





SERVICE MANUAL

P/N 99501-03

IMPORTANT NOTICE

Harley-Davidson motorcycles conform to all applicable U.S.A. Federal Motor Vehicle Safety Standards and U.S.A. Environmental Protection Agency regulations effective on the date of manufacture.

To maintain the safety, dependability, and emission and noise control performance, it is essential that the procedures, specifications and service instructions in this manual are followed.

Any substitution, alteration or adjustment of emission system and noise control components outside of factory specifications may be prohibited by law.

Harley-Davidson Motor Company

MAINTENANCE

CHASSIS 2

ENGINE

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FUEL SYSTEM

ELECTRIC STARTER

5

SERVICE MANUAL

2003

VRSCA

The information in this Service Manual applies to all 2003 VRSCA models.

COOLING SYSTEM

TRANSMISSION

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FUEL INJECTION

APPENDIX

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FOREWORD

GENERAL

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

HOW TO USE YOUR SERVICE MANUAL

Information is arranged as follows:

- Section 1–Maintenance
- Section 2–Chassis
- Section 3–Engine
- Section 4–Fuel System
- Section 5–Electric Starter
- Section 6–Cooling System
- Section 7–Transmission
- Section 8–Electrical
- Section 9–Fuel Injection
- Appendix A–Tools
- Appendix B–Wiring
- Appendix C–Metric Conversions
- Appendix D–Service Templates

Use the TABLE OF CONTENTS following this FOREWORD or the INDEX at the back of the book to find the desired subject.

Note that each manual section contains sequentially numbered topics. The numbering system allows quick cross references throughout the document.

For example, the sixth topic (ENGINE OIL AND FILTER) in section one (MAINTENANCE) could be referred to as:

1.6 ENGINE OIL AND FILTER

This cross reference directs the reader to section **1** (MAINTE-NANCE) and topic **6** (ENGINE OIL AND FILTER).

PREPARATION FOR SERVICE

WARNING

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

Good preparation is very important for efficient service work. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and will reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts. Cleaning will occasionally uncover sources of trouble. Tools, instruments and any parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a distraction and causes needless delay. See A.1 APPENDIX A-TOOLS for equipment required for special service work.

NOTES

- To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.
- In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.

SERVICE BULLETINS

In addition to the information presented in this Service Manual, Harley-Davidson Motor Company will periodically issue Service Bulletins to Harley dealers. Service Bulletins cover interim engineering changes and supplementary information.

USE GENUINE REPLACEMENT PARTS

AWARNING

When replacement parts are required, use only genuine Harley-Davidson parts or parts with equivalent characteristics (which include type, strength and material). Failure to do so may result in product malfunction. This could result in death or serious injury.

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

WARNINGS AND CAUTIONS

Statements in this service manual preceded by the following words are of special significance.

ADANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

CAUTION without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

WARNING

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

PRODUCT REFERENCES

WARNING

Follow the directions listed on all products. Carefully read all labels, warnings and cautions before use. Inadequate safety precautions could result in death or serious injury.

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

Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through:

Kent-Moore SPX Corporation 28635 Mound Road Warren, Michigan 48092-3499 Telephone: 1-800-345-2233

Sealing and Threadlocking Products

LOCTITE PRODUCTS

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

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

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

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SERVICING A NEW MOTORCYCLE

AWARNING

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

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

The performance of new motorcycle initial service is required to keep warranty in force and to ensure proper emissions systems operation. See 1600 km (1000 mile) MAINTENANCE under 1.3 MAINTENANCE SCHEDULE for details.

SAFE OPERATING MAINTENANCE

CAUTION

- Do not attempt to retighten engine head bolts. Retightening can cause engine damage.
- During the initial break-in period, use only Harley-Davidson 20W50 engine oil. Failure to use the recommended oil will result in improper break-in of the engine cylinders and piston rings.

A careful check of certain equipment is necessary after periods of storage, and frequently between regular service intervals, to determine if additional maintenance is required.

Check:

- 1. Tires for abrasions, cuts and correct pressure.
- 2. Drive belt for proper tension and condition.
- 3. Brakes, steering and throttle for responsiveness.
- Brake fluid level and condition. Hydraulic lines and fittings for leaks. Also, check brake pads and rotors for wear.
- 5. Cables for fraying, crimping and free operation.
- 6. Engine oil fluid level.
- 7. Headlamp, passing lamp, tail lamp, brake lamp and turn signal operation.

SHOP PRACTICES

Repair Notes

NOTE

- General maintenance practices are given in this section.
- Repair = Disassembly/Assembly.
- Replace = Removal/Installation.

All special tools and torque values are noted at the point of use.

All required parts or materials can be found in the appropriate PARTS CATALOG.

Safety

Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. Protect yourself and bystanders with approved eye protection. Don't just do the job – do the job safely.

Removing Parts

Always consider the weight of a part when lifting. Use a hoist whenever necessary. Do not lift heavy parts by hand. A hoist and adjustable lifting beam or sling are needed to remove some parts. The lengths of chains or cables from the hoist to the part should be equal and parallel and should be positioned directly over the center of the part. Be sure that no obstructions will interfere with the lifting operation. Never leave a part suspended in mid-air.

WARNING

Always check the capacity rating and condition of hoists, slings, chains or cables before use. Failure to do so can lead to an accident which could result in death or serious injury.

Always use blocking or proper stands to support the part that has been hoisted. If a part cannot be removed, verify that all bolts and attaching hardware have been removed. Check to see if any parts are in the way of the part being removed.

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

Cleaning

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

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

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

Disassembly/Assembly

Always assemble or disassemble one part at a time. Do not work on two assemblies simultaneously. Be sure to make all necessary adjustments. Recheck your work when finished. Be sure that everything is done.

Operate the vehicle to perform any final check or adjustments. If all is correct, the vehicle is ready to go back to the customer.

REPAIR AND REPLACEMENT PROCEDURES

Hardware and Threaded Parts

Install helical thread inserts when inside threads in castings are stripped, damaged or not capable of withstanding specified torque.

Replace bolts, nuts, studs, washers, spacers and small common hardware if missing or in any way damaged. Clean up or repair minor thread damage with a suitable thread chaser.

Replace all damaged or missing lubrication fittings.

Use Teflon pipe sealant on pipe fitting threads.

Wiring, Hoses and Lines

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

Instruments and Gauges

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

Bearings

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

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

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

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

Always use the proper tools and fixtures for removing and installing bearings.

Bearings do not usually need to be removed. Only remove bearings if necessary.

Bushings

Do not remove a bushing unless damaged, excessively worn or loose in its bore. Press out bushings that must be replaced.

When pressing or driving bushings, be sure to apply pressure in line with the bushing bore. Use a bearing/bushing driver or a bar with a smooth, flat end. Never use a hammer to drive bushings.

Inspect the bushing and the mated part for oil holes. Be sure all oil holes are properly aligned.

Gaskets

Always discard gaskets after removal. Replace with **new** gaskets. Never use the same gasket twice. Be sure that gasket holes match up with holes in the mating part.

Lip Type Seals

Lip seals are used to seal oil or grease and are usually installed with the sealing lip facing the contained lubricant. Seal orientation, however, may vary under different applications.

Seals should not be removed unless necessary. Only remove seals if required to gain access to other parts or if seal damage or wear dictates replacement.

Leaking oil or grease usually means that a seal is damaged. Replace leaking seals to prevent overheated bearings.

Always discard seals after removal. Do not use the same seal twice.

O-Rings (Preformed Packings)

Always discard o-rings after removal. Replace with **new** orings. To prevent leaks, lubricate the o-rings before installation. Apply the same type of lubricant as that being sealed. Be sure that all gasket, o-rings and seal mating surfaces are thoroughly clean before installation.

Gears

Always check gears for damaged or worn teeth.

Lubricate mating surfaces before pressing gears on shafts.

Shafts

If a shaft does not come out easily, check that all nuts, bolts or retaining rings have been removed. Check to see if other parts are in the way before using force.

Shafts fitted to tapered splines should be very tight. If shafts are not tight, disassemble and inspect tapered splines. Discard parts that are worn. Be sure tapered splines are clean, dry and free of burrs before putting them in place. Press mating parts together tightly.

Clean all rust from the machined surfaces of new parts.

Part Replacement

Always replace worn or damaged parts with new parts.

Part Protection

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

Cleaning Process

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

Rust or Corrosion Removal

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

TOOL SAFETY

Air Tools

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

Wrenches

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

Pliers/Cutters/Prybars

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

Hammers

 Never strike one hammer against a hardened object, such as another hammer.

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

Punches/Chisels

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

Screwdrivers

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

Ratchets and Handles

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

Sockets

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

Storage Units

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

FUEL AND OIL

FUEL

WARNING

Remove filler cap slowly and fill fuel tank slowly to prevent spillage; do not overfill or fill above the bottom of the filler neck insert. In addition, leave air space to allow for fuel expansion. Expansion can cause an overfilled tank to overflow gasoline through the filler cap onto surrounding areas. After refueling, be sure filler cap is securely tightened. Failure to comply may cause an explosion or fire which could result in death or serious injury.

Use a good quality leaded or unleaded gasoline of 91 pump octane (95 RON) or higher. Pump octane is the octane number usually shown on the gas pump.

GASOLINE BLENDS

CAUTION

Using gasoline that has an alcohol additive, such as methanol, may cause fuel system rubber components' failure and/or engine damage.

Harley-Davidson motorcycles were designed to give the best performance using unleaded gasoline. Some fuel suppliers sell gasoline/alcohol blends as a fuel. The type and amount of alcohol added to the fuel is important.

- DO NOT USE GASOLINES CONTAINING METHANOL. Using gasoline/methanol blends will result in starting and driveability deterioration and damage to critical fuel system components.
- ETHANOL is a mixture of 10% ethanol (Grain alcohol) and 90% unleaded gasoline. Gasoline/ethanol blends can be used in your motorcycle if the ethanol content does not exceed 10%.
- REFORMULATED OR OXYGENATED GASOLINES (RFG): "Reformulated gasoline" is a term used to describe gasoline blends that are specifically designed to burn cleaner than other types of gasoline. Your motorcycle will run normally using this type of gas.

You may find that some gasoline blends adversely affect the starting, driveability or fuel efficiency of your bike. If you experience one or more of these problems, we recommend you try a different brand of gasoline or gasoline with a higher octane rating.

ENGINE OIL

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

If it is necessary to add oil and Harley-Davidson oil is not available, use an oil certified for diesel engines. Acceptable diesel engine oil designations include CE, CF, CF-4 and CG-4. The preferred viscosities for the diesel engine oils, in descending order, are 20W-50, 15W-40 and 10W-40. At the first opportunity, see a Harley-Davidson dealer to change back to 100 percent Harley-Davidson oil.

See 1.3 MAINTENANCE SCHEDULE for all service information.

WINTER LUBRICATION

Combustion in an engine produces water vapor. During starting and warm-up in cold weather, especially in freezing temperatures, the vapor condenses to water before the crankcase is hot enough to exhaust it through the breather system. If the engine is run long enough for the crankcase to become thoroughly heated, the water returns to vapor and is then exhausted.

An engine used for only short trips, and seldom allowed to thoroughly warm up, accumulates increasing amounts of water in the oil pan. Water mixed with oil forms a sludge that causes accelerated engine wear. In freezing temperatures, the water becomes slush or ice, which may clog oil lines and result in engine failure.

Always change the engine oil more often in winter. If the engine is used for short runs, change the oil even more frequently. The farther below freezing the temperature drops the more often the oil should be changed.

MAINTENANCE SCHEDULE

MAINTENANCE TASK AND SERVICE DATA	P R E R I D E	1 0 0 MI 1 6 0 K M	2 5 0 0 MI 4 0 0 0 K	5 0 0 MI 8 0 0 K M	7 5 0 0 MI 1 2 0 0 0 K M	1 0 0 0 MI 1 6 0 0 0 K M	1 2 5 0 0 MI 2 0 0 0 0 0 K	1 5 0 0 0 MI 2 4 0 0 0 K M	1 7 5 0 0 MI 2 8 0 0 0 K M	2 0 0 0 0 MI 3 2 0 0 0 K M	2 5 0 0 MI 3 6 0 0 K M	2 5 0 0 0 MI 4 0 0 0 0 K	2 7 5 0 0 MI 4 4 0 0 K M	3 0 0 0 0 MI 4 8 0 0 0 K M	3 2 5 0 0 MI 5 2 0 0 0 5 0 0 K	3 5 0 0 0 MI 5 6 0 0 0 K M	3 7 5 0 0 MI 6 0 0 0 0 K M	4 0 0 0 0 MI 6 4 0 0 0 K M	4 2 5 0 0 MI 6 8 0 0 0 5 K	4 5 0 0 0 MI 7 2 0 0 0 K M	4 7 5 0 0 MI 7 6 0 0 K M	5 0 0 0 0 MI 8 0 0 0 0 K M
Engine oil Oil level: Fill to upper groove on dipstick with warm engine.	1	R		R	-	R	1	R	I	R	-	R	1	R	I	R	I	R	-	R		R
(1.6 ENGINE OIL AND FILTER) Engine filter <i>Filter tightening:</i> Hand tighten oil filter 2/3 to 1 turn after gasket surface contacts filter mounting surface.		R		R		R		R		R		R		R		R		R		R		R
(1.6 ENGINE OIL AND FILTER) Battery (1.7 BATTERY MAINTENANCE)		1	1	1	1	1	1	1	1	I	-	1	1	1	I	1	1	1	-	I	L	1
Clutch fluid Fluid type: D.O.T. 5 SILICONE BRAKE FLUID (1.12 CLUTCH)		I		I		I		I		I		I		1		I		Ι		I		I
Brake fluid level and condition Brake fluid type: D.O.T. 5 SILICONE BRAKE FLUID (1.8 BRAKES)		I		1		I		1		I		1		1		I		I		I		I

FIRST SCHEDULED MAINTENANCE

 A Harley-Davidson dealer should perform the first scheduled service listed in the Owner's Manual. See the Maintenance and Lubrication section in your Owner's Manual for more information.

Table Code:

A - Adjust.

I - Inspect, and if necessary, correct, adjust, clean or replace.

L - Lubricate with specified lubricant.

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D - Disassemble (Lube & Inspect).

MAINTENANCE TASK AND SERVICE DATA	PRERID	1 0 0 MI 1 6 0 K	2 5 0 0 MI 4 0 0 0 K	5 0 0 0 MI 8 0 0 0 K	7 5 0 0 MI 1 2 0 0 0 K	1 0 0 0 0 MI 1 6 0 0 0 K	1 2 5 0 0 MI 2 0 0 0 K	1 5 0 0 0 MI 2 4 0 0 0 K	1 7 5 0 0 MI 2 8 0 0 0 K	2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 2 5 0 0 MI 3 6 0 0 0 K	2 5 0 0 0 MI 4 0 0 0 K	2 7 5 0 0 MI 4 4 0 0 0 K	3 0 0 0 0 MI 4 8 0 0 0 K	3 2 5 0 0 MI 5 2 0 0 0 K	3 5 0 0 0 MI 5 6 0 0 0 K	3 7 5 0 0 MI 6 0 0 0 K	4 0 0 0 MI 6 4 0 0 0 K	4 2 5 0 0 MI 6 8 0 0 0 K	4 5 0 0 0 MI 7 2 0 0 0 K	4 7 5 0 0 MI 7 6 0 0 0 K	5 0 0 0 0 0 MI 8 0 0 0 0 0 K
Brake pads and discs for wear	E	м	M	М	M	М	M	M	M	м	M	м	M	м	M	м	M	M	M	м	M	М
Minimum pad thickness: varies upon application Maximum brake disc lateral runout: 0.3 mm (0.012 in.)	J	I		1	1	1		I	-	I	-	I		1		1	-	1		I	-	T
(1.10 BRAKE PADS AND DISCS)																						
Tire pressure and inspect tire for wear/damage	1	1	-	1	I	ī	I	ı	1	I.	1	i	1	1		1		1	1	1	-	
(1.11 TIRES AND WHEELS) Rear belt deflection inspection						_																
Deflection: 6 mm	1	I		1		I	-	I				1	I									
<i>Specialty tool:</i> Part No. HD-35381				9									Net a set	1		1	1	1		I	1	1
(1.14 REAR BELT DEFLECTION) Rear belt and sprocket																						
(1.15 REAR BELT AND SPROCK- ETS)		I		I		ı		I		1		I		I		I		ļ		1		I
Steering head bearings		Α								Α				D								
(1.17 STEERING HEAD BEARINGS)		~								~				U								
Front fork oil														R								
(1.18 FRONT FORK OIL) Spark plugs								-														
Plug type: No. 10R12A																						
<i>Plug gap:</i> 0.89 mm (0.035 in.)				I		R		Т		R		т		R		ı		R		I		R
<i>Plug torque:</i> 23 Nm (17 ft-lbs)																						
(1.19 SPARK PLUG/COIL)																						
Air filter Cover screw: 2.5-3 turns after contact (1.4 AIRBOX AND AIR FILTER)		I	1	I	T	I	1	1	1	1	1	I	I	I		I		I	-	Ι	1	I

Table Code:

A - Adjust.
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MAINTENANCE TASK AND SERVICE DATA	P R E R I D E	1 0 0 MI 1 6 0 0 K M	2 5 0 MI 4 0 0 K M	5 0 0 MI 8 0 0 0 K M	7 5 0 0 MI 1 2 0 0 0 K M	1 0 0 0 MI 1 6 0 0 0 K M	1 2 5 0 0 MI 2 0 0 0 0 0 0 K	1 5 0 0 0 MI 2 4 0 0 0 K M	1 7 5 0 0 MI 2 8 0 0 0 K M	2 0 0 0 0 MI 3 2 0 0 0 0 K M	2 2 5 0 0 MI 3 6 0 0 0 K M	2 5 0 0 0 MI 4 0 0 0 0 K M	2 7 5 0 0 MI 4 4 0 0 K M	3 0 0 0 0 MI 4 8 0 0 0 0 K M	3 2 5 0 0 MI 5 2 0 0 0 K M	3 5 0 0 0 MI 5 6 0 0 0 K M	3 7 5 0 0 MI 6 0 0 0 K M	4 0 0 0 MI 6 4 0 0 0 K M	4 2 5 0 0 MI 6 8 0 0 0 5 K M	4 5 0 0 0 MI 7 2 0 0 0 0 K M	4 7 5 0 0 MI 7 6 0 0 0 K M	5 0 0 0 MI 8 0 0 0 0 K M
Lubricate controls Front brake hand lever, clutch hand lever, throttle control cables, seat latch (1.20 CABLE AND CHASSIS LUBRI- CATION)		IL		IL		IL		IL		IL		IL		IL		IL		IL		IL		IL
Operation of throttle (1.21 THROTTLE CABLES)		1	-	l	1	I	1	ļ	I	1	1	1	1	Т	1	1	1	I	1	I	1	I
Check oil and brake lines for leaks		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	I	1	1
Jiffy stand Rear fork bearings		IL	IL	IL	IL	IL	IL	IL	IL	IL	IL	IL	IL	IL D	IL	IL	IL	IL	IL	IL	IL	IL
Valve lash														U		-						
(1.22 VALVE LASH)						1				1				1				I				1
Cooling system Check coolant level Check clamps for tightness Check freeze point (-32° C, -25° F) (1.5 COOLING SYSTEM)		I								1				R				Ĩ				L
Radiator clean		I	- I	I	1	Т	1	I	1	I	1	Ι	I	Т	1	I		I	1	I		I
Operation of all electrical equip- ment and switches		I	1	I	T	ţ	1	I	I	I	1	F	1	I	1	I	1	1	1	I	ł	I
All critical fasteners (1.25 CRITICAL FASTENERS) Road test		т х	x	x	X	т Х	X	X	X	т х	x	x	X	т х	X	X	X	T X	X	X	X	T X

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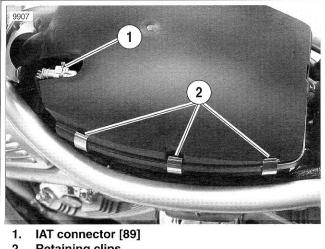
AIRBOX REMOVAL

- 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.



2. **Retaining clips**

Figure 1-2. Air Filter Top

See Figure 1-3. Remove wing nut securing filter cap and 4. air filter.

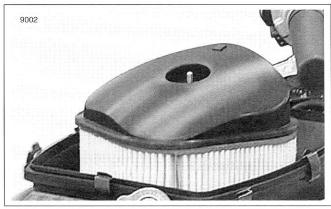


Figure 1-3. Air Filter

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

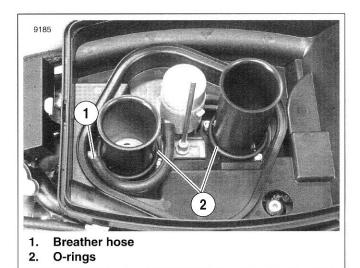


Figure 1-4. Velocity Stacks

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

If airbox is not to be reinstalled immediately, cover throttle body intakes with tape to prevent contaminates/ objects from falling down the throttle bores. Do not use shop rags or objects that could damage the throttle body butterflies.

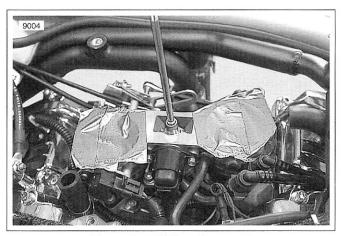


Figure 1-5. Airbox Removed

AIRBOX INSTALLATION

- 1. Remove tape from throttle body intakes.
- 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.

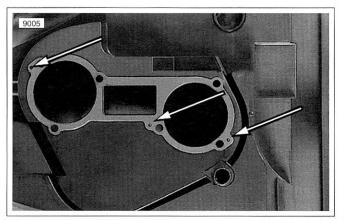


Figure 1-6. Air Filter Gasket Alignment Pins (3)

- 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.

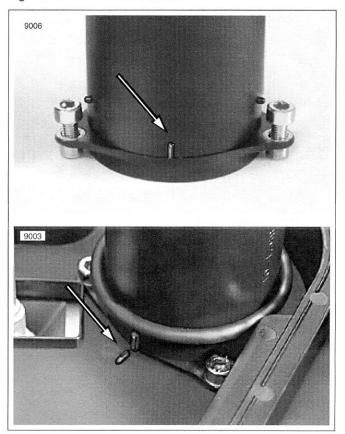


Figure 1-7. Velocity Stack Alignment Marks

- 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.
- 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.
- 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. Install 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.

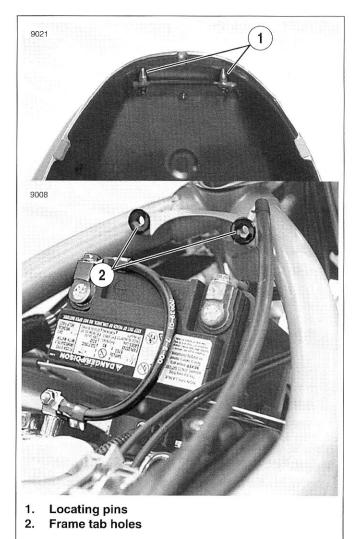


Figure 1-9. Airbox Cover

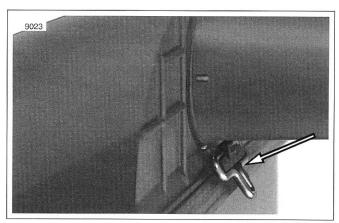


Figure 1-8. Front Airbox Clip

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 the filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

 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.

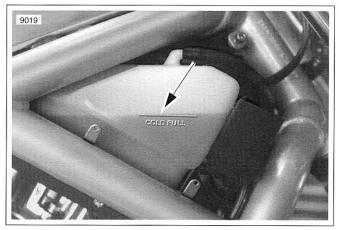


Figure 1-11. Cold Full Line On Overflow Bottle

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.

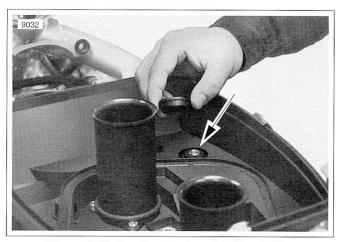


Figure 1-12. Cooling System Air Bleed Plug

- 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 side 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.
- 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 engine when oil level is below the add mark on the dipstick. Engine damage could result.

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 two minutes.**
- 2. Stand motorcycle upright (not leaning on side stand) on a level surface.
- 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.

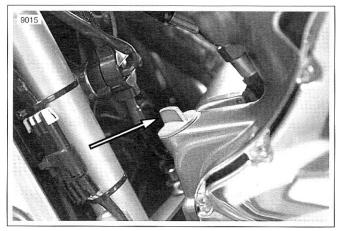


Figure 1-13. Dipstick/Filler Cap

5. See Figure 1-13. Remove filler cap and check oil level on dipstick.

CAUTION

To allow oil to drain into sump, wait approximately three minutes after adding oil before checking level with dipstick. Checking level immediately after adding oil could give a false reading, causing more oil to be added. An over-filled sump can cause engine damage.

 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 operate engine when oil level is below the add mark on the dipstick. Engine damage could result.

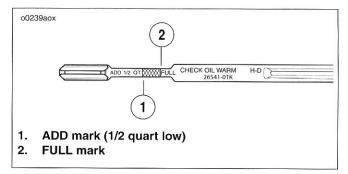


Figure 1-14. Dipstick

NOTE

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

CHANGING OIL AND FILTER

PART NO.

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.
- Ride motorcycle until engine is warmed up to normal 1. operating temperature.
- 2. See Figure 1-13. Remove the oil filler plug/dipstick on left side.
- See Figure 1-15. Remove the engine oil drain plug at З. 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.
 - Inspect oil drain plug for damage. Replace if a. required. Wipe any foreign material from plug.
 - b. Install drain plug. Tighten to 35 Nm (25.8 ft-lbs).
- See Figure 1-13. Select the grade of oil for the lowest 7. temperature expected before next oil change. See Table 1-1.
- 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 in 1.6 ENGINE OIL AND FILTER

NOTE Maximum capacity of oil system is 4.2 liters (4.5 quarts).

9016

Figure 1-15. Oil Drain Plug

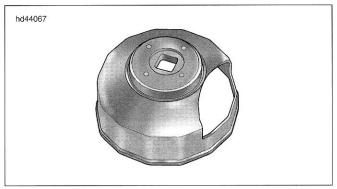


Figure 1-16. Oil Filter Wrench (HD-44067)

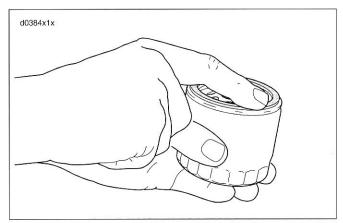


Figure 1-17. Lubing New Oil Filter

- Start engine and carefully check for oil leaks around 9. 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

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

Table 1-1. Recommended Engine Oils

SPECIALTY TOOL

GENERAL

WARNING

All batteries contain electrolyte. Electrolyte is a sulfuric acid solution that is highly corrosive and can cause severe chemical burns. Avoid contact with skin, eyes, and clothing. Avoid spillage. Always wear protective face shield, rubberized gloves and protective clothing when working with batteries. See Figure 1-18. A warning label is attached to the top of the battery. Never remove warning label from battery. Failure to read and understand all precautions contained in warning label before performing any service on batteries could result in death or serious injury. See Figure 1-19.

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.

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.

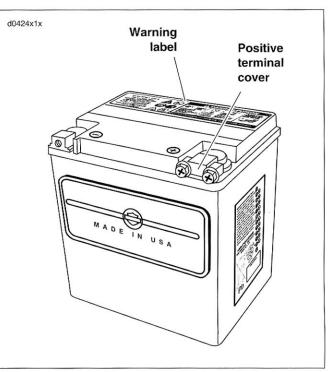


Figure 1-18. Battery

NOTE See 8.9 BATTERY for charging and testing information.



Figure 1-19. Battery Warning Label

DISCONNECTION/REMOVAL

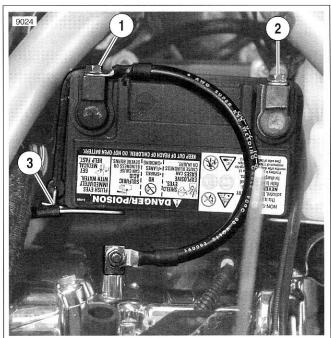
AWARNING

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

- 1. See Figure 1-21. Remove fastener (1) and remove right side cover (2).
- 2. Remove maxi-fuse (3).
- 3. Remove airbox. See 1.4 AIRBOX AND AIR FILTER.
- 4. See Figure 1-20. Remove negative terminal bolt (1) and positive terminal bolt (2).
- 5. Release battery strap clip (3) and remove battery.
- 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 1-2, 12 amp-hour battery, in Section 1 and charge battery at rate and time specified.

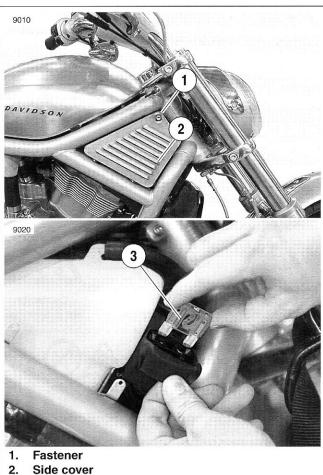
NOTE

The engine is equipped with a compression release, so a smaller battery provides adequate starting current.



- 1. Negative battery cable bolt
- 2. Positive battery cable bolt
- 3. Battery strap clip

Figure 1-20. Battery (12 amp-hour)



3. Maxi-fuse (40 amp)

Figure 1-21. Battery Disconnect

INSTALLATION/CONNECTION

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

AWARNING

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

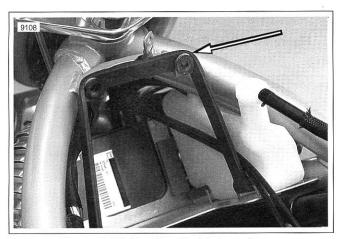


Figure 1-22. Position Hold-down Strap

- See Figure 1-22. Stretch rubber hold-down strap over airbox cover frame tabs.
- 2. See Figure 1-20. 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**).
- 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. Install airbox. See 1.4 AIRBOX AND AIR FILTER.
- Install maxi-fuse and side cover. Tighten side cover fastener to 11-17 Nm (98-150 in-lbs).

STORAGE

WARNING

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

CAUTION

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

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

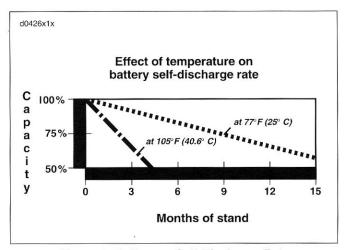


Figure 1-23. Battery Self-Discharge Rate

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.

ACAUTION

Direct contact of D.O.T. 5 brake fluid with eyes may 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 may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

- 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.
 - Remove cooling system side cover fastener on underside of side cover.
 - b. Swing out lower section and lift to unhook from top of assembly.
 - 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.

- 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.
- 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.

 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 BLEED-ING BRAKES.

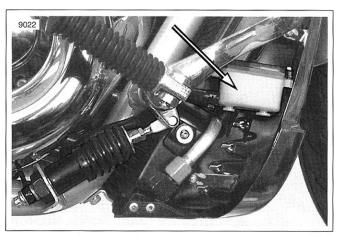


Figure 1-24. Rear Brake Master Cylinder Reservoir

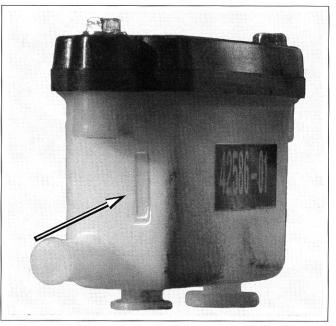


Figure 1-25. Rear Brake Fluid Reservoir Sight Gauge (reservoir removed from motorcycle)

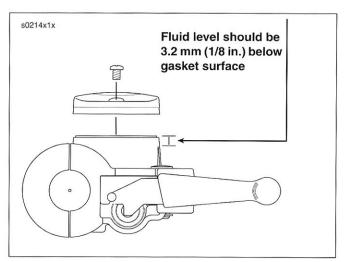


Figure 1-26. Front Brake Master Cylinder Reservoir

REAR BRAKE PEDAL

Pedal Adjustment

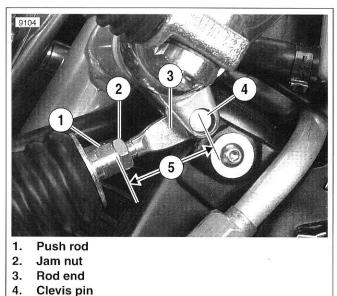
If adjustment is needed:

- 1. See Figure 1-27. With a wrench holding the push rod (1), loosen jam nut (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 jam nut (2).

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



5. 18-22 mm (0.690-0.890 in.)

Figure 1-27. Rear Brake Pedal

GENERAL

ACAUTION

Direct contact of D.O.T. 5 brake fluid with eyes may 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 may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

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.
- 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.
 - 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 CYLIN-DER/RESERVOIR.

NOTE

Do not fill above the rear brake reservoir above the top of the sight window at the rear of the reservoir.

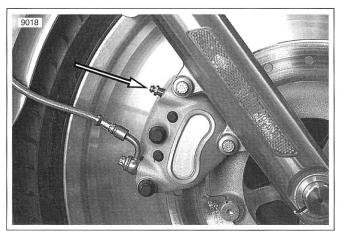


Figure 1-28. Front Brake Bleeder Valve

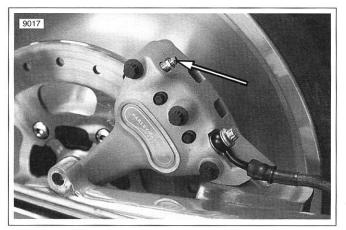


Figure 1-29. Rear Brake Bleeder Valve

- 4. Depress and hold brake lever/pedal to build up hydraulic pressure.
- 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).

INSPECTION

Check brake pads and discs:

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

Brake Pads

ACAUTION

Direct contact of D.O.T. 5 brake fluid with eyes may 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 may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

WARNING

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

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 Warpage

Maximum brake disc lateral runout and warpage 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.
- 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.

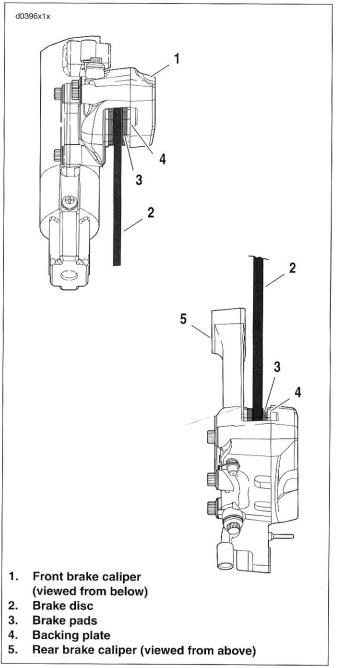


Figure 1-30. Brake Pad Inspection

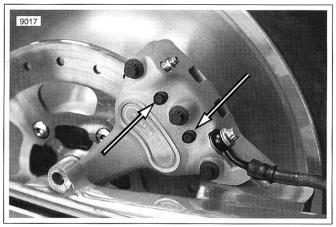


Figure 1-31. Rear Caliper Pad Pins (12 pt/0.25 in.)

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.

- 5. Install **new** inside brake pad using the same orientation as the pad previously removed. Curved portion of pad must face upward.
- 6. Install pad pins until the pins snap into place with an audible click. Do not fully tighten at this time.
- 7. Pump brake pedal lever to move inside pistons out until they contact the brake pads.
- 8. 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.

- 12. 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).

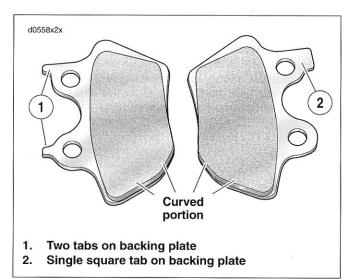
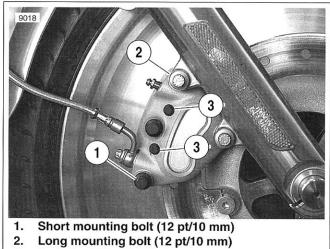


Figure 1-32. Brake Pad Orientation



3. 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.
- 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.
- 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 AND WHEELS

TIRES

AWARNING

For your own personal safety, tires, rims and air valves must be correctly matched to wheel rims. See your Harley-Davidson dealer. Mismatching tires, tubes, rims and air valves may result in damage to the tire bead during mounting or may allow the tire to slip on the rim, possibly causing tire failure which could result in death or serious injury.

- 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 exceed the maximum inflation pressure listed on tire sidewall. Overinflating could lead to tire failure which could result in death or serious injury.

3. Check for proper front and rear tire pressures when tires are cold. Compare results against 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 2.24 SEALED WHEEL BEARINGS.

Table 1-3. Tire Pressures

10-Sector States and the sector of the secto	P TIRES	ES SOLO RIDER		RIDER & ONE PASSENGER		
MODEL	TIRE	PSI	kPA	PSI	kPA	
VRSCA	Front	36	248	36	248	
VHSUA	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 BRAKE FLUID is used for the hydraulic clutch and is referred to as clutch fluid in this manual. Do not use other types of fluid as they are not compatible.

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

Be sure NO clutch fluid gets on rear tire, wheel or brakes when adding clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

WARNING

Do NOT allow foreign matter to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir may cause improper operation of the clutch and equipment damage. This could result in loss of control of the motorcycle and death or serious injury.

WARNING

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and seek medical attention immediately. Swallowing large amounts of D.O.T. 5 SILICONE BRAKE FLUID may cause digestive discomfort. If swallowed, seek medical attention immediately. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

- 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.
- 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 inlbs).

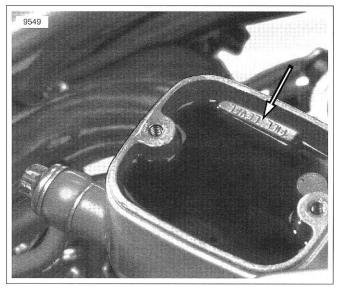


Figure 2-34. Fill Level (reservoir cover removed)

PROCEDURE

WARNING

Be sure NO clutch fluid gets on rear tire, wheel or brakes when adding clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

WARNING

Do NOT allow foreign matter to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir may cause improper operation of the clutch and equipment damage. This could result in loss of control of the motorcycle and death or serious injury.

ACAUTION

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and seek medical attention immediately. Swallowing large amounts of D.O.T. 5 SILICONE BRAKE FLUID may cause digestive discomfort. If swallowed, seek medical attention immediately. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

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.

 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.

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-Ibs).
 - d. Secondary clutch actuator cover fasteners to 6-10 Nm (53-89 in-lbs).
- 11. Test ride motorcycle. Incorrect pressure can cause:
 - a. Dragging clutch.
 - b. Hard shifting.

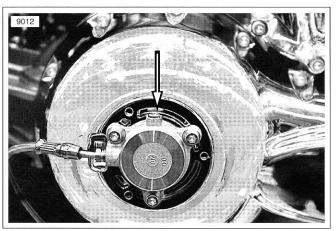


Figure 1-35. Secondary Clutch Actuator Bleed Screw

REAR BELT DEFLECTION

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.

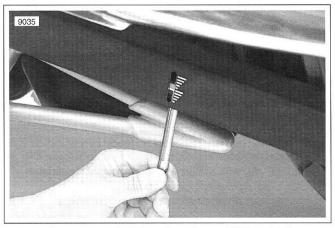


Figure 1-36. Belt Tension Gauge (HD-35381)

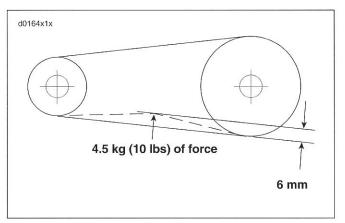


Figure 1-37. Checking Belt Deflection

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

NOTE

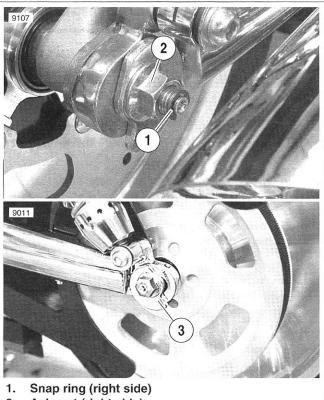
The left cam is welded to the axle and the right cam is keyed to the axle. Clockwise rotation of axle will tighten beltcounter-clockwise rotation will loosen belt.

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 ftlbs).
 - b. Install snap ring (1).



- Axle nut (right side)
- 3. Adjustment eccentric (left side)

Figure 1-38. Axle Adjusters

REAR BELT AND SPROCKETS

GENERAL

Inspect the drive belt and rear 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

Sprockets

NOTE

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

- 1. 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).
- 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.
 - 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.
- Replace rear sprocket if major tooth damage or loss of chrome exists.

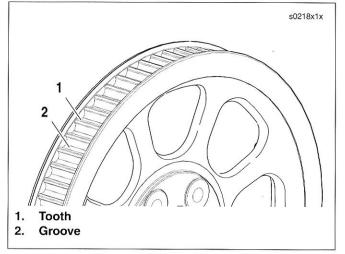


Figure 1-39. Rear Sprocket

Rear 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.

NOTE

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

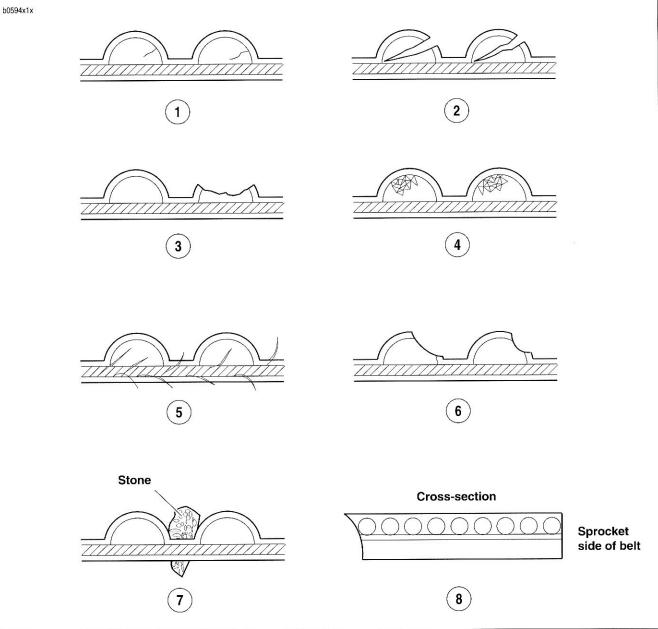


Figure 1-40. Drive Belt Wear Patterns

Table 1-4. Drive Belt Wear Analysis		Tab	le	1	-4.	Driv	/e	Belt	Wear	Anal	ysis
-------------------------------------	--	-----	----	---	-----	------	----	------	------	------	------

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		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		Replace belt	
7 Stone damage Replace belt if damage is on the edge		Replace belt if damage is on the edge	
8 Bevel wear (outboard edge only) OK to run, but monitor condition		OK to run, but monitor condition	

REAR SHOCK PRELOAD

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

The rear shock absorber springs can be adjusted for the weight the motorcycle is to carry. There is a spanner wrench for this purpose.

AWARNING

Both shock absorber adjuster plates must be adjusted to the same position. Not having the springs adjusted to the same length could adversely affect handling. This may lead to a loss of control of the motorcycle and could result in death or serious injury.

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 1-41. 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.

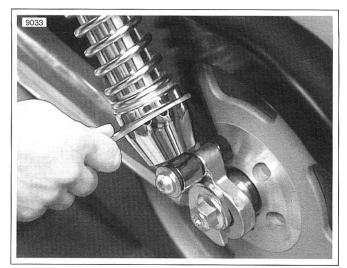


Figure 1-41. Rear Shock Adjustment

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 2.29 STEERING HEAD.
- 1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
- Remove all accessory weight and P&A parts, such as a windshield, or any part that may influence the way the front end swings.

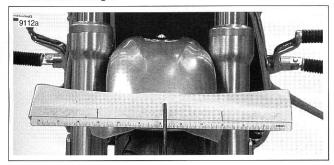


Figure 1-42. Fall-away Measurement

- 3. See Figure 1-42. 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.
- See Figure 1-48. 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" by itself. Record mark on ruler.
 - b. Repeat the previous step in the other direction.
 - c. Measure distance between marks.
- 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.

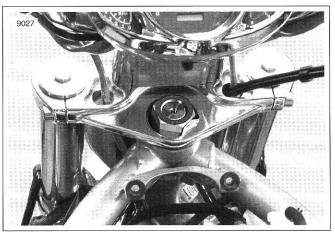


Figure 1-43. Steering Head

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.

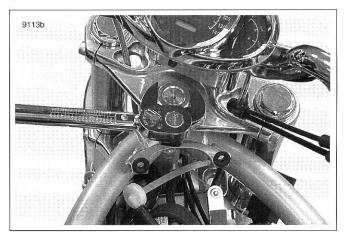


Figure 1-44. Tighten Steering Head

- 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 replace fork stem cap (6).

FRONT FORK OIL

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.
- See 2.18 FRONT BRAKE CALIPERS. Remove front brake caliper.
- 3. See 2.22 FRONT WHEEL. Remove front wheel.
- 4. See 2.27 FRONT FENDER. Remove front fender.
- 5. See Figure 1-48. 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.
- See Figure 1-45. Use FORK TUBE HOLDER (HD-41177) to clamp fork in vise without damaging the slider tube.

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

- 9. See Figure 1-48. 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 1-45. Position the fork tube in the FORK TUBE HOLDER.
- See 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.
- See Figure 1-46. 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 1-48. Reassemble the fork making sure tightly wound end of the spring (5) goes to the bottom.
- 17. Install washer (4) and spring collar (3).
- Install and tighten fork tube caps to 29.8-78.6 Nm (22-58 ft-lbs).
- 19. See Figure 1-47. 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	ММ	IN.
VRSCA	85	3.3

NOTE

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

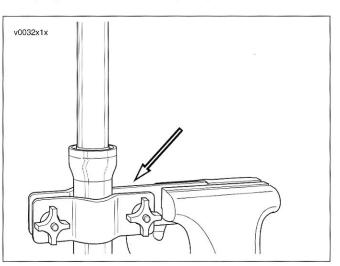


Figure 1-45. Fork Tube Holder (HD-41177)

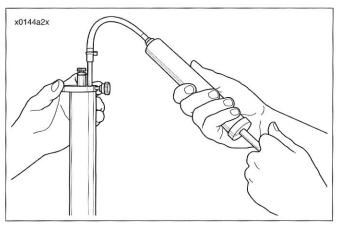


Figure 1-46. Fork Fluid Level

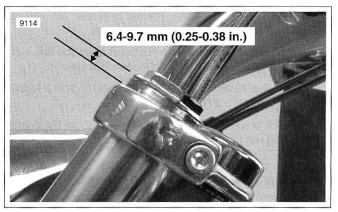


Figure 1-47. Fork Tube Position

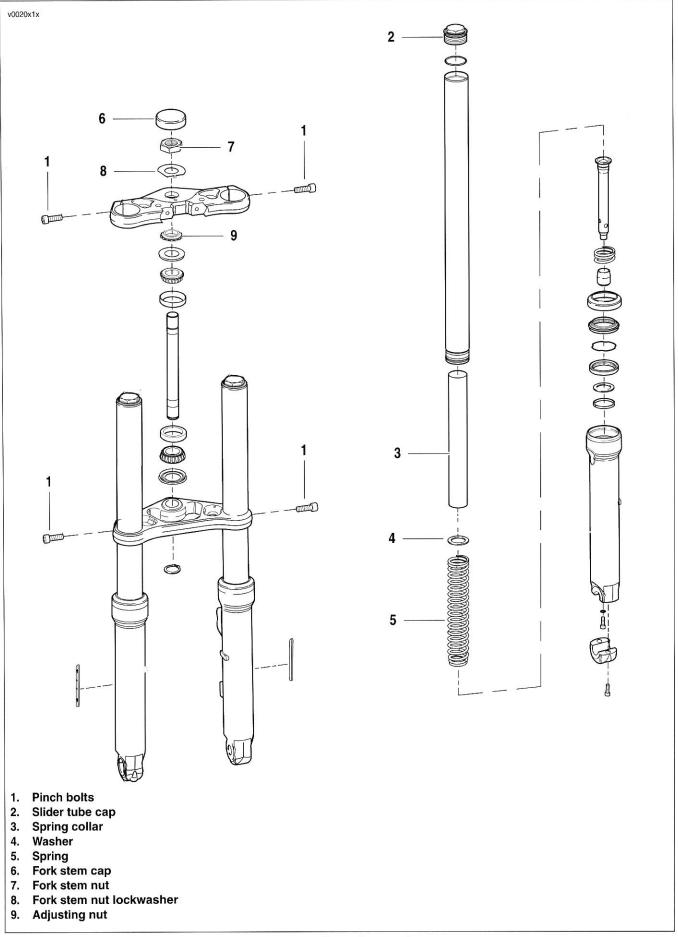


Figure 1-48. Front Suspension

SPARK PLUG/COIL

GENERAL

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

CAUTION

Use only Harley-Davidson spark plugs made for the VRSC. Use of other spark plugs may affect the running characteristics of the motor 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 1-49. 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 spark plug.

NOTE

Remove battery for access to front spark plug. See 1.7 BAT-TERY MAINTENANCE.

7. Remove front plug following steps 3 through 6.

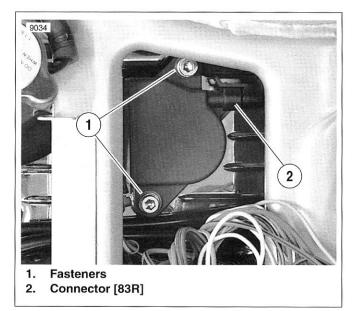


Figure 1-49. Rear Cylinder Coil

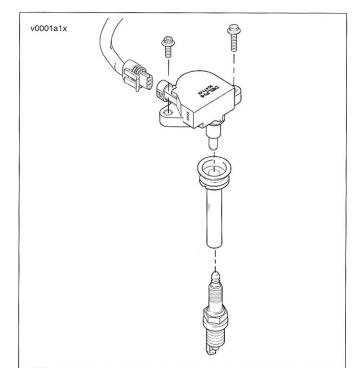


Figure 1-50. Plug Top Coil

- 8. See Figure 1-51. Compare your observations of the plug deposits with the descriptions provided.
 - a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
 - A dry, fluffy or sooty black deposit indicates an airfuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.
 - c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.
 - A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.
- 9. If the plugs require cleaning between tune-ups, proceed as follows:
 - Degrease firing end of spark plug using ELECTRI-CAL CONTACT CLEANER. Dry plug with compressed air.
 - b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.
 - c. If the plugs cannot be cleaned, replace with No. **10R12A** spark plugs.
- 10. 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.).
- 11. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.

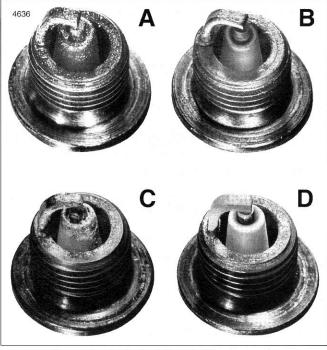


Figure 1-51. Typical Spark Plug Deposits

INSTALLATION

- Apply LOCTITE ANTI-SEIZE to plug threads. Install and tighten to 23 Nm (17 ft-lbs).
- 2. 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 9.7 Nm (86 in-lbs).
- 4. Connect connectors [83R] and [83F].
- 5. Install airbox assembly. See 1.4 AIRBOX AND AIR FIL-TER.

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

See 1.21 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 4000 km (2500 mile) service interval thereafter.

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

CABLE INSPECTION, LUBRICATION AND ADJUSTMENT

Inspect the throttle cables:

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

Inspection and Lubrication

- 1. See Figure 1-52. Turn the cable adjusters (2, 4) and jamnuts (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 replace throttle grip.
- Put one or two drops of SUPER OIL (Part No. HD-94968-85TV) into the housing of each cable.
- 7. Assembling the handlebar housing and tighten both screws (1) to 4.0-5.1 Nm (35-45 **in-lbs**).

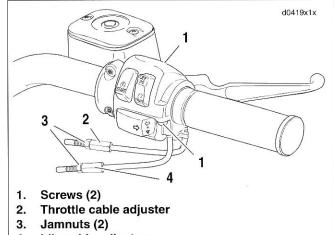
Adjustment

- 1. See Figure 1-52. Turn the cable adjusters (2, 4) and jamnuts (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. Turn the throttle grip wide open and hold it there.
 - Turn the throttle cable adjuster (2), lengthening the sleeve, until the throttle cam just touches the cam stop.
 - c. Tighten the adjuster jamnut (3) and release the throttle.
- 3. Turn the front wheel full right.
- 4. Turn the idle cable adjuster (4), lengthening the sleeve until the cable housing just touches the spring in the cable support sleeve.

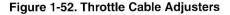
WARNING

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. Work the throttle grip to be sure the cable returns to idle position when released.
 - b. If the cable does not return to idle, turn idle adjuster, shortening the sleeve until correct adjustment is reached. Tighten the jamnut (3).



4. Idle cable adjuster



FUEL SYSTEM LINES AND FITTINGS

Inspect the fuel system lines:

- At every scheduled service interval.
- After the fuel tank filter has been serviced.

Check fuel system lines and fittings for leaks.

LASH MEASURMENT

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.

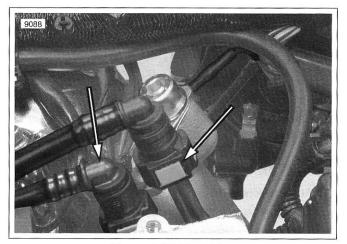
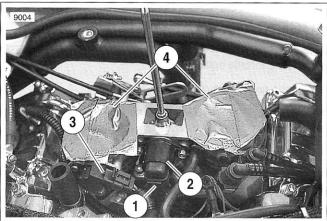


Figure 1-53. Fuel Line

- 3. See Figure 1-53. 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 1.19 SPARK PLUG/ COIL.
- 5. Disconnect idle air control (IAC) connector [87B] from throttle body.
- 6. Disconnect throttle position (TP) sensor connector [88B] from throttle body.



- 1. IAC sensor connector [87B]
- 2. Idle air control (IAC)
- 3. Throttle position (TP) sensor connector [88B]
- 4. Air intakes (covered)

Figure 9-54. Throttle Body Electrical Connectors

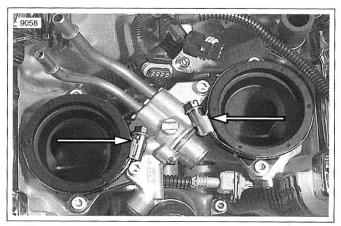
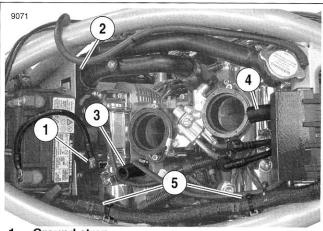


Figure 1-55. Intake Clamps, Throttle Body Removed



- 1. Ground strap
- 2. Radiator hose P clamp
- 3. Front cylinder breather hose
- 4. Rear cylinder breather hose
- 5. Cable straps

7. See Figure 1-55. Loosen clamps at each intake and lift throttle body straight up.

NOTE

Observe the position of the clamps for reassembly.

- 8. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
- 9. Cover intake openings to prevent objects from falling into intake bore.
- 10. See Figure 1-56. Remove ground strap at cam cover.
- 11. Remove p-clamp (2) retaining radiator hoses.
- 12. Remove front (3) and rear (4) breather hoses.
- 13. Remove main harness cable straps (5) along left side of frame.
- 14. See Figure 1-57. Remove vapor valve from t-stud.
- 15. Loosen all cam cover fasteners.

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.

- 16. Support motor with jack under oil pan.
- See Figure 1-58. Loosen front motor mount bolt and retract jack to allow the engine to drop down approximately 13 mm (1/2 in.).

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.

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

NOTE

The VRSCA has been manufactured with and without four cam-cover dowels. Do not drop any dowels into the open cylinder head.

- 19. 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.

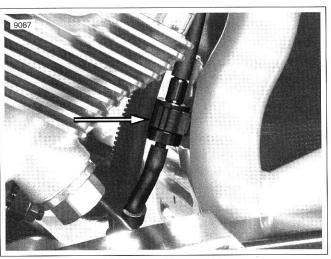


Figure 1-57. Vapor Valve

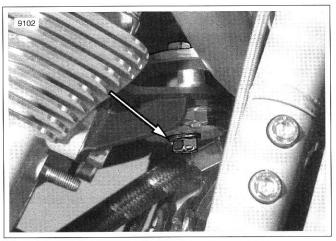


Figure 1-58. Front Motor Mount Bolt

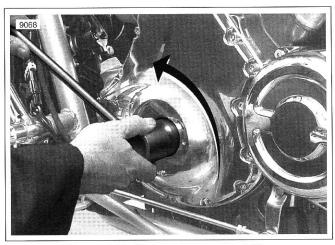


Figure 1-59. Correct Engine Rotation

21. Remove spark plugs. See 1.19 SPARK PLUG/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.
- 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 1-60.
 - a. When adjusting the front cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-60.
 - b. When adjusting the rear cylinder the cam lobes will be at the base circle position on the tappet as shown in Figure 1-61.

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 may result.

24. See Figure 1-62. 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 WORK-SHEET 1. in Appendix D.

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

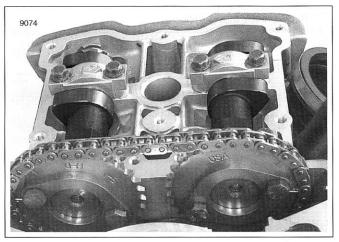


Figure 1-60. Front Cylinder Cam Lobe Position

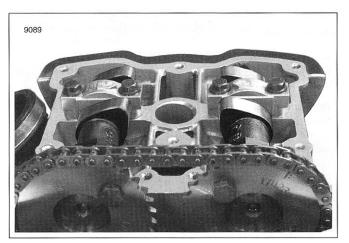


Figure 1-61. Rear Cylinder Cam Lobe Position

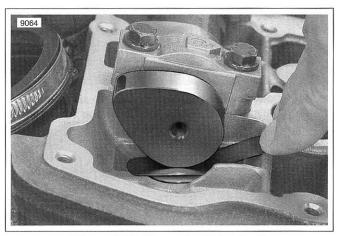


Figure 1-62. Measuring Valve Lash

- 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:
 - a. Measurement is larger than "Valve Lash Upper Limit."
 - b. 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 1.22 VALVE LASH.
- 30. If cam timing is correct, install spark plugs, install cam covers and front motor mount according to the instructions in the following procedure. See LASH ADJUST-MENT in 1.22 VALVE LASH.
- 31. If valve lash must be adjusted, verify cam timing before disassembly. See VERIFY CAM TIMING in 1.22 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

1. See Figure 1-63. 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.

2. See Figure 1-64. 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.
- 4. Verify that the TDC POSITIONING TOOL is fully extended and front piston is at TDC.
- See Figure 1-64. 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 (Part No. HD-45314) to lock engine at exact TDC.
- 6. See Figure 1-65. Engine is correctly timed with cam gear marks aligned and lobes positioned as shown.
- 7. If cam timing is not correct see 3.20 CAM DRIVE.
- 8. Remove CRANKSHAFT LOCKING PIN.
- Install engine timing plug in timing hole. Tighten to 23 Nm (17 ft-lbs).

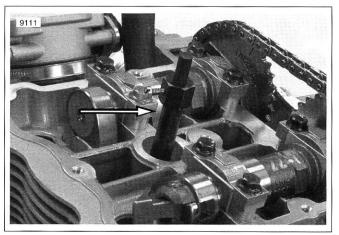


Figure 1-63. Top Dead Center Positioning Tool (HD-45653)

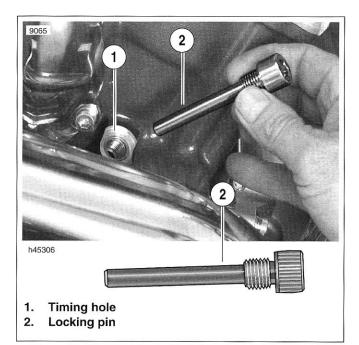
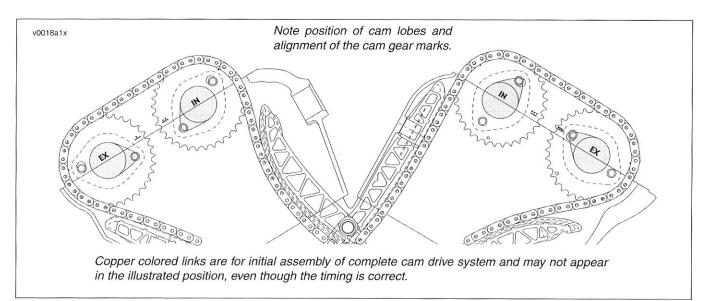


Figure 1-64. Crankshaft Locking Pin (HD-45306).



LASH ADJUSTMENT

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

- 1. See Figure 1-66. 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 1-67. 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 1-68. 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.

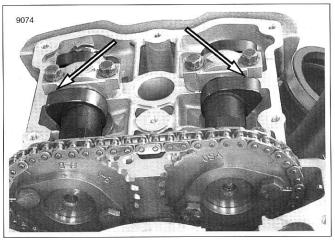


Figure 1-66. Front Cylinder 10 and 2 O'clock Cam Lobe Position

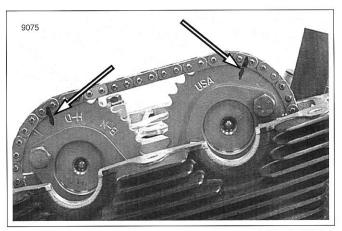


Figure 1-67. Reference Mark Cam Gear and Chain Link

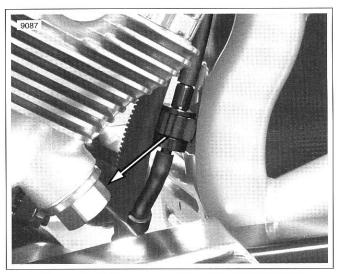


Figure 1-68. Secondary Cam Chain Tensioner

4. See Figure 1-69. Remove cam journal fasteners and caps from the cam needing adjustment.

NOTE

Remove and adjust only one camshaft at a time.

5. See Figure 1-70. 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.

6. 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.

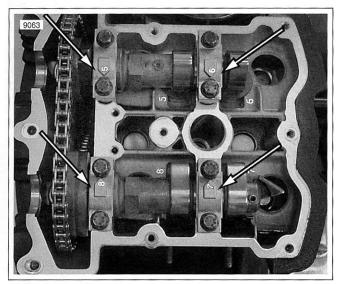


Figure 1-69. Cam Journal Caps

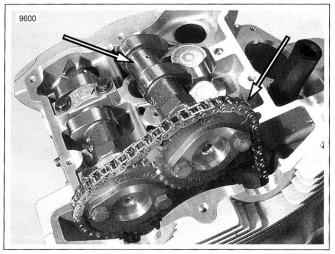


Figure 1-70. Move Cam Aside With Chain Engaged

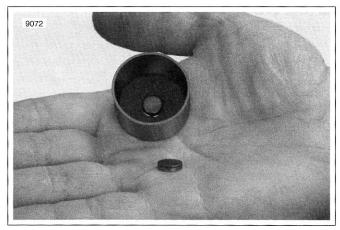


Figure 1-71. Tappet And Shim

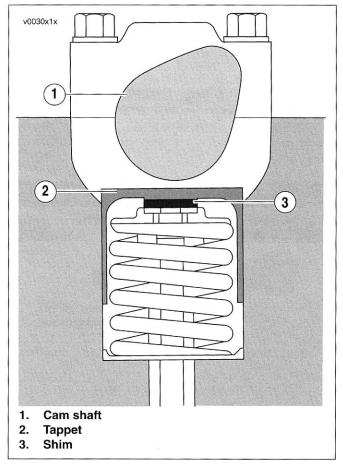


Figure 1-72. Cam, Tappet, Shim Relationship

 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 may 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."
- 9. Calculate and record "Desired Shim Size."
- Select and record the "Closest Shim Size" replacement shim. See Table D-1. Case 1 Valve Tappet Shims and Table D-2. Case 2 Valve Tappet Shims.
- 11. Always confirm **new** shim thickness with micrometer. Record for reference.
- 12. See Figure 1-74. Position **new** shim in spring retainer pocket. Use a magnet to position the shim and carefully push into place with finger.
- 13. Replace tappet.
- 14. If the initial lash measurement of the remaining valve exceeds the upper or lower valve lash limits, preform the lash adjustment on the remaining valve.
- See Figure 1-67. Install cam in alignment with new reference marks on drive chain and cam drive gear. Note new reference marks from step 2.
- 16. See Figure 1-75. 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.
- 17. Tighten cam bearing caps to 10 Nm (89 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.

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



Figure 1-73. Measure Shim

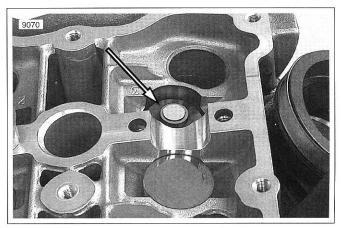


Figure 1-74. Position Shim

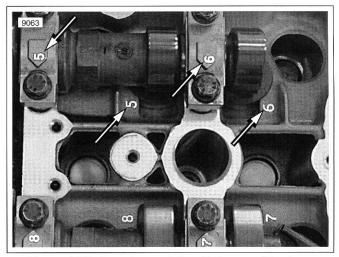


Figure 1-75. Cam Journal Cap Reference Numbers

- 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 1-61. 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 1.22 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 1-76. Use cable straps (1) to help retain gasket as shown.
- See Figure 1-78. 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.
- Visually check to ensure spark plug hole gasket (2) is in place.

NOTE

See Figure 1-77. 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.
- See Figure 1-79. Insert GASKET ALIGNMENT TOOL (HD-45340).

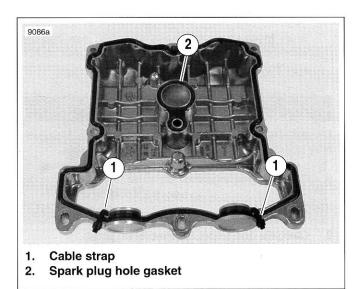


Figure 1-76. Cam Cover Gaskets



Figure 1-77. Spark Plug Hole Gasket (double lipped side)

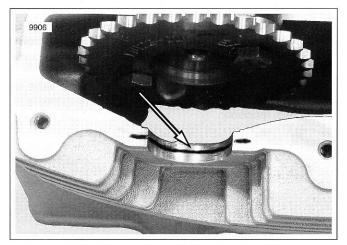


Figure 1-78. Silicone Bead Pattern in Head Recesses

- 34. See Figure 1-80. Insert fasteners in cam cover and tighten to 9.7 Nm (86 in-lbs) in sequence shown.
- 35. See Figure 1-58. Tighten front motor 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 1-81. Orient intake clamps as shown.
- 41. Install throttle body and tighten clamps.
- 42. See 1.19 SPARK PLUG/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.
- Install airbox assembly. See 1.4 AIRBOX AND AIR FIL-TER.

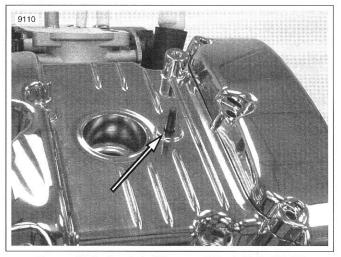


Figure 1-79. Gasket Alignment Tool (H-D-45340)

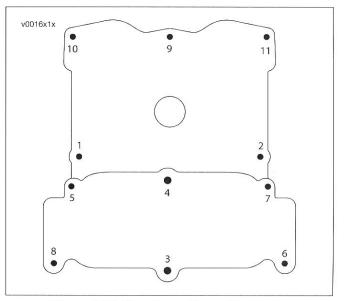


Figure 1-80. Cam Cover Torque Sequence

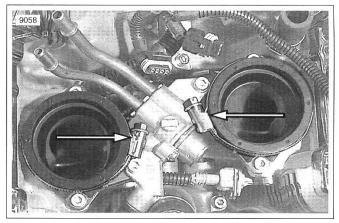


Figure 1-81. Intake Clamps, Throttle Body Removed

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.
- 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 FIL-TER.

WARNING

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

- 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 8.20 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 1-82. 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.
 - When the front cylinder intake valve is seated, turn crankshaft an additional 1/4 turn (90°) clockwise (CW).

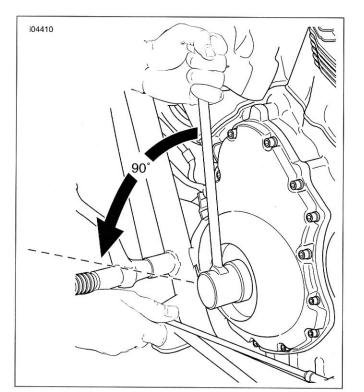


Figure 1-82. Positioning Piston

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.
- See Figure 1-83. install SECONDARY CHAM 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 MEASURE-MENT TOOL.
- 14. From the table, select the number of shims necessary for correct secondary cam chain tension. See Table 1-7.

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

Table 1-7. Tensioner Shims

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

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.

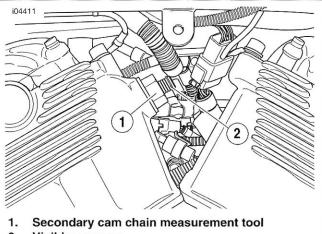
- See Figure 1-84. Wrap cardboard or heavy cloth around thick shaft on plunger (1). Gently twist while pulling to remove plunger (1) from tensioner (3).
- 16. Apply a thin film of Harley-Davidson Motorcycle Oil 20W50 to selected shims (2) and plunger (1).
- 17. Seat number of selected shims (2) and plunger (1) in tensioner (3).
- Lubricate tensioner seal (4) with Harley-Davidson Motorcycle Oil 20W50.
- 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.

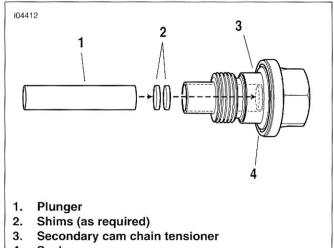
20. To position rear cylinder to adjust secondary cam chain:

- a. See Figure 1-82. 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.



2. Visible grooves

Figure 1-83. Secondary Cam Chain Measurement Tool Installed in Front Cylinder



4. Seal

Figure 1-84. Secondary Cam Chain Tensioner

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

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 1-83. Remove rear cylinder secondary cam chain tensioner and install SECONDARY CHAM 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. See 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 1-84. 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 8.20 HORN.
- 32. Connect negative battery cable.
- 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.

WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

INSPECTION

AWARNING

Do not modify ignition wiring to permit motorcycle operation with headlamp off. Operating with headlamp off may reduce your visibility to other motorists and cause an accident, which could result in death or serious injury.

Check headlamp for proper height and lateral alignment:

- When the new owner takes delivery of the motorcycle.
- When there is a change in load (adding luggage, etc.).
- 1. Verify correct front and rear tire pressure. See 1.11 TIRES AND WHEELS.
- 2. Place motorcycle on level floor (or pavement) in an area with minimum light.
- See Figure 1-85. 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.
- Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
- Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
- 6. See Figure 1-86. Turn ignition switch ON. Set handlebar headlamp switch to HIGH 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.

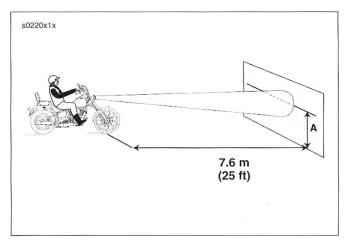


Figure 1-85. Headlamp Alignment

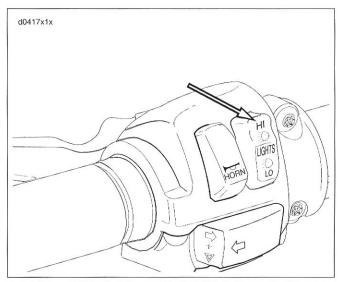


Figure 1-86. Headlamp Switch High Beam Setting

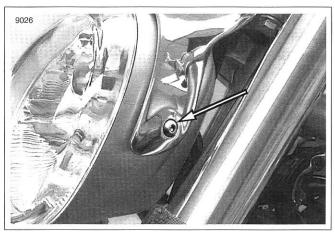


Figure 1-87. Headlamp Alignment Fastener

INSPECTION

Inspect critical fasteners, except head bolts:

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

See Table 1-8. Tighten all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

SYSTEM	FASTENER	TOR	QUE
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 Brake disc screws, fro Brake disc screws, re Reservoir screws	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
Axie nuts	Rear axle	129-142.3 Nm	95-105 ft-lbs
Front fork/handlebars	Lower fork pinch bolts	41-47 Nm	30-35 ft-lbs
FIGHTIORMANUEDAIS	Upper bracket pinch bolts	41-47 Nm	30-35 ft-lbs
Frame	Lower frame rail bolts	61-75 Nm	45-55 ft-lbs

Table 1-8. Critical Fasteners

PREPARATION FOR STORAGE

WARNING

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

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.

AWARNING

Remove filler cap slowly and fill fuel tank slowly to prevent spillage; do not overfill or fill above the bottom of the filler neck insert. In addition, leave air space to allow for fuel expansion. Expansion can cause an overfilled tank to overflow gasoline through the filler cap onto surrounding areas. After refueling, be sure filler cap is securely tightened. Failure to comply may cause an explosion or fire which could result in death or serious injury.

- 2. Choose one of the following two methods for preparing your fuel system.
 - 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.
- Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
- 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

Always unplug or turn off battery charger before connecting or disconnecting charger clamps at battery. Always disconnect the negative side first. Connecting or disconnecting clamps with charger on could cause a spark and a possible battery explosion. A battery explosion may rupture the battery case and spray sulfuric acid onto the surrounding area and personnel which could result in death or serious injury.

WARNING

Batteries produce explosive hydrogen gas at all times, especially when being charged. Keep cigarettes, open flame and sparks away from the battery at all times. Ventilate area when charging battery. Battery contains sulfuric acid which can cause severe burns to eyes, skin and clothing. To prevent death or serious injury, always protect hands and protect eyes with shield or goggles when working near a battery or acid. KEEP BATTERIES AND ACID OUT OF THE REACH OF CHILDREN!

- 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 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.

AWARNING

After extended periods of storage and prior to starting vehicle, place transmission in gear, disengage clutch by pulling in clutch hand lever completely, and push vehicle back and forth a few times to ensure proper clutch disengagement. Improper clutch disengagement could result in death or serious injury.

- 1. Charge and install the battery.
- 2. Remove and inspect the spark plugs. Replace if necessary.
- 3. Clean the air filter element.
- 4. If fuel tank was drained, fill fuel tank with fresh gasoline.
- 5. Start the engine and run until it reaches normal operating temperature.
- 6. Check engine oil level. Check the transmission lubricant level. Fill to proper levels with correct fluids, if required.
- 7. Perform all of the checks in the PRE-RIDING CHECK-LIST in the Owner's Manual.

TROUBLESHOOTING

GENERAL

AWARNING

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 VRSCA 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.
- Discharged battery, loose or corroded connections (solenoid chatters).
- 5. Starter control circuit, relay, or solenoid faulty.
- Electric starter shaft pinion gear not engaging or overrunning 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.

- Loose wire connection at coil, battery, or plug between ignition module or ECM.
- 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.
- 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

- 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.
- Upper engine mounting bracket loose/broken or mounting bracket pre-loaded.
- 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 VRSCA 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.
- 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 VRSCA 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.

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.
- Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See 1.17 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. Swing arm pivot.

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.

CODUCOT	PAGE NO.
2.1 Specifications	
2.2 Torque Values	
2.3 Vehicle Identification Number (V.I.N.)	
2.4 Frame/Lower Frame Rails	
2.5 Front Engine Mount	
2.6 Front Engine Mount Assembly	
2.7 Exhaust System	
2.8 Rear Engine Mounts	
2.9 Engine Replacement	
2.10 Jiffy Stand	
2.11 Footrests/Foot Controls	
2.12 Throttle Cables	
2.13 Clutch Master Cylinder/Reservoir	
2.14 Clutch Hand Lever	
2.15 Clutch Fluid Line	
2.16 Secondary Clutch Actuator	
2.17 Front Brake Master Cylinder/Reservoir	
2.18 Front Brake Calipers	
2.19 Rear Brake Master Cylinder/Reservoir	
2.20 Rear Brake Caliper	
2.21 Handlebars	
2.22 Front Wheel	
2.23 Rear Wheel	
2.24 Sealed Wheel Bearings	
2.25 Disc Rim Runout	
2.26 Tires	
2.27 Front Fender	
2.28 Front Fork	
2.29 Steering Head	
2.30 Fork Lock	
2.31 Belt Guard/Debris Deflector	
2.32 Rear Shock Absorbers	
2.33 Rear Fork	
2.34 Seat Latch	
2.35 Seat	
2.36 Rear Fender/Supports	3-95

Table 2-1. Dimensions

ITEM	ММ	IN
Wheel base	1713.2	67.5
Overall length	2375.6	93.6
Overall width	838.2	33.0
Road clearance	142.1	5.6
Overall height	1244.6	49.0
Saddle height	659.9	26.0

Table 2-2. Weights

ITEM	KG	LBS
Dry weight	270.4	595.7
GVWR	464.2	1022.4
GAWR - front	162.4	358.0
GAWR - rear	301.4	664.4

NOTE

Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding Gross Axle Weight Ratings (GAWR) are given on a label located on the left front frame cross tube.

Table 2-3. Fluid Capacities

the second se		
ITEM	LITERS	U.S.
Fuel tank total	14.0	3.7 gal
Oil tank w/filter	4.3	4.5 qts
Coolant	2.4	2.54 qts

Table 2-4. Wheel/Brake Disc/Tire Runout

RUNOUT	ММ	IN
Wheel - rim lateral	1.02	0.040
Wheel - rim radial	0.76	0.030
Front brake disc - lateral	0.3	0.012
Rear brake disc - lateral	0.3	0.012
Tire - lateral	1.52	0.060
Tire - radial	2.29	0.090

Table 2-5. Tires

WHEEL	DUNLOP SPORTMAX™ SIZE
Front	120/70Z/R-19
Rear	180/55Z/R-18

WARNING

Maximum inflation pressure must not exceed specification on tire sidewall. Exceeding inflation specifications can adversely affect handling or result in tire failure which could result in death or serious injury.

Table 2-6. Tire Pressures

	FRONT		REAR	
DUNLOP TIRES (ONLY)	kPa	PSI	kPa	PSI
Solo rider	248	36	262	38
Rider & passenger	248	36	276	40

WARNING

Tires, rims, and air valves must be correctly matched to wheel rims. See your Harley-Davidson Dealer for service. Mismatched tires, tubes, rims, and air valves may result in damage to the tire bead during mounting or may allow the tire to slip on the rim, possibly causing tire failure, which could result in death or serious injury.

NOTE

See 1.11 TIRES AND WHEELS for important information regarding tires.

AWARNING

Using tires in ways other than those specified below may adversely affect motorcycle stability. Instability may lead to loss of vehicle control, which could result in death or serious injury.

- Use tubeless tires on all Harley-Davidson disc wheels.
- Do not use inner tubes in radial tires.
- Always use the correct size tires. Tire sizes are molded on the tire sidewall.

TORQUE VALUES

ITEM	τοι	RQUE	NOTES
Auxiliary volume fasteners	23 Nm	17 ft-lbs	page 2-12, 2-21
Belt drive sprocket cover fasteners	6-10 Nm	53-88 in-lbs	page 2-21
Belt guard grommet bolt	6-10 Nm	53-88 in-lbs	page 2-86
Brake caliper bleeder valve, front and rear	9-11 Nm	80-100 in-lbs	page 2-54
Brake caliper bridge bolts, front	38-52 Nm	28-38 ft-lbs	page 2-54
Brake disc bolts, front	21-31 Nm	16-23 ft-lbs	page 2-60
Brake disc bolts, rear	41-53 Nm	30-38 ft lbs	page 2-65
Brake pad pins	20-23 Nm	180-200 in-lbs	page 2-54
Clutch fluid line flare nut	9-13 Nm	80-115 in-lbs	page 2-35
Compensator bowl screws	61-75 Nm	45-55 ft-lbs	page 2-65
Coolant air bleed plug	9-11 Nm	80-97 in-lbs	page 2-22
Cross member fasteners	20-26 Nm	15-19 ft-lbs	page 2-21
Debris deflector	6-10 Nm	53-88 in-lbs	page 2-66
Drive sprocket cover	6-10 Nm	53-88 in-lbs	page 2-12
Drive sprocket locking bolts	88-102 Nm	65-75 ft-lbs	page 2-21
Engine coolant drain	9.7 Nm	86 in-lbs	page 2-17
Engine mount bracket	34-41 Nm	25-30 ft-lbs	page 2-9
Engine mount double threaded studs	34-41 Nm	25-30 ft-lbs	page 2-9
Engine mount to bracket	34-41 Nm	25-30 ft-lbs	page 2-9
Engine mounting bolt thru travel limiting washer	34-41 Nm	25-30 ft-lbs	page 2-9
Exhaust clamp nut	32-37 Nm	24-27 ft-lbs	page 2-12, 2-21
Exhaust flange nuts	6-10 Nm	53-88 in-lbs	page 2-12, 2-21
Exhaust system support pin	23 Nm	17 ft-lbs	page 2-12, 2-21
Fender bracket to front fork bolts	20-26 Nm	15-19 ft-lbs	page 2-76
Fender fasteners w/grabstrap	8-12 Nm	71-106 in-lbs	page 2-95
Fender support bracket	34-41 Nm	25-30 ft-lbs	page 2-96
Footrest axle retaining bolt	11-17 Nm	9-12 ft-lbs	page 2-25
Footrest support mounting bolts	19-27 Nm	14-20 ft-lbs	page 2-25
Fork stem nut	61-75 Nm	45-55 ft-lbs	page 2-84
Fork tube caps	22-58 Nm	16-43 ft-lbs	page 2-81
Front and rear heat shield worm drive clamps	10 Nm	88 in-lbs	page 2-21
Front axle holder pinch bolts	16 Nm	11 ft-lbs	page 2-61
Front axle nut	68-75 Nm	50-55 ft-lbs	page 2-61
Front brake caliper top mounting bolt	38-52 Nm	28-38 ft-lbs	page 2-43
Front brake hose bracket bolt	6-10 Nm	53-89 in-lbs	page 2-84
Front brake master cylinder banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-39
Front engine mount	34-41 Nm	25-30 ft-lbs	page 2-8, 2-9
Front fender bracket fasteners	4.1 -6.8 Nm	36-60 in-lbs	page 2-76
Grabstrap	11-17 Nm	97-150 in-lbs	page 2-94

ITEM	TOR	QUE	NOTES
Handlebar clamp screws	8-9 Nm	71-80 in-lbs	page 2-31
Handlebar bolts	41-47 Nm	31-35 ft-lbs	page 2-57
Headlamp mounting bracket bolts	11-18 Nm	9-13 ft-lbs	page 2-57
Heat shield screws	10 Nm	88 in-Ibs	page 2-12
Inner fender fasteners	20-26 Nm	15-19 ft-lbs	page 2-96
Jiffy stand anchor	7-9 Nm	62-79 i n-lbs	page 2-24
Lower frame rail bolts	61-75 Nm	45- 55 ft-lbs	page 2-20
Lower handlebar cover	6-10 Nm	54-88 in-lbs	page 2-57
Lower muffler clamp	65 Nm	48 ft-lbs	page 2-21
Lower muffler fasteners	23 Nm	17 ft-lbs	page 2-12
Lower muffler fasteners	23 Nm	17 ft-lbs	page 2-21
Master cylinder clamp screw	38-72 Nm	28-53 ft-lbs	page 2-39
Mudflap stud plate fasteners	8-12 Nm	70-106 in-lbs	page 2-96
Oil drain plug	35 Nm	25 ft-lbs	page 2-14
Oil line sleeves	53-58 Nm	39-42 ft-lbs	page 2-21
P-clamp	6-10 Nm	53-88 in-lbs	page 2-21
Pillion mounting bolt	11-17 Nm	97-150 in-lbs	page 2-94
Pipe clamp	6.5 Nm	57 in-lbs	page 2-21
Pipe connecting clamp	6-10 Nm	53-88 in-lbs	page 2-21
Pivot shaft nut	61-75Nm	45-55 ft-lbs	page 2-91
Radiator drain plug	9-11 Nm	80-97 i n-lbs	page 2-16
Radiator hose clamps	3-4 Nm	27-35 in-lbs	page 2-21
Rear axle nut	129 Nm-142 Nm	95-105 ft-lbs	page 2-21
Rear brake reservoir cover screws	0.7-0.9 Nm	6-8 in-lbs	page 2-50
Rear caliper banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-55
Rear engine mount bracket	34-41 Nm	25-30 ft-lbs	page 2-13
Rear master cylinder banjo bolt	23-31 Nm	17-23 ft-lbs	page 2-50
Rear master cylinder cartridge retaining nut	41-54 Nm	30-40 ft-lbs	page 2-50
Seat latch	6-10 Nm	53-88 in-lbs	page 2-92
Seat pipe screw	12-18 Nm	106-159 in-lbs	page 2-81
Secondary clutch actuator	10 Nm	89 in-lbs	page 2-35
Secondary clutch actuator cover	6-10 Nm	53-89 in-lbs	page 2-35
Shift linkage to foot shift lever bolt	9-15 Nm	7-11 ft-lbs	page 2-25
Shifter arm clamp bolt	14-16 Nm	11-12 ft-lbs	page 2-21
Shifter linkage to shifter arm bolt	9-15 Nm	7-11 ft-lbs	page 2-21
Shock mount bolts	41-68 Nm	31-50 ft-lbs	page 2-87
Solenoid bracket nuts	6-10 Nm	53- 88 in-lbs	page 2-7
Solenoid cable terminal ring	6-10 Nm	53-88 in-lbs	page 2-21
Throttle body clamps	1.25 Nm	11 in-Ibs	page 2-22
Throttle housing screws	4-5 Nm	35-45 in-lbs	page 2-28
Fie link mounting bolts	34-41 Nm	25-30 ft-lbs	page 2-7
Top handlebar cover fasteners	1.3-1.9 Nm	12-16 in-lbs	page 2-57

ITEM	TOF	RQUE	NOTES
Top radiator mounting nuts	19-27 Nm	15-20 ft-lbs	page 2-21
Triple clamp pinch bolts	41-47 Nm	31-34 ft-lbs	page 2-84
Turn signal and license plate bracket	8-12 Nm	71-106 in-lbs	page 2-96
Upper muffler clamp	65 Nm	48 ft-lbs	page 2-12, 2-21
Upper muffler fasteners	23 Nm	17 ft-lbs	page 2-12, 2-21
Valve stem nut	1.4-1.7 Nm	12-15 in-lbs	page 2-73

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

GENERAL

See Figure 2-1. The full 17 digit serial or Vehicle Identification Number (V.I.N.) is stamped on the steering head. An abbreviated V.I.N. is stamped on the left side crankcase.

NOTE

See Figure 2-2. Always give the complete 17 digit V.I.N. when ordering parts or making inquiries about your motorcycle.

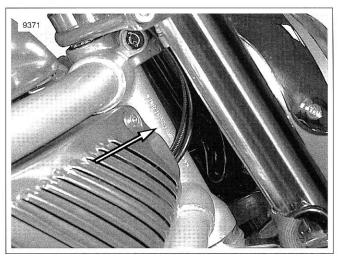


Figure 2-1. V.I.N. Location

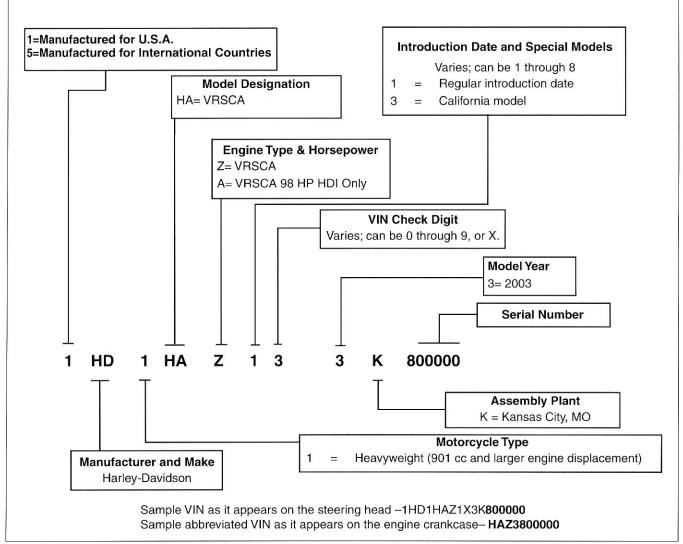


Figure 2-2. Vehicle Identification Number (V.I.N.)

GENERAL

The steel upper hydroformed main rails, joined with stamped sheet metal weldments for the steering head, seat, rear fork pivots, fuel tank shield, and rear fender, are bolted to left and right lower frame rails that complete the frame perimeter. The rider footrests and foot controls are mounted on the lower frame rails. The passenger footrests are mounted on the rear fork.

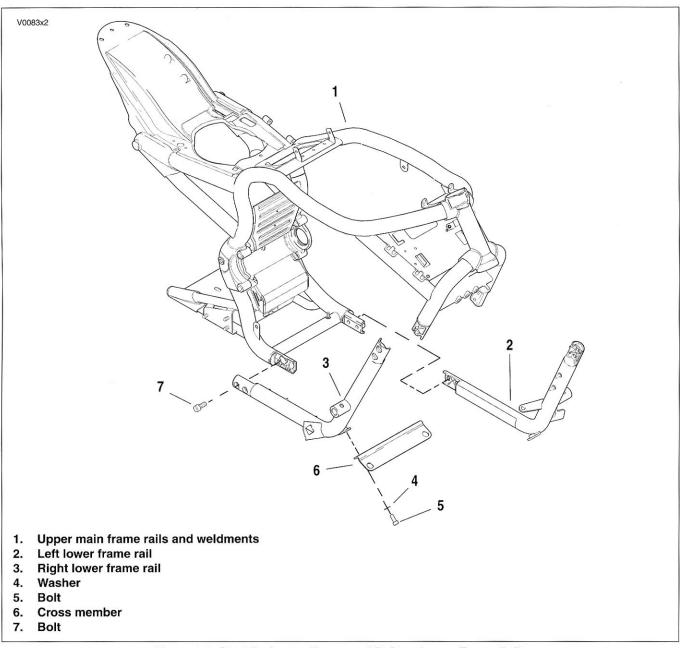


Figure 2-3. Steel Perimeter Frame and Bolt-on Lower Frame Rails

REMOVAL

- Support motorcycle under fuel tank frame weldment and/ or lock wheels so that frame rails and/or engine can be removed.
- 2. Remove 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 FIL-TER.

AWARNING

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

- 5. Disconnect negative battery cable.
- See Figure 2-3. Remove two cross member bolts (5) and washers (4). Pull bottom of radiator assembly forward with cross member or remove the radiator assembly as required. See 6.8 RADIATOR/OIL COOLER.
- Remove shift lever linkage, right foot rest axle and foot shift lever from frame rail. See 2.11 FOOTRESTS/FOOT CONTROLS.
- Remove left foot rest axle. See 2.11 FOOTRESTS/FOOT CONTROLS.
- Remove rear brake master cylinder and rear brake pedal. See 2.19 REAR BRAKE MASTER CYLINDER/ RESERVOIR.
- Remove clutch fluid line from clips on right lower frame rail. See 2.15 CLUTCH FLUID LINE.
- Remove starter solenoid bracket nuts and remove starter solenoid from right lower frame rail. See 5.5 STARTER SOLENOID.
- 12. Remove engine mount tie link from frame rail bracket. See 2.5 FRONT ENGINE MOUNT.

NOTE

Maintain tie link length for reinstallation. Do not loosen jam nuts on tie link.

13. Remove bolts (7) holding on the right and left lower frame rails (2 & 3). Remove the frame rails.

INSTALLATION

- See Figure 2-3. Install left and right lower frame rails (2 & 3) and finger tighten mounting bolts (7).
- Using clips, attach clutch fluid line to right lower frame rail. See 2.15 CLUTCH FLUID LINE.
- Attach the engine mount tie link to the frame rail bracket. Tighten to 34-41 Nm (25-30 ft-lbs). See 2.5 FRONT ENGINE MOUNT.
- Attach starter solenoid bracket to right lower frame rail with nuts. Tighten to 6-10 Nm (53-88 in-lbs).
- Attach right foot rest axle and foot shift lever to frame rail. Attach shift lever linkage. See 2.11 FOOTRESTS/FOOT CONTROLS.
- Attach rear brake master cylinder to bracket on left lower frame rail. See 2.19 REAR BRAKE MASTER CYLIN-DER/RESERVOIR.
- Install left foot rest axle with rear brake pedal. Attach rear brake pedal master cylinder to brake pedal. See 2.11 FOOTRESTS/FOOT CONTROLS.
- Replace radiator/oil cooler assembly as required or pull radiator/oil cooler assembly into position and install and finger tighten cross member mounting bolts (5) and washers (4). Tighten cross member bolts (5) to 20-26 Nm (15-19 ft-lbs). See 6.8 RADIATOR/OIL COOLER.
- Tighten lower frame rail bolts (7) to 61-75 Nm (45- 55 ftlbs).
- 10. Fill and bleed rear brake. See 1.9 BLEEDING BRAKES.
- 11. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
- 12. Replace airbox cover.

WARNING

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.

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

AWARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

REPLACEMENT

- 1. Support engine with a scissors jack under the oil pan.
- Remove the right side cover and maxi-fuse. See 8.5 MAXI-FUSE. Unlock and open seat.
- Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.

AWARNING

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

- 4. Disconnect negative battery cable.
- 5. See Figure 2-4. Loosen and remove nut (2) and travel limiting washer (1) from center mounting bolt (5).
- Loosen and remove nuts (3) from engine mount bolts (4) (Left side requires using a 8 mm ball Allen with a 2" extension).
- 7. By lifting up the center mounting bolt (5) slightly, the engine mount pivots down and out away from the fan shroud.
- 8. Install **new** motor mount and left and right engine mounting bolts (4).
- 9. Install travel limiting washer (1) and center mounting bolt nut (2).
- 10. Tighten all fasteners to 34-41 Nm (25-30 ft-lbs).
- 11. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
- 12. Replace airbox cover.

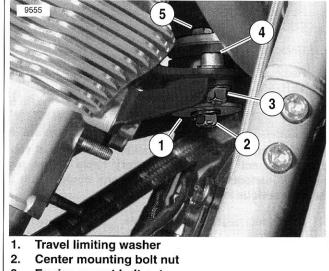
WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.



- 3. Engine mount bolt nut
- 4. Engine mount bolt and washer
- 5. Center mounting bolt

Figure 2-4. Engine Mount (exhaust removed for clarity)

REMOVAL

- Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlock and open seat.
- 3. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.

WARNING

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

- 4. Disconnect negative battery cable.
- 5. Remove radiator assembly as required. See 6.8 RADIA-TOR/OIL COOLER.
- 6. See Figure 2-5. Loosen and remove double threaded studs (11) that hold front engine mount bracket (3) to frame.
- Remove bolts (10) that hold front engine mount bracket
 (4) to engine and work assembly out of frame between two lower frame rails.
- 8. Loosen and remove tie link hold down bolt (12) to lower frame rail bracket.
- 9. Loosen and remove bolt (16), spacer (17), and tie link (15) from front of engine case.

NOTE

Maintain tie link length for a correctly aligned reinstallation. Do not loosen jam nuts and turn rod ends.

DISASSEMBLY AND ASSEMBLY

- 1. See Figure 2-5. Loosen and remove nut (8) from center mounting bolt (2) holding engine mount (6), travel limiting washer (7), and the two brackets (3, 4) together.
- 2. Remove two bolts (1) holding engine mount (6) to engine mount bracket (4). Remove engine mount (6).
- 3. Inspect for worn or damaged parts, replace as necessary.
- 4. Align engine mount bolt (2) through the frame bracket (4) and the engine mount (6) with the flange of the engine mount under the engine bracket and the large end up through the engine bracket. Slide on the travel limiting washer (7) and loosely install the flanged hex-nut (8).
- Install and tighten fasteners (1), washers (5) and nuts (8) holding engine mount (6) to bracket to 34-41 Nm (25-30 ft-lbs).

INSTALLATION

- 1. See Figure 2-5. Start, but do not tighten bolts (10) and washers (9) fastening engine mount bracket (4) to engine cylinder head.
- 2. Attach frame bracket to frame with double threaded studs.
- Alternately tighten and loosen engine mount bolts (10) and the two threaded studs (11). Tighten the engine bolts (10) and the two threaded studs (11) to 34-41 Nm (25-30 ft-lbs).
- 4. Tighten center mounting bolt (2) and travel limiting washer to 34-41 Nm (25-30 ft-lbs)
- 5. Install frame end of tie link (15) to frame bracket. Tighten to 34-41 Nm (25-30 ft-lbs).
- Insert bolt through tie link (15) and spacer (17) and thread into engine crankcase. Tighten bolt to 34-41 Nm (25-30 ft-lbs).
- 7. Replace radiator assembly. See 6.8 RADIATOR/OIL COOLER.
- 8. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
- 9. Install airbox cover.

WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

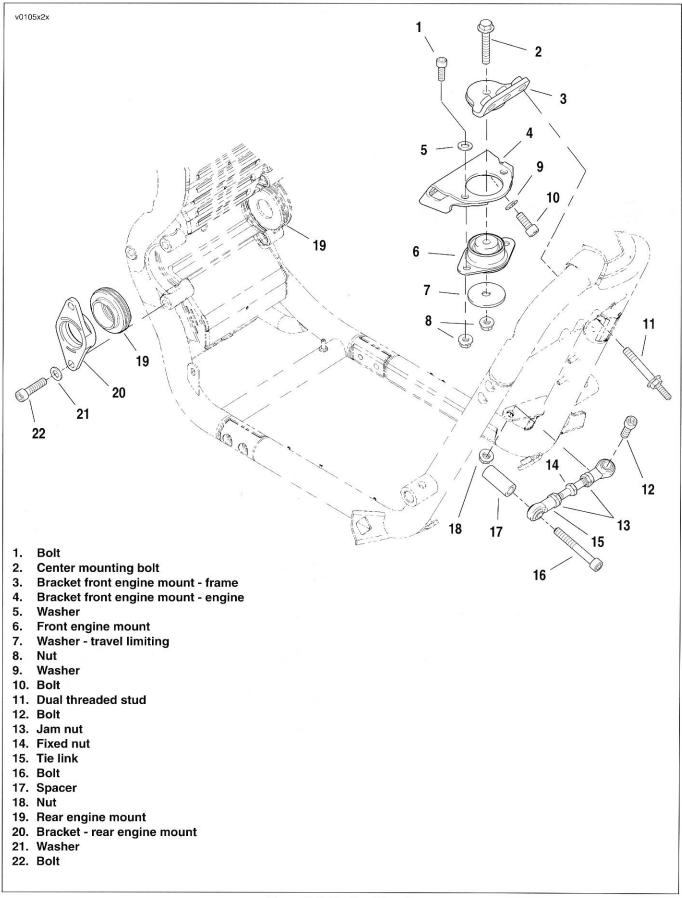


Figure 2-5. Engine Mounts

REMOVAL

AWARNING,

To avoid accidental start-up of vehicle and possible personal injury, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury. 2.7

- 1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. See Figure 2-6. Loosen upper muffler clamp (11).

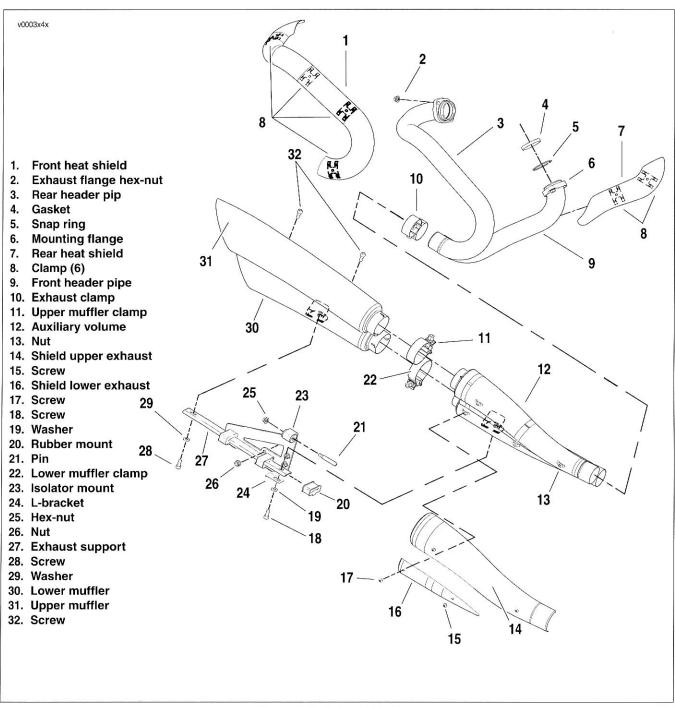


Figure 2-6. Exhaust System

3. Remove the two fasteners (32) holding the upper muffler (31) to the bottom muffler (30).

Slide upper muffler rearward to disconnect from the auxiliary volume (12).

- 5. Remove both heat shields (1, 7) from front and rear header pipes. It's not necessary to remove the heat shield (14) from the auxiliary volume (12).
- Remove the auxiliary volume fastener (18) and the lower muffler fastener (28) from the lower part of the exhaust support bracket. Save the L-bracket (24) found under the exhaust support.

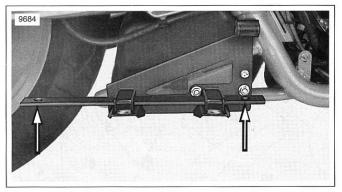


Figure 2-7. Exhaust Support Fastener Locations (Exhaust System Removed)

NOTE

Remove the left side drive sprocket cover for easier access to rear cylinder lower exhaust flange bolt.

- 7. Remove flanged hex-nuts (2) holding exhaust flange to front and rear cylinders.
- 8. Remove hex-nut (25) and pin (21) on exhaust support bracket.
- Remove header pipes with the auxiliary volume and lower muffler attached. Lift and adjust assembly until header pipes slide out and away from the cylinder heads.

NOTE

To maintain the alignment of these components, keep the lower muffler, the auxiliary volume, the exhaust clamp, and the front and rear header pipes firmly connected.

INSTALLATION

NOTE

Do not torque fasteners until required to do so by the following installation instructions. Hand tightening each fastener will pull the exhaust system into a position that will allow the crush of the exhaust gaskets during the torquing sequence to to draw the exhaust system up to the engine.

- 1. Install new exhaust header gaskets.
- See Figure 2-6. Gently lift the lower muffler, auxiliary volume, and header pipe assembly into position.

NOTE

A second technician may be required to hold the header pipes when aligning the exhaust header flanges with the studs in the cylinder heads.

- 3. Slip both front and rear header flanges over the studs in the cylinder heads. Thread hex-nuts (2) on header flange studs. Do not tighten.
- 4. Install support pin (21) in isolator mount (23) on the exhaust support. Thread on the hex-nut (25). Do not tighten.
- 5. Hold a 1/2 in. spacer between the frame rail and the header pipe exhaust clamp.
- 6. Thread in the lower muffler fastener (28) through the exhaust support.
- 7. Thread in the auxiliary volume fastener (18) through the L-bracket (24) and the exhaust support. Do not tighten.
- 8. Torque the pin hex-nut to 23 Nm (17 ft-lbs).
- Place clamp (11) on upper muffler (31). Slide muffler over upper opening of auxiliary volume (12). Position clamp with compression fastener to inboard with tightening nut upward.
- Thread upper muffler fasteners (32) into the lower muffler (30). Do not tighten.
- 11. Torque the fasteners to the indicated torque in the following order:
 - a. Upper muffler clamp 65 Nm (48 ft-lbs).
 - b. Upper muffler fasteners 23 Nm (17 ft-lbs).
 - c. Lower muffler and auxiliary volume fasteners to support bracket 23 Nm (17 ft-lbs).
 - d. Exhaust flange hex-nuts 6-10 Nm (53-88 in-lbs).
- 12. Check the tightness of the exhaust clamp by tightening the clamp nut to 32-37 Nm (24-27 ft-lbs).
- 13. Replace front and rear heat shields. Tighten the heat shield screws to 10 Nm (88 **in-lbs**).
- If removed, replace drive sprocket cover. Tighten to 6-10 Nm (53-88 in-lbs).
- 15. Replace the maxi-fuse and the right side cover.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45317	Engine assembly support fixture

1. Support motorcycle under fuel tank frame weldment and lock the front wheel so that the engine can be removed.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

- 2. Remove 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 FIL-TER.

AWARNING

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

- 5. Disconnect negative battery cable.
- With ENGINE ASSEMBLY SUPPORT FIXTURE (HD-45317) positioned under engine, remove engine from motorcycle and roll far enough from frame to remove left rear engine mount. See 2.9 ENGINE REPLACEMENT.
- 7. See Figure 2-5. Remove fasteners (23) holding right rear engine mount bracket (21) to the frame.
- 8. Remove both rear engine mounts (19) with left and right pivot shaft spacers. See 2.33 REAR FORK.
- 9. Clean as necessary the right rear engine mount frame weldment, and the rear engine mount bracket.

INSTALLATION

- 1. See Figure 2-5. Install left rear engine mount (19) in left side frame weldment.
- 2. Install pivot shaft spacer in left rear engine mount. See 2.33 REAR FORK.
- 3. Orient flanged side of right rear engine mount toward outside of the rear engine mount bracket (21), and thread mounting bolts (23) with narrow washers (22) through bracket into frame bosses.
- 4. Install pivot shaft spacer in right engine mount.
- 5. Tighten mounting bolts (23) to 34-41 Nm (25-30 ft-lbs).

NOTE

The left and right rear fork pivot shaft spacers are inserted into the engine mounts. Verify that the pivot shaft spacers are in position before installation of the pivot shaft.

- 6. Replace engine. See 2.9 ENGINE REPLACEMENT.
- 7. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
- 8. Install airbox cover.

WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

GENERAL

Removal and replacement of the engine may be required for either replacement engines or for engine overhaul.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-45317	Engine assembly support fixture

1. See Figure 2-8. On a table lift with a lift side extension, position a scissors jack under the fuel tank.

NOTE

To provide clearance and alignment, locate a scissors style jack under the fuel tank frame extensions to raise or lower the motorcycle throughout the procedure.

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (400 kPa, 58 psi). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing the fuel supply line from the fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

- 2. Open seat and remove or lift fuel filler boot.
- 3. Purge fuel supply line of high pressure gasoline.
 - a. Disconnect fuel module connector from top plate.
 - b. In neutral, start engine and allow engine to run.
 - c. When engine stalls, operate starter for 3 seconds to remove any remaining fuel from fuel lines.
- 4. Place a suitable container under engine, loosen oil drain plug and drain oil.
- 5. Replace and torque oil drain plug to 35 Nm (25 ft-lbs).
- 6. Allow engine to cool.
 - a. For replacement engines, leave oil filter threaded into its mounting plate.
 - b. For engine overhaul, remove oil filter as necessary.

IMPORTANT NOTE

Dispose of oil in accordance with local regulations.

- 7. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 8. Remove air filter cover. See 1.4 AIRBOX AND AIR FIL-TER.

WARNING

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

9. See Figure 2-9. Disconnect negative (1) and positive (2) battery cables from battery.

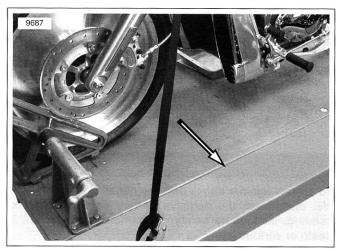
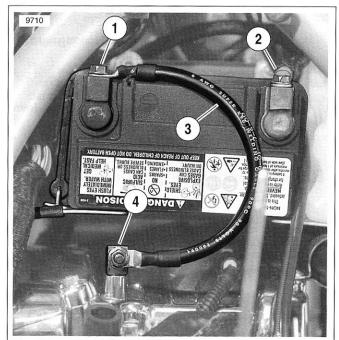


Figure 2-8. Lift Side Extension



- 1. Negative battery cable at battery
- 2. Positive battery cable at battery
- 3. Negative battery cable
- 4. L-bracket with negative battery cable

Figure 2-9. Battery Cable Connections

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- Remove air filter top, air filter, breather hose, velocity stacks, and air filter bottom. Unscrew threaded air filter hold down rod from throttle body. See 1.4 AIRBOX AND AIR FILTER.
- 11. At the fuel rail, disconnect pressure fuel line and return fuel line by pressing blue buttons with thumb and first finger.
- 12. See Figure 2-9. Disconnect copper L-bracket (4) with negative battery cable (3) from front cylinder head.
- 13. See Figure 2-11. Remove fastener on rear cylinder head and remove GND 1 (8), GND 2 (9), and ground wire (10) to horn. Replace fastener.
- 14. Remove fastener on front cylinder head and remove regulator ground (3). Replace fastener.
- 15. Disconnect wiring connectors from horn. Unbolt and remove horn from rubber grommet on frame.
- 16. Disconnect:
 - a. Front (2) and rear coil connectors.
 - b. Main engine sensor connector (7).
 - c. Throttle position sensor (4).
 - d. Idle air control actuator (5).
- 17. For a California model, pull the purge solenoid hose (6) off throttle body.
- 18. Perform throttle body procedure:
 - a. For a replacement engine, loosen throttle cable adjustor jam nuts. Turn throttle cable adjuster until cable is as short as possible. Remove throttle cable housings from guides at the throttle body and remove cable barrels from throttle cam. See 2.12 THROTTLE CABLES.

or

b. See Figure 2-10. For engine overhaul, loosen clamps at each intake and lift throttle body straight up. 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.

NOTE

For replacement engines, the engine wiring harness is left attached to the engine. The engine wiring harness will include connectors to the manifold air pressure sensor, the intake air temperature sensor, the coolant temperature sensor, the oil pressure sending unit, and both fuel injectors.

- Remove lower left and right side radiator covers. See 6.8 RADIATOR/OIL COOLER.
- 20. See Figure 2-12. Disconnect:
 - a. Crank position sensor connector (3).
 - b. Top and bottom fan power connectors (2).
 - c. Stator to voltage regulator connector (1).
 - d. Wiring frame clip (4).

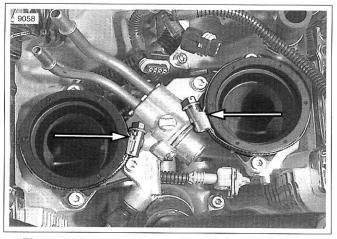


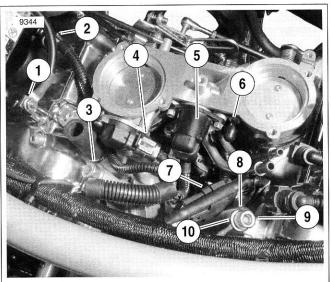
Figure 2-10. Intake Clamps (throttle body removed)

NOTE Observe the position of the clamps for reassembly. 21. See Figure 2-13. Cover front fender with a shop towel or protective cover. On right side, pull rear brake fluid reservoir from radiator cover. Remove two fasteners and washers (2) on each side of radiator cover and remove radiator cover. The radiator cover includes two chrome inlet bezels.

WARNING

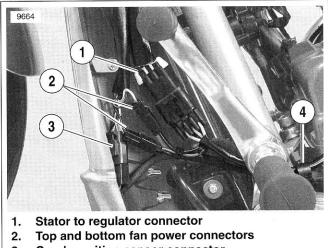
Allow engine to cool before opening the radiator cap to work on the liquid cooling system. Coolant can be extremely hot and at high pressure. Opening a hot cooling system may result in death or serious injury.

- 22. Place a suitable container under radiator and open pressure cap.
- 23. See Figure 2-13. Remove drain plug (1) and drain coolant from radiator. Leave container under engine until all coolant has been drained through front cylinder coolant drain plug.
- 24. Replace radiator drain plug (1) and tighten to 9-11 Nm (80-97 in-lbs).
- 25. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen worm drive clamps on radiator hoses.



- 1. Negative battery cable copper L-bracket
- Front cylinder coil connector 2.
- 3. **Regulator ground**
- Throttle position sensor connector 4.
- Idle air control actuator connector 5.
- Purge solenoid fitting 6.
- 7. Main engine sensor connector
- 8. GND 1
- 9. GND 2
- 10. Horn ground wire

Figure 2-11. Wiring Connections



- 3. Crank position sensor connector
- Wiring frame clip 4.

Figure 2-12. Left Side Wiring Connectors

- 26. Loosen and remove cross member fasteners from lower left frame rail.
- 27. Put radiator/oil cooler assembly forward at the bottom. Loosen and unthread oil line sleeves (18) at crankcase (oil in) and oil filter (oil out) mount.
- 28. Remove radiator/oil cooler assembly. See 6.8 RADIA-TOR/OIL COOLER.
- See Figure 2-14. Finish draining coolant by removing front cylinder coolant drain plug. Replace front cylinder coolant drain plug and tighten to 9.7 Nm (86 in-lbs).
- 30. Remove engine coolant pipes. See 6.6 COOLANT PIPES AND HOSES.

IMPORTANT NOTE

Dispose of antifreeze in accordance with local regulations.

- 31. Remove drive sprocket cover. Remove debris deflector/ belt guard if required for clearance.
- 32. See Figure 2-15. Loosen and remove bolts (3) holding drive sprocket locking device. Discard bolts.

NOTE

Do not remove the sprocket nut.

- 33. Loosen rear wheel axle nut. Move wheel forward and slip belt off drive sprocket.
- 34. See Figure 2-15. Remove retaining bolts (3). Remove drive sprocket (1).
- 35. Remove exhaust system. See 2.7 EXHAUST SYSTEM.
- Remove secondary clutch actuator cover and secondary clutch actuator. See 2.16 SECONDARY CLUTCH ACTU-ATOR.

NOTE

It is not necessary to loosen flare nut or to remove clutch fluid line from the secondary clutch actuator. Allow secondary clutch actuator to hang from clutch fluid line.

- 37. At front of engine, pull back solenoid cable protective boot from starter post and loosen and remove nut. Remove solenoid cable terminal ring. See 5.4 STARTER.
- Remove nuts holding starter solenoid to frame and pull solenoid off of frame studs. See 5.5 STARTER SOLE-NOID.

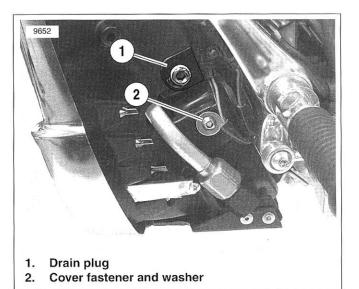


Figure 2-13. Radiator Cover Left Side

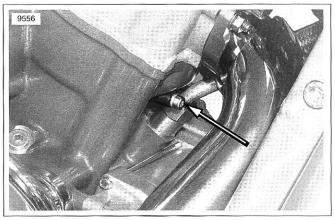


Figure 2-14. Front Cylinder Coolant Drain Plug

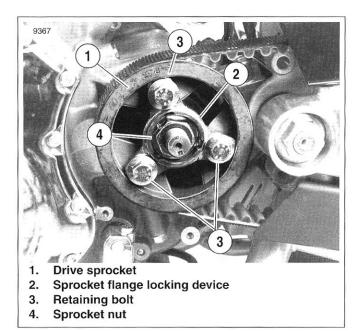


Figure 2-15. Drive Sprocket

- 39. See Figure 2-16. Position ENGINE ASSEMBLY SUP-PORT FIXTURE (Part No. HD-45317) under engine. Align the two hex socket-head bolts (2) at rear of fixture with mounting screw detents (4) at bottom rear of oil pan. Align the two separated hex head bolts (1) on each side of front of fixture with corresponding mounting screw detents (3) on sides of oil pan. Using scissors jack, lower motorcycle until engine oil pan screw detents rest on hex socket-head bolts.
- 40. Remove nut and travel limiting washer from center motor mount bolt. Remove center mounting bolt.
- 41. Remove fasteners holding front motor mount bracket to engine.
- Remove studs securing frame motor mount bracket to frame. Pull front motor mount assembly forward through frame rails.
- 43. Remove tie link bolt and spacer from engine case. See 2.5 FRONT ENGINE MOUNT.

NOTE

Maintain tie link length for reinstallation. Do not loosen jam nuts on tie link.

- 44. Remove rear fork pivot nut and slide out pivot shaft. Rear fork can be left in place.
- 45. Loosen fasteners holding rear engine mount bracket. See 2.8 REAR ENGINE MOUNTS.
- 46. Remove shifter arm with linkage attached from engine shifter shaft.
- 47. Remove engine ground cable from frame.
- Remove lower left frame rail with footrest, foot shift lever/ linkage, and tie link attached. See 2.4 FRAME/LOWER FRAME RAILS.

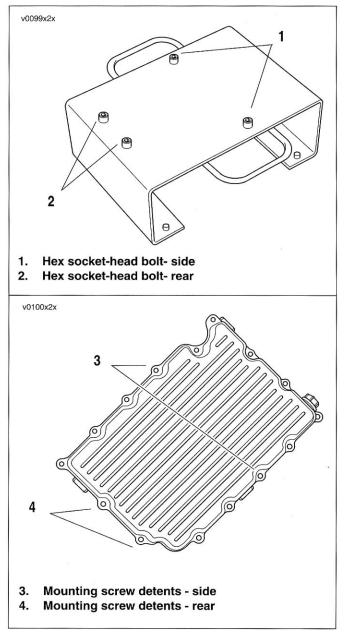


Figure 2-16. Engine Assembly Support Fixture Alignment

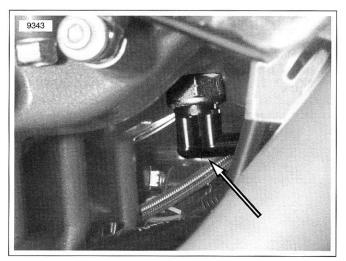


Figure 2-17. Neutral Light Sender Connectors

CAUTION

Do not push on the engine to move the engine. Support the engine and pull on the fixture handles.

- 49. With engine resting in ENGINE ASSEMBLY SUPPORT FIXTURE (HD-43517), gently pull on handles to work engine partially out of left side of frame.
- 50. See Figure 2-17. Pull connectors to neutral light sender under drive sprocket.

NOTE

The neutral light sender stays in the engine.

- 51. Pull purge solenoid hose off of charcoal canister (California models only).
- 52. See Figure 2-18. Pull connectors from stoplamp switch.
- 53. Pull electrical harness to stoplamp switch and purge solenoid hose (California models only) through top of the cavity in engine cases.
- 54. See Figure 2-19. Disconnect vehicle speed sensor wire from connector at top of frame under relay block and pull wire and connector down out of frame.

NOTE

The vehicle speed sensor and wire connector stay attached to the engine.

- 55. With fixture handles, pull engine out of frame onto left side extension.
- 56. See Figure 2-20. Engine may be secured with straps for hoisting.

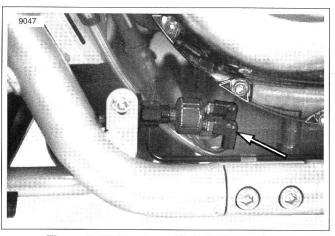


Figure 2-18. Stoplamp Switch Connectors

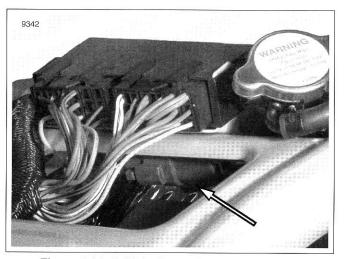


Figure 2-19. Vehicle Speed Sensor Connector

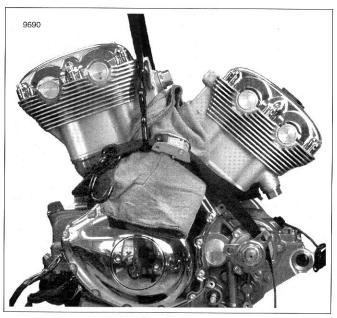


Figure 2-20. Engine Strapped for Hoisting

INSTALLATION

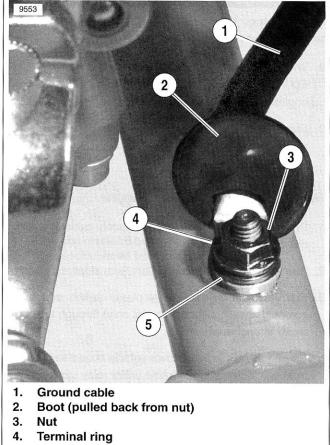
PART NO.	SPECIALTY TOOL	
HD-45317	Engine assembly support fixture	

- 1. Verify V.I.N. of replacement engine.
- 2. Check replacement/overhauled engine for:
 - a. Vehicle speed sensor and wiring.
 - b. Neutral sending switch.
 - c. Ground cable.
- 3. Verify that engine wiring harness is connected to:
 - a. Manifold air pressure sensor.
 - b. Intake air temperature sensor.
 - c. Coolant temperature sensor.
 - d. Oil pressure sending unit.
 - e. Injector connectors.
- 4. Check oil filter tightness. See 1.6 ENGINE OIL AND FIL-TER.
- Install rear engine mount in left side frame weldment. Pull engine partially into frame capturing left rear engine mount.

NOTE

The left and right rear fork pivot shaft spacers are inserted into the engine mounts. Verify that the pivot shaft spacers are in position before installing the pivot shaft.

- With engine oil pan screw detents resting on hex sockethead bolts of the ENGINE ASSEMBLY SUPPORT FIX-TURE (HD-45317), pull engine into frame with fixture handles.
- Thread stoplamp electrical wires and connectors and purge solenoid hose (California models only) through cavity in engine cases.
- 8. See Figure 2-18. Push on stoplamp switch wires.
- 9. Push purge solenoid hose onto charcoal canister (California models only).
- See Figure 2-21. Fasten ground cable (1) terminal ring (4) with washer (5) to frame. Tighten to 6-10 Nm (53-88 in-lbs) and replace rubber boot.
- 11. See Figure 2-17. Push on neutral light sender wires.
- 12. See Figure 2-19. Thread vehicle speed sender connector wire up through frame and connect to wiring harness.
- 13. Install rear engine mounting bracket and engine mount to right side frame weldment. Thread mounting bolts with narrow washers through bracket into frame bosses.



5. Washer

Figure 2-21. Ground Cable Installation

- Raise or lower frame with scissor jack to align pivot shaft bores of rear fork to rear engine mounts and engine case mounting bosses. Apply LOCTITE[®] ANTI-SEIZE and slide in rear fork pivot shaft.
- 15. Apply LOCTITE[®] 243 (blue) to threads of pivot shaft nut.
- Install upper engine mounting bracket to engine with fasteners and engine mounting bracket to frame with double threaded studs.
- 17. Install left frame rail with tie link and footrest, and shifter linkage attached.
- 18. Assemble spacer and tie link and thread into crankcase.
- 19. Tighten fasteners in following order:
 - a. Pivot shaft nut to 61-75 Nm (45-55 ft-lbs).
 - Rear engine mount bracket fasteners (including tie link fasteners) to 34-41 Nm (25-30 ft-lbs).
 - Front engine mount fasteners to 34-41 Nm (25-30 ftlbs).
 - Lower frame rail fasteners to 61-75 Nm (45- 55 ftlbs).
 - Engine crankcase end of tie line to 34-41 Nm (25-30 ft-lbs).

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- See Figure 2-22. Install shifter arm perpendicular to frame rail for correct operation. Tighten clamp bolt to 14-16 Nm (11-12 ft-lbs).
- 21. If removed, attach shifter linkage to shifter arm and tighten to 9-15 Nm (7-11 ft-lbs).
- 22. Install solenoid cable terminal ring to starter post. Install starter solenoid to frame posts.
- 23. Tighten solenoid fasteners to the following torques:
 - a. Solenoid cable terminal ring to starter post to 6-10 Nm (53-88 in-lbs).
 - b. Starter solenoid to frame posts to 6-10 Nm (53- 88 in-lbs).
- Install exhaust system. After loosely attaching lower muffler, auxiliary volume, and header pipes tighten the support pin nut to 23 Nm (17 ft-lbs). See 2.7 EXHAUST SYSTEM.
- 25. Loosely fasten upper muffler to lower and torque fasteners in the following order:
 - a. Upper muffler clamp to 65 Nm (48 ft-lbs).
 - b. Upper muffler fasteners to 23 Nm (17 ft-lbs).
 - c. Lower muffler and auxiliary volume fasteners to support bracket to 23 Nm (17 ft-lbs).
 - d. Exhaust flange nuts to 6-10 Nm (53-88 in-Ibs).
 - e. Exhaust clamp nut to 32-37 Nm (24-27 ft-lbs).
 - f. Front and rear heat shield worm drive clamps to 10 Nm (88 in-lbs).
- 26. Install drive sprocket. Tighten three **new** locking bolts to 88-102 Nm (65-75 ft-lbs).
- 27. Install and adjust drive belt. See 1.14 REAR BELT DEFLECTION.

AWARNING

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.

- 28. Tighten axle nut (2) to 129-142.4 Nm (95-105 ft-lbs) and install snap ring.
- 29. Install belt drive sprocket cover. Tighten cover fasteners to 6-10 Nm (53-88 **in-lbs**). If necessary, install debris deflector and belt guard.
- Install engine coolant pipes and hoses. Fasten p-clamp to cylinder head, pipe clamp, and worm drive clamps to both coolant pipe hoses. See 6.6 COOLANT PIPES AND HOSES.

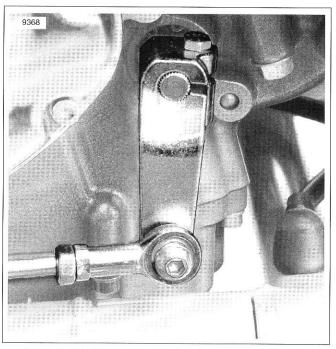


Figure 2-22. Shifter Arm Perpendicular to Frame Rail

- Fit radiator/oil cooler assembly to top mounting studs. Fit coolant out and in hoses to radiator beaded pipes. See 6.8 RADIATOR/OIL COOLER.
- Install oil line sleeves to crankcase and oil filter mount fittings. Tighten to 53-58 Nm (39-42 ft-lbs).
- Push radiator/oil cooler assembly mounting pins and grommets into cross member. Thread cross member mounting bolts into frame.

NOTE

Route hose to remote rear brake reservoir behind brake pedal above the clevis pin before installing cross member. Be sure remote hose is not pinched during installation of radiator/oil cooler assembly and cross member.

- 34. Tighten cooling system fasteners:
 - a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
 - b. Top mounting flange nuts to 19-27 Nm (15-20 ft-lbs).
 - c. Pipe clamp to 6.5 Nm (57 in-Ibs).
 - d. Pipe connecting clamp to 6-10 Nm (53-88 in-lbs).
 - e. P-clamp to 6-10 Nm (53-88 in-lbs).
 - f. Hose worm drive clamps to 3-4 Nm (27-35 in-lbs).
- 35. Route drain hose to overflow bottle.
- 36. Install radiator cover.

- 37. See Figure 2-12. Connect:
 - a. Crank position sensor connector (3).
 - b. Top and bottom fan power connectors (2).
 - c. Stator to voltage regulator connector (1).
 - d. Wiring frame clip (4).
- Push rear brake fluid reservoir onto radiator cover and install both lower radiator covers.
- 39. Install throttle body/cables:
 - For replacement engines: Insert throttle cable barrels into throttle cam, route cable around throttle cam and insert cable housing in cable guides. Adjust cables. See 1.21 THROTTLE CABLES.
 - b. For engine overhaul: Install throttle body and tighten clamps to 1.25 Nm (11 **in-lbs**).
- 40. See Figure 2-11. Connect:
 - a. Front (2) and rear coils.
 - b. Main engine sensor harness (6).
 - c. Throttle position sensor (4).
 - d. Idle speed control actuator (5).
 - e. Regulator ground (3).
- 41. Install horn to rubber grommet and bracket on engine. Connect horn wire to main harness.
- 42. Connect GND 2 (7), GND 1 (8), and horn ground (9) to rear engine cylinder head.
- 43. Connect negative battery copper L-bracket and cable to front cylinder head.
- 44. Install air filter bottom, velocity stacks, o-rings, breather hose, threaded air filter hold down rod, and air filter. See 1.4 AIRBOX AND AIR FILTER.
- 45. Fill engine with oil. See 1.2 FUEL AND OIL.
- 46. Open radiator air bleed plug and fill cooling system with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through coolant pressure cap. See 6.3 ENGINE COOLANT.
- 47. Tighten radiator air bleed plug to 9-11 Nm (80-97 in-lbs).

A WARNING

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

- Connect positive battery cable to battery and then connect negative battery cable to battery. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 49. With the spark plugs removed, use the starter to turn the engine over to prime the engine with oil. The engine oil pressure indicator lamp should illuminate. See 3.5 OIL PRESSURE.

50. Install air filter, air filter top and airbox cover.

AWARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

- 52. Replace maxi-fuse and right side cover.
- 53. Test ride motorcycle and adjust as required.

WARNING

Without the weight of the motorcycle resting on the jiffy stand, any vehicle movement could cause the jiffy stand to retract slightly from the full forward position. If the jiffy stand is not in the full forward or lock position when vehicle weight is rested on it, the vehicle could fall over which could result in death or serious injury.

WARNING

Always park the vehicle on a firm, level surface. The weight of the vehicle can cause it to fall over, which could result in death or serious injury.

WARNING

Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted during vehicle operation, unexpected contact with the road surface can distract the rider. While the jiffy stand will retract upon contact, the momentary disturbance and/or rider distraction can lead to loss of vehicle control which could result in death or serious injury.

- 1. Block motorcycle underneath frame so both wheels are raised off ground.
- 2. See Figure 2-24. Inspect leg stop and lock slot in jiffy stand weldment. If covered or plugged with dirt, wipe dirt off with a shop towel and spray catch and mating surface with LOCTITE[®] AEROSOL ANTI-SEIZE.
- Move jiffy stand leg forward and back while spraying antiseize to infuse LOCTITE[®] AEROSOL ANTI-SEIZE into mating parts.
- 4. Lubricate jiffy stand with LOCTITE[®] LUBRIPLATE.
- 5. Check condition of rubber bumper.



Figure 2-23. Jiffy Stand

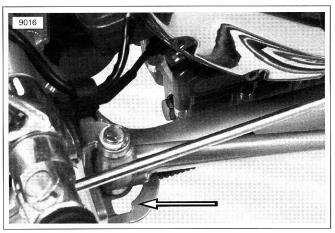


Figure 2-24. Jiffy Stand Catch and Lock Slot

REMOVAL

WARNING

Failure to support motorcycle with proper blocking equipment could result in death or serious injury.

- Block motorcycle underneath frame so both wheels are raised off ground. Jiffy stand should be able to move through its full range of travel without the weight of motorcycle resting on it.
- See Figure 2-26. Remove cotter pin (3) from clevis pin (2).

WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

- 3. With leg in the retracted position, detach spring (6) from jiffy stand leg (5), and anchor (7).
- 4. Remove clevis pin (2) by gently tapping on pin from bottom to drive pin up through mounting bracket.
- 5. Pull out jiffy stand leg and remove upper and lower bushings.
- 6. Loosen and remove the anchor (7).
- 7. Remove rubber bumper (1), if necessary.

NOTE

Jiffy stand brackets can be replaced by replacing the left lower frame rail. See 2.4 FRAME/LOWER FRAME RAILS.

INSTALLATION

WARNING

Wear gloves and protective eyeglasses (or face shield) when performing the following procedure. The jiffy stand spring tension could cause the spring, attached components and/or hand tools to fly outward at great speed and could cause death or serious injury.

- See Figure 2-26. Apply LOCTITE[®] 243 (blue) to anchor (7). Install and tighten anchor to 7-9 Nm (62-79 in-lbs).
- Apply LOCTITE[®] AEROSOL ANTI-SEIZE to both bushings (4) and install bushings in position for a retracted leg.
- 3. Orient leg retracted in mounting bracket, and install **new** clevis pin (2) through the upper bushing (4), leg (5), and lower bushing (4).
- 4. Install new cotter pin (3).
- 5. Attach spring (6) to the anchor and to jiffy stand leg (5). When properly installed, spring open hook on anchor faces outward and open hook on jiffy stand leg faces down when jiffy stand leg is extended.
- 6. Replace rubber bumper (1) if required.
- Check that jiffy stand operates correctly before supporting the weight of the motorcycle on the leg.

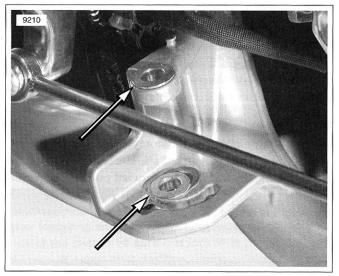


Figure 2-25. Bushings in Retracted Position

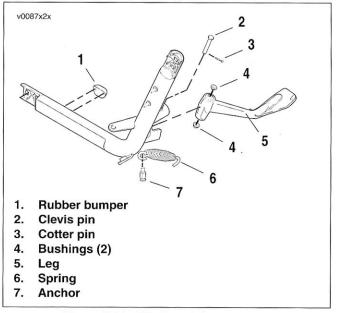


Figure 2-26. Jiffy Stand Components

RIDER FOOTRESTS

Removal

- 1. With motorcycle in neutral, remove fastener from shift linkage to foot shift lever.
- See Figure 2-27. Remove retaining ring (1) from clevis pin (4) holding left side footrest (3) to footrest axle (7). Remove clevis, footrest, and spring washer (5).

NOTE

Shift lever toe peg unthreads from shift lever. Remove and replace as required.

- Remove retaining bolt (9) holding left side footrest axle
 (7) to frame. Remove footrest axle (7) and foot shift lever
 (8).
- 4. Remove left side radiator cover.
- 5. Remove the cotter key from the clevis pin connecting brake pedal (10) to master cylinder brake rod.
- Cover outside face of clevis pin with cardboard and using a large pliers, squeeze pin until pin shoulder pops out of interference fit in the clevis. Remove clevis pin and brake rod.
- Remove retaining ring (1) from clevis pin (4) holding right side footrest (3) to footrest axle (7). Remove clevis, footrest, and spring washer.
- Remove retaining bolt (9) holding right side footrest axle
 (7) to frame. Pull footrest axle (7) from frame and rear brake pedal (10).

Installation

- See Figure 2-27. Install left side footrest axle (7) and foot shift lever (8). Tighten retaining bolt to 11-17 Nm (9-12 ftlbs).
- Install fastener holding shift linkage to foot shift lever (8). Tighten to 9-15 Nm (7-11 ft-lbs).

WARNING

Footpegs must fold upward and rearward. This will allow footpeg to fold, if by accident, it strikes ground surface when making a sharp turn. Failure to set footpeg to the proper fold-up angle could result in death or serious injury.

- 3. Orient footrest (3) to fold upwards on contact with ground.
- 4. Install clevis pin (4) through left side footrest axle (7), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1).
- Install right side footrest axle (7) through rear brake pedal (10). Using LOCTITE[®] 243 (blue), thread in and tighten retaining bolt to 11-17 Nm (9-12 ft-lbs).
- 6. Install clevis pin (4) through right side footrest axle (7), footrest 3), and spring washer (5). Secure with a **new** retaining ring (1).
- 7. Install clevis pin through rear brake pedal clevis and master cylinder brake rod.

 Cover the face of clevis pin and clevis with cardboard. Holding the brake pedal (10) firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install new cotter pin.

PASSENGER FOOTRESTS

Removal

- See Figure 2-27. Remove the retaining ring (1) from the clevis pin (4) holding the footrest (3) to the footrest support (6). Remove the clevis pin, footrest, and spring washer (5).
- 2. Loosen and remove the two fasteners (2) holding the footrest support (6) to the rear fork. Remove the footrest support.
- 3. Repeat for opposite side passenger footrest assembly.

Installation

- See Figure 2-27. Mount the footrest support (6) to the rear fork. Tighten the two fasteners (2) to 19-27 Nm (14-20 ft-lbs).
- 2. Orient footrest (3) to fold upwards on contact with ground.
- Install clevis pin (4) through the support (6), footrest (3), and spring washer (5). Secure with a **new** retaining ring (1).
- 4. Repeat for the opposite side passenger footrest assembly.

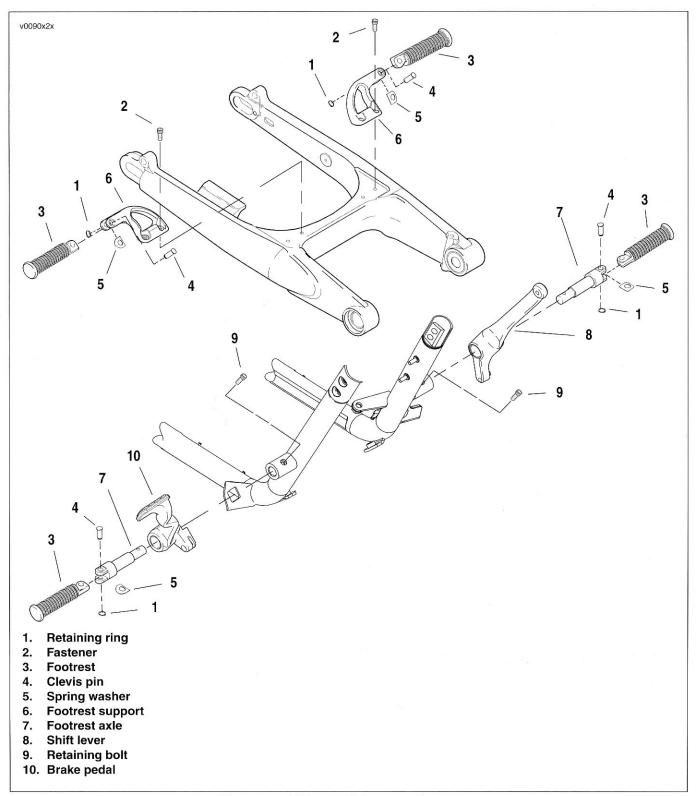


Figure 2-27. Rider and Passenger Foot Rests

REMOVAL/DISASSEMBLY

- See Figure 2-28. Loosen cable adjuster jam nuts (1). Screw throttle cable adjuster until it is a short as possible.
- 2. Remove screws that hold handlebar housing together to separate the upper and lower housings.
- Use a screwdriver to rotate cable ferrules in throttle grip notches. Remove cables from notches on inboard side of throttle grip and remove cables from throttle grip and lower housing.
- 4. Remove airbox. See 1.4 AIRBOX AND AIR FILTER.
- 5. Remove throttle cable housings from guides at throttle body and remove cable barrels from throttle cam.
- 6. See Figure 2-29. Pull cables from housing by placing a drop of oil on retaining ring that holds cable in housing, then firmly pull bent tubing portion of cable out of housing using a rocking motion.

CLEANING AND INSPECTION

Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection and a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.

- 1. Wash all components in non-flammable cleaning solvent. Blow parts dry with low pressure compressed air.
- 2. Replace control cables if frayed, kinked or bent.
- 3. Put one or two drops of oil into housing of each cable.

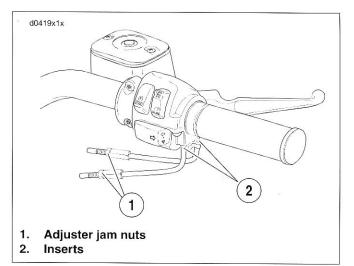
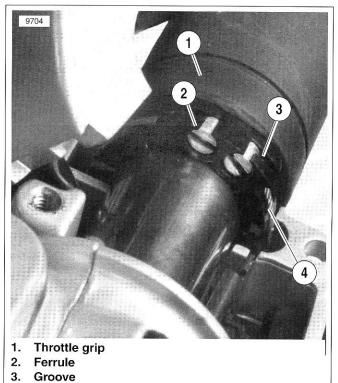


Figure 2-28. Handlebar Throttle Control



4. Idle cable (gold insert, rear hole)

Figure 2-29. Throttle Cable Attachment

ASSEMBLY AND INSTALLATION

- 1. Apply a light coating of graphite to handlebar and inside surface of housings.
- 2. See Figure 2-29. Attach control cable assemblies to lower housing.
 - Push silver insert of the cable housing into hole in front of tension adjuster screw. Snap in retaining ring.
 - Push gold insert of idle cable housing into hole at rear of tension adjuster screw. Snap in retaining ring.
 - c. Install adjusting screw, spring and friction pad in lower housing if they were removed.
- 3. Position throttle grip on the handlebar. Place lower housing on throttle grip.
- 4. Fit ferrules (2) over cable balls. Slide ferrules into throttle notches and rotate so cables fit grooves (3) in throttle grip.
- 5. Fasten upper housing to lower housing using two screws. Tighten to 4-5 Nm (35-45 **in-lbs**).
- 6. Route throttle cables through right side hole in upper fork clamp and behind radiator cover along side battery.

CAUTION

Throttle cables must be routed alongside battery between hold down strap and coolant overflow bottle. Routing throttle cables over battery and/or under battery hold down strap can cause damage to cable coverings and cables.

7. Insert throttle cable barrels on throttle cam and fit cables into guides.

WARNING

Do not tighten the friction adjustment screw to the point where the engine will not return to idle automatically. This could lead to an accident which could result in death or serious injury.

- 8. Adjust cables for correct throttle opening and closing. See 1.21 THROTTLE CABLES.
- 9. Install airbox. See 1.4 AIRBOX AND AIR FILTER.

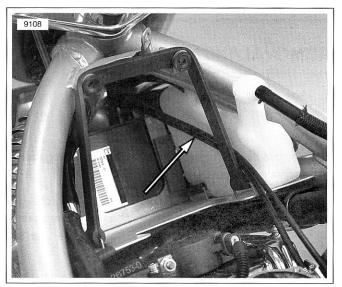


Figure 2-30. Throttle Cable Routing

GENERAL

The clutch is hydraulically actuated. Squeezing the clutch hand lever causes the clutch master cylinder to apply pressure via the clutch fluid in the clutch line to the secondary clutch actuator mounted to the engine right side cover. The secondary clutch actuator piston extends and contacts the clutch release bearing which disengages the clutch.

A bleeder screw at the secondary clutch actuator allows bleeding air from the clutch lines. D.O.T. 5 SILICONE BRAKE FLUID is used in the clutch system.

Check the clutch fluid level in the clutch fluid reservoir on left handlebar. If the sight gauge is dark, the fluid level in the reservoir is above the sight gauge prism and the reservoir is full. If the sight gauge appears clear, the fluid level is below the sight gauge prism and the fluid level should be checked. Fluid level should be level with the internal shelf marked FILL LEVEL with the motorcycle upright.

CAUTION

D.O.T. 5 SILICONE BRAKE FLUID is used for the hydraulic clutch and is referred to as clutch fluid in this manual. Do not use other types of fluid as they are not compatible.

REMOVAL

- 1. While holding turn signal locknut underneath clutch lever/master cylinder assembly, unthread mirror (counterclockwise). Remove mirror and turn signal.
- 2. Remove electrical controls.

CAUTION

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

- See Figure 2-31. Loosen, but do not remove, screws (10) with flat washers (9) that detach handlebar clamp (8) from clutch master cylinder/reservoir.
- 4. Loosen both screws (3) on cover (1) to relieve pressure in master cylinder reservoir.

WARNING

Be sure NO clutch fluid gets on tires, wheels, or brakes when draining clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

NOTE

Place a large cup under the banjo fitting. Hydraulic fluid will begin draining from the reservoir as the banjo bolt is removed.

CAUTION

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

5. Slowly loosen banjo bolt (6) and allow clutch fluid from reservoir to drain into cup.

IMPORTANT NOTE

Dispose of clutch fluid in accordance with local regulations.

6. Remove banjo bolt (6) and two steel/rubber washers (7) to disconnect fitting of hydraulic clutch fluid line (5) from clutch reservoir and master cylinder. Discard steel/rubber washers.

NOTE

To prevent the rest of the clutch fluid from draining from the clutch line and secondary clutch actuator, support the banjo fitting and clutch fluid line upright. Plug the banjo bolt hole with a finger to transfer the assembly to a workbench without spilling clutch fluid.

7. Remove handlebar clamp screws and take clamp and clutch master cylinder/reservoir assembly to a workbench.

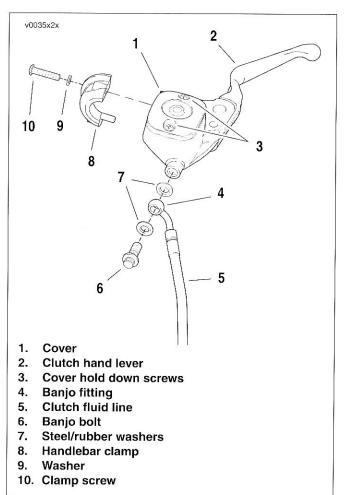


Figure 2-31. Clutch Master Cylinder/Reservoir

DISASSEMBLY

CAUTION

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

- Drain additional clutch fluid from master cylinder/reservoir.
- Remove screws securing master cylinder cover. Remove cover and gasket. Turn housing upside down to remove remaining clutch fluid from reservoir.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

3. Remove retaining ring from pivot pin groove.

NOTE

To take the piston spring load off the pin and remove the pivot pin, gently force the clutch lever toward the piston (as if operating the clutch).

- Remove pivot pin through top of housing. Remove and save pivot pin and clutch lever.
- 5. See Figure 2-32. Using a toothpick or small screwdriver, gently pry outer edge of piston boot (1) out of piston bore.
- 6. Remove piston (2) and spring (4).

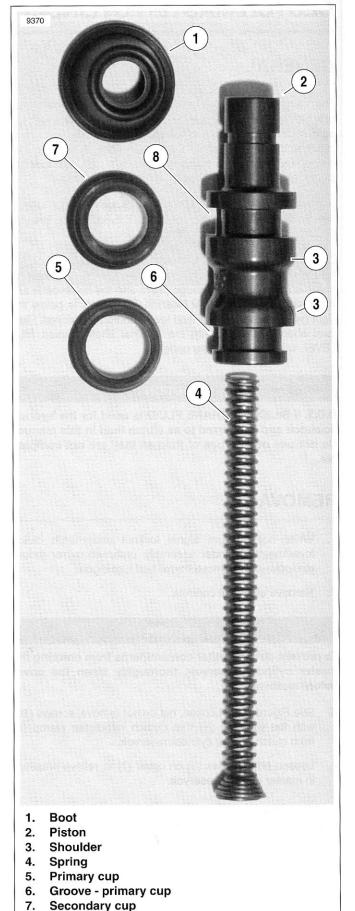
WARNING

Always use denatured alcohol or D.O.T. 5 SILICONE BRAKE FLUID to clean clutch system components. Do not use mineral base solvents (such as gasoline or paint thinner) or deterioration of rubber parts may occur after assembly. Deterioration of components may result in premature brake failure and death or serious injury. Wipe the housing with a lint free cloth. With a clean air supply, blow out drilled passages and bore in the master cylinder housing.

NOTE

Do not use a wire or sharp instrument to clean drilled oil passages.

- Inspect cylinder housing bore for scoring, pitting or corrosion. Also check outlet port for damage. Replace housing if necessary.
- 8. Inspect the cover, sight glass, and gasket for cuts, tears or general deterioration.



8. Groove - secondary cup

Figure 2-32. Clutch Master Cylinder Components

ASSEMBLY

To rebuild clutch master cylinder, use the components found in the SERVICE PARTS KIT No. 46244-01.

- See Figure 2-32. Lightly lubricate inside of primary cup (5) and fit over lip on spring end of piston (2) so the closed end (small ID) contacts evenly with the shoulder (3) in primary cup grove (6).
- Lightly lubricate inside of secondary cup (steep taper from center to outside diameter) (7) and fit over the lip on outboard end of piston (2) so that flared end is open toward the shoulder (3) of the secondary cup groove (8).
- 3. Install boot (1), large sealing ID first, on piston (2) until seal on smaller ID fits snugly into thin groove in piston.

NOTE

See Figure 2-33. The flared ends of the primary cup and the secondary cup face the spring end of the piston.

- Using lubricant in SERVICE PARTS KIT (Part No. 46244-01) thoroughly coat outside diameters of primary and secondary cups. Coat master cylinder piston bore.
- 5. With tapered end out, install spring (4) into opening on inboard side of piston assembly.
- Align and install piston assembly into bore. Firmly press on flat end of piston, compressing spring, until the entire assembly slides into cylinder bore.

NOTE

When fitting the piston sealing boot, be careful not to tear, perforate or damage the piston sealing boot.

- Compress piston until it is even with the end of bore. Using a small dull bladed screwdriver or similar tool, gently work around sealing edges of boot until entire circumference of boot is seated in cylinder bore groove.
- If cover gasket and/or sight glass replacement is necessary. Proceed as follows:
 - a. From inboard side, push sight glass toward top of cover until free.
 - b. Pull rubber gasket from cover.
 - c. Fit nipple of **new** gasket into hole of cover aligning gasket and cover thru holes.
 - d. From bottom of gasket, push flat end of sight glass through nipple until top of glass is flush with top of gasket. Verify that glass is square in bore. If lubrication is necessary, use clean D.O.T. 5 SILICONE BRAKE FLUID.
- Install cover with gasket on master cylinder reservoir. Install two screws to fasten the cover to reservoir, but do not tighten.

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

- 10. To install existing clutch hand lever, install clutch hand lever, pivot pin, and a **new** retaining ring.
- 11. To install a replacement clutch hand lever, use SERVICE PARTS KIT No. 46243-01. See 2.14 CLUTCH HAND LEVER.

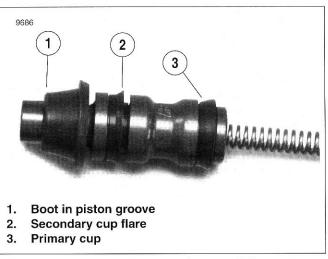


Figure 2-33. Assembled Cups and Piston

INSTALLATION

- See Figure 2-31. Attach master cylinder/reservoir to handlebars with handlebar clamp (8). Orient lever to rider position and tighten two clamp screws (10) to 8-9 Nm (71-80 in-lbs).
- Attach banjo fitting (4) of clutch fluid line to master cylinder with **new** steel/rubber washers. Install electrical controls.
- 3. Remove secondary clutch actuator cover and loosen bleeder screw.
- Fill reservoir with D.O.T. 5 SILICONE BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Finger tighten bleed screw.
- 5. Bleed clutch line. See 1.13 BLEEDING CLUTCH FLUID LINE.
- Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

NOTE

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

- 7. Verify pressure by squeezing clutch hand lever.
- 8. Tighten fasteners as follows:
 - a. Banjo bolt (6) to 23-31 Nm (17-23 ft-lbs).
 - b. Bleeder screw to 9-11 Nm (80-100 in-lbs).
 - c. Reservoir cover screws to 0.7-0.9 Nm (6-8 in-lbs).
 - d. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-89 in-lbs).

WARNING

Check for proper turn signal lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

- 9. Install rear view mirror and turn signals.
- 10. Test ride motorcycle.

To install a **new** clutch hand lever, use components found in SERVICE PARTS KIT No. 46243-01.

1. See Figure 2-34. Slide bushing cups onto pins of roller with cup flanges against roller.

NOTE

Be careful when handling the bushing cups. The bushing cups are hard plastic and can be easily broken.

- With connector bow (3) portion of the bushing cups parallel with groove in clutch handle, snap roller (4) pin with the bushing cups installed into clutch lever roller groove. If bushing is positioned correctly, roller/bushing assembly will install with a snap and will be held securely.
- 3. Lightly grease pivot bushing (2) and install into clutch hand lever (1) pivot hole. Position bushing until it is flush with both sides of lever.

NOTE

If the clutch master cylinder/reservoir is full of clutch fluid under pressure, it may be necessary to apply force to the hydraulic piston (in the clutch hand lever mount) in order to align the clutch hand lever and to allow the pivot pin to be inserted.

- 4. Orient clutch lever in lever mounting bracket. Insert pivot pin from top and tap into place.
- 5. Install retaining ring on pivot pin.

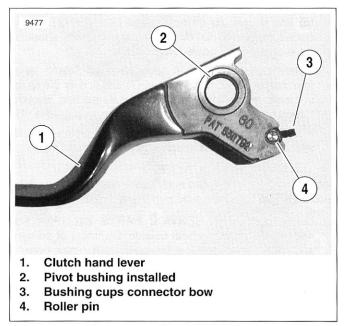


Figure 2-34. Clutch Hand Lever

REMOVAL

Inspect the clutch fluid line for wear, damage, and leaks. Replace if necessary.

1. Remove secondary clutch actuator cover from left side clutch cover.

WARNING

Be sure NO clutch fluid gets on rear tire, wheel or brakes when draining clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

 Place a suitable container under secondary clutch actuator. Loosen flare nut and allow clutch fluid to drain from clutch line.

IMPORTANT NOTE

Dispose of clutch fluid in accordance with local regulations.

- Remove banjo bolt and two steel/rubber washers to disconnect fitting of hydraulic clutch fluid line from clutch reservoir and master cylinder. Discard washers.
- 4. See Figure 2-35. Remove clutch fluid line from clips on frame.
- Carefully thread banjo fitting end of clutch line out through upper triple clamp. Thread flare nut end of clutch line out through bottom of motorcycle and remove clutch line through front down tubes.

INSTALLATION

- Route clutch line banjo fitting up through upper triple clamp, then route line behind steering head over to right frame rail and along inside of rail under engine and back up between bottom frame rails to loop out and forward to secondary clutch actuator mounted on clutch cover.
- 2. Thread in and finger tighten flare nut fastening clutch fluid line to secondary clutch actuator.
- 3. Attach banjo fitting of the clutch fluid line to master cylinder with **new** steel/rubber washers.
- 4. Replace all clutch line clips in corresponding locations along frame.

WARNING

Be sure NO clutch fluid gets on rear tire, wheel or brakes when adding clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

WARNING

Do NOT allow foreign matter to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir may cause improper operation of the clutch and equipment damage.

AWARNING

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and seek medical attention immediately. Swallowing large amounts of D.O.T. 5 SILICONE BRAKE Fluid may cause digestive discomfort. If swallowed, seek medical attention immediately. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

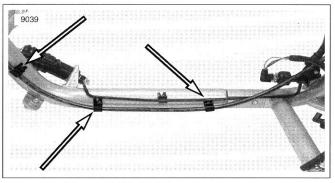


Figure 2-35. Clutch Fluid Line Clips

- 5. Remove secondary clutch actuator cover and loosen bleeder screw.
- Fill reservoir with D.O.T. 5 SILICONE BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Finger tighten bleed screw.

NOTE

A Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the bleed screw threads can be used to draw the fluid down the clutch line.

- 7. Bleed clutch line. See 1.13 BLEEDING CLUTCH FLUID LINE.
- 8. Verify that fluid level in clutch fluid reservoir is at FILL LEVEL with motorcycle upright.

NOTE

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

- 9. Test pressure by squeezing clutch hand lever.
- 10. Tighten fasteners as follows:
 - a. Banjo bolt (6) to 23-31 Nm (17-23 ft-lbs).
 - b. Clutch line flare nut to 9-13 Nm (80-115 in-Ibs).
 - c. Bleeder screw to 9-11 Nm (80-100 in-lbs).
 - d. Reservoir cover screws to 0.7-0.9 Nm (6-8 in-Ibs).
 - e. Secondary clutch actuator cover mounting bolts to 6-10 Nm (53-89 in-lbs).
- 11. Test ride motorcycle.

REMOVAL

- 1. Remove secondary clutch actuator cover.
- 2 See Figure 2-36. Remove mounting bolts (2) holding secondary clutch actuator (4) to clutch cover.

WARNING

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could push the piston out of its housing with sufficient force to cause death or serious injury.

3. See Figure 2-37. Inspect o-ring (2). Replace if necessary and re-install actuator.

IMPORTANT NOTE

Dispose of clutch fluid in accordance with local regulations.

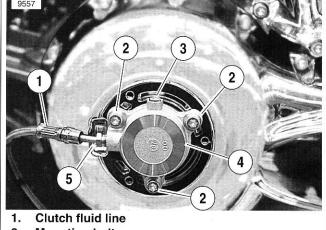
- 4. See Figure 2-36. If condition indicates replacement of secondary actuator:
 - a. Place a suitable container under secondary clutch actuator (4). Loosen flare nut (5) and allow clutch fluid to drain from clutch line (1).
 - Remove flare nut and remove actuator. b
 - C. Remove bleeder screw and drain remaining clutch fluid.

DISASSEMBLY

- See Figure 2-38. Remove o-ring (3) from bleeder screw 1. (2).
- Pull off boot (8), piston (7), seal (6), and spring (5) from 2. housing (1). Slip o-ring (4) off housing.
- 3. Clean with denatured alcohol or D.O.T. 5 SILICONE BRAKE FLUID, only.
- 4. Use air hose to clean inlet and bleeder ports.
- 5. Inspect cylinder housing bore for scoring, pitting or corrosion. Inspect inlet and bleeder ports. Replace housing if necessary.

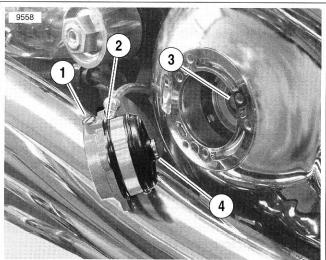
ASSEMBLY

- 1. See Figure 2-38. Coat cylinder bore, piston, o-ring, boot, and bleeder screw with lubricant from service kit.
- 2. Orient a new seal (6) with square split lip toward rider side of actuator and fit to piston (7).
- Insert spring into cylinder bore and insert piston into cyl-3. inder bore. Compress and guide seal lip as piston is pressed into bore.
- 4. Install a **new** o-ring (4) into groove at base of secondary clutch actuator housing (1).
- Fit boot (8) to piston (7) and push edge of boot over 5. machined lip around housing (1).
- 6. Fit new o-ring (3) to bleeder screw (2) and loosely install into housing.



- 2. Mounting bolts 3. **Bleeder screw**
- Secondary clutch actuator 4.
- 5. Flare nut

Figure 2-36. Secondary Clutch Actuator Installed



- 1. **Bleeder screw**
- 2. **O-ring**
- 3. **Clutch release bearing**
- 4. Secondary clutch actuator piston

Figure 2-37. Secondary Clutch Actuator

- 1. Install clutch fluid line flare nut to secondary clutch actuator. Tighten to 9-13 Nm (80-115 in-lbs).
- 2. Loosen bleeder screw.

WARNING

Be sure NO clutch fluid gets on rear tire, wheel or brakes when adding clutch fluid. Traction will be adversely affected which could result in loss of control of the motorcycle and death or serious injury.

WARNING

Do NOT allow foreign matter to enter the clutch master cylinder reservoir. Dirt or debris in the reservoir may cause improper operation of the clutch and equipment damage.

WARNING

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may cause eye irritation, swelling, and redness. Avoid eye contact. In case of eye contact flush with large amounts of water and seek medical attention immediately. Swallowing large amounts of D.O.T. 5 SILICONE BRAKE Fluid may cause digestive discomfort. If swallowed, seek medical attention immediately. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

WARNING

The piston in the secondary clutch actuator is under pressure. Squeezing the clutch hand lever could force the piston out of its housing with sufficient force to cause death or serious injury.

 Fill reservoir with D.O.T. 5 SILICONE BRAKE FLUID. Allow fluid to fill clutch line until a steady flow of clutch fluid flows from bleeder screw. Tighten bleeder screw.

NOTE

When filling an empty clutch fluid line, a Snap-on BASIC VACUUM BRAKE BLEEDER with a fitting that mates to the bleeder screw threads can be used to initially draw the fluid down the clutch line with little or no air in the line.

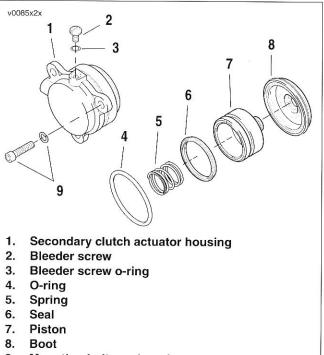
- 4. Bleed clutch fluid line. See 1.13 BLEEDING CLUTCH FLUID LINE.
- 5. Tighten fasteners as follows:
 - a. Banjo bolt to 23-31 Nm (17-23 ft-lbs).
 - b. Bleeder screw to 9-11 Nm (80-100 in-lbs).
 - c. Reservoir cover screws to 0.7-0.9 Nm (6-8 in-Ibs).

6. Determine sufficient piston travel.

NOTE

Insufficient piston travel may indicate a fluid or pressure leak somewhere in the actuator, clutch fluid line, or clutch master cylinder.

- Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (89 in-lbs).
- Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-89 in-lbs).



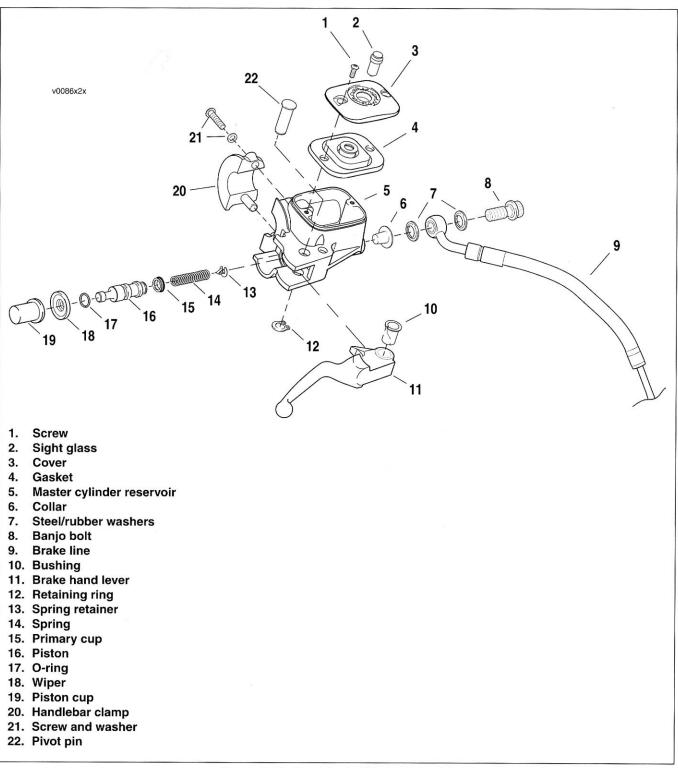
9. Mounting bolts and washers

Figure 2-38. Secondary Clutch Actuator Components

2.17

GENERAL

Master cylinders designed for dual disc (two caliper) operation have an 17.5 mm (11/16 inch) bore.





REMOVAL AND DISASSEMBLY

 Open bleeder nipple caps on front brake calipers. Install clear plastic tubing over each caliper bleeder valve, while placing free ends in a suitable container. Open bleeder valves about 1/2-turn. Pump brake hand lever to drain brake fluid from reservoir. Close bleeder valve. See 1.9 BLEEDING BRAKES.

CAUTION

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

 See Figure 2-39. Remove banjo bolt (8) and two steel/ rubber washers (7) to disconnect fitting of hydraulic brake line from front brake master cylinder. Discard washers.

CAUTION

Do not remove the master cylinder assembly without first placing a 4 mm (5/32 inch) thick cardboard insert between the brake lever and lever bracket. Removal without the insert may result in damage to the rubber boot and plunger of the front stoplight switch.

- 3. See Figure 2-40. Place cardboard insert (2) between brake lever and lever bracket.
- See Figure 2-39. Remove screw and washer (21) to detach handlebar clamp (20) from master cylinder reservoir (5).

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

- 5. Remove retaining ring (12) from pivot pin (22) groove.
- 6. Remove pivot pin (22) and brake hand lever (11).
- 7. Carefully remove wiper (18) with pick or similar tool.
- 8. Remove piston cap (19).
- 9. Remove piston (16) with o-ring (17) and primary cup (15).
- 10. Remove spring (14).

CAUTION

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

11. Remove both screws (1), cover (3) and the cover gasket (4).

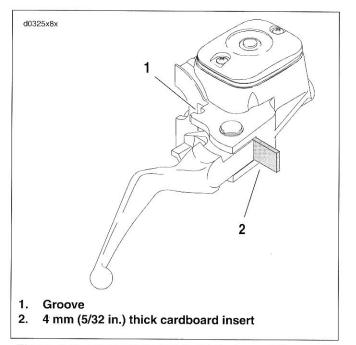


Figure 2-40. Front Brake Master Cylinder and Reservoir

CLEANING AND INSPECTION

ASSEMBLY

1. Always assemble master cylinder using **new** parts from repair kit.

WARNING

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

 Clean all parts with denatured alcohol or D.O.T. 5 SILI-CONE BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth.

WARNING

Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection and a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.

- 3. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.
- 4. Carefully inspect all parts for wear or damage and replace as necessary.
- 5. Inspect piston bore in master cylinder housing for scoring, pitting or corrosion. Replace housing if any of these conditions are found.
- Inspect outlet port that mates with brake line fitting. If any scratches, dents or other damage is found on this critical sealing surface, replace housing.
- Inspect cover, sight glass and gasket for cuts, tears or general deterioration. If gasket and/or sight glass replacement is necessary, proceed as follows:
 - a. From inboard side, push sight glass toward top of cover until free.
 - b. Pull rubber gasket from cover.
 - c. Fit nipple of **new** gasket into hole of cover aligning gasket and cover thru holes.
 - d. From bottom of gasket, push flat end of sight glass through nipple until top of glass is flush with top of gasket. Verify that glass is square in bore. If lubrication is necessary, use clean brake fluid.

To rebuild front brake master cylinder, use the components found in the SERVICE PARTS KIT No. 45072-96C.

- 1. See Figure 2-39. Fit o-ring (17) into groove at front of piston (16).
- 2. Fit primary cup (15) over lip at back of piston (16) so that closed side (smaller OD) contacts shoulder.
- Coat piston bore of housing with special lubricant supplied in the service parts kit. Also apply the lubricant to OD of installed o-ring (17) and primary cup (15).
- Clip spring retainer (13) onto end of spring and insert spring (14) into master cylinder bore so that spring retainer snaps into the recess at bottom.
- 5. Slide piston (16) over spring.
- 6. Fit wiper (18) over piston cup (19) so that the flat side of wiper contacts cup shoulder.
- 7. Fit piston cup (19) over piston (16).
- Press down on wiper (18) until it contacts counterbore. Larger OD of wiper must be completely seated in groove on outlet side of piston bore.
- 9. Install cover (3) with gasket (4) on master cylinder reservoir. Install two screws (1) to fasten the cover to reservoir, but do not tighten at this time.
- Align hole in brake hand lever (11) with hole in master cylinder reservoir (5). From top of assembly, slide pivot pin (22) through reservoir (5) and hand lever (11).

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

11. Install retaining ring (12) in pivot pin groove. Verify that retaining ring is completely seated in groove.

CAUTION

See Figure 2-40. Do not install the master cylinder assembly without first placing the 4 mm (5/32 in.) thick cardboard insert (or cable strap eyelet) between the brake lever and lever bracket. Installation without the insert may result in damage to the rubber boot and plunger of the front stoplight switch.

- 1. See Figure 2-41. Position brake lever/master cylinder assembly inboard of switch housing assembly engaging tab (2) on lower switch housing (1) in groove (3) at top of brake lever bracket (4).
- Align holes in handlebar clamp with those in master cyl-2. inder housing and start both screws with flat washers. Position for rider posture. Beginning with top screw, tighten to 38-72Nm (28-53 ft-lbs).

CAUTION

To avoid leakage, verify that the steel/rubber washers, banjo bolt, brake line fitting and master cylinder bore are completely clean.

- 3. Lubricate new steel/rubber washers with D.O.T. 5 SILI-CONE BRAKE FLUID. Position new steel/rubber washers on each side of hydraulic brake line fitting. Insert bolt through washers and fitting. Thread banjo bolt into master cylinder housing and tighten to 23-31 Nm (17-22 ftlbs).
- Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
- 5. Stand the motorcycle upright so that master cylinder is level. Remove master cylinder cover.

ACAUTION

Direct contact of D.O.T. 5 brake fluid with eyes may 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 may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

6. Add D.O.T. 5 SILICONE BRAKE FLUID to master cylinder reservoir until fluid level is 1/8 inch (3.2 mm) from top. Do not reuse old brake fluid. Use only D.O.T. 5 SILI-CONE BRAKE FLUID from a sealed container.

WARNING

Whenever the brake line is reconnected, 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.

- 7. Bleed brake system. See 1.9 BLEEDING BRAKES.

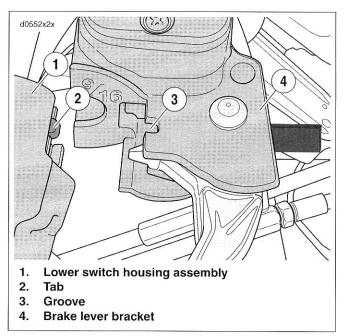


Figure 2-41. Master Cylinder and Brake Lever Bracket To Handlebar Switch Housing

WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control which could result in death or serious injury.

- 8. Verify operation of master cylinder relief port. Actuate brake hand lever with cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
- 9. Install gasket and cover on master cylinder. Tighten 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.

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

NOTE

A sight glass enables the rider to visually check the brake fluid level without removing the master cylinder cover. When the reservoir is full, the sight glass is dark. As the fluid level drops, the glass lightens up to indicate this condition to the rider.

FRONT BRAKE CALIPERS

REMOVAL

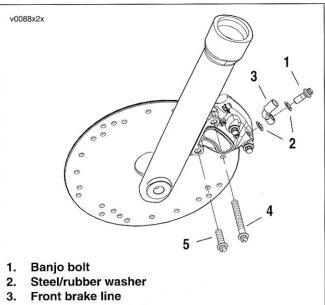
NOTE

If only replacing brake pads, see 1.10 BRAKE PADS AND DISCS.

CAUTION

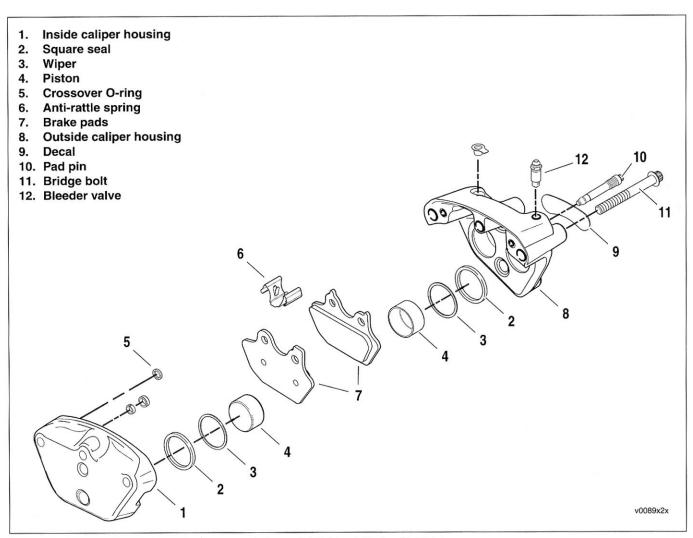
Damaged banjo bolt surfaces will leak when reassembled. Prevent damage to seating surfaces by carefully removing brake line components.

- See Figure 2-42. Remove banjo bolt (1) and both steel/ 1. rubber washers (2) to detach front brake line (3) from caliper. Discard washers.
- Remove both upper (4) and lower (5) mounting bolts. Lift 2. caliper upward to remove from brake disc.
- Repeat for opposite side caliper. 3.



- 4. Upper mounting bolt
- Lower mounting bolt 5.

Figure 2-42. Front Brake Caliper Mounting



DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-43293	Brake caliper piston remover

- 1. See Figure 2-43. Remove pad pins (10), brake pads (7) and bridge bolts (11) to separate caliper housings (1, 8).
- 2. Remove anti-rattle spring (6). If necessary, remove bleeder valve (12).
- 3. See Figure 2-45. Remove pistons.
 - a. Place BRAKE CALIPER PISTON REMOVER (Part No. HD-43293) between caliper housings.
 - b. Insert two bridge bolts (2) and tighten securely.
 - c. If the bleeder valve was removed, loosely reinstall or place a gloved finger over the bleeder valve hole on the outside caliper housing.

AWARNING

Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.

- d. Apply low pressure compressed air (1) to banjo bolt hole to remove pistons from caliper bores.
- e. Remove bridge bolts and remove tool.
- 4. See Figure 2-46. Remove and discard both crossover orings (1) from inside caliper housing.
- 5. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

Damaged pistons or piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

- See Figure 2-44. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.
- 7. Repeat for opposite caliper.

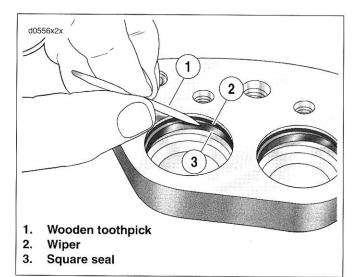
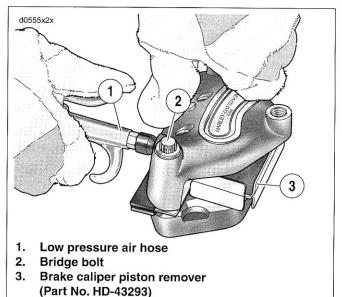


Figure 2-44. Wipers and Square Seals



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Figure 2-45. Unseating Pistons

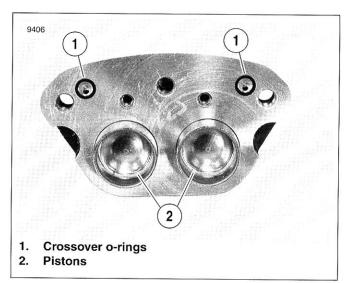


Figure 2-46. Crossover O-rings and Pistons

ASSEMBLY

WARNING

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

- Clean all parts with denatured alcohol or D.O.T. 5 SILI-CONE BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe parts dry with a clean, lint free cloth. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages.
- 2. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check pistons for pitting, scratching or corrosion on face and also on ground surfaces.
 - Inspect caliper piston bore. Do not hone bore. If bore should show pitting or corrosion, replace caliper.
 - c. Always replace wipers, square seals and crossover o-rings after disassembly.
 - d. Inspect pad pins for wear and grooving. If wear is more than 0.38 mm (0.015 in.), replace both pins.
- 3. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

AWARNING

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

- 4. Inspect brake pads and brake disc. See 1.10 BRAKE PADS AND DISCS.
- 5. Repeat for opposite caliper.

CAUTION

Do not use D.O.T. 5 SILICONE BRAKE FLUID for lubrication. Use of D.O.T. 5 brake fluid will result in increased lever travel.

- Lubricate the following parts prior to assembly using a light coat of G.E. VERSILUBE[®] #G322 L SILICONE GREASE (marked "Piston Lube") from the service parts kit. All other surfaces must be dry for assembly.
 - a. Lubricate nose radius and outside diameter of piston. Apply lube to inside of caliper piston bores.
 - b. Apply lube to inside diameter of seals and wipers.

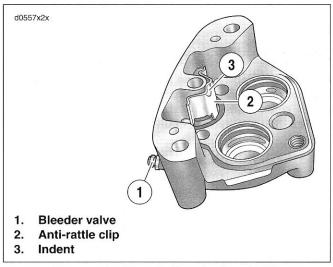


Figure 2-47. Front Caliper Anti-rattle Clip

CAUTION

Damaged piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

- 2. See Figure 2-44. Install a **new** square seal (3) and a **new** wiper (2) into each piston bore.
- Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
- 4. See Figure 2-46. Place two **new** crossover o-rings (1) on inside caliper housing.

5. Assemble caliper housings.

a. See Figure 2-47. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 9-11 Nm (80-100 in-lbs).

- Place outside caliper housing on workbench with decal side down. Install anti-rattle clip (2) in channel with indent (3) facing upwards.
- c. Verify that **new** crossover o-rings are installed on inside caliper housing.
- d. Mate inside and outside caliper housings using bridge bolts. Place one bridge bolt in the middle hole and one next to the bleeder valve. Loosely install bridge bolts.
- e. Check that anti-rattle spring is still seated between caliper housings.
- f. Tighten bridge bolts to 38-52 Nm (28-38 ft-lbs).

NOTE

See Figure 2-48. The front and rear brake calipers use the same brake pad set.

- 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.
- Insert one set of brake pads into caliper with friction material on pad facing opening for brake disc. Curved portion of pad must face rear of motorcycle when caliper is installed.
- If necessary, install **new** pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 20-23 Nm (180-200 in-lbs).
- 8. Repeat for opposite caliper.

NOTE

If pad pins do not fit, check the following:

- You are using a set of pads, not two identical pads.
- Anti-rattle clip orientation matches Figure 2-47.

Pads must be pushed tight against the anti-rattle clip before the pad pins can be installed.

INSTALLATION

- 1. See Figure 2-42. Attach calipers to fork legs.
 - a. Place caliper over brake disc with bleeder valve facing upwards.
 - b. Loosely install long upper mounting bolt (4) into top hole on fork leg.
 - Install short lower mounting bolt (5) into bottom hole on fork leg. Tighten bottom mounting bolt to 38-52 Nm (28-38 ft-lbs).
 - d. Final tighten the top mounting bolt to 38-52 Nm (28-38 ft-lbs).

CAUTION

To avoid leakage, verify that the washers, banjo bolt, brake line and caliper bore are completely clean.

- Lubricate new steel/rubber washers (2) with D.O.T. 5 SILICONE BRAKE FLUID. Connect the brake line (3) to caliper using two new steel/rubber washers (2) and banjo bolt (1). Tighten to 23-31 Nm (17-23 ft-lbs).
- 3. Repeat for opposite side caliper.

ACAUTION

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may 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 SILICONE BRAKE FLUID may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

- Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 5 SILICONE BRAKE FLUID. Verify that fluid level is at FILL LEVEL when the motorcycle is level.
- 5. Tighten cover screws to 0.7-0.9 Nm (6-8 in-lbs).

WARNING

Whenever brake calipers 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.

 Bleed brake system and tighten bleeder valve. See 1.9 BLEEDING BRAKES.

WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control which could result in death or serious injury.

- Verify proper operation of the master cylinder relief port. Actuate the brake lever with the cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
- Install gasket and cover on reservoir. Tighten to 0.7-0.9 Nm (6-8 in-lbs).

AWARNING

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

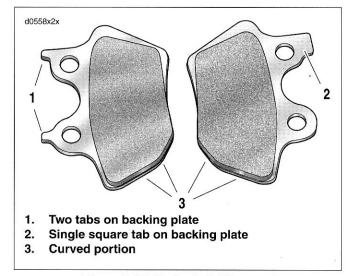
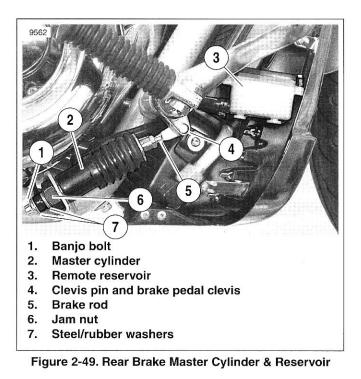


Figure 2-48. Brake Pad Alignment

CAUTION

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

- 1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Remove radiator left side cover.
- See Figure 2-49. With a suitable container under the master cylinder, remove the banjo bolt (1). Discard the two steel/rubber washers (7).
- 4. Remove the cotter key from the clevis pin (4).
- 5. See Figure 2-50. Cover the outside face of clevis pin with cardboard and using a large pliers, squeeze the pin until the pin shoulder pops out of its interference fit with the clevis. Remove the clevis pin.
- 6. See Figure 2-49. Remove the brake rod (5) from the clevis.
- 7. Pull remote reservoir from slot on radiator cover.
- Remove jam nut (6) to free master cylinder from mounting bracket.
- 9. Remove master cylinder with the remote reservoir.



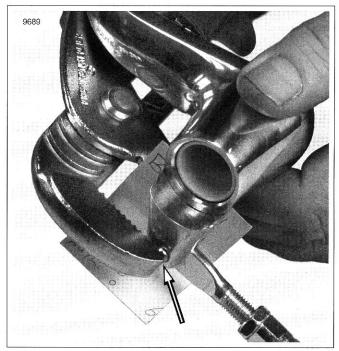


Figure 2-50. Releasing Clevis Pin (brake pedal removed from motorcycle for clarity)

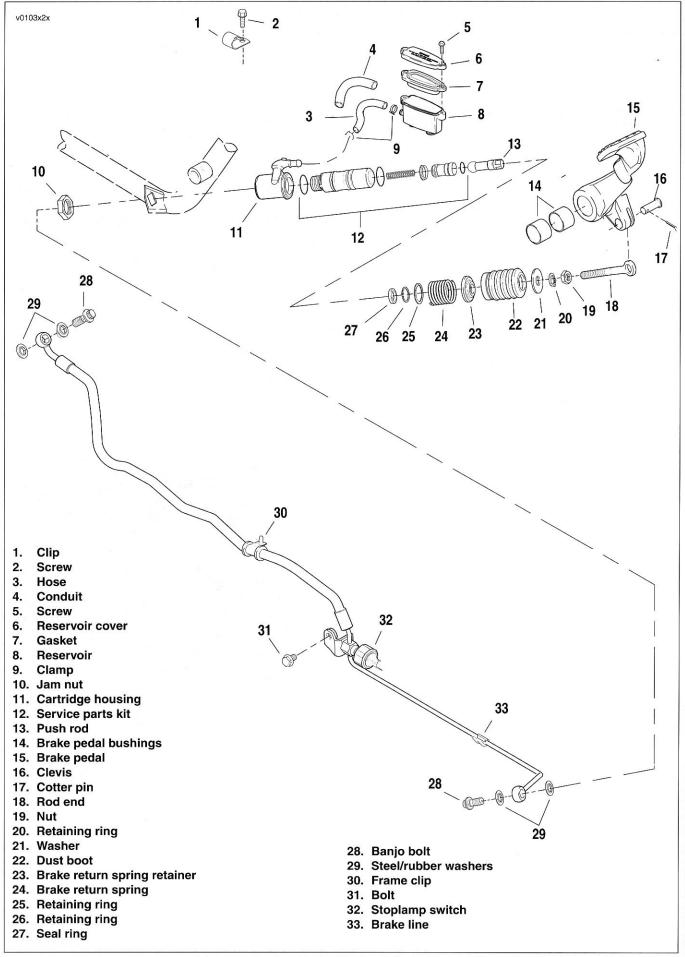


Figure 2-51. Rear Brake Master Cylinder/Reservoir

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

- See Figure 2-51. Remove the reservoir cover (6) and gasket (7).
- 2. Over suitable container, separate and drain the reservoir (8) and hose (3).
- 3. Using HOSE CLAMP PLIERS (HD-41137), remove the hose clamps (9) from the remote reservoir hose (3).
- 4. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.

NOTE

Measure and record the length of threads showing on the rod end.

- The master cylinder can be assembled to this dimension to return the brake pedal to its original operating position.
- Rod end thread engagement of the push rod should be at least 11.5 mm (0.450 in).
- 5. Turning push rod (13) with wrench, break jam nut (19) loose. Remove rod end (18) with jam nut (19).
- 6. Push on cartridge housing (11) to separate from cartridge. Use hand pressure only.
- Stand master cylinder assembly upright on banjo sealing surface. Be sure to lay down a clean shop cloth to protect the sealing surface from damage.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

- Push down on large flat washer (21) to compress spring (24).
- 9. While holding the spring (24) in a compressed state, remove the retaining ring (20). Carefully release spring tension.
- 10. Remove the large flat washer (21), dust boot (22), spring retainer (23), and spring (24).
- 11. Push on cartridge housing (11) to separate from cartridge. Use hand pressure only.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

12. See Figure 2-52. Push down on push rod to compress piston spring and remove retaining ring inside cartridge.

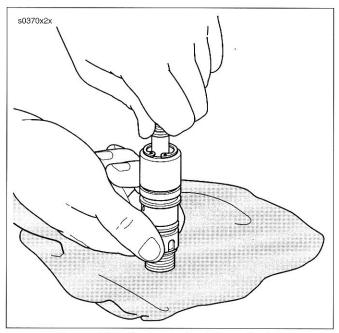


Figure 2-52. Compressing Piston Spring

- 13. See Figure 2-51. Remove pushrod (13) and seal ring (27).
- 14. Remove piston and piston spring.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

15. Remove large retaining ring (25) from cartridge.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

CLEANING AND INSPECTION

WARNING

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

- 1. Clean all rubber parts using denatured alcohol. Check dust boot for cuts or tears. Replace as necessary.
- 2. Inspect threads on the cartridge body, push rod and brake rod. Replace if threads are damaged.
- 3. Inspect spring for cracks or broken coils. Replace as necessary.
- 4. Wipe bore of cartridge housing with D.O.T. 5 SILICONE BRAKE FLUID.
- 5. Inspect reservoir cover gasket for cuts, tears or general deterioration. Replace as necessary.

ASSEMBLY

To rebuild rear brake master cylinder, use the components found in the SERVICE PARTS KIT No. 42383-87C.

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

- See Figure 2-53. Lubricate **new** o-rings (1) with D.O.T. 5 SILICONE BRAKE FLUID and carefully install in grooves on **new** cartridge (3).
- Install new primary cup (5) with the flared end toward the threaded end of the cartridge and new o-ring (7) on new piston (6).
- 3. Slide **new** spring (4) into piston (6) and slide into cartridge (3).

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage could propel the ring with force which could cause death or serious injury.

- Lay down a clean shop cloth to protect the banjo sealing surface from damage. Stand master cylinder assembly upright on banjo sealing surface.
- 5. See Figure 2-51. Insert ball end of push rod (13) with seal ring (27) around rod into piston cup. Pushing down to compress spring, install small retaining ring (26) in groove of cartridge body bore. Verify that retaining ring is completely seated in groove capturing seal ring and that push rod rotates freely.
- 6. Install large retaining ring (25) in groove closest to push rod end of cartridge body.
- 7. Insert cartridge into cartridge housing (11).

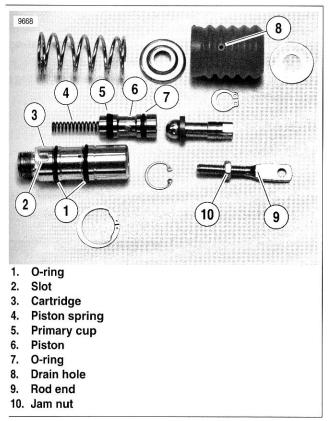


Figure 2-53. Master Cylinder Components

- 8. See Figure 2-53. Verify that tab inside of housing mates to slot (2) on threaded end of cartridge (3).
- See Figure 2-51. Install brake return spring (24), brake return spring retainer (23), boot (22), and large washer (21) over push rod (13).
- 10. Push down on large flat washer (21) to compress brake return spring. While holding the spring in a compressed state with brake return spring (24) seated on large retaining ring (25), install retaining ring (20) on push rod.
- 11. See Figure 2-53. Rotate boot so that drain hole (8) is at bottom. Bottom is side opposite tab in housing and mating slot in cartridge. Pull down dust boot to seat over lip on housing.
- 12. See Figure 2-51. With jam nut (19) in original location, thread in brake rod (18) until jam nut bottoms on the push rod (13).

NOTE

Normal brake pedal adjustment range is 18-22 mm (0.69-0.89 in.) from center of clevis to backside of jam nut. See REAR BRAKE PEDAL in 1.8 BRAKES.

- 13. Tighten jam nut to push rod.
- Using new clamps (9) and HOSE CLAMP PLIERS (Part No. HD-41137), install new hose (3) covered with conduit (4) connecting master cylinder to reservoir.
- 15. Replace cover (6) and gasket (7).

- 1. See Figure 2-49. Route remote reservoir (3) and hose behind rear brake pedal. Press reservoir mounting studs into slots on radiator cover.
- 2. Fit square on bottom of master cylinder cartridge housing (2) into square hole of mounting bracket.
- See Figure 2-51. Install the clevis pin (16) through the brake pedal (15) clevis and master cylinder brake rod (18).
- Cover the face of clevis pin (16) and clevis with cardboard. Holding the brake pedal firmly, tap on a rod to seat shoulder of clevis pin into clevis. Install **new** cotter pin (17).
- Apply LOCTITE[®] 243 (blue) to threads of jam nut (10). Thread jam nut (10) on cartridge housing and tighten to 41-54 Nm (30-40 ft-lbs).

NOTE

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

- Lubricate new steel/rubber washers (29) with D.O.T. 5 SILICONE BRAKE FLUID. Position new steel/rubber washers on each side of brake line (33). Insert the banjo bolt (28) through washers and fitting. Tighten to 23-31 Nm (17-23 ft-lbs).
- 7. Stand the motorcycle upright so that the reservoir is in a level position. Clean and remove reservoir cover.

ACAUTION

Direct contact of D.O.T. 5 SILICONE BRAKE FLUID with eyes may 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 SILICONE BRAKE FLUID may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

 See Figure 2-54. Add D.O.T. 5 SILICONE BRAKE FLUID to the master cylinder reservoir until the fluid level is 12.7 mm (1/2 in.) below top of reservoir and is visible in sight window at rear of reservoir. Use only D.O.T. 5 SILICONE BRAKE FLUID from a sealed container.

WARNING

Whenever the brake line is reconnected, 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. Bleed brake system. See 1.9 BLEEDING BRAKES.
- 10. Install gasket and cover on master cylinder. Tighten cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
- 11. Replace radiator side cover.
- 12. Replace maxi-fuse and right side cover.

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.

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

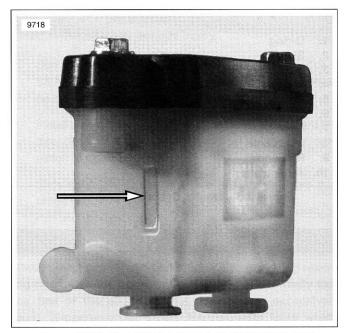


Figure 2-54. Rear Brake Reservoir Sight Window (removed from motorcycle)

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.10 BRAKE PADS AND DISCS.

1. Remove saddlebag if necessary to gain access to rear brake caliper.

CAUTION

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

- 2. Remove banjo bolt and both steel/rubber washers to detach rear brake line from caliper. Discard washers.
- 3. With motorcycle supported from underneath, remove axle nut and rear axle adjuster. Pull axle from the left side through right side rear fork arm and caliper only. Do not pull axle all the way out. See 2.23 REAR WHEEL.
- 4. Lift rear caliper away from axle and rear fork.

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-43293	Brake caliper piston remover

- 1. See Figure 2-55. Remove pad pins (10), brake pads (7) and bridge bolts (11) to separate caliper housings (1, 8).
- 2. Remove anti-rattle spring (6). If necessary, remove bleeder valve (12).
- 3. If necessary, cut rubber bumper (13) to remove.

WARNING

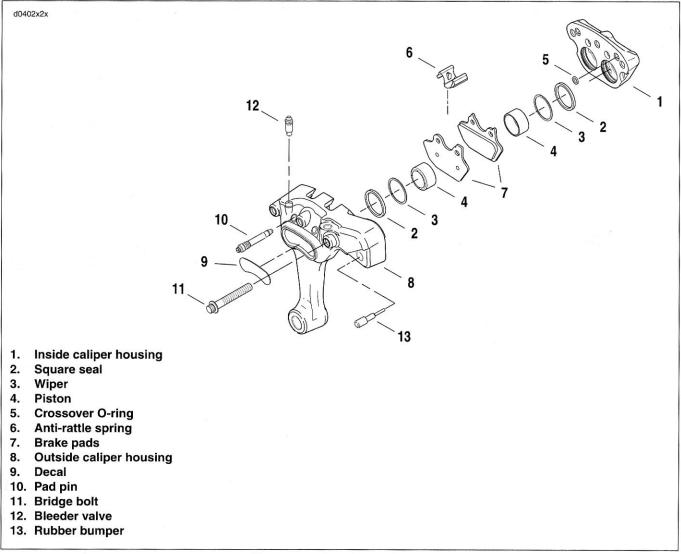
Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.

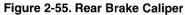
- 4. See Figure 2-56. Remove and discard both crossover orings (1) from inside caliper housing.
- 5. See Figure 2-57. Remove pistons.
 - a. Place BRAKE CALIPER PISTON REMOVER (HD-43293) between caliper housings.
 - b. Insert three bridge bolts and tighten securely.
 - c. If the bleeder valve was removed, loosely reinstall or place a gloved finger over the bleeder valve hole on outside caliper housing.
 - d. Apply low pressure compressed air to banjo bolt hole to remove pistons from caliper bores.
 - e. Remove bridge bolts and remove tool.
- 6. If necessary, wiggle pistons from caliper bores to completely remove. Discard all removed parts.

CAUTION

Damaged pistons or piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

7. See Figure 2-58. Using a wooden toothpick (1), remove wiper (2) and square seal (3) from each caliper bore.





CLEANING, INSPECTION AND REPAIR

WARNING

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

- Clean all parts with denatured alcohol or D.O.T. 5 SILI-CONE BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe parts dry with a clean, lint free cloth. Blow out drilled passages and bore with a clean air supply. Do not use wire or similar instrument to clean drilled passages.
- 2. Carefully inspect all components. Replace any parts that appear damaged or worn.
 - a. Check pistons for pitting, scratches or corrosion on face and also on ground surfaces.
 - Inspect caliper piston bore. Do not hone bore. If bore should show pitting or corrosion, replace caliper.
 - c. Inspect rubber damper for cuts, tears, or signs of deterioration.
 - d. Always replace wipers, square seals and crossover o-rings after disassembly.
 - e. Inspect brake pads and brake disc. See 1.10 BRAKE PADS AND DISCS.
 - f. Inspect pad pins for wear and grooving. if wear is more than 0.38 mm (0.015 in.), replace both pins.
 - g. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

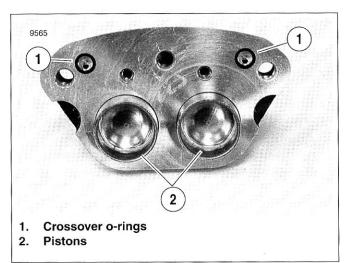
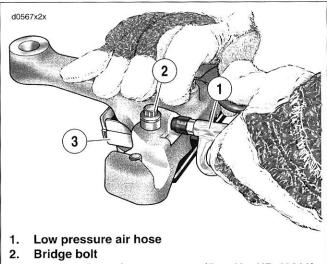


Figure 2-56. Crossover O-rings and Pistons



3. Brake caliper piston remover (Part No. HD-43293)

Figure 2-57. Removing Pistons

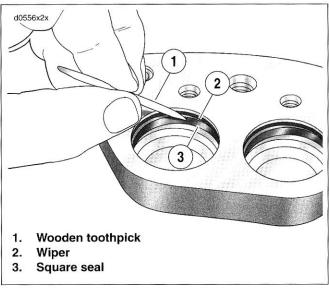


Figure 2-58. Wipers and Square Seals

ASSEMBLY

CAUTION

Do not use D.O.T. 5 SILICONE BRAKE FLUID for lubrication. Use of D.O.T. 5 SILICONE BRAKE FLUID will result in increased lever travel.

