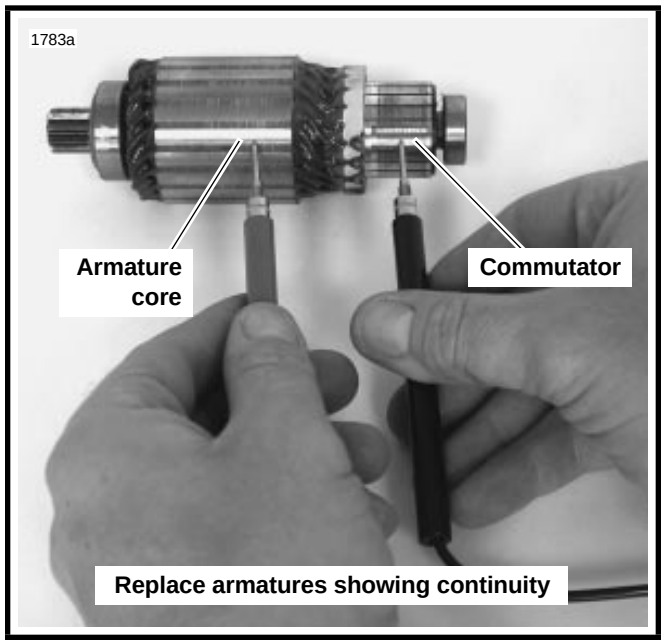


Figure 5-18. Grounded Armature Test

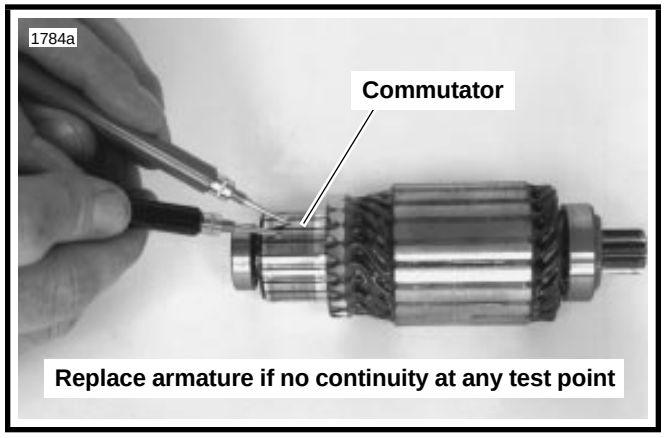


Figure 5-19. Open Armature Test

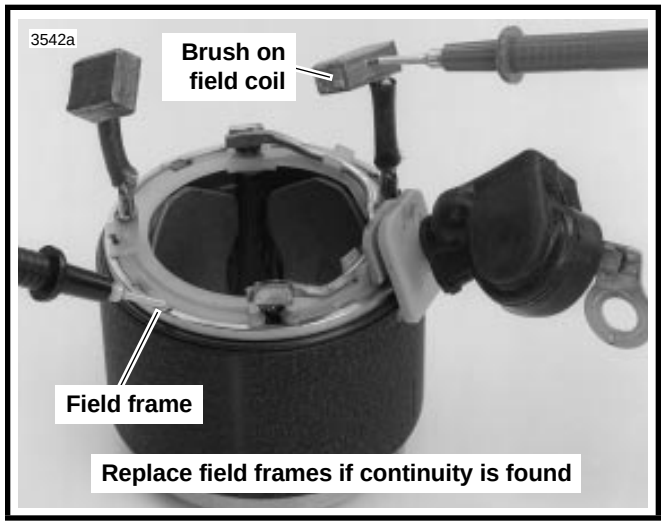


Figure 5-20. Grounded Field Test

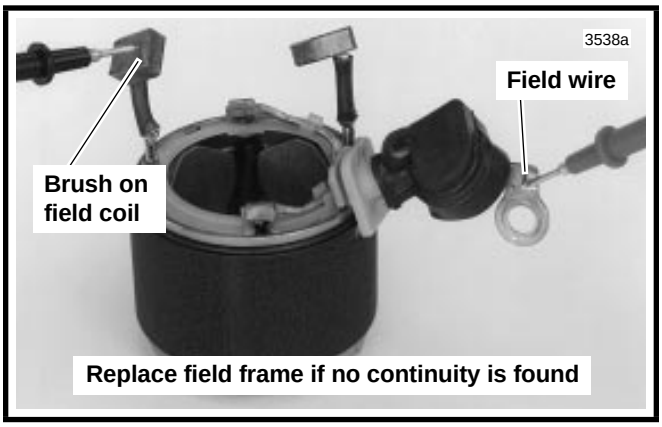


Figure 5-21. Open Field Test

13. See Figure 5-21. Check for OPEN FIELD COILS with an ohmmeter or continuity tester. Touch one probe to the field wire. Touch the other probe to each of the brushes attached to the field coils. There should be continuity. If there is no continuity at either brush, then the field coil(s) are open and the field frame must be replaced.

14. See Figure 5-22. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester. Touch one probe to holder plate. Touch the other probe to each of the positive (insulated) brush holders. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.

15. See Figure 5-14. Check armature bearings (8) and replace if necessary.

16. See Figure 5-23. Remove two drive housing mounting screws (with washers and lockwashers). Remove drive housing from solenoid housing.

17. See Figure 5-24. Remove drive (1), idler gear (2), idler gear bearing (3), and O-ring (4) from drive housing (O-ring is located in drive housing groove).

ASSEMBLY

1. See Figure 5-24. Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.

2. See Figure 5-14. When installing drive assembly components, open end of idler bearing cage (15) faces toward solenoid.

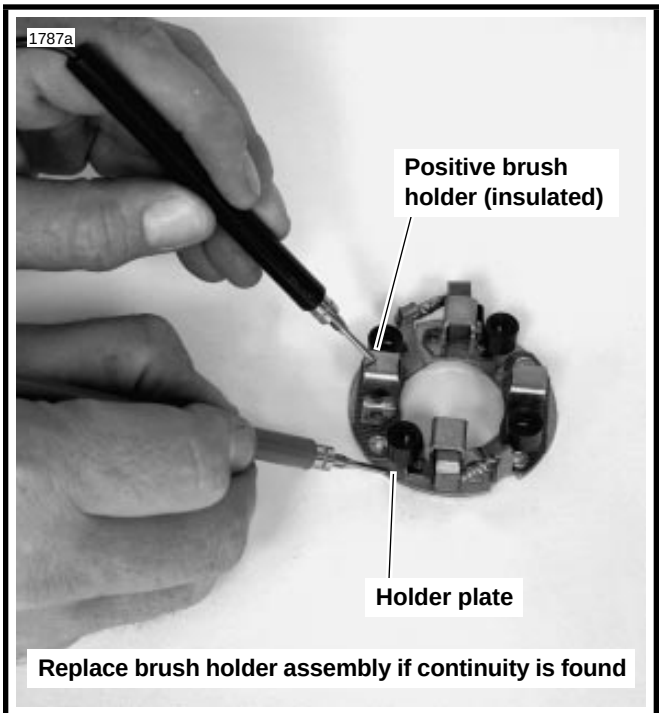


Figure 5-22. Brush Holder Insulation Test

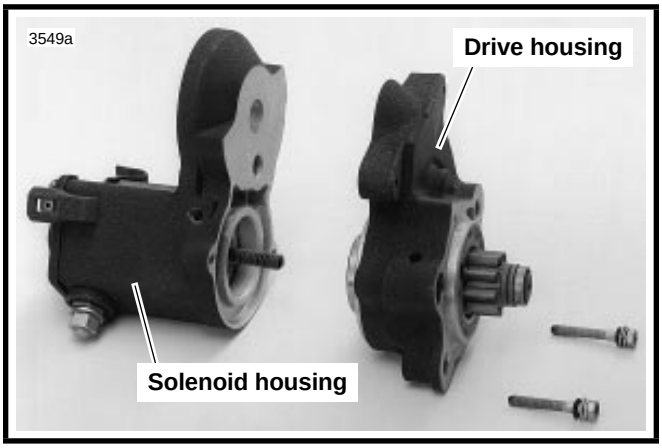


Figure 5-23. Removing Starter Drive Housing

3. When installing drive housing (10) to solenoid housing (11), use **new** O-ring (16). Be sure to install return spring (17) and ball (18).

4. Lubricate armature bearings (8) with high temperature grease, such as LUBRIPLATE 110. Install armature (6) and field frame (7) to solenoid housing (11).

5. Install brushes and brush holder (4).

6. Install end cover (3) with end cover screws (2) and O-rings (23).

7. Install thru-bolts (1).

8. Install solenoid wire to terminal.

INSTALLATION

1. Install starter and starter gasket from right side of motorcycle.

2. Install positive battery cable and solenoid wire to solenoid.

3. See Figure 5-8. Install the starter mounting bolts and washers. Tighten mounting bolts to 13-20 ft-lbs (17.6-27.1Nm).

4. Install primary cover. See PRIMARY CHAIN in Section 6.

5. Fill primary chaincase/transmission with proper lubricant. See CLUTCH, TRANSMISSION FLUID in Section 1.

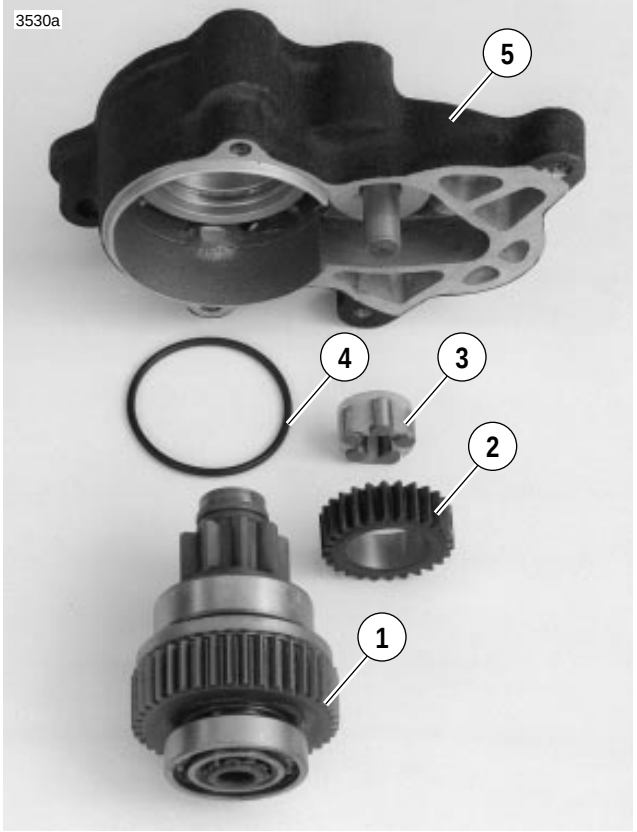
⚠WARNING

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 resulting in personal injury.

⚠CAUTION

Hold battery cable when tightening battery terminal hardware. Failure to hold cable will cause battery damage.

6. Connect battery cables, positive cable first. Tighten battery terminal hardware to 30-40 **in-lbs** (3.4-4.5 Nm).



1. **Drive**
2. **Idler gear**
3. **Idler gear bearing**
4. **O-ring**
5. **Drive housing**

Figure 5-24. Starter Drive Assembly

STARTER SOLENOID

GENERAL

See Figure 5-25. The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See Figure 5-25. Remove screws (1) and clip (2).
2. Remove cover (3) and gasket (4). Discard gasket.
3. Remove plunger (5) from solenoid housing (6).

ASSEMBLY

1. See Figure 5-25. Replace wire connection hardware as necessary.
2. Install plunger (5) in solenoid housing (6).
3. Install **new** gasket (4) onto cover (3).
4. Position cover with gasket onto solenoid housing. Install clip (2) and screws (1).

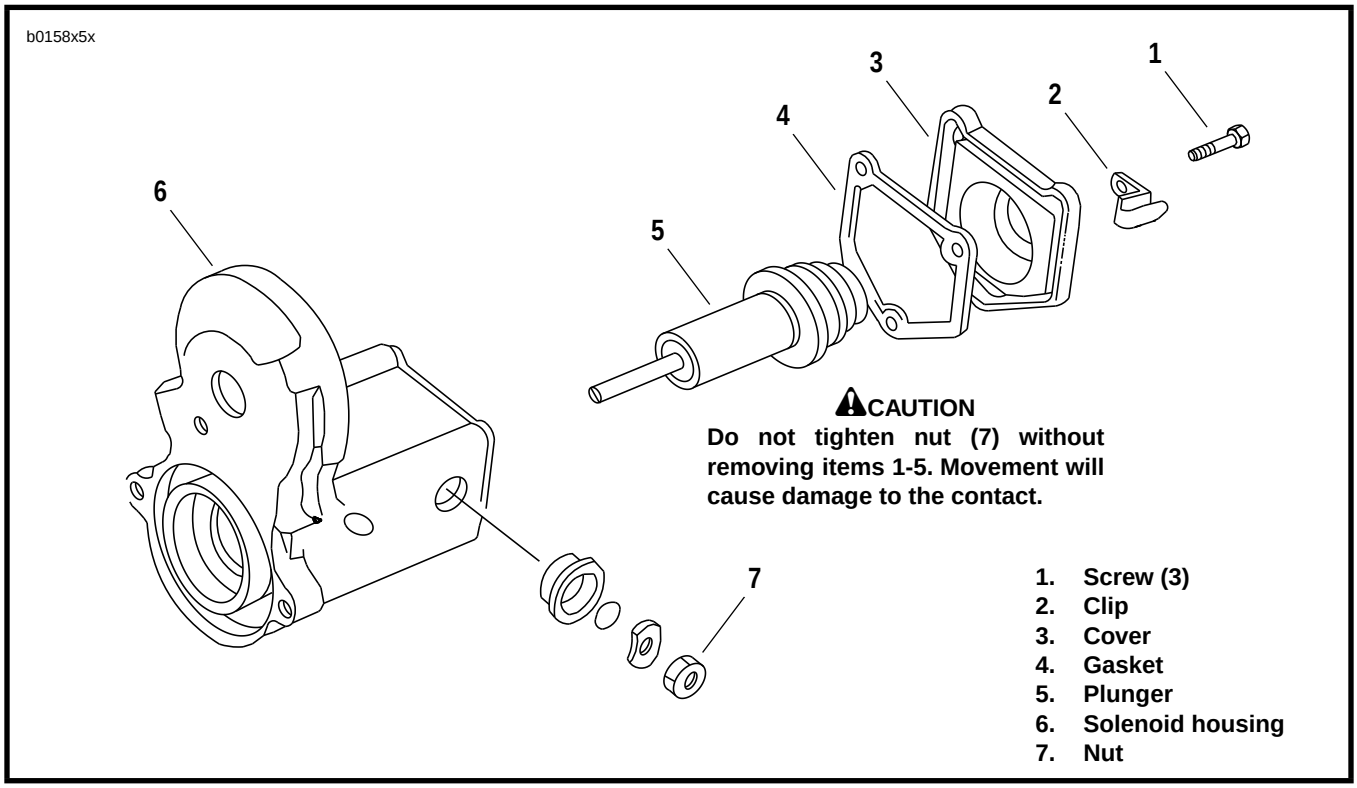


Figure 5-25. Starter Solenoid

SPECIFICATIONS

TRANSMISSION		
Transmission Type	5 forward speed, foot shift	
Clutch Type	Wet – multiple disc	
Clutch fluid capacity	1.0 quart	0.95 liter
Fluid part no.-quart	98854-96	
Fluid part no.-gallon	98855-96	

PRIMARY DRIVE (ENGINE-TO-TRANSMISSION)	
Engine sprocket	35 teeth
Clutch sprocket	56 teeth
Ratio	1.60: 1

TRANSMISSION GEAR RATIOS	FINAL*	OVERALL**
First (Low) Gear	2.69	9.717
Second Gear	1.97	7.118
Third Gear	1.43	5.180
Fourth Gear	1.18	4.269
Fifth (High) Gear	1.00	3.615

*Final gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.
**Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

FINAL DRIVE (TRANSMISSION-TO-REAR WHEEL)	
Transmission sprocket	27 teeth
Rear wheel sprocket	61 teeth
Secondary drive belt	128 teeth
Ratio	2.26:1

CLUTCH PLATE THICKNESS	NUMBER REQUIRED	NEW COMPONENTS		SERVICE WEAR LIMITS	
		IN.	MM	IN.	MM
Friction plate (fiber)	8	0.0866 + 0.0031	2.200 + 0.079	0.006	0.15
Steel plate	6	0.0629 + 0.0020	1.598 + 0.051	0.006	0.15
Clutch pack				0.661 minimum	16.79 minimum

NOTE

*Service wear limits are given as a guideline for measuring components that are not **new**. For measurement specifications not given under SERVICE WEAR LIMITS, see NEW COMPONENTS.*

ITEM	TORQUE		NOTES
Access door mounting bolts	13-17 ft-lbs	18-23 Nm	LOCTITE THREADLOCKER 242 (blue), page 6-30
Clutch inspection cover TORX screws with washers	7-9 ft-lbs	9-12 Nm	page 6-3
Clutch mainshaft nut	70-80 ft-lbs	95-108 Nm	LOCTITE THREADLOCKER 262 (red), left hand threads, page 6-13
Countershaft retainer TORX screw	13-17 ft-lbs	18-23 Nm	LOCTITE THREADLOCKER 242 (blue), page 6-25
Engine sprocket nut	150-165 ft-lbs	203-224 Nm	LOCTITE THREADLOCKER 262 (red), page 6-13
Isolator bolts	100-110 ft-lbs	135.6-149.1 Nm	LOCTITE THREADLOCKER 262 (red), page 6-7
Primary chain adjuster locknut	10-12 ft-lbs	14-16 Nm	on interior of chaincase, page 6-4
Primary chain adjuster locknut	20-25 ft-lbs	27-34 Nm	on exterior of chaincase, page 6-4
Primary chain inspection cover screws	40-60 **in-lbs**	4.5-6.8 Nm	page 6-3
Primary cover bolts	80-110 **in-lbs**	9.0-12.4 Nm	3 lengths, page 6-5
Rear shock mounting bolts	40-45 ft-lbs	47.5-61.0 Nm	metric, page 6-7
Shift lever pinch screw	100-120 **in-lbs**	11.3-13.6 Nm	page 6-5
Shifter shaft assembly nuts	90-110 **in-lbs**	10.2-12.4 Nm	same torque for top and bottom nuts, page 6-30
Tie bar bolts	30-33 ft-lbs	40.7-44.7 Nm	page 6-7
Transmission detent plate nut	13-17 ft-lbs	18-23 Nm	page 6-19
Transmission drain plug	14-21 ft-lbs	19-28 Nm	page 6-5
Transmission sprocket nut	See note		LOCTITE THREADLOCKER 262 (red), left hand threads, special torque turn method, page 6-30
Transmission sprocket screws	90-110 **in-lbs**	10.2-12.4 Nm	replace after 3 removals, page 6-31

PRIMARY CHAIN

GENERAL

An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both compartments.

