

REMOVAL

1. Unlock seat.
2. See [Figure 1-1](#). Remove airbox cover by turning bailhead fastener 1/4 turn counterclockwise (CCW). Pull airbox cover away from locating holes.



Figure 1-1. Airbox Cover

3. See [Figure 1-2](#). Remove IAT connector (1) by pushing down on bail wire to unlock. Airbox top is retained by eight clips (2), three per side, one at the rear and one in the front under the snorkel. Disconnect clips and remove airbox top.

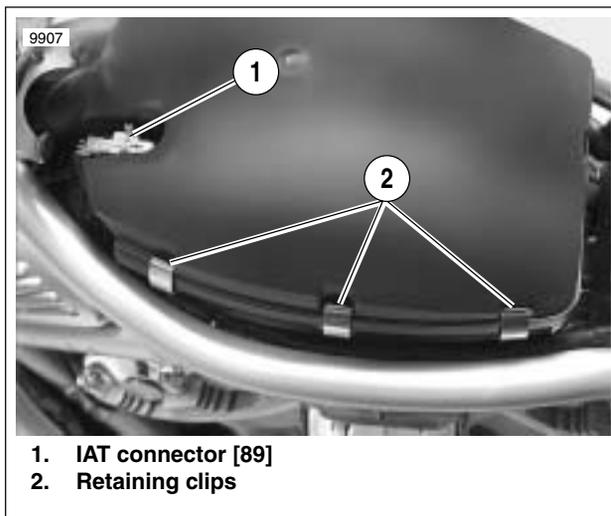


Figure 1-2. Air Filter Top

4. See [Figure 1-3](#). Remove wing nut securing filter cap and air filter.



Figure 1-3. Air Filter

5. See [Figure 1-4](#). Disconnect breather hose (1). Slide o-ring (2) up the velocity stack body to access the three retaining fasteners. Remove the velocity stacks.

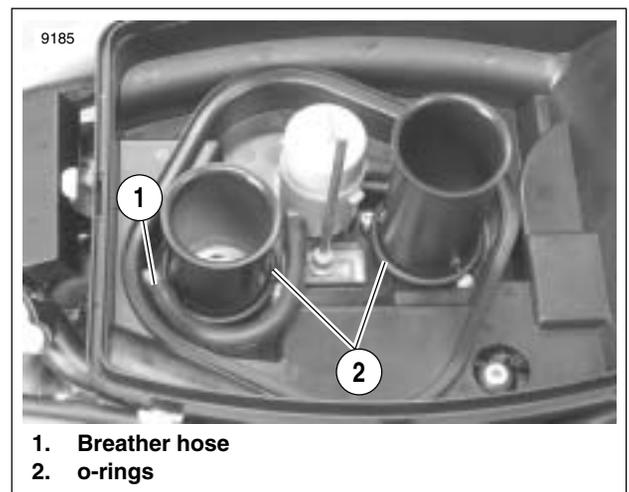


Figure 1-4. Velocity Stacks

6. Gently lift the air filter bottom. Front breather hose is a press-fit and will disconnect, rear breather has a worm clamp holding hose to air filter bottom. Loosen clamp and remove air filter bottom.

CAUTION

Cover the injector intakes with duct tape to prevent objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)



Figure 1-5. Airbox Removed

INSTALLATION

1. Remove tape from throttle body intakes.
2. See Figure 1-6. Inspect and replace bottom airbox gasket if damaged. Check gasket position on air filter bottom. Gasket is located by three alignment pins on mating surface.

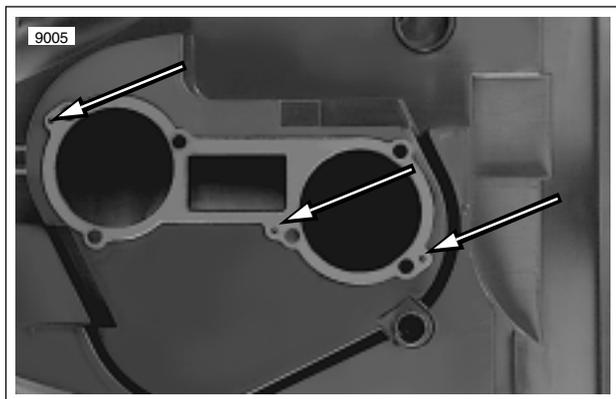


Figure 1-6. Air Filter Gasket Alignment Pins (3)

3. Place air filter bottom over throttle body and attach rear breather hose with hose clamp.
4. Align air filter bottom with front breather hose and press firmly in position.

NOTE

Velocity stacks have a mark at the bottom flange between two of the fastener locations. Align the mark with the corresponding mark on the air filter bottom.

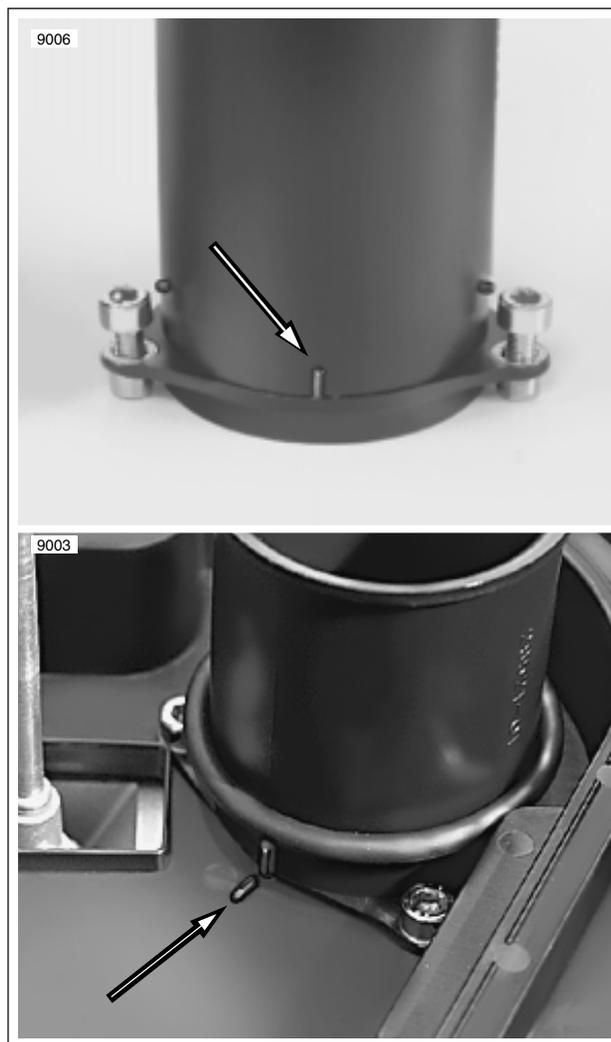


Figure 1-7. Velocity Stack Alignment Marks

HOME

5. Align index marks and install velocity stacks, longest in front. Tighten fasteners to 6 Nm (53 in-lbs).
6. Slide o-rings down the velocity stack body until they contact the three fasteners.

NOTE

The o-rings retain the velocity stack fasteners when assembling airbox.

7. Attach the breather hose.
8. Place air filter element in air filter bottom.
9. Align air filter cap and fasten with wing nut. Turn wing nut 2.5-3 turns after contact.
10. Position air filter top over bottom section with snorkel between frame tubes at the steering neck.
11. Fasten clips along each side and clip at rear.
12. See Figure 1-8. Front clip under snorkel is attached to top section and must be fastened over the lip on the air filter bottom.
13. See Figure 1-2. Attach IAT connector.
14. See Figure 1-9. Position the airbox cover with the locating pins (1) in the holes (2) on the frame tabs.
15. See Figure 1-1. Turn bailhead fastener 1/4 turn clockwise.

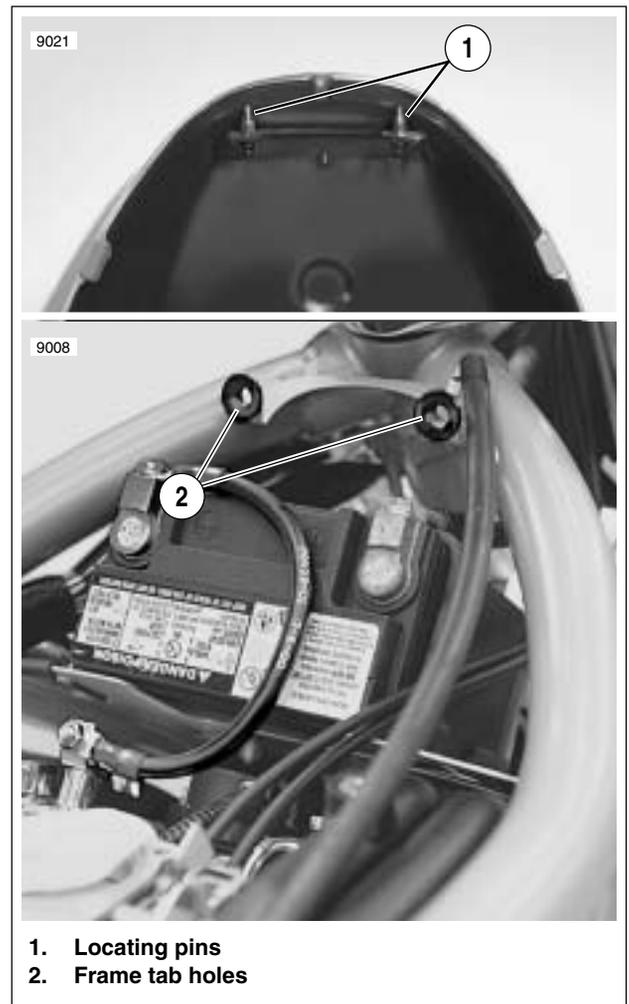


Figure 1-9. Airbox Cover

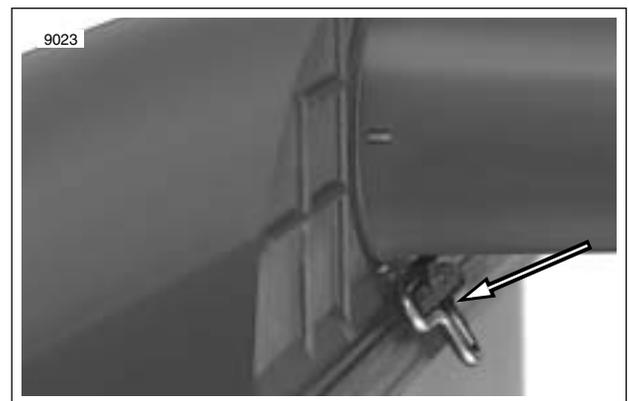


Figure 1-8. Front Airbox Clip

CHECKING COOLANT LEVEL IN OVERFLOW BOTTLE

1. See [Figure 1-10](#). Remove fastener at upper corner of right side cover and remove cover.

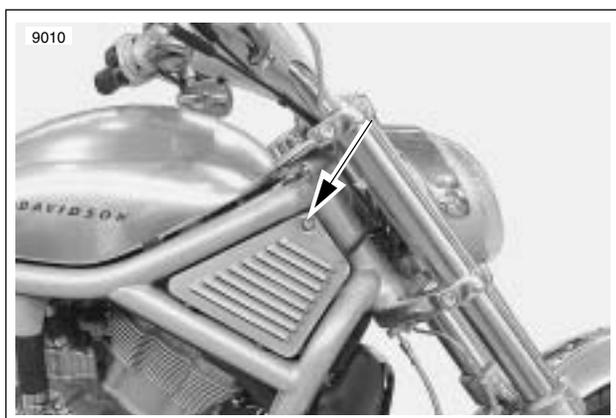


Figure 1-10. Removing Fastener and Cover to Check Coolant Level

WARNING

Do not remove radiator filler cap when engine is hot. The cooling system is under pressure and hot coolant and steam can escape, which could cause severe burns. Allow engine to cool before servicing the cooling system. (00091a)

CAUTION

Use **ONLY** Genuine Harley-Davidson Extended Life Anti-freeze & Coolant. Use of other coolants/mixtures may lead to engine damage. (00179a)

2. See [Figure 1-11](#). Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line on tank, remove cap from tank and add Harley-Davidson, FULLY FORMULATED ANTI-FREEZE until fluid level reaches COLD FULL line.

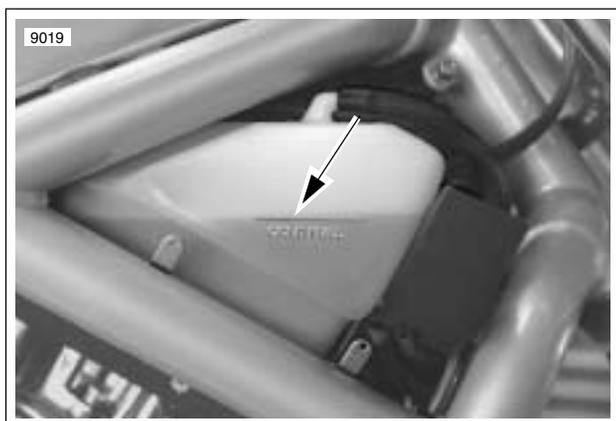


Figure 1-11. Cold Full Line On Overflow Bottle

CHECK FOR COOLANT IN SYSTEM

Coolant may be visible in the overflow bottle but not present in the rest of the cooling system. To ensure coolant is present:

1. Remove air filter top. See [1.4 AIRBOX AND AIR FILTER](#).



Figure 1-12. Cooling System Air Bleed Plug

2. See [Figure 1-12](#). Remove cooling system air bleed plug.
3. Gently squeeze vertical water pump coolant hose on right side of engine.
4. Coolant should be visible in the air bleed hole. If coolant is not visible, see [6.3 ENGINE COOLANT](#).

CHECKING AND ADDING OIL

Check engine oil level:

- As part of the pre-ride inspection.
- At every scheduled service interval.
- At every fuel stop.

NOTE

This engine has a wet sump, an integral transmission, gear driven primary drive and wet clutch. This design allows engine oil in the sump to be used to lubricate the engine, transmission and primary drive. The clutch and primary drive are located on the right side of the engine.

Cold Engine Oil Level Check

Check engine oil level with engine **COLD** as follows:

1. Stand motorcycle upright (not leaning on jiffy stand) on a level surface.
2. See [Figure 1-13](#). Oil filler cap with dipstick is located on the engine left side. Remove filler cap and dipstick and wipe dipstick clean.
3. Screw filler cap into engine. Make sure cap is fully seated on crankcase.
4. See [Figure 1-14](#). Remove filler cap and check oil level on dipstick.
5. If oil level is below the ADD mark the on cross-hatched band of the dipstick, add enough Harley-Davidson oil to bring level up to the FULL mark shown in [Figure 1-14](#).

CAUTION

Do NOT operate the engine when the oil level is below the add mark on the dipstick at operating temperature. Engine damage will result. (00187a)

Hot Engine Oil Level Check

Check engine oil level with engine at normal operating temperature as follows:

1. Stop engine and allow oil to drain into sump for **about three minutes**.
2. Stand motorcycle upright (not leaning on side stand) on a level surface.
3. See [Figure 1-13](#). Unscrew filler cap (with attached dipstick) located at front of engine on left side. Remove filler cap and dipstick and wipe dipstick clean.
4. Screw filler cap into engine. Make sure cap is fully seated on crankcase.

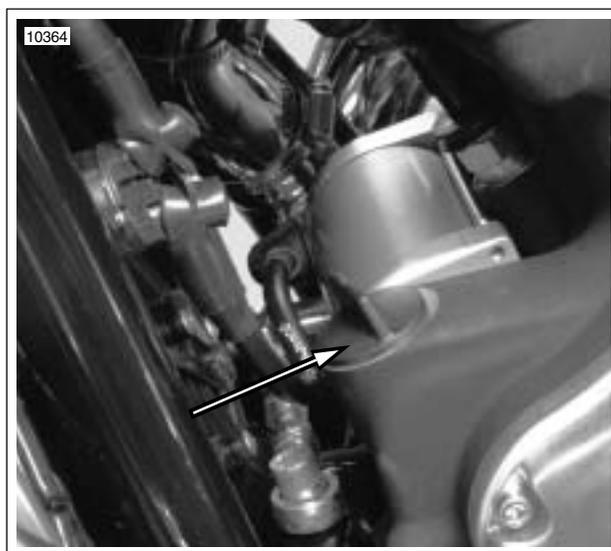


Figure 1-13. Dipstick/Filler Cap

5. See [Figure 1-13](#). Remove filler cap and check oil level on dipstick.

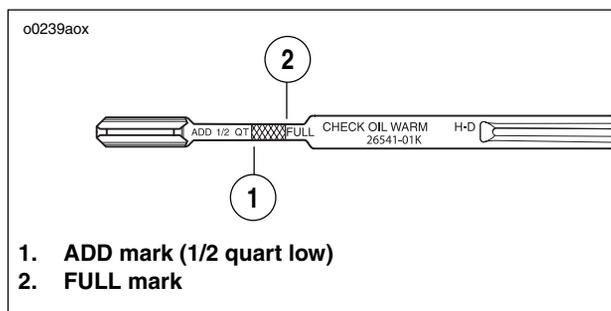
CAUTION

To avoid over-filling the oil sump, wait approximately three minutes after adding oil before checking the oil level with the dipstick. An over-filled sump can cause engine damage. (00188a)

6. If oil level is below ADD mark on the cross-hatched band of the dipstick, add enough Harley-Davidson oil to bring level up to the FULL mark. Observe CAUTION stated below.

CAUTION

Do not allow hot oil level to fall below Add/Fill mark on dipstick. Doing so can result in equipment damage and/or equipment malfunction. (00189a)



1. ADD mark (1/2 quart low)
2. FULL mark

Figure 1-14. Dipstick

NOTE

Cross hatched band of dipstick indicates 0.47 liter (1/2 quart) of Harley-Davidson oil.

CHANGING OIL AND FILTER

| PART NO. | SPECIALTY TOOL |
|----------|-------------------|
| HD-44067 | Oil filter wrench |

Change engine oil and filter:

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

NOTES

- *If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.*
- *VRSC models are shipped from the factory with Harley-Davidson Motor Oil.*
- *VRSC models come equipped from the factory with a premium 10 micron synthetic media oil filter. These are the only recommended replacement filters.*

1. Ride motorcycle until engine is warmed up to normal operating temperature.
2. See [Figure 1-13](#). Remove the oil filler plug/dipstick on left side.
3. See [Figure 1-15](#). Remove the engine oil drain plug at front of oil pan on left side. Allow oil to drain into a suitable container.

NOTE

Lower radiator mounting bracket can be loosened and moved forward slightly to improve access to oil filter.

4. Remove the oil filter using the OIL FILTER WRENCH. Clean the oil filter mount flange of any old gasket material.
5. See [Figure 1-17](#). Lube the gasket on **new** oil filter with engine oil and install **new** filter. Hand tighten oil filter 2/3 to 1 turn after gasket contacts filter mounting surface.
6. See [Figure 1-15](#). Install oil drain plug.
 - a. Inspect oil drain plug for damage. Replace if required. Wipe any foreign material from plug.
 - b. Install drain plug. Tighten to 35 Nm (25.8 ft-lbs).
7. See [Figure 1-13](#). Select the grade of oil for the lowest temperature expected before next oil change. Refer to [Table 1-1](#).

IMPORTANT NOTE

The position of the motorcycle when draining oil affects the amount of residual oil in the crankcase. Do not overfill.

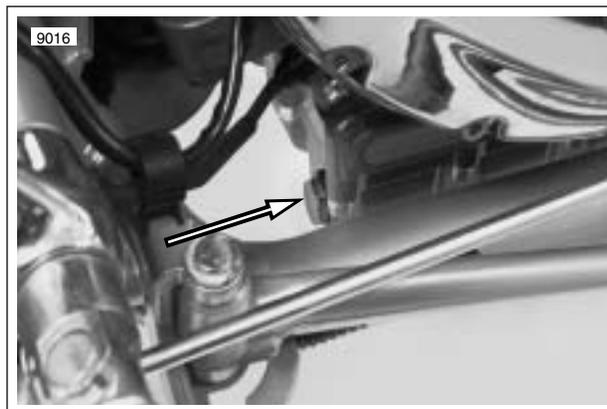


Figure 1-15. Oil Drain Plug

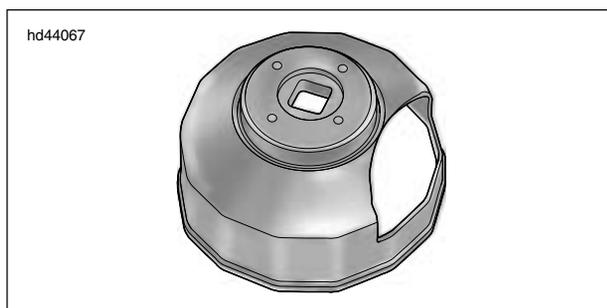


Figure 1-16. Oil Filter Wrench (HD-44067)

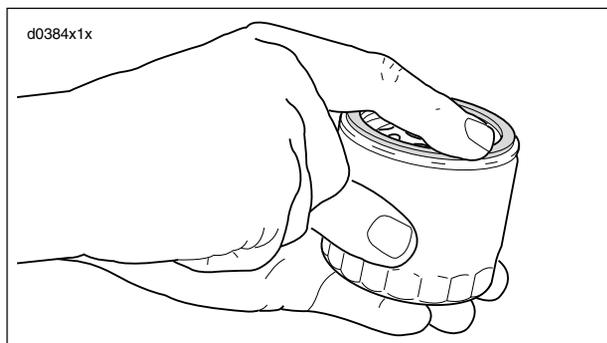


Figure 1-17. Lubing New Oil Filter

8. Fill engine and perform a cold engine oil level check until oil level indicates a level on the cross-hatched band of the dipstick. See [Cold Engine Oil Level Check](#) under **1.6 ENGINE OIL AND FILTER**.

