CHASSIS

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FUEL SYSTEM

ELECTRIC STARTER

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APPENDIX

INDEX

2006 SOFTAIL SERVICE MANUAL

The information in this Service Manual applies to all 2006 Softail[®] models.

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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–Drive
- Section 7–Transmission
- Section 8–Electrical
- Section 9–Fuel Injection
- Appendix A–Tools
- Appendix B–Wiring
- Appendix C–Metric Conversions
- Appendix D–Japanese Mainshaft/Countershaft
- Appendix E–Glossary

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 (BRAKES) in section one (MAIN-TENANCE) could be referred to as:

1.6 BRAKES

This cross reference directs the reader to section 1 (MAINTE-NANCE) and topic 6 (BRAKES).

PREPARATION FOR SERVICE

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

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 APPENDIX A–TOOLS for equipment required for special service work.

NOTE

- 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

WARNING

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. (00119a)

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. (00139a)

CAUTION

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage (00140a)

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 USA 48092-3499 Telephone: 1-800-345-2233

Midtronics Electronic Systems Analyzer

For replacement parts and service information, contact:

Midtronics, Inc. 7000 Monroe Street Willowbrook, Illinois USA 60527 Telephone: 1-800-776-1995

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 contact Loctite Corp. at 1-800-LOCTITE or www.loctite.com.

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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

WARNING

Always follow the listed service and maintenance recommendations, since they affect the safe operation of the motorcycle and the personal welfare of the rider. Failure to follow recommendations 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 FIRST SCHEDULED 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. Secondary 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 and transmission fluid levels.
- Headlamp, auxiliary lamp, tail lamp, brake lamp, horn 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 and Assembly

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

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

REPAIR AND REPLACEMENT PROCEDURES

Hardware and Threaded Parts

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

Replace bolts, nuts, studs, washers, spacers and small common hardware if missing or in any way damaged. Clean up or repair minor thread damage with a suitable 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-ring and seal mating surfaces are thoroughly clean before installation.

Gears

Always check gears for damaged or worn teeth.

Lubricate mating surfaces before pressing gears on shafts.

Shafts

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

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

Clean all rust from the machined surfaces of new parts.

Part Replacement

Always replace worn or damaged parts with new parts.

CLEANING

Part Protection

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

Cleaning Process

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

Rust or Corrosion Removal

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

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

WARNING

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

Use a good quality unleaded gasoline (91 pump octane or higher). Octane ratings are 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 CF, CF-4, CG-4 and CH-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 1.4 ENGINE OIL AND FILTER 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.

FIRST SCHEDULED MAINTENANCE

- On models with springer forks (FLSTSC, FXSTS), after 500 miles (800 km) 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.
- On models with hydraulic forks (FXSTD, FLSTC, FLSTF, FXST, FXSTB, FLSTN, FLST), after 1000 miles (1600 km) 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.

ITEM SERVICED	PROCEDURE	FIRST SERVICE	5000 mi 8000 km	10,000 mi 16,000 km	15,000 mi 24,000 km	20,000 - mi 32,000 km	25,000 mi 40,000 km	NOTES
Engine oil and filter	Replace	X	Х	Х	Х	Х	Х	
Oil lines and brake system	Inspect for leaks	Х	Х	Х	Х	Х	Х	1
Air cleaner	Inspect, service as required	Х	Х	X	Х	Х	Х	
Tires	Check pressure, inspect tread	Х	Х	X	Х	Х	Х	
Wheel spokes	Check tightness	X	Х			Х		1, 4
Primary chaincase lubricant	Replace	X		Х		Х		
Transmission lubricant	Replace	Х				Х		
Clutch	Check adjustment	X	Х	Х	Х	Х	Х	1
Primary chain	Check adjustment	X.	Х	X	Х	Х	Х	
Rear belt and sprockets	Inspect, adjust belt	Х	Х	X	Х	Х	Х	1
Throttle, brake, enrichener and clutch controls	Check, adjust and lubricate	x	Х	Х	Х	Х	Х	1, 4
Jiffy stand	Inspect and lubricate	X		Х		Х		1
Fuel valve, lines and fittings	Inspect for leaks	X	Х	X	Х	Х	Х	1, 4
Fuel tank filter screen	Clean (EFI: replace)						Х	1
Brake fluid	Check levels and condition	Х	Х	X	Х	Х	Х	6
Brake pads and discs	Inspect for wear	Х	Х	Х	Х	Х	Х	
Spark plugs	Inspect	X	Х		Х		Х	
	Replace			X		Х		
Electrical equipment and switches	Check operation	Х	Х	Х	Х	Х	Х	
Engine idle speed	Check adjustment	Х	Х	Х	Х	Х	Х	1
Front fork oil	Replace					Х		1

Table 1-1. Regular Service Intervals For Softail Models

NOTES:

- 1. Should be performed by an authorized Harley-Davidson dealer, unless you have the proper tools, service data and are mechanically qualified.
- 2. Disassemble, lubricate and inspect every 30,000 miles (48,000 km).
- 3. Perform annually.
- 4. Not all vehicles are equipped with enrichener, fuel valve or spoke wheels. Consult appropriate topic in service manual.
- 5. Disassemble, lubricate and inspect every 20,000 miles (32,000 km).
- 6. Change DOT 4 brake fluid and flush every two years.

ITEM SERVICED	PROCEDURE	FIRST SERVICE	5000 mi 8000 km	10,000 mi 16,000 km	15,000 mi 24,000 km	20,000 mi 32,000 km	25,000 mi 40,000 km	NOTES
Steering head bearings	Adjust	Х		X		Х		1
(Softail models)	Lubricate			Х		Х		2
Steering head bearings (Springer models)		Adjus	st and I	ubricate	every 2	500 mile	es	1, 5
Rear fork bearings (if applica- ble)	Repack					Х		1
Windshield bushings	Inspect			Х		Х		1
Springer rocker bearings	Adjust	Х		X		Х		1
Fuel door, tour-pak, saddle- bags	Lubricate hinges and latches	Х	Х	Х	Х	Х		
Critical fasteners	Check tightness	X		Х		Х		1
Battery	Check battery and clean connections							3
Road test	Verify component and system functions	Х	Х	X	×	Х	Х	

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3. Perform annually.

4. Not all vehicles are equipped with enrichener, fuel valve or spoke wheels. Consult appropriate topic in service manual.

5. Disassemble, lubricate and inspect every 20,000 miles (32,000 km).

6. Change DOT 4 brake fluid and flush every two years.

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque	14-21 ft-lbs (19-28 Nm)
	Oil capacity	3.5 qt. (3.3 L)
	Filter	Hand tighten 1/2-3/4 turn after gasket contact
	Chrome filter part number	63798-99
	Black filter part number	63731-99
Primary chain tension	Deflection with hot engine	5/8-7/8 in. (15.9-22.2 mm)
	Deflection with cold engine	3/8-5/8 in. (9.5-15.9 mm)
	Chain tensioner nut torque	21-29 ft-lbs (29-39 Nm)
	Primary chain inspection cover torque	84-108 in-lbs (10-12 Nm)
Primary chain lubricant	Lubricant capacity	26 oz. (769 mL)
	Primary chaincase drain plug torque	36-60 in-lbs (4-7 Nm)
Clutch adjustment	Free play at adjuster screw	1/2-1 turn
	Adjuster screw locknut torque	72-120 in-lbs (8-14 Nm)
	Free play at hand lever	1/16-1/8 (1.6-3.2 mm)
	Clutch inspection cover torque	84-108 in-Ibs (10-12 Nm)
Transmission lubricant	Lubricant level	Dipstick at FULL with motorcycle level and filler plug resting on threads
	Lubricant capacity	20-24 oz (590-710 mL)
	Transmission drain plug torque	14-21 ft-lbs (19-28 Nm)
	Filler plug torque	25-75 in-lbs (3-9 Nm)
Spark plugs	Туре	HD-6R12
	Gap	0.038-0.043 in. (0.97-1.09 mm)
	Torque	12-18 ft-lbs (16-24 Nm)
Engine idle speed	Idle speed	950-1050 RPM
Front fork oil	Туре	HYDRAULIC FORK OIL (TYPE E) Part No. 99884-80 (16 oz.)
Battery	Lubricant	ELECTRICAL CONTACT LUBRICANT Part No. 99861-02 (1 oz.)
	Battery terminal torque	60-96 in-lbs (6.8-10.9 Nm)
Fuel tank filter	Sealant for fuel valve and fuel tank adapter	LOCTITE PIPE SEALANT WITH TEFLON 565 Part No. 99818-97 (6 ml)
	Hex jam nut torque	15-20 ft-lbs (20-27 Nm)
Enrichener control	Hex nut torque	10-14 in-lbs (1.1-1.6 Nm)

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA		
Tire condition and pressure		FLST, FLSTC, FLSTF, FLSTSC, FLSTN Models: Front: 36 psi (2.5 bar) Rear: 36 psi (2.5 bar)		
	Pressure for solo rider	FXST, FXSTS, FXSTB Models: Front: 30 psi (2.1 bar) Rear: 38 psi (2.6 bar)		
		FXSTD Model: Front: 30 psi (2.1 bar) Rear: 36 psi (2.5 bar)		
		FLST, FLSTC, FLSTF, FLSTSC, FLSTN Models: Front: 36 psi (2.5 bar) Rear: 40 psi (2.8 bar)		
	Pressure for rider and passenger	FXST, FXSTS, FXSTB Models: Front: 30 psi (2.1 bar) Rear: 42 psi (2.9 bar)		
		FXSTD Model: Front: 30 psi (2.1 bar) Rear: 40 psi (2.8 bar)		
	Wear	Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains		
Wheel spokes	Spoke nipple torque	40-50 in-Ibs (4.5-5.6 Nm)		
Steering head bearings	Lubricant for neck fitting .	SPECIAL PURPOSE GREASE Part No. 99857-97 (14 oz. cartridge)		
Brake fluid reservoir level	D.O.T. 4 hydraulic brake fluid part number	99953-99A (12 oz.)		
	Proper fluid level	1/8 in. (3.2 mm) from the top		
	Master cylinder reservoir cover torque	6-8 in-lbs (0.7-0.9 Nm)		
Brake pad linings and discs	Minimum brake pad thickness	0.04 in. (1.02 mm)		
	Minimum brake disc thickness	See stamp on side of disc		
Drive belt	Upward measurement force applied at midpoint of top belt strand	10 lb. (4.5 kg)		
	Belt deflection with approximate weight of the owner on motorcycle	1/4-5/16 in. (6.4-7.9 mm)		
Air cleaner	Air cleaner cover bracket screw torque	20-40 in-lbs (2-5 Nm)		
	Air cleaner cover screw torque	30-60 in-lbs (4-7 Nm)		
	Adhesive for air cleaner cover screw	LOCTITE THREADLOCKER 243 Part No. 99642-97 (6 ml)		
Clutch and throttle cables	Lubricant	SUPER OIL Part No. 94968-85TV (1/4 fl. oz.)		
	Handlebar clamp screw torque	12-15 ft-lbs (16.3-20.3 Nm)		
	Handlebar switch housing screw torque	35-45 in-lbs (4-5 Nm)		

Table 1-2. Quick Reference Maintenance Chart

CHECKING AND ADDING OIL

See Figure 1-1. Check engine oil level:

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

Type of Oil

Refer to Table 1-3. Use the proper grade of oil for the lowest temperature expected before the next oil change. See 1.2 FUEL AND OIL for specific information regarding winter needs.

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 CF, CF-4, CG-4 and CH-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.

Checking Oil Level

Ride motorcycle until engine is warmed up to operating temperature, then do the following.

- 1. Idle motorcycle on jiffy stand for 1-2 minutes.
- Shut motorcycle off and leave motorcycle resting on jiffy stand.
- See Figure 1-2. Check oil level on dipstick. If necessary, add oil until oil registers at upper groove on dipstick. Do not overfill oil tank.

HARLEY- DAVIDSON TYPE	VISCOSITY	HARLEY- DAVIDSON RATING	LOWEST AMBIENT TEMP °F	COLD WEATHER STARTS BELOW 50° F
H.D. Multi-Grade	SAE 10W40	HD 360	Below 40° (4°C)	Excellent
H.D. Multi-Grade	SAE 20W50	HD 360	Above 40° (4°C)	Good
H.D. Regular Heavy	SAE 50	HD 360	Above 60° (16°C)	Poor
H.D. Extra Heavy	SAE 60	HD 360	Above 80° (27°C)	Poor

Table 1-3. Recommended Oil Grades



Figure 1-1. Checking Oil Tank Level



Figure 1-2. Oil Tank Dipstick Upper Groove

CHANGING OIL AND FILTER

PART NO.	SPECIALTY TOOL
HD-42311 or HD-44067	Oil filter wrench

NOTES

- If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.
- All Softails are shipped from the factory with SAE 20W50 Harley-Davidson 360 Motor Oil.
- All Softails come equipped from the factory with a premium 10 micron synthetic media oil filter, Part No. 63798-99 (Chrome) or 63731-99 (Black). These are the only recommended replacement filters.
- 1. Ride motorcycle until engine is warmed up to normal operating temperature.
- 2. See Figure 1-1. Remove the oil filler plug/dipstick by pulling steadily while moving plug back and forth.
- 3. See Figure 1-3. Remove the engine oil drain plug with Oring (2). Allow oil to drain into a suitable container.

CAUTION

See Figure 1-4. Use OIL FILTER WRENCH (Part No. HD-42311 or HD-44067) for filter removal. These tools can prevent damage to crankshaft position sensor and/or sensor cable.

- Remove the oil filter using the OIL FILTER WRENCH. Clean the oil filter mount flange of any old gasket material.
- See Figure 1-5. Lube the gasket on new oil filter with engine oil and install new filter. Hand tighten oil filter 1/2 to 3/4 turn after gasket contacts filter mounting surface.
- 6. See Figure 1-3. Install oil tank drain plug.
 - a. Inspect O-ring for tears or damage. Replace if required. Wipe any foreign material from plug.
 - b. Install O-ring and drain plug. Tighten to 14-21 ft-lbs (19.0-28.5 Nm).
- See Figure 1-1. Fill oil tank with no more than 3.5 quarts (3.3 liters) of oil. Use the proper grade of oil for the lowest temperature expected before next oil change. See Table 1-3.
- 8. Start engine and carefully check for oil leaks around drain plug and oil filter.
- 9. Check engine oil level.



Figure 1-3. Oil Tank Drain Plug



Figure 1-4. Oil Filter Wrench Part No. HD-42311 (left), Part No. HD-44067 (right)



Figure 1-5. Lubing New Oil Filter

BATTERY MAINTENANCE

GENERAL

AWARNING

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

WARNING

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

Table 1-4. Battery Electrolyte Antidotes

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



1.5

Figure 1-6. Battery

NOTE See 8.17 BATTERY for charging and testing information.



Figure 1-7. Battery Warning Label

DISCONNECTION AND REMOVAL

1. Remove seat.

AWARNING

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

- 2. See Figure 1-8. Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal (2).
- Unthread bolt and remove battery positive cable (red) from battery positive (+) terminal (3).
- 4. Lift battery from within oil tank.

INSTALLATION AND CONNECTION

 See Figure 1-9. Verify that the positive battery cable from the starter (4) is routed next to tab (3) on the battery tray pad (2). Place the fully charged battery into the battery pad, terminal side facing front wheel.

NOTE

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

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

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

 See Figure 1-8. Insert bolt through battery positive cable (red) into threaded hole of battery positive (+) terminal (3). Tighten bolt to 60-96 in-lbs (6.8-10.9 Nm).



- 1. Battery
- 2. Negative battery terminal
- 3. Positive battery terminal

Figure 1-8. Battery Assembly

- Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal (2). Tighten bolt to 60-96 in-lbs (6.8-10.9 Nm).
- Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat.

INSPECTION

- Battery top must be clean and dry. Dirt and electrolyte on top of the battery can cause battery to self-discharge. Clean battery top with a solution of baking soda (sodium bicarbonate) and water (5 teaspoons baking soda per quart or liter of water). When the solution stops bubbling, rinse off the battery with clean water.
- 2. Clean cable connectors and battery terminals using a wire brush or sandpaper. Remove any oxidation.
- Inspect the battery screws, clamps and cables for breakage, loose connections and corrosion. Clean clamps.
- Check the battery posts for melting or damage caused by overtightening.
- Inspect the battery for discoloration, raised top or a warped or distorted case, which might indicate that the battery has been frozen, overheated or overcharged.
- 6. Inspect the battery case for cracks or leaks.

STORAGE

AWARNING

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

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 8.17 BATTERY.

See Figure 1-10. 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).

NOTES

- The GLOBAL BATTERY CHARGER (Part No. 99863-01A) 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 8.17 BATTERY.



Figure 1-9. Positive Battery Cable Routing



Figure 1-10. Battery Self-Discharge Rate

FLUID INSPECTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

 See Figure 1-11. Check level in rear brake master cylinder reservoir. Level should be 1/8 in. (3.2 mm) below the gasket surface.

CAUTION

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

- See Figure 1-12. Check level in front brake master cylinder reservoir. Level should be 1/8 in. (3.2 mm) below the gasket surface.
- 3. Install gaskets and covers. Tighten reservoir cover screws to 6-8 in-lbs (0.7-0.9 Nm).

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

 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. 4 BRAKE FLUID. See 1.7 BLEEDING BRAKES.



Figure 1-11. Rear Brake Master Cylinder Reservoir



Figure 1-12. Front Brake Master Cylinder Reservoir

REAR BRAKE PEDAL

Pedal Height

The rear brake pedal is nonadjustable. When brake system components are properly assembled, brake pedal is correctly adjusted.

Pedal Lubrication

See Figure 1-13. Rear brake pedal contains greaseless bushings (4, 5). Replace bushings if worn.

Pedal Pad

If replacing brake pedal pad (8), slide old pad off brake pedal (7) then slide **new** pad on pedal.



Figure 1-13. Rear Brake Pedal (typical)

GENERAL

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

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

PROCEDURE

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.

- Remove bleeder valve cap. Install end of a length of clear plastic tubing over caliper bleeder valve; place other end in a clean container. Stand motorcycle upright.
 - a. Front brake bleeder valve-see Figure 1-14.
 - b. Rear brake bleeder valve-see Figure 1-15.
- Add D.O.T. 4 BRAKE FLUID to master cylinder reservoir. Fluid level should be 1/8 in. (3.2 mm) below the gasket surface. 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.



Figure 1-14. Front Brake Bleeder Valve



Figure 1-15. Rear Brake Bleeder Valve (typical)

- 4. Repeat Steps 2-3 until all air bubbles are purged.
- Tighten bleeder valve to 80-100 in-lbs (9.0-11.3 Nm). Install bleeder valve cap.
- 6. Verify master cylinder fluid level as described in Step 2.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

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

BRAKE PADS AND DISCS

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. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

AWARNING

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

See Figure 1-16. 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.

- FLSTSC/FXSTS front brake pads: 0.06 in. (1.6 mm) or less above the backing plate (4).
- All other brake pads: 0.04 in. (1.02 mm) 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. Inspect pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.

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 0.008 in. (0.2 mm).



Figure 1-16. Brake Pad Inspection

BRAKE PAD REPLACEMENT

Rear Brake Caliper

- 1. If present, remove right saddlebag.
- Remove the rear 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.
- 3. See Figure 1-17. Loosen, but do not remove, both pad pins (12 pt/0.25 in.).
- 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.

NOTE

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.

NOTES

- See Figure 1-18. The rear brake pads on FXST, FXSTB and FXSTS models are different then the pads on other models.
- See Figure 1-19. Install pad with two tabs (1) on the inboard side of the rear caliper.
- Install new inside brake pad using the same orientation as the pad previously removed. Curved portion of pad must face upward.
- 7. Install pad pins until the pins snap into place with an audible click. Do not fully tighten at this time.



Figure 1-17. Pad Retaining Bolts (Rear Caliper Shown)



4. FXST, FXSTB and FXSTS outboard pad

Figure 1-18. FXST, FXSTB and FXSTS Brake Pads



Figure 1-19. Brake Pad Orientation

- Pump brake pedal lever to move inside pistons out until they contact inside brake pads.
- Pry the outside pad back. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
- Verify that inside pads are captured between brake disc and pistons. Completely remove pad pins to free outside brake pad. Note the pad's original orientation for replacement purposes.
- Inspect pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.
- 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 180-200 in-lbs (20.3-22.6 Nm).

AWARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

- 14. 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. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 6-8 in-lbs (0.7-0.9 Nm).
- 16. Install right saddlebag if necessary.

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

17. Test brake system.

- a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
- Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.7 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.



3. Pad pins (12 pt/0.25 in)

Figure 1-20. Front Brake Caliper
Front Brake Caliper: All But FLSTSC/ FXSTS

NOTE

See 2.19 FRONT BRAKE CALIPER: FLSTSC or 2.20 FRONT BRAKE CALIPER: FXSTS to change front brake pads on that model.

- 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.
- See Figure 1-20. Loosen, but do not remove, both pad pins (3) (12 pt/0.25 in.).
- 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.
- Inspect pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.

NOTE

- See Figure 1-19. The front and rear brake calipers use the same exact 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.
- 7. Install **new** pads into caliper. Curved portion of pad must face rear of motorcycle.
- 8. Loosely install the pad pins until you hear an audible click.

- 9. Attach caliper to front fork.
 - a. See Figure 1-20. 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 28-38 ft-lbs (38.0-51.5 Nm).
 - d. Final tighten the top mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).
 - Final tighten both pad pins to 180-200 in-lbs (20.3-22.6 Nm).

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

- 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.
- 11. Check brake fluid level in master cylinder. Fill to proper level if necessary using D.O.T. 4 BRAKE FLUID. Install master cylinder reservoir cap. Tighten reservoir cap screws to 6-8 **in-lbs** (0.7-0.9 Nm).

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 12. Test brake system.
 - a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system. See 1.7 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

AWARNING

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

- In addition, using tires other than those specified may adversely affect motorcycle handling.
- Tubeless tires fitted with the correct size inner tubes may be used on all Harley-Davidson laced (wire spoked) wheels. Protective rubber rim strips must be used with tubeless tires (fitted with correct size inner tubes) when mounted on laced (wire spoked) wheels.
- 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.
- Inspect each tire for wear. Replace tires before they reach the tread wear indicator bars.

NOTE

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

WARNING

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

 Check for proper front and rear tire pressures when tires are cold. Compare results against Table 1-5.

Table 1-5. Tire Pressures

DUNLOP TIRES ONLY		SOLO RIDER		RIDER & ONE PASSENGER	
MODEL	TIRE	PSI	kPA	PSI	kPA
FLSTC, FLSTF, FLSTSC, FLSTN FLST	Front	36	248	36	248
	Rear	36	248	40	276
FXST, FXSTB, FXSTS	Front	30	207	30	207
	Rear	38	262	42	290
FXSTD	Front	30	- 207	30	207
	Rear	36	248	40	276

TIRE REPLACEMENT

See Figure 1-21. Tread wear indicator bars appear on tire tread surfaces when 1/32 inch (0.8 mm) or less 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, indicating 1/32 inch (0.8 mm) tread pattern depth remaining.

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

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

WHEEL BEARINGS

Service wheel bearings:

- Inspect any time the wheels are removed.
- Inspect the play of the wheel bearings by finger while they are in the wheel. Rotate the inner race to inspect for abnormal noise and smooth rotation.
- Check wheel bearings and axle spacers for wear and corrosion. Replace bearings in sets only. See 2.9 SEALED WHEEL BEARINGS.

WHEEL SPOKES

1. Raise motorcycle wheel off the ground.

CAUTION

If nipples require more than one full turn to tighten spoke, remove tire to check that spoke is not protruding far enough to damage tube.

 Lightly tap each spoke with a spoke wrench. Loose spokes will sound dull and must be tightened. Tighten spokes to 40-50 in-Ibs (4.5-5.6 Nm). If more than a few spokes are loose, true the entire wheel following procedure under 2.12 TRUING LACED WHEEL.



Figure 1-21. Tread Wear Indicators

PRIMARY CHAIN

INSPECTION

CAUTION

See Figure 1-22. The gasket (1) between the primary chain inspection cover and the chaincase cover must be replaced each time the cover is removed. Failure to replace gasket may result in chaincase lubricant leaks.

WARNING

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

- 1. Disconnect negative battery cable.
- 2. With motorcycle upright and level, remove the primary chain inspection cover (2). Remove and discard gasket.

CAUTION

Adjust the primary chain at the tightest spot in the chain. Do not adjust chain tighter than specified play. Running chains too tight will result in excessive wear.

- Check the primary chain tension. Push on the upper strand on the chain to verify that it has free movement midway between the engine compensating sprocket in the front and the clutch sprocket in the rear.
 - a. With the engine cold, upward (not total) free play in upper strand should be 5/8-7/8 in. (15.9-22.3 mm).
 - b. With the engine hot, upward (not total) free play in upper strand should be 3/8-5/8 in. (9.5-15.9 mm).
- 4. If free play adjustment is required, see Figure 1-23.
 - a. Loosen, but do not remove, the center bolt nut (1).
 - Move the shoe assembly (2) up or down to obtain the specified free play.
 - c. Tighten center bolt nut to 21-29 ft-lbs (28.5-39.3 Nm). Replace the primary chain (3) if it is worn to the point where it cannot be properly adjusted.
- See Figure 1-22. Install inspection cover (2) with new gasket (1). Tighten cover screws (3, 4) to 84-108 in-lbs (9.5-12.2 Nm).
- 6. Connect negative battery cable.



Figure 1-22. Inspection Cover



Figure 1-23. Primary Chain Adjustment

CHANGING LUBRICANT

- 1. See Figure 1-24. Remove drain plug at bottom of primary chaincase. Drain lubricant into suitable container.
- 2. Clean drain plug. If plug has accumulated a lot of debris, inspect the condition of chaincase components.
- 3. Install new o-ring on drain plug.
- Install drain plug back into primary chaincase cover. Tighten plug to 36-60 in-lbs (4.1-6.8 Nm).
- See Figure 1-25. Remove five TORX screws with captive washers (1) to detach clutch inspection cover (2) from primary chaincase cover.
- Remove the gasket. Wipe oil from groove in chaincase cover and mounting surface.

AWARNING

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

CAUTION

Do not over-fill the primary chaincase with lubricant. Over-filling may cause rough clutch engagement, incomplete disengagement, clutch drag and/or difficulty in finding neutral at engine idle.

 See Figure 1-26. Pour 26 oz. (769 ml) of primary chaincase lubricant in through the clutch inspection cover opening. The primary chaincase lubricant level is acceptable when lubricant is visible between clutch and inner wall of chaincase with motorcycle with motorcycle standing upright.

NOTE

- Use only Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 998851-05 (quart).
- If new clutch discs are being installed, or if the lubricant has been wiped from serviceable discs, submerge the discs in FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT for a minimum of five minutes before installation.



Figure 1-24. Removing Chaincase Drain Plug



Figure 1-25. Clutch Cover



Figure 1-26. Lubricant Level With Motorcycle Upright

- To avoid punching holes in the clutch inspection cover gasket or enlarging existing holes, install clutch inspection cover gasket as follows:
 - a. Thoroughly wipe all lubricant from gasket surfaces, cover mounting surface and groove in chaincase.
 - b. Align the triangular shaped hole in the gasket with the top hole in the clutch inspection cover. Be sure the rubber molding and the words "towards clutch" face the motorcycle.
 - c. Insert screw (with captive washer) through clutch inspection cover and carefully thread it all the way through triangular shaped hole in gasket. Do not push screw through hole.
 - Hang the clutch inspection cover on the primary chaincase cover flange by starting the top cover screw.
 - e. Start the remaining four screws (with captive washers).
 - f. Alternately tighten screws to 84-108 in-lbs (9.5-12.2 Nm) following torque sequence shown in Figure 1-27.



Figure 1-27. Clutch Cover Torque Sequence

ADJUSTMENT

CAUTION

Perform the clutch adjustment with the motorcycle at room temperature. The clearance at the adjuster screw will increase as the powertrain temperature increases. If adjuster screw is adjusted with power train hot, clearance at push rod bearing could be insufficient with power train cold and clutch slippage could occur.

- 1. Stand motorcycle upright and level. Point front wheel straight ahead.
- Remove five TORX screws with captive washers to detach clutch inspection cover from primary chaincase cover.
- 3. Remove and discard gasket.
- 4. See Figure 1-28. Add free play to cable.
 - a. Slide rubber boot (1) off cable adjuster.
 - b. Holding cable adjuster (2) with 1/2 in. wrench, loosen jam nut (3) using a 9/16 in. wrench.
 - c. Turn cable adjuster (2) until there is a large amount of free play at clutch hand lever.
- See Figure 1-29. Loosen locknut (1) on clutch adjuster screw (2). To take up all free play, turn screw inward (clockwise) until lightly seated. Activate the clutch lever to verify the balls are seated in the ramps.
- Back out adjusting screw (counterclockwise) 1/2 to 1 full turn. Tighten jamnut to 72-120 in-lbs (8.1-13.6 Nm), while holding adjusting screw with an Allen wrench.
- 7. Squeeze clutch lever to maximum limit three times, to set ball and ramp release mechanism.
- 8. Check free play.
 - a. Turn cable adjuster away from jam nut until slack is eliminated at hand lever.
 - See Figure 1-30. Pull clutch cable ferrule (2) away from clutch lever bracket (3) to check free play. Turn cable adjuster as necessary to obtain 1/16-1/8 in. (1.6-3.2 mm) free play between end of cable ferrule and clutch lever bracket.
- Hold adjuster with 1/2 in. wrench. Using 9/16 in. wrench, tighten jam nut against cable adjuster. Cover cable adjuster mechanism with rubber boot.







Figure 1-29. Clutch Adjuster Screw



Figure 1-30. Clutch Hand Lever

- Install clutch inspection cover and gasket. To avoid punching holes in the clutch inspection cover gasket or enlarging existing holes, install gasket as follows:
 - a. Thoroughly wipe all lubricant from gasket surfaces, cover mounting surface and groove in chaincase.
 - Align the triangular shaped hole in the gasket with the top hole in the clutch inspection cover. Be sure the rubber molding and the words "towards clutch" face the motorcycle.
 - c. Insert screw (with captive washer) through clutch inspection cover and carefully thread it all the way through triangular shaped hole in gasket. Do not push screw through hole.
 - Hang the clutch inspection cover on the primary chaincase cover flange by starting the top cover screw.
 - Start the remaining four screws (with captive washers).
 - Alternately tighten screws to 84-108 in-lbs (9.5-12.2 Nm) following torque sequence shown in Figure 1-31.



Figure 1-31. Clutch Cover Torque Sequence

CHANGING LUBRICANT

- 1. See Figure 1-32. Remove transmission filler plug.
- See Figure 1-33. Remove transmission drain plug and drain lubricant into a suitable container.

CAUTION

Do not overtighten drain plug. When draining or adding lubricant, do not allow dirt, debris or other contaminants to enter transmission drain case. These actions may result in damage to the motorcycle.

- 3. Install drain plug.
 - Inspect O-ring on drain plug for tears or damage. Replace as required. Wipe any foreign material from plug.
 - Install O-ring and drain plug. Tighten to 14-21 ft-lbs (19.0-28.5 Nm). Do not over-tighten.

AWARNING

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

- Fill the transmission with 20-24 oz. (591.5-709.8 ml) of Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05, quart size).
- 5. Check lubricant level.
 - a. Place motorcycle in a level, upright position.
 - Wipe dipstick clean. Place dipstick inside fill hole.
 Dipstick should rest on top thread of filler hole.
 Remove dipstick and check level.
 - See Figure 1-34. Lubricant level should be at the F(ULL) mark on dipstick when removed.
- 6. Install filler plug/dipstick.
 - Check O-ring on dipstick for tears or damage. Replace as required. Wipe any foreign material from plug.
 - Install filler plug/dipstick. tighten to 25-75 in-lbs (2.8-8.5 Nm).



Figure 1-32. Transmission Lubricant Check/Fill



Figure 1-33. Transmission Drain Plug



Figure 1-34. Filler Plug/Dipstick

REAR BELT DEFLECTION

INSPECTION

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

Check rear belt deflection:

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

When checking belt deflection:

- Set belt tension at tightest point in belt.
- Perform procedure with motorcycle cold.
- Measure belt deflection with the approximate weight of the owner on motorcycle.

NOTE

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

 See Figure 1-35. Obtain BELT TENSION GAUGE (HD-35381).

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.

- See Figure 1-36. Check that the drive belt top strand deflects 1/4-5/16 in. (6.4-7.9 mm) while applying 10 lbs (4.5 kg) of force upward.
- If belt adjustment is necessary, see Figure 1-37. Remove spring clip (1) and loosen axle nut (2) and jam nut (3).
- Adjust belt tension by turning the axle adjusters (4) an equal number of turns to keep the wheel aligned until the specification in step 2 is achieved.
- Tighten axle adjuster jam nuts (3) to 15-20 ft-lbs (20.3-27.1 Nm). Check that rear wheel is properly aligned. See 2.15 VEHICLE ALIGNMENT.

AWARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

- 6. Install axle nut.
 - a. Tighten axle nut (2) to 60 ft-lbs (81.3 Nm).
 - b. Check to see if the spring clip (1) can be installed. If required, tighten nut just enough to align axle hole and nut slots, but do not exceed 65 ft-lbs (88.1 Nm).



Figure 1-35. Belt Tension Gauge (Part No. HD-35381)



Figure 1-36. Checking Belt Deflection



- 1. Spring clip
- 2. Axle nut
- 3. Axle adjuster jam nut
- 4. Axle adjuster

Figure 1-37. Axle Adjusters

GENERAL

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.

- See Figure 1-38. 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 1-38. Rear Sprocket

Rear Belt

See Figure 1-39. 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 1-39. Drive Belt Wear Patterns

Table 1-	5. Drive	Belt Wear	Analysis	in	Figure	1-39.
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PATTERN	CONDITION	REQUIRED ACTION	
1	Internal tooth cracks (hairline)	OK to run, but monitor condition	
2	External tooth cracks	Replace belt	
3	Missing teeth	Replace belt	
4	Chipping (not serious)	OK to run, but monitor condition	
5	Fuzzy edge cord	OK to run, but monitor condition	
6	Hook wear	Replace belt	
7	Stone damage	Replace belt if damage is on the edge	
8	Bevel wear (outboard edge only)	OK to run, but monitor condition	

REAR SHOCK PRELOAD

PART NO.	SPECIALTY TOOL	
HD-94455-89	Spanner wrench	

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

1. See Figure 1-40. Loosen the locknuts (2).

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

- See Figure 1-41. Use the SPANNER WRENCH (Part No. 94455-89) and extend or compress the springs to the rider's desired position. Mark the adjuster plates so you adjust both springs to the same position.
 - a. Turning the adjuster plates OUT (toward the locknut) increases the spring preload to carry a heavier load.
 - b. Turning the adjuster plates IN (away from the locknut) decreases the spring preload to carry a lighter load.
- 3. Tighten the locknuts against the adjuster plates.



Figure 1-40. Rear Shock Adjustment



Figure 1-41. Spanner Wrench

ADJUSTMENT

Bearing Adjustment (Fall-away)

- Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
- Remove all accessory weight, such as a windshield, that may influence the way the front end swings. If clutch cable is routed so it pulls the front end one way or the other, disconnect it.
- Place a suitable marking material, such as masking tape, over the fender tip.
- Install a pointer so the base is stationary on the floor and the pointer indicates the center of the fender. The front end should be straight ahead, however the balance point may be slightly off center.
- 5. Loosen fork stem bracket pinch bolts.
- 6. Check steering head bearing tension.
 - a. Tap the fender on one side until the front end begins to "fall-away" by itself. Label this point on the marking material.
 - b. Repeat the previous step in the other direction.
 - c. Measure distance between marks.
- The distance between the "fall-away" marks must be 1.0-2.0 in. (25.4-50.8 mm). Tighten or loosen the fork adjuster nut/bolt until the measurement is within limits.
 - a. If the distance is more than 2.0 in. (50.8 mm), loosen the adjuster nut.
 - b. If it is less than 1.0 in. (25.4 mm), tighten the adjuster nut.



Figure 1-42. Grease Fitting

NOTE

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

- 8. Tighten fork stem bracket pinch bolts.
 - a. On FXSTD models, apply LOCTITE ANTI-SEIZE to fork stem bracket pinch bolts before installation. Tighten to 35-40 ft-lbs (47.5-54.2 Nm).
 - b. On all models except FXSTD, tighten pinch bolts to . 30-35 ft-lbs (40.7-47.5 Nm).
- Repeat the "fall-away" procedure to be sure the adjustment is correct.

LUBRICATION

See Figure 1-42. Use SPECIAL PURPOSE GREASE (Part No. 99857-97) every 5,000 mile (8,000 km) service interval. Fill grease fitting on steering neck until grease begins to come out the top and bottom of the steering head.

GENERAL

AWARNING

The front end components of the Springer and their design relationships to each other are very important. Altering these relationships by modifying the springer front end could adversely affect the handling of your motorcycle and lead to an accident which could result in death or serious injury.

NOTES

- Do not alter the fender brackets to lower the fender. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Do not replace the O.E.M. tire with a higher-aspect ratio tire. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Do not replace the O.E.M. tire on FXSTS model with a traditional-looking 21 in. front wheel, tire and front fender. In addition to above, this could adversely affect the handling characteristics of this motorcycle.
- Do not replace the O.E.M. tire on FLSTSC model with a custom-looking 16 in. front wheel, tire and front fender. In addition to above, this could adversely affect the handling characteristics of this motorcycle.
- Harley-Davidson has designed and manufactured this special, custom front end according to our very stringent and well-tested standards. If you modify the Springer front end in any way that changes our original design, Harley-Davidson cannot and will not assume responsibility.

ACAUTION

Only Touring Harley-Davidson Motorcycles are suitable for sidecar use. Consult a Harley-Davidson dealer. Use of motorcycles other than Touring models with sidecars could result in death or serious injury. (00040a)

NOTE

The springer fork was NOT designed for sidecar use. DO NOT use either the FXSTS or FLSTSC motorcycle, or any springer fork-equipped vehicle for this purpose.

Lubrication

Use SPECIAL PURPOSE GREASE (Part No. 99857-97) at every 2500 mi (4000 km). Fill grease fitting on steering neck until grease begins to come out the top and bottom of the steering head.

Adjustment

PART NO.	SPECIALTY TOOL	
HD-47255	Springer steering head bearing tool	

CAUTION

Do not use this tool to seat the upper bearing retainer nut. High torque will bend the pins in the tool.

This tool can be used to adjust the steering head bearings by removing only the acorn nut and rubber washer. Without the tool, you will have to remove the handlebars, risers, rigid fork leg studs and upper triple clamp to adjust the steering head bearing.



Figure 1-43. Springer Steering Head Bearing Tool

FLSTSC MODELS

NOTE

The fork has more weight on the left side than the right side. The balance point is just right of center.

- 1. Raise the motorcycle so wheels are off the floor an equal amount.
- 2. Remove the clutch cable.
- 3. Remove the throttle cables.
- See Figure 1-44. Remove acorn nut (1) and washer (2). Loosen, but do not remove, the upper triple clamp pinch bolt (3).
- 5. Remove all accessory weight, such as a windshield, that may influence the way the front end swings.
- Place a suitable marking material, such as masking tape, over the fender tip.
- 7. Find the balance point of the front end.
- 8. Install a pointer so the base is stationary on the floor and the pointer is centered on the fender.
- 9. Check steering head bearing tension.
 - Tap the fender on one side until the front end begins to "fall-away" by itself. Label this point on the marking material.
 - b. Repeat the previous step in the other direction.
 - c. Measure the distance between marks.
- The distance between the "fall-away" marks must be 1.0-2.0 in. (25.4-50.8 mm). Tighten or loosen the hex bearing retaining nut until the measurement is within limits.
 - a. If the distance is more than 2.0 in. (50.8 mm), loosen the adjuster nut.
 - b. If it is less than 1.0 in. (25.4 mm), tighten the adjuster nut.
- Tighten the upper clamp pinch bolt (3) to 25-30 ft-lbs (33.9-40.7 Nm).
- Install the rubber washer and acorn nut. Tighten acorn nut to 30-35 in-Ibs (3.4-4.0 Nm).
- Repeat the "fall-away" procedure to verify that adjustment is correct.

FXSTS MODELS

NOTE

The fork has more weight on the right side than the left side. The balance point is just off full left lock.

- Raise the motorcycle so wheels are off the floor an equal amount.
- See Figure 1-44. Remove the acorn nut (1) and rubber washer (2). Loosen, but do not remove, the upper triple clamp pinch bolt (3).
- 3. Turn the fork to full left lock.

- 1. Acorn nut
- 2. Rubber washer
- 3. Pinch bolt
- 4. Hex bearing retainer



Figure 1-44. FLSTSC/FXSTS Fork Adjustment

- 4. See Figure 1-45. Hang a plum bob (2) from the hole (1) in the fender. Lay a ruler (3) on the floor directly under the plumb bob, with the point of the plumb bob at zero.
- 5. See Figure 1-43. Insert the hex bearing retainer tool into the upper triple clamp and hex bearing retainer holes.
- 6. Move the front wheel to the balance point and tap it until it begins to "fall-away" to the right.
- Adjust the hex bearing retainer with the tool until the total measurement, from zero to "fall-away" (from full left lock to "fall-away" to the right) is 4.0-6.0 in. (101.6-152.4 mm).
- See Figure 1-44. Tighten pinch bolt (3) to 25-30 ft-lbs (33.9-40.7 Nm).
- 9. Install the rubber washer (2) and acorn nut (1). Tighten to 30-35 in-lbs (3.4-4.0 Nm).



Figure 1-45. Adjusting FXSTS "Fall-away"

INSPECTION

CAUTION

To perform this adjustment, the spring fork must be secured to the rigid fork. Use cable ties to tie wrap the fork legs in place as shown in Figure 1-46. The spring fork can be disconnected from the rockers without removing the front end from the motorcycle.

- Remove front brake caliper and brake line. See 2.19 FRONT BRAKE CALIPER: FLSTSC or 2.20 FRONT BRAKE CALIPER: FXSTS.
- Remove front wheel. See 2.6 FRONT WHEEL: FLSTSC or 2.7 FRONT WHEEL: FXSTS.
- On FLSTSC only, remove front fender. See 2.32 FRONT FENDER: FLSTSC.

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Figure 1-46. Cable Strap Spring Fork Legs

WARNING

See Figure 1-46. Use nylon cable ties around the rigid and spring fork legs to hold them in place. If the spring fork legs are not held in place, next to the rigid fork legs, the spring pressure will snap them forward with great force, which could result in death or serious injury.

- See Figure 1-46. Use cable ties to tie wrap the spring fork legs to the rigid fork legs.
- See Figure 1-47. Loosen, but do not remove, the bearing retainer jam nuts (7) and bearing retainers (6) on the rockers.

NOTE

Installed direction of rigid fork bearing retainer jam nut (7) depends upon the rocker. On **FXSTS** models, the **threaded side** of the rocker and jam nut is **inboard** of the rigid fork leg. On **FLSTSC** models, the **threaded side** of the rocker and jam nut is **outboard** the rigid fork leg.

- Loosen spring fork pivot studs (5) (thick head) and remove the acorn nut (1) and washer (2) from each stud. Do not remove the pivot stud from the rocker at this time.
- 7. Tighten bearing retainers (6) to 25-35 in-Ibs (2.8-4.0 Nm).
- Hold the bearing retainer in place with a hex driver while tightening jam nut (7) to 95-105 ft-lbs (128.8-142.4 Nm).
- 9. Remove the pivot studs (5) from the spring fork (8).



- 1. Nut (2) (acorn on FXSTS/hex on FLSTSC)
- 2. Washer, rocker to fork leg (2)
- 3. Spherical bearing, fork to rocker (2)
- 4. Pivot stud, rigid fork to rocker
- 5. Pivot stud, spring fork to rocker (thick head)
- 6. Bearing retainer, rigid fork
- 7. Bearing retainer jam nut
- 8. Spring fork leg
- 9. Rigid fork leg
- 10. Spherical bearing ball, fork to rocker (2)
- 11. Spherical bearing race, fork to rocker (2))

Figure 1-47. Rocker Assembly

- See Figure 1-48. Using a dial or beam type torque wrench, rotate the rigid fork pivot stud and rocker through the arc shown. The torque reading should be 25-35 in-Ibs (2.8-4.0 Nm).
- If the torque reading in the previous step is out of specification, adjust the bearing retainer to obtain a 25-35 in-Ibs (2.8-4.0 Nm) reading.

NOTE

If you feel metal to metal contact (grinding while moving the rocker), replace the spherical bearings.

- See Figure 1-47. Attach the spring fork legs (8) to the rockers by installing the pivot studs (5) (thick head), from the inboard side, with washers (2) and nuts (1) (acorn on FXSTS/hex on FLSTSC). Tighten nuts to 45-50 ft-lbs (61.0-67.8 Nm).
- 13. On FLSTSC only, install fender. See 2.32 FRONT FENDER: FLSTSC.
- 14. Install front wheel. See 2.6 FRONT WHEEL: FLSTSC or 2.7 FRONT WHEEL: FXSTS.
- Install front brake caliper and brake line. See 2.19 FRONT BRAKE CALIPER: FLSTSC or 2.20 FRONT BRAKE CALIPER: FXSTS.



Figure 1-48. Rocker Rotation

REPLACING FORK OIL

 Support the motorcycle so the front end is off the floor and the forks are fully extended.

AWARNING

The FLSTC, FLSTF and FLST models have a preloaded fork spring. The fork tube plug is under spring pressure. Disassemble the fork tube(s) carefully. The spring can force parts from the tube unexpectedly, which could result in death or serious injury.

- 2. See Figure 1-49. Remove the fork tube caps.
- 3. Drain fork oil.
 - FXSTD models, see Figure 1-50. Remove the drain screws and washers from each fork and drain the fork oil.
 - All models except FXSTD, see Figure 1-51. Remove and discard the drain screws and washers from each fork and drain the fork oil.
- 4. Install new drain screws and washers.
 - a. FXSTD models, apply LOCTITE THREADLOCKER 243 (blue) to drain screws and tighten to 12-18 inlbs (1.4-2.0 Nm).
 - All models except FXSTD, tighten drain screws to 52-78 in-lbs (5.9-8.9 Nm).



Figure 1-49. Fork Tube Cap



Figure 1-50. Fork Drain Screw: FXSTD (Left Side Shown)

- Refer to Table 1-7. Fill the fork with Harley-Davidson TYPE E FORK OIL (Part No. HD-99884-80).
- 6. Tighten fork tube caps to 40-60 ft-lbs (54.2-81.3 Nm).

Table 1-7. Type E Fork Oil Amounts

MODEL	oz	cc	IN.	MM
FLSTF, FLSTC, FLSTN, FLST	12.9	382	4.72	119.9
FXST, FXSTB	12.0	356	7.28	184.9
FXSTD	11.6	343	7.48	189.9

NOTE

Refer to Table 1-7. Fork oil amounts can be measured two ways.

- Use oz./cc measurement if fork is left in frame.
- Use in./mm measurement if fork is disassembled. In this case, oil level is measured from top of fork tube, with spring removed and fork fully compressed.



Figure 1-51. Fork Drain Screw: All Models Except FXSTD (Right Side Shown)

INSPECTION

- After the engine has cooled to room temperature, disconnect cables from both spark plugs.
- Remove spark plugs. If a plug has eroded electrodes, heavy deposits or a cracked insulator, discard it.
- See Figure 1-52. Compare your observations of the plug deposits with the descriptions provided below.
 - a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
 - 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.
 - d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.
- 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. 6R12 spark plugs.



Figure 1-52. Typical Spark Plug Deposits

- 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 0.038-0.043 in. (0.97-1.09 mm).
- Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.
- Apply LOCTITE ANTI-SEIZE to plugs. Install and tighten to 12-18 ft-lbs (16.3-24.4 Nm).
- Connect spark plug cables. Rear cylinder plug cable attaches to top coil terminal. Verify that cables are securely connected to coil and spark plugs.

REMOVAL

- See Figure 1-53. Remove screw (1) and air cleaner cover (2).
- 2. Remove three TORX screws (4) and bracket (5) from filter element (6).
- Gently pull both rubber breather tubes (9) from the back of the element. Remove filter element (6) and gasket (7).
- Replace the filter element if damaged or if filter media cannot be adequately cleaned.

AWARNING

Do not use gasoline or solvents to clean filter element. Flammable cleaning agents can cause an intake system fire, which could result in death or serious injury. (00101a)

5. Gently pull the breather tubes from the breather bolts on the backplate (8).

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 6. Clean filter element.
 - a. Wash the paper/wire mesh air filter element and breather tubes in lukewarm water with a mild detergent. Do not strike filter element on a hard surface to dislodge dirt.
 - b. Allow filter to either air dry or blow it dry, from the inside, with low pressure air. Do not use air cleaner filter oil on the Harley-Davidson paper/wire mesh air filter element.
 - c. Hold the filter element up to a strong light source. If light is uniformly visible through the element, it is sufficiently clean.
- 7. Inspect seal ring (3) on cover for cracks or tears. Verify that it seals tightly to backplate. Replace as required.





 Inspect breather tubes for tears, cuts, holes or other damage. Replace as necessary.

NOTE

The breather tubes allow crankcase vapors to be directed into the air filter element. By providing effective recirculation of crankcase vapor, the tubes serve to eliminate the pollutants normally discharged from the crankcase. Air cleaner mounting without installation of the breather tubes, or with breather tubes that are not air tight, allows crankcase vapors to be vented into the atmosphere in violation of legal emissions standards. This will also negatively affect the engine's breather system as it will cause the umbrella valve to flutter.

- 9. Wipe inside of air cleaner cover and backplate with damp cloth to remove dust.
- 10. On California models only, make sure trap door swings freely.

INSTALLATION

- 1. See Figure 1-54. Position new gasket on backplate.
- See Figure 1-55. Insert two breather tubes into the holes in back of the filter element and place the element back into position. Attach breather tubes to breather screws on backplate.
- 3. See Figure 1-53. Install air filter element and bracket.
 - a. Make sure gasket holes are aligned with backplate holes.
 - b. Use three TORX screws (4) to secure bracket and filter element. Tighten to 40-60 in-lbs (4.5-6.8 Nm).
- 4. Install air filter cover (2).
 - a. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to threads of air cleaner cover screw (1).
 - Install air cleaner cover using screw. Tighten to 36-60 in-lbs (4.1-6.8 Nm).