Since the primary chain runs in lubricant, little service will be required other than checking lubricant level and chain tension. If, through hard usage, the primary chain does become worn, it must be replaced. Remove and install the chain following the procedure under PRIMARY DRIVE/CLUTCH, REMOVAL on page 6-10.

ADJUSTMENT/LUBRICATION

See PRIMARY CHAIN in Section 1 for inspection and adjustment procedures.

See CLUTCH, TRANSMISSION FLUID in Section 1 for complete lubrication service on the primary chain.

REMOVAL

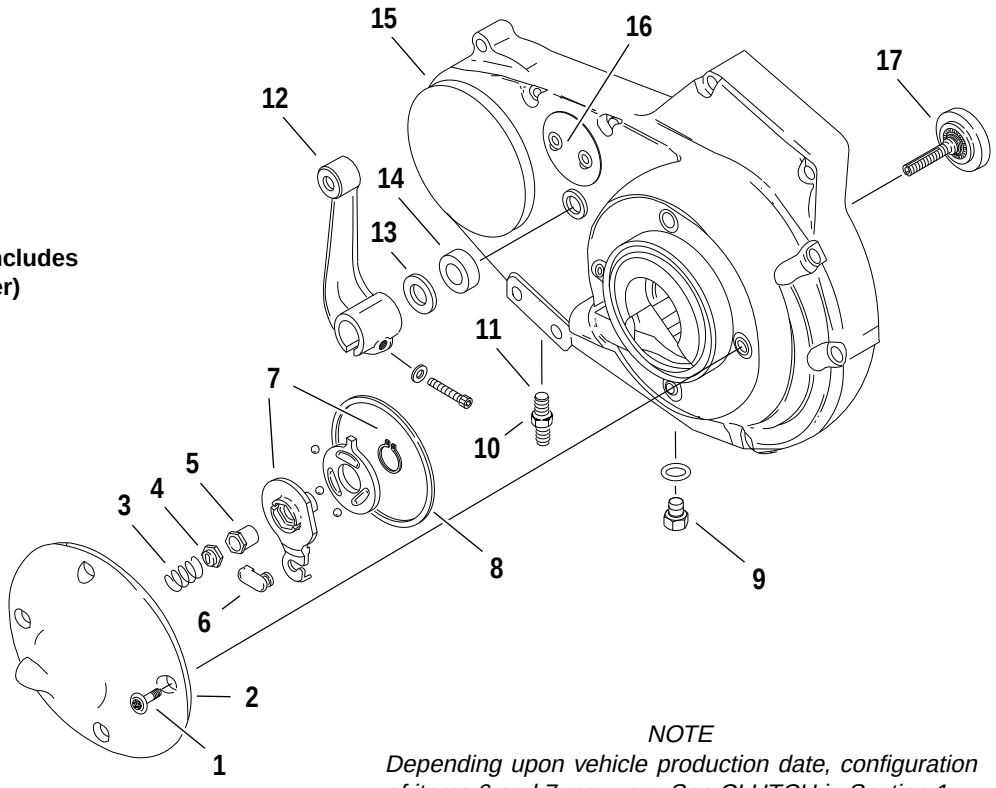
Primary Cover

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove muffler. See EXHAUST SYSTEM in Section 2.
3. See Figure 6-1. Place a drain pan under the engine. Remove drain plug (9) and drain lubricant from primary drive.
4. Remove shift lever assembly (12) and rubber washer (13). Do not to scratch primary cover (15).
5. Add freeplay to clutch cable. See CLUTCH in Section 1.

1. **TORX screw with washers (4)**
2. **Clutch inspection cover**
3. **Spring**
4. **Lockplate**
5. **Nut**
6. **Coupling**
7. **Ramp assembly**
8. **Quad ring**
9. **Drain plug**
10. **Locknut**
11. **Chain adjuster screw**
12. **Shift lever assembly (includes pinch screw and washer)**
13. **Rubber washer**
14. **Oil seal**
15. **Primary cover**
16. **Primary chain inspection cover**
17. **Clutch adjusting screw**



NOTE

Depending upon vehicle production date, configuration of items 6 and 7 may vary. See CLUTCH in Section 1.

Figure 6-1. Primary cover

6. Loosen locknut (10). Turn chain adjuster screw (11) counterclockwise (outward) to relax primary chain tension.

7. Remove four TORX screws with washers (1) and clutch inspection cover (2). Remove and discard Quad ring (2) from groove in primary cover.

8. Slide spring (3) with attached hex lockplate (4) from flats of clutch adjusting screw (17).

9. Turn clutch adjusting screw (17) clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly (7) moves forward. Unscrew nut (5) from end of adjusting screw.

10. Remove hook of ramp from button to the rear of cable end coupling (6). Remove cable end from slot in coupling. Remove coupling and ramp assembly.

11. Remove screws which secure primary cover. Remove cover and gasket. Discard gasket.

12. Remove and discard shift lever oil seal (14).

Primary Chain Adjuster

1. See Figure 6-2. Remove primary cover (1).

2. Remove locknut (2) from chain adjuster screw (3). Turn adjuster screw out of threaded boss in primary cover.

3. Slide shoe (6) off plate (5) (shoe must be slid off plate toward closed or blind side of shoe). Remove locknut (4) and plate (5).

INSTALLATION

Primary Chain Adjuster

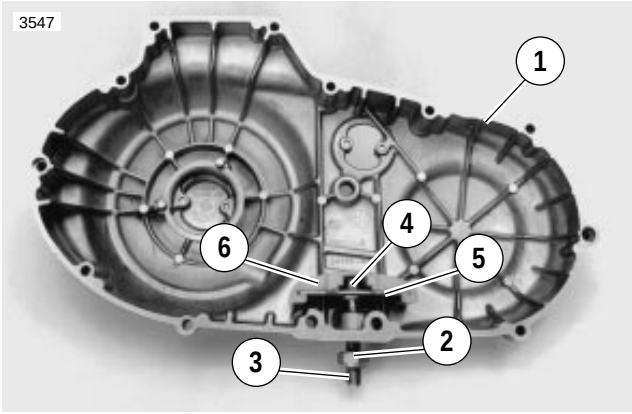
1. See Figure 6-3. If shoe (6) is badly worn, replace it or adjust assembly.

2. Install plate (5) over top of chain adjuster screw (3). Place spacer (7) over top of adjuster screw next to plate. Secure plate and spacer to adjuster screw by threading on locknut (4). Tighten locknut to 10-12 ft-lbs (14-16 Nm).

3. Place plate into slots at open end of shoe (6). Slide shoe over plate until locknut at top end of adjuster screw is against closed (blind) side of shoe.

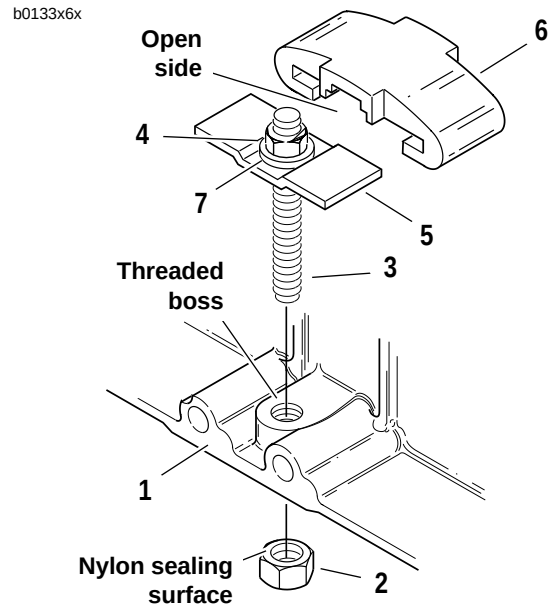
4. Position adjuster inside primary cover (1) with closed side of shoe against cover. Thread adjuster screw into tapped boss at bottom of primary cover. At outside of cover, install locknut (2) onto adjuster screw with nylon sealing surface toward cover.

5. Install primary cover.



1.	**Primary cover**	**4.**	**Locknut (interior)**
2.	**Locknut (exterior)**	**5.**	**Plate**
3.	**Chain adjuster screw**	**6.**	**Shoe**

Figure 6-2. Removing Primary Chain Adjuster



1.	**Primary cover**	**5.**	**Plate**
2.	**Locknut (exterior)**	**6.**	**Shoe**
3.	**Chain adjuster screw**	**7.**	**Spacer**
4.	**Locknut (interior)**		

Figure 6-3. Primary Chain Adjuster

Primary Cover

1. Remove foreign material from magnetic drain plug. Install plug and tighten to 14-21 ft-lbs (19-28 Nm).

2. Wipe gasket surface clean. Install **new** gasket on primary cover.

3. See Figure 6-4. Install primary cover and gasket onto left crankcase half using mounting bolts. Tighten bolts to 80-110 **in-lbs** (9.0-12.4 Nm).

4. See Figure 6-1. Install **new** shift lever oil seal (14).

5. Fit coupling (6) over clutch cable end. Place hook of ramp (7) around coupling button and rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover.

6. Thread nut (5) on adjusting screw (17) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counterclockwise.

7. Fill transmission to proper level with fresh lubricant. See CLUTCH, TRANSMISSION FLUID in Section 1.

8. Adjust clutch. See CLUTCH, ADJUSTMENT in Section 1.

9. Adjust primary chain tension. See PRIMARY CHAIN, ADJUSTMENT in Section 1.

10. Install rubber washer (13) and shift lever assembly (12). Shift lever must bisect primary chain inspection cover. See Figure 6-5. Tighten pinch screw to 100-120 **in-lbs** (11.3-13.6 Nm).

11. Install muffler. See EXHAUST SYSTEM in Section 2.

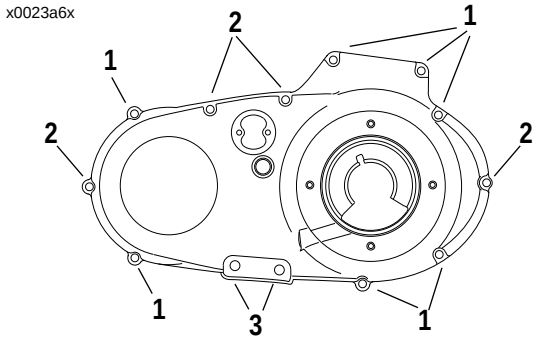
⚠WARNING

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 producing personal injury.

⚠CAUTION

Hold battery cable when tightening battery terminal hardware. Failure to hold cable may cause battery damage.

12. Connect battery cables, positive cable first.



1. 1/4-20 x 1-3/4 in. bolt with washers (7)
2. 1/4-20 x 2-1/4 in. bolt with washers (4)
3. 5/16-18 x 3-1/2 in. bolt with washers (2)

Figure 6-4. Install Primary Cover Bolts

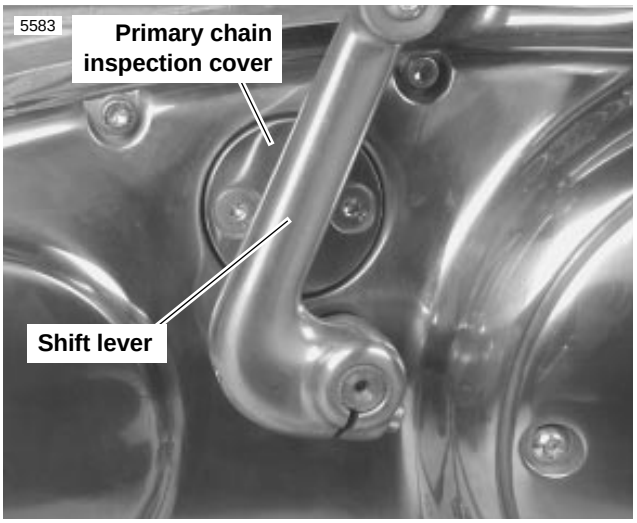


Figure 6-5. Shift Lever

SECONDARY DRIVE BELT

GENERAL

The secondary drive belt should be checked for unusual wear, cracking or loss of teeth. Check the belt sprocket for unusual wear, broken teeth or damaged flange.

See REAR BELT DEFLECTION in Section 1 for inspection, adjustment and cleaning procedures.

REMOVAL

Belt removal requires special lifts to support the motorcycle. If you do not have the proper equipment, have your Buell dealer perform the repair.

1. Lift and secure the motorcycle.
   a. Place vehicle on a lift and anchor front wheel in place.
   b. Raise rear wheel off lift using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Drain oil tank. See ENGINE LUBRICATION SYSTEM in Section 1.

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

⚠CAUTION

Hold battery cable when loosening battery terminal hardware. Failure to hold cable may cause battery damage.

3. Disconnect **both** battery cables, negative cable first.
4. Remove rear fender. See FENDERS in Section 2.
5. Remove rear caliper. See REAR BRAKE CALIPER, REMOVAL/DISASSEMBLY in Section 2.
6. Remove lower belt guard and sprocket cover. See SPROCKET COVER and FENDERS in Section 2.
7. Remove seat, fuel tank and tail section. See TAIL SECTION, REMOVAL in Section 2.
8. Remove air cleaner assembly. See AIR CLEANER, REMOVAL in Section 4.
9. Detach belt from rear sprocket.
   a. Loosen rear axle nut (metric).
   b. Loosen both rear axle adjuster nuts on swingarm.
   c. Slide wheel forward.
   d. Remove belt from rear sprocket.
10. Remove both rider footrests from frame.
11. See Figure 6-6. Place a floor hoist behind the lift. Attach straps to frame and hoist. Raise hoist until straps tighten.
12. Remove rear shock mounting bolt (metric) from swingarm. Allow rear shock to hang from front mount.

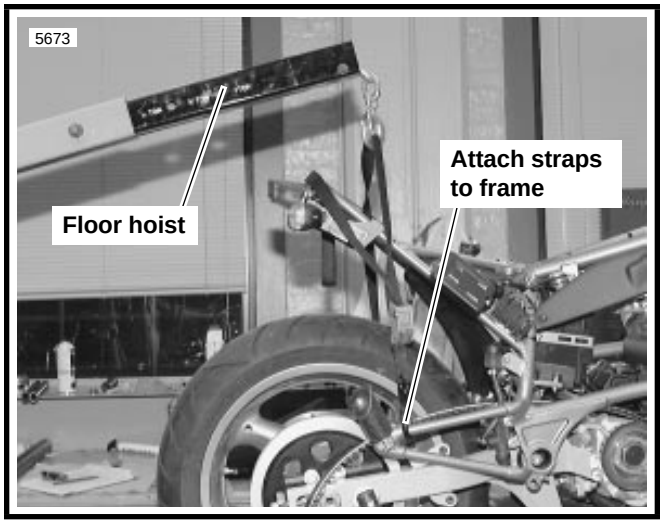


Figure 6-6. Floor Hoist

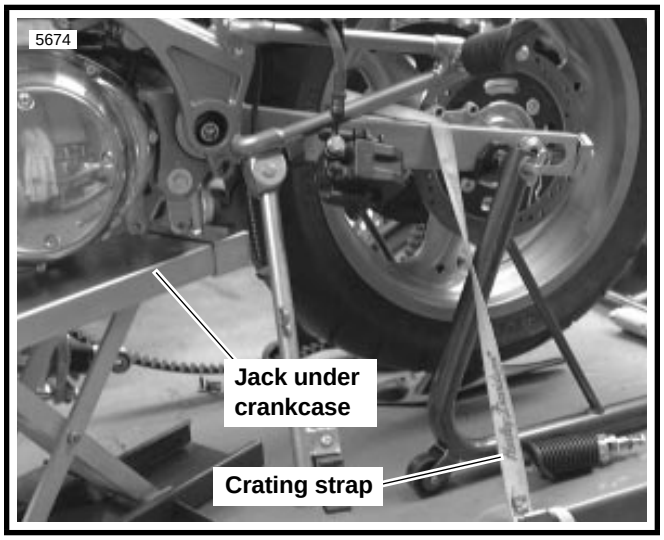


Figure 6-7. Crating Strap

13. Remove muffler and exhaust header. See EXHAUST SYSTEM in Section 2.
14. Detach feed, vent and return hoses from oil tank.
15. See Figure 6-7. Place a jack underneath the rear swingarm and underneath the front of the crankcase.
16. Place a crating strap over swingarm and around lift. Tighten crating strap until snug.
17. Detach tie bars from frame mounts in the following sequence. Do not remove tie bars from engine.
    a. Rear tie bar. Use a swivel socket.
    b. Top tie bar.
    c. Front tie bar and clutch cable clamp.
18. Remove isolator bolts and washers on each side.