NOTE

Maximum capacity of oil system is 4.7 liters (5 quarts).

9. Start engine and carefully check for oil leaks around drain plug and oil filter.
10. Perform a complete hot engine oil level check. See [Hot Engine Oil Level Check](#) in **1.6 ENGINE OIL AND FILTER**

Table 1-1. Recommended Engine Oils

| Harley-Davidson Type | Viscosity | Harley-Davidson Rating | Lowest Ambient Temperature | Cold Weather Starts Below 50° F (10° C) |
|----------------------|-----------|------------------------|----------------------------|---|
| HD Multi-grade | SAE 10W40 | HD 360 | Below 40° F (4° C) | Excellent |
| HD Multi-grade | SAE 20W50 | HD 360 | Above 40° F (4° C) | Good |

GENERAL

⚠ WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. **KEEP BATTERIES AWAY FROM CHILDREN.** (00063)

⚠ WARNING

Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)

All AGM (absorption glass mat) batteries are permanently sealed, maintenance-free, valve-regulated, lead/calcium and sulfuric acid batteries. The batteries are shipped pre-charged and ready to be put into service. Do not attempt to open these batteries for any reason.

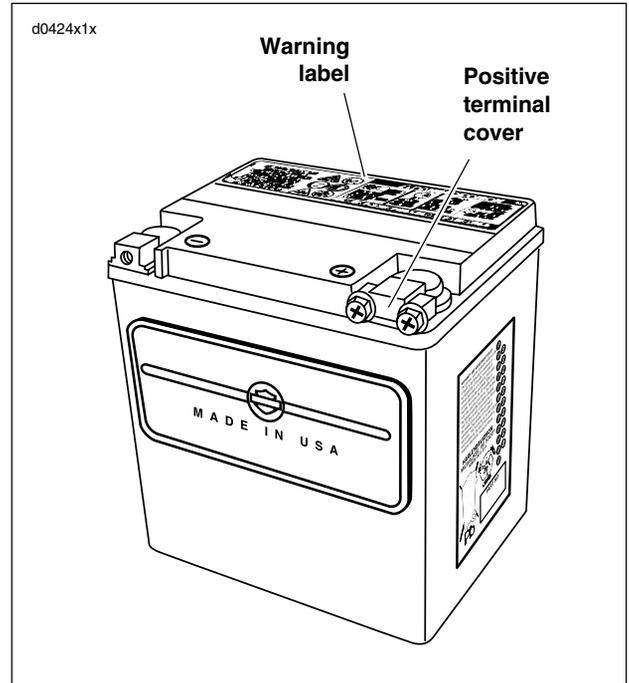


Figure 1-18. Battery

Table 1-2. Battery Electrolyte Antidotes

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

NOTE

See 8.9 BATTERY for charging and testing information.

d0425x1x



Contents are Corrosive.



Wear Safety Glasses.



Contents are Explosive.



Keep Flames Away.



Read Instructions.



Keep Away From Children.

NON-SPILLABLE

This is a ready filled, activated, SEALED BATTERY. NEVER remove strip. Refer to owner's manual for charging instructions.

If battery is put into service after date shown, charge for minimum of 1 hour at 6-10 amps. (See side of battery for date.)

⚠ DANGER/POISON



EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.



SHIELD EYES.



NO SPARKS FLAMES SMOKING



SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.



FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.

KEEP OUT OF REACH OF CHILDREN. DO NOT OPEN BATTERY.

3-4425

Figure 1-19. Battery Warning Label

DISCONNECTION/REMOVAL

1. Remove right side cover and remove maxi-fuse. See 8.5 [MAXI-FUSE](#).
2. Remove airbox. See 1.4 [AIRBOX AND AIR FILTER](#).

CAUTION

Cover the injector intakes with duct tape to prevent contaminants/objects from falling down the injector bore. do NOT use shop cloths or objects that could damage the injector butterflies. (00212a)

3. Cover throttle body throats (injector bore).



Figure 1-20. Cover Throttle Body Throats

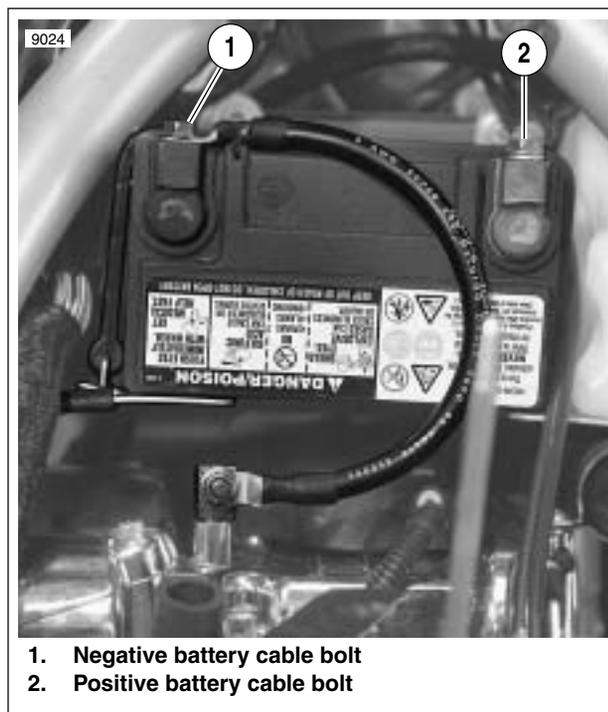
WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

4. See [Figure 1-21](#). Remove negative terminal bolt (1) and positive terminal bolt (2).
5. Stretch battery strap up and over airbox grommet bracket.
6. Remove battery and release tension on battery strap.
7. Check the voltage of the battery to make sure it is 12.6 V. If the open circuit (disconnected) voltage reading is below 12.6 V, refer to [Table 8-7.](#), and charge battery at rate and time specified.

NOTE

The engine is equipped with an ACR (automatic compression release) so a smaller battery provides adequate starting current.



1. Negative battery cable bolt
2. Positive battery cable bolt

Figure 1-21. Battery (12 amp-hour)

INSTALLATION/CONNECTION

CAUTION

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

CAUTION

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

WARNING

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

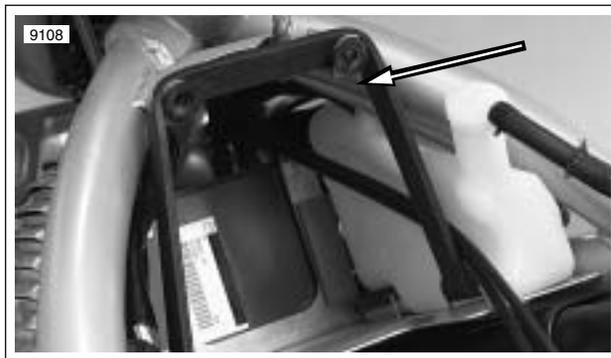


Figure 1-22. Stretch Hold-down Strap over Bracket

1. See Figure 1-22. Stretch rubber hold-down strap over airbox grommet bracket.
2. See Figure 1-21. Install battery with negative terminal on left side. Move hold-down strap over battery case.
3. Attach positive battery cable first. Tighten terminal bolt (2) to 6.8-10.9 Nm (60-96 in-lbs).
4. Attach negative battery cable and tighten terminal bolt (1) to 6.8-10.9 Nm (60-96 in-lbs).

NOTE

Battery must sit flat on bottom of tray pad. Verify that battery does not sit on front edge of tray pad.

5. Remove covering over throttle bodies.
6. Install airbox. See 1.4 AIRBOX AND AIR FILTER.
7. Install maxi-fuse and side cover.
8. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

STORAGE

WARNING

Store the battery out of the reach of children. Inadequate safety precautions could result in death or serious injury.

CAUTION

Do not allow battery to completely discharge. The electrolyte in a discharged battery will freeze. The more discharged a battery is, the more easily it can freeze and crack the battery case. (00218a)

If the motorcycle is to be stored with the security system armed, connect a Battery Tender Plus! Automatic Battery Charger (Part No. 99863-93TA) to maintain battery charge.

If the motorcycle is to be stored with the battery installed, a Battery Tender unavailable, and with the security system **not** armed, remove the right side cover and the maxi-fuse. See 8.5 MAXI-FUSE.

If the motorcycle will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge. See 8.9 BATTERY.

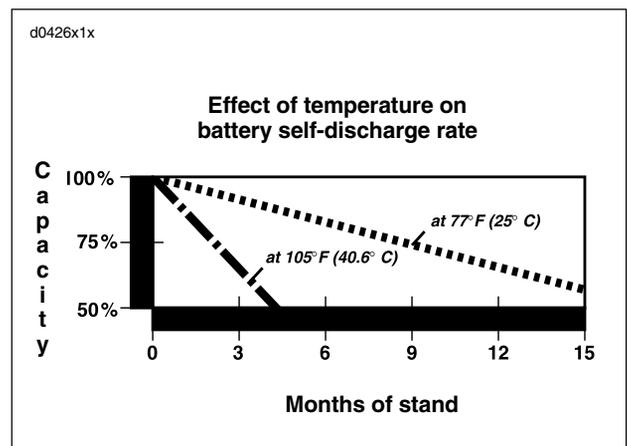


Figure 1-23. Battery Self-Discharge Rate

See Figure 1-23. Self-discharge is a normal condition and occurs continuously at a rate that depends on the ambient temperature and the battery's state of charge. Batteries discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool (not freezing), dry place.

Charge the battery every month if stored at temperatures below 60° F (16° C). Charge the battery more frequently if stored in a warm area above 60° F (16° C).

NOTE

The Battery Tender Plus! Automatic Battery Charger (Part No. 99863-93TA) may be used to maintain battery charge for extended periods of time without risk of overcharging or boiling.

When returning a battery to service after storage, refer to the instructions under 8.9 BATTERY.

FLUID INSPECTION

Check brake fluid reservoir level and condition:

- At the first scheduled service interval.
- At every 5000 mile (8000 km) service interval thereafter.
- When storing or removing the motorcycle for the season.
- Also, check for fluid leaks at every service interval.

CAUTION

Direct contact of D.O.T. 5 brake fluid with eyes can cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 5 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00144a)

1. See Figure 1-24. Check level in rear brake master cylinder reservoir. Level should be 12.7 mm (0.5 in.) below the gasket surface.
 - a. Remove cooling system side cover fastener on underside of side cover.
 - b. Swing out lower section and lift to unhook from top of assembly.
 - c. View fluid level through sight window at rear of reservoir.

CAUTION

To prevent dirt from entering the master cylinder reservoir, thoroughly clean the cover before removal.

2. See Figure 1-26. Check level in front brake master cylinder reservoir. Level should be at 3.2 mm (1/8 in.) below the gasket surface.
3. Install gaskets and covers. Tighten reservoir cover screws to 0.7-0.9 Nm (6-8 in-lbs).

WARNING

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

4. Front brake hand lever and rear brake foot pedal must have a firm feel when applied. If not, bleed system using only D.O.T. 5 SILICONE BRAKE FLUID. See 1.9 BLEEDING BRAKES.

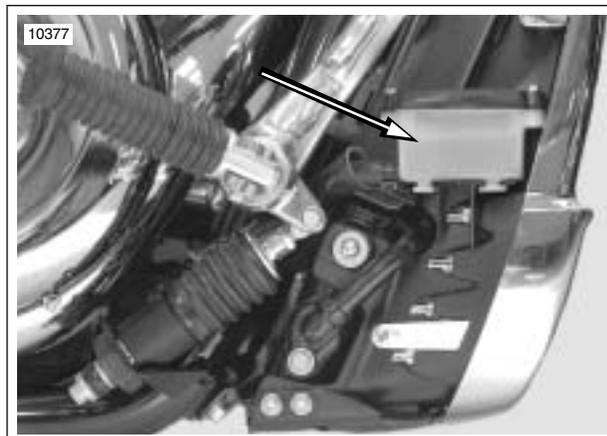


Figure 1-24. Rear Brake Master Cylinder Reservoir



Figure 1-25. Rear Brake Fluid Reservoir Sight Gauge (reservoir removed from motorcycle)

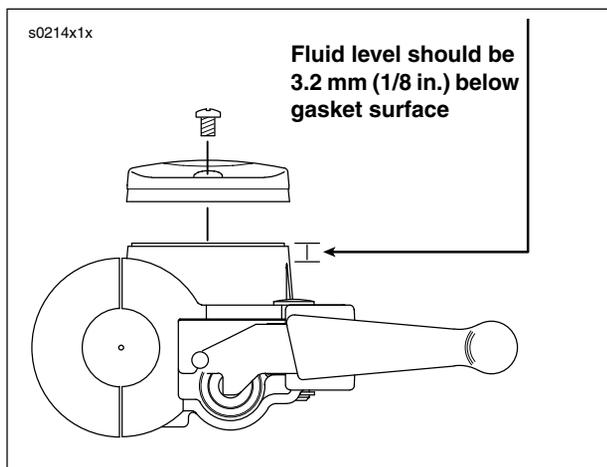


Figure 1-26. Front Brake Master Cylinder Reservoir

REAR BRAKE PEDAL

Pedal Adjustment

If adjustment is needed:

1. See [Figure 1-27](#). With a wrench holding the push rod (1), loosen jamnut (2).
2. Turn push rod (1) to set threaded rod end (3) length (5) to 18-22 mm (0.690-0.890 in.).

NOTE

Measure pedal adjustment from the centerline of the clevis pin (4) to the backside of the jamnut (2).

3. With a wrench holding the push rod (1), tighten jamnut (2).

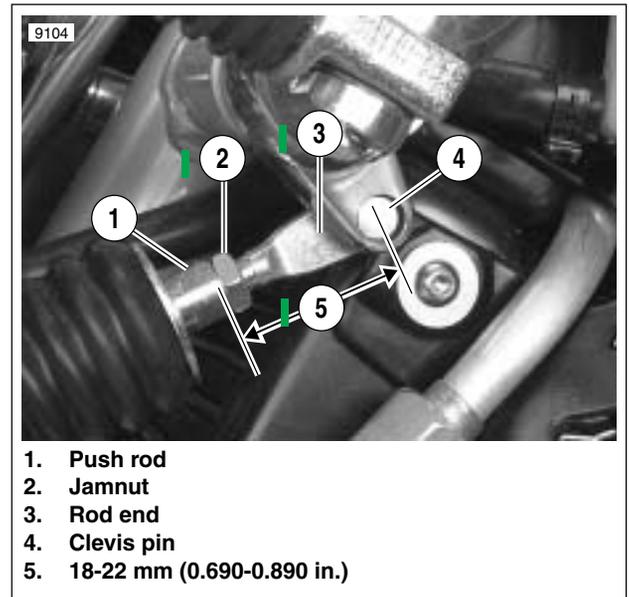


Figure 1-27. Rear Brake Pedal

GENERAL

CAUTION

Direct contact of D.O.T. 5 brake fluid with eyes can cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 5 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00144a)

Check brake fluid level and condition:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) 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. Bleed front and rear brakes separately. Remove bleeder valve cap. Install end of a length of clear plastic tubing over caliper bleeder valve. Place opposite end in a clean container.
 - a. Front brake bleeder valve-see [Figure 1-28](#).
 - b. Rear brake bleeder valve-see [Figure 1-29](#).
2. Stand motorcycle upright. Clean and remove covers to master cylinder reservoir.
3. Add D.O.T. 5 SILICONE BRAKE FLUID to master cylinder reservoir.
 - a. Front brake master cylinder reservoir: Fluid level should be at FILL LEVEL. See [2.17 FRONT BRAKE MASTER CYLINDER/RESERVOIR](#).
 - b. Rear brake master cylinder reservoir: Fluid level should be 12.7 mm (0.5 in.) below reservoir's gasket surface. See [2.19 REAR BRAKE MASTER CYLINDER/RESERVOIR](#).
4. Depress and hold brake lever/pedal to build up hydraulic pressure.
5. Open bleeder valve slowly about 1/2-turn counterclockwise; brake fluid will flow from bleeder valve and through tubing. When brake lever/pedal has moved its full range of travel, close bleeder valve (clockwise). Allow brake lever/pedal to return slowly to its released position.
6. Repeat steps 4-5 until all air bubbles are purged.
7. Remove clear plastic tubing and tighten bleeder valve to 9.0-11.3 Nm (80-100 in-lbs.) Install bleeder valve cap.
8. Verify master cylinder fluid level as described in step 2.

WARNING

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

9. Attach covers to master cylinder reservoirs. Tighten screws on covers to 0.7-0.9 Nm (6-8 in-lbs).

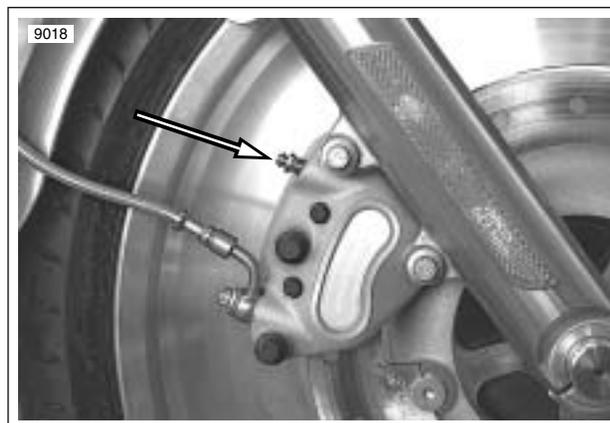


Figure 1-28. Front Brake Bleeder Valve

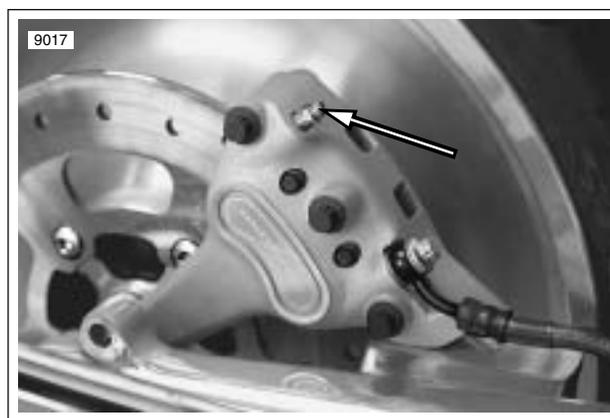


Figure 1-29. Rear Brake Bleeder Valve

INSPECTION

Check brake pads and discs:

- At every scheduled service interval.
- Whenever the components are removed during service procedures.

Brake Pads

CAUTION

Direct contact of D.O.T. 5 brake fluid with eyes can cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 5 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00144a)

WARNING

Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (0011a)

See [Figure 1-30](#). Replace brake pads (3) if brake pad friction material on either the front or rear caliper is worn to service limit. Always replace both pads in a caliper as a set.

- Front brake pads: 1.6 mm (0.06 in.) or less above the backing plate (4).
- All other brake pads: 1.02 mm (0.04 in.) or less above the backing plate (4).

When checking the brake pads and discs, inspect the brake hoses for correct routing and any signs of damage.

Brake Disc Thickness

The minimum brake disc (2) thickness is stamped on the side of the disc. Replace disc if badly scored.

Brake Disc Lateral Runout and Warp

Maximum brake disc lateral runout and warp is 0.3 mm (0.012 in.).

BRAKE PAD REPLACEMENT

Rear Brake Caliper

1. Remove the rear master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 3.2 mm (1/8 in.). You may have to remove fluid to allow for this.
2. See [Figure 1-31](#). Loosen, but do not remove, both pad pins (12 pt/0.25 in.).
3. Pry the inside pad back. Use steady pressure to prevent scoring the brake disc. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.