- Lubricate the following parts prior to assembly using a light coat of G.E. VERSILUBE[®] #G322 L SILICONE GREASE (marked "Piston Lube") from the SERVICE PARTS KIT. All other surfaces must be dry for assembly.
 - a. Lubricate nose radius and outside diameter of piston. Apply lube to inside of caliper piston bores.
 - b. Apply lube to inside diameter of **new** seals and wipers.

CAUTION

Damaged piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

- 2. See Figure 2-55. Install a **new** square seal (2) and a **new** wiper (3) into each piston bore.
- Carefully insert pistons (4) by hand into bores of inside and outside caliper housings (1, 8). If resistance is felt, remove piston and check that seal and wiper are properly installed.
- Assemble caliper housings.
 - a. If removed, install bleeder valve (12) on outside caliper housing (8). Tighten bleeder valve to 9-11 Nm (80-100 in-lbs).
 - b. Place outside caliper housing (8) on workbench with decal side down. Install anti-rattle clip (6) in channel with indent facing upwards.
 - c. Place two **new** crossover o-rings (5) into grooves on inside caliper housing (1).
 - d. Mate inside and outside caliper housings (1, 8) using three bridge bolts (11). Loosely install bridge bolts.
 - e. Check that anti-rattle clip is still seated between caliper housings.
 - f. Tighten bridge bolts to 38-52 Nm (28-38 ft-lbs).
 - g. If rubber bumper (13) on outside housing was removed, lubricate **new** part before installation.

WARNING

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

 See Figure 2-59. Insert **new** set of brake pads into caliper with friction material on pad facing opening for brake disc. Curved portion of pad must face upward when caliper is installed.

NOTE

Install pad with the two tabs on the backing plate on the inboard side of the rear caliper.

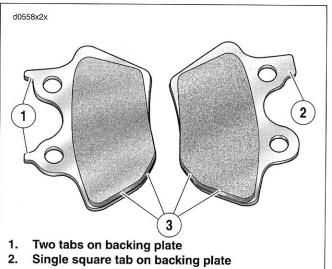
 See Figure 2-55. If necessary, Install new pad pins (10). Pad pins will give an audible click when inserted into inside housing. Tighten to 20-23 Nm (180-200 in-lbs).

NOTE

If pad pins do not fit, check the following:

- You are using a set of pads, not two identical pads.
- Anti-rattle clip orientation matches Figure 2-60.

Pads must be pushed tight against the anti-rattle clip before the pad pins can be installed.







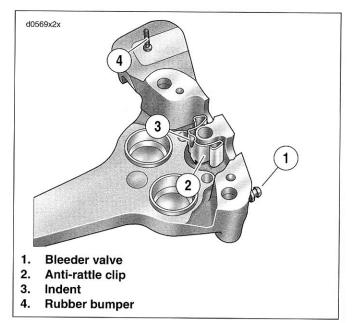


Figure 2-60. Anti-rattle Clip

 Place caliper on rear axle with notch inside rear fork weldment. Verify that rubber bumper is contacting underside of the caliper weldment for the full length of bumper. Install rear axle and check drive belt tension. See 2.23 REAR WHEEL.

CAUTION

To avoid leakage, verify that the washers, banjo bolt, brake line and caliper bore are completely clean.

 Lubricate new steel/rubber washers with D.O.T. 5 SILI-CONE BRAKE FLUID. Connect brake line to caliper using two new washers and banjo bolt. Tighten to 23-31 Nm (17-23 ft-lbs).

ACAUTION

Direct contact of D.O.T. 5 brake fluid with eyes may 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 may cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN.

 Remove radiator side cover to access master cylinder. See 2.19 REAR BRAKE MASTER CYLINDER/RESER-VOIR. Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 5 SILICONE BRAKE FLUID. Verify that fluid level is at the FILL LEVEL boss when the motorcycle is level.

AWARNING

Whenever brake calipers 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.

4. Bleed brake system. See 1.9 BLEEDING BRAKES.

WARNING

A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control which could result in death or serious injury.

- Verify proper operation of master cylinder relief port. Actuate brake pedal with cover removed. A slight spurt of fluid will break surface if all internal components are working properly.
- 6. Install gasket and cover on master cylinder. Tighten cover screws to 0.7-0.9 Nm (6-8 **in-lbs**).
- 7. Install radiator side cover.
- 8. Install right saddlebag if necessary.

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. Test brake system.
 - a. Turn ignition switch ON. Pump brake foot pedal to verify operation of brake lamp.
 - b. Test ride motorcycle. If brakes feel spongy, bleed the system again. 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.

HANDLEBARS

REMOVAL

- 1. Remove right side cover and maxi-fuse.
- 2. Remove rear view mirrors and turn signals.
- 3. Remove throttle cables from throttle control. See 2.12 THROTTLE CABLES.
- Remove front brake master cylinder/reservoir, turn signal assembly, and throttle control from right handlebar. See 2.17 FRONT BRAKE MASTER CYLINDER/RESER-VOIR.
- 5. Cut clip holding wiring harness to right handlebar.
- Remove clutch master cylinder/reservoir, turn signal assembly from left handlebar. See 2.13 CLUTCH MAS-TER CYLINDER/RESERVOIR.
- 7. Cut clip holding wiring harness to left handlebar.
- See Figure 2-61. To free lower end of top handlebar cover, loosen mounting bolts (3) holding headlamp bracket (2) to upper triple clamp (1).
- See Figure 2-62. Without removing cover, remove fasteners (7) holding top handlebar cover (2) and instrument bezel (1) to lower handlebar cover (6).

CAUTION

See Figure 2-62. Snap and hook at bottom of bezel holding top cover to lower handlebar cover can be damaged if forced during removal or installation.

10. From headlamp bracket end of cover, gently tilt top handlebar cover (2) and instrument bezel (1) up and back to remove cover and bezel.

NOTE

Bezel can remain snapped to upper handlebar cover.

- Remove wiring harness connector to instrument cluster (9) and remove instrument cluster.
- 12. Remove fasteners (7) holding lower handlebar cover (6) to handlebars (8).
- 13. If necessary, remove the handgrip (10).
- 14. Remove fasteners (5) holding handlebars to upper triple clamp (4). Remove handlebars.

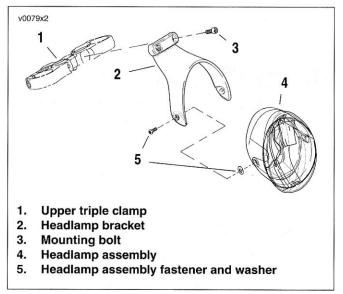
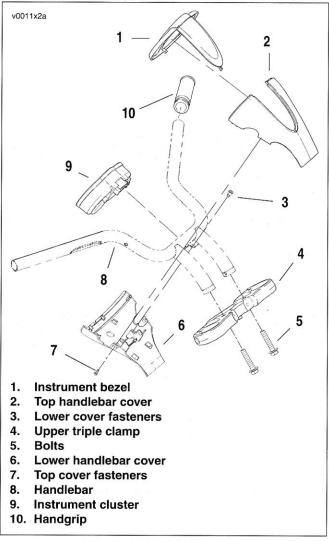


Figure 2-61. Headlamp Bracket and Headlamp Assembly



- See Figure 2-62. Mount handlebars (8) on upper triple clamp (4). Tighten handlebar fasteners (5) to 41-47 Nm (31-35 ft-lbs).
- Mount lower handlebar cover (6) to handlebar (8). Tighten fasteners (3) to 6-10 Nm (53-88 in-lbs).
- 3. Mount instrument cluster (9). Connect wiring harness to instrument cluster.

CAUTION

Snap holding bottom of bezel and top cover to lower handlebar cover can be damaged if forced during removal or installation.

- Orient instrument bezel and fit bezel hook over tab on lower handlebar cover. Gently tilt bezel (1) and top handlebar cover (2) until bezel hook snaps onto tab.
- 5. Fit top cover (2) under headlamp bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
- Install fasteners (7) that hold top handlebar cover (2), instrument bezel (1), and capture instrument cluster (9). Tighten fasteners to 1.3-1.9 Nm (12-16 in-lbs).
- See Figure 2-61. Tighten headlamp bracket (2) fasteners
 (3) to 11-18 Nm (9-13 ft-lbs).
- 8. Install left handgrip.
- Install left turn signal assembly, front brake master cylinder/reservoir, and brake hand lever, and throttle control handgrip. See 2.17 FRONT BRAKE MASTER CYLIN-DER/RESERVOIR.
- 10. Install a **new** clip to hold the wiring harness to the left handlebar.
- 11. Install throttle cable to throttle control handgrip. See 2.12 THROTTLE CABLES.
- Install right turn signal assembly, clutch master cylinder/ reservoir, and clutch hand lever assembly. See 2.13 CLUTCH MASTER CYLINDER/RESERVOIR.
- 13. Install a **new** clip to hold wiring harness to the right handlebar.
- 14. Install rear view mirrors and turn signals.
- 15. Install maxi-fuse and right side cover.

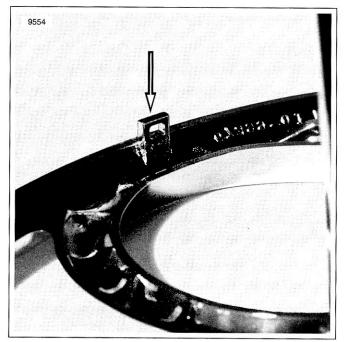


Figure 2-63. Bezel Hook

FRONT WHEEL

GENERAL

Maximum tire mileage and good handling qualities are directly related to wheel and tire care. Wheels and tires should be inspected regularly for wear. If handling problems occur, check 1.27 TROUBLESHOOTING for possible causes.

Preliminary Inspection - Brake Discs

- 1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
- If warped, replace disc. Maximum allowable lateral runout of a spring washer mounted brake disc is 0.3 mm (0.012 in.).
- 3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

- 1. Block motorcycle underneath frame so front wheel is raised off the ground.
- 2. Inspect tire for wear and wear pattern. Replace tire as necessary.
- 3. Inspect air valve. Replace as necessary.
- 4. Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.24 SEALED WHEEL BEARINGS.

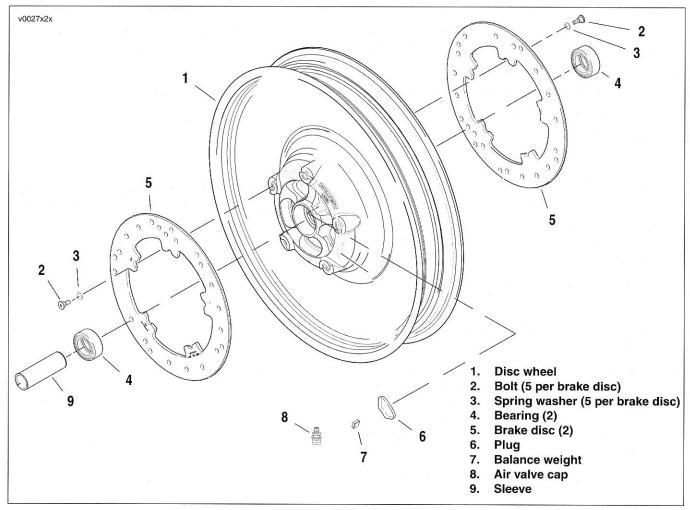


Figure 2-64. Front Wheel Components

REMOVAL

1. Block motorcycle underneath frame so front wheel is off the ground.

WARNING

To protect against shock and accidental start-up of vehicle, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

- 2. Remove right side cover and maxi-fuse.
- See Figure 2-65. Remove both upper and lower mount-3. ing bolts to remove brake caliper assembly.
- 4. Support calipers using a rubber bungee cord. Be careful not to scratch fender or fork slider finish.
- 5. Repeat to remove opposite caliper.

NOTE

Do not operate front brake lever with the front wheel removed or the caliper piston may be forced out of piston bore. Reseating the piston requires disassembly of the caliper.

- 6. See Figure 2-66. Loosen pinch bolts (2) in right side axle holder (4).
- 7. Insert screwdriver or steel rod through hole in axle (1) on right side. While holding axle stationary, remove axle nut (5).
- 8. Pull axle out while retaining the left and right wheel spacers (3).
- 9. Remove wheel assembly from forks.

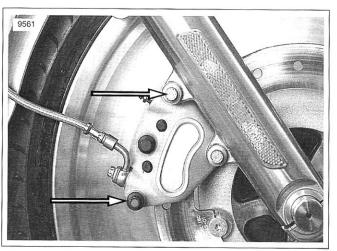
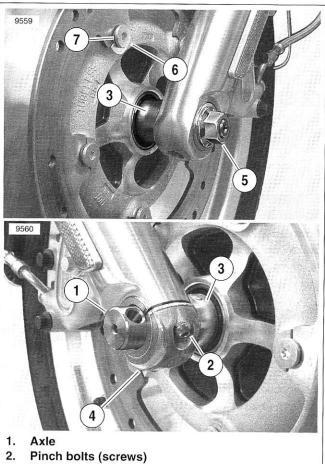


Figure 2-65. Caliper Mounting Bolts



- Left and right wheel spacer 3.
- 4. Axle holder (right side only)
- 5. Axle nut
- 6. Bolt
- 7. Spring washer

Figure 2-66. Front Wheel Mounting

DISASSEMBLY

ASSEMBLY

NOTE

See 2.26 TIRES to service tire or valve stem assembly.

- 1. Remove spacers from left and right sides.
- If tire replacement is necessary, remove tire and valve stem. See 2.26 TIRES.
- If wheel bearing replacement is necessary, remove the sleeve and press out the sealed wheel bearings. See 2.24 SEALED WHEEL BEARINGS.
- If it is necessary to remove brake discs and if wheel is to be assembled with same discs, mark both wheel and discs, so they can be installed in their original locations.
- See Figure 2-64. If removing brake discs (5), remove five bolts (2) and spring washers (3) securing brake disc to the wheel (1). Repeat procedure to remove disc on opposite side of wheel. Discard bolts and spring washers.

CLEANING AND INSPECTION

- 1. Thoroughly clean all parts in solvent.
- 2. Inspect all parts for damage or excessive wear.

WARNING

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

- Inspect brake discs. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc. Also replace discs if warped or badly scored. See 1.10 BRAKE PADS AND DISCS.
- 4. Inspect brake pads. Minimum brake pad thickness is 1.6 mm (0.06 in.). See 1.10 BRAKE PADS AND DISCS.

WARNING

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

NOTE

Always install first of two bearings on the side opposite the valve stem side of the wheel.

 If sealed wheel bearings must be serviced, always replace bearings as a complete set. See 2.24 SEALED WHEEL BEARINGS.

WARNING

Do not exceed the maximum tire pressure listed on the sidewall. Incorrect tire pressure could lead to premature tire failure and possible death or serious injury.

- 2. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.26 TIRES.
- Verify that wheel and tire are true. See 2.26 TIRES and 2.25 DISC RIM RUNOUT.

WARNING

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

- 4. See Figure 2-64. If necessary, install brake discs in their original positions. Verify that brake disc is clean.
 - a. On left side of wheel, install five **new** bolts (2) and five **new** spring washers (3) to attach left brake disc.
 Tighten bolts to 21-31 Nm (16-23 ft-lbs).
 - b. On right side of wheel, install five **new** bolts (2) and five **new** spring washers (3 to attach right brake disc. Tighten bolts to 21-31 Nm (16-23 ft-lbs).
- After wheel is balanced, apply a coat of LOCTITE[®] ANTI-SEIZE LUBRICANT to entire surface of right side bearing race.

- 1. Apply a light coat of LOCTITE® ANTI-SEIZE LUBRI-CANT to the axle.
- 2. See Figure 2-67. Place wheel and spacers into front fork and install axle (5). Verify that axle spacers on right and left side are properly installed.
- 3. Thread on the axle nut. Insert drill bit, screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 68-75 Nm (50-55 ft-lbs).
- Insert 7/16" drill bit (4) into hole in axle (5). 4.
- 5. Pull fork leg so that it just contacts the drill bit, screwdriver or steel rod and then tighten axle holder pinch bolts (3) to 16 Nm (12 ft-lbs). Ensure that gap between the axle holder (3) and the fork slider (1) is equal at front and rear of axle holder.
- 6. Remove drill bit, screwdriver or steel rod from axle hole.

WARNING

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

- Install the brake caliper to the fork legs.
 - a. Loosely install long mounting bolt into top hole on fork leg.
 - b. Install short mounting bolt into bottom hole on fork leg. Tighten bottom mounting bolt to 38-52 Nm (28-38 ft-lbs).
 - c. Final tighten top mounting bolt to 38-52 Nm (28-38 ft-lbs).
- Repeat steps 6-7 to install brake caliper on other side of 8. wheel.

WARNING

Whenever a wheel is 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.

Always test motorcycle brakes at low speed after completing repairs or bleeding the system. Failure to do so could result in death or serious injury.

- 968 3 1. Fork slider Axle holder pinch bolt
 - 2.
 - 3. Axle holder
- 4. Drill bit, screwdriver or steel rod
- 5. Axle

Figure 2-67. Aligning Fork to Wheel

10. Replace maxi-fuse and right side cover.

GENERAL

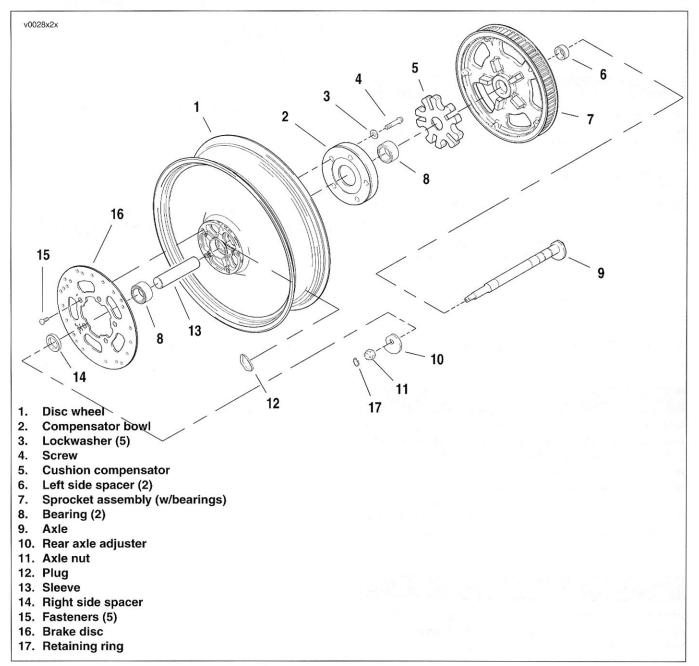
Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. Wheels and tires should be inspected regularly for wear. If handling problems occur, check 1.27 TROUBLESHOOTING for possible causes.

Preliminary Inspection - Brake Disc

- 1. Measure brake disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
- 2. Replace disc if warped. Maximum allowable runout of a rear brake disc is 0.3 mm (0.012 in.).
- 3. If scored, replace disc.

Preliminary Inspection - Wheel/Tire

- 1. Block motorcycle underneath frame so front wheel is raised off the ground.
- 2. Inspect tire for wear and wear pattern. Remove wheel assembly and replace tire as necessary. See 2.26 TIRES.
- 3. Inspect air valve. Replace as necessary.
- Inspect wheel bearing end play and service bearings if necessary. If end play is 0.051 mm (0.002 in.) or more, replace the wheel bearings. See 2.24 SEALED WHEEL BEARINGS.



REMOVAL

1. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.

NOTE

A scissors style jack will allow you to raise or lower the motorcycle at different points throughout the procedure to provide both clearance and alignment during removal and installation.

- 2. Remove right side cover and maxi-fuse.
- 3. See Figure 2-69. Remove fasteners holding lower debris deflector (4) to rear fork. Remove debris deflector.
- 4. If necessary, remove fasteners holding belt guard (1) to rear fork. Back lower shock bolt (2) out until belt quard is free and remove belt guard. Shock bolt retaining threads are integral to belt guard. Leave shock bolt in place to maintain alignment.
- 5. See Figure 2-70. Remove snap ring (2), axle nut (1) and adjuster (3) from right side of axle.
- 6. Relieve belt tension by rotating axle adjusters.

CAUTION

Support rear tire from underneath during removal. Failure to support rear tire may cause damage to the motorcycle as the axle is removed.

- Tap axle towards left side until rear brake caliper is free. 7.
- 8. See Figure 2-71. Slide rear caliper up off of brake disc towards front of motorcycle. Using a bungee cord, secure caliper to right side shock. Be sure rubber bumper stays with caliper.
- 9. Remove axle. Identify and set aside right and left spacers, right side axle adjuster, axle nut, and snap ring.

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.

10. Move wheel forward and slip belt off sprocket. Adjust height of the scissors jack to allow removing wheel assembly without damaging components.

NOTE

Note the height of the license plate bracket. Pulling the rear wheel can break off the reflector brackets.

11. Pull wheel and drive belt sprocket assembly from rear fork.

NOTE

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

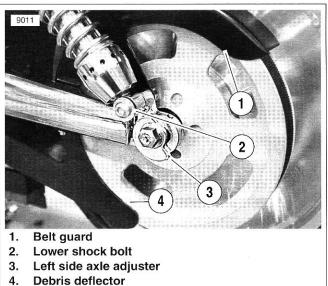


Figure 2-69. Rear Axle: Left Side

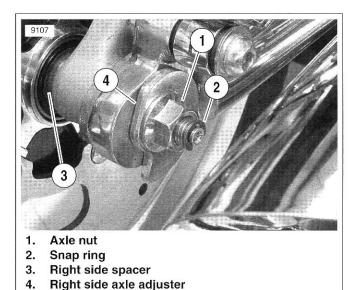


Figure 2-70. Rear Axle (right side)

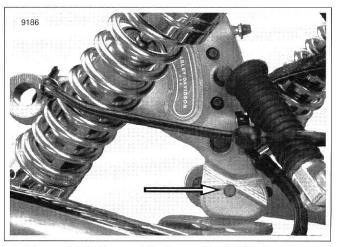


Figure 2-71. Secured Caliper with Rubber Bumper

DISASSEMBLY

- See Figure 2-72. Pull sprocket out of rubber compensator cushion (1) and compensator bowl (4) mounted to disc wheel.
- Pull compensator spacer (2) and compensator cushion
 (1) from compensator bowl (4) mounted to disc wheel.
- If tire replacement is necessary, remove tire and valve stem. See 2.26 TIRES.

NOTE

If drive sprocket bearing surface is rough or if bearing is leaking grease, replace bearing in CLEANING AND INSPEC-TION procedures.

- See Figure 2-68. If necessary, remove screws (4) and helical spring lockwashers (3) holding compensator bowl (2) to disc wheel (1). Remove compensator bowl (2).
- If necessary, remove fasteners (15) that hold brake disc (16) to disc wheel (1) and remove brake disc (16).

CLEANING AND INSPECTION

1. Clean all parts in solvent and inspect all parts for damage or excessive wear.

NOTE

The wheels are aluminum and do not have a protective coating. Damage from harsh chemicals, acid based wheel cleaners, brake dust and lack of maintenance can occur. Use HARLEY-DAVIDSON WHEEL & TIRE CLEANER (Part No. 94658-98) to clean the wheels and tires and then use HAR-LEY GLOSS (Part No. 94627-98) to protect the aluminum wheel surfaces.

- 2. Inspect rear belt. See 1.15 REAR BELT AND SPROCK-ETS.
- Inspect sprocket bearing. If bearing surface is rough or if bearing was leaking grease, replace sprocket bearing as follows:
 - a. Supporting hub inside compensator dogs. use a suitable drift to press bearing out of sprocket hub.
 - b. Lubricate the bearing bore in the sprocket hub.
 - c. Supporting hub from cosmetic side in such a manner as to not damage machined surface, use a suitable drift to press in a **new** bearing. To avoid damaging bearing, drift should press on outside race of bearing.
- Inspect compensator cushion for missing chunks or excessive debris beyond normal wear marks. Replace if necessary.
- Inspect brake disc. Replace disc if warped or badly scored. Measure disc thickness for excessive wear. Minimum acceptable thickness is stamped on side of disc.
- 6. If sealed wheel bearings must be serviced, see 2.24 SEALED WHEEL BEARINGS

WARNING

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

 Inspect brake pads, calipers, and brake lines. Replace pads and service calipers and brake lines as required. See 1.10 BRAKE PADS AND DISCS.

ASSEMBLY

- 1. If necessary, mount tire, valve stem and balance wheel assembly as required. See 2.26 TIRES.
- 2. Install brake disc, if removed, on valve stem side of wheel.
 - a. Apply a drop of LOCTITE[®] 243 (blue) to the five bolts that hold on rear brake disc.
 - b. Thread in and alternately tighten to 41-53 Nm (30-38 ft-lbs).
- Install compensator bowl. Thread in screws and helical spring lockwashers. Tighten to 61-75 Nm (45-55 ft-lbs).
- 4. Verify that wheel and tire are true and balanced. See 2.25 DISC RIM RUNOUT and 2.26 TIRES.
- 5. After wheel is balanced, apply LOCTITE[®] ANTI-SEIZE LUBRICANT to entire surface of left side (compensator bowl) bearing race only.
- See Figure 2-72. Lubricate compensator cushion (1) with a detergent spray like Windex[™] and install compensator cushion. Be sure the PULLEY SIDE legend (3) is facing out.
- 7. Install the compensation spacer (2) with the grooved end in the cushion (1).
- 8. Insert sprocket dogs into compensator cushion to mate sprocket to rear wheel.

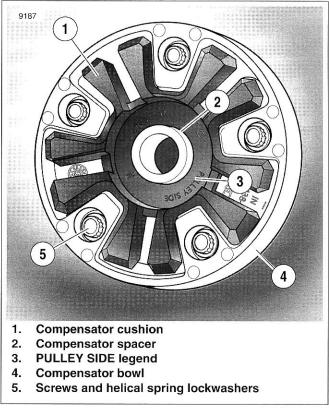


Figure 2-72. Compensator Cushion in Compensator Bowl

- 1. Install wheel into rear fork.
- 2. Slide drive belt over drive sprocket.
- Slide brake calipers over front brake disc between brake pads. Lubricate rubber bumper with a detergent spray and slide slot in the caliper over brake anchor weldment on rear fork. Be sure rubber bumper is in place under weldment.
- 4. Coat axle with LOCTITE[®] ANTI-SEIZE LUBRICANT and install.
 - From left side, carefully insert axle through rear fork, left side spacer, drive sprocket, compensator cushion, into wheel assembly.
 - b. Continue sliding axle through wheel assembly hub sleeve, right side spacer, brake caliper, and left rear fork. Center right side spacer on wheel bearing to allow axle to pass through. Axle is fully installed when left side cam is tight against rear fork.
 - c. Slip on right side axle adjuster. Right side axle adjuster will only fit in a manner that matches position of left side eccentric.
 - Coat flange of axle nut with LOCTITE[®] ANTI-SEIZE LUBRICANT and thread on and finger tighten axle nut.

WARNING

Whenever a wheel is 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.

- 5. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
- 6. Verify axle alignment and then check belt deflection. See 1.14 REAR BELT DEFLECTION.
- 7. 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.

- 8. Tighten axle nut to 129-142 Nm (95-105 ft-lbs).
- 9. Install snap ring.
- 10. If belt guard was removed, slide belt guard slots onto rubber grommets. Thread shock mount bolt into belt guard and tighten shock mount bolt to 41-68 Nm (30-50 ft-lbs).
- Slide debris deflector slots on to its corresponding rubber grommet. Install debris deflector bolt and tighten bolt to 6-10 Nm (53-88 in-lbs).
- 12. Measure belt guard to drive sprocket clearance.
- 13. If clearance is less than 5 mm (0.197 in.), protect guard/ sprocket and adjust as required.
- 14. Replace maxi-fuse and right side cover.

Inspection for lateral end play, removal, and installation procedures for sealed wheel bearings are the same for both the front wheel and the rear wheel.

INSPECTION - LATERAL END PLAY

- 1. Block motorcycle underneath frame so wheel is raised off ground.
- 2. See Figure 2-73. Mount a magnetic base dial indicator to brake disc with dial's contact point on end of axle.
- 3. To check for lateral end play, turn wheel through several rotations, then move wheel side to side.
 - a. If end play is less than service wear limit of 0.051 mm (0.02 in.), bearing passes inspection.
 - b. If end play exceeds service wear limit or feels rough, remove wheel and replace both wheel bearings.

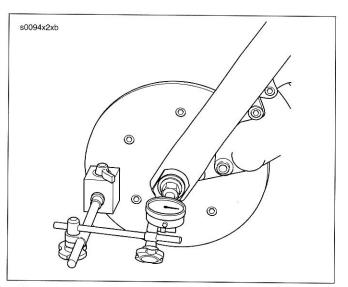
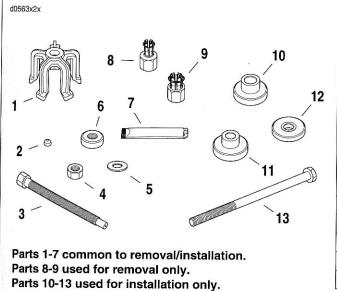


Figure 2-73. Measuring Lateral End Play (Front Wheel)



NO.	DESCRIPTION	PART NO.
1	Bridge	HD-44060-5
2	Steel ball	12547
3	Forcing screw	HD-44060-4
4	Nut	10210
5	Washer	12004
6	Nice bearing	RS25100-200
7	Lubricant	J-23444A
8	Collet, 3/4 in.	HD-44060-3
9	Collet, 1.0 in.	HD-44060-7
10	Pilot, 1.0 in.	HD-44060-8
11	Pilot, 3/4 in.	HD-44060-6
12	Support plate	HD-44060-1
13	Threaded rod	280856

Figure 2-74. HD-44060 Wheel Bearing Tools

REMOVAL

PART NO.	SPECIALTY TOOL
HD-44060	Wheel bearing installer/remover

- 1. Remove wheel. See 2.23 REAR WHEEL and 2.22 FRONT WHEEL.
- See Figure 2-75. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing removal.
 - a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
 - b. Install nut (2), washer (3) and Nice bearing (4) on screw. Insert assembly through hole in bridge (6).
 - c. Drop ball bearing inside collet (5). Fasten collet and ball bearing to forcing screw (1).
- 3. Hold end of forcing screw (1) and turn collet (5) to expand edges of collet.
- See Figure 2-76. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn nut (2) to remove bearing from wheel.
- 5. Remove spacer from inside wheel hub.
- 6. Repeat procedure for opposite side bearing. Discard all bearings upon removal.

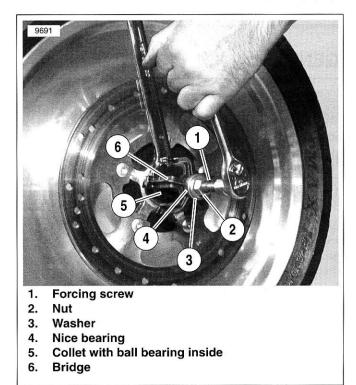


Figure 2-75. Gripping Bearing

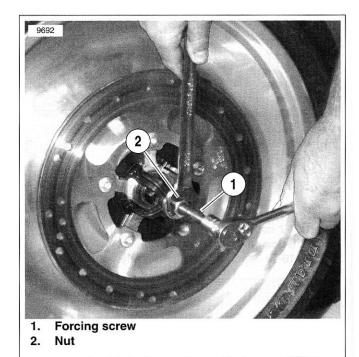


Figure 2-76. Removing Bearing

PART NO.	SPECIALTY TOOL
HD-44060	Wheel bearing installer/remover

NOTE

On a front wheel, install bearing on the left side first. On a rear wheel, install bearing on the brake disc or right side first.

- Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble tools required for bearing installation.
 - a. Sparingly apply graphite lubricant to threads of a draw down bolt or a suitable threaded rod with double locking nuts to prolong service life and ensure smooth operation.
 - b. See Figure 2-77. Place threaded rod (1) through support plate (2).
 - c. Insert assembly through wheel.
 - d. Place the **new** bearing on threaded rod (1) with lettered side outward.
 - e. Install pilot (6), Nice bearing (5), washer (4) and nut(3) over rod.
- Hold hex end of threaded rod (1) and turn nut (3) to install bearing. Bearing will be fully seated when nut can no longer be turned. Remove tool.
- 3. Install spacer sleeve inside wheel hub.
- 4. Reverse tool and install opposite side bearing.

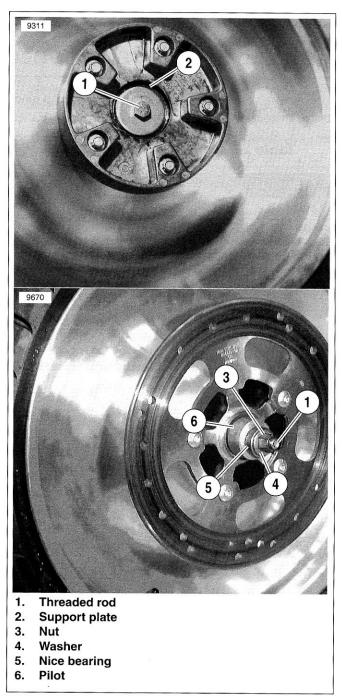


Figure 2-77. Installing Wheel Bearing

DISC RIM RUNOUT

GENERAL

Disc wheels should be checked for lateral and radial runout before installing a new tire or tube.

Table 2-7. Rim Runout Maximums

RUNOUT	ММ	IN
Lateral	1.02	0.040
Radial	0.76	0.030

LATERAL RUNOUT

See Figure 2-78. Install arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-95599-80). To check rim lateral runout, place a gauge rod or dial indicator near rim bead. Spin wheel. If lateral runout exceeds 1.02 mm (0.040 in.), replace wheel.

PART NO.	SPECIALTY TOOL	
HD-95599-80	Wheel truing stand	Ł

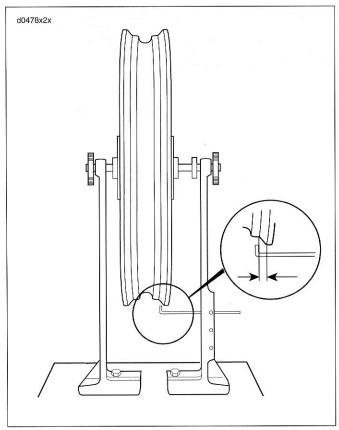


Figure 2-78. Rim Lateral Runout

RADIAL RUNOUT

See Figure 2-79. Spin wheel to check for radial runout. Replace wheel if rim radial runout exceeds 0.76 mm (0.030 in.).

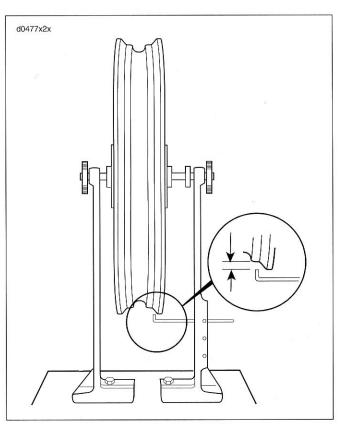


Figure 2-79. Rim Radial Runout

TIRES

GENERAL

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

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

WARNING

Harley-Davidson recommends replacement of any tire punctured or damaged. In some cases small punctures in the tread area may be repaired from within the dismounted tire by your Harley-Davidson dealer. Speed should not exceed 80 km/h (50 mph) for the first 24 hours after repair and the repaired tire should NEVER be used over 130 km/h (80 mph). In emergency situations, if a temporary repair is made, ride slowly with as light a load as possible until the tire is permanently repaired or replaced. Failure to heed this warning could result in death or serious injury.

Tubeless tires may be repaired in the tread area only if the puncture is 6.4 mm (1/4 in.) or smaller. All repairs must be made from inside the tire.

Acceptable repair methods include a patch and plug combination, chemical or hot vulcanizing patches or head-type plugs. When repairing tires, use TIRE SPREADER (Part No. HD-21000) to spread the tire sidewalls.

WARNING

Never repair a tire with less than 1.6 mm (1/16 in.) tread depth. Inadequate tread depth can cause an accident which could result in death or serious injury.

WARNING

Always check both tire sidewalls for arrows indicating proper forward tire rotation. Some tires require different tire rotation depending on whether tire is used on front or rear wheel. Improper mounting can result in premature tire failure and handling problems, which may cause an accident which could result in death or serious injury.

DEMOUNTNG TIRES

- 1. Remove wheel from motorcycle. See 2.22 FRONT WHEEL, and/or 2.23 REAR WHEEL. Remove drive sprocket from a rear wheel.
- 2. Deflate tire. Use a valve core tool to remove valve core from valve stem.

WARNING

Read the operating manual for the manufacturer and model of tire machine used. Failure to follow operational procedures or to heed any cautions/warnings in the manual for the tire machine could result in death or serious injury.

 See Figure 2-80. Use a pneumatic bead breaker to loosen bead. Rotate wheel and apply bead breaker at several points along circumference of the rim until entire bead drops into rim well.

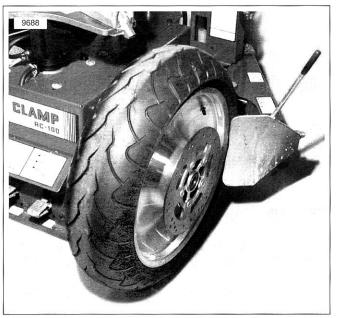


Figure 2-80. Pneumatic Bead Breaker

- 4. Install wheel onto jaws of tire machine. Lubricate tire bead with soap solution.
- 5. Fit wedge over rim of wheel.
- See Figure 2-81. Pull bead up over rim in one spot and fit bead to wedge. Spin wheel to draw full length of bead over rim and off wheel. Do not use excessive force when starting bead over rim.



Figure 2-81. Tire Machine Pulling Bead Off Rim

CAUTION

Follow the tire machine manufacture's recommendation for the correct placement of the bead on the mandrel. Incorrect mounting may damage the bead and ruin the tire.

7. If necessary, repeat for opposite bead and remove tire from wheel.

CLEANING AND INSPECTION

- 1. Clean inside of rim. If rim is dirty or corroded, clean with a stiff wire brush.
- Wheels should be checked for lateral and radial runout before installing a new tire or tube. See 2.25 DISC RIM RUNOUT.
- 3. Inspect tire for wear. Measure tread depth.

PART NO.	SPECIALTY TOOL
HD-21000	Tire spreader

4. Use TIRE SPREADER (HD-21000) and inspect inside of tire for wear and damage.

TIRE REPLACEMENT

See Figure 82. Tire wear indicator bars will appear on tire tread surfaces when 1/32 inch (0.8 mm) or less of tire tread remains. Arrows on tire sidewalls pinpoint location of wear bar indicators. Always remove tires from service before they reach the tread wear indicator bars (1/32 of an inch/0.8 mm tread pattern depth remaining).

New tires are needed if any of the following conditions exist.

- 1. Tire wear indicator bars become visible on the tread surfaces.
- 2. Tire cords or fabric become visible through cracked sidewalls, snags or deep cuts.
- 3. A bump, bulge or split in the tire.
- 4. Puncture, cut or other damage to the tire that cannot be repaired.

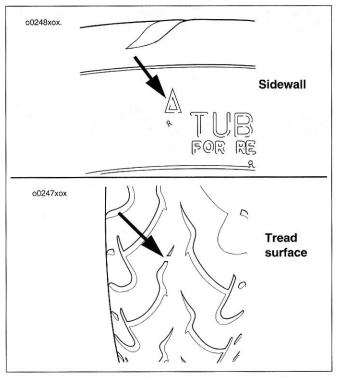


Figure 82. Tread Wear Indicators for VRSCA

MOUNTING TIRES

WARNING

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

WARNING

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

WARNING

Damaged or leaking valves must be replaced.

NOTE

New radial tires are extremely stiff and tires stored near the bottom of a tire stack may take a compressed set.

NOTE

Warm radial tires mount easier than cold tires. Prior to mounting, store new tire in a warm area and/or in sun light. Tire temperature should not exceed 48° C (120° F).

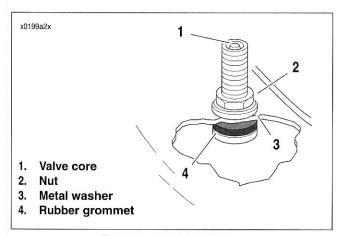


Figure 2-83. Valve Stem

See Figure 2-83. Replace damaged or leaking valve stems.

NOTE

Leaving the valve core out of the valve stem will allow a sufficient volume of air to inflate the radial tire to seat the beads on the rim.

- a. Insert valve stem with rubber grommet (4) in place into rim hole.
- b. Install metal washer (3) over valve stem.
- c. Install nut (2). Tighten to 1.4-1.7 Nm (12-15 in-lbs).

2. Thoroughly lubricate bead on both sides of tire with a rubber lubricant. Lubricate inside diameter of bead and side wall. Lubricate rim flanges and safety hump on wheel.

WARNING

Read the operating manual for the manufacturer and model of tire machine used. Failure to follow operational procedures or to heed any cautions/warnings in the manual for the brand/model of tire machine could result in death or serious injury.

3. With rim installed in pneumatic tire machine jaws, orient tire with rotational arrow pointing in direction of forward rotation. Push one side off bottom bead into rim well and walk the bottom bead around until it is completely in the rim well.

NOTE

The tire has a colored dot on sidewall, it is a balance mark and should be located next to valve stem hole.

- 4. Position yellow dot at valve stem and starting 180 degrees opposite valve stem, mount top bead to shoe of pneumatic tire machine.
- 5. Rotate wheel to pull bead into rim well. Remove wheel from tire machine.

WARNING

Do not exceed more than the tire manufacturer's recommended pressure to seat the beads. Inflating the tire more than the manufacturer's recommended pressure to seat the beads can cause the tire rim assembly to burst with sufficient force which could result in death or serious injury.

- 6. Center tire to wheel and inflate tire to trial seat bead on the rim. Identify any spot around rim where bead does not seat correctly before deflating the tire.
- While inflating a second time, press down on sidewall opposite spot where bead did not seat during first inflation.
- Continue to deflate and inflate tire while by pressing on side of tire opposite any spot on tire where bead is not seating. Continue procedure until tire is centered all the way around rim.
- 9. Install a **new** valve core and adjust air pressure as required to match recommended pressures. See 1.11 TIRES AND WHEELS.
- 10. Check tire for both radial and lateral runout. See TIRE RUNOUT in 2.26 TIRES.
- 11. Balance tire as required. See 2.26 TIRES.
- 12. Clean wheel and rim of any rubber lubricant or soap used in mounting tire.

NOTE

Lubricants or detergents can cause corrosion on the motorcycle's wheel if not removed immediately after mounting and balancing a tire.

TIRE RUNOUT

Mounted tires should be checked for both lateral and radial tire runout.

Table 2-8. Tire Runout Maxir	mums
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RUNOUT	ММ	IN
Lateral	2.29	0.090
Radial	2.03	0.080

Lateral Runout

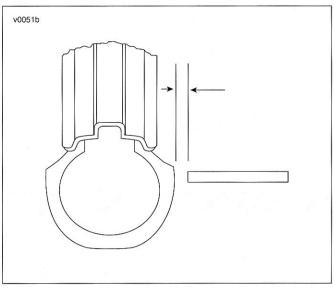


Figure 2-84. Lateral Tire Runout

1. See Figure 2-84. Check tire runout by turning wheel on axle, measuring tire lateral runout.

NOTE

Be sure bead is properly seated on rim. Deflate and reseat tire if necessary.

- Maximum tire lateral runout is 1.52 mm (0.060 in.). If tire tread runout exceeds 1.52 mm (0.060 in.), remove tire from rim and check wheel rim lateral runout to see if rim is at fault. See 2.25 DISC RIM RUNOUT.
- 3. If rim lateral runout is less than 0.76 mm (0.030 in.), tire is at fault and should be replaced. If rim lateral runout is more than 0.76 mm (0.030 in.), correct by replacing disc wheel.

Radial Runout

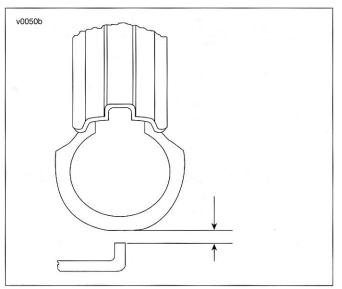


Figure 2-85. Radial Tire Runout

1. See Figure 2-85. With a tire centered and mounted on the rim, check runout by turning wheel on axle, measuring amount of radial displacement from a fixed point near the tire.

NOTE

Make sure bead is properly seated on rim. Deflate and reseat tire if necessary.

- Maximum tire tread runout is 2.29 mm (0.090 in.). If tire tread runout exceeds 2.29 mm (0.090 in.), remove tire from rim and check rim radial runout to see if rim is at fault. See 2.25 DISC RIM RUNOUT.
- 3. If rim radial runout is less than 0.76 mm (0.030 in.), tire is at fault and should be replaced. If rim radial runout is more than 0.76 mm (0.030 in.), correct by replacing wheel.

WHEEL BALANCING

Wheels must be balanced to improve handling and reduce vibration, especially at high road speeds.

PART NO.	SPECIALTY TOOL
HD-95599-80	Wheel truing stand

Static balancing using WHEEL TRUING STAND (HD-95599-80) will produce satisfactory results.

Dynamic balancing, utilizing a wheel spinner, should be used to produce finer tolerances for best high speed handling characteristics. Follow the instructions supplied with the balance machine you are using.

Cast aluminum wheels require the special self adhesive balance weights listed below.

Table 2-9. Balance Weights

COLOR	GRAMS	OZ.
Silver (HD-95595-84)	7	0.25
Black (HD-95594-84)	7	0.25

 Use a balancing machine to determine amount of balance weight required to bring wheel within 7 g (0.25 oz.) at 97 km/h (60 mph).

NOTES

- The maximum weight permissible to accomplish balance is 99 g (3.5 oz.) total weight applied on the rim.
- Self adhesive wheel weights should be applied to the flat surface of the rim in increments of 7 g (0.25 oz.).
- If 28 g (1.0 oz.) or more weight must be added at one location, split the amount so that half is applied to each side of the rim.
- To apply self adhesive wheel weights, make sure that area of application is completely clean, dry, and free of oil and grease.
- Remove paper backing from weight and apply 3 drops of LOCTITE[®] SUPERBONDER 420 to the adhesive side of weight.
- 4. Place weight on rim, press firmly in place and hold for 10 seconds. Wheel should not be used for 8 hours to allow adhesive to cure completely.
- 5. Recheck balance. Repeat procedures as necessary.

REMOVAL

CAUTION

Be careful lifting fenders out of forks or you may scratch the paint. If necessary, cover fender with a clean shop rag to prevent damage.

- 1. See Figure 2-86. Remove fasteners (3) from front fork and remove fender and bracket.
- 2. Remove fasteners (1, 2) that hold bracket to fender and separate bracket and fender.

INSTALLATION

- 1. See Figure 2-86. Attach fender to fender bracket. Tighten fasteners (1, 2) to 4.1-6.8 Nm (36-60 **in-lbs**).
- 2. Position fender and bracket in front fork and secure with fasteners (3)/ Tighten to 20-26 Nm (15-19 ft-lbs).

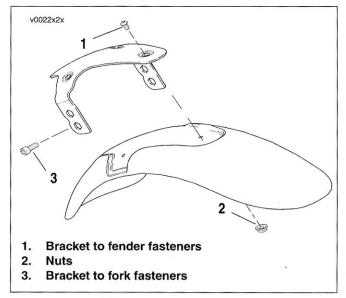


Figure 2-86. Front Fender

FRONT FORK

REMOVAL

- 1. Support motorcycle so front end is off floor and forks are fully extended.
- 2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 3. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 4. Remove negative battery cable.
- 5. Remove both front brake calipers. See 2.18 FRONT BRAKE CALIPERS.
- 6. Remove front wheel. See 2.22 FRONT WHEEL.
- 7. Remove front fender bracket with the front fender. See 2.27 FRONT FENDER.
- See Figure 2-90. On one side, first loosen pinch bolt (5) on top triple clamp (4).
- 9. Break loose but do not remove fork tube cap (17).
- 10. Loosen pinch bolts (5) on bottom triple clamp (14) and pull fork tube and slider assembly (10) from triple clamp.
- 11. Repeat procedure for opposite fork tube and slider assembly (10).

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder

- 1. See Figure 2-87. Clamp fork tube and slider assembly in FORK TUBE HOLDER (HD-41177) and mount in vise.
- See Figure 2-90. While internal components are still under tension and less prone to rotate, break loose but do not completely unthread seat pipe screw (35). On right fork tube and slider assembly, remove axle holder (36) to access seat pipe screw.

WARNING

The fork tube caps are under spring pressure. Always wear proper eye protection when removing fork tube caps. The spring can force parts from the tube unexpectedly, which could result in death or serious injury.

- 3. Remove fork tube cap (17) and o-ring (18).
- 4. Remove the long spring collar (21).
- Remove from FORK TUBE HOLDER and invert fork over a suitable container. Allow fork to drain. Extend and retract slider several times to push oil out of internal components. The washer (22), and spring (23) will fall out of fork tube.

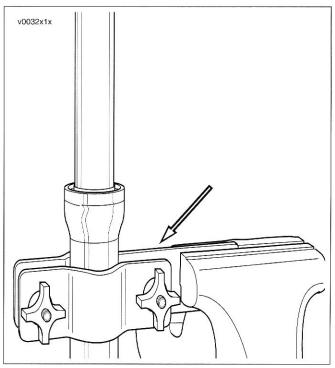


Figure 2-87. Fork Tube Holder (HD-41177) (mounted vertically to slider)

- Clamp fork tube in holder. Mount FORK TUBE HOLDER (HD-41177) horizontally in vise.
- 7. Remove slider cover (27) from slider by inserting brass drift into notch in slider and lightly tapping cover.
- 8. Compress stopper ring (29) and remove stopper ring from groove in top of slider bore.

AWARNING

The VRSCA models have a preloaded fork spring. The seat pipe is under spring pressure. Always wear proper eye protection when disassembling the fork tube and slider assembly. Disassemble the fork tube and slider assemblies carefully. The springs can force parts from the fork tube or slider unexpectedly, which could result in death or serious injury.

- Remove seat pipe screw (35) and washer (34) from bottom of slider (33). Retain the seat pipe screw and washer.
- 10. Withdraw slider (33) from fork tube (19) until bushing guide (32) contacts bushing (20) on fork tube. Busing guide (32) is a slight interference fit in slider.
- 11. Using the slider as a slide hammer, hit the bushing with the bushing guide with a quick continuous stroke until slider is pulled free of the fork tube.
- 12. Drain the slider and allow the stop oil lock piece (26) to fall free.

NOTE

If replacing the slider only, the components remaining in the fork tube can be left assembled and the fork re-assembled from ASSEMBLY procedures step 5.

- If still attached to seat pipe, remove stop oil lock piece (26) from the lower end of seat pipe.
- 14. Remove seat pipe (24) piston and ring assembly.
- 15. Remove rebound spring (23).
- 16. Remove oil seal (30), seal spacer (31), and bushing guide (32).
- 17. Repeat procedure for opposite fork tube and slider assembly (10).

CLEANING AND INSPECTION

- 1. Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be repaired or replaced.
- 2. Inspect fork tube bushing and slider guide bushing and replace as required.
- 3. Always replace oil seals and o-rings.
- Check dust cover where it rubs on fork tube. The dust cover should present a good continuous seal and not show excessive wear.
- Check the fork tube where it rubs on dust cover. The tube should show a bright, shining surface, free of scoring or abrasions.
- 6. If springs are broken, replace springs.
- 7. If a fork tube or slider is bent or damaged, replace it.
- Replace all other worn or damaged components as necessary.

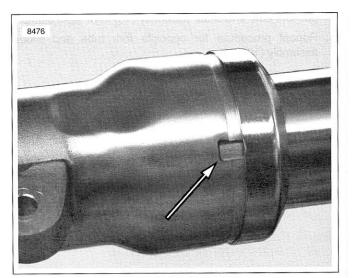


Figure 2-88. Notch in Slider

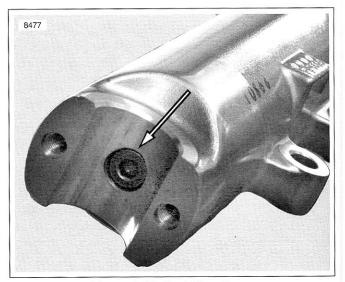
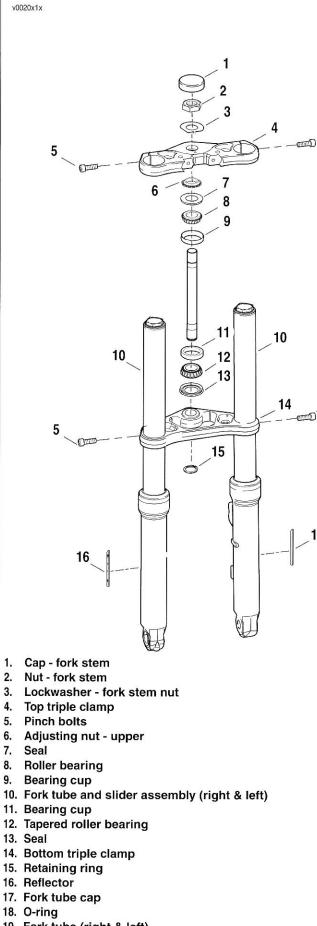
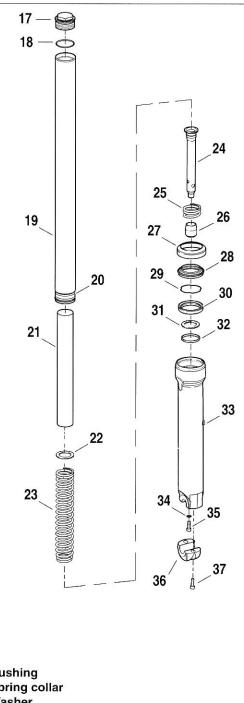


Figure 2-89. Seat Pipe Screw (right fork assembly)





19. Fork tube (right & left)

- 20. Bushing
- 21. Spring collar
- 22. Washer

5

5

16

- 23. Rebound spring
- 24. Seat pipe
- 25. Spring
- 26. Stop oil lock piece
- 27. Slider cover
- 28. Dust shield
- 29. Stopper ring
- 30. Oil seal
- 31. Seal spacer
- 32. Bushing guide
- 33. Slider
- 34. Washer
- 35. Seat pipe screw
- 36. Axle holder
- 37. Axle holder screw

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-41177	Fork tube holder
HD-45305	Fork seal driver
HD-59000A	Pro-level oil gauge

- 1. See Figure 2-90. Insert seat pipe and piston assembly (24) with the rebound spring (23) into fork tube (19).
- Slide bushing guide (32) down to bushing (20) on fork tube (19). Follow with spacer (31), oil seal (30), stopper ring (29), dust shield (28) and slider cover (27).
- 3. Install fork tube into FORK TUBE HOLDER (HD-41177) mounted horizontally in a vise.
- 4. Fit stop oil lock piece (26) onto seat pipe (24).
- 5. See Figure 2-91. Side seat pipe back into fork tube until seat pipe is centered in tube.
- See Figure 2-90. Gently install slider (33) onto fork tube (19) and bushing (20).
- 7. Thread seat pipe screw (35) and washer (34) into seat pipe (24) through bottom of slider (33). Draw fastener into seat pipe but do not torque.
- 8. Verify action of fork by sliding slider up and down fork tube.
- 9. Assemble the FORK SEAL DRIVER (Part No. HD-45305) over fork tube in front of oil seal.
- See Figure 2-92. Holding FORK SEAL DRIVER (4) together, tap oil seal (3), spacer (2) and bushing guide (1) into slider bore.

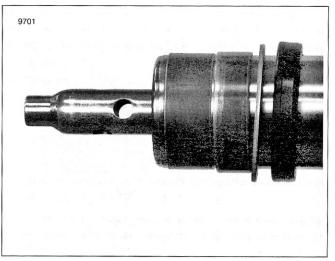
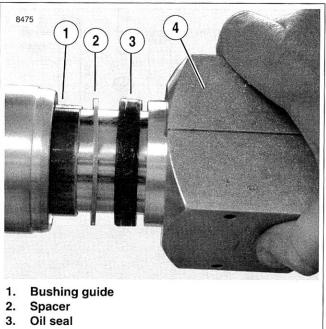


Figure 2-91. Seat Pipe Centered in Fork Tube



4. Fork seal driver

Figure 2-92. Assembled Fork Seal Driver

- 11. See Figure 2-90. Install stopper ring (29) into groove in top of oil seal.
- 12. Push dust shield (28) against oil seal and stopper ring
- 13. Rotate slider cover to match any removal burrs to notch in slider and snap slider cover (27) into place.
- Move slider through its full range of travel several times to verify alignment. Then, pulling down on slide to apply downward force on rebound spring (23), tighten seat pipe screw to 12-18 Nm (106-159 in-lbs).
- Re-position fork tube in FORK TUBE HOLDER (HD-41177) vertically. With slider tube compressed, fill the fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80) until it is approximately 85 mm (3.3 in.) from top of fork tube. See 1.18 FRONT FORK OIL.
- 16. Slowly pump slider 8 to 10 times to exhaust air from assembly. Fully compress slider to determine oil level.

NOTE

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

- 17. Using the PRO-LEVEL OIL GAUGE (HD-59000A), adjust the oil level to 85 mm (3.3 in.) from top of fork tube.
- 18. Pull out the slider (33) and install the rebound spring (23) in the fork tube with the tightly wound end at the bottom.
- 19. Install the washer (22) and spring collar (21).

WARNING

The fork tube caps are under spring pressure. Always wear proper eye protection when removing/installing fork tube caps. The spring can force parts from the tube unexpectedly, which could result in death or serious injury.

20. With a **new** o-ring, install and tighten fork tube caps to 22-58 Nm (16-43 ft-lbs).

NOTE

To prevent cross threading fork tube caps, use caution when threading in the caps with the spring compressed.

21. Repeat for opposite fork tube and slider assembly.

INSTALLATION

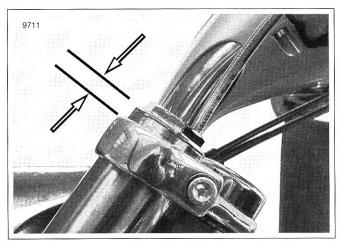


Figure 2-93. Fork Tube Projection (6.4-9.7 mm)

- See Figure 2-93. Insert fork tube and slider assemblies through lower triple clamp and upper triple clamp. fork tubes should project above upper triple clamp 6.4-9.7 mm (0.25-0.38 in.). Tighten pinch bolts to 41-47 Nm (31-34 ft-lbs).
- 2. Install front fender and bracket. See 2.27 FRONT FENDER.
- 3. Install front brake caliper hydraulic lines and install front brake calipers. See 2.18 FRONT BRAKE CALIPERS.
- 4. Install front wheel and align the wheel to the forks. See 2.22 FRONT WHEEL.
- 5. Adjust fall-away. See 1.17 STEERING HEAD BEAR-INGS.
- 6. Replace negative battery cable. Tighten to 6.8-10.8 Nm (60-96 **in-lbs**).
- 7. Replace airbox cover
- 8. Replace maxi-fuse and right side cover.

STEERING HEAD

REMOVAL

NOTE

If bearing races are removed, the bearings cannot be reused-they must be replaced. See CLEANING AND INSPECTION in 2.29 STEERING HEAD.

- Support motorcycle so front end is off floor and forks are 1. fully extended.
- 2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 3. Remove headlamp and headlamp bracket. See 2.21 HANDLEBARS.
- Remove both front brake calipers. See 2.18 FRONT 4. BRAKE CALIPERS.
- Remove front wheel. See 2.22 FRONT WHEEL. 5.
- 6 Remove front fender bracket with front fender. See 2.27 FRONT FENDER.
- 7. Loosen but do not remove fork tube caps.
- See Figure 2-94. Loosen pinch bolts (5) on top and bot-8. tom tripe clamps and pull fork tubes from triple clamps. See 2.28 FRONT FORK.
- 9 Remove brake hose bracket from the bottom of fork stem (10) and bracket.
- 10. Remove fork stem cap (1). Bend lockwasher (3) tab away from fork stem nut (2). Remove fork stem nut.
- 11. Lift handlebars from steering head with upper triple clamp (4) attached. Be careful not to pinch or kink control cables.
- 12. Remove adjusting nut (6), seal (7), and upper bearing (8) out of bearing race.
- 13. Pull fork stem (10) and lower triple clamp (14) from bottom of steering head.

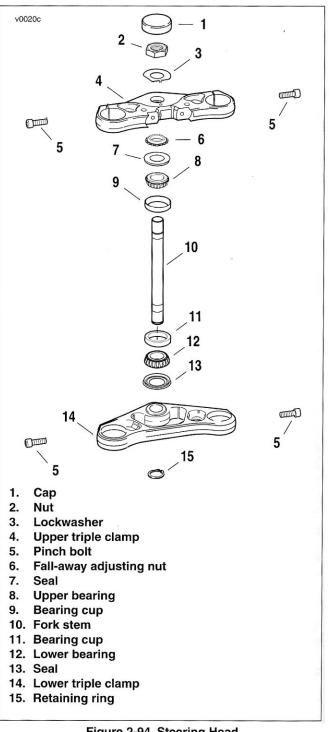


Figure 2-94. Steering Head

CLEANING AND INSPECTION

- Check upper and lower bearing races in steering head. If they are pitted or grooved, replace bearings and races in sets.
- 2. Check roughness of bearings by turning them in race. Replace bearings if they do not turn freely and smoothly.

CAUTION

Always replace both races and bearings even if one race and bearing appear to be good. Mismatched bearing components may lead to excessive wear and the need for premature bearing replacement.

Lower Fork Stem Bearing

PART NO.	SPECIALTY TOOL	
HD-95637-46A	Universal wedge attachment	

- See Figure 2-95. Assemble a bearing puller using a using a UNIVERSAL WEDGE ATTACHMENT (HD-95637-46A), two lengths of threaded rod, washers, nuts, a cross clamp or bridge, and a forcing screw and a washer or protective cap.
- 2. Turn forcing screw to remove bearings and seal from lower triple clamp.

Steering Head Bearing Race

PART NO. SPECIALTY TOOL	
HD-33416	Universal driver handle
HD-39301-A	Steering head bearing race remover

- See Figure 2-96. With the tapered side down, seat STEERING HEAD BEARING RACE REMOVER (HD-393201-A) on upper bearing race leaving a gap in middle and with lower lip of removers capturing bottom edge of bearing race.
- 2. Install collet on driver.
- 3. Insert UNIVERSAL DRIVER HANDLE (HD-33416) at bottom of steering head tube, and while holding remover tool on race, center collet in gap between remover halves. Tap driver to remove upper race.
- 4. Reverse tool and repeat procedure to remove lower bearing race.

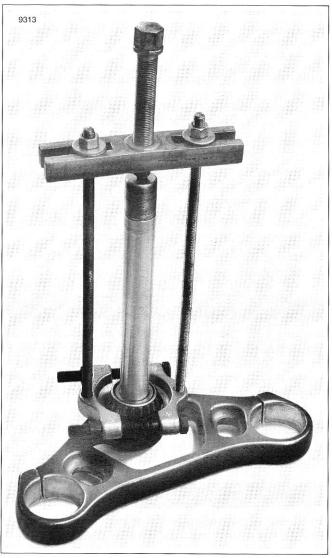


Figure 2-95. Bearing Puller Based on Universal Wedge Attachment

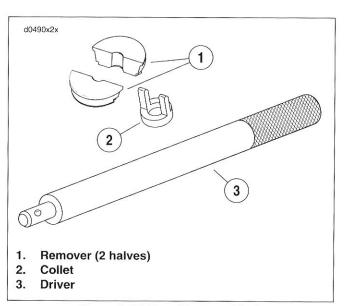


Figure 2-96. Race Remover Tools (HD-33416 and HD-39301-A)

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-39302	Steering head bearing race installer

- 1. Lubricate outside of **new** steering head bearing races with lubricant provided or engine oil.
- See Figure 2-97. Assemble STEERING HEAD BEAR-ING RACE INSTALLER (HD-39302) and bearing races on tool's draw down bolt through steering head. Orient races so lettered edges are at bottom of steering head bore in steering head.
- Continue to thread nut on draw down bolt until races fit, and are parallel to steering head bore.
- 4. Slowly tighten nut while stopping periodically to check for bearing race to steering head parallelism.

WARNING

Use care not to damage the new races' tapered surface. The race should be firmly seated against the shoulder in the bore. If it is loose, the steering head adjustment will become loose, adversely affecting the motorcycle's handling, which may lead to an accident which could result in death or serious injury.

 When bearing races are fully seated in bore of steering head, pack new bearings with HARLEY-DAVIDSON SPECIAL PURPOSE GREASE (HD-99857-97).

CAUTION

Do not use a sleeve that is larger than the inner race of the bearing or bearing cage may be damaged. A damaged bearing cage will require replacement of both the cage and the bearing.

- 6. Install a new lower seal on fork stem.
- 7. Use sleeve or drift that will contact only inner race of bearing and press lower bearing into place on fork stem.

NOTE

A sleeve (drift) to press on the lower fork stem bearing can be constructed out of thick walled pipe, 22.86 cm (9.0 in.) long with an inside diameter of 25.65 mm (1.010 in.) and an outside diameter of 31.75 mm (1.250 in.).

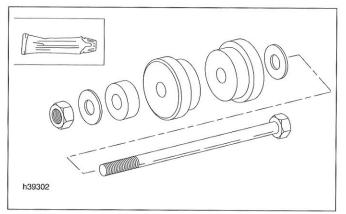


Figure 2-97. Steering Head Bearing Race Installer (HD-39302)

INSTALLATION

 See Figure 2-94. Insert fork stem (10) and lower triple clamp (14) assembly into frame steering head and install a **new** upper bearing (8) and **new** seal (7). Secure with adjusting nut (6). Tighten adjusting nut until bearings have no noticeable shake. Fork stem must turn freely from side to side.

CAUTION

Overtightening adjusting nut will cause the bearings to wear excessively leading to the need for premature bearing replacement.

2. Install upper triple clamp (4), a **new** lockwasher (3). Be sure pin on lockwasher registers in upper bracket hole.

WARNING

An improperly adjusted fork stem nut may adversely affect handling, which could lead to an accident which could result in death or serious injury.

- 3. Thread on and finger tighten fork stem nut (2).
- Fasten brake hose bracket to lower triple clamp (14). Tighten bolt to 6-10 Nm (53-89 in-lbs).
- 5. Install fork tube assemblies into bottom and top triple clamps (4, 14).
- See Figure 2-93. The fork tube should project above upper triple clamp 0.64-0.97 mm (0.25-0.038 in.). Tighten pinch bolts to 41-47 Nm (31-34 ft-lbs).
- 7. Install handlebar brackets, handlebars, clutch and brake lever assemblies.
- 8. Install headlamp assembly. See 2.21 HANDLEBARS.
- 9. Install front fender and bracket. See 2.27 FRONT FENDER.
- 10. Install front wheel assembly. See 2.22 FRONT WHEEL.
- 11. Install right and left front brake calipers. See 2.18 FRONT BRAKE CALIPERS.
- Adjust steering head bearing fall away. Tighten or loosen adjuster nut until the fall away measurement is within 127-178 mm (5.0-7.0 in.). See 2.29 STEERING HEAD.
- See Figure 2-94. Tighten fork stem nut (2) to 61-75 Nm (45-55 ft-lbs). Bend the lockwasher (3) tab against nut flat.
- 14. Replace fork stem cap (1).

GENERAL

To insure that the ignition key and the fork lock key are the same, both locks may need to be changed when one is changed.

REMOVAL

- 1. Remove the upper triple clamp.
- 2. See Figure 2-98. Insert key (1) and turn 1/2 way so that plunger (4) rotates in plunger boss (9).
- Look into the half-moon opening (8) on back of fork lock boss. The slot (5) in plunger (4) should be visible in the opening.

NOTE

If the plunger shot is not visible in the half-moon opening with the key 1/2 way between lock and unlock, the plunger can be rotated with pliers counterclockwise to compress the rotation pin and remove the plunger.

- 4. Using a thin tool, press in rotation pin (3) through slot (5) in plunger.
- 5. While pressing rotation pin (3) in, push up through small hole in bottom of plunger boss (2) until plunger (4) holds rotation pin (3) in. Remove tool and continue to push plunger (4) out of plunger boss (9).
- 6. Use ignition key (1) to pull tumbler (7) out.

INSTALLATION

1. Lightly grease open end of tumbler.

NOTE

The lock can be installed so that the key will lock the forks with either a counterclockwise or clockwise turn. When the splined retaining key is on top of tumbler, the key will rotate counterclockwise to lock the forks and clockwise to unlock the forks.

 See Figure 2-98. Slide tumbler (7) into fork lock boss (8) with rotation pin (3) and retaining key (2) at the top of the fork lock boss (8).

NOTE

The beveled end of the plunger will compress the rotation pin so that the plunger can be slid into place.

- 3. With the beveled end of plunger (6) facing the rotation pin (3), push the plunger into boss until plunger locks into place.
- Turn the key from notch to notch. Locking pin should be below fork lock boss in unlocked position and 1/4 inch above boss in locked position.
- 5. Install upper triple clamp.

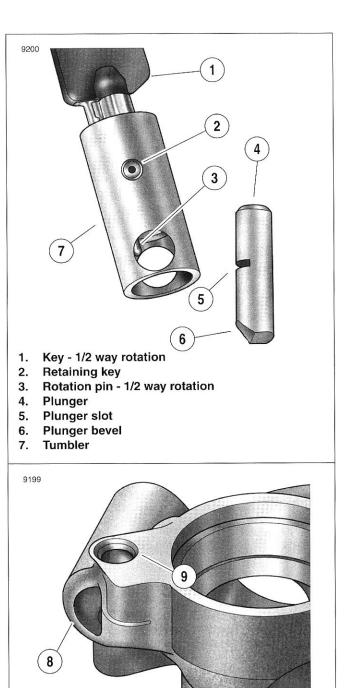


Figure 2-98. Fork Lock Components

Half-moon opening - fork lock boss

8.

9.

Plunger boss

BELT GUARD/DEBRIS DEFLECTOR

2.31

REMOVAL

Belt Guard

- 1. See Figure 2-99. Unthread left side lower shock mount bolt from belt guard (1) without removing shock mount bolt from rear fork.
- Pull belt guard (1) rearward off of side rubber grommet (5) and upper rubber grommet (6). If necessary, remove fasteners (3) holding grommets (5, 6) to rear fork.
- 3. Inspect rubber grommets (5, 6) on the rear fork and remove the bolts and rubber grommets if necessary.

Debris Deflector

- 1. See Figure 2-99. Remove bolt (3) and washer (4) from the underside of the rear fork near the rear shock mount.
- 2. Pull the debris deflector (8) rearward off of the lower rubber grommet (7) and remove the debris guard.
- 3. Inspect the rubber grommet (7) on the rear fork and remove the bolt and rubber grommet if necessary.

INSTALLATION

Belt Guard

- 1. See Figure 2-99. If necessary, replace the rubber grommets (5, 6) and bolts. Tighten bolts to 6-10 Nm (53-88 in-Ibs).
- Slide the belt guard slots into position on the rubber grommets.
- Thread lower rear shock mount into thread boss on belt guard. Tighten to 41-68 Nm (31-50 ft-lbs).
- 4. Measure guard to drive sprocket clearance.
- 5. If clearance is less than 5 mm (0.197 in.), protect guard/ sprocket and adjust as required.

Debris Deflector

- See Figure 2-99. If necessary, replace rubber grommet (7) and bolt (3). Tighten bolt to 6-10 Nm (53-88 in-lbs).
- 2. Slide debris deflector slot (2) into position on the rubber grommet (7).
- Thread rear bolt (3) and washer (4) through debris deflector (8) into rear fork. Tighten bolt to 6-10 Nm (53.1-88.5 in-lbs).

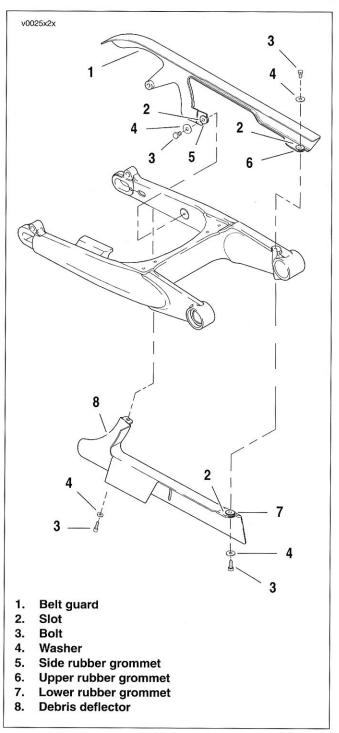


Figure 2-99. Belt Guard/Debris Deflector

REMOVAL

- 1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
- 2. See Figure 2-100. Remove lower bolt (1), washer (3), and thin height hex-nut (5) attaching right side shock to rear fork.
- 3. Remove lower bolt (1) and washer (3) from left side shock to rear fork and belt guard. Allow rear tire to rest on ground.
- Remove top fastener (1) and spacer (2) from left side top shock mount and remove shock. Retain shock mounting nut which passes through fender support and side rail assembly.
- Remove fastener (1) and spacer (2) from right side top shock mount and remove shock. Retain shock mounting nut which passes through fender support and side rail assembly.

NOTE

The rear shock absorbers on VRSCA motorcycles are not repairable. If a shock absorber becomes worn or damaged, it must be replaced as an assembly.

INSTALLATION

- See Figure 2-100. Coat shoulder of top shock bolt (1) with LOCTITE[®] 243 (blue). Insert bolt and spacer (2) through upper shock mounts.
- 2. Insert shock mounting nuts through left and right fender support and side rails.
- 3. Thread top shock bolts (1) through top shock damper spacer (2) into threads of shock mounting nut.
- 4. Pivot shock absorbers to align lower shock mounts with mounting holes in rear fork.
- 5. Lift rear fork to meet lower shock mounts.
- 6. Coat threads with LOCTITE[®] ANTI-SEIZE and thread left side lower shock bolt (1) and washer (3) through shock mount and rear fork into belt guard.
- Coat threads with LOCTITE[®] ANTI-SEIZE and thread right side bottom shock mount bolt (1) and washer (3) through bottom shock mount in rear fork into thin height nut (5).
- 8. Tighten shock mount fasteners to 41-68 Nm (31-50 ftlbs).

WARNING

Both shock absorber adjuster must be adjusted to the same preload position. Shock absorbers that are not adjusted to the same preload position could adversely affect handling. This may lead to a loss of control of the motorcycle and could result in death or serious injury.

9. Verify that preload settings on both shock absorbers are equal. See 1.16 SUSPENSION ADJUSTMENTS.

NOTE

See 1.16 SUSPENSION ADJUSTMENTS for information regarding setting up the suspension for carrying cargo.

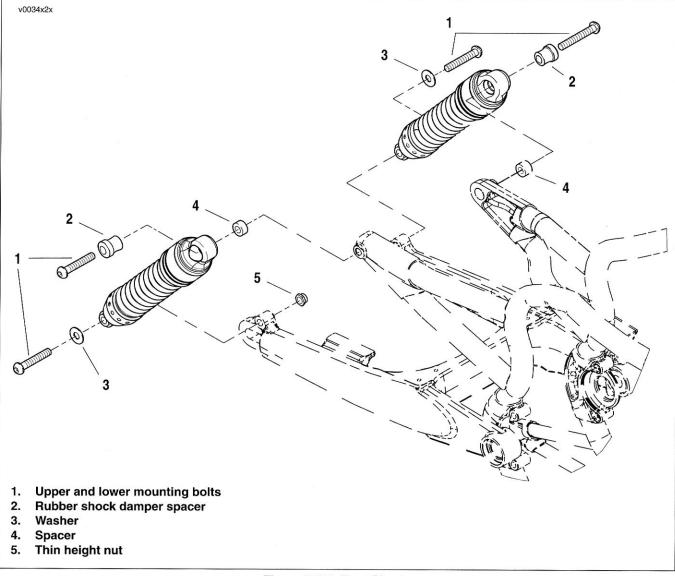


Figure 2-100. Rear Shocks

REMOVAL

NOTE

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

- 1. Remove right side cover and maxi-fuse.
- 2. Remove belt guard and debris deflector. See 2.31 BELT GUARD/DEBRIS DEFLECTOR.
- 3. Remove rear wheel. See 2.23 REAR WHEEL.
- 4. Remove rear brake caliper brake fluid line from clips on rear fork. See 2.20 REAR BRAKE CALIPER.
- 5. Remove left lower rear shock absorber bolt. Remove right rear shock absorber bolt and thin height nut. See 2.32 REAR SHOCK ABSORBERS.

NOTE

Block or support engine before removing pivot shaft.

- 6. See Figure 2-101. Remove pivot shaft nut (2).
- Support rear fork and slide pivot shaft (8) out of rear fork. Rear fork (1) can now be removed from frame. Discard dust seals (3).

NOTE

The left and right pivot spacers (5, 6) will remain inside the motor mounts.

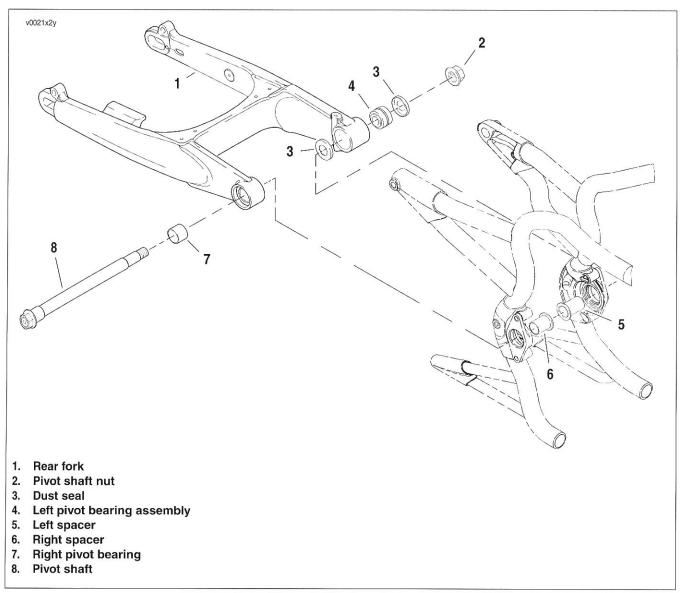


Figure 2-101. Rear Fork

DISASSEMBLY

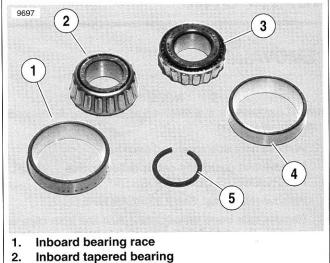
NOTE

Remove left pivot bearing assembly from fork only if replacement is required. The complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.

- 1. See Figure 2-102. Remove left pivot tapered bearings and bearing spacer.
- Use a brass drift to drive out inboard and outboard bearing races.
- See Figure 2-103. Using a die grinder, grind a spot to weaken c-clip bearing race separator at a point 180° opposite the open end. Pry out and break at grind point.
- 4. Remove remaining c-clip half.
- 5. See Figure 2-101. Carefully press right side bearing (7) from fork.
- Clean all components in solvent and blow dry. Carefully inspect all bearing components for wear and/or corrosion.
- Check that rear fork is not bent or twisted. Replace it if it is damaged.

ASSEMBLY

- See Figure 2-101. Carefully press new right side bearing (7) into fork.
- See Figure 2-103. Snap new c-clip into groove in center of left side pivot bore.
- See Figure 2-102. Press new inboard (1) and outboard (4) bearing races into pivot bore.
- 4. Pack the **new** tapered bearings (2, 3) with HARLEY DAVIDSON WHEEL BEARING GREASE (HD-99855-89)
- 5. Install inboard bearing, bearing spacer, and outboard bearing into bearing races.
- 6. See Figure 2-101. Fit **new** dust seals (3) over left and right sides of bearings.
- 7. With soft hammer, tap dust seals into place.



- 3. Outboard tapered bearing
- 4. Outboard bearing race
- 5. Bearing spacer

Figure 2-102. Left Pivot Bearing Components

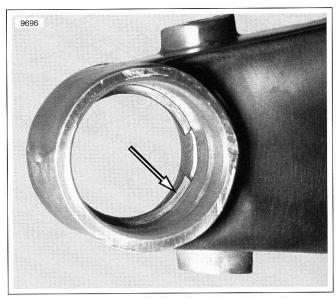


Figure 2-103. C-clip Bearing Race Separator in Left Pivot Bore

INSTALLATION

- 1. Slide rear fork assembly into position.
- 2. See Figure 2-101. From right side, slide pivot shaft (8) through dust seals (3), rear fork pivot bearings (4, 7) and engine mounts, spacers (5, 6).
- Apply two or three drops of LOCTITE[®] 243 (blue) to threads of pivot shaft nut (2). Install and tighten pivot shaft nut (2) to 61-75 Nm (45-55 ft-lbs).

NOTE

Proper pivot shaft tightening is important to maintain rear fork alignment.

- Check for freedom of rotation of rear fork around bearings and that fork and frame side rails have not been distorted when pivot shaft nut was tightened.
- 5. Install both rear shock absorbers. See 2.32 REAR SHOCK ABSORBERS.
- 6. Install rear brake caliper and clip brake line to rear fork. See 2.20 REAR BRAKE CALIPER
- 7. Install rear wheel. See 2.23 REAR WHEEL.
- 8. Install belt guard and debris deflector. See 2.31 BELT GUARD/DEBRIS DEFLECTOR.
- 9. Install maxi-fuse and right side cover.

SEAT LATCH

REPLACEMENT

- 1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlatch and open seat.
- 3. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.

WARNING

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

- 4. Disconnect negative battery cable.
- Remove two fasteners and washers. Pull seat latch mechanism by cable from frame. See 8.6 IGNITION/ LIGHT SWITCH.
- See Figure 2-104. To disconnect seat latch, remove single fastener and remove top plate. Remove cable barrel (1) from rocker (2) and remove cable from cable guide (6).
- 7. Remove top plate of new seat latch.
- 8. With key switch in FUEL, compress spring over cable and install cable barrel (1) through slot (3) in rocker (2).
- 9. Hold rocker (2) on pivot (4). Use divider (5) in guide to separate spring from cable sheath. Install top plate.
- 10. Secure seat latch mechanism to frame with two fasteners and washers. Tighten to 6-10 Nm (53-88 **in-lbs**).
- 11. Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 12. Replace airbox cover.
- 13. Replace maxi-fuse and side cover.

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.

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

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

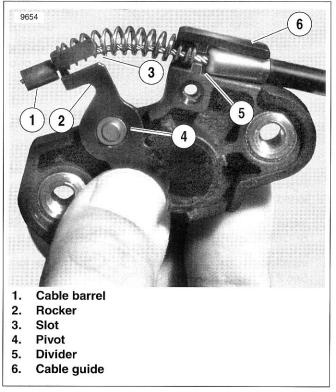


Figure 2-104. Seat Latch (top plate removed)

REMOVAL

- 1. Unlock and open seat.
- 2. See Figure 2-105. Remove seat tether (2) from the hole in frame.
- 3. Pry hinge clip (1) from seat hinge pins. Slide seat rearward to release hinge pins from bushings on frame.
- See Figure 2-106. Remove pillion mounting bolt and washer (5). Save bolt and washer for reinstallation. Slide grabstrap (2) forward off pillion.
- 5. Push pillion forward to release slot on the bottom of pillion from tongue on fender. Lift pillion back and away from motorcycle.
- 6. If necessary, remove grabstrap.

CLEANING AND INSPECTION

- 1. Inspect all components for wear or damage.
- 2. Clean underside of pillion and seat. Clean fender and frame mounting surfaces.

NOTE

Do not use ordinary soap to clean the seat. Thoroughly clean with a quality saddle soap. Once the seat is dry, it can be treated with HARLEY-DAVIDSON LEATHER CARE DRESS-ING (Part No. 98261-91V).

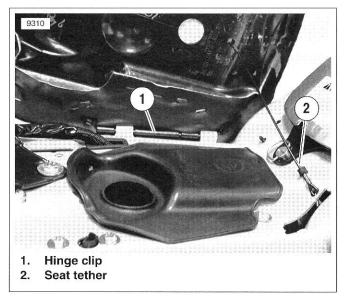


Figure 2-105. Seat Hinge and Tether

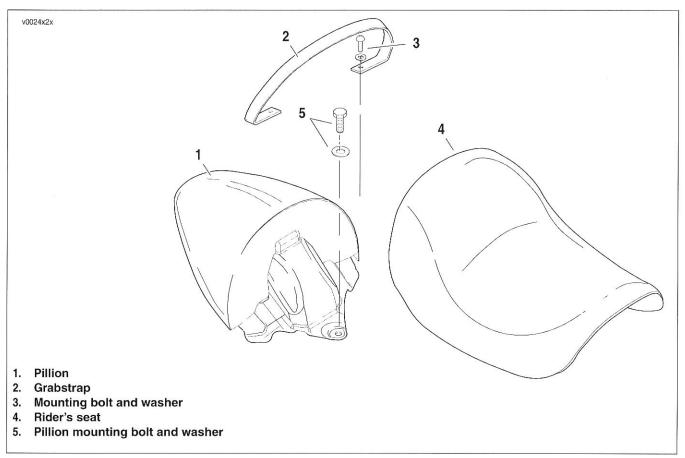


Figure 2-106. Seat and Pillion

INSTALLATION

- If necessary, install grabstrap. Tighten to 11-17 Nm (97-150 in-lbs).
- Push pillion toward front of motorcycle until mounting hole in base is approximately 25 mm (1 inch) in front of mounting hole in frame.
- While applying downward pressure on middle of pillion, slide pillion rearward to fully engage slot on bottom with tongue on top of fender. Push rearward until mounting hole on pillion base is aligned with mounting hole in frame.
- 4. Install pillion base to frame.Tighten fastener to 11-17 Nm (97-150 in-lbs).
- 5. Install seat. Make sure both seat pins engage their bushings on the frame.
- 6. Press clip over seat hinge.
- 7. Install seat tether to hole in frame.

WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

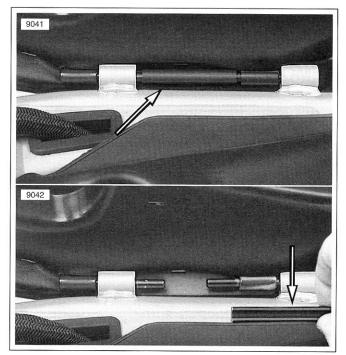


Figure 2-107. Seat Hinge and Clip

REMOVAL

AWARNING

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

- 1. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Disconnect negative battery cable.
- 3. Remove pillion. See 2.35 SEAT.
- See Figure 2-108. Remove lock nuts (4) holding turn signal/security module (TSSM) bracket. Thread lock nuts on bracket for use later. Fold module (2) and bracket aside.
- 5. Remove fasteners (1) holding fender to inner fender. Remove grabstrap (5) and lift fender up from seat end.
- 6. Separate tail/stop lamp connector [93] and remove fender and stop light assembly.
- 7. Disconnect:

Left [19] and right [18] rear turn signals.

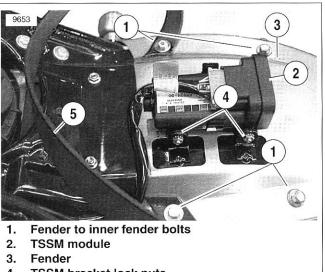
License plate lamp connector [45].

- 8. See Figure 2-109. Remove fasteners (3) holding rear turn signal and license plate bracket to inner fender.
- Remove fasteners (2) holding inner fender to fender support brackets.
- Remove fasteners mounting inner fender to fender weldment. Remove wiring harness as required and remove inner fender (1).
- 11. To remove two fender support brackets, use a suitable lift to support motorcycle under frame until rear tire is slightly off ground.
- Remove upper shock bolts and capture shock mounting nuts. Lower tire to ground. See 2.32 REAR SHOCK ABSORBERS.
- See Figure 2-110. Remove two inner bolts fastening support brackets to frame side rails. Remove support brackets.
- 14. Remove mud flap stud plate and mudflap.
- 15. Install rear fender and install grabstrap. Tighten to 8-12 Nm (71-106 **in-lbs**).
- 16. Install turn signal/security module (TSSM) and bracket.
- 17. Install pillion. See 2.35 SEAT.
- Connect negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 19. Install maxi-fuse and right side cover.

AWARNING

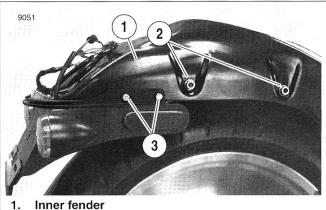
Check for proper turn signal and tail lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

20. Verify turn signal lamp operation.



- 4. TSSM bracket lock nuts
- 5. Grabstrap

Figure 2-108. Rear Fender Components (under pillion)

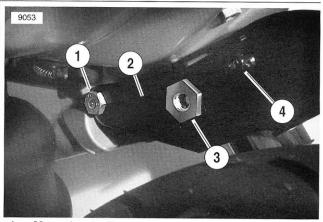


- 2. Inner fender bolts
- 3. Rear turn signal and license bracket bolts

Figure 2-109. Inner Fender and Rear Turn Signal and License Plate Bracket

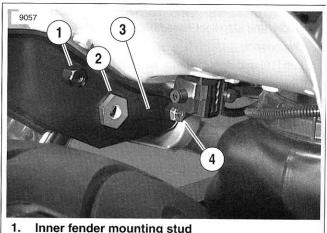
INSTALLATION

- 1. Install mudflap and stud plate to frame fender weldment. Tighten to 8-12 Nm (70.8-106.2 in-lbs).
- 2. See Figure 2-110. Loosely install both fender support brackets (2). Finger tighten fasteners (1).
- 3. Insert upper shock mounting nut (3) through support bracket and into frame side rails.
- 4. Lower motorcycle on rear tire to align rear shock mounting eye with mounting nuts. Install rear shock mounting bolt and spacers. See 2.32 REAR SHOCK ABSORB-ERS.
- 5. Tighten fasteners:
 - Rear shock mounting bolts 41-68 Nm (30-50 fta. lbs).
 - b. Fender support bracket fasteners - 34-41 Nm (25-30 ft-lbs).
- 6. Install inner fender. Tighten fasteners to 20-26 Nm (15-19 ft-lbs).
- 7. Route wiring harness for tail/stop lamp, license plate lamp, and turn signals. Install turn signal and license plate bracket assembly. Tighten to 8-12 Nm (71-106 inlbs).
- 8. Connect:
 - a. Left [19] and right [18] rear turn signals.
 - License plate lamp connector [45]. b.
 - Tail/stop lamp connector [93]. c.



- 1. Mounting bolt
- Fender support bracket 2.
- 3. Upper shock mounting nut
- 4. Inner fender mounting stud

Figure 2-110. Right Side Fender Support Bracket



- Inner fender mounting stud
- 2. Lower shock mounting nut
- 3. Fender support bracket
- 4. Mounting bolt

Figure 2-111. Left Side Fender Support Bracket

ENGINE

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Table 3-1. Engine General

ITEM	DATA	
Number of cylinders	2	
Туре	4-cycle, 60°, liquid cooled V-twin	
Torque (domestic model at crank)	100 Nm (74 ft-lbs) @ 7000 rpm	
Bore	100 mm (3.94 in.)	
Stroke	72 mm (2.835 in.)	
Piston displacement (approx.)	1130 cc (69 cubic in.)	
Max. sustained engine speed	9000 rpm	
Idle speed	1200 rpm ± 50	
Engine & transmission weight	89.4 kg (197 lbs)	

Table 3-2. Oil Pump

ITEM	DATA	
Туре	Gerotor, internal oil pump, wet sump	
Pressure	3-6.5 bar (43-94 psi) at 3000 rpm and normal operating temperature of 70° C (158° F)	
Filtration	10 micron media between pump & engine	

Table 3-3. Water Pump

ITEM	DATA
Туре	Impeller type, thermostat controlled bypass

Table 3-4. Valve Diameters

ITEM	ММ	IN
Intake	40.0	1.575
Exhaust	34.5	1.358

Table 3-5. Valve Lash

ITE	ΞM	ММ	IN
Intake	Max	0.245	0.0096
make	Min	0.195	0.0078
Eule aurat	Max	0.345	0.0135
Exhaust	Min	0.295	0.0117

Table 3-6. Cylinder Heads

ITEM	ММ	IN
Valve guide in head (tight)	Max 0.051	0.002
	Min 0.022	0.0009
Valve seat in head (tight)	Max 0.100	0.0039
	Min 0.059	0.002
Head gasket surface (flatness)	0.020	0.0008
Valve-to-guide running clearance - intake	Max 0.0585	0.0023
	Min 0.0285	0.0011
Valve-to-guide running clearance - exhaust	Max 0.0685	0.0026
	Min 0.0385	0.0015
Valve guide I.D.	Max 6.015	0.2368
	Min 6.000	0.2362
Valve stem diameter	Inta	ake
	Max 5.9715	0.2351
	Min 5.9565	0.2345
	Exhaust	
	Max 5.9615	0.2347
	Min 5.9465	0.2341
Valve to guide running clearance	Intake	
	Max 0.0585	0.0023
	Min 0.0285	0.0011
	Exhaust	
	Max 0.0685	0.0027
	Min 0.0385	0.0015
Valve seat to cylinder head press	Max 0.0100	0.0004
	Min 0.0590	0.0023
Valve seat run-out	Max 0.0050	0.0002
Valve seat to guide run-out	Max 0.0200	0.0008
Valve spring free length	Outer	
	Max 45.630	1.797
	Inner	
	Max 43.770	1.723
Valve spring installed height	Ou	ter
	Max 39.000	1.535
	Inn	er
	Max 37.000	1.457
Cylinder head flatness	Max 0.0200	0.0008

ITEM	KG	LB
Spring force installed .	Outer @ 39 mm	n (1.535 in.) max
	Max 20.80	45.86
	Min 18.97	41.88
	Inner @37 mm	(1.457 in.) max
	Max 11.31	24.95
	Min 10.10	22.26
Maximally compressed (intake and exhaust)	Outer	
	Max 66.58	146.80
	Min 60.87	134.22
	Inner	
	Max 34.15	75.31
	Min 31.10	68.57

Table 3-11. Cylinder Heads (continued)

Table 3-12. Cam Drive

Chain guide wear	Pittings to be smaller than 16 mm in length, Maximum depth of tensioner show wear 0.8 mm.
Sprocket wear	Visual check, no pittings allowed lateral wear caused by chain is allowed

Table 3-13. Cam Timing

Intake	1 06 ± 1°	
Exhaust	105 ± 1°	
Total intake lift	10.9 mm (0.4291 in.)	
Duration intake @1 mm	248°	
Total exhaust Lift	9.98 mm (0.3929 in.)	
Duration exhaust @ 1 mm	206°	

Table 3-14. Piston Ring Gap

ITEM	ММ	IN
Top ring gap	Max 0.550	0.022
	Min 0.350	0.014
2nd ring gap	Max 0.600	0.024
	Min 0.400	0.016
Oil control ring gap	Max 0.890	0.035
	Min 0.380	0.015
Top ring side clearance	Max 0.075	0.003
	Min 0.020	0.001
2nd ring side clearance	Max 0.055	0.002
	Min 0.010	0.000

Table 3-15. Connecting Rod/Piston

ITEM	ММ	IN
Rod small end bore dia.	Max 22.028	0.8672
	Min 22.018	0.8669
Piston pin diameter	Max 22.000	0.8661
	Min 21.995	0.8659
Running clearance	Max 0.033	0.0013
	Min 0.018	0.0007

Table 3-16. Connecting Rod Journals

ITEM	ММ	IN	
Rod bearing journal	Red		
	Max 47.991	1.8894	
	Min 47.983	1.8891	
	Blue		
× 1	Max 47.983	1.8891	
	Min 47.975	1.8888	
Rod bearing bore with-	Max 51.616	2.0321	
out bearing	Min 51.600	2.0315	
Rod bearing bore with	Red		
bearing	Max 48.052	1.8918	
	Min 48.020	1.8906	
	Blue		
	Max 48.044	1.8915	
	Min 48.012	1.890	
Running clearance	Max 0.069	0.0027	
	Min 0.029	0.0011	
Axial ground play	Max 0.290	0.0114	
	Min 0.140	0.0055	

Table 3-17. Balance Shaft/Crankcase

ITEM	мм	IN
Balance shaft journal	Max 17.012	0.6698
-	Min 17.001	0.6693
Press fit inner race to	Max -0.020	- 0.0008
journal	Min -0.001	- 0.0000
Crankcase balance shaft	Max 39.971	1.5737
bearing bore	Min 39.955	1.5730
Bearing outer race to	Max -0.045	- 0.0018
bearing bore press fit	Min -0.018	- 0.0007

Table 3-18. Crankcase/Cylinder Liner

ITEM	ММ	IN
Cylinder liner cover over	Max 0.130	0.0051
stand	Min 0.090	0.0035
Cylinder head deck flat-	Max 0.020	0.0008
ness	Min 0.000	0.0000

Table 3-19. Piston/Cylinder Liner

ITEM Cylinder liner I.D. out of round installed		ММ	IN
		Max 0.020	0.0008
	Piston major	diameter	
	Class I	Max 99.953	3.9352
		Min 99.949	3.9350
	Class X	Max 99.961	3.9355
		Min 99.953	3.9352
	Class II	Max 99.965	3.9365
		Min 99.961	3.9355
	Running Cle	earance	
Class cylinder liner	Class piston		ender och price en upgeligt i ser en och en er en er en er en er en er
	Х	Max 0.047	0.0019
	^	Min 0.026	0.0010
П	Х	Max 0.060	0.0024
Ш	^	Min 0.039	0.0015
1	I	Max 0.051	0.0020
I		Min 0.034	0.0013
II		Max 0.052	0.0020
Ш		Min 0.035	0.0014

Table 3-20. Crankshaft/Crankcase

ITEM	ALTERNA	ATOR SIDE	CLUTC	CLUTCH SIDE	
	ММ	IN	ММ	IN	
Main bearing journal		E	Blue		
	Max 55.977	2.20382	Max 55.952	2.20283	
	Min 55.971	2.20358	Min 55.946	2.20260	
		G	reen		
	Max 55.984	2.20409	Max 55.959	2.20311	
	Min 55.977	2.20382	Min 55.952	2.20283	
		F	Red	and a second	
	Max 55.990	2.20433	Max 55.965	2.20334	
	Min 55.984	2.20410	Min 55.959	2.20312	
Main bearing bore	Max 61.019	2.40232			
	Min 61.000	2.40158	_		
Running clearance		Blue			
	Max 0.059	0.00232	Max 0.059	0.00232	
	Min 0.026	0.00103	Min 0.026	0.00103	
		G	reen		
	Max 0.061	0.00240	Max 0.061	0.00240	
	Min 0.027	0.00107	Min 0.027	0.00107	
		F	Red		
	Max 0.062	0.00244	Max 0.062	0.00244	
	Min 0.029	0.00115	Min 0.029	0.00115	
Axial end play	Max 0.060	0.00236			
	Min 0.050	0.00197			

GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

Table 3-21. Crankshaft/Crankcase

ITEM	REPLACE IF WEAR EXCEEDS		
	MM	IN	
Main bearing journal	55.940	2.202	
Axial end play	0.300	0.011	
Main bearing bore	61.019	2.4023	

Table 3-22. Connecting Rod/Piston

ITEM	REPLACE IF WEAR EXCEEDS		
	ММ	IN	
Small end bore diameter	22.050	0.868	
Piston pin diameter	21.985	0.904	

Table 3-23. Connecting Rod/Crankshaft

ITEM	REPLACE IF WEAR EXCEEDS		
	ММ	IN	
Rod bearing journal	47.970	1.888	
Rod bearing bore	51.616	2.0321	

Table 3-24. Piston/Cylinder Liner

ITEM	REPLACE IF WEAR EXCEEDS		
	ММ	IN	
Cylinder liner i. d. bore (freestate)	100.085	3.9403	
Cylinder liner out-of- round (installed)	0.080	0.0031	
Piston major diameter Class X	99.925	3.9341	
Running clearance	0.080	0.0031	

Table 3-25. Piston Rings

ITEM	REPLACE IF WEAR EXCEEDS		
	ММ	IN	
Top ring gap	0.700	0.0276	
2nd ring gap	0.750	0.0295	
Oil control ring gap	1.050	0.0413	
Top ring side clearance	0.100	0.0039	
2nd ring side clearance	0.070	0.0028	

Table 3-26. Cylinder Heads

ITEM	REPLACE IF WEAR EXCEEDS		
	ММ	IN	
Cylinder head flatness	0.100	0.0039	
Cylinder head cam bore diameter	26.035	1.0250	
Tappet bucket o.d. diameter	30.962	1.2190	
Cylinder head bucket bore diameter	31.040	1.2220	
Valve guide i.d. diame- ter	6.040	0.2378	
Valve stem deflection	0.08	0.00315	
Valve seat width - intake	1.700	0.0669	
Valve seat width - exhaust	2.00	0.0787	
Valve seat-to-guide runout	0.080	0.0031	

ITEM	TOP	QUE	NOTES
5 mm head bolts	9.7 Nm	85 in-lbs	page 3-94
Bypass fastener	35 Nm	25 ft-lbs	page 3-37
Cam chain tensioner	100 Nm	78 ft-lbs	page 3-97, 3-99
Cam cover	9.7 Nm	85 in-lbs	page 3-99
Cam journal caps	9.7 Nm	85 in-lbs	page 3-35, 3-97, 3-99
Clutch hub nut	220 Nm	162 ft lbs	page 3-48
Clutch pack spring screws	9.7 Nm	85 in-lbs	page 3-46
Clutch side crankcase cover	9.7 Nm	85 in-lbs	page 3-48
Coil fasteners	9.7 Nm	85 in-lbs	page 3-19
Connecting rod caps	Special	method	page 3-88
Counterbalancer gear fastener	Special	method	page 3-70
Engine timing plug	23 Nm	17 ft-lbs	page 3-99
Fuel rail into rubber boots	9.7 Nm	85 in-lbs	page 3-19
Head bolts	Special	method	page 3-93
Intake hose clamps	1.25 Nm	11 in-Ibs	page 3-19
Main bearing bolts	Special method		page 3-62
Oil filter mount fasteners	9.7 Nm	85 in-lbs	page 3-89
Oil pan fasteners	9.7 Nm	85 in-lbs	page 3-64
Oil pickup fasteners	9.7 Nm	85 in-lbs	page 3-64
Oil pump cover fasteners	9.7 Nm	85 in-lbs	page 3-37
Oil pump fasteners	9.7 Nm	85 in-lbs	page 3-37
Output shaft bearing fasteners	23 Nm	17 ft-lbs	page 3-64
Primary chain fixed tensioner fastener	9.7 Nm	85 in-lbs	page 3-91
Primary chain hydraulic tensioner fastener	9.7 Nm	85 in-lbs	page 3-91
Primary gear fasteners	Special	method	page 3-82
Rod caps	27 Nm + 90 ^o	20 ft-lbs + 90 ^o	page 3-78
Rotor shell fastener	Special	method	page 3-100
Secondary clutch actuator	10 Nm	89 in-lbs	page 3-48, 3-49
Secondary clutch actuator cover	6-10 Nm	53-89 in-lbs	page 3-48
Spark plugs	23 Nm	17 ft-lbs	page 3-19
Starter limiter fastener	46 Nm	34 ft-lbs	page 3-100
Triple sprocket fastener	23 Nm	17 ft-lbs	page 3-91
Upper and lower input bearing retainer fasteners	23 Nm	17 ft-lbs	page 3-64

GENERAL

The engine oil serves two purposes. First, the oil lubricates all of the metal to metal parts that are in motion relative to each other. Second, the oil cools the engine, specifically, the pistons.