19. Slowly raise floor hoist until rubber isolators can be removed. Frame will rise while swingarm and engine remain secured to lift by crating strap.

NOTE

Rubber isolators align with a frame mounted metal pin.

20. Remove belt through gap between frame and swingarm mount block.

INSTALLATION

1. Install **new** belt over sprockets.
2. Install rubber isolators.
   a. Align metal pin on frame with hole in isolator.
   b. Slowly lower floor hoist to drop frame and isolators around swingarm mount block.

NOTE

If isolator fit is troublesome, place a flat tool such a disposable putty knife between swingarm mount block and isolator. As frame lowers, withdraw tool when edge of isolator slides around edge of mount block.

3. Apply LOCTITE THREADLOCKER 262 (red) to isolator bolts. Install isolator bolts and washers through isolators and into swingarm mount block. Tighten bolts to 100-110 ft-lbs (135.6-149.1 Nm).
4. Attach tie bars to frame in the following order.
   a. Place clutch cable clamp on front tie bar bolt. Clamp should hold cable on air cleaner side of motor. Insert bolt from front through frame and tie bar. Fasten with flat washer and nut. Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
   b. Insert bolt through top tie bar, washer, spacer and frame tab. Secure with locknut. Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
   c. Rear tie bar must be horizontal and below frame tab. Insert bolt upwards through tie bar and frame. Fasten with nut. Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
5. Remove crating strap from lift and swingarm.
6. Remove jacks from underneath swingarm and crankcase.
7. Attach rear shock to swingarm with bolt (metric) and nut. Tighten to 40-45 ft-lbs (47.5-61.0 Nm).
8. Remove floor hoist straps from frame.
9. Connect and fill lubrication system. See ENGINE LUBRICATION SYSTEM in Section 1.
10. Install muffer and exhaust header. See EXHAUST SYSTEM in Section 2.
11. Align belt and rear wheel. See REAR BELT DEFLECTION in Section 1.
12. Install rider footrests. See FOOTRESTS, INSTALLATION in Section 2.
13. Install air cleaner. See AIR CLEANER, INSTALLATION in Section 4.
14. Install sprocket cover and rear belt guard. See SPROCKET COVER and FENDERS in Section 2.
15. Install rear fender. See FENDERS, REMOVAL/INSTALLATION in Section 2.
16. Install rear caliper. See REAR BRAKE CALIPER, INSTALLATION in Section 2.

⚠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 and personal injury.

17. Install tail section, fuel tank and seat. See TAIL SECTION, INSTALLATION in Section 2.

⚠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 resulting in personal injury.

⚠CAUTION

Hold battery cable when tightening battery terminal hardware. Failure to hold cable may cause battery damage.

18. Connect **both** battery cables, positive cable first.
19. Perform the following tests.
   a. Check license plate lamp illumination.
   b. Check oil level after starting vehicle and allowing motorcycle to reach normal operating temperature.
20. Remove supports.
   a. Remove REAR WHEEL SUPPORT STAND.
   b. Free front wheel and remove motorcycle from lift.

CLUTCH

GENERAL

See Figure 6-9. The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping and shifting gears.

The clutch is a wet, multiple-disc clutch with six steel plates (19), one spring plate (20), and eight fiber (friction) plates (18) stacked alternately in the clutch shell (26). The order of plate assembly, from inboard to outboard, is as follows:

F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

(F = Friction plate, St = Steel plate, **Sp** = Spring plate)

The friction plates (clutch driving plates) are keyed to the clutch shell (26), which is driven by the engine through the primary chain. The steel plates (clutch driven plates) and the centrally located spring plate (also a clutch driven plate) are keyed to the clutch hub (23), which drives the rear wheel through the transmission and secondary drive belt.

When the clutch is engaged (clutch lever released), the diaphragm spring (11) applies strong inward force against the pressure plate (17); the pressure plate then presses the clutch plates (18, 19 and 20) together, allowing no slippage between the plates and causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell (26) is fully transmitted through the “locked” clutch plates to the clutch hub (23). As long as the transmission is set in a forward gear, power from the engine will be transmitted to the rear wheel.

When the clutch is disengaged (clutch lever pulled to left handlebar grip), the pressure plate (17) is pulled outward (by clutch cable action) against the diaphragm spring (11), thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates (18, 19 and 20) together. The friction plates (18) are now free to rotate at a different relative speed than that of the steel and spring plates (19, 20) (i.e. – slippage between the clutch plates occurs). The result is that the rotational force of the clutch shell (26) is no longer fully transmitted through the “unlocked” clutch plates to the clutch hub (23). The engine is free to rotate at a different speed than the rear wheel.

Table 6-1. Clutch Troubleshooting

SYMPTOM	CAUSE (CHECK IN FOLLOWING ORDER)	REMEDY
Clutch slips.	Incorrect clutch release adjustment. Worn clutch plates.	Check and adjust clutch release mechanism. Check service wear limits. Replace plates.
Clutch drags.	Incorrect clutch release adjustment. Worn clutch release ramps or balls. Warped clutch steel plates. Blade worn or damaged clutch gear splines. Overfilled primary.	Check and adjust clutch release mechanism. Replace release ramps and/or balls. Replace clutch steel plates. Replace clutch gear or hub as required. Drain lubricant to correct level.

CLUTCH RELEASE MECHANISM

ADJUSTMENT

See CLUTCH, ADJUSTMENT in Section 1.

DISASSEMBLY

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

1. Pull clutch cable ferrule (end of cable housing) away from clutch hand lever bracket. Gap between ferrule and bracket should be 1/16-1/8 (1.6-3.2 mm). Adjust freeplay by turning cable adjuster.
2. See Figure 6-8. Remove four TORX screws with washers (1) and clutch inspection cover (2).
3. Slide spring (3) with attached screw lockplate (4) from flats of adjusting screw (12).
4. Turn adjusting screw (12) clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (5) from end of adjusting screw.
5. Remove hook of ramp from cable end coupling (16). Remove cable end (10) from slot in coupling.
6. Remove retaining ring (13) from ramp assembly to separate inner and outer halves. Remove three balls (7) from ramp sockets.

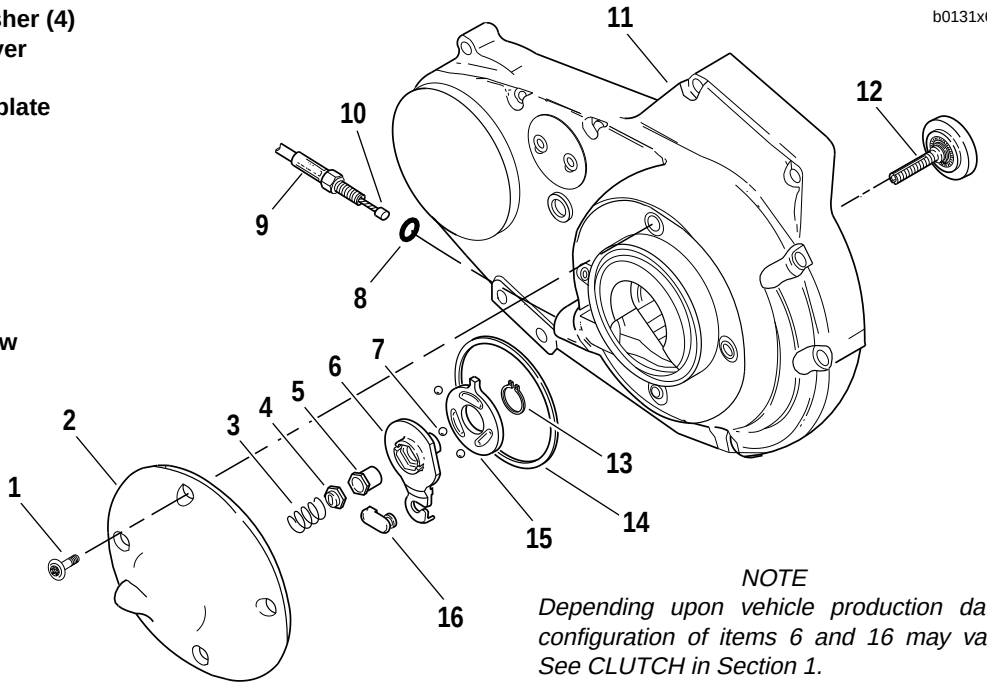
CLEANING, INSPECTION AND REPAIR

1. Thoroughly clean all parts in cleaning solvent.
2. See Figure 6-8. Inspect three balls (7) of release mechanism and ball socket surfaces of inner and outer ramps for wear, pitting, surface breakdown and other damage. Replace parts as necessary.
3. Check hub fit of inner (15) and outer (6) ramps. Replace ramps if excessively worn.
4. Check clutch cable for frayed or worn ends. Replace cable if damaged or worn.
5. Change or add transmission fluid if necessary. See CLUTCH, TRANSMISSION FLUID in Section 1.

ASSEMBLY

1. See Figure 6-8. Apply multi-purpose grease to balls (7) and ramps (6, 15). Insert balls in sockets of outer ramp. Install inner ramp on hub of outer ramp with tang 180° from hook of outer ramp. Install retaining ring in groove of outer ramp hub.
2. Fit coupling (16) over cable end. Place hook of ramp around coupling button and rotate assembly counterclockwise until tang on inner ramp fits in slot of primary cover (11).
3. Thread nut (5) on adjusting screw (12) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counterclockwise until resistance is felt.
4. Adjust clutch release mechanism. See CLUTCH, ADJUSTMENT in Section 1.

1. **TORX screw with washer (4)**
2. **Clutch inspection cover**
3. **Spring**
4. **Adjusting screw lockplate**
5. **Nut**
6. **Outer ramp**
7. **Ball (3)**
8. **O-ring**
9. **Cable end fitting**
10. **Clutch cable end**
11. **Primary cover**
12. **Clutch adjusting screw assembly**
13. **Retaining ring**
14. **Quad ring**
15. **Inner ramp**
16. **Coupling**



NOTE
Depending upon vehicle production date, configuration of items 6 and 16 may vary. See CLUTCH in Section 1.

Figure 6-8. Clutch Release Mechanism

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Always disconnect the negative cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion producing personal injury.

NOTE

See Figure 6-9. If replacement of clutch pack (friction plates [18], steel plates [19], and spring plate [20]) is the only service work to be performed, perform REMOVAL Step 1 only, and then proceed to DISASSEMBLY, NOTE.

1. Remove primary cover. See PRIMARY CHAIN on page 6-3.
2. Install SPROCKET LOCKING LINK (Part No. HD-38362). Remove the engine sprocket nut. Loosen, but do not remove, engine sprocket. If necessary, use the slotted portion of TWO CLAW PULLER (Part No. HD-97292-61) and two bolts to loosen the engine sprocket.
3. Remove retaining ring (12). Remove adjusting screw assembly (13, 14, 15 and 16) from pressure plate (17).

⚠CAUTION

Clutch hub nut (21) has left-hand threads. To prevent damage, turn nut clockwise to loosen and remove from mainshaft.

4. Remove nut (21) and washer (22). Remove the clutch assembly, primary chain, and engine sprocket as an assembly from the vehicle.
5. If primary chain is damaged or excessively worn, remove it from engine sprocket and clutch assembly; replace original primary chain with a **new** one.

DISASSEMBLY

NOTE

See Figure 6-9. If replacement of clutch pack (friction plates [18], steel plates [19], and spring plate [20]) is the only service work to be performed, perform DISASSEMBLY Steps 2, 3, 4, 5 and 7 only, and then proceed to INSPECTION AND REPAIR, NOTE. ***Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.***

1. See Figure 6-9. With clutch assembly removed from primary chaincase, reinstall adjusting screw assembly (13, 14, 15 and 16) into pressure plate (17), noting that two tabs on perimeter of release plate (13) must be inserted into corresponding recesses in pressure plate (17). Secure the adjusting screw assembly with retaining ring (12).

⚠WARNING

See Figure 6-10. Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL (Part No. HD-38515-A), CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) and proper eye protection. Otherwise, the highly compressed diaphragm spring could fly out with great force, possibly causing personal injury.

2. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-10.) onto the clutch adjusting screw (item 16, Figure 6-9.) Place the bridge (item 2, Figure 6-10.) of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring (item 10, Figure 6-9.) Thread the tool handle (item 3, Figure 6-10.) onto end of forcing screw.

⚠CAUTION

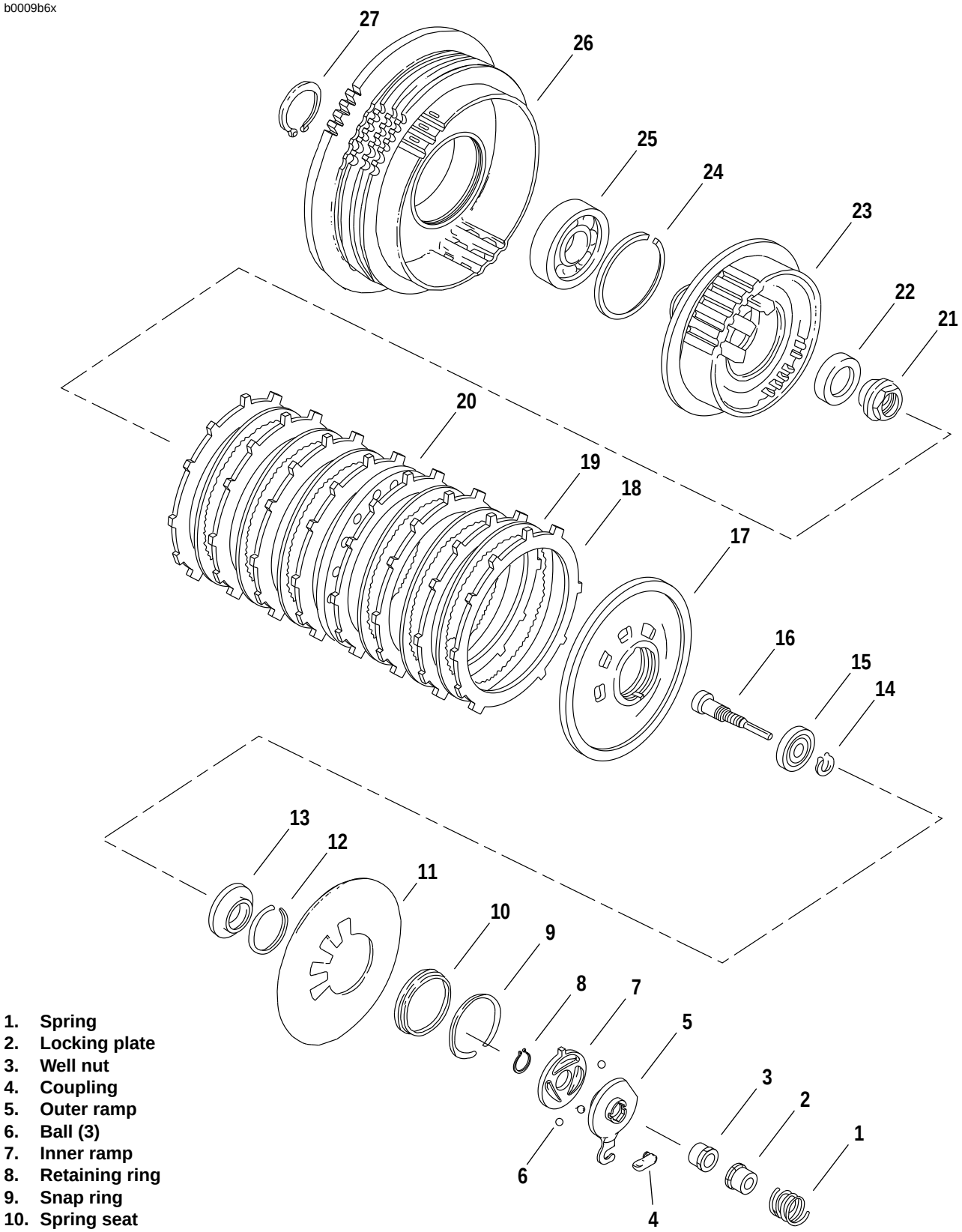
See Figure 6-9. Turn compressing tool handle only the amount required to remove spring seat (10) and snap ring (9). Excessive compression of diaphragm spring could damage clutch pressure plate.

3. See Figure 6-10. With a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning, turn handle clockwise until tool relieves pressure on snap ring (9) and spring seat (10).
4. Remove snap ring (9) and spring seat (10) from the groove in clutch hub (23) prongs. Remove the assembly of diaphragm spring (11), pressure plate (17), adjusting screw components, and compressing tool.
5. Turn the compressing tool handle counterclockwise until the clutch spring forcing screw disconnects from the clutch adjusting screw (16). Remove snap ring (9), spring seat (10), and diaphragm spring (11) from pressure plate (17) assembly.
6. Remove retaining ring (12) and adjusting screw assembly (13, 14, 15 and 16) from pressure plate (17). If necessary, disassemble adjusting screw assembly by removing retaining ring (14), and then separating the remaining adjusting screw components (13, 15 and 16).
7. Remove the clutch pack, which consists of eight friction plates (18), six steel plates (19), and a spring plate (20), from the clutch hub (23).