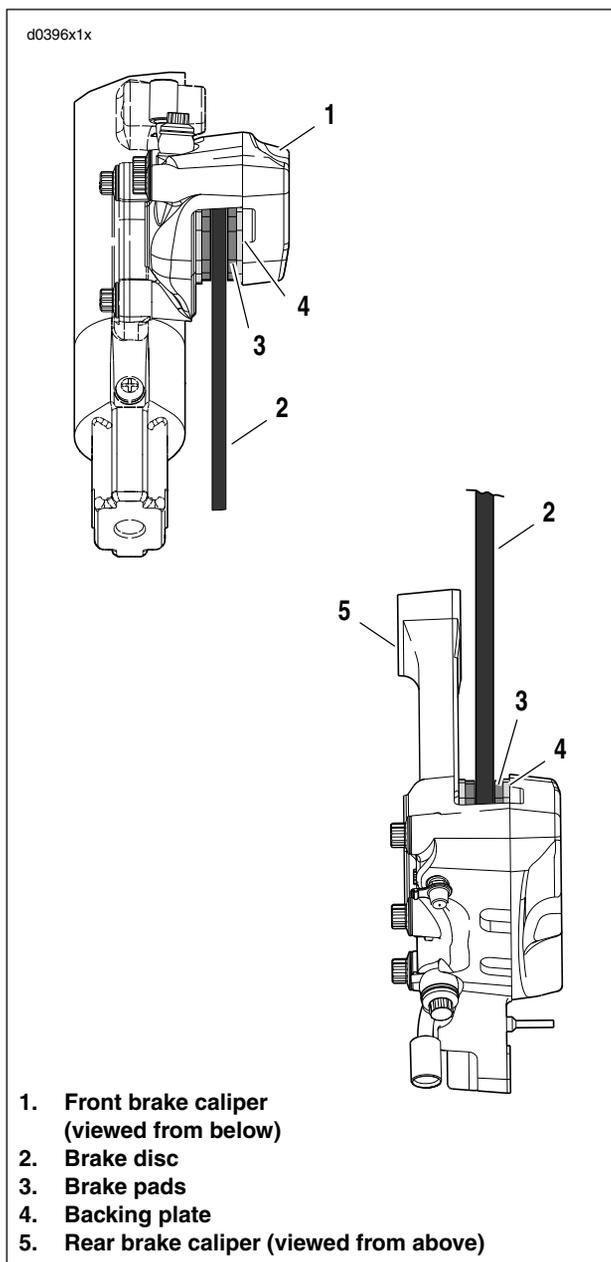


Figure 1-30. Brake Pad Inspection

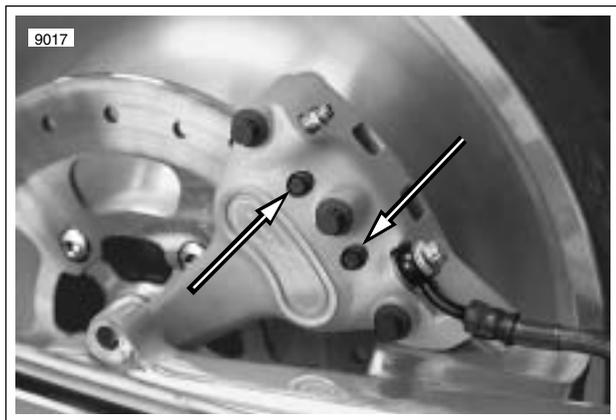


Figure 1-31. Rear Caliper Pad Pins (12 pt/0.25 in.)

CAUTION

Do not completely pull pad pins from caliper during the next step. Completely removing pad pins at this time will cause difficulty during assembly.

- Once the pistons have been fully retracted into their bores, pull pad pins part way until the inside pads drop free. Note the pad's original orientation for replacement purposes.

NOTE

See Figure 1-32. Install pad with two tabs (1) on the inboard side of the rear caliper.

WARNING

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

- Install **new** inside brake pad using the same orientation as the pad previously removed. Curved portion of pad must face upward.
- Install pad pins until the pins snap into place with an audible click. Do not fully tighten at this time.
- Pump brake pedal lever to move inside pistons out until they contact the brake pads.
- Pry the outside pad back. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
- Verify that inside pads are captured between brake disc and pistons. Completely remove pad pins to free outside brake pad. Note the pad's original orientation for replacement purposes.
- Install **new** outside brake pad using the same orientation as the pad previously removed. If the inside pad moved during the previous step, reinstall. Curved portion of pad must face upward.
- Install both pad pins through holes in inner and outer brake pads. Tighten to 20.3-22.6 Nm (180-200 in-lbs).

WARNING

Whenever new pads are installed, **BEFORE** moving motorcycle, you must pump brake fluid until the pistons push the pads against the brake disc. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle which could result in death or serious injury.

- Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
- Check brake fluid level in master cylinder. Fill to proper level if necessary using D.O.T. 5 SILICONE BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.7-0.9 Nm (6-8 in-lbs).

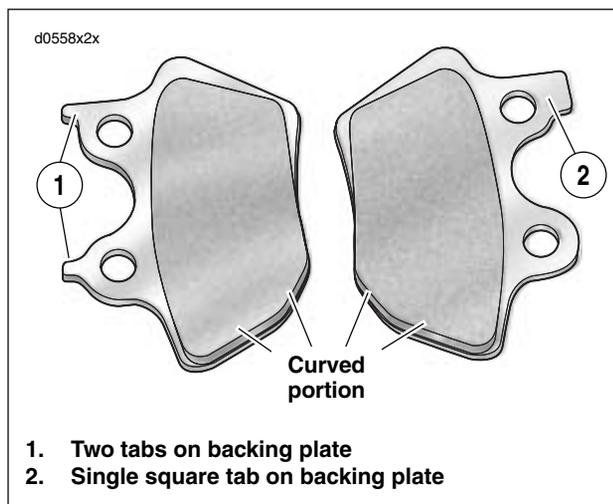
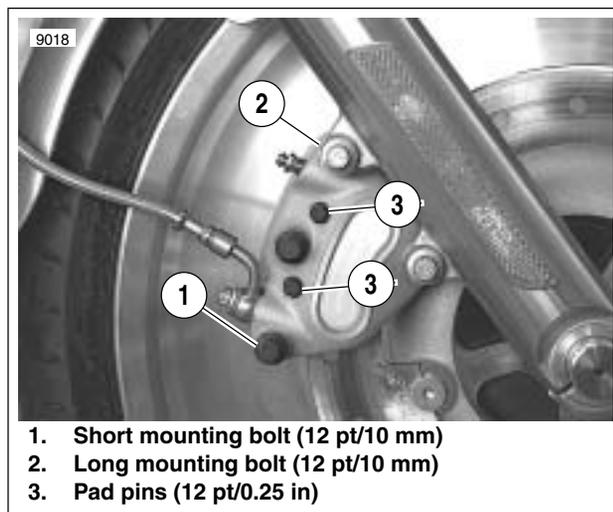


Figure 1-32. Brake Pad Orientation



- Short mounting bolt (12 pt/10 mm)
- Long mounting bolt (12 pt/10 mm)
- Pad pins (12 pt/0.25 in)

Figure 1-33. Front Brake Caliper (Right Side Shown)

⚠ WARNING

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

14. Test brake system.
 - a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.9 BLEEDING BRAKES.

NOTE

Avoid making hard stops for the first 100 miles (160 km). This allows the **new** pads to become conditioned to the brake discs.

Front Brake Caliper

1. Remove the front master cylinder reservoir cap. As the pistons are pushed back into the caliper, fluid level may rise more than 1/8 in. (3.2 mm). You may have to remove fluid to allow for this.
2. See Figure 1-33. Loosen, but do not remove, both pad pins (3) (12 pt/0.25 in.).
3. Remove both caliper mounting bolts (1, 2) (metric). Detach caliper from front forks and brake disc.
4. Pry the pads back to force all four caliper pistons into their bores.
5. With the pistons retracted, remove the pad pins and brake pads.

NOTES

- See Figure 1-32. On the right side of the vehicle, the pad with two tabs (1) installs on the inboard side of the caliper.
 - On the left side of the vehicle, the pad with two tabs (1), installs on the outboard side of the caliper.
 - Do not substitute front and rear brake pads.
6. Install **new** pads into caliper. Curved portion of pad must face rear of motorcycle.
 7. Loosely install the pad pins until you hear an audible click.
 8. Attach caliper to front fork.
 - a. See Figure 1-33. Place caliper over brake disc with bleeder valve facing upwards.
 - b. Loosely install long mounting bolt (2) (12 pt/10 mm) into top hole on fork leg.
 - c. Install short mounting bolt (1) (12 pt/10 mm) into bottom hole on fork leg. Tighten bottom mounting bolt to 38.0-51.5 Nm (28-38 ft-lbs).
 - d. Final tighten the top mounting bolt to 38.0-51.5 Nm (28-38 ft-lbs).
 - e. Final tighten both pad pins to 20-23 Nm (180-200 in-lbs).

⚠ WARNING

Whenever new pads are installed, **BEFORE** moving motorcycle, you must pump brake fluid until the pistons push the pads against the brake disc. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle which could result in death or serious injury.

9. Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads. If the front wheel is off the ground, rotate wheel to check for excessive brake pad drag.
10. Check brake fluid level in master cylinder. Fill to proper level if necessary using D.O.T. 5 SILICONE BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 0.7-0.9 Nm (6-8 in-lbs).

⚠ WARNING

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

11. Test brake system.
 - a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - b. Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.9 BLEEDING BRAKES.

NOTE

Avoid making hard stops for the first 100 miles (160 km). This allows the **new** pads to become conditioned to the brake discs.

TIRES

WARNING

Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a)

- In addition, using tires other than those specified may adversely affect motorcycle handling.
- Inner tubes must not be used in radial tires and radial tires must not be used on laced (wire spoked) wheels.
- Tubeless tires are used on all Harley-Davidson cast and disc wheels.
- Tire sizes are molded on the tire sidewall. Inner tube sizes are printed on the tube.

Check tire pressure and tread:

- As part of the pre-ride inspection.
 - At every scheduled service interval.
1. Inspect each tire for punctures, cuts, and breaks.
 2. Inspect each tire for wear. See TIRE REPLACEMENT under [2.26 TIRES](#). Replace tires before they reach the tread wear indicator bars.

NOTE

Missing indicator wear bars represent less than 0.8 mm (1/32 in.) tread pattern depth remaining.

WARNING

Do not inflate tire beyond maximum pressure as specified on sidewall. Over inflated tires can blow out, which could result in death or serious injury. (00027a)

3. Check for proper front and rear tire pressures when tires are cold. Refer to [Table 1-3](#). Adjust pressure if required.

WHEEL BEARINGS

Service wheel bearings:

- Inspect any time the wheels are removed.
- Replace when bearings exceed end play service wear limit of 0.051 mm (0.002 in.).

Check wheel bearings and axle spacers for wear and corrosion. Excessive play or roughness indicates worn bearings. Replace bearings in sets only. See [2.25 SEALED WHEEL BEARINGS](#).

Table 1-3. Tire Pressures

| DUNLOP TIRES ONLY | | SOLO RIDER | | RIDER & ONE PASSENGER | |
|-------------------|-------|------------|-----|-----------------------|-----|
| MODEL | TIRE | PSI | kPA | PSI | kPA |
| VRSC | Front | 36 | 248 | 36 | 248 |
| | Rear | 38 | 262 | 40 | 276 |

GENERAL

The clutch is hydraulically actuated. A hand lever actuated master cylinder creates pressure in a clutch fluid line that activates a secondary clutch actuator mounted in the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing to release the clutch.

CAUTION

D.O.T. 5 silicone hydraulic brake fluid is used in the hydraulic clutch. Do not use other types of fluids as they are not compatible and could cause equipment damage. (00204a)

CHECKING CLUTCH FLUID LEVEL

Though the sight gauge in the top of the reservoir cover will indicate a low clutch fluid level when the gauge is clear, the cover should always be removed to verify fluid level.

WARNING

Check that no lubricant gets on rear tire, wheel or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00o47a)

CAUTION

Do NOT allow dirt or debris to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation of the clutch and equipment damage. (00205a)

WARNING

Direct contact of D.O.T. 5 brake fluid with eyes can cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 5 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00144a)

1. Stand motorcycle upright and square handlebars to level clutch reservoir.
2. Clean and remove reservoir cover.

CAUTION

Clutch fluid volume actually increases with clutch wear. Do not overfill reservoir.

3. Verify that fluid level is at FILL LEVEL marked on ledge on rear inside wall of reservoir.
4. If necessary, add D.O.T. 5 SILICONE BRAKE FLUID, (HD-99902-77) to master cylinder reservoir. Fluid level should not exceed FILL LEVEL.
5. Tighten reservoir cover screws to 0.7-0.9 Nm (6-8 in-lbs).

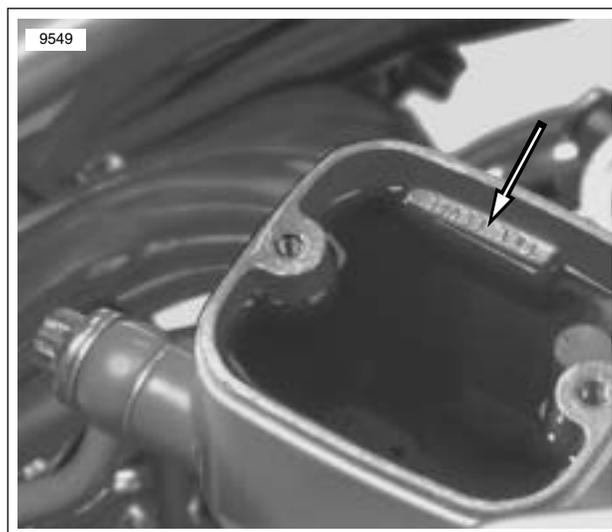


Figure 1-34. Fill Level (reservoir cover removed)

PROCEDURE

WARNING

Check that no lubricant gets on rear tire, wheel or brakes when changing fluid. Traction can be adversely affected, which could result in loss of control of the motorcycle and death or serious injury. (00047a)

CAUTION

Do NOT allow dirt or debris to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir can cause improper operation of the clutch and equipment damage. (00205a)

CAUTION

Direct contact of D.O.T. 5 brake fluid with eyes can cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 5 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00144a)

NOTE

When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the secondary clutch actuator bleeder screw threads can be used to initially draw the fluid down the clutch line.

1. Stand motorcycle upright and square handlebars to level clutch reservoir. Remove reservoir cover.

CAUTION

Clutch fluid volume actually increases with clutch wear. Do not overfill reservoir.

2. If necessary, add D.O.T. 5 SILICONE BRAKE FLUID, (HD-99902-77) to master cylinder reservoir. Initial fluid level should not exceed FILL LEVEL.

CAUTION

Loosen banjo bolt only enough to allow air bubbles to escape. Clutch fluid under pressure can squirt a steady stream several feet.

3. While holding reservoir cover in place:
 - a. Pump clutch hand lever 5 times.
 - b. Hold clutch hand lever against handlebar.
 - c. Hold shop towel under fitting and loosen banjo bolt.
 - d. Watch banjo fitting for air bubbles.
 - e. Retighten banjo fitting.
 - f. Release hand lever.
4. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes banjo fitting and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.
5. Remove secondary clutch actuator cover.
6. Cover exhaust with towel and place a suitable pan under right side case to catch excess clutch fluid.

7. While holding reservoir cover in place:
 - a. Pump clutch hand lever 5 times.
 - b. Hold clutch hand lever against handlebar.
 - c. Loosen secondary clutch actuator bleed screw.
 - d. Watch bleed screw for air bubbles.
 - e. Tighten bleeder screw.
 - f. Release hand lever.
8. Fill reservoir to FILL LEVEL and repeat the previous step three times or more until only a steady flow of clutch fluid escapes bleeder screw and fluid level in reservoir is at FILL LEVEL with motorcycle in an upright position.

CAUTION

Clutch fluid volume actually increases with clutch wear. Do not overfill reservoir.

9. Test pressure by squeezing clutch hand lever.

NOTE

If continued repetition of procedure does not build pressure in line and maintain FILL LEVEL, there is a leak in the clutch system. If the leak is not visible, remove and check the secondary clutch actuator boot for leakage.

10. Tighten fasteners as follows:
 - a. Reservoir banjo bolt to 23-31 Nm (17-23 ft-lbs).
 - b. Reservoir cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
 - c. Bleed screw to 9-11 Nm (80-100 **in-lbs**).
 - d. Secondary clutch actuator cover fasteners to 6-10 Nm (53-88 **in-lbs**).
11. Test ride motorcycle. Incorrect pressure can cause:
 - a. Dragging clutch.
 - b. Hard shifting.

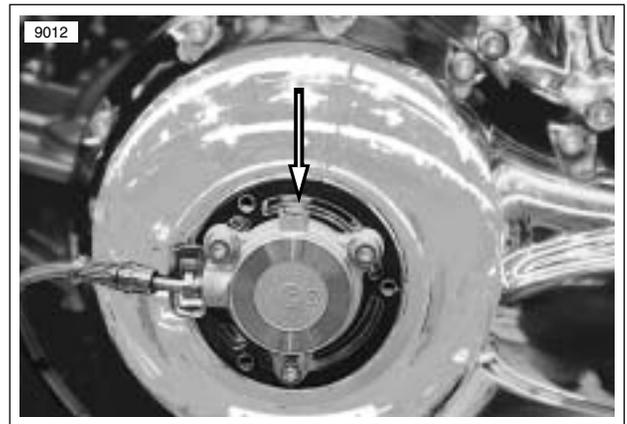


Figure 1-35. Secondary Clutch Actuator Bleed Screw

INSPECTION

| PART NO. | SPECIALTY TOOL |
|----------|--------------------|
| HD-35381 | Belt tension gauge |

Check rear belt deflection:

- As part of the pre-ride inspection.
- At every scheduled service interval.

NOTE

Customers may purchase belt tension gauge from an authorized Harley-Davidson dealer.

CAUTION

Setting tension without using **BELT TENSION GAUGE** typically results in loose belts. Loose belts will fail due to ratcheting (jumping a tooth) which causes tensile cord crimping and breakage.

1. See [Figure 1-36](#). Check rear belt tension with motorcycle cold, standing upright, transmission in NEUTRAL and no rider on motorcycle.
2. See [Figure 1-37](#). Using **BELT TENSION GAUGE (HD-35381)**, apply 4.5 kg (10 lbs) of force upward.
3. Verify that the drive belt deflects 6 mm.

NOTE

Belt deflection window on the debris deflector is graduated in 2 mm increments.



Figure 1-36. Belt Tension Gauge (HD-35381)

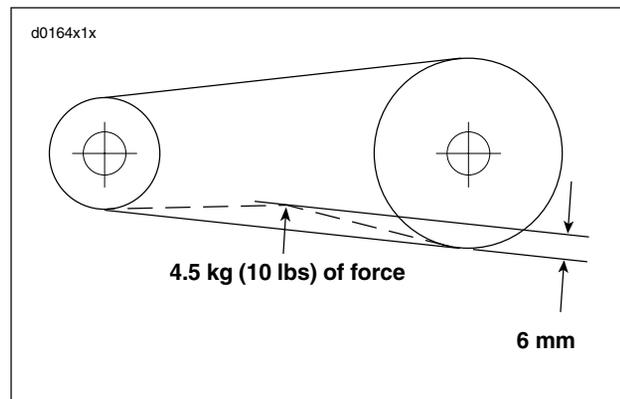


Figure 1-37. Checking Belt Deflection

4. If belt adjustment is necessary, see [Figure 1-38](#). Remove snap ring (1) and loosen axle nut (2) on right side of motorcycle.

NOTE

The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten belt. Counterclockwise rotation will loosen belt.

5. Adjust belt tension on left side by turning the axle adjustment eccentric (3) until the specification in step 2 is achieved.

⚠ WARNING

Do not exceed 142.4 Nm (105 ft-lbs) when tightening the axle nut. Exceeding 142.4 Nm (105 ft-lbs) may cause the wheel bearings to seize during operation, which could result in death or serious injury.