Figure 1-54. Gasket Installation (carbureted shown)



Figure 1-55. Breather Hose Holes on Backside of Filter

GENERAL

Inspect and lubricate the front brake lever, clutch hand lever, throttle control cables, clutch cable, foot shift lever, rear brake lever bearings and jiffy stand:

CABLES AND HAND LEVERS

CAUTION

On carbureted models, do not lubricate the enrichener cable or inside of enrichener cable conduit. The cable must have sliding resistance to work properly.

See 1.24 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 scheduled service interval.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals. See 2.41 JIFFY STAND for more information.

CABLE INSPECTION, LUBRICATION AND ADJUSTMENT

Inspection and Lubrication

- 1. See Figure 1-56. Remove two screws (1) to separate the upper handlebar housing from the lower housing.
- 2. Turn the cable adjusters (2, 4) and jamnuts (3) as short as they will go.
- 3. Unhook each ferrule and cable from the throttle grip and remove the throttle sleeve.
- Apply a light coat of graphite to the handlebar and replace throttle grip.
- Put one or two drops of SUPER OIL (Part No. 94968-85TV) into the housing of each cable.
- When assembling the handlebar housing, tighten both screws (1) to 35-45 in-Ibs (4.0-5.1 Nm).



Figure 1-56. Throttle Cable Adjusters

Adjustment

- 1. See Figure 1-56. 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.
 - b. On carbureted models, See Figure 1-57. Turn the throttle cable adjuster, lengthening the sleeve, until the throttle cam (2) just touches the cam stop (5).
 - c. On EFI models, See Figure 1-58. Turn the throttle cable adjuster, lengthening the sleeve, until the throttle cam (2) just touches the cam stop (5).
 - d. Tighten the adjuster jamnut and release the throttle.
- 3. Turn the front wheel full right.
- Turn the idle cable adjuster, 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.



Figure 1-57. Idle Cable Connection (carbureted shown)



Figure 1-58. Idle Cable Connection (EFI shown)

ENRICHENER OPERATION

CAUTION

Pay close attention to the vehicle's warm-up time. Either excessive or insufficient use of the enrichener may cause poor performance, erratic idle, poor fuel economy, spark plug fouling and equipment damage. (00164a)

CAUTION

Do not lubricate the enrichener cable or inside of enrichener cable conduit. The cable must have sliding resistance to work properly.

See Figure 1-59. Check fuel enrichener operation. The fuel enrichener knob (1) should open, remain open and then close without binding. The knurled plastic nut (2) next to the enrichener knob controls the ease or difficulty with which the cable slides within the cable conduit.

- 1. Loosen hex nut (5) at backside of mounting bracket.
- 2. Move cable assembly free of slot in mounting bracket.
- Hold cable assembly at flat (3) with an adjustable wrench. Turn knurled plastic nut (2) by hand to set sliding resistance.
 - Turn counterclockwise to reduce resistance until knob slides inward unaided.
 - b. Turn clockwise to increase resistance until knob remains fully out without holding and closes with relative ease.
- Position cable assembly in slot in bracket. Tighten hex nut (5) at backside of bracket to 10-14 in-lbs (1.1-1.6 Nm).

NOTE

The star washer (4) goes between the bracket and nut (5).



Figure 1-59. Enrichener Control

IDLE SPEED INSPECTION

PART NO.	SPECIALTY TOOL
HD-33413-A	Carburetor idle adjuster
HD-33413-1A	Idle adjuster tip

NOTE

- The C.V. carburetor has an enrichener circuit that will cause the engine to idle above the normal idle range (950-1050 RPM) with the engine at normal operating temperature and the enrichener knob pulled fully out.
- The increase in idle speed is intended to alert the rider that the engine is warmed up to normal operating temperature and the enrichener knob should be pushed all the way in.

CAUTION

Do not continue to use the enrichener when the engine is at full operating temperature. Doing so will result in fouled spark plugs.

- TECHNICIAN Be sure the engine is warmed up to normal operating temperature and the enrichener knob is pushed all the way in BEFORE adjusting engine idle speed. Be aware that because there are variations in individual components, it is possible for a properly warmed up engine to idle above the normal idle range (950-1050 RPM) with the enrichener knob pulled PAR-TIALLY OUT.
- Attach a DIGITAL MULTIMETER (Part No. HD-39978 or HD-39200) equipped with a RPM INDUCTIVE PICKUP (Part No. HD-41334) over front spark plug cable to monitor engine RPM.
- Start motorcycle engine and let vehicle reach normal operating temperature with enrichener knob pushed fully in (enrichener closed).
- 3. See Figure 1-60. Set idle speed to 950-1050 RPM using the CARBURETOR IDLE ADJUSTER (Part No. HD-33413-A) and TIP (Part No. HD-33413-1A).
 - a. Turn clockwise to increase idle speed.
 - b. Turn counterclockwise to decrease idle speed.

IGNITION TIMING

See Figure 1-61. Ignition timing on carbureted models is controlled by the ignition control module based on input from:

- Manifold absolute pressure sensor.
- Crank position sensor.



Figure 1-60. Idle Adjustment Screw: Carbureted Models



Figure 1-61. Ignition Control Module: Carbureted Models

There is no ignition timing adjustment required. Should a sensor fail, the resulting trouble code will identify the problem. See Softail Models Electrical Diagnostic Manual for more information.

INSPECTION

PART NO.	SPECIALTY TOOL	
HD-23738-A	Plastic Mity-Vac hand pump	
HD-97087-65B	Hose clamp pliers	

NOTE

See 4.6 FUEL SUPPLY VALVE: CARBURETED for more information.

1. See Figure 1-62. Turn ignition OFF. Turn fuel supply valve handle to OFF (horizontal) position.

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- See Figure 1-63. Remove the fuel hose (8) from the outlet nipple (6). Remove the vacuum hose from the vacuum nipple (4).
- 3. Attach a piece of fuel hose to fuel outlet nipple and route hose into a proper, clean gasoline container.
- 4. Turn valve handle to RESERVE (up).
- Using the appropriate hose adapter, connect the PLAS-TIC MITY-VAC® HAND PUMP (Part No. HD-23738-A) to vacuum nipple (4) on valve. See Figure 1-64.

CAUTION

Do not apply a vacuum greater than 25 in. of Hg to the valve at the vacuum nipple to avoid damaging the valve diaphragm.

- Gently apply a vacuum of 1-10 in. of Mercury (Hg) or just enough vacuum to get a good flow of gasoline through the valve.
- See Figure 1-63. After draining tank, turn the fuel valve nut (2) that attaches the valve to the fuel tank adapter (9) counterclockwise and remove the valve, gasket (3), and filter (1).
- 8. Clean or replace the fuel filter.
- Coat valve threads with LOCTITE PIPE SEALANT WITH TEFLON.
- 10. Install new gasket on valve and install fuel filter.



Figure 1-62. Fuel Supply Valve OFF



Figure 1-63. Fuel Supply Valve Assembly



Figure 1-64. Mity-Vac Hand Pump

AWARNING

Do not thread hex nut onto valve more than two turns to prevent "bottoming" nut on valve, which can cause a fuel leak. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00276a)

NOTE

If fuel valve adapter (9) is being replaced or reinstalled, coat threads with LOCTITE PIPE SEALANT WITH TEFLON. Torque adapter to 22-26 ft-lbs (29.8-35.2 Nm).

- 11. Attach fuel supply valve to fuel valve adapter.
 - Thread fuel valve nut (2) on right hand threads of fuel tank adapter two turns.
 - Hold fuel valve nut and thread body of fuel supply valve into left hand threads of nut for two turns.
 - Hold valve and tighten fuel valve nut (clockwise) to 15-20 ft-lbs (20.3-27.1 Nm).
- See Figure 1-65. Connect the fuel hose to the valve using **new** clamp and HOSE CLAMP PLIERS (Part No. HD-97087-65B).
- See Figure 1-66. Connect the fuel hose to the carburetor using **new** clamp and HOSE CLAMP PLIERS (Part No. HD-97087-65B).

CAUTION

Do not allow dirt or fluids to get into the vacuum hose assembly that connects the fuel valve to the carburetor. Contaminants could block the vacuum signal or inhibit free motion of moving parts which could cause the fuel valve to remain open.

Connect vacuum line to vacuum nipple and fill tank with gasoline.

NOTE

See Figure 1-63. If vacuum line is connected to the atmosphere vent nipple (5) (bottom nipple) the valve will not open.

15. Turn valve handle to ON and start engine. No special procedures are required to start fuel flow.

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.



Figure 1-65. Hose Clamp Pliers



Figure 1-66. Carburetor Connection

ENGINE MOUNTS

INSPECTION

- 1. See Figure 1-67. Tighten the rear fork pivot nut to 90-110 ft-lbs (122.0-149.1 Nm).
- See Figure 1-68. Tighten front engine mounting nuts (1) to 70-80 ft-lbs (94.9-108.5 Nm).
- Tighten the upper engine mounting to cylinder head bolts (2) to 28-35 ft-lbs (38.0-47.5 Nm)
- Tighten the upper engine to frame mounting bolt (3) to 45-50 ft-lbs (61.0-67.8 Nm).
- 5. Inspect all the engine mounting hardware for damage.



Figure 1-67. Pivot Nut



Figure 1-68. Engine Mounts

INSPECTION

AWARNING

The automatic-on headlamp feature provides increased visibility of the rider to other motorists. Be sure headlamp is on at all times. Poor visibility of rider to other motorists can result in death or serious injury. (00030b)

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.)
- Verify correct front and rear tire pressure. See 1.9 TIRES AND WHEELS.
- Place motorcycle on level floor (or pavement) in an area with minimum light.
- Position motorcycle 25 ft (7.6 m) away from a screen or wall. Measure the distance from directly below the front axle to the base of the screen/wall.
- 4. Set mark for alignment purposes.
 - a. See Figure 1-69. For FXSTD, FXST, FXSTB, FXSTS FLSTSC and (and HDI FLSTC/FLSTF) vehicles, draw a horizontal line 35 in. (0.9 m) above floor on screen/wall.
 - See Figure 1-70. For FLSTC, FLSTF and FLSTN vehicles, draw a horizontal line level with the center of the headlamp.
- 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).
- See Figure 1-71. Turn ignition switch ON. Set handlebar headlamp switch to HIGH beam position.
- 8. Check light beam for alignment.
 - a. The main beam, which is a broad, flat pattern of light, should be centered equally above and below the horizontal line.
 - b. The main beam of light should also be directed straight ahead. Properly adjusted headlamps project an equal area of light to right and left of center.
 - c. Adjust headlamp alignment if necessary.



Figure 1-69. Headlamp Alignment



Figure 1-70. Headlamp Alignment: FLSTC/FLSTF/FLSTN/ FLST (Domestic Models)



Figure 1-71. High Beam Setting

ADJUSTMENT

FLSTSC/FXSTS Models

- 1. See Figure 1-72. Set vertical adjustment.
 - a. Loosen the two vertical adjustment fasteners (1).
 - b. Tilt headlamp up or down in relationship to the horizontal line from the headlamp alignment inspection.
 - c. Tighten both fasteners to 25-35 ft-lbs (33.9-47.5 Nm).

CAUTION

Position FXSTS headlamp as far forward as the slot will allow. This will prevent the headlamp from contacting the springs which may result in vehicle damage.

- 2. Set horizontal adjustment.
 - a. Loosen the horizontal adjustment fastener (2).
 - b. Tilt headlamp left or right to direct light beam straight ahead.
 - c. Move headlamp adjustment mechanism forward to the end of the bracket slot.
 - d. Tighten fastener to 25-35 ft-lbs (33.9-47.5 Nm).

FLSTC/FLSTF/FLSTN/FXSTB/FXST, FLST MODELS

- 1. See Figure 1-73. Loosen horizontal adjusting bolt (2) to adjust headlamp beam side to side.
- 2. Tighten fastener to 30-35 ft-lbs (40.7-47.5 Nm).
- Loosen vertical adjusting bolt (1) to adjust headlamp up or down.
- 4. Tighten fastener to 35-45 ft-lbs (47.5-61.0 Nm).

FXSTD MODELS

- See Figure 1-74. Loosen horizontal adjusting bolt (2) to adjust headlamp beam side to side.
- 2. Tighten fastener to 25-30 ft-lbs (33.9-40.7 Nm).
- Loosen vertical adjusting bolt (1) to adjust headlamp up or down.
- 4. Tighten fastener to 25-30 ft-lbs (33.9-40.7 Nm).



Figure 1-72. Headlamp Adjustment: FLSTSC, FXSTS



- 1. Vertical adjusting bolt
- 2. Horizontal adjusting bolt

Figure 1-73. Headlamp Adjustment: FLSTC, FLSTF, FLSTN, FXSTB, FXST, FLST



Figure 1-74. Headlamp Adjustment: FXSTD

INSPECTION

Inspect critical fasteners, except head bolts:

• At the scheduled service intervals.

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

SYSTEM	FASTENER	TOR	QUE
	Upper and lower switch housings	35-45 in-lbs	4.0-5.1 Nm
Hand controls	Clutch lever handlebar clamp	60-80 in-lbs	6.8-9.0 Nm
	Master cylinder handlebar clamp	60-80 in-lbs	6.8-9.0 Nm
	Banjo bolts	17-22 ft-lbs	23.0-29.8 Nm
	Lower brake caliper mounting pin	28-38 ft-lbs	38.0-51.5 Nm
Duchas	Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm
Brakes	Brake disc screws, rear	30-35 ft-lbs	40.7-47.5 Nm
	Reservoir screws	6-8 in-lbs	0.7-0.9 Nm
	Rear master cylinder mounting nut	40-50 ft-lbs	54.2-67.8 Nm
	Front axle: all but FLSTSC/FXSTS	50-55 ft-lbs	67.8-74.6 Nm
Axle nuts	Front axle: FLSTSC/FXSTS	60-65 ft-lbs	81.3-88.1 Nm
	Rear axle	60-65 ft-lbs	81.3-88.1 Nm
	Lower fork pinch bolts: all but FXSTD	30-35 ft-lbs	40.7-47.5 Nm
	Lower fork pinch bolts: FXSTD	35-40 ft-lbs	47.5-54.2 Nm
Front fork/handlebars	Upper bracket pinch bolts	23-28 ft-lbs	31.2-38.0 Nm
	Riser clamp screws	144-180 in-lbs	16.3-20.3 Nm
	Riser lock nuts	30-40 ft-lbs	40.7-54.2 Nm

Table 1-8. Critical Fasteners

WARNING

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

If the motorcycle will not be operated for several months, such as during the winter season, there are several things which should be done to protect parts against corrosion, to preserve the battery, and to prevent the buildup of gum and varnish in the carburetor.

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

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

WARNING

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

- 2. Choose one of the following two methods for preparing your fuel system.
 - a. Fill fuel tank and add a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions. Turn fuel supply valve off. Start motorcycle and run vehicle until fuel in carburetor float bowl is gone and engine stops running.
 - b. Drain all gasoline from the fuel tank. Spray the inside of the fuel tank with one of the commercially available rust preventatives. Follow the manufacturer's instructions.

- Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
- 4. Adjust primary chain. See 1.10 PRIMARY CHAIN.
- Inspect rear belt deflection. See 1.14 REAR BELT DEFLECTION.
- Inspect rear belt and sprockets. See 1.15 REAR BELT AND SPROCKETS.
- Inspect air cleaner filter. See 1.22 AIR CLEANER FIL-TER.
- Lubricate controls. See 1.23 CABLE AND CHASSIS LUBRICATION.
- Inspect operation of all electrical equipment and switches.
- 10. Check tire inflation. and inspect tires for wear and damage. 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.

AWARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

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

- Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a).
- Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. KEEP BATTERIES AWAY FROM CHILDREN. (00065a)
- Remove battery from vehicle. Charge battery until the correct voltage is obtained. 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). See 1.5 BATTERY MAINTENANCE.

ACAUTION

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

 If the motorcycle is to be covered, use a material that will breathe, such as light canvas or Storage Cover (Part No. 98716-87). Plastic materials that do not breathe promote the formation of condensation, which leads to corrosion.

REMOVAL FROM STORAGE

WARNING

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

- 1. Charge and install the battery.
- Remove and inspect the spark plugs. Replace if necessary.
- 3. Clean the air cleaner element.
- 4. If fuel tank was drained, fill fuel tank with fresh gasoline.
- Start the engine and run until it reaches normal operating temperature.
- 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.

GENERAL

AWARNING

The troubleshooting section of this manual is a guide to diagnose problems. Read the appropriate sections of this manual before performing any work. Improper repair and/or maintenance 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.

NOTE

For further troubleshooting information see Softail Models Electrical Diagnostic Manual.

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.
- Discharged battery, loose or corroded connections (solenoid chatters).
- 4. Starter control circuit, relay, or solenoid faulty.
- Electric starter shaft pinion gear not engaging or overrunning clutch slipping.
- 6. Security system activated.

Engine Turns Over But Does Not Start

- 1. Fuel tank empty or fuel supply valve turned off.
- 2. Fouled spark plugs.
- Engine flooded with gasoline as a result of over use of enrichener.*
- Vacuum hose to automatic fuel supply valve disconnected, leaking, or pinched.*
- Discharged battery, loose or broken battery terminal connections.
- 6. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

- Spark plug cables in bad condition and shorting, cable connections loose or cables connected to incorrect cylinders.
- Loose wire connection at coil, battery, or plug between ignition control module or ECM.
- Ignition timing incorrect due to faulty coil, ignition control module, ECM or sensors.

- Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.
- 11. Fuel valve or filter clogged.*
- 12. Sticking or damaged valve or wrong length push rod.
- 13. Cam primary gear key sheared or missing the spacer.

Starts Hard

- Spark plugs in bad condition or have improper gap or are partially fouled.
- 2. Spark plug cables in bad condition.
- 3. Battery nearly discharged.
- Loose wire connection at one of the battery terminals, coil, or plug between ECM or ignition control module.
- 5. Throttle controls not adjusted correctly.
- 6. Water or dirt in fuel system and/or carburetor.
- 7. Water or dirt in carburetor.*
- 8. Intake air leak.
- Fuel tank vent hose and vapor valve plugged, or fuel line closed off, restricting fuel flow.*
- 10. Enrichener valve inoperative.*
- 11. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

- 12. Ignition not functioning properly (possible sensor failure).
- 13. Faulty ignition coil.
- 14. Valves sticking.

Starts But Runs Irregularly or Misses

- 1. Spark plugs in bad condition or partially fouled.
- 2. Spark plug cables in bad condition and leaking.
- 3. Spark plug gap too close or too wide.
- 4. Faulty ignition coil, module, or sensor.
- 5. Battery nearly discharged.
- Damaged wire or loose connection at battery terminals, coil, or plug between ignition sensor and module.
- 7. Intermittent short circuit due to damaged wire insulation.
- 8. Water or dirt in fuel system or filter.
- 9. Water or dirt in carburetor.*
- 10. Fuel tank vent system plugged.
- 11. Carburetor vent line closed off*.
- 12. Throttle controls misadjusted.
- 13. Air leak at intake manifold or air cleaner.
- 14. Damaged carburetor.*
- 15. Clogged fuel injectors.

* Carbureted models

- 16. Loose or dirty ignition control module or ECM connector.
- 17. Faulty Sensor(s): Manifold Absolute Pressure (MAP), Crank Position (CKP),
- 18. Incorrect valve timing.
- 19. Weak or broken valve springs.
- 20. Damaged intake or exhaust valve.

A Spark Plug Fouls Repeatedly

- 1. Fuel mixture too rich or enrichener left on too long.*
- 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.
- Excessive carbon deposit on piston head or in combustion chamber.
- Ignition timing advanced due to faulty sensor inputs (MAP, CKP).

Overheating

- 1. Insufficient oil supply or oil not circulating.
- 2. Insufficient air flow over engine.
- 3. Heavy carbon deposits.
- 4. Ignition timing retarded due to faulty sensor(s): Manifold Absolute Pressure (MAP) and/or Crank Position (CKP).
- 5. Leaking valve.

Valve Train Noise

- 1. Low oil pressure caused by oil feed pump not functioning properly or oil passages obstructed.
- 2. Faulty hydraulic lifters.
- 3. Bent push rod.
- 4. Incorrect push rod length.
- 5. Rocker arm binding on shaft.
- 6. Valve sticking in guide.
- 7. Chain tensioning spring or shoe worn.

Excessive Vibration

- 1. Wheels and/or tires worn or damaged.
- 2. Engine/transmission/rear wheel not aligned properly.
- 3. Primary chain badly worn or links tight as a result of insufficient lubrication or misalignment.
- 4. Engine to transmission mounting bolts loose.
- 5. Upper engine mounting bracket loose.
- Ignition timing advanced due to faulty sensor inputs (MAP, CKP)/poorly tuned engine.
- 7. Internal engine problem.
- 8. Broken frame.
- 9. Engine counterbalancer out of time.

Check Engine Light Illuminates During Operation

1. Fault detected. See Softail Models Electrical Diagnostic Manual.

LUBRICATION SYSTEM

Oil Does Not Return To Oil Tank

- 1. Oil tank empty.
- 2. Oil pump not functioning.
- 3. Restricted oil lines or fittings.
- 4. Restricted oil filter.
- 5. O-ring damaged or missing from oil pump/crankcase junction (also results in poor engine performance).

Engine Uses Too Much Oil Or Smokes Excessively

- 1. Oil tank overfilled.
- 2. Restricted oil return line to tank.
- 3. Restricted breather operation.
- 4. Restricted oil filter.
- 5. Piston rings badly worn or broken.
- 6. Valve guides or seals worn.
- 7. O-ring damaged or missing from oil pump/crankcase junction (also results in poor engine performance).
- 8. Plugged crankcase scavenge port.

Engine Leaks Oil From Cases, Push Rods, Hoses, Etc.

- 1. Loose parts.
- 2. Imperfect seal at gaskets, push rod cover, washers, etc.
- 3. Restricted breather hose to air cleaner.
- 4. Restricted oil filter.
- 5. Oil tank overfilled.
- Lower rocker housing gasket installed incorrectly (upside down).
- 7. Restricted oil return line to tank.

Low Oil Pressure

- 1. Oil tank underfilled.
- 2. Faulty low oil pressure switch.
- 3. Oil pump O-ring damaged or missing.
- 4. Bypass valve stuck in open position.
- 5. Ball missing or leaking in cam support plate.

High Oil Pressure

- 1. Oil tank overfilled.
- 2. Bypass valve stuck in closed position.

ELECTRICAL SYSTEM

NOTE

For diagnostic information see Softail Models 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

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

CARBURETOR

Floods

- 1. Dirt or other foreign matter between valve and its seat.
- 2. Inlet valve sticking.
- 3. Inlet valve and/or valve seat worn or damaged.
- 4. Float misadjusted.
- 5. Leaky or damaged float.
- 6. Excessive "pumping" of hand throttle grip.
- 7. See 4.2 FUEL SYSTEM TROUBLESHOOTING.

TRANSMISSION

Shifts Hard

- 1. Primary chaincase overfilled with lubricant.
- 2. Clutch dragging slightly.
- 3. Transmission lubrication too heavy (winter operation).
- 4. Shifter return spring (inside transmission) bent or broken.
- 5. Bent shifter rod.
- 6. Shifter forks (inside transmission) sprung.
- Corners worn off transmission gear dogs (inside transmission).

Jumps Out Of Gear

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

Clutch Slips

- 1. Clutch controls improperly adjusted.
- 2. Insufficient clutch spring tension.
- 3. Worn friction discs.

Clutch Drags Or Does Not Release

- 1. Lubricant level too high in primary chaincase.
- 2. Clutch controls improperly adjusted.
- 3. Primary chain badly misaligned.
- 4. Clutch spring tension.
- 5. Clutch discs warped.

Clutch Chatters

1. Friction discs or steel discs worn or warped.

Irregularities

- 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 1.9 TIRES AND WHEELS.
- 5. Shock absorber not functioning normally.
- 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: ALL BUT FLSTSC/FXSTS or 1.18 STEERING HEAD BEAR-INGS: FLSTSC/FXSTS.
- 10. Tire and wheel unbalanced.
- 11. Loose spokes (laced wheel vehicles only).
- 12. Rims and tires out-of-round or eccentric with hub.
- 13. Rims and tires out-of-true sideways.
- 14. Swing arm pivot improper torque.

Brake Does Not Hold Normally

- 1. Master cylinder reservoir low on fluid.
- 2. Brake system contains air bubbles.
- Master cylinder/caliper piston seals worn or parts damaged.
- 4. Brake pads contaminated with grease or oil.
- 5. Brake pads badly worn.
- 6. Brake disc badly worn or warped.
- Brake drags brake pedal and master cylinder piston not returning completely.
- Brake fades due to heat build up brake pads dragging or excessive braking.
- 9. Brake fluid leak when under pressure.

CHASSIS

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SPECIFICATIONS

MODEL	FUEL TA	FUEL TANK TOTAL		FUEL TANK RESERVE		OIL TANK W/FILTER		TRANSMISSION (APPROX.)		PRIMARY CHAINCASE	
	gal.	liter	gal.	liter	qt.	liter	oz.	liter	oz.	liter	
FLSTC											
FLSTF	3				3.5	3.5 3.31	31 24	0.71	26	0.77	
FLSTSC			0.5	1.89							
FLSTN		10.00									
FLST	5.0	18.92									
FXST											
FXSTB											
FXSTS											
FXSTD	4.9	18.55	0.5	1.89	3.5	3.31	24	0.71	26	0.77	

MODEL	WHEEL BASE		OVERALL LENGTH		OVERALL WIDTH		ROAD CLEARANCE		OVERALL HEIGHT		SADDLE HEIGHT*	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
FLSTC	64.5	1638.3	94.5	2400.3	37.5	952.5	5.1	129.5	57.8	1468.1	25.5	647.7
FLSTF	64.5	1638.3	94.3	2395.2	40.2	1021.1	5.1	129.5	44.5	1130.3	25.4	645.2
FLSTSC	64.5	1638.3	94.5	2400.3	32.7	830.6	4.9	124.5	43.6	1107.4	25.9	657.9
FLSTN	64.5	1638.3	94.7	2405.4	38.4	975.4	4.8	121.9	43.5	1104.9	24.5	622.3
FLST	64.5	1638.3	94.5	2400.3	37.5	952.5	5.1	129.5	57.8	1468.1	25.5	647.7
FXST	66.9	1699.3	95.0	2413.0	38.6	980.4	6.0	142.4	47.3	1201.4	25.2	640.0
FXSTB	66.9	1699.3	95.0	2413.0	31.9	810.3	6.0	142.4	45.1	1145.5	26.0	660.4
FXSTS	65.4	1661.2	93.5	2374.9	36.3	922.0	6.1	154.9	46.7	1186.2	24.9	632.5
FXSTD	66.6	1691.6	95.4	2423.2	35.9	911.9	5.6	142.2	46.4	1178.6	26.0	660.4

* With 180 Lb./81.6 kg Rider

MODEL	WEIGHT (AS SHIPPED)		GVWR		GAWR FRONT		GAWR REAR	
	lb.	kg	lb.	kg	lb.	kg	lb.	kg
FLSTC	719	326	1160	527	430	195	730	331
FLSTF	683	310	1160	527	430	195	730	331
FLSTSC	710	322	1160	527	430	195	730	331
FLSTN	693	314	1160	527	430	195	730	331
FLST	672	305	1160	527	430	195	730	331
FXST	651	295	1125	510	415	188	710	322
FXSTB	651	295	1125	510	415	188	710	332
FXSTS	671	304	1125	510	415	188	710	322
FXSTD	651	295	1125	510	415	188	710	322

NOTE

Gross vehicle weight rating (GVWR) (maximum allowable loaded vehicle weight) and corresponding gross axle weight rating (GAWR) are given on a label located on the frame steering head.

NOTE

See 1.9 TIRES AND WHEELS for important information regarding tire data and tire inflations

TORQUE VALUES

ITEM	TORQUE		NOTES
Belt sprocket screws	55-60 ft-lbs	74.6-81.3 Nm	cast wheels, page 2-22
Brake caliper bleeder valve	80-100 in-lbs	9.0-11.3 Nm	all but FLSTSC/FXSTS, front and rear, page 2-56
Brake caliper bleeder valve	80-100 in-lbs	9.0-11.3 Nm	front and rear, page 2-69, page 2-75
Brake caliper bridge bolts	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC/FXSTS front, page 2-69, page 2-75
Brake caliper bridge bolts	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC/FXSTS, front and rear, page 2-56
Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm	all but FLSTSC/FXSTS, page 2-11
Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm	FLSTSC, page 2-14
Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm	FXSTS, page 2-17
Brake disc screws, rear	30-45 ft-lbs	40.7-61.0 Nm	LOCTITE THREADLOCKER 243_(blue), page 2-22
Brake pad pins	180-200 in-lbs	20.3-22.6 Nm	all but FLSTSC/FXSTS front, 12 pt/0.25 in., page 2-57, page 2-70, page 2-76
Brake reaction link acorn lock- nuts	35-40 ft-lbs	47.5-54.2 Nm	FLSTSC, discard upon removal, page 2-60
Brake reaction link locknut, rigid fork	14-18 ft-lbs	13.6-27.1 Nm	FXSTS, page 2-62
Brake reaction link nut	10-20 ft-lbs	13.6-27.1 Nm	FXSTS, page 2-62
Clutch lever handlebar clamp screw	108-132 in-lbs	12.2-14.9 Nm	page 2-104
Fender mounting bracket lock- nut	21-27 ft-lbs	28.5-36.6 Nm	FLSTN, page 2-122
Fender pivot shafts	10-20 ft-lbs	13.6-27.1 Nm	FXSTS, LOCTITE THREADLOCKER 262, page 2-111
Fender shoulder screws	10-20 ft-lbs	13.6-27.1 Nm	FXSTS, page 2-111
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	all but FXSTD/FLSTS/FLSTN, page 2-113, page 2-115
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	FLSTN, page 2-122
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	FLSTSC, page 2-119
Fender support screws	12-15 ft-lbs	16.3-20.3 Nm	FXSTD, inside of fender, page 2-117
Fender support screws	14-16 ft-lbs	19.0-21.7 Nm	FXSTD, LOCTITE THREADLOCKER 243 (blue), near oil tank, page 2-117
Floorboard/footpeg bracket screws, left side	25-30 ft-lbs	33.9-40.7 Nm	LOCTITE THREADLOCKER 243 (blue), page 2-127
Fork leg bracket screws	35-40 ft-lbs	47.5-54.2 Nm	FLSTSC, page 2-60
Fork rocker bearing retainer jam nut	95-105 ft-lbs	128.8-142.4 Nm	FLSTSC/FXSTS, page 2-90
Fork rocker bearing retainer	25-35 in-lbs	2.8-4.0 Nm	FLSTSC/FXSTS, LOCTITE ANTI-SEIZE, page 2-90
Fork rocker nut	45-50 ft-lbs	61-68 Nm	FLSTSC/FXSTS, LOCTITE THREADLOCKER 243 (blue), page 2-90
Fork stem acorn nut	30-35 in-lbs	3.4-4.0 Nm	FLSTSC/FXSTS, page 2-85
Fork stem bracket pinch bolt	30-35 ft-lbs	40.7-47.5 Nm	all but FXSTD, page 2-81
Fork stem bracket pinch bolt	35-40 ft-lbs	47.5-54.2 Nm	FXSTD, LOCTITE ANTI-SEIZE, page 2-81
Fork stem nut	35-45 ft-lbs	47.5-61.0 Nm	FXSTD/FXST/FXSTB, page 2-95

ITEM	TORQUE		NOTES		
Fork stem upper bracket pinch bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTC/FLSTF, page 2-95		
Fork tube caps	40-60 ft-lbs	54.2-81.3 Nm	all but FLSTSC/FXSTS, page 2-81		
Front axle nut	50-55 ft-lbs	61.0-74.6 Nm	FXST, FXSTB, FLSTC, FLSTF, FLSTN page 2-11		
Front axle nut	50-55 ft-lbs	61.0-74.6 Nm	FXSTD, page 2-13		
Front axle nut	60-65 ft-lbs	81.3-88.1 Nm	FLSTSC, page 2-16		
Front axle nut	60-65 ft-lbs	81.3-88.1 Nm	FXSTS, discard upon removal, page 2-19		
Front axle slider cap nuts	11-15 ft-lbs	14.9-20.3 Nm	FXST, FXSTB, FLSTC, FLSTF, FLSTN, FLST page 2-11		
Front axle slider cap screws	11-15 ft-lbs	14.9-20.3 Nm	FXSTD, tighten rear screw last, page 2-13		
Front brake caliper lower mounting bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTSC, page 2-59		
Front brake caliper lower mounting bolt	25-30 ft-lbs	33.9-40.7 Nm	FXSTS, page 2-62		
Front brake caliper lower mounting bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTS/FXSTS, short bolt, 12 pt/10 mm, page 2-57		
Front brake caliper lower mounting bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC/FXSTS, short bolt, 12 pt/10 mm, page 2-11, page 2-13		
Front brake caliper top mount- ing bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC/FXSTS, long bolt, 12 pt/10 mm, page 2-11, page 2-13, page 2-57		
Front brake hose bracket bolt	96-120 in-lbs	10.8-13.6 Nm	FLSTC/FLSTF, page 2-95		
Front brake hose bracket bolt	96-120 in-lbs	10.8-13.6 Nm	FXSTD/FXST/FXSTB, page 2-95		
Front brake master cylinder clamp screw	108-132 in-lbs	12.2-14.9 Nm	page 2-104		
Front brake reservoir cover screws	6-8 in-lbs	0.7-0.9 Nm	page 2-45, page 2-47, page 2-57, page 2-59, page 2-63		
Front caliper banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	FXSTS, page 2-59, page 2-62		
Front caliper bleeder valve	80-100 in-lbs	9.0-11.3 Nm	FLSTSC, page 2-59		
Front caliper bleeder valve	80-100 in-lbs	9.0-11.3 Nm	FXSTS, page 2-62		
Front caliper retaining pad screw	40-50 in-lbs	4.5-5.6 Nm	FXSTS, page 2-65		
Front caliper upper mounting bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTSC, page 2-59		
Front caliper upper mounting bolt	25-30 ft-lbs	33.9-40.7 Nm	FXSTS, page 2-62		
Front fender acorn nuts	15-21 ft-lbs	20.3-28.5 Nm	FXST/FXSTB, page 2-106		
Front fender nut	18-22 ft-lbs	24.4-29.8 Nm	FLSTS, page 2-109		
Front fender nuts	15-21 ft-lbs	20.3-28.5 Nm	FLSTC, page 2-106		
Front fender nuts	15-21 ft-lbs	20.3-28.5 Nm	FLSTF, page 2-107		
Front fender screw locknut	10-20 ft-lbs	13.6-27.1 Nm	FXSTS, page 2-111		
Front fender screws	15-21 ft-lbs	20.3-28.5 Nm	FXSTD, page 2-107		
Front fender screws	20-25 ft-lbs	27.1-33.9 Nm	FXSTS, page 2-111		
Front luggage rack fastener	96-120 in-lbs	10.8-13.6 Nm	FLSTN, page 2-134		
Front master cylinder banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	page 2-45		
Front shock acorn nuts	45-50 ft-lbs	61.0-67.8 Nm	FLSTSC/FXSTS, LOCTITE THREADLOCKER 243 (blue), page 2-84		

ITEM	TORQUE		NOTES
Hand control clamp screw	35-45 in-lbs	4.0-5.1 Nm	page 2-104
Handlebar riser locknuts	25-35 ft-lbs	33.9-47.5 Nm	FLSTSC/FXSTS, page 2-82
Handlebar riser screws	144-180 in-lbs	16.3-20.3 Nm	FLSTSC/FXSTS, page 2-82
Handlebar upper clamp screws	144-180 in-lbs	16.3-20.3 Nm	FXSTD, page 2-103
Jiffy stand bolt	144-180 in-lbs	16.3-20.3 Nm	page 2-126
License plate bracket screws	144-180 in-lbs	16.3-20.3 Nm	FXSTD, page 2-117
Lower handlebar clamp fasten- ers	30-40 ft-lbs	40.7-54.3 Nm	all but FXSTD/FLSTSC/FXSTS, page 2-103
Lower handlebar clamp fasten- ers	30-40 ft-lbs	40.7-54.3 Nm	FXSTD, page 2-103
Master cylinder clamp screw	70-80 in-lbs	7.9-9.0 Nm	T27 TORX, page 2-44
Pivot shaft nut	90-110 ft-lbs	122-149.1 Nm	page 2-97
Rear axle nut	60-65 ft-lbs	81.3-88.1 Nm	page 2-22
Rear luggage rack fastener	12-14 ft-lbs	16.3-19.0 Nm	FLSTN, page 2-134
Rear master cylinder banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	page 2-46
Rear master cylinder nut	50 ft-lbs	67.8 Nm	page 2-46
Rear shock bolt	121-136 ft-lbs	164.0-184.4 Nm	LOCTITE THREADLOCKER 243 (blue), page 2-98
Rear shock locknut	32-39 ft-lbs	43.4-52.9 Nm	page 2-98
Rigid fork leg studs	60-65 ft-lbs	81.3-88.1 Nm	FLSTSC/FXSTS, 3 step process, page 2-85
Rocker pivot stud nut	45-50 ft-lbs	61.0-67.8 Nm	FLSTSC/FXSTS, page 2-88
Saddlebag acorn nut	120-144 in-lbs	13.6-16.3 Nm	FLSTC, page 2-135
Saddlebag mounting flange nut	120-144 in-lbs	13.6-16.3 Nm	FLSTC, inside saddlebag, page 2-135
Saddlebag stud nut	21-27 ft-lbs	28.5-36.6 Nm	FLSTC, page 2-135
Sissy bar fasteners	35-60 in-lbs	4.0-6.8 Nm	page 2-131
Spoke nipples: chrome alumi- num profile laced rim	40-50 i n-lbs	4.5-5.6 Nm	16 in., page 2-27, page 2-30
Spoke nipples: steel laced rim	40-50 in-lbs	4.5-5.6 Nm	16 in., page 2-27, page 2-30
Spring bridge acorn nuts	30-35 ft-lbs	40.7-47.5 Nm	FLSTSC/FXSTS, page 2-89
Spring rod acorn nut	20-25 ft-lbs	27.1-33.9 Nm	FLSTSC/FXSTS, page 2-88
Throttle housing screws	35-45 in-lbs	4.0-5.1 Nm	page 2-99
Upper triple clamp pinch bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTSC/FXSTS, page 2-85
Valve stem nut	12-15 in-lbs	1.4-1.7 Nm	tubeless tire, page 2-37
Valve stem nut	25-35 in-lbs	2.8-4.0 Nm	tube tires, page 2-37

TIRES

AWARNING

Match tires, tubes, air valves and caps to the correct wheel rim. Contact a Harley-Davidson dealer. Mismatching can result in damage to the tire bead, allow tire slippage on the rim or cause tire failure, which could result in death or serious injury. (00023a) Tire sizes are molded on the sidewall. Refer to the TIRE FIT-MENT TABLES below. Rim size and contour are cast or stamped into the exterior surface of the rim.

Example: T21 x 2.15 TLA DOT. "T" indicates that the rim conforms to Tire and Rim Association standards. The "21" is the normal diameter of the rim in inches, measured at the bead seat diameter. The "2.15" is the width of the bead seat measured in inches. "TLA" designates the rim contour. "DOT" means that the rim meets Department of Transportation Federal Motor Vehicle Safety Standards.

Table 2-1. Fitment – Tubeless Cast Wheels

WHEEL SIZE	RIM SIZE &	RIM VALVE	TIRE SIZE
& POSITION	CONTOUR	HOLE DIA.	DUNLOP D402
16 in. – Front	T16 x 3.00 D	0.35 in.	MT90B16 72H
			DUNLOP D401
16 in. – Rear	T16 x 3.00 D	0.35 in	150/80B16 71H
			DUNLOP D205
17 in Rear (FXST/FXSTB/FXSTS)	T17 x 6.00 MT	0.35 in	200/55R17 78V
			DUNLOP K591
17 in Rear (FXSTD)	T17 x 4.5 MT	0.35 in	160/70B17 73V

Table 2-2. Tire Fitment – Tube Type Laced Wheels

	STEE	L LACED RIM	
WHEEL SIZE	RIM SIZE &	TUBE SIZE	TIRE SIZE
& POSITION	CONTOOR	Side Valve Tube	DUNLOP D402
21 in Front	T21x 2.15 TLA	MH90x21	MH90 - 21 54H
16 in. – Front	T16 x 3.00 D	MT90-16	MT90B16 72H
16 in. – Rear (FLSTN)	T16 x 3.00 D	MT90-16/MU85-16	MU85B16 77H
			DUNLOP D401
16 in. – Rear (all but FLSTN)	T16 x 3.00 D	MT90-16	150/80B16 71H
	CHROME ALUMIN	UM PROFILE LACED RIM	
		Center Valve Tube	DUNLOP D402
21 in Front	T21x 2.15 MT	MH90x21	MH90 - 21 54H
16 in. – Front	T16 x 3.0 MT	MT90-16	MT90B16 72H
16 in. – Rear (FLSTN)	T16 x 3.0 MT	MT90-16/MU85-16	MU85B16 77H
			DUNLOP D401
16 in. – Rear (all but FLSTN)	T16 x 3.0 MT	MT90-16	150/80B16 71H

2006 VEHICLES DUNLOP	TIRE PRESSURE (Cold)							
ONLY	Fr	ont	Rear					
FLSTC/F/N/SC/I	PSI	kPa	PSI	kPa				
Solo rider	36	248	36	248				
Rider & one passenger	36	248	40	276				
FXST/B//S/I	PSI	kPa	PSI	kPa				
Solo rider	30	207	38	262				
Rider & one passenger	30	207	42	290				
FXSTD								
Solo rider	30	207	36	248				
Rider & one passenger	30	207	40	276				

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Table 2-3. Tire Pressure – All Models

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 right side of the steering head and on a label located on the right side down tube.

An abbreviated V.I.N. is stamped on the left side crankcase at the base of the cylinders.

Sample V.I.N. as it appears on the steering head: 1HD1BJY116Y010000

Sample abbreviated V.I.N. as it appears on the left crankcase: BJY6010000

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. Softail Vehicle Identification Number (typical)

ITEM	DESCRIPTION	POSSIBLE VALUES
1	Market destination	1=Originally manufactured for sale <u>within</u> the United States 5=Originally manufactured for sale <u>outside</u> of the United States
2	Manufacturer and make	HD=Harley-Davidson
3	Motorcycle type	1=Heavyweight motorcycle 901 cc and larger
4	Model	see Softail Model V.I.N. Codes table
5	Engine type	Y=Twin Cam 88B, 1450cc air-cooled, carbureted, coun- terbalanced B=Twin Cam 88B, 1450cc air-cooled, fuel injected, counterbalanced
6	Introduction date	1=Regular 2=Mid-year 3=California/regular 4=Cosmetic changes and/or special introductory date 5=California/cosmetic changes and/or special introduc- tory date 6=California/mid-year
7	VIN check digit	Can be 0-9 or X
8	Model year	6=2006
9	Plant of manufacture	Y=York, PA.
10	Sequential number (last 6 digits)	varies

Table 2-4. Harley-Davidson 2006 Softail Model V.I.N. Description

Table 2-5. 2006 Softail Model V.I.N. Codes

CODE	MODEL NAME	CODE	MODEL NAME	CODE	MODEL NAME
BH	FXST	BX	FLSTFI	BR	FLSTSC
BV	FXSTI	BS	FXSTD	BY	FLSTSCI
BJ	FLSTC	JB	FXSTDI	JE	FLST
BW	FLSTCI	BT	FXSTB	JF	FLSTI
BL	FXSTS	JA	FXSTBI	JG	FLSTFI (Shrine)
BZ	FXSTSI	BN	FLSTN	JH	FLSTCI (Shrine)
BM	FLSTF .	JD	FLSTNI		

REMOVAL

- 1. Block motorcycle underneath frame so front wheel is raised off the ground.
- Inspect wheel bearing end play and service bearings if necessary. See 2.9 SEALED WHEEL BEARINGS.
- See Figure 2-3. Remove brake caliper. Support caliper using a rubber bungee cord. Be careful not to scratch the fender paint.

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.

- 4. Remove axle nut, lockwasher and washer (3).
- Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
- See Figure 2-4. Loosen the slider cap nuts (2) and pull the axle (1) free.
- 7. Remove wheel from forks.

NOTE

On FLSTC models, the hub cap will come off with the wheel.

DISASSEMBLY

NOTE

See 2.14 TIRES to service tire or valve stem assembly.

Disc Wheel

- See Figure 2-5. Remove spacers (2, 8) from left and right sides.
- If necessary, remove brake disc (9) and/or hub plate (6). Label components so they may be installed in their original locations.
 - On left side of wheel, remove five screws (5) to detach left brake disc (9).
 - b. On right side of wheel, remove five screws (5) to remove hub plate (6).

Laced Wheel

- See Figure 2-6. On all models with laced wheels except FLSTC and FXSTD, remove spacers (3, 7) from left and right sides. All FLSTC models use a spacer within the hub cap assembly (2) on the right side.
- If necessary, remove brake disc (8). Label components so they may be installed in their original locations. On left side of wheel, remove five screws (12) to detach left brake disc (8).
- 3. To disassemble FLSTC hub cap, remove snap ring from hub spacer. Discard snap ring.



3. Axle nut, lockwasher and washer

Figure 2-3. Caliper Mounting Bolts: All but FLSTSC, FXSTS, FXSTD (Left Side)



Figure 2-4. Front Wheel Mounting All but FLSTSC, FXSTS, FXSTD (Right Side)



Figure 2-5. Disc Front Wheel: FLSTF



Figure 2-6. Laced Front Wheel: All But FLSTF, FXSTD

CLEANING AND INSPECTION

 Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.9 SEALED WHEEL BEARINGS.

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

 Inspect brake rotor and pads. See 1.8 BRAKE PADS AND DISCS.

ASSEMBLY

Disc Wheel

1. Verify that wheel and tire are true. See 2.13 DISC RIM RUNOUT.

WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

- See Figure 2-5. If necessary, install brake disc (9) and/or hub plate (6) in their original positions. Verify that brake disc is clean. Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
 - a. On left side of wheel, install five **new** screws (5) to attach left brake disc (9).
 - b. On right side of wheel, install five **new** screws (5) to attach hub plate (6).
- Install spacers (2, 8) with largest chamfered end facing away from wheel.

Laced Wheel

- If hub and rim were disassembled, see 2.10 WHEEL LACING: 16 IN. RIM or 2.11 WHEEL LACING: 21 IN. RIM.
- Verify that wheel and tire are true. See 2.12 TRUING LACED WHEEL.
- On FLSTC models, attach hub cap to spacer with new snap ring.

WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

- See Figure 2-6. If necessary, install brake disc in its original position. Verify that brake disc is clean. On left side of wheel, install five **new** screws (12) to attach brake disc (8). Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
- Install hub assembly (2) or spacers (3, 7) with largest chamfered end facing away from wheel.

INSTALLATION

- Apply a light coat of LOCTITE ANTI-SEIZE LUBRICANT to the axle.
- Place wheel into front fork and install axle. Verify that axle spacers on right and left side are properly installed.
- Install the washer, lockwasher and axle nut. Insert screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 50-55 ft-lbs (67.8-74.6 Nm).

NOTE

In next step, make sure front and rear gaps between slider cap and slider is even.

- See Figure 2-4. Tighten the slider cap nuts to 11-15 ft-lbs (14.9-20.3 Nm).
- 5. See Figure 2-3. Install the brake caliper to the fork legs.
 - Loosely install long mounting bolt (1) (12 pt/10 mm) into top hole on fork leg.
 - Install short mounting bolt (2) (12 pt/10 mm) into bottom hole on fork leg. Tighten bottom mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).
 - c. Final tighten the top mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).

AWARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

 Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

REMOVAL

- 1. Block motorcycle underneath frame so front wheel is raised off the ground.
- Inspect wheel bearing end play and service bearings if necessary. See 2.9 SEALED WHEEL BEARINGS.
- See Figure 2-7. Remove brake caliper. Support caliper using a rubber bungee cord. Be careful not to scratch the fender paint.

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.

- 4. Remove left axle nut, lockwasher and washer (3).
- 5. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
- 6. See Figure 2-8. Loosen the slider cap screws (2) and pull the axle free.
- 7. Remove wheel from forks.

DISASSEMBLY

NOTE

See 2.14 TIRES to service tire or valve stem assembly.

- See Figure 2-9. Remove spacers (3, 7) from left and right sides.
- If necessary, remove brake disc (8). Label components so they may be installed in their original locations. On left side of wheel, remove five screws (11) to detach left brake disc.

CLEANING AND INSPECTION

 Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.9 SEALED WHEEL BEARINGS.

AWARNING

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

 Inspect brake rotor and pads. See 1.8 BRAKE PADS AND DISCS.



Figure 2-7. Caliper Mounting Bolts: FXSTD (Left Side)



Axie nut @ 50-55 ft-lbs (67.6 74.6
Slider cap screws

Figure 2-8. Front Wheel Mounting FXSTD (Right Side)

ASSEMBLY

- 1. If hub and rim were disassembled, see 2.11 WHEEL LACING: 21 IN. RIM.
- 2. Verify that wheel and tire are true. See 2.12 TRUING LACED WHEEL.

AWARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

- See Figure 2-9. If necessary, install brake disc (8) in its original position. Verify that brake disc is clean. On left side of wheel, install five **new** screws (11) to attach left brake disc. Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
- 4. Install spacers (3, 7) with largest chamfered end facing away from wheel.

INSTALLATION

- Apply a light coat of LOCTITE ANTI-SEIZE LUBRICANT to the axle.
- Verify that axle spacers on right and left side are properly installed. Place wheel into front fork and install axle.

- Install the washer, lockwasher and left axle nut. Hold right side axle nut with wrench then tighten left axle nut to 50-55 ft-lbs (67.8-74.6 Nm).
- See Figure 2-8. Tighten front slider cap screw to 11-15 ftlbs (14.9-20.3 Nm) and then tighten rear slider cap screw to 11-15 ft-lbs (14.9-20.3 Nm). Using this sequence ensures proper installation.
- 5. See Figure 2-7. Install the brake caliper to the fork legs.
 - a. Loosely install long mounting bolt (1) (12 pt/10 mm) into top hole on fork leg.
 - Install short mounting bolt (2) (12 pt/10 mm) into bottom hole on fork leg. Tighten bottom mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).
 - Final tighten the top mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).

AWARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

 Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.



Figure 2-9. Front Wheel FXSTD

PART NO.	SPECIALTY TOOL	
HD-41494	Hub cap remover/installer	

- Block motorcycle underneath frame so front wheel is raised off the ground.
- Inspect wheel bearing end play and service bearings if necessary. See 2.9 SEALED WHEEL BEARINGS.
- 3. Remove front brake caliper. See 2.19 FRONT BRAKE CALIPER: FLSTSC. Support caliper using a rubber bungee cord. Be careful not to scratch the fender paint.

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.

- See Figure 2-10. Remove hub caps (1, 25) and hub cap seals (2, 24) using HUB CAP REMOVER/INSTALLER (Part No. HD-41494).
- 5. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
- 6. Remove retaining pin (23) from castle nut (22).
- 7. Place a towel under hub to catch any loose parts which may fall from hub.
- 8. Slide axle out of hub and rockers to remove front wheel.

DISASSEMBLY

NOTE

See 2.14 TIRES to service tire or valve stem assembly.

- 1. See Figure 2-10. Remove spacers (8, 13).
- If necessary, remove brake disc. Label components so they may be installed in their original locations. On left side of wheel, remove five screws to detach left brake disc.

NOTE

See 2.24 SPRINGER FORK: FLSTSC/FXSTS to service fork rockers.

CLEANING AND INSPECTION

 Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.9 SEALED WHEEL BEARINGS

WARNING

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

- 2. Inspect brake rotor and pads.
 - a. Minimum brake pad thickness: 0.06 in. (1.6 mm) or less above the backing plate.
 - Minimum brake disc thickness is stamped on the side of the disc. Replace disc if badly scored.
 - c. Maximum brake disc lateral runout and warpage is 0.008 in. (0.2 mm).

ASSEMBLY

- 1. If hub and rim were disassembled, see 2.10 WHEEL LACING: 16 IN. RIM.
- 2. Verify that wheel and tire are true. See 2.12 TRUING LACED WHEEL.

WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

- If necessary, install brake disc in its original position. Verify that brake disc is clean. On left side of wheel, install five **new** screws to attach brake disc. Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
- See Figure 2-10. If bearings were removed, verify that sleeve (10) is installed. Install spacers (8, 13) next to bearings.



Figure 2-10. Front Wheel: FLSTSC

INSTALLATION

PART NO.	SPECIALTY TOOL	
HD-41494	Hub cap remover/installer	

- 1. See Figure 2-10. Install axle.
 - a. Apply a light coat of LOCTITE ANTI-SEIZE LUBRI-CANT to the axle (3).
 - b. From right side of wheel, insert axle through right spacer (4), nylon insert (5), O-ring (6), fender, right rocker (7), right side bearing spacer (8) and right side of hub.

CAUTION

Place gray, Teflon-coated side of washer (15) against brake caliper mount. If washer is worn enough to show brass underneath the Teflon surface, replace it.

c. Continue through left side of hub, left side bearing spacer (13), brake caliper mount (14), washer (15), rubber spacer (16), left rocker (17), fender, O-ring (19), nylon insert (20) and left side spacer (21).

AWARNING

Do not operate motorcycle without retaining pin (23) installed. Failure to install pin may adversely affect handling which could result in death or serious injury.

 Install castle nut (22). Tighten castle nut to 60-65 ft-lbs (81.3-88.1 Nm) and check if retaining pin (23) can be installed. If necessary, tighten just enough to align hole and nut slots. Install retaining pin.



Figure 2-11. Hub Cap Tool

- Install left and right hub cap seals (2, 24) and hub caps (1, 25) using HUB CAP REMOVER/INSTALLER (Part No. HD-41494). See Figure 2-11. Tighten until hub cap makes contact, then tighten 1/4 turn more.
- 4. Install front brake caliper. See 2.19 FRONT BRAKE CALIPER: FLSTSC.

WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

 Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

REMOVAL

- 1. Block motorcycle underneath frame so front wheel is raised off the ground.
- Inspect wheel bearing end play and service bearings if necessary. See 2.9 SEALED WHEEL BEARINGS.
- Remove front brake caliper. See 2.20 FRONT BRAKE CALIPER: FXSTS. Support caliper using a rubber bungee cord. Be careful not to scratch the fender paint.

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.

- Remove front fender. See 2.33 FRONT FENDER: FXSTS.
- See Figure 2-12. Remove the axle locknut (15) and washer (14). Discard locknut.
- 6. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
- Place a towel under hub to catch any loose parts which may fall from hub.
- 8. Slide axle out of hub and rockers to remove front wheel.

DISASSEMBLY

NOTE

See 2.14 TIRES to service tire or valve stem assembly.

- 1. See Figure 2-12. Remove spacers (7, 12).
- If necessary, remove brake disc. Label components so they may be installed in their original locations. On left side of wheel, remove five screws to detach left brake disc.

NOTE

See 2.24 SPRINGER FORK: FLSTSC/FXSTS to service fork rockers.

CLEANING AND INSPECTION

 Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.9 SEALED WHEEL BEARINGS

WARNING

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

- 2. Inspect brake rotor and pads.
 - Minimum brake pad thickness: 0.06 in. (1.6 mm) or less above the backing plate.
 - Minimum brake disc thickness is stamped on the side of the disc. Replace disc if badly scored.
 - Maximum brake disc lateral runout and warpage is 0.008 in. (0.2 mm).

ASSEMBLY

- If hub and rim were disassembled, see 2.11 WHEEL LACING: 21 IN. RIM.
- Verify that wheel and tire are true. See 2.12 TRUING LACED WHEEL.

WARNING

Be sure that brake fluid or other lubricants do not contact brake pads or discs. Such contact can adversely affect braking ability, which could cause loss of control, resulting in death or serious injury. (00290a)

- If necessary, install brake disc in its original position. Verify that brake disc is clean. On left side of wheel, install five **new** screws to attach left brake disc. Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
- See Figure 2-12. If bearings were removed, verify that sleeve (9) is installed. Install spacers (7, 12) next to bearings.





INSTALLATION

- 1. See Figure 2-12. Install axle.
 - Apply a light coat of LOCTITE ANTI-SEIZE LUBRI-CANT to the axle (1).

CAUTION

Place gray, Teflon-coated side of washers (3, 5) against brake caliper mount. If washers are worn enough to show brass underneath the Teflon surface, replace them.

- b. From right side of wheel, insert axle through right rocker (2), right outside washer (3, small I.D.), brake caliper mount (4), right inside washer (5, large I.D.), wave washer (6), right side bearing spacer (7) and right side of hub.
- c. Continue through the left side of hub, left side spacer (12) and left rocker (13).
- Install washer (14) and new axle locknut (15). Tighten locknut to 60-65 ft-lbs (81.3-88.1 Nm) while holding axle stationary.

- 3. Install front fender. See 2.33 FRONT FENDER: FXSTS.
- Install front brake caliper. See 2.20 FRONT BRAKE CALIPER: FXSTS.

AWARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

 Pump brake hand lever to move pistons out until they contact both brake pads. Verify piston location against pads.

REMOVAL

- 1. Block motorcycle underneath frame so weight of motorcycle is off of rear wheel.
- Remove saddlebags for extra working clearance if nec-2 essary.
- 3. See 2.40 BELT GUARD/DEBRIS DEFLECTOR. Remove belt guard and debris deflector from rear fork.
- 4. Inspect wheel bearing end play and service bearings if necessary. See 2.9 SEALED WHEEL BEARINGS.
- 5. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
- Remove rear brake pads. See 1.8 BRAKE PADS AND 6. DISCS
- 7. See Figure 2-13. Loosen jam nut (5) and retract axle adjuster (6). Remove spring clip (1), axle nut (2), washer (3) and collar (4) from left side of axle.

CAUTION

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

8. Tap axle towards right side and remove. Belt adjuster collars will fall loose as axle is removed.

NOTE

Apply alcohol to rubber bumper on brake caliper/mount to ease removal.

- 9. Lift rear caliper towards the front of motorcycle. Notch in caliper mount must clear tab on rear fork. Move caliper into position between top and bottom rails of rear fork.
- 10. Move wheel forward and slip belt off sprocket.
- 11. Raise motorcycle to allow enough clearance for removal of rear wheel.
- 12. Pull wheel and belt sprocket 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.

DISASSEMBLY

1. See Figure 2-15. Remove spacers (2, 10) from left and right sides.

NOTE

On FXSTD models, inspect seal ring (16). Replace if damaged.

- 2. If necessary, remove brake disc and/or rear sprocket. Label components so they may be installed in their original locations.
 - a. On left side of wheel, remove five screws (14) and washers (15) to detach rear sprocket (9).
 - On right side of wheel, remove five screws (3) to b. remove rear brake disc (4).



- 3. Washer
- Collar 4.
- Jam nut 5.
- 6. Adjuster

Figure 2-13. Rear Axle: Left Side



- 1.
- 2. Collar
- 3 Jam nut
- 4. Adjuster

Figure 2-14. Rear Axle: Right Side



Figure 2-15. Rear Wheel/Hub

CLEANING AND INSPECTION

 Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.9 SEALED WHEEL BEARINGS

WARNING

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

- 2. Inspect brake rotor and pads. See 1.8 BRAKE PADS AND DISCS.
- Inspect rear belt and sprocket. See 1.15 REAR BELT AND SPROCKETS.

ASSEMBLY

- 1. See Figure 2-15. If hub and rim (8) were disassembled, see 2.10 WHEEL LACING: 16 IN. RIM.
- 2. Verify that wheel and tire are true.
 - a. For laced wheels, see 2.12 TRUING LACED WHEEL.
 - b. For disc wheels, see 2.13 DISC RIM RUNOUT.
- 3. Install brake disc (4) on valve stem side of wheel if removed.
 - a. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to the five screws (3).
 - b. Tighten to 30-45 ft-lbs (40.7-61.0 Nm).

NOTE

On FXSTD models, install seal ring (16) onto the wheel side of the sprocket with the rounded edge toward the sprocket.

- 4. Install belt sprocket (9) if removed.
 - Apply two drops of LOCTITE THREADLOCKER 262 (red) to the five screws (14). Install sprocket using screws (14) and washers (15).
 - b. Tighten screws to 55-65 ft-lbs (74.6-88.1 Nm).

INSTALLATION

- 1. Roll wheel into rear fork and position brake disc side spacer between wheel and fork.
- 2. Slide drive belt over drive sprocket.
- Coat axle with LOCTITE ANTI-SEIZE LUBRICANT and install.
 - a. From right side, carefully insert axle through right rear fork, rear caliper bracket, right side spacer and brake disc.
 - b. Continue sliding axle through wheel hub sleeve, sprocket, left side spacer and left rear fork.

WARNING

Check wheel bearing end play after tightening axle nut to specified torque. Excessive end play can adversely affect stability and handling. Insufficient end play can cause bearing seizure. Either condition can cause loss of control, which could result in death or serious injury. (00285a)

- 4. See Figure 2-13. Install collar (4), washer (3) and axle nut (2) on left side of axle.
 - a. Tighten axle nut to 60-65 ft-lbs (81.3-88.1 Nm).
 - b. Check to see if the spring clip (1) can be installed. If required, tighten axle nut to no more than 65 ft-lbs (88.1 Nm) and align axle hole and nut slots. Install spring clip.
- 5. Install debris deflector.
- 6. Install brake pads. See 1.8 BRAKE PADS AND DISCS

WARNING

Whenever a wheel is installed and before moving the motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00284a)

- Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
- Verify correct axle alignment (2.15 VEHICLE ALIGN-MENT) and then check belt deflection (1.14 REAR BELT DEFLECTION).

SEALED WHEEL BEARINGS

INSPECTION

See WHEEL BEARINGS under 1.9 TIRES AND WHEELS for wheel bearing inspection information.

REMOVAL

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

- Remove wheel from motorcycle. On FLSTF, remove hub plate from disc wheel on opposite side of front brake disc.
- 2. See Figure 2-16. Obtain WHEEL BEARING INSTALLER/ REMOVER (Part No. HD-44060) and assemble.
 - Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
 - Install nut (2), washer (3) and Nice bearing (4) on screw. Insert assembly through hole in bridge (5).
 - c. Drop ball bearing inside collet (6). Fasten collet and ball bearing to forcing screw (1).
- 3. Hold end of forcing screw (1) and turn collet (6) to expand edges of collet.
- See Figure 2-17. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn the nut (2) to remove bearing from wheel.
- 5. Remove spacer from inside wheel hub.
- Repeat procedure for opposite side bearing. Discard all bearings upon removal.



Figure 2-16. Removal Tool



Figure 2-17. Remove Bearing

INSTALLATION

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

NOTE

Always install first bearing on brake disc side.

- 1. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble.
 - Sparingly apply graphite lubricant to threads of threaded rod to prolong service life and ensure smooth operation.
 - b. See Figure 2-18. Place threaded rod through support plate. Insert assembly through wheel.
 - c. See Figure 2-19. Place the **new** bearing (6) on rod (1) with lettered side outward.
 - d. Install pilot (5), Nice bearing (4), washer (3) and nut (2) over rod.
- 2. Hold hex end of threaded rod (1) and turn nut (2) to install bearing (6). 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.
- On FLSTF disc front wheels, install hub plate opposite front brake disc. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTS/FXSTD.



Figure 2-18. Installation Tool Support Plate



Figure 2-19. Installing Bearing



Figure 2-20. Wheel Bearing Remover/Installer (Part No. HD-44060)

GENERAL

NOTE

If only rim is to be replaced, tape spokes together to hold position on hub and remove spokes from rim. Install taped hub/spoke assembly to new rim and tighten spokes. Then remove tape and true wheels.

Torx head spokes, the 16 in. laced wheel hub and the 16 in. wheel are shown below.

WARNING

Avoid using oils that attack or contribute to the deterioration of rubber materials. Use of unsuitable oils may lead to premature tire failure, which could result in death or serious injury.

CAUTION

Do not install incorrect spokes or spoke nipples on rim. Steel laced rims use zinc plated spokes and spoke nipples. Chrome aluminum profile laced rims use chrome plated spokes and spoke nipples.

NOTE

Steel laced rims use **zinc** plated spokes and spoke nipples. Chrome aluminum profile laced rims use **chrome** plated spokes and spoke nipples.

See Figure 2-21. Measure distance "A" to determine spoke length.

Table 2-6. 16 In. Rim Spoke Length

Rim	IN.	MM.
Steel laced	6.71-6.75	170.4-171.5
Chrome aluminum profile laced	6.88-6.92	174.8-175.8



Figure 2-21. Spoke Length

See Figure 2-22. Torx head spokes, the 16 in. laced wheel hub and the 16 in. wheel are shown below.



Figure 2-22.

PROCEDURE

 Place the hub on table with brake disc side (narrow flange) up. Insert a spoke in each hole of the **lower** row as shown below. Angle spokes clockwise.



Figure 2-23.

- Center the rim over the hub assembly with the valve stem hole facing upward.
- Using any lower row spoke, place the first spoke into the rim hole to the left of the valve stem hole on the upper half of the rim centerline.



Figure 2-24. 4. Install the rest of lower row spokes in every fourth hole.



Figure 2-25.

2-26 2006 Softail: Chassis

 Place the first upper row spoke into the hub as shown below. Angle the spoke counterclockwise crossing four lower row spokes. The spoke must enter the hole to the left of the valve stem hole.



Figure 2-26.

6. Install the remaining nine upper row spokes into every fourth remaining hole above the rim centerline.



Figure 2-27.

- Turn rim over so brake disc side (narrow flange) faces down. Place any **lower** row spoke into hub. Angle spoke clockwise and place into rim hole angled to accept it.
- d0463x2x

Figure 2-28.

8. Place the remaining nine lower row spokes, angled clockwise, into hub and rim.



Figure 2-29.

9. Insert any **upper** row spoke into hub and angle spoke counterclockwise. Place spoke into appropriate rim hole.



Figure 2-30.

10. Install remaining nine upper row spokes.



Figure 2-31.

- 11. Tighten spoke nipples:
 - Tighten steel laced rim spoke nipples to 40-50 inlbs (4.5-5.6 Nm).
 - b. Tighten chrome aluminum laced profile rim spoke nipples to 40-50 in-lbs (4.5-5.6 Nm).
- 12. True wheel. See 2.12 TRUING LACED WHEEL.

PROCEDURE

NOTE

If only rim is to be replaced, tape spokes together to hold position on hub and remove spokes from rim. Install taped hub/spoke assembly to new rim and tighten spokes. Then remove tape and true wheels.

WARNING

Avoid using oils that attack or contribute to the deterioration of rubber materials. Use of unsuitable oils may lead to premature tire failure, which could result in death or serious injury.

CAUTION

Do not install incorrect spokes or spoke nipples on rim. Steel laced rims use zinc plated spokes and spoke nipples. Chrome aluminum profile laced rims use chrome plated spokes and spoke nipples.

NOTE

Steel laced rims use **zinc** plated spokes and spoke nipples. Chrome aluminum profile laced rims use **chrome** plated spokes and spoke nipples.

See Figure 2-32. Measure distance "A" to determine spoke length.

Rim	IN.	MM.
Steel laced	9.42-9.46	239.3-240.3
Chrome aluminum profile laced	9.52-9.56	241.8-242.8

Table 2-7. 21 In. Rim Spoke Length



Figure 2-32. Spoke Length

- See Figure 2-33. Place the hub on table with brake disc side (wide flange) down. Insert a spoke in each hole of the **lower** row as shown below. Angle spokes clockwise.
- Center the rim over the hub assembly with the valve stem hole facing upward.
- See Figure 2-34. Using any **lower** row spoke, place the first spoke into the rim hole, angled to correctly accept the spoke, on the upper half of the rim centerline.



Figure 2-33.



Figure 2-34.

4. Install the rest of lower row spokes in every fourth hole.



Figure 2-35.

5. Place the first upper row spoke into the hub as shown

right of the valve stem hole.

below. Angle the spoke counterclockwise crossing four lower row spokes. The spoke must enter the hole to the 6. Install the remaining nine upper row spokes into every fourth remaining hole above the rim centerline. This completes spoke installation on this side.



Figure 2-37.

7. Turn rim over, brake disc side up. Place any lower row spoke into hub. Angle spoke clockwise and place into rim hole angled to accept it.



Figure 2-36.



Figure 2-38.

- 8. Place the remaining nine lower row spokes, angled clockwise, into hub and rim.
- dut3x2x

Figure 2-39.

 Insert any upper row spoke into hub and angle spoke counterclockwise into appropriate rim hole. Install remaining upper row spokes.



Figure 2-40.

- 10. Tighten spoke nipples:
 - Tighten steel laced rim spoke nipples to 40-50 inlbs (4.5-5.6 Nm).
 - Tighten chrome aluminum laced profile rim spoke nipples to 40-50 in-lbs (4.5-5.6 Nm).
- 11. True wheel. See 2.12 TRUING LACED WHEEL.
GENERAL

PART NO.	SPECIALTY TOOL
HD-99500-80	Wheel truing stand
HD-94681-80	Spoke wrench

The rim must be trued both laterally and radially. If **new** bearings were installed, wheels may be trued with only the bearings and center spacer installed.

LATERAL TRUING

- See Figure 2-41. Divide the wheel spokes into four groups of four and mark the center of each group with a piece of tape. The groups should be directly across from one another and approximately 90° apart.
- 2. Tighten the spokes in these four groups finger tight. Leave all other spokes loose.
- See Figure 2-42. Place wheel in WHEEL TRUING STAND (Part No. HD-95500-80). Tighten arbor screws so hub will turn on its bearings.
- Lay a straightedge across hub brake disc flange and one of the marked spoke groups. Measure distance "A" from the straightedge to the location shown in Figure 2-43.



Figure 2-41. Marking Spoke Groups



Figure 2-42. Check Laced Hub Offset Dimension (Rear Wheel Shown)

5. If the dimension is not correct, tighten the four spokes accordingly. Use SPOKE WRENCH (Part No. HD-94681-80). For example, if the measurement on the **right** rim edge side is **less** than it should be, **loosen** the two spokes attached to the hub **right** side and **tighten** the two spokes attached to the hub **left** side. Turn all four spokes an equal number of turns until offset dimension is correct.

NOTE

Always loosen the appropriate spokes before tightening the other two. Reversing this procedure will cause the rim to become out-of-round.

6. Repeat the previous step for all four groups on the wheel.

NOTE

FXST, FXSTB, FXSTS models are not equipped with laced rear wheels.

Table 2-8. Wheel Offset Dimensions

MODEL	WHEEL	IN.	MM			
STEEL LACED RIM						
FXST, FXSTD, FXSTB	Front	1.665-1.685	42.291-42.800			
FXSTS	Front	1.465-1.485	37.211-37.719			
FLSTC, FLSTN FLSTSC	Front	1.272-1.292	32.309-32.817			
FLST	Front	1.132-1.152	28.753-29.261			
FLSTC, FLSTN, FLSTSC, FLST	Rear	1.392-1.412	35.357-35.864			
CHROME A	LUMINUM	PROFILE LAG	CED RIM			
FXST, FXSTB	Front	1.695-1.715	43.053-43.561			
FXSTS	Front	1.450-1.470	36.830-37.338			
FLSTC, FLSTF, FLSTSC, FLSTN, FLST	Front	0.990-1.010	25.146-25.654			
FLSTC, FLSTF, FLSTSC, FLSTN, FLST	Rear	1.110-1.130	28.194-28.702			



Figure 2-43. Laced Hub Offset Dimension

RADIAL TRUING

- See Figure 2-44. Adjust truing stand gauge to the rim's tire bead seat as shown. The rim should be trued within 0.031 in. (0.79 mm).
- Spin the rim slowly. If the rim contacts the gauge on or near a marked group of spokes, loosen the spokes in the marked group on the opposite side of the rim. Now tighten the spokes in the group where the rim makes contact. Loosen and tighten spokes an equal number of turns.
- If the rim contacts the gauge between two marked groups, loosen the spokes in both opposite groups and tighten the spoke groups on the side of the rim that makes contact.
- 4. When the wheel is centered and trued, start at the valve hole and tighten the rest of the spoke nipples one turn at a time until they are snug.
- Seat each spoke head in the hub flange using a flat nose punch and mallet. Then check wheel trueness again and tighten the nipples accordingly.

CAUTION

Do not tighten spokes too tight, or nipples may be drawn through rim, or hub flanges may be distorted. If spokes are left too loose, they will continue to loosen when wheel is put into service.

File or grind off ends of spokes protruding through nipples to prevent puncturing tube when tire is mounted.

NOTE

After installation of front wheel, visually check the relationship of the front wheel to the fork fender bosses. The front wheel should be approximately centered between the bosses.



Figure 2-44. Truing Rim Radially

GENERAL

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

LATERAL RUNOUT

See Figure 2-45. Install arbor in the wheel hub and place wheel in the truing stand. To check rim lateral runout, place a gauge rod or dial indicator near the rim bead. If lateral runout exceeds 0.040 in. (1.02 mm), replace the wheel.



Figure 2-45. Checking Lateral Runout

RADIAL RUNOUT

See Figure 2-46. Check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).



Figure 2-46. Checking Radial Runout

TIRES

GENERAL

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

WARNING

Replace punctured or damaged tires. In some cases, small punctures in the tread area may be repaired from within the demounted tire by a Harley-Davidson dealer. Speed should NOT exceed 50 mph (80 km/h) for the first 24 hours after repair, and the repaired tire should NEVER be used over 80 mph (130 km/h). Failure to follow this warning could result in death or serious injury. (00015a)

Tubeless tires may be repaired in the tread area only if the puncture is 1/4 in. (6.4 mm) 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 tubeless tires, use TIRE SPREADER (Part No. HD-21000) to spread the tire sidewalls.

WARNING

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

NOTE

DUNLOP[®] front and rear tires for FLSTC, FLSTF and FLSTSC models are not the same. They are not interchangeable. Use the front tire ONLY for a front tire. Put ONLY a front tire on the front of the vehicle.

REMOVAL

- 1. Remove wheel from motorcycle.
- 2. Let the air out of the tire or tube.
- Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to loosen the bead from the rim.



Figure 2-47. Starting Tire Off Rim

4. See Figure 2-47. Using tire tools (not sharp instruments), and RIM PROTECTORS (Part No. HD-01289) start upper bead over edge of rim at valve. Do not use excessive force when starting bead over rim. Bead wires may be damaged ruining the tire. Repeat all around rim until first bead is over rim.

CAUTION

If tire tools are used, take care not to damage the tire and rim sealing surfaces. Use RIM PROTECTORS (Part No. HD-01289) to protect rims.

 Push lower bead into rim well on one side and insert tire tool underneath bead from opposite side. Pry bead over rim edge. Remove tire from rim.

NOTE

It is not always necessary to completely remove tire from rim. Removing one side allows the tire to be inspected.

CLEANING AND INSPECTION

- 1. Clean the inside of tire and rim.
- 2. If rim is dirty or rusty, clean with a stiff wire brush.
- 3. Inspect the tire for wear.

NOTE

Consult the latest Harley-Davidson parts and accessories catalog to find part numbers for tires and rim strips.

INSTALLATION

AWARNING

- Use only Harley-Davidson approved tires. Using non-. approved tires can adversely affect stability, which could result in death or serious injury. (00024a)
- Only install original equipment tire valves and valve caps. A valve, or valve and cap combination, that is too long or too heavy can strike adjacent components and damage the valve, causing rapid tire deflation. Rapid tire deflation can cause loss of vehicle control, which could result in death or serious injury. (00281a)

NOTE

Damaged or leaking valves must be replaced.

- 1. For tubeless tires, see Figure 2-48. Replace damaged or leaking valve stems.
 - a. Insert valve stem with rubber grommet (1) in place into the rim hole.
 - Install metal washer (2) over valve stem. b
 - Install nut (3). Tighten to 12-15 in-lbs (1.4-1.7 Nm). C.
- 2. For tube tires, see Figure 2-49. Replace damaged or leaking tube.
 - a. Check that rim strip is in position and rim strip hole is aligned with valve hole in rim.
 - b. Insert tube valve stem with nut (1) and washer (4) into the rim hole.
 - Install nut (2) on outside of valve stem so rim and C. rim strip are between the two nuts.
 - d. Tighten nut to 25-35 in-lbs (2.8-4.0 Nm).



Figure 2-49. Valve Stem: Tube Tire



Figure 2-50. Starting Bead on Rim



Figure 2-51. Starting Second Bead on Rim



Figure 2-48. Valve Stem: Tubeless Tires

- Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant. Install RIM PROTECTORS, (Part No. HD-01289) to prevent scarring rims.
- 4. See Figure 2-50. Starting at the valve stem, start the first bead into the rim well. Work the bead on as far as possible by hand. Use the tire tool to pry the remaining bead over the rim flange. If tire has colored dot on sidewall, it is a balance mark and should be located next to valve stem hole.
- 5. See Figure 2-51. Starting 180 degrees from the valve stem, start the second bead onto the rim. Work the bead onto the rim with tire tools, working toward valve in both directions. Remove the valve core from the rim hole before prying the remaining bead over the rim flange.

AWARNING

Do not exceed manufacturer's recommended pressure to seat beads. Exceeding recommended bead seat pressure can cause tire rim assembly to burst, which could result in death or serious injury. (00282a)

- 6. Inflate the tire to recommended pressure to seat the bead. See 1.9 TIRES AND WHEELS.
- 7. Use BEAD EXPANDER (Part No. HD-28700) to seat beads on tubeless tires.

CHECKING TIRE RUNOUT

Radial Runout

- 1. See Figure 2-52. Check runout by turning wheel on axle, measuring amount of radial displacement from a fixed point near the tire.
- Maximum tire tread runout is 0.090 in. (2.29 mm). If tire tread runout exceeds 0.090 in. (2.29 mm), remove tire from rim and check rim runout to see if rim is at fault. See 2.12 TRUING LACED WHEEL or 2.13 DISC RIM RUNOUT.

NOTE

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

 If rim runout is less than 0.030 in. (0.76 mm), tire is at fault and should be replaced. If rim runout is more than 0.030 in. (0.76 mm), correct by replacing disc wheel or truing laced wheel. If you turn nipples more than one full turn, remove tire to check for protrusions. Install tire and recheck tire tread runout.

Lateral Runout

1. See Figure 2-53. Check runout by turning wheel on axle, measuring tread runout.



Figure 2-52. Radial Tire Runout



Figure 2-53. Lateral Tire Runout

 Maximum tire tread runout is 0.080 in. (2.03 mm). If tire tread runout exceeds 0.080 in. (2.03 mm), remove tire from rim and check rim bead runout to see if rim is at fault. See 2.12 TRUING LACED WHEEL or 2.13 DISC RIM RUNOUT.

NOTE

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

3. If rim bead runout is less than 0.030 in. (0.76 mm), tire is at fault and should be replaced. If rim bead runout is more than 0.030 in. (0.76 mm), correct by replacing disc wheel or truing laced wheel. If you turn nipples more than one full turn, remove tire to check for protrusions. Install tire and recheck tire tread runout.

WHEEL BALANCING

Wheels must be balanced to improve handling and reduce vibration, especially at high road speeds. In most cases, static balancing using WHEEL TRUING STAND (Part No. HD-95500-80) 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.

The maximum weight permissible to accomplish balance is 3.5 oz. (99 g) total weight applied on the rim. Wheels should be balanced to within 0.5 oz. (14 g) at 60 mph (97 km/h).

SIZE OZ.	SIZE GRAMS	PART NUMBER	TYPE
1.0	28	95582-47	spoke nipple
0.75	21	95581-47	spoke nipple
0.5	14	95578-41	spoke nipple
0.25	7	95594-84 (black)	self adhesive
0.25	7	95595-84 (silver)	self adhesive

Table 2-9. Wheel Weights

NOTE

Self adhesive wheel weights should be applied to the flat surface of the rim in increments of 0.25 oz. (7 g).

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 420 (Superbonder) to the adhesive side of the weight. Place the weight on the rim, press firmly in place and hold for 10 seconds. Full adhesive cure takes 8 hours.

NOTE

If 1.0 oz. (28 g) or more weight must be added at one location, split the amount so that half is applied to each side of the rim. Wheel should not be used for 8 hours to allow adhesive to cure completely.

INSPECTION

AWARNING

Only a Harley-Davidson dealer should perform vehicle alignment. Improper alignment can adversely affect stability and handling, which could result in death or serious injury. (00060a)

- 1. Verify wheels are true to specifications. See 2.12 TRU-ING LACED WHEEL or 2.13 DISC RIM RUNOUT.
- Check steering head bearing adjustment and adjust if necessary. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC/FXSTS or 1.18 STEERING HEAD BEARINGS: FLSTSC/FXSTS.
- Check that center of rear axle is equidistant from the center of the rear fork pivot shaft. Check measurements on both sides of vehicle. The measurement must be equal to within 1/32 in. (0.794 mm) on both sides of vehicle. Adjust if necessary.

GENERAL

WARNING

Do not use parts from single caliper repair kits (9/16 inch bore) on dual caliper models. Likewise, do not use parts from dual caliper repair kits (11/16 inch bore) on single caliper models. Using incorrect parts can cause brake failure, which could result in death or serious injury. (00278a)

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

See Figure 2-54. Master cylinders designed for dual disc (two caliper) operation have an 11/16 inch (17.5 mm) bore, while those that are designed for single disc (one caliper) operation have a 9/16 inch (14.3 mm) bore. The bore size is stamped on the master cylinder assembly inboard of the handlebar clamp bracket.

REMOVAL/DISASSEMBLY

 Open bleeder nipple cap on front brake caliper. Install end of a length of clear plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake hand lever to drain brake fluid. Close bleeder valve.

CAUTION

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

 Remove bolt and two steel/rubber washers to disconnect fitting of hydraulic brake line from master cylinder. Discard washers.

CAUTION

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

- See Figure 2-57. Place the cardboard insert between the brake lever and lever bracket.
- See Figure 2-56. Remove the two T27 TORX screws with flat washers (9) to detach the handlebar clamp (8) from the master cylinder reservoir (14).



Figure 2-54. Bore Sizes

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- Remove retaining ring (18) from pivot pin groove at bottom of master cylinder bracket.
- 6. Remove pivot pin (15) and brake hand lever (17).
- 7. Carefully remove wiper (2) with pick or similar tool.
- 8. Remove piston cap (3).
- 9. Remove piston (5) with O-ring (4) and primary cup (6).
- 10. Remove spring (7).

CAUTION

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

11. Remove both screws (13), cover (11) and the cover gasket (10).

CLEANING AND INSPECTION

AWARNING

Do not use parts from single caliper repair kits (9/16 inch bore) on dual caliper models. Likewise, do not use parts from dual caliper repair kits (11/16 inch bore) on single caliper models. Using incorrect parts can cause brake failure, which could result in death or serious injury. (00278a)

 Always reassemble the master cylinder using new parts from the correct repair kit (9/16 inch bore- HD Part No. 45006-96C).

WARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

 Clean all parts with denatured alcohol or D.O.T. 4 BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe dry with a clean, lint free cloth. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages in bottom of reservoir.



Figure 2-55. Cardboard Insert

- Carefully inspect all parts for wear or damage and replace as necessary.
- Inspect the piston bore in the master cylinder housing for scoring, pitting or corrosion. Replace the housing if any of these conditions are found.
- Inspect the outlet port that mates with the brake line fitting. As a critical sealing surface, replace the housing if any scratches, dents or other damage is noted.
- Inspect the cover gasket for cuts, tears or general deterioration. Replace as necessary.



Figure 2-56. Front Brake Master Cylinder

ASSEMBLY/INSTALLATION

- 1. See Figure 2-56. Fit O-ring (4) into groove at front of piston (5) (pin side).
- 2. Fit primary cup (6) over lip at back of piston so that closed side (smaller OD) contacts shoulder.
- Coat piston bore of housing with special lubricant (1) supplied in the service parts kit. Also apply the lubricant to OD of installed O-ring (4) and primary cup (6).
- 4. Insert spring (7) into master cylinder bore so that it seats against the recess at bottom.
- 5. Slide piston over spring.
- 6. Fit wiper (2) over piston cap (3) so that the flat side of wiper contacts cap shoulder.
- 7. Fit piston cap over piston pin (5).
- Press down on wiper until it contacts the counterbore. Larger OD of wiper must be completely seated in groove on outlet side of piston bore.
- Install the cover (11) with gasket (10) on the master cylinder reservoir. Install two screws (13) to fasten the cover to the reservoir, but do not tighten at this time.
- Align hole in brake hand lever (17) with hole in master cylinder bracket. From the top of the assembly, slide pivot pin (15) through bracket and hand lever.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

11. Install retaining ring (18) in pivot pin groove. Verify that retaining ring is completely seated in groove.

CAUTION

Do not remove or install the master cylinder assembly without first positioning a 5/32-inch (4 mm) thick insert between the brake lever and lever bracket. Removing or installing the master cylinder assembly without the insert in place may result in damage to the rubber boot and plunger on the front stoplight switch. (00324a)

- See Figure 2-58. Position the brake lever/master cylinder assembly inboard of the switch housing assembly engaging the tab (2) on the lower switch housing (1) in the groove (3) at the top of the brake lever bracket (4).
- Align the holes in the handlebar clamp with those in the master cylinder housing and start both T27 TORX screws with flat washers. Position for rider comfort. Beginning with the top screw, tighten to 70-80 in-lbs (7.9-9.0 Nm).



Figure 2-57. Cardboard Insert



Figure 2-58. Attach Master Cylinder To Right Handlebar Switches

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

- Lubricate new steel/rubber washers with D.O.T. 4 BRAKE FLUID. Position new steel/rubber washers on each side of hydraulic brake line fitting. Insert bolt through washers and fitting. Thread bolt into master cylinder housing and tighten to 17-22 ft-lbs (23.0-29.8 Nm).
- Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
- Stand the motorcycle upright so that the master cylinder is in a level position. Remove the master cylinder cover.

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top. Do not reuse old brake fluid. Use only D.O.T. 4 fluid from a sealed container.

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

18. Bleed brake system and tighten bleeder valve as directed. See 1.7 BLEEDING BRAKES.

AWARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

- Verify proper operation of the master cylinder relief port. Actuate the brake hand 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 master cylinder. Tighten cover screws to 6-8 in-lbs (0.7-0.9 Nm).

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 21. Test brake system.
 - a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 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.

REMOVAL

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- See Figure 2-59. Remove banjo bolt (1) and two steel/ rubber washers (2) to disconnect brake line from master cylinder. Discard washers.
- 2. Remove nut (4) to free assembly from mounting bracket.
- See Figure 2-60. Remove cotter pin (1) and washer (2) from clevis pin (3). Remove master cylinder assembly from brake pedal.
- 4. If disassembling master cylinder, support assembly in vise and tap out push rod pin (4) using a brass drift.

INSTALLATION

- See Figure 2-60. If disassembled, support master cylinder assembly in vise. Tap in **new** push rod pin (4) using a brass drift.
- Install master cylinder assembly on brake pedal. Install washer (2) and new cotter pin (1) on clevis pin (3).
- See Figure 2-59. Fit collar on cartridge body into hole of mounting bracket. Apply LOCTITE THREADLOCKER 243 (blue) to threads of nut (4). Install nut on cartridge body until finger tight. Tighten to 50 ft-lbs (67.8 Nm).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

- Lubricate new steel/rubber washers (2) with D.O.T. 4 BRAKE FLUID. Position new steel/rubber washers on each side of brake line (3). Insert the banjo bolt (1) through washers and fitting. Tighten to 17-22 ft-lbs (23-30 Nm).
- Grease fitting with WHEEL BEARING GREASE (Part No. 99856-92) until a small amount of grease is visible around edges of brake lever.
- Install length of clear plastic tubing over caliper bleeder valve. Place free end of tube in a clean container.
- Stand the motorcycle upright so that the master cylinder is in a level position. Remove the master cylinder cover.



Figure 2-59. Rear Brake Control: Front Mount



Figure 2-60. Rear Brake Control: Rear Mount

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top. Do not reuse old brake fluid. Use only D.O.T. 4 fluid from a sealed container.

AWARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

- Bleed brake system and tighten bleeder valve as directed. See 1.7 BLEEDING BRAKES.
- Install gasket and cover on master cylinder. Tighten cover screws to 6-8 in-lbs (0.7-0.9 Nm).

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 11. Test brake system.
 - Turn ignition switch ON. Pump brake foot pedal to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 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.





DISASSEMBLY

NOTE

Do not disassemble the cartridge body. The cartridge body components are not sold separately, so if piston seal leakage is evident, replace the entire cartridge body assembly.

- 1. Thoroughly clean exterior of master cylinder assembly with denatured alcohol.
- Stand master cylinder assembly upright on banjo sealing surface. For best results, suspend reservoir over edge of table. Be sure to lay down a clean shop cloth to protect the sealing surface from damage.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

 See Figure 2-62. Push down on large flat washer to compress spring. While holding the spring in a compressed state, remove retaining ring from groove in clevis and then carefully release spring. Discard retaining ring.

NOTE

Push rod, clevis and spacer washer are a one-piece assembly.

- Remove the large flat washer, dust boot and spring from push rod end of cartridge body. Remove spring and spring retainer from dust boot.
- See Figure 2-63. Push on threaded end of cartridge body to remove from reservoir adapter. Use hand pressure only. Exercise care to keep cartridge body free of dirt and grease.
- Carefully remove two O-rings from outside of cartridge body. Exercise caution to avoid scratching O-ring grooves.
- Remove small retaining ring from push rod end of cartridge body. Assembly is spring loaded so be sure to hold the parts together as retaining ring is removed.
- Remove push rod with captured spacer washer from cartridge body. Remove small retaining ring from push rod, if attached. Discard retaining ring.



Figure 2-62. Removing Clevis



Figure 2-63. Removing Cartridge

CLEANING AND INSPECTION

AWARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

- Clean all metal parts, except the cartridge body assembly, and blow dry with compressed air. Clean all rubber parts using denatured alcohol.
- 2. Inspect the reservoir adapter bore for scratches. Replace the reservoir if scratches are present.
- Check the dust boot for cuts or tears. Replace as necessary.
- 4. Inspect the threads on the cartridge body and push rod. Replace part if threads are damaged.
- Inspect the spring for cracks or broken coils. Replace as necessary.
- Inspect O-ring grooves on the cartridge body for dirt. Carefully clean O-ring grooves using a soft cotton cloth moistened with alcohol and allow to dry. Inspect O-ring grooves for scratches. Replace cartridge body if grooves are scratched.
- Inspect the reservoir cover 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 some lubrication is necessary, use a small quantity of clean brake fluid.

ASSEMBLY

- 1. To install piston in cartridge body, proceed as follows:
 - Install small spring into cartridge body making sure that spring is seated in counterbore.
 - Lightly lubricate primary cup and O-ring on piston with D.O.T. 4 BRAKE FLUID.
 - c. Install piston over spring.
- Install new large retaining ring in groove on push rod side of cartridge body.
- Position new retaining ring on push rod between spacer washer and clevis, or on clevis inboard of the retaining ring groove.



Figure 2-64. Compress Spring and Retaining Ring

NOTE

The push rod, clevis and spacer washer are a one-piece assembly.

 See Figure 2-64. Stand cartridge body upright on banjo sealing surface. Lay down a clean shop cloth to protect the sealing surface from damage.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- Insert ball end of push rod into piston cup. Pushing down on push rod to compress spring, fit captured spacer washer into cartridge body. Further compressing spring as necessary, install retaining ring positioned in step 4 in groove of cartridge body bore.
- Verify that retaining ring is completely seated in groove and that push rod rotates freely.
- Lubricate new O-rings with D.O.T. 4 BRAKE FLUID and carefully install in grooves on outside of cartridge body.

- Wipe bore of reservoir adapter with D.O.T. 4 BRAKE FLUID.
- Insert cartridge body into reservoir adapter indexing tab on adapter in slot on threaded end of cartridge. Use hand pressure only. Cartridge body is fully installed when reservoir adapter contacts large retaining ring.
- Stand master cylinder assembly upright on banjo sealing surface. For best results, suspend reservoir over edge of table. Be sure to lay down a clean shop cloth to protect the sealing surface from damage.
- 11. See Figure 2-65. Install spring over push rod and cartridge body until it contacts side of large retaining ring.
- 12. Place concave side of spring retainer over end of spring fitting inside tabs in slot of clevis.
- 13. Slide dust boot over spring and spring retainer.
- 14. Place large flat washer on top of dust boot fitting inside tabs in slot of clevis.
- 15. Push down on large flat washer to compress spring. While holding spring in a compressed state, install **new** retaining ring in groove of clevis.
- Pull down dust boot as necessary to seat over lip on reservoir adapter.
- Rotate boot so that hole is at the bottom. Bottom is the side opposite the index tab on reservoir adapter.
- 18. Continue with instructions under INSTALLATION.



Figure 2-65. Master Cylinder Assembly

REMOVAL

NOTE

If only replacing brake pads, see 1.8 BRAKE PADS AND DISCS.

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- See Figure 2-66. Remove the banjo bolt (1) and both steel/rubber washers (2) to detach front brake line (3) from caliper. Discard washers.
- Remove both the upper (4) and lower (5) mounting bolts (12 pt/10 mm). Lift caliper upward to remove from brake disc.

- 1. Banjo bolt
- 2. Washers (2)
- 3. Front brake line
- 4. Upper mounting bolt (12 pt/10 mm)
- 5. Lower mounting bolt (12 pt/10 mm)



Figure 2-66. Front Caliper Mount

DISASSEMBLY

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

- See Figure 2-67. Remove pad pins (10) (12 pt/0.25 in.), brake pads (7) and bridge bolts (11) (12 pt/10 mm) to separate caliper housings (1, 8).
- 2. Remove anti-rattle spring (6). If necessary, remove bleeder valve (12).



Figure 2-67. Front Brake Caliper

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 3. See Figure 2-68. Remove pistons.
 - Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293-A) between caliper housings.
 - b. Insert two bridge bolts (2) (12 pt/10 mm) 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.
 - 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 2-69. 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 2-70. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



Figure 2-68. Removing Pistons



Figure 2-69. Crossover O-rings and Inside Housing

CLEANING, INSPECTION AND REPAIR

AWARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

- Clean all parts with denatured alcohol or D.O.T. 4 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.
- Carefully inspect all components. Replace any parts that appear damaged or worn.
 - 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. Inspect pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.
 - d. Always replace wipers, square seals and crossover O-rings after disassembly.
- 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 and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

 Inspect brake pads and brake disc. See 1.8 BRAKE PADS AND DISCS.



Figure 2-70. Wipers and Square Seals



Figure 2-71. Front Caliper Anti-rattle Clip

ASSEMBLY

CAUTION

Do not use D.O.T. 4 brake fluid for lubrication. Use of D.O.T. 4 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.
 - 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.

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 2-70. 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.
- See Figure 2-69. Place two new crossover O-rings (1) on inside caliper housing.
- 5. Assemble caliper housings.
 - See Figure 2-71. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 in-lbs (9.0-11.3 Nm).
 - 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 (12 pt/10 mm). 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 28-38 ft-lbs (38.0-51.5 Nm).

NOTE

See Figure 2-72. Install pad with two tabs (1) on the inboard side of the rear 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.





 Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 in-lbs (20.3-22.6 Nm).

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 2-71.

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

INSTALLATION

- 1. See Figure 2-66. Attach caliper to fork leg.
 - Place caliper over brake disc with bleeder valve facing upwards.
 - Loosely install long mounting bolt (4) (12 pt/10 mm) into top hole on fork leg.
 - c. Install short mounting bolt (5) (12 pt/10 mm) into bottom hole on fork leg. Tighten bottom mounting bolt to 28-38 ft-lbs (38.51.5 Nm).
 - Final tighten the top mounting bolt to 28-38 ft-lbs (38.51.5 Nm).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s) and brake line are clean and undamaged before assembly. (00323a)

 Lubricate new steel/rubber washers with D.O.T. 4 BRAKE FLUID. Connect the brake line (3) to caliper using two new steel/rubber washers (2) and banjo bolt (1). Tighten to 17-22 ft-lbs (23.0-29.8).

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is 1/8 in. (3.2 mm) below top of reservoir with master cylinder in a level position.

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

4. Bleed brake system. See 1.7 BLEEDING BRAKES.

AWARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

- 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 master cylinder. Tighten cover screws to 6-8 in-lbs (0.7-0.9 Nm).

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 7. Test brake system.
 - Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 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

NOTE

The FLSTSC and FXSTS use the same front brake caliper. See 2.20 FRONT BRAKE CALIPER: FXSTS for all disassembly, cleaning, inspection and assembly information.

Removal

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- See Figure 2-73. Remove banjo bolt (2) and two steel/ rubber washers (3) to disconnect brake line (1) from caliper. Discard washers.
- 2. If removing brake line, disconnect fitting on line from master cylinder. Discard washers.
- Remove brake line clamp bolts, but leave clamps on brake line.

NOTE

If you are removing the front fork, you must remove the brake line assembly from the fork. If you are removing the front fork, do steps 4 through 6.

- Remove spring pin (9) from upper caliper mounting bolt (7).
- 5. Remove upper (7) and lower (6) caliper mounting bolts.
- 6. Remove brake caliper (5).

NOTE

Gently rock caliper to compress the caliper piston and ease removal.

 If brake caliper needs repair, See 2.20 FRONT BRAKE CALIPER: FXSTS.

NOTE

Except for brake bracket and mounting plate, the front brake is the same as described in 2.20 FRONT BRAKE CALIPER: FXSTS.



Figure 2-73. Front Brake Caliper: FLSTSC

Installation

- See Figure 2-73. Coat the outside diameter of lower mounting bolt (6) with Dow Corning MOLY 44 light grease (Part No. 94674-99).
- 2. Place caliper mounting plate, with disc pad, on disc.
- 3. Install brake caliper (5) on brake disc.

NOTE

See Figure 2-74. The Springer brake bracket has a cast-in nub that engages a hole in the mounting plate.

- Position the caliper with the disc between the friction pads. Side caliper mounting plate into brake caliper from the rear. Be sure that the spring clip on the caliper mounting plate is properly positioned in the brake caliper.
- See Figure 2-73. Place flat washer (8) on upper mounting bolt (7), then insert the bolt through the bracket holes and the mounting plate. Screw the bolt into the threaded bushing.

- Insert the lower mounting bolt (6) through the caliper (5) and the bracket hole.
- See Figure 2-74. Thread lower mounting bolt into the tapped hole at the lower end of mounting plate. Tighten to 25-30 ft-lbs (33.9-40.7 Nm).
- See Figure 2-73. Tighten the upper mounting bolt (7) to 25-30 ft-lbs (33.9-40.7 Nm). Install washer and new spring pin (9).
- Install bleeder valve (4) into the caliper, if removed. Tighten to 80-100 in-lbs (9.0-11.3 Nm).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

 Install the brake line (1), if removed. The brake line is installed from the left side of the front fork. Lubricate **new** banjo washers (3) with D.O.T. 4 BRAKE FLUID and connect the brake line (1) to the caliper (5). Tighten banjo bolt (2) to 17-22 ft-lbs (23.0-29.8 Nm). Install brake line clamp and brake line clamp bolt.

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top. Do not reuse old brake fluid. Use only D.O.T. 4 fluid from a sealed container.

AWARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

12. Bleed brake system and tighten bleeder valve as directed. See 1.7 BLEEDING BRAKES.

WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

- 13. Verify proper operation of the master cylinder relief port. Actuate the brake hand 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 master cylinder. Tighten cover screws to 6-8 in-lbs (0.7-0.9 Nm).



Figure 2-74. Springer Brake Bracket

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 15. Test brake system.
 - Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 BLEEDING BRAKES.

BRAKE REACTION LINK

Removal

- 1. Remove brake caliper.
- 2. Remove front wheel. See 2.6 FRONT WHEEL: FLSTSC
- Remove front fender. See 2.32 FRONT FENDER: FLSTSC.
- See Figure 2-75. Remove screw (7), acorn locknut and washer (9) connecting brake reaction link (8) to caliper bracket (10). Discard acorn locknut.
- Remove the caliper bracket (10), washer (13), rubber spacer (12) and pivot sleeve (11) from rocker.
- Remove screw (6) and acorn locknut and washer (3) connecting brake reaction link (9) to fork leg bracket (4). Discard acorn locknut.
- Remove screws (5) connecting fork leg bracket (4) to rigid fork leg (1).