⚠CAUTION

Due to the possible damage to the bearing (25), the clutch hub (23) and shell (26) assembly should not be disassembled unless the bearing, hub, or shell require replacement. If the assembly is pressed apart, the bearing must be replaced.

8. Remove retaining ring (27) from inboard end of clutch hub (23). Using an arbor press, separate clutch hub (23) from assembly of clutch shell (26), bearing (25), and retaining ring (24).
9. Remove retaining ring (24) from groove in clutch shell (26). Press on the inboard side of bearing (25) outer race to remove bearing from clutch shell.

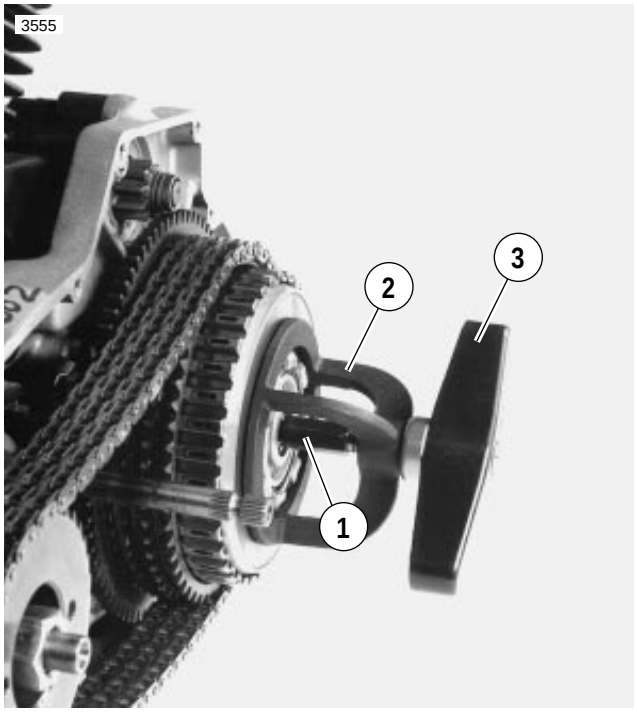


1. Spring
2. Locking plate
3. Well nut
4. Coupling
5. Outer ramp
6. Ball (3)
7. Inner ramp
8. Retaining ring
9. Snap ring
10. Spring seat
11. Diaphragm spring
12. Retaining ring
13. Release plate
14. Retaining ring
15. Bearing
16. Adjusting screw
17. Pressure plate
18. Friction plate (8)
19. Steel plate (6)
20. Spring plate
21. Mainshaft nut
22. Washer
23. Clutch hub
24. Retaining ring
25. Bearing
26. Clutch shell
27. Retaining ring

NOTE

Depending upon vehicle production date, configuration of items 4 and 5 may vary. See CLUTCH in Section 1.

Figure 6-9. Clutch Assembly



1. Clutch spring forcing screw **2. Bridge** **3. Tool handle**

Figure 6-10. Compressing Clutch Diaphragm Spring

INSPECTION/REPAIR

NOTE

If replacement of clutch pack (friction plates [18], steel plates [19], and spring plate [20]) is the only service work to be performed, perform all INSPECTION AND REPAIR steps (except Step 5), and then proceed to ASSEMBLY, NOTE.

See Figure 6-9. Wash all parts, except the friction (driven) plates (18) and bearing (25), in cleaning solvent. Blow dry with compressed air. Examine the clutch components as follows:

1. Check for worn lining surface.
2. Inspect for checked or chipped lining.
3. Inspect each steel (drive) plate (19) for grooves. Also, check each steel plate for flatness in several places using a feeler gauge; the plate must be placed on a surface plate or flat surface. Replace any plates that are damaged or that are warped more than 0.006 in. (0.15 mm).
4. Wipe the lubricant from the eight friction plates, and stack them on top of each other. Measure the thickness of the eight stacked friction plates with a dial caliper or micrometer. The minimum thickness must be 0.661 in. (16.79 mm). If the thickness is less than specified, the friction plates and steel plates must be discarded, and a **new** set of both friction and steel plates must be installed.
5. Check the bearing (25) for smoothness by rotating the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced.
6. Check the primary chain sprocket and the starter ring gear on the clutch shell (26). If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
7. Check the slots that mate with the clutch plates on both clutch shell and hub. If slots are worn or damaged, replace shell and/or hub.
8. Check the diaphragm spring (11) for cracks or bent tabs. Install a **new** spring if either condition exists.

ASSEMBLY

NOTE

See Figure 6-9. If replacement of clutch pack (friction plates [18], steel plates [19], and spring plate [20]) is the only service work to be performed, perform ASSEMBLY Steps 2, 5, 6, 7, and 8 only, and then proceed to INSTALLATION, NOTE. ***Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.***

1. See Figure 6-9. If the assembly of the clutch hub (23) and shell (26) was disassembled, press **new** bearing (25) in clutch shell; secure bearing with a **new** retaining ring (24). Press inboard end of clutch hub into shell bearing; secure with **new** retaining ring (27) on end of hub.
2. Install the clutch pack, which consists of eight friction plates (18), six steel plates (19), and a spring plate (20), into the clutch hub (23). The order of plate assembly, from inboard to outboard, is as follows:

F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

INBOARD.....OUTBOARD

F	=	Friction plate
St	=	Steel plate
Sp	=	Spring plate

If disassembled, assemble bearing (15) and adjusting screw (16) in release plate (13); secure with **new** retaining ring (14).

3. Install adjusting screw assembly (13, 14, 15 and 16) into pressure plate (17), noting that two tabs on perimeter of release plate (13) must be inserted into corresponding recesses in pressure plate (17). Secure the adjusting screw assembly with retaining ring (12).
4. Position diaphragm spring (11), with its concave side facing inboard (toward pressure plate), onto pressure plate (17) assembly. Position spring seat (10), with its flat, larger O.D. side facing inboard (toward diaphragm spring), and a **new** snap ring (9) onto convex (outboard) side of diaphragm spring (11).
5. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-10.) onto the clutch adjusting screw (item 16, Figure 6-9.). Place the bridge (item 2, Figure 6-10.) of SPRING COMPRESSING TOOL (Part No. HD-38515-A) against diaphragm spring (item 10, Figure 6-9.). Thread the tool handle (item 3, Figure 6-10.) onto end of forcing screw. Do not tighten compressing tool against diaphragm spring at this time.

6. See Figure 6-9. Align square openings of pressure plate (17) and diaphragm spring (11) so that the assembly can be installed over prongs of clutch hub (23). Place assembly of spring seat, snap ring, diaphragm spring, pressure plate, adjusting screw components, and compressing tool onto clutch hub (23), and against clutch pack.

⚠CAUTION

Turn compressing tool handle only the amount required to install spring seat (10) and snap ring (9). Excessive compression of diaphragm spring (11) could damage clutch pressure plate.

7. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning. Turn compressing tool handle clockwise until diaphragm spring (11) compresses just enough to install spring seat (10) and snap ring (9) into the groove in clutch hub (23) prongs. With snap ring positioned against flange face (outboard side) of spring seat, and fully seated in groove of clutch hub, carefully loosen and remove compression tool.

8. Remove retaining ring (12). Remove adjusting screw assembly (13, 14, 15 and 16) from pressure plate (17).

INSTALLATION

NOTE

See Figure 6-9.If replacement of clutch pack (friction plates [18], steel plates [19], and spring plate [20]) was the only service work performed, perform INSTALLATION Step 5 only.

1. Install the engine sprocket, clutch assembly, and primary chain as a unit into primary chaincase.

2. Install SPROCKET LOCKING LINK (Part No. HD-38362). Apply two or three drops of LOCTITE THREADLOCKER 262 (red) onto threads of sprocket shaft. Install the engine sprocket nut. Tighten nut to 150-165 ft-lbs (203-224 Nm).

⚠CAUTION

Washer (22) must be installed with the word “out” facing the mainshaft nut (21) or transmission may be damaged.

3. Apply two or three drops of LOCTITE THREADLOCKER 262 (red) onto threads on end of mainshaft. Install washer (22) and nut (21) **(left-hand threads)** on mainshaft. Tighten nut (21) to 70-80 ft-lbs (95-108 Nm).

4. Install adjusting screw assembly (13, 14, 15 and 16) in the pressure plate (17), noting that two tabs on perimeter of release plate (13) must be inserted into corresponding recesses in pressure plate (17). Secure assembly with a **new** retaining ring (12).

5. Install primary cover. See PRIMARY CHAIN on page 6-5.

⚠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 resulting in personal injury.

6. Connect battery cables, positive cable first.

TRANSMISSION

GENERAL

See Figure 6-11. The transmission is a five-speed constant-mesh type housed in an extension of the crankcase. The transmission permits the rider to vary the ratio of engine speed-to-rear driving wheel speed in order to meet the varying conditions of operation.

The transmission is foot-operated by the gear shifter lever, which transmits the force through a gear shifter shaft. The shifter shaft actuates a pawl and a shifter fork drum. The shifter fork drum moves shifter forks, which slide a series of shifter clutch gears, on the mainshaft and countershaft, into and out of mesh with the other gears.

LUBRICATION

Drain transmission and refill to correct level with fresh, clean lubricant at least once each year or every 5000 miles (8000 km), whichever comes first. For best results, drain lubricant while hot.

See CLUTCH, TRANSMISSION FLUID in Section 1 for more information.

XLH transpower flow

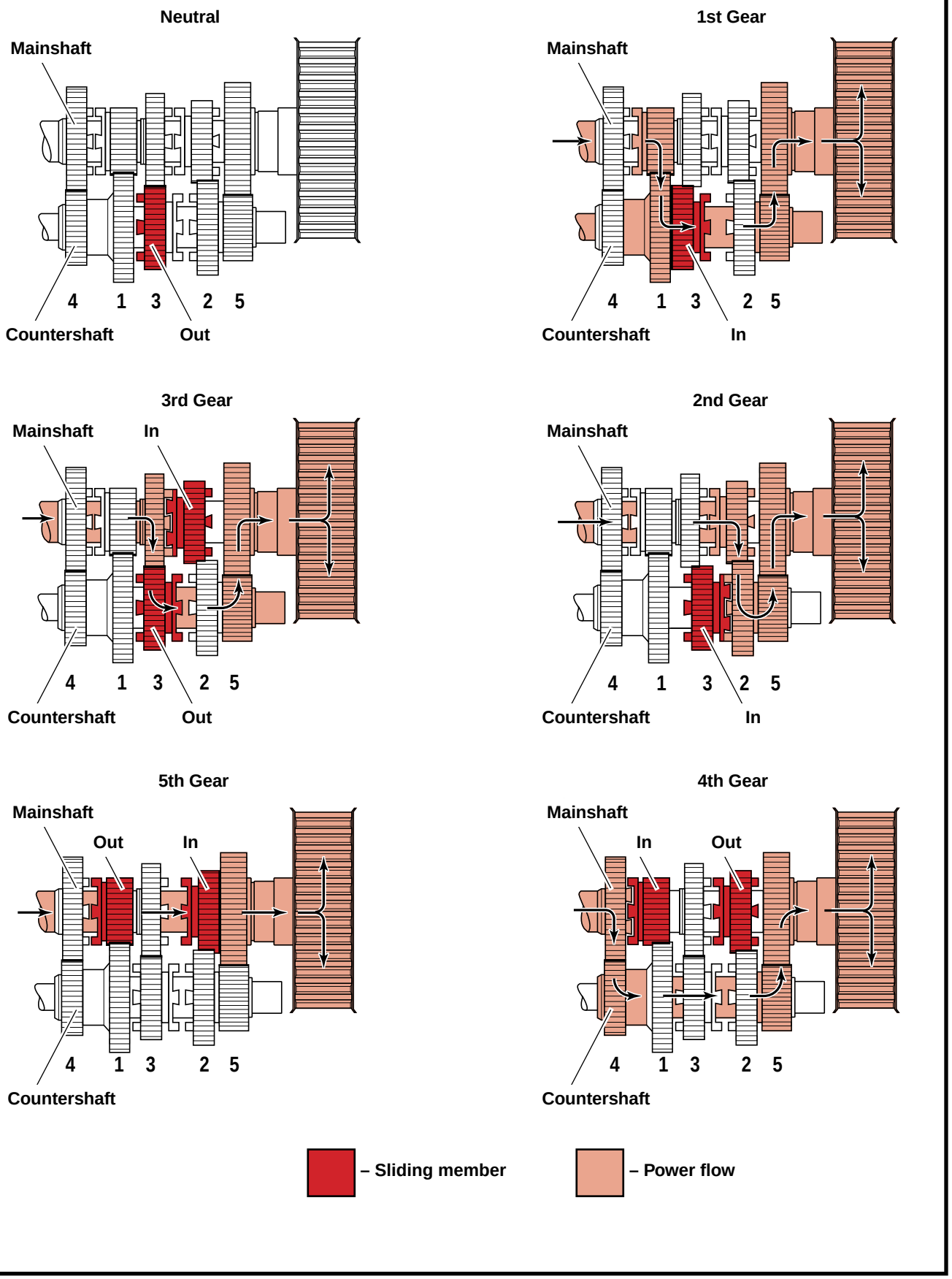


Figure 6-11. Transmission Power Flow

TRANSMISSION CASE

GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. An access cover (door) allows removal of transmission components without removing the engine or disassembling (splitting) the crankcase.

REMOVAL

1. Raise rear wheel off floor using REAR WHEEL SUPPORT STAND (Part No. B-41174).
2. Remove rear fender. See FENDERS in Section 2.
3. See Figure 6-12. Loosen rear axle nut (metric). Reduce tension on secondary drive belt by turning axle adjuster nuts on each side of swingarm an equal number of turns counterclockwise. Move rear wheel as far forward as possible.
4. Remove muffler. See EXHAUST SYSTEM in Section 2. Place a drain pan under the engine. Remove drain plug and drain lubricant from primary drive/transmission.
5. Remove swingarm/drive support screws and retaining nut. Remove sprocket cover, washer and spacer.
6. See Figure 6-13. Place transmission in first gear. Remove two socket head screws (5) and lockplate (4).

⚠CAUTION

Transmission sprocket nut has left-hand threads. To prevent damage, turn nut clockwise to loosen and remove from main drive gear shaft.

7. Remove transmission sprocket nut (3) from main drive gear shaft (1).
8. Remove secondary drive belt from transmission sprocket (2). Remove transmission sprocket from main drive gear shaft (1).
9. Remove primary cover. See PRIMARY CHAIN on page 6-3.
10. Remove clutch assembly, primary chain and engine sprocket. See PRIMARY DRIVE/CLUTCH on page 6-10.
11. See Figure 6-14. Lock transmission in gear. Remove countershaft TORX screw and retainer.
12. See Figure 6-15. Detach spring (1) from groove in post (2).
13. Remove retaining ring (10) and detent plate (9). You will need to use a **new** retaining ring for installation.
14. Remove two locknuts (3) and washers (11) which attach shifter shaft assembly (6) to studs at transmission case. Remove shifter shaft assembly.
15. Remove five access door bolts (7) and washers (8). Remove transmission assembly by pulling it straight outward, away from transmission case.