6. Tighten axle nut (2).
 - a. Tighten axle nut (2) to 129.0-142.4 Nm (95-105 ft-lbs).
 - b. Install snap ring (1).

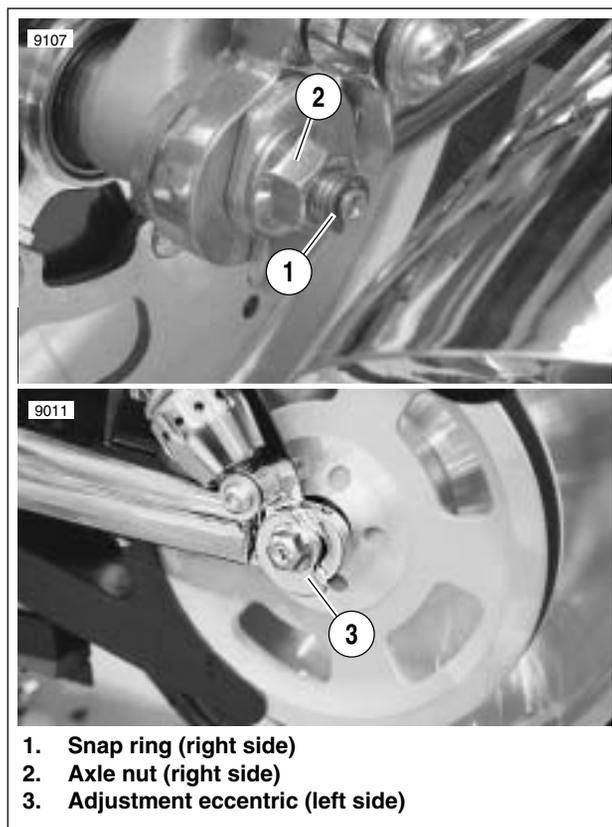


Figure 1-38. Axle Adjusters

GENERAL

Inspect the drive belt and wheel sprocket:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) service interval thereafter.

NOTE

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

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets.

Clean the belt with a rag which is slightly damp with a light cleaning agent.

INSPECTION

Sprocket

NOTE

If chrome chips or gouges in wheel sprocket are large enough to be harmful, they will leave a pattern on the belt face.

1. See [Figure 1-39](#). Inspect each tooth (1) of rear sprocket for:
 - a. Major tooth damage.
 - b. Large chrome chips with sharp edges.
 - c. Gouges caused by hard objects.
 - d. Excessive loss of chrome plating (see step 2).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
 - a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
 - b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.

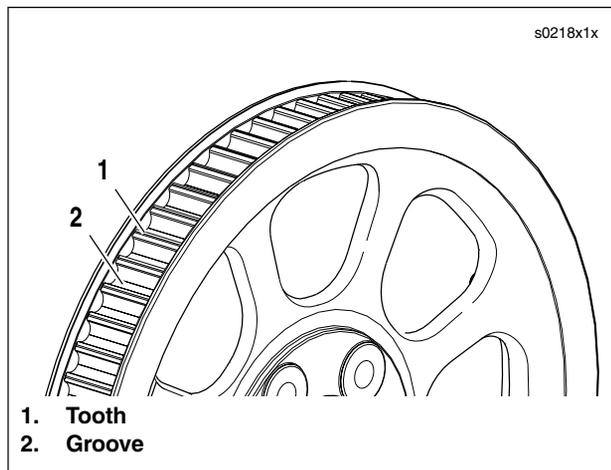


Figure 1-39. Rear Sprocket

Drive Belt

See [Figure 1-40](#). Inspect drive belt for:

- Cuts or unusual wear patterns.
- Outside edge bevelling (8). Some bevelling is common, but it indicates that sprockets are misaligned.
- Outside ribbed surface for signs of stone puncture (7). If cracks/damage exists near edge of belt, replace belt immediately. Damage to center of belt will require belt replacement eventually, but when cracks extend to edge of belt, belt failure is imminent.
- Inside (toothed portion) of belt for exposed tensile cords (normally covered by nylon layer and polyethylene layer). This condition will result in belt failure and indicates worn transmission sprocket teeth. Replace belt and transmission sprocket.
- Signs of puncture or cracking at the base of the belt teeth. Replace belt if either condition exists.
- Replace belt if conditions 2, 3, 6 or 7 (on edge of belt) exist. See [1.14 REAR BELT DEFLECTION](#).

NOTE

Refer to [Table 1-4](#). Condition 1 may develop into 2 or 3 over time. Condition 1 is not grounds for replacing the belt, but it should be watched closely before condition 2 develops which will require belt replacement.

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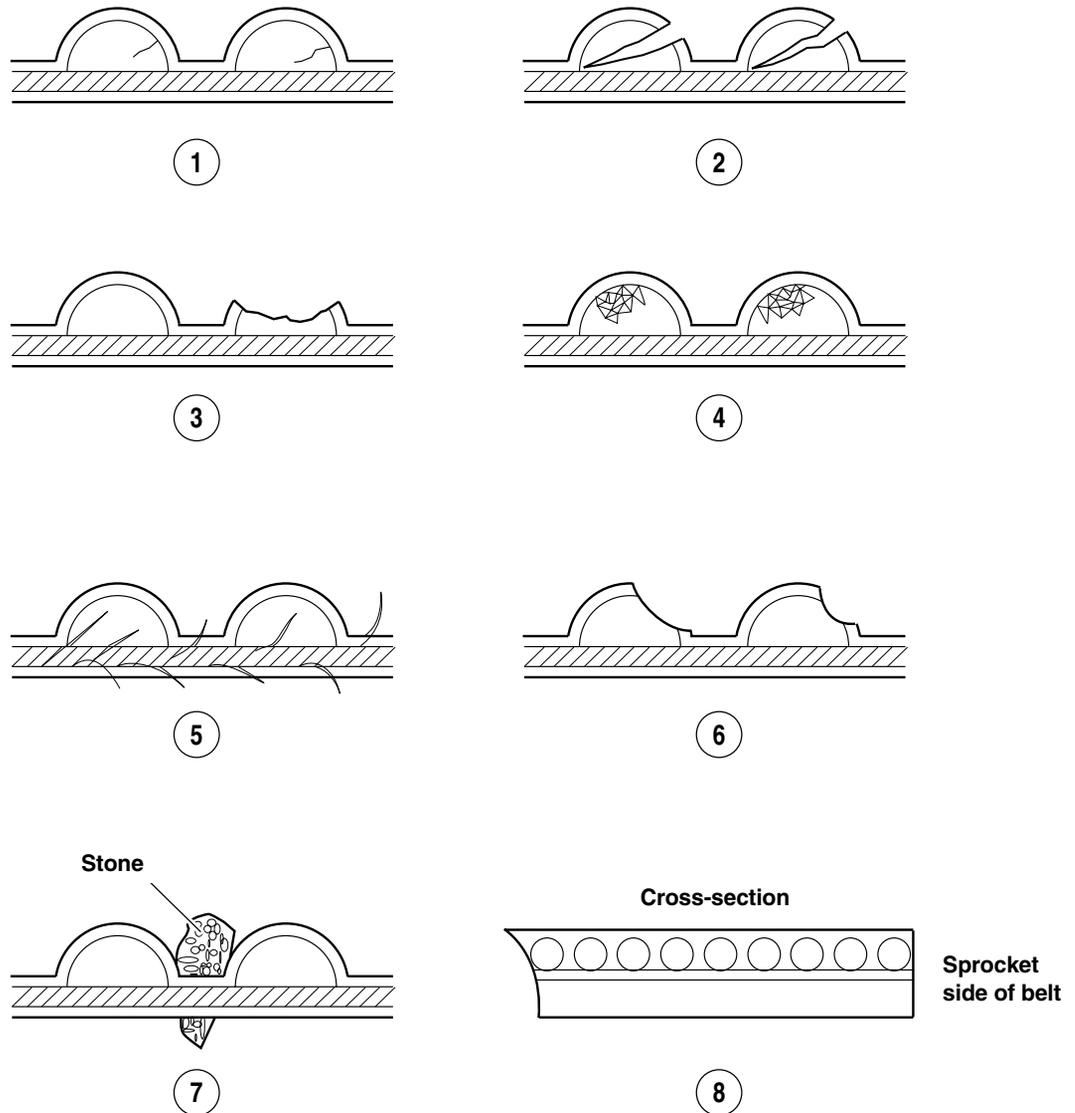


Figure 1-40. Drive Belt Wear Patterns

Table 1-4. Drive Belt Wear Analysis

| PATTERN | CONDITION | REQUIRED ACTION |
|---------|----------------------------------|---------------------------------------|
| 1 | Internal tooth cracks (hairline) | OK to run, but monitor condition |
| 2 | External tooth cracks | Replace belt |
| 3 | Missing teeth | Replace belt |
| 4 | Chipping (not serious) | OK to run, but monitor condition |
| 5 | Fuzzy edge cord | OK to run, but monitor condition |
| 6 | Hook wear | Replace belt |
| 7 | Stone damage | Replace belt if damage is on the edge |
| 8 | Bevel wear (outboard edge only) | OK to run, but monitor condition |

REPLACEMENT

1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
2. See Figure 1-42. Remove drive sprocket cover (6) fasteners (9) and washers (8). Grommets (7) and bushings (10) should stay with cover (6).
3. See Figure 1-42. Loosen locking bolts (5) holding drive sprocket (3) to drive sprocket flange (4).
4. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.
5. Remove fastener holding lower debris deflector to rear fork. Pull debris deflector rearward off of rubber grommet. See 2.33 BELT GUARD/DEBRIS DEFLECTOR.
6. Loosen left lower shock bolt out until belt guard is free and pull belt guard rearward off of rubber grommets.
7. Remove axle retaining ring and loosen axle nut and adjuster from right side of axle.
8. Relieve belt tension by rotating axle adjusters.

CAUTION

Polished aluminum wheels can be scratched or damaged when slid out of and into the rear fork. Exercise caution to avoid dragging wheel and sprocket surfaces against rear fork components.

9. Remove shock bolt and swing shock up and out of the way.
10. See Figure 1-42. Slip drive belt (2) off wheel sprocket (1) and drive sprocket (3).
11. Inspect both drive and wheel sprocket for indicators of wear, misalignment, and damage. See 1.15 Drive BELT AND Wheel SPROCKET.

NOTE

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

NOTE

Do not remove the drive sprocket flange nut.

12. Remove locking bolts (5) from drive sprocket. Discard bolts (5).
13. Rotate drive sprocket (3) to fit spoke pattern of flange (4) and remove sprocket (3).
14. Install drive sprocket (3) by matching spokes of drive sprocket to open spaces of drive sprocket flange (4) and rotate drive sprocket (3) to align sprocket bolt holes behind mounting flange (4) bolt holes.
15. Install and tighten three **new** locking bolts (5) to 88-102 Nm (65-75 ft-lbs).

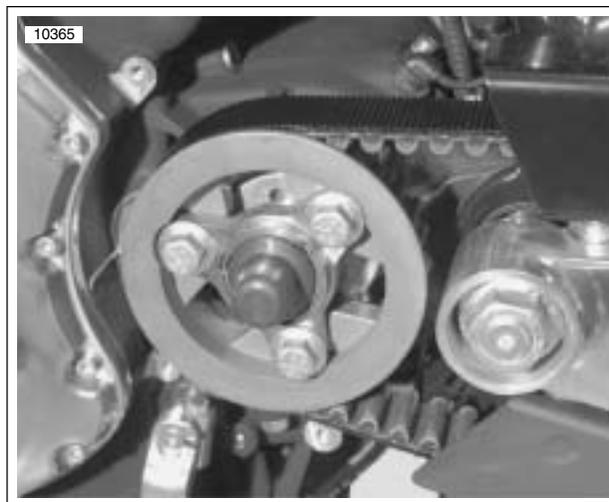


Figure 1-41. Drive Sprocket

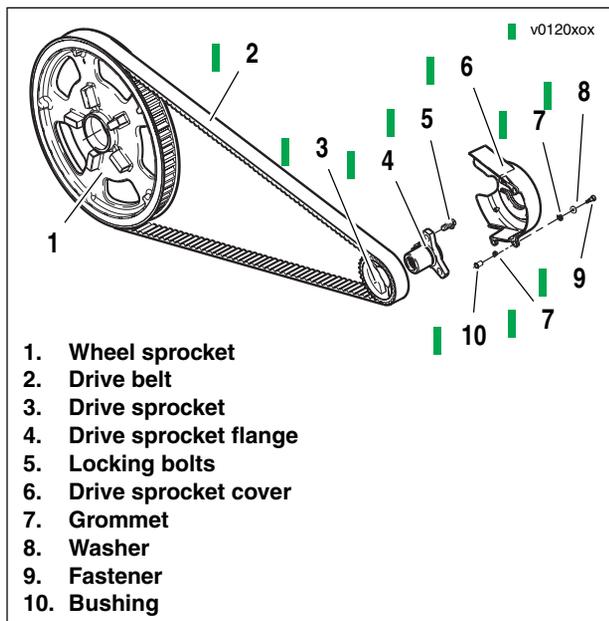


Figure 1-42. Sprocket and Belt Components

16. Remove the rear wheel and replace the wheel sprocket. See [2.24 REAR WHEEL](#).
17. See [Figure 1-42](#). Fit replacement belt (2) around drive sprocket (3) and over wheel sprocket (1).
18. Rotate axle adjusters to seat drive belt on sprockets. Tighten axle nut to hold in place.
19. Slide belt guard slots onto rubber grommet.
20. Thread shock mount bolt into belt guard and tighten shock mount bolt to 41-68 Nm (30-50 ft-lbs).
21. Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector fastener and tighten to 6-10 Nm (53-88 **in-lbs**).
22. Measure belt guard to drive sprocket clearance.
23. If clearance is less than 5 mm (0.197 in.), protect guard/sprocket and adjust as required.
24. Verify axle alignment and check belt deflection. See [1.14 REAR BELT DEFLECTION](#).
25. Use a wrench to rotate rear axle adjuster until drive belt deflection is within specifications.

 **WARNING**

Do not exceed 142 Nm (105 ft-lbs) when tightening the axle nut. Exceeding 142 Nm (105 ft-lbs) will cause the wheel bearings to seize during vehicle operation, which could result in death or serious injury.

26. Tighten axle nut to 129-142 Nm (95-105 ft-lbs).
27. Install snap ring.
28. Install belt drive sprocket cover (6). Tighten cover fasteners (9) to 6-10 Nm (53-88 **in-lbs**).
29. Install maxi-fuse and right side cover.

REAR SHOCK PRELOAD

| PART NO. | SPECIALTY TOOL |
|--------------|----------------|
| HD-94700-52C | Spanner wrench |

The rear shock absorber springs can be adjusted for motor-cycle load. A spanner wrench is required for this adjustment.

⚠ WARNING

Be sure both shock absorbers are adjusted to same preload position. Improper adjustment can adversely affect stability and handling, which could result in death or serious injury. (00036a)

The rear shock absorber springs can be adjusted to five positions to compensate for various loads.

- For heavy loads, the springs should be compressed.
- For lighter loads the springs should be extended.

See [Figure 1-43](#). To adjust the rear shock absorber, turn spring adjusting cam to desired position with SPANNER WRENCH (HD-94700-52C). Both spring adjusting cams must be adjusted to the same position.



Figure 1-43. Rear Shock Adjustment

ADJUSTMENT (FALL-AWAY)

Check steering head:

- At the 1600 km (1000 mile) service interval, adjust steering head bearing fall away.
 - At every 48,280 km (30,000 mile) service interval, disassemble, inspect and repack the steering head bearing. See 2.31 STEERING HEAD.
1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
 2. Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front end swings.

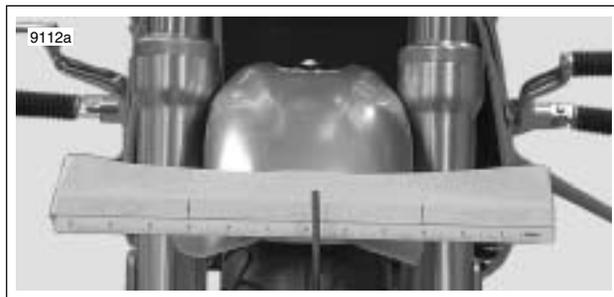


Figure 1-44. Fall-away Measurement

3. See Figure 1-44. Place masking tape on front fender to protect surface. Tape ruler to protected area on front fender.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the fender. The front end should be straight ahead, however the balance point may be slightly off center.
5. See Figure 1-50. Loosen fork stem bracket pinch bolts (1).
6. Check steering fall-away.
 - a. Tap the tire on one side until the front end begins to “fall-away.” Record mark on ruler.
 - b. Tap the tire on the opposite side until the front end begins to “fall-away.” Record mark on ruler.
 - c. Measure distance between marks or subtract reading at one mark from reading at other.
7. The distance between the “fall-away” marks must be 127-178 mm (5.0-7.0 in.). Tighten or loosen adjuster nut (9) until the measurement is within limits.
 - a. Remove fork stem cap (6), bend down the fork stem lockwasher tabs (8), and loosen fork stem nut (7).
 - b. If the distance is more 178 mm (7.0 in.) loosen adjusting nut (9).
 - c. If it is less than 127 mm (5.0 in.), tighten the adjusting nut (9).

NOTE

Tighten fork stem nut (7) to 61-74.5 Nm (45-55 ft-lbs) each time fall-away is checked.



Figure 1-45. Steering Head

NOTE

If adjustment seems to have no impact, check to see if fork tubes are stuck in clamps. If necessary, strike triple clamps with a dead blow hammer to free. Retest steering head bearing tension after freeing forks.



Figure 1-46. Tighten Steering Head

8. Tighten fork stem bracket pinch bolts (1) to 41-47 Nm (30-35 ft-lbs).
9. Repeat the “fall-away” procedure to be sure the adjustment is correct.
10. When fall-away is within 127-178 mm (5.0-7.0 in.) bend up the fork stem lock washer tab (8) and reinstall fork stem cap (6).

REPLACING FORK OIL

Replace front fork oil in models with hydraulic forks:

- At every 48,000 km (30,000 mile) service interval.
- Prior to extended storage.

| PART NO. | SPECIALTY TOOL |
|-----------|---------------------|
| HD-41177 | Fork tube holder |
| HD-59000A | Pro-level oil gauge |

1. Support the motorcycle so the front end is off the floor and the forks are fully extended.
2. See 2.18 FRONT BRAKE CALIPERS. Remove front brake caliper.
3. See 2.23 FRONT WHEEL. Remove front wheel.
4. See 2.29 FRONT FENDER. Remove front fender.
5. See Figure 1-50. Loosen, but do not remove slider tube caps (2).
6. Loosen upper and lower triple clamp pinch screws (1).
7. Pull the fork slides from the brackets.
8. See Figure 1-47. Use FORK TUBE HOLDER (HD-41177) to clamp fork in vise without damaging the slider tube.

CAUTION

Be aware slider tube cap is under spring tension. Remove carefully to avoid injury.

9. See Figure 1-50. Remove slider tube cap (2).
10. Remove spring collar (3), washer (4), and spring (5).
11. Invert forks over a suitable container and extend and retract the slider several times. Allow the fork to drain in the inverted position.
12. See Figure 1-47. Position the fork tube in the FORK TUBE HOLDER.
13. Refer to Table 1-5. Oil amount is determined by filling to a measured level. With the slider tube fully compressed, fill the fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 50 mm (2 in.) from the top of the fork tube.
14. Slowly pump the slider tube 8 to 10 times to exhaust air from the system. Fully compress the slider tube to determine oil level.
15. See Figure 1-48. Using the PRO-LEVEL OIL GAUGE (HD-59000A), adjust the oil level to 85 mm (3.3 in.) from top of fork tube.
16. See Figure 1-50. Reassemble the fork making sure tightly wound end of the spring (5) goes to the bottom.
17. Install washer (4) and spring collar (3).
18. Install and tighten fork tube caps to 29.8-78.6 Nm (22-58 ft-lbs).
19. See Figure 1-49. Install fork tube assemblies in triple clamp brackets. Fork tube should project above upper triple clamp 6.4-9.7 mm (0.25-0.38 in.).

Table 1-5. Type E Fork Oil Levels

| MODEL | MM | IN. |
|-------|----|-----|
| VRSC | 85 | 3.3 |

NOTE

Fork oil level is measured from top of fork tube, with spacer and spring removed and fork fully compressed.