See Figure 3-1. As the oil is warmed to normal operating temperature, the oil is scavenged from the sump at the screened pick up (1) by the oil pump (2).

The oil pump (2) pressurizes the oil and the pressure maintains the flow of oil through the engine. The oil flows through a bypass valve and through the oil passages to the oil filter (3). If oil pressure exceeds 88 psi, the bypass valve is activated, rerouting oil back through the suction side of the oil pump.

The filtered oil flows into the oil lines up and over the top of the radiator/oil cooler assembly and down to the left side of the oil cooler (4). Flowing across the cooler, the cooled oil is routed up and over the radiator/oil cooler assembly and then down to the oil fitting (5) on the front of the crankcase.

At the crankcase oil fitting, oil is routed to three passages:

- 1. Oil entering the passage (6) on the water pump side lubricates the right main bearings. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the rear connecting rod journals.
- Oil entering the middle passage (7) supplies oil to the front piston jet. The piston jets spray oil to cool the underside of the pistons.
- See Figure 3-2. Oil entering the cam drive side passage (8) feeds the cam drive side main bearing. The oil flows in a groove in the main bearing then through a drilled hole in the crankshaft to lubricate the front connecting rod bearings.

From the cam drive side main bearing, the oil is routed in two directions:

- a. Oil is routed up to the cam drive triple gear bushing (9) where oil is routed along the shaft to the water pump impeller. The oil also flows to front cylinder head through an oil sending unit (10) which shuts off the oil pressure light when oil pressure reaches 13.8-34.5 kPa (2-5 psi). The oil passages continue on to the intake and exhaust cams (13) lubricating the cam journals through grooves in the bearings and to the secondary cam chain tensioner (12).
- b. The second set of passages from the cam drive side main bearings lead the oil flow to the primary cam chain tensioner and up to the secondary cam chain tensioner, the rear cylinder head and the rear intake and exhaust jam journals. From the primary cam chain tensioner the oil also branches to the rear piston jet to cool the underside of the rear piston. The final passages from the cam drive side main bearing routes oil back to the transmission and clutch where the oil lubricates and cools the transmission input and output shafts.

See Figure 3-3. Returning oil to the sump (19), the rear cylinder head drains onto the clutch (16) to lubricate primary gear and clutch assembly. Oil from the rear cylinder head also drains on the transmission input and output shaft gearset (16) where gear meshing transfers oil to all gears and then to the oil sump (17).

The oil in the front cylinder head drains down the cylinder head drain passage (18) to the sump (19).

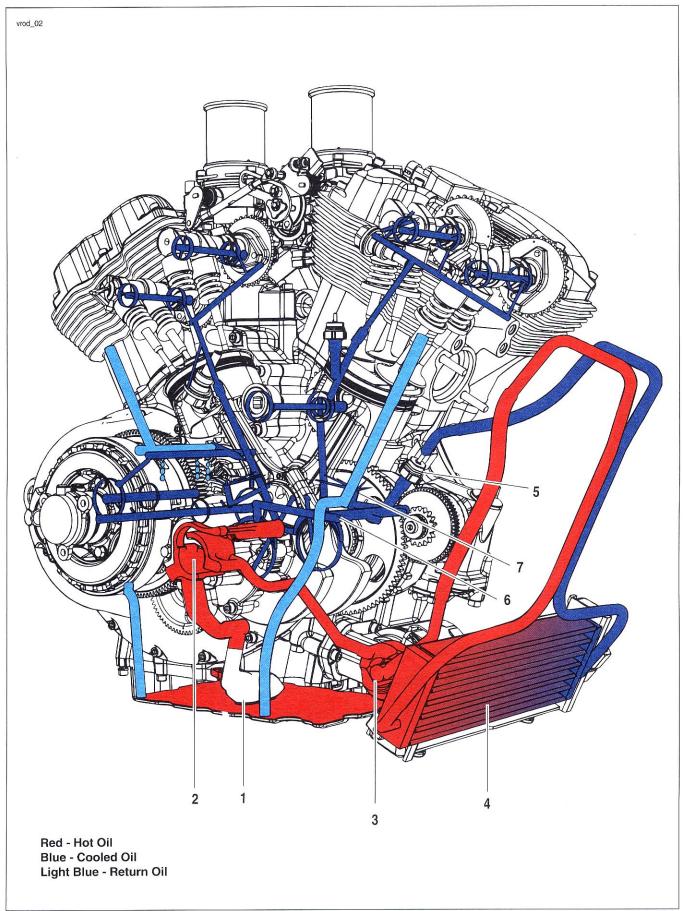


Figure 3-1. Oil Flow A

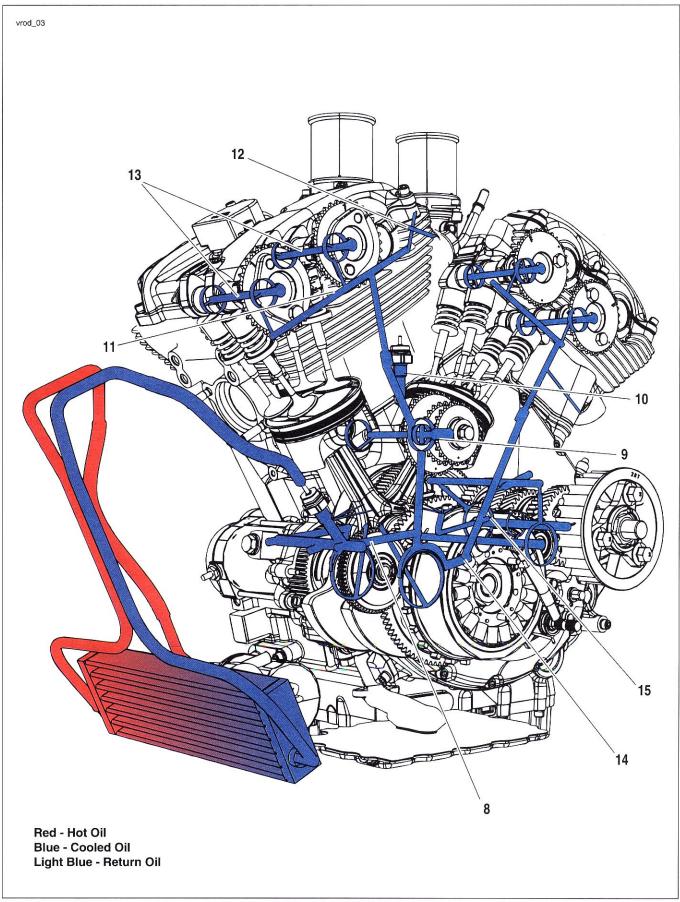


Figure 3-2. Oil Flow B

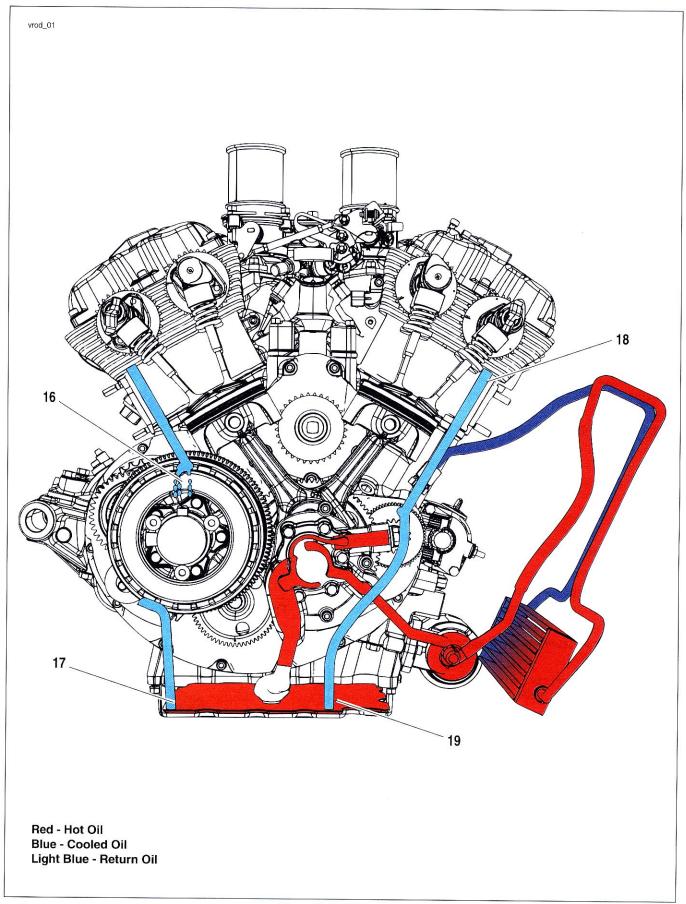


Figure 3-3. Oil Flow C

OIL PRESSURE INDICATOR LAMP

See Figure 3-4. The red oil pressure indicator lamp illuminates to indicate improper circulation of the engine oil. The lamp illuminates when the ignition is first turned on (before the engine is started), but should be extinguished once the engine is running.

CAUTION

Check the engine oil level if the oil pressure indicator lamp remains illuminated. If the oil level is normal, stop the engine immediately. Do not ride the vehicle until the problem is located and corrected.

If the indicator lamp is not extinguished, it may be the result of a low oil level or diluted oil supply. A defect in the lamp wiring, faulty oil pressure sending unit, damaged oil pump, plugged oil filter element, incorrect oil viscosity, broken or weak spring in the oil pressure relief valve and/or damaged or incorrectly installed o-rings in the engine may also cause the indicator lamp to remain on.

To troubleshoot the problem, always check the engine oil level first. If the oil level is OK, check oil pressure.

CHECKING OIL PRESSURE

PART NO.	SPECIALTY TOOL
HD-45308	Oil pressure gauge
HD-45309	Oil pressure gauge adapter

Operating oil pressure is checked as follows:

- 1. Fill crankcase to proper level.
- 2. Remove oil pressure switch from crankcase.
- Attach OIL PRESSURE GAUGE (1) (HD-45308) to ADAPTER (2) (HD-45309).
- 4. Install in oil pressure switch mounting hole.

NOTE

Engine oil should be at normal operating temperature 70° C (158° F) for an accurate reading.

5. Oil pressure should be 3-6.5 bar (43-94 psi) at 3000 rpm and normal operating temperature of 70° C (158° F).

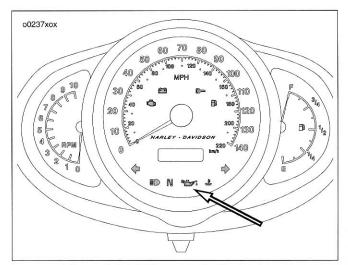


Figure 3-4. Oil Pressure Indicator Lamp

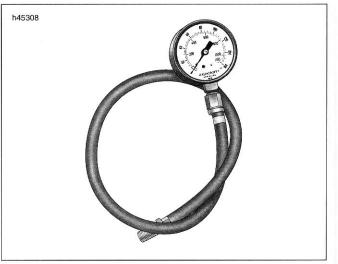


Figure 3-5. Oil Pressure Gauge (HD-45308)

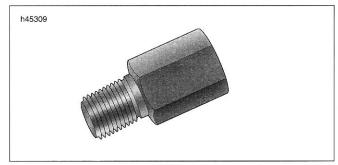


Figure 3-6. Oil Pressure Gauge Adapter (HD-45309)

TOP END REPAIR

Valve lash adjustment and secondary cam chain adjustment can be done with engine in chassis. Cam drive inspection and some part replacement can be done with the engine in chassis.

For all other top end repairs, the engine must be removed from the chassis. See 2.9 ENGINE REPLACEMENT.

BOTTOM END REPAIR

Bottom end repair can only be done with engine removed from chassis. See 2.9 ENGINE REPLACEMENT.

TYPICAL SYMPTOMS

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults. But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

Certain "knocking" noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both out of tolerance, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

DIAGNOSING VALVE TRAIN NOISE

To diagnose and correct noisy valve train components, use the following procedures:

PART NO.	SPECIALTY TOOL	
HD-45334	Secondary chain measurement tool	

1. Visually inspect camshaft lobes for abnormal wear.

- 2. If there is noise and engine has low oil pressure, drop oil pan and inspect for metal debris.
- 3. On high mileage engines with good oil pressure, if there is a noise at start-up which goes away, use SECOND-ARY CHAIN MEASUREMENT TOOL (HD-45334) to check cam chain wear. See 1.23 SECONDARY CAM CHAIN.
- 4. Verify valve lash. See 1.22 VALVE LASH.

COMPRESSION TEST

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1) that has a screw-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature when possible.

PART NO.	SPECIALTY TOOL	
HD-22332-1	Cylinder compression gauge	

- 1. See AIRBOX, BATTERY, and SPARK PLUG REMOVAL.
- 2. Connect compression tester to front cylinder per manufacturer's instructions.
- 3. Reinstall battery.
- 4. Make sure transmission is in neutral. With throttle plates in wide open position, crank engine continuously through 5 to 7 full compression strokes.
- 5. Note gauge readings at the end of the first and last compression strokes. Record test results.
- 6. Repeat steps 2 through 4 on rear cylinder.

7. Compare test results to the upper and lower limits posted in Table 3-27.

Table 3-27. Cylinder Compression

	FRONT		REAR	
	BAR	PSI	BAR	PSI
Upper limit	9.45	137	17.03	247
Mid-range	8.62	125	15.51	225
Lower limit	7.79	113	14.0	203

NOTE

The automatic compression release (ACR) has its greatest effect on the front cylinder because of differences in valve timing between the front and rear cylinder.

8. If compression of a cylinder does not fall within its upper and lower limits, see Table 3-28.

Table 3-28. Compression Test Results

TEST RESULTS	DIAGNOSIS
Compression low on first stroke, tends to build up on the following strokes, but does not reach normal. Improves con- siderably when oil is added to cylinder.	Ring trouble
Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Verify valve lash.	Valve trouble
Same results as valve trouble.	Head gasket leak

 To verify worn piston rings, inject approximately 1/2 oz. (15 ml) engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

CYLINDER LEAKAGE TEST

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

Use CYLINDER LEAKDOWN TESTER (HD-35667A) and 12 mm adapter and follow the instructions supplied with the tester.

PART NO.	SPECIALTY TOOL			
HD-35667A	Cylinder leakdown tester			
HD-45314	Crankshaft rotating wrench			

- 1. Run engine to normal operating temperature.
- 2. Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 3. Remove inspection cover.
- 4. Remove airbox cover, air filter top and air filter. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

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

- 5. Hold throttle wide open to observe the front cylinder intake valve through the intake port.
- Turn engine over in direction of operation with CRANK-SHAFT ROTATING WRENCH (HD-45314). Open the valve fully, then close. When the intake valve has closed on the valve seat, turn the engine an additional 1/4 turn.
- Slowly continue to turn the engine an additional 1/8th turn until the automatic compression release deactivates. The front cylinder is now close to TDC.
- To keep the engine from turning over when air pressure is applied to the cylinder, engage transmission in fifth gear and lock the rear brake anc hold engine with CRANKSHAFT ROTATING WRENCH (HD-45314) if needed.

NOTE

Before performing the cylinder leakage test, verify that the tester itself is free from leakage to obtain the most accurate test results. With a soap solution [applied around all tester fittings], connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.

 Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent of leakage. Leakage greater than 15% indicates internal engine problems. 10. Listen for air leaks at throttle body, exhaust pipe, head gasket and crankcase breather. Air escaping through the throttle body indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

If air is escaping through valves, measure and adjust valve lash as required. See 1.22 VALVE LASH.

11. Repeat procedure on rear cylinder.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform COMPRESSION TEST or CYLINDER LEAKAGE TEST as described. If further testing is needed, remove suspect head(s) and inspect for the following:

Check Prior to Cylinder Head Removal

- 1. Crankcase overfilled.
- 2. Oil carryover.
- 3. Breather hose restricted.
- 4. Restricted oil filter.

Check After Cylinder Head Removal

- 1. Valve guide seals.
- 2. Valve guide to valve stem clearance.
- 3. Gasket surface of both head and cylinder.
- Cylinder head casting's porosity allowing oil to drain into combustion chamber.
- 5. Piston/ring failure.

STRIPPING MOTORCYCLE FOR SERVICE

GENERAL

NOTE

If cylinder head, crankcase, or transmission work needs to be performed, engine must be removed from chassis. See 2.9 ENGINE REPLACEMENT.

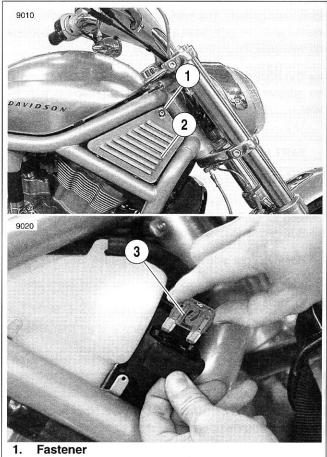
- 1. If engine is to be removed, position motorcycle on a lift with side extensions.
- 2. See Figure 3-7. Remove right side cover.
- 3. Remove maxi-fuse.
- 4. Remove the engine. See 2.9 ENGINE REPLACEMENT.

WARNING

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

AWARNING

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



2. Side cover

3. Maxi-fuse (40 amp)

Figure 3-7. Maxi-Fuse

ENGINE CRADLE AND STAND

See Figure 3-8. When the engine has been removed from the chassis, use HD-42310 BENCHTOP STAND or HD-43646 ROLLING STAND with HD-42310-40 ENGINE CRADLE. Threaded holes are provided in the upper engine half for attachment to the engine cradle. All fluids should be drained from the engine. Install engine as shown.

PART NO.	SPECIALTY TOOL		
HD-45646	Rolling stand		
HD-42310-40	Engine cradle		

1. See Figure 3-9. Using hardware provided with the engine cradle, install fasteners at rear.

2. See Figure 3-10. Using hardware provided with the engine cradle, install fasteners at front.

CAUTION

Dirt caked on fins and other areas can fall into crankcase bore or stick to subassemblies as parts are removed. Abrasive particles can damage machined surfaces or plug oil passageways. Remove all dirt and particles before disassembly to prevent component damage.

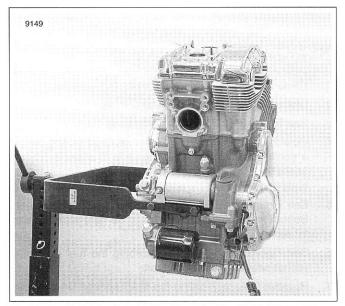


Figure 3-8. Engine In Engine Cradle (H-D 42310-40)

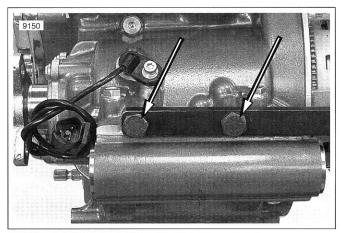


Figure 3-9. Cradle Attachment at Rear

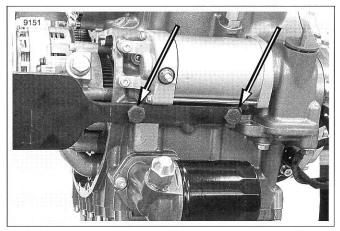


Figure 3-10. Cradle Attachment at Front

REMOVAL

- 1. Disconnect the idle speed control (IAC) connector.
- 2. Disconnect the throttle position (TP) sensor.
- 3. See Figure 3-11. Loosen throttle body clamps.
- 4. Detach throttle body from rubber seals by pulling up with a gentle rocking motion. If engine is in chassis, it is not necessary to disconnect throttle cables. Move throttle body and cables aside and secure away from engine.
- See Figure 3-12. Remove fuel rail/intake seal fasteners. Bottom nut is captured but should be held with a wrench for removal.
- 6. See Figure 3-13. Without disturbing the fuel rail, rotate rubber seal from under fuel rail.
- Remove fastener holding the MAP sensor. Un-plug connector [80].
- See Figure 3-15. Pull front injector from front intake runner.
- 9. With front injector free, swing fuel rail toward cam drive side and pull rear injector from rear intake runner.
- 10. See Figure 3-14. Unplug connector [84], front injector and connector [85], rear injector.
- 11. Unplug engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
- 12. Unplug engine harness at connector [145].
- 13. Disassemble and service fuel rail and fuel injectors. See 9.9 FUEL RAIL/FUEL INJECTORS.

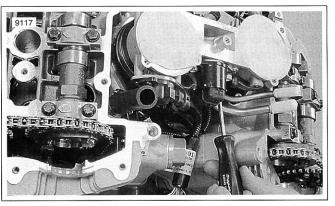


Figure 3-11. Loosen Throttle Body Clamps

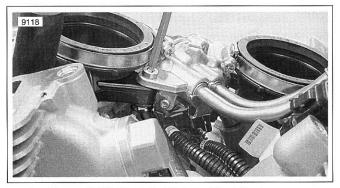


Figure 3-12. Fuel Rail/intake Seal Fasteners

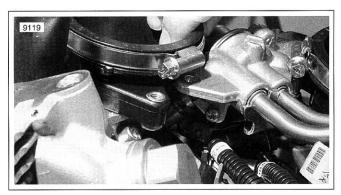


Figure 3-13. Rubber Seal



Figure 3-14. Fuel Rail with Injectors

INSTALLATION

- 1. Assemble fuel rail and fuel injectors. See 9.9 FUEL RAIL/ FUEL INJECTORS.
- 2. Connect engine harness at connector [145].
- 3. Connect engine coolant temperature sensor connector [90] and oil pressure sending unit connector [120].
- 4. See Figure 3-14. Connect connector [84], front injector and connector [85], rear injector on fuel rail.
- 5. Supporting fuel rail oriented with fuel tubes toward the left rear, push rear injector into bore in intake runner.
- 6. Swing fuel rail over and push front injector into intake runner in front cylinder.
- 7. Rotate rubber boots under fuel rail and install rubber boots over intake runners.
- Install fasteners through fuel rail into rubber boots. Tighten to 9.7 Nm (85 in-lbs).
- 9. See Figure 3-16. Orient intake clamps as shown.
- 10. Press throttle body and cables into rubber boots.
- 11. See Figure 3-17. Tighten intake hose clamps (7) to 1.25 Nm (11 in-lbs).
- 12. See 1.19 SPARK PLUG/COIL. Install spark plugs and coils. Tighten to:
 - a. Tighten spark plugs to 23 Nm (17 ft-lbs).
 - b. Tighten coil fasteners to 9.7 Nm (85 in-lbs).
- 13. Attach the idle speed control (IAC) connector.
- 14. Attach the throttle position (TP) sensor.
- 15. Install right angle connectors on rigid fuel lines from fuel rail. Push until audible "click" is heard.

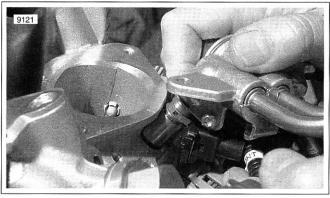


Figure 3-15. Front Injector

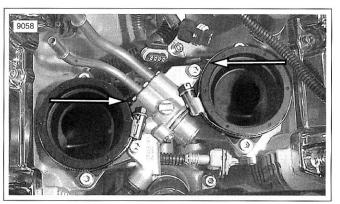


Figure 3-16. Throttle Body Intake Clamps

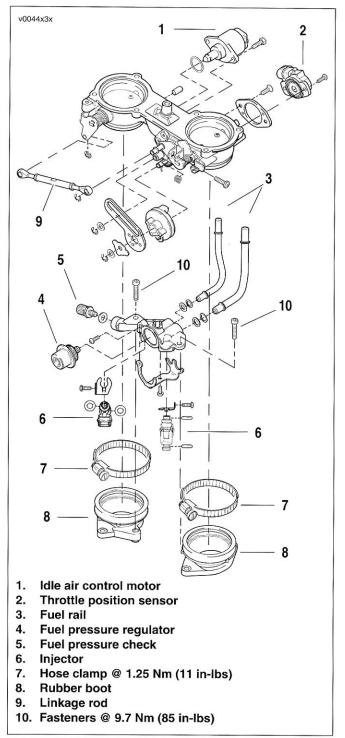


Figure 3-17. Throttle Body and Fuel Rail

CAM DRIVE REMOVAL

PART NO.	SPECIALTY TOOL	
HD-45314	Crankshaft rotating wrench	
HD-45653	TDC positioning tool	
HD-45306	Crankshaft locking pin	
HD-45491	Tappet compressing tool	

- 1. Remove plug top coils and spark plugs. See 1.19 SPARK PLUG/COIL.
- 2. Remove cam cover.
- 3. See Figure 3-18. 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.

CAUTION

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

- Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and engine is approaching TDC.
- See Figure 3-19. When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306).
- The crankshaft locking pin should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
- 7. Remove TDC POSITIONING TOOL (HD-45653) from front spark plug hole.

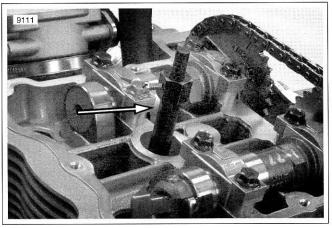


Figure 3-18. Top Dead Center Positioning Tool

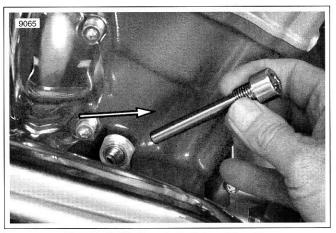


Figure 3-19. Crankshaft Locking Pln

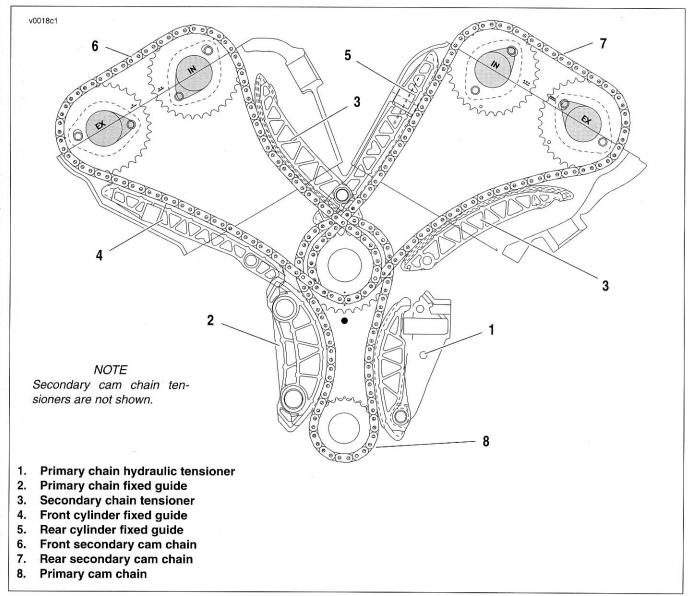


Figure 3-20. Cam Drive

- See Figure 3-21. Holding 36 mm rotor nut with CRANK-SHAFT ROTATING WRENCH (HD-45314), loosen rotor fastener. Air impact tool may be used for REMOVAL ONLY.
- 9. See Figure 3-22. Holding 36 mm rotor nut with CRANK-SHAFT ROTATING WRENCH (HD-45314), loosen starter limiter fastener.
- 10. See Figure 3-23. Loosen triple sprocket fastener.
- 11. See Figure 3-24. Remove rotor shell.

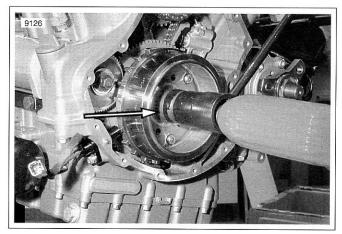


Figure 3-21. Rotor Fastener

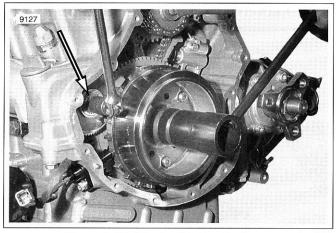


Figure 3-22. Starter Limiter Fastener

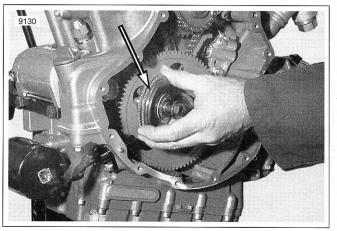


Figure 3-25. Starter Limiter Gear Assembly

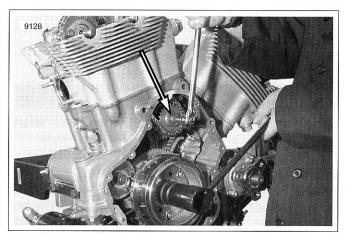


Figure 3-23. Triple Sprocket Fastener

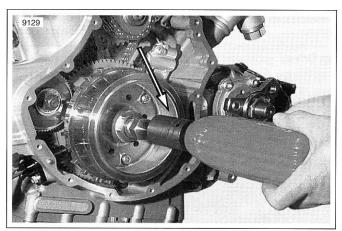


Figure 3-24. Rotor Shell

12. See Figure 3-25. Remove starter limiter fastener and starter limiter gear assembly.

WARNING

Always wear proper eye protection when removing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not excessively worn or damaged. Slippage may propel the ring with enough force to cause an accident. This could result in death or serious injury.

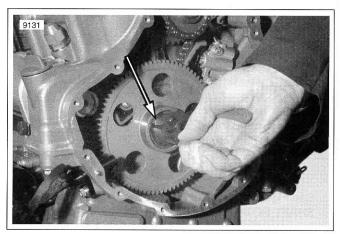


Figure 3-26. Snap Ring

- 13. See Figure 3-26. Remove snap ring from crankshaft.
- 14. See Figure 3-27. Slide snap ring, washer, and gear ball clutch with needle roller and cage assembly off of crank-shaft.
- 15. See Figure 3-28. For this procedure, the front cylinder cams are pre-loaded. Install TAPPET COMPRESSING TOOL (HD-45491) on front cylinder to aid in dissassembly.
 - a. Loosen 19 mm nut on tappet compressing tool.
 - b. Tools are marked intake and exhaust. Position them accordingly.
 - c. Use M6x25 fasteners to secure tools to head.
 - d. Tighten 19 mm nut to compress tappets.
- 16. See Figure 3-29. Remove secondary cam chain tensioner.

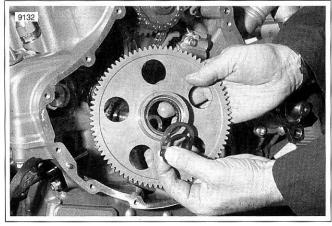


Figure 3-27. Snap Ring Removal

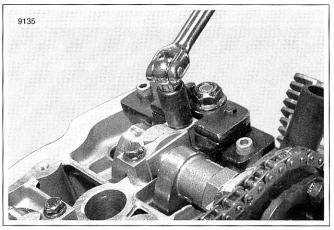


Figure 3-30. Cam Bearing Cap Removal

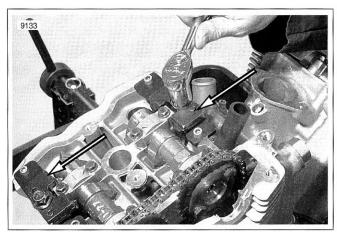


Figure 3-28. Tappet Compressing Tools (HD-45491)

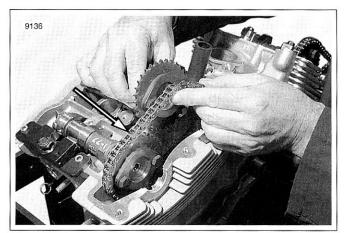


Figure 3-31. Cam Drive Chain

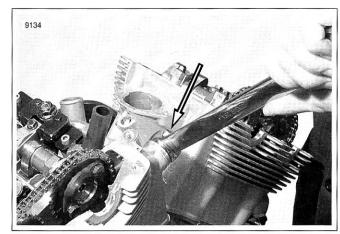


Figure 3-29. Remove Secondary Cam Chain Tensioner

- 17. See Figure 3-30. Remove cam bearing caps.
- 18. See Figure 3-31. Roll chain over cam drive gear. Lift cam and drive gear from head.
- 19. In this position the rear cams are not preloaded. Remove rear cylinder bearing caps. Disconnect cams from chain.
- 20. Remove chains.
- 21. Remove water pump cover.
- 22. See Figure 3-32. Remove water pump housing. Using a soft face hammer, GENTLY tap around edge of housing while exerting outward pressure.

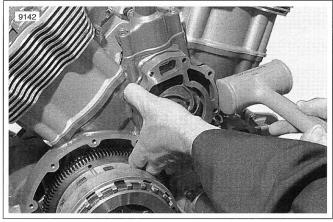


Figure 3-32. Removing Water Pump Housing

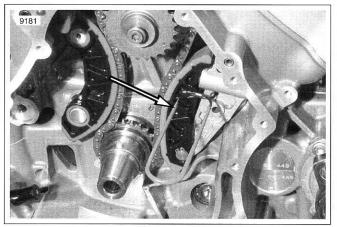
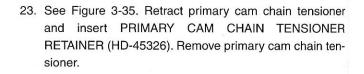


Figure 3-35. Primary Chain Tensioner Retainer (HD-45326)



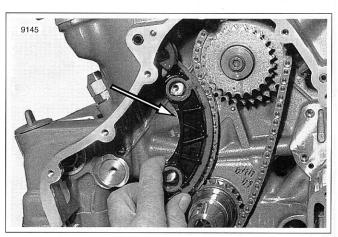


Figure 3-36. Primary Chain Fixed Guide

- 24. See Figure 3-36. Remove primary cam chain fixed guide.
- 25. See Figure 3-37. Remove the triple sprocket fastener.

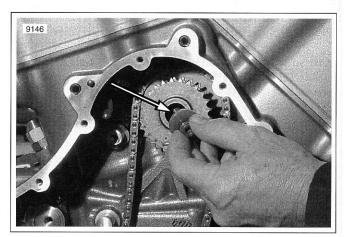


Figure 3-37. Triple Sprocket Fastener

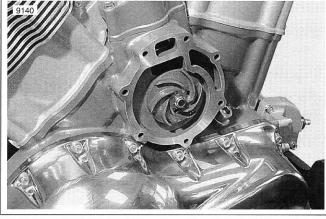


Figure 3-33. Water Pump Impeller/Bearing Housing

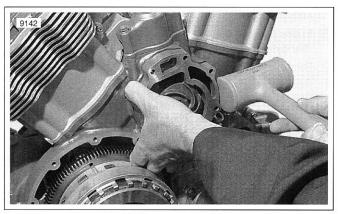


Figure 3-34.

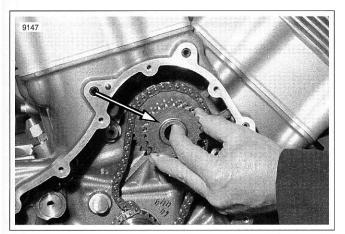


Figure 3-38. Triple Sprocket/Water Pump Shaft

- 26. See Figure 3-38. Push triple sprocket/water pump shaft through engine toward the clutch side.
- 27. See Figure 3-39. Remove triple sprocket and primary cam chain.

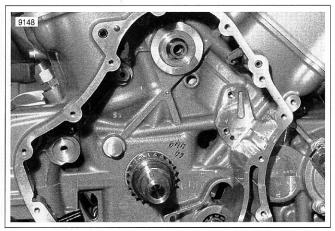


Figure 3-39. Triple Sprocket and Primary Cam Chain Removed

GENERAL

If TAPPET COMPRESSING TOOL (HD-45491) is in place from the cam drive removal process, remove it before proceeding. Removing the head with valves extended could result in damage.

REMOVAL AND DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-39786	Cylinder head holding fixture
HD-45333	Cylinder head holder
HD-45312	Cam chain tensioner guide pin remover/ installer
HD-45491	Tappet compressing tool
HD-34736-B	Valve spring compressor

- See Figure 3-41. Remove seven fasteners retaining head. The four main headbolts are external TORX E14. Use Snap-on tool 1MFLE140 to remove main headbolts.
- 2. Remove the cylinder heads.
- 3. See Figure 3-40. Use CYLINDER HEAD HOLDING FIX-TURE (HD-39786) and CYLINDER HEAD HOLDER (HD-45333) to secure cylinder head for service.

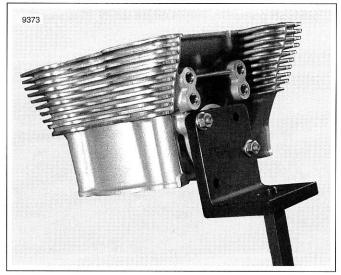


Figure 3-40. Cylinder Head Holder

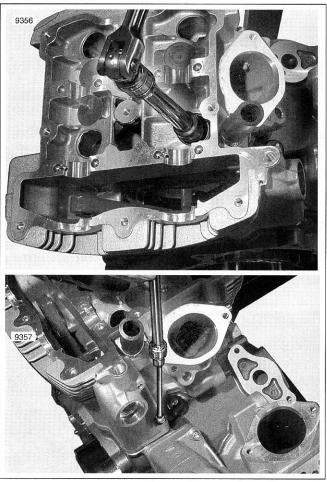


Figure 3-41. Cylinder Head Fasteners

- 4. See Figure 3-42. Use CAM CHAIN TENSIONER GUIDE PIN REMOVER/INSTALLER (HD-45312) to remove cam chain tensioner pins.
- 5. See Figure 3-43. Clean oil film from tappets and use marker to number tappets according to the cast in number at each valve. Remove tappets and shims and keep together for assembly in same position.
- 6. See Figure 3-44. Install VALVE SPRING COMPRESSOR (HD-34736-B). Remove valves, springs and keepers. Keep removed parts organized so they will be assembled in same position.
- 7. See Figure 3-45. Tightly wound coils are always installed to the bottom.

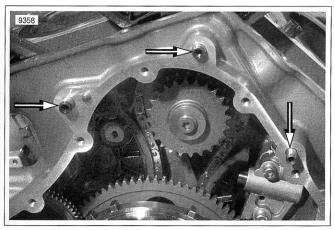


Figure 3-42. Cam Chain Tensioner Guide Pins

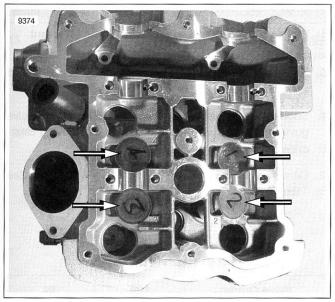


Figure 3-43. Number Tappets

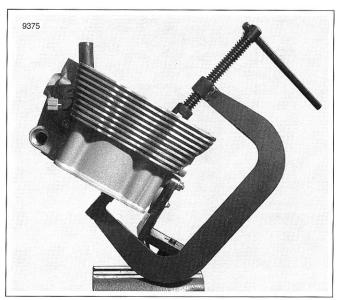


Figure 3-44. Valve Spring Compressor

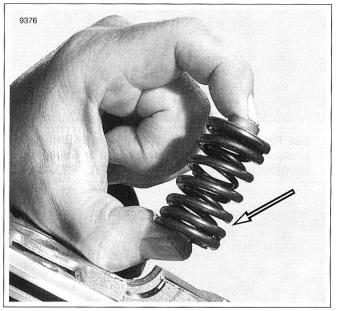


Figure 3-45. Valve Spring Coils

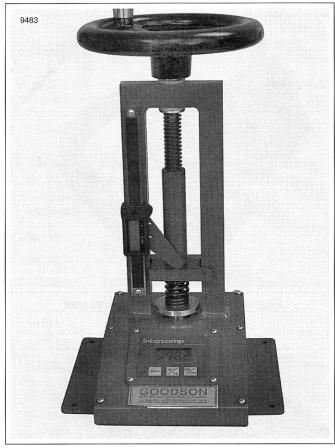


Figure 3-46. Valve Spring Compressor

8. See Figure 3-46. Check valve spring height and compression rate. Replace if spring height or spring rate is not within specification. See 3.1 SPECIFICATIONS.

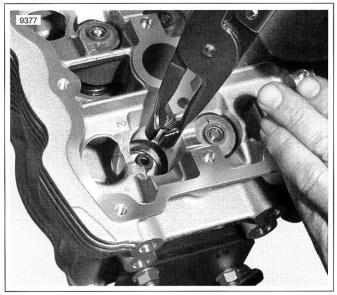


Figure 3-47. Valve Seal

9. See Figure 3-47. Remove valve guide seal with Snap-on tool number YA8230.

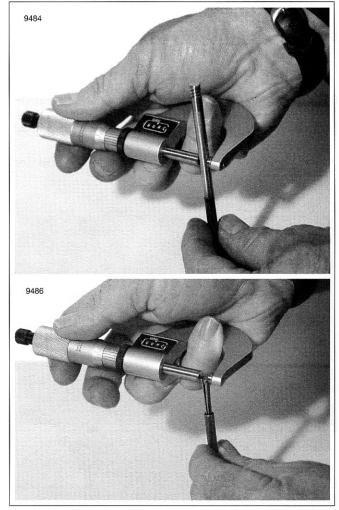


Figure 3-48. Valve Stem and Guide Measurement

- 10. See Figure 3-48. Measure valve stem diameter and valve guide bore.
- 11. Subtract the valve stem measurement from the valve guide bore measurement to calculate the running clearance.
- 12. Compare the measurements to the following table. See Table 3-29.

Table 3-29. Valve Guide Running Clearance

Valve (Guide	ММ	IN
Intake	Min	0.0285	0.0012
	Max	0.0585	0.0023
Exhaust	Min	0.0385	0.0016
	Max	0.0685	0.0026

NOTE

Do not remove valve guides within valve guide running clearance. See Table 3-29. See Figure 3-49. Remove and replace the valve guides that do not meet specifications. Position head for removal of valve guide. Use CYLINDER HEAD SUPPORT STAND (HD-39782) with CYLINDER SUPPORT ADAPTER (HD-39782-13) for intake valves and CYLIN-DER SUPPORT ADAPTER (HD-39782-14) for exhaust valves.

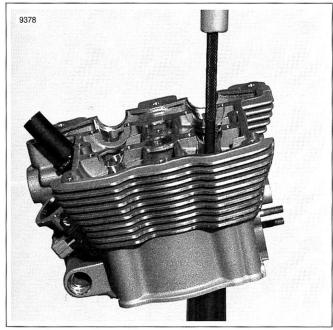


Figure 3-49. Valve Guide Removal

- See Figure 3-50. Measure cylinder valve guide bore to determine valve guide diameter needed. Select valve guide no larger than 0.051 mm (0.0020 in.) to 0.022 mm (0.00086 in.) over size of cylinder bore.
- See Figure 3-51. Use VALVE GUIDE REMOVER/ INSTALLER (HD-45320) to install valve guide at correct height.

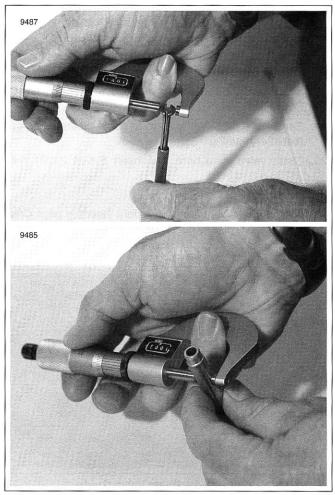


Figure 3-50. Valve Guide Dimensions

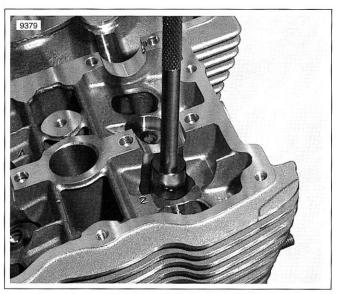


Figure 3-51. Valve Guide Installation

- 16. See Figure 3-52. Use VALVE GUIDE REAMER (HD-45319) to return installed guide to correct diameter.
- 17. See Figure 3-53. Use VALVE GUIDE FLEX HONE (HD-45321) to get the correct surface finish for proper valve stem-to-guide fit and lubrication.
- 18. See Figure 3-54. Clean valve guide with VALVE GUIDE CLEANING BRUSH (HD-34751).
- 19. See Figure 3-55. Verify stem to guide clearance is correct after reaming.
- 20. Clean valve stem bore and insert 6 MM PILOT (HD-35758-51) in bore.

NOTE ALWAYS clean valve stem bore before inserting pilot. Clean bores of all valve guides not replaced as well.

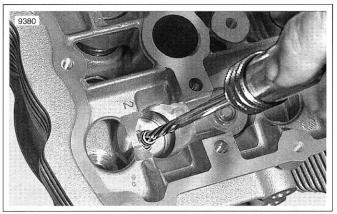


Figure 3-52. Ream Valve Guide

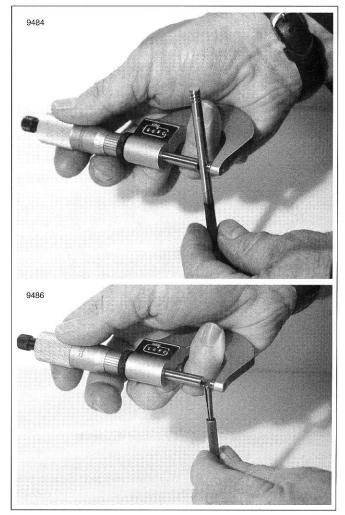


Figure 3-55. Measure Stem to Guide Clearance

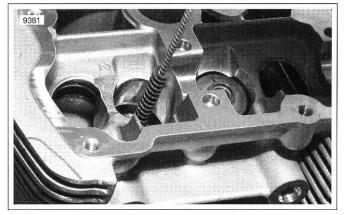


Figure 3-53. Hone Valve Guide

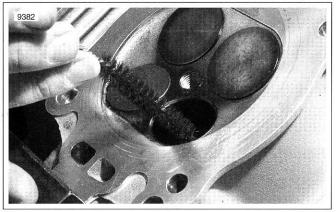


Figure 3-54. Valve Guide Cleaning Brush (HD-34751) 3-30 2003 VRSCA: Engine

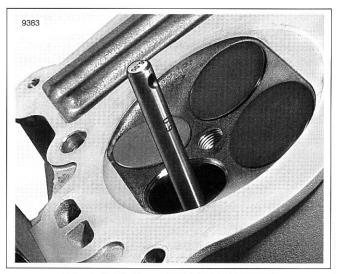


Figure 3-56. 6 mm Pilot (HD-35758-51)

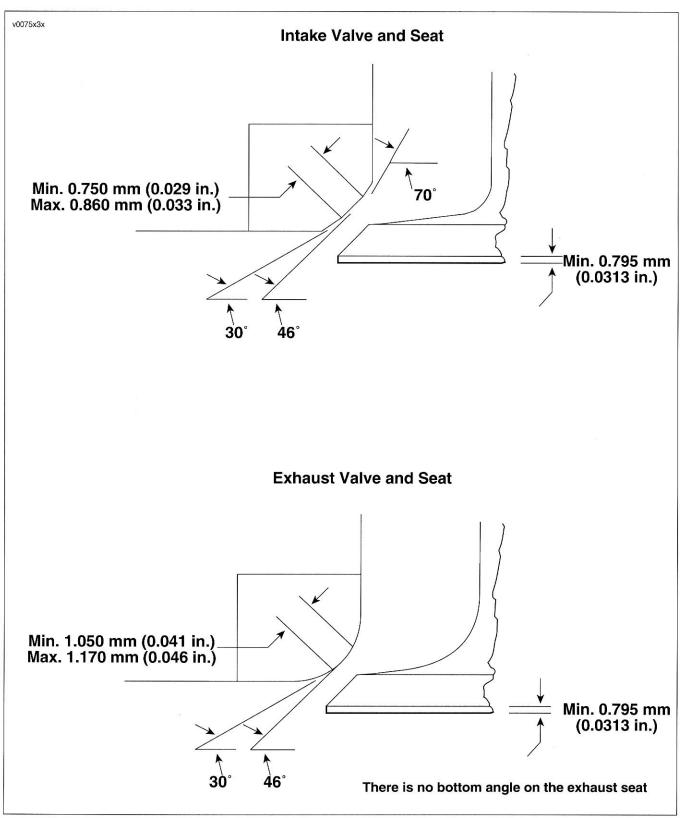


Figure 3-57. Valve and Seat Dimensions

PROCEDURE FOR USING THE NEWAY VALVE SEAT CUTTER

PART NO.	NEWAY NO.	SPECIALTY TOOL
HD-45333		Cylinder head holder
HD-39786		Cylinder head holding fixture
HD-35758-51		6 mm pilot
HD-35758-53	203	46°/31° Exhaust seat cutter
HD-35758-54	271	70° Intake seat cutter
HD-35758-A	622	46°/31° Intake seat cutter
HD-34751		Cleaning brush

NOTE

Verify correct valve stem to valve guide clearance before refacing. See Table 3-6. If **new** guides must be installed, complete that task before refacing valves and seats.

NOTE

This procedure is not based on the lapping of valves. The end result is an interference fit between the valve of 45° and the valve seat which will be 46° .



Figure 3-58. Cylinder Head Holder

- See Figure 3-58. Use CYLINDER HEAD HOLDING FIX-TURE (HD-39786) and CYLINDER HEAD HOLDER (HD-45333) to secure cylinder head for service.
- From the NEWAY VALVE SEAT CUTTER SET (HD-35758A) use # 622 and cut intake (# 203 for exhaust) valve seat angle to 46°. Do not remove any more metal than is necessary to clean up the seat (that is, to provide a uniform finish and remove pitting).
- In order to determine the correct location of the 46° valve seat in the head, measure the width of the valve to be used and subtract 1.02 mm (0.040 in.) from that number.
- Set your dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.

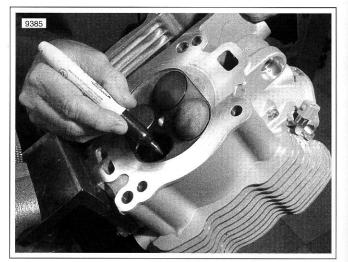


Figure 3-59. Mark Valve Seat

5. Use a permanent magic marker to highlight the valve seat area that is going to be cut and be sure to highlight all 3 angles. Allow marker to dry before proceeding.

NOTE

Always ensure cutter blades and cutter pilot are clean before beginning the cutting process. The correct cleaning brush is supplied with the Neway tool set. Also ensure the inside of the valve guide is clean by using Kent-Moore CLEANING BRUSH (HD-34751).

- 6. Choose the cutter pilot that fits properly into the valve guide hole and securely seat the pilot by pushing down and turning using the installation tool supplied in the tool set.
- Choose the proper 46° cutter (intake or exhaust) and gently slide the cutter onto the pilot being careful not to drop the cutter onto the seat.

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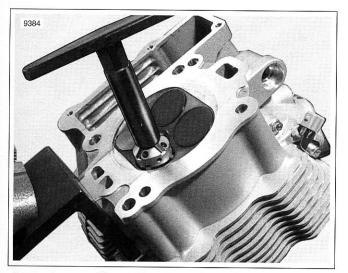


Figure 3-60. Neway Cutter

 While applying a constant and consistent pressure, remove just enough material to show a complete cleanup on the 46° angle.

NOTE

If the width of the clean-up angle is greater on one side of the seat than the other, the guide may need to be replaced due to improper installation.

NOTE

After making the 46° cut, if you discover a groove cut completely around the seat this means the blades of the cutter are in alignment and need to be staggered. This is accomplished by loosening all of the blades from the cutter body and moving each blade slightly in it's cradle in opposite directions on the cutter. The tool needed to loosen the blades is supplied in the tool set. A permanent magic marker mark every 90° will help in determining where new angles are.

- Next, with your dial caliper locked to the predetermined setting, measure the 46° cut at the outer most edge at the widest point of the circle to determine what cut needs to be made next.
 - a. If the 46° cut is to high (towards the combustion chamber), use the 31° cutter to lower the valve seat closer to the port.
 - b. If the 46° cut is too low, and the width of the valve seat is too wide, use the 70° (intake only) cutter to raise the valve seat or move it away from the port.

NOTE

Due to using the top measurement of our valve seat as a reference point it will usually be necessary to use the 31° cutter following the initial 46° cut.

NOTE

On Revolution engines, do not cut the bottom angle on the exhaust seat.

NOTE

Always highlight the valve seat with the permanent magic marker in order to ensure the location of the 46° valve seat.

- 10. If the location of the valve seat is not correct, repeat steps 6 through 8.
- 11. When you accomplish a complete clean-up of the 46° angle and the width is at least 0.750 mm (0.029 in.) for intake or 1.050 mm (0.041 in.) for exhaust, proceed to the next step.
- 12. Select the proper 70° cutter (for intake) and gently slide the cutter down the cutter pilot to the valve seat. The exhaust does not have a bottom angle.
- 13. See Figure 3-57. Remove just enough material to provide the proper valve seat width.
- 14. Remove cutter pilot and wash head thoroughly and dry completely.
- 15. Repeat the process on any valve seat that needs service.
- 16. Insert valve to be used in the valve guide and bottom on the valve seat. Positioning the cylinder head port upwards and with slight thumb pressure against the valve, completely fill the port with solvent to verify proper seal between the valve and the valve seat.

NOTE

Hold pressure against the valve for a minimum of 10 seconds. If any leakage occurs, examine the valve seat for irregularities or defects and if necessary repeat the above cutting process.

HEAD ASSEMBLY

PART NO.	SPECIALTY TOOL			
HD-45322	Valve guide seal installer			
HD-34736-B	Valve spring compressor			

- 1. Thoroughly clean head before beginning assembly.
- 2. See Figure 3-61. Insert lower spring collar.
- 3. Lubricate valve with Harley-Davidson Motorcycle Oil 20W50 and position in head.
- See Figure 3-62. Place VALVE GUIDE SEAL INSTALLER (HD-45322) tapered pin over valve stem and position new seal on the tapered pin. Drive seal into position.

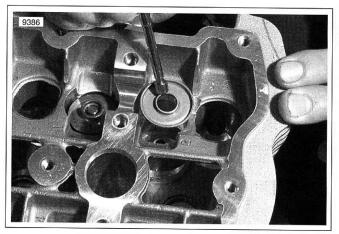


Figure 3-61. Lower Spring Collar

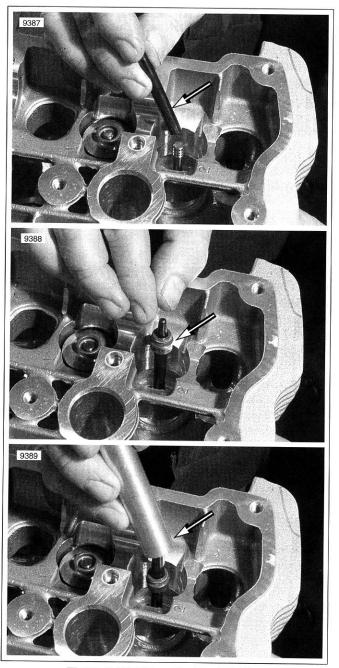


Figure 3-62. Valve Seal Installation

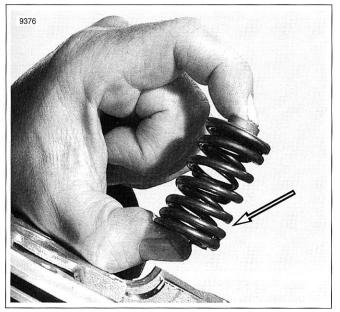


Figure 3-63. Valve Spring Coils

spring and with tightly wound coils to the bottom.

5.

See Figure 3-63. Install upper spring collar and valve

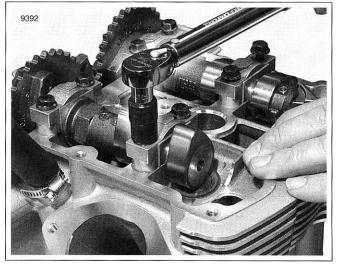


Figure 3-65. Cam Journal Caps @ 9.7 Nm (85 in-lbs)

12. See Figure 3-65. Install cams and cam journal caps. Tighten cam journal caps to 9.7 Nm (85 **in-lbs**).

NOTE To accurately check valve lash, cam journal caps MUST be tightened to 9.7 Nm (85 **in-Ibs**).

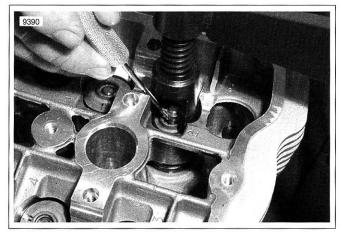


Figure 3-64. Install Valve Keepers

- See Figure 3-64. Install VALVE SPRING COMPRESSOR (HD-34736-B) and compress spring to expose valve stem. Apply a light grease around the valve stem to hold keepers in position when relaxing the compressor tool.
- 7. Install valve keepers and remove compressor tool.
- 8. Using a micrometer measure and record for reference all valve shims.
- Install all valve shims in their original location. Use a magnet to position the shim and push into place with finger.
- 10. Replace tappets in their original locations.
- Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

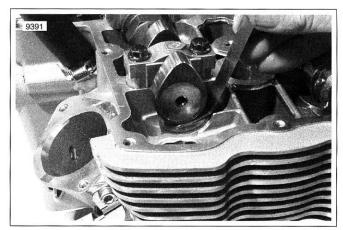


Figure 3-66. Check Valve Lash

- See Figure 3-66. Using a blade type feeler gauge measure valve lash. See LASH MEASURMENT in 1.22 VALVE LASH and D.2 VALVE LASH CALCULATION WORKSHEET 1.
- 14. Adjust valve lash as required. See LASH MEASUR-MENT in 1.22 VALVE LASH.

NOTE

Valve lash can be measured and adjusted before the heads are installed on engine. However, after head installation, valve lash should be measured and adjusted as required.

REPLACEMENT

1. See Figure 3-67. With oil pump on engine, loosen bypass fastener and front cover fasteners.

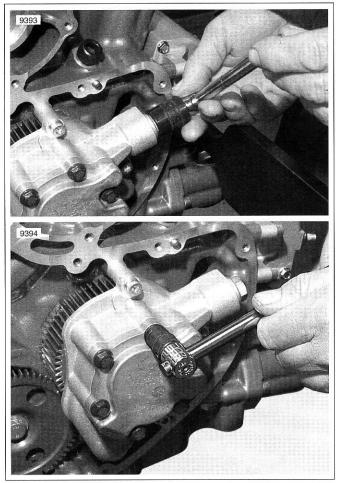


Figure 3-67. Oil Pump Fasteners

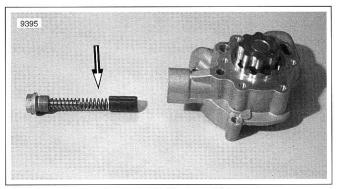


Figure 3-69. Bypass Valve

3. See Figure 3-69. Remove bypass valve assembly. Examine valve piston and valve piston bore in pump housing. There should be no scoring and valve piston should move freely in the bore without sticking.

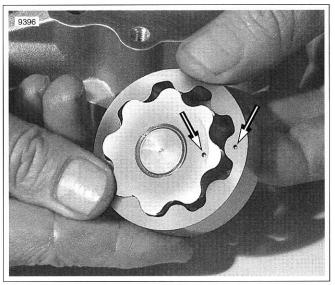


Figure 3-70. Oil Pump Gerotor

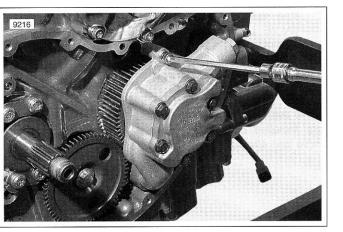


Figure 3-68. Remove Oil Pump

- See Figure 3-68. Remove three fasteners holding oil pump in case.
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4. See Figure 3-70. Examine gerotor. Replace parts showing scoring. Note assembly marks on the gerotor. Marks must be on the same side when assembling.

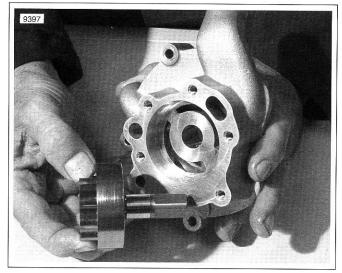


Figure 3-71. Lubricate Assembly

 See Figure 3-71. Thoroughly lubricate during assembly. Pack pump housing with Lubriplate No. 105 (NAPA Part No. 765-2651) to insure oil pick-up is immediate.

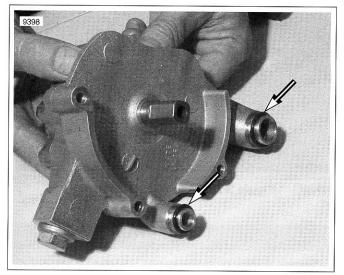


Figure 3-72. Lubricate O-Rings

6. See Figure 3-72. Install **new** o-rings and lubricate with Harley-Davidson Motorcycle Oil 20W50.

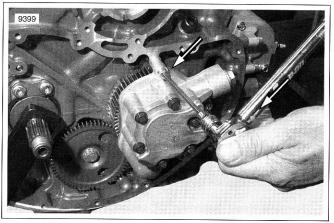


Figure 3-73. Oil Pump Installation @ 9.7 Nm (85 in-lbs)

7. See Figure 3-73. Install pump in engine. Tighten three fasteners to 9.7 Nm (85 in-lbs).

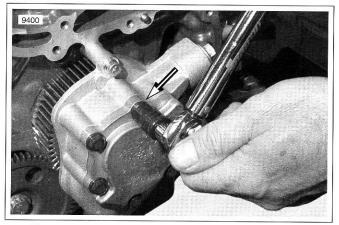


Figure 3-74. Oil Pump Cover @ 9.7 Nm (85 in-lbs)

- 8. See Figure 3-74. Using a crisscross pattern, tighten the oil pump cover fasteners to 9.7 Nm (85 **in-lbs**).
- 9. Tighten bypass fastener to 35 Nm (25 ft-lbs).

REMOVAL

PART NO.	SPECIALTY TOOL	
HD-45318	Clutch hub holder	

- 1. See Figure 3-75. If engine is in chassis, remove secondary clutch actuator cover.
- 2. Remove three fasteners on secondary clutch actuator and remove from clutch housing. Wrap clutch actuation cylinder with shop towel and secure away from engine.
- 3. See Figure 3-76. Remove clutch side crankcase cover.

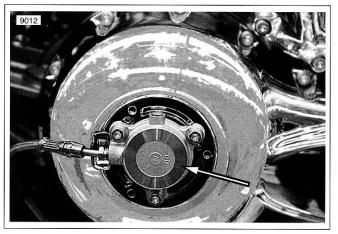


Figure 3-75. Secondary Clutch Actuator

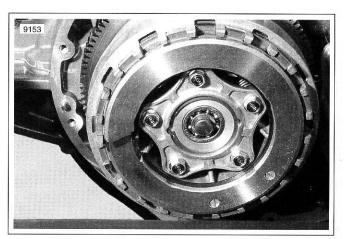


Figure 3-76. Clutch Cover Removed

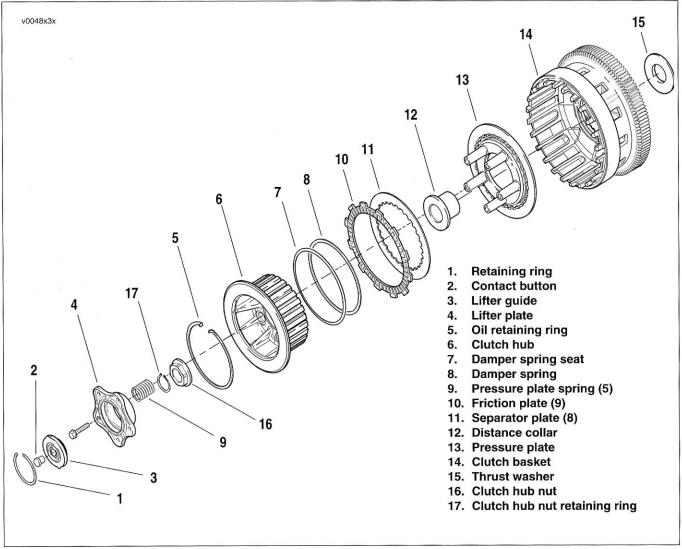


Figure 3-77. Clutch

AWARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

4. See Figure 3-78. Remove retaining ring and lifter guide.

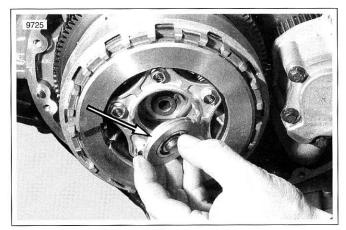


Figure 3-78. Lifter Guide

- 5. See Figure 3-79. Remove clutch hub retaining ring and nut.
- 6. See Figure 3-77. and Figure 3-80. Remove oil retaining clip (5) for proper tool installation.
- See Figure 3-81. Install CLUTCH HUB HOLDER (HD-45318). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

CAUTION

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

8. See Figure 3-82. It may be necessary to rotate engine slightly to properly engage the clutch hub.

CAUTION

When LOCTITE[®] cannot be broken under normal conditions with conventional methods, apply moderate heat or use an air impact wrench ONLY TO LOOSEN clutch hub mainshaft nut. Failure to do so may result in damaged clutch hub and/or threads.

CAUTION

When applying heat to the clutch hub mainshaft nut, do so carefully. Excessive heat will damage pressure plate springs.

AWARNING

Use extreme caution when operating propane torch. Read the manufacturer's instructions carefully before use. Do not direct open flame or heat toward any fuel system component. Extreme heat can cause fuel ignition and explosion. Inadequate safety precautions could result in death or serious injury.

 See Figure 3-84. Heat clutch hub nut with a propane torch to loosen LOCTITE[®]. An air impact can be used to (REMOVAL ONLY) remove nut.

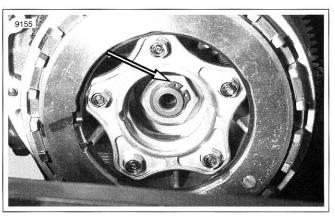


Figure 3-79. Clutch Hub Nut Retaining Ring

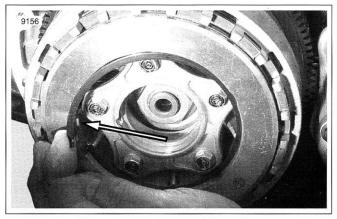


Figure 3-80. Oil Retaining Clip

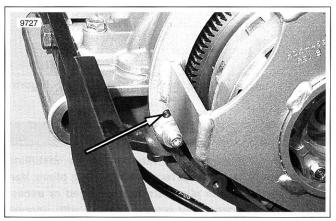


Figure 3-81. Clutch Hub Holder Dowel Pin Position

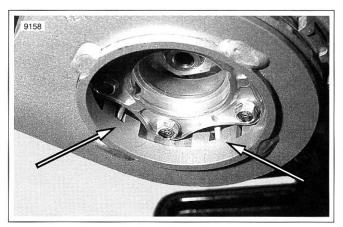


Figure 3-82. Tool and Hub Properly Engaged

10. See Figure 3-83. Remove clutch hub nut.

NOTE

Clutch hub nut is one-time-use only. Always use a new nut for assembly (Part No. 8008M).

- 11. See Figure 3-85. Remove clutch assembly.
- 12. See Figure 3-86. Note position of thrust washer behind the clutch basket.
- 13. Remove CLUTCH HUB HOLDER (HD-45318).

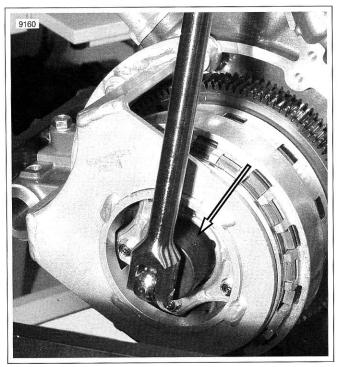


Figure 3-83. Remove Clutch Hub Nut

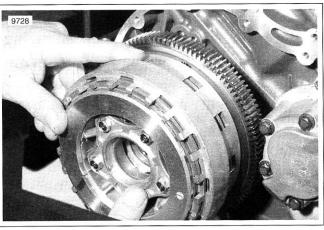


Figure 3-85. Remove Clutch Assembly

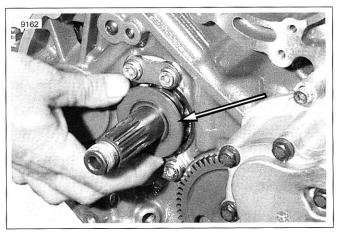


Figure 3-86. Thrust Washer Position

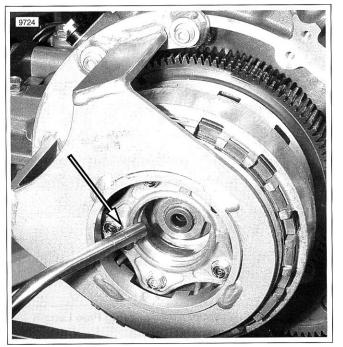


Figure 3-84. Heat Clutch Hub Nut

DISASSEMBLY

- 1. Use a marker to mark clutch basket and clutch pack for assembly.
- 2. See Figure 3-87. Remove clutch pack from clutch basket.
- 3. See Figure 3-88. To prevent breaking lifter plate, slowly loosen (2-3 turns at a time) fasteners in a crisscross pattern.
- 4. See Figure 3-89. Remove clutch springs and measure clutch spring free length.
- 5. Replace clutch springs if free length is less than 43 mm (1.7 in).
- 6. Slide hub from the clutch plate. Remove friction plates and steel plates for inspection.

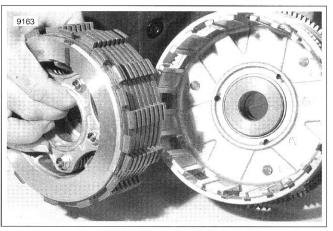


Figure 3-87. Remove Clutch Pack



Figure 3-88. Lifter Plate Fasteners

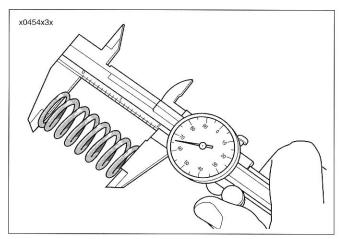


Figure 3-89. Measure Clutch Spring Free Length

CLEANING AND INSPECTION

ASSEMBLY

AWARNING

Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.

- 1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Blow parts dry with low pressure compressed air.
- 2. Check friction plates as follows:
 - a. Blow off all lubricant from the friction plates. Do not wipe off with a rag.
 - Measure the thickness of each plate with a dial caliper or micrometer.
 - c. If the thickness of any plate is less than 3.62 mm (0.142 in.), discard all friction plates and replace with an entirely **new** set.
 - d. Look for worn or damaged fiber surface material (both sides).

NOTE

Replace all nine friction plates with an entirely new set if any individual plate shows evidence of wear or damage. Friction plates must be presoaked before installation.

- 3. Check the steel plates as follows:
 - a. Discard any plate that is grooved or bluish in color. Blue plates are likely warped or distorted.
 - b. Check each plate for distortion. Lay the plate on a precision flat surface. Insert a feeler gauge between the plate and the flat surface in several places. Replace any steel plate that is warped more than 0.15 mm (0.006 in.).
- 4. Holding the clutch hub, rotate the pressure plate to check bearing for smoothness. Replace the bearing if it runs rough, binds or has any end play.
- 5. Check the slots that mate with the clutch plates on both the clutch shell and hub. Replace shell or hub if slots are worn or damaged.

PART NO.	SPECIALTY TOOL
HD-45654	Clutch disc aligning spacer
HD-45318	Clutch hub holder

1. See Figure 3-90. Place flat steel damper spring seat on the clutch outer hub. Position the damper spring on the damper spring seat with concave side up.

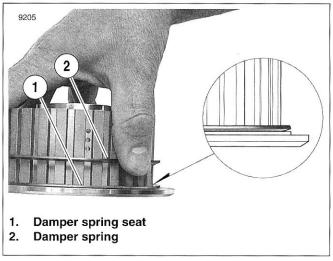


Figure 3-90. Damper Spring Position

NOTE

New plates should be soaked for 10 minutes in Harley-Davidson Motorcycle Oil 20W50 and assembled wet.

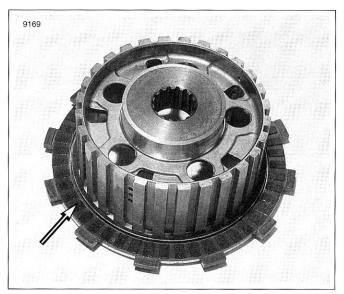


Figure 3-91. Friction Plate

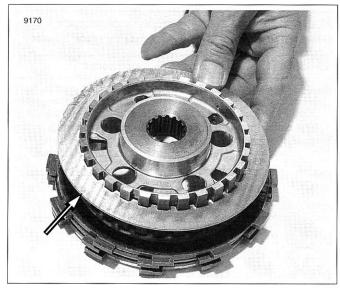


Figure 3-92. Steel Plate

 See Figure 3-91. See Figure 3-92. Install friction plate first and then a steel plate. Install the remaining plates (9 friction plates and 8 steel plates) in the same manner, alternating between friction plates and steel plates, ending with a friction plate.

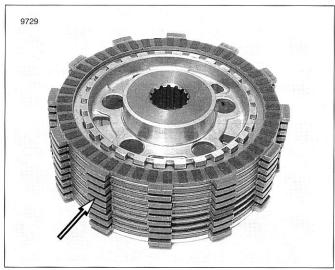


Figure 3-93. Align Friction Plates

3. See Figure 3-93. Align ears on friction plates as shown.

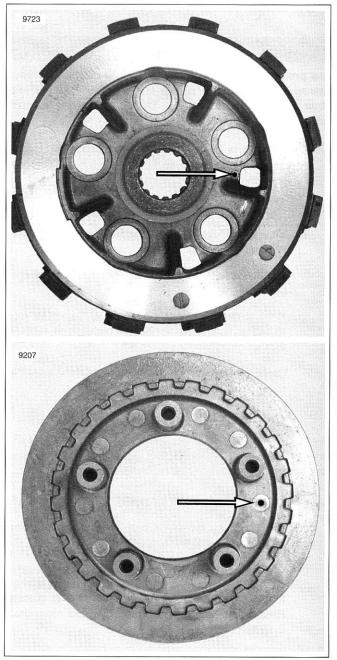


Figure 3-94. Alignment Marks

4. See Figure 3-94. Note the alignment marks on the pressure plate and the clutch outer hub. The outer hub and pressure plate are balanced assemblies and must be aligned correctly.

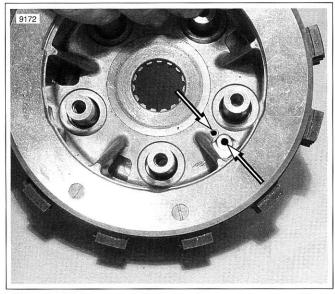
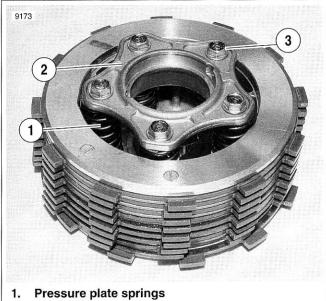


Figure 3-95. Align Clutch Outer Hub and Pressure Plate

5. See Figure 3-95. Assemble the clutch hub (with plates in place) and pressure plate with the marks aligned as shown. Full engagement of hub and pressure plate will only occur if alignment is correct.



- Lifter plate 2.
- Fasteners 3.

Figure 3-96. Align Clutch Hub and Pressure Plate

6. See Figure 3-96. Install the five pressure plate springs over the threaded bosses on the pressure plate. Position the lifter plate over the springs and install fasteners loose enough to allow the clutch plates to be moved for final alignment.

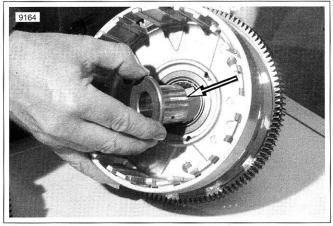


Figure 3-97. Distance Collar

7. See Figure 3-97. Insert distance collar in clutch basket as shown.

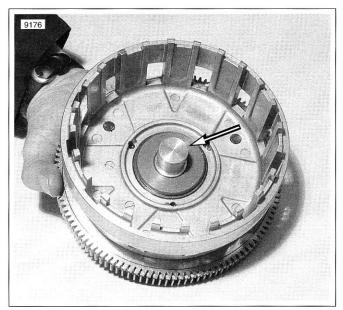


Figure 3-98. Clutch Disc Aligning Spacer (HD-45654)

8. See Figure 3-98. Insert CLUTCH DISC ALIGNING SPACER (HD-45654) from the primary gear side.

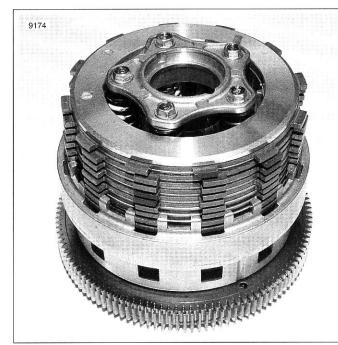


Figure 3-99. Insert Clutch Pack in Clutch Basket

9. See Figure 3-99. Align friction plate ears so clutch pack assembly drops into clutch basket under its own weight.

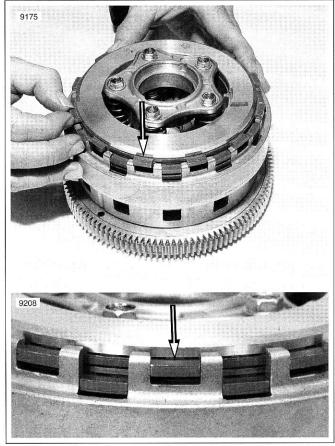


Figure 3-100. Align Friction Plates

10. See Figure 3-100. Top friction plate must be indexed to fit in the top slot of the clutch basket.

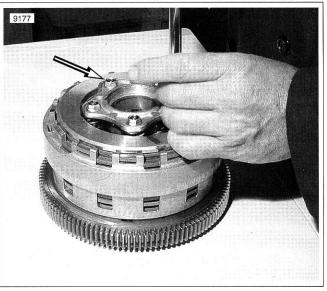


Figure 3-101. Spring Screws

11. See Figure 3-101. Using a crisscross pattern, tighten five spring screws to 9.7 Nm (85 **in-lbs**).

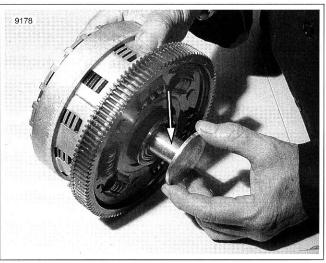


Figure 3-102. Remove Tool HD-45654

12. See Figure 3-102. Remove CLUTCH DISC ALIGNING SPACER (HD-45654).

INSTALLATION

- 1. See Figure 3-103. Separate clutch pack from the clutch shell.
- 2. See Figure 3-104. Check position of thrust washer.
- 3. See Figure 3-105. Slide clutch basket on to the input shaft.
- 4. See Figure 3-106. Clutch basket will not go completely into position until the spring loaded backlash gear is aligned. Use a suitable drift pin in hole to align backlash gear.

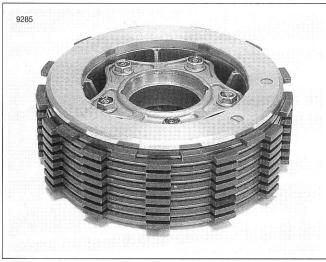
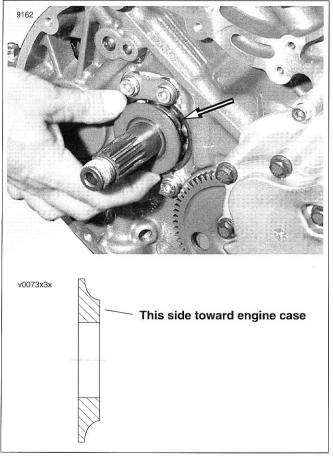


Figure 3-103. Clutch Pack



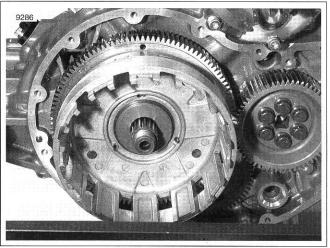


Figure 3-105. Clutch Basket

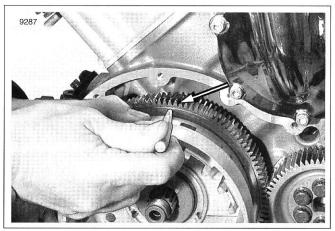


Figure 3-106. Back Lash Gear Alignment

Figure 3-104. Thrust Washer Position

- 5. See Figure 3-107. Slide clutch pack into clutch housing. It may be necessary to rotate input shaft to align splines of shaft and outer hub.
- See Figure 3-81. Install CLUTCH HUB HOLDER (HD-45318). The clutch hub holder can only be installed in one position. The engine case dowel pin must match the hole in the tool.

CAUTION

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

7. See Figure 3-82. If necessary, rotate engine slightly to properly engage the clutch hub.

NOTE

Clutch hub nut is one-time-use only. Always use a **new** nut for assembly (Part No. 8008M).

8. See Figure 3-108. Install a **new** clutch hub nut and tighten to 220 Nm (162 ft lbs).

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

- 9. Install new clutch hub retaining ring.
- 10. Install oil retaining ring.
- 11. Install lifter guide and retaining ring.
- 12. See Figure 3-109. Install clutch side crankcase cover. Tighten fasteners in sequence to 9.7 Nm (85 **in-lbs**).
- Press secondary clutch actuator into its mounting flange on crankcase cover. Install fasteners and tighten to 10 Nm (89 in-lbs).
- 14. Install secondary clutch actuator cover. Tighten to 6-10 Nm (53-89 in-lbs).

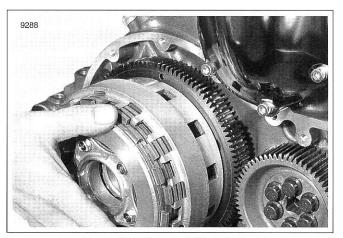


Figure 3-107. Install Clutch Pack

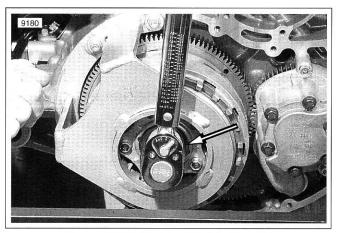


Figure 3-108. Tighten Clutch Hub Nut

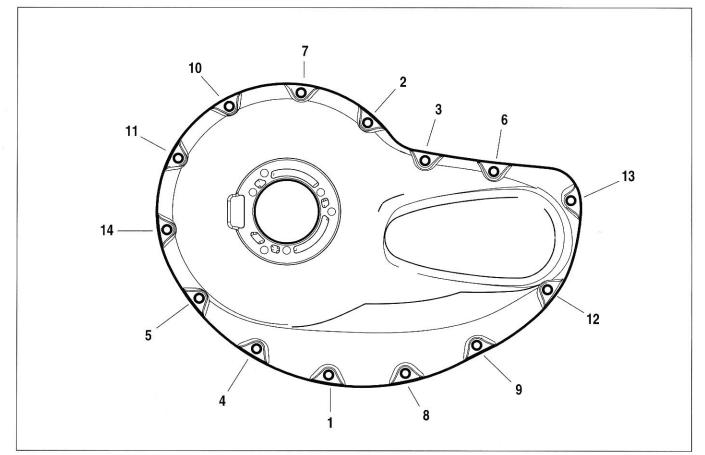


Figure 3-109. Clutch Side Crankcase Cover Torque Sequence @ 9.7 Nm (85 in-lbs)

DISASSEMBLY

PART NO.	SPECIALTY TOOL	
HD-45304	Alternator stator cover remover/installer tool	
HD-45340	D-45340 Gasket alignment dowels	
HD-45301	ID-45301 Transmission assembly retainer tool	

- 1. Remove inspection cover. Remove the 14 fasteners on the alternator cover.
- 2. See Figure 3-110. Using the inspection cover fasteners, position the ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (HD-45304) as shown.
- 3. Install GASKET ALIGNMENT DOWELS (HD-45340) in two of the alternator cover holes to steady the cover as it is removed.
- 4. Remove the alternator cover.
- 5. See Figure 3-111. Remove the clutch cover.
- 6. See Figure 3-112. Remove clutch assembly. See 3.13 CLUTCH.

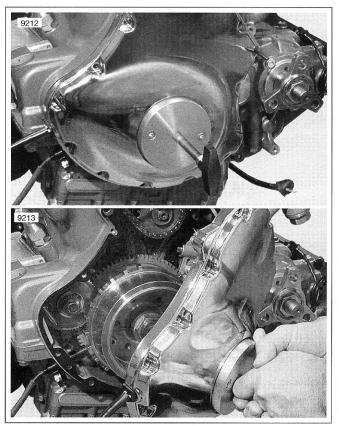


Figure 3-110. Remove Alternator Cover

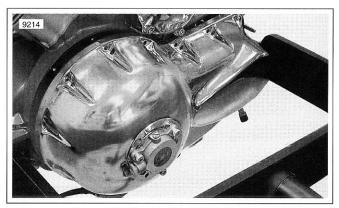


Figure 3-111. Remove Clutch Cover

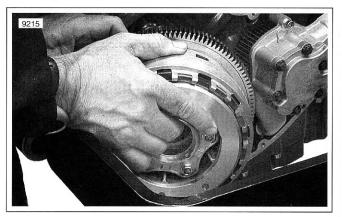


Figure 3-112. Remove Clutch Assembly

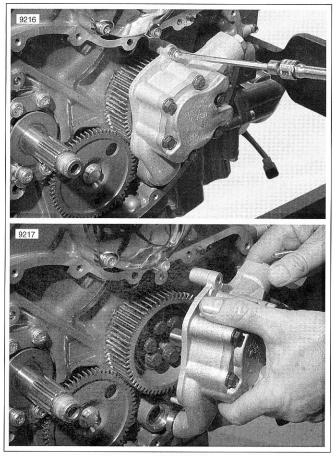


Figure 3-113. Oil Pump

7. See Figure 3-113. Remove three fasteners holding oil pump in case.

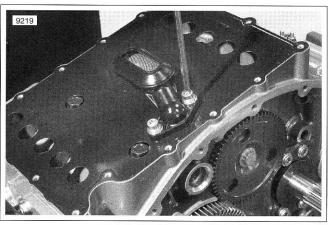


Figure 3-115. Oil Pickup

9. See Figure 3-115. Remove oil pickup and gasket/baffle.

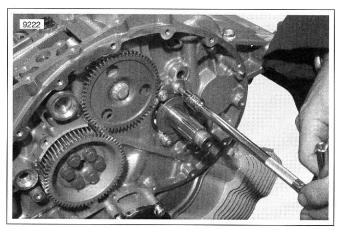


Figure 3-116. Input Bearing Retainer

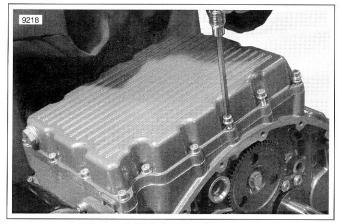


Figure 3-114. Oil Pan Removal

8. Carefully invert engine. Remove oil pan. Note position of engine ground cable for assembly.

10. See Figure 3-116. Loosen, but do not remove, the input bearing retainer fasteners.

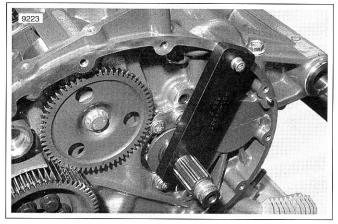


Figure 3-117. Input Shaft Retainer

11. See Figure 3-117. Install TRANSMISSION ASSEMBLY RETAINER TOOL (HD-45301) on the input shaft.

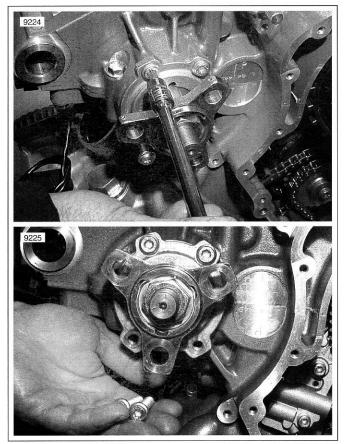


Figure 3-118. Output Shaft Seal Retainer

- 12. See Figure 3-118. Loosen all four output shaft seal retainer fasteners. Remove the two fasteners from the upper case, leaving the loosened lower case fasteners in place. These fasteners will keep the transmission positioned in the lower crankcase.
- 13. See Figure 3-119. Remove the 19 case fasteners.
- 14. Carefully separate the case halves. Use of a rubber mallet may be necessary to loosen the sealed case halves.

CAUTION

Do not pry on sealing surfaces to separate case halves. Engine damage and/or case leaks may result.

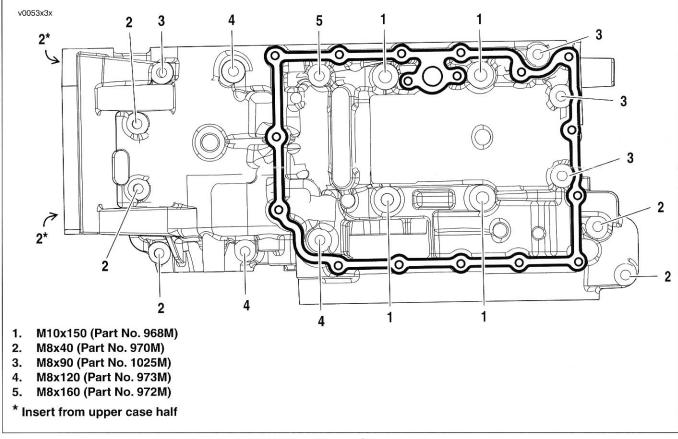


Figure 3-119. Engine Case Fasteners

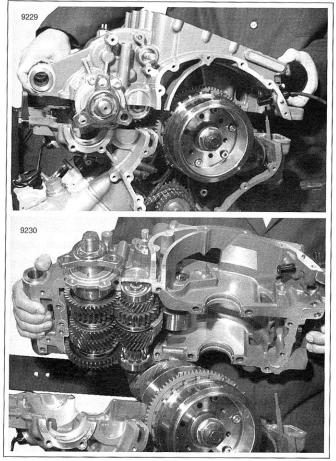


Figure 3-120. Separate Engine Cases

NOTE

Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.

15. See Figure 3-120. Lift lower case by swing arm pivot housing and oil filter can.

CAUTION

Whenever case halves are separated for service the crankshaft bearings MUST BE REPLACED. Failure to replace bearings will result in engine damage.

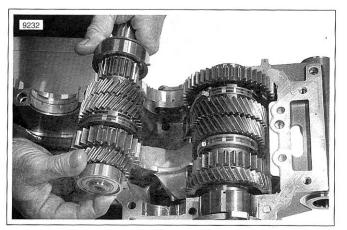


Figure 3-121. Input Shaft

 See Figure 3-121. Remove input shaft. See Figure 3-123. Note the alignment pins (6) on the bearing outer race. If the pins are damaged or missing the bearing must be replaced.

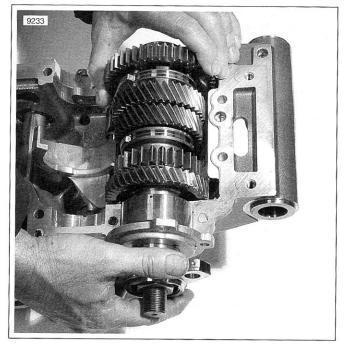


Figure 3-122. Output Shaft

 See Figure 3-122. Remove output shaft. See Figure 3-123. Note the alignment pins (6) on the bearing outer race. If the pins are damaged or missing the bearing must be replaced.