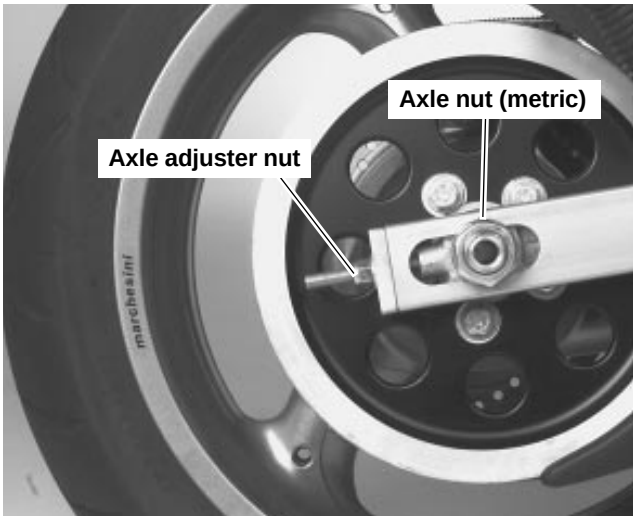
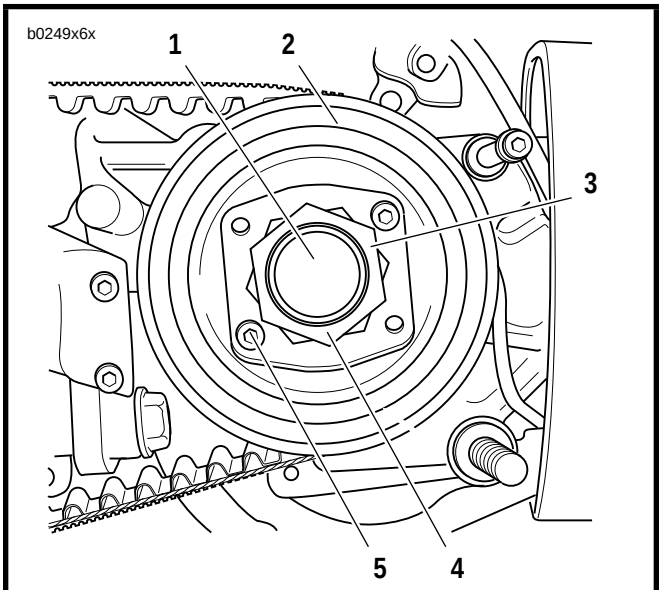


Figure 6-12. Secondary Drive Belt Adjustment



1. **Main drive gear shaft**
2. **Transmission sprocket**
3. **Transmission sprocket nut (left hand threads)**
4. **Lockplate**
5. **Socket head screw (2)**

Figure 6-13. Transmission Sprocket

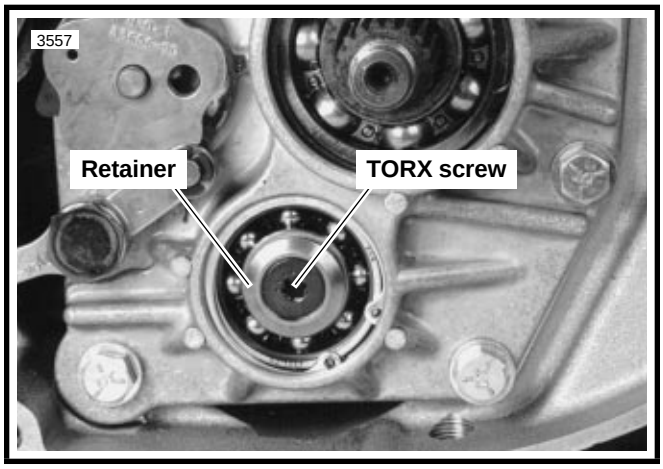


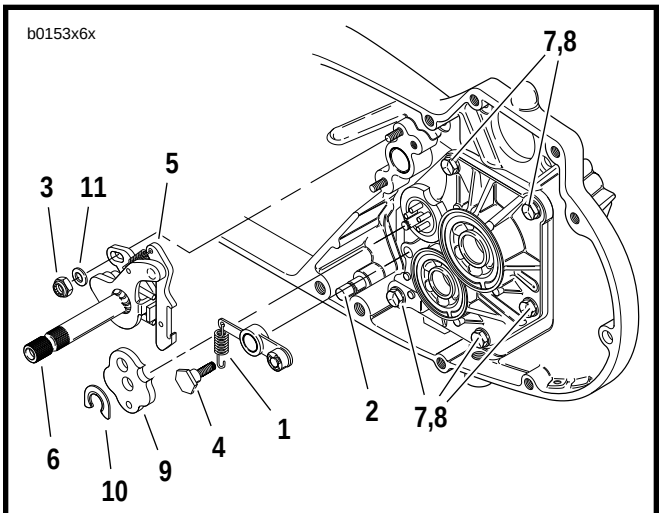
Figure 6-14. Countershaft Retainer

CLEANING, INSPECTION AND REPAIR

Thoroughly clean transmission compartment with cleaning solvent. Blow parts dry with compressed air. Inspect parts to determine if any must be replaced. Replace all parts that are badly worn or damaged.

Neutral Indicator Switch

See Figure 6-16. The neutral indicator switch is threaded into the transmission portion of the right crankcase half. See NEUTRAL INDICATOR SWITCH in Section 7 for testing, removal and installation procedures.



1. Spring
2. Post
3. Locknut (2)
4. Detent arm screw
5. Pawl
6. Shifter shaft assembly
7. Bolt (5)
8. Washer (5)
9. Detent plate
10. Retaining ring
11. Washer (2)

Figure 6-15. Shifter Shaft Assembly

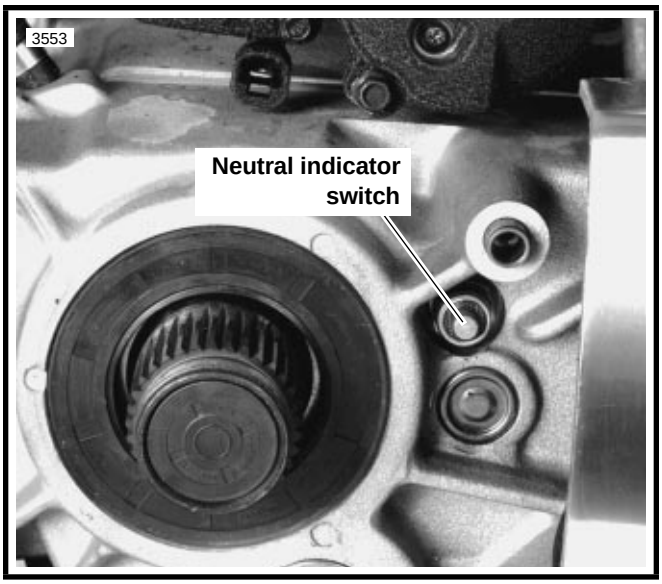
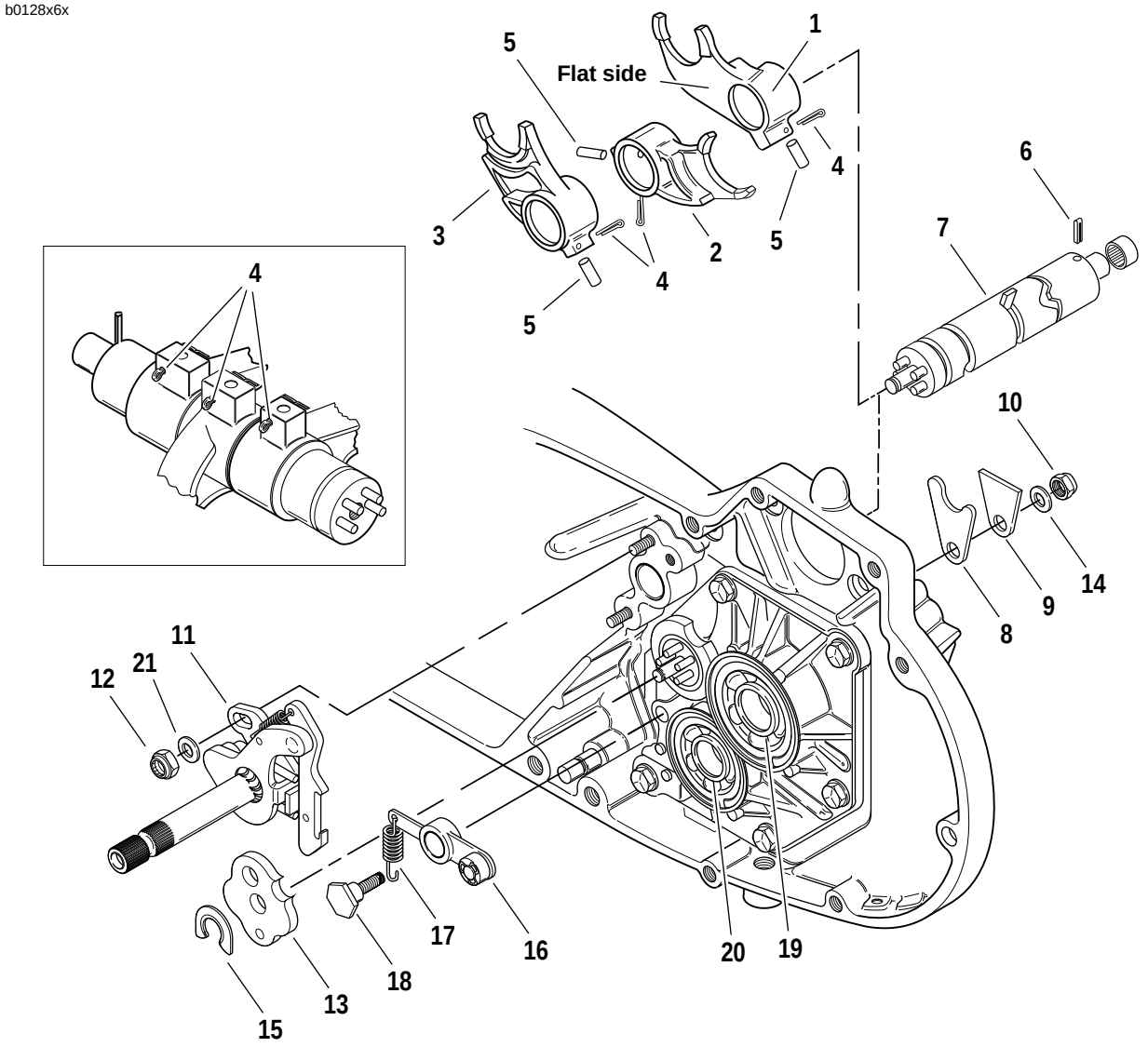


Figure 6-16. Neutral Indicator Switch

SHIFTER FORKS AND DRUM

DISASSEMBLY

1. Remove transmission assembly. See TRANSMISSION CASE, REMOVAL on page 6-16. Mount transmission assembly in vise with protected jaws.
2. See Figure 6-17. Remove nut (10), washer (14), screw (18), drum lock plates (8, 9), detent arm (16), and spring (17).
3. Remove and discard the three fork cotter pins (4).



1. Shifter fork 3rd and 5th gear	8. Plate, shifter drum locating	15. Bowed snap ring
2. Shifter fork 1st and 2nd gear	9. Plate, reinforcing	16. Detent arm
3. Shifter fork 4th gear	10. Nut (2)	17. Spring
4. Cotter pin	11. Shifter shaft assembly	18. Screw, detent
5. Pin, shifter fork	12. Nut	19. Bearing, mainshaft
6. Pin, neutral indicator	13. Plate, detent	20. Bearing countershaft
7. Shifter fork drum	14. Washer	21. Washer

Figure 6-17. Shifter Mechanism

4. Remove three shift fork pins (5). A small magnet is useful in freeing the fork pins (5).
5. Slide shifter drum (7) away from access door, through shifter forks. The neutral switch pin prevents removal in the other direction.
6. Remove shift forks (1, 2 and 3).

CLEANING, INSPECTION AND REPAIR

1. See Figure 6-17. Clean all parts except bearings (19, 20) with solvent.
2. Inspect bearings (19, 20) and shifter drum ends. If ends of shifter drum are pitted or grooved, replace the shifter drum and bearings. If replacing bearings, see ACCESS DOOR BEARINGS on page 6-28.
3. Inspect shifter drum (7) for cracks or wear. Replace if necessary.

ASSEMBLY

1. See Figure 6-18 for shifter fork identification. See Figure 6-17. Lubricate the shaft bore in fork (1) with SPORT-TRANS FLUID. Place 3rd and 5th gear shifter fork (1) in the fork groove of mainshaft 2nd gear. Be sure the flat side of fork is facing the access cover.

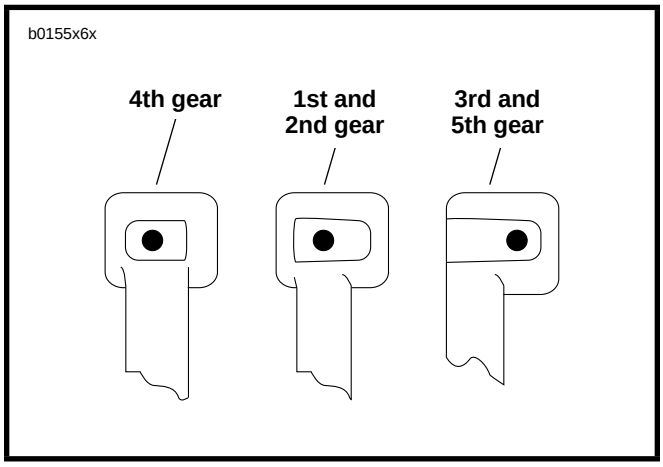


Figure 6-18. Shifter Fork Identification

2. Lubricate the shaft bore in fork (2) with SPORT-TRANS FLUID. Place 1st and 2nd gear shifter fork (2) in the fork groove of countershaft 3rd gear. Be sure the flat side of fork is facing away from the access door.
3. Lubricate the shaft bore in fork (3) with SPORT-TRANS FLUID. Place 4th gear shifter fork (3) in the fork groove of mainshaft 1st gear. Be sure the flat side of fork is facing away from the access door.
4. See Figure 6-17. Position the shifter drum shaft so that the neutral indicator switch activator pin (6) is upward. The shaft is then in the neutral position. Insert the pin end of drum shaft (7) through the hubs of shifter forks (1, 2 and 3) and through the bearing in access cover.

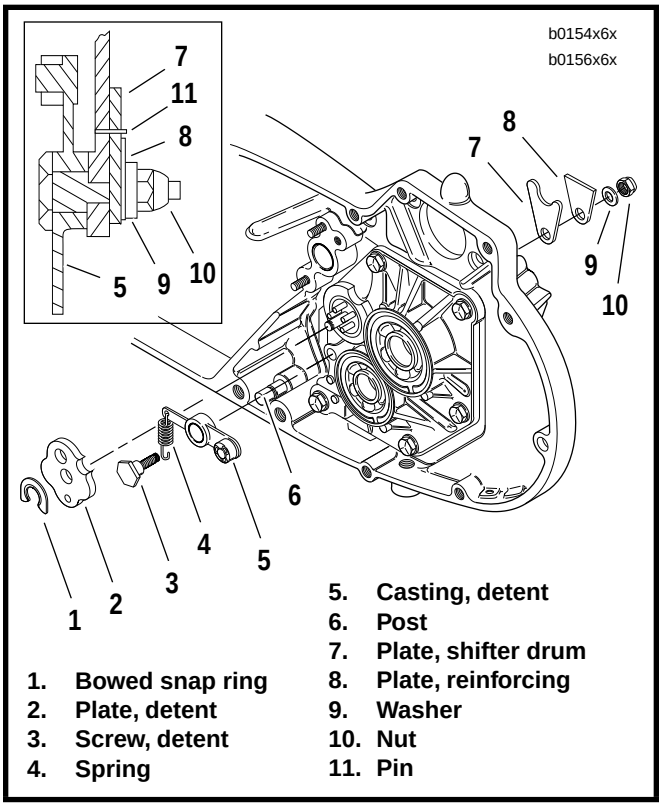


Figure 6-19. Detent Plate Mounting

5. Align the hole through the top of each shifter fork with the appropriate cam groove in the shifter drum. Lubricate pins (5) with SPORT-TRANS FLUID. Drop pins (5) through the holes in shifter forks. With a small screwdriver press on the pins while manipulating the forks back and forth until the pin seats in the drum groove. Secure pins in place with **new** cotter pins (4).

⚠CAUTION

The cotter pins must be inserted through the shifter forks as shown in the inset of Figure 6-17 to prevent possible damage to cotter pins (4).

NOTE

See Figure 6-19. Detent plate (2) and bowed snap ring (1) are not installed at this time. These parts are installed during transmission installation after the final shifter pawl adjustment is made. See TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT on page 6-30.

6. At the inside of the access door, place the shifter drum plate (7) in the groove of the drum shaft. See inset Figure 6-19. Take care to correctly align the drum plates (7) and (8) with the pin pressed in the drum plate. Take detent screw (3) and insert it through detent arm (5), access door, shift drum plate (7), drum reinforcement plate (8), and washer (9). Thread nut (10) on detent screw and tighten to 13-17 ft-lbs (18-23 Nm).

DISASSEMBLY

1. Remove transmission assembly. See TRANSMISSION CASE, REMOVAL on page 6-16. Remove shifter forks and drum as described under SHIFTER FORKS AND DRUM on page 6-18.

2. See Figure 6-20. Clamp transmission assembly in vise, with protective jaws, as shown, to work on disassembly.

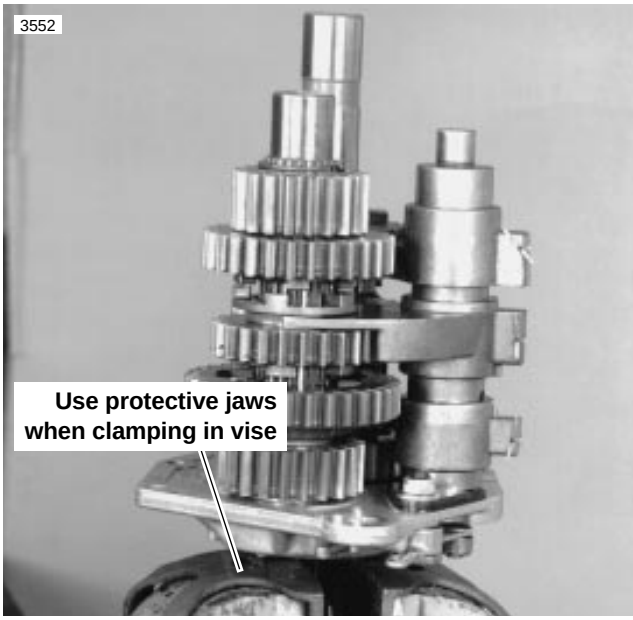


Figure 6-20.

NOTE

As the transmission runs, each part develops a certain wear pattern and a kind of "set" with its mating parts. For this reason, it is important that each component be reinstalled in its original location and facing its original direction.