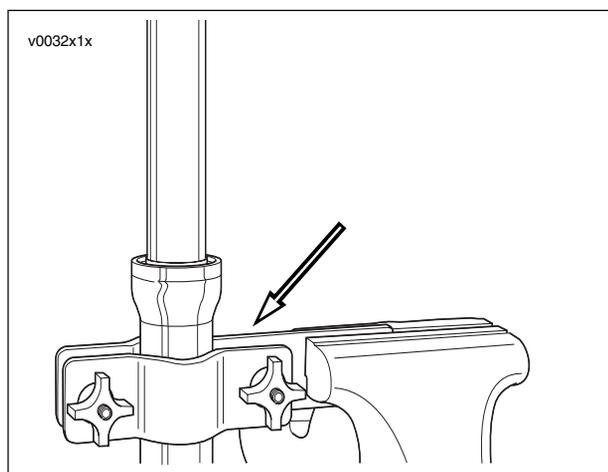


Figure 1-47. Fork Tube Holder (HD-41177)

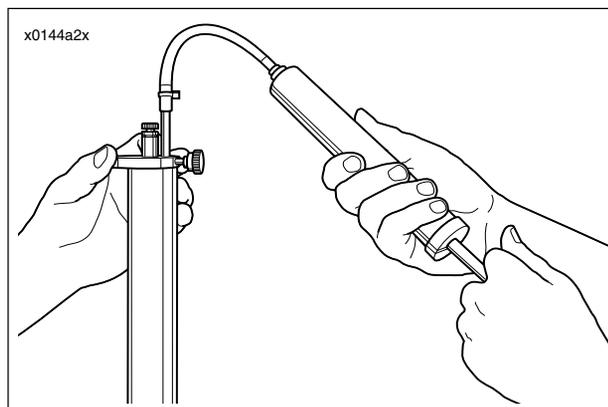


Figure 1-48. Fork Fluid Level

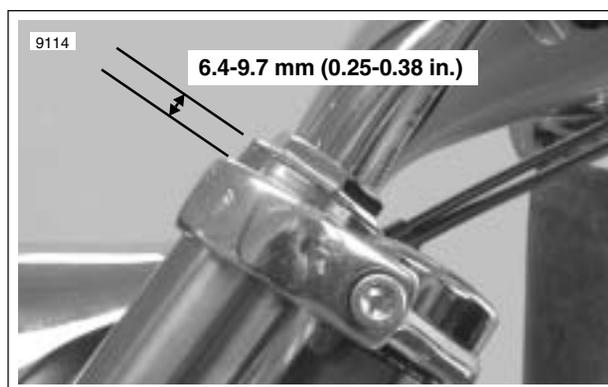
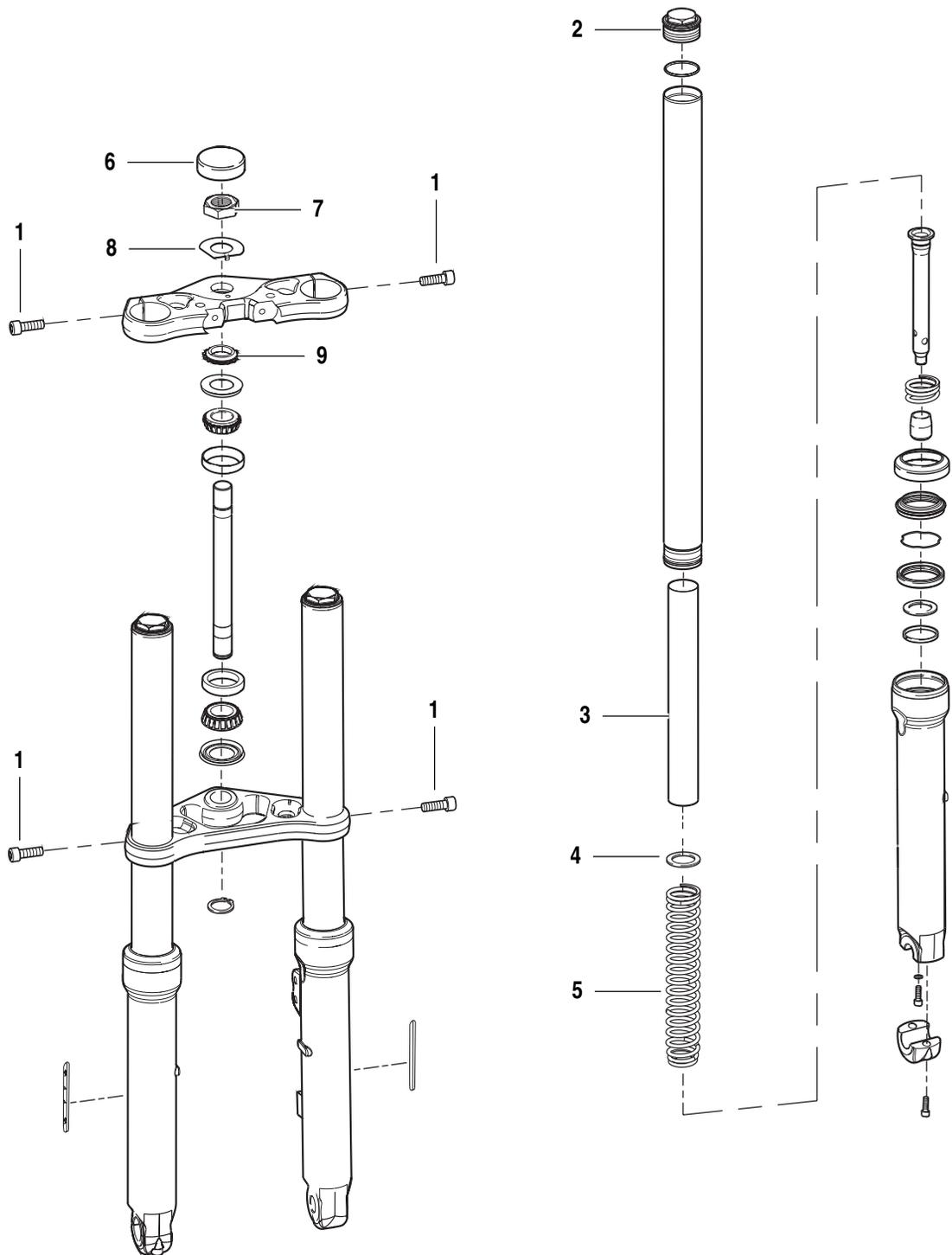


Figure 1-49. Fork Tube Position

v0020x1x



1. Pinch bolts
2. Slider tube cap
3. Spring collar
4. Washer
5. Spring
6. Fork stem cap
7. Fork stem nut
8. Fork stem nut lockwasher
9. Adjusting nut

Figure 1-50. Fork Components

GENERAL

The spark plugs have been carefully selected for the performance characteristics of the VRSC engine. Use only **10R12A** spark plugs in the VRSC engine.

CAUTION

Use only Harley-Davidson spark plugs made for the VRSC. Use of other spark plugs may affect the running characteristics of the engine and could result in serious engine damage.

REMOVAL/INSPECTION

Check spark plugs:

- Inspect at every 8000 km (5000 mile) service interval.
 - Replace every 16,000 km (10,000 mile) service interval.
1. After the engine has cooled to room temperature remove airbox assembly. See [1.4 AIRBOX AND AIR FILTER](#).
 2. Lift fuse block off the retaining bracket and move to side.
 3. See [Figure 1-51](#). Remove rear coil fasteners (1).
 4. Detach connector (2) [83R] at rear coil, [83F] at front coil.
 5. Pull coil and boot assembly straight up to disconnect spark plug.
 6. Using a spark plug socket with plug retaining sleeve, remove rear spark plug.
 7. Remove battery for access to front spark plug. See [1.7 BATTERY MAINTENANCE](#).
 8. Remove front plug following steps 3 through 6.

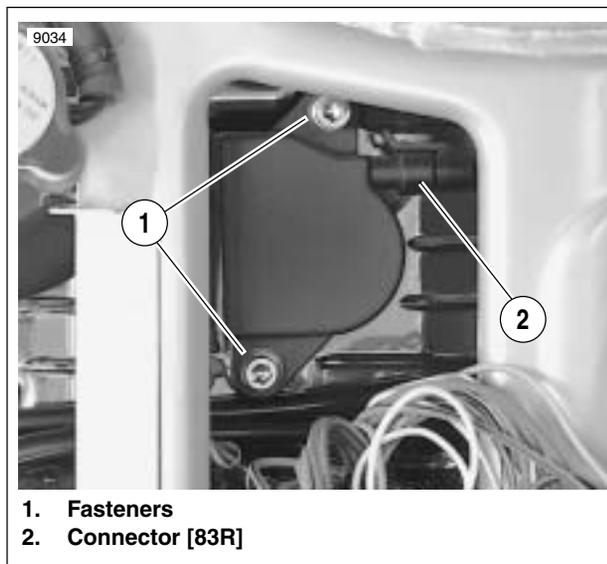


Figure 1-51. Rear Cylinder Coil

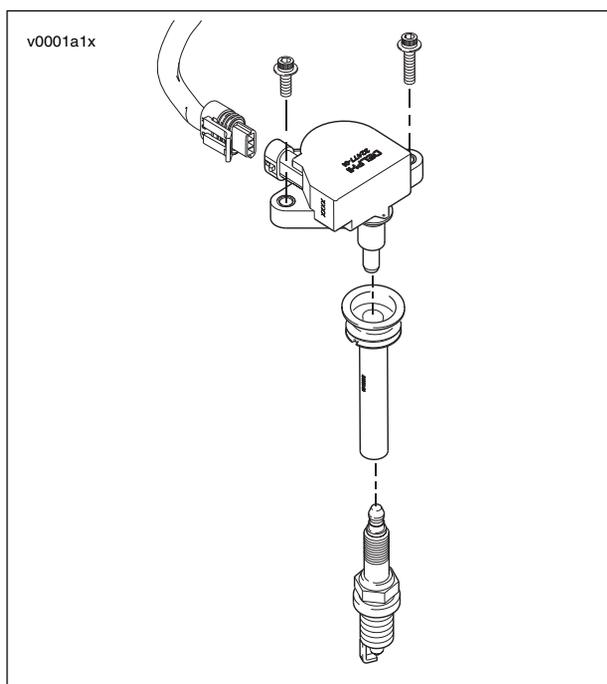


Figure 1-52. Plug Top Coil

9. See [Figure 1-53](#). Compare your observations of the plug deposits with the descriptions provided.

- 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.
- A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.
- 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.
- A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.

10. If the plugs require cleaning between tune-ups, proceed as follows:

- Degrease firing end of spark plug using **ELECTRICAL CONTACT CLEANER**. Dry plug with compressed air.
- 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.
- If the plugs cannot be cleaned, replace with No. **10R12A** spark plugs.

11. Check electrode gap with a wire-type feeler gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Proper gap measurement is 0.89 mm (0.035 in.).

12. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.



Figure 1-53. Typical Spark Plug Deposits

INSTALLATION

- Apply **LOCTITE ANTI-SEIZE** to plug threads. Install and tighten to 23 Nm (17 ft-lbs).
- Install coil and boot assembly over spark plug with wiring connector facing rear of motorcycle.
- Insert coil fasteners with long fastener used on left side. Tighten to 23 Nm (17 ft-lbs).
- Connect connectors [83R] and [83F].
- Install battery. See [1.7 BATTERY MAINTENANCE](#).
- Install airbox assembly. See [1.4 AIRBOX AND AIR FILTER](#).

GENERAL

Inspect and lubricate the front brake lever, clutch hand lever, throttle control cables, and jiffy stand:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) service interval thereafter.
- If service is on muddy or dusty roads, clean and lubricate components at shorter intervals.

CABLES AND HAND LEVERS

Inspect and lubricate throttle cables. See [1.22 THROTTLE CABLES](#) for throttle cables.

Use SUPER OIL (Part No. HD-94968-85TV) for hand levers.

JIFFY STAND

Clean and lubricate the jiffy stand:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) service interval thereafter.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals.

FUEL SYSTEM LINES AND FITTINGS

1. Inspect the fuel system lines.
2. Check the fuel system lines and fittings for leaks.
3. See [Figure 1-54](#). Check fuel system lines for chafing against frame components.

HYDRAULIC LINES

1. Inspect hydraulic brake fluid lines and clutch fluid lines for leaks.
2. On VRSCA models, check inside clear plastic tubing over braided lines for leakage inside tubing.

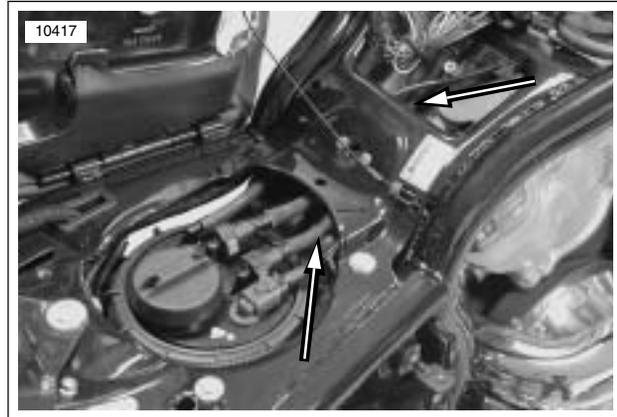


Figure 1-54. Fuel Line Inspection Points

INSPECTION

Inspect the throttle cables:

- At the first scheduled service interval.
- At every 8000 km (5000 mile) service interval thereafter.

CAUTION

Throttle cables must always be routed along the side of the battery. NEVER route the cables over the battery. Serious equipment damage due to short circuit can occur.

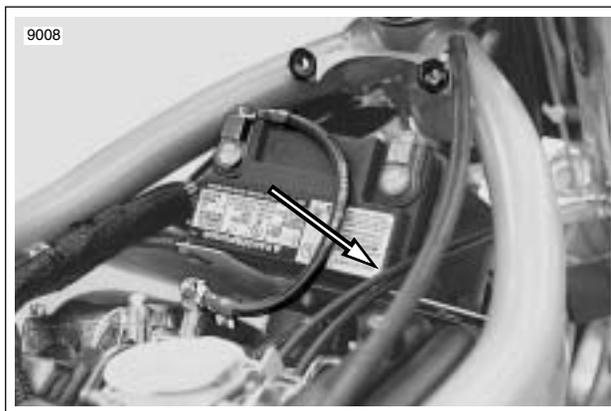


Figure 1-55. Cable Routing

LUBRICATION

1. See [Figure 1-56](#). Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go.
2. Remove two screws (1) to separate the upper handlebar housing from the lower housing.
3. Use a screwdriver to rotate each ferrule and remove cable from the throttle grip.
4. Slide the throttle grip off the handlebar.
5. Apply a light coat of graphite to the handlebar and reinstall throttle grip.
6. Put one or two drops of SUPER OIL (Part No. HD-94968-85TV) into the housing of each cable.
7. Remove the airbox cover and the airbox and inspect cable routing. See [1.4 AIRBOX AND AIR FILTER](#).
8. Install the airbox and airbox cover. See [1.4 AIRBOX AND AIR FILTER](#).
9. Assembling the handlebar housing and tighten both screws (1) to 4.0-5.1 Nm (35-45 **in-lbs**).

ADJUSTMENT

1. See [Figure 1-56](#). Turn the cable adjusters (2, 4) and jam nuts (3) as short as they will go. Both cables should have zero adjustment at the start of this procedure.
2. Point the front wheel straight ahead.
 - a. Rotate the throttle grip wide open and hold it there.
 - b. Turn the throttle cable adjuster (2), lengthening the sleeve, until the throttle cam just touches the cam stop.
 - c. Tighten the throttle cable adjuster (2) an additional 2 to 3 full turns.
3. Turn the front wheel full right.
4. Turn the idle cable adjuster (4), lengthening the sleeve until the cable housing just touches the bottom of the pocket retainer on the throttle body linkage.

WARNING

Check that the throttle control operates freely without binding. Irregular or sticking throttle response could cause a loss of control, leading to an accident which could result in death or serious injury.

5. Check adjustment.
 - a. Rotate the throttle grip and release to be sure the cable returns sharply to idle position. If the cable does not return to idle, turn idle cable adjuster (4), shortening the sleeve until correct adjustment is reached.
 - b. Verify that the throttle operates without binding.
 - c. Verify sufficient free play.
6. Tighten both jam nuts (3).

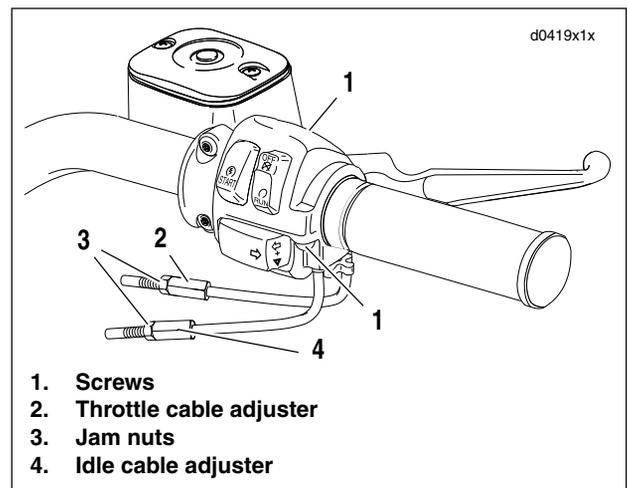


Figure 1-56. Throttle Cable Adjusters

LASH MEASUREMENT

| Part No. | Specialty Tool |
|----------|----------------------------|
| HD-45314 | Crankshaft rotating wrench |

1. Remove airbox assembly. See [1.4 AIRBOX AND AIR FILTER](#).
2. Remove battery. See [1.7 BATTERY MAINTENANCE](#).

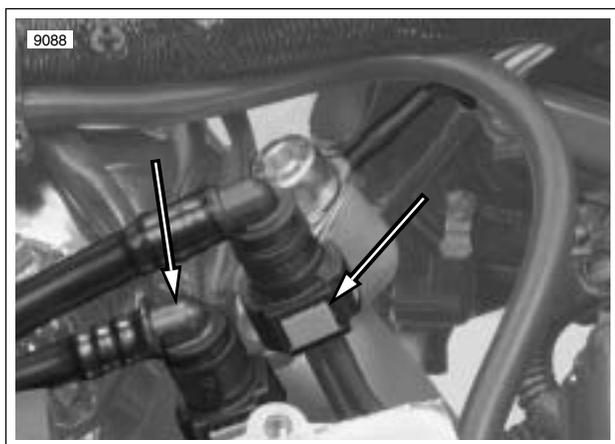


Figure 1-57. Fuel Line

3. See [Figure 1-57](#). Remove fuel lines.
 - a. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
 - b. Remove fittings at the fuel tank.
 - c. Pull fuel lines away from the throttle body.
 - d. Remove ground wires.
4. Remove front and rear coils. See [1.20 SPARK PLUG AND COIL](#).
5. Disconnect idle air control (IAC) connector [87B] from throttle body.
6. Disconnect throttle position (TP) sensor connector [88B] from throttle body.

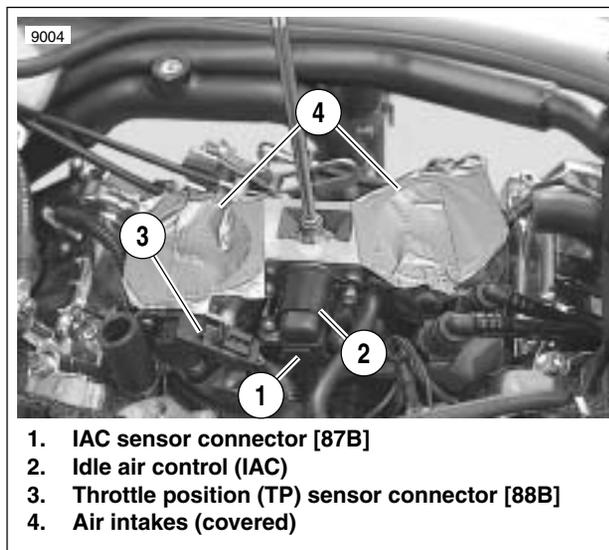


Figure 1-58. Throttle Body Electrical Connectors

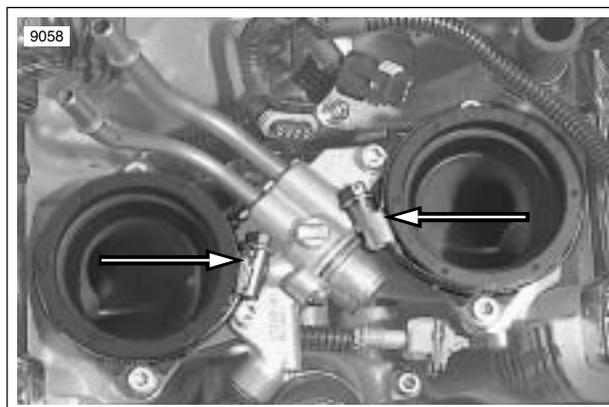


Figure 1-59. Intake Clamps, Throttle Body Removed

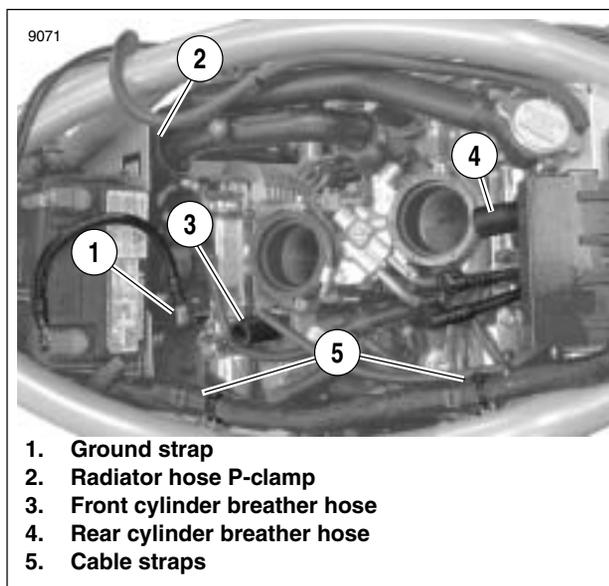


Figure 1-60. Upper Engine

- See Figure 1-59. Loosen clamps at each intake and lift throttle body straight up.