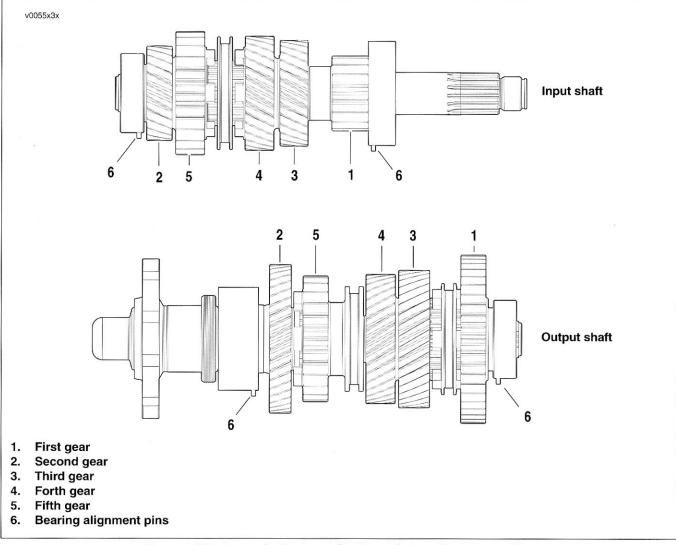


Figure 3-123. Transmission Input Shaft and Output Shaft Assemblies

Shift Drum Removal

PART NO.	SPECIALTY TOOL	
HD-45339	Shift mechanism/detent retractor	

- 1. See Figure 3-124. Remove input shaft bearing retainer to fully expose shifting fork shaft.
- 2. See Figure 3-125. Remove neutral switch.
- 3. See Figure 3-126. Using a drift pin, pull shifter fork shaft to edge of case to free shifter forks.

CAUTION

Shafts in the Revolution transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.

- See Figure 3-127. Use the shifter fork shaft to position the SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339).
 - See Figure 3-128. Engage the shifter gliding part, tighten brass thumb screw to keep gliding part in retracted position.
 - Push shifter detent arm spring away from shifting drum star wheel. Lock in place with black knurled thumb screw.
 - c. Extract shift drum shaft and remove shift drum.

CAUTION

Always compress shifter pawl gliding part before shift drum detent arm moved out of position. Failure to do so could bend or break shift detent arm assembly tab.

NOTE

If the SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339) is positioned correctly the shift drum will rotate freely.

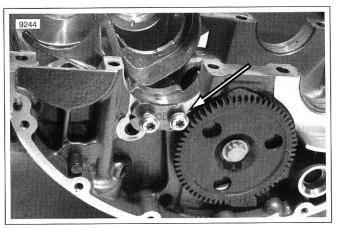


Figure 3-124. Input Shaft Bearing Retainer

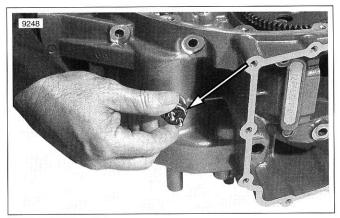


Figure 3-125. Neutral Switch

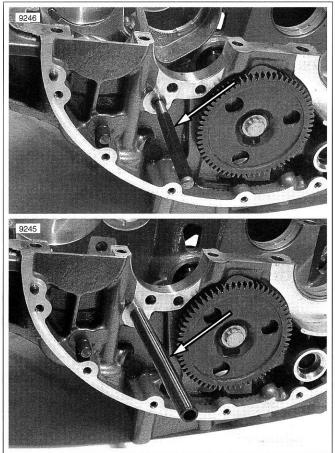


Figure 3-126. Shifter Fork Shaft

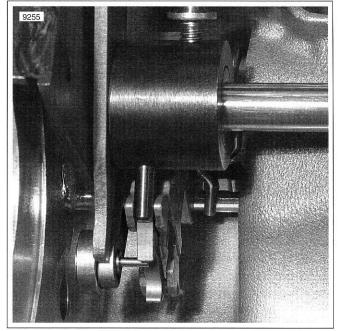


Figure 3-128. Shift Mechanism/Detent Retractor (HD-45339)

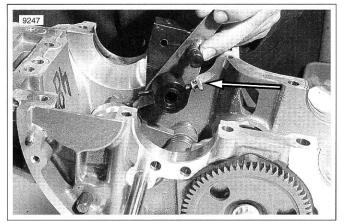


Figure 3-127. Shift Mechanism/Detent Retractor (HD-45339)

PART NO.	SPECIALTY TOOL	
HD-45339	Shift mechanism/detent retractor	
HD-45338	Shift lever substitute	
HD-45301	Transmission assembly retainer	
HD-45311	Counterbalance alignment pin	
HD-45316	Crankshaft assembly retainer	
HD-45306	Crankshaft locking pin	
HD-45310	Lower crankshaft alignment dowels	

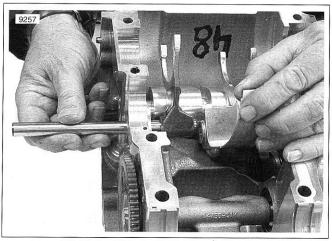


Figure 3-130. Shifter Fork Shaft Installation

CAUTION

Shafts in the Revolution transmission are closely toleranced. Insertion of shafts must be done by hand. NEVER use a hammer or other tool to remove or install shafts. Transmission damage will result if force is used to insert shafts.

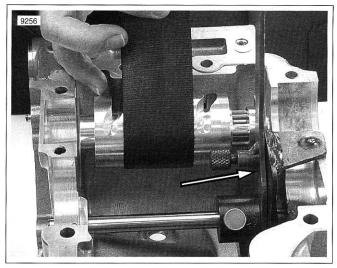


Figure 3-129. Position Shift Drum

- See Figure 3-129. Use SHIFT MECHANISM/DENTENT RETRACTOR (HD-45339) in reverse of disassembly to compress shifter gliding part and to compress shifting detent arm and spring. Using the nylon strap from the SHIFT MECHANISM/DETENT RETRACTOR (HD-45339), lower the shift drum in place and insert the shift drum shaft.
- 2. See Figure 3-130. Insert shifter fork shaft through engine case and slide shifter forks in position.
- 3. See Figure 3-131. Shifter forks must be positioned as shown.
- 4. See Figure 3-132. Install input shaft bearing retainer loosely in place.

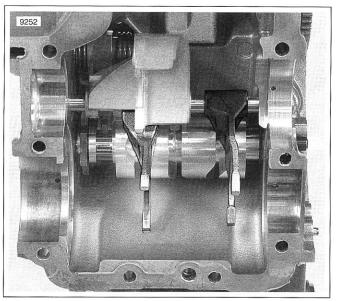


Figure 3-131. Shifter Fork Orientation

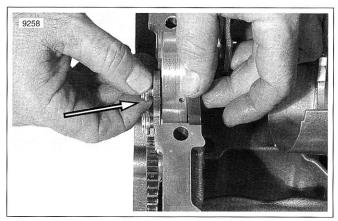


Figure 3-132. Input Shaft Bearing Retainer

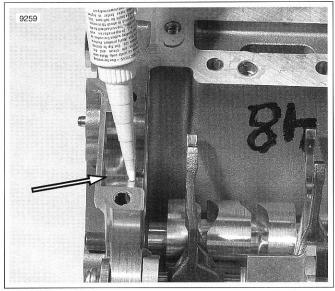


Figure 3-133. Locating Pin Hole

 See Figure 3-133. A SMALL dab of RTV VRSC crankcase sealer around the output bearing locating pin hole will help to keep bearing from dropping during assembly. THIS IS ONLY DONE ON THE OUTPUT SHAFT FIRST GEAR BEARING.

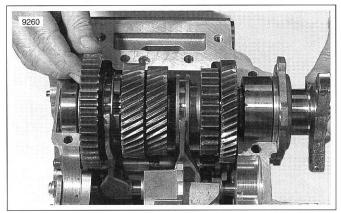


Figure 3-134. Output Shaft

CAUTION

Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.

See Figure 3-134. and Figure 3-123. Carefully lower output shaft into case. Inspect to be certain that the locating pins (6) on the bearing outer race are in the case holes.

NOTE

Output shaft will turn freely when it is in the correct position.

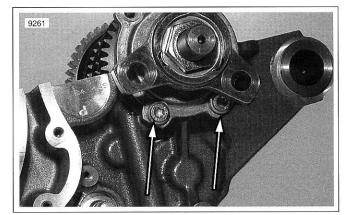


Figure 3-135. Output Shaft Seal Retainer

7. See Figure 3-135. Install two upper case fasteners in output shaft seal retainer.

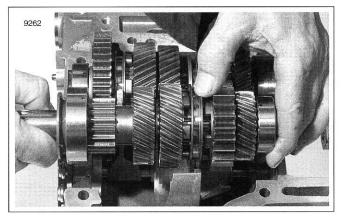


Figure 3-136. Input Shaft

CAUTION

Attempting to assemble engine without the bearing locating pins in the correct position, will cause engine damage.

- 8. See Figure 3-136. and Figure 3-123. Carefully lower input shaft into case. Inspect to be certain that the locating pins (6) on the bearing outer race are in the case holes and shifting forks are in the correct location.
- Use SHIFT LEVER SUBSTITUTE (HD-45338) to dry shift transmission while rotating input and output shaft. Make sure transmission shifts through all gears correctly.

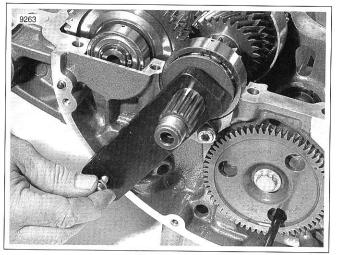


Figure 3-137. Retain Input Shaft

10. See Figure 3-137. Install TRANSMISSION ASSEMBLY RETAINER (HD-45301) on input shaft as shown.

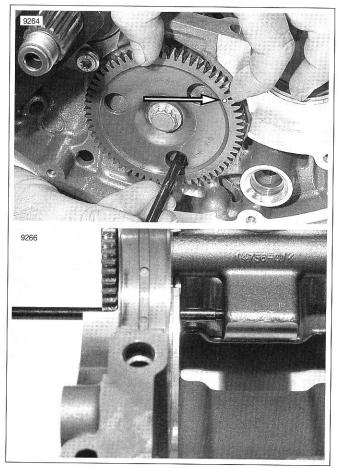


Figure 3-138. Counterbalancer Alignment

11. See Figure 3-138. Install COUNTERBALANCER ALIGN-MENT PIN (HD-45311). With the alignment mark in the 2 o'clock position, the case hole and the index hole in the counterbalancer will align.

IMPORTANT NOTE

Crankshaft bearings must be replaced every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.

- 12. Replace the crankshaft bearings at this time. See 3.16 CRANKSHAFT BEARING REPLACEMENT.
- See Figure 3-139. Lubricate crankshaft bearings, input and output shaft and counterbalancer bearings with Harley-Davidson Motorcycle Oil 20W50. Use Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) on bearing shells.

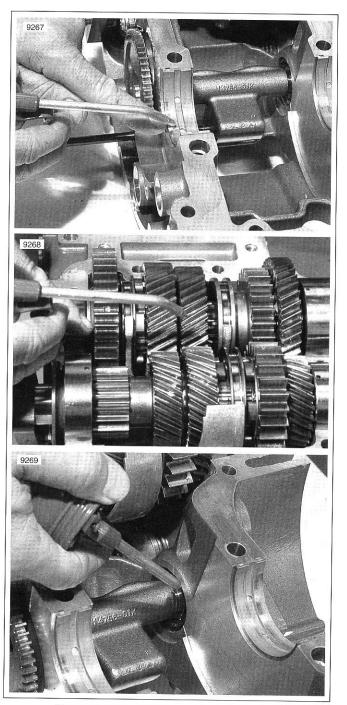


Figure 3-139. Pre-Assembly Lubrication

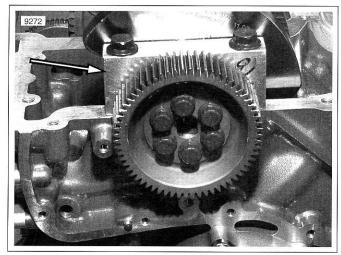


Figure 3-140. Retain Crankshaft Thrust Bearing

 See Figure 3-140. If engine was not at TDC, position the CRANKSHAFT ASSEMBLY RETAINER (HD-45316) to hold crankshaft thrust bearing half in place while attaining TDC.

CAUTION

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

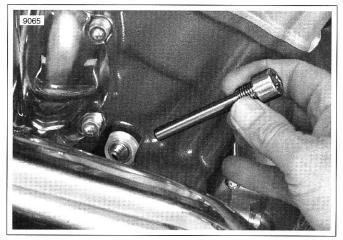


Figure 3-141. Crankshaft Locking Pin (HD-45306)

15. See Figure 3-141. Position the crankshaft assembly at TDC and insert the CRANKSHAFT LOCKING PIN (HD-45306).

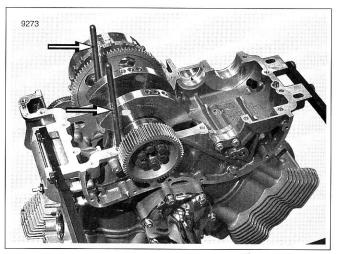


Figure 3-142. Lower Crankcase Alignment Dowels (HD-45310)

16. See Figure 3-142. Install LOWER CRANKCASE ALIGN-MENT DOWELS (HD-45310).

NOTE If dipstick has not been removed, do so at this time.

17. See Figure 3-132. Check that upper crankcase input bearing retainer is loosely in position.

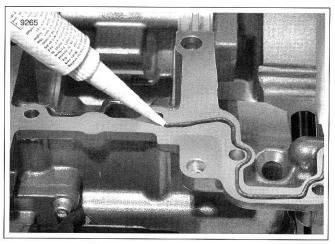


Figure 3-143. Apply Sealant

 See Figure 3-143. See Figure 3-144. Apply VRSC CRANKCASE SEALANT (Part No. 99650-02) to the lower case half.

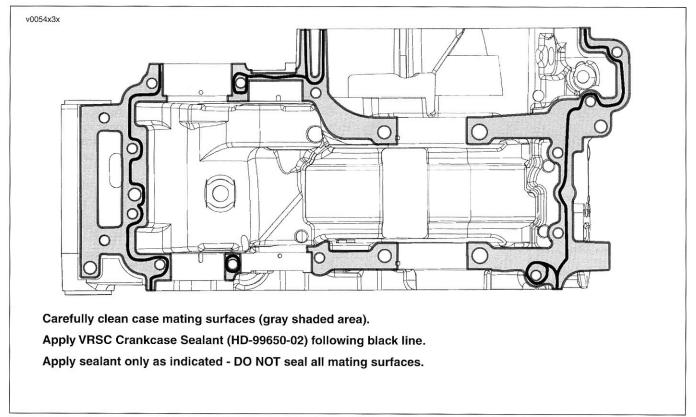


Figure 3-144. Lower Case Sealant Path

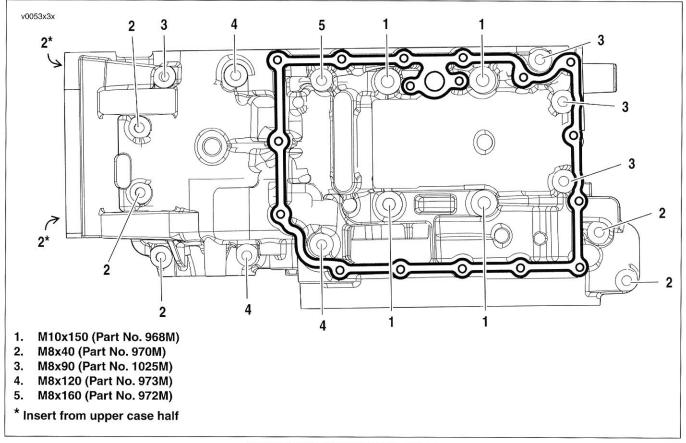


Figure 3-145. Case Fastener Sizes

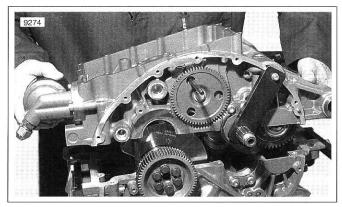


Figure 3-146. Lower Case Over Alignment Dowels

NOTE

Lower case with the transmission gears in place is heavy. Get assistance when lifting lower case.

 See Figure 3-146. Position lower case half over the LOWER CRANKCASE ALIGNMENT DOWELS (HD-45310).

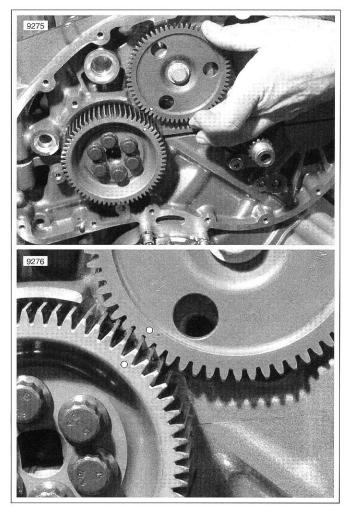


Figure 3-147. Lower Case Over Alignment Dowels

20. See Figure 3-147. When the counterbalancer gear and the primary crankshaft gear are close to engagement, remove the COUNTERBALANCER ALIGNMENT PIN (HD-45311). Hand position the counterbalancer gear so the timing marks are aligned exactly as shown.

CAUTION

Confirm the correct alignment of the counterbalancer gear and the primary crankshaft gear timing marks. Engine damage will occur if the counterbalancer gear and the primary crankshaft gear are not correctly timed.

- 21. See Figure 3-145. Match and thread-in all 19 case fasteners.
- 22. See Figure 3-149. Torque in sequence all 19 case fasteners to 25 Nm (18.4 ft-lbs).
- 23. Dab a marker next to each torqued fastener as it is tightened.

CAUTION

Complete the tightening process on the main bearing bolts before tightening the rest of the case fasteners. Failure to do so will result in engine damage.

- 24. See Figure 3-149. Torque in sequence the four M10 x 150 main bearing bolts (1, 2, 3, 4) main bearing bolts in this sequence.
 - a. Loosen each main bearing bolt (1, 2, 3, 4) one full turn (- 360°).
 - b. See Figure 3-149. Torque in sequence each main bearing bolt (1, 2, 3, 4) to 15 Nm (11.1 ft-lbs).
 - c. See Figure 3-148. Position the TORQUE ANGLE GAUGE (Snap-on Part No. TA360) per instruction sheet and tighten each bolt an additional quarter turn (+ 90°).

NOTE

The notation for this torque sequence is written:

25 Nm - 360°,15 Nm + 90°.

d. Dab a marker next to each torqued main bearing bolt to identify which bolts have been tightened with the complete sequence.

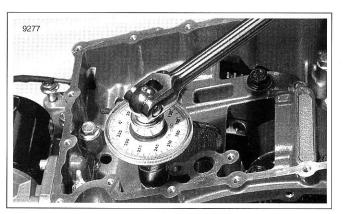


Figure 3-148. Torque Angle Gauge

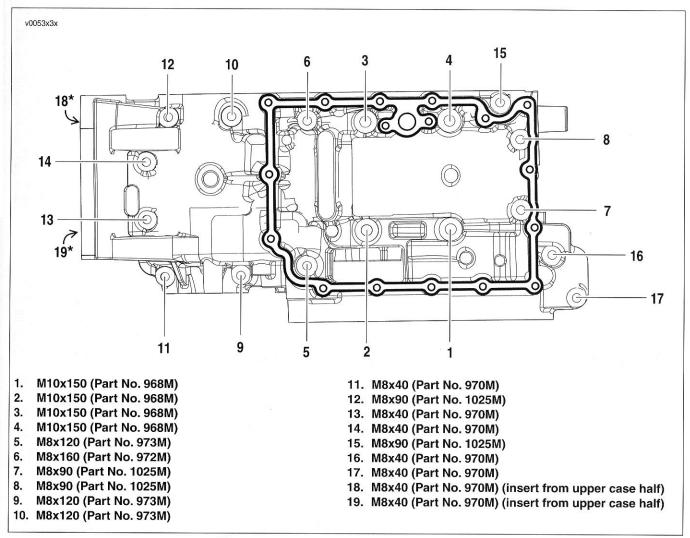


Figure 3-149. Engine Case Torque Sequence

	Table 3-30.	Engine	Case	Fastener	Torque
--	-------------	--------	------	----------	--------

FASTENER #	то	RQUE
	NM	FT-LBS
1 through 19 (in sequence)	25	18.4
1, 2, 3, 4 (in sequence)	Backoff (-) 360°	
1, 2, 3, 4 (in sequence)	15	11
1, 2, 3, 4 (in sequence)	Tighte	n (+) 90°

- 25. See Figure 3-150. Tighten the upper and lower input bearing retainer fasteners to 23 Nm (17 ft-lbs).
- 26. See Figure 3-151. Tighten the four output shaft bearing fasteners to 23 Nm (17 ft-lbs).
- See Figure 3-152. Place **new** oil pan gasket in position. Install oil pickup and fasteners. Tighten to 9.7 Nm (85 in-Ibs).
- 28. See Figure 3-153. Install oil pan and fasteners. Tighten to 9.7 Nm (85 **in-lbs**).

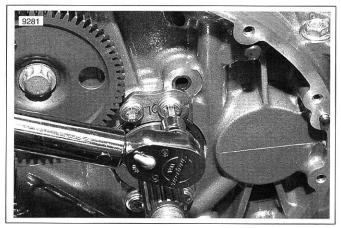


Figure 3-150. Input Bearing Retainer

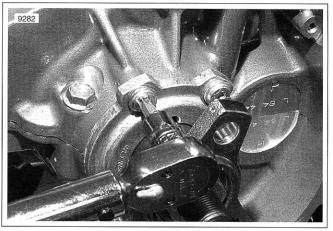


Figure 3-151. Output Shaft Bearing Retainer

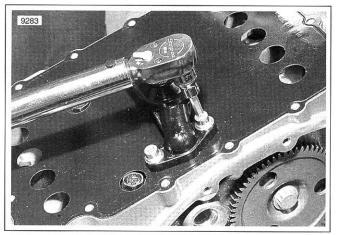


Figure 3-152. Oil Pickup

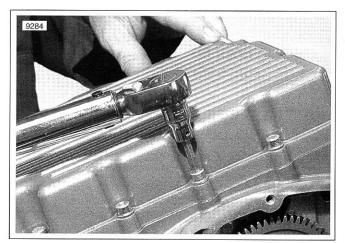


Figure 3-153. Oil Pan

REMOVAL

PART NO.	SPECIALTY TOOL	
HD-45311	Counterbalancer alignment pin	
HD-45490	Balancer bearing remover/installer tools	
HD-34902	Big-twin mainshaft primary bearing remover and installer	
HD-95637	Wedge attachment	

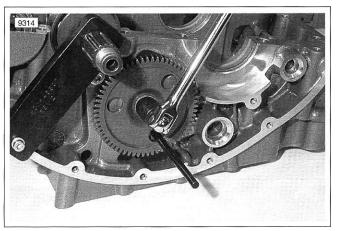


Figure 3-154. Counterbalancer Gear Fastener

- 1. See Figure 3-154. Install COUNTERBALANCER ALIGN-MENT PIN (HD-45311). With the alignment mark in the 2 o'clock position, the case hole and the index hole in the counterbalancer will align.
- 2. Remove fastener and discard. The counterbalancer gear retaining fastener is one-time-use only. Always use a new fastener when installing counterbalancer gear.

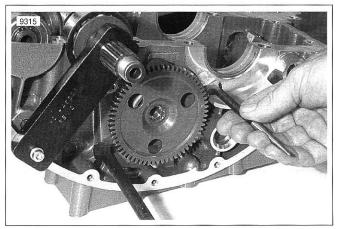


Figure 3-155. Counterbalancer Gear Removal

 See Figure 3-155. Gently pry counterbalancer gear from shaft. NOTE Use Snap-on pliers SRPC3890 for removal/installation of the retaining rings.

3.15

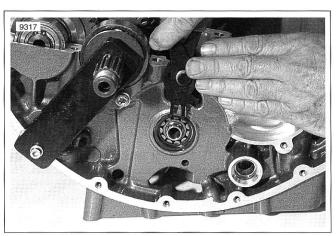


Figure 3-156. Retaining Ring Removal

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

4. See Figure 3-156. Remove outer retaining ring.

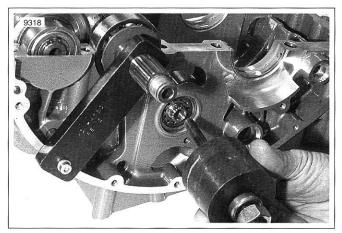


Figure 3-157. Counterbalancer Tool

5. See Figure 3-157. Thread end of BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490) into balancer shaft.

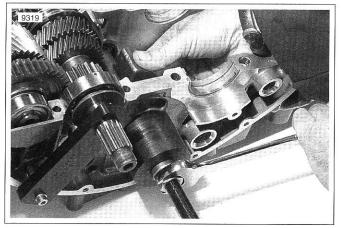


Figure 3-158. Counterbalancer Outboard Bearing Removal

6. See Figure 3-158. The counterweight must be held in the position shown to prevent binding against the case. The tool will pull the outboard bearing and balancer through the case. When the bearing is free, remove tool and bearing.

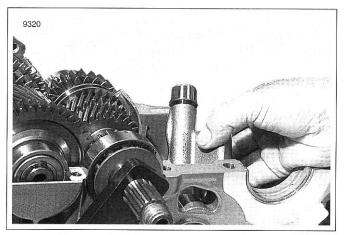


Figure 3-159. Counterbalancer Removal

7. See Figure 3-159. Counterbalancer can be removed from engine.

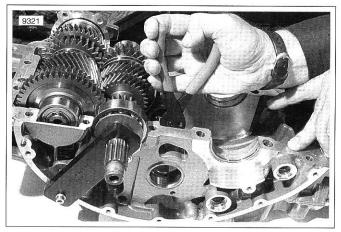


Figure 3-160. Outboard Inner Retaining Ring

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

8. See Figure 3-160. Remove outboard inner retaining ring.

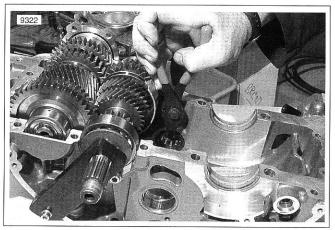


Figure 3-161. Counterbalancer Inboard Retaining Ring

9. See Figure 3-161. Remove inboard retaining ring.

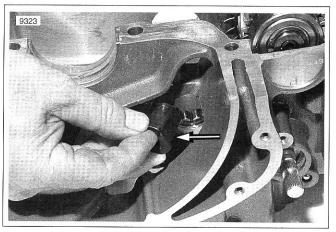


Figure 3-162. Bearing Removal Insert

10. See Figure 3-162. Position the bearing removal insert as shown. Note the position of the flat.

- 11. See Figure 3-163. Thread puller rod into insert.
- 12. See Figure 3-164. Hold screw end of puller and turn large nut to remove the bearing.

NOTE

If counterbalancer bearings are being replaced, ALWAYS replace the inner race.

13. See Figure 3-165. Use BIG-TWIN MAINSHAFT PRI-MARY BEARING RACE REMOVER AND INSTALLER (HD-34902) and WEDGE ATTACHMENT (HD-95637) to remove inboard and outboard bearing inner races.

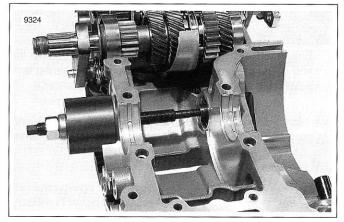


Figure 3-163. Position Puller

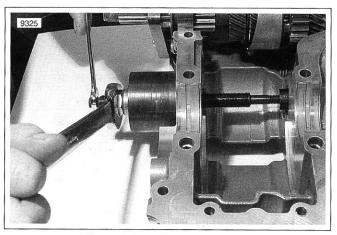


Figure 3-164. Remove Bearing

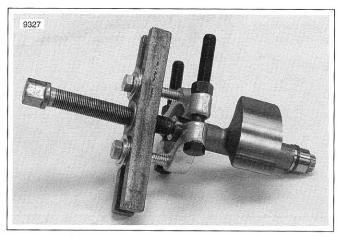


Figure 3-165. Remove Bearing Race

INSTALLATION

- 1. See Figure 3-166. Press **new** inner race of inboard bearing even with the end of the counterbalancer.
- 2. See Figure 3-167. Press **new** outboard bearing race flush against the shoulder of the balancer.

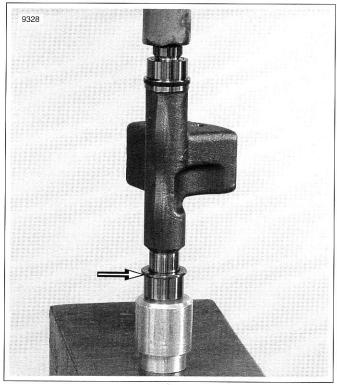


Figure 3-166. Inboard Bearing Race

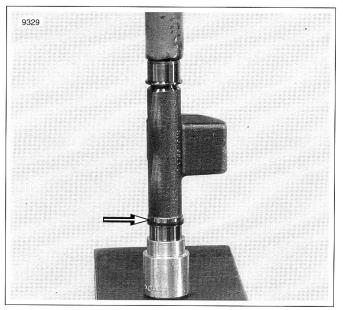


Figure 3-167. Outboard Bearing Race

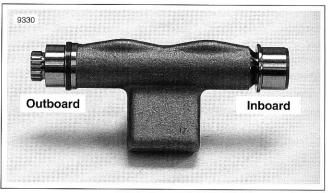


Figure 3-168. Installed Inner Races

3. See Figure 3-168. Inboard bearing race is even with the end of the counterbalancer shaft. Outboard bearing race is fully seated against shoulder of counterbalancer.

NOTE

Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation.

NOTE

When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.

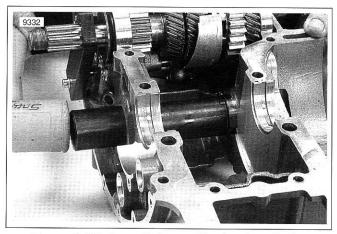


Figure 3-169. Inner Balancer Bearing Installation

 See Figure 3-169. Using the bearing installer from the BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490) drive the inner counterbalancer bearing into the case with a soft faced hammer, until the retaining ring groove is visible.

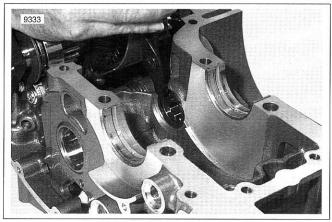


Figure 3-170. Inner Balancer Bearing Installation

5. See Figure 3-170. Install inner retaining ring. Be certain retaining ring is fully seated.

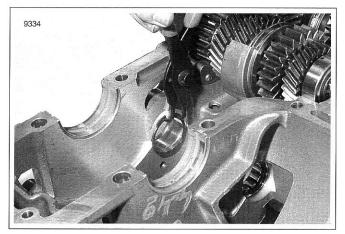


Figure 3-171. Outboard Bearing Inner Retaining Ring Installation

6. See Figure 3-171. Install outboard bearing inner retaining ring. Be certain retaining ring is fully seated.

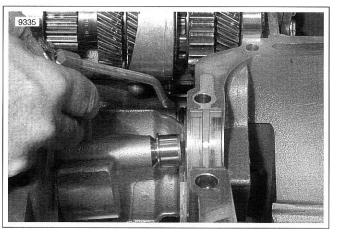


Figure 3-172. Position Counterbalancer

NOTE

Use Harley-Davidson Motorcycle Oil 20W50 to thoroughly lubricate bearing surfaces and case bores before bearing installation process. Use Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) on inner races.

7. See Figure 3-172. Position counterbalancer in case.

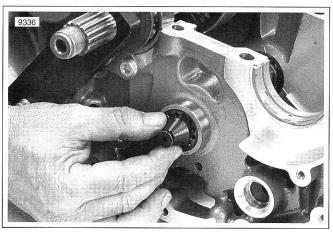


Figure 3-173. Insert Tapered Guide

NOTE

When installing bearings, always drive/push against the side of the bearing with the manufactures lettering/part number.

 See Figure 3-173. Start bearing by hand. Insert tapered guide from the BALANCER BEARING REMOVER/ INSTALLER TOOLS (HD-45490).

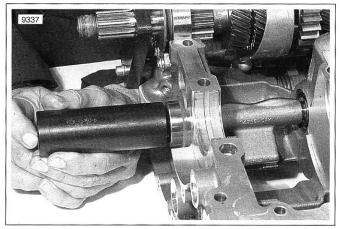


Figure 3-174. Outboard Bearing Installation

 See Figure 3-174. Use the driver from the BALANCER BEARING REMOVER/INSTALLER TOOLS (HD-45490). Drive the bearing in with a soft faced hammer until the retaining ring groove is exposed.

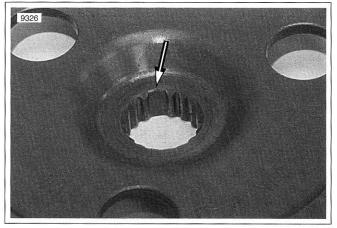


Figure 3-176. Counterbalancer Gear Master Tooth Flat

11. See Figure 3-176. Note the position of the counterbalancer master tooth flat. Align the master tooth flat with the corresponding master tooth on the balancer shaft.

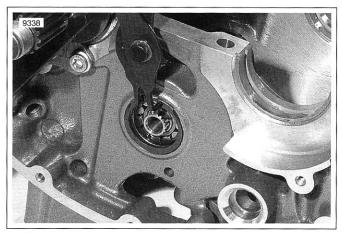


Figure 3-175. Outboard Retaining Ring Installation

10. See Figure 3-175. Install out board retaining ring. Be certain retaining ring is fully seated.

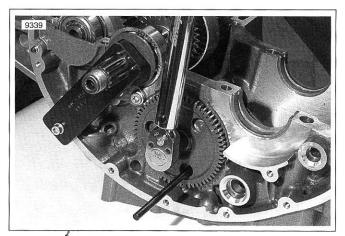


Figure 3-177. Counterbalancer Gear Installation

 See Figure 3-177. Install the COUNTERBALANCER ALIGNMENT PIN (HD-45311). Use a new counterbalancer gear fastener and tighten to 50 Nm (37 ft-lbs) plus 90°.

GENERAL

Crankshaft bearings MUST be replaced every time the cases are split for service. If the cam drive is not being serviced, crankshaft bearings can be replaced without removing the cam drive chain.

The alternator side and clutch side crankshaft bearings must be replaced with bearings color coded to match the color code stamped on the counterweight on the clutch side of the crankshaft. To select the correct bearing set, see 3.18 CRANKSHAFT, PISTON AND CYLINDER LINER.

ALTERNATOR SIDE

1. See Figure 3-21. Remove rotor bolt from cam drive side.

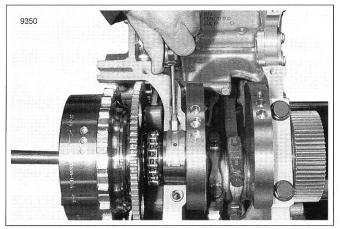


Figure 3-178. Cam Drive Side Bearing Removal

 See Figure 3-178. Insert Snap-on # 2050 Prybar in rotor bolt hole.

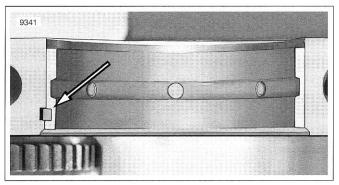


Figure 3-179. Crankshaft Bearing Notch (crankshaft removed for clarity)

- 3. See Figure 3-179. Note the notch in the crankshaft bearing.
- 4. See Figure 3-178. Gently lift crankshaft to take weight off the bearing.
- 5. Use a small screwdriver in the notch of the crankcase at the end of the bearing to lever and roll old bearing

around crankshaft journal until it can be removed by hand.

NOTE

Remove and replace one crankshaft bearing at a time. Make sure CRANKSHAFT ASSEMBLY RETAINERS (HD-45316) are loosened. Select **new** bearing. Apply Lubriplate No. 105 Assembly Grease (NAPA Part No. 765-2651) and Harley-Davidson Motorcycle Oil 20W50 to the journal side of the bearing.

- Select the alternator side bearing set to match color code on crankshaft counterweight. See 3.18 CRANK-SHAFT, PISTON AND CYLINDER LINER.
- 7. While gently lifting crankshaft with prybar move **new** bearing into position by hand.

CLUTCH SIDE

- 1. See Figure 3-180. Insert a 10" long 1/2" drive extension in the square hole of the crankshaft drive gear.
- See Figure 3-180. Apply gentle upward pressure on the 1/2" drive extension. Using a screwdriver on the side opposite the bearing notch, very carefully tap on old bearing until it is exposed enough to be removed by hand.
- Select the clutch side bearing set to match color code on crankshaft counterweight. See 3.18 CRANKSHAFT, PIS-TON AND CYLINDER LINER.
- 4. Select a **new** bearing and apply Harley-Davidson Motorcycle Oil 20W50 to the journal side of the bearing.
- 5. See Figure 3-181. Position the **new** bearing so the notch rolls into the case last and matches the engine case relief notch.
- 6. While lifting gently with extension roll bearing into place with finger pressure.

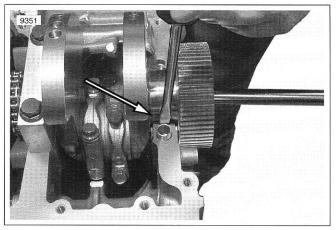


Figure 3-180. Water Pump Side Bearing Removal

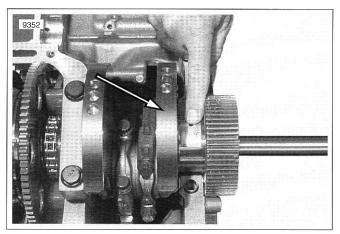


Figure 3-181. Water Pump Side Bearing Removal

GENERAL

This procedure is shown with the engine removed. The shift shaft and seal may be replaced without removing the engine from the chassis.

REMOVAL

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

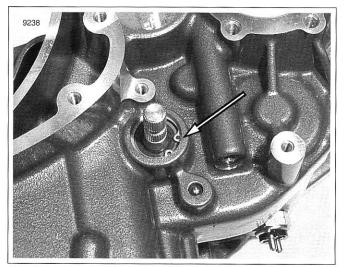


Figure 3-182. Shift Shaft Outer Retaining Ring

1. See Figure 3-182. Remove the outer snap ring (zinc plated).

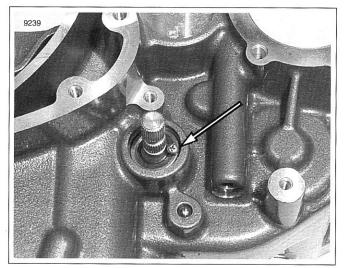


Figure 3-183. Shift Shaft Seal

2. See Figure 3-183. Drill small hole in the shift shaft seal. Thread sheet metal screw into the hole.

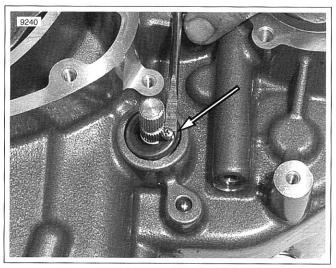


Figure 3-184. Shift Shaft Seal Removal

3. See Figure 3-184. Gently pry seal from engine case.

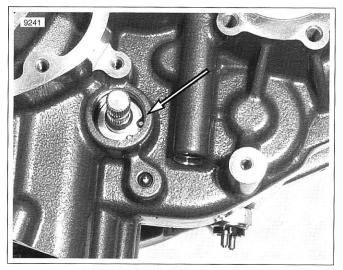


Figure 3-185. Shift Shaft Inner Retaining Ring

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

- See Figure 3-185. With the shaft seal removed, the inner retaining ring (black) is exposed. Remove the retaining ring.
- 5. Remove shift shaft using hand effort.

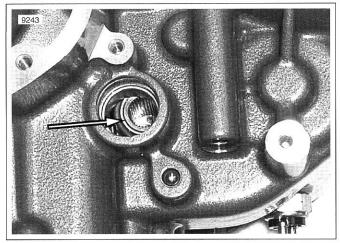


Figure 3-186. Shift Actuator

 See Figure 3-186. The shift actuator is spring loaded and will move away from alignment with the case hole when the shift shaft is removed.

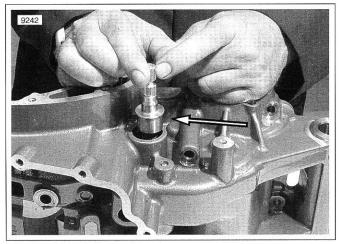


Figure 3-187. Shift Shaft Installation

INSTALLATION

PART NO.	SPECIALTY TOOL	
HD-45337	Shift shaft seal installer	

 See Figure 3-187. To insert shift shaft, use leading end of shift shaft to engage the shift actuator. Using hand pressure, center the shift shaft to engage the actuator splines. Seat shift shaft deep enough to expose inner retaining ring groove.

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

NOTE

The inner (black) retaining ring and the outer (zinc plated) retaining ring are different in size by 1 mm.

2. Insert inner retaining ring (black).

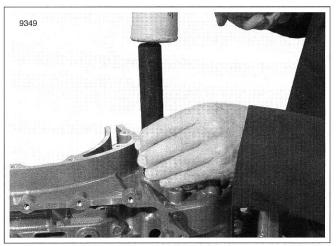


Figure 3-188. Shift Shaft Seal Installation

- See Figure 3-188. Lubricate shift shaft seal with Harley-Davidson Motorcycle Oil 20W50 and insert using SHIFT SHAFT SEAL INSTALLER (HD-45337).
- 4. Install outer retaining ring (zinc plated).

GENERAL

Remove cam drive, rotor and cylinder heads. Split crankcases. Remove lower crankcase and set aside.

PART NO.	SPECIALTY TOOL	
HD-45316	Crankshaft assembly retainer	
HD-44358	Flywheel support fixture	
HD-45313	Cylinder liner remover/installer	
HD-96333-51C	Piston ring compressor	
HD-45306	Crankshaft locking pin	

1. See Figure 3-189. Install CRANKSHAFT ASSEMBLY RETAINER (HD-45316).

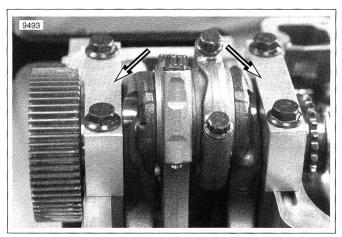


Figure 3-189. Install Crankshaft Assembly Retainers (HD-45316)

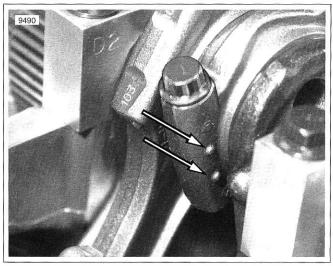


Figure 3-190. Connecting Rod Orientation

2. See Figure 3-190. Note the casting bumps on the connecting rods and caps. The rear cylinder must have the bumps toward the water pump side and the front cylinder toward the cam drive side.

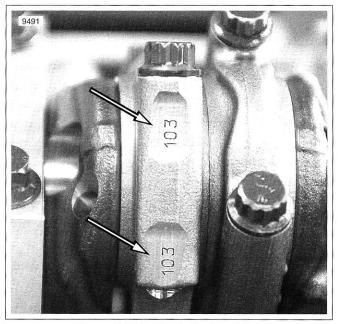


Figure 3-191. Match Rod and Cap

 See Figure 3-191. Note the numbers on connecting rod and cap. Connecting rods and caps must be used in matched sets.

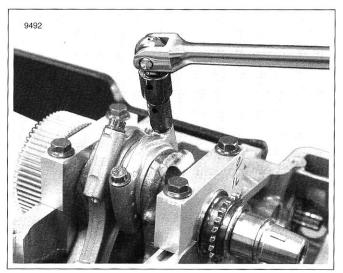


Figure 3-192. Loosen Rod Cap Fasteners

- 4. See Figure 3-192. Loosen connecting rod caps fasteners.
- 5. Remove the CRANKSHAFT ASSEMBLY RETAINERS (HD-45316).

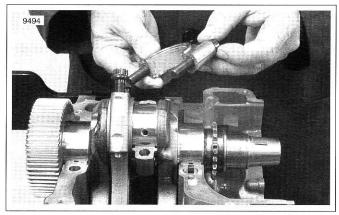


Figure 3-193. Remove Rod Caps

6. See Figure 3-193. Inspect connecting rod bearing shells. Look for scoring or discoloration.

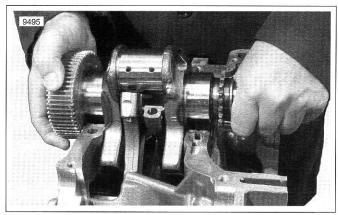


Figure 3-194. Remove Crankshaft

7. See Figure 3-194. Remove crankshaft.

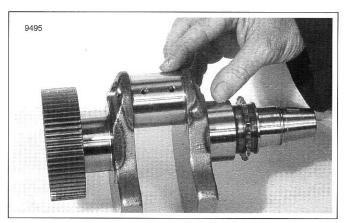
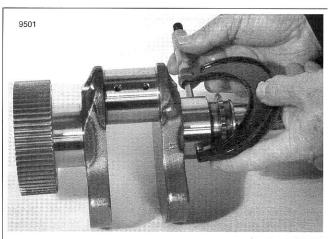


Figure 3-195. Inspect Crankshaft

8. See Figure 3-195. Check journals for scoring, bluing and surface damage. Check main drive gear for wear or missing teeth.

NOTE

Mild bluing around crankshaft journal and sprocket edges is due to heat treating process and is normal. However, metal transfer and bluing on journal surface indicates damage and crankshaft must be replaced.



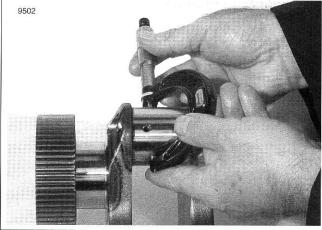


Figure 3-196. Measure Journal

9. See Figure 3-196. Measure crankshaft journals. For crankshaft bearing selection see Table 3-33.

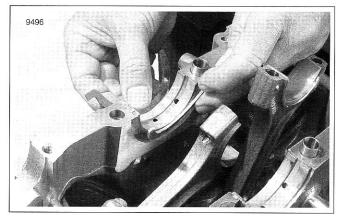


Figure 3-197. Remove Main Bearing Retainers

10. See Figure 3-197. Remove crankshaft main bearing retainers.

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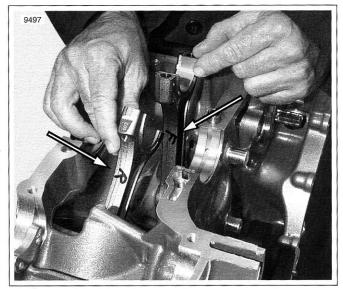


Figure 3-198. Mark Connecting Rods

11. See Figure 3-198. If rods are to be reused, mark them F (front) and R (rear). Rod must be installed in the same position.

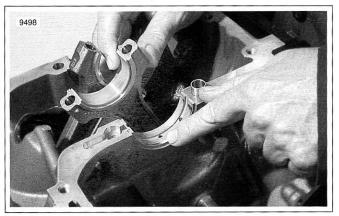


Figure 3-199. Bearing Shells

12. See Figure 3-199. Inspect bearing shells for scoring or discoloration.

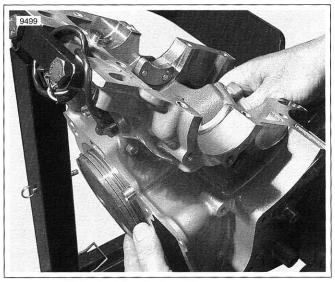


Figure 3-200. Remove Pistons

13. See Figure 3-200. Carefully push piston and rod out top of cylinder. Avoid contacting piston jet. Do not let the connecting rod contact the cylinder liner wall.

WARNING

Always wear proper eye protection when removing retaining rings. Slippage may propel the ring with enough force to cause eye injury.

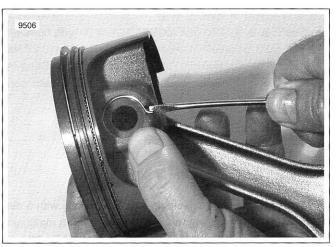


Figure 3-201. Wrist Pin Retaining Rings

14. See Figure 3-201. Remove and discard wrist pin retaining rings. Place small screwdriver under end and twist.

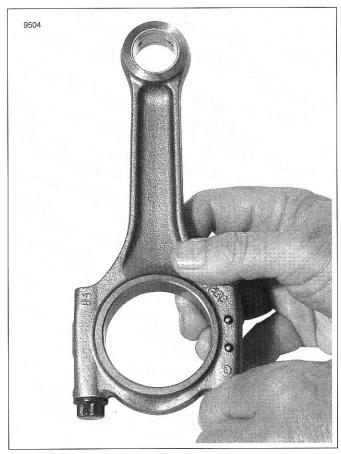


Figure 3-202. Install Rod Caps For Inspection

 See Figure 3-202. Note rod and cap identifying numbers and casting bumps. Install rod caps and tighten to 27 Nm (20 ft-lbs). Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

NOTE

The notation for this torque sequence is written:

27 Nm + 90°

- 16. See Figure 3-203. Check big end dimensions with a dial bore gauge. Measurement must be between a maximum of 51.616 mm (2.032 in.) and a minimum of 51.60 mm (2.031 in.).
- 17. See Figure 3-204. Inspect small end bushing and wrist pin fit. The running clearance should be between a maximum of 0.033 mm (0.001 in.) and a minimum of 0.018 mm (0.0007 in.).

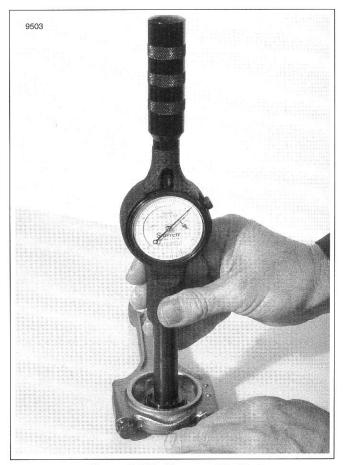


Figure 3-203. Measure Big End

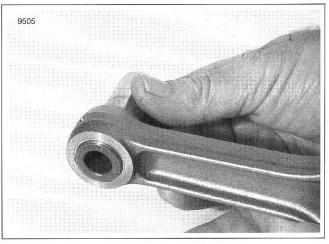


Figure 3-204. Inspect Small End

18. Match replacement pistons to replacement liners. See Table 3-19.

Table 3-31. Piston to Cylinder Liner

Liner	Piston	
Class I	Class I or Class X	
Class II	Class II or Class X	

 See Figure 3-205. Measure piston diameter on thrust surface. Measurement should be between a maximum of 99.961 mm (3.9354 in.) and a minimum of 99.953 mm (3.9351 in.) at the largest point of the piston thrust surface.

NOTE

Piston size could vary 0.0076 mm (0.0003 in.) depending on class of piston.

20. See Figure 3-206. EX on piston top goes toward the exhaust valves. Front piston EX will go toward the front of the engine. Rear piston EX will go toward the rear of the engine.

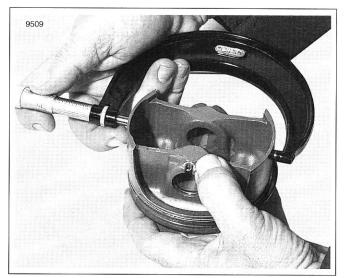


Figure 3-205. Piston Measurement

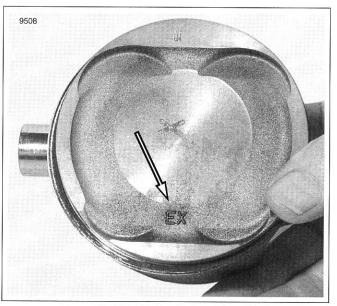


Figure 3-206. Piston Orientation Mark

- 21. See Figure 3-208. Remove and discard primary drive gear fasteners.
- 22. See Figure 3-207. FLYWHEEL SUPPORT FIXTURE (HD-44358) can be modified to hold Revolution crankshaft when removing or installing primary drive gear. Open bore of center hole to 59.7 mm (2.350 in.).

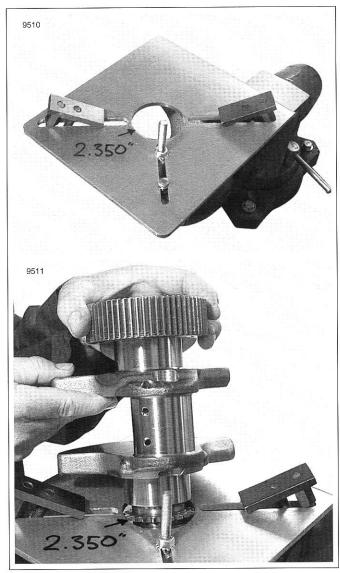


Figure 3-207. Flywheel Support Fixture

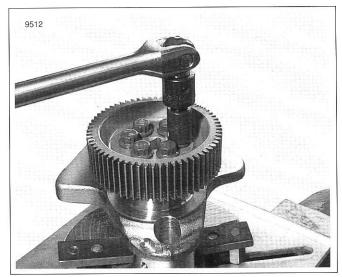


Figure 3-208. Remove Primary Gear



Figure 3-209. Primary Gear Timing Marks

- 23. See Figure 3-209. Examine primary drive gear. Inspect thrust surfaces for excessive wear or chipping. Note the timing marks on the primary drive gear and the crank-shaft. Assemble with the timing mark on the drive gear over the timing mark on the crankshaft.
- 24. See Figure 3-210. Lubricate **new** primary drive gear fasteners with Harley-Davidson Motorcycle Oil 20W50. Lubricate threads and under head of bolt.



Figure 3-210. Installing Primary Gear

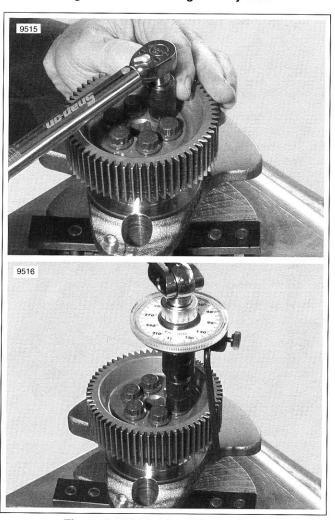


Figure 3-211. Tighten Primary Gear

- 25. See Figure 3-211. Using a crisscross pattern, tighten the primary gear fasteners to 10 Nm (88 in-lbs). Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten bolt an additional 90°.
- 27. See Figure 3-213. Install CYLINDER LINER REMOVER/ INSTALLER (HD-45313) according to instruction sheet and remove liner.

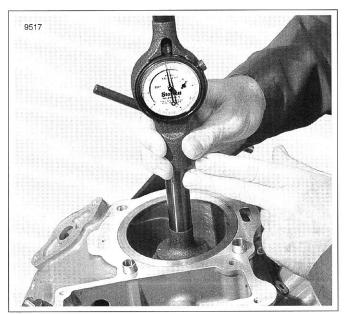


Figure 3-212. Measure Cylinder Bore

26. See Figure 3-212. Using a dial bore gauge, check cylinder concentricity. See specifications for serviceability.

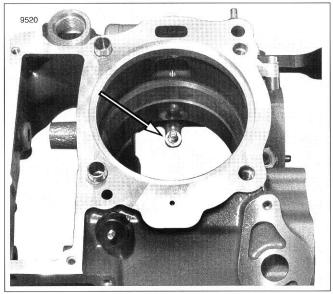


Figure 3-214. Piston Jet

28. See Figure 3-214. Inspect piston jet. Piston jet must fit tight and have no visible damage. If loose or damaged crankcase must be replaced.

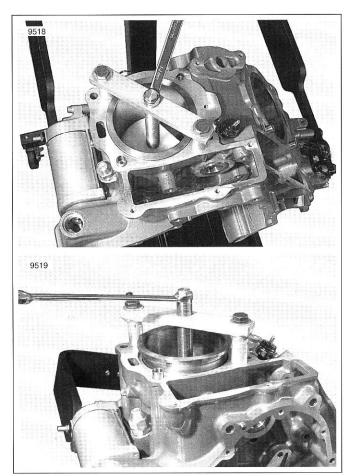


Figure 3-213. Remove Cylinder Liner

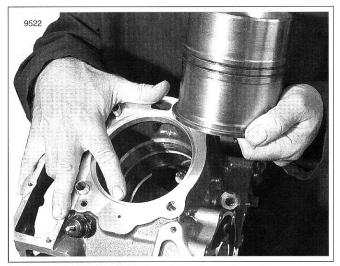


Figure 3-215. Clean Liner and Case Step

29. See Figure 3-215. Carefully clean cylinder liner and step in case. Debris in the step could prevent the cylinder liner from fully seating.

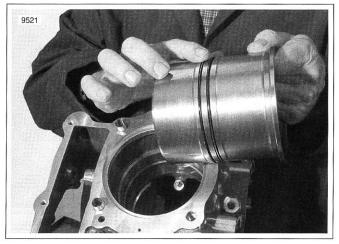


Figure 3-216. Lubricate Liner

 See Figure 3-216. Lubricate o-rings with Harley-Davidson Motorcycle Oil 20W50.

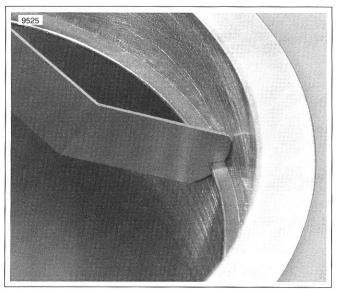


Figure 3-218. Ring End Gap

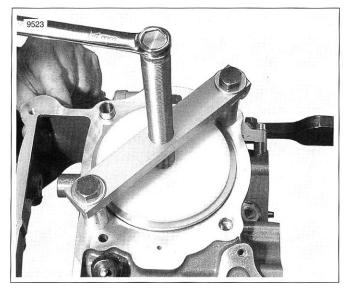


Figure 3-217. Insert Liner

- 31. See Figure 3-217. Insert liner in the case bore. Install CYLINDER LINER REMOVER/INSTALLER (HD-45313) according to instruction sheet and install liner.
- 32. See Figure 3-218. Check ring end gap by placing ring in cylinder and measure gap using feeler gauges. See specifications for serviceability.
- See Figure 3-219. Carefully install piston rings. Second compression ring is installed with the mark to the top. When ring set is installed, gaps must be staggered.

NOTE

34. If engine is to be assembled at this point, make sure all part are cleaned and lubricated appropriately.

AWARNING

Always wear proper eye protection when removing/ installing retaining rings. Slippage may propel the ring with enough force to cause eye injury.

35. See Figure 3-220. Install wrist pin and wrist pin retaining rings.

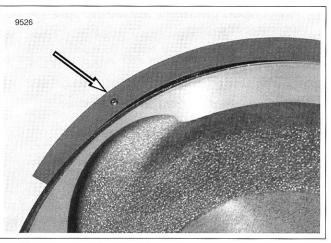


Figure 3-219. Second Compression Ring Top Mark

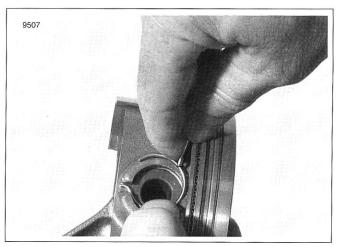


Figure 3-220. Wrist Pins and Retaining Rings

- See Figure 3-222. To install piston, complete each of the following steps:
 - a. Lightly lubricate inside of PISTON RING COM-PRESSOR (HD-96333-51C) and rings and piston skirt with Harley-Davidson Motorcycle Oil 20W50.
 - See Figure 3-221. Orient the brackets on the compressor ring down (Note arrow on compression ring) toward the crankcase. Orient the squeeze handle parallel to crankcase.

CAUTION

Failure to install pistons correctly oriented will result in engine failure.

c. Orient piston and connecting rod to crankcase.

IMPORTANT NOTE

Correct piston and connecting rod orientation is as follows:

- Front cylinder connecting rod and cap bumps to cam drive side of engine
- Rear cylinder connecting rod and cap bumps to water pump side of engine
- EX mark toward the front on front cylinder
- EX mark toward the rear on rear cylinder
 - Clamp the PISTON RING COMPRESSOR (HD-96333-51C) around rings and pistons.
 - Adjust tension on handle to compress rings but still allow piston and rings to slip out of compressor into cylinder bore.

CAUTION

If piston jet is damaged, crankcase will have to be replaced.

f. See Figure 3-214. With free hand inside crankcase, guide rod past piston jet.

CAUTION

Whenever resistance is encountered, stop and examine components. A ring can gouge the cylinder wall when forced.

- g. See Figure 3-222. Using a rubber or wooden mallet handle, very gently tap piston around circumference into bore. Hold constant pressure on the piston ring compressor until rings have entered bore.
- When piston and rings are in the bore, move piston up and down the bore to insure rings have not broken during installation.

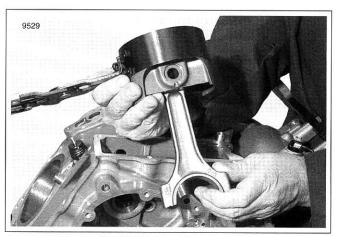


Figure 3-221. Piston Ring Compressor

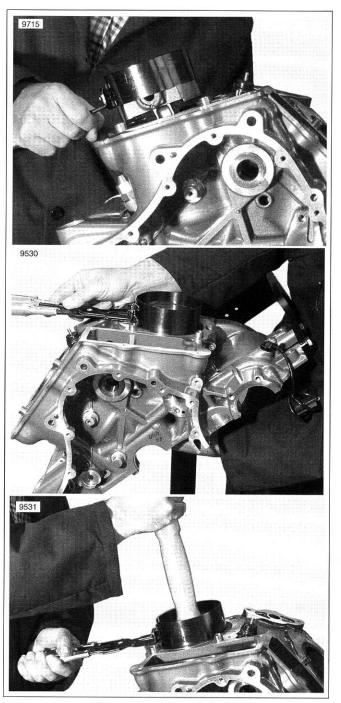


Figure 3-222. Insert Piston

- 37. Invert engine. Clean connecting rod bore and crank bore making sure its free of oil.
- See Figure 3-226. Select rod bearing replacement set to match rod bearing journal diameter color code (3) on crankshaft. See Table 3-32.

NOTE

Rod bearing sets (front and rear) are available in two sizes, coded red (R) and blue (B). The rod bearing color code appears on the bearing shell edge.

COLOR CODE	H-D PART NO.	SPECIFICATION	
D. J	24412-01K	Max	47.991 mm
Red	24412-01K	Min 47.983 m	47.983 mm
Dius	24413-01K	Max	47.983 mm
Blue	24413-01K	Min	47.975 mm

Table 3-32. Rod Bearing Journal Diameter

 See Figure 3-223. Install rod bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

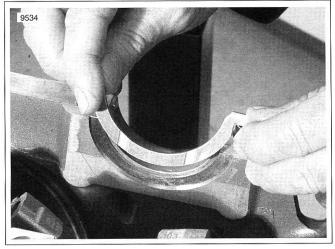
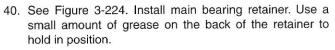


Figure 3-224. Install Main Bearing Retainer



 See Figure 3-225. Move connecting rods so front connecting rod points to rear, and rear rod points to front of engine.

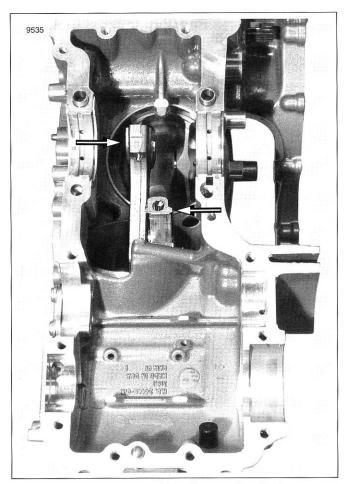


Figure 3-225. Position Connecting Rods

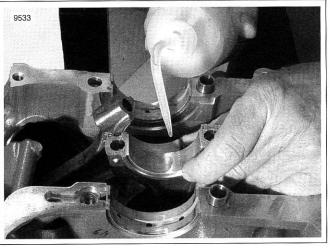
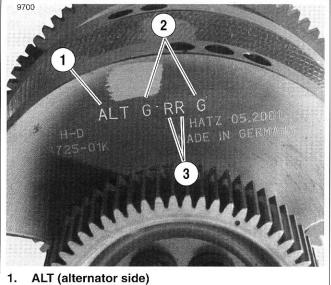


Figure 3-223. Lubricate Bearings



- 2. G (green main bearing code)
- 3. R (red rod bearing code)

Figure 3-226. Crankshaft Color Code

- 42. See Figure 3-226. Crankshaft counter weight is stamped with a color code for main bearing and rod journal replacement sets. Read from left to right, the letter code corresponds to the alternator and clutch side main bearing journals (2) and the front rod and rear rod journals (3).
- 43. See Table 3-33. Select main bearing set corresponding to color code (2) on crankshaft.

Table	3-33.	Main	Bearing	Journal	Diameter
	0.00.		Doaring	oournui	Diamotor

COLOR CODE	H-D PART NO.		ALTERNA- TOR SIDE	CLUTCH SIDE
Blue	24411-01K	Max	55.977 mm	55.952 mm
Diue	24411-01K	Min	55.971 mm	55.946 mm
Green	24410-01K	Мах	55.984 mm	55.959 mm
Green 24410-01K	Min	55.977 mm	55.952 mm	
R ed 24409	24409-01K	Мах	55.990 mm	55.965 mm
	24409-01K	Min	55.984 mm	55.959 mm

NOTE

Main bearings are available in 3 sets (alternator and clutch side bearings) to fit three sizes of journals. The sets are color coded, blue (B), green (G) and red (R).

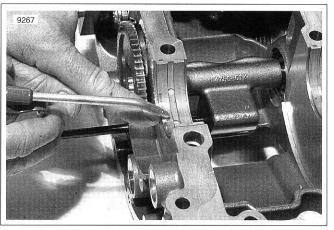


Figure 3-227. Lubricate Crankshaft Bearings

44. See Figure 3-227. Install crankshaft bearings and lubricate bearing surface with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

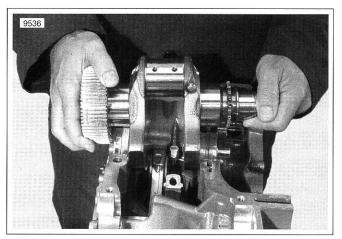


Figure 3-228. Install Crankshaft

- 45. See Figure 3-228. Carefully position crankshaft.
- 46. See Figure 3-189. When crankshaft is in position Install CRANKSHAFT ASSEMBLY RETAINER (HD-45316).

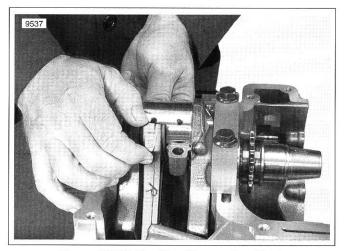


Figure 3-229. Position Connecting Rods

47. See Figure 3-229. Pull piston and rod assembly up to crankshaft journal.

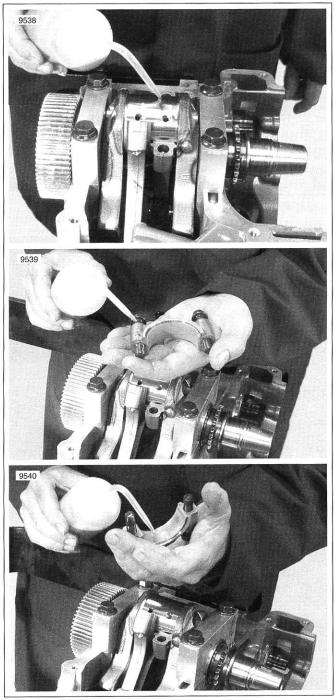


Figure 3-230. Lubricate Crankshaft and Rods

48. See Figure 3-230. Lubricate crankshaft journal, connecting rod cap bearings, connecting rod bolt threads and under head of rod cap bolt with Harley-Davidson Motor-cycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended for the rod bearings.

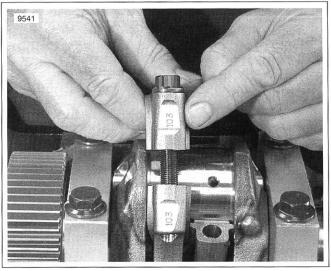


Figure 3-231. Install Connecting Rod Caps

- 49. See Figure 3-231. Install connecting rod caps. Confirm connecting rods and caps have identical numbers and cast bumps are oriented correctly.
 - a. Front cylinder connecting rod and cap bumps to cam drive side of engine.
 - b. Rear cylinder connecting rod and cap bumps to water pump side of engine.

- See Figure 3-232.Tighten connecting rod caps to 27 Nm (20 ft-lbs).
- See Figure 3-233. Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten connecting rod bolts an additional 90°.

NOTE

The notation for this torque sequence is written:

27 Nm **+** 90°

CAUTION

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

- 52. When all rod bolts are correctly torqued, turn engine to TDC and insert CRANKSHAFT LOCKING PIN (HD-45306).
- 53. Continue with appropriate steps under 3.14 UPPER AND LOWER CRANKCASE SERVICE.

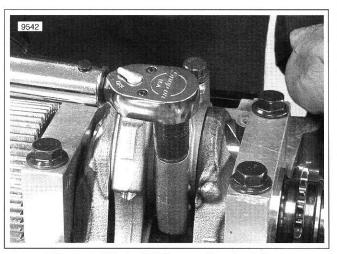


Figure 3-232. Install Connecting Rod Caps

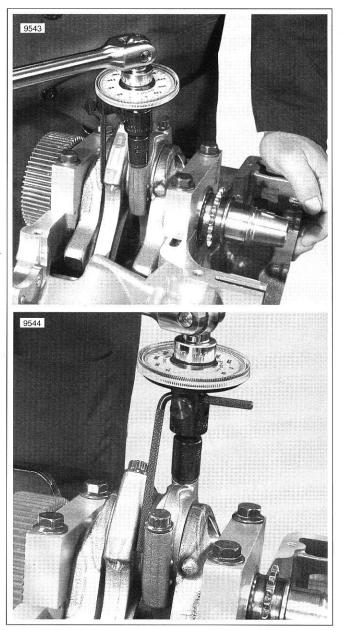


Figure 3-233. Tighten Connecting Rod Caps

OIL FILTER MOUNT

REPLACEMENT

- 1. See Figure 3-234. Remove three fasteners and remove oil filter mount.
- 2. See Figure 3-235. Remove o-ring and discard.
- 3. Inspect oil passages for debris and dirt. Clean as required.
- 4. Install new o-ring and install oil filter mount.

NOTE Always replace o-ring when oil filter mount has been removed and/or replaced.

5. Tighten oil filter mount fasteners to 9.7 Nm (85 in-lbs).

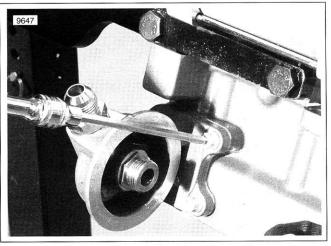


Figure 3-234. Remove Oil Filter Mount Fasteners

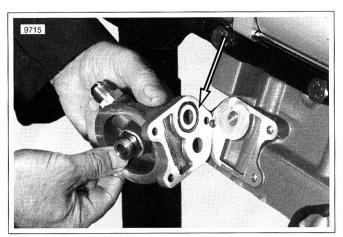


Figure 3-235. Replace O-Ring

ASSEMBLY

- Rotate the front cylinder piston to TDC. Remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306). The CRANK-SHAFT LOCKING PIN should insert flush with engine case.
- 2. See Figure 3-236. Insert water pump shaft through case until flush with case on cam drive side.
- 3. See Figure 3-237. Position triple gear on water pump shaft and drive chain on crankshaft drive gear. Squeeze drive chain to simulate the chain position with the chain tensioners in place. Walk chain around crankshaft gear to change position.
- 4. See Figure 3-238. Install primary chain fixed tensioner. Note the flat in the chain tensioner bore and the flat on the mounting shaft in the case.

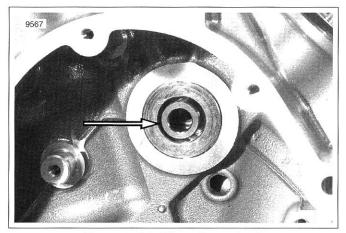


Figure 3-236. Water Pump Shaft

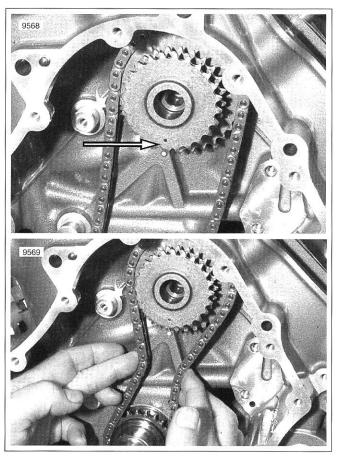


Figure 3-237. Triple Gear Timing Marks

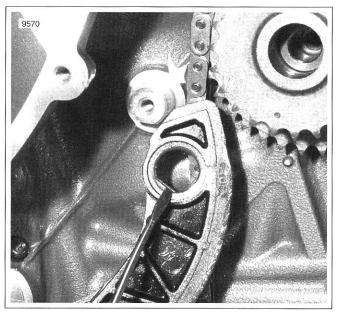


Figure 3-238. Primary Chain Fixed Tensioner

- 5. See Figure 3-239. Use a small screw driver to help guide the chain over the edge of the primary cam chain fixed tensioner.
- See Figure 3-240. Retract the chain tensioner and install PRIMARY CAM CHAIN TENSIONER RETAINER (HD-45326).
- 7. Confirm the position of the timing marks.
- 8. See Figure 3-241. Install primary chain hydraulic tensioner fastener. Tighten to 9.7 Nm (85 **in-lbs**).
- 9. See Figure 3-242. Install triple sprocket fastener. Tighten to 23 Nm (17 ft-lbs).
- 10. See Figure 3-243. Install fastener on primary chain fixed tensioner. Tighten to 9.7 Nm (85 **in-lbs**).
- 11. See Figure 3-244. Insert 8 mm pin through case and rear cylinder hydraulic cam chain tensioner.

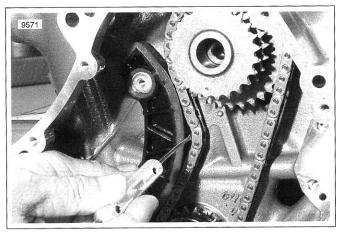


Figure 3-239. Water Pump Shaft

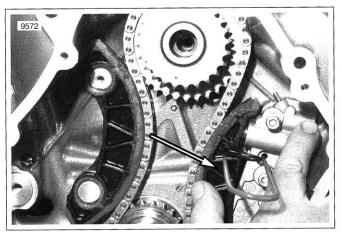


Figure 3-240. Primary Chain Tensioner Retainer

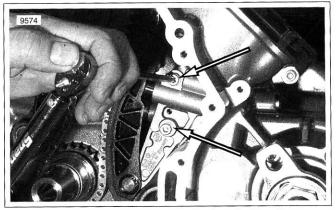


Figure 3-241. Primary Chain Hydraulic Tensioner

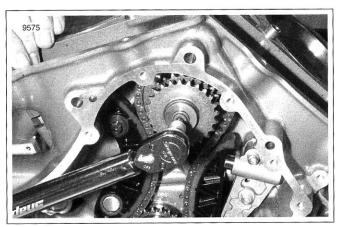


Figure 3-242. Triple Sprocket

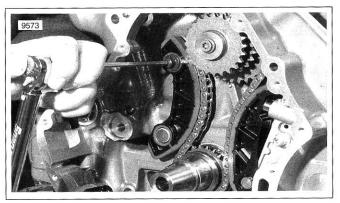


Figure 3-243. Primary Chain Fixed Tensioner

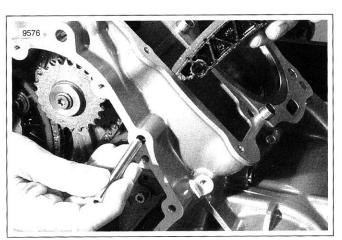


Figure 3-244. Rear Cylinder Cam Chain Tensioner

- 12. See Figure 3-245. Front hydraulic and rear fixed cam chain tensioner interlock. Position in case and insert 10 mm pin.
- 13. See Figure 3-246. Position front cylinder fixed cam chain tensioner and insert 10 mm pin.
- 14. Install cylinder heads. See 3.21 CYLINDER HEADS.
- 15. Installing and timing the cams. See 3.22 INSTALLING AND TIMING THE CAMS.

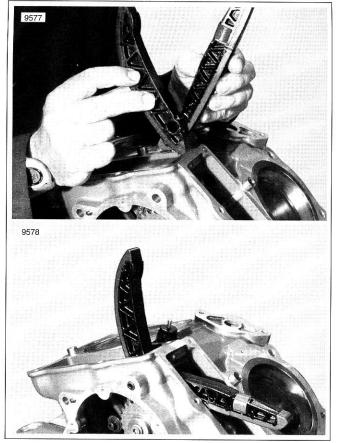


Figure 3-245. Front Hydraulic and Rear Fixed Cam Chain Tensioner

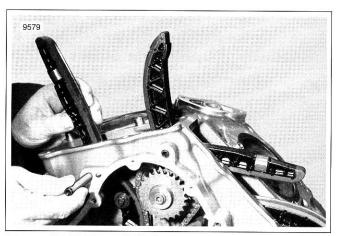


Figure 3-246. Front Cylinder Fixed Cam Chain Tensioner

CYLINDER HEADS

GENERAL

Cylinder head removal is part of top end disassembly. See 3.10 TOP END DISASSEMBLY.

Clean and examine heads carefully before installation. If heads, values, guides or springs require service, see 3.11 CYLINDER HEAD SERVICE.

If heads have been serviced, remove cam journal caps and cams prior to cylinder head installation. The cams will be reinstalled after the heads have been installed and the head bolts torqued to specifications. See 3.22 INSTALLING AND TIMING THE CAMS.

Initial valve lash measurement and adjustment are to be completed as part of cylinder head service. However, after torquing the cylinder head and installing the cam drive and timing the cams, valve lash should be measured and a valve lash calculation worksheet completed. See 1.22 VALVE LASH.

INSTALLATION

PART NO.	SPECIALTY TOOL	
HD-45491	Tappet compressing tool	

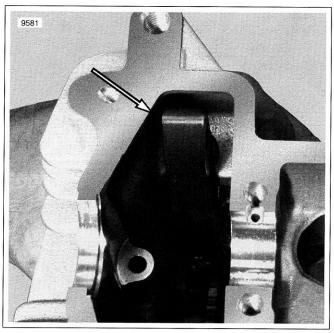


Figure 3-247. Tensioner Position In Cylinder Head

1. Place head gasket on rear cylinder with TOP marking facing up.

NOTE

Note the head gaskets are different for each head and are marked TOP.

2. See Figure 3-247. Make sure tensioner is locked in head as shown.

NOTE

Tensioner position is the same in both rear and front cylinder head.

- 3. See Figure 3-248. Use Harley-Davidson Motorcycle Oil 20W50 to lubricate the four main head bolts. Lubricate the threads and under the bolt head.
- 4. See Figure 3-249. Tighten four main head bolts in sequence.
 - See Figure 3-250.Tighten bolts to 35 Nm (25.8 ftlbs).
 - b. Loosen each bolt one full turn (360°).
 - c. Tighten bolts to 20 Nm (14.8 ft-lbs).
 - Position the Torque Angle Gauge (Snap-on Part No. TA360) per instruction sheet and tighten bolt an additional 90°.

NOTE

The notation for this torque sequence is written: 35 Nm - 360°, 20 Nm + 90°. 5. See Figure 3-251. Install 5 mm head bolts and tighten to 9.7 Nm (85 **in-Ibs**).

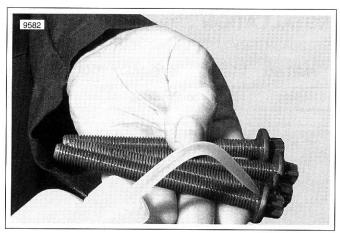


Figure 3-248. Lubricate Head Bolts

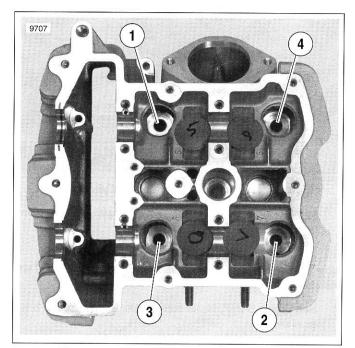


Figure 3-249. Head Bolt Torque Sequence (rear cylinder head)

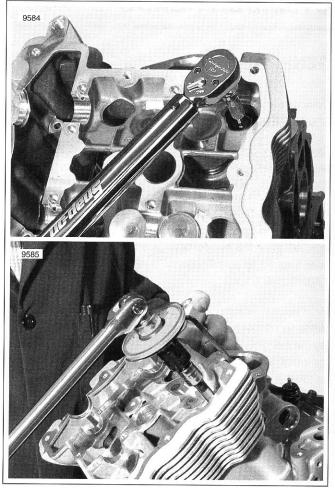


Figure 3-250. Tighten Head Bolts

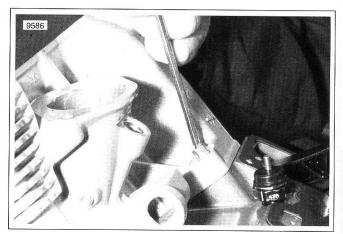


Figure 3-251. 5 mm Head Fasteners @ 9.7 Nm (85 in-lbs)

PROCEDURE

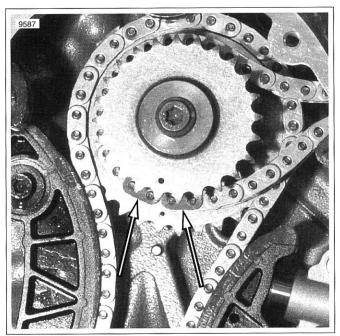


Figure 3-252. Copper Timing Links

PART NO.	SPECIALTY TOOL	
HD-45314	Crankshaft rotating wrench	
HD-45653	TDC positioning tool	
HD-45306	Crankshaft locking pin	
HD-45491	Tappet compressing tool	

1. 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.

CAUTION

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

- 2. Using CRANKSHAFT ROTATING WRENCH (HD-45314) rotate the engine counter-clockwise (direction of operation). Note when exhaust valve is closing (TDC positioning tool will start to extend as valve closes) and engine is approaching TDC.
- When the TDC reference tool is fully extended, remove plug from timing hole on right side of engine and insert CRANKSHAFT LOCKING PIN (HD-45306).

- 4. The CRANKSHAFT LOCKING PIN should insert flush with engine case. It may be necessary to gently rock the crankshaft using the CRANKSHAFT ROTATING WRENCH (HD-45314) to lock engine at exact TDC.
- 5. Remove TDC POSITIONING TOOL (HD-45653) from front spark plug hole.
- If removed, record shim thickness for reference and install all eight shims in their original location. Use a magnet to position the shim and push into place with finger.
- 7. Replace tappets in their original locations.
- See Figure 3-252. Insert rear cylinder cam drive chain down from the rear head. Wrap chain around middle row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.

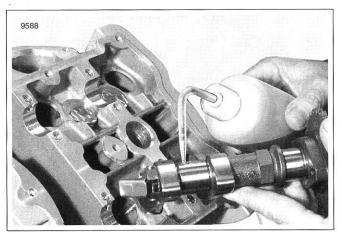


Figure 3-253. Lubricate Cam

 See Figure 3-253. Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.

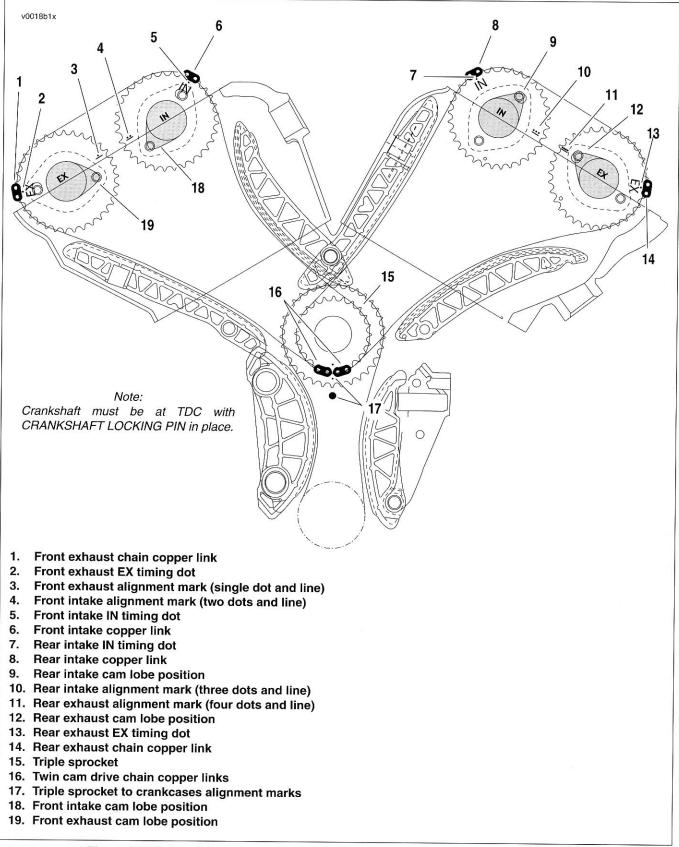


Figure 3-254. Cam Drive Timing Marks (secondary cam chain tensioners are not shown)

- See Figure 3-254. Insert rear exhaust cam into cylinder head and rotate cam sprocket so single copper link (14) straddles the single dot timing mark labeled as EX (13).
- 11. Insert rear intake cam into cylinder head and rotate cam sprocket so single copper link (8) straddles the single dot timing mark labeled IN (7).
- 12. Verify that the single copper links on the cam drive chain straddle the single dot timing marks and that the three dot timing line (10) on the intake cam and the four dot timing line (11) on the exhaust cam at the cam cover gasket surface are aligned.
- 13. See Figure 3-256. Lubricate cam journal caps and fasteners.
- 14. Cam journal caps are numbered. Install cam journal caps with corresponding number on head, arrow pointing to center of head.
- 15. Tighten cam journal caps to 9.7 Nm (85 in-lbs).
- 16. See Figure 3-257. Install rear cylinder cam chain tensioner and tighten to 100 Nm (78 ft-lbs).

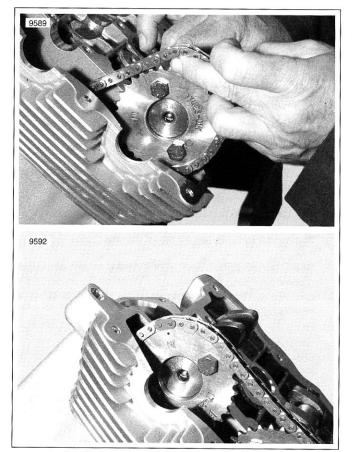


Figure 3-255. Rear Cylinder Cams

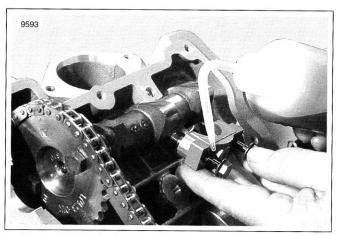


Figure 3-256. Lubricate Journal Caps and Fasteners

CAUTION

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

- 17. See Figure 3-28. Install TAPPET COMPRESSING TOOL (HD-45491) on front cylinder.
 - a. Loosen 19 mm nut on tappet compressing tool.
 - b. Tools are marked intake and exhaust. Position them accordingly.
 - c. Use M6x25 fasteners to secure tools to head.
- 18. Tighten 19 mm nut to compress tappets.
- 19. See Figure 3-258. Insert front cylinder timing cam drive chain down from the front head. Wrap chain around front row of triple sprocket teeth with the copper chain links straddling the triple gear timing marks.

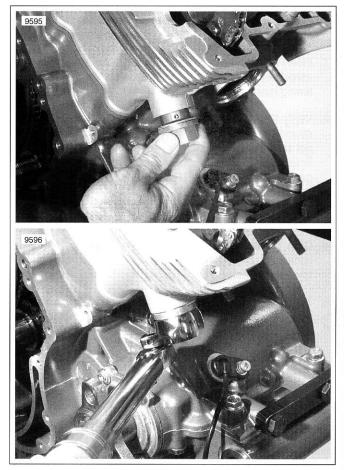


Figure 3-257. Rear Cylinder Cam Chain Tensioner

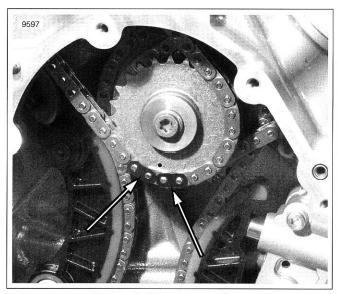


Figure 3-258. Copper Links

- Lubricate cam journals, lobes, and tappets with Harley-Davidson Motorcycle Oil 20W50. In addition, a thin film of Lubriplate No. 105 Motor Assembly Grease (NAPA Part No. 765-2651) is recommended.
- 21. See Figure 3-254. Insert front exhaust cam into cylinder head and rotate cam sprocket so single copper link (1) straddles the single dot timing mark labeled EX (2).
- Insert front intake cam into cylinder head and rotate cam sprocket so single copper link (6) straddles the single dot timing mark labeled IN (5).
- 23. Install and tighten cam journal caps to 9.7 Nm (85 inlbs).
- 24. Verify that the single copper links on the front cylinder cam drive chain straddle the single dot timing marks and that the one dot timing line (3) on the exhaust cam and the two dot timing line (4) on the intake cam at the cam cover gasket surface are aligned.

NOTE

Compare lobe positions of each cam shaft to Figure 3-254. If timing marks are correct but camshaft lobes are incorrect, the drive sprocket could be installed incorrectly on the camshaft.

- 25. Remove TAPPET COMPRESSION TOOL.
- 26. Install front cylinder cam chain tensioner and tighten to 100 Nm (78 ft-lbs).
- 27. Check valve lash and adjust as necessary. See 1.22 VALVE LASH.
- 28. Remove CRANKSHAFT LOCKING PIN (HD-45306).
- 29. Install the engine timing plug and tighten to 23 Nm (17 ft lbs).
- 30. Install cam cover and tighten fasteners to 9.7 Nm (86 in-Ibs) in sequence shown. See 1.22 VALVE LASH.

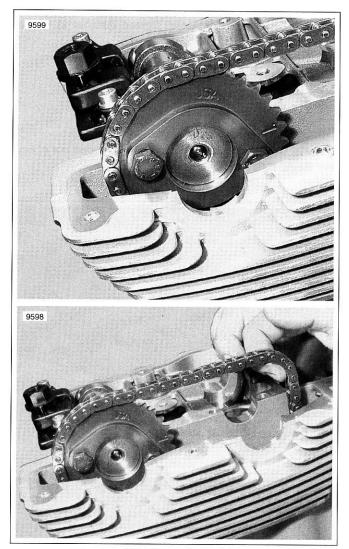


Figure 3-259. Cam Chain Alignment

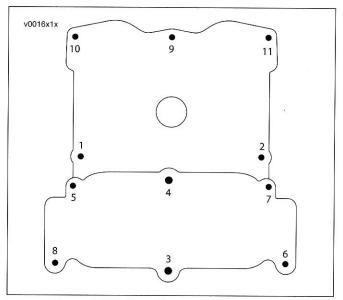


Figure 1-260. Cam Cover Torque Sequence

- See Figure 3-261. Install starter limiter gear assembly and starter limiter fastener. Tighten fastener to 46 Nm (34 ft-lbs).
- 32. See Figure 3-264. Install rotor shell and tighten.
 - a. Tighten to 82 Nm (60 ft-lbs).
 - b. Loosen one full turn.
 - c. Tighten to 180 Nm (132 ft-lbs).

NOTE

Check to be certain woodruff key has not slipped out of keyway during assembly.

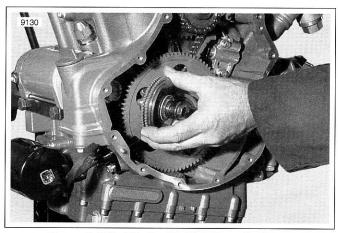


Figure 3-261. Starter Limiter Gear Fastener

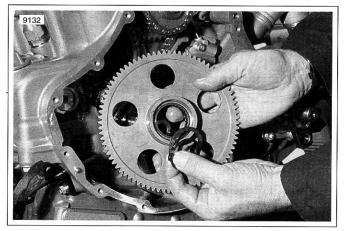


Figure 3-262. Install Needle Roller and Cage, Gear Ball Clutch and Washer

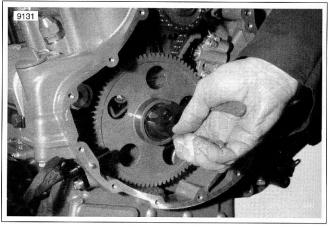


Figure 3-263. Gear Ball Clutch Retaining Ring

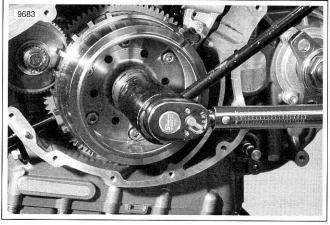


Figure 3-264. Install Rotor Shell @ 82 Nm (60 ft-lbs)

FUEL SYSTEM

4

SUBJECT	PAGE	NO.
4.1 Specifications		4-1
4.2 Fuel Pump/Filters/Fuel Level Sender Assembly		4-2
4.3 Fuel Tank		4-7
4.4 Vapor Valve		4-9
4.5 Evaporative Emissions Control-CA Models		4-10

Table 4-1. Capacities

FUEL TANK CAPACITY	GALLONS	LITERS
Total	3.7	14

TORQUE VALUES

ITEM	TORQUE		NOTES
Fuel plate lock ring	54-61 Nm	40-45 ft-lbs	page 4-4
Fuel tank bracket bolts	61-75 Nm	45-55 ft-lbs	page 4-8
Purge solenoid bolt	6-10 Nm	53-88 in-lbs	page 4-11
Mudflap stud plate fasteners	8-12 Nm	71-106 in-lbs	page 4-11

REMOVAL

1. Unlatch and open seat. Remove fuel cap, remove fuel filler boot, and replace fuel cap.

WARNING

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

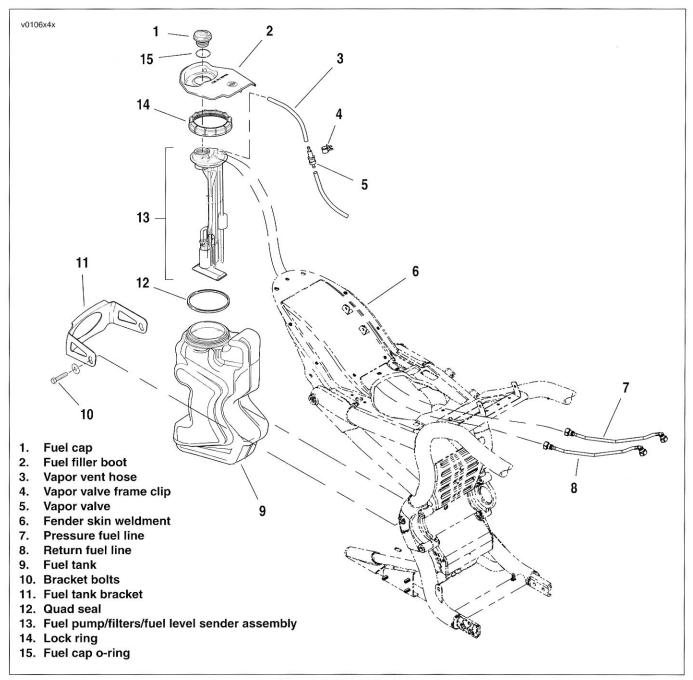


Figure 4-1. Fuel System

PART NO.	SPECIALTY TOOL	
HD-45324	Fuel cap remover/installer	

WARNING

The gasoline in the fuel supply line downstream of the fuel pump is under high pressure (400 kPa, 58 psi). To avoid an uncontrolled discharge or spray of gasoline, always purge the system of high pressure gas before removing the fuel supply line from the fuel tank. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

- 2. Purge the fuel supply line of high pressure gasoline.
 - a. See Figure 4-3. Disconnect the fuel module connector (5) from the top plate (1).
 - b. Start the engine and allow the vehicle to run.
 - c. When the engine stalls, operate the starter for 3 seconds to remove any remaining fuel from the fuel lines.
- 3. Remove right side cover.
- 4. See Figure 4-2. Remove maxi-fuse.

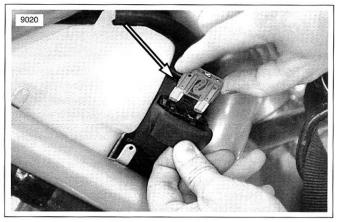


Figure 4-2. Maxi-fuse

5. Remove airbox. See 1.4 AIRBOX AND AIR FILTER.

WARNING

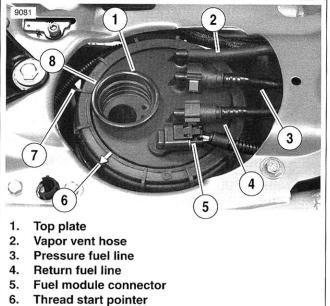
To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

6. Disconnect the negative battery cable.

- Determine how long before the assembly can be reinstalled.
 - a. If the fuel tank is to be left unattended for any length of time, remove the fuel cap and drain the fuel tank. Use a pump or siphon and an approved gasoline storage container of sufficient capacity.

or

b. If the fuel pump/filters/fuel level sender assembly is to be repaired and reinstalled immediately, the open fuel tank can be covered temporarily until the fuel pump/filters/fuel level sender assembly is reinstalled.