Installation

- See Figure 2-75. Attach fork leg bracket (4) to rigid fork (1) using two screws (5). Tighten to 35-40 ft-lbs (47.5-54.2 Nm).
- Attach brake reaction link (8) to fork leg bracket (4) with screw (6), washer and **new** acorn locknut (3). Tighten acorn locknut to 35-40 ft-lbs (47.5-54.2 Nm).
- Insert new pivot sleeve (11) for caliper bracket assembly into left rocker, if required.
- Assemble rubber spacer (12) and washer (13), with teflon-coated side towards caliper bracket, onto pivot sleeve.
- 5. Install new bushing (14) into caliper bracket (10) if removed.
- 6. Place caliper bracket (10) onto pivot sleeve (11).
- Attach brake reaction link and caliper bracket using screw (7), washer and new acorn locknut (9). Tighten acorn locknut to 35-40 ft-lbs (47.5-54.2 Nm).
- 8. Install front fender. See 2.32 FRONT FENDER: FLSTSC.
- 9. Install front wheel. See 2.6 FRONT WHEEL: FLSTSC.
- 10. Install front brake caliper.



Figure 2-75. Brake Reaction Link: FLSTSC

REMOVAL

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- Remove banjo bolt and two steel/rubber washers to disconnect brake line from caliper. Discard washers.
- If removing brake line, disconnect fitting on line from master cylinder. Discard washers.

NOTE

If you are removing the front fork, you must remove the brake line assembly from the fork. If you are removing the front fork, do steps 3 through 5.

- See Figure 2-76. Remove cotter pins (3, 4) from brake reaction link screw (11) (brake bracket) and weld stud on rigid fork (1).
- 4. Remove nuts (5, 6), rubber spacer (7), washers (8, 9) and brake bracket screw (11).
- Remove brake reaction link (10). Remove cotter pin (18) and washer (17) from upper mounting bolt (12).

NOTE

Gently rock caliper to compress the caliper piston and ease removal.

 Remove upper mounting bolt (12) and washer (13). Remove lower mounting bolt (15) securing brake caliper to brake mounting bracket. Remove brake caliper.



INSTALLATION

- See Figure 2-76. Coat the outside diameter of lower mounting bolt (15) with Dow Corning MOLY 44 light grease (Part No. 94674-99).
- Position the caliper with the disc between the friction pads. Align the two mounting holes in the caliper with the mounting holes in the bracket.
- Place flat washer (13) on upper mounting bolt (12), then insert the bolt through the bracket holes and the mounting plate. Screw the bolt into the threaded bushing.

NOTE

See Figure 2-77. The Springer brake bracket has a cast-in nub that engages a hole in the mounting plate.

- See Figure 2-76. Insert the lower mounting bolt (15) through the caliper and the bracket hole. Thread it into the tapped hole at the lower end of mounting plate. Tighten lower mounting bolt to 25-30 ft-lbs (33.9-40.7 Nm).
- 5. Tighten upper mounting bolt (12) to 25-30 ft-lbs (33.9-40.7 Nm). Install washer (17) and **new** cotter pin (18).
- Install bleeder valve into the caliper, if removed. Tighten to 80-100 in-lbs (9.0-11.3 Nm)
- Place brake reaction link (10) in position on rigid fork weld stud (1). Align brake reaction link with hole in brake bracket and install screw (11).
- Install washers (8, 9), rubber spacer (7) and nuts (5, 6). Tighten nut (5) to 10-20 ft-lbs (13.6-27.1 Nm). Install new cotter pin (4).
- 9. Install washer and locknut (2). Tighten to 10-20 ft-lbs (13.6-27.1 Nm). Install **new** cotter pin (3).

CAUTION

Avoid leakage. Be sure gaskets, banjo bolt(s), brake line and master cylinder bore are clean and undamaged before assembly. (00322a)

 Install the brake line if removed. Lubricate **new** banjo washers with D.O.T. 4 BRAKE FLUID and connect the brake line to the caliper. Tighten banjo bolt to 17-22 ft-lbs (23.0-29.8 Nm). Install brake line clamp and brake line clamp bolt.



Figure 2-77. Springer Brake Bracket

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Add D.O.T. 4 BRAKE FLUID to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top. Do not reuse old brake fluid. Use only D.O.T. 4 fluid from a sealed container.

AWARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

 Bleed brake system and tighten bleeder valve as directed. See 1.7 BLEEDING BRAKES.

WARNING

A plugged or covered relief port can cause brake drag or lock-up, which could lead to loss of control, resulting in death or serious injury. (00288a)

- Verify proper operation of the master cylinder relief port. Actuate the brake hand 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 master cylinder. Tighten cover screws to 6-8 in-lbs (0.7-0.9 Nm).

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 15. Test brake system.
 - a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 BLEEDING BRAKES.

DISASSEMBLY

- See Figure 2-78. Remove retainer screw (10), retaining pad (9) and inside pad (11).
- Remove the outer pad (11), mounting bracket (17) and spring clip (14) as an assembly. Remove pad from mounting bracket by pushing the pad free of the spring clip.
- Pry out the piston retaining ring (8) by inserting a small screwdriver into the notched groove at the bottom of the piston bore.

When removing the piston with air pressure, wear heavy gloves or hold piston with heavy towel to prevent personal injury. Piston may develop considerable force from pressure build-up and you should take care to keep your hands out from under piston to prevent minor or moderate injury.

NOTE

Be sure piston is not dropped on hard surface.

- Remove the piston dust boot (7). Then remove the piston by applying air pressure to the hydraulic brake line inlet.
- Pull guide pin (16) out, then remove dust boot (15) from groove in caliper.
- Pry seal (5) and the three O-rings (2) out of their grooves.

CLEANING AND INSPECTION

AWARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

 Clean all parts with denatured alcohol or D.O.T. 4 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, 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. Always replace seals and O-rings after disassembly.

WARNING

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

 Inspect brake pads and brake disc. If brake pad friction material is worn to 1/16 in. (1.6 mm) or less, replace entire set. After the brake pads are installed, burnish by making normal stops.

CAUTION

Avoid hard stops for approximately 300 miles (500 km) after replacing brake pads. Proper burnishing will not occur if hard stops are made during the wear-in period.



Figure 2-78. Front Brake Caliper: FXSTS

ASSEMBLY

CAUTION

Be sure washers, banjo bolt, hydraulic brake line and master cylinder bore are free of D.O.T. 4 BRAKE FLUID, dirt and metal chips before assembly to avoid leakage.

- See Figure 2-78. Apply a thin coating of G.E. VERSI-LUBE® #G322 L SILICONE GREASE to the exterior surfaces of seal (5) and O-rings (2) in their respective grooves.
- Push the piston dust boot (7), with the open side downward, over the top of the piston. Push downward on the boot until the inner lip seats in the groove at the top of the piston.
- Coat the outside diameter and bottom chamfer of piston (6) with GE Silicone Versilube grease (G322L) and push the piston with dust boot into the piston bore. If necessary, press the piston in with a "C" clamp.

NOTE

Piston must be pressed all the way into the bore when **new** brake pads have been installed to assure proper clearance when calipers are assembled to vehicle.

- Position the gap of the retaining ring (8) at the top of the caliper and compress the retaining wire into the piston bore. Push the retaining wire firmly against the piston dust boot.
- Lightly coat the bores of the caliper mounting lugs with Dow Corning MOLY 44 grease (Part No. 94674-99).
- Lightly coat the cavity of dust boot (15) with Dow Corning 44 grease. Insert the flanged end of dust boot into the internal groove of the top caliper mounting lug.
- Push the guide pin (16) into dust boot. Push guide pin until the dust boot seats in the grooved shoulder of the pin.
- 8. Place the inner pad (11) (without insulator backing) in the recessed seat machined into the caliper.
- Position the retaining pad (9) within the counterbore at the inside end of the caliper. Insert self-tapping retainer screw (10) through the hole in the center of pad retainer and thread into the hole in the pad. Tighten the screw to 40-50 in-lbs (4.5-5.6 Nm).



Figure 2-79. Spring Clip Installation

- Lay the mounting bracket (17) down on a firm flat surface. The upper mounting bolt hole must be positioned at the upper right.
- See Figure 2-79. Install the spring clip at the top of mounting plate as shown.
- 12. See Figure 2-78. Take the pad (11) that has the insulator backing, and place it on top of the spring clip with the lower end of the pad slightly entering the opening of the mounting plate. With the pad centered within the mounting plate and the insulated back facing downward, push down on the pad until it is against the flat surface and is held firmly by spring tension from the spring clip.
- Insert the outer pad (11), mounting bracket (17) and spring clip (14) assembly into place with the backside of the pad against the face of the piston.

NOTE

The spring clip loop and friction material must always face away from the piston. If it is wrong, the pad must be removed, the mounting plate reversed and the parts assembled again.

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.8 BRAKE PADS AND DISCS.

1. If present, remove right saddlebag.

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- 2. See Figure 2-80. Remove the banjo bolt (1) and both steel/rubber washers (2) to detach rear brake line (3) from caliper. Discard washers.
- 3. Pull axle from rear wheel. See 2.8 REAR WHEEL.
- 4. Lift rear caliper away from axle and rear fork. Notch (4) in caliper mount must clear tab on rear fork.

DISASSEMBLY

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

1. See Figure 2-81. Remove pad pins (10) (12 pt/0.25 in.), brake pads (7) and bridge bolts (11) (12 pt/10 mm) to separate caliper housings (1, 8).

- 1. Banjo bolt
- 2. Washers (2)
- 3. Rear brake line



Figure 2-80. Rear Caliper Mount

- 2. Remove anti-rattle spring (6). If necessary, remove bleeder valve (12).
- 3. If necessary, cut rubber bumper (13) to remove.


Figure 2-81. Rear Brake Caliper

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 4. See Figure 2-82. Remove pistons.
 - a. Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293-A) between caliper housings.
 - b. Insert three bridge bolts (2) (12 pt/10 mm) 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.
 - d. Apply low pressure compressed air (1) to banjo bolt hole to remove pistons from caliper bores.
 - e. Remove bridge bolts and remove tool.
- 5. See Figure 2-83. Remove and discard both crossover Orings (1) from inside caliper housing.
- 6. 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 2-84. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



Figure 2-82. Removing Pistons







3. Square seal

Figure 2-84. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

AWARNING

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

- Clean all parts with denatured alcohol or D.O.T. 4 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.
- Carefully inspect all components. Replace any parts that appear damaged or worn.
 - 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 pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.
 - Always replace wipers, square seals and crossover O-rings after disassembly.
- 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 and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

 Inspect brake pads and brake disc. See 1.8 BRAKE PADS AND DISCS.

ASSEMBLY

CAUTION

Do not use D.O.T. 4 brake fluid for lubrication. Use of D.O.T. 4 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 2-85. 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 2-84. 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.
- See Figure 2-83. Place two new crossover O-rings (1) on inside caliper housing.
- 5. Assemble caliper housings.
 - See Figure 2-85. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 in-lbs (9.0-11.3 Nm).
 - Place outside caliper housing on workbench with decal side down. Install anti-rattle clip (2) in channel with indent (3) facing upwards.
 - Verify that new crossover O-rings are installed on inside caliper housing.
 - Mate inside and outside caliper housings using three bridge bolts (12 pt/10 mm). Loosely install bridge bolts.
 - Check that anti-rattle spring is still seated between caliper housings.
 - f. Tighten bridge bolts to 28-38 ft-lbs (38.0-51.5 Nm).
 - g. If rubber bumper (4) on outside housing was removed, lubricate **new** part before installation.

NOTE

- See Figure 2-86. The front and rear brake calipers use the same exact brake pad set.
- See Install pad with two tabs (1) on the inboard side of the rear 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 upward when caliper is installed.
- Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 in-lbs (20.3-22.6 Nm).

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 2-85.

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

INSTALLATION

1. See Figure 2-80. Place caliper on rear axle with notch (4) inside rear fork tab. Verify that the rubber bumper is contacting the underside of the caliper mount for the full length of the bumper. Install rear axle and check drive belt tension. See 2.8 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. 4 BRAKE FLUID. Connect the brake line (3) to caliper using two new washers (2) and banjo bolt (1). Tighten to 17-22 ft-lbs (23.0-29.8).

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is 1/8 in. (3.2 mm) below top of reservoir with master cylinder in a level position.





WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

4. Bleed brake system. See 1.7 BLEEDING BRAKES.

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 5. Test brake system.
 - a. Turn ignition switch ON. Pump brake foot pedal to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 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.

REAR BRAKE CALIPER: FXST/FXSTB/FXSTS

REMOVAL

NOTE

If only replacing brake pads, do not remove rear brake caliper. Should pad replacement be necessary, see 1.8 BRAKE PADS AND DISCS.

CAUTION

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

CAUTION

D.O.T. 4 brake fluid will damage painted and molded-in color surfaces it comes in contact with. Always use caution and protect surfaces from spills whenever brake work is performed. Failure to comply can result in cosmetic damage. (00239a)

- See Figure 2-87. Remove the banjo bolt (3) and both 1. steel/rubber washers (2) to detach rear brake line (4) from caliper. Discard washers.
- 2. Remove both the upper (6) and lower (5) mounting bolts (12 pt/10 mm). Slide caliper towards front of vehicle to remove from brake disc.
- To remove rear caliper mount: 3.
 - a. Pull axle from rear wheel. See 2.8 REAR WHEEL.
 - b. Lift rear caliper mount away from axle and rear fork. Notch in caliper mount must clear tab on rear fork.

DISASSEMBLY

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

1. See Figure 2-88. Remove pad pins (10) (12 pt/0.25 in.), brake pads (7) and bridge bolts (11) (12 pt/10 mm) to separate caliper housings (1, 8).



- 2. Washers (2)
- 3. Banjo bolt
- 4. Rear brake line
- 5. Lower mounting bolt
- 6. Upper mounting bolt

Figure 2-87. Rear Caliper Mount

- Remove anti-rattle spring (6). If necessary, remove 2. bleeder valve (12).
- If necessary, cut rubber bumper (13) to remove. 3.



Figure 2-88. Rear Brake Caliper

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- See Figure 2-89. Remove pistons. 4
 - a. Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293-A) between caliper housings.
 - b. Insert two bridge bolts (2) (12 pt/10 mm) 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.
 - Apply low pressure compressed air (1) to banjo bolt d. hole to remove pistons from caliper bores.
 - Remove bridge bolts and remove tool. e.
- 5. See Figure 2-90. Remove and discard both crossover Orings (1) from inside caliper housing.
- 6. 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.

7. See Figure 2-91. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



Figure 2-89. Removing Pistons



Figure 2-90. Crossover O-rings and Inside Housing



- 2. Wiper
- 3. Square seal

Figure 2-91. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

- Clean all parts with denatured alcohol or D.O.T. 4 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, 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 pad pins for grooving and wear. Measure the pad pin diameter in an unworn area, and then in the area of any grooving or wear. If wear is more than 0.015 in. (0.38 mm), replace both pins.
 - d. Always replace wipers, square seals and crossover O-rings after disassembly.
- 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 and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

 Inspect brake pads and brake disc. See 1.8 BRAKE PADS AND DISCS.



Figure 2-92. Anti-rattle Clip

ASSEMBLY

CAUTION

Do not use D.O.T. 4 brake fluid for lubrication. Use of D.O.T. 4 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.
 - 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.

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.

- See Figure 2-91. 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.
- See Figure 2-90. Place two new crossover O-rings (1) on inside caliper housing.
- 5. Assemble caliper housings.
 - See Figure 2-92. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 in-lbs (9.0-11.3 Nm).
 - 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.
 - Mate inside and outside caliper housings using three bridge bolts (12 pt/10 mm). Loosely install bridge bolts.
 - e. Check that anti-rattle spring is still seated between caliper housings.
 - f. Tighten bridge bolts to 28-38 ft-lbs (38.0-51.5 Nm).
 - g. If rubber bumper (4) on outside housing was removed, lubricate **new** part before installation.

NOTE

- See Figure 2-93. The rear brake pads on FXST, FXSTB and FXSTS models are different then the pads on other models.
- See Figure 2-94. Install pad with two tabs (1) on the inboard side of the rear caliper.



FXST, FXSTB and FXSTS outboard pad

Figure 2-93. FXST, FXSTB and FXSTS Brake Pads

- Insert one 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.
- Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 in-lbs (20.3-22.6 Nm).

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 2-92.

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

INSTALLATION

 See Figure 2-87. Place caliper on rear axle with notch (4) inside rear fork tab. Verify that the rubber bumper is contacting the underside of the caliper mount for the full length of the bumper. Install rear axle and check drive belt tension. See 2.8 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. 4 BRAKE FLUID. Connect the brake line (3) to caliper using two new washers (2) and banjo bolt (1). Tighten to 17-22 ft-lbs (23.0-29.8).

ACAUTION

Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. 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. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

 Remove cover from rear brake master cylinder. Fill master cylinder with D.O.T. 4 BRAKE FLUID. Verify that fluid level is 1/8 in. (3.2 mm) below top of reservoir with master cylinder in a level position.



2. Single square tab on backing plate

Figure 2-94. Brake Pad Alignment

WARNING

After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

4. Bleed brake system. See 1.7 BLEEDING BRAKES.

WARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a)

- 5. Test brake system.
 - a. Turn ignition switch ON. Pump brake foot pedal to verify operation of the brake lamp.
 - Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 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.

GENERAL

There are three varieties of hydraulic forks:

- All FLSTC, FLSTF, FLSTN and FLST Softail models use the type shown in Figure 2-95.
- All FXST and FXSTB Softail models use the type shown in Figure 2-96.
- FXSTD Softail models use the type shown in Figure 2-97.

Use the following information to service the models listed above. For other vehicles, see 2.24 SPRINGER FORK: FLSTSC/FXSTS.

REMOVAL

- Remove front wheel and brake caliper. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTS/FXSTD or 2.5 FRONT WHEEL: FXSTD
- Remove front fender. See 2.31 FRONT FENDER: ALL BUT FLSTSC/FXSTS.
- Remove the slider tube cap (1), spacer (2) and oil seal (3) from the top of one fork side.
- Loosen the pinch bolt (4) and pull the fork side from the brackets.
- 5. Repeat Steps 3 and 4 for the other fork side.

DISASSEMBLY

WARNING

See Figure 2-95. The FLSTC/FLSTF/FLSTN and FLST models have a preloaded fork spring. Fork tube plug (5) is under spring pressure. Disassemble the fork tube(s) carefully. The spring can force parts from the tube unexpectedly, which could result in death or serious injury.

- Support the vehicle so the front end is off floor and the forks are fully extended.
- Remove the fork tube plug (5) and O-ring (6). Pull spring (7) out of slider tube (8). Remove drain screw (9) and washer (10), and drain the fork.
- See Figure 2-96. On FXST/FXSTB only, remove dust cover (23).
- See Figure 2-97. FXSTD model front forks have a fork cap and dust shield. Remove fork cap (23) by inserting wooden block into slot in fork cap and tapping slightly then remove dust shield (36).
- See Figure 2-95. Compress retaining ring (11) and remove the clip from the internal groove at the top of slider (12).

NOTE

Since there is little resistance to rotation when removing socket screw (13), the job is done more easily with an air impact wrench.

 Use an allen wrench and remove socket screw (13) with washer (14) from the bottom end of fork slider (12). This will free damper tube (15) and fork tube (8) so that they can be removed from slider.

- 7. The upper bushing (16) is a slight interference fit in slider (12). The upper bushing together with spacer (17) and oil seal (18) are removed by lightly hitting the upper bushing with the lower bushing (19) as the fork tube is pulled free of the fork slider in a quick continuous stroke. Continue this slide hammer action until the components are freed.
- Push the damper tube (15) and damper tube spring (20) free of slider tube (8) by inserting a small diameter rod through the opening in the bottom of tube.
- Remove lower stop (21) from the lower end of damper tube (15).
- 10. Damper tube ring (22) can now be removed from the grooves at the top end of damper tube (15). Lower bushing (19) should not be removed unless it is to be replaced. When replacing lower bushing (19), expand the **new** split bushing diameter only enough to fit over slider tube (8) and slide bushing into the bushing groove.

CLEANING AND INSPECTION

Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be repaired or replaced.

- 1. Inspect damper tube rings (22) on damper tube (15) and replace if worn excessively or damaged.
- On FXSTD models, check dust shield (36) where it rubs on slider tube (8). The tube should show a bright, shining surface, free of scoring or abrasions, and the dust shield should present a good continuous seal and not show excessive wear.
- 3. Replace either of the springs (7 or 20) if broken.
- 4. Inspect small hole in lower end of slider tube (8) and be sure it is not obstructed.
- 5. Be sure O-ring (6) is in good condition, without irregularities, and that it provides proper sealing when in place.
- 6. Install new screws (9 and 13) and washers (10 and 14).
- 7. Replace bent or damaged slider tube (8).



Figure 2-95. Front Forks: FLSTC, FLSTF, FLSTN, FLST



Figure 2-96. Front Forks: FXST and FXSTB



ASSEMBLY

INS	TAL	LA	TI	ON

PART NO.	SPECIALTY TOOL	
HD-34634	Fork seal installer	

- Install damper tube rings (22). Place damper tube spring (20) on damper tube (15). Insert damper tube into fork tube (8).
- Insert spring (7) into slider tube (8), tapered side toward damper tube, and push bottom of damper tube (15) through the opening at the bottom end of the fork tube. Place lower stop (21) over end of damper tube (15).
- Position slider tube (8) and damper tube (15) in slider (12). Hold the assembly in place by exerting pressure on the spring and install socket screw (13) with washer (14).
- Place upper bushing (16), seal spacer (17) and a new seal (18) (in that order) over fork slider (12). Be sure that the flanged surface of the seal spacer (17) is up and lettered side of the seal is facing upward.
- Place FORK SEAL INSTALLER (Part No. HD-34634) over fork slider (12). Seat bushing (16), spacer (17), and seal (18) into the slider bore by lightly tapping the components into place with the installation tool.
- 6. Install retaining ring (11).
- 7. On FXST/FXSTB models, install dust cover (23).
- On FXSTD models, install dust shield then install fork cap using FORK SEAL INSTALLER (Part No. HD-34634).
- 9. Fill fork sides with Harley-Davidson TYPE E FORK OIL. See 1.20 FRONT FORK OIL.

- Insert both fork side assemblies up through the fork stem and bracket (24) and upper bracket (29).
- Install spacer (2), fork tube plug (5) and **new** oil seal (3). Tighten securely. Be sure one flat on each fork tube plug (5) faces toward the inside of the fork.
- Install slider tube cap(s) (1). Tighten to 40-60 ft-lbs (54.2-81.3 Nm).
- 4. Tighten fork stem bracket pinch bolt(s) (4).
 - All but FXSTD, tighten to 30-35 ft-lbs (40.7-47.5 Nm).
 - b. On FXSTD models, apply LOCTITE ANTI-SEIZE to threads and tighten to 35-40 ft-lbs (47.5-54.2 Nm).
- Check steering head bearing adjustment if fork stem was removed. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC/FXSTS.

This topic is divided as follows:

- Handlebars and risers: page 2-82.
- Front shock absorber: page 2-84.
- Rigid fork: page 2-85.
- Spring fork: page 2-86.
- Fork rockers: page 2-90.
- Fork stem bearings: page 2-91.

Other important information related to springer forks can be found under:

- 1.18 STEERING HEAD BEARINGS: FLSTSC/FXSTS.
- 1.19 ROCKER BEARINGS: FLSTSC/FXSTS.

HANDLEBAR AND RISERS

Removal

- 1. See Figure 2-98. Remove handlebar riser screws (1) and riser clamp (2). Remove handlebars.
- One of the risers contains a ground spring (3) which provides an electrical ground for the front turn signals. Remove ground spring.
- 3. Remove riser locknuts (4) and washers (5). Discard locknuts.
- 4. Remove the risers (7). If necessary, remove the riser rubber bushings (6) and rigid fork leg studs (8).

Installation

- See Figure 2-98. If you removed the rubber bushings (6), lubricate the outside of the bushings and install them in risers (7). Be sure the lip on the bottom rubber is fitted into the recess in the bottom of the riser.
- 2. Place the risers (7) in position over the rigid fork leg studs (8).

NOTE

Be sure the risers are correctly oriented for the handlebars.

- Install washers (5) and **new** locknuts (4). Tighten locknuts to 25-35 ft-lbs (33.9-47.5 Nm). Place ground spring (3) in one of the risers.
- Place handlebars on risers and put clamps (2) in position. Install screws (1). Make the gap between clamps and risers even, front and rear. Adjust handlebars and tighten screws to 144-180 in-lbs (16.3-20.3 Nm).



Figure 2-98. Spring Fork Handlebars



Figure 2-99. Front Fork: FLSTSC/FXSTS

- 1. Acorn nut (2)
- 2. Spring rod washer (2)
- 3. Spring bridge
- 4. Spring bridge restraint, upper (2)
- 5. Rebound spring, top (2)
- 6. Acorn nut with washer (2)
- 7. Rubber washer
- 8. Screw
- 9. Upper triple clamp
- 10. Steering head bearing retainer
- 11. Spring cup, rebound spring (2)
- 12. Travel bumper, upper (2)
- 13. Spring rod bushing (2)
- 14. Screw and lockwasher
- 15. Screw
- 16. Screw and washer
- 17. Acorn nut and washer (4)
- 18. Steering stem retaining ring
- 19. Travel bumper, lower (2)

- 20. Spring cup, compression spring (2)
- 21. Compression spring, outer (2)
- 22. Reflector (2)
- 23. Rigid fork
- 24. Compression spring, inner (4)
- 25. Spring rod assembly (2)
- 26. Spring seat (4)
- 27. Front shock absorber
- 28. Acorn nut, lower spring rod (2)
- 29. Spring fork
- 30. Lower bearing dust shield
- 31. Roller bearing with cup (2)
- 32. Upper bearing dust shield

NOTE

Parts are not shown:

- front shock absorber sticker
- bumper for the rigid fork

Legend For Figure 2-99. Front Fork: FLSTSC/FXSTS

FRONT SHOCK ABSORBER

Removal

NOTE

The shock absorber does not have a spring, so there is no pre-load.

- 1. See Figure 2-100. Remove acorn nuts and washers (1).
- 2. Remove both screws and washers (2). Remove front shock absorber (3).

Installation

AWARNING

Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)

 See Figure 2-100. Apply LOCTITE THREADLOCKER 243 (blue) to screws (2). Place shock absorber (3) in position in bracket holes and install screws, washers and acorn nuts. Tighten acorn nuts to 45-50 ft-lbs (61.0-67.8 Nm).

CAUTION

Be sure there is no free play between shock absorber eyes and shock absorber brackets. Free play between shock absorber eyes and shock absorber brackets indicates incorrect shock absorber usage.



RIGID FORK

Removal

NOTE

It is possible to remove the spring fork without removing the entire fork assembly, if you follow steps 1-6 under RIGID FORK REMOVAL and then steps 1-10 under SPRING FORK DISASSEMBLY. Block up front of bike so front wheel is off the floor.

- Remove headlamp and mounting block. See 8.19 HEAD-LAMP. Move headlamp out of the way and let wire support it.
- Remove handlebars and risers. See HANDLEBAR AND RISERS on page 2-82.
- Remove front brake caliper and brake line. See 2.20 FRONT BRAKE CALIPER: FXSTS.
- 4. Remove wheel. See 2.7 FRONT WHEEL: FXSTS.
- Remove front fender. See 2.33 FRONT FENDER: FXSTS.
- See Figure 2-101. Remove fork stem acorn nut (2) and rubber washer (3). Loosen the upper triple clamp pinch bolt (4).
- 7. Remove the rigid fork leg studs (1).
- 8. Remove upper triple clamp (5).
- 9. Remove hex bearing retainer (6) and dust shield (7).
- 10. Lower fork stem slightly and remove fork lock. See 2.42 FORK LOCK.
- 11. Remove fork stem and fork from steering head.

Installation

1. Insert fork stem and fork lock in steering head.

NOTE

Retainer is installed with hex DOWN as shown.

- 2. See Figure 2-101. Install upper dust shield (7) and hex bearing retainer (6).
- Seat steering head bearing by tightening bearing retainer (6) to 40 ft-lbs (54.2 Nm). Loosen and then retorque bearing retainer to 72 in-lbs (8.1 Nm).
- Place upper triple clamp (5) in position on stem and rigid fork legs.

NOTE

Install rigid fork leg studs (1) in three next three steps.

- 5. Start threads of both studs in fork leg.
- 6. Tighten both studs.
- 7. Torque both studs to 60-65 ft-lbs (81.3-88.1 Nm).

- 1. Rigid fork leg stud (2)
- 2. Acorn nut with washer
- 3. Rubber washer
- 4. Bolt
- 5. Upper triple clamp
- 6. Steering head bearing retainer
- 7. Upper bearing dust shield
- 8. Upper roller bearing and cone
- 9. Fork neck/frame



Figure 2-101. Steering Head/Fork Stem Assembly

- Install the upper triple clamp pinch bolt (4). Tighten to 25-30 ft-lbs (33.9-40.7 Nm).
- Install fork stem rubber washer (3) and acorn nut (2). Tighten to 30-35 in-lbs (3.4-4.0 Nm).
- Adjust fall-away. See 1.18 STEERING HEAD BEAR-INGS: FLSTSC/FXSTS.

SPRING FORK

Disassembly

AWARNING

The springs are compressed. If they are released suddenly, the spring pressure will snap them forward with great force, which could result in death or serious injury.

- 1. Remove front shock absorber.
- 2. See Figure 2-103. Make a spring fork compression tool as shown.
 - a. Slide rod, without long hex nut (2) and washers (3), into the hole above the upper shock eye mount.
 - b. Install block in the bottom shock absorber eye using the shock absorber mounting bolt and washers.
 - c. Install the washers and long hex nut on the rod.

WARNING

See Figure 2-102. Use nylon cable ties around the rigid and spring fork legs to hold them in place. If the spring fork legs are not held in place, next to the rigid fork legs, the spring pressure will snap them forward with great force, which could result in death or serious injury.

 See Figure 2-102. Use cable ties to tie wrap the fork legs in place as shown.



Figure 2-102. Nylon Ties on Fork Legs

4. Use the tool and compress the compression (lower) springs until they bottom on the travel bumpers. This will release the pressure on the rebound (upper) springs.



Figure 2-103. Fork Spring Compression Tool

- See Figure 2-104. Remove acorn nuts (1), washers (2) and spring bridge (3).
- 6. Remove upper spring restraints (4).
- 7. Remove upper (rebound) springs (5).
- 8. Remove rebound spring cups (6).
- 9. Remove upper rubber travel bumpers (7).
- 10. Remove bushings (8).
- 11. See Figure 2-105. Remove rocker head pivot studs (1), washers (3) and acorn nuts (4) from rockers (2).
- 12. Unscrew the tool, gradually releasing the tension on the lower (compression) springs.
- 13. Remove spring fork assembly from rigid fork assembly and rockers. Slide legs out of nylon tie wraps



Figure 2-104. Rebound Spring: Disassembly

- See Figure 2-106. Remove compression spring cups (2) and lower rubber travel bumpers (1). Remove outer compression springs (3).
- 15. Remove inner/upper compression springs (4).

NOTE

Rotate spring to position that allows the easiest access through the coils to cross-hole at the bottom of the lower spring rod.

- Insert a # 2 Phillips head screwdriver in the cross-hole at the bottom of the lower spring rod (5) and loosen long acorn nuts (8). Remove screwdriver. Remove the long acorn nuts and spring rod assemblies.
- 17. Remove spring seats (6) and inner/lower compression springs (7) from spring rod (5).

CAUTION

DO NOT remove the upper spring rods from the lower spring rods. If either the upper spring rod(s) or the lower spring rod(s) are damaged, replace as an assembly.



Figure 2-105. Rocker Assembly

Assembly

- 1. See Figure 2-106. Place both spring seats (6) on the spring rod (5).
- 2. Place inner/lower compression spring (7) over lower spring rod and spring seats.
- 3. Position spring rods assembly in spring fork bracket.
- 4. Install long acorn nut (8).
- Use a #2 Phillips head screwdriver in the cross-hole at the bottom of the spring rod (5). Tighten long acorn nut to 20-25 ft-lbs (27.1-33.9 Nm).
- 6. Place inner/upper compression spring (4) on spring seats.
- 7. Place outside compression spring (3) over the inside compression springs.
 - 1. Travel bumper, lower (2)
 - 2. Spring cup, compression spring (2)
- 3. Compression spring, outer (2)
- 4. Compression spring, inner/upper(2)
- 5. Spring rod assembly (2)
- 6. Spring seat (4)
- 7. Compression spring, inner/lower (2)
- 8. Acorn nut, lower spring rod (2)

- 8. Install compression spring cup (2) and lower rubber travel bumpers (1).
- 9. Repeat steps 1 through 8 above for other side.
- 10. Position spring fork assembly in rigid fork assembly so lower springs, lower rubber travel bumpers, and spring cups are at the bottom of the rigid fork spring brace. Make sure lower rubber travel bumpers are seated in the rigid fork, and be sure the spring fork legs are in the nylon cable ties.
- 11. Use the compression tool and compress the compression (lower) springs.
- 12. See Figure 2-105. Place spring fork lower end in position in rocker (2).
- 13. Install thick head pivot stud (1) with thick washer (3) and acorn nut (4). Tighten nut to 45-50 ft-lbs (61.0-67.8 Nm).



Figure 2-106. Compression Spring

- See Figure 2-107. Oil bushing (8) and place on spring rod. Slide bushing down until it bottoms in lower rubber travel bumpers (9).
- 16. Install upper rubber travel bumpers (7) over spring rod and bushing.
- 17. Install rebound spring cup (6).
- 18. Install rebound spring (5).
- 19. Repeat steps 15 through 18 for other side.
- Apply LOCTITE ANTI-SEIZE to top 0.5 in. (12.7 mm) of upper spring rods.

WARNING

Tighten both spring restraints evenly. Not having the same amount of exposed spring rod on each side could adversely affect handling. This could lead to loss of control of the vehicle which could result in death or serious injury.

 See Figure 2-108. Place upper spring restraints in position. Tighten spring restraints until the spring rods protrude 0.625-0.750 in. (16-19 mm) from the tops of the spring restraints.

NOTES

- Be sure headlamp wire is between rebound springs before installing upper triple clamp or spring bridge.
- Curved edge of spring bridge goes forward.
- See Figure 2-107. Place spring bridge (3) in position. Install washers (2) and acorn nuts (1). Tighten acorn nuts to 30-35 ft-lbs (40.7-47.5 Nm).
- 23. Install front shock absorber.
- 24. Install front fender. See 2.33 FRONT FENDER: FXSTS.
- 25. Install wheel. See 2.7 FRONT WHEEL: FXSTS.
- 26. Install front brake caliper and brake line. See 2.20 FRONT BRAKE CALIPER: FXSTS.
- 27. Install handlebars and risers. See HANDLEBAR AND RISERS on page 2-82.
- Install headlamp and mounting block. See 8.19 HEAD-LAMP.



Figure 2-107. Rebound Spring: Assembly



Figure 2-108. Checking Spring Rod

FORK ROCKERS

Removal

- 1. Remove front brake caliper. See 2.20 FRONT BRAKE CALIPER: FXSTS.
- 2. Remove front wheel. See 2.7 FRONT WHEEL: FXSTS.

AWARNING

See Figure 2-102. Use nylon cable ties around the rigid and spring fork legs to hold them in place. If the spring fork legs are not held in place, next to the rigid fork legs, the spring pressure will snap them forward with great force, which could result in death or serious injury.

- 3. See Figure 2-102. Use cable ties to tie wrap the fork legs in place as shown.
- 4. See Figure 2-109. Remove the spring fork rocker pivot studs (5), washers (2) and acorn nuts (1) from rocker.
- 5. Remove bearing retainer jam nuts (7).
- 6. Remove bearing retainers (6).
- Remove acorn nuts (1) from rigid fork pivot studs. Remove rigid fork thin head pivot studs (4) from rockers and rigid fork legs. Remove bearings (10) from thin head pivot studs (4).
- 8. Remove rockers.

Installation

NOTE

The **threaded side** of the rocker and jam nut (7) is installed **inboard** of the rigid fork leg.

- 1. If bearing races were removed, press races into rockers.
- See Figure 2-109. Grease rocker bearing race with a finger full of grease. Place one bearing half (10) in rocker race, spherical surface against the race.
- 3. Place other half of bearing on pivot stud (4), spherical surface towards stud head.
- Place rocker in position in rigid fork leg, with rocker facing forward.
- Install pivot stud (thin head) assembly, from bearing retainer side, through rigid fork leg, bearing and other side of rocker.
- Install thick washer (2) and acorn nut (1). Use LOCTITE THREADLOCKER 243 (blue) on acorn nut. Tighten nut to 45-50 ft-lbs (61.0-67.8 Nm).
- Apply LOCTITE ANTI-SEIZE to threads of bearing retainer (6). Apply a finger full of grease on the bearing race. Install bearing retainer. Tighten the retainer to 25-35 in-lbs (2.8-4.0 Nm).
- Secure bearing retainer by installing jam nut (7). Tighten to 95-105 ft-lbs (128.8-142.4 Nm).

NOTE

Hold retainer in place with hex driver while tightening jam nut.

 To adjust rockers, see 1.19 ROCKER BEARINGS: FLSTSC/FXSTS.

- 1. Nut (2)
- 2. Washer, rocker to fork leg (2)
- 3. Spherical bearing, fork to rocker (2)
- 4. Pivot stud, rigid fork to rocker
- 5. Pivot stud, spring fork to rocker (thick head)
- 6. Bearing retainer, rigid fork
- 7. Bearing retainer jam nut
- 8. Spring fork leg
- 9. Rigid fork leg
- 10. Spherical bearing ball, fork to rocker (2)
- 11. Spherical bearing race, fork to rocker (2)





FORK STEM BEARINGS

Removal/Installation

CAUTION

Cover rigid fork legs when prying bearing off to protect from nicks and damage.

1. See Figure 2-110. Remove bearing (1) and dust shield (2) from fork stem.

NOTE

Springer rigid fork stem bracket has notches (3) machined into the pad on the bracket. These notches make it possible to use a pair of pry bars to pry the lower dust shield and bearing off the fork stem.

2. Press dust shield (2) and bearing (1) onto fork stem.

NOTE

See 2.25 STEERING HEAD to replace lower bearing race within steering neck.

- 1. Bearing cone
- 2. Dust shield
- 3. Pry points for removal



Figure 2-110. Fork Stem Bearings

STEERING HEAD

REMOVAL

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

NOTE

If bearing races are removed, the bearings cannot be reused-they must be replaced. See Removing Lower Bearings From Fork Stem.

FLSTC, FLSTF, FLSTN, FLST Models

- 1. Remove fork shrouds.
- Remove the fork sides. See 2.23 FRONT FORKS: ALL BUT FLSTSC/FXSTS.
- 3. Remove the headlamp and headlamp bracket.
- 4. See Figure 2-111. Remove the brake hose bracket from the bottom of the fork stem and bracket (12).
- 5. Remove the fork stem cap (1). Loosen pinch bolt (4) and remove fork stem bolt (2). Remove washer (3) with the handlebar and upper bracket (5).
- 6. Remove the fork stem and bracket (12) from the steering head. Remove the upper dust shield (6).
- 7. Remove upper bearing (7).

FXSTD, FXST, FXSTB Models

- 1. Remove the fork sides. See 2.23 FRONT FORKS: ALL BUT FLSTSC/FXSTS.
- 2. Remove the headlamp and headlamp bracket.
- 3. See Figure 2-112. Remove the brake hose bracket from the bottom of the fork stem and bracket (13).
- 4. Remove the fork stem cap (1). Bend the lockwasher (3) tab away from the fork stem nut (2). Remove the fork stem nut with the handlebar and upper bracket (4).
- Remove the adjusting nut (6) and pull the fork stem and bracket (13) out of the steering head. Remove the upper dust shield (7).
- 6. Remove upper bearing (8).







Figure 2-112. Steering Head: FXSTD/FXST/FXSTB

FLSTSC, FXSTS Models

- 1. Remove fork from steering head. See 2.24 SPRINGER FORK: FLSTSC/FXSTS.
- 2. See Figure 2-113. Remove upper bearing dust shield (1).
- 3. Remove upper bearing (2).

CLEANING AND INSPECTION

All Models

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

DISASSEMBLY

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.

Removing Lower Bearings From Fork Stem

NOTE

Cover rigid fork legs when prying bearing off.

- 1. Chisel cage that holds rollers on bearing.
- Turn the fork stem upside down and heat the inner race. The race will expand and fall off fork stem. Once the race is removed, you will be able to remove the lower dust shield.

NOTE

See Figure 2-114. The Springer rigid fork stem bracket has notches machined into the pad on the bracket. These notches make it possible to use a pair of pry bars to pry the lower dust shield and bearing off the fork stem.







Figure 2-114. Pry Points: FLSTSC/FXSTS

Steering Head Bearing Race Removal

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

- See Figure 2-115. With the tapered side down, seat the two-piece remover tool on the upper bearing race leaving a gap in the middle.
- 2. Install the collet on the driver.
- Insert the driver at the bottom of the steering head tube, and while holding the remover tool on the race, center the collet in the gap. Tap the driver to remove the upper race.
- 4. Reverse the tool and repeat the procedure to remove the lower bearing race.

ASSEMBLY

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

- 1. Lubricate outside of the bearing races with engine oil.
- 2. Install the **new** races using STEERING HEAD BEARING RACE INSTALLER (Part No. HD-39302).

AWARNING

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.

 Pack the new bearings with Harley-Davidson Special Purpose Grease.

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.

 Install the lower dust shield on the fork stem. Press the lower bearing into place. Use a sleeve that will contact only the inner race of the **new** bearing.



Figure 2-115. Remove Upper and Lower Steering Head Bearing Races

FLSTC, FLSTF, FLSTN, FLST Models

- See Figure 2-111. Insert the fork stem and bracket assembly (12) into the frame steering head. Install the upper bearing (7) and dust shield (6).
- Install the upper bracket (5), a new washer (3). and fork stem bolt (2). Tighten the fork stem bolt until the bearings have no noticeable shake. Fork stem must turn freely from side to side.

CAUTION

Overtightening stem bolt will cause the bearings to wear excessively leading to the need for premature bearing replacement.

- Fasten the brake hose bracket to bottom bracket using original hardware. Tighten bolt to 96-120 in-lbs (10.8-13.6 Nm).
- 4. Install the headlamp assembly.
- 5. Install the fork sides.
- Fill neck with Harley-Davidson Special Purpose Grease through grease fitting located in the steering head.

WARNING

Properly adjust fork stem bearings. Improper adjustments affect stability and handling, which could result in death or serious injury. (00301a)

- Adjust fall-away. See 1.17 STEERING HEAD BEAR-INGS: ALL BUT FLSTSC/FXSTS.
- Apply LOCTITE ANTI-SEIZE to upper bracket pinch bolt. Tighten pinch bolt (4) to 25-30 ft-lbs (33.9-40.7 Nm).
- 9. Install the fork stem cap (1).

FXSTD, FXST, FXSTB Models

 See Figure 2-112. Insert the fork stem bracket assembly (13) into the frame steering head and install the upper bearing (8) and dust shield (7). Secure with the adjusting nut (6). Tighten adjusting nut until the 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.

- Install the upper bracket (4), a new lockwasher (3) and fork stem nut (2). Be sure pin on lockwasher is engaged in upper bracket hole.
- Fasten the brake hose bracket to bottom bracket using original hardware. Tighten bolt to 96-120 in-lbs (10.8-13.6 Nm).
- 4. Install the headlamp assembly:
- 5. Install the fork sides.
- 6. Fill neck with Harley-Davidson Special Purpose Grease through grease fitting located in the steering head.

AWARNING

Properly adjust fork stem bearings. Improper adjustments affect stability and handling, which could result in death or serious injury. (00301a)

- Adjust fall-away. See 1.17 STEERING HEAD BEAR-INGS: ALL BUT FLSTSC/FXSTS.
- Tighten fork stem nut (2) to 35-45 ft-lbs (47.5-61.0 Nm). Bend the lockwasher (3) tab against the nut flat.
- 9. Install the fork stem cap (1).

FLSTSC, FXSTS Models

See 2.24 SPRINGER FORK: FLSTSC/FXSTS.

REAR FORK

REMOVAL

- 1. Remove the rear wheel. See 2.8 REAR WHEEL.
- Remove the belt guard. Remove rear brake caliper and mounting bracket. See 2.22 REAR BRAKE CALIPER: FXST/FXSTB/FXSTS.
- See Figure 2-116. Remove two bolts (1) from rear inner fender (2). Lift upper right corner of fender towards rear tire and lift upward.
- Remove the rear shock absorber bolts and washers (8) only. See 2.27 REAR SHOCK ABSORBERS.
- 5. On California models, detach evaporative canister from transmission.

 Remove pivot shaft (4) and two spacers (11). Remove the two bushings (10) inside the spherical bearings (7). The rear fork can now be removed from the frame.

CLEANING AND INSPECTION

The spherical bearings are lifetime lubricated and will require no further attention other than cleaning. The sleeve type spherical bearings, if not damaged, will last the life of the motorcycle. Clean the bearing bore with a clean shop towel, removing any dirt or grit adhering to the bearing surface.

Rough check the rear fork for correct alignment. A bent rear fork must be replaced.



Figure 2-116. Rear Fork

INSTALLATION

- See Figure 2-116. Place rear fork (3) in the frame so that the bores in the frame align with the bores in the fork. Insert the bushings (10) into the spherical bearings (7) from the inside.
- 2. Install pivot shaft.
 - a. Apply LOCTITE ANTI-SEIZE to pivot shaft (4).
 - From the right side, install pivot shaft and spacers with spacer collars facing transmission case. See Figure 2-117.
 - c. Apply LOCTITE THREADLOCKER 262 (red) to threads of pivot shaft nut. Install and tighten pivot shaft nut to 90-110 ft-lbs (122-149.1 Nm).

NOTE

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

- Check for freedom of rotation of the rear fork around the bearings and that the fork and frame side members have not been distorted when the pivot shaft nut was tightened.
- 4. See Figure 2-116. Install the canister (California models), fender extension (2), brake caliper and rear wheel.
- Install both rear shock absorbers (9) using bolts and washers (8). See 2.27 REAR SHOCK ABSORBERS.



- 1. Back of transmission
- 2. Spacer collar against transmission

Figure 2-117. Spacer Collars (Electrical Panel Removed For Illustration)

GENERAL

The rear shock absorber on Softail motorcycles is not repairable. If the shock absorber becomes damaged, it must be replaced as an assembly.

NOTE

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

REMOVAL

- Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
- 2. See Figure 2-118. Remove bolt and washer (1) attaching shock to rear fork.

NOTE

Snap-on adapter, Part No. SRES24, is necessary to gain access to shock bolt.

3. Remove flange locknut (5) and washer with grommet (4) at front of shock.

INSTALLATION

- See Figure 2-118. Place washer with grommet (4) inside frame. Install bushing (3) over stud end of shock. Insert stud end through keyed frame tab and loosely install the flange locknut (5).
- Coat shoulder of bolt (1) with LOCTITE ANTI-SEIZE and threads of bolt with LOCTITE THREADLOCKER 243 (blue). Insert bolt and washer (1) through shock end. Pivot shock absorber to align bolt with hole in rear fork.

CAUTION

Softail shock absorber bolt torquing procedure requires the use of a SNAP-ON-ADAPTER, Part No. SRES24. Since the adapter lengthens the torque wrench, torque must be computed with a TORQUE COMPUTER, Snap-On Part No. SS-306G.

- 3. Tighten rear shock hardware.
 - a. Tighten bolt and washer (1) at rear of shock to 121-136 ft-lbs (164.0-184.4 Nm).
 - Tighten the flange locknut (5) to 32-39 ft-lbs (43.4-52.9 Nm).
- 4. Adjust both shock absorbers equally. See 1.16 SUSPEN-SION ADJUSTMENTS.





REMOVAL/DISASSEMBLY

- See Figure 2-119. Loosen cable adjuster jam nuts. Screw throttle cable adjuster until it is a short as possible. Remove the two screws that hold the handlebar housing together to separate the upper and lower housings.
- Unhook the ferrules and cables from the throttle grip and lower housing.
- Remove air cleaner assembly. See 4.8 AIR CLEANER: CARBURETED or 9.4 AIR CLEANER: EFI.
- Disconnect throttle cables from carburetor or throttle body. See 1.24 THROTTLE CABLES.
- See Figure 2-120. Pull the cables from the housing by placing a drop of oil on the retaining ring that holds the cable in the housing, then firmly pull the bent tubing portion of the cable out of the housing using a rocking motion.

CLEANING AND INSPECTION

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

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

ASSEMBLY/INSTALLATION

- 1. Apply a light coating of graphite to the handlebar and inside surface of the housings.
- See Figure 2-120. Attach the control cable assemblies to the lower housing.
 - Push the silver insert of the throttle cable housing into the hole in front of the tension adjuster screw.
 - Push the gold diameter insert of the idle cable housing into the hole at the rear of the tension adjuster screw.
 - c. Install adjusting screw, spring and friction pad in the lower housing if they were removed.
- Position the throttle grip on the handlebar. Place the lower housing on the throttle. Position the ferrules and retaining rings over the cable balls and seat them in the throttle notches.



Figure 2-119. Handlebar Throttle Control



Figure 2-120. Throttle Cable Attachment

WARNING

Do not tighten throttle friction adjustment screw to the point where the engine will not return to idle automatically. Overtightening can lead to loss of vehicle control, which could result in death or serious injury. (00031a)

- Fasten upper housing to lower housing using two screws. Tighten to 35-45 in-lbs (4.0-5.1 Nm).
- Check throttle cable routing. See CABLE ROUTING which follows.
- Install throttle cables on carburetor or throttle body and adjust. See 1.24 THROTTLE CABLES.
- Install air cleaner. See 4.8 AIR CLEANER: CARBU-RETED or 9.4 AIR CLEANER: EFI.

All Models Except FXSTS/FLSTSC/FXSTD

On all models except FXSTS/FXSTD/FLSTSC, the throttle cables are routed between the brake line and the handlebars. They continue under the fuel tank through two cable clamps and back to carburetor or throttle body.

FXSTS/FLSTSC Models

On FLSTSC and FXSTS models, the throttle cables are routed forward from the throttle control and through the clip attached to the rigid fork. They continue under the fuel tank through two cable clamps and back to carburetor or throttle body.