NOTE

Observe the position of the clamps for reassembly.

- With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
- Cover intake openings to prevent objects from falling into intake bore.
- See Figure 1-60. Remove ground strap at cam cover.
- Remove p-clamp (2) retaining radiator hoses.
- Remove front (3) and rear (4) breather hoses.
- Remove main harness cable straps (5) along left side of frame.
- See Figure 1-61. Remove vapor valve from t-stud.

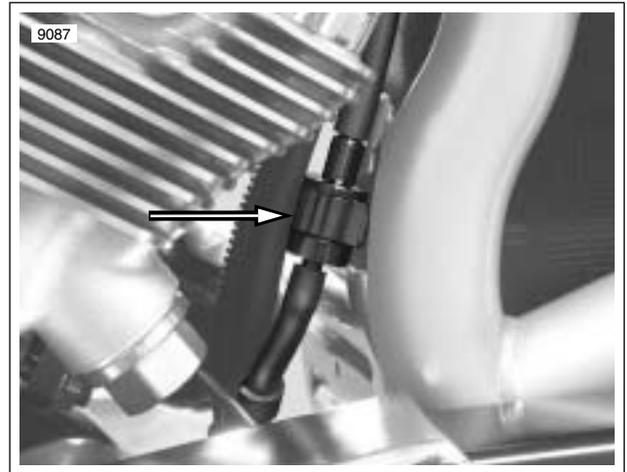


Figure 1-61. Vapor Valve

- See Figure 1-62. Loosen all cam cover fasteners in reverse order of torque sequence.

NOTE

There are holes and openings in the frame and battery box area that, with the use of a ball end hex tool, will allow access to the cam cover fasteners. Suggest using Snap-on Tool #FABLM5E.

- Support engine with jack under oil pan.
- See Figure 1-63. Loosen front engine mount bolt and retract jack to allow the engine to drop down approximately 13 mm (1/2 in.).

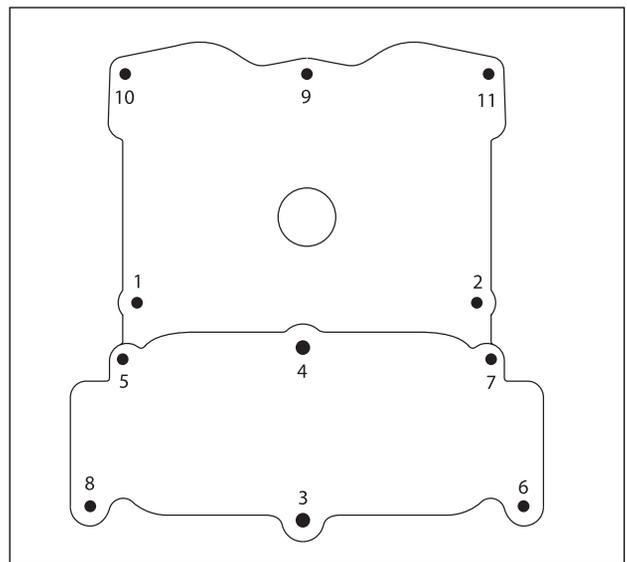


Figure 1-62. Cam Cover Torque Sequence

NOTE

It may be necessary to loosen drive belt, and loosen exhaust at rear support bracket to allow the engine to drop sufficiently.

CAUTION

Do not allow dowels from cam cover to drop into the engine. If this should occur, they must be retrieved or serious engine damage will result.

- Remove fasteners from small cam cover. Lift cover to clear dowels and remove from left side.

NOTE

Some VRSC motorcycles were manufactured with removable cam cover dowels which may drop from cam covers as they are removed.

- Remove all remaining fasteners from cam cover.
- Gently pry up cover and gasket. Remove cam cover by lifting up and over cam drive sprockets and removing from right side of motorcycle.

NOTE

It may be necessary to manipulate or move radiator hoses to allow front cam cover removal.

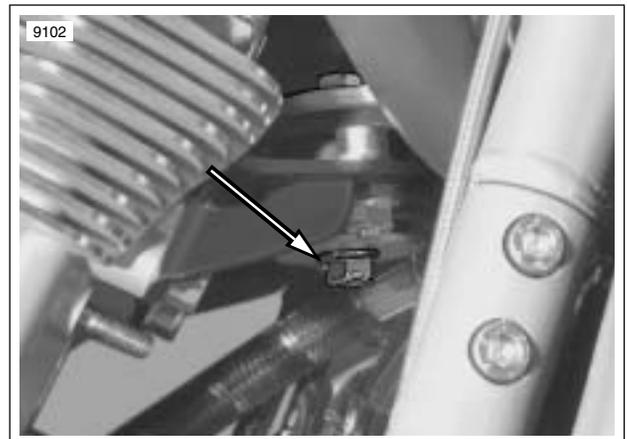


Figure 1-63. Front Engine Mount Bolt

- 21. Remove spark plugs. See 1.20 SPARK PLUG AND COIL.

NOTE

Spark plugs are only removed to allow the engine to be rotated easily. Spark plugs should be re-installed and torqued immediately after lash is set and before assembly begins.

- 22. Remove alternator derby cover to access 36 mm rotor nut.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Cam chain tension is not maintained and cams can get out of time. Engine damage can result.

- 23. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counter-clockwise (direction of operation) until nose of camshaft intake and exhaust are at the 10 o'clock and 2 o'clock position as shown in Figure 1-65.

- a. When adjusting the front cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-65.
- b. When adjusting the rear cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-66.

NOTE

See Figure 1-67. When the cam covers are off the heads, always inspect the ACR (automatic compression release). The pivot pin must be secure and the rocker arm must rotate back and forth freely around the pin.



Figure 1-64. Correct Engine Rotation

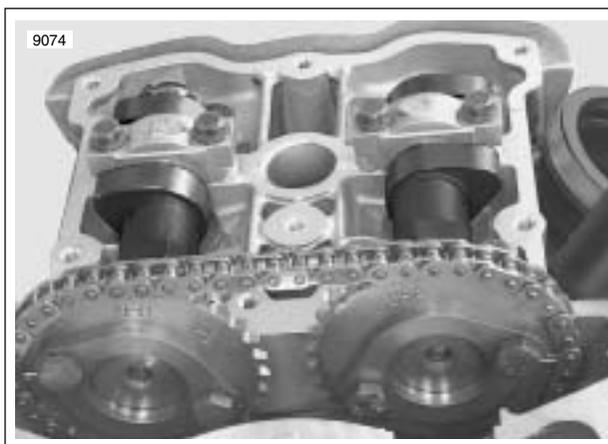


Figure 1-65. Front Cylinder Cam Lobe Position

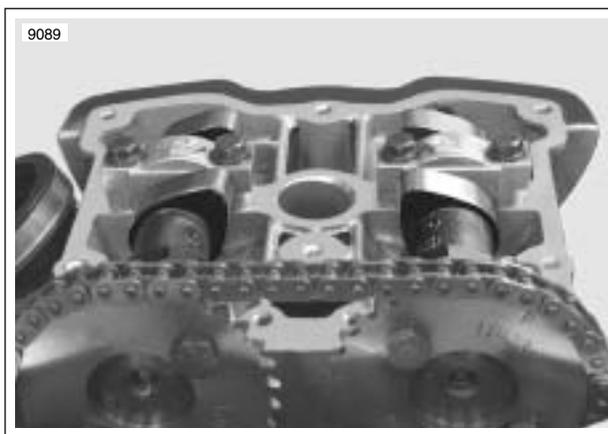


Figure 1-66. Rear Cylinder Cam Lobe Position

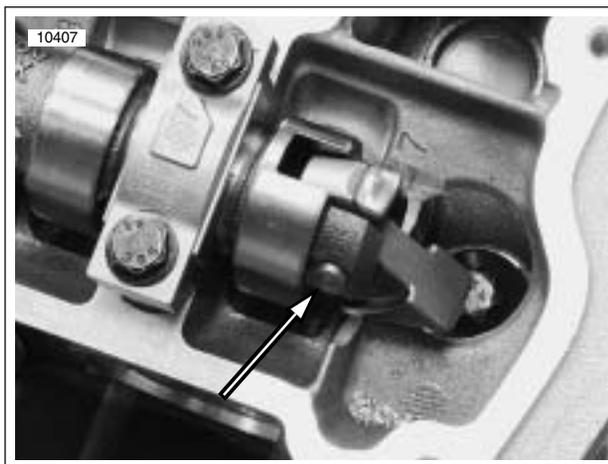


Figure 1-67. ACR (automatic compression release) Pivot

24. See Figure 1-68. Use blade style metric feeler gages to measure the gap (lash) between the cam and tappet.

NOTES

- An angle blade feeler gage may increase the reliability of the readings.
 - A valve lash calculation worksheet is provided in Appendix D to record the valve lash data. Use this sheet to determine the correct shim selection. Incorrect lash adjustment can cause serious engine damage.
25. Copy the [D.2 VALVE LASH CALCULATION WORKSHEET 1](#). in Appendix D.

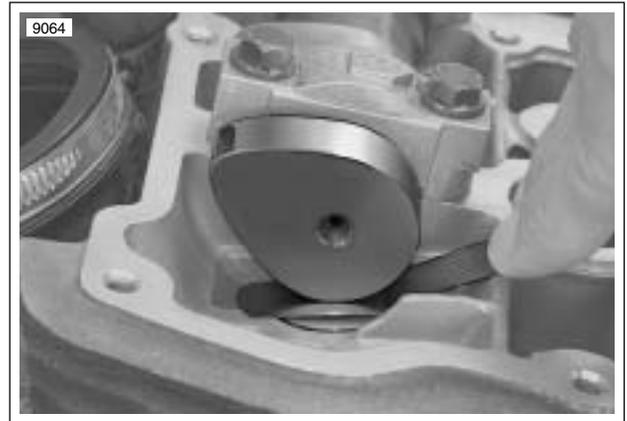


Figure 1-68. Measuring Valve Lash

Table 1-6. Valve Lash Specifications

| | | MM | IN. |
|---------|-----|-------|--------|
| Intake | Max | 0.245 | 0.0096 |
| | Min | 0.195 | 0.0078 |
| Exhaust | Max | 0.345 | 0.0135 |
| | Min | 0.295 | 0.0117 |

26. Gage the lash for exhaust and intake valves and record selected blade thickness in the “Initial Lash Measurement” column of the valve lash calculation worksheet.
27. Repeat valve lash measurements on other cylinder head and record initial lash measurements.
28. Compare measurements to “Valve Lash Upper Limit” column and “Valve Lash Lower Limit” column. A valve requires lash adjustment if:
- Measurement is larger than “Valve Lash Upper Limit.”
 - Measurement is smaller than “Valve Lash Lower Limit.”
29. If all valves are within specification, verify cam timing before reassembly. See [VERIFY CAM TIMING](#) in [1.23 VALVE LASH](#).
30. If cam timing is correct, install spark plugs, install cam covers and front engine mount according to the instructions in the following procedure. See [LASH ADJUSTMENT](#) in [1.23 VALVE LASH](#).
31. If valve lash must be adjusted, verify cam timing before disassembly. See [VERIFY CAM TIMING](#) in [1.23 VALVE LASH](#).

CAUTION

Fasteners or objects dropped into engine during disassembly/assembly must be retrieved or severe engine damage will result.

VERIFY CAM TIMING

| PART NO. | SPECIALTY TOOL |
|----------|----------------------------|
| HD-45653 | TDC positioning tool |
| HD-45306 | Crankshaft locking pin |
| HD-45314 | Crankshaft rotating wrench |

- See [Figure 1-69](#). Install TDC POSITIONING TOOL (HD-45653) in front spark plug hole.

CAUTION

Never insert a foreign object, such as a screwdriver in the spark plug hole. Engine damage can result.

- See [Figure 1-70](#). Remove plug from timing hole.

CAUTION

DO NOT ROTATE ENGINE CLOCKWISE. This is opposite the normal engine operation. Engine damage may result.

- Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counterclockwise (CCW) (direction of operation) and observe exhaust cam lobe. Note when exhaust valve is closing (TDC Tool will start to extend as valve closes) and engine is approaching TDC.
- Verify that the TDC POSITIONING TOOL is fully extended and front piston is at TDC.
- See [Figure 1-70](#). Insert CRANKSHAFT LOCKING PIN (HD-45306). The CRANKSHAFT LOCKING PIN should insert flush with engine case. If necessary, gently rock crankshaft using CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
- See [Figure 1-71](#). Note position of cam sprocket gear marks and cam lobe positions. At front cylinder TDC, timing is correct when:
 - The front exhaust and intake cam gear marks (2, 3) are aligned.
 - The front exhaust and intake cam lobes (6, 7) are positioned as illustrated.
 - The rear intake and exhaust cam gear marks (4, 5) are aligned.
 - The rear intake and exhaust cam lobes (8, 9) are positioned as illustrated.

NOTE

Copper colored links (1) are only used in installation of cam chains. They may not appear in the positions illustrated.

- If cam timing is incorrect, see [3.20 CAM DRIVE](#).
- If cam timing is correct, Remove CRANKSHAFT LOCKING PIN.
- Install engine timing plug in timing hole. Tighten to 23 Nm (17 ft-lbs).

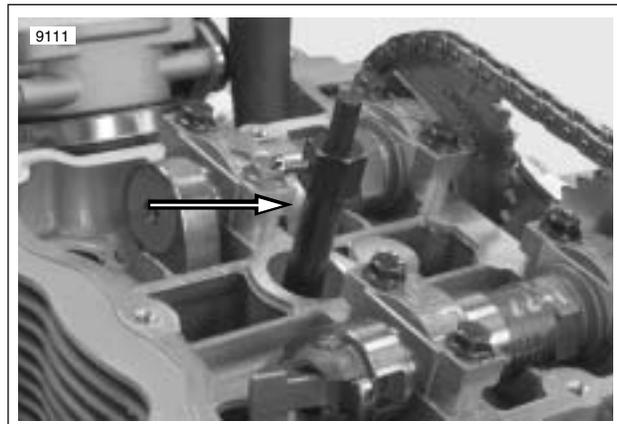
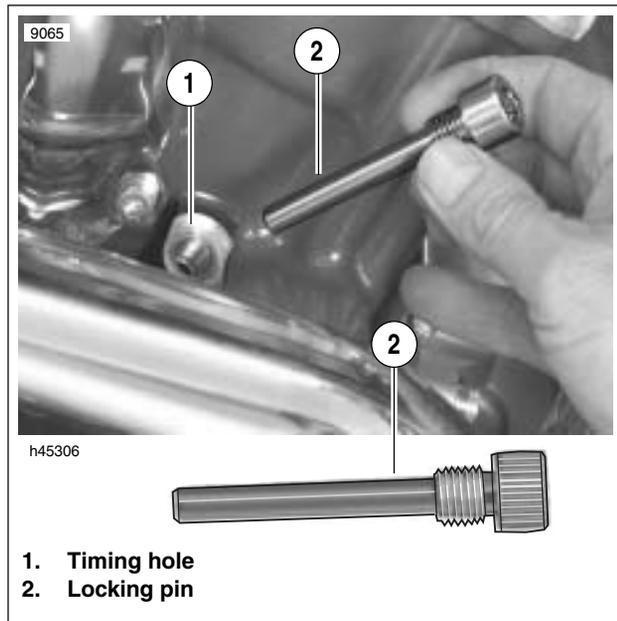


Figure 1-69. Top Dead Center Positioning Tool (HD-45653)



- Timing hole
- Locking pin

Figure 1-70. Crankshaft Locking Pin (HD-45306).

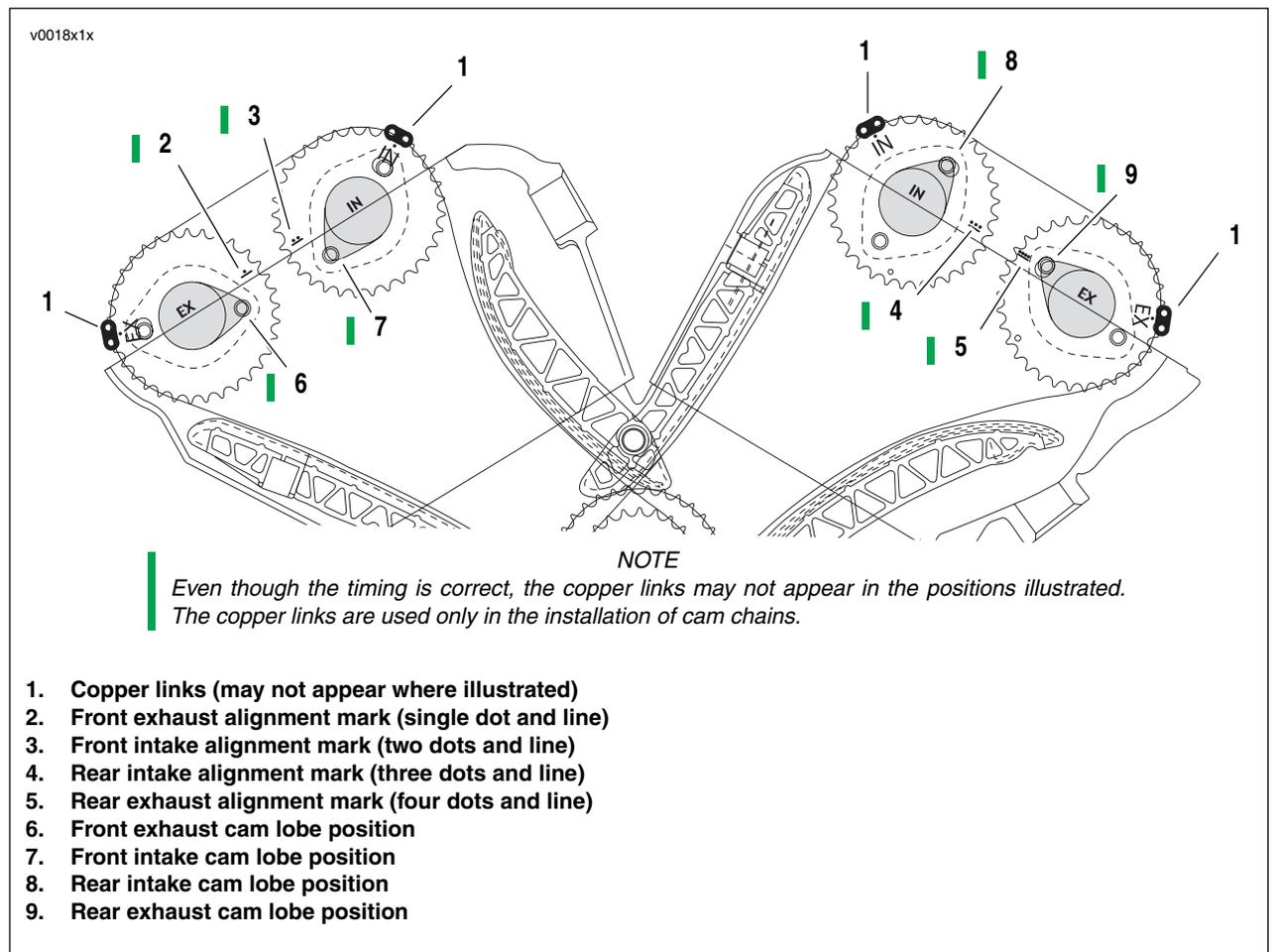


Figure 1-71. TDC Cam Timing Orientation

LASH ADJUSTMENT

| PART NO. | SPECIALTY TOOL |
|----------|----------------------------|
| HD-45314 | Crankshaft rotating wrench |
| HD-45340 | Gasket alignment tool |

1. See [Figure 1-72](#). Using CRANKSHAFT ROTATING WRENCH (HD-45314), rotate the engine counter-clockwise (direction of operation) to position front cylinder cam lobes at 10 o'clock and 2 o'clock.
2. See [Figure 1-73](#). Clean oil from cam drive gear and chain link. Make a reference mark on chain and cam drive gear, both intake and exhaust, as shown.

NOTE

Copper colored links are for initial assembly of complete cam drive system.