- 7. Wiring harness (resistive plug/purge solenoid)
- 8. Lock ring

Figure 4-3. Fuel Tank Top Plate

WARNING

Some gasoline will drain from the fuel lines when disconnected from the fuel tank top plate. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

- 8. See Figure 4-3. At the fuel rail, disconnect the larger pressure fuel line (3) and the smaller return fuel line (4) by pressing blue buttons with thumb and first finger. Then disconnect both fuel lines from the fuel tank top plate. Pull the lines out of the rotational path of the lock ring.
- 9. Use opposite thumbs to push the vapor vent hose (2) off of the outlet tube.

10. Assure that all components are out of the rotational path of the lock ring.

NOTE

Motorcycles not equipped with the H-D Security System will have the siren connector terminated to a cap attached to the wiring harness of the fuel module connector. Pull the siren connector and press the wiring harness out of the way before turning lock ring.

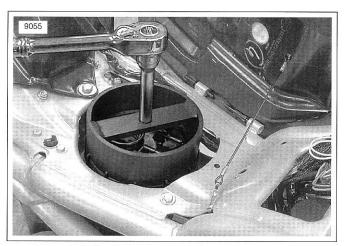


Figure 4-4. Fuel Cap Remover/Installer (HD-45324)

 See Figure 4-4. Use FUEL CAP REMOVER/INSTALLER (HD-45324) to unthread and lift off the lock ring.

WARNING

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

- 12. Lift the fuel pump/filters/fuel level sender assembly out of the fuel tank.
- 13. Cover the fuel tank opening or drain the fuel tank as required.

INSTALLATION

1. Apply a small dab of silicone gasket sealer at four spots around the bottom side of a **new** quad seal. Install the quad seal onto shoulder of the tank opening. Let the gasket sealer cure for five minutes.

PART NO.	SPECIALTY TOOL	
HD-45324	Fuel cap remover/installer	

2. See Figure 4-6. Insert fuel pump/filters/fuel level sender assembly into fuel tank. The two side by side tabs (1) on the right underside of the top plate mate to a notch in the collar in the fuel tank allowing the top plate to fall into position and the rubber spacer/bumper (5) on the bottom of the fuel pump/filters/fuel level sender assembly to rest on the bottom of fuel tank.

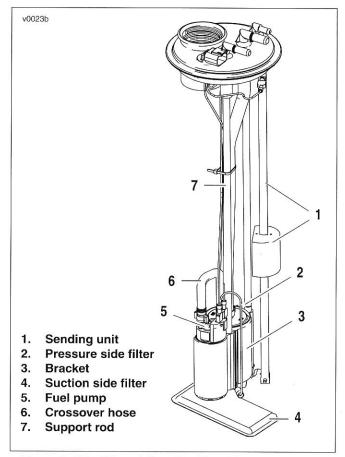


Figure 4-5. Fuel Pump/Filters/Fuel Level Sender Assembly

- See Figure 4-3. Orient the pointer (6) on the lock ring to point 90 degrees to the left side of the motorcycle. In this position the start of the lock ring threads match the start of the threads on the collar of the opening in the fuel tank. Thread on lock ring. Use FUEL CAP REMOVER/ INSTALLER (HD-45324) to tighten the lock ring to 54-61 Nm (40-45 ft-lbs).
- 4. Connect the fuel module connector (5) while supporting the top plate connector with the opposite hand.

NOTE

To avoid bending the connector pins, gently press the socket fuel module connector parallel or straight into the pin fuel module connector on the fuel tank top plate.

5. Install the smaller return fuel line (4) and the larger pressure fuel line (3) while supporting the mating port. Press the lines on until the click is heard that indicates engagement.

WARNING

Connecting the fuel lines to the wrong outlet port can result in a reverse flow of gasoline upon start up. Inadequate safety precautions could result in death or injury.

- 6. Attach the pressure (3) and the return (4) fuel lines to the fuel rail.
- 7. Press on the fuel vapor vent hose (2) while supporting the mating port.

8. Replace fuel filler boot. Fuel as required and replace the fuel cap.

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

- 9. Connect negative battery cable.
- 10. Install airbox. See 1.4 AIRBOX AND AIR FILTER.
- 11. Close and latch seat.
- 12. Replace the maxi-fuse and right side cover.
- 13. Check fuel system pressure. See 9.10 FUEL PRES-SURE TEST.

SUCTION SIDE FUEL FILTER

WARNING

Some gasoline will drain from the individual components when disconnected from the fuel pump/filters/fuel level sender assembly. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

See Figure 4-5. The suction side filter (4) filters the fuel as it enters the strained intake of the fuel pump. The suction side filter is replaced along with the fuel pump at the service interval of 161,000 kilometers (100,000 miles).

PRESSURE SIDE FUEL FILTER

See Figure 4-5. The pressure side filter (2) filters the fuel before it inters the pressure fuel line. The pressure side filter is serviced at a service interval of 161,000 kilometers (100,000 miles) or at anytime the fuel pump is serviced.

Removal

PART NO.	SPECIALTY TOOL	
HD-41137	Hose clamp pliers	

To remove, cut the clamps and disconnect the two hoses (6) from the filter. Press the pressure side filter up and out of the bracket.

Installation

To replace, press a **new** pressure side filter into its bracket up against the bracket stop, replace the fuel crossover hose and the pressure fuel line, and install a **new** clamp over the crossover hose using side of HOSE CLAMP PLIERS (HD-41137).

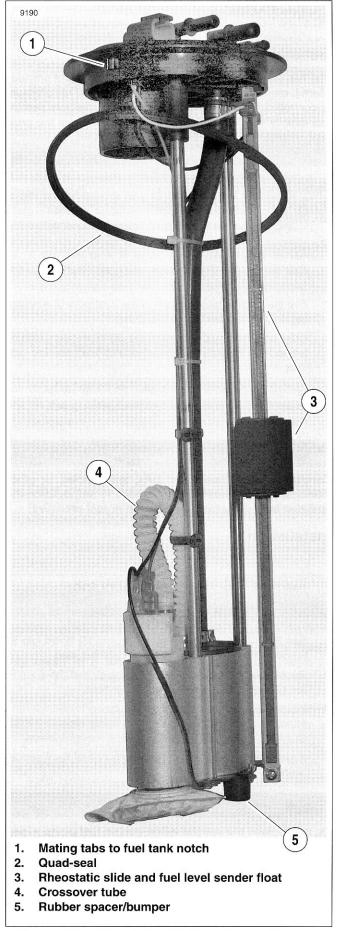


Figure 4-6. Fuel Pump/Filters/Fuel Level Sender Assembly

General

The fuel pump pumps fuel from the tank sump and provides filtered, pressurized fuel to the fuel rail. The fuel rail pressure is controlled by a pressure regulator. The injectors receive fuel directly from the fuel rail. The bypass fuel from the pressure regulator is returned to the tank sump via the external fuel return line.

NOTE

Before removing the fuel pump, perform appropriate diagnostics listed in the VRSCA Electrical Diagnostic Manual (Part No. 99499-02).

Removal

- 1. See Figure 4-5. Remove the black and red wire leads from the fuel pump (5).
- Pull the suction side filter off of the inlet port. The retaining ring will remain on the fuel pump.
- Cut clamp holding crossover hose (6) to pressure side filter and pull the fuel crossover hose off the pressure side filter.
- 4. Push the fuel pump up and out of its bracket (3).
- Inspect all fuel pump and fuel level sending unit (1) wiring.

CAUTION

Carefully inspect hoses for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.

Installation

PART NO.	SPECIALTY TOOL
HD-41137	Hose clamp pliers

- 1. See Figure 4-5. Push a **new** fuel pump (5) down into its bracket (3) against the screwed on bracket stop.
- 2. Route **new** crossover hose (6) on the side of the support rod (7) opposite the fuel level sender float.
- Install new clamps over new crossover hose (6) and attach to the pressure side filter using side of HOSE CLAMP PLIERS (HD-41137).
- 4. If required, replace fuel pump wiring or fuel level sender wiring.

CAUTION

Do not replace the special teflon coated fuel pump wiring with ordinary bulk wire. Ordinary insulation materials may deteriorate when in contact with gasoline.

- 5. Press the black and red wire leads onto the clips.
- 6. Press a **new** suction side filter (4) onto the strainer inlet at the bottom of the fuel pump (5).
- Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.2 FUEL PUMP/FILTERS/FUEL LEVEL SENDER ASSEMBLY.

8. After installation of fuel pump/filters/fuel level sender assembly, verify fuel pump operation with a fuel system pressure test. See 9.10 FUEL PRESSURE TEST.

FUEL LEVEL SENDER

WARNING

Some gasoline will drain from the individual components when disconnected from the fuel pump/filters/fuel level sender assembly. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

Removal

- 1. See Figure 4-6. Remove yellow wire lead and the double black wire leads from the rheostatic slide (3).
- Inspect and replace as required all fuel level sender wiring.
- Remove the retaining screw at the bottom of the rheostatic slide (3).
- 4. Pull the rheostatic slide (3) from its slot in the top plate and remove the fuel level sender float (3).

Installation

- See Figure 4-6. Slide rheostatic slide with fuel level sender float (3) into notch in top plate. Orient the scale so that the graduated side of the slide faces the fuel level wire connector on the top plate.
- 2. With the fuel level sender float on the slide (3) so that the half-round side faces out, thread in and tighten the retaining screw into the stop bracket at the bottom of the rheostatic slide (3).
- Attach the yellow wire lead to the graduated side of the rheostatic slide (3) and the double black lead to the opposite side.
- Install fuel pump/filters/fuel level sender assembly into gas tank. See 4.2 FUEL PUMP/FILTERS/FUEL LEVEL SENDER ASSEMBLY.
- Verify that the fuel gauge indicates the corresponding fuel level after installing the fuel pump/filters/fuel level sender assembly.

FUEL TANK

REMOVAL

- 1. Purge the fuel supply line of high pressure gasoline.
 - Disconnect the fuel module connector from the top plate. See 4.2 FUEL PUMP/FILTERS/FUEL LEVEL SENDER ASSEMBLY.
 - b. Start the engine and allow the vehicle to run. When the engine stalls, operate the starter for 3 second
- 2. Remove right side cover.
- 3. See Figure 4-2. Locate and remove maxi-fuse.
- 4. Unlatch and open seat.
- 5. Remove the airbox. See 1.4 AIRBOX AND AIR FILTER.

AWARNING

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

- 6. Disconnect the negative battery cable.
- 7. Remove rear wheel and rear fork. See 2.23 REAR WHEEL and 2.33 REAR FORK.
- 8. Remove the two hex-nuts fastening the mud flap stud plate and the mudflap to the frame fender weldment. Remove the mudflap and the stud plate. See 2.36 REAR FENDER/SUPPORTS.
- 9. Remove fuel cap and fuel filler boot. Replace fuel cap.

AWARNING

Some gasoline will drain from the fuel lines when disconnected from the fuel tank top plate. Thoroughly wipe up any spilled fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

- 10. See Figure 4-3. At the fuel rail, disconnect the larger pressure fuel line (3) and the smaller return fuel line (4) by pressing blue buttons with thumb and first finger. Then disconnect both fuel lines from the fuel tank top plate.
- 11. Use opposite thumbs to push the vapor vent hose off of the outlet tube.

- 12. Unbolt the two bolts and their washers on the bracket that holds the fuel tank against the frame.
- 13. Remove fuel tank from motorcycle.

WARNING

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

14. If the fuel tank is going to be stored prior to service, either drain using a siphon or cap the pressure fuel port, the return fuel port, and the vapor vent port on the fuel tank top plate.

CLEANING AND INSPECTING

- Drain the fuel tank. Use a common pump or siphon and an approved gasoline storage container of sufficient capacity.
- Remove fuel pump/filter/fuel level sender assembly from tank.
- 3. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent.
- Flush the tank thoroughly after cleaning and allow it to air dry.

WARNING

Extreme caution should be taken when repairing tanks. If all traces of fuel are not purged, an open flame repair may result in a tank explosion which could result in death or serious injury.

- 5. Inspect the evaporative emissions system vapor valve line and pressure and return fuel lines for cuts, cracks or holes. Replace lines as needed.
- 6. Inspect the tank for leaks and other damage. If damaged, replace it.

1. Position the fuel tank in the frame and position the fuel tank mounting bracket to the frame.

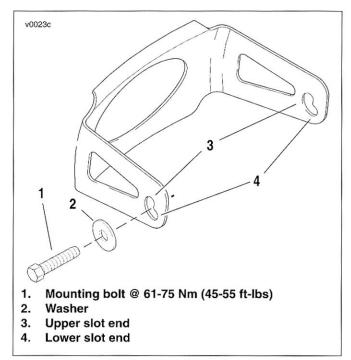


Figure 4-7. Fuel Tank Mounting Bracket

- See Figure 4-7. Loosely thread in the two mounting bolts
 (1) and washers (2) through the forward lower slot ends
 (4) of the bracket into the threaded boss on the frame.
- 3. Evenly press forward and downward on the bracket against the fuel tank until the mounting bolts slide back and up into the upper slot ends (3).
- 4. Tighten the mounting bolts to 61-75 Nm (45-55 ft-lbs).
- 5. Connect the fuel module connector while supporting the top plate connector half with the opposite hand.
- 6. See Figure 4-3. Install the smaller return fuel line (4) and the larger pressure fuel line (3) while supporting the mating port. Press the lines on until the click is heard that indicates engagement.

WARNING

Connecting the fuel lines to the wrong outlet port can result in a reverse flow of gasoline upon start up. Inadequate safety precautions could result in death or injury.

- 7. Attach the pressure (3) and the return (4) fuel lines to the fuel rail.
- 8. Press on the vapor vent hose while supporting the mating port with the opposite hand.
- 9. Install mudflap and stud plate. See 2.36 REAR FENDER/SUPPORTS.
- 10. Install rear fork. See 2.33 REAR FORK.
- 11. Install the rear wheel assembly and adjust the drive belt tension. See 2.23 REAR WHEEL.

WARNING

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

- 12. Replace the filler boot and fuel the motorcycle as required. Replace the fuel cap.
- 13. Install airbox. See 1.4 AIRBOX AND AIR FILTER.
- 14. Connect negative battery cable.
- 15. Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bailhead fastener 1/4 turn clockwise.
- 16. Close and latch seat.
- 17. Replace the maxi-fuse and the side cover.
- 18. Check fuel system pressure. See 9.10 FUEL PRES-SURE TEST.

4-8 2003 VRSCA: Fuel System

GENERAL

See Figure 4-8. The vapor valve is mounted to the left hand frame rail directly in front of the fuel tank. Hydrocarbon vapors in the fuel tank are vented through a hose to the vapor valve. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.

WARNING

The vapor valve must be mounted in a vertical position, with the long fitting at the top, otherwise, excessive fuel vapor pressure may build up in the fuel tank. Excessive pressure could cause a fuel leak resulting in a fire or an explosion which could result in death or serious injury.

REPLACEMENT

Pull off the upper formed fuel vapor valve hose and the lower hose. Remove the vapor valve from its clip. When installing the vapor valve, place the valve back into the clip with the long necked end at the top.

NOTE

On non-California models, the bottom hose is vented to the atmosphere. On California models, the hose from the vapor valve bottom fitting goes to a evaporative (EVAP) emissions control system. See 4.5 EVAPORATIVE EMISSIONS CONTROL-CA MODELS.

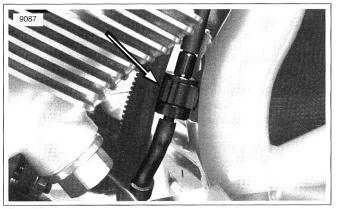


Figure 4-8. Vapor Valve

RESISTIVE PLUG

California models have a purge solenoid to allow hydrocarbon vapor to flow from the charcoal canister to the throttle body.

See Figure 4-9. All non-California models have a resistive plug connected to the purge solenoid connector. The diagnostic system will display the same diagnostic codes whether a resistive plug is in place or the connection is made to a purge solenoid.

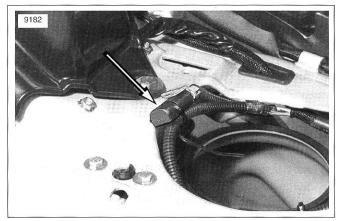


Figure 4-9. Resistive Plug

GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

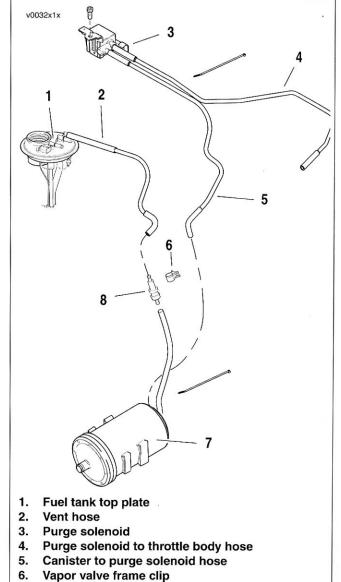
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- When the engine is running, intake venturi negative pressure (vacuum) draws off the hydrocarbon vapors from the charcoal canister when the purge solenoid is open. These vapors pass through the intake and are burned as part of normal combustion in the engine. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed.

AWARNING

Verify that the evaporative emissions vent hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged which could result in death or serious injury.

NOTE

The EVAP system has been designed to operate with a minimum of maintenance. Check that all hoses are properly connected, are not pinched or kinked and are routed properly. Improper connections could leak charcoal from canister.



- 7. Charcoal canister
- 8. Vapor valve

Figure 4-10. Evaporative Emissions Control System

PURGE SOLENOID

The purge solenoid allows hydrocarbon vapor flow from the charcoal canister to the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed, or low vehicle speed. The power for the solenoid comes from the system relay. The EVMS provides the path to ground to trigger the purge solenoid.

NOTE

Before removing the purge solenoid, perform diagnostics listed in the VRSCA Electrical Diagnostic Manual (Part No. 99499-02).



Figure 4-11. Purge Solenoid (mudflap removed)

Removal

1. Remove right side cover.

WARNING

To avoid accidental start-up of vehicle and possible personal injury, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

- 2. See Figure 4-2. Remove maxi-fuse.
- Remove the two hex-nuts fastening the mud flap stud plate and the mudflap to the frame fender weldment. Remove the mudflap and the stud plate. See 2.36 REAR FENDER/SUPPORTS.
- 4. Disconnect the wire connector to the purge solenoid.
- 5. Gently pull off the charcoal canister to purge solenoid hose.
- 6. Gently pull off the purge solenoid to throttle body hose.
- 7. Remove the hold down bolt and the purge solenoid.

Installation

- Thread the purge solenoid bolt into the threaded fender skin weldment boss and tighten it into the purge solenoid under the fender skin. Tighten to 6-10 Nm (53-88 in-lbs).
- 2. Push on the purge solenoid to throttle body hose.
- 3. Push on the charcoal canister to purge solenoid hose.
- 4. Connect the wire connector.

- Install the mudflap and stud plate to the frame fender weldment. Thread on and tighten the two hex-nuts to 8-12 Nm (71-106 in-lbs). See 2.36 REAR FENDER/SUP-PORTS.
- 6. Replace the maxi-fuse and the right side cover.

NOTE

On non-California models the wire connector to the purge solenoid is capped with a resistive plug. However, the diagnostic codes will be the same. See RESISTIVE PLUG in 4.4 VAPOR VALVE.

VAPOR VALVE

WARNING

The vapor valve must be mounted in a vertical position, with the long fitting at the top, otherwise, excessive fuel vapor pressure may build up in the fuel tank. Excessive pressure could cause a fuel leak resulting in a fire or an explosion which could result in death or serious injury.

See Figure 4-8. The vapor valve is mounted to the left hand frame rail directly in front of the fuel tank. See 4.4 VAPOR VALVE.

NOTE

On CA (California) models, the hose from the vapor valve bottom fitting goes to the charcoal EVAP canister.

CHARCOAL CANISTER

Removal/Inspection

The EVAP charcoal canister is mounted below the swingarm pivot in front of the fuel tank on the shield. It can be accessed from the left side of the motorcycle.

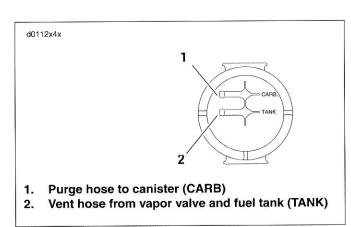


Figure 4-12. Charcoal Canister Connections

 See Figure 4-12. Note the two hose connections, CARB (1) and TANK (2), on the left side of the canister. Gently pull the hoses off the charcoal canister.

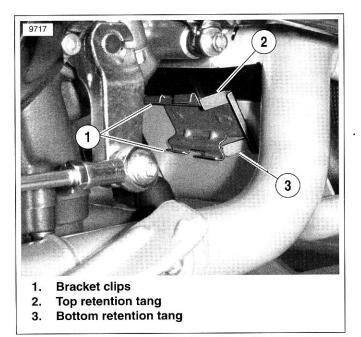


Figure 4-13. Charcoal Canister Mounting Bracket

2. See Figure 4-13. With a screwdriver, press the retention tang (3) in on the bottom of the canister bracket while pressing on the opposite side of the canister. When the bracket on the canister slides just far enough out of the bracket clips (1) to hold the bottom tang in, press in on the top tang (2) and continue to slide the charcoal canister out until it drops free from the bracket clips.

- 3. Remove charcoal canister.
- Inspect and replace as required the hose sections to vapor valve.
- Inspect and replace as required the charcoal canister to purge solenoid hose segments.

Installation

- 1. Position the two segments of the brackets on the **new** charcoal canister between the two segments of the canister mounting bracket welded to the frame.
- 2. See Figure 4-13. Press the canister in toward the bracket until it holds both the upper and lower retention tangs in.
- 3. Slide the canister into the bracket clips (1) until the tangs (2, 3) snap into place.
- 4. See Figure 4-12. Attach hoses to left side canister connections (1, 2) as marked.
- 5. Install new EVAP system label on front frame down tube.

HOSE ROUTING/REPLACEMENT

NOTE

Record location of cable ties before removal. Install cable ties in same location when installing.

AWARNING

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

- 1. Route purge solenoid hoses.
 - a. See Figure 4-10. Attach the purge solenoid to throttle body hose (4) to the throttle body.
 - b. Route purge solenoid to throttle body hose (4) under frame tube to purge solenoid (3). Install cable ties.
 - c. Attach the canister to purge solenoid hose (5) to the purge solenoid.
 - d. Route canister to purge solenoid hose (5) to the charcoal canister (7). See Figure 4-12. Attach the hose to the fitting marked CARB (1) on left side of canister. Install cable ties.
- 2. Route fuel tank vapor vent hoses.
 - a. See Figure 4-10. Route fuel tank vent hose (2) along left side of frame to top or long end of the vapor valve (8) clipped on frame tube. Install cable ties. Gently press the hose onto the top plate outlet port and onto the long end of the vapor valve.
 - See Figure 4-12. Attach short segment of hose to the bottom or short end of the vapor valve and to the fitting marked TANK (2) on left side of the charcoal canister.

ELECTRIC STARTER 5

SUBJECT PAGE	NO.
5.1 Specifications	5-1
5.2 Electric Starter System	5-2
5.3 Starter Relay	5-4
5.4 Starter	5-6
5.5 Starter Solenoid	5-7

Table 5-1. Starter Performance

STARTER				
Free speed	9200 rpm (min)			
Free current	32 Amp			
Cranking current	180 Amp			

TORQUE VALUES

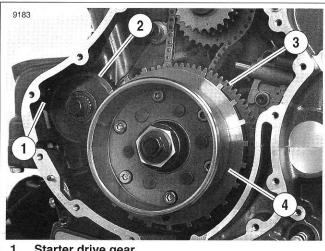
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ITEM Starter mounting bolts	TORQUE		NOTES
	6-10 Nm	53-88 in-lbs	page 5-6
Solenoid cable terminal ring	6-10 Nm	53-88 in-lbs	page 5-6
Solenoid bracket hex-nuts	6-10 Nm	53- 88 in-lbs	page 5-7
Lower radiator bolts	23 Nm	17 ft-lbs	page 5-7
Negative battery cable to solenoid post	6-10 Nm	53-88 in-lbs	page 5-7
Solenoid cable to solenoid post	6-10 Nm	53-88 in-lbs	page 5-7

GENERAL

The electric starter system is made up of the starter relay, starter solenoid, and starter motor. The starter drive gear engages a geared limiter assembly which engages a starter ring gear whose hub rotates inside a ball clutch on the rotor assembly.

The rotation of the starter is transferred to the crankshaft of the engine through the ball clutch. The starter motor torque is multiplied through the gear reduction of the starter drive gear to the limiter assembly gear and to the starter ring gear. The three gears remain in constant engagement.



- 1. Starter drive gear
- 2. Limiter assembly
- 3. Starter ring gear
- 4. Rotor

Figure 5-1. Starter Drive (Left side engine cover/stator removed)

Wiring Diagrams

See Figure 5-3. For additional information concerning the starting system circuit, see the wiring diagrams in Appendix B.

Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

Starter

The starter is not repairable. Replace the unit if it fails.

Starter Solenoid

The starter solenoid is not repairable. Replace the unit if it fails.

OPERATION

When the starter switch is pushed, the starter relay is activated which activates the starter solenoid allowing current to flow to the starter motor.

The starter drive gear transfers rotation to the limiter assembly and the limiter assembly gear transfers rotation to the starter ring gear. The starter ring gear drives the alternator rotor on the end of the crankshaft.

When the engine starts, a ball clutch on the back side of the rotor disengages allowing the starter ring gear and the rotor to rotate independently of each other.

NOTE

For troubleshooting and diagnostic information see VRSCA Electrical Diagnostic Manual.

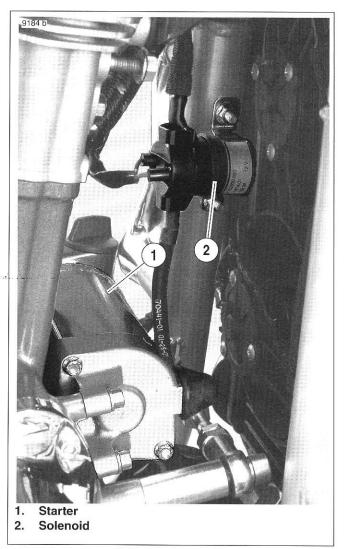


Figure 5-2. Starter and Solenoid

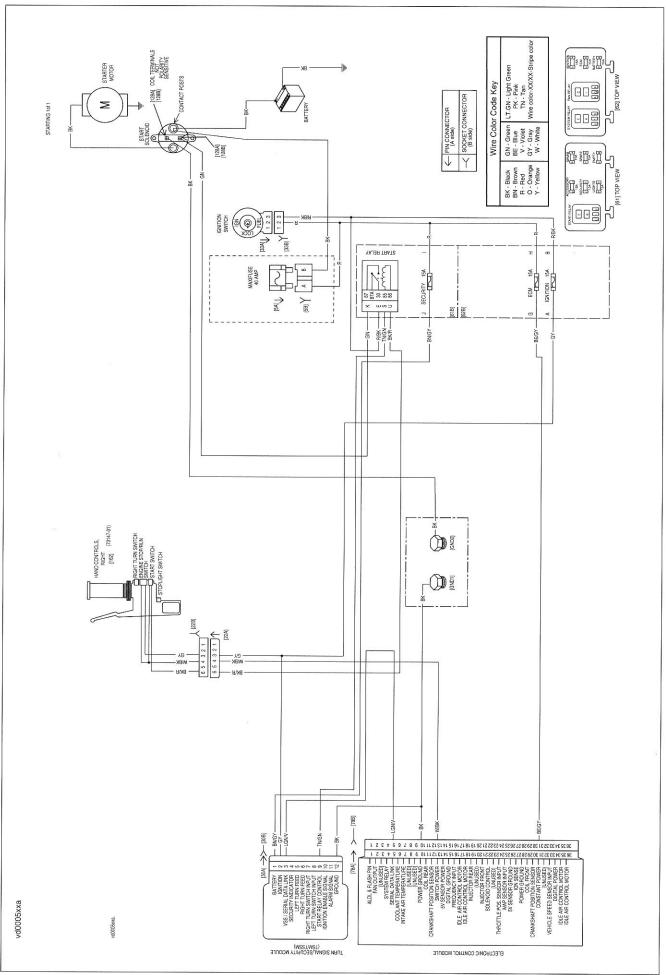


Figure 5-3. Starting Circuit

STARTER RELAY

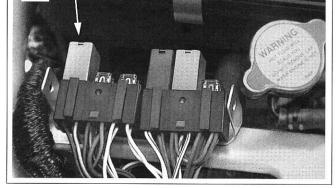
REMOVAL

NOTE

Before removing the relay, perform diagnostics listed in the VRSCA Electrical Diagnostic Manual.

The starter relay is located beneath the airbox cover in the fuse block.

- 1. Remove right side cover.
- 2. See Figure 5-4. Locate and remove maxi-fuse.



9031

Figure 5-5. Starter Relay (fuse block cover removed)

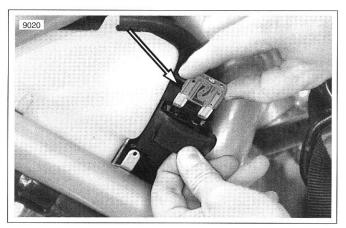


Figure 5-4. Maxi-fuse

- 3. Unlatch and open seat.
- 4. Remove the airbox cover. See 1.4 AIRBOX AND AIR FILTER.

WARNING

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

- 5. Disconnect the negative battery cable.
- See Figure 5-5. Locate fuse block behind air cleaner. Pull fuse blocks from tabs on mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover. To remove cover, raise latches slightly to disengage tabs on fuse blocks.
- Remove gray starter relay from fuse block with single relay.

INSTALLATION

- 1. Install relay in fuse block.
- 2. Slide cover over fuse blocks until latches fully engage tabs on blocks.
- 3. Slide fuse blocks onto frame mounting bracket. Tabs on bracket fit into slots on each side of fuse block cover.

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

WARNING

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

- 4. Connect negative battery cable. See 1.7 BATTERY MAINTENANCE.
- Install airbox cover by positioning the airbox cover with the locating pins in the holes on the frame tabs. Turn bailhead fastener 1/4 turn clockwise.
- 6. Replace maxi-fuse and right side cover.

WARNING

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.

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

AWARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.

REMOVAL

NOTE

Before removing the starter, perform diagnostics listed in the VRSCA Electrical Diagnostic Manual.

- 1. Remove right side cover.
- 2. See Figure 5-4. Remove maxi-fuse.
- 3. Unlatch and open seat.
- 4. Remove the airbox cover. See 1.4 AIRBOX AND AIR FILTER.

WARNING

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

- 5. Disconnect the negative battery cable.
- 6. Remove exhaust system to provide clearance for starter removal. See 2.7 EXHAUST SYSTEM.
- 7. See Figure 5-6. Pull back solenoid cable protective boot and loosen and remove hex-nut. Remove solenoid cable terminal ring (2).
- 8. Remove both starter mounting bolts and washers (1).
- 9. Remove starter from right side of motorcycle.

INSTALLATION

- 1. Lubricate the starter o-ring with Harley-Davidson Special Purpose Grease, Part No. 99857-97.
- 2. Install starter gear shaft into engine housing.

NOTE

Be sure starter gear shaft engages the teeth of the limiter assembly in the engine housing.

- See Figure 5-6. Install the two starter mounting bolts and washers (1). Alternately tighten the bolts to 6-10 Nm (53-88 in-lbs).
- Slide solenoid cable terminal ring (2) over starter post. Thread on and tighten hex-nut to 6-10 Nm (53-88 inlbs).
- 5. Slide protective boot securely over terminal.

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

WARNING

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

- 6. Connect negative battery cable. See 1.7 BATTERY MAINTENANCE.
- 7. Install airbox cover. See 1.4 AIRBOX AND AIR FILTER.
- 8. Replace maxi-fuse and the right side cover.

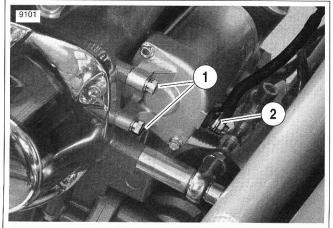
WARNING

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.

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

WARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.



- 1. Starter mounting bolts and washers
- 2. Solenoid cable terminal ring

5-6

GENERAL

The starter solenoid is a switch that is designed to open and close the circuit to the electric starter motor.

REMOVAL

1. Remove right side cover.

CAUTION

The radiator fans are thermostatically controlled and will run will the ignition switch in the OFF position. However, pulling the maxi-fuse will disconnect power to the fans. To prevent damage to engine components, be sure the radiator has cooled before removing the maxi-fuse.

- 2. See Figure 5-4. Remove maxi-fuse.
- 3. Unlatch and open rider's seat.
- 4. Remove the airbox cover. See 1.4 AIRBOX AND AIR FILTER.

AWARNING

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

- 5. Disconnect the negative battery cable.
- 6. See Figure 5-7. Pull black wire lead (3) and green wire lead (5) from solenoid.
- 7. Press small screw driver into u-shaped bracket (6) to unsnap cover (1).
- Unthread two hex-nuts and remove negative battery cable (2) and the solenoid cable (4) from the solenoid posts.
- 9. Remove two bottom radiator bolts and pull bottom of radiator forward.
- 10. See Figure 5-8. Unthread two hex-nuts and remove solenoid and bracket from frame studs.

INSTALLATION

- 1. See Figure 5-8. Install replacement solenoid on frame studs.
- Thread on the two hex-nuts and tighten to 6-10 Nm (53-88 in-lbs).
- Seat radiator and thread in and torque the two bottom radiator bolts to 23 Nm (17 ft-lbs).
- See Figure 5-7. Install negative battery cable (2) and solenoid cable (4) on the solenoid posts. Thread on and torgue the hex-nuts to 6-10 Nm (53- 88 in-lbs).
- 5. Snap the cover (1) closed.
- 6. Push in the black wire lead (3) on the outside and the green wire lead (5) on the inside.

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

WARNING

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

7. Connect negative battery cable. See 1.7 BATTERY MAINTENANCE.

- 8. Install airbox cover. See 1.4 AIRBOX AND AIR FILTER.
- 9. Replace the maxi-fuse and the right side cover.

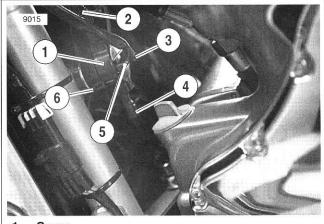
AWARNING

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.

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

AWARNING

After installing and locking seat, pull upward on the latch side of the seat to be sure it is locked in position. If seat is loose, it could shift position during vehicle operation resulting in loss of control of the vehicle and death or serious injury.



- 1. Cover
- 2. Negative battery cable
- 3. Black wire lead
- 4. Solenoid cable
- 5. Green wire lead
- 6. U-shaped bracket

Figure 5-7. Starter Solenoid

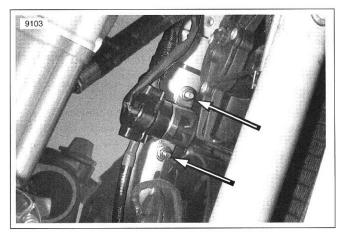


Figure 5-8. Solenoid Bracket Hex-Nuts (exhaust system removed for clarity)

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6.8 Radiator/Oil Cooler	6-18
6.9 Oil Cooler	6-21

COOLING SYSTEM

6

Table 6-1. Capacities

ITEM	LITERS	QUARTS
Engine coolant	2.4	2.54
Engine oil w/filter	4.3	4.5

Table 6-2. Coolant Pressure

ITEM	КРА	PSI
Cap lower limit	96	14
Rated cap pressure	110	16
Cap upper limit	124	18i
System pressure	103	15

Table 6-3. Coolant Temperatures

ITEM	°C	°F
Thermostat initially opens	85	185
Thermostat fully open	100	212
Engine temperature lamp	112.8	235
Antifreeze protection	- 36.7	- 34

Table 6-4. Fan Operation

STATUS	°C	°F
On	96	205
Off	91	195

TORQUE VALUES

ITEM	TOR	QUE	NOTES
Air bleed plug	9-11 Nm	80-97 i n-Ibs	page 6-9, 6-16
Coolant air bleed plug	9-11 Nm	80-97 i n-Ibs	page 6-11, 6-13
Coolant hose clamps	3-4 Nm	27-35 i n-lbs	page 6-16
Cross member fasteners	20-26 Nm	15-19 ft-lbs	page 6-20
Engine coolant drain plug	9.7 Nm	86 i n-Ibs	page 6-9
Hose clamp	3-4 Nm	27-35 i n-lbs	page 6-13
Hose cover	3-4 Nm	27-35 i n-Ibs	page 6-13
Oil cooler to radiator	9-11 Nm	80-97 i n-Ibs	page 6-21
Oil line fittings	25-30 Nm	19-22 ft-lbs	page 6-17
Oil line sleeves	53-58 Nm	39-42 ft-lbs	page 6-17, 6-20
Oil pipe sleeves to oil cooler	50-55 Nm	37-40 ft-lbs	page 6-22
P-clamp	6-10 Nm	53-88 i n-Ibs	page 6-16, 6-20
Pipe clamp	6.5 Nm	57 i n-Ibs	page 6-16, 6-20
Pipe connection clamp	6-10 Nm	53-88 ft-lbs	page 6-11
Radiator drain plug	9-11 Nm	80-97 i n-Ibs	page 6-9
Radiator hose clamps	3-4 Nm	27-35 i n-lbs	page 6-20
Radiator oil line bracket	15 Nm	11 ft-lbs	page 6-21
Thermostat housing fasteners	9.7 Nm	85 i n-Ibs	page 6-11
Top radiator mounting nuts	19-27 Nm	15-20 ft-lbs	page 6-20
Water pump mounting fasteners	9.7 Nm	85 i n-lbs	page 6-13

COOLANT FLOW

GENERAL

The VRSCA engine is cooled by a an ethylene-glycol coolant and the lubricating engine oil.

The ethylene-glycol coolant is pressurized and circulated through the engine and a cooling radiator by an impeller type water pump utilizing a thermostat controlled bypass.

The coolant pressure determines the coolant boiling point. The boiling point rises as the pressure increases and drops as the pressure decreases. At the rated system pressure of 103 kPa (15 psi), the boiling point rises to over 121° C (250° F).

The engine oil also cools the engine. Specifically, an oil jet under each piston sprays a mist of oil to lower the operating temperature of that piston. See 3.4 OIL FLOW.

FLOW DESCRIPTION

See Figure 6-1. To warm the engine up quickly, the ethyleneglycol coolant is re-circulated through the cylinders (13) and combustion chamber (12) in the cylinder heads. The thermostat (4) blocks the passage to the radiator (11) to recirculate the coolant.

As coolant exits the pump (3), it flows through the crankcase and around the cylinder liners (13) removing the heat build-up caused by the motion of the piston rings. From the cylinder liners (13), the coolant flows up through the cylinder head and around the exhaust valves and combustion chamber (12). After the coolant passes around the combustion chamber (12), it then flows back through the closed thermostat (4) into the pump (3) to repeat the cycle. This flow continues until the coolant reaches 85° C (185° F) and the thermostat (4) opens.

Once the coolant exceeds 100° C (212° F), the thermostat (4) remains open and blocks the by-pass between the entrance and exit ports of the case.

An engine coolant temperature (ECT) sensor is mounted to the thermostat (4). If the temperature should exceed 112.7 $^{\circ}$ C (235 $^{\circ}$ F), the engine coolant temperature indicator on the instrument cluster will illuminate.

After the coolant leaves the cylinder heads, it flows through the radiator coolant inlet pipe (5) to the radiator (11). The ethylene-glycol is cooled as it flows through the radiator (11) from left to right.

To increase the amount of air flowing through the radiator (11), two cooling fans will turn on when the coolant temperature exceeds 96° C (205° F) and will turn off when the temperature drops below 91° C (195° F).

The coolant exits the top right of the radiator (11) and flows through the radiator outlet coolant pipe (10) to the coolant pump (3) inlet.

The pressure cap (6) and radiator filler neck pressurize the coolant system. When the coolant pressure exceeds the pressure cap (6) lower limit of 96 kPa (14 psi), the lower valve opens and the excess pressure and expanded coolant flow to the overflow bottle (8) through the overflow tube (7). The overflow bottle (8) is vented to the atmosphere through a long tube (9) which loops over the top of the radiator/oil cooler assembly and down below the coolant level. When the pressure drops, the pressure cap (6) vacuum valve opens to draw coolant back into the coolant inlet pipe (5) from the overflow bottle (8).

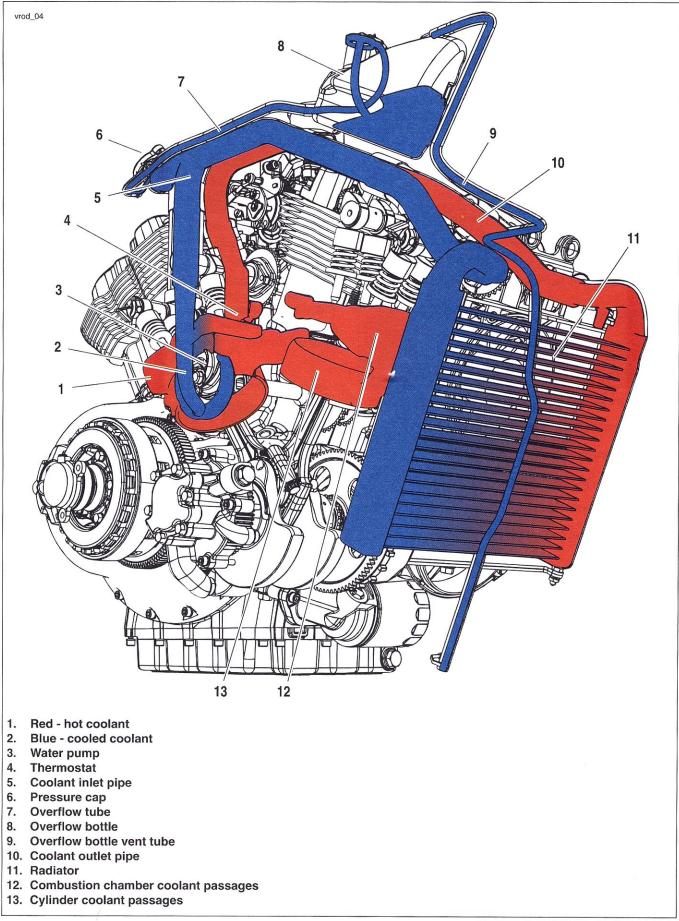


Figure 6-1. Engine Coolant Flow

TROUBLESHOOTING

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.

Low Engine Temperature

- 1. Open thermostat.
- 2. Defective engine coolant sensor.
- 3. Defective cooling fan.

High Engine Temperature

- 1. Stuck thermostat.
- 2. Blocked hoses, pipes or passages.
- 3. Defective cooling fan.
- 4. Faulty water pump.
- 5. Low coolant level.
- 6. Air in hoses, pipe or passages.
- 7. Defective pressure cap.
- 8. Defective engine coolant sensor.

Coolant Leaks

- 1. Damaged pressure cap gasket.
- 2. Faulty water pump.
- 3. Deteriorated o-rings on water pump.
- 4. Damaged engine gasket.
- 5. Leaking hose or hose connection.

PRESSURE CAP

The pressure cap and radiator filler neck pressurize the coolant system. The pressure cap's upper spring diaphragm gasket seals to the upper sealing seat in the filler neck. The lower pressure limiting valve in the pressure cap seals to the lower seat. The filler neck has an overflow tube between and upper and lower sealing seat.

Rising pressure compresses the spring and the lower valve opens. Excess pressure and expanded coolant flow to the overflow bottle through the overflow tube. When the pressure drops, the vacuum valve opens to draw coolant back into the radiator through the overflow tube from the overflow bottle.

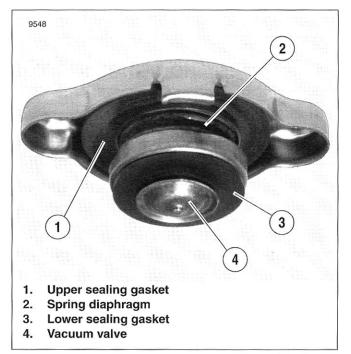


Figure 6-2. Pressure Cap

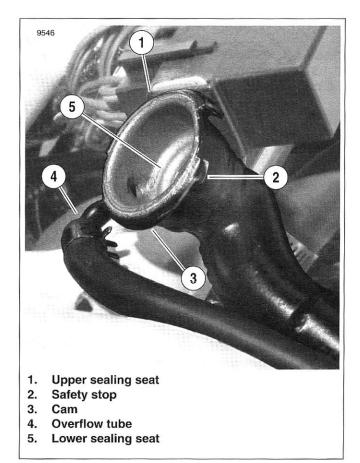


Figure 6-3. Filler Neck

PRESSURE CAP TEST

PART NO.	SPECIALTY TOOL	
HD-45335	Coolant system pressure tester	

The pressure cap should be tested for the correct operating range every time the antifreeze is changed or any cooling system maintenance performed.

WARNING

Do not remove the pressure cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- See Figure 6-3. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop (2). Let pressure escape. Press down and turn cap to pass over safety stops and remove.
- 2. Inspect cap for gasket deterioration and broken springs.
- Turn butterfly valve parallel to boss on COOLANT SYS-TEM PRESSURE TESTER (HD-45335) tester head and turn pressure cap adapter onto tester head. Turn butterfly valve perpendicular to seal tester head.

NOTE

To test new caps, wet the upper sealing gasket before turning onto adapter.

- 4. Turn pressure cap onto adapter. Rotate to safety stops.
- 5. See Figure 6-4. Pump handle to pressurize pressure limiting valve in cap. Stop pumping when pressure valve in cap opens.
- 6. Replace pressure cap if:
 - a. Leaks below low limit, 96 kPa (14 psi).
 - b. Opens above high limit, 124 kPa (18 psi).
 - c. Pressure falls rapidly when pressurized within range.
- 7. Open butterfly valve and remove adaptor and cap.

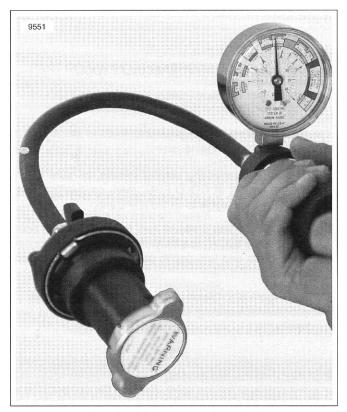


Figure 6-4. Pressure Cap Test

SYSTEM PRESSURE TEST

PART NO.	SPECIALTY TOOL
HD-45335	Coolant system pressure tester

The cooling system can be pressure tested to identify a leak and to verify a blown engine gasket.

- 1. Before troubleshooting cooling system, be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.
- Using a cloth over pressure cap, turn cap 1/4 turn ccunterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
- 3. See Figure 6-3. Clean and inspect filler neck, upper (1) and lower (5) sealing seats, overflow tube (4), and overflow bottle.

NOTE

Bent filler neck cams and safety stops can cause cap to leak or affect pressure limiting valve. Replace the coolant pipe as required.

 See Figure 6-5. Turn butterfly valve parallel to boss on COOLANT SYSTEM PRESSURE TESTER (HD-45335) head and turn adapter onto head. Turn butterfly valve perpendicular to seal head to adapter.

NOTE

Wet the upper sealing surfaces before turning adapter onto tester head.

5. Turn double ended pressure cap onto the end of the adapter and onto filler neck. Rotate to the safety stops.

CAUTION

When performing the coolant system pressure test, never exceed the upper limit rating of the pressure cap. Excessive pressure can rupture cooling pipes, hoses, and radiator.

- 6. Pump tester until pressure reaches 103 kPa (15 psi).
- 7. Match movement of needle to system pressure test table. See Table 6-5.

Table 6-5. System Pressure Test

NEEDLE MOVEMENT	LEAK	ACTION
Holds steady for 2 minutes	None	None
Drops slowly	Small	Dye test
Drops quickly	Major	Visual

 Release pressure in system by turning butterfly pressure valve perpendicular to head. Wait until pressure is released before removing double ended cap from filler neck.

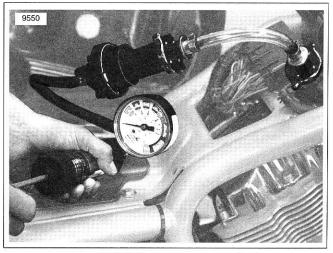


Figure 6-5. System Pressure Test

LEAK DETECTION DYE TEST

PART NO.	SPECIALTY TOOL
HD-29545-6	Coolant fluorescent leak detection dye
HD-35457	Black light leak detector

NOTE

If the coolant overflow bottle is empty when the engine is cold, it is possible that air has been drawn into the coolant system. The system must be purged of any trapped air and refilled with coolant.

 Before troubleshooting cooling system be sure engine coolant level is at COLD FULL mark on overflow bottle when the motorcycle is on the jiffy stand.

WARNING

Do not remove the pressure cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops of filler neck and remove.
- 3. If filler neck is full of coolant, remove an amount of coolant equal to the amount of dye.
- See Figure 6-6. Pour COOLANT FLUORESCENT LEAK DETECTION DYE (HD-29545-6) into filler neck.

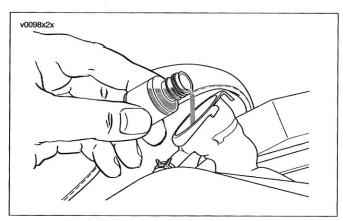


Figure 6-6. Pouring Dye into Filler Neck

- 5. Replace pressure cap and run engine for 10 minutes.
- Use BLACK LIGHT LEAK DETECTOR (HD-35457) to illuminate entire cooling system. A yellow fluorescence at any spot indicates a leak.
- 7. Remove oil dipstick and inspect engine oil for yellow dye.

NOTE

Dye in the oil may indicate a damaged engine head gasket. Draining and replacing coolant contaminated oil will be necessary as part of engine service.

TESTS FOR BLOWN GASKET

PART NO.	SPECIALTY TOOL	
HD-45335	Coolant system pressure tester	

If a pressure test indicates a leak but there is no visible leak, even after a leak detection dye test, perform the following tests to verify a damaged engine gasket.

- 1. Start and run cold engine. White smoke from exhaust system indicates a blown gasket.
- 2. Run engine. Shut off engine.
 - Remove oil level dipstick. Light colored foam on dipstick indicates a blown gasket.
 - Open oil drain plug and drain a small amount of oil.
 Water or coolant will drain out first if gasket is blown.

CAUTION

Do not allow pressure to build up past the maximum for system. If pressure rises past, turn off engine and turn butterfly pressure valve perpendicular to tester head to release pressure.

WARNING

Do not continue to run engine unattended with COLLANT SYSTEM PRESSURE TESTER installed. There is no safety valve with the pressure cap removed and the COL-LANT SYSTEM PRESSURE TESTER installed.

- With COOLANT SYSTEM PRESSURE TESTER (HD-45335) installed, start cold engine and idle engine to normal operating temperature.
 - a. If gauge indicates fast pressure build up, a gasket is blown.
 - b. If pressure does not build up immediately, pump tester to system pressure. If gauge needle vibrates, there is a compression or combustion leak. Disconnect one spark plug at a time. The needle will stop vibrating when spark is removed from leaking cylinder.

NOTE

After replacing an engine head gasket, draining and replacing contaminated oil will be necessary as part of engine service.

ENGINE COOLANT

GENERAL

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE & COOLANT provides temperature protection to -36.7° C (-34° F).

GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTI-FREEZE & COOLANT is pre-diluted and ready to use fullstrength. DO NOT add water. A mixture of de-ionized water and ethylene glycol-based antifreeze may be used if GENU-INE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT is unavailable.

NOTE

When temperatures drop below -36.7°C (-34°F), a mixture of ethylene glycol-based antifreeze and de-ionized water can be mixed to provided additional protection. Follow the directions on the container of un-diluted ethylene glycol to arrive at a percentage mixture that will provide protection for the anticipated temperatures.

REPLACING COOLANT

PART NO.	SPECIALTY TOOL
HD-23688	Coolant & battery tester - Fahrenheit
HD-26568	Coolant & battery tester - Celsius

WARNING

Do not remove the pressure filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system to cool.
- 2. Remove right side cover and maxi-fuse.
- Open seat. Using a cloth over pressure cap, turn cap 1/4 turn counterclockwise (CCW) to safety stop. Let pressure escape. Press down and turn cap to pass over safety stops and remove.
- 4. Use COOLANT AND BATTERY TESTER (HD-23688 or HD-26568) to test antifreeze protection.
 - a. Place a few drips of sample on prism and close cover.
 - b. Hold prism up to light and read temperature scale through eye piece.

NOTE

There are several scales visible in eye piece. Read only the temperature scale labeled ethylene-glycol. If the indicated temperature is less than the rated or required protection, replace the antifreeze.

5. Remove airbox cover. Remove air filter top, and air filter. See 1.4 AIRBOX AND AIR FILTER.

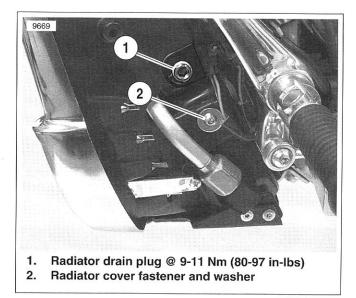


Figure 6-7. Radiator Left Side (cover removed)

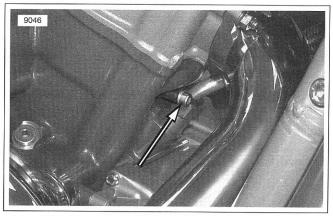


Figure 6-8. Front Coolant Drain Plug @ 9.7 Nm (86 in-lbs)

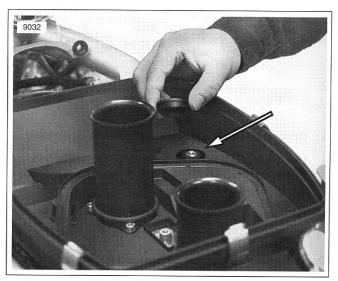


Figure 6-9. Air Bleed Plug @ 9-11 Nm (80-97 in-lbs)

- See Figure 6-7. Remove left side radiator cover. Place a container under engine coolant radiator and remove radiator drain plug (1) and drain coolant from the radiator.
- 7. See Figure 6-8. Place a container under engine and remove front engine coolant drain plug. Allow remaining coolant to drain from engine.

NOTE

With the motorcycle in normal orientation, there is no need to remove the rear engine coolant drain plug.

- Install and tighten radiator drain plug to 9-11 Nm (80-97 in-lbs).
- Install and tighten front engine coolant drain plug to 9.7 Nm (86 in-lbs).
- 10. Replace radiator cover.

CAUTION

De-ionized water must be used with the antifreeze in the cooling system. Hard water can cause scale accumulation in water passages which reduces cooling system efficiency, leading to overheating and engine damage.

WARNING

The coolant mixture contains toxic chemicals, which may be fatal if swallowed. Vapors can cause eye irritation. Contact with skin or eyes can cause irritation. If swallowed, do not induce vomiting; call a physician immediately. In case of skin or eye contact, flush thoroughly with water, go to hospital if necessary. Dispose of used coolant according to federal, state, and local regulations.

- 11. See Figure 6-9. Loosen air bleed plug.
- 12. Through the filler neck, fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOL-ANT up to lower sealing surface in filler neck.
- Replace pressure cap and tighten air bleed plug to 9-11 Nm (80-97 in-lbs).
- 14. Replace air filter, air filter top, and airbox cover.
- 15. Replace maxi-fuse and side cover.
- 16. After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, add antifreeze to overflow bottle until fluid level reaches COLD FULL line.
- Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

GENERAL

The thermostat is a valve that remains closed until the engine reaches operating temperature. The thermostat opens allowing engine coolant to flow out of the engine to the radiator when the coolant temperature exceeds 85° C (185° F). The thermostat is fully open at 100° C (212° F).

REMOVAL

PART NO.	SPECIALITY TOOL	
HD-45307	Thermostat removal tool	

AWARNING

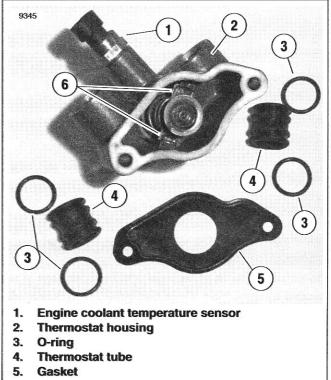
Do not remove the pressure filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system and engine to cool.
- 2. Remove right side cover and maxi-fuse.
- 3. Open seat and remove pressure cap.
- 4. Remove left side radiator cover. Remove radiator drain plug and drain engine coolant into suitable container.
- Replace radiator drain plug and tighten to 9-11 Nm (80-97 in-lbs) and replace radiator cover.
- Remove air filter cover, air filter top, air filter, breather hose, velocity stacks, and air filter bottom. See 1.4 AIR-BOX AND AIR FILTER.
- 7. Remove pipe clamp and p-clamp from coolant pipes.
- 8. Loosen lower clamp on hose to engine coolant pipe. Pull coolant outlet pipe and hose up.
- Loosen and remove fasteners and lock washers holding housing to engine case. Pull thermostat housing off engine.
- See Figure 6-10. Disconnect coolant temperature sensor (1) from wiring harness.

NOTE

See Figure 6-10. The sensor (1) for the engine coolant temperature is threaded into the engine side of the thermostat housing. When illuminated red, the engine coolant temperature indicator lamp on the instrument cluster indicates that the coolant temperature has exceeded 112.7 C (235° F).

- 11. Pull thermostat tubes (4) and o-rings (3) out of engine.
- See Figure 6-11. To remove thermostat from housing, engage tabs on thermostat with slots of THERMOSTAT REMOVAL TOOL (Part No. HD-45307).
- Press on end of tool to compress thermostat spring while turning tool 90° counterclockwise (CCW). Remove thermostat.



6. Tabs

Figure 6-10. Thermostat and Housing

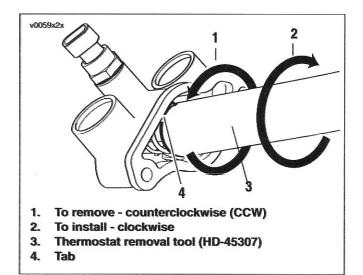


Figure 6-11. Thermostat Removal Tool

INSTALLATION

PART NO.	SPECIALITY TOOL	
HD-45307	Thermostat removal tool	_

 See Figure 6-11. To install **new** thermostat into housing, engage slots of THERMOSTAT REMOVAL TOOL (HD-45307) into tabs of thermostat while compressing thermostat spring. Turn tool 90° clockwise (CW) to lock thermostat into housing.

NOTE

New components can be lubricated with engine coolant to ease assembly.

- 2. See Figure 6-10. With **new** o-rings (3) on thermostat tubes (4), push tubes into engine case.
- 3. Connect engine coolant temperature sensor (1) to wiring harness.
- 4. Be sure lower clamp is in place on hose to engine coolant pipe.
- 5. Orient **new** thermostat housing gasket (5) to mating surface on engine case.
- 6. Push housing pipe into pipe hose and over thermostat tubes (4). Fit housing (2) to engine case.
- 7. Thread in housing fasteners and tighten to 9.7 Nm (85 in-lbs).
- 8. With lower hose clamp in correct orientation, tighten clamp to 3-4 Nm (27-35 in-lbs).
- 9. Install pipe clamp and p-clamp. Tighten fasteners to 6-10 Nm (53-88 ft-lbs).
- 10. Install air filter bottom, velocity stacks, o-rings and breather hose. See 1.4 AIRBOX AND AIR FILTER.
- 11. Loosen air bleed plug. Remove pressure cap and fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOLANT through filler neck.
- 12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**) and replace pressure cap.
- 13. Replace air filter, air filter top and airbox cover.
- 14. Replace maxi-fuse and side cover.
- 15. Rinse the motorcycle with water to remove any spilled coolant.
- 16. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
- 17. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.

REMOVAL

AWARNING

Do not remove the pressure filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system to cool.
- Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.
- 3. Open seat and remove pressure cap.
- 4. Remove left side radiator cover. Remove radiator plug and drain engine coolant into suitable container.
- 5. Place a suitable container under engine and remove front engine coolant drain plug to drain coolant from engine.

NOTE

With the motorcycle in normal orientation, there is no need to remove the rear engine coolant drain plug.

- Install and tighten radiator drain plug to 9-11 Nm (80-97 in-lbs).
- Install and tighten front engine coolant drain plug to 9.7 Nm (86 in-lbs).
- 8. Replace left side radiator cover.
- 9. Remove airbox cover. Remove air filter top and air filter. See 1.4 AIRBOX AND AIR FILTER.
- 10. Remove pipe clamp and p-clamp from coolant pipes. See 6.6 COOLANT PIPES AND HOSES.
- Remove hose cover clamp from upper end of hose to coolant pipe and loosen lower hose clamp. Pull coolant pipe up.
- 12. See Figure 6-12. Unbolt water pump bolts and remove water pump cover.
- 13. Remove the insert.
- 14. See Figure 6-13. Using a soft mallet, tap on side of water pump to loosen.
- 15. See Figure 6-14. Remove bearing housing assembly with the o-rings and gasket.

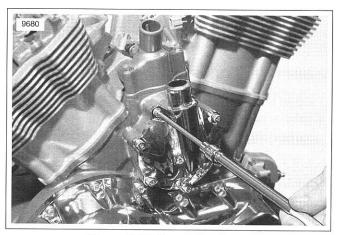


Figure 6-12. Removing Cover

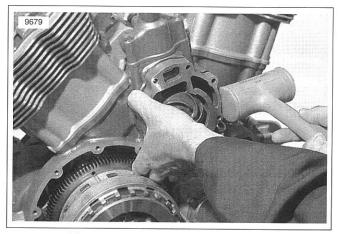


Figure 6-13. Removing Water Pump (clutch cover removed for clarity)

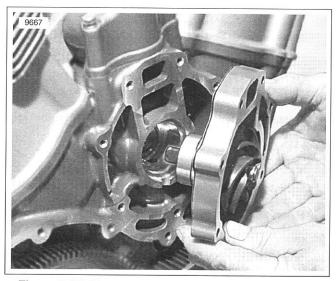


Figure 6-14. Water Pump Bearing Housing Assembly (clutch cover removed for clarity)

INSTALLATION

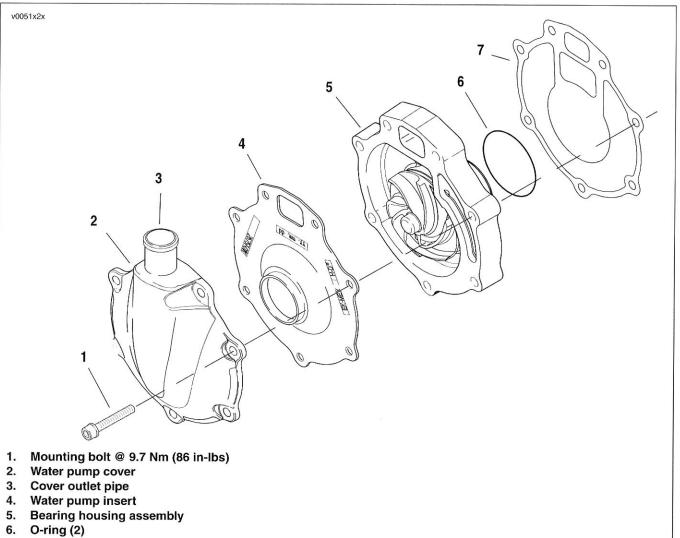
- 1. Clean engine cavity.
- 2. See Figure 6-15. Lube and install **new** o-ring (6) on bearing housing assembly (5).
- 3. Install **new** gasket (7) with part numbers facing out on the face of water pump.
- 4. Align pump square drive with drive shaft and push water pump into engine cavity.

NOTE

A lubricant, as tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.

- 5. Thread on mounting bolts (1) ho'ding bearing housing assembly (5), water pump insert (4) and water pump cover (2) over water pump cavity.
- 6. Tighten water pump mounting bolts to 9.7 Nm (86 inlbs).
- 7. Push pump to engine coolant pipe hose on cover outlet pipe (3).
- Install lower bright hose clamp and tighten to 3-4 Nm (27-35 in-lbs).

- 9. Install and tighten hose cover to 3-4 Nm (27-35 in-lbs).
- 10. Install pipe clamp and p-clamp. See 6.6 COOLANT PIPES AND HOSES.
- 11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOL-ANT through filler neck.
- 12. Tighten air bleed plug to 9-11 Nm (80-97 in-lbs) and replace pressure cap.
- 13. Replace maxi-fuse and right side cover.
- 14. Rinse motorcycle with water to remove any spilled collant.
- 15. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
- 16. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.



7. Gasket

Figure 6-15. Water Pump

REMOVAL

- 1. Allow cooling system to cool.
- Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

WARNING

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

3. Remove the negative battery cable.

WARNING

Do not remove the filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 4. Open seat and remove pressure cap.
- 5. Remove left side radiator cover. Remove radiator plug and drain engine coolant into suitable container.
- Remove air filter top, air filter, breather hose, velocity stacks and air filter bottom. See 1.4 AIRBOX AND AIR FILTER.
- 7. See Figure 6-16. Loosen pipe clamp (4). Loosen and remove fastener (7) holding p-clamp (8) to engine.
- Squeeze clamp (17) and pull off end of overflow hose (23) at overflow bottle (14). Pull drain hose to radiator/oil cooler off overflow bottle. Remove overflow bottle (14).
- 9. Loosen clamps (12, 19) on bottom of hoses to water pump and thermostat.
- 10. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen clamps (12) and pull hoses (10, 13) off radiator.
- 11. Remove engine coolant pipes (2, 3) with hoses (10, 13, 20, 21).

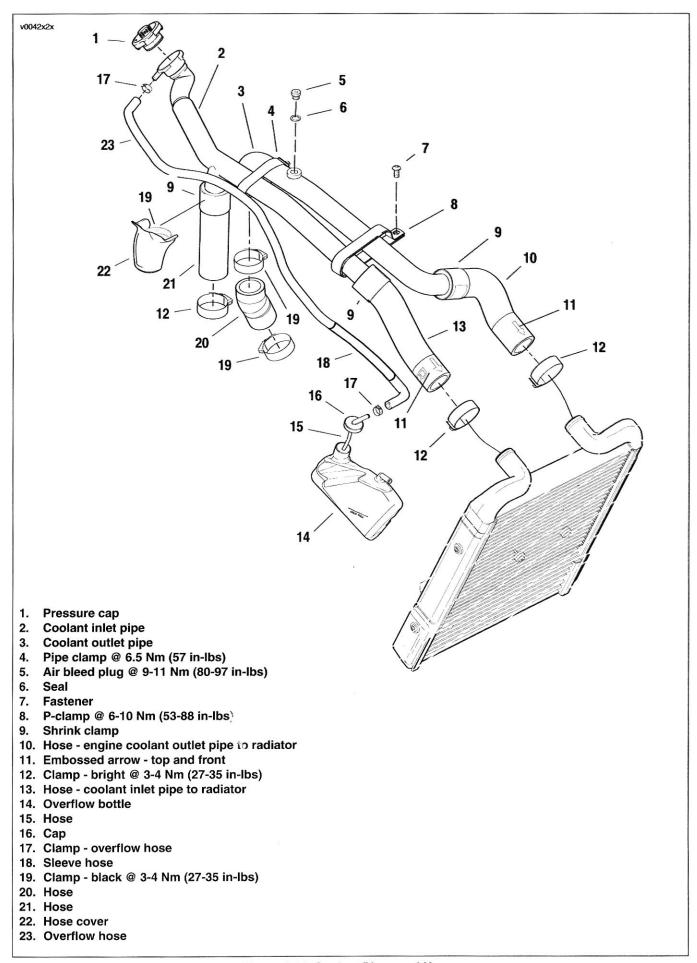
DISASSEMBLY

 See Figure 6-16. Cut shrink clamps (9) from the coolant inlet and the coolant outlet pipes (2, 3) and hoses (10, 13, 21).

NOTE

To remove shrink clamps without cutting, use a soldering iron and, carefully, melt a slice through the band without damaging the hose.

- 2. Loosen overflow hose clamp (17) and remove overflow hose (23) from filler neck.
- 3. Remove hose cover (22) and loosen upper clamp (19) from the water pump to coolant inlet pipe hose.
- Clean hose mounting stems on the engine coolant inlet pipe (2) and the engine coolant outlet pipe (3) with a wire brush.
- 5. Inspect all components and replace as required.



PART NO.	SPECIALTY TOOL
HD-25070	Robinair heat gun

- 1. See Figure 6-16. If removed, thread the air bleed plug (5) with **new** seal (6) into the coolant outlet pipe (3).
- Remove new shrink clamp (9) from packaging brace by squeezing band to collapse, then fold in half and remove from cardboard. Slide shrink clamps over hoses.
- 3. Orient radiator hoses with embossed arrow (11) on top and towards front. Push hose over fitting beads on coolant inlet and coolant outlet pipes (2, 3).
- 4. Orient shrink clamps (9) so print on the clamp is visible after shrinking. Slide clamp over end of hose to overlap the bulge formed by fitting bead of coolant pipe.

CAUTION

Do NOT use open flame to shrink clamp. Using an open flame could result in uncontrolled melting of clamp.

5. Using an ROBINAIR HEAT GUN (Part No. HD-25070) or similar tool, apply heat to shrink clamps (9). Move heat tool around clamp continuously to prevent burning.

NOTE

Heated area must cover at least 1/3 of clamp surface. If heating shrink clamp while hose and pipe are still mounted in motorcycle, take care not to damage surrounding components.

6. Heat until print turns grey and them remove heat.

NOTE

Check seal by trying to rotate hose on fitting by hand. Hose and clamp should NOT turn when using reasonable torque.

7. Repeat for each shrink clamp required.

INSTALLATION

- See Figure 6-16. With upper black clamp (19) on hose (20) and lower black clamp (19) loose, install coolant outlet pipe (3).
- With embossed arrow (11) pointing towards front and on top, push hose (10) over neck bead of radiator inlet neck. Push hose (20) onto outlet neck of thermostat housing.

NOTE

A lubricant, tire soap or detergent and water, can be used to lubricate the hose to aid in pushing hose over neck beads.

- 3. With hose cover (22), clamp (19), and bright clamp (12) loose on hose, install coolant inlet pipe (2).
- 4. With embossed arrow (11) pointing towards front and on top, push hose (13) over neck bead of radiator outlet and push hose (21) over water pump inlet neck.
- 5. Use a long thin screwdriver (Snap-on Part No. SDD1410) to tighten worm drive clamps (12, 19) to 3-4 Nm (27-35 **in-lbs**).
- Install p-clamp (8) and pipe clamp (4) over both pipes. Tighten pipe clamp (4) to 6.5 Nm (57 in-lbs) and tighten p-clamp to 6-10 Nm (53-88 in-lbs).
- Install, through right side cover opening, overflow bottle (14) with hose (15), and cap (16). L-shaped catch on bottom of bottle fits to slot in battery bracket. Push on drain hose to radiator/oil cooler assembly.
- 8. Install and clamp overflow hose (23) to filler neck and overflow bottle cap (16).
- 9. Pressure test to 103 kPa (15 psi).
- 10. Install air filter bottom, velocity stacks, o-rings, and breather hose. See 1.4 AIRBOX AND AIR FILTER.
- 11. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COQL-ANT through filler neck.
- 12. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**). and replace pressure cap.
- 13. Replace the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 14. Install air filter, air filter top and airbox cover.
- 15. Install right side cover and maxi-fuse.
- 16. Rinse motorcycle with water to remove any spilled collant.
- 17. After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
- 18. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with the motorcycle on the jiffy stand.

OIL LINE FITTINGS

REMOVAL

AWARNING

Do not remove the filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system to cool.
- 2. Remove right side cover and maxi-fuse.

AWARNING

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

- 3. Remove negative battery cable.
- Holding each oil line fitting with a wrench and holding a cup under ends of oil lines, loosen and unthread sleeves at crankcase (oil in) and oil filter (oil out).
- 5. Remove radiator/oil cooler assembly. See 6.8 RADIA-TOR/OIL COOLER.
- 6. Remove oil line fittings:
 - a. See Figure 6-18. Oil in fitting.
 - b. See Figure 6-17. Oil out fitting.

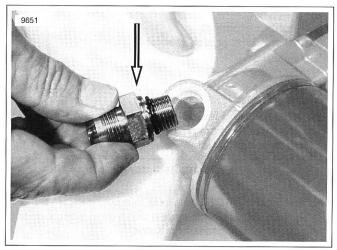
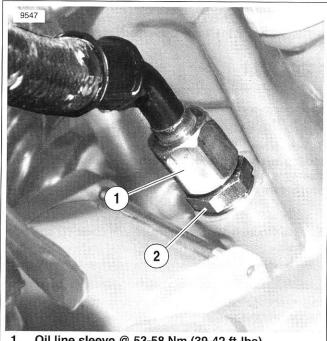


Figure 6-17. Oil Out Fitting

INSTALLATION

 Install oil line fittings with o-ring on crankcase (oil in) and oil filter mount (oil out). Tighten to 25-30 Nm (19-22 ftlbs).



Oil line sleeve @ 53-58 Nm (39-42 ft-lbs)
 Oil in fitting @ 25-30 Nm (19-22 ft-lbs)

Figure 6-18. Oil In Fitting

- 2. Replace the radiator/oil cooler assembly. See 6.8 RADI-ATOR/OIL COOLER.
- While holding each crankcase fitting (oil in & oil out) with an angled wrench, install and tighten oil line sleeves to 53-58 Nm (39-42 ft-lbs).
- 4. Check oil level and add oil if required.
- 5. Replace the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 6. Install maxi-fuse and right side cover.
- 7. After running engine,
 - a. Inspect oil sleeves and fittings for oil leaks.
 - b. Check oil level and add oil if required.
 - c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand. See 1.5 COOLING SYSTEM.

GENERAL

The heat exchangers, or radiators, for both engine cooling and oil cooling are bolted together in a single radiator/oil cooler assembly. The radiator/oil cooler assembly is fasten to the frame with:

- Double threaded studs near the steering head.
- Two pins and rubber grommets on the bottom of the oil cooler that fit the frame cross member.

REMOVAL

WARNING

Do not remove the filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system to cool.
- 2. See Figure 6-19. Remove right side cover (1) and maxifuse.

WARNING

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

- 3. Remove negative battery cable.
- 4. Remove airbox decorative cover, airbox cover, air filter cover and air filter. See 1.4 AIRBOX AND AIR FILTER.
- 5. See Figure 6-19. Remove fasteners (11) and left and right radiator side covers (10).
- Cover front fender with shop towel or protective cover. Remove fasteners and washers (9) on each side of radiator cover (6). Remove radiator cover with chrome inlet bezels (7) attached.
- 7. Open seat and remove pressure cap.
- See Figure 6-20. Place a suitable container under radiator. Remove radiator drain plug (11) and drain coolant from radiator. Replace drain plug. See 6.3 ENGINE COOLANT.
- 9. Place a container under engine, remove oil filler plug/dipstick, and oil drain plug and drain oil. Replace dipstick and drain plug. See 1.6 ENGINE OIL AND FILTER.

NOTE

Both the oil line sleeves remain threaded onto the oil cooler and the lines remain clipped to the radiator/oil cooler assembly. The drain hose from the expansion bottle also remains clipped to the assembly.

- 10. Disconnect:
 - a. Crank position sensor connector [79].
 - b. Top and bottom fan power connectors [97T], [97B].
 - c. Stator to voltage regulator connector [46].

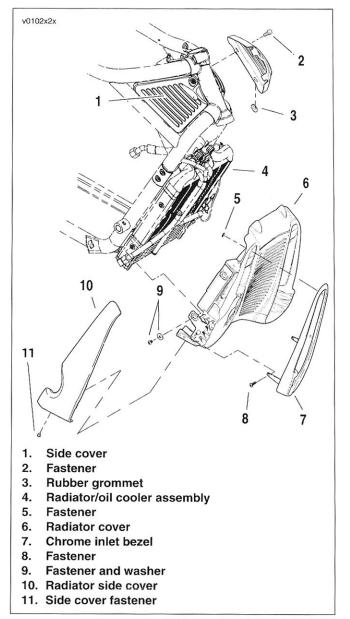
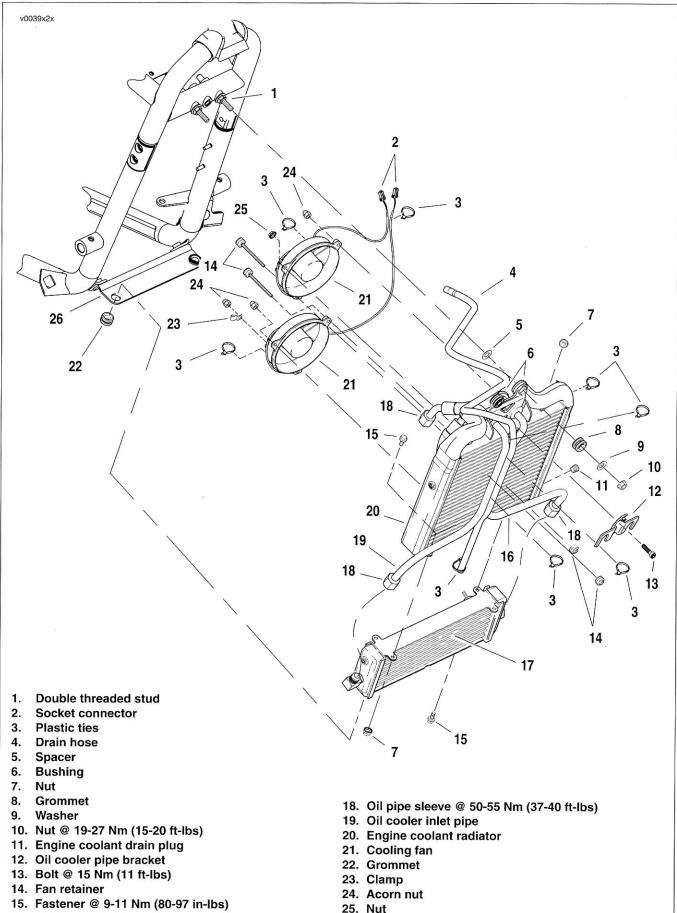


Figure 6-19. Radiator Covers

- 11. See Figure 6-16. Use a long thin screwdriver (Snap-on Part No. SDD1410) to loosen worm drive clamps on both engine coolant hoses at radiator.
- 12. See Figure 6-20. Disconnect the end of drain hose (4) from the overflow bottle.
- See Figure 6-20. Loosen but do not remove nuts (10) holding assembly to front engine mount studs (1). Remove fasteners under radiator assembly that hold cross member to frame. Gently pull bottom of radiator/oil cooler assembly forward.
- See Figure 6-21. Holding each oil line fitting with a wrench and holding a cup under ends of oil lines, loosen and unthread sleeves at crankcase (oil in) and oil filter (oil out).
- 15. Remove nuts (10) holding radiator assembly to engine mount studs (1) and remove radiator/oil cooler assembly.



- 16. Oil cooler outlet pipe
- 17. Oil cooler

Figure 6-20. Radiator/Oil Cooler Assembly

26. Cross member

INSTALLATION

CAUTION

Be sure to carefully clean the front surface of the radiator regularly. Leaves and other debris can collect on the radiator surface and degrade radiator performance. This could lead to engine overheating and engine damage.

- 1. Cover front fender with a shop towel or protective cover.
- 2. See Figure 6-20. Hold radiator/oil cooler assembly up to frame and thread on oil line sleeves (18).
- Thread on but do not tighten nuts (*0) holding radiator/oil cooler assembly to engine mount studs (1).

NOTE

The oil lines should be angled and routed so there is no interference between the radiator fans and the oil lines when the radiator is in place on the frame.

- See Figure 6-21. While holding each oil line fitting (oil in & oil out) with an angled wrench, install and tighten oil line sleeves to 53-58 Nm (39-42 ft-lbs).
- See Figure 6-20. Slip cross member (26) over grommets (22) on radiator mounting pins. Install cross member to frame.
- 6. Tighten cooling system fasteners to following:
 - a. Cross member fasteners to 20-26 Nm (15-19 ft-lbs).
 - b. Top mounting nuts (10) to 19-27 Nm (15-20 ft-lbs).
 - c. Pipe clamp to 6.5 Nm (57 in-lbs).
 - d. P-clamp to 6-10 Nm (53-88 in-lbs).
 - e. Hose clamps to 3-4 Nm (27-35 in-lbs).
- 7. Route drain hose (4) to overflow bottle.
- 8. Install radiator cover.
- 9. Connect:
 - a. Crank position sensor connector [79].
 - b. Top and bottom fan power connectors [97T], [97B].
 - c. Stator to voltage regulator connector [46].
- 10. Install left and right side radiator covers.
- 11. Fill engine with oil. See 1.6 ENGINE OIL AND FILTER.
- 12. Install air filter bottom, velocity stacks, o-rings and breather hose. See 1.4 AIRBOX AND AIR FILTER.
- 13. Loosen air bleed plug. Fill with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOL-ANT through filler neck. See 6.3 ENGINE COOLANT.
- 14. Tighten air bleed plug to 9-11 Nm (80-97 **in-lbs**). and replace pressure cap.
- 15. Install air filter, air filter top and air filter cover. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

WARNING

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

- 16. Replace the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 17. Install right side cover and maxi-fuse.
- 18. After running engine, inspect oil sleeves and fittings for oil leaks. Check oil level and add oil if required.
- After running engine, check coolant level in overflow bottle with coolant cold with motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
- 20. Continue to run engine, check level, and add antifreeze until fluid level remains at COLD FULL line with motorcycle on jiffy stand.

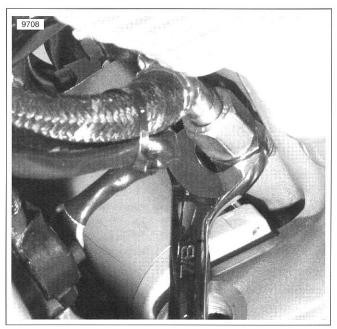


Figure 6-21. Holding Oil Line Fitting with Angled Wrench

REMOVAL

WARNING

Do not remove the filler cap when the engine is hot. The cooling system is under pressure and hot coolant and steam may escape causing severe burns. Allow engine to cool before servicing the cooling system.

- 1. Allow cooling system to cool.
- Remove right side cover and maxi-fuse. See 8.5 MAXI-FUSE.

WARNING

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

- 3. Remove negative battery cable.
- 4. Remove the radiator/oil cooler assembly. See 6.8 RADI-ATOR/OIL COOLER.
- 5. See Figure 6-20. With assembly on bench and holding a cup under each line, loosen two sleeves (18) that connect oil pipes (16, 19) to oil cooler (17).
- 6. If replacing oil pipes:
 - a. Remove oil line bracket fastener (13) and bracket (12) with spacers (5) bushings (6), grommets (8) and washers (9).
 - b. Cut cable wraps (3) to drain hose and oil lines.
 - c. Remove drain hose (4) and oil cooler outlet and inlet pipes (16, 19).
- 7. Cut cable wrap (3) holding expansion bottle drain hose to oil cooler.
- 8. Remove fasteners (15) holding oil cooler (17) to engine coolant radiator (20). Remove oil cooler.

INSTALLATION

- See Figure 6-20. Install oil cooler (17) to engine coolant radiator (20). Tighten fasteners (7) to 9-11 Nm (80-97 inlbs).
- 2. If installing oil pipes:
 - a. Route oil pipes (16, 19) in front and over top of engine coolant radiator (20).
 - b. Install bracket (12) over the oil lines and tighten fastener (13) to 15 Nm (11 ft-lbs).
 - c. See Figure 6-22.Cable wrap oil pipes and drain hose to coolant radiator at upper and lower points on straight portion prior to bend in pipes.
 - d. See Figure 6-20. Install spacer (5), bushings (6), grommet (8), and washers (9) to mounting bracket.

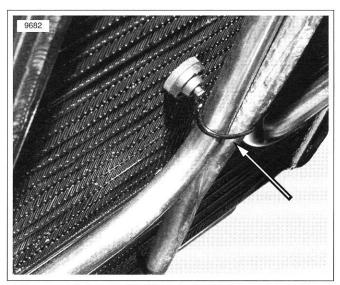


Figure 6-22. Lower Oil Pipes to Drain Hose Cable Wrap

- 3. Install sleeves (17) of the oil pipes (14, 18) to oil cooler.
- 4. See Figure 6-23. Support oil cooler fitting with a wrench and tighten sleeves to 50-55 Nm (37-40 ft-lbs).
- 5. See Figure 6-22. Cable wrap (3) drain hose (4) at bottom of oil cooler.
- 6. Replace the radiator/oil cooler assembly. See 6.8 RADI-ATOR/OIL COOLER.

CAUTION

Attach the cables to the correct battery terminals using the proper torque. Overtightening bolts can damage battery terminals and incorrect connections may damage the motorcycle's electrical system.

WARNING

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

- Replace the negative battery cable. Tighten to 6.8-10.8 Nm (60-96 in-lbs).
- 8. Install maxi-fuse and right side cover.
- 9. After running engine:
 - a. Inspect oil sleeves and fittings for oil leaks.
 - b. Check oil level and add oil if required.
 - c. Check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand and add coolant if required.

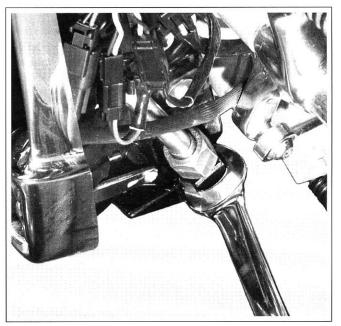


Figure 6-23. Support Wrench on Oil Cooler (radiator/oil cooler installed)

SUBJECT

PAGE NO.

7.1 Specifications	7-1
7.2 Output Shaft	7-2
7.3 Input Shaft	7-11

TRANSMISSION

7

ENGINE OUTPUT	TRANSMISSION INPUT	RATIO
64	117	1.828

Table 7-2. Transmission Gearing

GEAR	INPUT	OUTPUT	RATIO
1st	18	45	2.500
2nd	25	42	1.680
3rd	29	39	1.345
4th	31	36	1.161
5th	25	26	1.040

Table 7-3. Secondary Gearing

TRANSMISSION OUTPUT	REAR WHEEL	RATIO	
30	72	2.4	

Table 7-4. Overall Gear Ratio

GEAR	RATIO
1st	10.968
2nd	7.370
3rd	5.901
4th	5.094
5th	4.563

Table 7-5. Engine Speed@60mph (Approx)

GEAR	RPM
1st	8877
2nd	5965
3rd	4775
4th	4124
5th	3652

TORQUE VALUES

ITEM	TORQUE		NOTES
Output shaft nut	60 Nm	118 ft-lbs	page 7-4

GENERAL

This procedure starts with the input shaft and output shaft removed from the engine. See 3.11 UPPER AND LOWER CRANKCASE SERVICE for removal of input shaft and output shaft.

DISASSEMBLY - 2ND GEAR END

Bearing Removal - 2nd Gear End

PART NO.	D. SPECIALTY TOOL	
HD-45331	Final drive sprocket flange locking tool	

1. See Figure 7-1. Remove lock ring from output flange nut.

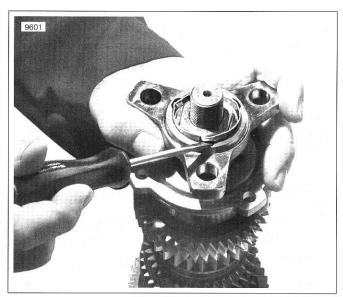


Figure 7-1. Output Shaft Lock Ring

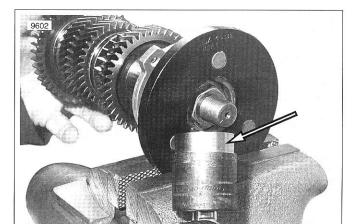


Figure 7-2. Modify Socket for Output Nut Removal

2. See Figure 7-2. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331) to remove the output shaft nut, use a 30 mm socket cut down to 39.6 mm (1.56 in.) to clear the flange.

NOTE

Output flange nut is one time use only, but do not discard at this time. Retain removed nut to pull flange on shaft during assembly.

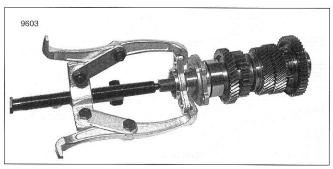


Figure 7-3. Output Drive Flange

3. See Figure 7-3. Remove output shaft drive flange and seal retainer.

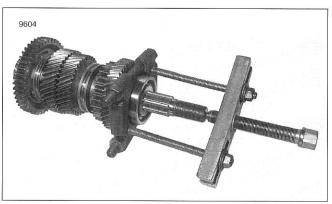
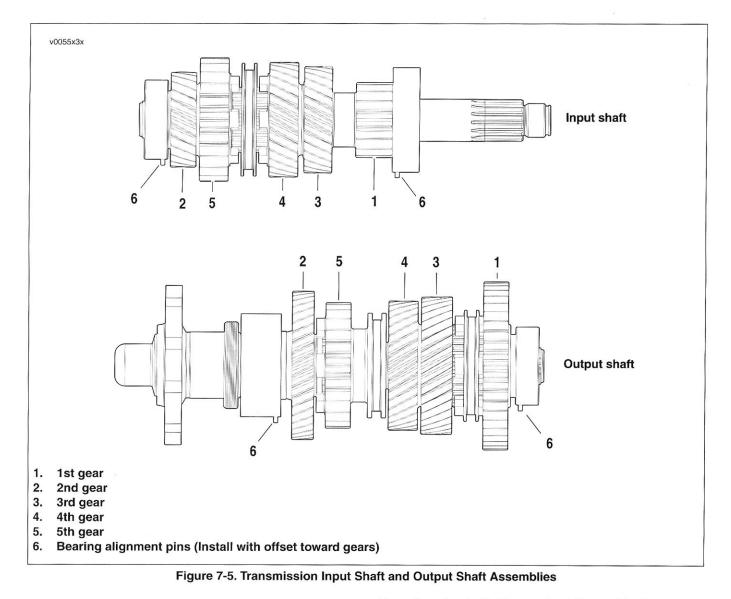


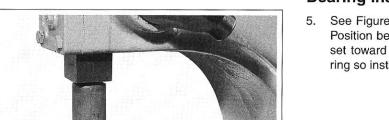
Figure 7-4. Output Shaft Bearing

4. See Figure 7-4. Remove output shaft bearing.

IMPORTANT NOTE

If no further disassembly of this end is needed go to step 5. If further disassembly of this end is needed go to step 13.





Bearing Installation - 2nd Gear End

 See Figure 7-5. and Figure 7-6. Lubricate **new** bearing. Position bearing on shaft with bearing alignment pin offset toward gears. and press onto shaft. Use a pressing ring so installation force is on the inner race only.

Figure 7-6. Output Shaft Bearing

9605

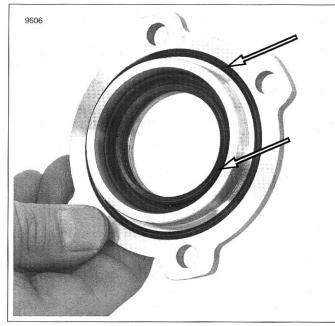


Figure 7-7. Seal Retainer

 See Figure 7-7. Replace flange seal and o-ring. Lubricate the flange seal with Harley-Davidson Motorcycle Oil 20W50.

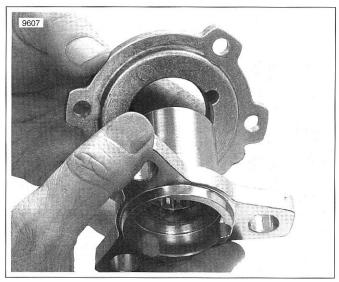


Figure 7-8. Seal Retainer and Output Flange

7. See Figure 7-8. Slide seal retainer on the output flange.

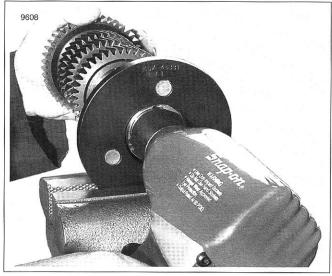


Figure 7-9. Install Output Shaft Nut

 See Figure 7-9. Place output shaft in FINAL DRIVE SPROCKET FLANGE LOCKING TOOL (HD-45331) to install the output shaft nut.

CAUTION

Do not attempt to drive flange on with a hammer. Damage to the output shaft can result.

9. Use the **old** output shaft nut to pull the output flange on the shaft.

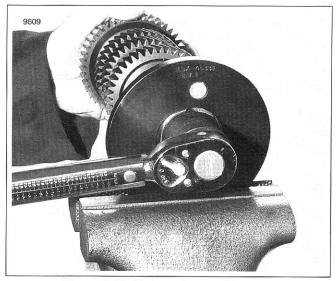


Figure 7-10. Tighten Output Shaft Nut

- 10. See Figure 7-10. Remove and discard the **old** output shaft nut.
- 11. Install a **new** o-ring behind the flange nut and install the **new** output shaft nut. Tighten nut to 160 Nm (118 ft-lbs).

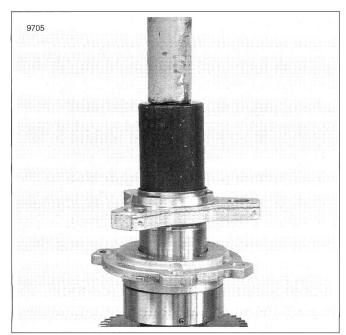


Figure 7-11. Output Shaft Nut Lock Ring -Shaft Out of Engine

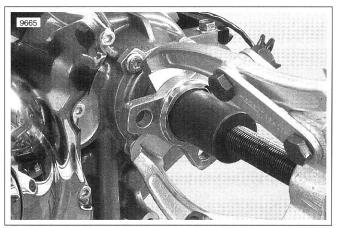


Figure 7-12. Output Shaft Nut Lock Ring -Engine Assembled

- 12. See Figure 7-11. Position locking ring over the output shaft nut. Use FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (HD-45332) to crimp in position.
- 13. See Figure 7-12. If servicing flange or seals of assembled engine, locking ring may be installed as shown.

CAUTION

Never use a hammer to hit on the FINAL DRIVE SPROCKET LOCKING DEVICE INSTALLER (HD-45332). Damage to output shaft bearing could result.

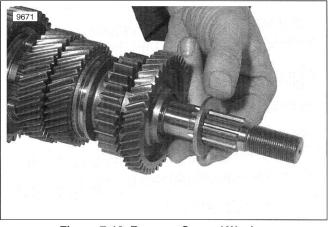


Figure 7-13. Remove Ground Washer

14. See Figure 7-13. Remove ground washer.

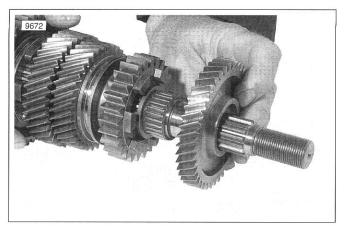


Figure 7-14. 2nd Gear

15. See Figure 7-14. Remove 2nd gear.

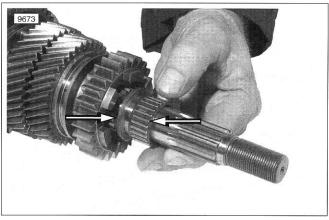


Figure 7-15. Bearing and Washer

16. See Figure 7-15. Remove split cage bearing and hardened washer.

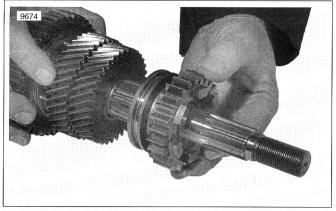


Figure 7-16. 5th Gear

17. See Figure 7-16. Remove 5th gear.

NOTE

4th gear is part of output shaft and is not removable. Damage to 4th gear requires replacement of the output shaft.

ASSEMBLY - 2ND GEAR END

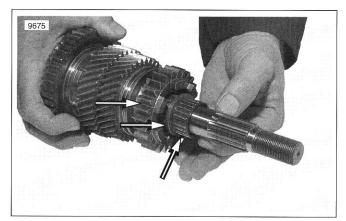


Figure 7-17. 5th Gear Installation

1. See Figure 7-17. Install 5th gear ground washer and split cage bearing.

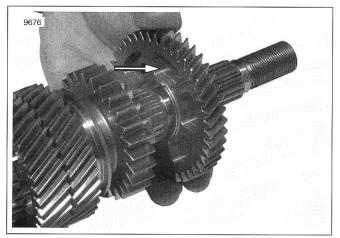


Figure 7-18. 2nd Gear Installation

2. See Figure 7-18. Install 2nd gear. Note 2nd gear pockets are installed toward the 5th gear engagement dogs.

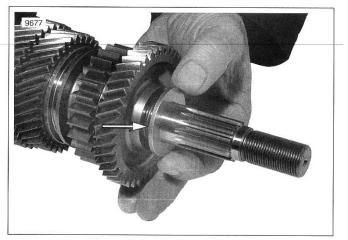


Figure 7-19. Hardened Washer

- 3. See Figure 7-19. Install hardened washer.
- 4. To complete output shaft assembly 2nd gear end, go to Bearing Installation 2nd Gear End.