FXSTD Models

On the FXSTD, the throttle cables are routed forward from throttle control and between front brake line and front fork upper bracket to the right side of steering head. They continue under the fuel tank through two cable clamps and back to carburetor or throttle body.

HANDLEBARS

NOTE

For FLSTSC/FXSTS models, see HANDLEBAR AND RIS-ERS under 2.24 SPRINGER FORK: FLSTSC/FXSTS.

REMOVAL

All But FXSTD/FXSTS/FLSTSC

WARNING

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

- 1. Disconnect negative battery cable.
- Place blanket or protective cover over front of fuel tank to protect against scratches and other damage.
- Remove front master cylinder assembly. See 2.16 FRONT BRAKE MASTER CYLINDER.
- Remove two screws securing clutch control assembly to left side of handlebar. See 2.30 CLUTCH HAND CON-TROL.
- Remove right handlebar switch assembly and throttle. See 8.42 RIGHT HANDLEBAR SWITCH.
- Remove left handlebar switch assembly. See 8.43 LEFT HANDLEBAR SWITCH.
- 7. Remove left handlebar grip.
- See Figure 2-121. Remove upper handlebar clamp fasteners (2).
 - a. For FLSTC/FLSTF/FLST/FXST/FXSTB models, remove upper handlebar clamp (4).
 - For FLSTN models, remove upper handlebar clamp (3).
- 9. Remove handlebar (1).
- If removing lower handlebar clamps (6), remove two lower handlebar clamp fasteners (16), lockwashers (15), ground cable (14) and ground cable washer (13) and lower handlebar clamps from upper fork bracket (10). Replace bushings (8) if necessary.



16. Lower handlebar clamp fastener (2)

Figure 2-121. Handlebars: All but FXSTD, FXSTS, FLSTSC

FXSTD

AWARNING

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

- 1. Disconnect negative battery cable.
- 2. Place blanket or protective cover over front of fuel tank to protect against scratches and other damage.
- 3. Remove front master cylinder assembly. See 2.16 FRONT BRAKE MASTER CYLINDER.
- Remove two screws securing clutch control assembly to left side of handlebar. See 2.30 CLUTCH HAND CON-TROL.
- 5. Remove right handlebar switch assembly and throttle. See 8.42 RIGHT HANDLEBAR SWITCH.
- Remove left handlebar switch assembly. See 8.43 LEFT HANDLEBAR SWITCH.
- 7. Remove left handlebar grip.
- 8. See Figure 2-121. Remove upper handlebar clamp fasteners. Remove upper handlebar clamps and handlebar.
- 9. If removing lower handlebar clamps (6), remove two bolts (16), washers (15) and lower handlebar clamps from upper fork bracket.



Figure 2-122. Handlebars: FXSTD
INSTALLATION

All But FXSTD/FXSTS/FLSTSC

 See Figure 2-121. If lower handlebar clamps (6) were removed, install lockwashers (15) on lower handlebar clamp fasteners (16). Install ground cable (14) and ground cable washer (13) on right-side fastener.

NOTE

In next step, make sure cup washers (7), bushings (8) and spacer (9) are in position in upper fork bracket (10).

- Slide lower handlebar clamp fasteners through upper fork bracket.
- Loosely install lower handlebar clamps to upper fork bracket using lower handlebar clamp fasteners.
- See Figure 2-123. Place handlebars on lower handlebar clamps. Install upper handlebar clamps. Install but do not tighten clamp fasteners.
- Using knurled areas of handlebar as a guide, center handlebars between lower handlebar clamps.

NOTE

On some models, knurled areas of handlebar will be completely hidden by upper handlebar clamp and will not be visible at all when handlebar is centered properly.

- Raise handlebars to normal riding position and hold in position.
- 7. Secure handlebars in clamp:
 - Tighten two rear screws (3) until cast-in spacers contact handlebar lower clamps (1).
 - Tighten front fasteners (4) to 12-15 ft-lbs (16.3-20.3 Nm).
 - Final tighten rear fasteners to 12-15 ft-lbs (16.3-20.3 Nm). Slight gap between upper and lower clamps should exist at front.
- See Figure 2-121. Tighten lower handlebar clamp fasteners ers (16) to 30-40 ft-lbs (40.7-54.3 Nm).

FXSTD

- See Figure 2-122. If lower handlebar clamps (5) were removed, loosely install clamp to upper fork bracket (6) with two fasteners (9), lockwashers (8) and washers (7).
- Using knurled areas of handlebar as a guide, center handlebars between lower handlebar clamps.
- Make the gap between upper handlebar clamps and lower handlebar clamps even, front and rear. Adjust handlebars and tighten screws to 144-180 in-lbs (16.3-20.3 Nm).
- Tighten lower handlebar clamp fasteners to 30-40 ft-lbs (40.7-54.3 Nm).



Figure 2-123. Handlebar Riser

All Models

- Install front master cylinder assembly. See 2.16 FRONT BRAKE MASTER CYLINDER.
- 2. Install new left hand grip in place as follows:
 - Using a piece of emery cloth, rough grip end of left handlebar.

NOTE

Before applying adhesive in the next step, clean the left handlebar with acetone.

- Apply LOCTITE PRISM PRIMER (770) to inside of hand grip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
- c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of hand grip. Install new hand grip on left handlebar.

NOTE

SUPERBONDER will set in four minutes and be fully cured in 24 hours.

- Position left hand control and loosely install hand control clamp screws. See 8.43 LEFT HANDLEBAR SWITCH.
- Attach clutch control assembly to left side of handlebar. Tighten screws to 108-132 in-lbs (12.2-14.9 Nm). See 2.30 CLUTCH HAND CONTROL.
- Tighten left hand control clamp screws to 35-45 in-lbs (4.0-5.1 Nm).
- Tighten right hand control clamp screws to 35-45 in-lbs (4.0-5.1 Nm).
- Attach front brake master cylinder assembly with torx screws. Tighten to 108-132 in-Ibs (12.2-14.9 Nm).
- Wrap four new wiring harness retainers around handlebar wiring harnesses and push retainers into holes in handlebar.
- 9. Connect negative battery cable.

ACAUTION

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

- 10. Verify the following:
 - a. Cable adjustment/operation.
 - b. Proper throttle cable operation.
 - c. All electrical switch functions.
 - d. Proper brake operation and brake light function.

CLUTCH HAND CONTROL

REMOVAL

- Loosen clutch adjuster so clutch cable is fully slack. See 1.12 CLUTCH.
- See Figure 2-124. Remove remove the retaining ring (2) and pivot pin (4). Remove the clutch cable anchor pin (1) from the hand lever.
- Drain transmission lubricant and remove fill plug dipstick. Remove transmission side cover. See 7.5 TRANSMIS-SION CLUTCH RELEASE COVER.
- See Figure 2-125. Note position of retaining ring opening. Retaining ring opening must be positioned in approximately the same location during assembly. Remove retaining ring (1).
- Pull inner ramp (2) and coupling (3) out of side cover. Hold inner and outer ramps together to keep balls from falling free.
- Rotate the inner ramp to a position which will allow the coupling to be disconnected from the inner ramp lever arm. Disconnect coupling from inner ramp. Disconnect cable end (4) from coupling.
- 7. Back out threaded cable fitting (5) from side cover.

INSTALLATION

- See Figure 2-125. Install new O-ring on end of clutch cable threads. Thread clutch cable fitting (5) into side cover. Do not tighten at this time.
- Connect cable end to coupling (3). Rotate ramps for best access and install coupling on inner ramp (2). Place ramp assembly in position in side cover.
- Install retaining ring (1). Position retaining ring opening to the right of the outer ramp tang (the stop that prevents rotation).
- Place new gasket on side cover and install, fully tightening the clutch cable fitting. See 7.5 TRANSMISSION CLUTCH RELEASE COVER.
- 5. Place a few drops of oil inside cable housing.

NOTE

Anchor pin does not require lubrication.

- 6. Check that clutch cable is properly routed.
 - Route clutch cable across the front of handlebars for the following models: FXSTD, FXSTS, FXST, FXSTB. Route clutch cable behind handlebars for the following models: FLSTF, FLSTC.
 - b. Route cable down to clamp on left frame downtube.
 - c. Route cable under gear cover and through bracket.
 - d. Route cable to transmission cover.



Figure 2-124. Clutch Cable Installation



Figure 2-125. Clutch Cable Connection

- See Figure 2-124. Insert anchor pin (1) through handle and clutch cable clevis end (3).
- 8. Place handle in bracket and install pivot pin (4) and retaining ring (2).
- 9. Adjust clutch cable. See 1.12 CLUTCH.

FXST, FXSTB MODELS

CAUTION

Be careful lifting fenders out of forks or paint may be scratched. If necessary, cover fender with suitable material to prevent damage.

Removal

See Figure 2-126. Remove the acorn nuts, washers and screws to detach fender.

Installation

See Figure 2-126. Position fender into position and secure with screws, washers, and acorn nuts. Tighten all acorn nuts to 15-21 ft-lbs (20.3-28.5 Nm).

FLSTC, FLSTN, FLST MODELS

CAUTION

Be careful lifting fenders out of forks or paint may be scratched. If necessary, cover fender with suitable material to prevent damage.

Removal

- Remove front wheel. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTS/FXSTD.
- 2. Disconnect fender tip lamp.
- See Figure 2-127. Remove screws and nuts that hold fender in place and remove fender.

Installation

- Put fender in position and install screws and nuts. Tighten nuts to 15-21 ft-lbs (20.3-28.5 Nm).
- 2. Connect fender tip lamp.
- 3. Install front wheel.



Figure 2-126. Front Fender: FXST and FXSTB



Figure 2-127. Front Fender: FLSTC

FLSTF MODELS

CAUTION

Be careful lifting fenders out of forks or paint may be scratched. If necessary, cover fender with suitable material to prevent damage.

Removal

- Remove front wheel. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTS/FXSTD.
- See Figure 2-128. Remove screws and nuts that hold fender in place and remove fender.

Installation

- See Figure 2-128. Put fender in position and install screws and nuts. Tighten nuts to 15-21 ft-lbs (20.3-28.5 Nm).
- 2. Install front wheel.

FXSTD MODELS

CAUTION

Be careful lifting fenders out of forks or paint may be scratched. If necessary, cover fender with suitable material to prevent damage.

Removal

See Figure 2-129. Remove the four screws and washers to detach fender.

Installation

See Figure 2-129. Place fender into position. Secure with four screws and washers. Tighten mounting hardware to 15-21 ftlbs (20.3-28.5 Nm). s0338x2x

Figure 2-128. Front Fender: FLSTF



Figure 2-129. Front Fender

FRONT FENDER: FLSTSC

REMOVAL

Front Fender

1. Remove front wheel and brake caliper. See 2.6 FRONT WHEEL: FLSTSC.



Figure 2-130. FLSTSC Fender Hardware

- 2. See Figure 2-130. Remove spring pin and nut (1) from screw that mounts fender to bracket.
- 3. Insert axle into fender to support assembly.
- 4. Remove screw and washer (2) while supporting fender.
- 5. Remove axle while supporting rear portion of fender.

CAUTION

Removal of the front fender on FLSTSC models is different from other models due to tight clearances. Cover fender with a clean shop rag to protect paint from damage. Read through all of the instructions before attempting to remove the front fender.

- 6. Front fender removal is accomplished in two steps:
 - See Figure 2-131. Slide fender down until mounting bracket is just in front of the rigid fork leg.
 - b. See Figure 2-132. Rotate fender, putting fork between fender bracket and fender, and remove fender.

Front Fender Bearing Replacement

- 1. Position front fender on arbor press, outboard side up, so fender bore lip rests on edge of press platform.
- See Figure 2-133. Using an arbor press and suitable tool that makes contact with outer race of bearing (6) but is smaller than the fender bore, press spherical bearing out of fender bore, outboard to inboard.



Figure 2-131. FLSTSC Front Fender Bracket



Figure 2-132. FLSTSC Fender Replacement

- Position metal plate and suitable tool that makes contact with outer race of bearing and inner race of fender bore under inboard side of fender bore.
- Install new spherical bearing (outboard to inboard) with first suitable tool and arbor press. Bearing is properly seated when outer race bottoms out on second suitable tool (is flush with inboard side of fender bore).
- 5. Repeat all steps for the other spherical bearing.

INSTALLATION

WARNING

Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)

DO NOT:

- Alter the fender brackets to lower the fender. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Replace the O.E.M. tire with a higher-aspect ratio tire. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Replace the O.E.M. tire on FLSTSC model with a custom-looking 21 in. front wheel, tire and front fender. In addition to above, this could adversely affect the handling characteristics of this motorcycle.

Harley-Davidson has designed and manufactured this special, custom front end according to our very stringent and well-tested standards. If you modify the Springer front end in any way that changes our original design, Harley-Davidson cannot and will not assume responsibility.

- 1. Front fender installation is accomplished in two steps:
 - See Figure 2-132. Install fender by keeping right fork leg between fender and struts and rotating fender towards the left leg position.
 - See Figure 2-131. Raise fender until fender holes are aligned with fork holes for axle.
- While holding fender, slide axle through the fender and front forks to support assembly.
- See Figure 2-130. Install screw, washer and new nut. Tighten to 18-22 ft-lbs (24.4-29.8 Nm).
- 4. Install spring pin.
- 5. Remove front axle.



Figure 2-133. FLSTSC Fender Bearings

NOTE

See Figure 2-133. Parts 1-5 are shown for reference only. They are normally removed as the wheel is pulled from the vehicle.



Figure 2-134. FLSTSC Spacer Alignment

See Figure 2-134. Install spacers to axle with step towards the front wheel.

NOTE

The thick spacer (3) goes on the left (brake disc) side.

 Install front wheel and brake caliper. See 2.6 FRONT WHEEL: FLSTSC.

PART NO.	SPECIALTY TOOL	
HD-39754	Fender link tool	

 See Figure 2-135. Remove cotter pin (2), locknut (3), shaft nut (4), washer (8) and screw (11) from brake reaction link (9).

NOTE

Rubber spacer (5) and washer (6) may come off with the shaft nut (4) or may stay in the fender bracket bushing.

 Lift fender up, away from tire. Place FENDER LINK TOOL (Part No. HD-39754) between the pivot links (15) and tighten snugly. Remove locknuts (12) and shoulder screws (16). Fender inserts (13) are loose in fender. Do not misplace fender inserts.

CAUTION

Be careful lifting fender out of fork and fender links or you may scratch the paint. If necessary, cover fender with suitable material to prevent damage.

- Very carefully lift fender (1) out of forks and pivot links (15). Remove fender link assembly tool.
- 4. If necessary, the washers (17), rubber spacers (18) and pivot shafts (19) can be removed.



Figure 2-135. FXSTS Front Fender

INSTALLATION

AWARNING

Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)

DO NOT:

- Alter the fender brackets to lower the fender. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Replace the O.E.M. tire with a higher-aspect ratio tire. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.
- Replace the O.E.M. tire on FXSTS model with a traditional-looking 16 in. front wheel, tire and front fender. In addition to above, this could adversely affect the handling characteristics of this motorcycle.

Harley-Davidson has designed and manufactured this special, custom front end according to our very stringent and well-tested standards. If you modify the Springer front end in any way that changes our original design, Harley-Davidson cannot and will not assume responsibility.

PART NO.	SPECIALTY TOOL	
HD-39754	Fender link tool	

- See Figure 2-135. If pivot shafts (19) were removed, apply LOCTITE THREADLOCKER 262 (red) to threads before installation. Tighten to 10-20 ft-lbs (13.6-27.1 Nm).
- 2. Be sure rubber spacer (18) and washer (17) are in place. Install pivot links (15) on pivot shafts.
- Place FENDER LINK TOOL (Part No. HD-39754) between the pivot links (15) and tighten snugly. The tool will properly spread and hold the links in position while you install the fender.
- Very carefully position fender (1) between forks and pivot links (15).
- Be sure fender inserts (13) are in fender. Install shoulder screws (16) and locknuts (12). Remove fender link assembly tool. Tighten shoulder screws to 10-20 ft-lbs (13.6-27.1 Nm).
- Be sure rubber spacer (5) and washer (6) are in place. Place washer (8) between fender bushing and brake reaction link (9). Install screw (11) and shaft nut (4). Tighten to 20-25 ft-lbs (27.1-33.9 Nm).
- Install locknut (3). Tighten to 10-20 ft-lbs (13.6-27.1 Nm). Install new cotter pin (2).

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- Remove saddlebags, if equipped. See 2.49 SADDLE-BAGS: FLSTC

NOTE

To ensure proper installation, make note of fender wire routing and hardware locations before removal.

- 4. Disconnect rear wiring harness connector [7] under seat.
- Disconnect left and right turn signal connectors from within tail lamp. See 8.20 TAIL LAMP: ALL BUT FXSTD/ FLSTSC/FLSTN.
- 6. Remove ignition control module and ignition control module tray. See 8.5 IGNITION CONTROL MODULE.

FLSTC

- See Figure 2-136. Remove screws (4) and saddlebag support studs (5) from front (8) and rear (6) fender mounting brackets.
- 2. Lift fender from frame.

FLSTF/FLST

- See Figure 2-137. Remove screws (4) from front fender mounting brackets (9), rear fender mounting brackets (7) and wire retainer plates (6).
- 2. Lift fender from frame.



8. Fender mounting bracket (front, 2)





- 8. Fender support (2)
- 9. Fender mounting bracket (front, 2)

Figure 2-137. Rear Fender: FLSTF/FLST

INSTALLATION

- Route turn signal wires through holes in fender. Install wires inside connector terminals.
- Carefully place the fender into position. Install fender supports using hardware shown. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
 - a. FLSTC models, see Figure 2-136.
 - b. FLSTF/FLST models, see Figure 2-137.
- Connect the turn signal wiring harness at connector [7] under the seat. Also attach wiring for left and right turn signals.
- Install ignition control module tray and ignition control module.
- 5. Install saddlebags if equipped.
- 6. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

8. Check turn signal and lamp operation.

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- 3. Remove saddlebags, if equipped.

NOTE

To ensure proper installation, make note of fender wire routing and hardware locations before removal.

- 4. Disconnect rear wiring harness connector [7] under seat.
- Disconnect left and right turn signal connectors from within tail lamp. See 8.20 TAIL LAMP: ALL BUT FXSTD/ FLSTSC/FLSTN.
- 6. Remove ignition control module. See 8.5 IGNITION CONTROL MODULE.
- 7. See Figure 2-138. Loosen but do not remove fender support fasteners (1).
- 8. Remove front fender screw (2) from front fender mounting bracket (8).
- 9. Remove middle fender mounting screw (3) from forward fender mounting bracket.
- 10. Remove rear fender mounting screw (4) from rearward fender mounting bracket (6).
- 11. Remove fender support fasteners and fender support (7).
- 12. Repeat for opposite side.

NOTE

After removing both fender support brackets, support fender by installing a long screwdriver through frame and fender holes.

- 13. Remove locknuts and washers (5) from rear fender mounting bracket.
- 14. Lift fender from frame.



- 6. Fender mounting bracket (rearward, 2)
- 7. Fender support (2)
- 8. Fender mounting bracket (forward, 2)

Figure 2-138. Rear Fender: FXST, FXSTS and FXSTB

INSTALLATION

NOTE

In next step, be sure wire harness is routed so tire will not contact wiring.

- 1. Route turn signal wires through holes in fender. Install wires inside connector terminals.
- See Figure 2-138. Carefully place the fender into position. Install fender supports using hardware shown. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
- Connect the turn signal wiring harness at connector [7] under the seat. Also attach wiring for left and right turn signals.
- 4. Install ignition control module.
- 5. Install saddlebags if equipped.

6. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

8. Check turn signal and lamp operation.



Figure 2-139. FXST, FXSTS, FXSTB Rear Fender Wire Routing

REAR FENDER: FXSTD

REMOVAL

- Block motorcycle underneath frame so rear wheel is raised off the ground. This will provide extra clearance for fender removal.
- 2. Remove seat.

WARNING

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

- 3. Disconnect negative battery cable.
- See Figure 2-140. Remove all fasteners from both fender supports (2).
 - a. Remove screws and washers (1) from inside fender.
 - b. Remove screws (3) and spacers (4) next to oil tank.
- Remove tail lamp. Disconnect and detach rear turn signals. See 8.21 TAIL LAMP: FXSTD and 8.25 TURN SIG-NALS/RUNNING LIGHTS.
- Disconnect both ignition control module connectors and rear lighting harness.
- See Figure 2-141. Remove nuts (3) from both fender mounting brackets (1).
- 8. Lift fender away from frame.

DISASSEMBLY

- 1. See Figure 2-142. Remove two screws and washers (2) to detach license plate bracket (1) from rear fender.
- Remove tail lamp harness (4) from behind bracket (3) if necessary.



Figure 2-140. Rear Fender Support





ASSEMBLY

- See Figure 2-142. Place tail lamp harness (4) behind bracket (3) if removed. Harness runs along same side as wiring slot (5).
- Secure license plate bracket (1) using two screws and washers (2). Tighten to 144-180 in-lbs (16.3-20.3 Nm).

INSTALLATION

- See Figure 2-141. Place fender over rear tire and inside frame tubes. Verify wiring for tail lamp harness and ECM connectors are not pinned under fender.
- Loosely install both fender mounting brackets (1) using two nuts (3) on each side. When finished, final tighten to 20-25 ft-lbs (27.1-33.9 Nm).
- See Figure 2-140. Apply LOCTITE THREADLOCKER 243 (blue) to screws (3). Install screws and spacers (4) to attach both fender supports (2). Spacers (4) belong on forward screws (3). When finished, final tighten to 14-16 ft-lbs (19.0-21.7 Nm).
- 4. Attach turn signals. See 8.25 TURN SIGNALS/RUN-NING LIGHTS.
- Loosely install screws and washers (1) from inside of fender. Tighten to 12-15 ft-lbs (16.3-20.3 Nm).
- Connect both ignition control module connectors and rear lighting harness.
- 7. Install tail lamp. See 8.21 TAIL LAMP: FXSTD.
- 8. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

10. Check turn signal and lamp operation.



Figure 2-142. Rear Fender

1. Remove seat. see 2.47 SEAT: FLSTSC/FLSTN/FLST.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 2-143. Disconnect rear wiring harness connector (1) [7] under seat.
- 4. Remove nylon fastener (3) from electrical box (2).

NOTE

Note location of hardware for correct installation.

- See Figure 2-144. Remove fender mounting fasteners (2) and fender mounting bracket (4). Insert rods through forward most holes created by removing fasteners. Rods will keep fender in place during next step.
- 6. Remove fender mounting fasteners (3).
- 7. Remove rods.
- Slide fender towards rear of vehicle to disengage fender from frame rails.

DISASSEMBLY

- If rear fender is to be completely disassembled, perform the following:
 - See Figure 2-145. Remove fastener (1). Disengage tail lamp connector cover (2) from clip (3).
 - Remove wire terminals from turn signal connectors. See B.2 DEUTSCH ELECTRICAL CONNECTORS for connector disassembly.
 - c. See Figure 2-144. Detach fender supports (7) by removing fender mounting fasteners (1).
 - See Figure 2-146. Remove screw and washer (1) from inside fender support to detach turn signal from mount (2).
- 2. See 8.22 TAIL LAMP: FLSTSC/FLSTN for FLSTSC tail lamp removal.



- 1. Rear wiring harness connector [7]
- 2. Electrical box
- 3. Nylon fastener

Figure 2-143. Electrical Box: Typical



Figure 2-144. Rear Fender: FLSTSC/FLSTN

ASSEMBLY

- See Figure 2-146. Install screw and washer (1) to inside of fender support to connect turn signal (3) and mount (2).
- See Figure 2-144. Install fender support (7) using wire retainer plate (6), fender mounting bracket (5) and fender mounting fasteners (1). Do not tighten fender mounting bracket fasteners at this time.
- See 8.22 TAIL LAMP: FLSTSC/FLSTN for FLSTSC tail lamp installation.
- 2. See Figure 2-147. Route rear turn signal wiring as shown. Install cable tie (4).

INSTALLATION

- See Figure 2-144. Carefully place the fender into position. Install fender supports using hardware and brackets shown. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
- 2. See Figure 2-143. Install nylon fastener (3) into electrical box (2) and fender.
- 3. Connect the harness at connector (1) [7].
- 4. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

6. Check turn signal and lamp operation.



- 2. Tail lamp connector cover
- 3. Clip

Figure 2-145. Tail Lamp Connector Cover: Typical



Figure 2-146. Rear Turn Signals: All But FLSTC



- 1. Wire clip (left)
- 2. Left turn signal wiring
- 3. Clip
- 4. Cable tie
- 5. Right turn signal wiring
- 6. Wire clip (right)

Figure 2-147. Rear Turn Signal Routing: FLSTSC

1. Remove seat. see 2.47 SEAT: FLSTSC/FLSTN/FLST.

AWARNING

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

- 2. Disconnect negative battery cable.
- See Figure 2-148. Disconnect rear wiring harness connector (1) [7] under seat.
- 4. Remove nylon fastener (3) from electrical box (2).

NOTE

Note location of hardware for correct installation.

- See Figure 2-149. Remove fender mounting fasteners (3) and fender mounting bracket (21). Insert rods through forward most holes created by fastener removal. Rods will keep fender in place during next step.
- 6. Remove fender mounting fasteners (2).
- 7. Remove rods.
- Slide fender towards rear of vehicle to disengage fender from frame rails.

DISASSEMBLY

- See Figure 2-149. If rear fender is to be completely disassembled, detach fender supports (1) by removing fender mounting fasteners (4).
- To remove fender support (18) and fender mounting brackets (22), remove locknuts (7) and washers (8)
- See 8.22 TAIL LAMP: FLSTSC/FLSTN for tail lamp removal.
- See 8.25 TURN SIGNALS/RUNNING LIGHTS for turn signal bracket removal.
- 5. See 2.48 LUGGAGE RACK: FLSTN for FLSTN luggage rack removal.



- 1. Rear wiring harness connector [7]
- 2. Electrical box
- 3. Nylon fastener

Figure 2-148. Electrical Box: Typical



Figure 2-149. Rear Fender: FLSTN

ASSEMBLY

- 1. See 8.22 TAIL LAMP: FLSTSC/FLSTN for tail lamp assembly.
- 2. See 8.25 TURN SIGNALS/RUNNING LIGHTS for turn signal bracket assembly.

NOTE

See Figure 2-150. If fender support (2) has been removed, do not tighten luggage rack hardware until rest of fender has been installed.

- See Figure 2-149. If fender support (18) has not been removed, then move to next step. However, if fender support has been removed, then proceed as follows:
 - a. Place fender support into position in fender (11).
 - Install but do not tighten luggage rack hardware. See 2.48 LUGGAGE RACK: FLSTN.
 - c. Install fender mounting brackets (22) using locknuts
 (7) and washers (8). Tighten locknuts to 21-27 ft-lbs
 (28.5-36.6 Nm).
- Install fender supports (1) using fender mounting fasteners (4). Snug but do not fully tighten fasteners at this time.

INSTALLATION

- See Figure 2-149. Carefully place the fender into position. Install fender supports using hardware and brackets shown. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
- 2. Tighten luggage rack fasteners. See 2.48 LUGGAGE RACK: FLSTN.
- See Figure 2-148. Install nylon fastener (3) into electrical box (2) and fender.
- 4. Connect the harness at connector (1) [7].
- 5. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

7. Check turn signal and lamp operation.



Figure 2-150. Rear Fender Wire Routing: FLSTN

INSTALLATION

CAUTION

Do NOT use solvents or harsh chemicals to remove adhesive as damage to painted surfaces may occur.

- 1. Remove wire terminals from harness connectors.
- 2. Remove wire harness from conduit.
- Thoroughly clean inside surface of fender with soap and water until it is free of dirt, oil, or other debris.
- Dry the surface, then wipe the area where conduit will be placed with Isopropyl Alcohol. Allow to dry completely.
- Slide tail lamp wiring harness through new conduit and plug connectors into appropriate sockets. See B.7 CON-NECTOR LOCATIONS and the wiring diagrams in the appendix for more information.
- 6. See Figure 2-151. Remove protective strip covering adhesive on conduit.
- 7. See Figure 2-153. Lightly position the conduit in place.
- See Figure 2-152. Using a wallpaper corner roller (available at most home improvement stores), roll along conduit to purge the air from between the adhesive and the fender.

NOTES

- Do NOT rub the conduit to make it adhere to the fender. This will not do an adequate job of purging the air from between the adhesive and fender.
- Once the adhesive is in place, it requires 72 hours to fully cure. Continue with installation but do NOT pull or try to reposition the conduit during this period.



2.39



Figure 2-151. Removing Protective Strip From Conduit



2. Wallpaper corner roller

Figure 2-152. Purging Air Between Adhesive and Fender



Figure 2-153. Conduit Placement

BELT GUARD/DEBRIS DEFLECTOR

REMOVAL

Belt Guard

- 1. Remove left saddlebag if present.
- See Figure 2-154. Remove acorn bolt (9) from tee nut (7).
- 3. Hold bolt and washer (6) with wrench. Remove the acorn nut (4) to detach belt guard (5).

Debris Deflector

- 1. Remove left saddlebag if present.
- 2. Remove lower acorn bolt (3).
- Loosen, but do not remove, bolt (1) at front (slotted) portion of deflector.
- 4. Hold bolt and washer (6) with wrench. Remove the acorn nut (4). Lift debris deflector up and away from frame.

INSTALLATION

Belt Guard

- 1. Place the belt guard (5) into position. Tab for bolt and washer (6) must fit inboard of tab on debris deflector (2).
- Install bolt and washer (6) through belt guard (5), debris deflector (2) and rear fork. Install acorn nut (4) securely.
- 3. Install acorn bolt (9) into tee nut (7).
- 4. Install left saddlebag if removed.

Debris Deflector

- Place debris deflector (2) into position. Slotted opening on front of deflector slides over bolt (1). Do not tighten bolt at this time.
- Install bolt and washer (6) through belt guard (5), debris deflector (2) and rear fork. Install acorn nut (4) securely.
- Install lower acorn bolt (3) and tighten bolt (1) at front of deflector.
- 4. Install left saddlebag if removed.



Figure 2-154. Belt Guard/Debris Deflector

CLEANING

WARNING

- The jiffy stand locks when placed in the full forward (down) position with vehicle weight on it. If the jiffy stand is not in the full forward (down) position with vehicle weight on it, the vehicle can fall over which could result in death or serious injury. (00006a)
- Always park motorcycle on a level, firm surface. An unbalanced motorcycle can fall over, which could result in death or serious injury. (00039a)
- Be sure jiffy stand is fully retracted before riding. If jiffy stand is not fully retracted, it can contact the road surface causing a loss of vehicle control, which could result in death or serious injury. (00007a)
- 1. Block motorcycle underneath frame so both wheels are raised off the ground.
- See Figure 2-155. Inspect top of leg stop (4). If covered with dirt, wipe dirt off with a shop towel and spray catch and mating surface with LOCTITE AEROSOL ANTI-SEIZE.
- Move jiffy stand (9) forward and back to infuse anti-seize into mating parts.
- 4. If leg stop is covered with mud/grime, remove bolt (1), lockwasher (2), washer (3) and leg stop (4). Clean catch.
- Spray LOCTITE AEROSOL ANTI-SEIZE on shaft of jiffy stand leg. Move leg back and forth and downward while spraying lubricant.
- Assemble the leg stop so it engages the flats on the shaft of the jiffy stand leg and secure with bolt (1), lockwasher (2) and washer (3). Tighten to 144-180 in-lbs (16.3-20.3 Nm).
- 7. Check that jiffy stand operates correctly before using.



Figure 2-155. Jiffy Stand

INSTALLATION

- 1. Block motorcycle underneath frame so both wheels are raised off the ground.
- 2. See Figure 2-155. Remove the three screws (6) and washers (7) from bracket (5).
- 3. Detach shifter linkage.
- Detach spring (10) from jiffy stand and bracket. Jiffy stand and floorboard/footpeg components will drop as an assembly.
- 1. See Figure 2-155. Install bracket.
 - a. Apply LOCTITE THREADLOCKER 243 (blue) to screws (6).
 - b. Install jiffy stand and bracket assembly with three screws (6) and washers (7).
 - c. Tighten to 25-30 ft-lbs (33.9-40.7 Nm).
- Attach spring (10) to bracket (5) and jiffy stand (9). When properly installed, hook on spring side connected to bracket faces upward.
- 3. Attach shifter linkage.
- 4. Check that jiffy stand operates correctly before using.

FORK LOCK

REMOVAL

- 1. Remove fork stem. See 2.25 STEERING HEAD.
- 2. See Figure 2-156. Remove set screw (1).
- 3. Insert key (3) in lock (2) and turn partially.
- 4. Wiggle lock and pull until enough of the lock comes out to get a grip with pliers or other suitable tool.
- Rotate steering stem slightly, while pulling on lock until lock is removed.

INSTALLATION

NOTES

- There is an internal boss in the left side of the steering head opposite the external boss. The end of the lock fits into this internal boss.
- See Figure 2-157. There is a flat in the bottom of the lock into which the set screw fits. This flat must be at the bottom when the lock is installed.
- When the lock is correctly installed, a forward-facing flat on the lock will fit against a flat inside the external lock boss and the face of the lock will be flush with the face of the external boss.
- 1. Grease the end of the lock (the part that goes into the internal boss) and slide lock into external boss.
- 2. Insert fork stem into frame. See 2.25 STEERING HEAD.

NOTE

Stem must be in locked fork position.

- 3. Move fork stem into locked fork position. Rotate fork stem slightly, while fully installing lock.
- 4. See Figure 2-156. Apply LOCTITE THREADLOCKER 243 (blue) to set screw (1) and install.
- 5. Insert key (3) in the lock (2) and tighten set screw until lock begins to bind; then back set screw out 1/2 turn.
- 6. Seal screw with a good quality sealant.
- Finish fork stem installation including installing upper triple clamp and handlebars. See 2.25 STEERING HEAD.



Figure 2-156. Fork Lock Installation



Figure 2-157. Fork Lock

SEAT/STRAP RETENTION NUT

REPLACEMENT

NOTE

If the retention washer is removed the retention nut will fall through the fender. The procedure below lifts the retention nut up through the fender on the cable strap for ease of replacement.

- 1. Slide retention nut over tapered end of cable strap so that larger O.D. of nut rests on cable strap eyelet.
- 2. From bottom of rear fender, feed cable strap up through fender hole.
- See Figure 2-158. With tab (1) on retention nut (2) seated in notch of fender hole, pull up on cable strap to hold nut snug against underside of rear fender.
- 4. From the side opposite the tab, slide on the retention washer (3) to lock the position of the retention nut.



Figure 2-158. Seat Retention Nut



Figure 2-159. Retention Nut In Use

Seat Strap

Seat strap installation depends upon model being serviced. Install bolt in appropriate hole according to Figure 2-160.

Seat

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

NOTE

Thumbscrew can be unthreaded and threaded using the SEAT MOUNTING SCREW TOOL (HD-47190).

See Figure 2-161. Seat attaches with a single thumbscrew on the seat bracket (1). When installing seat, insert tang at front of seat into the channel in the frame and install rear thumbscrew.



Figure 2-160. Seat Strap: FXST, FXSTB and FXSTS



Figure 2-161. Seat: FXST, FXSTB and FXSTS

Seat

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

NOTE

Thumbscrew can be unthreaded and threaded using the SEAT MOUNTING SCREW TOOL (HD-47190).

See Figure 2-162. Seat attaches with a single thumbscrew on the seat bracket (7) and two thumbscrews on the side (3). Install seat as follows.

- Attach passenger seat to seat base if removed. Place assembly through seat strap. On FLSTF models, connect sides of loop snap.
- 2. Insert tang at front of seat into the channel in the frame.
- 3. Install rear thumbscrew.
- 4. Install side mounting thumbscrews.
- 5. Attach seat strap.
 - a. Tuck any slack material under seat.
 - b. Place loose seat strap bracket over mounting fastener on frame.
 - Pull up on strap bracket until an audible click is heard. A secured strap bracket will require force to undo.

Sissy Bar: FLSTC Models

The FLSTC features a sissy bar upright and pad (1). Remove this assembly only when necessary. Tighten sissy bar fasteners to 35-60 **in-lbs** (4.0-6.8 Nm).



Figure 2-162. Seat: FLSTC and FLSTF

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

NOTE

Thumbscrew can be unthreaded and threaded using the SEAT MOUNTING SCREW TOOL (HD-47190).

See Figure 2-163. Seat attaches with a single thumbscrew on the seat bracket (2). When installing seat, insert tang at front of seat into the channel in the frame and install rear thumbscrew.



Figure 2-163. Seat

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

NOTE

Thumbscrew can be unthreaded and threaded using the SEAT MOUNTING SCREW TOOL (HD-47190).

See Figure 2-164. The passenger seat attaches with a single thumbscrew (1) at the rear and engages the seat mounting fasteners (3) at the front.

To remove seat (4, 5, 6), remove passenger seat (2, 10) and seat mounting fasteners (3). When installing seat, insert tang at front of seat into the channel in the frame and install seat mounting nuts. Install passenger seat.



Figure 2-164. Seat: FLSTSC/FLSTN/FLST

- 1. Remove seat. See 2.47 SEAT: FLSTSC/FLSTN/FLST.
- 2. Remove front fasteners (1) and rear fasteners (3) to detach luggage rack (2) from fender.
- 3. Place luggage rack on fender.
- 4. Install, but do not tighten front fasteners.
- Install rear fastener. Tighten to 12-14 ft-lbs (16.3-19.0 Nm).
- 6. Tighten front fasteners to 96-120 in-Ibs (10.8-13.6 Nm).



Figure 2-165. Luggage Rack

- 1. See Figure 2-166. Remove acorn nut (7) and washer (8) from lower support.
- 2. Remove flange nuts and washers (5) from inside saddlebag.
- Lift saddlebag away from motorcycle. Remove nuts (1) and studs (4) if necessary.

INSTALLATION

NOTES

- On FLSTC models, there are no washers between studs (4) and sissybar sideplate (3).
- If replacing isolator (9), long (silver) threads face saddlebag and short (yellow) threads face support.
- See Figure 2-166. If removed, install studs (4) and tighten nuts (1) behind fender support (2) to 21-27 ft-lbs (28.5-36.6 Nm).
- Install flange nuts and washers (5) inside saddlebags. Tighten to 120-144 in-Ibs (13.6-16.3 Nm).
- Install lower bracket acorn nut (7) and washer (8). Tighten to 120-144 in-Ibs (13.6-16.3 Nm).



Figure 2-166. Saddlebags: FLSTC

- 1. See Figure 2-167. Use a finger to raise the wireform latch springs on each side of the windshield.
- Standing at the front of the vehicle, gently pull the top of the windshield until the upper notches on the side brackets are free of the upper grommets.
- 3. Carefully raise the windshield until the lower notches in the side brackets are free of the lower grommets.
- 4. Remove windshield from vehicle.

INSTALLATION

CAUTION

Be sure that the notches on each bracket of the windshield are firmly seated on a rubber grommet.

- 1. Lower the windshield into position until the bottom notches are seated on the lower grommets.
- 2. See Figure 2-167. Standing at the front of the vehicle, gently push the top of the windshield toward the rear until the upper notches fully engage the upper grommets.
- Push down on the wireform latch springs so that they overhang the rubber grommets. If some adjustment is necessary, loosen the retaining bolts and rotate the latch springs into the proper position.



Figure 2-167. Windshield: FLSTC

ENGINE

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SPECIFICATIONS

GENERAL	DATA	
Number of cylinders	2	
Туре	4-cycle, 45 degree, air cooled V-twin	
Torque	85 ft-lbs @ 3000 RPM	
(domestic models at crank)	115.2 Nm @ 3000 RPM	
Base	3.75 in.	
Bore	95.25 mm	
Otralia	4.00 in.	
Stroke	101.6 mm	
Distanting a second (second)	88 cubic in.	
Piston displacement (approx.)	1450 cc	
Maximum sustained engine speed	5500 RPM	
Idle speed	1000 RPM +/- 50	
Engine and transmission	204 lbs	
weight	92.5 kg	

ROCKER ARM SHAFTS	IN.	MM
Shaft fit in rocker arm support plate (loose)	0.0007-0.0022	0.018-0.056

HYDRAULIC LIFTERS	IN.	MM
Fit in crankcase (loose)	0.0008-0.0020	0.02-0.05

CYLINDER HEADS	IN.	MM
Valve guide in head (tight)	0.0020-0.0033	0.051-0.084
Valve seat in head (tight)	0.003-0.0045	0.076-0.114
Head gasket surface (flatness)	0.0-0.006	0.0-0.015

OIL PUMP	DATA
Туре	Twin gerotor, dual scavenge, crank mounted and driven, internal oil pump, dry sump
Pressure	30-38 PSI (207-262 kN/m ²) at 2000 RPM and normal operating temperature of 230°F (110°C)
Filtration	10 micron media, filtered between pump and engine

ROCKER ARMS	IN.	MM
Shaft fit in bushing (loose)	0.0005-0.0020	0.013-0.051
End clearance	0.003-0.013	0.08-0.33
Bushing fit in rocker arm (tight)	0.002-0.004	0.051-0.102

VALVES	IN.	MM
Exhaust: fit in guide	0.001-0.003	0.0254-0.0762
Intake: fit in guide	0.001-0.003	0.0254-0.0762
Seat width	0.040-0.062	1.02-1.58
Stem protrusion from cylinder head boss	2.012-2.032	51.10-51.61

VALVE SPRING	IN	MM
Closed	135 lbs @ 1.850 in.	61.2 kg @ 47.0 mm
Open	312 lbs @ 1.300 in.	141.5 kg @ 33.0 mm
Free length	2.325 in.	59.1 mm
PISTONS	IN.	MM
------------------------	---------------	-------------
Fit in cylinder	0.0014-0.0025	0.036-0.064
Ring end gap:		
Top compression		
ring	0.010-0.020	0.254-0.508
2nd compression		
ring	0.014-0.024	0.356-0.610
Oil control ring	0.010-0.050	0.254-1.27
Ring side clearance:		
Top compression		
ring	0.0012-0.0037	0.030-0.094
2nd compression	0.0012-0.0037	0.030-0.094
ring	0.0031-0.0091	0.079-0.231
Oil control ring		
Piston pin fit (loose)	0.0002-0.0005	0.005-0.013

FLYWHEELS	IN.	MM
Runout (flywheels at rim)	0.000-0.010	0.0-0.254
Runout (shaft at flywheel)	0.000-0.002	0.0-0.051
End play	0.003-0.010	0.076-0.254

IN.	ММ
0.0002-0.0015	0.005-0.038
0.0-0.003	0.0-0.076
0.0038-0.0054	0.097-0.137
0.0004-0.0014	0.010-0.036
	IN. 0.0002-0.0015 0.0-0.003 0.0038-0.0054 0.0004-0.0014

CONNECTING RODS	IN.	MM
Piston pin fit (loose)	0.0007-0.0012	0.018-0.030
Side play between flywheels	0.005-0.015	0.13-0.38
Connecting rod to crankpin (loose)	0.0004-0.0017	0.0102-0.0432

ENGINE TORQUE VALUES

ITEM	TORQUE		NOTES
Balancer chain sprocket nuts	78-82 ft-lbs	105.7-111.2 Nm	replace if possible, use LOCTITE THREADLOCKER 271 (red) otherwise, page 3-53
Balancer shaft housing screws	18-22 ft-lbs	24.4-29.8 Nm	T40 TORX, LOCTITE THREADLOCKER 262 (red), special sequence to tighten, page 3-52
Bearing retainer plate screws	20-30 in-lbs	2.3-3.4 Nm	use LOCTITE THREADLOCKER 243 (blue), Page 3- 110
Breather cover bolts	90-120 in-lbs	10.2-13.6 Nm	page 3-43
Cam cover screws	125-155 in-lbs	14.1-17.5 Nm	special pattern to tighten, page 3-64
Cam support plate screws	90-120 in-lbs	10.2-13.6 Nm	special pattern to tighten, page 3-59
Crank sprocket bolt	special meth	od to tighten	replace if possible, use LOCTITE THREADLOCKER 262 (red) otherwise, page 3-63
Crankcase bolts	15-19 ft-lbs	20.3-25.8 Nm	special pattern to tighten, page 3-56
Cylinder head bolts	see note		special pattern to tighten, page 3-38
Cylinder head bracket bolts	35-40 ft-lbs	47.5-54.2 Nm	page 3-23, page 3-25
Cylinder stud	10-20 ft-lbs	13.6 -27.1 Nm	page 3-128
Engine/transmission bracket bolts	30-35 ft-lbs	40.7-47.5 Nm	page 3-25
Front engine mounting bolts	70-80 ft-lbs	94.9-108.5 Nm	page 3-25
Lifter cover screws	90-120 in-lbs	10.2-13.6 Nm	crosswise pattern to tighten, page 3-41
Oil fitting	120-168 in-lbs	13.6-19.0 Nm	LOCTITE PIPE SEALANT 565, page 3-128
Oil pump screws/alignment tools, initial torque	40-45 in-lbs	4.5-5.1 Nm	Special tools and pattern to tighten, page 3-60
Oil pump screws	90-120 in-lbs	10.2-13.6 Nm	special pattern to tighten, page 3-60
Pipe plug	120-144 in-lbs	13.6-16.3 Nm	LOCTITE PIPE SEALANT 565, page 3-128
Piston jet screws	25-35 in-lbs	2.8-4.0 Nm	replace if possible, use LOCTITE THREADLOCKER 222 (purple) otherwise, page 3-121
Pivot shaft nut	90-110 ft-lbs	122-149.1 Nm	page 3-25
Rear cam sprocket bolt	special meth	od to tighten	replace if possible, use LOCTITE THREADLOCKER 262 (red) otherwise 3-63
Rocker arm support plate bolts	18-22 ft-lbs	24.4-29.8 Nm	2 sizes, 1/4 turn sequence, page 3-42
Rocker cover bolts	15-18 ft-lbs	20.3-24.4 Nm	LOCTITE THREADLOCKER 243 (blue), special pat- tern to tighten, page 3-43
Temperature sensor hole screw	120-180 in-lbs	13.6-20.3 Nm	Page 3-87
Top engine mount bolt	45-50 ft-lbs	61.0-67.8 Nm	page 3-23, page 3-25
Transmission mounting bolts	30-35 ft-lbs	40.7-47.5 Nm	criss-cross pattern, page 3-25

GENERAL

Wear limits are given here as a guideline for measuring used engine components. Replace components when they exceed values listed here.

	REPLACE IF WEAR EXCEEDS		
RUCKER ARMS	IN.	MM	
Shaft fit in bushing (loose)	0.0035	0.089	
End clearance	0.025	0.635	

ROCKER ARM SHAFTS	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Shaft fit in rocker support (loose)	0.0035	0.089

REPLACE IF	
IN.	MM
Less than	Less than
0.002	0.051
Less than	Less than
0.002	0.051
More than	More than
0.006	0.15
	REPL IN. Less than 0.002 Less than 0.002 More than 0.006

	REPLACE IF WEAR EXCEEDS	
CYLINDERS	IN.	MM
Taper	0.002	0.051
Out of round	0.002	0.051
Warpage of gasket or O-ring surfaces: top	0.006	0.152
Warpage of gasket or O-ring surfaces: base	0.004	0.102

CYLINDER BORES	REPLACE IF WEAR EXCEEDS		
	IN.	MM	
Standard	3.752	95.301	
0.005 in. oversize	3.757	95.428	
0.010 in. oversize	3.762	95.555	

HYDRAULIC	REPLACE IF WEAR EXCEEDS	
LIFTERS	IN.	MM
Fit in crankcase	0.003	0.076
Roller fit	0.0015	0.038
Roller end clearance	0.015	0.38

CAM SUPPORT	REPLACE IF		
PLATE	IN.	MM	
Cam chain tensioner shoe	More than 0.090	More than 2.29	
	1/2 thickness of shoe		
Crankshaft bushing fit to support plate	Less than 0.0008	Less than 0.0203	
Crankshaft bushing maximum ID	More than 0.8545	More than 21.704	

3-4

	PISTONS	REPLACE	IF WEAR EDS
		IN.	ММ
Fit in cyline	der (loose)	0.003	0.076
Piston pin	fit (loose)	0.0008	0.020
	Top compression	0.030	0.76
Ring end gap	2nd compression	0.034	0.86
ond gup	Oil control rails	0.050	1.27
Rina	Top compression	0.0045	0.11
side	2nd compression	0.0045	0.11
clearance	Oil control rails	0.010	0.25

CONNECTING DODG	REPLACE IF W	EAR EXCEEDS
CONNECTING RODS	IN.	MM
Piston pin fit (loose)	0.002	0.051
Side play between flywheels	0.020	0.508
Fit on crankpin (loose)	0.002	0.051

	REPLACE IF WEAR EXC	EAR EXCEEDS
FLYWHEELS	IN.	MM
Runout (flywheels at rim)	0.015	0.381
Runout (shaft at flywheel)	0.003	0.076
End play	0.010	0.254

CRANKSHAFT	REPL	ACE IF
ROLLER BEARING	IN.	MM
Roller bearing fit (loose)	More than 0.0015	More than 0.038
Crankshaft runout	More than 0.003	More than 0.076
Bearing fit in crankcase (tight)	Less than 0.0038	Less than 0.097
Inner race on crankshaft (tight)	Less than 0.0004	Less than 0.010

BALANCE CHAIN GUIDES	REPLACE IF WEAR EXCEEDS		
	IN.	ММ	
Front and man	0.090	2.29	
Front and rear	1/2 thickness of guide		
Lawar	0.090	2.29	
Lower	1/2 thickne	ess of guide	

BREATHER ASSEMBLY IN.	EAR EXCEEDS	
	IN.	MM
Breather Cover Warpage	0.005	0.13
Breather Baffle Warpage	0.005	0.13

VALVE STEM	REPLACE IF WEAR EXCEED	
TO GUIDE	IN.	ММ
Intake	0.0038	0.0965
Exhaust	0.0038	0.0965

ENGINE OIL FLOW

OIL FEED

CAUTION

The oiling system is carefully designed for optimum efficiency. All oil holes and passageways are specially sized. Exercise caution to avoid enlarging oil holes during cleaning. Any modification of the oiling system will adversely affect oil pressure or cooling and lubrication efficiency.

See Figure 3-1. Oil flows from the oil tank feed line (1) to the engine feed connection (2) at the rear right side of the crankcase.