3. See [Figure 1-74](#). Remove secondary cam chain tensioner.

CAUTION

NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

CAUTION

Do not remove cam drive gear bolts. It is not necessary for the lash adjustment.

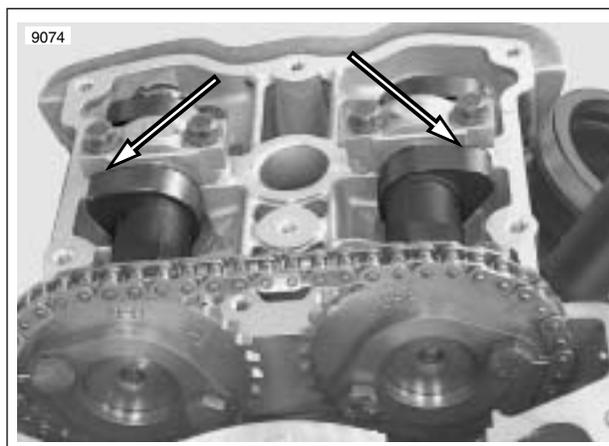


Figure 1-72. Front Cylinder 10 and 2 O'clock Cam Lobe Position

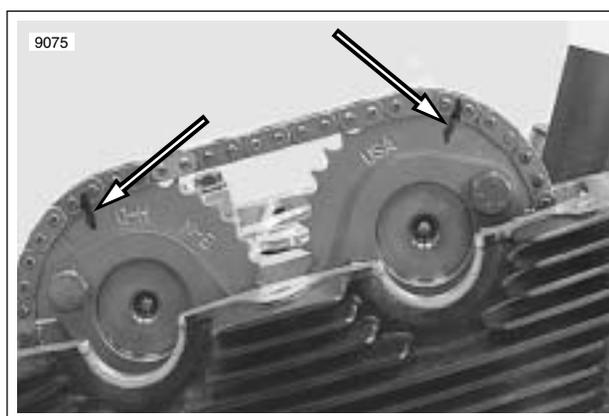


Figure 1-73. Reference Mark Cam Gear and Chain Link

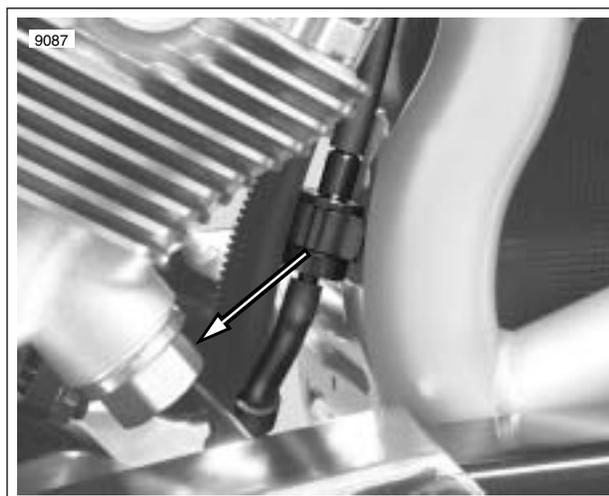


Figure 1-74. Secondary Cam Chain Tensioner

- See [Figure 1-75](#). Remove cam journal fasteners and caps from the cam needing adjustment.

NOTE

Remove and adjust only one camshaft at a time.

- See [Figure 1-76](#). Carefully move cam and drive gear aside. Keep cam drive gear and chain engaged.

NOTE

Handle chain and cam assembly carefully so as not to remove reference marks.

- Carefully remove tappet. Oil film will usually cause shim to adhere to the under side of the tappet. Take care that shim does not dislodge and fall into engine. To remove tappet, use of a strong magnet is suggested. This will keep shim and tappet together during removal.



Figure 1-77. Tappet And Shim

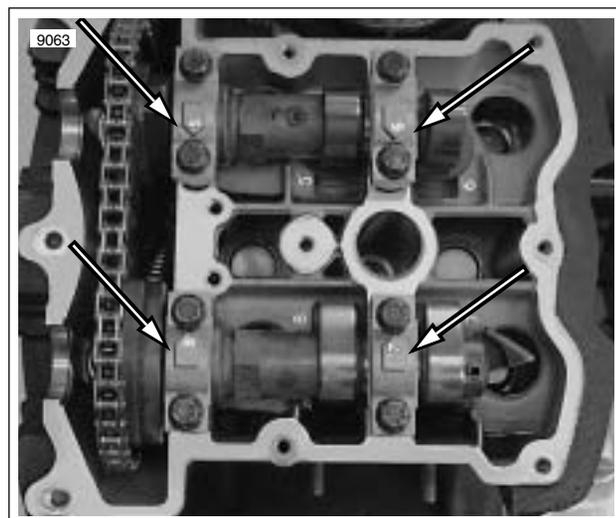


Figure 1-75. Cam Journal Caps

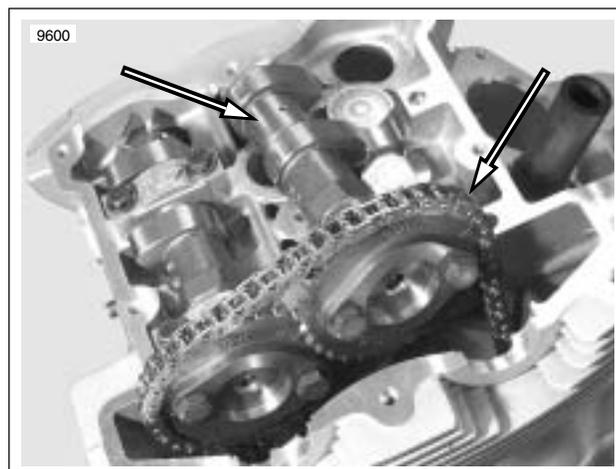


Figure 1-76. Move Cam Aside With Chain Engaged

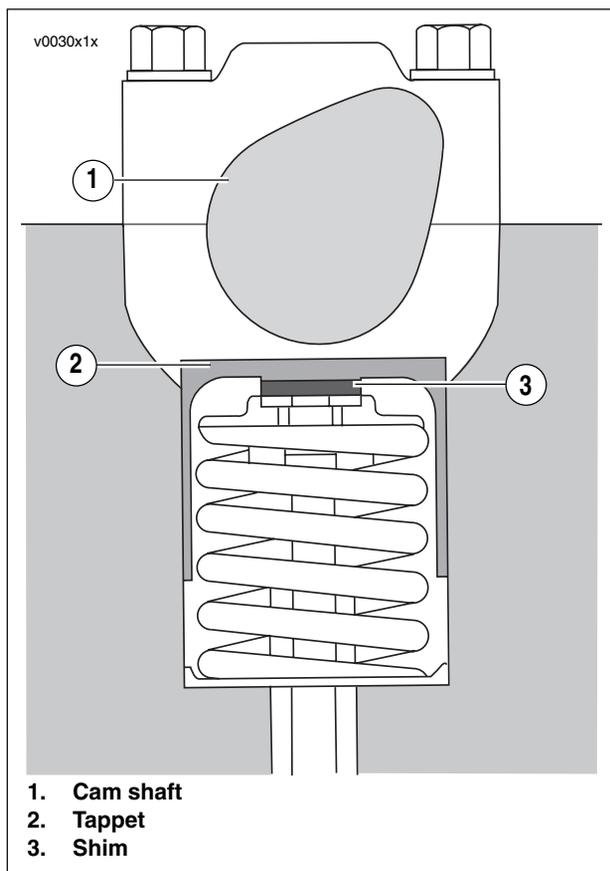


Figure 1-78. Cam, Tappet, Shim Orientation

- Use a micrometer to measure the thickness of the removed shim. Record measurement in the "Installed Shim Measurement" column on valve lash calculation worksheet. See [D.2 VALVE LASH CALCULATION WORKSHEET 1](#).

CAUTION

Do not use shim stock to adjust valve lash. Shim stock can dislodge and cause severe engine damage.

- Calculate and record on the valve lash calculation worksheet the "New Shim Lower Limit" and the "New Shim Upper Limit."
- Calculate and record "Desired Shim Size."
- Select and record the "Closest Shim Size" replacement shim. Refer to [Table D-1. Case 1 Valve Tappet Shims](#) and [Table D-2. Case 2 Valve Tappet Shims](#).
- Always confirm **new** shim thickness with micrometer. Record for reference.
- See [Figure 1-80](#). Position **new** shim in spring retainer pocket. Use a magnet to position the shim and carefully push into place with finger.
- Reinstall tappet.
- If the initial lash measurement of the remaining valve exceeds the upper or lower valve lash limits, perform the lash adjustment on the remaining valve.
- See [Figure 1-73](#). Install cam in alignment with **new** reference marks on drive chain and cam drive gear. Note **new** reference marks from step 2.
- See [Figure 1-81](#). Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head. Lubricate cam journal and journal cap with oil before placing in position.
- Tighten cam bearing caps to 10 Nm (88 in-lbs).
- Review the valve lash calculation worksheet and make adjustments to the valves activated by the opposite cam if necessary.

CAUTION

NEVER rotate engine with secondary cam chain tensioner removed. Engine damage and/or loss of correct timing will occur.

- When second cam has been set aside, the valve lash adjusted, and the cam reinstalled, install secondary cam chain tensioner.



Figure 1-79. Measure Shim

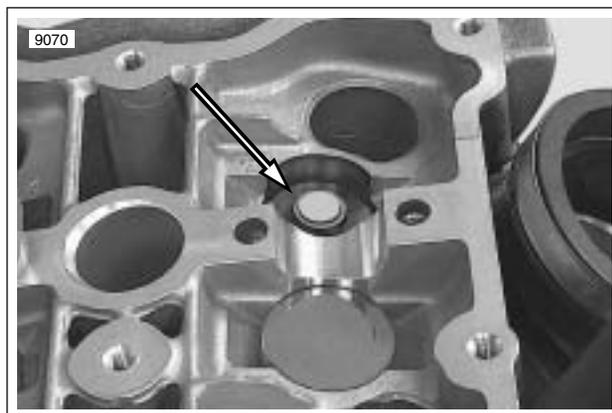


Figure 1-80. Position Shim

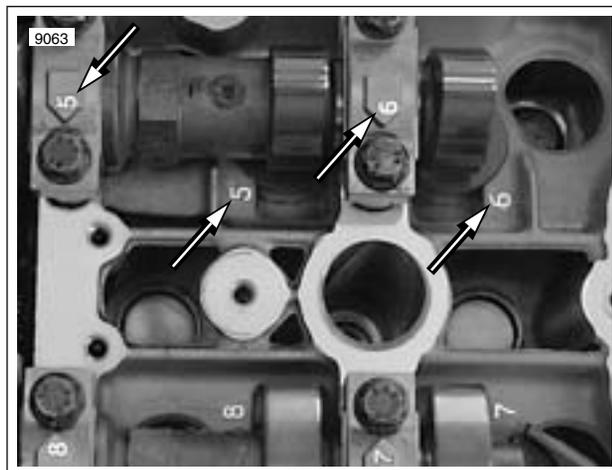


Figure 1-81. Cam Journal Cap Reference Numbers

20. Rotate engine two complete revolutions (counter-clockwise, direction of rotation) until cam lobes return to 10 o'clock and 2 o'clock position.
21. Re-measure valve lash of all front cylinder cams and record "Final Lash Reading" on the worksheet.
22. Review the worksheet for the rear cylinder valves and make adjustments as needed.
23. See [Figure 1-66](#). Turn engine over to position rear cylinder cams at the 2 o'clock and 10 o'clock position and repeat the procedures for the rear cylinder.
24. After lash adjustment is complete, verify cam timing on both cylinders. See [VERIFY CAM TIMING](#) in [1.23 VALVE LASH](#).
25. When lash adjustment is verified install and tighten spark plugs to 23 Nm (17 ft-lbs).
26. Clean cam cover and install **new** gasket.
27. See [Figure 1-82](#). Use cable straps (1) to help retain gasket as shown.
28. See [Figure 1-84](#). Apply a thin bead of silicone along both half-moon shaped recesses in cylinder head. Cam cover gasket must stay in place, a small amount of sealer, lightly applied will help.
29. Carefully install cam cover and gasket. Cable straps will allow the cam bore plug to be moved horizontally to clear cam drive gears.
30. Visually check to ensure spark plug hole gasket (2) is in place.

NOTE

See [Figure 1-83](#). The seal of the spark plug hole gasket is correct when the tapered edge of the gasket is in the cam cover and the double lipped side of the rings is facing out to mate with the flat of the cylinder head.

31. Remove cable straps.
32. Place small cam cover in position.
33. See [Figure 1-85](#). Insert GASKET ALIGNMENT TOOL (HD-45340).

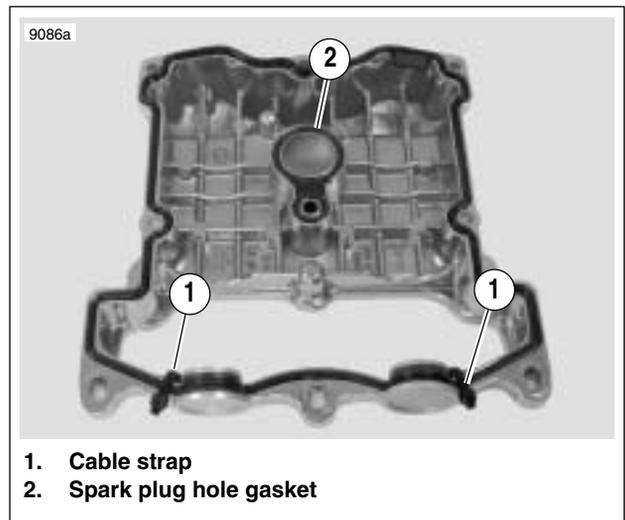


Figure 1-82. Cam Cover Gaskets



Figure 1-83. Spark Plug Hole Gasket (double lipped side)

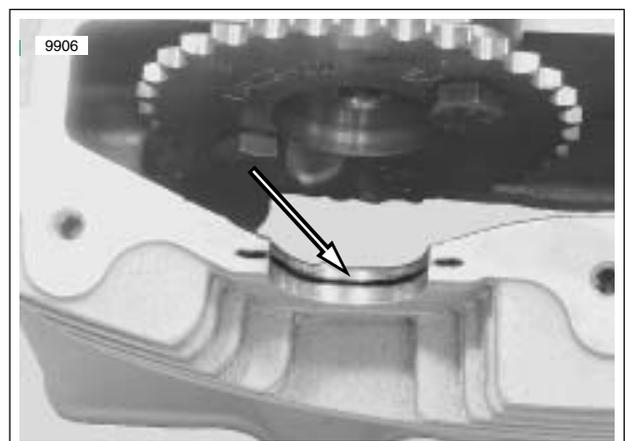


Figure 1-84. Silicone Bead Pattern in Head Recesses

HOME

34. See [Figure 1-86](#). Insert fasteners in cam cover and tighten to 9.7 Nm (86 in-lbs) in sequence.
35. See [Figure 1-63](#). Tighten front engine mount fastener to 38 Nm (28 ft-lbs).
36. Position the main harness along the left side of the frame and install cable straps.
37. Install front cylinder and rear cylinder breather hoses.
38. Install p-clamp around the right side radiator hoses and tighten fastener to 9.7 Nm (86 in-lbs).
39. Connect ground strap to cam cover. Tighten to 9.7 Nm (86 in-lbs).
40. See [Figure 1-87](#). Orient intake clamps as shown.
41. Install throttle body and tighten clamps.
42. See [1.20 SPARK PLUG AND COIL](#). Install coils.
43. Attach the idle speed control (IAC) connector.
44. Attach the throttle position (TP) sensor.
45. Attach fuel lines.
 - a. Insert fuel lines from injector back under frame and connect to fuel tank.
 - b. Push connector onto fuel tank elbow until a “click” is heard.
 - c. Install right angle connectors on rigid lines from injector. Push until a “click” is heard.
46. Install battery. See [1.7 BATTERY MAINTENANCE](#).
47. Install airbox assembly. See [1.4 AIRBOX AND AIR FILTER](#).

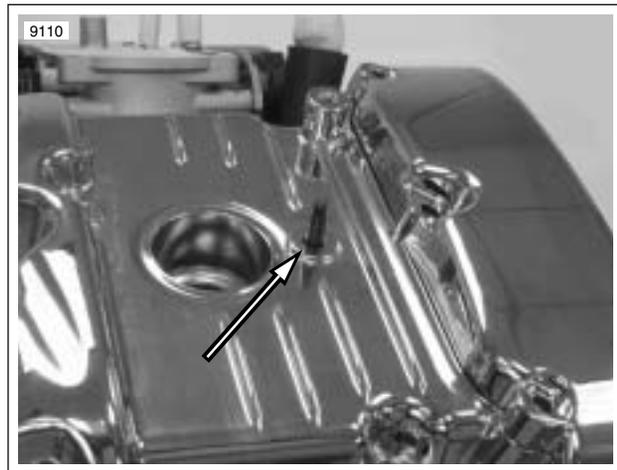


Figure 1-85. Gasket Alignment Tool (H-D-45340)

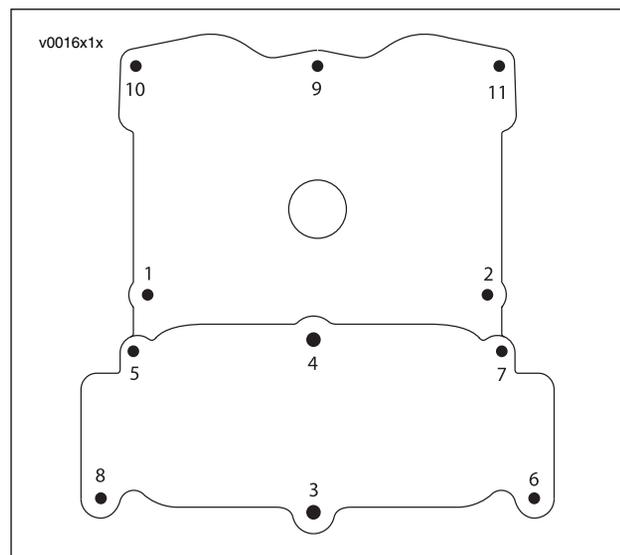


Figure 1-86. Cam Cover Torque Sequence

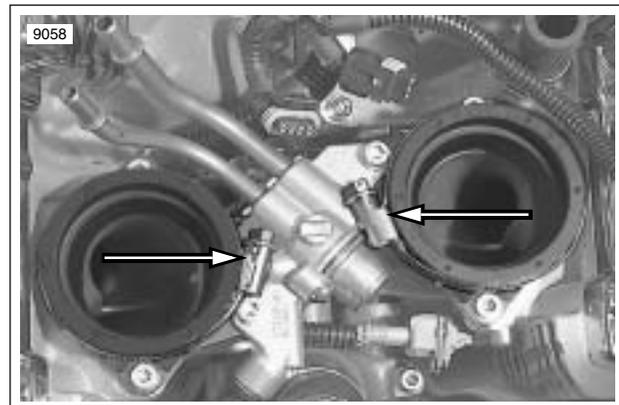


Figure 1-87. Intake Clamps, Throttle Body Removed

GENERAL

On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, check secondary cam chain wear. Before beginning procedure, note if the rattle is heard during engine start-up.

ADJUSTMENT

| PART NO. | SPECIALTY TOOL |
|----------|--------------------------------------|
| HD-45314 | Crankshaft rotating wrench |
| HD-45334 | Secondary cam chain measurement tool |

1. Support engine with a scissors jack under the frame at the fuel tank.
2. Remove the right side cover and maxi-fuse. See [8.5 MAXI-FUSE](#).
3. Unlock and open seat.
4. Remove airbox cover. See [1.4 AIRBOX AND AIR FILTER](#).

WARNING

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

5. Disconnect negative battery cable.
6. Remove air filter top and air filter. See [1.4 AIRBOX AND AIR FILTER](#).
7. Remove the horn. See [8.24 HORN](#).
8. Remove the derby cover from the left side crankcase cover.

CAUTION

Turn the engine crankshaft counterclockwise only. Turning it clockwise could cause the cam chain to jump over the cam sprocket.

9. To position the front piston to adjust the secondary cam chain:
 - a. See [Figure 1-88](#). Install CRANKSHAFT ROTATING WRENCH (HD-45314).
 - b. Hold the throttle wide open and watch front cylinder intake valve through intake port.
 - c. Turn crankshaft counterclockwise to open valve fully and then to close the valve.
 - d. When the front cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90°) counterclockwise.