Bearing Removal - 1st Gear End

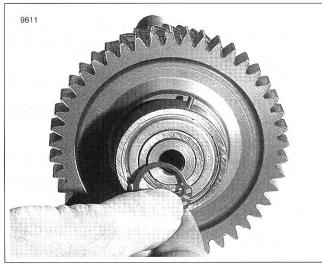


Figure 7-20. 1st Gear Bearing Retaining Ring

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

5. See Figure 7-20. Remove the retaining ring from the 1st gear bearing end of the output shaft.

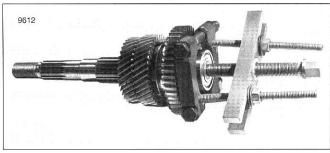


Figure 7-21. 1st Gear Bearing Removal

6. See Figure 7-21. Remove and discard 1st gear bearing.

NOTE

Once removed, transmission bearings MUST be replaced.

IMPORTANT NOTE

If no further disassembly of this end is needed go to step 7. If further disassembly of this end is needed go to step 8.

Bearing Installation - 1st Gear End

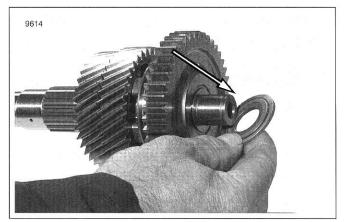


Figure 7-22. Thrust Washer

 See Figure 7-22. Check position of stepped thrust washer. Step should face 1st gear, flat side toward bearing.

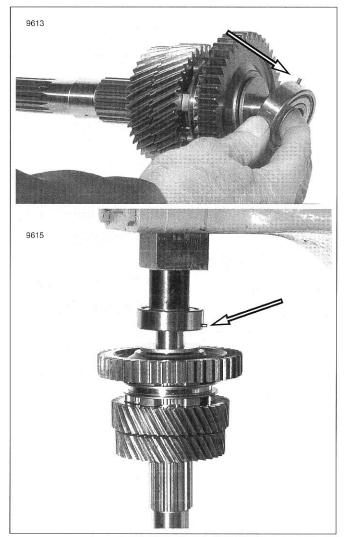


Figure 7-23. 1st Gear Bearing Installation

8. See Figure 7-23. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

Awarni<u>ng</u>

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

- 9. Install retaining ring.
- 10. See Figure 7-5. Remove stepped washer and 1st gear (1).

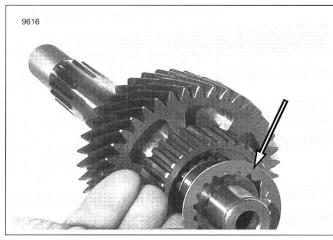


Figure 7-24. Splined Washer

11. See Figure 7-24. Remove splined washer.

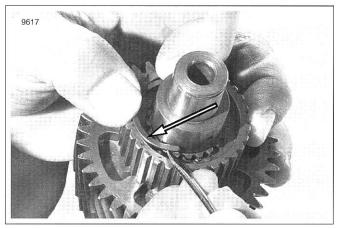


Figure 7-25. Half Moon Keepers

12. See Figure 7-25. Remove the half moon keepers.

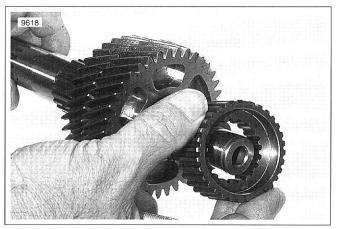


Figure 7-26. Splined Slider

13. See Figure 7-26. Remove the splined slider.

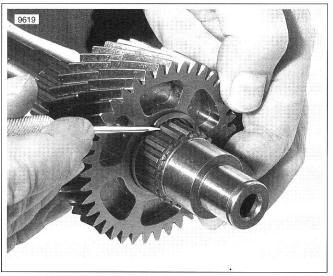


Figure 7-27. Half Moon Keepers

14. See Figure 7-27. Remove half moon keepers.

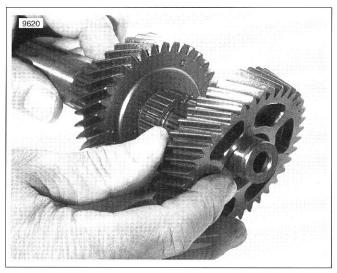


Figure 7-28. 3rd Gear

- 15. See Figure 7-28. Remove 3rd gear and split cage needle bearing.
- 16. 4th gear is part of the output shaft and is not removable.

ASSEMBLY - 1ST GEAR END

Carefully clean and inspect parts to be reused. Examine gears for cracks, chipping and excessive wear.

1. See Figure 7-29. Install split cage needle bearing. Install 3rd gear.

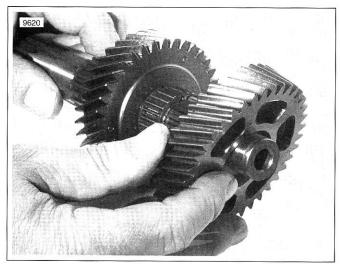


Figure 7-29. 3rd Gear

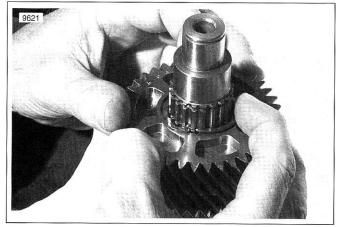


Figure 7-30. Half Moon Keepers

2. See Figure 7-30. Install half moon keepers.

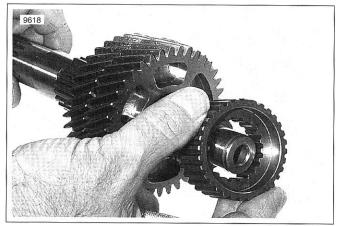


Figure 7-31. Splined Slider

3. See Figure 7-31. Install splined slider.

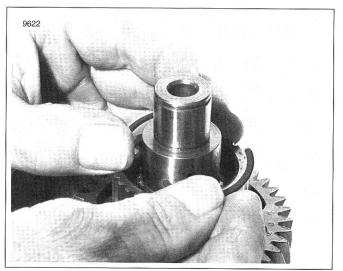


Figure 7-32. Half Moon Keepers

4. See Figure 7-32. Install half moon keepers.

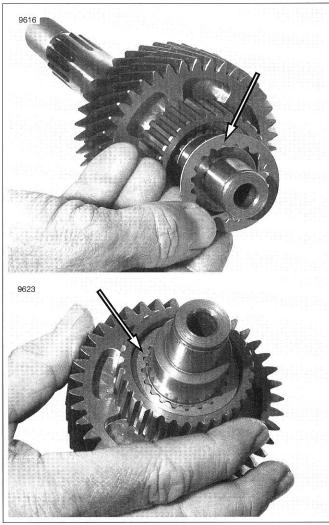


Figure 7-33. Splined Thrust Washer

5. See Figure 7-33. Install splined thrust washer with flat side out as shown.

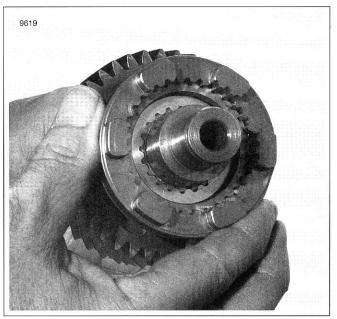


Figure 7-34. Shift Fork Slider

6. See Figure 7-34. Install shift fork slider.

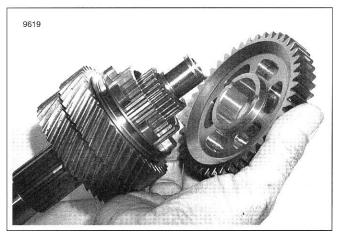


Figure 7-35. 1st Gear

- 7. See Figure 7-35. Install 1st gear.
- 8. To complete output shaft assembly 1st gear end, go to Bearing Installation 1st Gear End.

DISASSEMBLY - 2ND GEAR END

Bearing Removal - 2nd Gear End

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

1. See Figure 7-36. Remove retaining ring at 2nd gear crankcase bearing.

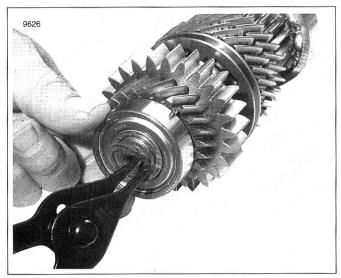


Figure 7-36. 2nd Gear Bearing Retaining Ring

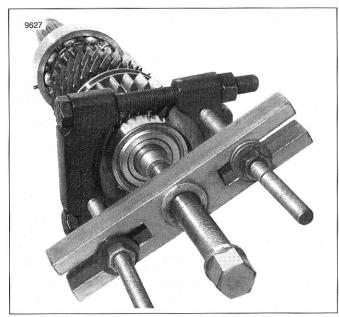


Figure 7-37. 2nd Gear Bearing Removal

 See Figure 7-37. Use puller to remove 2nd gear bearing. To protect the end of the shaft use END CAP (HD-34902), part of BIG-TWIN MAINSHAFT PRIMARY BEARING RACE REMOVER AND INSTALLER (HD-34902-B).

IMPORTANT NOTE

If no further disassembly of this end is needed go to step 3. If further disassembly of this end is needed go to step 4.

Bearing Installation - 2nd Gear End



Figure 7-38. 2nd Gear Bearing Alignment Pin

3. See Figure 7-38. Install **new** bearing with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

WARNING

Always wear proper eye protection when installing retaining rings. Use the correct retaining ring pliers. Verify that the tips of the pliers are not damaged or excessively worn. Slippage may propel the ring with enough force to cause eye injury.

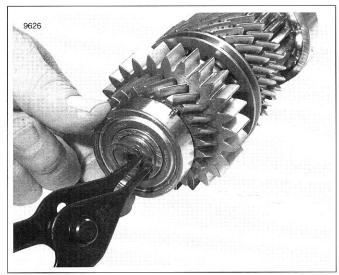


Figure 7-39. 2nd Gear Bearing Retaining Ring

4. See Figure 7-39. Install retaining ring.

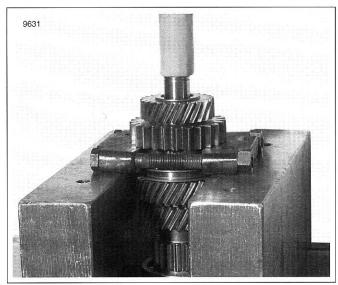


Figure 7-40. 2nd and 5th Gear Removal

5. See Figure 7-40. Place a puller clamp behind 5th gear and press off 2nd and 5th gear. Support the input shaft when removing the gears.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft regardless of its condition.

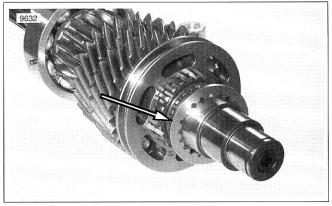


Figure 7-41. Splined Thrust Washer

6. See Figure 7-41. Remove the splined thrust washer.

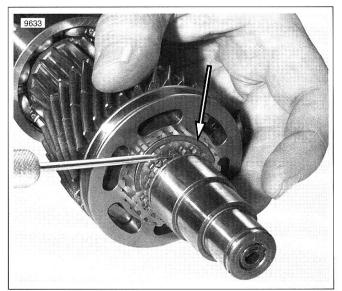


Figure 7-42. Half Moon Keepers

7. See Figure 7-42. Remove half moon keepers.

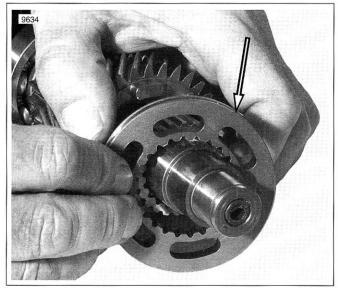


Figure 7-43. Shifting Fork Ring

8. See Figure 7-43. Remove shifting fork ring.

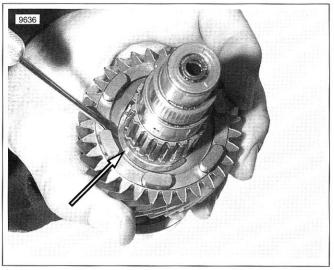
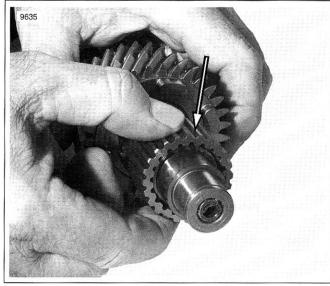


Figure 7-45. Half Moon Keepers

10. See Figure 7-45. Remove half moon keepers.





9. See Figure 7-44. Remove splined slider.

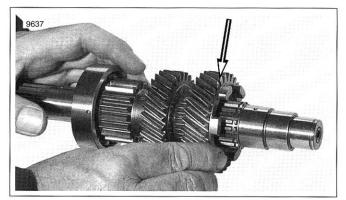


Figure 7-46. 4th Gear

11. See Figure 7-46. Remove 4th gear.

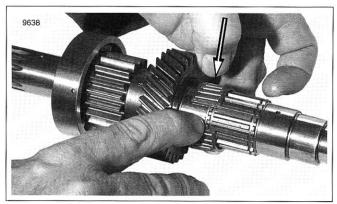


Figure 7-47. Split Cage Bearing

12. See Figure 7-47. Remove split cage bearing.

NOTE

See Figure 7-5. 1st gear and 3rd gear are part of the input shaft assembly and are not removable. Damage to 1st or 3rd gear requires replacement of the input shaft.

ASSEMBLY - 2ND GEAR END

1. See Figure 7-48. Lubricate **new** split cage bearing and position on shaft. Install 4th gear and place half moon keepers in position.

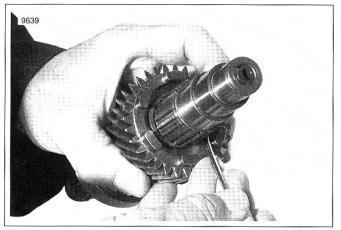


Figure 7-48. 4th Gear and Keepers

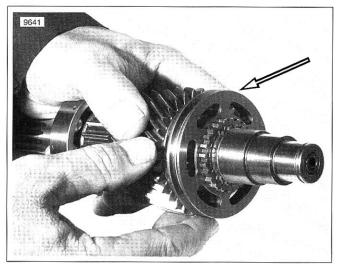


Figure 7-50. Shift Fork Slider

3. See Figure 7-50. Install shift fork slider.

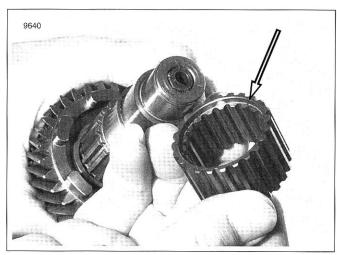


Figure 7-49. Splined Slider

2. See Figure 7-49. Insert splined slider with stepped side toward 4th gear.

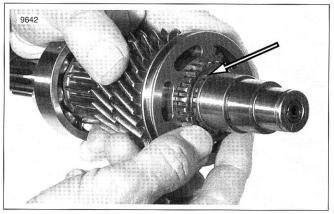


Figure 7-51. Half Moon Keepers

4. See Figure 7-51. Install half moon keepers.

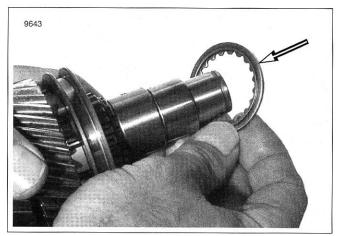


Figure 7-52. Splined Thrust Washer

5. See Figure 7-52. Install splined thrust washer, stepped side toward gears.

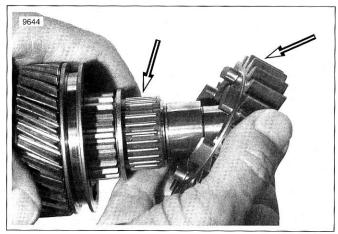


Figure 7-53. Bearing and 5th Gear

6. See Figure 7-53. Install lubricated **new** split cage bearing behind splined thrust washer. Install 5th gear over split cage bearing.

NOTE

2nd gear is an interference fit and MUST be replaced when removed from the input shaft, regardless of its condition.

- 7. See Figure 7-53. Install **new** 2nd gear. Use a pressing ring to clear the shaft. Press gear on shaft until it bottoms on the gearset.
- 8. To complete input shaft assembly -2nd gear end go to **Bearing Installation 2nd Gear End**.

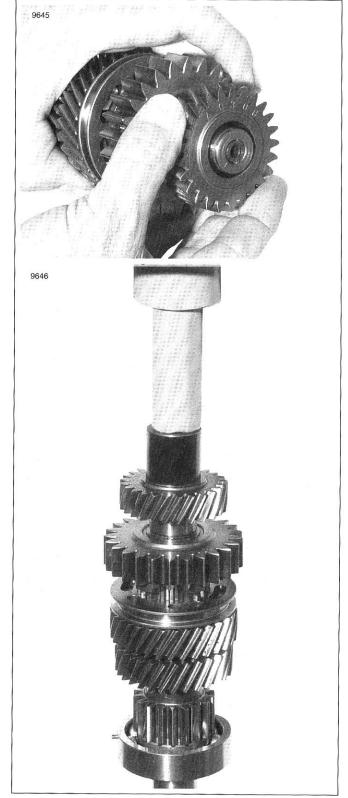


Figure 7-54. 2nd Gear

ASSEMBLY - 1ST GEAR END

Bearing Removal - 1st Gear End

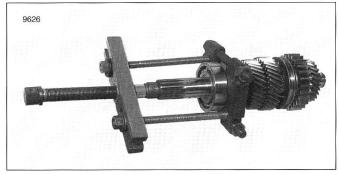


Figure 7-55. 1st Gear Bearing Removal

9. See Figure 7-55. Remove 1st gear crankcase bearing.

Bearing Installation - 1st Gear End

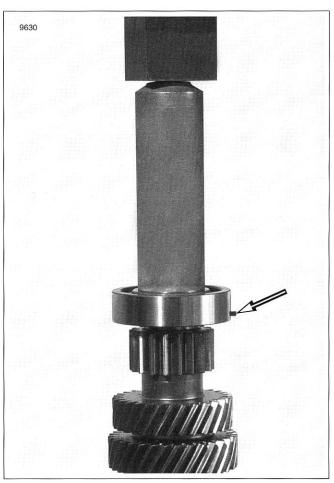


Figure 7-56. 1st Gear Bearing Replacement

10. See Figure 7-56. Install **new** bearing, with bearing alignment pin offset toward the gears. Use a pressing ring so installation force is on the inner race only.

SUBJECT

PAGE NO.

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ELECTRICAL

Table 8-1. Ignition System Specifications

IGNITION	DATA		
Idle speed	1200 ± 50 rpm		
Spark plug size	12 mm		
Casely alug con	0.035 in.		
Spark plug gap	0.89 mm		
Spark plug type	Harley-Davidson No. 10R12A (no substitute)		
Ignition coil primary resistance	0.41 ± 0.04 ohms		
Ignition coil secondary resistance	4000 ± 450 ohms		

Table 8-2. Fuse Specifications

FUSE	RATING (AMPERES)		
Maxi-fuse	40		
Battery fuse (instrument console/fan relay)	15		
Ignition fuse	15		
Lighting fuse	15		
Accessory fuse	15		
ECM fuse	15		
Security fuse	15		

Table 8-3. Charging System Specifications

CHARGING SYSTEM	DATA		
Battery	12 amp hour/200 CCA		
Alternator AC voltage output, open circuit (at stator connector)	19 VAC ± 10% per 1000 rpm 22.5 VAC ± 10% @ idle (1200 rpm)		
Alternator stator coil resistance	0.2 + 0.2 - 0.0 ohms		
Regulator voltage output (with fully charged battery)	14.5 ± 0.25 volts @ 1200 rpm 68° F± 9° F(20° C ± 5° C)		
Regulator current	22A min. @ 1200 rpm 36A min. @ 3500 rpm		

TORQUE VALUES

ITEM	TOR	NOTES	
Alternator cover fastener	9.7 Nm	85 in-lbs	page 8-10
Battery cable nut	6-10 Nm	53-88 in-lbs	page 8-18
Battery terminal bolt	6.8-10.8 Nm	60-96 i n-lbs	page 8-16, 8-16, 8-31
CKP sensor fastener	8.2-10.7 Nm	73-95 in-lbs	page 8-6
Derby cover fastener	8.2-10.7 Nm	72-95 in-lbs	page 8-10
Fan fastener	4.5-5.5 Nm	40-48 in-lbs	page 8-35
Front cross member fastener	20-26 Nm	15-19 ft-lbs	page 8-35
Handlebar cover fastener	1.3-1.9 Nm	12-16 in-lbs	page 8-27
Headlamp bracket fastener	11-18 Nm	8-13 ft-lbs	page 8-27
Headlamp mounting fastener	4.5-7.5 Nm	40-66 in-lbs	page 8-20
Horn assembly acorn nut	9-15 Nm	80-132 in-lbs	page 8-33
Horn flange nut	6-8 Nm	53-70 in-lbs	page 8-33
Ignition/light switch fastener	6-10 Nm	53-88 in-lbs	page 8-8
Neutral switch	12.8-16.5 Nm	113-146 in-lbs	page 8-29
Oil pressure switch	10.8-13.6 Nm	96-120 in-lbs	page 8-31
Passenger seat mounting fastener	11-17 Nm	97-150 in-lbs	page 8-25
Radiator cover fastener	4.1-6.8 Nm	36-60 in-lbs	page 8-12, 8-35
Radiator trim cover fastener	3-4 Nm	26-35 in-lbs	page 8-10
Radiator trim cover fastener	3-4 Nm	26-35 in-lbs	page 8-12, 8-35
Seat latch fasteners	6-10 Nm	53-88 in-lbs	page 8-8
Side cover fastener	4.1-6.8 Nm	36-60 in-lbs	page 8-7
Stator harness clip fastener	8.2-10.7 Nm	72-95 in-lbs	page 8-10
Stator harness fastener	8.2-10.7 Nm	72-95 in-lbs	page 8-10
Stator mounting fastener	8.2-10.7 Nm	72-95 in-lbs	page 8-10
Top radiator fastener	19-27 Nm	14-20 ft-lbs	page 8-35
Voltage regulator fastener	6-10 Nm	53-88 in-lbs	page 8-12
Voltage regulator ground wire fastener	16-20 Nm	12-15 ft-lbs	page 8-12
VSS mounting fastener	8.2-10.7 Nm	73-95 in-lbs	page 8-28

GENERAL

See Table 8-4. This table gives the location and bulb requirements for Harley-Davidson VRSCA motorcycles.

NOTES

- All VRSCA speedometers, tachometers indicator lamps and odometers are illuminated with LEDs.
- LEDs are non-repairable. The entire instrument cluster must be replaced if an LED fails.

LAMP DESCRIPTION (ALL LAMPS 12 VOLT)	NO. OF BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	WATTAGE	PART NO.
Headlamp	· · · · · · · · · · · · · · · · · · ·			
Low Beam	1	4.30	55.0	68881-01
High Beam	1	5.10	65.3	67717-01
Low Beam (HDI)	1	4.30	55.0	68881-01
High Beam (HDI)	1	5.10	65.3	67717-01
Position lamp (HDI)	1	0.37	5.2	53436-97
Tail/stop lamp				
Tail Lamp	1	0.59	8.3	68168-89A
Stop Lamp	1	2.25	28.8	68168-89A
Tail Lamp (HDI)	1	0.42	5.7	68169-90A
Stop Lamp (HDI)	1	1.75	23.6	68169-90A
Turn signal lamps				
Front/Running	2	2.25/0.59	28.8/8.3	68168-89
Rear	2	2.25	28.8	68572-64B
Front/Running (HDI)	2	1.75	21.0	68163-84
Rear (HDI)	2	1.75	21.0	68163-84
License plate lamp				
License Plate Illumination	2	0.33	4.6	68193-95
License Plate Illumination (HDI)	2	0.37	5.2	53436-97

Table 8-4. VRSCA Bulb Chart

GENERAL

The relay/fuse block assembly consists of two relay/fuse blocks and is located under the airbox cover, next to the radiator cap. All relays and fuses (with the exception of the main battery fuse - see 8.5 MAXI-FUSE) are contained in these two relay/fuse blocks.

RELAY/FUSE BLOCK REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlock and open seat.
- Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- See Figure 8-1. Gently lift up each relay/fuse block cover release tab (2) and slide each relay/fuse block assembly out of the cover.

See Figure 8-2. Each relay/fuse block assembly contains both fuses (1) and relays (3). There is one unused, empty fuse socket (2).

FUSE REPLACEMENT

- 1. See Figure 8-3. Grasp the suspect fuse and gently pull straight out of the fuse socket.
- 2. Inspect the fuse element. Replace the fuse if the element is burned or broken.
- Line up the pins of the fuse with the socket holes in the relay/fuse block. Push gently down on the fuse body until it bottoms out in the socket.

NOTE

Two spare fuses are located in the left relay/fuse block.

CAUTION

Always use replacement fuses that are of the correct type and amperage rating. Use of incorrect fuses can result in damage to the electrical system.

NOTE

Use only automotive type ATO fuses as replacements.

RELAY REPLACEMENT

- 1. See Figure 8-3. If a relay is diagnosed as defective, grasp the body of the relay and with a gentle rocking motion, pull straight out of the socket.
- Line up the pins of the **new** relay with the socket holes in the relay/fuse block. Push gently down on the relay body until it bottoms out in the socket.

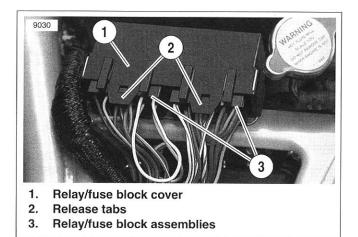


Figure 8-1. Relay/Fuse Block Assembly

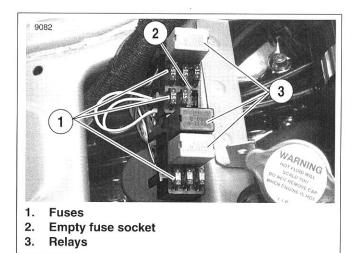


Figure 8-2. Relays and Fuses

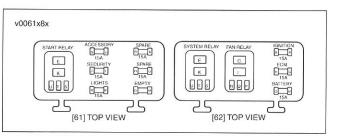


Figure 8-3. Relay/Fuse Block Layout

RELAY/FUSE BLOCK

- See Figure 8-1. Slide each relay/fuse block assembly back into relay/fuse block cover. Push relay/fuse block assembly into the cover until cover release tab locks into place.
- 2. Replace airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 3. 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.

- 4. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 5. Test the vehicle system that is controlled by the relay or fuse that was replaced.

GENERAL

See Figure 8-4. The Crank Position Sensor (CKP) (1) is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 22 teeth (2) machined in the left side flywheel (3). Two consecutive teeth are missing in the flywheel to establish a reference point. The CKP sensor sends a signal to the ignition module. This signal is used to reference engine position (TDC) and engine speed. The CKP sensor is located near the lower front left corner of the engine crank-case.

REMOVAL

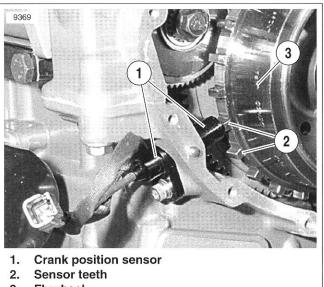
- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Remove left side radiator trim cover.
- 3. Clip and remove cable strap securing CKP sensor wiring harness to fan wiring harnesses.
- 4. Disconnect CKP sensor harness connector [79A].
- 5. See Figure 8-5. Unlatch cable clip (3) on top of jiffy stand bracket and remove CKP sensor cable harness.
- 6. Remove fastener and captive washer (2). Carefully remove CKP sensor and o-ring (1) from engine crank-case.

INSTALLATION

NOTE

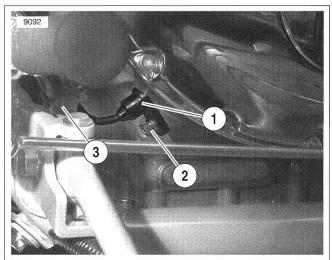
The **new** CKP o-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil to install it.

- See Figure 8-5. Install **new** CKP sensor (1) and o-ring with fastener and captive washer (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
- 2. Route CKP sensor wiring harness through cable clip (3) on top of jiffy stand bracket. Latch cable clip.
- 3. Route CKP sensor wiring harness to wiring harness on left side of radiator and attach to connector [79B].
- Secure CKP sensor wiring harness to fan wiring harnesses with new cable strap.
- 5. Install left side radiator trim cover. Make sure no wires become pinched under cover.
- 6. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 7. Start engine and verify proper operation.



3. Flywheel

Figure 8-4. Flywheel and Crank Position Sensor



- 1. Crank position sensor
- 2. Fastener with captive washer@ 8.2-10.7 Nm (73-95 in-lbs)
- 3. Cable clip

Figure 8-5. Crank Position Sensor Mounting

REPLACEMENT

The VRSCA has a main battery fuse to protect the motorcycle wiring. This 40-amp maxi-fuse provides main battery power to the motorcycle. It is located in a rubber-coated fuse holder behind the motorcycle's right front side cover.

- 1. See Figure 8-6. Remove the fastener (1) securing the side cover (2). Carefully lift the side cover off the mount-ing tabs (3) and set it aside.
- 2. Grasp the fuse holder (5) in one hand, the plastic body of the maxi-fuse (4) in the other, and pull the maxi-fuse straight out of the fuse holder.
- Insert the prongs of the new maxi-fuse in the fuse holder slots. Push the maxi-fuse firmly down into the fuse holder.
- 4. Replace the side cover and install the fastener. Tighten to 4.1-6.8 Nm (36-60 **in-lbs**).

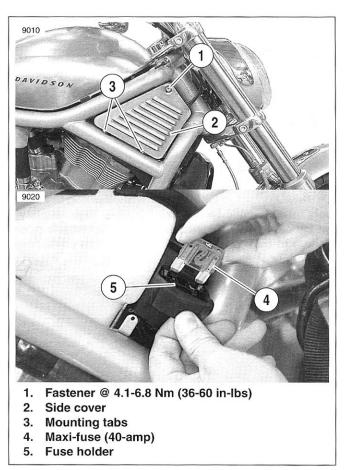


Figure 8-6. Maxi-Fuse Removal and Replacement

GENERAL

The VRSCA model ignition/light switch is non-repairable. If damaged, it must be replaced. The replacement ignition/light switch includes a fork lock, plunger and keys. The ignition/ light switch and fork lock should be replaced at the same time so the customer may continue to use one key for both ignition and fork lock.

AWARNING

DO NOT modify the ignition/light switch wiring to circumvent the automatic-on headlamp feature. High visibility is an important safety consideration for motorcycle riders. Failure to have proper headlamp operation could result in death or serious injury.

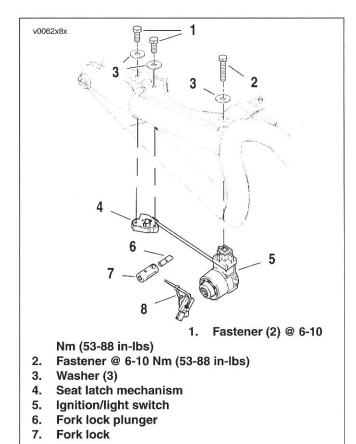
REPLACEMENT

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlock and open seat.
- 3. See Figure 8-7. Remove two fasteners (1), washers (3) and seat latch mechanism (4) from frame.
- Remove fastener (2), washer (3) and ignition/light switch (5) from frame.
- Using IGNITION SWITCH CONNECTOR REMOVAL TOOL (HD-45961), carefully release latching tab securing wiring harness connector to back of ignition/light switch. Pull connector out of ignition/light switch socket.
- Insert wiring harness connector into new ignition/light switch socket. Gently push connector into socket until it locks into place.
- See Figure 8-7. Install ignition/light switch into hole in frame. Make sure square boss on top of switch fits into square hole in frame. Secure with fastener (2) and washer (3). Tighten fastener to 6-10 Nm (53-88 in-lbs).
- Secure seat latch mechanism to frame with two fasteners (1) and washers (3). Tighten fasteners to 6-10 Nm (53-88 in-lbs).
- 9. 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.

- 10. Replace fork lock and plunger. See 2.30 FORK LOCK.
- 11. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 12. Test all functions of ignition/light switch.





GENERAL

The alternator is located behind the alternator cover, on the lower left side of the engine. The alternator cover is secured with 14 fasteners. The derby cover is located on the alternator cover, secured with two fasteners.

NOTE

For diagnostic information, see the VRSCA Electrical Diagnostic Manual .

ACAUTION

The alternator stator is mounted in the alternator cover. The alternator rotor is mounted on the end of the engine crankshaft. Be careful to keep fingers away from the edges of the alternator cover when removing or installing the cover. The magnetic attraction between the stator and rotor is strong and could cause the cover to be pulled toward the engine case with enough force to cause moderate injury.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Remove fastener securing bottom of left radiator trim cover. Remove trim cover.
- 3. See Figure 8-8. Remove voltage regulator 3-wire harness connector clip from left side of radiator cover. Disconnect voltage regulator connector [46B] from alternator stator connector [46A].
- 4. Unlatch cable clip on top of jiffy stand and remove alternator wiring harness.
- 5. Remove two fasteners securing derby cover. Remove cover.
- 6. See Figure 8-9. Place drip pan underneath alternator cover to catch any residual oil that may drain out when cover is removed.
- Using two derby cover fasteners (3), position ALTERNA-TOR STATOR COVER REMOVER/INSTALLER TOOL (Part Number HD-45304) (4) as shown.
- 8. Remove 14 fasteners securing alternator cover (1).
- Install two GASKET ALIGNMENT DOWELS (Part Number HD-45340) (2) in two of the alternator cover holes to steady cover as it is removed.
- 10. Remove alternator cover.
- 11. See Figure 8-10. Remove fastener (5) and harness clip (6) from alternator cover.
- 12. Remove fastener and captive washer (4) from alternator cover.
- 13. Remove grommet (7) from slot in alternator cover.
- 14. Remove three stator mounting fasteners (3) and pull stator straight up out of alternator cover.

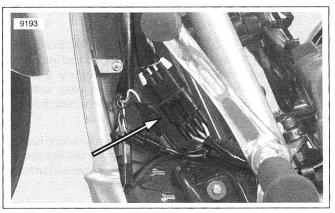
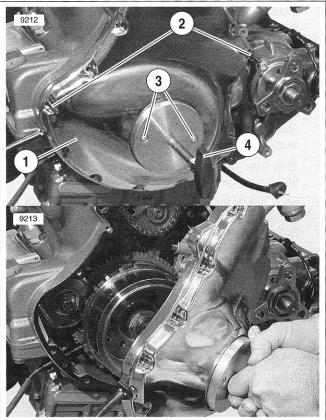


Figure 8-8. Stator-to-Regulator Connector



- 1. Alternator cover
- 2. Gasket alignment dowel (2)
- 3. Derby cover fasteners
- 4. Alternator cover remover/installer tool (HD-45304)

Figure 8-9. Removing Alternator Cover

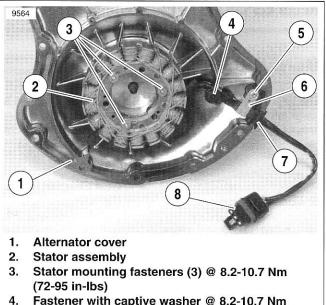
INSTALLATION

- Thoroughly clean alternator cover and gasket sealing surface on engine case. Remove any sealing material from gasket sealing surfaces.
- See Figure 8-10. Install stator assembly (2) in alternator cover (1). Make sure to orient stator so that wiring harness exits stator housing at approximately 3 O'clock position. Line up three fastener holes in stator with holes in alternator cover. Install three stator mounting fasteners and tighten to 8.2-10.7 Nm (72-95 in-lbs).
- 3. Put a thin film of silicone sealant on stator wiring harness grommet (7). Press grommet down into slot in alternator cover. Make sure flat surface of grommet is flush with gasket sealing surface of alternator cover.
- Install fastener with captive washer (4). Make sure wiring harness is fully seated in slot and not pinched between washer and alternator cover. Tighten to 8.2-10.7 Nm (72-95 in-lbs).
- Install harness clip (6) into alternator cover. Secure with fastener (5). Tighten to 8.2-10.7 Nm (72-95 in-lbs).
- See Figure 8-9. Make sure ALTERNATOR STATOR COVER REMOVER/INSTALLER TOOL (Part Number HD-45304) (4) is installed as shown. Secure to alternator cover with two derby cover fasteners. Turn handle of tool clockwise (CW) several turns.
- 7. Make sure two GASKET ALIGNMENT DOWELS (Part Number HD-45340) (2) are installed in case.
- 8. Slide **new** alternator cover gasket onto alignment dowels and press flush against engine case.
- Slide alternator cover onto alignment dowels. Turn handle of remover/installer counterclockwise (CCW) until it turns freely. Remove two derby cover fasteners and remover/installer tool.

NOTE

To avoid oil leaks caused by warping of alternator cover, in next step, tighten fasteners in alternating pattern back and forth across face of cover. See Figure 8-11.

- 10. Secure alternator cover to engine case with 14 fasteners. Tighten to 9.7 Nm (85 in-lbs).
- 11. Clean derby cover. Inspect o-ring on derby cover. Replace if damaged.
- Install derby cover on alternator cover with two fasteners. Tighten to 8.2-10.7 Nm (72-95 in-lbs).
- 13. Route stator wiring harness through cable clip on top of jiffy stand. Latch cable clip.
- 14. Plug stator connector into three-wire voltage regulator connector. Secure connector to left side of radiator cover with connector clip.
- Install radiator trim cover onto radiator cover. Make sure no wires become pinched under cover. Secure with fastener. Tighten to 3-4 Nm (26-35 in-lbs).
- 16. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 17. Test alternator output according to instructions in VRSCA Electrical Diagnostic Manual.



- 4. Fastener with captive washer @ 8.2-10.7 Nm (72-95 in-lbs)
- 5. Fastener @ 8.2-10.7 Nm (72-95 in-lbs)
- 6. Harness clip
- 7. Grommet
- 8. Stator wiring harness connector

Figure 8-10. Removing Stator from Alternator Cover

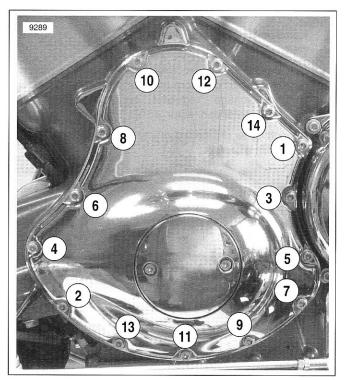


Figure 8-11. Alternator Cover Fastener Tightening Sequence @ 9.7 Nm (85 in-lbs)

VOLTAGE REGULATOR

GENERAL

The voltage regulator is mounted between the front frame downtubes, directly above the radiator.

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails.

REMOVAL

- 1. Unlock and open seat.
- 2. Remove the airbox assembly. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

See Figure 8-12. Cover the injector intakes with duct tape to prevent contaminates/objects from falling down the injector bore. Do NOT use shop cloths or objects that could damage the injector butterflies.

- 3. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 4. See Figure 8-13. Remove the mounting fasteners (1) and left and right radiator trim covers (2).

NOTE

Before removing voltage regulator wires, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

5. See Figure 8-14. Remove fastener, washer and voltage regulator ground wire from front cylinder head. Cut and remove any cable straps securing ground wire to frame.

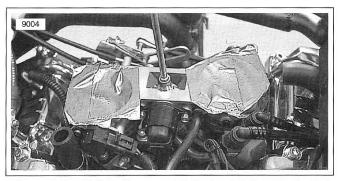
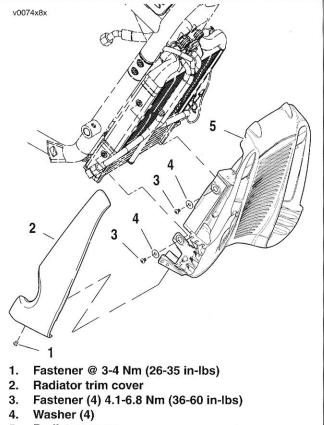


Figure 8-12. Airbox Removed, Injector Intakes Protected



5. Radiator cover

Figure 8-13. Removing Radiator Covers

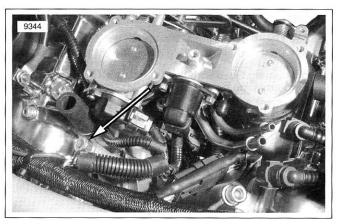


Figure 8-14. Voltage Regulator Grounding Fastener

- 6. See Figure 8-15. Remove voltage regulator 3-wire harness connector clip from left side of radiator cover. Disconnect voltage regulator connector [46B] from alternator connector [46A].
- 7. Remove all other wiring harness cable straps and clips attached to left side of radiator cover.
- See Figure 8-16. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
- 9. See Figure 8-13. Remove mounting fasteners (3), washers (4) and radiator cover (5).
- 10. Disconnect voltage regulator connector [77B] from maxifuse connector [77A]. This connector is located on the front of the radiator near the top.
- 11. Remove two fasteners securing voltage regulator to frame and remove voltage regulator from vehicle.

INSTALLATION

- 1. Attach **new** voltage regulator to frame with two mounting fasteners. Tighten to 6-10 Nm (53-88 **in-lbs**).
- 2. Route voltage regulator wire harnesses.
 - a. Route ground wire along left top frame tube to mounting fastener on front cylinder head.
 - b. Route maxi-fuse wire along top of radiator and plug into connector [77A].
 - c. Route three-wire harness along top of radiator and down left side. Plug into alternator connector [46A].
- 3. See Figure 8-14. Attach voltage regulator ground wire to front cylinder head. Tighten to 16-20 Nm (12-15 ft-lbs).
- 4. Secure voltage regulator wire harnesses with cable straps at appropriate locations.
- See Figure 8-13. Attach radiator cover with four fasteners (3) and washers (4). Tighten to 4.1-6.8 Nm (36-60 inlbs).
- See Figure 8-16. Press rear brake master cylinder reservoir back into its mounting slots in right side of radiator cover.
- 7. Reroute wiring harnesses down left side of radiator cover and attach with clips or cable straps as appropriate.
- See Figure 8-13. Attach left and right radiator trim covers (2) to radiator cover with mounting fasteners (1). Tighten to 3-4 Nm (26-35 in-lbs).
- 9. Remove duct tape from injector intakes.
- 10. Install airbox assembly. See 1.4 AIRBOX AND AIR FIL-TER.
- 11. 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.

- 12. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 13. See the VRSCA Electrical Diagnostic Manual and check voltage regulator for proper output.

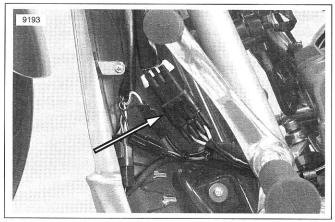


Figure 8-15. Voltage Regulator-To-Alternator Connector [12]

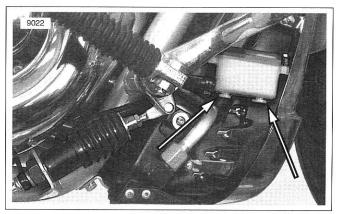


Figure 8-16. Rear Brake Master Cylinder Reservoir Mounting Slots

GENERAL

See Figure 8-17. All Harley-Davidson batteries are permanently sealed, maintenance-free, lead/calcium and sulfuric acid batteries. The batteries are shipped pre-charged and ready to be put into service. Do <u>NOT</u> attempt to open these batteries for any reason.

The battery is located behind the headlamp, under the frame backbone.

NOTE

See 1.4 AIRBOX AND AIR FILTER. You must remove the airbox assembly to gain access to the battery.

WARNING

Battery posts, terminals and related accessories contain lead and lead components, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Wash hands after handling.

WARNING

- All batteries contain electrolyte. Electrolyte is a sulfuric acid solution that is highly corrosive and can cause severe chemical burns. Avoid contact with skin, eyes, and clothing. Avoid spillage. Always wear approved protective face shield, rubberized gloves, and protective clothing when working with batteries or electrolyte solution. KEEP BATTERIES AND ACID OUT OF REACH OF CHILDREN.
- See Figure 8-17. A warning label is attached to the top of the battery. Never remove the warning label from the battery.
- See Figure 8-18. Inadequate safety precautions and work procedures could result in death or serious injury.

WARNING

To avoid accidental start-up of vehicle and possible personal injury, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

Table 8-5. Battery Electrolyte Antidote

ANTIDOTE-BATTERY ACID			
External	Flush with water.		
Internal	Drink large quantities of milk or water, fol- lowed by milk of magnesia, vegetable oil, or beaten eggs. Call doctor immediately.		
Eyes	Flush with water, and get immediate medical attention.		

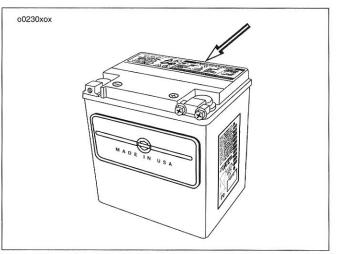


Figure 8-17. Battery Warning Label

WARNING

Never remove the warning label attached to the top of the battery. Failure to read and understand all precautions contained in the warning label on the battery before performing any service could result in death or serious injury.

See Figure 8-18. The battery warning label contains important safety information.

BATTERY TESTING

Voltmeter Test

See Table 8-6. The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then re-check the voltage after the battery has set for one to two hours.

Table 8-6. Voltmeter Test

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





BATTERY DISCONNECTION AND REMOVAL

- 1. Unlock and open seat.
- 2. Remove airbox assembly. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

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

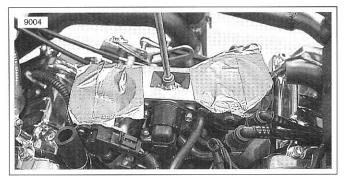


Figure 8-19. Airbox Removed, Injector Intakes Protected

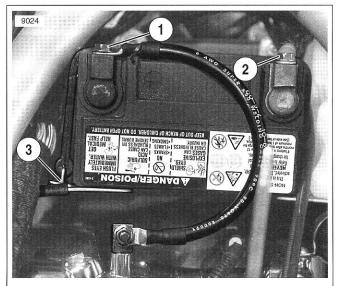
AWARNING

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

WARNING

Always disconnect the negative (–) battery cable first. If the positive (+) battery cable should contact the chassis ground with the negative (–) cable connected, the resulting sparks could cause a battery explosion which could result in death or serious injury.

 See Figure 8-20. Unscrew the negative battery terminal bolt and remove the battery negative cable from the negative (–) terminal of the battery.



- 1. Negative battery terminal bolt
- 2. Positive battery terminal bolt
- 3. Battery strap clip

Figure 8-20. Battery (12 amp-hour)

- 4. Unscrew the positive battery terminal bolt and remove the battery positive cable from the positive (+) terminal of the battery.
- 5. Release the battery strap clip and remove the battery from the battery tray.

Cleaning And Inspection

The battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause the battery to self-discharge.

- Clean the battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water).
- 2. When the solution stops bubbling, rinse off the battery with clean water.
- 3. Clean cable connectors and battery terminals using a wire brush or sandpaper; remove any oxidation.
- Inspect the battery fasteners, clamps, and cables for breakage, loose connections, and corrosion; clean the clamps.
- 5. Check the battery posts for melting or damage caused by overtightening.
- 6. Inspect the battery for discoloration, raised top or a warped or distorted case, which might indicate that the battery has been frozen, overheated or overcharged.
- 7. Inspect the battery case for cracks or leaks.

BATTERY CHARGING

Safety Precautions

Never charge a battery without first reviewing the instructions for the charger being used. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear proper eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger OFF before connecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery; red positive (+) lead to the positive (+) battery terminal and black negative (-) lead to the negative (-) battery terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure the ignition and all electrical accessories are turned off.
- Make sure the charger leads to the battery are not broken, frayed, or loose.
- If the battery becomes hot, or if violent gassing or spewing of electrolyte occurs, reduce the charging rate or turn off the charger temporarily.
- Always turn charger "OFF" before removing charger leads from the battery to avoid dangerous sparks.

Charging Battery

Charge the battery if any of the following conditions exist:

- The vehicle lights appear dim.
- The electric starter sounds weak.
- The battery has not been used for an extended period of time.

AWARNING

Always charge the battery in a well ventilated area. Explosive hydrogen gas escapes from the battery during charging. Keep open flames, electrical sparks and smoking materials away from the battery at all times. Failure to do so could result in death or serious injury.

CAUTION

If the battery releases an excessive amount of gas during charging, decrease the charging rate. If the battery gets hotter than 110° F (43° C) during charging, disconnect the charger and allow the battery to cool. Overheating may result in plate distortion, internal shorting, drying out or other damage.

1. See BATTERY TESTING in this section. Perform a voltmeter test to determine the state of charge. If the battery needs to be charged, proceed to step 2.

CAUTION

Always remove the battery from the motorcycle before charging. Accidental electrolyte leakage will damage motorcycle parts.

- 2. See BATTERY DISCONNECTION AND REMOVAL in this section. Remove the battery from the motorcycle.
- 3. Place the battery on a level surface.

WARNING

Always unplug or turn OFF the battery charger before connecting the charger clamps to the battery. Connecting clamps with the charger ON could cause a spark resulting in a battery explosion. A battery explosion may rupture the battery case causing a discharge or spray of sulfuric acid which could result in death or serious injury.

CAUTION

Do NOT reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged.

- 4. Connect the red battery charger lead to the positive (+) terminal of the battery.
- 5. Connect the black battery charger lead to the negative (-) terminal of the battery.

NOTE

If the battery is still in the vehicle, connect the negative (–) lead to the chassis ground. Be sure the ignition and all electrical accessories are turned off.

- 6. For battery charging rates/times, see Table 8-7. Step away from the battery and turn on the charger.
- After the battery is fully charged, disconnect the black battery charger lead from the negative (–) terminal of the battery.
- 8. Disconnect the red battery charger lead from the positive (+) terminal of the battery.
- 9. Mark the charging date on the battery.

	STATE O	STATE OF CHARGE		6 4 mm	10 Amp	20 Amp
		6 Amp Charger	Charger	Charger		
	12.8 V	100%	-	-	-	-
-	12.6 V	75%	1 hour 20 minutes	40 minutes	25 minutes	12 minutes
12	12.3 V	50%	2 hours 40 minutes	80 minutes	50 minutes	25 minutes
	12.0 V	25%	4 hours	2 hours	1 hour 10 minutes	40 minutes
	11.8 V	0%	5 hours 20 minutes	2 hours 40 minutes	1 hour 40 minutes	50 minutes

Table 8-7. Battery Charging Rates/Times

The figures listed above assume the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.

The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, **never** exceed 15 volts for more than 30 minutes.

BATTERY INSTALLATION AND CONNECTION

- 1. Slide the fully charged battery on its side into the battery tray, terminal side up, negative (-) battery terminal toward the left side of the motorcycle.
- 2. Secure the battery to the tray with the battery strap. Slide the strap clips onto the attachment points on the battery tray.

CAUTION

Connect the cables to the correct battery terminals. Failure to do so may result in damage to the motorcycle electrical system.

WARNING

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

WARNING

Do not allow the positive cable (+) to contact ground with the negative (-) cable installed. Resulting sparks may cause a battery explosion which could result in death or serious injury.

CAUTION

Do not overtighten the bolts on the battery terminals. Use recommended torque values. Overtightening battery terminal bolts may result in damage to the battery terminals.

- 3. Insert a battery terminal bolt through the battery positive cable (+) (red), into the threaded hole of the battery positive (+) terminal.
- 4. Tighten bolt to 6.8-10.8 Nm (60-96 in-lbs).
- 5. Insert the other battery terminal bolt through the battery negative cable (black), into the threaded hole of the battery negative (–) terminal.
- 6. Tighten bolt to 6.8-10.8 Nm (60-96 in-lbs).

CAUTION

Keep the battery clean. Lightly coat the terminals with petroleum jelly to prevent corrosion. Failure to do so may result in damage to the battery terminals.

- 7. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.
- 8. Remove the duct tape from the injector intakes.
- 9. Install airbox assembly. See 1.4 AIRBOX AND AIR FIL-TER.
- 10. 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.

BATTERY STORAGE

AWARNING

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

CAUTION

Do not allow the battery to completely discharge power. The electrolyte in a discharged battery will freeze if exposed to freezing temperatures. The more discharged a battery is, the more easily it can freeze. A completely discharged battery may result in a cracked battery case and buckled battery plates.

See BATTERY CHARGING in this section. 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 Figure 8-21. 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 the fully charged battery in a cool, 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).

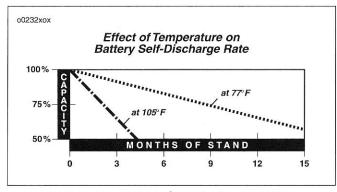


Figure 8-21. Battery Self-Discharging Rate

NOTE

The H-D 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 BATTERY CHARGING in this section.

CAUTION

Do NOT trickle charge the battery more than 24 hours at a time. Charging more than 24 hours at a time may result in equipment damage.

CAUTION

It is possible to overload the motorcycle's charging system by adding too many electrical accessories. If the combined electrical accessories consume more electrical current than the vehicle's charging system can produce, the electrical consumption can discharge the battery and cause vehicle electrical system damage.

GENERAL

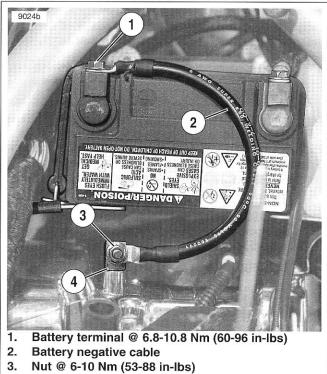
Replacement of the negative battery cable will be described here. The positive battery cable is an integral part of the main wiring harness.

NEGATIVE CABLE REPLACEMENT

- 1. Unlock and open seat.
- 2. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 3. See Figure 8-22. Remove battery negative terminal (1) fastener.
- 4. Remove nut (3) securing negative battery cable (2) to stud on adapter bracket (4) and negative battery cable.
- 5. Install **new** battery cable. Secure with nut on adapter bracket stud. Tighten to 6-10 Nm (53-88 **in-lbs**).
- Secure other end of battery cable to battery negative terminal with fastener. Tighten to 6.8-10.8 Nm (60-96 inlbs).
- 7. 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.



4. Adapter bracket

Figure 8-22. Battery Negative Cable

HEADLAMP

GENERAL

The headlamp contains separate high and low-beam headlamp bulbs. Each bulb is a replaceable high output quartz halogen bulb type.

CAUTION

When replacement is required, use only the specified headlamp bulb, available from your Harley-Davidson dealer. An improper wattage headlamp bulb may cause charging system problems.

CAUTION

Never touch the quartz headlamp bulb with your fingers. Fingerprints will etch the glass and decrease bulb life. Always grasp the bulb with paper or a clean dry cloth during handling. Failure to do so may result in bulb damage.

WARNING

The headlamp bulb contains Halogen gas under pressure. Handle the bulb carefully and wear eye protection. Failure to do so could result in death or serious injury.

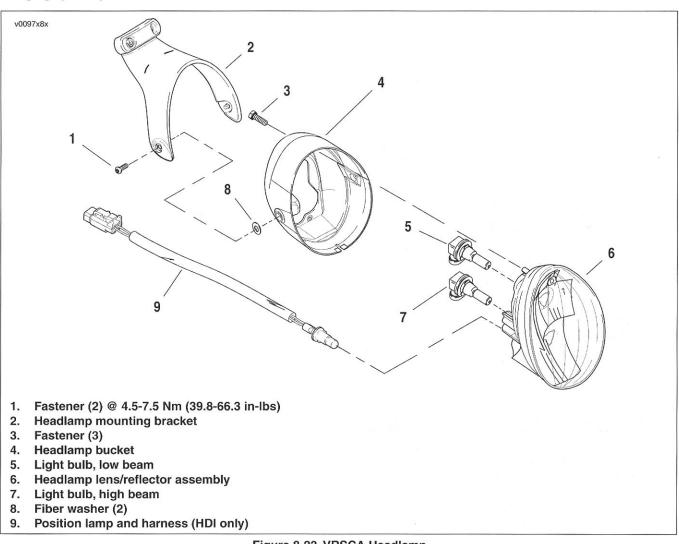


Figure 8-23. VRSCA Headlamp

Removal

NOTE

It is not necessary to disassemble the headlamp assembly in order to replace headlamp bulbs.

- 1. See Figure 8-23. To replace the low beam (5) or high beam (7) headlamp bulb, reach behind the headlamp bucket (4) and grasp the appropriate headlamp bulb socket connector.
- 2. Squeeze the release latches on the connector and pull the connector away from the headlamp bulb.
- 3. While facing the headlamp from behind (looking toward the front of the motorcycle), twist the headlamp bulb approximately 45 degrees counterclockwise (ccw) and gently pull straight out of the headlamp.

Installation

NOTE

The low beam headlamp bulb (labeled H11) mounts in the top hole in the rear of the headlamp assembly. The high beam bulb (labeled H9) mounts in the bottom hole.

- 1. See Figure 8-23. To install a **new** headlamp bulb, insert it into the hole in the rear of the headlamp. Facing the headlamp assembly from the rear (looking toward the front of the motorcycle):
 - a. Position the low beam bulb (5) with its connector housing pointing to approximately 4 o'clock.
 - b. Position the high beam bulb (7) with it's connector housing pointing to approximately 5 o'clock.
- 2. Gently twist the bulb clockwise (CW) approximately 45 degrees, until it stops.

CAUTION

Do NOT force the connector onto the headlamp bulb socket. The two headlamp connectors are not interchangeable. Forcing the wrong connector onto the bulb will damage the connector pins and/or bulb socket.

3. Gently push the headlamp wiring connector onto the headlamp bulb socket until it clicks into place.

Removal

WARNING

The headlamp bulb contains Halogen gas under pressure. Handle the bulb carefully and wear eye protection. Failure to do so could result in death or serious injury.

- 1. Remove both headlamp bulbs.
- 2. See Figure 8-23. Remove fasteners (1) and fiber washers (8) securing the headlamp assembly to the headlamp mounting bracket (2).
- Remove fasteners (3) securing the headlamp lens/reflector assembly (6) to the headlamp bucket (4). Slide the headlamp bucket away from the lens/reflector assembly.
- HDI ONLY: Remove the position lamp (9) from the lens/ reflector assembly.

Installation

- 1. See Figure 8-23. Slide the headlamp bucket (4) onto the rear of the lens/reflector assembly and secure with fasteners (3).
- Attach the headlamp assembly to the headlamp mounting bracket (2) with two fasteners (1) and fiber washers (8). Tighten to 4.5-7.5 Nm (40-66 in-lbs).
- 3. Adjust headlamp beam. See 1.24 HEADLAMP ALIGN-MENT.

TAIL LAMP

REMOVAL

- 1. See Figure 8-24. Insert a small screwdriver into middle hole of license plate light cover. Push forward with screw-driver to release tail lamp housing retaining clip.
- 2. Lift rear of tail lamp housing up and slide housing assembly away from fender.
- 3. See Figure 8-25. To replace tail lamp bulb:
 - a. Turn bulb socket assembly (2) clockwise (CW) and pull outward from tail lamp housing.
 - b. Remove bulb by turning counterclockwise (CCW) and pulling from bulb socket assembly.
 - c. Push **new** bulb into bulb socket assembly and turn clockwise.
 - d. Insert bulb socket assembly into tail lamp housing and turn counterclockwise to lock in place.
- 4. To replace license plate bulbs:
 - a. Remove license plate bulbs (5) by turning housing counterclockwise. Tab on bulb housing must clear tab on license plate light housing.
 - b. Pull bulb from socket and replace with new bulb.
 - c. Install housing by aligning tabs and turning clockwise.
- 5. To replace entire tail lamp assembly:
 - a. Press down on release latch on connector socket (1).
 - b. Detach socket from wiring harness connector.

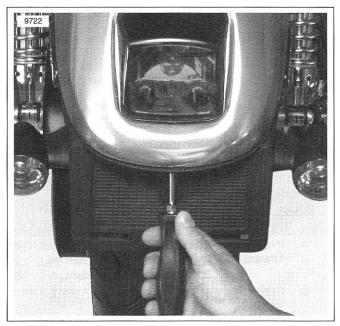
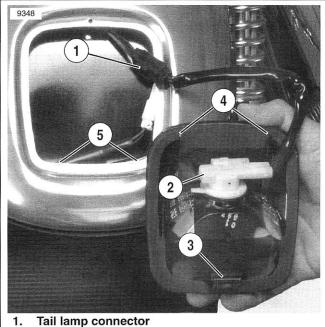


Figure 8-24. Releasing Tail Lamp Retaining Clip



- 2. Tail lamp bulb socket assembly
- 3. Retaining clip
- 4. Mounting tabs
- 5. License plate lamps (2)

Figure 8-25. Tail Lamp Wiring

INSTALLATION

- 1. See Figure 8-25. Route all electrical connectors and wiring harnesses to either side of tail lamp opening in fender, away from tail lamp bulb housing.
- If entire tail lamp assembly was replaced, insert wiring harness connector (1) in socket and push together gently until release latch locks in place.

NOTE

When installing tail lamp assembly, make sure tail lamp bulb is pointing toward rear of vehicle.

- 3. Install tail lamp assembly as follows:
 - a. Insert tabs (4) on front of tail lamp housing under forward edge of fender opening.
 - b. Carefully push tail lamp assembly toward front of vehicle.
 - c. Engage retaining clip (3) with rear edge of fender opening. Gently press down on tail lamp assembly until clip locks in place.

NOTE

Retaining clip must engage rear fender opening for tail lamp to remain locked into position in rear fender.

WARNING

Check for proper tail lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

4. Turn ignition ON and test for proper tail lamp and brake lamp operation.

TURN SIGNALS/RUNNING LIGHTS

BULB REPLACEMENT

- 1. Locate notch on edge of front or rear turn signal lens cap.
- 2. Insert coin in notch. Carefully twist coin until lens pops out of turn signal housing.
- 3. Replace bulb.
 - a. Push bulb in and turn counterclockwise.
 - b. Pull bulb from socket when tab on bulb clears opening on socket.
 - c. Push new light bulb in and turn clockwise to lock in place.
- 4. Snap lens back into turn signal housing with the notch facing down.

NOTE

If after replacing a bulb, the turn signal or running lamp will not light, check the wiring, the ground at the socket and/or the switch.

LAMP REPLACEMENT

General

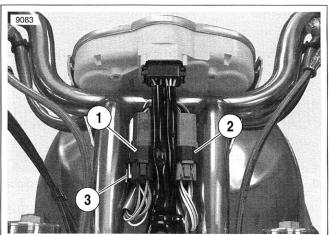
- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Change turn signal following steps under Front Turn Signals or Rear Turn Signals in this section.
- 3. Replace maxi-fuse. See 8.5 MAXI-FUSE.

Front Turn Signals

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

- 1. See 8.15 INSTRUMENT CLUSTER. Remove front handlebar cover and instrument cluster.
- 2. See Figure 8-26. Clip cable strap around handlebar control connectors and electrical bracket.
- 3. Pull electrical bracket away from handlebar uprights.
- Front turn signal connector socket [31A] is attached to back side of electrical bracket. Disconnect front turn signal connector [31B] from socket.
- Note locations of turn signal wires in connector. Remove appropriate turn signal wire terminals from connector. See the VRSCA Electrical Diagnostic Manual for more information. Remove turn signal wire harness from handlebar clips.
- 6. See Figure 8-27. Hold retainer (5) and loosen ball stud clamp (4) to remove turn signal (1).



- 1. Right handlebar controls connector [22]
- 2. Left handlebar controls connector [24]
- 3. Electrical bracket

Figure 8-26. Handlebar Control Connectors

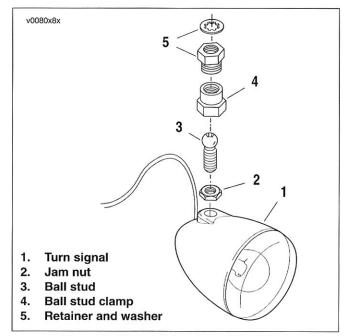


Figure 8-27. Front Turn Signal Mounting

- Lay old turn signal assembly next to new one and cut new wires to length. Trim sheath back approximately 63.5 mm (2.5 in) from ends of wires. Crimp new terminals onto wires. See the VRSCA Electrical Diagnostic Manual for more information.
- Install new turn signal lamp housing and route wire harness through handlebar clips. Insert terminals into turn signal connector and mate connector to socket.
- 9. Install cable strap around electrical bracket, handlebar control connectors and turn signal connector.
- 10. Press electrical bracket back in place between handlebar uprights.
- 11. See 8.15 INSTRUMENT CLUSTER. Install instrument cluster and handlebar covers.

Rear Turn Signals

NOTE

Before removing turn signal wires, carefully note routing and location of each wire terminal in connector.

- 1. See 8.12 TAIL LAMP. Remove tail lamp housing assembly from rear fender. Locate appropriate rear turn signal harness and connector inside tail lamp housing recess in rear fender.
- See Figure 8-28. Drawing shows rear lighting module assembly removed from rear fender for clarity. Note locations of turn signal wires in connector (2). Remove turn signal wire terminals from connector. See the VRSCA Electrical Diagnostic Manual for more information.
- 3. Remove fasteners (3) and support plate (4). Remove turn signal housing (1) from vehicle. Carefully pull turn signal wiring harness through holes in fender.
- 4. Install **new** turn signal housing and support plate, routing wiring harness back through holes in fender. Bring wire ends into tail lamp housing recess in rear fender.
- Insert terminals into turn signal connector and mate connector to socket.
- 6. See 8.12 TAIL LAMP and install tail lamp housing assembly into rear fender.

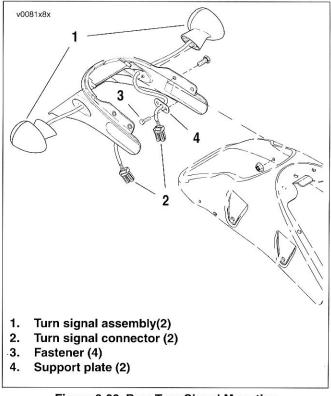


Figure 8-28. Rear Turn Signal Mounting

The Turn Signal Security Module (TSSM) is located beneath the passenger seat, mounted in a bracket on the rear fender.

REMOVAL

- 1. Verify security lamp is not blinking (vehicle is disarmed).
- 2. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 3. Unlock and open seat.
- 4. See Figure 8-29. Remove fastener (2) and washer (3). Slide passenger seat (1) forward slightly to detach it from the mounting tab on the rear of the fender. Then slide seat back and out from underneath seat strap. Remove
- passenger seat from motorcycle.
- See Figure 8-30. Squeeze wiring harness connector release latches (3) and carefully pull wiring harness connector (2) out of connector socket on TSSM (1).
- 6. Lift up TSSM and slide it out of mounting bracket (4).

INSTALLATION

- 1. Slide **new** TSSM into mounting bracket. Make sure TSSM slides all the way forward in the bracket.
- Carefully insert wiring harness connector into TSSM socket. Push connector all the way in until release latches lock in place.

CAUTION

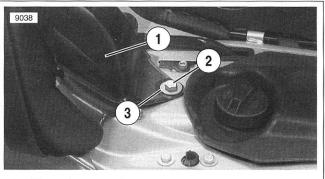
The wiring harness connector is keyed and can only be inserted fully in the TSSM socket one way. DO NOT force the connector into the socket. Doing so can damage the connector and/or socket.

- 3. See Figure 8-29. Slide passenger seat under seat strap and engage mounting tab on the fender into slot in bottom rear of seat. Make sure TSSM wiring harness is not pinched under seat frame.
- Attach passenger seat to motorcycle with fastener (2) and washer (3). Tighten to 11-17 Nm (97-150 in-lbs).
- 5. Turn ignition switch to the FUEL position and close seat. Then turn ignition switch to the LOCK position.

CAUTION

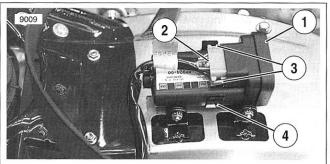
When closing the seat, make sure the ignition switch is in the FUEL position. If the ignition switch is in any other position when the seat is closed, the seat latch mechanism could be damaged

6. Replace maxi-fuse. See 8.5 MAXI-FUSE.



- 1. Passenger seat
- 2. Fastener @ 11-17 Nm (97-150 in-lbs)
- 3. Washer

Figure 8-29. Passenger Seat Attachment



- 1. TSSM
- 2. Wiring harness connector
- 3. Connector release latch (2)
- 4. TSSM mounting bracket

Figure 8-30. Turn Signal Security Module Mounting

The instrument cluster contains the speedometer, tachometer, fuel gauge and indicator lamps. It is a sealed unit. If any of the instruments or indicator lamps becomes defective, the entire instrument cluster must be replaced.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- See Figure 8-31. To free lower end of top handlebar cover, loosen two mounting fasteners (9) holding headlamp bracket (8) to upper triple clamp (7).
- 3. Without removing cover, remove two fasteners (6) securing handlebar top cover (2) and instrument housing bezel (1) to handlebar bottom cover (5).

CAUTION

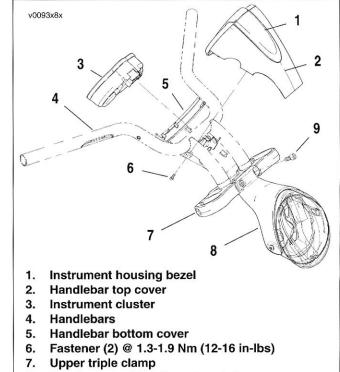
See Figure 8-32. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.

 From headlamp bracket end of cover, gently tilt top handlebar cover and instrument bezel up and back to remove cover and bezel.

NOTE

Bezel can remain snapped to upper handlebar cover.

- See Figure 8-33. Squeeze two release latches (4) together and gently pull wiring harness connector (3) [39] from instrument cluster socket (2).
- 6. Remove instrument cluster (1) from handlebar bottom cover.



- 8. Headlamp and headlamp bracket
- 9. Fastener (2) @ 11-18 Nm (8-13 ft-lbs)

Figure 8-31. Instrument Cluster Removal

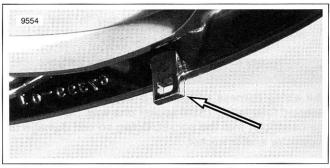


Figure 8-32. Bezel Hook

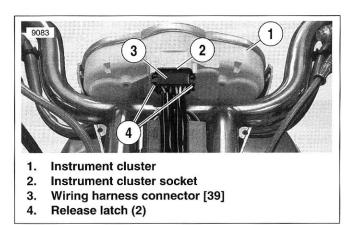


Figure 8-33. Instrument Cluster Harness Connector

- 1. Set new instrument cluster into handlebar bottom cover.
- 2. See Figure 8-33. Install wiring harness connector (3) into instrument cluster socket (2). Gently push connector into socket until release latches (4) lock into place.

CAUTION

See Figure 8-32. Bezel hook holds bottom of bezel and top cover to lower handlebar cover and can be damaged if forced during removal or installation.

- See Figure 8-31. Orient instrument housing bezel (1) and handlebar top cover (2), and fit bezel hook over tab on handlebar bottom cover (5). Gently press handlebar top cover and instrument housing bezel down until bezel hook snaps onto tab.
- 4. Fit bottom end of handlebar top cover behind headlamp mounting bracket. Bezel edge should fit snugly to grooved rim of lower and upper cover.
- 5. Secure handlebar covers with two fasteners (6). Tighten fasteners to 1.3-1.9 Nm (12-16 **in-lbs**).
- Tighten headlamp bracket fasteners (9) to 11-18 Nm (8-13 ft-lbs).
- 7. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 8. Verify that instrument cluster is operational:
 - a. Turn ignition/seat release switch to the ACC position. Instrument background lighting will illuminate, gauge needles will sweep their full range of motion and the battery, security, coolant temperature and check engine indicator lamps will illuminate.
 - b. Turn ignition/seat release switch to the LOCK position.

The Vehicle Speed Sensor (VSS) is a hall effect sensor that takes readings off a drive gear in the transmission.

The VSS is located behind the rear cylinder on the back of the engine case, below the cam chain tension adjuster.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlock and open seat.
- 3. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- Disconnect VSS wiring harness cable connector [65B]. See Figure 8-34. This connector is located under the vehicle's frame directly beneath the relay/fuse block.
- 5. Trace the VSS wiring harness back to the VSS, clipping and removing any cable straps securing the harness to the motorcycle. Note the location of the cable straps as you will secure the harness with **new** cable straps at those locations when installing the **new** VSS.
- 6. See Figure 8-35. Remove the three fasteners (4) securing the transmission sprocket cover (3) to the engine crankcase and remove the sprocket cover.
- 7. Remove the fastener (2) securing the VSS. Carefully pull the VSS and o-ring (1) straight out of the transmission case.

INSTALLATION

NOTE

The **new** VSS o-ring has a blue teflon coating that provides lubrication during installation. It is not necessary to coat the o-ring with engine oil to install it.

- 1. See Figure 8-35. Install **new** VSS (1) with o-ring, and fastener (2). Tighten to 8.2-10.7 Nm (73-95 **in-lbs**).
- Route VSS wiring harness up and attach to connector [79B].

NOTES

- The VSS cable harness must not be positioned near the exhaust system or cylinder fins. Make sure cable straps secure cable away from those areas.
- Leave a small amount of slack in the cable from sensor to first cable strap.
- 3. Secure VSS wiring harness with new cable straps.
- 4. Replace airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 5. 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.

6. Replace maxi-fuse. See 8.5 MAXI-FUSE.

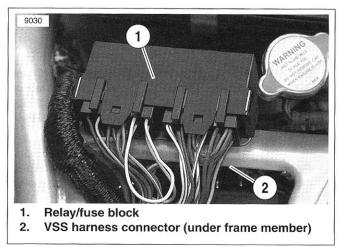
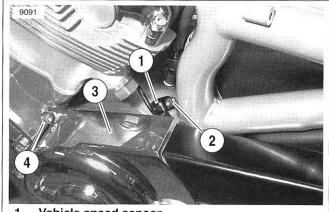


Figure 8-34. VSS Connector



- 1. Vehicle speed sensor
- 2. Fastener @ 8.2-10.7 Nm (73-95 in-lbs)
- 3. Transmission sprocket cover
- 4. Sprocket cover fastener (3)

Figure 8-35. Vehicle Speed Sensor

The neutral switch is located on the bottom of the engine case near the rear of the engine. The two-terminal switch is normally closed. When the transmission is in NEUTRAL and the ignition switch is in the IGN position, the neutral switch causes the NEUTRAL indicator lamp to illuminate.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Make sure transmission is shifted into NEUTRAL.
- Place a clean container under motorcycle to catch any oil that may escape.
- See Figure 8-36. Remove two wiring harness connectors
 (2) from neutral switch (1). Gently pull connectors straight off switch studs.
- 5. Using a 7/8 in. box wrench, remove neutral switch and oring from engine case.

INSTALLATION

NOTE

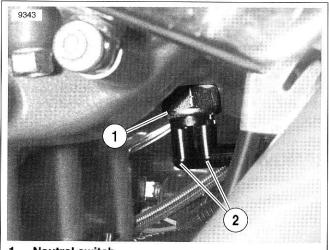
The transmission shifter must be in the NEUTRAL position when installing the switch to allow the switch ball to engage the shifter cam ramp.

- 1. See Figure 8-37. Lubricate **new** o-ring (2) with engine oil.
- Install neutral switch with o-ring into engine case. Tighten to 12.8-16.5 Nm (113-146 in-lbs).

NOTE

The neutral switch is not polarity sensitive. Either connector may be attached to either stud.

- See Figure 8-36. Install wiring harness connectors (2) onto studs on neutral switch (1). Gently push connectors until they bottom out on studs.
- 4. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 5. Test neutral switch for proper operation.
 - a. Turn ignition switch to IGN position.
 - b. Verify that transmission shifter is in NEUTRAL.
 - c. Check to see that NEUTRAL indicator lamp illuminates.
 - d. Turn off ignition switch.
- If any oil escaped while neutral switch was removed from vehicle, check the engine oil level. See 1.6 ENGINE OIL AND FILTER. Replenish engine oil as necessary.



- 1. Neutral switch
- 2. Wiring harness connectors (2)

Figure 8-36. Neutral Switch Location

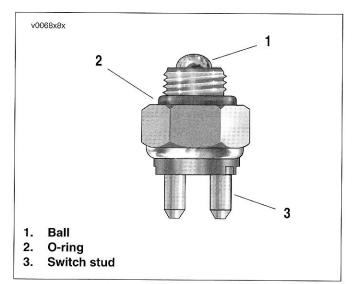


Figure 8-37. Neutral Switch

The oil pressure switch monitors oil pressure in the crankcase. If the oil pressure drops below 13.8-34.5 kPa (2-5 psi), the oil pressure switch is tripped and illuminates the low oil pressure indicator light. The oil pressure switch is located in the valley on top of the engine crankcase between the cylinders.

REMOVAL

- 1. Unlock and open seat.
- Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.

CAUTION

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

AWARNING

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

- 3. Disconnect negative battery cable.
- Remove the idle air control (IAC) motor wiring harness connector [87B] and throttle position sensor (TPS) connector [88B] from the fuel injector assembly. Tuck the wiring harnesses back out of the way.
- 5. See Figure 8-38. Remove the wiring harness connector from the oil pressure switch.

NOTES

- The engine in the figure has been stripped to clarify the location of the oil pressure switch.
- It will be necessary to use a universal adapter and extension with the oil pressure switch socket in the next step to fully seat the socket on the oil pressure switch. In place of a universal adapter and standard extension, a Snapon Wobble Extension, such as the FXW8 or FXW11A may be used.

CAUTION

When removing the oil pressure switch, take care to avoid damaging wiring connectors and sensor bodies located nearby.

6. Using OIL PRESSURE SWITCH SOCKET (HD-45300), remove the oil pressure switch.

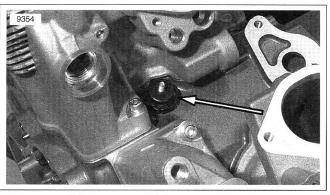


Figure 8-38. Oil Pressure Switch

INSTALLATION

NOTE

Perform step 1 below only if original oil pressure switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.

- Coat threads of oil pressure switch with LOCTITE[®] HIGH PERFORMANCE PIPE SEALANT with TEFLON (LOC-TITE[®] Part No. PST565).
- Using OIL PRESSURE SWITCH SOCKET (HD-45300), install oil pressure switch. Tighten to 10.8-13.6 Nm (96-120 in-lbs).
- 3. Attach wiring connector to oil pressure switch.
- 4. Attach IAC motor and TPS sensor wiring harness connectors [87B] and [88B].
- Connect negative battery cable. Tighten bolt to 6.8-10.8 Nm (60-96 in-lbs).
- 6. Remove duct tape from injector intakes.
- Replace airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 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.

9. Test oil pressure switch for proper operation.

The stop light switch monitors brake fluid pressure in the rear brake line. When the vehicle operator steps on the rear brake pedal and pressure in the brake line reaches a preset level, the stop light switch is tripped and illuminates the stop light. The stop light switch is located on the rear brake line T-fitting.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Unlock and open seat.
- 3. Remove exhaust mufflers and collector. See 2.7 EXHAUST SYSTEM.
- 4. See Figure 8-39. Remove two wiring harness terminal connectors (1) from stop light switch (2).
- 5. Place a clean container under stop light switch and brake line to catch escaping fluid.
- 6. Using a 1-inch open end wrench, remove stop light switch from T-fitting (3).

INSTALLATION

NOTE

Perform step 1 below only if original rear stop light switch is being re-installed. new switches have a sealant contact patch on the threads. If new switch is being installed, begin with step 2.

- Coat threads of stop light switch with LOCTITE[®] HIGH PERFORMANCE PIPE SEALANT with TEFLON (LOC-TITE[®] Part No. PST565).
- 2. Install stop light switch to brake line T-fitting. Tighten switch with a 1-inch open end wrench.
- 3. Attach two wiring harness terminal connectors to stop light switch.
- 4. Install exhaust collector and mufflers. See 2.7 EXHAUST SYSTEM.
- 5. 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.

WARNING

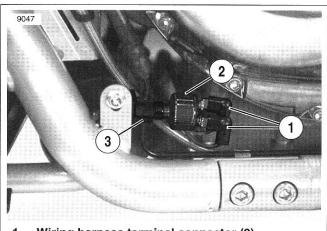
After completing repairs or bleeding the brake system, always test motorcycle brakes at low speed. If brakes are not operating properly or braking efficiency is poor, testing at high speeds could result in death or serious injury.

6. Bleed brake system. See 1.9 BLEEDING BRAKES.

AWARNING

Check for proper tail lamp/stop light operation before riding motorcycle. Visibility is a major concern for motorcyclists. Failure to have proper lamp operation could result in death or serious injury.

- 7. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 8. Check tail lamp/stop light for proper operation.



- 1. Wiring harness terminal connector (2)
- 2. Stop light switch
- 3. Rear brake line T-fitting

Figure 8-39. Stop Light Switch

HORN

INSPECTION

The horn is located on the left side of the motorcycle, mounted under the top frame rail, between the engine cylinder heads.

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed or damaged horn terminal wires, discharged battery or corroded ground.

The horn is permanently sealed and non-repairable. If defective, it must be replaced.

NOTE

No tonal adjustments can be made to this horn.

REPLACEMENT

- See Figure 8-40. Remove acorn nut (1) and washer (2) 1. and detach horn assembly from motorcycle.
- Remove ground and power wires (9, 10) from posts on 2. back side of horn (8).
- Remove nut (7) securing horn to mounting bracket (6). 3.

NOTE

When tightening the flange nut in the next step, make certain the horn does not come in contact with the horn cover. If it does, loosen the flange nut, reposition the horn, and retighten the flange nut.

CAUTION

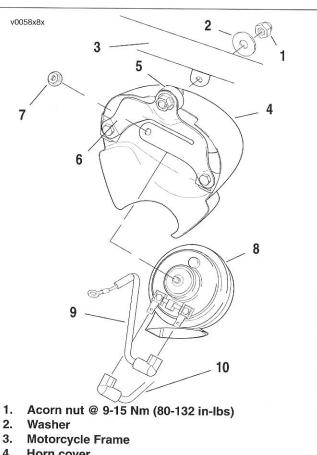
Overtightening the flange nut can cause permanent horn damage resulting in reduced volume and tone quality.

- Install new horn on bracket. Secure with flange nut (7). 4. Tighten to 6-8 Nm (53-70 in-lbs).
- 5. See Figure 8-41. Attach wiring.
 - Connect BK ground wire to silver post (2). a.
 - b. Connect Y/BK horn power wire to copper post (3).

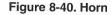
NOTE

When tightening the acorn nut in the next step, make certain the horn cover does not come in contact with the fins on the cylinder heads. If it does, loosen the acorn nut, reposition the horn assembly and retighten the nut.

See Figure 8-40. Attach horn assembly to motorcycle 6. using washer (2) and acorn nut (1). Tighten to 9-15 Nm (80-132 in-lbs).



- 4. Horn cover
- 5. Rubber mount
- Horn mounting bracket 6.
- 7. Flange nut @ 6-8 Nm (53-70 in-lbs)
- 8. Horn
- 9. Ground wire
- 10. Horn power wire



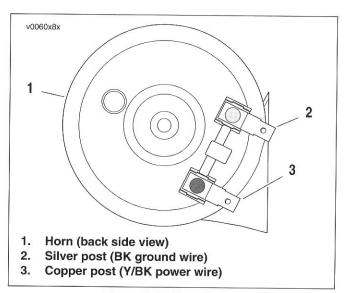


Figure 8-41. Horn Wiring

The cooling fans are mounted one above the other, behind the radiator. The cooling fans are controlled electronically and are turned on and off as necessary to maintain an acceptable coolant temperature range.

REMOVAL

- 1. Remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Remove exhaust system. See 2.7 EXHAUST SYSTEM.
- 3. See Figure 8-13. Remove fasteners (1) and left and right radiator trim covers (2).

NOTE

Before removing wiring harnesses, carefully note wire routing. In particular, pay close attention to locations of cable straps that must be replaced.

- See Figure 8-16. Pull rear brake master cylinder reservoir straight away from its mounting slots in right side of radiator cover.
- 5. See Figure 8-42. Clip cable straps securing cooling fan wiring harnesses to other harnesses on left side of radiator cover. Disconnect appropriate cooling fan wiring harness connector.
- See Figure 8-13. Remove all other wiring harness cable straps and clips attached to left side of radiator cover (5).
- 7. Remove mounting fasteners (3), washers (4) and radiator cover (5).
- See Figure 8-43. Remove fasteners (4) and washers (5). Slide front cross member (3) off bottom radiator mounting studs.
- 9. Loosen nuts (6) and carefully pull bottom of radiator forward a few inches to gain access to cooling fans.
- 10. See Figure 8-44. Remove cooling fan.
 - a. To detach top fan, remove acorn nut (5), washer (7) and flange nut (6). To detach bottom fan, remove acorn nuts (5), washer (7) and P-clamp (9).
 - b. Carefully pry retainer (2) off retainer shaft (3). Retainer is on front side of radiator. Remove retainer shaft and rubber washers.
 - c. Slide cooling fan off mounting studs and remove from vehicle.

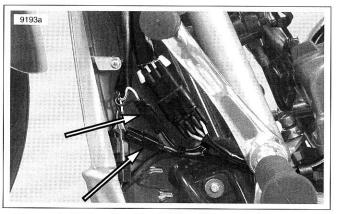


Figure 8-42. Cooling Fan Wiring Harness Connectors

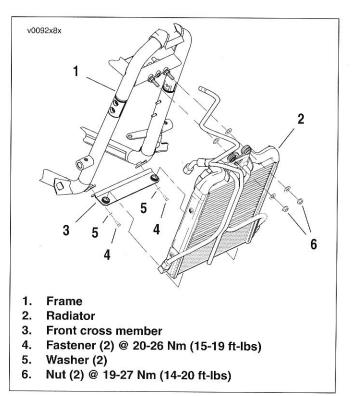


Figure 8-43. Radiator Mounting

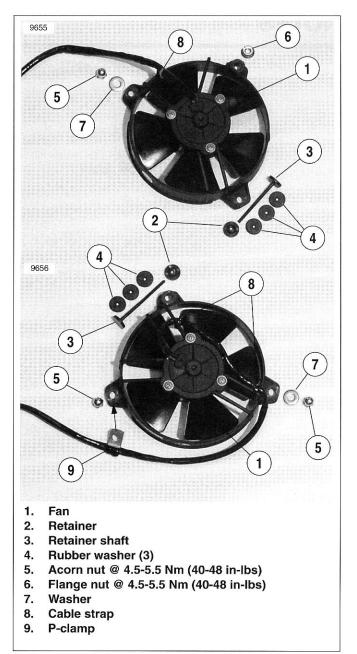
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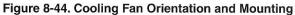
INSTALLATION

NOTE

Cooling fans are identical with the exception of the location of cable straps securing wiring harness to cooling fan. Note location(s) of cable strap(s) (8) in Figure 8-44. When installing **new** cooling fan (1), secure wiring harness to cooling fan with cable strap(s) in same location(s), routing harness appropriately.

- 1. See Figure 8-44. Note orientation of cooling fans and locations of mounting hardware and cable straps. Mount cooling fan.
 - Note location of retainer assembly. See Figure 8-45.
 Pass new retainer shaft (1) through mounting hole in cooling fan (2).
 - b. Slide two rubber washers (3) on retainer shaft.
 - c. Carefully push retainer shaft through opening in cooling fins in radiator core (4).
 - d. Install one rubber washer (3) on retainer shaft.
 - e. Press retainer (5) on retainer shaft so entire assembly is a snug fit.
 - f. Clip off excess length of retainer shaft.
 - g. See Figure 8-44. To mount top fan, install acorn nut (5), washer (7) and flange nut (6). To mount bottom fan, install P-clamp (9), acorn nuts (5) and washer (7). Tighten nuts to 4.5-5.5 Nm (40-48 in-lbs).
- 2. Route fan wiring harness to left side of radiator.
- 3. See Figure 8-43. Slide front cross member (3) onto mounting studs on bottom of radiator (2).
- 4. Attach front cross member to motorcycle frame with fasteners (4) and washers (5). Tighten to 20-26 Nm (15-19 ft-lbs).
- 5. Tighten nuts (6) to 19-27 Nm (14-20 ft-lbs).
- See Figure 8-13. Mount radiator cover (5) with fasteners
 (3) and washers (4). Tighten to 4.1-6.8 Nm (36-60 inlbs).
- Connect cooling fan wiring harness connector. Attach all harnesses to left side radiator cover as appropriate, with clips and/or cable straps.
- 8. See Figure 8-16. Push rear brake master cylinder reservoir into mounting slots in right side of radiator cover.
- 9. See Figure 8-13. Install left and right radiator trim covers and fasteners. Tighten to 3-4 Nm (26-35 **in-lbs**).
- 10. Install exhaust system. See 2.7 EXHAUST SYSTEM.
- 11. Replace maxi-fuse. See 8.5 MAXI-FUSE.
- 12. Test cooling fan operation. See the VRSCA Electrical Diagnostic Manual .





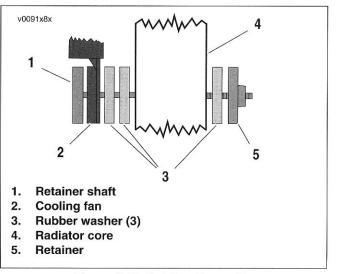


Figure 8-45. Retainer Assembly

SUBJECT

PAGE NO.

9.1 Specifications	9-1
9.2 Electronic Fuel Injection: EFI	9-3
9.3 Electronic Control Module: ECM	9-5
9.4 Throttle Position Sensor: TP	9-6
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FUEL INJECTION

9

Table 9-1. Spark Specifications

IGNITION	DATA	
Idle speed	1200 ± 50 rpm	
Spark plug size	12 mm	
Charly plug gon	0.035 in.	
Spark plug gap	0.89 mm	
Spark plug type	Harley-Davidson No. 10R12A (no substitute	
Ignition coil primary resistance at room temperature	0.3-0.5 ohms	
Ignition coil secondary resistance at room temperature	2750-3250 ohms	

Table 9-3. Charging Specifications

ITEM	DATA
Battery	12 amp hour/200 CCA
Alternator AC voltage output	16-22 VAC per 1000 rpm
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output @ 3600 rpm	14.4-14.6 volts
Regulator amperes @ 3600 rpm	30-35 amps

Table 9-2. Fuse Specifications

ITEM	RATING (AMPERES)		
Main fuse	40		
Ignition fuse	15		
Lighting fuse	15		
Accessory fuse	15		
Battery fuse	15		
Security fuse	15		
ECM power fuse	15		

NOTE

The fuse labeled "Security" provides basic turn signal functionality on vehicles without a factory-installed security system. Do not remove this fuse or use it as a replacement fuse for other systems.

TORQUE VALUES

ITEM	TORQUE		TORQUE NOTES		NOTES
Electronic control module (ECM) mounting bolts	6-10 Nm	53-89 i n-lbs	page 9-5		
Engine coolant temperature sensor (ECT)	23 Nm	17 ft-lbs	hand start 2-3 turns, page 9-8		
Fuel injector clip screws	2.0-2.8 Nm	18-25 i n-lbs	page 9-13		
Fuel pressure regulator clip	2.0-2.8 Nm	18-25 in-lbs	page 9-13		
Fuel rail Schrader valve	6.8-9.6 Nm	60-85 in-lbs	page 9-12		
Idle air control (IAC) screws	2.8-4.0 Nm	25-35 in-lbs	use new screws or LOCTITE THREADLOCKER 243 (blue), page 9-10		
Intake air temperature (IAT) sensor screws	6-10 Nm	53-89 in-lbs	page 9-7		
Manifold air pressure sensor (MAP)	6-10 Nm	53-89 in-lbs	page 9-11		
Throttle body clamps	1.25 Nm	11 in-Ibs	page 9-8		
Throttle position sensor screws	2.0-2.8 Nm	18-25 in-lbs	page 9-6		

The engine management system consists of the following components:

- Electronic control module (ECM).
- Crank position sensor (CKP).
- Manifold absolute pressure sensor (MAP).
- Intake air temperature sensor (IAT).
- Engine coolant temperature sensor (ECT).
- Idle air control (IAC).
- Throttle position sensor (TP).
- Vehicle speed sensor (VSS).
- Turn signal module (TSM) or optional factory-installed turn signal security module (TSSM). This includes an integrated bank angle sensor (BAS).
- Fan relay.
- System relay.
- Ignition (plug top) coils.
- Purge solenoid (California models only).

The ECM is mounted ahead of the battery behind the left side cover. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, MAP and TP sensor) and controls the low-voltage circuits for the ignition coils and injectors. The Scanalyzer can access the data received by and stored in the ECM.

The ECM contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. (The ECM has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The crank position sensor (CKP) is located on the left front of the lower crankcase half. The CKP generates an AC signal which is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 22 teeth on the alternator rotor (two teeth are missing to establish a reference point). The MAP sensor is located on top of the front intake manifold. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ECM where the module adjusts the spark and fuel timing advance curves for optimum performance.

The bank angle sensor is within the turn signal/turn signal security module. If the vehicle lean angle exceeds 45 degrees, the ignition system is shut off. Once the sensor is tripped, the motorcycle must be uprighted, turned off and then on again before the engine can be restarted. This is communicated across the data link.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark). The coil also has an extra terminal to monitor current on the coil secondary circuit. This is used for knock detection and combustion diagnostics.

The ignition system gives a spark near top dead center for starting. At rpm and loads above this, the system gives a spark advance that varies between 0° and 50° .

The IAT, ECT and TP sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The engine coolant temperature (ECT) sensor also controls the cooling fan relay that provides 12vdc to the fans. The VSS is used as an input for idle speed control.

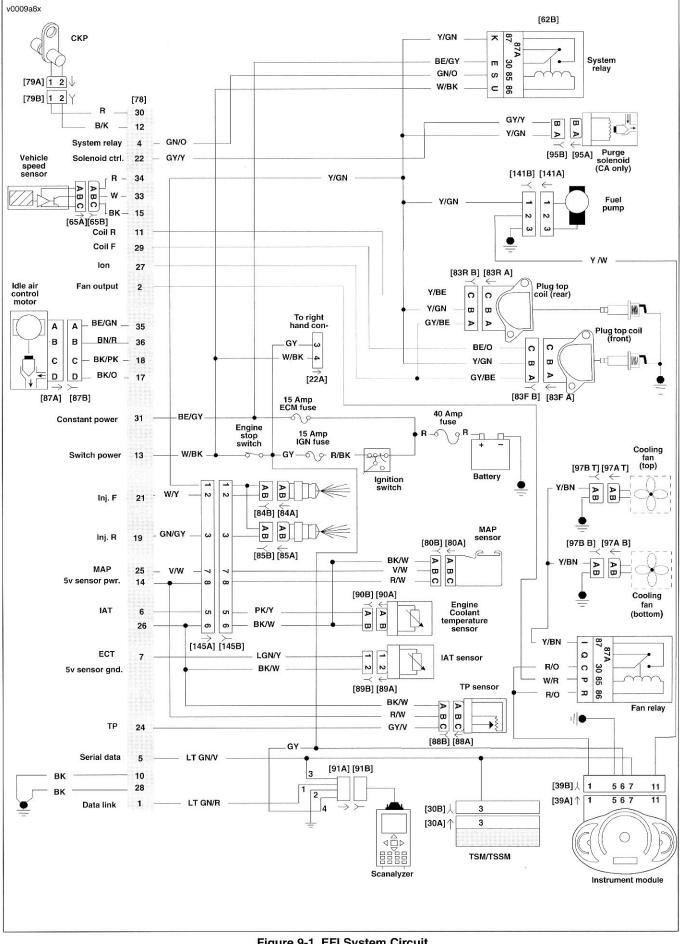
The purge solenoid (California models only) allows vapors from the charcoal canister to flow to the throttle body. The timing and amount of solenoid opening depends on engine speed.

NOTE

On models not equipped with a purge solenoid, a resistive plug (Part No. 72529-01) is installed in the purge solenoid connector [95B] to prevent an error message being generated.

TROUBLESHOOTING

See the VRSCA Electrical Diagnostic Manual for troubleshooting and diagnostic information.



The electronic control module (ECM) is mounted under the left side cover. Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the electronic control module.

NOTE

The electronic control module cannot be repaired. Replace the unit if it fails.

REMOVAL

- Remove left side cover 1.
- 2. Remove right side cover.

AWARNING

To protect against shock and accidental start-up of vehicle, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

- Remove maxi-fuse. See 8.5 MAXI-FUSE. 3.
- See Figure 9-2. Depress latch (2) on ECM connector (1) 4 [78B] and disconnect from ECM.
- 5. See Figure 9-3. Remove left and right ECM mounting bolts (2, 3).
- Remove ECM (1) from left side of vehicle. 6.

INSTALLATION

NOTE

In next step, connector side of ECM should face left side of vehicle and connector tab (4) should face front of vehicle.

- See Figure 9-3. Put left side ECM mounting bolt (2) into 1. left side ECM mounting hole. Install ECM (1) from left side of vehicle.
- Loosely thread left side ECM mounting bolt into ECM 2. mounting bracket. Do not tighten.
- 3. Install right side ECM mounting bolt into right side ECM mounting hole. Tighten left and right bolts to 6.0-10.0 Nm (53.0-89.0 in-lbs).
- See Figure 9-2. Connect ECM connector (1) [78B] to 4. ECM.
- Install maxi-fuse. 5.
- 6. Install left and right side cover.