Figure 3-1. Oil Flow From Tank

See Figure 3-2. Running through a passageway in the crankcase (1), oil exits a hole in the crankcase flange and enters a hole on the inboard side of the cam support plate (2). Passing through a channel in the cam support plate, the oil enters the feed side of the oil pump (3). See 3.5 OIL PUMP OPERA-TION. The feed gerotors of the pump direct the flow up a second channel in the cam support plate.

A passage (5) connects to a pressure relief valve (6) mounted in the bypass port of the cam support plate. When the oil pressure exceeds the setting of the valve spring (35 PSI), the orifice opens to bypass (7) excess oil back to the feed side of the pump (3).

Oil not returned to the feed side exits a hole on the inboard side of the cam support plate and passes through a hole in the crankcase flange. Flowing through a passageway in the crankcase, where a reading is taken by the oil pressure sending unit (8), the oil exits the lower hole in the oil filter mount. See Figure 3-3.



- 3. Feed side of oil pump
- Oil pump output 4.
- **Overflow passage** 5.
- Pressure relief valve 6.
- 7. **Bypass passage**
- Oil pressure sending unit 8.
- 9. Return from oil filter into cam support plate
- 10. Feed to chain guide bracket

Figure 3-2. Cam Support Plate Oil Flow



Figure 3-3. Oil Filter Flow

After circulating through the oil filter, the flow of oil is directed back into the crankcase through the spigot in the oil filter mount. See Figure 3-2. Exiting a passageway in the crankcase through a hole in the crankcase flange, the flow of oil reenters the cam support plate (9).

Filtered oil is then routed to the top and bottom ends of the engine. See TOP END, BOTTOM END and CHAIN GUIDE BRACKET which follow.

TOP END

Two illustrations accompany this explanation.

- Cam support plate oil flow is shown in Figure 3-4.
- Top end oil flow is shown in Figure 3-5.

Oil passes through a channel in the cam support plate exiting the inboard side through two holes near the top (A11, A12). Entering two holes in the crankcase flange (B13, B14), one leading to the front cylinder and the other to the rear, the oil travels through passageways in the crankcase to the hydraulic lifter bores (D15).

Exiting a hole in each lifter bore (E16), the oil flows around the lifter and enters a hole at the side of the lifter body. As the chamber inside the lifter body is filled, the push rod socket rises to achieve the no-lash fit of the valve train components. The flow of oil then exits a hole centered in the lifter socket and runs up the hollow push rods.

NOTE

Note that there is one additional hole drilled into the inside lifter bores. While the oblong hole circulates oil around the lifter body as described, the round hole (E17) feeds oil to the piston jets in the flywheel compartment.

Exiting holes at the top of the hollow push rods, oil enters a hole at the bottom of the intake and exhaust actuator arms. Lubricating the rocker arm bushings, oil flows down the rocker arm shafts and exits a pin hole in the outboard side of each rocker arm housing (F18) where it sprays the valve springs and the top of the valve stem.

Oil runs down to the low side of the rocker housing and enters the exhaust valve spring pocket where a drain hole (G19) leads to a passageway in the cylinder head casting.

Oil exits the bottom of the cylinder head and passes through a ring dowel (H20) on the "down side" of the cylinder flange. The oil runs through a vertical passageway in the cylinder, passes through a second ring dowel on the "down side" of the cylinder deck (I21) and enters the left crankcase half.

Flowing through a horizontal passageway in the left crankcase half (J22), oil runs through a third ring dowel (K23) to the right crankcase half where it travels through another passageway before emptying into the cam compartment (B23, B24).

Oil collecting in the cam compartment is picked up by one of two scavenge lobes on the oil pump (B25).

BOTTOM END

Three illustrations accompany this explanation.

- Cam support plate oil flow is shown in Figure 3-4.
- Top end oil flow is shown in Figure 3-5.
- Bottom end oil flow is shown in Figure 3-6.

Oil travels down the center passage of the cam support plate (A26) and sprays out through pin holes on each side of the casting to lubricate both the primary and secondary cam chains. Oil also passes through a hole in the crankshaft bushing where the flow enters a drilling in the crankshaft (L27).

Oil runs down the center of the crankshaft and then up a cross drilling into the right side of the flywheel. The flow exits a drilling in the crank pin bore, enters the crank pin and then sprays out through three holes to lubricate the lower rod bearing set.

The oil splash and mist created by the action of the flywheel lubricates the crankshaft bearing and the camshaft needle bearings in the right crankcase half. This same action serves to lubricate the sprocket shaft bearing in the left crankcase half (M28).

Since the oil mist also lubricates the cylinder walls, three holes on each side of the piston (in the area of the third ring land) evacuates excess oil scraped from the walls on the piston downstroke.

The piston jets (N29), which receive a supply of oil from the intake lifter bores, spray the underside of the piston for cooling of the piston crown and skirt area. A check valve in each jet opens only when the oil pressure reaches 12-18 PSI, at which point the engine is operating above idle speed. At idle speeds (9-12 PSI), the orifice remains closed to prevent over oiling and to ensure proper system operating pressure.

Oil spray from each piston jet also enters a hole at the bottom of each pin boss (O30) for lubrication of the piston pin. Another hole at the top of the connecting rod (D31) allows a portion of the oil to reach the upper rod bushing.

Surplus oil falls back to the bottom of the flywheel compartment where it collects in the sump area (P32). Oil in the sump is drawn to the cam compartment through an internal channel (P33, C34) that connects with the second scavenge lobe of the oil pump (B35).



Figure 3-4. Engine Oil Flow: Cam Support Plate/Right Crankcase Half



Figure 3-5. Engine Oil Flow: Top End



Figure 3-6. Engine Oil Flow: Bottom End

CHAIN GUIDE BRACKET

Three illustrations accompany this explanation.

- Cam support plate oil flow is shown in Figure 3-2.
- Bottom end oil flow is shown in Figure 3-6.
- Chain guide bracket oil flow is shown in Figure 3-7.

Oil travels down the center passage of the cam support plate (A26) and enters a passage heading to the rear of the cam support plate (A39).

As oil exits the inboard side of the cam support plate, it enters a crankcase dowel. The hole contains the chain guide screen and O-ring (Q40).

NOTE

This screen blocks any debris which might enter the chain guide bracket. The screen has no regular maintenance schedule. However, clean the screen and replace the O-ring every time the engine is disassembled.

Oil travels through the right side crankcase (R41) and goes into the chain guide bracket rubber interconnect (S42). Inside the chain guide (T43), oil travels to both the front and rear hydraulic tensioners (T45, T44). The tensioners sit underneath the front and rear tensioner guides which provide support for the counterbalancer chain. A small hole at the top of each tensioner vents any trapped air into the flywheel compartment.

OIL RETURN

The "dual kidney" designation given to the oil pump refers to its two scavenging functions, whereby it simultaneously draws oil from both the cam and flywheel compartments.

Oil sucked up by the scavenge lobes passes through the scavenge gerotors of the oil pump and is directed through a return channel in the cam support plate (A36). See 3.5 OIL PUMP OPERATION.

Exiting a hole on the inboard side of the cam support plate, the oil enters a hole in the crankcase flange (B37).

The oil flows through a passageway in the crankcase and exits the upper fitting at the rear right side of the crankcase (A38). See Figure 3-1. Passing through a flexible hose connection (3), the flow of oil runs returns to the oil tank.

Also note that a third hose (4) clamped to a fitting behind the rear lifter cover connects the cam compartment with the oil tank via a third drilling in the transmission case. This crankcase breather connection provides the pressure balance necessary for oil circulation.



Figure 3-7. Engine Oil Flow: Chain Guide Bracket

GENERAL

See Figure 3-8. The oil pump consists of a housing containing two gerotor gear sets, one feed and the other scavenge. Driven by the crankshaft, the feed gerotor set distributes oil to the engine, while the scavenge gerotor set draws oil from the cam and flywheel compartments and returns it to the oil pan.

Each gerotor gear set has two parts, an inner and outer gerotor. The inner and outer gerotors have fixed centers that are slightly offset to one another. Also, the inner gerotor has one less tooth.



Figure 3-8. Oil Pump Gerotors

OPERATION

See Figure 3-9. As the crankshaft rotates, the cavity between the inner and outer gerotors on the inlet side of the pump increases in volume. This creates a vacuum causing oil to be drawn in. The cavity continues to increase until the volume is equivalent to that of the missing tooth on the inner gerotor. Note that the inlet and outlet sides of the pump are sealed by the tips and lobes of the inner and outer gerotors.

See Figure 3-10. Continued rotation moves the pocket of oil to the outlet side of the pump. In this area, the cavity decreases in volume as the gerotor teeth mesh causing the oil to be squeezed out the discharge port. As the cavity on the outlet side is emptied, a second seal formed by the tips and lobes of the inner and outer gerotors prevents oil on the outlet side (high pressure) from being transferred to the inlet side (low pressure). In operation, the gerotors provide a continuous flow of oil.



Figure 3-9. Inlet Side Oil Flow



Figure 3-10. Outlet Side Oil Flow

BREATHER OPERATION

GENERAL

NOTE

The crankcase breather system relieves crankcase pressure produced by the downstroke of the pistons and allows crankcase vapors vacated from each cylinder to be directed into the air filter element. Through effective recirculation of crankcase vapors, the system serves to eliminate the pollutants normally discharged from the crankcase.

See Figure 3-11. As each piston pushes downward on its power and intake stroke, displaced air in the flywheel compartment is vented through the crankshaft roller bearing into the cam compartment and then up the push rod covers (1) into the rocker housing.

Air rushes under the rocker arm support plate, which is elevated slightly, and passes through an opening at the bottom of the plate to enter the breather baffle compartment (2).

In the baffle compartment, the flow of air passes upward through the oil filter gauze, where the oil is removed from the air. Two pin holes in the rocker arm support plate act as drain holes to rid the baffle compartment of the oil separated from the air.

Passing through the oil filter gauze, the flow of air passes through the umbrella valve (3) into the breather compartment. The flaps of the umbrella valve only allow air to be vented one way, rising to allow the passage of air, but then falling back into place to seal the vent holes as the flow of air stops.

In the breather compartment, the flow of air reverses direction passing downward through holes aligned in the breather baffle, rocker arm support plate and rocker housing. Exiting the rocker housing, the air enters a passageway cast into the top of the cylinder head. Proper orientation of the rocker housing gasket is critical for effective sealing of this passageway.

Flowing through the cylinder head passageway, the air passes through a drilling in the air cleaner backplate bolt (4) and then through a breather tube (5) into the air filter element.

NOTE

Air cleaner mounting without installation of the breather tubes allows crankcase vapors to be vented into the atmosphere in violation of legal emissions standards.



re 3-11. Breather Air Flow (breather disassemble illustration purposes only)

OIL PRESSURE INDICATOR LAMP

See Figure 3-12. 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

If the oil pressure indicator lamp remains lit, always check the oil supply first. If the oil supply is normal and the lamp is still lit, stop the engine at once and do not ride further until the trouble is located and the necessary repairs are made. Failure to do so may result in engine damage. (00157a)

If the indicator lamp is not extinguished, it may be the result of a low oil level or diluted oil supply. In freezing weather, the oil feed and return lines can clog with ice or sludge. A problem 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, determine if oil returns to the pan from the oil return hose. If oil does not return, shut off the engine until the problem is located and corrected.

CHECKING OIL PRESSURE

PART NO.	SPECIALTY TOOL
HD-96921-52B	Oil pressure gauge
HD-96921-110	Oil pressure gauge adapter

Check operating oil pressure as follows:

- Fill oil tank to proper level. See 1.4 ENGINE OIL AND FILTER.
- See Figure 3-13. Remove oil pressure switch from crankcase. See 8.37 OIL PRESSURE SWITCH.
- See Figure 3-14. Install adapter (2) in oil pressure switch mounting hole. Tighten adapter until snug.
- Assemble banjo bolt (3), washer (4), oil pressure gauge (1) banjo fitting and second washer onto adapter and tighten until snug.
- 5. Start engine and allow to reach operating temperature.

NOTE

Engine oil should be at normal operating temperature (230° F/110° C) for an accurate reading.

- 6. Oil pressure should be 30-38 PSI (207-262 kPa) at 2000 RPM and normal operating temperature.
- Stop engine. Remove oil pressure gauge assembly from oil pressure switch mounting hole in crankcase.
- Reinstall oil pressure switch. See 8.37 OIL PRESSURE SWITCH.



Figure 3-12. Oil Pressure Indicator Lamp



Figure 3-13. Oil Pressure Switch



Figure 3-14. Oil Pressure Gauge

TOP END REPAIR

NOTE

During top end disassembly, the engine may be left in the chassis for service.

If servicing only cylinder head components, pistons, cylinders and/or upper rod bushings, see 3.9 TOP END SERVICE. Two options are available depending upon engine status.

- ENGINE IN CHASSIS on page 3-16.
- ENGINE REMOVED FROM CHASSIS on page 3-17.

BOTTOM END REPAIR

NOTE

Servicing components in the cam compartment requires only partial disassembly. This can be done with the engine left in the chassis.

After disassembling as far as the cylinder heads you may find that bottom end repair is necessary. Bottom end service may require either partial or complete disassembly of the engine.

- To service the cam compartment, see ENGINE IN CHASSIS: CAM COMPARTMENT SERVICE on page 3-18.
- To service components in the flywheel compartment, the engine must be removed and the crankcase halves split.
 See ENGINE REMOVED: FLYWHEEL COMPARTMENT SERVICE OR COMPLETE ENGINE OVERHAUL on page 3-19.

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 (see 1.32 TROUBLESHOOTING). 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.

NOTE

Some illustrations may depict a simple looking crankcase or cam support plate. Individual features which don't apply to service procedures, such as oil connect lines, are shown for reference only.

TOP END SERVICE

ENGINE IN CHASSIS





ENGINE IN CHASSIS: CAM COMPARTMENT SERVICE



ENGINE REMOVED: FLYWHEEL COMPARTMENT SERVICE OR COMPLETE ENGINE OVERHAUL



To diagnose and correct noisy hydraulic lifters and valve train components, use the following procedures:

- With engine and oil at normal operating temperature, check oil pressure at 2000 RPM. If oil pressure is above 50 PSI (345 kN/m²) or below 5 PSI (34 kN/m²), inspect oil pump, crankcase passages, and oil hoses for restrictions or blockage. Repair or replace parts as necessary.
- If oil is reaching the hydraulic lifters, remove and inspect. See LIFTER INSPECTION under 3.22 PUSH RODS, LIFTERS AND COVERS. Clean lifter bore of all foreign material. Replace hydraulic lifter if required.
- Examine push rod, lifter and lifter block for proper fit and any signs of unusual wear. Replace parts as necessary.
- 4. Visually inspect camshaft lobes for abnormal wear.
- Remove camshaft and pinion gear, clean and inspect for wear and fit. Measure pitch diameters and check for outof-round condition. Replace parts as necessary.
- 6. Check cam chain tensioning spring and shoe for wear.
- Remove cylinder head and rocker box assemblies. Check rocker arm end play and check for binding. Inspect valve stems for scuffing and check stem to guide clearance. Check valve seats for signs of looseness or shifting.
- 8. Grind valves and valve seats.

COMPRESSION TEST

NOTE

The Twin Cam 88B engine uses a 12 mm adapter with the compression gauge.

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.

- 1. Disconnect spark plug wires, clean around plug base and remove plugs.
- 2. Connect compression tester to front cylinder per manufacturer's instructions.
- Make sure transmission is in neutral. With throttle plate in wide open position, crank engine continuously through 5 to 7 full compression strokes.
- 4. Note gauge readings at the end of the first and last compression strokes. Record test results.
- 5. Repeat steps 2 through 4 on rear cylinder.
- If the final readings are 90 PSI (620 kN/m²) or more, and if the final readings do not indicate more than a 10% variance between cylinders, compression is considered normal. If compression does not meet specifications, see Table 3-1.
- 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.

Table 3-1. Compression Test Results

DIAGNOSIS	TEST RESULTS
Ring trouble	Compression low on first stroke, tends to build up on the following strokes, but does not reach normal. Improves con- siderably when oil is added to cylinder.
Valve trouble	Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Check for correct push rod length.
Head gasket leak	Same reaction as valve trouble.

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 (Part No. HD-35667-A) and 12 mm adapter and follow the specific instructions supplied with the tester.

The following are some general instructions that apply to Harley-Davidson V-twin engines:

- 1. Run engine until it reaches normal operating temperature.
- 2. Stop engine. Clean dirt from around spark plugs and remove the spark plugs.
- 3. Remove the air cleaner and set the throttle to the wide open position.
- The piston in the cylinder being tested must be at top dead center of compression stroke (both valves closed) during the test.
- 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.

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 10% indicates internal engine problems.
- Listen for air leaks at carburetor intake, exhaust pipe, and head gasket. Air escaping through the carburetor indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

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

8. 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. Oil tank overfilled.
- 2. Oil carryover.
- 3. Breather hose restricted.
- 4. Restricted oil filter.

Check After Cylinder Head Removal

- 1. Oil return passages for clogging.
- 2. Valve guide seals.
- 3. Valve guide to valve stem clearance.
- 4. Gasket surface of both head and cylinder.
- Cylinder head casting's porosity allowing oil to drain into combustion chamber.
- O-ring damaged or missing from oil pump/crankcase junction.

NOTE

If performing top end service (or both cam compartment and top end), follow all the steps listed. If servicing cam compartment components only, perform steps 1 though 8.

- 1. Position motorcycle on a suitable lift.
- 2. Remove seat.

AWARNING

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

- 3. Disconnect negative battery cable.
- 4. Remove right floorboard.
- Remove heat shields and exhaust. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- Remove air cleaner cover and backplate. See 4.8 AIR CLEANER: CARBURETED or 9.4 AIR CLEANER: EFI.

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- Drain fuel tank. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- Disconnect fuel gauge connector. Remove fuel tank and instrument console. See 4.7 FUEL TANK: CARBU-RETED. or 9.5 FUEL TANK: EFI.
- On carbureted models, loosen and remove throttle control cables from carburetor.
- 10. On EFI models, loosen and remove throttle control cables from induction module.
- 11. Remove spark plug cables from spark plugs. Remove spark plugs to avoid damaging them.
- Remove bolts from top engine mount and frame. On carbureted models, slide enrichener out of slot on bracket. Remove top engine mount and horn bracket as an assembly.
- On carbureted models, remove MAP sensor connector [80] from MAP sensor. Remove carburetor and intake manifold as an assembly. See 4.4 CARBURETOR.
- 14. On EFI models, remove induction module connectors and induction module. See 9.10 INDUCTION MODULE.

NOTE

If top end service was performed (or both cam compartment and top end), follow all the steps listed. If only cam compartment components were serviced start with step 5.

- On carbureted models, install intake manifold and carburetor as an assembly. See 4.4 CARBURETOR. Install MAP sensor connector [80] to MAP sensor.
- On EFI models, install induction module. See 9.10 INDUCTION MODULE. Install induction module connectors.
- Install horn bracket assembly to frame tab and cylinder heads. Install enrichener to slot in bracket.
 - Tighten two cylinder head bracket bolts to 35-40 ftlbs (47.5-54.2 Nm).
 - Tighten the upper engine to frame mounting bolt to 45-50 ft-lbs (61.0-67.8 Nm).
- Install spark plugs to cylinder heads. Connect spark plug cables to spark plugs. See 1.21 SPARK PLUGS.
- On carbureted models, install throttle cables to carburetor.
- On EFI models, install throttle cables to induction module.
- On carbureted models, connect fuel lines to carburetor with new hose clamps.
- 8. On EFI models, connect fuel hose to fuel tank.
- Install instrument console, fuel tank, fuel gauge connector, and fuel tank crossover tube. See 4.7 FUEL TANK: CARBURETED. or 9.5 FUEL TANK: EFI.
- 10. Install backplate and air cleaner cover. See 4.8 AIR CLEANER: CARBURETED or 9.4 AIR CLEANER: EFI.

- Install heat shields and exhaust. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- 12. Install right floorboard.
- 13. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

- 14. Install seat.
- 15. Remove motorcycle from lift. -

- 1. Position motorcycle on a suitable lift.
- 2. Remove seat.

WARNING

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

- 3. Disconnect both battery cables, negative cable first. Remove battery.
- Drain primary chaincase and oil tank. See 1.4 ENGINE OIL AND FILTER and 1.11 PRIMARY CHAINCASE LUBRICANT.

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- Drain fuel tank. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- 6. Remove instrument panel and fuel tank. See 4.7 FUEL TANK: CARBURETED. or 9.5 FUEL TANK: EFI.
- 7. Remove left and right floorboards.
- Remove heat shields and exhaust. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- 9. Remove two bolts from rear inner fender. Lift upper right corner of fender towards rear tire and lift upward.
- Loosen, but do not remove, front bolt from slotted hole on lower belt guard. Remove belt guard and loosen rear axle.

- 11. Remove the two bolts at the top of the electrical panel. Unplug the speedometer sensor connector to free the harness from the transmission.
- 12. Remove oil lines from crankcase and oil tank. Remove oil tank. See 3.32 OIL TANK.
- Remove primary chaincase cover and primary chaincase. See 6.2 PRIMARY CHAINCASE.
- Remove upper and lower fasteners from seat post. Disconnect coil connector and remove the post with the coil attached.
- 15. Position a jack with a wooden block under the engine. Remove the shift arm and the bracket (right side) connecting the frame to the transmission case.
- 16. Remove the four fasteners connecting the engine to the transmission.
- Note routing of clutch cable before removing. Disconnect clutch cable from clutch lever. Unclip cable at left side frame downtube and pull cable through chassis to right side of motorcycle. Leave cable installed on transmission.
- 18. Remove hose bracket from the rear of the transmission. On California models, remove the three hoses from the evaporative emissions canister.
- 19. Remove the pivot shaft, moving the electrical panel out of the way. Disconnect neutral switch wires and slide the transmission back and then out the right side.
- Remove bolts from horn bracket and cylinder heads. On carbureted models, slide enrichener out of slot on bracket. Remove bracket as an assembly. Disconnect horn wire.
- On carbureted models, remove MAP sensor connector [80] from MAP sensor. Remove air cleaner cover and backplate. See 4.8 AIR CLEANER: CARBURETED. Disconnect throttle cables.
- 22. On EFI models, remove induction module connectors. Remove air cleaner cover and backplate. See 9.4 AIR CLEANER: EFI. Disconnect throttle cables.
- Disconnect voltage regulator and detach from frame. Detach crank position sensor and oil pressure sending unit connector. See Section 8.
- 24. Remove two bolts on front engine mount. Lift engine out from right side of frame.

- Using a suitable hoist, position engine in chassis from the right side.
- Loosely install the front two mounting bolts and spacers from the right side. The shorter top bolt has a spacer installed on the right side between the frame and the engine. The longer lower bolt has a spacer on both sides. Loosely install corresponding washers and nuts.
- On carbureted models, connect MAP sensor connector [80] and horn wire. Attach the enrichener cable to the top engine mount. Install top engine mount using bolt, lockwasher and flat washer. Loosely tighten all bolts connecting engine to mount.
- On EFI models, attach induction module connectors and horn wire. Install top engine mount using bolt, lockwasher and flat washer. Loosely tighten all bolts connecting engine to mount.
- Attach throttle cables. Adjust throttle cables. On carbureted models, install fuel feed line to carburetor with new hose clamp. On EFI models, connect fuel hose to fuel tank.
- Install air cleaner backplate and cover. See 4.8 AIR CLEANER: CARBURETED. or 9.4 AIR CLEANER: EFI.
- Install voltage regulator. Route wire above the lower front engine mounting bolt and attach connector. Attach crank position sensor and oil pressure sending unit connector. See Section 8.
- See Figure 3-15. Install transmission case from the right side. Align all four transmission mounting holes verifying that the two lower locating dowels engage their holes in crankcase. Tighten the four transmission mounting bolts in a criss-cross pattern as follows.
 - a. Tighten finger tight.
 - b. Tighten to 15 ft-lbs (20.3 Nm).
 - c. Tighten to 30-35 ft-lbs (40.7-47.5 Nm).
- Apply LOCTITE ANTI-SEIZE to pivot shaft. From the right side, install pivot shaft and spacers with spacer collars facing transmission case.
- Apply LOCTITE THREADLOCKER 262 (red) to threads of pivot shaft nut. Install and tighten pivot shaft nut to 90-110 ft-lbs (122-149.1 Nm).
- Apply LOCTITE THREADLOCKER 262 (red) to both front mounting bolts. Tighten bolts to 70-80 ft-lbs (94.9-108.5 Nm).
- Install lower bracket (right side). Apply LOCTITE THREADLOCKER 262 (red). Tighten bracket bolts to 30-35 ft-lbs (40.7-47.5 Nm).
- 13. Final tighten upper engine mount hardware.
 - Tighten two cylinder head bracket bolts to 35-40 ftlbs (47.5-54.2 Nm).
 - Tighten the upper engine to frame mounting bolt to 45-50 ft-lbs (61.0-67.8 Nm).



Figure 3-15. Transmission Case Hardware

 Attach vapor valve bracket to rear of transmission case. On California models, see 4.14 EVAPORATIVE EMIS-SIONS CONTROL: CA MODELS to route evaporative emission hoses.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket could cause primary chaincase leaks.

- Install primary chaincase. Attach the clutch cable, adjust the clutch and fill with lubricant. Start with 6.2 PRIMARY CHAINCASE and follow all necessary steps.
- Install the left floorboard. This includes connecting the side stand spring and shift linkage.
- 17. Install the seat post. Connect the coil connector and the neutral switch wires.
- Install oil tank and connect all oil lines. See 3.32 OIL TANK.

- 19. Attach speedometer sensor connector from transmission to corresponding connector on the electrical panel. Move the panel into position and tighten the two upper bolts. Verify that all wiring is in place and not twisted or kinked.
- Raise the rear of the motorcycle and install rear inner fender. Inner fender uses two bolts at the bottom and fits over a frame tab at the top.
- 21. Install belt guard and tighten front bolt in slot. Tighten axle nut.
- Install heat shields, exhaust and right floorboard. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/ FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYS-TEM: FLSTSC as appropriate.
- Install instrument console, fuel tank, fuel gauge connector, and fuel tank crossover tube. See 4.7 FUEL TANK: CARBURETED. or 9.5 FUEL TANK: EFI.

AWARNING

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

24. Install battery and connect battery cables, positive cable first.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

- 25. Install seat.
- 26. Install **new** oil filter and fill oil tank to proper level. See 1.4 ENGINE OIL AND FILTER.
- 27. Remove motorcycle from lift.
- Perform vehicle alignment. See 2.15 VEHICLE ALIGN-MENT.
- 29. Check rear belt deflection and alignment. See 1.14 REAR BELT DEFLECTION.
- Check rear brakes, clutch and throttle for proper operation.
- Check oil level after running motorcycle on side stand. See 1.4 ENGINE OIL AND FILTER.

TOP END OVERHAUL: DISASSEMBLY

GENERAL

To perform a complete top end overhaul, follow all steps listed in this section including inspection and repair procedures.

BREATHER ASSEMBLY

CAUTION

Dirt caked on cooling 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.

1. Use low pressure spray to thoroughly clean exterior surfaces of engine prior to disassembly.

NOTE

- See Figure 3-16. If the engine is left in the chassis for service, use the ROCKER COVER WRENCH (HD-47258) and ROCKER HOUSING WRENCH (HD-47248) to remove the rocker cover and rocker housing bolts, respectively. These tools are especially useful when removing the bolts on the left side of the engine (particularly the rear) where there is close proximity to the frame. With both an external and internal hex, the bolts also can be removed with either a 7/16 inch socket or open end/box wrench (open spaces), or a short 3/16 inch allen wrench (tight spaces).
- It is assumed that each step performed on one cylinder is automatically repeated on the other.
- See Figure 3-17. Following the sequence shown, alternately loosen the six rocker cover bolts. Remove the rocker cover bolts and their captive washers.
- 3. Remove the rocker cover and gasket. Discard gasket.
- See Figure 3-19. Remove two bolts to release breather assembly and filter element from the rocker arm support plate. See 3.20 BREATHER ASSEMBLY for inspection and repair information.



Figure 3-16. Rocker Cover Bolt (Rocker Housing Bolt Similar)



in the sequence shown.

Figure 3-17. Rocker Cover Bolt Removal

ROCKER ARM SUPPORT PLATE

 See Figure 3-18. Insert the blade of a small screwdriver into cast loop of spring cap retainer (at top of upper push rod cover). While pushing down on spring cap, rotate bottom of screwdriver toward outboard side to remove. Repeat step on second push rod cover.



Figure 3-18. Removing Spring Cap Retainer

Collapse upper and lower push rod covers.

2.

CAUTION

Removing the rocker arms with the valve train loaded can result in bent push rods, damaged bushings or a warped support plate.

- To remove the rocker arm support plate, **both** lifters of the cylinder being serviced must be on the base circle (or lowest position) of the cam. To find the base circle, it is first necessary to rotate the engine. Based on the level of disassembly required, three methods of engine rotation are presented below.
 - a. With primary cover installed Remove spark plugs. With vehicle on center stand, place the transmission in 5th gear and rotate rear wheel in a clockwise direction (as viewed from right side) until the base circle is found. Continue with step 4.
 - b. With primary cover removed Remove spark plugs. Remove primary cover. Place the transmission in neutral. Fit a 1-1/2 in. socket on the compensating sprocket shaft nut. Rotate nut in a counterclockwise direction until the base circle is found. Continue with step 4.



Figure 3-19. Breather Bolts and Rocker Arm Bolts

CAUTION

Do not attempt to rotate engine by removing cam cover and placing socket on crank or primary cam sprocket flange bolt. Head of flange bolt can break off possibly resulting in damage to flywheel or camshaft.

PART NO.	SPECIALTY TOOL
HD-47257	Sprocket shaft engine rotation wrench

- c. With engine mounted in engine stand Install SPROCKET SHAFT ENGINE ROTATION WRENCH (Part No. HD-47257) on sprocket shaft and rotate in a counterclockwise direction until the base circle is found. Continue with step 4.
- Using one of the methods above, rotate engine until piston is at top dead center (TDC) of compression stroke.
 - To accomplish this, first raise lower push rod cover to access intake lifter (inside hole of lifter cover).
 - Place index finger on top of the intake lifter. While rotating engine, feel lifter rise (valve open) and fall (valve closed).
 - c. Now place finger tightly over spark plug hole and rotate engine again. In the compression stroke, air will be forced out against your finger until the piston reaches the TDC position. Stop engine rotation when the flow of air through the spark plug hole stops.
 - d. Direct the beam of a small flashlight into spark plug hole to verify piston is at TDC. Both intake and exhaust valves are now closed and the push rods are in the unloaded position.
- See Figure 3-19. Alternately loosen each of the four rocker arm support plate bolts just 1/4 turn. Continue turning the bolts in these increments until loose. Remove the rocker arm support plate bolts with flat washers.
- Remove the rocker arm support plate assembly from the rocker housing. See 3.21 ROCKER ARM SUPPORT PLATE for inspection and repair information.

NOTE

Always service each cylinder separately. After the first cylinder is serviced the engine must be rotated to find the base circle on the second cam. Service on the remaining cylinder can then proceed.



Figure 3-20. Sprocket Shaft Engine Rotation Wrench

PUSH RODS, LIFTERS AND COVERS

- See Figure 3-21. Remove the intake and exhaust push rods and push rod covers.
 - a. Tag the push rods for location (front/rear cylinder), and orientation (top/bottom) as they are removed. This will simplify installation.
 - Remove push rod covers from cylinder head and lifter cover bores.
 - c. Remove three O-rings from push rod covers and discard. If O-ring is missing from upper push rod cover, be sure to dislodge it from the cylinder head bore.
- 2. See Figure 3-22. Remove lifter covers.
 - Using a crosswise pattern, remove four screws with captive washers (1) to release the lifter cover (2).
 - b. Remove the lifter cover and gasket. Discard gasket.
- 3. Remove lifters.
 - a. Remove the anti-rotational pin to free the hydraulic lifters.
 - Tag the lifters for location (front/rear cylinder) and function (intake/exhaust) as they are removed. This will simplify installation.
 - Place the lifters in clean plastic bags to keep out dust, dirt and debris.
- See Figure 3-23. Remove and discard O-ring from groove around breather baffle hole in rocker housing.
- 5. See 3.22 PUSH RODS, LIFTERS AND COVERS for inspection and repair information.

CYLINDER HEAD

- See Figure 3-23. Following the sequence shown, alternately loosen the six rocker housing bolts. Remove rocker housing bolts and their captive washers.
- 2. Remove rocker housing and gasket. Discard gasket.

CAUTION

To prevent distortion of the cylinder head, cylinder and cylinder studs, gradually loosen the cylinder head bolts in the specified sequence.

- 3. See Figure 3-24. Remove cylinder head bolts.
 - Following the sequence shown, alternately loosen each of the four cylinder head bolts just 1/4 turn.
 - b. Continue turning the bolts in these increments until loose.
 - c. Remove the cylinder head bolts.
- See Figure 3-25. Remove cylinder head and head gasket (2). Discard gasket.

NOTE

Save the cylinder head gasket (if salvageable) and ring dowel O-rings for use with the CYLINDER TORQUE PLATES (Part No. HD-42324-A) when measuring, boring or honing of the cylinder is required.

5. See 3.23 CYLINDER HEAD for inspection and repair information.



Figure 3-21. Push Rod Locations



2. Lifter cover

Figure 3-22. Lifter Cover

CYLINDER

 Raise the cylinder just enough to place clean shop towels under the piston. This will prevent any dirt or debris, such as broken ring pieces, from falling into the crankcase bore.

CAUTION

Exercise caution to avoid bending the cylinder studs. Even a slight bend or nick can cause a stress riser leading to stud failure.

- Carefully remove the cylinder. Exercise caution to avoid bending the cylinder studs. As the piston becomes free of the cylinder, hold it upright to prevent it from striking the studs or dragging across the stud thread area.
- Slide approximately 6.0 in. (152 mm) of plastic tubing, rubber hose or conduit over each cylinder stud. Use material with I.D. of 0.5 in. (12.7 mm) to protect cylinder studs and piston from damage.
- See Figure 3-25. Remove O-ring seal (4) from the bottom of the cylinder liner. Discard O-ring seal.
- 5. See Figure 3-26. Remove O-ring from ring dowel (4) on base of cylinder deck. Discard O-ring.
- See 3.24 CYLINDER for inspection and repair information.



Figure 3-23. Rocker Housing Bolts







Figure 3-25. Cylinder Assembly

PISTON

PART NO.	SPECIALTY TOOL
HD-42317-A	Piston pin circlip remover/installer
HD-42320-A	Piston pin remover

 Verify that clean shop towels are properly positioned over the crankcase bore to prevent the piston pin circlip from falling into the crankcase.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- 2. See Figure 3-26. Remove the piston pin circlip.
 - Insert the PISTON PIN CIRCLIP REMOVER/ INSTALLER (1) (Part No. HD-42317-A) into the piston pin bore. Position claw on tool in slot of piston (2) (directly under circlip).
 - b. Hold a shop towel over the piston pin bore in case a circlip should fly out during removal. Squeeze the handles of the tool together and pull from bore. Remove circlip from claw and discard.

NOTE

It is not necessary to remove both piston pin circlips during piston removal. Leave the second circlip in the pin bore.

- See Figure 3-27. Remove the piston pin. If piston pin is difficult to remove, use PISTON PIN REMOVER (Part No. HD-42320-A).
 - a. Remove acorn nut and spacer from rod end of tool.
 - Slide rod end through piston pin. Install spacer and acorn nut (1) on end of rod.
 - c. Position rubber-coated tips (2) of tool on flat each side of pin bore.
 - d. Turn handle (3) in a clockwise direction until piston pin is pulled free of bore.
- 4. Remove the piston. Be sure to hold the connecting rod shank upright to prevent it from striking the crankcase. Place a 3.0 in. (76.2 mm) long piece of foam-type water pipe insulation around each connecting rod. Use material with an O.D. of 2.25 in. (57.1 mm) and an I.D. of 1.0 in. (25.4 mm) to prevent damage.
- Turn the piston over. Mark the pin boss with the letters "F(ront)" or "R(ear)" to identify location.

- 1. Piston pin circlip remover/installer
- 2. Piston
- 3. Protective material over cylinder studs
- 4. Cylinder deck dowel (O-ring not shown)



Figure 3-26. Piston Pin Circlip Removal (Part No. HD-42317-A)



Figure 3-27. Piston Pin Remover (Part No. HD-42320-A)

- Service as needed. See the following topics for inspection and repair information.
 - a. See 3.25 PISTON.
 - b. See 3.26 UPPER CONNECTING ROD.
- 7. Complete engine work.
 - a. If performing a top end overhaul only, see 3.17 TOP END OVERHAUL: ASSEMBLY.
 - b. If performing a complete engine overhaul, see 3.18 BOTTOM END OVERHAUL: DISASSEMBLY.

GENERAL

NOTE

It is assumed that each step performed on one cylinder is automatically repeated on the other.

This section provides a sequential process for engine reassembly after a complete 3.16 TOP END OVERHAUL: DISAS-SEMBLY. If you reached this section after an inspection or repair procedure, start where necessary and continue to the end of the section.

- Piston installation-see below.
- Cylinder installation-see page 3-35.
- Cylinder head installation-see page 3-38.
- Push rods, lifters and covers installation-see page 3-41.
- Rocker arm support plate installation-see page 3-42.
- Breather assembly installation-see page 3-43.

PISTON

PART NO.	SPECIALTY TOOL
HD-42317-A	Piston pin circlip remover/installer
HD-42320-A	Piston pin remover

- 1. Slide approximately 6.0 in. (152 mm) of plastic tubing, rubber hose or conduit over each cylinder stud, if removed. Use material with I.D. of 0.5 in. (12.7 mm) to protect cylinder studs and piston from damage.
- Apply clean H-D 20W50 engine oil to piston pin, piston bosses and upper connecting rod bushing.
- Remove water pipe insulation from connecting rod shank.
- See Figure 3-28. Place piston over rod end so that the arrow stamped at the top of the piston points toward the front of the engine.
- See Figure 3-29. Insert piston pin (1) through pin bore and upper connecting rod bushing. Push pin until it contacts circlip installed in opposite pin boss. Verify that end gap (3) for circlip is 180 degrees from opening (2).
- Place clean shop towels over the cylinder and lifter bores to prevent the piston pin circlip from falling into the crankcase. Verify that the circlip groove is clean and free of dirt and grime.



Figure 3-28. Piston Installation Arrow



Figure 3-29. Preinstalled Circlip

CAUTION

Do not reuse piston pin circlips. The circlips could weaken during removal causing them to break or dislodge during engine operation, a condition that will result in engine damage.

- Install new piston pin circlip with the PISTON PIN CIR-CLIP REMOVER/INSTALLER (Part No. HD-42317-A).
 - See Figure 3-30. Slide circlip down nose of tool until it contacts claw. Lightly squeeze handles of tool to capture circlip in claw.
 - Releasing pressure on handles, rotate circlip so that the end gap is centered at top of tool and then recapture in claw.
 - c. Tilt the circlip forward until the end gap contacts nose of tool.
 - d. See Figure 3-31. Insert the tool (1) into the piston pin bore until claw is aligned with slot (2) in piston.
 - e. Firmly push the tool into the piston pin bore until it bottoms. Release handles and remove tool.
 - f. Inspect the circlip to verify that it is fully seated in the groove.

CYLINDER

PART NO.	SPECIALTY TOOL
HD-42322	Piston support plate
HD-95952-1	Threaded cylinders
HD-95952-33C	Connecting rod clamping tool
HD-96333-51D	Piston ring compressor
HD-96333-103	Ring compressor band

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

- See Figure 3-31. Apply a very thin film of clean H-D 20W50 engine oil to new O-rings for both cylinder deck ring dowels (3). Install and verify that O-ring is properly seated in groove.
- See Figure 3-32. Apply a very thin film of clean H-D 20W50 engine oil to new O-ring seal for the bottom of the cylinder liner. Install new O-ring seal.

NOTE

Excessive lubrication of cylinder sleeve O-ring seal will result in oil weepage between cylinder and crankcase as engine is run. This condition may be incorrectly diagnosed as an oil leak.



Figure 3-30. Aligning Circlip

- 1. Piston pin circlip remover/installer
- 2. Slot
- 3. Cylinder deck dowel (O-ring not shown)



Figure 3-31. Pin Circlip Remover/Installer (Part No. HD-42317-A)



Figure 3-32. O-ring Seal For Cylinder

- See Figure 3-33. Verify that the piston ring end gaps are staggered. Rotate each ring to position the gap 90 to 180 degrees from the gap in the ring above it. Locate the top piston ring (5) gap towards the intake port.
- 4. Apply clean H-D 20W50 engine oil to piston, piston rings and cylinder bore.
- Remove protective covers from cylinder studs. Rotate engine until piston is at top dead center. If necessary, see ROCKER ARM SUPPORT PLATE under 3.16 TOP END OVERHAUL: DISASSEMBLY.
- 6. See Figure 3-34. Install the PISTON SUPPORT PLATE (Part No. HD-42322).
 - a. Slide both adjustable knobs (2) on support plate (1) down away from forked end. Tighten knobs when contact is made with flats at end of slots.
 - b. With the forked end of the tool pointing towards the center of the engine and the adjustable knobs facing downward, capture shank of connecting rod in fork. Lay tool on cylinder deck so that adjustable knobs contact wall of cylinder bore.
 - c. Rotate engine until piston skirt is centered and firmly seated on top of support plate.
- 7. See Figure 3-35. Install cylinder using PISTON RING COMPRESSOR (Part No. HD-96333-51D).
 - a. Fit tabs on pliers (1) into slots of ring compressor band (2). The arrow stamped on the band indicates the side that faces up, so disregard the word "bottom." Place band around piston. Press the lever on the right side of the pliers to open the jaws for band expansion.
 - b. Orient tool so that the top of the band is positioned between the top compression ring and the piston crown. Tightly squeeze handles of tool to compress piston rings. The racheting action of the tool allows release of the handles after the rings are compressed.
 - c. With the indent in the cooling fins facing the right side of the engine, gently slide cylinder over the cylinder studs and the piston crown resting it on the top of the ring compressor band.
 - d. Place the palms of both hands at the top of the cylinder. Push down on the cylinder with a sharp, quick motion to pass the piston ring area.
 - e. Rotate the engine slightly to raise piston off support plate. Remove pliers from band and then remove band from around shank of connecting rod.
- 8. Remove shop towels from around the crankcase bore exercising caution to keep out any dirt or debris.
- Carefully set the cylinder over the two ring dowels in the cylinder deck. Push down on the cylinder until it is fully seated in the crankcase bore.

NOTE

See Figure 3-36. To hold the first cylinder in position while installing the second, install THREADED CYLINDERS (Part No. HD-95952-1) from CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33C) onto cylinder studs with the knurled side down. This will prevent the piston rings from raising the cylinder as the engine is rotated to bring the other piston into position for installation of the second cylinder.







Figure 3-34. Piston Support Plate (Part No. HD-42322)



Figure 3-35. Piston Ring Compressor (Part No. 96333-51C)



Figure 3-36. Install Threaded Cylinders to Studs (Part No. HD-95952-1)



Figure 3-37. Cylinder Dowels
CYLINDER HEAD

CAUTION

To ensure proper head gasket alignment, install new Orings over cylinder ring dowels before installing the head gasket. Improper head gasket alignment will cause leaks.

- With the part number topside, place the head gasket over the two ring dowels in the upper flange of the cylinder.
- 2. Note that the word "Front" or "Rear" is cast into the top of the cylinder head to ensure proper installation. With the indent in the cooling fins facing the right side of the engine, gently slide cylinder head over the two cylinder flange ring dowels. Lower the cylinder head at an angle that closely approximates the angle of the crankcase to avoid damage to machined surfaces or the ring dowels.

CAUTION

Thoroughly clean and lubricate the threads of the cylinder head bolts before installation. Friction caused by dirt and grime will result in a false torque indication.

- Lightly coat the threads and bottom face of the cylinder head bolts in clean H-D 20W50 engine oil. Wipe off any excess oil.
- See Figure 3-38. Loosely install the cylinder head bolts onto the cylinder studs. Place two short bolts on the left side of the engine and two long bolts on the right.

CAUTION

Improperly tightened cylinder head bolts could result in gasket leaks, stud failure and distortion of the cylinder and/or cylinder head.

- 5. Tighten the four cylinder head bolts.
 - a. Following sequence shown, alternately turn each cylinder head bolt until finger tight.
 - Following the same sequence, tighten the cylinder head bolts to 120-144 in-lbs (13.5-16.2 Nm).
 - Continuing the same sequence, tighten each bolt to 15-17 ft-lbs (20.3-23.0 Nm).
 - d. See Figure 3-39. Using a grease pencil, mark a straight line on the cylinder head bolt continuing the line over onto the cylinder head.
 - e. Using the marks as a guide, turn each bolt 1/4 turn or 90 degrees. Be sure to tighten the cylinder head bolts in the sequence shown in Figure 3-38.

NOTE

For best results, use Snap-on Torque Angle Gauge TA360.



Figure 3-38. Cylinder Head Bolt Torque Sequence



Figure 3-39. Final Tightening For Cylinder Head Bolts

CAUTION

Even though all bolt holes (rocker housing, rocker arm support plate and breather assembly) could appear to be in alignment, the rocker housing gasket could be installed upside down. An upside down gasket will result in an open breather channel causing a major oil leak when the vehicle is started, possibly resulting in engine and/or property damage.

- See Figure 3-40. Install a new rocker housing gasket on the cylinder head flange. Verify that the rocker housing gasket covers the breather channel.
- See Figure 3-42. With the indent (1) facing forward, place the rocker housing into position aligning the holes in the housing with those in the gasket.
- See Figure 3-41. Apply a small dab of LOCTITE THREADLOCKER 243 (blue) to threads of six rocker housing bolts. Loosely install the rocker housing bolts. Place two long bolts on the left side of the engine and four intermediate bolts in the interior. Alternately tighten the bolts to 120-168 in-lbs (13.6-19.0 Nm) in the sequence shown.

NOTE

If the engine was left in the chassis for service, final tighten the rear left rocker housing bolt (rear cylinder) using a torque wrench with a 1/4 in. drive.

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

 See Figure 3-42. Apply a very thin film of clean H-D 20W50 engine oil to **new** baffle hole O-ring (2). Install **new** O-ring in groove around breather baffle hole in rocker housing.

NOTE

Do not confuse breather baffle hole O-ring (Part No. 11270) with the top push rod O-ring (Part No. 11293).



Figure 3-40. Install Rocker Housing Gasket (Rear Cylinder Shown)







Indent
 Breather baffle hole O-ring

Figure 3-42. Rocker Housing Alignment

PUSH RODS, LIFTERS AND COVERS

- Remove any labels used on the hydraulic lifters. Install lifters in the crankcase bores with the oil hole on the inboard side and the flats on the lifters facing forward and rearward. To avoid damage, do not drop lifters onto cam lobes.
- See Figure 3-43. Place the anti-rotational pin (4) on the machined flat between the blocks cast into the crankcase.
- 3. Install a **new** lifter cover gasket (2) aligning the holes in the gasket with those in the cover (1).

CAUTION

Movement or loss of the anti-rotational pin can result in lifter rotation causing severe engine damage.

- 4. Install the lifter cover and start the four allen head socket screws (1/4 x 1.0 in). During installation, verify that the anti-rotational pin (4) is held in place by the ribs (3) cast into the inboard side of the lifter cover. Tighten the lifter cover screws to 90-120 in-Ibs (10.2-13.6 Nm) in a crosswise pattern.
- 5. Install push rod covers.
 - Hand compress the push rod cover assembly and fit the O-ring end of the lower push rod cover into the lifter cover bore.
 - b. Expanding the assembly, fit the O-ring end of the upper push rod cover into the cylinder head bore.
 - c. Do not install the spring cap retainers at this time.

NOTE

See ROCKER ARM SUPPORT PLATE which follows to install spring cap retainers.

- Refer to Table 3-2. Install the push rods in their original positions. Be sure to remove any tags that may have been used for identification.
 - a. See Figure 3-44. For example, if reassembling the rear cylinder, slide the intake push rod (silver) through the front hole in the rocker housing engaging the lifter socket in the inside hole of the lifter cover.
 - b. Slide the exhaust push rod (black) through the rear hole in the rocker housing engaging the lifter socket in the outside hole of the lifter cover.

Table 3-2. Push Rod/Lifter Locations

CYLINDER	COVER & PUSH ROD	LIFTER BORE COVER	CYLINDER HEAD/ ROCKER HOUSING BORE
Frenk	Intake	Inside	Rear
Front	Exhaust	Outside	Front
Deer	Intake	Inside	Front
Hear	Exhaust	Outside	Rear



Figure 3-43. Installing Lifters



- 3. Rear cylinder intake push rod
- 4. Rear cylinder exhaust push rod

Figure 3-44. Lifter Bore Covers

ROCKER ARM SUPPORT PLATE

CAUTION

Installing the rocker arms and rotating the engine with the valve train loaded can result in bent push rods, damaged bushings or a warped support plate.

- To install the rocker arm support plate, **both** lifters of the cylinder being serviced must be on the base circle (or lowest position) of the cam. To rotate engine, see ROCKER ARM SUPPORT PLATE under 3.16 TOP END OVERHAUL: DISASSEMBLY.
- See Figure 3-45. Place the rocker arm support plate assembly into the rocker housing. Loosely install the four rocker arm support plate bolts with flat washers. Place two short bolts on the left side of the engine and two long bolts on the right. Loosely install the breather assembly bolts at this time.

CAUTION

If the engine was left in the chassis for service, final tighten the rocker arm support plate bolt on the rear left side of the rear cylinder using a 3/8 in. drive torque wrench with a 1/2 in. flank drive "dog bone" torque adapter (Snap-On FRDH161). Failure to properly use this combination will overtighten the bolts causing distortion of the rocker housing.

- 3. Tighten rocker arm support plate bolts.
 - Following the sequence shown, alternately tighten each of the four rocker arm support plate bolts just 1/4 turn. Continue turning the bolts in these increments until snug.
 - Following the same sequence, tighten the bolts to 18-22 ft-lbs (24.4-29.8 Nm).
- 4. Lift up lower push rod covers and verify that both push rods spin freely.

NOTE

Always service each cylinder separately. After the first cylinder is serviced the engine must be rotated to find the base circle on the second cam. Service on the remaining cylinder can then proceed.