3. See Figure 6-21. As each component is removed, place it on a clean surface in the exact order of removal.

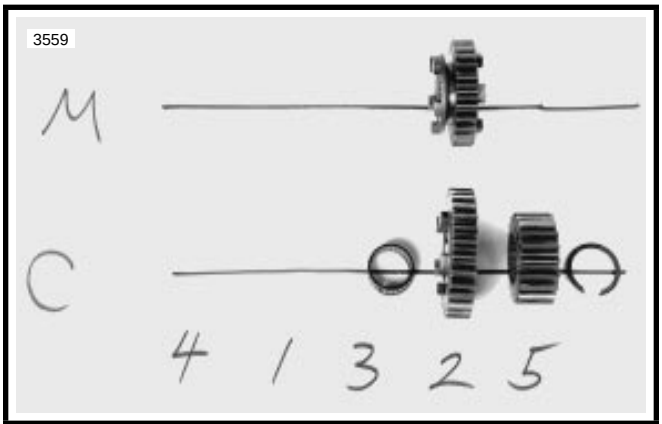


Figure 6-21.

See Figure 6-22. Using RETAINING RING PLIERS (Part No. J-5586) remove and discard retaining ring (5) next to countershaft 5th gear (12). Slide countershaft 5th (12), mainshaft 2nd (22) and countershaft 2nd (11) off end of shafts. Remove split bearing (7) that was under gear (11) and thrust washer (6) on the countershaft.

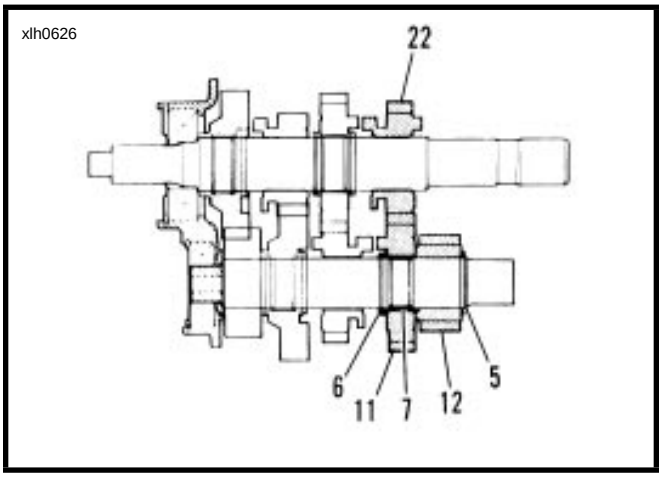
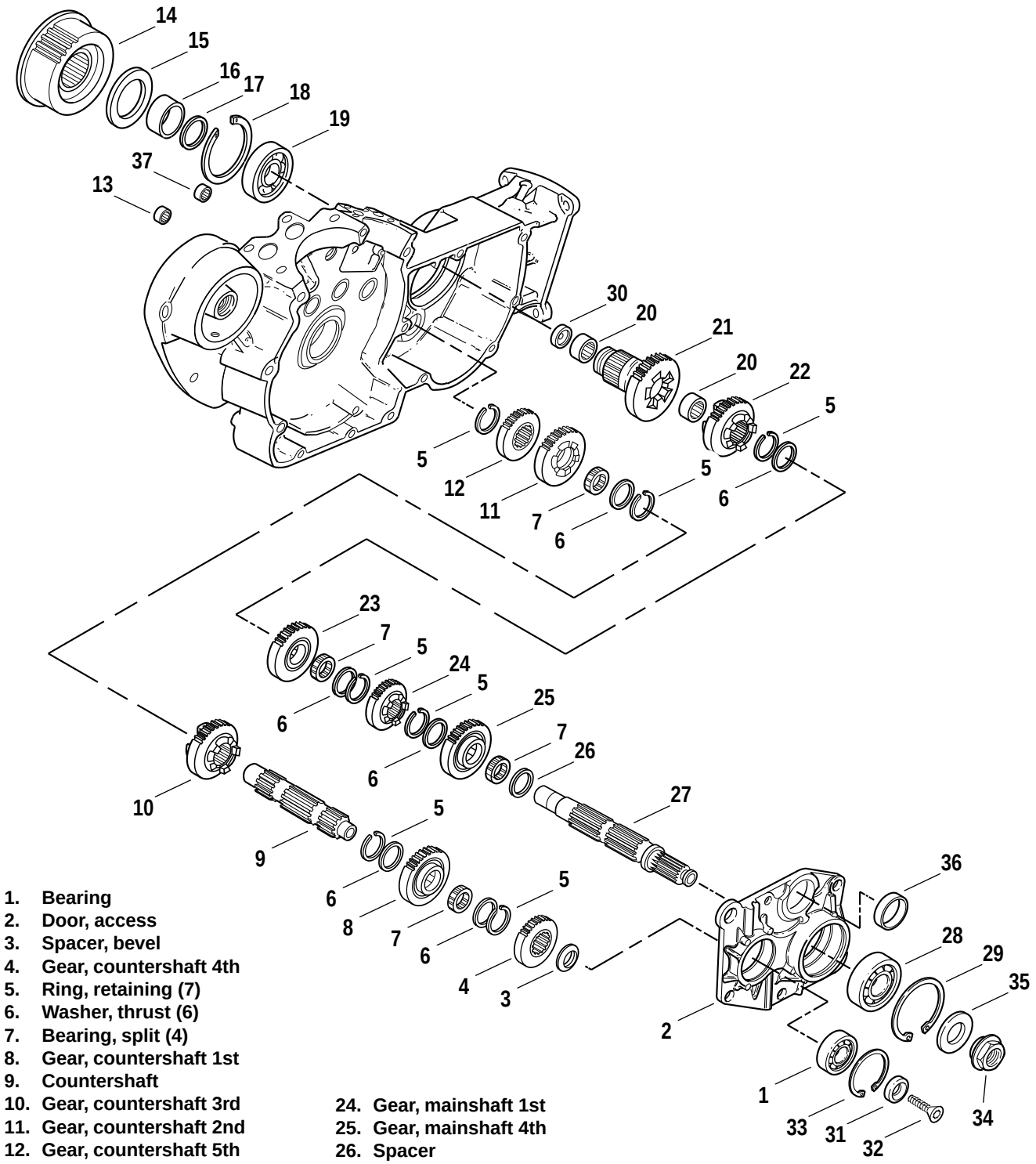


Figure 6-22.

b0129x6x



1. Bearing
2. Door, access
3. Spacer, bevel
4. Gear, countershaft 4th
5. Ring, retaining (7)
6. Washer, thrust (6)
7. Bearing, split (4)
8. Gear, countershaft 1st
9. Countershaft
10. Gear, countershaft 3rd
11. Gear, countershaft 2nd
12. Gear, countershaft 5th
13. Bearing, closed (countershaft)
14. Sprocket, chain/belt
15. Seal, oil
16. Spacer (belt drive)
17. Ring, Quad
18. Ring, retaining
19. Bearing, ball
20. Bearing, needle
21. Gear, mainshaft 5th
22. Gear, mainshaft 2nd
23. Gear, mainshaft 3rd
24. Gear, mainshaft 1st
25. Gear, mainshaft 4th
26. Spacer
27. Mainshaft
28. Bearing
29. Ring, retaining
30. Seal
31. Retention collar
32. Torx screw
33. Ring, retaining
34. Nut, mainshaft
35. Washer, spring
36. Bushing
37. Bearing closed (shifter shaft)

Figure 6-23. Transmission Assembly

4. See Figure 6-24. Remove retaining ring (5) next to countershaft 3rd gear (10). Slide countershaft 3rd gear (10) off free end of shaft.

5. At mainshaft, between mainshaft 1st gear (24) and mainshaft 3rd gear (23), expand retaining ring (5) and move next to mainshaft 1st gear along with thrust washer (6). Move mainshaft 3rd gear as far as possible toward mainshaft 1st gear (24). Expand retaining ring (5) at opposite side of mainshaft 3rd gear and slide off end of shaft. Remove mainshaft 3rd gear (23) and its split bearing (7).

6. Slide thrust washer (6) off end of mainshaft. Expand retaining ring (5), which is next to mainshaft 1st gear (24), and slide off end of shaft.

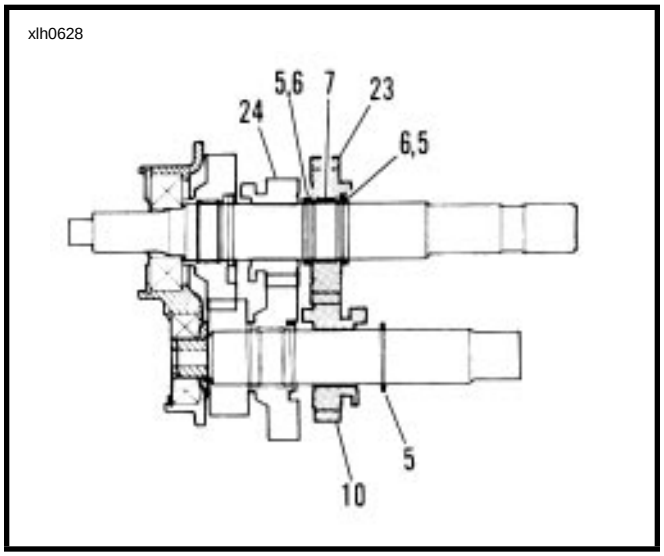


Figure 6-24.

7. See Figure 6-25. Place COUNTERSHAFT GEAR SUPPORT PLATE (Part No. HD-37404) under countershaft 4th gear (4). Place assembly on press with suitable metal blocks under the support plate. Place a socket or mandrel, smaller than inside diameter of bearing, and press countershaft free of access cover. Slide mainshaft 1st gear (24) off mainshaft.

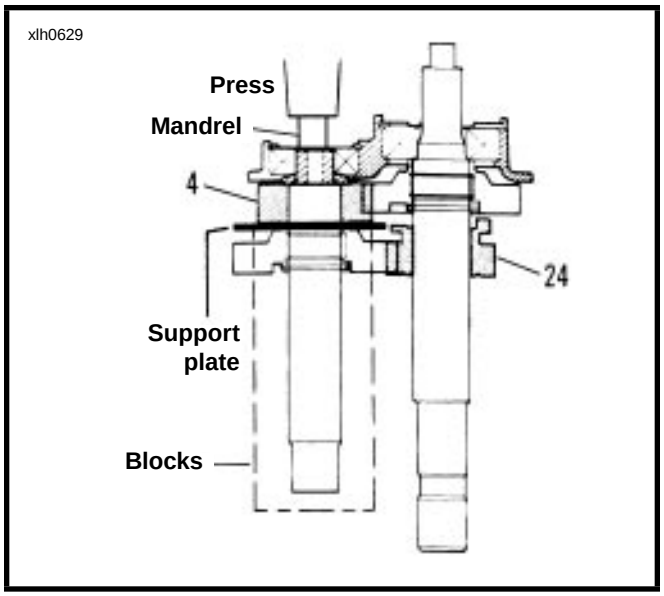


Figure 6-25.

8. See Figure 6-26. Remove beveled spacer (3) and countershaft 4th gear (4).

9. Expand retaining ring (5) located next to countershaft 1st gear (8). Remove retaining ring (5) and thrust washer (6). Slide countershaft 1st gear off end of shaft. Remove split bearing (7).

10. Remove thrust washer (6). Expand remaining retaining ring (5) and slide off shaft. This completes disassembly of countershaft.

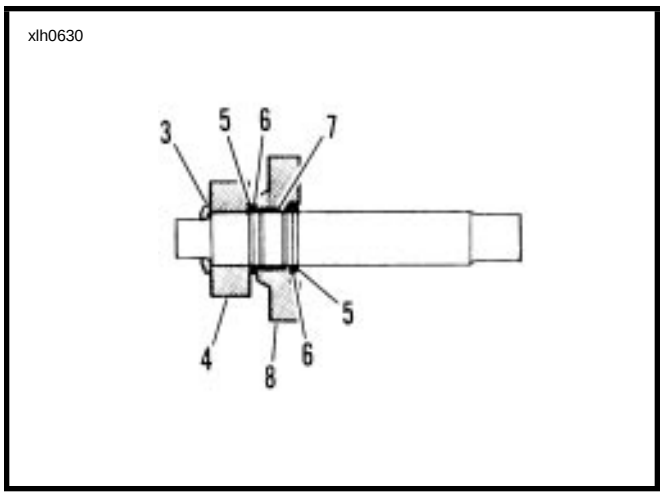


Figure 6-26.

11. See Figure 6-27. Place mainshaft and access door assembly on arbor press with support under mainshaft 4th gear (25). Press on end of shaft until mainshaft is free of access door bearing. Remove spacer (26), mainshaft 4th gear (25) and split bearing (7).

12. Remove thrust washer (6). Expand and remove remaining retaining ring (5).

CLEANING, INSPECTION AND REPAIR

1. Clean all parts (except bearings) in cleaning solvent and blow dry with compressed air.

2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.

3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, cracked, battered, chipped or dimpled.

4. Discard all retaining rings that were removed.

ASSEMBLY

⚠CAUTION

During assembly, the split bearings (7) and the internal bores of the gears must be lubricated with SPORT-TRANS FLUID prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. Find a section of pipe that matches the inner race of bearing (28). See Figure 6-28. Place the door assembly, outside downward, on a press with the inner race of bearing (28) resting on the section of pipe. Insert the splined end of the shaft through the bearing and hold in a vertical position. Press the shaft into the bearing until the bearing bottoms against the shaft shoulder.

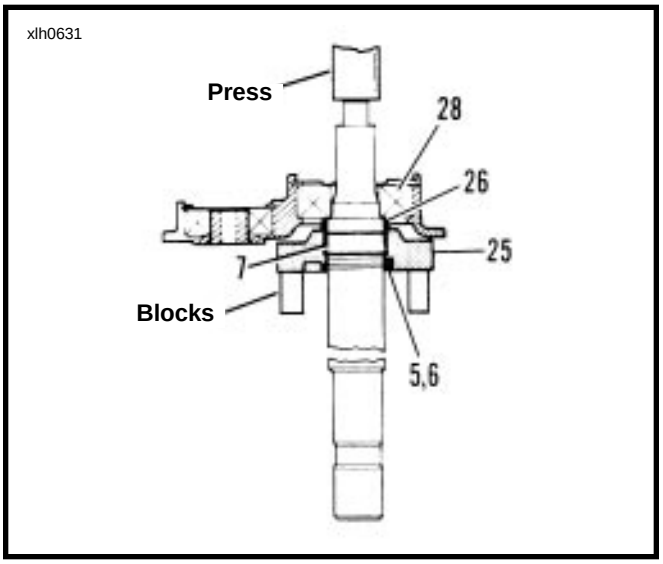


Figure 6-27.

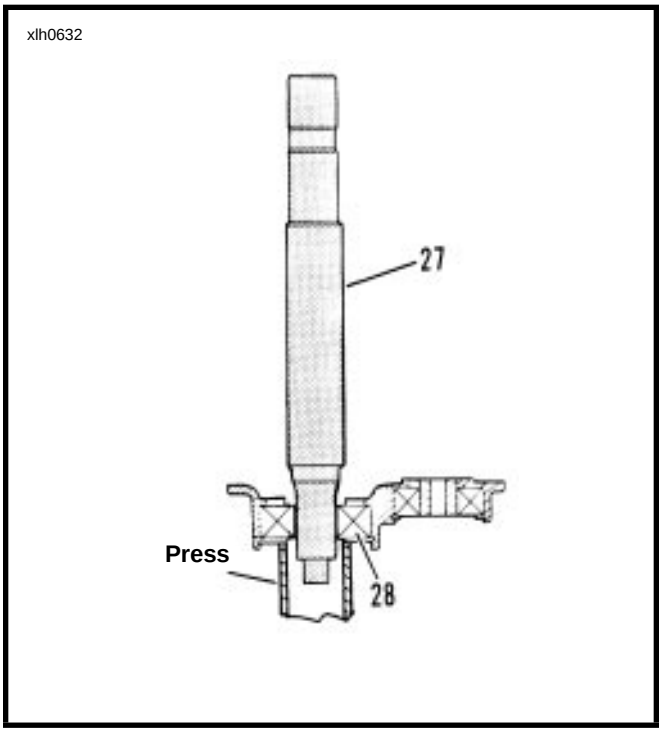


Figure 6-28.

2. See Figure 6-29. Place spacer (26) over mainshaft and position next to bearing (28). Position split bearing (7) into machined seat next to spacer (26). Locate mainshaft 4th gear (25), which can be identified by the two radial grooves at one side. Slide gear (25) onto shaft with radial grooves facing door. Position gear over bearing next to spacer (26).

3. Install thrust washer (6) and retaining ring (5) next to gear (25). It will be necessary to push the retaining ring into final position with a screwdriver.

4. Slide mainshaft 1st gear (24) onto mainshaft with the locking dogs facing gear (25).

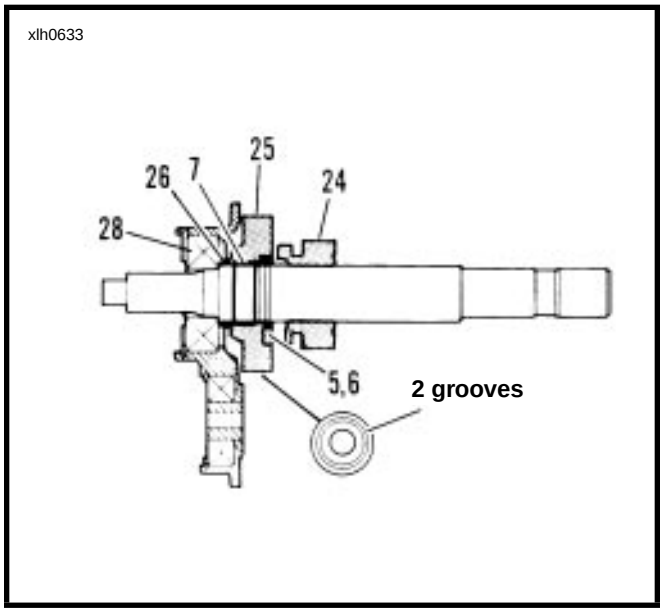


Figure 6-29.