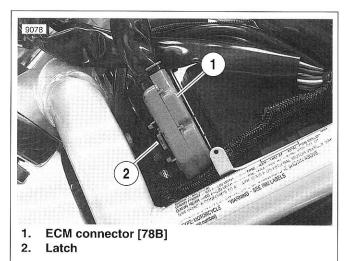
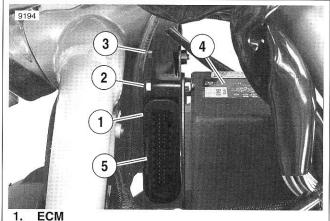


Figure 9-2. ECM Connector



- Left ECM mounting bolt 2
- 3. **Right ECM mounting bolt**
- 4. Battery
- 5. Connector tab

Figure 9-3. ECM Mount

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the throttle position sensor (TP sensor).

REMOVAL

1. Remove airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

If airbox is not to be reinstalled immediately, cover throttle body intakes with tape to prevent contaminates/ objects from falling down the throttle bores. Do not use shop rags or objects that could damage the throttle body butterflies.

2. See Figure 9-4. Cover air intakes (3) to prevent debris from entering cylinders.

WARNING

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

- 3. Disconnect negative battery cable.
- 4. Unplug TP sensor connector [88B] (2) by pulling external latch outward and using rocking motion to remove.
- 5. Remove two screws to detach TP sensor (1) from throttle body. Discard screws.

INSTALLATION

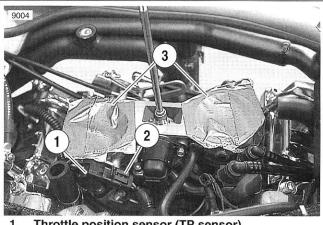
NOTES

- Throttle must be closed for proper installation of throttle position sensor.
- Throttle position sensor does not have to be adjusted.
- 1. See Figure 9-5. With connector facing rear of vehicle, verify that shaft pocket of TP sensor fits over shaft on throttle body.
- 2. Align holes in TP sensor with holes in throttle body.

NOTE

TP sensor may have to be turned slightly for holes to align.

- Install new screws and tighten to 2.0-2.8 Nm (18-25 inlbs).
- 4. See Figure 9-4. Connect TP sensor connector (2).
- 5. Connect negative battery cable.
- Install airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.



- 1. Throttle position sensor (TP sensor)
- 2. TP sensor connector [88B]
- 3. Air intakes (covered)

Figure 9-4. Throttle Position Sensor

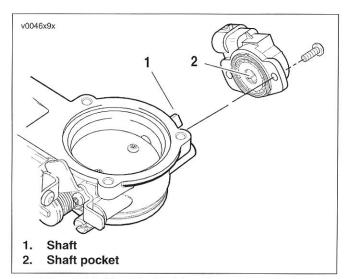


Figure 9-5. Throttle Position Sensor Installation

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the intake air temperature sensor (IAT sensor).

REMOVAL

WARNING

To protect against shock and accidental start-up of vehicle, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

- Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
- 2. Remove airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 3. See Figure 9-6. Remove IAT sensor connector [89B].
 - a. See Figure 9-7. Depress wire form.
 - b. Use rocking motion to detach connector from IAT.
- 4. See Figure 9-8. Depress the retaining fingers (2) on the under side of IAT sensor and pull IAT sensor from upper airbox.

Note

A short length of tubing with an ID of 7.62 mm (.312 in) can be pushed over the retaining fingers to ease the sensor removal.

INSTALLATION

- 1. See Figure 9-8. Inspect IAT o-ring (1). Replace IAT sensor if o-ring is worn or damaged.
- 2. Apply clean engine oil to IAT sensor o-ring.
- 3. Install IAT sensor into upper airbox.
- 4. Connect IAT sensor connector [89B].
- 5. Replace airbox cover. See 1.4 AIRBOX AND AIR FIL-TER.
- 6. Replace the maxi-fuse.
- 7. Replace right side cover.

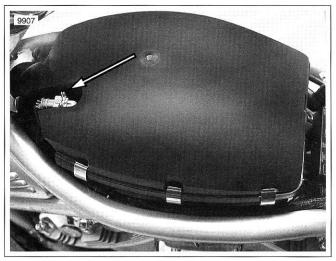


Figure 9-6. Intake Air Temperature Sensor Location

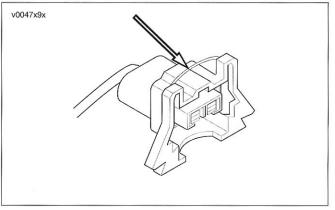


Figure 9-7. IAT Connector Wire Form

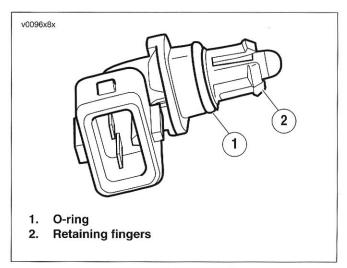


Figure 9-8. IAT Sensor

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the engine coolant temperature (ECT) sensor.

REMOVAL

AWARNING

To protect against shock and accidental start-up of vehicle, remove the maxi-fuse before proceeding. Inadequate safety precautions could result in death or serious injury.

- 1. Remove right side cover and remove maxi-fuse. See 8.5 MAXI-FUSE.
- Remove airbox assembly. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

If airbox is not to be reinstalled immediately, cover throttle body intakes with tape to prevent contaminates/ objects from falling down the throttle bores. Do not use shop rags or objects that could damage the throttle body butterflies.

- Cover air intakes to prevent debris from entering cylinders.
- 4. Remove block drain screw. Drain cooling system. See 6.3 ENGINE COOLANT.
- 5. Loosen clamps at each intake and lift throttle body straight up.

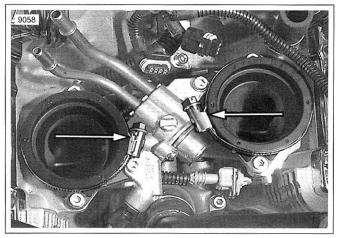


Figure 1-9. Intake Clamps, Throttle Body Removed

NOTE

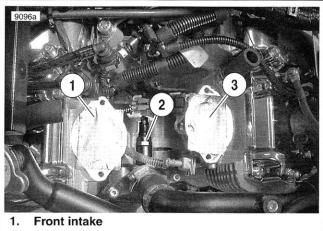
Observe the position of the clamps for reassembly.

- 6. With throttle cables attached, wrap a shop towel around body for protection and secure away from engine.
- 7. Cover intake openings to prevent objects from falling into intake bore.Remove throttle body and fuel rail.

- 8. See Figure 9-10. Unplug ECT sensor connector [90B] by pulling external latch outward and using rocking motion to remove.
- 9. Loosen ECT sensor using socket. When sensor starts to turn easily, finish removing by hand.

INSTALLATION

- 1. Hand start **new** ECT sensor into thermostat housing 2-3 turns.
- 2. Tighten sensor to 23 Nm (17 ft-lbs).
- 3. Connect ECT sensor connector [90B].
- 4. Uncover intake openings and throttle body.
- 5. Orient intake clamps as shown and install throttle body and fuel rail. Tighten clamps 1.25 Nm (11 **in-lbs**).
- 6. See 1.19 SPARK PLUG/COIL. Install coils.
- 7. 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 audible "click" is heard.
- 8. Fill engine coolant system with GENUINE HARLEY-DAVIDSON EXTENDED LIFE ANTIFREEZE & COOL-ANT through the coolant overflow bottle.
- 9. Replace the maxi-fuse and right side cover.
- After running engine, check coolant level in overflow bottle with coolant cold and motorcycle on jiffy stand. If level is below COLD FULL line, remove cap from overflow bottle and add antifreeze until fluid level reaches COLD FULL line.
- 11. Continue to run engine, check level, and add antifreeze until coolant level remains at COLD FULL line with the motorcycle on the jiffy stand.



- 2. ECT
- 3. Rear intake

Figure 9-10. ECT Sensor Location

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the idle air control (IAC).

REMOVAL

WARNING

Before IAC can be removed, throttle body must be removed from vehicle. Heat must be applied to IAC screws for removal. Heat can only by applied to screws away from fuel. Failure to remove throttle body before applying heat to screws could result in death or serious injury.

1. Remove airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

If airbox is not to be reinstalled immediately, cover throttle body intakes with tape to prevent contaminates/ objects from falling down the throttle bores. Do not use shop rags or objects that could damage the throttle body butterflies.

2. See Figure 9-11. Cover air intakes (3) to prevent debris from entering cylinders.

WARNING

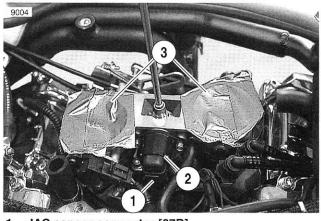
To protect against shock and accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

- 3. Disconnect negative battery cable.
- 4. Remove throttle body. See 3.9 THROTTLE BODY.
- 5. Disconnect throttle cables from throttle body.

CAUTION

Do not apply excessive heat to idle air control. Apply only enough heat to break LOCTITE[®] patch on screws. Excessive heat will cause damage to idle air control.

- See Figure 9-12. Using heat gun, apply heat to idle air control screws (2) to break LOCTITE[®] patch. Remove screws.
- 7. Pull IAC (1) and o-ring from throttle body (3).



- 1. IAC sensor connector [87B]
- 2. Idle air control (IAC)
- 3. Air intakes (covered)

Figure 9-11. IAC Sensor

INSTALLATION

- 1. Inspect IAC o-ring, replace if damaged.
- 2. Apply clean engine oil to IAC o-ring.
- 3. Place idle air control and o-ring into throttle body. Be sure o-ring is properly seated in throttle body groove.
- See Figure 9-12. Apply LOCTITE[®] TREADLOCKER 243 (blue) to screws (2). Loosely install front and rear IAC screws (2).
- 5. Tighten front and rear IAC screws to 2-4 Nm (25-35 inlbs).
- 6. Connect throttle cables to throttle body.
- 7. Install throttle body. See 3.9 THROTTLE BODY.
- 8. Connect negative battery cable.
- 9. Install airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.

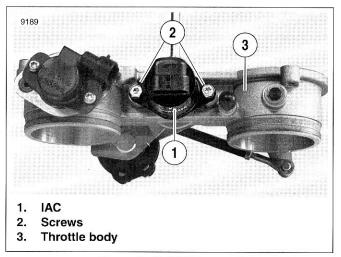


Figure 9-12. IAC Removal

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the manifold absolute pressure sensor (MAP).

REMOVAL

1. Remove airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.

CAUTION

If airbox is not to be reinstalled immediately, cover throttle body intakes with tape to prevent contaminates/ objects from falling down the throttle bores. Do not use shop rags or objects that could damage the throttle body butterflies.

Cover air intakes to prevent debris from entering cylinders.

WARNING

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

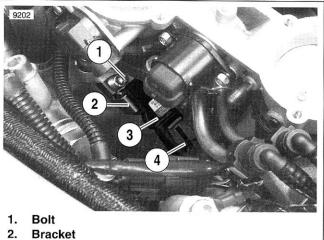
- 3. Disconnect negative battery cable.
- See Figure 9-13. Remove bolt (1) securing MAP sensor bracket (2) to front cylinder.
- 5. Unplug MAP sensor connector [80B] (4) by pulling external latch outward and using rocking motion to remove.

NOTE

If the original sensor is re-installed, the grommet must be inspected. Grommets not in good condition could cause vacuum leaks.

INSTALLATION

- 1. Plug connector into MAP sensor.
- 2. See Figure 9-14. Install bracket (2) over MAP sensor (3).
- Install (push) MAP sensor and grommet to intake manifold.
- Secure MAP sensor bracket with bolt. Tighten bolt to 6.0-10.0 Nm (53.0-89.0 in-lbs).
- 5. Connect negative battery cable.
- Install airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.



9.8

- 3. MAP sensor
- 4. Connector [80B]

Figure 9-13. MAP Sensor Location

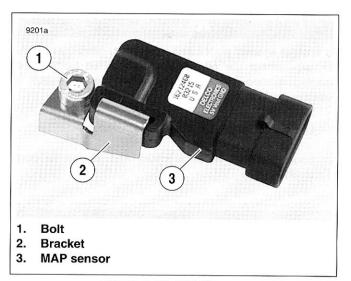


Figure 9-14. MAP Sensor

WARNING

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

Refer to the VRSCA Electrical Diagnostic Manual for information on the function and testing of the fuel injectors.

REMOVAL

 Remove airbox and air filter. See 1.4 AIRBOX AND AIR FILTER.

WARNING

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

- 2. Disconnect negative battery cable.
- Loosen clamps at each intake and lift throttle body straight up.

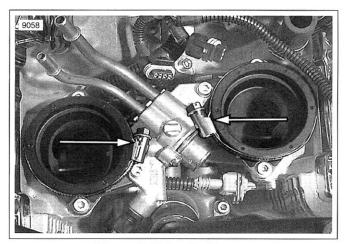


Figure 1-15. Intake Clamps (throttle body removed)

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.throttle body and fuel rail. See 3.9 THROTTLE BODY.

DISASSEMBLY

Fuel Injectors

- 1. See Figure 9-16. Remove screw (7).
- 2. Pull fuel injector and clip from induction module.
- 3. Remove clip from fuel injector.
- 4. Repeat procedure for other fuel injector.

Fuel Pressure Regulator

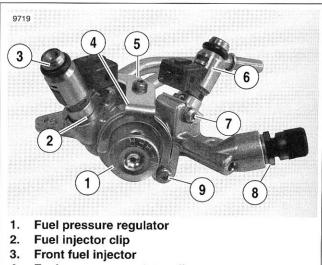
- 1. See Figure 9-16. Remove screws (5, 9).
- 2. Remove fuel pressure regulator clip (4) from fuel rail.
- Use rocking motion to detach fuel pressure regulator (1) from fuel rail.

Fuel Tubes

NOTE

Do not remove fuel tubes, o-rings or spacers if not replacing.

- 1. See Figure 9-16. Remove screws (9, 5).
- 2. Remove fuel pressure regulator clip (4) from fuel rail.
- 3. See Figure 9-17. Pull feed (4) and return (5) fuel tubes from fuel rail.



- 4. Fuel pressure regulator clip
- 5. Screw
- 6. Rear fuel injector
- 7. Screw
- 8. Schrader valve 6.8-9.6 Nm (60.0-85.0 in-lbs)
- 9. Screw

ASSEMBLY

Fuel Injectors

- 1. Inspect fuel injector o-rings, replace if damaged
- 2. Apply clean engine oil to fuel injector o-rings.
- 3. Insert fuel injector into fuel rail.
- 4. Slide fuel injector clip into slot in fuel injector.
- 5. Secure with screw and tighten to 2.0-2.8 Nm (18.0-25.0 in-lbs).
- 6. Repeat for other fuel injector.

Fuel Pressure Regulator

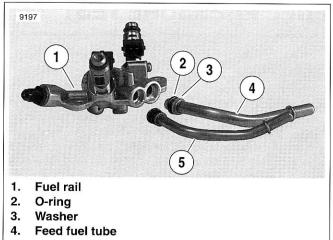
- 1. Inspect fuel pressure regulator o-rings. Replace pressure regulator if o-rings are damaged.
- 2. Apply **clean** engine oil to fuel pressure regulator o-rings.
- 3. Install fuel pressure regulator into bore in fuel rail.
- 4. See Figure 9-16. Install fuel pressure regulator clip over fuel tubes.
- Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 inlbs).

Fuel Tubes

- 1. See Figure 9-17. Install washers (3) over fuel tube.
- 2. Apply clean engine oil to new fuel tube o-rings (2).
- 3. Install feed and return fuel tubes into proper holes in fuel rail.
- 4. See Figure 9-16. Install fuel pressure regulator clip over fuel tubes.
- 5. Install screws (5, 9). Tighten to 2.0-2.8 Nm (18.0-25.0 inlbs).

INSTALLATION

- 1. Install fuel rail and throttle body. See 3.9 THROTTLE BODY.
- 2. Connect negative battery cable.
- 3. Install airbox and filter. See 1.4 AIRBOX AND AIR FIL-TER.



5. Return fuel tube

Figure 9-17. Fuel Tubes

The fuel pump is located in the fuel tank. It delivers fuel to the fuel metering assembly. The fuel metering assembly contains the fuel injectors and the pressure regulator, where the system pressure is controlled. Excess fuel pressure is returned to the fuel tank by a return line. The ECM controls the system relay that supplies 12 vdc to the fuel pump.

When the engine is stopped, the pump can be turned on by applying battery voltage to pin 1 and ground to pin 3 of the fuel pump connector [86A] or by using the Scanalyzer.

Improper fuel system pressure may contribute to one of the following conditions:

- Cranks, but won't run.
- Cuts out (may feel like ignition problem).
- Hesitation, loss of power or poor fuel economy.

NOTE

Refer to the VRSCA Electrical Diagnostic Manual for further information on the function and testing of the fuel system.

TESTING

The fuel pressure gauge (0-100 PSI) allows for fuel injector and fuel system pressure diagnosis.

PART NO.	SPECIALTY TOOL
HD-41182	Fuel pressure gauge
26338-68	1/8 in. pipe thread 90° (right angle) elbow

- 1. See Figure 9-18. Disconnect fuel pump connector [141] from top of fuel tank.
- 2. Start the engine and allow the vehicle to run.
- When engine stalls, operate the starter for 3 seconds to 3. remove any remaining fuel from the fuel lines. Turn ignition key off.
- 4. See Figure 9-19. Insert a 1/8 in. pipe thread 90° degree (right angle) elbow (1) between the fuel valve (2) and the Schrader valve adapter (3).
- 5. See Figure 9-20. Remove protective cap from Schrader valve in fuel metering assembly.
- Verify that the fuel valve and air bleed petcock on the 6. FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.

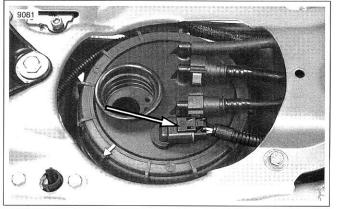
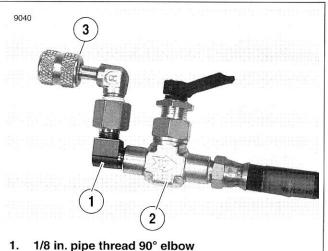


Figure 9-18. Fuel Pump Connector [141]



- **Fuel valve** 2.
- 3. Schrader valve adapter

Figure 9-19. Fuel Pressure Gauge Valves

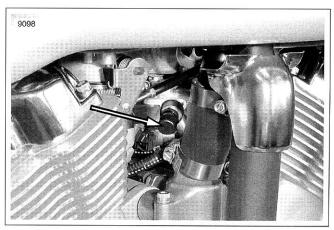


Figure 9-20. Schrader Valve Location

- Connect fuel pressure gauge to Schrader valve. Reconnect connector [141].
- Start and idle engine to pressurize the fuel system. Open the fuel valve to allow the flow of fuel down the hose of the pressure gauge.
- 9. Position the clear air bleed tube in a suitable container and open and close the air bleed petcock to purge the gauge and hose of air. Repeat this step several times until only solid fuel (without bubbles) flows from the air bleed tube. Close the petcock.
- Open and close throttle to change engine speed. Note the reading of the pressure gauge. Fuel pressure should remain steady at 380-425 kPa (55-62 psi).
- 11. Turn the engine off. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

WARNING

A small amount of gasoline may drain from the quickconnect fitting when the fuel supply line is removed. Thoroughly wipe up any spilt fuel immediately. Dispose of rags in a suitable manner. Gasoline is extremely flammable and highly explosive. Inadequate safety precautions could result in death or serious injury.

 Remove fuel pressure gauge from the Schrader valve in fuel metering assembly. Install protective cap over Schrader valve.

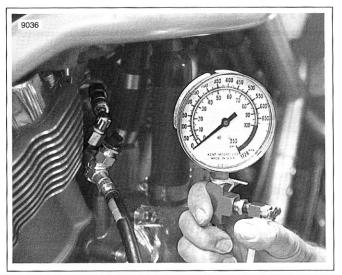


Figure 9-21. Fuel Pressure Gauge Installed

INTAKE LEAK TEST

GENERAL

ADANGER

Propane is an extremely flammable liquid and vapor. Vapor may cause flash fire. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

WARNING

Read all directions and warnings on propane bottle. Failure to follow all directions and warnings on bottle could result in death or serious injury.

- To prevent false readings, keep airbox cover installed when performing test.
- Do not direct propane into air horn, false readings will result.

LEAK TESTER

Parts List

- Standard 14 oz. propane cylinder.
- Snap-on YA7148 Propane Enrichment Kit.
- 304 mm (12 in.) long-6 mm (1/4 in.) diameter copper tubing.

Tester Assembly

- 1. Cut rubber hose from kit to 457 mm (18 in.) in length.
- 2. See Figure 9-22. Flatten one end of copper tube to form a nozzle.
- 3. Insert round side of copper tube into end of tubing.

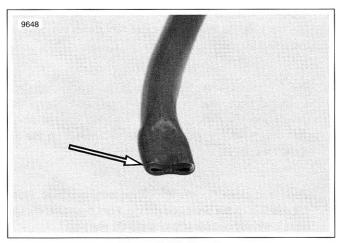


Figure 9-22. Nozzle

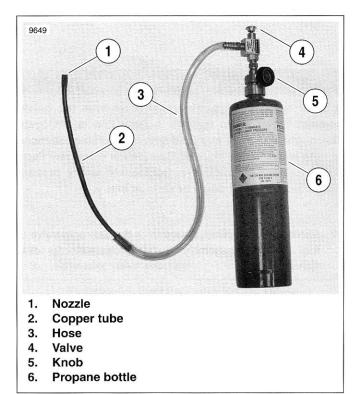


Figure 9-23. Leak Tester

INTAKE LEAK TESTING

- 1. Start engine.
- 2. Warm engine to operating temperature.
- 3. See Figure 9-23. Turn knob (5) counterclockwise to open propane bottle (6).

ADANGER

Propane is an extremely flammable liquid and vapor. Vapor may cause flash fire. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

NOTE

Do not direct propane stream toward front of engine. If propane enters air horn, a false reading will be obtained.

- 4. See Figure 9-24. Aim nozzle toward possible sources of leak such as fuel injectors and intake tract.
- See Figure 9-23. Push valve (4) to release propane. Tone of engine will change when propane enters source of leak.

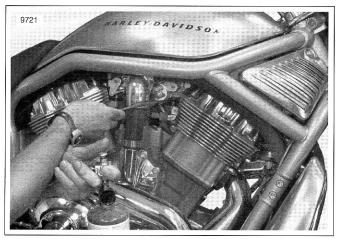


Figure 9-24. Checking for Leaks

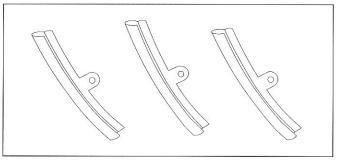
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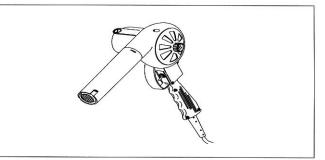
APPENDIX A-TOOLS	A-1
APPENDIX B-WIRING	B-1
APPENDIX C-METRIC CONVERSIONS	C-1
APPENDIX D-VALVE LASH	D-1

APPENDIX

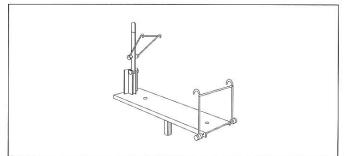
APPENDIX A-TOOLS



Part No. HD-01289 Rim Protectors



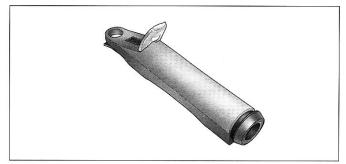
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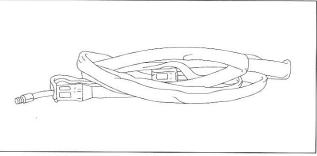
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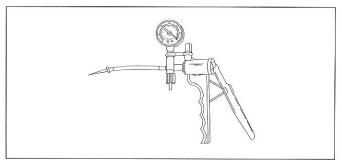
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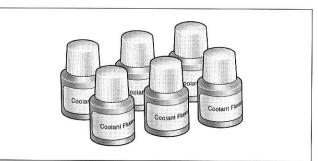
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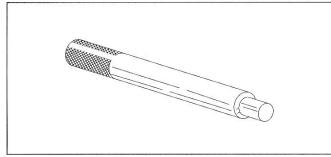
Part No. HD-28700 Tire Bead Expander



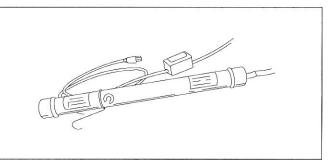
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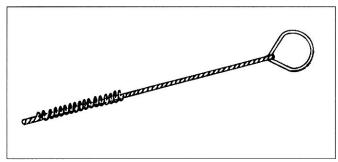
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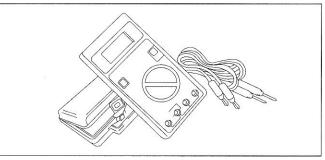
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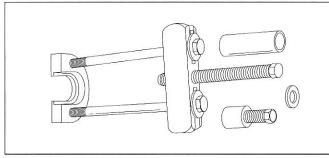
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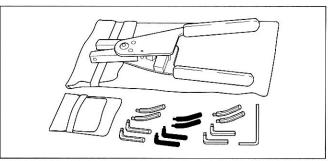
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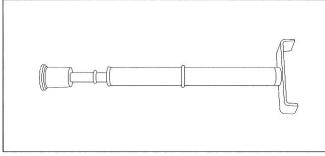
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Part No. HD-34902A Mainshaft Primary Bearing Race Remover And Installer



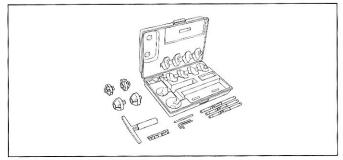
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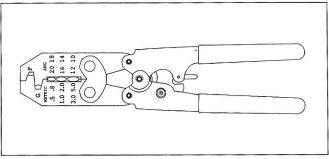
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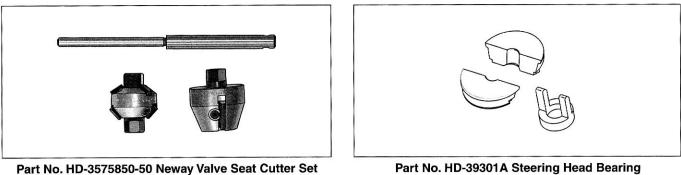
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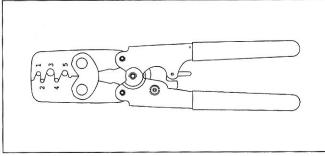
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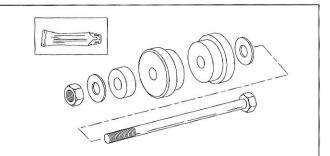
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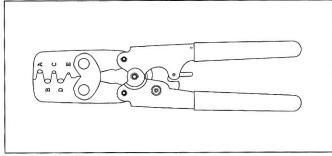
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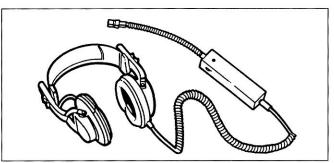
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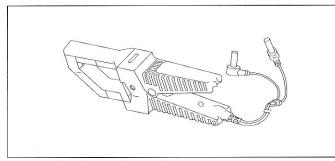
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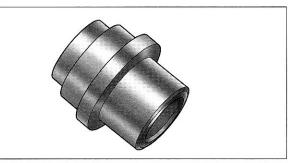
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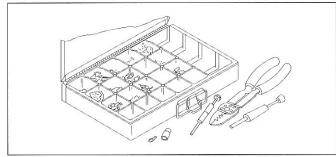
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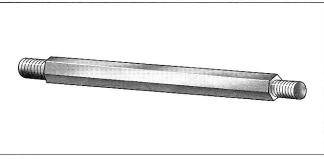
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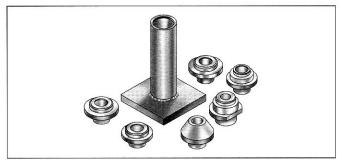
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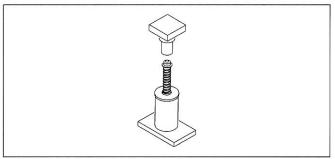
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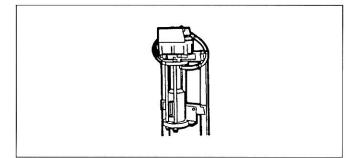
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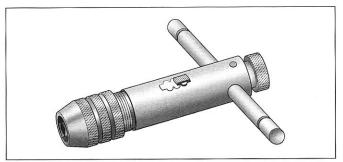
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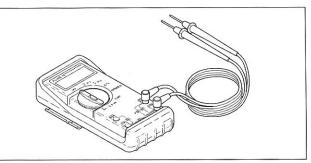
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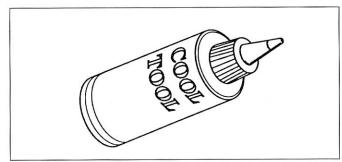
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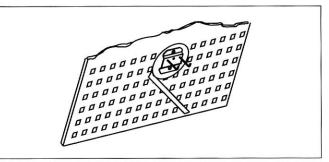
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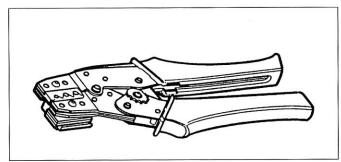
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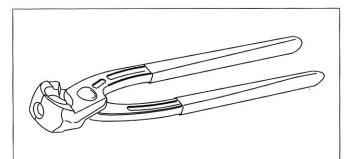
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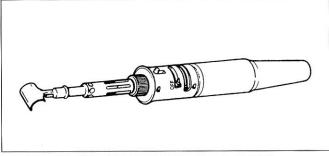
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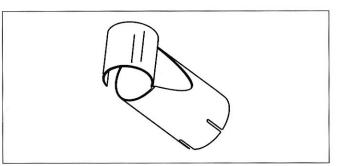
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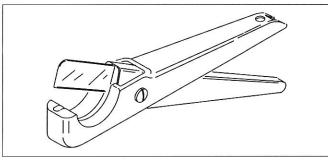
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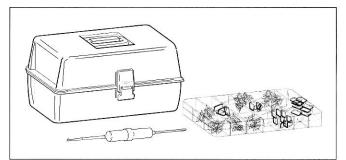
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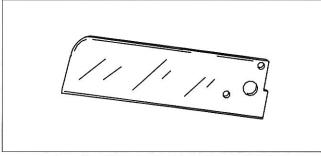
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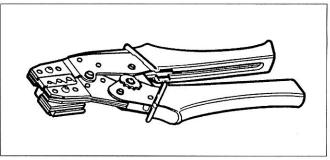
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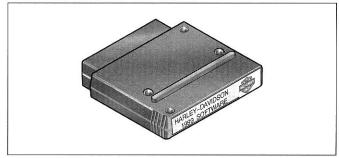
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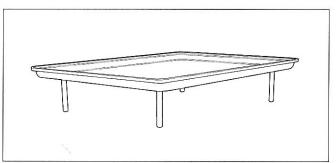
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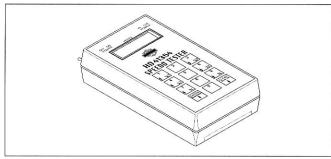
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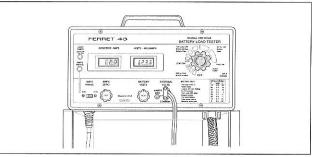
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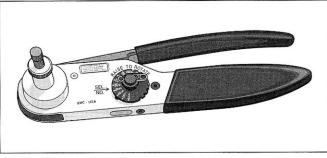
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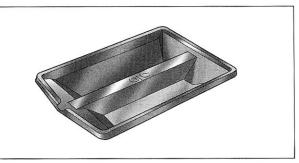
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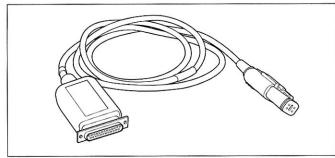
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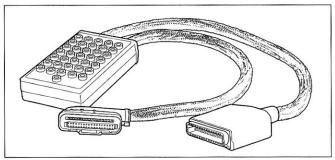
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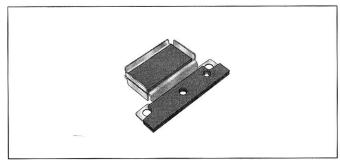
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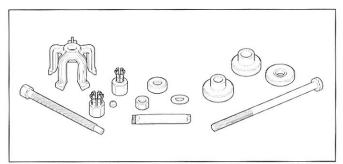
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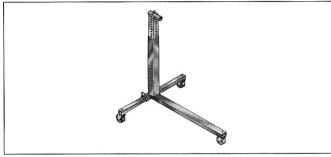
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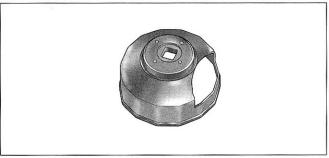
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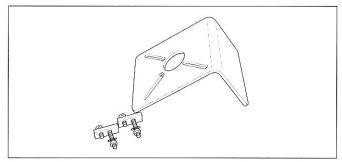
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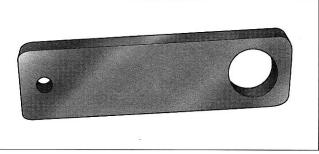
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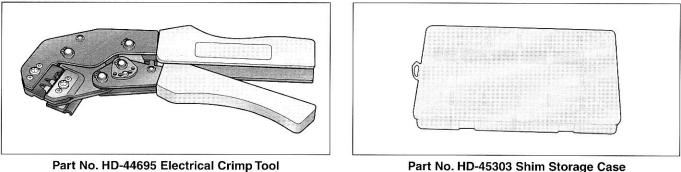
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Part No. HD-44358 Rowe Flywheel Fixture



Part No. HD-45301 Transmission Assembly Retainer



Part No. HD-45303 Shim Storage Case



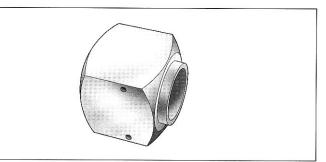
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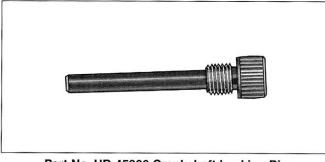
Part No. HD-45304 Alternator Stator/Cover Remover/ Installer



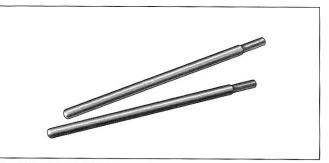
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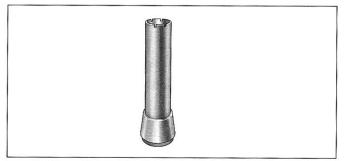
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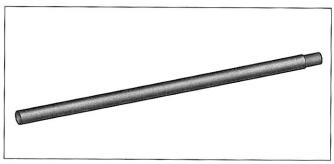
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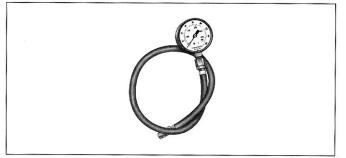
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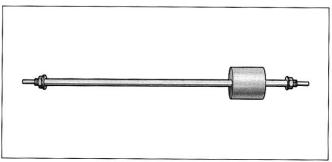
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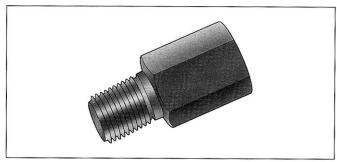
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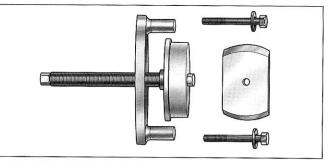
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Part No. HD-45312 Cam Chain Tensioner/Guide Pin Remover/Installer



Part No. HD-45309 Oil Pressure Gauge Adapter



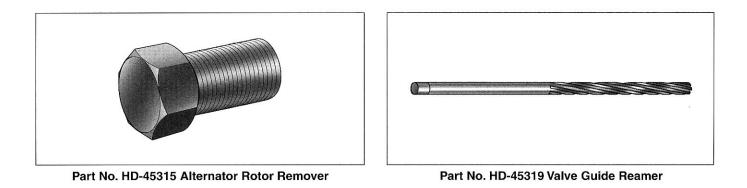
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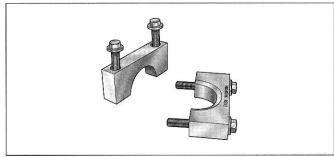


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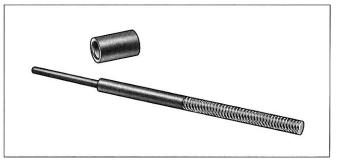


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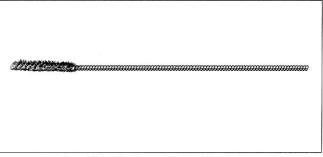
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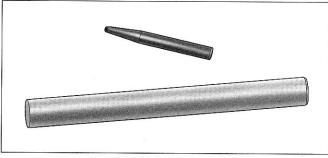
Part No. HD-45320 Valve Guide Remover/Installer



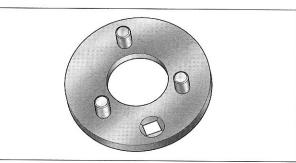
Part No. HD-45317 Engine Assembly Support Fixture



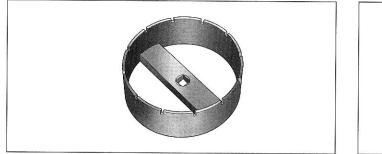
Part No. HD-45321 Valve Flex Hone



Part No. HD-45322 Valve Guide Sealer Installer



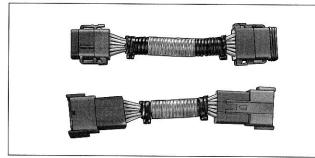
Part No. HD-45331 Final Drive Sprocket Flange Locking Tool



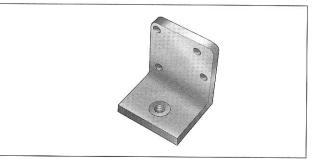
Part No. HD-45324 Fuel Cap Remover/Installer



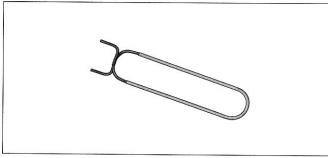
Part No. HD-45332 Final Drive Sprocket Locking Device Installer



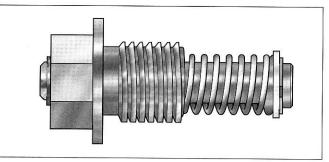
Part No. HD-45325 Jumper Harness



Part No. HD-45333 Cylinder Head Holder



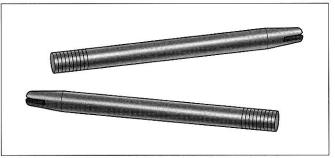
Part No. HD-45326 Primary Chain Tensioner Retainer



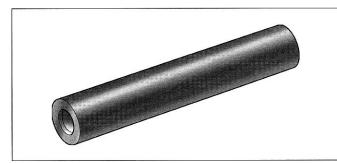
Part No. HD-45334 Secondary Chain Measuring Tool



Part No. HD-45335 Coolant System Pressure Tester



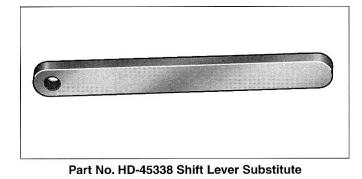
Part No. HD-45340 Gasket Alignment Dowels

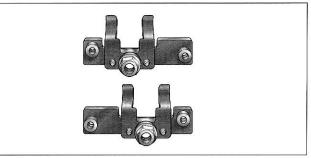


Part No. HD-45337 Shift Shaft Seal Installer

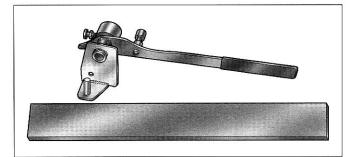


Part No. HD-45490 Balancer Bearing Remover/Installer Tools

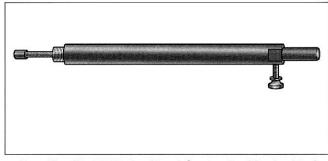




Part No. HD-45491 Tappet Compressing Tool



Part No. HD-45339 Shift Mechanism/Detent Retractor



Part No. HD-45653 Top Dead Center Positioning Tool

REMOVING SOCKET/PIN TERMINALS

- 1. Remove connector from the retaining device, either attachment or rosebud clip.
- Depress the button on the socket terminal side of the connector (plug) and pull apart the pin and socket halves.
- Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.
- Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.
- 5. See Figure B-1. With the flat edge against the terminal, insert the pick tool (Snap-on TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A "click" is heard if the tang is engaged but then inadvert-

ently released. Repeat the step without releasing the tang.

NOTE

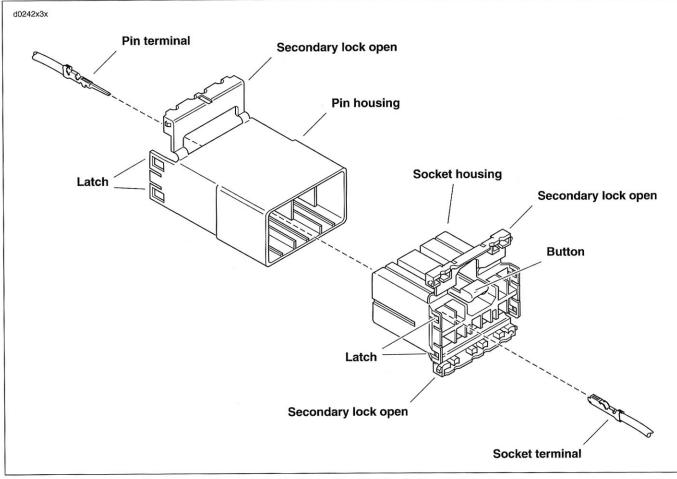
- If pick tool is not available, a push pin/safety pin may be used instead.
- An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp Multilock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.

INSTALLING SOCKET/PIN TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings. See Figure B-2.

 From the secondary lock side of the connector, insert the terminal into its respective numbered chamber until it snaps in place. For proper fit, the slot in the terminal must face the tang in the chamber.



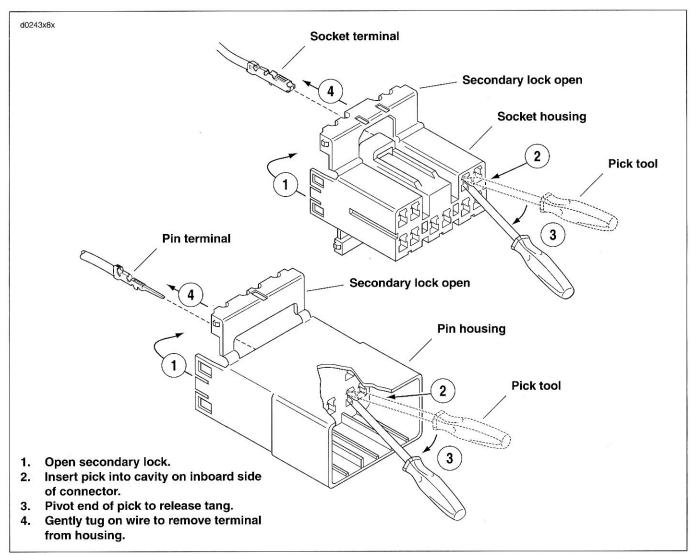


Figure B-2. Release Tang and Back Out Terminals

NOTES

- See Figure B-3. The tang in the chamber engages the slot to lock the terminal in position.
- On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.
- On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward.
- Up and down can be determined by the position of the release button (used to separate the pin and socket halves). Consider the button to always be on top of the connector.
- 2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.
- 3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
- 4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.
- 5. Install connector on retaining device, either attachment or rosebud clip.

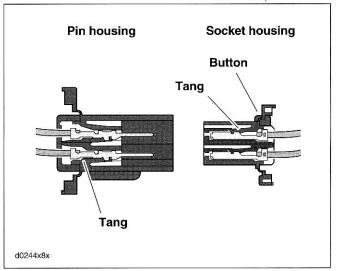


Figure B-3. Multilock Connector Cutaway View

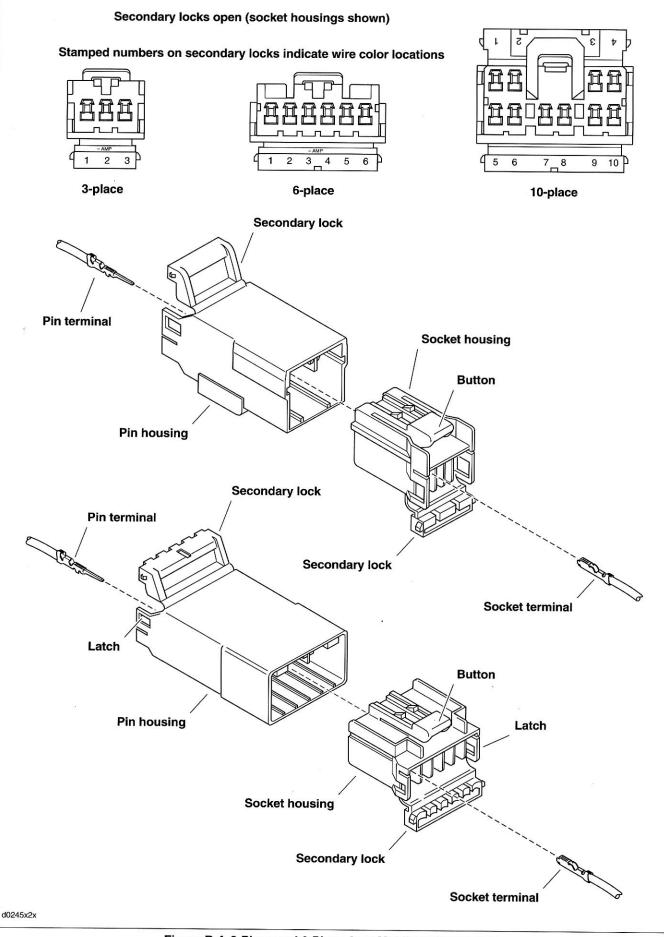


Figure B-4. 3-Place and 6-Place Amp Multilock Connectors

CRIMPING INSTRUCTIONS

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

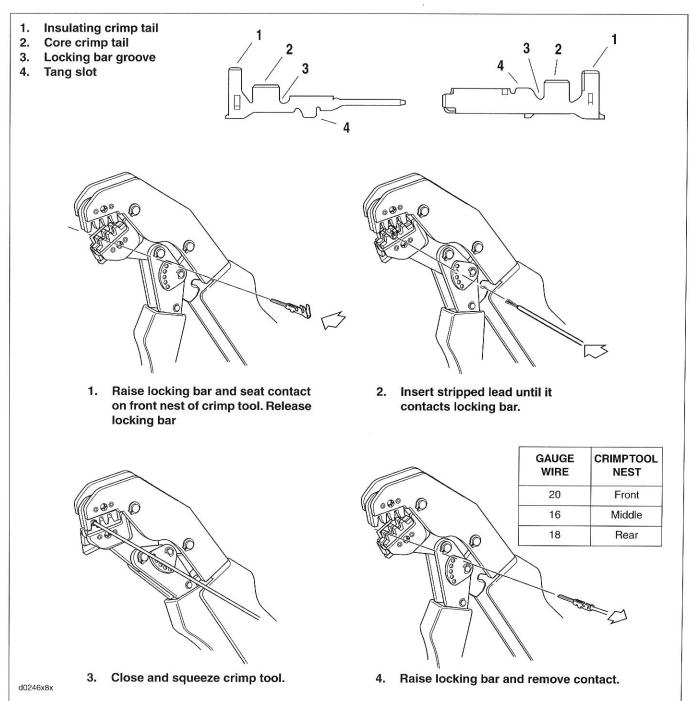


Figure B-5. Amp Multilock Crimping Procedure

GENERAL

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

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

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

NOTE

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

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

REMOVING/DISASSEMBLING

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

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

NOTE

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

REMOVING/INSTALLING SOCKETS

- See Figure B-7. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge in line with the groove (in line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
- See Figure B-8. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

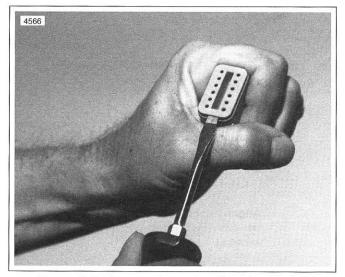


Figure B-6. Remove Secondary Locking Wedge

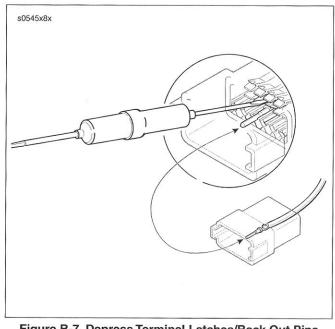


Figure B-7. Depress Terminal Latches/Back Out Pins

NOTE

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

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

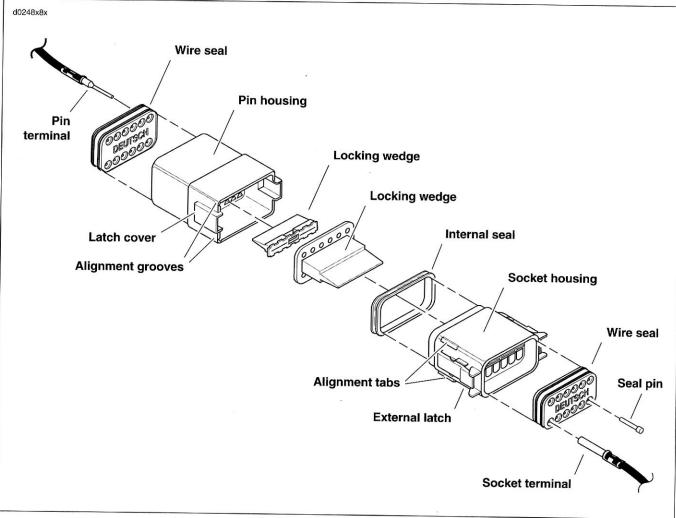


Figure B-8. 12-pin Deutsch Connector (Exploded View)

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

NOTES

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

REMOVING/INSTALLING PINS

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

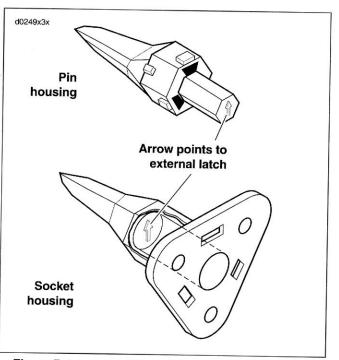


Figure B-9. Depress Terminal Latches/Back Out Pins

NOTE

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

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

NOTES

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

ASSEMBLING/INSTALLING

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

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

NOTE

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

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

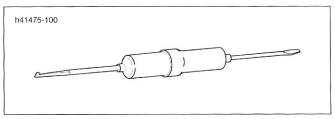


Figure B-10. Deutsch Connector Pick Tool (Part No. HD-41475-100)

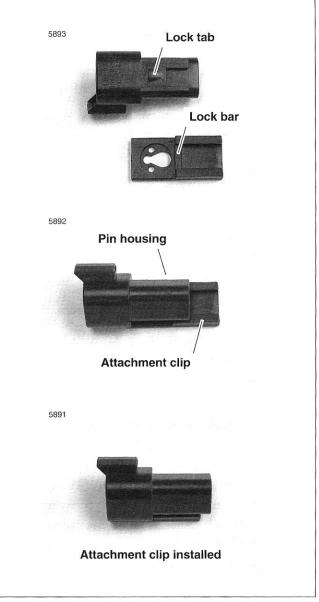


Figure B-11. Attachment Clip Installation

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

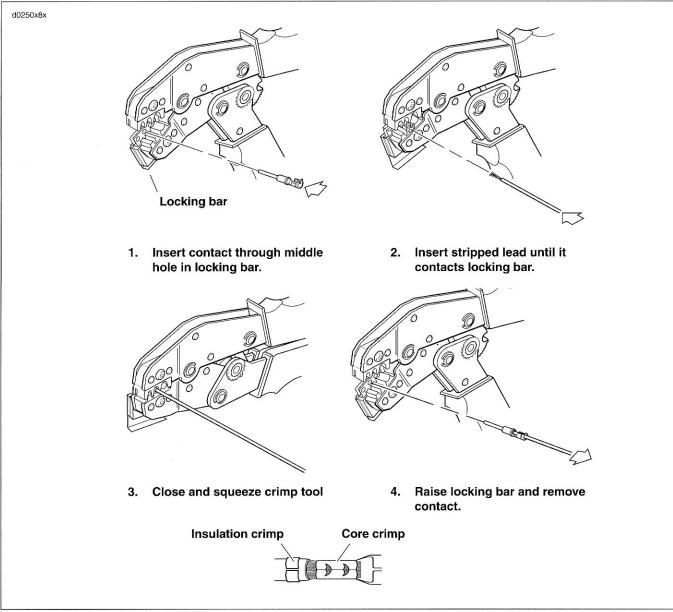


Figure B-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

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

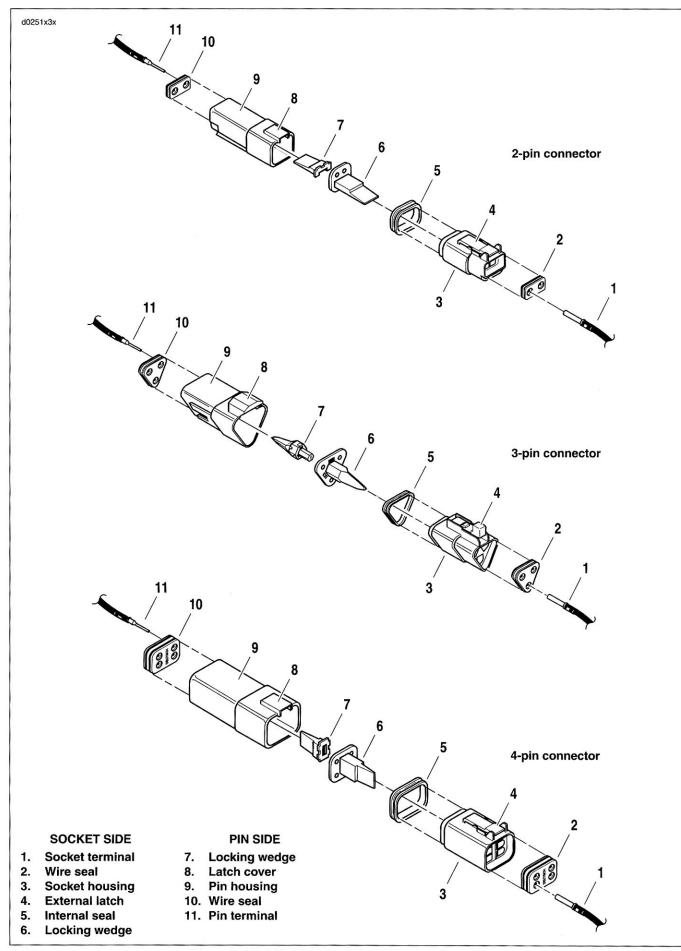
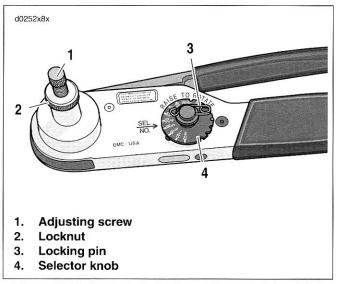


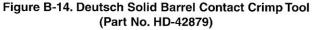
Figure B-13. 2-Pin, 3-pin and 4-pin Deutsch Connectors

GENERAL

For Size 20, 16 and 12 Contacts Wire Range 26-12 AWG

Mini-Deutsch connectors make use of a solid barrel contact without crimp tails. As a result, a special TERMINAL CRIMP TOOL (Part No. HD-42879) is needed to install pin and socket terminals on wires.





CRIMPING INSTRUCTIONS

- 1. Squeeze the handles to cycle the crimp tool to the fully open position.
- 2. See Figure B-14. Remove locking pin (3) from selector knob (4).
- See Figure B-15. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow.
- 4. Loosen knurled locknut and turn adjusting screw clockwise (in) until it stops.
- 5. Turn tool over and drop contact into indentor cover hole with the wire end out.
- Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
- See Figure B-16. Slowly squeeze handles of crimp tool until contact (2) is centered between indentor points (3).

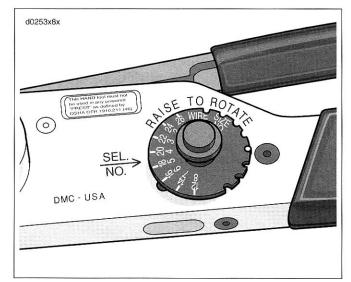


Figure B-15. Selector Knob

- 1. Indentor cover
- 2. Contact
- 3. Indentor points

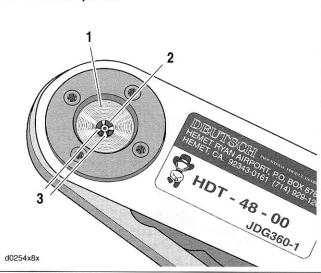


Figure B-16. Indentor Points

- 8. Strip wire lead removing 1/4 in. (6.3 mm) of insulation.
- 9. See Figure B-17. Insert bare wire strands into contact barrel.
- 10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 11. Remove crimped contact from indentor.
- 12. Inspect the quality of the crimp. Verify that all wire strands are in crimp barrel.

NOTE

Tool must be readjusted when changing contact size/type.

13. Install pin to lock position of selector knob.

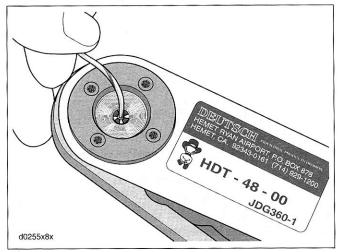


Figure B-17. Contact Barrel

SEALED BUTT SPLICE CONNECTORS

INSTALLATION

Butt splicing may be a necessary procedure for the replacement of some components.

- 1. Strip 3/8 in. (9.5 mm) of insulation off the ends of the wires.
- Compress the handles of the Packard Crimp Tool (HD-38125-8) until the ratchet automatically opens.
- 3. See Table B-1. Since the size of the connectors varies with the gauge of the wire, always used the correct components when creating sealed splices.
- See Figure B-18. Determine the correct dye or nest for the crimping operation. Match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool.
- Gently apply pressure to the handles until the crimper lightly secures one side of the metal insert inside the butt splice connector. The connector must be crimped in two stages; one side then the other.
- 6. See Figure B-19. Feed the wire into the butt splice connector until the stripped end contacts the wire stop inside the metal insert.
- 7. Squeeze the handles of the crimp tool until tightly closed. The tool automatically opens when the crimping sequence is complete.
- 8. Repeat steps 5, 6, and 7 on the other side of the butt splice connector.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

WARNING

Use caution when operating the UltraTorch UT-100 or any other radiant heating device. Read the manufacturers instructions carefully before use. Always keep hands away from tool tip area and heat shrink attachment. Avoid directing the heat toward any fuel system component. Extreme heat can cause fuel ignition or explosion. Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed. Be sure to turn the "ON/OFF" switch to the "OFF" position after use. Improper handling could result in death or serious injury.

9. Using the UltraTorch UT-100 (Part No. HD-39969), Robinair Heat Gun (Part No. HD-25070) with heat shrink attachment (Part No. HD-41183) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector.

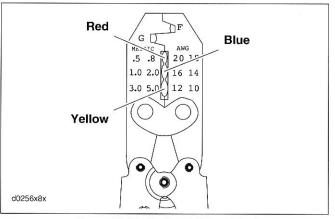


Figure B-18. Packard Crimp Tool (Part No. HD-38125-8)

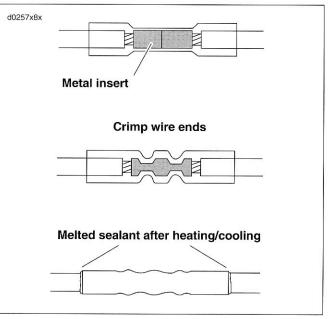


Figure B-19. Installing Sealed Butt Splice Connectors

Table B-1. Common Sealed Splices

GAUGE WIRE	CONNECTOR COLOR	PART NO.				
18-20	Red	70585-93				
14-16	Blue	70586-93				
10-12	Yellow	70587-93				

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

10. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

GENERAL

From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber. Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a **new** terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

Two types of Packard pull-to-seat electrical connectors are used. One type has an external latch to lock the pin and socket halves together, while the other makes use of a wireform. See Figure B-20. The manner in which the terminals are picked differs between these two types of connectors, as further described below.

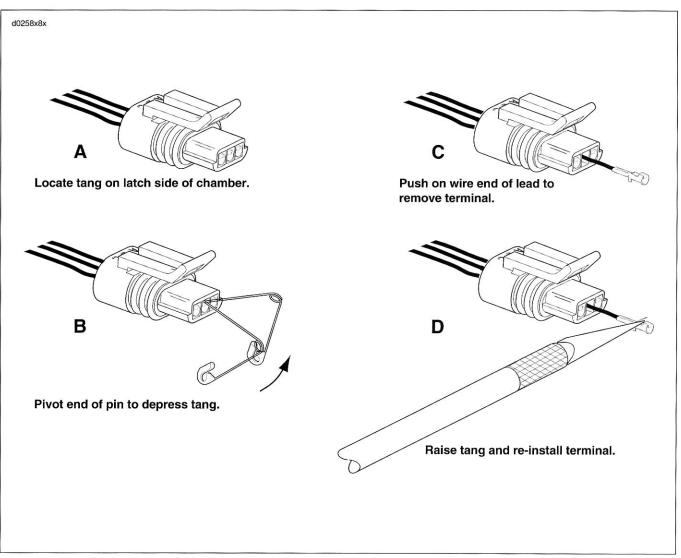


Figure B-20. Packard Connectors

Removing External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

- 1. Remove the connector from the retaining device, if present.
- 2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.
- 3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure B-20. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
- 4. At a slight angle, gently insert the point of a one inch safety pin down the middle of the chamber (about 1/8 inch) and pivot the end of the pin toward the terminal body. When a click is heard, remove the pin and repeat the procedure. See B in Figure B-20. The click is the sound of the tang returning to the locked position as it slips from the point of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

NOTES

- On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.
- When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.
- 5. Remove the pin and push on the wire end of the lead to extract the terminal from the mating end of the connector. See C in Figure B-20. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions.

Installing External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

- 1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See D in Figure B-20.
- 2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
- Push on the lead to verify that the terminal is locked in place.
- 4. Push the pin and socket halves of the connector together until the latches "click."

PUSH-TO-SEAT TERMINALS

Removing Push-to-Seat Terminals

Like most connectors, Packard push-to-seat terminals are pulled out the wire end of the connector. To remove a pushto-seat terminal, proceed as follows:

- 1. Remove the connector from the retaining device, if present.
- 2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.

NOTE

Both the Ignition Light/Key Switch and the Main Power connectors are provided with secondary locks. The secondary lock, which may be molded onto the connector or exist as a separate piece, aids in terminal retention. Secondary locks must be opened (or removed) before the terminals can be extracted from the connector housing.

- Open or remove the secondary lock. Ignition Switch: Bend back the latch slightly and free one side of the secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access the terminals in the chambers of the connector housing.
- 4. Looking in the mating end or terminal side of the connector (opposite the secondary lock), take note of the larger cavity next to each terminal.
- 5. Insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick toward the terminal to depress the locking tang. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat the step if the terminal is still locked in place.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions.

Installing Push-to-Seat Terminals

NOTE

For wire location purposes, alpha characters are stamped onto the secondary locks or onto the wire end of the connector housing.

- 1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body.
- Push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
- Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
- Close or install the secondary lock. Ignition Switch: Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
- Push the pin and socket halves of the connector together until the latches "click."
- 6. Install connector on retaining device, if present.

CRIMPING INSTRUCTIONS

- 1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
- 2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

 Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word "TIP" appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure B-21.

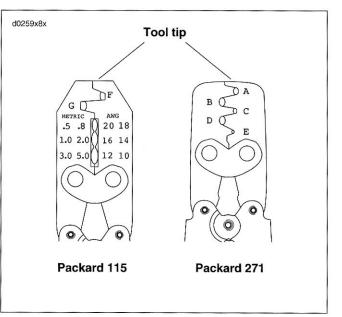


Figure B-21. Packard Terminal Crimp Tools

Table B-2. Packard Terminal Crimp Tools

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

- Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
- 5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
- 6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
- Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 8. Determine the correct dye or nest for the insulation/seal crimp.
- 9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
- 10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 11. See Figure B-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.

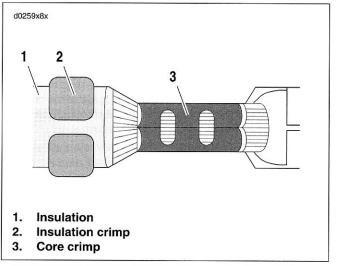


Figure B-22. Inspect Core and Insulation/Seal Crimps

DISASSEMBLY

- 1. See Figure B-23. Depress tabs (3) on the sides of connector and remove clear plastic cover (4).
- 2. Remove cable strap (2).
- 3. See Figure B-24. Pry three tabs to separate connector halves.
- 4. Push on desired wire from back of connector to expose wire terminal.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard socket terminals on wires. If new terminals must be installed, see CRIMPING INSTRUCTIONS below.

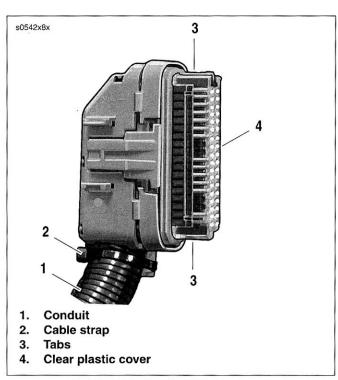
ASSEMBLY

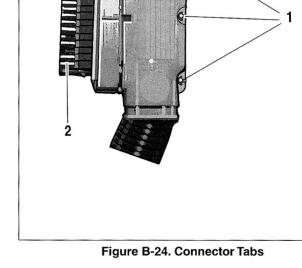
1. Push wire into correct hole until terminal is seated.

NOTE

In next step be sure wires are not pinched while mating connector halves.

- See Figure B-23. Mate connector halves making sure wires are not pinched and end of wire conduit (1) is inside connector halves.
- 3. Install new cable strap on end of connector.
- 4. Install clear plastic cover over terminals.





s0543x8x

Figure B-23. ECM Connector

CRIMPING INSTRUCTIONS

- 1. Strip wire lead removing 5/32 in. (4 mm) of insulation.
- 2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word "TIP" appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure B-21.

- 4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.
- 5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
- 6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
- Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 8. Determine the correct dye or nest for the insulation/seal crimp.
- 9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
- 10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 11. See Figure B-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.

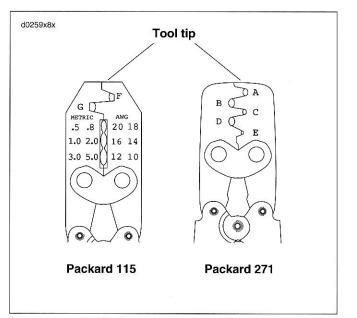


Figure B-25. Packard Terminal Crimp Tools

Table B-3. Packard Terminal Crimp Tools

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

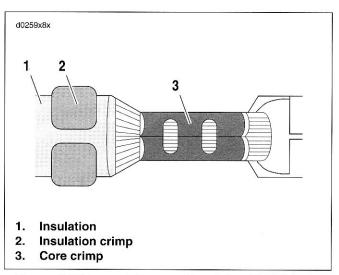


Figure B-26. Inspect Core and Insulation/Seal Crimps

CONNECTOR NO.	DESCRIPTION	ТҮРЕ	LOCATION
[5]	main fuse	spade terminals	under right side cover
[18]	right rear turn signal	2-place Multilock	under outer rear fender
[19]	left rear turn signal	2-place Multilock	under outer rear fender
[22]	right hand controls	6-place Deutsch	under handlebar cover
[24]	left hand controls and horn	6-place Deutsch	under handlebar cover
[29]	position lamp (HDI)	2-place Mini-Deutsch	under left side cover
[30]	turn signal/security module	12-place Deutsch	under passenger seat
[31]	front turn signals	6-place Multilock	under handlebar cover
[33]	ignition key switch	3-place Packard	back of ignition switch
[38L]	low beam lamp	2-place Amp	back of headlamp
[38H]	high beam lamp	2-place Amp	back of headlamp
[39]	instrument module (IM)	12-place Mini-Deutsch	under handlebar cover
[45]	license plate lamp	3-place Multilock	under outer rear fender
[46]	voltage regulator to stator	3-place Packard	under left trim cover
[65]	vehicle speed sensor (VSS)	3-place Deutsch	above rear rocker box
[77]	voltage regulator to main harness	1-place Deutsch	behind radiator cover
[78]	electronic control module (ECM)	36-place Packard	under left side cover
[79]	crank position sensor (CKP)	2-place Mini-Deutsch	under left trim cover
[80]	manifold air pressure sensor (MAP)	3-place Packard	front intake passage
[83 F]	front plug top coil	3-place Packard	on top of front rocker box
[83 R]	rear plug top coil	3-place Packard	on top of rear rocker box
[84]	front injector	2-place Packard	throttle body
[85]	rear injector	2-place Packard	throttle body
[87]	idle air control (IAC)	4-place Packard	below air cleaner assembly
[88]	throttle position sensor (TP)	3-place Packard	front of throttle body
[89]	intake air temperature sensor (IAT)	2-place Packard	upper airbox
[90]	engine coolant sensor (ECT)	2-place Packard	water pump housing
[91]	data link connector	4-place Deutsch	under left side cover
[93]	tail lamp	4-place Multilock	under outer rear fender
[95]	purge solenoid	2-place Packard	below seat
[97 T]	cooling fan	2-place Multilock	under left trim cover
[97 B]	cooling fan	2-place Multilock	under left trim cover
[120]	oil pressure switch	post terminal	crankcase between cylinders
[122]	horn	spade terminals	between cylinders, left side
[128A]	starter solenoid coil	spade terminals	behind radiator-left side
[61]	starter relay	5-place Amp	under air box cover, in fuse block
[62]	system relay	5-place Amp	under air box cover, in fuse block
[62]	fan relay	5-place Amp	under air box cover, in fuse block

Table B-4. Connector Location

CONNECTOR NO.	DESCRIPTION	ТҮРЕ	LOCATION
[141]	fuel pump and sender	3-place Mini-Deutsch	top of fuel tank
[142]	security siren (optional)	3-place Packard	electrical panel behind fender extension
[145]	engine harness	12-place Mini-Deutsch	below air cleaner assembly
-	fuse block	spade terminals	under air box cover
2 .	rear stoplight switch	spade terminals	behind transmission
-	neutral switch	post terminals	bottom rear of crankcase
-	harness grounds (2)	ring terminals	front and rear cam covers

Table B-4. Connector Locations

DIAGRAM	PAGE
2003 VRSCA MODEL, MAIN HARNESS: PAGE 1 OF 2	B-23
2003 VRSCA MODEL, MAIN HARNESS: PAGE 2 OF 2	B-24
2003 VRSCA MODEL, IGNITION CIRCUIT: PAGE 1 OF 1	B-25
2003 VRSCA MODEL, CHARGING CIRCUIT: PAGE 1 OF 1	B-26
2003 VRSCA MODEL, STARTING CIRCUIT: PAGE 1 OF 1	B-27
2003 VRSCA MODEL, LIGHTING CIRCUIT: PAGE 1 OF 1	B-28
2003 VRSCA MODEL, HORN AND INSTRUMENT CIRCUIT: PAGE 1 OF 1	B-29
2003 VRSCA MODEL, SECURITY CIRCUIT: PAGE 1 OF 1	B-30

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

Table C-1. Linear Conversion Table

GENERAL

Torque specifications for specific components are listed in each section at the point of use. When converting to Newtonmeters, use the formulas given under the metric chart. For all other steel fasteners, use the values listed in one of the tables below.

n the metric table, the values listed are in Newton-meters.

In the English table, torque values listed are in ft-lbs, except those marked with an asterisk (*), which are in in-lbs. I

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

AWARNING

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

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

Table C-2. Metric Torque Values

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

Table C-3. English Torque Values

Torque values in **in-lbs**.

UNITED STATES SYSTEM

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

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

METRIC SYSTEM

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

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

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

Table D-1. Case 1 Valve Tappet Shims

Part No.	Shim Thickness						
H-D 18696-01K	1.825 mm						
H-D 18697-01K	1.850 mm						
H-D 18698-01K	1.875 mm						
H-D 18699-01K	1.900 mm						
H-D 18700-01K	1.925 mm						
H-D 18701-01K	1.950 mm						
H-D 18702-01K	1.975 mm						
H-D 18666-01K	2.000 mm						
H-D 18624-01K	2.025 mm						
H-D 18667-01K	2.050 mm						
H-D 18625-01K	2.075 mm						
H-D 18668-01K	2.100 mm						
H-D 18626-01K	2.125 mm						
H-D 18669-01K	2.150 mm						
H-D 18627-01K	2.175 mm						
H-D 18670-01K	2.200 mm						
H-D 18628-01K	2.225 mm						
H-D 18628-01K	2.250 mm						
H-D 18629-01K	2.275 mm						
H-D 18672-01K	2.300 mm						
H-D 18630-01K	2.325 mm						
H-D 18673-01K	2.350 mm						
H-D 18631-01K	2.375 mm						
H-D 18674-01K	2.400 mm						

/alve Tappet Shims
Shim Thickness
2.425 mm
2.450 mm
2.475 mm
2.500 mm
2.526 mm
2.550 mm
2.575 mm
2.600 mm
2.625 mm
2.650 mm
2.675 mm
2.700 mm
2.725 mm
2.750 mm
2.775 mm
2.800 mm
2.825 mm
2.850mm
2.875 mm
2.900 mm
2.925 mm
2.950 mm
2.975 mm
3.000 mm

-1 04

Intake lash Exhaust lash			0.22 mm ± 0.025 (0.0087 in. ± 0.00098) 0.32 mm ± 0.025 (0.0126 in. ± 0.00098)	0.22 mm ± 0.025 (0.0087 in. ±	± 0.00098)	• Alwa	ys measure shi	im, never trust	Always measure shim, never trust bin location or etched size.	stched size. justment.	
Exhaust lash			0.32 mm ± 0	1012 10 0196 in		Г				justment.	
				"NED (U.V.1EV	± 0.00098)	 Phot 	Photocopy this form for use on each valve lash adjustment.	n for use on ea	ch valve lash ad		
			iti e e h	ln stalled Chim	Valve I ash	Valve Lack	NEW SHIM DWFR LIMIT	NEW SHIM UDDER LIMIT	DESIRED SHIMSIZE Calculate	Shim Size	
Cylinder	Valve Number	Valve Type	Measurement	Measurement	Upper Limit mm (in.)	Lower Limit mm (in.)	Calculate Columns (1)+(2)-(3)	Calculate Columns (1)+(2)-(4)	$\frac{\text{Columns}}{2} = (S)$	Chosen (closest to column S)	Final Lash Reading
			(1)	(2)	(3)	(4)	(L)	(n)	(S)		the state of the s
	-	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	2	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	в	Intake			0.245 (0.0096)	0.195 (0.0078)					
	4	Intake			0.245 (0.0096)	0.195 (0.0078)					
			(1)	(2)	(3)	(4)	()	(n)	(S)		
	5	Intake			0.245 (0.0096)	0.195 (0.0078)					
	9	Intake			0.245 (0.0096)	0.195 (0.0078)					
	7	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	80	Exhaust			0.345 (0.0135)	0.295 (0.0117)					

VALVE LASH CALCULATION WORKSHEET 1

IMPORTANT NOTES

 Valve numbers correspond to the "cast-in" number in the cylinder head casting located at each valve tappet.

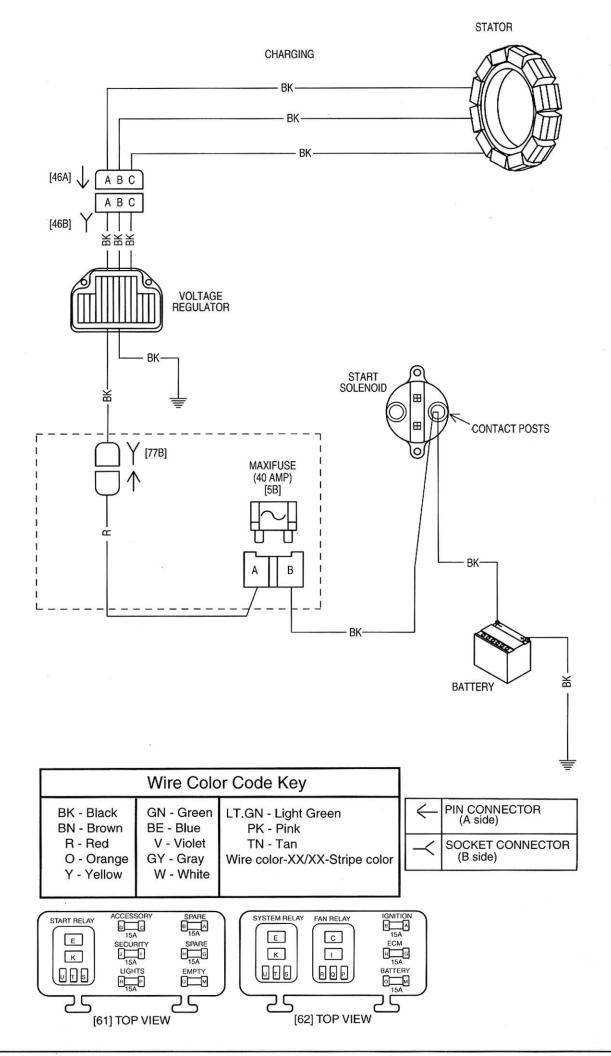
Technician

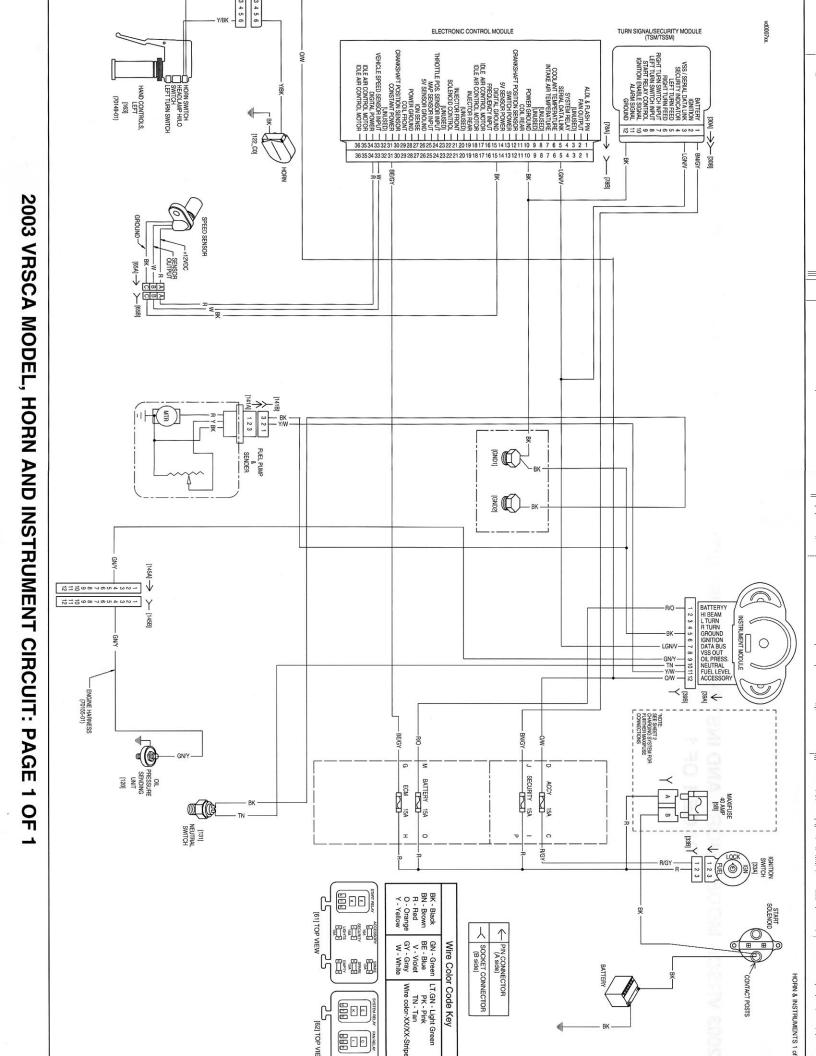
V.I.N.

D.2

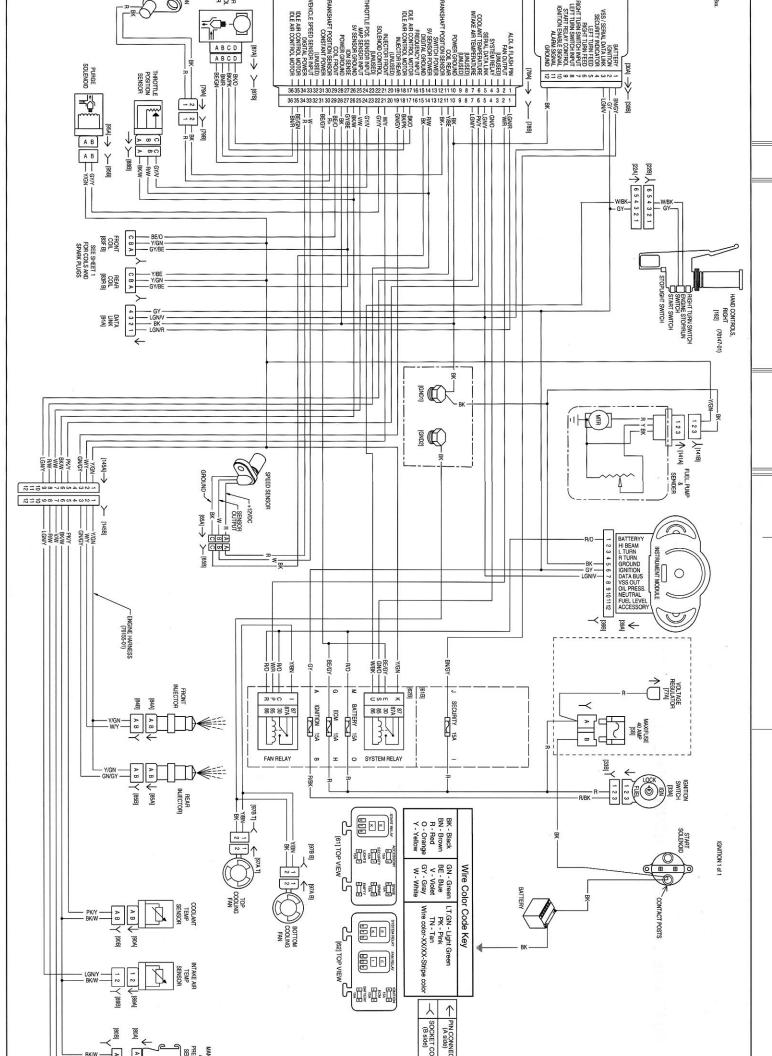
	2							ADDINI	MPORTANT NOTES		
Technician	L					 Valv. 	e numbers corr	espond to the	Valve numbers correspond to the "cast-in" number in the cylinder head casting	er in the cylinde	r head casting
Date						loca	located at each valve tappet.	re tappet.			
Intake lash	Ę		0.22 mm ± (0.22 mm ± 0.025 (0.0087 in. ± 0	± 0.00098)	Alwa	ays measure sh	im, never trust	Always measure shim, never trust bin location or etched size.	etched size.	
Exhaust lash	ash		0.32 mm ± (0.32 mm ± 0.025 (0.0126 in. ± 0	± 0.00098)	• Pho	tocopy this forn	n for use on ea	Photocopy this form for use on each valve lash adjustment.	djustment.	
Cylinder	Valve Number	Valve Type	Initial Lash Measurement	Installed Shim Measurement	Valve Lash Upper Limit mm (in.)	Valve Lash Lower Limit mm (in.)	NEW SHIM LOWER LIMIT Calculate Columns (1)+(2)-(3)	NEW SHIM UPPER LIMIT Calculate Columns (1)+(2)-(4)	$DESIREDSHIMSIZECalculateColumns\frac{(L) + (U)}{2} = (S)$	Shim Size Chosen that is closest to column (S)	Final Lash Reading
			Ð	(2)	(3)	(4)	(F)	(n)	(S)		
	-	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	2	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
LIOUI	m	Intake			0.245 (0.0096)	0.195 (0.0078)					
	4	Intake			0.245 (0.0096)	0.195 (0.0078)					
			(j)	(2)	(3)	(4)	(r)	(n)	(S)		
	5	Intake			0.245 (0.0096)	0.195 (0.0078)					
	9	Intake			0.245 (0.0096)	0.195 (0.0078)					
1001	2	Exhaust			0.345 (0.0135)	0.295 (0.0117)					
	80	Exhaust			0.345 (0.0135)	0.295 (0.0117)					

VALVE LASH CALCULATION WORKSHEET 2

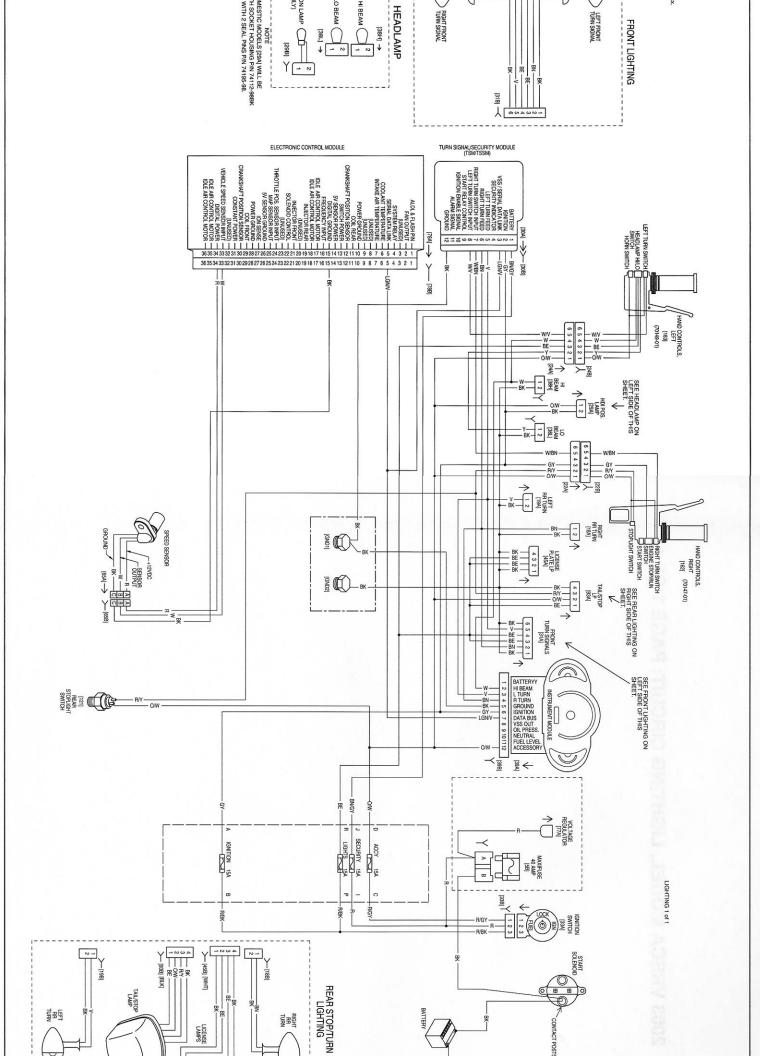


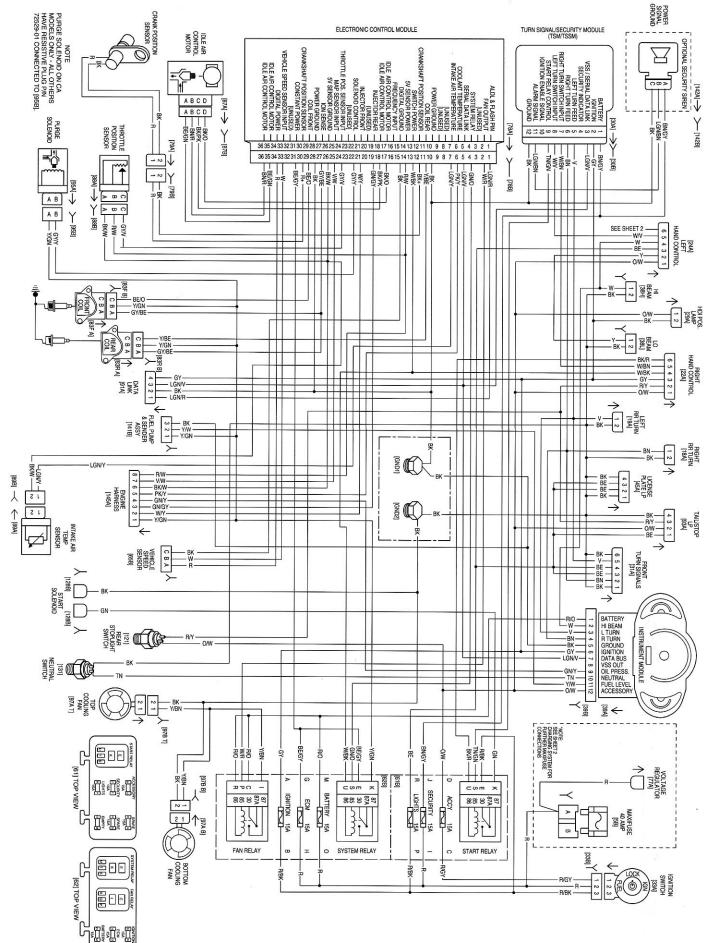








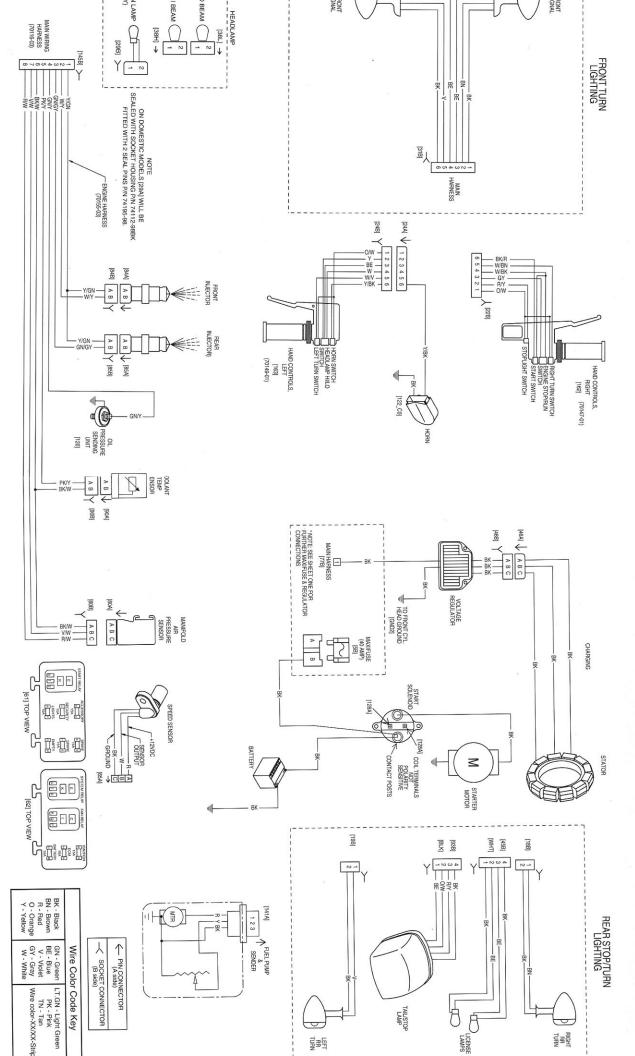




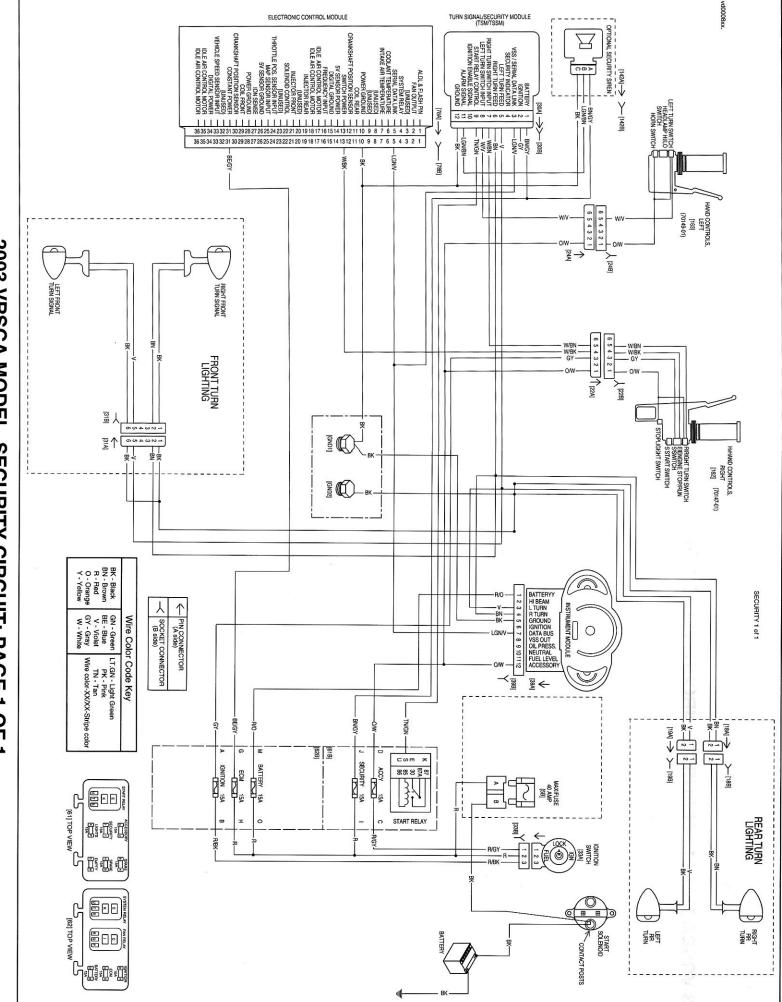
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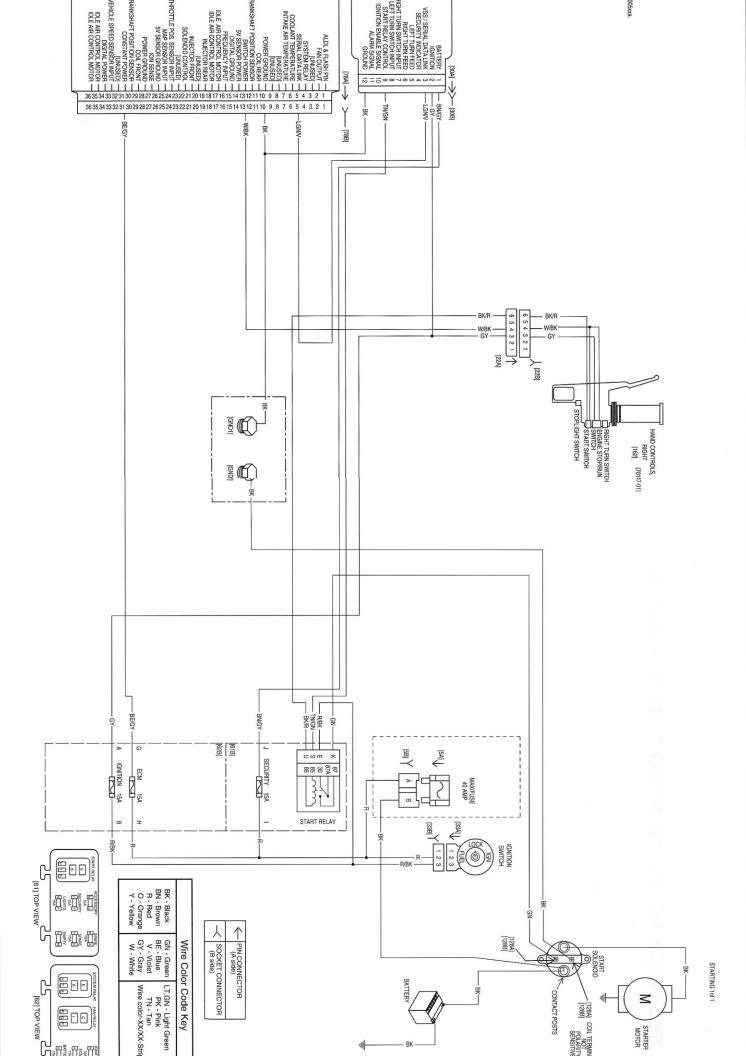


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Symbols

(CARB) California Air Resources Board	
(CKP) Crank Position Sensor	
(ECM) Electronic Control Module	
(ECT) Engine Coolant Temperature Sensor .	
(EFI) Electronic Fuel Injection	
(EVAP) Evaporative Emissions Control	
(IAC) Idle Air Control	
(MAP) Manifold Absolute Pressure Sensor	
(TSSM) Turn Signal Security Module	
(VIN) Vehicle Identification Number	
(VSS) Vehicle Speed Sensor	

Numerics

46°/31° Exhaust Seat Cutter (HD-35758-53).
46°/31° Intake Seat Cutter (HD-35758-A)
70° Intake Seat Cutter (HD-35758-54)

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