- 5. Complete installation of the push rod covers.
 - Verify that the O-ring ends of the upper and lower push rod covers fit snugly into the cylinder head and lifter cover bores.
 - b. Lodge the upper edge of spring cap retainer into the cylinder head bore leaving the bottom edge free.
 - c. Insert blade of small screwdriver between bottom edge of spring cap retainer and top of spring cap.

NOTE

For best results, be sure that screwdriver, spring cap and spring cap retainer are free of grease and oil.



Figure 3-45. Rocker Arm Torque Sequence

- d. See Figure 3-46. While simultaneously depressing spring cap with tip of screwdriver, use forefinger to slide bottom edge of spring cap retainer down shaft towards tip of screwdriver blade. As spring cap reaches its full length of travel, spring cap retainer should be in approximate position against upper push rod cover.
- e. Verify that spring cap retainer is seated tightly against upper push rod cover.

BREATHER ASSEMBLY

NOTE

See 3.20 BREATHER ASSEMBLY for breather assembly service procedures.

- See Figure 3-45. Alternately tighten the two bolts to secure breather assembly to 90-120 in-lbs (10.2-13.6 Nm).
- See Figure 3-47. Install a **new** rocker cover gasket with indent facing forward on the rocker housing flange. Place the rocker cover into position aligning the holes in the cover with those in the gasket.

CAUTION

If the engine was left in the chassis for service, final tighten the three rocker cover bolts on the left side of the rear cylinder using a 3/8 in. drive torque wrench with a 7/ 16 in. flank drive "dog bone" torque adapter (Snap-On FRDH141). Failure to properly use this combination will overtighten the bolts causing distortion of the rocker cover.

- 3. See Figure 3-48. Install rocker cover bolts.
 - Apply a small dab of LOCTITE THREADLOCKER 243 (blue) to threads of six rocker cover bolts.
 - Loosely install three short bolts on the left side of the engine.
 - c. Loosely install three long bolts on the right.
 - Following the sequence shown, tighten bolts to 15-18 ft-lbs (20.3-24.4 Nm).
- 4. Complete motorcycle assembly.
 - If engine was left in the chassis for service, see 3.13 ASSEMBLING MOTORCYCLE AFTER SERVICE.
 - b. If engine was removed for service, see 3.15 INSTALLING ENGINE IN CHASSIS.



Figure 3-46. Install Spring Cap Retainers



Figure 3-47. Rocker Cover Gasket Indent (Front Cylinder Shown)



Figure 3-48. Rocker Cover Bolts Torque Sequence

BOTTOM END OVERHAUL: DISASSEMBLY

GENERAL

To perform a complete bottom end overhaul, follow all steps listed in this section including inspection and repair procedures.

COVER AND CAM SUPPORT PLATE

PART NO.	SPECIALTY TOOL	
HD-42313	Cam chain tensioner unloader	

1. Prepare engine for bottom end service.

- If performing a complete engine overhaul, perform all steps under 3.16 TOP END OVERHAUL: DISAS-SEMBLY.
- b. If only servicing cam compartment components, partial top end disassembly is required. See appropriate topics under 3.16 TOP END OVERHAUL: DISASSEMBLY. Remove breather assembly, rocker arm support plate, push rods and push rod covers. Do not remove lifters. Instead, support lifters using improvised tool as described under 3.27 COVER AND CAM SUPPORT PLATE.

NOTE

The cam support plate, lifter cover and crankshaft position sensor mount all use the same short allen head socket screw (1/4 x 1 in.). Only the cam cover uses the longer screw (1/4 x 1-1/4 in.). For ease of assembly, do not mix the short and long screws. Store the long screws inside the cam cover to avoid confusion. The short screws are interchangeable.

- See Figure 3-49. Remove the ten allen head socket screws with captive washers to release the cam cover. Remove and discard the cam cover gasket.
- See Figure 3-50. Using a colored marker, mark one of the links (1) of the primary cam chain. Maintaining the original direction of rotation during assembly may prolong service life.



Figure 3-49. Cam Cover Screws



- 1. Link
- 2. Rear cam sprocket bolt (large) and flat washer
- 3. Rear cam sprocket
- 4. Crank sprocket bolt (small) and flat washer
- 5. Crank sprocket
- Primary cam chain tensioner

Figure 3-50. Cam Support Plate Assembly

WARNING

Use extreme caution when operating propane torch. Read the manufacturer's instructions carefully before use. Do not direct open flame or heat towards any fuel system component. Extreme heat can cause fuel ignition and explosion. Inadequate safety precautions could result in death or serious injury.

- 4. Remove the rear cam sprocket bolt and flat washer (2) from the rear cam sprocket (3).
- 5. Remove the crank sprocket bolt and flat washer (4) from the crank sprocket (5).

CAUTION

Only use approved methods for removing rear cam bolt. Other methods of removal, such as the use of a large breaker bar, may result in damage to chain drive and other components.

CAUTION

Do not direct heat at chain tensioner assembly and other components. Directing heat at components other than the rear cam bolt will result in damage to components.

NOTE

If too much LOCTITE or perhaps the wrong LOCTITE was used to install the rear cam bolt, it may be very difficult to remove. In these cases, break down LOCTITE by using heat from a small propane torch. Apply flame evenly around bolt in a circular motion, but not for so long as to turn bolt blue.



Figure 3-51. Retract Cam Chain Tensioner

- Use CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313) to retract primary cam chain tensioner (6).
 - a. See Figure 3-51. With the handle pointing toward the front of the cam support plate, place cup of tool over spring coil. Correctly positioned, the slot (3) in the tool should be adjacent to the hole in the tensioner.
 - b. Rotate the handle of the tool in a counterclockwise direction until the hole in the tensioner is aligned with the hole in the boss of the cam support plate.
 - c. Insert a retention pin (2) through the hole in the tensioner and into the hole in the cam support plate.
- Insert small pry bar (seal remover) between inboard side of rear cam sprocket and cam support plate. Working around its circumference, carefully ease off rear cam sprocket until loose on camshaft.
- Ease off crank sprocket with a slightly smaller pry bar (seal remover). Remove the rear cam sprocket, primary cam chain and crank sprocket.
- 9. See Figure 3-52. Remove rear cam sprocket spacer (3) from the rear camshaft.
- 10. Squeeze tabs to remove chain guide (4) from between blocks cast into cam support plate (1).
- See Figure 3-53. Following the sequence shown, alternately loosen and then remove the four allen head socket screws with captive washers to release the cam support plate from the oil pump flange.

ACAUTION

Do not pull the retention pin from the primary cam chain tensioner after removal of the cam support plate. With 35-40 pounds of spring pressure behind the tensioner, allowing it to accelerate through its full length of travel will result in spring stretching and/or cracking of the tensioner shoe. Furthermore, if the tensioner should contact fingers or other parts of the hand, minor or moderate hand injury could occur.

12. See Figure 3-54. Following the sequence shown, alternately loosen and then remove the six allen head socket screws with captive washers to release the cam support plate from the crankcase flange.



Figure 3-52. Rear Cam Sprocket Spacer



Figure 3-53. Oil Pump Torque Sequence

- See Figure 3-55. Two ring dowels (2, 3) in crankcase flange locate cam support plate.
 - Insert small pry bar (seal remover) between inboard side of cam support plate and crankcase flange in area adjacent to ring dowels.
 - Alternately work each side free and then carefully ease cam support plate from end of crankshaft.
- 14. See Figure 3-56. Remove O-ring (1) from groove around oil feed hole in crankcase flange. Discard O-ring.
- 15. Remove and discard O-ring from chain guide screen (3). Leave screen in place until disassembly.
- See 3.27 COVER AND CAM SUPPORT PLATE for inspection and repair information.



Figure 3-54. Cam Support Plate Torque Sequence



Figure 3-55. Ring Dowels



- 2. Outboard O-ring on oil pump
- 3. Chain guide screen and O-ring



Figure 3-56. Oil Pump O-rings

CRANKCASE

PART NO.	SPECIALTY TOOL	
HD-42310-25	Softail engine cradle	

- 1. Carefully pull oil pump from crankshaft.
- See Figure 3-56. Remove O-ring (2) from outboard side of oil pump housing. Remove O-ring from scavenge port stub. Discard O-rings. See 3.28 OIL PUMP for inspection and repair information.

AWARNING

Do NOT rotate left crankcase half in the engine stand so the flywheel sprocket shaft is facing up. the flywheel assembly will fall out of the case, resulting in parts damage and could result in death or serious injury.

- 3. Rotate crankcase in the engine stand so that the cam cover flange is facing straight upward.
- See Figure 3-57. Remove the twelve crankcase bolts in the sequence shown.

AWARNING

Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

- Using pry points, loosen case halves. Lift right crankcase half off end of crankshaft.
- See Figure 3-58. Remove O-rings (1) from two dowel rings (2) in split line face of right case half. Discard Orings.



Figure 3-57. Crankcase Bolt Sequence



Figure 3-58. Right Crankcase Forward Dowel Ring (Rear Dowel Ring Not Shown)

- 7. See Figure 3-59. Remove and discard rubber interconnect from chain guide bracket assembly.
- See 3.29 CRANKCASE for right crankcase inspection and repair information. Continue with COUNTERBAL-ANCER ASSEMBLY removal to service flywheel or any of the left crankcase components.



Figure 3-59. Rubber Interconnect

COUNTERBALANCER ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-44062	Balance shaft retention pins
HD-44063	Hydraulic tensioner compressor
HD-44408	Hydraulic tensioner retainers

- See Figure 3-60. Rotate flywheel assembly to align holes in balance shafts (1) with holes in shaft supports (4). Insert BALANCE SHAFT RETENTION PINS (5) (Part No. HD-44062) inside front and rear shaft supports to lock balance shafts in place. Locking the balancers in this position times the engine.
- 2. See Figure 3-61. Compress both hydraulic tensioners.
 - Clamp rubber tip of HYDRAULIC TENSIONER COMPRESSOR (1) (Part No. HD-44063) over balance chain and bottom of chain guide bracket assembly.
 - b. Pump handle on tool to compress hydraulic tensioner.
 - c. Slide HYDRAULIC TENSIONER RETAINER (2) (Part No. HD-44408) over lip of tensioner (3).
 - d. Release pressure on tool (1) and remove.
 - e. Repeat procedure on remaining tensioner assembly.



Shaft support
 Retention pin





- 2. Hydraulic tensioner retainers
- 3. Hydraulic tensioner
- 4. Nut and washer

Figure 3-61. Hydraulic Tensioner Tools (Front Tensioner Shown)

WARNING

Use extreme caution when operating propane torch. Read the manufacturer's instructions carefully before use. Do not direct open flame or heat towards any fuel system component. Extreme heat can cause fuel ignition and explosion. Inadequate safety precautions could result in death or serious injury.

Loosen the self locking nuts (4) on the front and rear balance shafts.

CAUTION

Only use approved methods for removing self-locking nuts. Other methods of removal, such as the use of a large breaker bar, may result in damage to chain drive and other components.

CAUTION

Do not direct heat at chain tensioner assembly and other components. Directing heat at components other than the self-locking nuts will result in damage to components.

NOTE

If too much LOCTITE or perhaps the wrong LOCTITE was used to install the self-locking nuts, they may be very difficult to remove. In these cases, break down LOCTITE by using heat from a small propane torch. Apply flame evenly around nut in a circular motion, but not for so long as to turn nut blue.

- See Figure 3-62. Pry tab on tensioner guide clear of locking post. Use a small screwdriver to pry front chain tensioner guide (1) upward from locking post. Repeat procedure on rear chain tensioner guide (2).
- Pry lower chain tensioner guide (3) away from chain guide bracket assembly. Note the two retention tabs (4) on the lower chain tensioner guide which must be freed.
- See Figure 3-61. Remove the self locking nuts and washers (4) on the front and rear balance shafts.
- See Figure 3-62. Pry front (5) and rear (6) sprockets away from chain guide bracket assembly to release balance chain (7). Remove spacer from forward balance shaft.
- Remove three T40 TORX screws (8) from each balance shaft support to free chain guide bracket assembly.

CAUTION

See Figure 3-63. Inspect tip of each BALANCE SHAFT RETENTION PIN after removal. If the ball at the end of the tool should separate and become loose in the engine assembly, severe engine damage could occur.



Figure 3-62. Chain Tensioner Guides



Figure 3-63. Balance Shaft Retention Pin

- Remove both BALANCE SHAFT RETENTION PINS (Part No. HD-44062) from front and rear shaft supports. Check that ball on tip of tool has not separated from pin.
- See Figure 3-64. Remove front and rear balance shaft supports (2) and balance shafts (4) from left crankcase half.
- 11. Inspect and repair components as necessary.
 - See 3.30 COUNTERBALANCER ASSEMBLY for chain guide bracket assembly and outside balance shaft supports bearings (2).
 - See LEFT CRANKCASE HALF under 3.29 CRANK-CASE for balance shaft support bearings in left crankcase half.
 - c. See 3.31 FLYWHEEL/CONNECTING ROD for flywheel inspection and repair information.



5. Inside bearing

Figure 3-64. Balance Shaft Assembly (Front Balance Assembly Shown)

GENERAL

This section provides a sequential process for engine reassembly after a complete 3.18 BOTTOM END OVERHAUL: DISASSEMBLY. If you reached this section after an inspection or repair procedure, start where necessary and continue to the end of the section.

- Counterbalancer assembly-see below.
- Crankcase installation-see page 3-55.
- Cover and cam support plate installation-see page 3-59.

COUNTERBALANCER ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-42310-25	Softail engine cradle
HD-44062	Balance shaft retention pins
HD-44063	Hydraulic tensioner compressor
HD-44064	Balance shaft sprocket alignment tool
HD-44408	Hydraulic tensioner retainers

Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

1. Rotate left crankcase in the engine stand so that the balance sprocket on the flywheel is facing straight upward.

CAUTION

Do not apply crankcase sealant to edge surface of balance shaft housings. Improper preparation of housings could cause balance sprocket misalignment and result in engine damage.

- 2. Install balance shafts and housings.
 - Insert balance shafts, smooth end down, into left crankcase bearings. Either shaft may be used front or rear.
 - Select balance shaft housing assembly marked with an "F" for front. Place assembly over front balance shaft inside left crankcase.
 - c. Select balance shaft housing assembly marked with an "R" for rear. Place assembly over rear balance shaft inside left crankcase.



Figure 3-65. Balance Shaft Housing Torque Sequence



Figure 3-66. Flywheel Alignment Mark

- 3. See Figure 3-65. Install chain guide bracket assembly.
 - With hydraulic tensioners compressed, slide chain guide bracket assembly over front and rear balance shafts.
 - Apply LOCTITE THREADLOCKER 262 (red) to threads of T40 TORX screws for each balance shaft housing.
 - c. Insert three T40 TORX screws into each balance shaft housing. Tighten screws to 18-22 ft-lbs (24.4-29.8 Nm) in the sequence shown.
- See Figure 3-66. Rotate flywheel assembly to align the mark (1) on flywheel balance sprocket to be directly below (6 o'clock position) the crankpin hole (3).
- Insert BALANCE SHAFT RETENTION PINS (Part No. HD-44062) inside front and rear shaft supports to lock balance shafts in place. Locking the balancers in this position times the engine.

- 6. Place spacer over front balance shaft.
- Install front sprocket (labeled "F") and rear sprocket (labeled "R") over balance shafts. Labels must face away from chain guide bracket.
- 8. Loosely install a nut and washer on each balance shaft.
- See Figure 3-67. Check flywheel sprocket to balance shaft alignment using BALANCE SHAFT SPROCKET ALIGNMENT TOOL (Part No. HD-44064).
 - Slide tool over crankshaft and shoulder on timing chain gear. Tighten screw onto crankshaft until it bottoms on shoulder screw.
 - b. Swing tool to each sprocket face.
 - c. Alignment must be within 0.014 in. (0.356 mm) as indicated by the steps on the bottom of the tool. The tool's outside step must clear the top surface of the sprocket while the inside step must not pass over the sprocket edge. To adjust alignment, replace spacer behind front sprocket using a **new** spacer listed in Table 3-3.
 - Remove nuts, washers and front and rear sprockets from balance shafts.
- 10. See Figure 3-68. Install balance chain.
 - Apply a very thin film of clean H-D 20W50 engine oil to balance chain.
 - b. Inspect balance chain for timing marks. Insert front sprocket (labeled "F") and rear sprocket (labeled "R") inside chain. Colored links on chain should be next to marks on sprockets.
 - c. Slide chain/sprocket assembly over balance shafts. Start with rear sprocket, then align middle sprocket to mark on balance chain with flywheel balance sprocket mark and then install front sprocket.
 - Verify that marks on sprockets and chain face away from chain guide bracket assembly.
 - e. Check that the middle chain mark is directly below alignment mark on flywheel balance sprocket.
- Install new nut and washer over each balance shaft. If new nuts are not available, apply LOCTITE THREAD-LOCKER 271 (red) to existing nuts. Tighten both nuts to 78-82 ft-lbs (105.7-111.2 Nm).
- Verify correct position of all three timing marks on chain and timing mark on flywheel balance sprocket.

- See Figure 3-69. Install chain tensioner guides. A small screwdriver may be used to aid installation.
 - a. Obtain chain tensioner guide (1) labeled "F" for front. With label facing away from chain guide bracket, install guide on post by pushing down until guide snaps into place.
 - b. Obtain chain tensioner guide (2) labeled "R" for rear. With label facing away from chain guide bracket, install guide on post by pushing down until guide snaps into place.
 - c. Install lower chain tensioner guide (3) by snapping both retention tabs (4) into place on chain guide bracket assembly.
- 14. See Figure 3-70. Release both hydraulic tensioners.
 - Clamp rubber tip of HYDRAULIC TENSIONER COMPRESSOR (1) (Part No. HD-44063) over balance chain and bottom of chain guide bracket assembly.
 - b. Pump handle on tool to compress hydraulic tensioner.
 - c. Remove HYDRAULIC TENSIONER RETAINER (2) (Part No. HD-44408) from lip of tensioner.
 - d. Slowly release pressure on tool and remove.
 - e. Repeat procedure on remaining tensioner assembly.

CAUTION

See Figure 3-71. Inspect tip of each BALANCE SHAFT RETENTION PIN after removal. If the ball at the end of the tool should separate and become loose in the engine assembly, severe engine damage could occur.

 Remove both BALANCE SHAFT RETENTION PINS (Part No. HD-44062) from front and rear shaft supports. Check that ball on tip of tool has not separated from pin.

Table 3-3. Balance Sprocket Spacers

PART NO.	IN.	MM.
14780-00	0.130	3.302
14781-00	0.140	3.556
14782-00	0.150	3.810
14783-00	0.160	4.064
14784-00	0.170	4.318
14785-00	0.180	4.572
14786-00	0.190	4.826
14787-00	0.200	5.080
14788-00	0.210	5.334



Figure 3-67. Sprocket Alignment



Figure 3-68. Balance Chain



- 4. Retention tabs
- 5. Rubber interconnect

Figure 3-69. Chain Tensioner Guides

CRANKCASE

PART NO.	SPECIALTY TOOL
HD-35667-A	Cylinder leakdown tester
HD-39361-A	Sprocket shaft oil seal installer
HD-42326-A	Crankshaft guide
HD-97225-55B	Sprocket shaft bearing tool

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

- 1. Bolt left crankcase half upright in engine stand.
- To facilitate assembly and prevent damage to the crankshaft (roller) bearing in the left crankcase half, slide CRANKSHAFT GUIDE tool (Part No. HD-42326-A) onto flywheel sprocket shaft.
- Slide flywheel assembly into left crankcase half. Remove CRANKSHAFT GUIDE tool.
- Tip crankcase assembly in engine stand so that flywheel pinion shaft is pointing straight up.
- Install new O-rings over two ring dowels in split line face of right case half. Apply a very thin film of clean H-D 20W50 engine oil to O-rings before installation.



Figure 3-70. Hydraulic Tensioner Tools (Front Tensioner Shown)



Figure 3-71. Balance Shaft Retention Pin

- See Figure 3-69. Install new rubber interconnect (5) on chain guide bracket assembly.
- See Figure 3-68. Verify correct position of all three timing marks on chain and timing mark on flywheel balance sprocket.
- With the right crankcase half resting on the cam cover flange, apply a bead of sealant (approximately 0.056 in./ 1.42 mm wide) to the split line face. For best results, use HIGH-PERFORMANCE SEALANT, GRAY (Part No. 99650-02).
- See Figure 3-72. To facilitate assembly and prevent damage to the crankshaft (roller) bearing in the right crankcase half, place CRANKSHAFT GUIDE (2) (Part No. HD-42326-A) over end of crankshaft until it contacts shoulder on shaft.
- Mate case halves sliding bearing roller in right crankcase half over end of crankshaft. Remove tool.
- 11. See Figure 3-73. Start the twelve crankcase bolts and tighten in the following sequence.
 - Alternately turn each crankcase bolt until finger tight.
 - Tighten the crankcase bolts to 10 ft-lbs (13.6 Nm) in the order shown.
 - c. Following the same sequence, tighten each bolt to 15-19 ft-lbs (20.3-25.8 Nm).
- 12. Tip crankcase assembly so that sprocket shaft is pointing straight up.
- Install thrust washer on sprocket shaft with "THIS SIDE OUT" facing out (and the chamfer inboard). If using OE part without markings, orient as required to preserve existing wear pattern.



- 1. Water pipe insulation
- 2. Crankshaft guide





Figure 3-73. Tighten In Sequence Shown

- See Figure 3-74. Install new oil seal using pilot, Nice bearing, large flat washer and handle from SPROCKET SHAFT BEARING TOOL (Part No. HD-97225-55B).
 - Verify that seal lip garter spring is in place on both sides of seal.
 - b. Thread pilot onto sprocket shaft until contact is made with shoulder.
 - With the lettering facing outside, slide oil seal over pilot until it contacts bearing bore.
 - d. Set SPROCKET SHAFT OIL SEAL INSTALLER (1) (Part No. HD-39361-A) over pilot until it contacts oil seal.
 - e. Slide Nice bearing and large flat washer over pilot until contact is made with seal installer.
 - f. Thread handle onto pilot shaft.
 - g. Rotate handle in a clockwise direction until oil seal installer makes firm contact with crankcase stator mount.
 - h. Remove handle, flat washer, Nice bearing, seal installer and pilot from sprocket shaft.
- Slide sprocket shaft spacer over end of sprocket shaft. Push spacer into oil seal until seated against outer bearing cone.

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- See Figure 3-75. Remove screen and O-ring from chain guide oil passage (2). Perform leakdown test to verify proper assembly.
 - a. Obtain CYLINDER LEAKDOWN TESTER (Part No. HD-35667-A) and a leakdown tester nipple which will fit inside the chain guide oil passage.
 - b. Allow compressed air to run to discharge any water.
 - c. Regulate air pressure to 35 PSI (241 kN/m²). Feed shop air into leakdown tester and test for calibration. Place your gloved thumb on and off the adapter outlet and watch the pressure change.

NOTES

- Individuals not using MAC leakdown testers supplied by KENT-MOORE TOOLS must also calibrate line pressure to 35 PSI (241 kN/m²) using a remote pressure regulator if necessary.
- All SNAP-ON meters will use a baseline of a 50% change when outlet is plugged.
 - Apply a light coat of clean H-D 20W50 engine oil to nipple. Insert nipple into chain guide oil passage (2).
 - e. Record the change in flow rate. A typical system will read a 1-8 PSI (7-55 kN/m²) drop on a MAC meter or a 6-16% drop (SNAP-ON meter reads 56-66) from 35 PSI (241 kN/m²).



Figure 3-74. Sprocket Shaft Oil Seal Installer (Part No. HD-39361-A)



2. Chain guide oil passage

Figure 3-75. Leakdown Test

- f. If a leak rate higher than 11 PSI (75 kN/m²) on a MAC meter or greater than a 20% drop (SNAP-ON meter reads 70 or greater) is detected, disassemble the engine and inspect the rubber interconnect. Replace if missing or damaged. If the interconnect is fine, replace the chain guide bracket.
- g. Reinstall chain guide screen and O-ring.

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

- 17. See Figure 3-76. Assemble and install oil pump. Lubricate parts with clean H-D 20W50 engine oil during assembly.
 - Apply a very thin film of clean H-D 20W50 engine oil to **new** scavenge port stub O-ring (7). Install **new** Oring on scavenge port stub of oil pump housing.
 - b. Slide oil pump housing (6) onto crankshaft fitting Oring on scavenge port stub into crankcase bore at back of cam compartment. Firmly push on scavenge port stub with thumb to be sure that it is snug in bore. Inspect O-ring on stub to verify that it is not pinched or distorted.
 - c. Separate the gerotor gears into two sets, one wide(4) (scavenge) and the other narrow (1) (feed).
 - d. Fit the smaller of the wide gerotor gears into the larger. Slide the wide gerotor set (4) down the crankshaft until it bottoms in the oil pump housing.
 - e. Slide inside separator plate (2) down the crankshaft until it contacts the wide gerotor set (4). Install wave washer (3) and outside separator plate (2).
 - f. Fit the smaller of the narrow gerotor gears into the larger. Slide the narrow gerotor set (1) down the crankshaft until it contacts the outside separator plate (2).

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

g. See Figure 3-77. Apply a very thin film of clean H-D 20W50 engine oil to **new** O-ring (3) for outboard side of oil pump housing. Install **new** O-ring in groove on oil pump housing.



outringe port o ring



- 1. Oil feed hole O-ring
- 2. Rear ring dowel
- 3. O-ring on oil pump housing
- 4. Chain guide screen and O-ring



Figure 3-77. Oil Feed Hole

COVER AND CAM SUPPORT PLATE

PART NO.	SPECIALTY TOOL
HD-42313	Cam chain tensioner unloader
HD-42314	Crankshaft/camshaft sprocket locking tool
HD-33443	Alignment tool

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

- See Figure 3-77. Apply a very thin film of clean H-D 20W50 engine oil to **new** O-ring (1) for crankcase flange. Install **new** O-ring in groove around oil feed hole directly below rear ring dowel (2).
- Remove, clean and reinstall chain guide screen (4). Apply a very thin film of clean H-D 20W50 engine oil to new O-ring for screen. Install new O-ring in groove on crankcase post.
- Eliminate secondary cam chain tension. For best results, place cam support plate in a vise using brass jaw inserts to prevent casting damage.
 - a. Place cup of CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313) over spring coil of secondary cam chain tensioner. Position finger on tool between tensioner and shoe.
 - b. Rotate tool in a counterclockwise direction. Insert retention pin through hole in boss on primary cam chain side of cam support plate. Pin engages hooks on tensioner to hold it in the retracted position.
- Lubricate cam needle bearings with clean H-D 20W50 engine oil.
- See Figure 3-78. Using a straightedge, verify that the pin stamped timing lines on the ends of the front and rear camshafts are in alignment. If necessary, rotate camshafts in order to make this observation.
- Aligning bushing in cam support plate with end of crankshaft, slide cam support plate over crankshaft onto two ring dowels in crankcase flange. Use a rubber mallet to fully seat cam support plate on ring dowels.
- 7. See Figure 3-79. Install cam support plate screws.
 - a. Loosely install the six screws (1/4 x 1.0 in.) to secure the cam support plate to the crankcase flange.
 - b. Tighten screws to 90-120 in-lbs (10.2-13.6 Nm) in the sequence shown.



Figure 3-78. Checking Camshaft Alignment



Figure 3-79. Cam Support Plate Torque Sequence: Alternately tighten all six cam support plate screws in the sequence shown.

- 8. See Figure 3-80. Install oil pump.
 - a. See Figure 3-81. Loosely insert alignment tools into holes 1 and 2.
 - b. Start two screws (1/4 x 1.0 in.) into holes 3 and 4.
 - While rotating engine, enabling the pump to find its natural center, tighten the tools and screws until snug.
 - d. Tighten alignment tools to 40-45 **in-lbs** (4.5-5.1 Nm) in sequence shown.
 - e. Alternately tighten screws in holes #3 and #4 to 40-45 in-lbs (4.5-5.1 Nm).
 - f. Remove alignment tool in hole #1 and replace with screw (1/4 x 1.0 in.). Tighten screw to 40-45 in-lbs (4.5-5.1 Nm). Repeat this step for alignment tool in hole #2.
 - g. Final tighten all screws to 90-120 in-lbs (10.2-13.6 Nm) in the sequence shown. Numbers cast adjacent to the bolt holes also indicate the oil pump torque sequence.

For methods of engine rotation, see ROCKER ARM SUP-PORT PLATE under 3.16 TOP END OVERHAUL: DISAS-SEMBLY.

- 9. Pull retention pin from hole in cam support plate to release secondary cam chain tensioner.
- 10. Squeeze tabs and install chain guide between blocks cast into cam support plate.
- 11. With the lettering facing inboard, install rear cam sprocket spacer onto the rear camshaft.
- 12. If using the original cam support plate, camshafts, primary cam sprocket, crank sprocket and flywheel assembly, then move to next step. However, if any of these parts have been replaced, then proceed as follows:
 - Install primary cam sprocket onto splines of rear camshaft. Install long flange bolt with thicker flat washer to secure sprocket to end of camshaft.
 - Install crank sprocket onto crankshaft. Install short flange bolt with smaller diameter flat washer (that is, washer from bulk inventory) to secure sprocket to end of crankshaft.

NOTE

Use of smaller diameter flat washer with crank sprocket flange bolt allows room on sprocket face for placement of straightedge under step 12(e).

c. See Figure 3-82. To prevent rotation, position the CRANKSHAFT/CAMSHAFT SPROCKET LOCKING TOOL (Part No. HD-42314) between the crank and primary cam sprockets. The handle of the tool is stamped "Crank" and "Cam" to ensure proper orientation. Tighten the crank and primary cam sprocket flange bolts to 15 ft-lbs (20.3 Nm). Remove the sprocket locking tool.



Figure 3-80. Oil Pump Torque Sequence: Alternately tighten all four oil pump screws in the sequence shown.



Figure 3-81. Alignment Tool HD-33443



Figure 3-82. Locking Crank and Rear Cam Sprockets

Crankshaft and rear camshaft endplay can be removed by performing one of the following steps.

- Rotate engine stand so cam compartment is pointing upward. Push on crankshaft and rear camshaft to eliminate endplay.
- Install compensating sprocket assembly to pull the crankshaft to the left side of the engine. Push on crankshaft and rear camshaft to eliminate endplay.
 - d. Remove crankshaft and rear camshaft end play.
 - e. Place a straightedge across the crank and primary cam sprocket faces. Try to insert a 0.010 inch feeler gauge between the straightedge and each sprocket face. See Figure 3-83. If the feeler gauge does not fit at either location, then proceed to step 12(f).

Refer to Table 3-4. On the other hand, if the crank sprocket rises above the face of the primary cam sprocket more than 0.010 inch, remove the flange bolt and primary cam sprocket, and noting the part number stamped on the existing spacer, replace it with the next larger size

Replace the spacer with the next smaller size only if the primary cam sprocket rises above the face of the crank sprocket more than 0.010 inch. Return to step 11 to repeat the check with the new spacer installed.

 Remove both crank and primary cam sprockets. Discard smaller diameter flat washer obtained from bulk inventory.

NOTE

Height differences between rear cam sprocket and crank sprocket can be addressed by changing the spacer behind the rear cam sprocket. See spacer sizes in Table 3-4.

- If the crank sprocket rises above the face of the rear cam sprocket more than 0.010 in. (0.254 mm), remove the flange bolt and rear cam sprocket. Note the part number stamped on the existing spacer behind rear cam sprocket. Replace spacer with the next larger size.
- If the rear cam sprocket rises above the face of the crank sprocket more than 0.010 in. (0.254 mm), replace the spacer with the next smaller size only.
- Repeat height inspection with the new spacer installed.



Figure 3-83. Check Alignment of Crank and Rear Cam Sprocket Faces



6. Primary cam chain tensioner

Figure 3-84. Cam Support Plate Assembly

Table 3-4. Rear Cam Sprocket Spacers

PART NO.	IN.	MM
25722-00	0.287	7.29
25723-00	0.297	7.54
25721-00	0.307	7.80
25719-00	0.317	8.05
25717-00	0.327	8.31
25725-00	0.337	8.56

- See Figure 3-84. Apply a light amount of clean H-D 20W50 oil to splines on rear cam. Install the primary cam chain and sprocket assembly.
 - Place the rear cam sprocket (3) in the cam chain.
 Hold the sprocket allowing the chain to hang loose.
 Rotate the sprocket so that the punch mark on the sprocket root faces straight downward.

To maintain the original direction of rotation, verify that the colored mark placed on the chain link and crank sprocket is facing opposite the cam support plate during installation.

- Place the crank sprocket (5) in the opposite end of the chain with the punch mark on the sprocket tooth facing straight upward.
- c. Maintaining the position of the sprockets on the chain with the punch marks in alignment, start the rear cam sprocket onto the end of the rear camshaft. Note that the sprocket has an integral key that must be aligned with the keyway in the camshaft.
- d. Maintaining the position of the crank sprocket on the chain, rotate the rear cam sprocket in a clockwise direction until the flat on the crank sprocket is aligned with the flat on the crankshaft. Install the crank sprocket.
- 14. See Figure 3-85. Rotate the rear cam sprocket in a clockwise direction until the punch mark on the root is aligned with the punch mark on the crank sprocket tooth. Lay a straightedge across the centerline of the crank and rear cam sprocket flange bolt holes to verify that the punch marks are in alignment.

NOTES

- If the punch marks are not in alignment, then the sprockets must be removed and reinstalled. Misaligned sprockets will make the engine run erratically.
- Rear sprocket bolt and crank sprocket bolt must install freely by hand. Before installing bolts, remove any buildup of LOCTITE THREADLOCKER from the bolt holes with the proper sized thread chaser.
- See Figure 3-86. Apply oil to bottom of **new** crank flange bolt head and washer (3). Loosely install bolt (small) with flat washer to secure crank sprocket (4) to end of crankshaft.



Figure 3-85. Verify Alignment of Crank and Rear Cam Sprocket Punch Marks



- 1. Rear sprocket bolt (large) and flat washer
- 2. Rear cam sprocket
- 3. Crank sprocket bolt (small) and flat washer
- 4. Crank sprocket

Figure 3-86. Sprocket Bolts

 Apply oil to bottom of **new** rear sprocket bolt head and washer (1). Loosely install bolt (large) with flat washer to secure rear cam sprocket (2) to end of camshaft.

NOTE

Both crank and rear cam sprocket flange bolts are specially hardened while the flat washers are of a special diameter. Therefore, use only genuine Harley-Davidson parts when replacement is necessary. If **new** flange bolts are not available, thoroughly clean threads and apply a **small** amount of LOCTITE THREADLOCKER 262 (red) before installation. The crank and rear cam sprocket flange bolts and flat washers are **not** interchangeable.

- Position the CRANKSHAFT/CAMSHAFT SPROCKET LOCKING TOOL (Part No. HD-42314) between the crank and rear cam sprockets to prevent rotation. The handle of the tool is stamped "Crank" and "Cam" to ensure proper orientation.
 - a. Tighten both bolts (1, 3) to 15 ft-lbs (20.3 Nm).
 - b. Loosen both bolts one revolution (360 degrees).
 - c. Final tighten the rear cam sprocket bolt (1) to 34 ftlbs (46.1 Nm).
 - Final tighten the crank sprocket bolt (3) to 24 ft-lbs (32.5 Nm).
 - e. Remove the sprocket locking tool.

ACAUTION

Ease the primary cam chain tensioner into the unloaded position using the proper tool. Do not pull the retention pin to unload the tensioner or damage to the pin could occur. Furthermore, if the tensioner should contact fingers or other parts of the hand, minor or moderate hand injury could occur.

- Hold the retracted primary cam chain tensioner with the CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313), pull retention pin from hole in cam support plate and ease the assembly into the unloaded position.
- Apply clean H-D 20W50 engine oil to crank and rear cam sprockets.
- 20. See Figure 3-87. Align holes in **new** cam cover gasket with those in the crankcase flange.



Figure 3-87. Cam Cover Gasket

CAUTION

Before installing cam cover, verify cleanliness of blind holes in the crankcase flange. Tightening a screw with dirt, water or oil in the hole can cause the casting to crack or break. Damage to the casting requires replacement of the right crankcase half.

- See Figure 3-88. Install the cam cover using ten allen head socket screws (1/4 x 1-1/4 in.). Following the sequence shown, alternately tighten screws to 125-155 in-lbs (14.1-17.5 Nm).
- 22. Complete motorcycle assembly.
 - a. If engine was completely overhauled, see 3.17 TOP END OVERHAUL: ASSEMBLY. Perform all steps.
 - b. If only cam compartment components were serviced, install push rod covers, push rods, rocker arm support plate and breather assembly. See appropriate topics under 3.17 TOP END OVERHAUL: ASSEMBLY.



Figure 3-88. Cam Cover Installation: Alternately tighten cover screws to 125-155 in-lbs (14.1-17.5 Nm) in the sequence shown.

REMOVAL OVERVIEW

See beginning of 3.16 TOP END OVERHAUL: DISASSEM-BLY to remove breather assembly.

DISASSEMBLY

- See Figure 3-89. Remove two fasteners (1) from the breather assembly cover (2) and remove breather assembly from rocker arm support plate (8).
- Remove the breather cover and cover gasket (3). Discard gasket. Remove breather baffle (5) and breather baffle gasket (7). Discard gasket. Pull filter element (6) from bore on underside of breather baffle. Pull umbrella valve (4) from hole at top of breather baffle. Discard both filter element and umbrella valve.

CLEANING AND INSPECTION

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- Clean all parts in a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air.
- See Figure 3-89. Set a straightedge diagonally across the length of the breather cover (2) intersecting the opposite corners of the gasket surface. Slide a feeler gauge beneath the straightedge to check the breather cover for warpage. Repeat the step checking the opposite diagonal. Discard the breather cover if any low spot exceeds 0.005 inch (0.13 mm).
- Using method outlined in previous step, inspect the breather baffle (5) gasket surface for flatness. Discard the breather baffle if any low spot exceeds 0.005 inch (0.13 mm).

ASSEMBLY

- See Figure 3-89. Insert stem of new umbrella valve (4) through center hole at top of breather baffle (5). Carefully pull rubber bead on stem through hole in baffle. Use denatured alcohol or glass cleaner to lubricate stem, if necessary. Verify that rubber bead is pulled completely through hole and resides on bottom side of baffle.
- Press new filter element (6) into bore at bottom of baffle. Hole in filter element accommodates umbrella valve stem.



- 3. Place breather baffle gasket (7) on a clean flat surface.
 - Aligning holes, place breather baffle (5), cover gasket (3) and breather cover (2) on top of breather baffle gasket.
 - Slide two fasteners (1) through stackup to keep assembly together until time of installation.

INSTALLATION OVERVIEW

See BREATHER ASSEMBLY under 3.17 TOP END OVER-HAUL: ASSEMBLY.

- 1. Install breather assembly.
- 2. Continue with vehicle assembly as directed.

ROCKER ARM SUPPORT PLATE

3.21

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- 2. Remove rocker arm support plate.

DISASSEMBLY

- 1. See Figure 3-90. Remove four bolts with flat washers (1) from the rocker arm support plate (5). The rocker arm shafts (4) on the push rod side (right) are notched to lock them in position.
- Using a hammer and brass drift, tap left side of rocker arm shafts (4) so that the notched ends exit the rocker arm support plate (5) first. Mark the shafts so that they are installed in their original locations at time of assembly.
- Remove the rocker arms from the rocker arm support plate. Mark the rocker arms to indicate location.

CLEANING AND INSPECTION

PART NO.	SPECIALTY TOOL	
HD-94804-57	Rocker arm bushing reamer	

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 1. Clean all parts in a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air.
- See Figure 3-90. Check rocker arms (3) for uneven wear or pitting where contact is made with the valve stem tips. Check for concave wear where rocker arms contact the push rod ends. Replace rocker arm if excessive wear is found at either location.
- 3. Verify that oil holes in rocker arms and rocker arm support plate (5) are clean and open.
- 4. Inspect rocker arm shafts (4) for scratches, burrs, scoring or excessive wear. Replace as necessary.



5. Rocker arm support plate

Figure 3-90. Rocker Arm Assembly

- 5. Check support plate to rocker shaft fit.
 - a. See Figure 3-91. Measure the inside diameter of the rocker arm support plate bore.
 - b. See Figure 3-92. Measure the outside diameter of the rocker arm shaft where it fits in the bore.
 - Repeat the measurement on opposite side of support plate and shaft. Replace shaft or support plate if any measurement equals or exceeds 0.0035 in. (0.089 mm).
- 6. Check rocker arm shaft to bushing fit.
 - a. See Figure 3-93. Measure the inside diameter of the rocker arm bushing.
 - See Figure 3-94. Measure the outside diameter of the rocker arm shaft where it rides in the bushing.
 - Repeat measurement on opposite side of rocker arm and shaft. Replace shaft or bushings if any measurement equals or exceeds service wear limit of 0.0035 in. (0.089 mm).



Figure 3-91. Checking Support Plate Bore



Figure 3-92. Checking Shaft to Support Plate Fit



Figure 3-93. Checking Bushings

- 7. To replace rocker arm bushings, proceed as follows:
 - a. See Figure 3-95. Obtain a 9/16"-18 (14.29 mm) tap. Turn tap into bushing until tight. Place rocker arm under ram of arbor press with tap at bottom. Slide a discarded rocker arm shaft through open end of rocker arm until contact is made with tap. Using shaft as driver (and untapped bushing as pilot), press against shaft until both tap and bushing are free. Repeat step to remove second bushing.
 - b. See Figure 3-96. Using a suitable driver, press new bushing into side of rocker arm until flush with casting. Be sure to orient bushing so that split line faces top of rocker arm. Repeat step to install second bushing.
 - c. See Figure 3-97. Lock rocker arm in a vise using brass jaw inserts or shop towels to prevent casting damage. Insert tapered end of ROCKER ARM BUSHING REAMER (Part No. HD-94804-57) into rocker arm using the far side bushing as a pilot. Rotate reamer until the closest bushing is reamed, and then continuing in the same direction, ream the far side bushing.

If short reamer is used, rotate tool while backing reamer out of first bushing. Inserting tool in opposite end of rocker arm, ream second bushing using reamed bushing as pilot.

CAUTION

Never back reamer out of rocker arm or new bushing will be damaged.

- d. See Figure 3-97. Lock rocker arm in a vise using brass jaw inserts or shop towels to prevent casting damage. Insert tapered end of ROCKER ARM BUSHING REAMER (Part No. HD-94804-57) into old bushing in rocker arm. Note that old bushing on drive side of reamer as pilot. Rotate reamer until the new bushing on the far side is reamed, and then continuing in the same direction, draw drive side of reamer from new bushing.
- e. Repeat steps 7a thru 7c to remove, install and ream second bushing.



Figure 3-94. Checking Shaft to Bushing Fit



Figure 3-95. Removing Bushings

ASSEMBLY

- 1. Place the rocker arms into position on the rocker arm support plate.
- Push the un-notched ends of the rocker arm shafts into the right side of the support plate and then into the rocker arms. As they approach their fully installed positions, rotate the shafts so that the notches are aligned with the bolt holes in the support plate.
- 3. See Figure 3-98. Check for proper end play.
 - Insert a feeler gauge between the rocker arm and support plate.
 - b. Repeat measurement on other rocker arm.
 - c. Replace the rocker arm, rocker arm support plate or both if end play exceeds 0.025 in. (0.635 mm).
- Install the four bolts with flat washers in the rocker arm support plate. Remember that the two bolts on the push rod side (right) must engage the notches in the rocker arm shafts for proper assembly.

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Install rocker arm support plate.
- 2. Install breather assembly.
- 3. Continue with vehicle assembly as directed.



Figure 3-96. Install Bushings



Figure 3-97. Ream Bushings



Figure 3-98. Check End Play

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- Remove rocker arm support plate.
- 3 Remove push rods, lifters and covers.

DISASSEMBLY

See Figure 3-99. With the exception of the lifter covers, all parts should have been disassembled and marked during the removal procedure. Disassemble the lifter covers as follows:

- 1. Separate upper (2) and lower push rod covers (8).
- 2. Remove O-ring (9) from seat at bottom of lower push rod cover. Discard O-ring.
- 3. Remove O-ring (1) from seat at top of upper push rod cover. Slide O-ring (7), flat washer (6), spring (5) and spring cap (4) from body of upper push rod cover (2). Discard O-rings.

CLEANING AND INSPECTION

- 1. See Figure 3-99. Scrape old gasket material from the lifter cover (11) flange. Old gasket material left on mating surfaces will cause leaks.
- 2. With the exception of the hydraulic lifters (14), clean all parts in a non-volatile cleaning solution or solvent. Verify that the O-ring seats and contact surfaces of the push rod covers (2, 8) are completely clean.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

3. Blow parts dry with low pressure compressed air. Verify that all oil holes are clean and open.



- 2. Spring cap retainer
- 3.
- 4. Spring cap
- Spring 5.
- Flat washer 6.
- 7. Middle O-ring (intermediate)
- 8. Lower push rod cover
- 9. Lower O-ring (large)
- 10. Lifter cover screw
- 11. Lifter cover
- 12. Anti-rotational pin
- 13. Lifter cover gasket
- 14. Hydraulic lifter
- 15. Push rod

Figure 3-99. Push Rods, Lifters and Covers

- Verify that the hydraulic lifter rollers turn freely and are free of flat spots, scuff marks and pitting. If flat spots exist, examine the cam lobe on which the lifter operates.
- Inspect the lifter socket for signs of wear. Verify that the plunger of the hydraulic lifter is fully extended up against the C-clip. Use index finger to pump plunger to verify lifter operation.
- Examine the push rods (15). Replace any push rods that are bent, dented, broken or discolored. Replace the rod if the ball ends show signs of excessive wear or damage.
- 7. Cover all parts with a clean plastic sheet to protect them from dust and dirt.

LIFTER INSPECTION

NOTE

Inside and outside micrometers used for measuring lifters and lifter bores must be calibrated to ensure accurate readings.

- Inspect lifters for excessive clearance in bores. Accurately measure tappet bore inner diameter with a gauge.
 - Clearance should be within 0.0008-0.0020 in. (0.0203-0.0508 mm).
 - Fit a **new** lifters and/or replace crankcases if clearance exceeds SERVICE WEAR LIMIT of 0.0030 in. (0.076 mm).
- 2. Check lifter radial play.
 - Roller clearance on pin should be within 0.0006-0.0010 in. (0.0152-0.0254 mm).
 - Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.0015 in. (0.0381 mm).
- 3. Check lifter roller end clearance.
 - End clearance should be within 0.008-0.022 in. (0.203-0.559 mm).
 - Replace lifters showing any sign of up or down movement on roller.
 - Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.026 in. (0.660 mm).
- Soak lifters in clean engine oil. Keep covered until assembly.



Figure 3-100. Assembled Push Rod Cover

ASSEMBLY

With the exception of the lifter covers, all parts will be assembled during the installation procedure. Assemble the lifter covers as follows:

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

- See Figure 3-100. Obtain three new o-rings (1, 7 and 9). Apply a very thin film of clean H-D 20W50 engine oil to O-rings before installation.
- Install new small O-ring (1) on seat at the top of the upper push rod cover (2).
- Slide the spring cap (4), spring (5), flat washer (6) and new intermediate size O-ring (7) onto the body of the upper push rod cover. Move parts up body until spring cap (4) contacts upper O-ring seat.
- 4. Fit the straight end of the upper push rod cover into the flared end of the lower push rod cover (8).
- 5. Install **new** large O-ring (9) on seat at bottom of lower push rod cover.

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Install push rods, lifters and lifter covers.
- 2. Install rocker arm support plate.
- 3. Install breather assembly.
- 4. Continue with vehicle assembly as directed.

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- 2. Remove rocker arm support plate.
- Remove push rods and push rod covers. Do not remove lifters or lifter covers.
- 4. Remove cylinder head.

DISASSEMBLY

PART NO.	SPECIALTY TOOL
HD-34736-B	Valve spring compressor
HD-39786-A	Cylinder head holding fixture

- 1. Before proceeding with the disassembly procedure, determine if cylinder head reconditioning is necessary.
 - a. Raise valve ports of cylinder head to strong light source. If light is visible around edges of seats, then move to step 2 to recondition cylinder head.
 - b. Fill ports at top of cylinder head with solvent. Wait ten full seconds and then check for leakage into combustion chamber. If solvent leakage into combustion chamber is evident, then move to step 2 to recondition cylinder head.
- 2. See Figure 3-101. Secure cylinder head for service.
 - a. Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (1) (Part No. HD-39786-A) into cylinder head (2) spark plug hole.
 - Clamp tool in vise at a 45 degree angle or one that offers a comfortable working position.



Figure 3-101. Cylinder Head Holding Fixture (Part No. HD-39786-A)
- 3. See Figure 3-102. Release valve spring compression.
 - a. Place VALVE SPRING COMPRESSOR (2) (Part No. HD-34736-B) over cylinder head. Center blunt end on the valve head. Seat adapter at end of forcing screw on the valve spring retainer.
 - b. Rotate forcing screw to compress valve springs.
 - c. See Figure 3-103. If spring retainer (2) has not broken free of tapered keepers (1), give head of tool a sharp tap with a soft mallet. Using magnetic rod or small screwdriver, remove the keepers (1) from the valve stem (11) groove.
 - d. Rotate forcing screw to release the valve spring compression.
- 4. Remove the spring retainer (2) and valve spring (3).
- 5. Slide the valve (11) from the valve guide (5).
- Using pliers, twist and remove the spring seat/valve stem seal (4) from the top of the valve guide. Discard spring seat/valve stem seal.
- Mark the bottom of the valve "F(ront)" or "R(ear)" for identification. Also, separate and tag tapered keepers, valve spring and spring retainer so that they are installed on the same valve at time of assembly.
- 8. Repeat steps 3-7 to remove the other valve components.
- 9. Release the cylinder head holding fixture from the vise. Remove fixture tool from spark plug hole.



Figure 3-102. Valve Spring Compressor (Part No. HD-34736-B)



Figure 3-103. Cylinder Head Assembly

CLEANING

 See Figure 3-103. Remove old gasket material from cylinder head (9). Gasket material left on sealing surfaces will cause leaks.