5. See Figure 6-30. Install retaining ring (5). Position retaining ring in the second ring groove from the end with internal threads. Install thrust washer (6) next to retaining ring. Install split bearing (7) in seat next to washer (6).

6. Locate countershaft first gear (8). Gear (8) has a ring groove at one side of the gear. Install gear (8) over split bearing (7).

7. Install thrust washer (6) and retaining ring (5) next to gear (8).

8. Locate countershaft 4th gear (4). This gear is splined and has a single radial groove at one side. Position gear next to retaining ring (5). Place beveled washer (3) over end of shaft with beveled side away from gear (4).

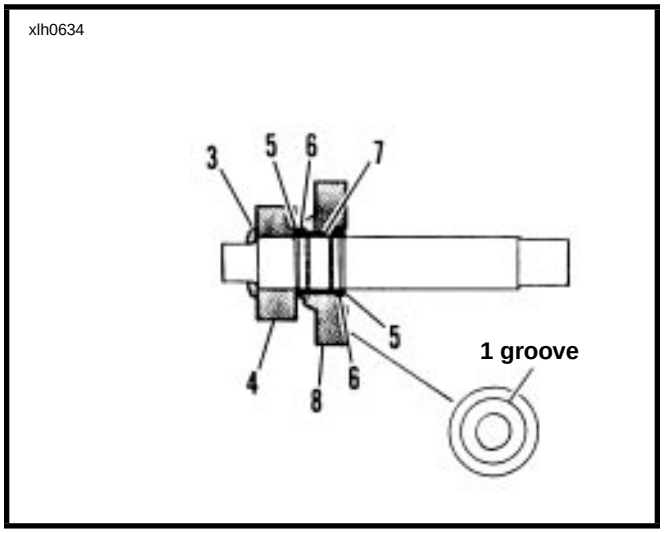


Figure 6-30.

9. See Figure 6-31. Stand countershaft assembly on press with small end (end with threaded hole) upward. Place access cover and mainshaft assembly on top of countershaft with bearing (1) in access cover over end of countershaft. Place a socket or section of pipe on inner race of bearing (1). Hold assembly straight, making sure gear teeth on countershaft are engaged with gear teeth on mainshaft, and press bearing onto shaft until beveled spacer bottoms against bearing.

NOTE

When correctly installed, countershaft 4th gear should have zero end play.

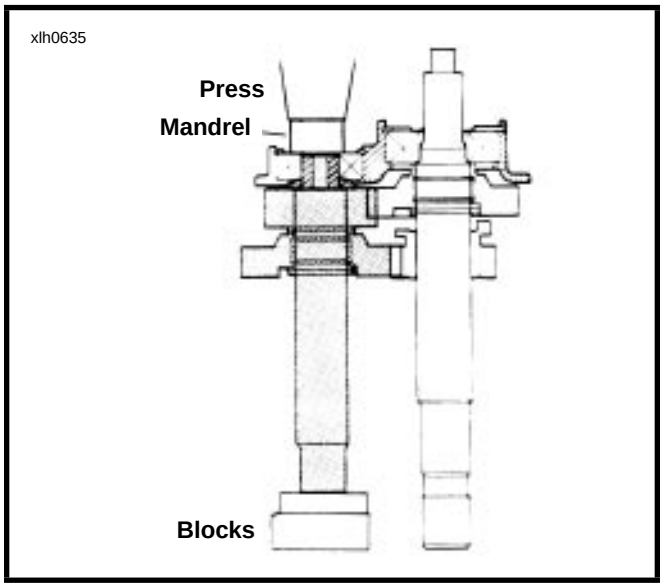


Figure 6-31.

10. See Figure 6-32. At mainshaft, install retaining ring (5) and thrust washer (6). Install split bearing (7) in seat next to thrust washer (6).

11. Install mainshaft 3rd gear (23) onto shaft over bearing (7).

12. Install thrust washer (6) and retaining ring (5) next to gear (23).

13. Install countershaft 3rd gear (10) onto shaft.

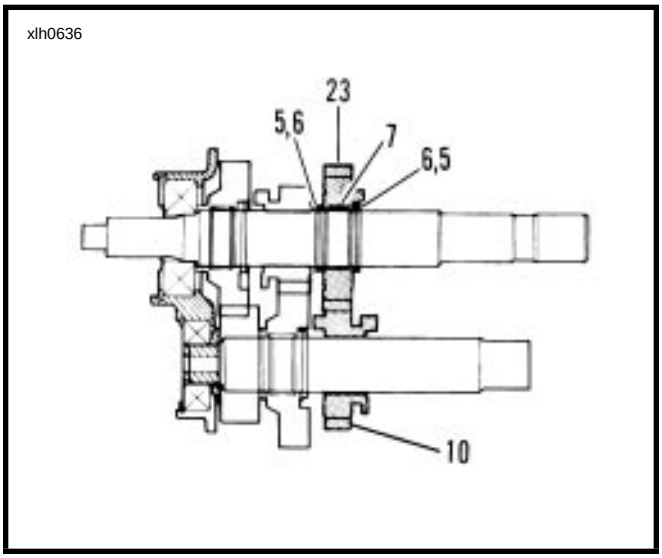


Figure 6-32.

14. See Figure 6-33. Install retaining ring (5) and thrust washer (6). Install split bearing (7) into seat next to thrust washer (6).

15. Install countershaft 2nd gear (11) over bearing (7).

16. Install mainshaft 2nd gear (22) onto shaft.

17. Install countershaft 5th gear (12).

18. Expand retaining ring (5) and slide into groove next to countershaft 5th gear (12).

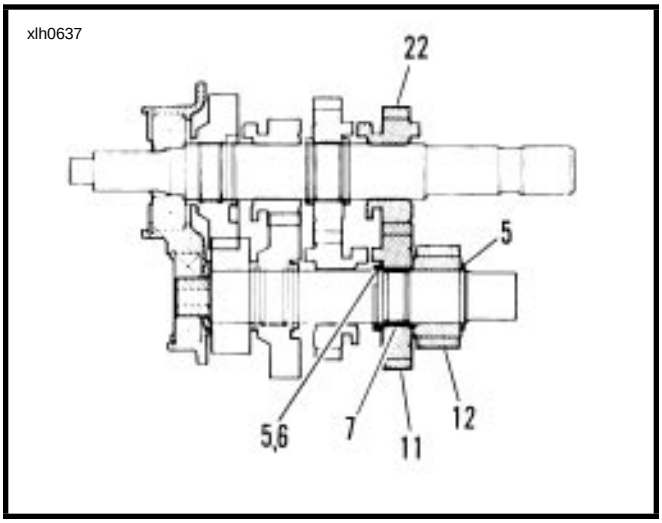


Figure 6-33.

19. See Figure 6-34. At outside of access door, position retention collar (31) next to end of countershaft with beveled side facing outward. Apply a few drops of LOCTITE THREADLOCKER 242 (blue) to the threads of TORX screw (32). Insert TORX screw (32) through retention collar, and thread into end of shaft. Place transmission in gear, and tighten TORX screw to 13-17 ft-lbs (18-23 Nm).

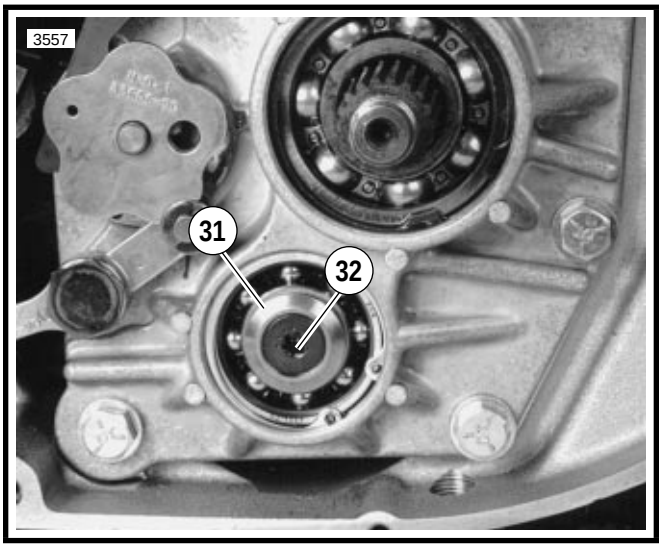


Figure 6-34.

MAIN DRIVE GEAR

REMOVAL

1. Remove transmission. See TRANSMISSION CASE, REMOVAL on page 6-16.
2. See Figure 6-35. From inside case tap out seal (3) at end of mainshaft 5th gear (1). Discard seal (3).
3. See Figure 6-36. Use MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-A) with CROSS PLATE (Part No. HD-35316-91). Take support bracket (1) and insert pins, at one side, into holes which are now exposed under access cover.
4. See Figure 6-37. Insert bolt (2) through support bracket (1) and 5th gear (3).

⚠CAUTION

When removing the main drive gear, the gear is pressed out against the resistance of the bearing inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing will also have to be replaced.

5. At outside of case, place driver (4) and thrust washer (5) over end of bolt (2). Install and tighten nut (6) until 5th gear (3) is free.

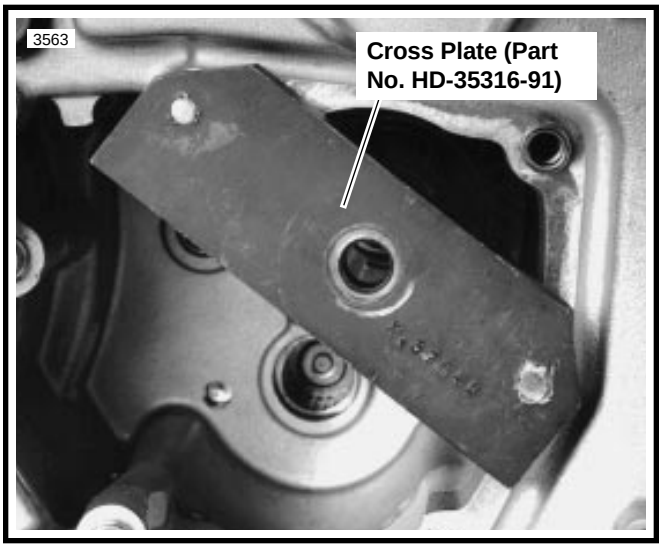
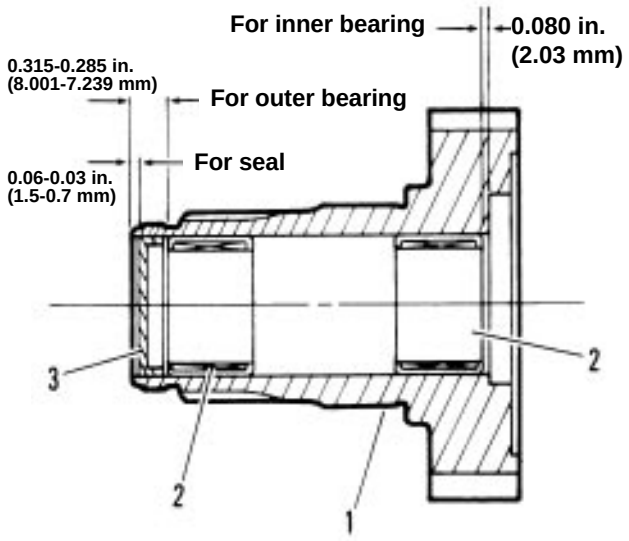
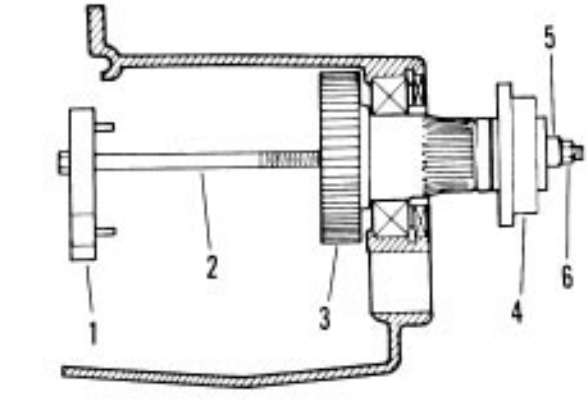


Figure 6-36. Support Bracket Mounting



1. Main drive gear
2. Needle bearing
3. Seal

Figure 6-35. Main Drive Gear Assembly



1. Support bracket
2. Bolt
3. 5th gear
4. Driver
5. Thrust washer
6. Nut

Figure 6-37. Removing Main Drive Gear

DISASSEMBLY

Drive out needle bearings, from inside bore of main drive gear. Do not reuse bearings after removal.

ASSEMBLY

1. Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL (Part No. HD-37842A). See Figure 6-38. The tool is stamped 0.080 in. (2.032 mm) for the end of the tool to be used for driving the bearing into the inner end and 0.315 in. (8.001 mm) for the outer end bearing.

2. Place main drive gear on a press. With the bearing installation tool, press in the outer bearing to a depth of 0.315-0.285 in. (8.001-7.239 mm). Press in the inner bearing to a depth of 0.080 in. (2.032 mm). The installation tool will automatically bottom on the gear when the correct depth is reached.

INSTALLATION

1. Replace main drive gear bearing. See ACCESS DOOR BEARINGS, INSTALLATION on page 6-28.

2. Use MAIN DRIVE GEAR REMOVER AND INSTALLER TOOL. See Figure 6-39. Take bolt (2) and place washer (5) followed by main drive gear (4) over end of bolt. From inside of case insert bolt and main drive gear through inner race of ball bearing.

3. Insert threaded end of bolt (2) through installer cup (3) and thrust washer (1). Thread nut (6) onto end of bolt (2). Tighten nut (6) until shoulder on gear (4) bottoms against inner race of bearing.

4. See Figure 6-35. Tap in **new** seal (3) at threaded end of 5th gear.

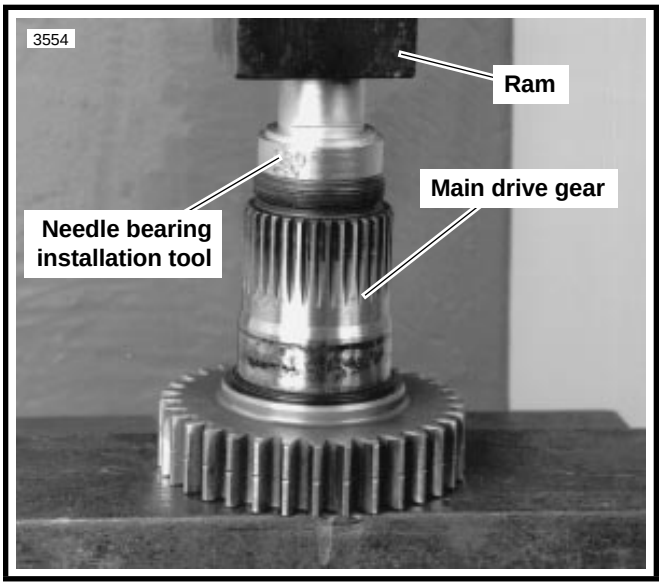
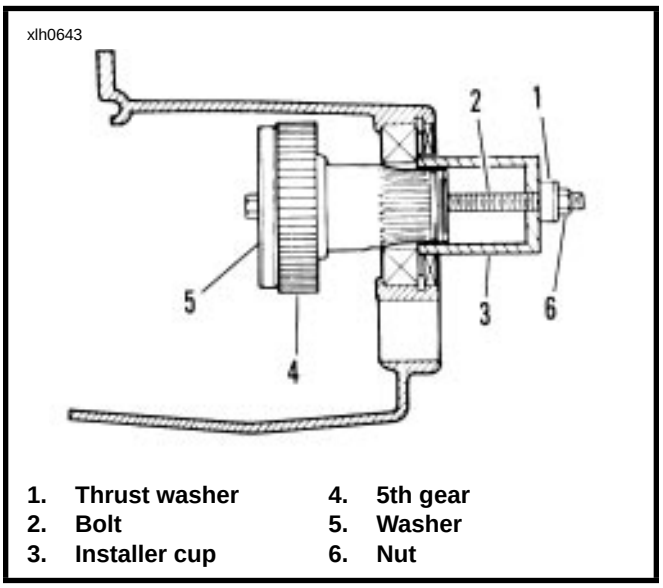


Figure 6-38. Needle Bearing Installation Tool



1.	**Thrust washer**	**4.**	**5th gear**
2.	**Bolt**	**5.**	**Washer**
3.	**Installer cup**	**6.**	**Nut**

Figure 6-39. Main Drive Gear Installation

ACCESS DOOR BEARINGS

REMOVAL

Mainshaft and Countershaft Bearings

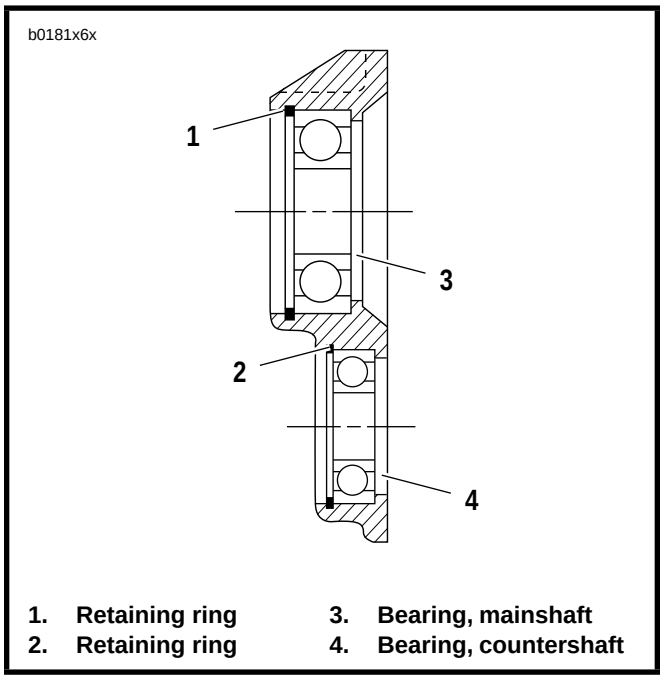
1. Remove transmission assembly. See TRANSMISSION CASE, REMOVAL on page 6-16. Remove shifter forks and drum as described under SHIFTER FORKS AND DRUM on page 6-18. Remove countershaft and mainshaft. See MAINSHAFT AND COUNTERSHAFT starting on page 6-20.