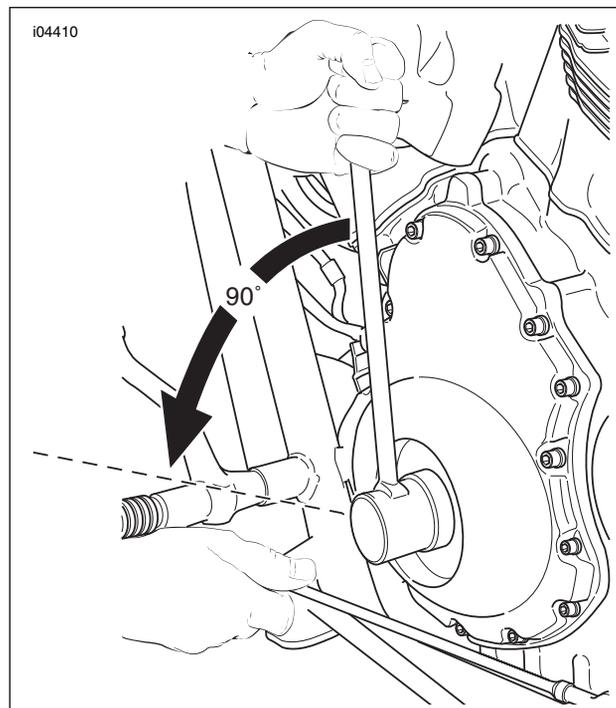


Figure 1-88. Positioning Piston

CAUTION

Never rotate the engine without the secondary cam chain tensioner installed. Cam timing could be changed, causing engine damage.

NOTE

Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (HD-45334).

10. Remove the secondary cam chain tensioner.
11. See [Figure 1-89](#). install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against the cylinder head.
12. Note the number of grooves showing on the tool.
13. Remove the SECONDARY CAM CHAIN MEASUREMENT TOOL.
14. From the table, select the number of shims necessary for correct secondary cam chain tension. Refer to [Table 1-7](#).

NOTE

If a start-up rattle is present, add 1 or 2 shims to the tensioner. If there is no start-up rattle, do not add shims to the tensioner.

Table 1-7. Tensioner Shims

| Grooves | Shims Required |
|---------|----------------|
| 4 | 1* |
| 3 | 2* |
| 2 | 3 |
| 1 | 4 |

* Do not add shims if start-up rattle is not heard.

15. See [Figure 1-90](#). Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
16. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
17. Seat number of selected shims (2) and plunger (1) in tensioner (3).
18. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
19. Install front cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).

CAUTION

Turn the engine crankshaft counterclockwise only. Turning it clockwise could cause the cam chain to jump over the cam sprocket. Cam timing could be changed, causing engine damage.

20. To position rear cylinder to adjust secondary cam chain:
 - a. See [Figure 1-88](#). Install CRANKSHAFT ROTATING WRENCH (HD-45314).
 - b. Hold throttle wide open and watch rear cylinder intake valve through intake port.
 - c. Turn crankshaft counterclockwise to open valve fully and then close intake valve.

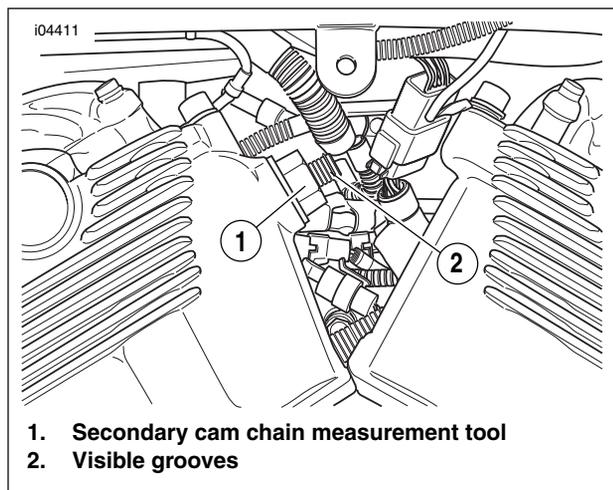


Figure 1-89. Secondary Cam Chain Measurement Tool Installed in Front Cylinder

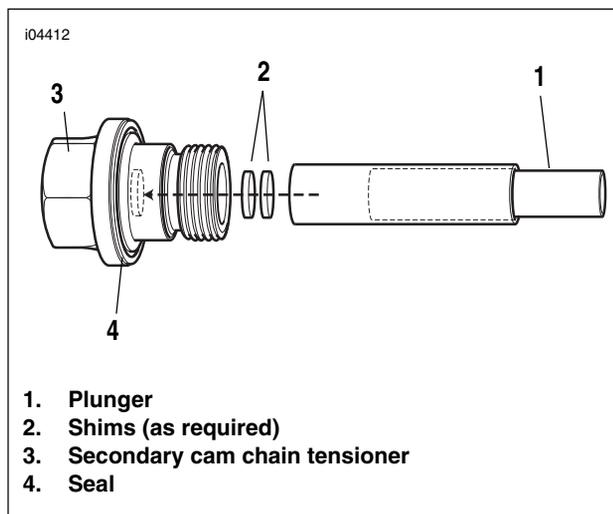


Figure 1-90. Secondary Cam Chain Tensioner

21. When rear cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90°) counterclockwise (CCW).

NOTE

Do not use the sealing washer from the secondary cam chain tensioner when installing the SECONDARY CAM CHAIN MEASUREMENT TOOL (HD-45334).

22. See [Figure 1-89](#). Remove rear cylinder secondary cam chain tensioner and install SECONDARY CAM CHAIN MEASUREMENT TOOL. Thread-in the tool until it is seated against cylinder head.
23. Note the number of grooves showing on tool.
24. Remove SECONDARY CAM CHAIN MEASUREMENT TOOL.
25. Refer to [Table 1-7](#). From the table, select the number of shims necessary for correct secondary cam chain tension.

NOTE

If a start-up rattle was noticed, 1 or 2 shims are added to the tensioner. If there was no start-up rattle, do not add 1 or 2 shims to the tensioner.

26. See [Figure 1-90](#). Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
27. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
28. Seat number of selected shims (2) and plunger (1) in tensioner (3).

29. Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
30. Install rear cylinder secondary cam chain tensioner. Tighten to 100 Nm (74 ft-lbs).
31. Install the horn. See [8.24 HORN](#).
32. Connect negative battery cable.
33. Install air filter and air filter top. See [1.4 AIRBOX AND AIR FILTER](#).
34. Install airbox cover.
35. Install the right side cover and maxi-fuse.

CAUTION

When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged. (00196a)

36. Turn ignition switch to FUEL and close seat. Then turn ignition switch to LOCK.

INSPECTION

WARNING

The automatic-on headlamp feature provides increased visibility for riders. Be sure headlamp is on at all times. Low visibility of rider can result in death or serious injury. (00030a)

Check headlamp for proper height and lateral alignment:

- When the new owner takes delivery of the motorcycle.
 - When there is a change in load (adding luggage, etc.).
1. Verify correct front and rear tire pressure. See [1.11 TIRES AND WHEELS](#).
 2. Place motorcycle on level floor (or pavement) in an area with minimum light.
 3. See [Figure 1-91](#). Position motorcycle 7.6 m (25 ft) away from a screen or wall. Measure the vertical distance from center of headlamp to floor, and draw a horizontal line (A) on screen or wall at same height above floor.
 4. Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
 5. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
 6. See [Figure 1-92](#). Turn ignition switch ON. Set handlebar headlamp switch to HI beam position.
 7. Check light beam for alignment.
 - a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
 - b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
 - c. Adjust headlamp alignment if necessary.

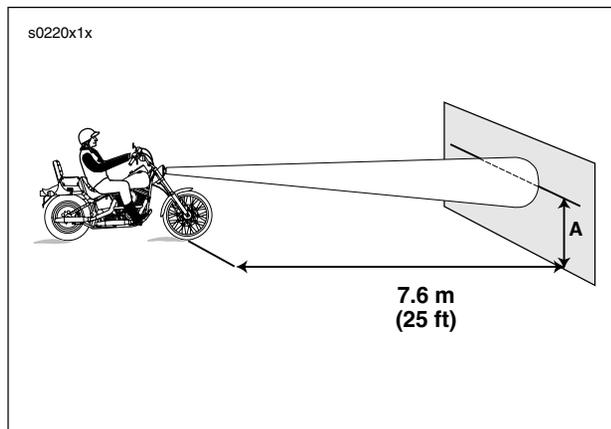


Figure 1-91. Headlamp Alignment

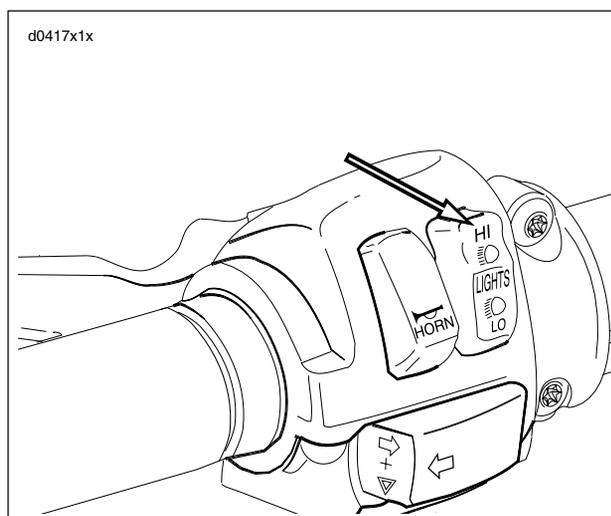


Figure 1-92. Headlamp Switch



Figure 1-93. Headlamp Alignment Fastener

INSPECTION

Inspect critical fasteners, except head bolts:

- At the first scheduled service interval.
- At every 16,000 km (10,000 mile) service interval thereafter.

Refer to [Table 1-8](#). Tighten all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

Table 1-8. Critical Fasteners

| SYSTEM | FASTENER | TORQUE | |
|-----------------------|-----------------------------------|--------------|---------------|
| | | | |
| Hand controls | Upper and lower switch housings | 4.0-5.1 Nm | 35-45 in-lbs |
| | Clutch lever handlebar clamp | 6.8-9.0 Nm | 60-80 in-lbs |
| | Master cylinder handlebar clamp | 6.8-9.0 Nm | 60-80 in-lbs |
| Brakes | Banjo bolts | 23.0-29.8 Nm | 17-22 ft-lbs |
| | Lower brake caliper mounting pin | 38.0-51.5 Nm | 28-38 ft-lbs |
| | Brake disc screws, front | 21.7-32.5 Nm | 16-24 ft-lbs |
| | Brake disc screws, rear | 40.7-47.5 Nm | 30-35 ft-lbs |
| | Reservoir screws | 0.7-0.9 Nm | 6-8 in-lbs |
| | Rear master cylinder mounting nut | 54.2-67.8 Nm | 40-50 ft-lbs |
| Axle nuts | Front axle | 68-75 Nm | 50-55 ft-lbs |
| | Rear axle | 129-142.3 Nm | 95-105 ft-lbs |
| Front fork/handlebars | Lower fork pinch bolts | 41-47 Nm | 30-35 ft-lbs |
| | Upper bracket pinch bolts | 41-47 Nm | 30-35 ft-lbs |
| Frame | Lower frame rail bolts | 61-75 Nm | 45-55 ft-lbs |

PREPARATION FOR STORAGE

WARNING

Do not store motorcycle with gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00003a)

If the motorcycle will not be operated for several months, such as during the winter season, there are several things which should be done.

This work should be performed by a local Harley-Davidson dealer or other qualified technician following the procedures in this service manual.

1. Run motorcycle until engine is at normal operating temperature. Stop the engine then drain the oil, install a **new** oil filter, and fill with the proper grade oil.

WARNING

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

2. Choose one of the following two methods for preparing your fuel system.
 - a. Fill fuel tank and add a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions.
 - b. Drain all gasoline from the fuel tank.
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. 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 discs or brake pads. Oil on disc pads degrades braking efficiency and may lead to an accident which could result in death or serious injury.

5. Wash anodized and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.
6. Check coolant for correct range of temperature protection.

WARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00067a)

WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)

7. Remove battery from vehicle. Charge battery until the correct voltage is obtained. See [8.9 BATTERY](#). Charge the battery every other month if it is stored at temperatures below 60° F (16° C). Charge battery once a month if it is stored at temperatures above 60° F (16° C).
8. If the motorcycle is to be stored with the security system armed, connect a Battery Tender Plus! Automatic Battery Charger (Part No. 99863-93TA) to maintain battery charge.
9. If the motorcycle is to be stored with the battery installed, a Battery Tender unavailable, and with the security system **not** armed, remove the right side cover and the maxi-fuse. See [8.5 MAXI-FUSE](#).
10. If the 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, which leads to corrosion.

REMOVAL FROM STORAGE

WARNING

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

1. If removed, charge and install the battery. See [8.9 BATTERY](#).
2. Remove and inspect the spark plugs. Replace if necessary.
3. Clean the air filter element.
4. If removed, install maxi-fuse and right side cover.
5. If fuel tank was drained, fill fuel tank with fresh gasoline.
6. Start the engine and run until it reaches normal operating temperature.
7. Check engine oil level. Fill to proper levels with correct fluids, if required.
8. Perform all of the checks in the PRE-RIDING CHECKLIST in the Owner's Manual.

GENERAL

WARNING

The troubleshooting section of this manual is intended solely as a guide to diagnosing problems. Carefully read the appropriate sections of this manual before performing any work. Observe all cautions and warnings. Failure to observe cautions and warnings could result in death or serious injury.

The following check list of possible operating troubles and their probable causes will be helpful in keeping a motorcycle in good operating condition. More than one of these conditions may be causing the trouble and all should be carefully checked.

NOTES

- For further troubleshooting information see the *VRSC Electrical Diagnostic Manual*.
- For troubleshooting the cooling system, review the check list of operating troubles [6.2 COOLANT FLOW](#).

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Ignition switch not in ON position.
2. Engine run switch in OFF position.
3. Maxi-fuse not in place.
4. Discharged battery, loose or corroded connections (solenoid chatters).
5. Starter control circuit, relay, or solenoid faulty.
6. Electric starter shaft pinion gear not engaging or over-running clutch slipping.
7. Crankshaft locking pin is in place.

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fouled spark plugs.
3. Discharged battery, loose or broken battery terminal connections.
4. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

5. Loose wire connection at coil, battery, or plug between ignition module or ECM.
6. Ignition timing incorrect due to faulty coil, ignition module, ECM or sensors.
7. Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.
8. Fuel filter clogged.
9. Sticking or damaged valve.

Starts Hard

1. Spark plugs in bad condition or have improper gap or are partially fouled.
2. Battery nearly discharged.
3. Loose wire connection at one of the battery terminals, coil, or plug between ECM or ignition module.
4. Water or dirt in fuel system.
5. Intake air leak.
6. Fuel tank vent hose and vapor valve plugged, or fuel line closed off, restricting fuel flow.
7. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

8. Ignition not functioning properly (possible sensor failure).
9. Faulty ignition coil.
10. Valves sticking or valves too tight.
11. Rotor key sheared.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug gap too close or too wide.
3. Faulty ignition coil, module, or sensor.
4. Battery nearly discharged.
5. Damaged wire or loose connection at battery terminals, coil, or plug between ignition sensor and module.
6. Intermittent short circuit due to damaged wire insulation.
7. Water or dirt in fuel system or filter.
8. Fuel tank vent system plugged or closed off.
9. Air leak at intake manifold or air filter.
10. MAP sensor inoperative.
11. Loose or dirty ignition module or ECM connector at crankcase.
12. Faulty Sensor(s): Manifold Absolute Pressure (MAP), or Crank Position (CKP).
13. Incorrect valve timing.
14. Weak or broken valve springs.
15. Damaged intake or exhaust valve.

A Spark Plug Fouls Repeatedly

1. Fuel mixture too rich.
2. Incorrect spark plug for the kind of service.
3. Piston rings badly worn or broken.
4. Valve guides or seals badly worn.

Pre-Ignition or Detonation (Knocks or Pings)

1. Fuel octane rating too low.
2. Faulty spark plugs.
3. Incorrect spark plug for the kind of service.
4. Excessive carbon deposit on piston head or in combustion chamber.
5. Ignition timing advanced due to faulty sensor inputs (MAP, CKP).
6. Air leak

Overheating

1. Insufficient oil supply or oil not circulating.
2. Insufficient air flow over engine.
3. Heavy carbon deposit.
4. Ignition timing retarded due to faulty sensor(s): Manifold Absolute Pressure (MAP) and/or Crank Position (CKP).
5. Leaking valve.
6. Radiator dirty, plugged.
7. Insufficient coolant supply.
8. Vent hose crimped.
9. Air in cooling system.

Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
2. Valve sticking in guide.
3. Chain tensioning spring or shoe worn.
4. Cam timing incorrect.
5. Secondary cam tensioner out of range.

Excessive Vibration

1. Wheels and/or tires worn or damaged.
2. Engine/transmission/rear wheel not aligned properly.
3. Upper engine mounting bracket loose/broken or mounting bracket pre-loaded.
4. Ignition timing advanced due to faulty sensor inputs (MAP, CKP)/poorly tuned engine.
5. Internal engine problem.
6. Broken frame.
7. Engine counterbalancer out of time or bearing failed.
8. Exhaust system binding or hitting frame.

Check Engine Light Illuminates During Operation

Fault detected. See the VRSC Electrical Diagnostic Manual.

LUBRICATION SYSTEM

Engine Uses Too Much Oil Or Smokes Excessively

1. Restricted breather operation.
2. Restricted oil filter.
3. Piston rings badly worn or broken.
4. Valve guides or seals worn.
5. Oil diluted with gas.

Engine Leaks Oil From Cases, Hoses, Etc.

1. Loose parts.
2. Imperfect seal at gaskets, washers, etc.
3. Restricted breather hose to air filter.
4. Restricted oil filter.
5. Porosity.

Low Oil Pressure

1. Oil underfilled.
2. Faulty low oil pressure switch.
3. Oil pump o-ring damaged or missing.
4. Bypass valve stuck in open position.
5. Oil diluted with gas.
6. Open in oiling circuit.

High Oil Pressure

1. Overfilled with oil.
2. Bypass valve stuck in closed position.

ELECTRICAL SYSTEM

NOTE

For diagnostic information see the VRSC Electrical Diagnostic Manual.

Alternator Does Not Charge

1. Voltage regulator/rectifier module not grounded.
2. Engine ground wire loose or broken.
3. Faulty regulator-rectifier module.
4. Loose or broken wires in charging circuit.
5. Faulty stator and/or rotor.

Alternator Charge Rate Is Below Normal

1. Weak or damaged battery.
2. Loose connections.
3. Faulty regulator-rectifier module.
4. Faulty stator and/or rotor.

Speedometer Operates Erratically

1. Contaminated speedometer sensor (remove sensor and clean off metal particles).
2. Loose connections.

TRANSMISSION

Shifts Hard

1. Clutch dragging slightly.
2. Shifter return spring (inside transmission) bent or broken.
3. Bent shifter rod.
4. Shifter forks (inside transmission) sprung.
5. Corners worn off shifter clutch dogs (inside transmission).
6. Hydraulic clutch circuit not bled correctly.

Jumps Out Of Gear

1. Shifter rod improperly adjusted.
2. Shifter drum (inside transmission) damaged.
3. Shifter engaging parts (inside transmission) badly worn and rounded.
4. Shifter forks bent.
5. Damaged gears.

Clutch Slips

1. Insufficient clutch spring tension.
2. Worn friction discs.

Clutch Drags Or Does Not Release

1. Lubricant level too high in primary chaincase.
2. Clutch spring tension.
3. Clutch discs warped.
4. Clutch spacer missing or installed backwards.

Clutch Chatters

1. Friction discs worn or warped.
2. Steel discs worn or warped.

HANDLING

Irregularities

1. Improperly loaded motorcycle. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage tends to cause unstable handling.
2. Damaged tire(s) or improper front-rear tire combination.
3. Irregular or peaked front tire tread wear.
4. Incorrect tire pressure. See [1.11 TIRES AND WHEELS](#).
5. Shock absorber not functioning normally.
6. Loose wheel axle nuts. Tighten to recommended torque specification.
7. Excessive wheel hub bearing play.
8. Rear wheel out of alignment with frame and front wheel.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See [1.18 STEERING HEAD BEARINGS](#).
10. Tire and wheel unbalanced.
11. Rims and tires out-of-round or eccentric with hub.
12. Rims and tires out-of-true sideways.
13. Rear fork loose on pivot shaft.

BRAKES

Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid.
2. Brake system contains air bubbles.
3. Master or wheel cylinder piston worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn.
6. Brake disc badly worn or warped.
7. Brake drags –brake pedal and master cylinder piston not returning completely.
8. Brake fades due to heat build up – brake pads dragging or excessive braking.

NOTES