2. Inspect the mainshaft and countershaft ball bearings for pitting, scoring, discoloration or other damage.

3. See Figure 6-40. If bearing replacement is required, remove retaining rings (1, 2). Press out bearings (3, 4) from the inside of the door.

Shift Drum Bushing

1. Inspect the shifter drum bushing for pitting, scoring, discoloration or excessive wear. If bushing requires replacement press bushing out of door from either side.



1. **Retaining ring**
2. **Retaining ring**
3. **Bearing, mainshaft**
4. **Bearing, countershaft**

Figure 6-40. Ball Bearing Assembly

INSTALLATION

Mainshaft and Countershaft Bearings

1. Lay access door on press with inside surface of door downward.

2. Lay bearing squarely over bore with printed side of bearing upward. Place section of pipe or tubing (slightly smaller than outside diameter of bearing) against outer race. Press bearing into bore until bearing bottoms against shoulder.

3. Install **new** retaining ring with beveled side facing away from bearing.

Shift Drum Bushing

1. Lay access door on press with outside surface of door downward.

2. See Figure 6-41. Lay bushing squarely over bore. Locate socket or pipe that is slightly larger than diameter of bushing. Place socket or pipe on bushing and press into bore until bushing is flush with or 0.020 in. (0.51 mm) below inside surface. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against door when bushing is flush with top surface.

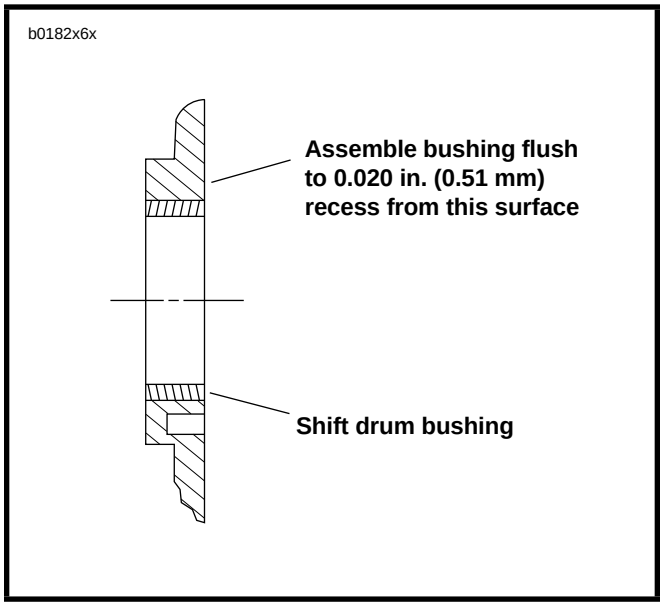


Figure 6-41. Shift Drum Bushing Assembly

RIGHT TRANSMISSION CASE BEARINGS

REMOVAL

1. Remove transmission assembly. See TRANSMISSION CASE, REMOVAL on page 6-16. Remove main drive 5th gear. See MAIN DRIVE GEAR on page 6-26.
2. At outside of case remove seal next to 5th gear bearing retainer. Remove retaining ring.
3. From inside transmission case drive bearings (5th gear, countershaft or shifter shaft) out of bores. Carefully tap bearings free by working around bearing diameter to keep bearing from skewing.

INSTALLATION

Mainshaft 5th Gear Ball Bearing

1. Locate MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-A). See Figure 6-42. Place support bracket pins in appropriate holes in transmission case.
2. See Figure 6-43. Insert bolt (2) through support bracket (1), **new** bearing (3), driver (4) and thrust bearing (5). Thread nut (6) on end of bolt. Tighten nut carefully until bearing is started in bore squarely. Tighten nut (6) until bearing is seated against shoulder in bore.
3. At outside of case install beveled retaining ring in groove inside bearing bore with beveled side facing outside of case.
4. Lubricate bearing with SPORT-TRANS FLUID.

Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. (31.75 mm) in diameter.
2. From the outside of the case place the needle bearing open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven inward flush or 0.030 in. (0.76 mm) below the outside surface of the case.
3. Lubricate bearing with SPORT-TRANS FLUID.

Shift Drum Needle Bearing

1. Find a suitable bearing driver 13/16 in. (20.64 mm) in diameter.
2. From the outside of the case place the needle bearing, open end first, next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when driven inward flush or 0.030 in. (0.76 mm) below the outside surface.
3. Lubricate bearing with SPORT-TRANS FLUID.

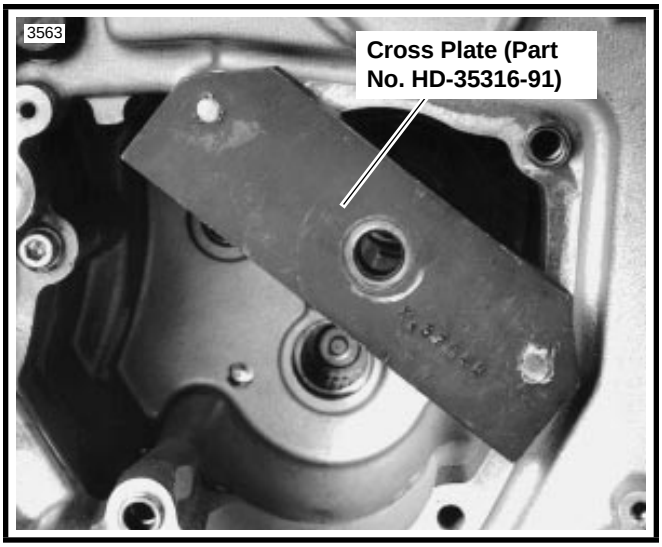
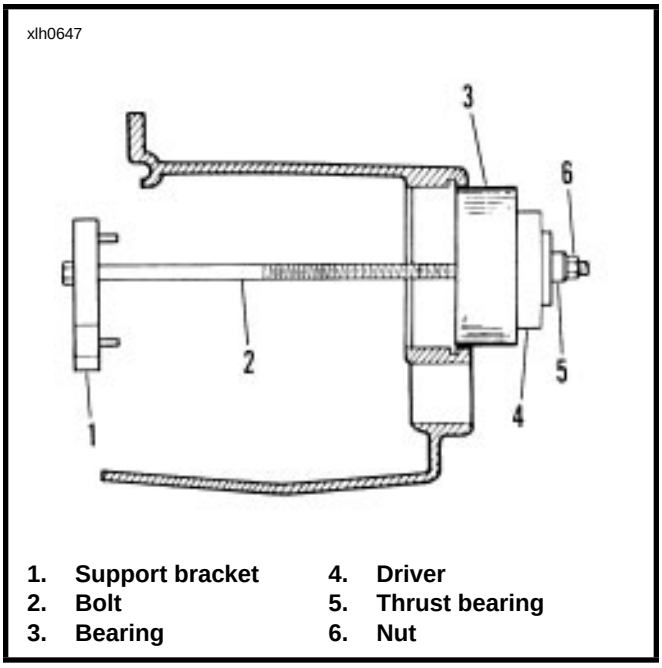


Figure 6-42. Cross Plate Mounting



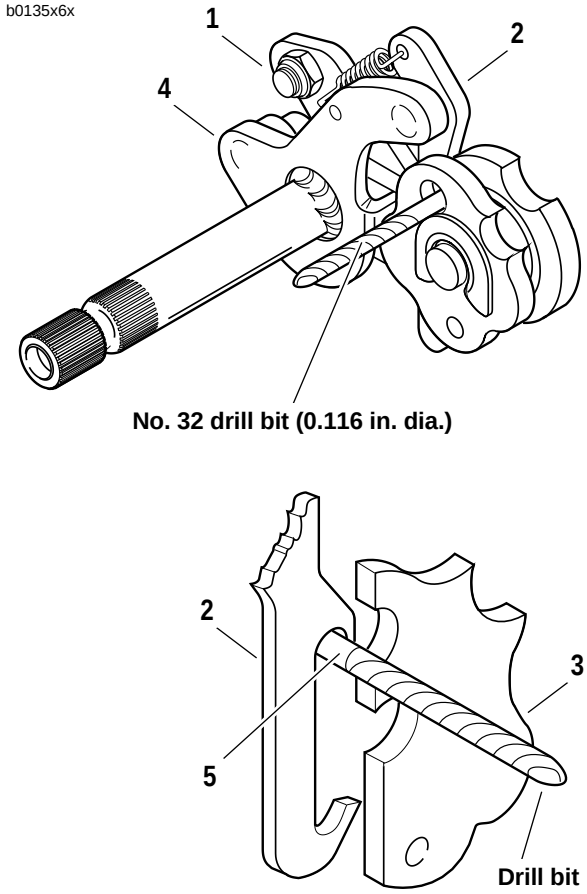
1.	**Support bracket**	**4.**	**Driver**
2.	**Bolt**	**5.**	**Thrust bearing**
3.	**Bearing**	**6.**	**Nut**

Figure 6-43. Installing Mainshaft Ball Bearing

TRANSMISSION INSTALLATION AND SHIFTER PAWL ADJUSTMENT

Verify that all parts have been properly installed, as described earlier in this section under RIGHT TRANSMISSION CASE BEARINGS, MAIN DRIVE GEAR, MAINSHAFT AND COUNTERSHAFT, and SHIFTER FORKS AND DRUM.

1. Carefully insert transmission into case opening. Position the assembly so that the mainshaft enters fifth gear, and so that the countershaft and drum shifter shaft enter their respective bearings.
2. See Figure 6-15. Apply a few drops of LOCTITE THREADLOCKER 242 (blue) to the threads of the five access door mounting bolts (7). Insert the bolts with washers (8) through holes in access door, and thread into tapped holes in right transmission case. Tighten bolts to 13-17 ft-lbs (18-23 Nm).
3. Lift pawl (5) over drum pins, and place shifter shaft assembly (6) on studs at transmission case. Loosely install a washer (11) and locknut (3) on each stud.
4. Attach the loop of spring (1) over and into groove in post (2).
5. Place detent plate (9) over drum pins. Rotate plate until blind holes in plate align with pins in end of drum shaft. Install **new** retaining ring (10) using SHIFT DRUM RETAINING RING INSTALLER (Part No. HD-39151). Verify that retaining ring is fully engaged with drum groove.
6. See Figure 6-44. Place transmission in third gear. Place a No. 32 drill bit (0.116 in. dia.) through hole in detent plate (3), and between pawl (2) and drive pin at end of shifter drum shaft. Push down top of crank (4) to remove all clearance between pawl and drill bit; this will correctly align pawl to shift drum pins (do not push down with too great a force, as this might cause the shifter drum to rotate). With bit in place, tighten shifter shaft assembly bottom nut (1) first to 90-110 **in-lbs** (10.2-12.4 Nm). Then, tighten shifter shaft assembly top nut (1) to the same torque. **Remove drill bit.**
7. See Figure 6-23. Place **new** quad ring (17) over threaded end of fifth gear (21), and position next to the gear taper. Install spacer (16) over threaded end of fifth gear with chamfered end toward quad ring. Slide spacer up against bearing (19).
8. Coat lips of seal (15) with SPORT-TRANS FLUID. Position seal over spacer (16) with lips of seal toward case. Gently tap seal into bore of case until the outside of seal is flush with outer edge of bore. It is acceptable to recess seal to about 0.030 in. (0.76 mm) below outer edge of bore; seal recession will be limited by seal bottoming against retaining ring (18).
9. See Figure 6-45. Install transmission sprocket (2) with secondary drive belt onto main drive gear shaft (1).
10. Place transmission in neutral. Apply a few drops of LOCTITE THREADLOCKER 262 (red) to the **left-hand threads** of transmission sprocket nut (3). Position nut with washer-faced side facing transmission sprocket.



1. Nut
2. Pawl
3. Detent plate
4. Crank
5. Shifter drum pin

Figure 6-44. Shifter Shaft Assembly Alignment

11. Increase belt deflection by loosing rear axle and moving rear wheel forward. Turn the nut **counterclockwise** to install it onto main drive gear shaft.

    a. Use SPROCKET HOLDING TOOL (Part No. HD-41321) and MAINSHAFT LOCKNUT WRENCH (Part No. HD-94660-37B) and a torque wrench. Tighten nut to 50 ft-lbs (68 Nm) INITIAL torque, ONLY.

    b. See Figure 6-46. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.

    c. Tighten the transmission sprocket nut an additional 30°-40°.

    d. See Figure 6-45. Install lockplate (4) over nut (3) so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's (2) two tapped holes.

NOTE

The lockplate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally TIGHTENED until the screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

e. See Figure 6-46. If lockplate will not align with holes, tighten nut to 45° maximum.

⚠CAUTION

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs. Do not loosen sprocket nut while attempting to align the screw holes. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened 45° as specified above. Tightening too much or too little may cause the nut to come loose during vehicle operation.

12. If you cannot align lockplate and sprocket screw holes, nut may be additionally tightened until screw holes align.

13. Install two socket head screws (5) through aligned holes of lockplate and into tapped holes of sprocket. Tighten screws to 90-110 **in-lbs** (10.2-12.4 Nm).

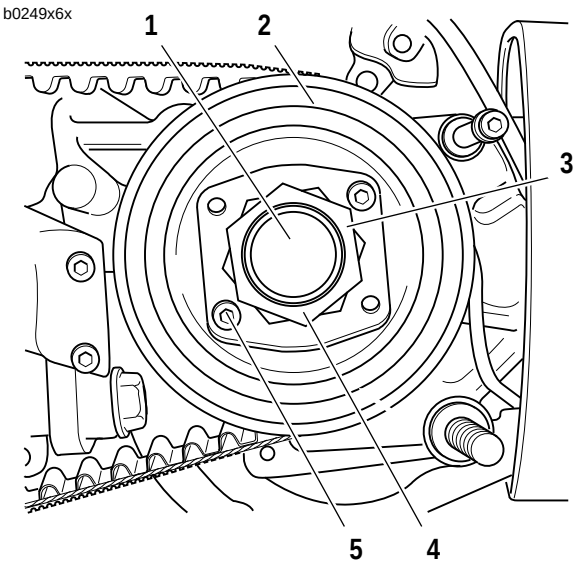
NOTE

*The original equipment socket head screws (5) have thread-locking compound applied to them. Since this compound remains effective for about three removal/installation cycles, the original screws may be reused up to three times. After the third removal/installation cycle, replace both screws with **new** screws identical to the original.*

14. Install the remaining removed components in the reverse order of the removal procedures. See the procedures listed in the respective component sections.

15. Adjust drive belt tension. See REAR BELT DEFLECTION in Section 1.

16. Fill transmission to proper level with fresh lubricant. See CLUTCH, TRANSMISSION FLUID in Section 1.



1. Main drive gear shaft
2. Transmission sprocket
3. Transmission sprocket nut (left hand threads)
4. Lockplate
5. Socket head screw (2)

Figure 6-45. Transmission Sprocket

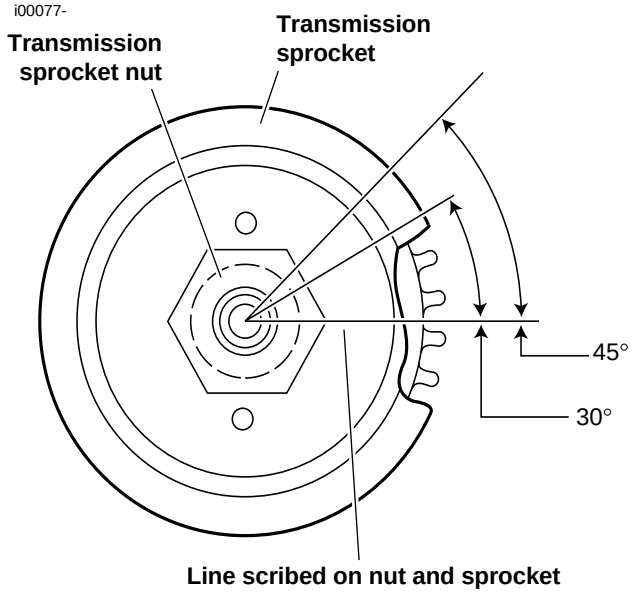


Figure 6-46. Aligning Transmission Sprocket