CAUTION

- Do not use glass or sand to bead blast surfaces exposed to the engine oil. Bead blasting materials become lodged in the pores of the casting where they cannot be removed through ordinary cleaning methods. Only after the engine is put into use will heat expansion cause this material to be released, and the resulting oil contamination will accelerate wear and lead to engine failure. If bead blasting must be employed, use walnut shells or other soft nondamaging abrasive that can be digested in the engine oil.
- Be aware that bead blasting materials could also enter threaded holes adversely affecting fastener engagement and torque indication. Carefully cover all threaded holes if bead blasting is employed.
- Remove all carbon deposits from combustion chamber and machined surfaces of cylinder head. Exercise caution to avoid removing any metal material. For best results, use an air tool with a **worn** wire brush. Scraping may result in scratches or nicks.
- To soften stubborn deposits, soak the cylinder head in a chemical solution, such as GUNK HYDRO-SEAL or other carbon and gum dissolving agent. Repeat step 2 as necessary.
- Thoroughly clean the cylinder head, spring retainers, tapered keepers, valves and valve springs in a non-volatile cleaning solution or solvent. Follow up with a thorough wash in hot soapy water.

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

5. Blow parts dry with low pressure compressed air.

INSPECTION

Cylinder Head

- Check for scratches and nicks on all gasket sealing surfaces.
- 2. Check for warpage.
 - a. With the combustion chamber side facing upward, set a straightedge diagonally across the length of the cylinder head intersecting the upper and lower corners of the gasket surface.
 - Slide a feeler gauge beneath the straightedge to check the head for warpage.
 - c. Checking the opposite diagonal, repeat the procedure to verify that the gasket surface is flat (especially if a head gasket was blown). Discard the head if any low spot is 0.005 in. (0.13 mm) or greater.

NOTE

For best results, use one of the CYLINDER TORQUE PLATES (HD-42324-A) in lieu of the straightedge. Lay the upper plate (without vise grip) flat on the machined surface of the head. As a preliminary check, see if the plate rocks from side to side. A head on which the plate rocks is immediately suspect. Insert a feeler gauge between the plate and head at various locations to see if warpage exceeds above specification.

3. Verify that oil passageways are open and clean.

Valve Guides

PART NO. SPECIALTY TOOI	
B-45525	Valve guide hone
HD-34751-A Valve guide cleaning brush	

- 1. Inspect external surfaces, particularly the combustion chamber side, for cracks. Replace the guide if any cracks are found.
- 2. Prepare valve guides for inspection.
 - a. Lightly hone bore using the VALVE GUIDE HONE (Part No. B-45525).
 - b. Scrub with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751-A) to remove any dust or debris.
 - c. Polish the valve stem with fine emery cloth or steel wool to remove carbon buildup.
- 3. Check valve stem to guide clearance:
 - a. Carefully measure the **inside** diameter of the valve guide using an inside ball micrometer.
 - b. Measure the **outside** diameter of the valve stem with an outside micrometer.
 - c. Refer to Table 3-5. If the clearance between stem and guide exceeds the limits shown, the valve stem and/or guide are excessively worn.
 - d. Repeat measurements with a **new** valve to determine if the guide must be replaced.

Table 3-5. Valve Stem To Guide Clearance Service Wear Limits

VALVE	IN.	MM
Intake	0.0038	0.0965
Exhaust	0.0038	0.0965

Valves

- Replace the valve if there is evidence of burning or cracking.
- Inspect the end of the valve stem for pitting or uneven wear. Replace the valve if either of these conditions are found.
- Inspect for burrs around the valve stem keeper groove. Remove burrs with a fine tooth file if found.
- To determine if the valve stem is excessively worn, see valve guide inspection.

Valve Springs

PART NO.	SPECIALTY TOOL
HD-96796-47	Valve spring tester

- Inspect springs for broken or discolored coils. Replace springs if either of these conditions are found.
- Set the intake and exhaust valve springs on a level surface and use a straightedge to check for proper squareness and height. Too much height corresponds to a reduction in spring pressure which results in sluggish valve action.
- Check free length of springs using a dial vernier caliper or load test with the VALVE SPRING TESTER (Part No. HD-96796-47). Replace springs if free length or compression force do not meet specifications. See 3.1 SPECIFICATIONS.

Tapered Keepers

- 1. Inspect parts for damage or rust pits. Replace as necessary.
- Inspect inboard side of tapered keepers for excessive wear. Upraised center must be pronounced and fit snugly in valve stem groove. Place keepers into groove and verify that they grip tightly without sliding.

Valve Seats

- 1. Inspect seats for cracking, chipping or burning. Replace seats if any evidence of these conditions are found.
- Check seats for recession by measuring valve stem protrusion. See VALVE AND SEAT REFACING on page 3-82.

VALVE GUIDE REPLACEMENT

Removal

PART NO.	SPECIALTY TOOL	
B-45524-1	Valve guide driver	
HD-39782-A	Cylinder head support stand	

NOTE

If valve guide replacement is necessary, always install **new** guide before refacing valve seat.

CAUTION

Support stand ensures that valve guide and seat are perpendicular. If perpendicularity is not achieved, the cylinder head valve guide bore will be damaged during the press procedure.

- 1. See Figure 3-104. Prepare cylinder head for valve guide replacement.
 - a. Insert sleeve of intake (3) or exhaust (4) seat adapter into tube at top support stand (2).
 - Position cylinder head so that valve seat is centered on seat adapter.

CAUTION

Do not press out the valve guide from the bottom of the cylinder head. Carbon buildup on the combustion chamber side of the guide can deeply gouge the cylinder head bore diminishing the likelihood of achieving the proper interference fit and possibly requiring replacement of the cylinder head casting.

- At top of the cylinder head, insert valve guide driver (1) into valve guide bore until stopped by shoulder.
- See Figure 3-105. Center valve guide driver under ram of arbor press. Apply pressure until valve guide drops free of cylinder head. Discard valve guide.
- Remove lock ring at top of cylinder head. Discard lock ring.

NOTE

Lock ring is not present on OEM intake valve guides.

- 1. Valve guide driver (Part No. B-45524-1)
- 2. Cylinder head stand (Part No HD-39782-A)
- 3. Intake seat adapter (Part No. HD-39782A-3)
- 4. Exhaust seat adapter (Part No. HD-39782A-4)
- 5. Valve guide installer sleeve (Part No. B-45524-2A)



Figure 3-104. Valve Guide Replacement Tools



Figure 3-105. Remove Valve Guide

Installation

PART NO. SPECIALTY TOOL		
B-45525	Valve guide hone	
B-45524-2A	Valve guide installer sleeve	
B-45524-1	Valve guide driver	
HD-34751-A	Valve guide cleaning brush	
HD-39782-A	Cylinder head support stand	
HD-39786-A	Cylinder head holding fixture	
HD-39847	Reamer T-handle	
B-45523	Valve guide reamer	

- 1. Check valve guide to valve bore clearance.
 - a. Measure the outside diameter of a **new** standard valve guide.
 - Measure the cylinder head valve guide bore. The valve guide should be 0.0020-0.0033 in. (0.051-0.084 mm) larger than the bore.
 - c. If clearance is not within specification, then select one of the following oversize guides: 0.001 in. (0.025 mm), 0.002 in. (0.05 mm) or 0.003 in. (0.08 mm).

NOTE

Since some material is typically removed when the guide is pressed out, it is normal to go to the next larger size for the proper interference fit.

2. Measure cylinder head bore and outside diameter of selected oversize guide to verify correct interference fit.

CAUTION

Support stand ensures that valve guide and seat are perpendicular. If perpendicularity is not achieved, cylinder head valve guide bore will be damaged during the press procedure.

- 3. Prepare cylinder head for valve guide replacement.
 - a. See Figure 3-104. Insert sleeve of intake (3) or exhaust (4) seat adapter into tube at top of support stand (2). Position cylinder head so that valve seat is centered on seat adapter.
 - Apply Vaseline to lightly lubricate external surfaces of valve guide. Spread lubricant so that thin film covers entire surface area.
 - c. At top of cylinder head, start valve guide into bore.



Figure 3-106. Install Valve Guide

- See Figure 3-106. Place installer sleeve (2) over valve guide and then insert tapered end of valve guide driver (1) into sleeve.
- e. Center valve guide driver under ram of arbor press and apply pressure only until valve guide is started in bore and then back off ram slightly to allow guide to center itself.

Always back off ram to allow the valve guide to find center. Pressing guide into cylinder head in one stroke can bend driver, break guide, distort cylinder head casting and/or damage cylinder head valve guide bore.

- f. Verify that support stand (3) and driver (1) are square. Center driver under ram and press valve guide further into bore, but then back off ram again to allow valve guide to find center.
- g. Repeat step 3f and then apply pressure to driver until installer sleeve contacts machined area of cylinder head.
- Install new lock ring into valve guide groove. Verify that lock ring is square and fully seated in the groove.
- 4. Secure cylinder head for service.
 - Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786-A) into cylinder head spark plug hole.
 - b. Clamp tool in vise at a 45 degree angle or one that offers a comfortable working position.

NOTE

Valve guides must be reamed to within 0.0005-0.0001 in. (0.013-0.0025 mm) of finished size.

T-handle
Valve guide reamer

Figure 3-107. Reaming Valve Guide Bore

- See Figure 3-107. Obtain the VALVE GUIDE REAMER (Part No. B-45523), REAMER T-HANDLE (Part No. HD-39847) and REAMER LUBRICANT (Part No. HD-39964).
 - a. Install T-handle (1) on reamer (2).
 - Apply a liberal amount of reamer lubricant to valve guide bore and bit of reamer. Start bit of reamer into bore at top of cylinder head.
 - c. Placing thumb on drive socket of reamer T-handle, apply slight pressure on reamer while rotating in a clockwise direction. Squirt additional lubricant onto reamer and into guide as necessary.

CAUTION

For best results, do not push on reamer or apply pressure to the reamer handle. While excessive pressure results in a rough cut, bore will be tapered if pressure is not centrally applied.

 Continue rotating reamer T-handle until entire bit has passed through valve guide bore and shank of reamer rotates freely.

CAUTION

Never back reamer out of valve guide or bore will be damaged.

 Remove T-handle from reamer, and carefully pulling on bit, draw shaft of reamer out combustion chamber side of valve guide.

Abrasive particles can damage machined surfaces and plug oil passageways possibly resulting in engine failure.

- Direct compressed air into the valve guide bore to remove any metal shavings or debris.
- See Figure 3-108. Clean valve guide bore with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751-A).
- See Figure 3-109. Obtain the VALVE GUIDE HONE (Part No. B-45525) and REAMER LUBRICANT (Part No. HD-39964).
 - a. Install hone in a high speed electric drill.
 - b. Apply reamer lubricant to finishing stones of hone and valve guide bore.
 - c. Start finishing stones of hone into bore.
 - d. Activating the drill, move the entire length of the finishing stone arrangement forward and backward through the bore for 10 to 12 complete strokes. Work for a crosshatch pattern of approximately 60°.

CAUTION

Abrasive particles can damage machined surfaces and plug oil passageways possibly resulting in engine failure.

 Direct compressed air into the valve guide bore to remove any debris. Clean with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751).

NOTE

Always verify valve stem to valve guide clearance after honing, since a worn reamer may cut the bore undersize.

- 10. Check valve stem to valve guide clearance.
 - Measure the inside diameter of the valve guide with an inside ball micrometer.
 - Measure the outside diameter of the valve stem with an outside micrometer.
 - c. Refer to Table 3-6. If the clearance between stem and guide is not within the limits shown, the low end being preferable, then the valve stem may be excessively worn or the valve guide bore undercut.



Figure 3-108. Scrubbing Valve Guide Bore



Figure 3-109. Honing Valve Guide Bore

- 11. Clean cylinder head assembly again.
 - a. Using cleaning solvent, thoroughly clean cylinder head and valve guide bore.
 - b. Scrub valve guide bore with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751-A). For best results, use a thin engine oil and clean valve guide bore with the type of swabs or patches found in gun cleaning kits.
 - c. Continue to wipe bore until clean cloth shows no evidence of dirt or debris. Follow up with a thorough wash in hot soapy water.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

12. Blow parts dry with low pressure compressed air.

Table 3-6. Valve Stem To Guide Clearance

VALVE	IN.	MM
Intake	0.001-0.003	0.0254-0.0762
Exhaust	0.001-0.003	0.0254-0.0762

VALVE AND SEAT REFACING

PART NO.	SPECIALTY TOOL
HD-35758-B	Neway valve seat cutter
HD-39786-A	Cylinder head holding fixture
HD-34751-A	Valve guide cleaning brush

NOTES

- Verify correct valve stem to valve guide clearance before refacing. Refer to Table 3-6. If new guides must be installed, complete that task before refacing valve seats.
- This procedure is not based on the lapping of valves. The end result is an interference fit between the 45° valve face and the valve seat which will be 46°.
- Wipe valve seats and valve faces clean. From the bottom of the cylinder head, insert the valve stem into the valve guide. Push on bottom of valve until it contacts the valve seat.
- 2. See Figure 3-110. Measure valve stem protrusion. Seat wear causes the valve stem protrusion to change.
 - a. Placing finger at bottom of valve to keep valve seated, use a dial vernier caliper to check the distance from the top of the valve stem to the machined area on the cylinder head.
 - Seat wear and valve refacing causes the valve stem protrusion to change. If protrusion exceeds 2.069 in. (52.55 mm), then replace the valve seat or cylinder head as necessary.

CAUTION

Do not shorten the valve by grinding on the end of the stem. Grinding replaces the hardened case with mild steel which results in accelerated wear.

- 3. Secure cylinder head for servicing.
 - a. Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786-A) into cylinder head spark plug hole.
 - b. Clamp fixture in vise and further tighten cylinder head onto the fixture to prevent any movement during operation.
 - c. Place cylinder head at a 45 degree angle or one that offers a comfortable working position.
- 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 0.080 in. (2.032 mm) from that number.
- 5. Set your dial caliper to the lesser measurement and lock down for quick reference. This is the location of your valve seat.
- 6. Use a permanent magic marker to highlight the valve seat area that is going to be cut. Be sure to highlight all three angles. Allow marker to dry before proceeding.



Figure 3-110. Checking Valve Stem Protrusion

NOTES

- 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.
- Always ensure the inside of the valve guide is clean by using Kent-Moore cleaning brush (Part No HD-34751).
- See Figure 3-111. Obtain the NEWAY VALVE SEAT CUTTER SET (Part no. HD-35758-B). Choose the cutter pilot that fits properly into the valve guide hole. 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. Be careful not to drop the cutter onto the seat.
- 9. While applying a constant and consistent pressure, remove just enough material to show a complete cleanup on the 46° angle. Do not remove any more metal than is necessary to clean up the seat (that is, to provide a uniform finish and remove pitting).

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 its 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 outermost edge at the widest point of the circle to determine what cut needs to be made next.
 - a. If the 46° cut is too high (towards the combustion chamber), use the 31° cutter to lower the valve seat closer to the port.
 - If the 46° cut is too low, use the 60° cutter to raise the valve seat or move it away from the port.

NOTES

- Because you are using the top measurement of the valve seat as a reference point it will usually be necessary to use the 31° cutter following the initial 46° cut.
- Always highlight the valve seat with the permanent magic marker in order to ensure the location of the 46° valve seat.



Figure 3-111. Neway Valve Seat Cutter Set

- 11. If the location of the valve seat is not correct, repeat steps 8 and 9.
- When you accomplish a complete clean-up of the 46° angle and the width is at least 0.062 in. (1.575 mm), proceed to the next step.
- Select the proper 60° cutter and gently slide the cutter down the cutter pilot to the valve seat.
- 14. Remove just enough material to provide an even valve seat width of 0.040-0.062 in. (1.016-1.575 mm).
- 15. Remove cutter and cutter pilot.
- 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.

- 17. Repeat the process on any valve seat that needs service.
- Clean valves, cylinder head and valve seats in solvent. Follow up with a thorough wash in hot soapy water.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

19. Blow parts dry with low pressure compressed air.



Figure 3-112. Valve and Seat Dimensions

PART NO.	SPECIALTY TOOL	
HD-34736-B	Valve spring compressor	
B-45524-1	Valve guide driver	
HD-34751-A	Valve guide cleaning brush	
HD-39786-A	Cylinder head holding fixture	

- 1. Secure cylinder head for service.
 - Thread 12 mm end of CYLINDER HEAD HOLDING FIXTURE (Part No. HD-39786-A) into cylinder head spark plug hole.
 - b. Clamp tool in vise at a 45 degree angle or one that offers a comfortable working position.

NOTE

At the time of disassembly, all parts should have been marked or tagged so that they are installed on the same valve (and in the same head).

- Run the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751-A) through the valve guide bore to verify cleanliness.
- 3. Using TORCO MPZ or another suitable product, apply a liberal amount of engine assembly lube to valve stem.
- 4. From the bottom of the cylinder head, insert the valve stem into the valve guide.
- To distribute the assembly lube evenly around the valve stem and guide, hand spin the valve as it is installed. Work the valve back and forth in the bore to verify that it slides smoothly and seats properly.
- Remove the valve and apply a second coat of assembly lube to the valve stem. Install the valve in the valve guide.

CAUTION

Failure to install plastic capsule will cause the valve stem seal to catch the edge of the valve stem keeper groove. The resulting damage will lead to leakage around the valve stem, excessive oil consumption and valve sticking.

- See Figure 3-113. Push on bottom of valve until it contacts the valve seat. Placing finger at bottom of valve to keep valve seated, slide plastic capsule over valve stem tip and keeper groove.
- Apply a very thin film of clean H-D 20W50 engine oil to capsule.
- 9. See Figure 3-114. Obtain **new** valve stem seal and spring seat. Assemble parts as shown.
- Slide new valve stem seal/spring seat over capsule and down valve stem until contact is made with top of valve guide and machined area of cylinder head casting. Remove capsule from valve stem tip.



Figure 3-113. Plastic Capsule



Figure 3-114. Valve Stem Seal/Spring Seat Assembly

Removing the valve after seal installation will cause the valve stem seal to catch the edge of the valve stem keeper groove. The resulting damage will lead to leakage around the valve stem, excessive oil consumption and valve sticking.

- 11. See Figure 3-115. Apply a liberal amount of assembly lube to valve stem tip and keeper groove (1).
- 12. With the smaller diameter coils topside, install the valve spring (3) over the valve guide (5). Place the spring retainer (2) on top of the valve spring.
- 13. Obtain the VALVE SPRING COMPRESSOR (Part No. HD-34736-B) and proceed as follows:
 - a. Place tool over cylinder head so that the blunt end is centered on the valve head and adapter at end of forcing screw is seated on the valve spring retainer.

CAUTION

Over-compressing the valve spring can damage the valve stem seal resulting in leakage around the valve stem, excessive oil consumption and valve sticking.

- b. Rotate forcing screw to compress valve springs.
- c. With the tapered side down, fit the keepers into the valve stem groove. For best results, apply a dab of grease to the inboard side of the keepers before installation and use a magnetic rod for easy placement.
- d. Arranging tapered keepers so that the gaps are evenly spaced, turn forcing screw to release valve spring compression.



Figure 3-115. Valve Assembly

- Tap the end of the valve stem once or twice with a soft mallet to ensure that tapered keepers are tightly seated in the valve stem groove.
- 15. Repeat steps 1-14 to install the other valve components.
- 16. Release the cylinder head holding fixture from the vise. Remove fixture tool from spark plug hole.
- 17. Cover the cylinder head to protect it from dust and dirt until time of installation.

NOTE

See Figure 3-116. Since carbureted models are not equipped with a temperature sensor, a screw may used to plug the temperature sensor hole in the front cylinder head. If reinstalling this screw, tighten to 120-180 **in-lbs** (13.6-20.3 Nm).

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Install cylinder head.
- 2. Install push rod covers and push rods.
- 3. Install rocker arm support plate.
- 4. Install breather assembly.
- 5. Continue with vehicle assembly as directed.



Figure 3-116. Temperature Sensor Hole Screw

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- 2. Remove rocker arm support plate.
- 3. Remove push rods and push rod covers. Do not remove lifters or lifter covers.
- 4. Remove cylinder head.
- 5. Remove cylinder.

CLEANING

PART NO.	SPECIALTY TOOL	
HD-42324-A	Cylinder torque plates	

 See Figure 3-117. Scrape old gasket material from the machined surface at the top of the cylinder (3). Old gasket (1) material left on the mating surface will cause leaks.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- Clean cylinder in a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air. Verify that oil passageways are clean and open.
- Inspect the cylinder bore for defects or damage in the ring travel area. Replace cylinders that are severely scored, scuffed, scratched, burnt or gouged.
- Using Magnaflux Dye Penetrant, inspect the cylinder for cracks. If no cracks are found, thoroughly wash cylinder to remove traces of dye.
- 5. Use a file to carefully remove any nicks or burrs from the machined surfaces of the cylinder.
- See Figure 3-118. Check the machined surfaces for flatness using a feeler gauge and CYLINDER TORQUE PLATES (Part No. HD-42324-A) as follows:
 - Lay gasket side of the upper torque plate (3) (without vise grip step) flat against the head gasket surface of the cylinder.
 - b. As a preliminary check, see if the plate rocks from side to side. A cylinder on which the plate rocks is immediately suspect.
 - Insert a feeler gauge between the plate and cylinder at various locations.
 - d. The head gasket surface must be flat within 0.006 in. (0.15 mm).



Figure 3-117. Cylinder Assembly

- e. Now turn the cylinder upside down and lay the seal side of the lower torque plate (2) (with vise grip step) flat against the O-ring seal surface. Repeat steps 6b and 6c above.
- f. The O-ring seal surface must be flat within 0.004 in. (0.102 mm).
- g. Replace the cylinder (and piston) if either surface is not within specification.

INSPECTION

PART NO.	SPECIALTY TOOL
HD-42324-A	Cylinder torque plates

CAUTION

Failure to use cylinder torque plates can produce measurements that vary by as much as 0.001 in. (0.025 mm), possibly resulting in the use of parts that are not suitable for service.

- See Figure 3-119. To simulate an assembled cylinder for accurately measuring cylinder taper and out-of-round conditions, as well as for boring, honing or deglazing, obtain the CYLINDER TORQUE PLATES (Part No. HD-42324-A). Install the torgue plates as follows:
 - Remove O-ring seal from cylinder sleeve, if installed.
 - b. Place used head gasket over two ring dowels at top of cylinder.
 - c. Install brass jaws or shop towels around teeth of vise to prevent damage to tool. Clamp stepped side of lower plate in vise with the simulated split line (machined strip) facing away.
 - d. Lightly oil threads and shoulders of four bolts (1) with clean H-D 20W50 engine oil. Slide four bolts all the way through holes of lower plate (2) until washers contact outboard side.
 - Slide cylinder down bolts with the indent in the cooling fins facing upward.
 - f. With the two ring dowels and head gasket in place, align holes in upper plate with ends of bolts. Blind holes in upper plate accommodate ring dowels in cylinder. Alternately tighten four bolts into upper plate in a crosswise pattern until snug.
 - g. Tighten the bolts to 120-144 in-lbs (13.6-16.3 Nm) in the sequence shown
 - h. Following the same sequence, tighten each bolt to 15-17 ft-lbs (20.3-23.1 Nm).
 - Using a grease pencil, mark a straight line on one of the bolts continuing the line over onto the lower plate. Repeat step for remaining three bolts.
 - Using the marks as a guide, turn each bolt 1/4 turn or 90 degrees. Be sure to tighten the bolts in the sequence shown in Figure 3-119.

NOTE

For best results, obtain Snap-On® Torque Angle Gauge TA360.

For purposes of inspection, remove the assembly from the vise and place on bench top.





Maximum cylinder wear occurs at the very top of top ring travel. Minimum wear occurs below ring travel. Failure to measure the cylinder at these points could result in a faulty decision regarding the suitability of the cylinder for continued use.

- See Figure 3-120. Using an inside micrometer or dial bore gauge, check cylinder bore for out-of-round and taper. Proceed as follows:
 - a. At the top of the piston ring travel zone (starting about 0.50 in. or 12.70 mm from the top of the cylinder), measure the cylinder diameter at two locations; parallel and perpendicular to the crankshaft. Record the readings.
 - Repeat the two measurements at the center of the piston ring travel zone.
 - c. Repeat the measurements again at the bottom of the bore at a point below the piston ring travel zone.
 - d. Rebore the cylinder if the parallel and perpendicular measurements at either the top, middle or bottom of the bore vary by more than 0.002 in. (0.058 mm). This indicates an out-of-round condition.
 - e. Rebore the cylinder if the top, middle and bottom bore diameters either parallel or perpendicular to the crankshaft vary by more than 0.002 in. (0.058 mm). This indicates excessive taper.
- 3. Continue with cylinder service.
 - If cylinders are not scuffed or scored, and are not worn beyond the service limits, see DEGLAZING CYLINDER below.
 - b. If cylinders are worn beyond the service limits, then they must be rebored and/or honed to accept the next standard oversize piston. See BORING AND HONING CYLINDER which follows.

DEGLAZING CYLINDER

NOTE

Deglazing removes wear patterns, minor scuff marks and scratches without enlarging the bore diameter.

- 1. Lightly swab the cylinder bore with a cloth dipped in clean engine oil.
- Obtain a 240 grit flexible ball-type deglazing tool with a bristle tip or finishing stone arrangement able to produce a 60° cross hatch pattern.
- Install the deglazing tool in a slow-speed drill. The speed at which the tool rotates determines the speed at which it must be stroked up and down the bore to produce the desired cross hatch pattern.



Figure 3-119. Attaching Cylinder Torque Plates

- Starting at the bottom of the cylinder, move the deglazing tool up and down the entire length of the cylinder bore for 10 to 12 complete strokes.
- Stop to examine the cylinder bore and/or take measurements. A precise 60° cross hatch pattern in the piston travel area is the most important.

The angular cross hatch pattern ensures an even flow of oil onto the cylinder walls and promotes longer cylinder, piston and ring life. An Improper crosshatch pattern will result in insufficient oil retention and possible piston seizure and/or high oil consumption.

CAUTION

Failure to remove all abrasive particles could result in premature cylinder, piston and ring wear and possible engine failure.

- Thoroughly wash the cylinder bore with liquid dishwashing soap and warm water to remove all abrasive particles and residual grit. Continue cleaning until a clean cloth shows no evidence or dirt or debris.
- Hot rinse the cylinder and dry with moisture free compressed air. Immediately apply a thin film of clean engine oil to a clean white paper towel and thoroughly wipe the inside of the cylinder. This prevents the cylinder bore from rusting.

NOTE

After wiping the cylinder with a clean, oiled paper towel, the towel will be dark with contamination. Repeat this process using a new lightly oiled paper towel each time until the towel remains white. The cylinder is now clean.

 With the cylinder at room temperature, check the piston clearance in the cylinder in which the piston will run. See INSPECTION under 3.25 PISTON.



Figure 3-120. Measure For Out-of-Round and Taper

BORING AND HONING CYLINDER

 Bore cylinder with gaskets and torque plates attached. Refer to Table 3-7. Bore the cylinder to 0.003 in. (0.08 mm) under the desired finished size.

CAUTION

An improper crosshatch pattern or too fine a hone will result in insufficient oil retention and possible piston seizure and/or high oil consumption.

- Hone the cylinder to its finished size using a 280 grit rigid hone followed by a 240 grit flexible ball hone. Honing must be done with the torque plates attached. All honing must be done from the bottom (crankcase) end of the cylinder. Work for a 60° crosshatch pattern.
- Stop frequently to examine the cylinder bore and/or take measurements. Remember, a precise 60° crosshatch pattern in the piston travel area is important.

CAUTION

Failure to remove all abrasive particles may result in premature cylinder, piston and ring wear and possible engine failure.

 Thoroughly wash the cylinder bore with liquid dishwashing soap and warm water to remove all abrasive particles and residual grit. Continue cleaning until a clean cloth shows no evidence or dirt or debris.

- 5. Hot rinse the cylinder and dry with moisture free compressed air.
- Immediately apply a thin film of clean engine oil to a clean white paper towel and thoroughly wipe the inside of the cylinder. This prevents the cylinder bore from rusting.

NOTE

After wiping the cylinder with a clean, oiled paper towel, the towel will be dark with contamination. Repeat this process using a new lightly oiled paper towel each time until the towel remains white. The cylinder is now clean.

7. With the cylinder at room temperature, check the piston clearance in the cylinder in which the piston will run. See INSPECTION under 3.25 PISTON.

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Install cylinder.
- 2. Install cylinder head.
- 3. Install push rod covers and push rods.
- 4. Install rocker arm support plate.
- 5. Install breather assembly.
- 6. Continue with vehicle assembly as directed.

Table 3-7. Oversize Pistons/Cylinder Bores

	PISTON		CYLINDER BORI	E FINISHED SIZE
SIZE	IN.	MM	IN.	MM
Standard	N/A	N/A	3.7500-3.7505	95.250-95.263
Ovorsizo	0.005	0.13	3.7550-3.7555	95.377-95.390
OVERSIZE	0.010	0.25	3.7600-3.7605	95.504-95.517

NOTE

Example: A 0.005 in. (0.13 mm) oversize piston will have the proper running clearance with a cylinder bore size of 3.7550-3.7555 in. (95.377-95.390 mm).

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- 2. Remove rocker arm support plate.
- Remove push rods and push rod covers. Do not remove lifters or lifter covers.
- 4. Remove cylinder head.
- 5. Remove cylinder.
- 6. Remove piston.

DISASSEMBLY

Piston Rings

WARNING

Always wear proper eye protection when removing the compression rings. Slippage could propel the ring with force which could result in death or serious injury.

- See Figure 3-121. Carefully remove top (7) and second (6) compression rings using the proper piston ring expander (Snap-On PRS8).
- 2. Using your fingers, remove the oil rail spacer (5) from the third ring groove. Remove top and bottom oil rails (4).
- 3. Discard the piston rings.

CLEANING

CAUTION

Do not sand blast or glass bead blast pistons. Bead blasting rounds off ring lands and will result in oil contamination leading to accelerated wear.

 To remove all carbon and combustion deposits, soak the pistons in a special detergent that will not corrode aluminum. Maintain the temperature of the cleaning solution well below 212° F (100° C).

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

Thoroughly rinse the pistons. Blow parts dry with moisture free compressed air.



Figure 3-121. Piston Assembly

- Clean the oil drain holes leading from the oil control ring groove to the underside of the piston crown. Run a small bristle brush through the passageways to ensure their cleanliness, but be careful not to damage or enlarge the holes. Do not use a wire brush.
- 4. Verify that all other oil holes are clean and open.

CAUTION

Exercise care to avoid scratching the sides of the piston ring grooves.

- Thoroughly clean the three piston ring grooves of all carbon deposits. A broken compression ring properly ground to a sharp chisel-like edge may be used for this purpose.
- Using Magnaflux Dye Penetrant, inspect the piston for surface cracks. Pay special attention to the area around the pin bores, ring lands and oil drain holes beneath the piston crown. If no cracks are found, thoroughly wash piston to remove traces of dye.

INSPECTION

- 1. See Figure 3-122. Check piston pin.
 - a. Lightly oil a good piston pin and insert it into the piston pin bore to feel for the proper interference fit. The pin should slide in and out without binding, but also without pivoting or rocking.
 - b. Replace piston and/or pin if clearance exceeds 0.0008 in. (0.020 mm).
- 2. Carefully inspect the pistons for damage or excessive wear.

NOTE

Pistons with superficial wear marks, minor scratching or mild scoring may continue to be used.

- a. Discard pistons with cracked, broken or bent ring lands.
- b. Check the piston skirt for cracks, gouges, deep scratches or heavy scoring.
- c. Check the piston heads for evidence of burning, etching or melting.
- d. Look for marks or imprints caused by contact with valves.
- Run your index finger around the edge of the piston crown to feel for dings, nicks or burrs. Lightly file the edge of the crown to remove any defects.

CAUTION

Worn ring grooves result in high oil consumption and blow-by of exhaust gases. Blow-by of exhaust gases contaminates the engine oil supply with acids and leaves sludge in the crankcase. It also reduces engine efficiency by weakening the combustion seal necessary for efficient transfer of energy to the piston.

- 4. See Figure 3-123. Measure piston ring side clearance.
 - a. Insert the edge of a **new** ring into the piston ring groove. Insert a feeler gauge between the upper surface of the ring and the ring land.
 - Since the grooves wear unevenly, repeat this check at several locations around the piston groove circumference.
 - Discard the piston if the side clearance of either compression ring exceeds 0.0045 in. (0.11 mm).
 - Discard the piston if the oil control ring side clearance exceeds 0.010 in. (0.25 mm).

NOTE

Check the piston clearance in the cylinder in which the piston will run. The torque plates must be installed on the cylinder and it must be deglazed and suitable for continued service.



Figure 3-122. Piston Pin Clearance



Figure 3-123. Measure Piston Ring Side Clearance

This inspection is very heat sensitive. Do not check piston running clearance immediately after honing or deglazing cylinder. Even holding the piston in your hand for too long can cause measurements to vary by as much as 0.0002 in. (0.005 mm). Both piston and cylinder must be at room temperatures before proceeding.

NOTE

Piston measurement is taken on the bare aluminum to avoid measuring errors. An oval-shaped opening is present on each side of the piston for proper placement of the micrometer. See upper frame of Figure 3-124. The oval openings are too small for a standard flat anvil micrometer which would result in measuring errors. Use a 3-4 inch blade or ball anvil style micrometer, or a 4-5 inch micrometer with spherical ball anvil adapters. See lower frame of Figure 3-124.

- See Figure 3-124. Measure running clearance of pistons as follows:
 - a. Holding outside micrometer, measure piston skirt diameter across the thrust faces (perpendicular to piston pin bore). Start below the bottom ring land and move micrometer towards bottom of skirt. Micrometer will be loose, then tight (about 0.5 in./ 12.7 mm from bottom), and then loose again.
 - Measure the piston skirt at the tightest spot and then transfer that measurement to dial bore gauge.
 - c. Using a grease pencil, mark the top, middle and bottom of the piston ring travel zone in the cylinder bore. Measure at markings in cylinder parallel and perpendicular to crankshaft.
 - d. Replace piston and/or cylinder if running clearance exceeds 0.003 in. (0.076 mm).



Figure 3-124. Measuring Running Clearance Piston

ASSEMBLY

Piston Rings

NOTE

Always use **new** piston rings. Piston rings take a definite set and must not be reused if the engine has been operated. Always deglaze (or hone) the cylinder before installing **new** rings. Ring sets are available to fit oversize pistons.

CAUTION

Insufficient ring gap could cause the ends to abut at engine operating temperatures, resulting in ring breakage, cylinder scuffing and/or piston seizure.

CAUTION

Excessive ring gap results in high oil consumption and blow-by of exhaust gases. While blow-by contaminates the oil supply and leaves sludge in the crankcase, it also reduces engine efficiency by weakening the combustion seal necessary for efficient transfer of energy to the piston.

- See Figure 3-125. Check ring gap before placing each ring on the piston.
 - a. Insert the **new** ring into the cylinder and square it in the bore using the top of the piston. Measure the ring gap with a feeler gauge.
 - Top compression ring gap must be 0.010-0.020 in. (0.25-0.51 mm).
 - c. Second compression ring gap must be 0.014-0.024 in. (0.36-0.61 mm).
 - d. Oil control rail gap must be 0.010-0.050 in. (0.25-1.27 mm).

NOTE

See Figure 3-125. Ring end gap dimensions also apply to oversize rings. Replace rings if gap exceeds specification. If gap is under specification, filing is permissible.

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

 Use compressed air to remove any dirt or dust that may have settled in the oil drain holes and piston ring grooves.



Figure 3-125. Measure Ring Gap

- 3. See Figure 3-126. Install piston rings.
 - Apply clean H-D 20W50 engine oil to three piston ring grooves.
 - b. Install expansion ring (4) into third ring groove.
 - c. Spiral bottom oil rail (5) into space below expansion ring (4). Position gap 90 degrees from the gap in the expansion ring.
 - Spiral upper oil rail (3) into space above expansion ring (4). Position gap 180 degrees from the gap in the expansion ring.

AWARNING

Always wear proper eye protection when installing the compression rings. Slippage could propel the ring with force which could result in death or serious injury.

CAUTION

Use the proper piston ring spreader to prevent excessive ring twist and expansion. Over expansion could cause the ring to crack opposite the ring gap. Defective or distorted rings result in blow-by of exhaust gases, increased oil consumption and lower service life on valves and other components.

CAUTION

Installing the second compression ring upside down will cause oil to be scraped up into the combustion chamber resulting in excessive oil consumption and low service life on valves and other components.

- e. Using the proper piston ring expander (Snap-On PRS8), carefully install the second compression ring. Make sure the dot (punch mark) near the ring gap faces the piston crown. Rotate the ring so the gap is 90 degrees from the gap in the top oil rail.
- f. Using the proper piston ring expander (Snap-On PRS8), carefully install the top compression ring. Make sure the dot (punch mark) near the ring gap faces the piston crown. Rotate the ring so the gap is 180 degrees from the gap in the second compression ring.
- g. Rotate the three piston rings using the palms of both hands. The rings must rotate freely without sticking.
- h. See Figure 3-127. Verify the ring gaps are still properly staggered.

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Attach piston to connecting rod.
- 2. Install cylinder.
- 3. Install cylinder head.
- 4. Install push rod covers and push rods.
- 5. Install rocker arm support plate.
- 6. Install breather assembly.
- 7. Continue with vehicle assembly as directed.



- 1. Top compression ring
- 2. Second compression ring
- 3. Upper oil rail spacer
- Expansion ring
- 5. Bottom oil rail spacer





Figure 3-127. Piston Ring Alignment

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

- 1. Remove breather assembly.
- Remove rocker arm support plate. 2.
- Remove push rods and push rod covers. Do not remove 3. lifters or lifter covers.
- Remove cylinder head. 4.
- Remove cylinder. 5.
- Remove piston. 6.
- 7. Service upper connecting rod bushing.

NOTE

Service of connecting rods is limited to replacement of the upper bushing. Damage to connecting rods or lower bushing service requires replacement of the flywheel assembly.

DISASSEMBLY/ASSEMBLY

Removing Upper Connecting Rod Bushing

PART NO.	SPECIALTY TOOL
HD-95952-33C	Connecting rod clamping tool
HD-95970-32D	Connecting rod bushing remover/ installer

NOTE

Replace the upper rod bushing if the piston pin to rod bushing clearance exceeds 0.002 in. (0.051 mm).

CAUTION

Place clean shop towels in and around the crankcase bore to prevent chips and shavings from falling into the crankcase.

- 1. See Figure 3-128. Obtain the CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33C).
 - Slide clamp (2) over connecting rod so that slots a. engage cylinder head studs. Exercise caution to avoid scratching or bending studs.
 - b. With the knurled side up, install threaded cylinders (1) onto studs to secure position of clamp.
 - c. Alternately turn each clamp thumbscrew (3) a few turns to gradually fix position of connecting rod. Turning only one thumbscrew will move rod off-center, while tightening second thumbscrew can cause rod to flex or bend.

- 1. Threaded cylinders
- Clamp 2.



Figure 3-128. Connecting Rod Clamping Tool (Part No. HD-95952-33C)

- See Figure 3-129. Obtain the CONNECTING ROD 2 BUSHING REMOVER/INSTALLER (Part No. HD-95970-32D).
 - Sparingly apply graphite lubricant to threads of rod a to prolong service life and ensure smooth operation.
 - Slide receiver cup (6) onto threaded rod (2) with the b. closed side facing nut (7).
 - Insert threaded rod through upper rod bushing. C.
 - See Figure 3-130. Slide remover side of driver down d. threaded rod. The driver is stamped to ensure proper orientation.
 - See Figure 3-129. Slide Nice bearing (4) and flat e. washer (3) down threaded rod until it contacts driver.
 - f. Thread the hex cylinder onto rod until assembly is snug.
 - Holding nut (7) with a 5/8 in. box wrench, turn hex g. cylinder (1) with a 5/8 in. socket until bushing is free. See Figure 3-132.
 - h. Unthread hex cylinder from rod. Remove flat washer, Nice bearing and driver. Remove threaded rod from bushing bore.
 - Remove bushing from receiver cup and discard. i.





Installing Upper Connecting Rod Bushing

PART NO.	SPECIALTY TOOL
HD-95952-33C	Connecting rod clamping tool
HD-95970-32D	Connecting rod bushing remover/ installer

See Figure 3-129. Obtain the CONNECTING ROD BUSHING REMOVER/INSTALLER (Part No. HD-95970-32D)

- 1. Slide receiver cup (6) onto threaded rod (2) with the closed side facing nut (7).
- 2. Insert threaded rod through upper rod bushing bore.
- See Figure 3-131. Slide new bushing down threaded rod. Start bushing into bore. Verify that center of slot in bushing (2) is aligned with oil hole in connecting rod (3). Also, be sure that bushing is square in bore and not cocked.
- Slide installer side of driver (1) down threaded rod until shoulder contacts bushing. The driver is stamped to ensure proper orientation.
- See Figure 3-129. Slide Nice bearing (4) and flat washer (3) down threaded rod until it contacts driver.
- Thread the hex cylinder (1) onto rod until assembly is snug.
- Holding nut (7) with a 5/8 in. box wrench, turn hex cylinder (1) with a 5/8 in. socket until collar on driver bottoms against connecting rod. See Figure 3-132.
- Unthread hex cylinder from rod and remove flat washer, Nice bearing and driver. Remove threaded rod from bushing bore, but exercise caution to avoid scratching or gouging bushing.



Figure 3-130. Remover Stackup

- 1. Installer side of driver
- 2. Slot in bushing
- 3. Oil hole in connecting rod



Figure 3-131. Installer Stackup



Figure 3-132. Remove/Install Bushing

Reaming Upper Connecting Rod Bushing

PART NO.	SPECIALTY TOOL
HD-42318	Connecting rod bushing reamer
HD-43645	Reamer handle/drive socket
HD-95952-33C	Connecting rod clamping tool

See Figure 3-133. Obtain the CONNECTING ROD BUSHING REAMER (Part No. HD-42318) and REAMER HANDLE/ DRIVE SOCKET (Part No. HD-43645).

- Carefully insert bit of reamer (2) into upper connecting rod bushing. Do not apply lubricant to reamer or bushing. Ream the bushing dry or cut will not be accurate.
- 2. Install handle/drive socket (1) on reamer lug.
- Placing thumb on drive socket, apply slight pressure on reamer while rotating handle/drive socket in a clockwise direction.

CAUTION

For best results, do not push on reamer or apply pressure to the reamer handle. While excessive pressure results in a rough cut, bushing bore will be tapered if pressure is not centrally applied.

 Continue rotating handle/drive socket until entire bit has passed through bushing and shank of reamer rotates freely in the bore.

CAUTION

Never back reamer out of connecting rod or bushing will be damaged.

5. Remove handle/drive socket, and carefully pulling on bit, draw shaft of reamer out of connecting rod bushing.

CAUTION

Abrasive particles can damage machined surfaces and plug oil passageways possibly resulting in engine failure.

 Using contact cleaner or cleaning solvent, thoroughly wipe upper connecting rod and bushing of any metal shavings or debris.



Figure 3-133. Connecting Rod Bushing Reamer (Part No. HD-42318) and Handle/Drive Socket (Part No. HD-43645)

Honing Upper Connecting Rod Bushing

PART NO.	SPECIALTY TOOL
HD-42569	Connecting rod bushing hone
HD-95952-33C	Connecting rod clamping tool

- See Figure 3-134. Obtain the CONNECTING ROD BUSHING HONE (Part No. HD-42569) and REAMER LUBRICANT (Part No. HD-39964).
 - a. Install hone in a high speed electric drill.
 - Apply reamer lubricant to finishing stones of hone and inside of upper connecting rod bushing.
 - c. Start finishing stones of hone into bushing.
 - d. Activating the drill, move the entire length of the finishing stone arrangement forward and backward through the bushing bore for 10 to 12 complete strokes. Work for a crosshatch pattern of approximately 60°.

CAUTION

Abrasive particles can damage machined surfaces and plug oil passageways possibly resulting in engine failure.

- Using contact cleaner or cleaning solvent, thoroughly wipe upper connecting rod and bushing of any metal shavings or debris. Continue wiping until a clean cloth shows no evidence of dirt or debris.
- Lightly oil a good piston pin and insert it into the upper connecting rod bushing bore to feel for the proper interference fit. The pin should slide in and out of the bushing without binding, but also without pivoting or rocking.
- 4. Remove shop towels exercising caution that shavings, chips and other debris do not fall into crankcase.

INSTALLATION OVERVIEW

See 3.17 TOP END OVERHAUL: ASSEMBLY.

- 1. Service or replace connecting rod upper bushing
- 2. Attach piston to connecting rod.
- 3. Install cylinder.
- 4. Install cylinder head.
- 5. Install push rod covers and push rods.
- 6. Install rocker arm support plate.
- 7. Install breather assembly.
- 8. Continue with vehicle assembly as directed.



Figure 3-134. Honing Upper Connecting Rod Bushing

NOTES

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REMOVAL OVERVIEW

- 1. See 3.16 TOP END OVERHAUL: DISASSEMBLY.
 - a. Remove breather assembly.
 - b. Remove rocker arm support plate.
 - c. Remove push rods and push rod covers. Do not remove lifters or lifter covers.
- See Figure 3-135. Fashion lifter holding tool to prevent the hydraulic lifters from dropping into the cam compartment during cam support plate removal.
 - Obtain a large binder clip (1) which is available at any office supply store. Squeeze wireforms (2) to remove from binder clip.
 - b. Compress wireform (2) slightly and insert free ends into outer and inner lifter cover bores so that legs engage walls of both hydraulic lifter sockets.
- See beginning of 3.18 BOTTOM END OVERHAUL: DIS-ASSEMBLY to remove cover and cam support plate.



Figure 3-135. Hydraulic Lifter Holding Tool



Figure 3-136. Cover and Cam Support Plate Assembly

DISASSEMBLY/ASSEMBLY

ACAUTION

Do not pull the retention pins from the primary or secondary cam chain tensioners with the chains and sprockets removed. With 35-40 pounds of spring pressure behind the tensioner, allowing it to accelerate through its full length of travel will cause spring stretching and/or cracking of the tensioner shoe, damage which requires replacement of the assembly. Furthermore, if tensioner should contact with fingers or other parts of the hand minor or moderate injury could occur.

NOTE

If the retention pins interfere with cleaning or service procedures, hold the retracted cam chain tensioner with the CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313), pull the retention pin and ease the assembly into the unloaded position.

CRANKSHAFT BUSHING

Removal

PART NO.	SPECIALTY TOOL
HD-42315	Crankshaft bushing remover/installer

- See Figure 3-137. Obtain the CRANKSHAFT BUSHING REMOVER/INSTALLER (Part No. HD-42315).
- 2. Center support tube under ram of arbor press.
- Center crankshaft bushing in cam support plate over support tube. Be sure that the primary cam chain side of the cam support plate is facing upward.

CAUTION

If the crankshaft bushing is pressed out the primary cam chain side, the bore will be damaged by the knurled edge of the bushing. Damage to the bore requires replacement of the cam support plate.

- Insert remover side of driver into crankshaft bore so that shoulder on tool is seated on edge of bushing.
- Press on driver until collar of tool contacts cam support plate. Remove bushing from support tube and discard.

Installation

PART NO.	SPECIALTY TOOL
HD-42315	Crankshaft bushing remover/installer

- See Figure 3-137. Obtain the CRANKSHAFT BUSHING REMOVER/INSTALLER (Part No. HD-42315).
- 2. Center support tube under ram of arbor press.



Figure 3-137. Crankshaft Bushing Remover Installer (Part No. HD-42315)

- Turn cam support plate over so that secondary cam chain side is facing upward.
- Start new bushing into bore with the knurled edge topside. Be sure that hole in bushing is aligned with oil hole in bushing bore.

If the crankshaft bushing is pressed in from the primary cam chain side, or from the secondary cam chain side with the knurled edge of the bushing down, the bushing bore will be damaged. Damage to the bore requires replacement of the cam support plate.

- 5. Center crankshaft bushing bore over support tube.
- 6. Insert installer side of driver into bushing.
- 7. Press on driver until collar of tool makes firm contact with cam support plate.
- Ream the crankshaft bushing following the directions below.

Reaming Crankshaft Bushing

PART NO.	SPECIALTY TOOL
HD-42316	Crankshaft bushing reamer
HD-43645	Handle/drive socket

NOTE

A **new** crankshaft bushing must be reamed for proper size and alignment. If crankcase halves are not split, ream the bushing using a spare right case half to avoid further engine disassembly.

- Slide cam support plate onto two ring dowels in crankcase flange.
- Install six allen head socket screws (1/4 x 1 in.) to secure cam support plate to crankcase flange. Alternately tighten screws until snug.
- See Figure 3-138. Obtain the CRANKSHAFT BUSHING REAMER (Part No. HD-42316) and REAMER HANDLE/ DRIVE SOCKET (Part No. HD-43645).
 - a. From flywheel compartment side, carefully insert tapered end of reamer pilot (2) into crankshaft roller bearing (5) until it stops.
 - Slide reamer (3) through pilot starting bit into crankshaft bushing in cam support plate. Do not apply lubricant to reamer or bushing. Ream the bushing dry or cut will not be accurate.
 - c. Install handle/drive socket (1) on reamer lug.
 - d. Placing thumb on drive socket, apply slight pressure on reamer (3) while rotating handle/drive socket (1) in a clockwise direction.

- 1. Handle/drive socket
- 2. Pilot
- 3. Reamer
- 4. Right crankcase
- 5. Roller bearing





Figure 3-138. Crankshaft Bushing Reamer (Part No. HD-42316) and Handle/Drive Socket (Part No. HD-43645)

For best results, do not push on reamer or apply pressure to the reamer handle. While excessive pressure results in a rough cut, bushing bore will be tapered if pressure is not centrally applied.

 Continue rotating handle/drive socket until entire bit has passed through bushing and shank of reamer rotates freely in the bore.

CAUTION

Never back reamer out flywheel side of crankcase or crankshaft bushing will be damaged.

- Remove handle/drive socket, and carefully pulling on bit, draw shaft of reamer out of bushing on cam side of crankcase.
- g. Remove pilot from crankshaft roller bearing. Tap on pilot using a soft rubber mallet, if necessary.
- 4. Remove the allen head socket screws to release the cam support plate from the crankcase flange.

CAMSHAFTS AND CAMSHAFT BEARINGS

Removal

PART NO.	SPECIALTY TOOL
HD-34902-B	Mainshaft bearing inner racer puller/installer
HD-42313	Cam chain tensioner unloader
HD-43644	Camshaft/camshaft bearing remover/installer
HD-95637-46A	Wedge attachment

- 1. See Figure 3-139. Eliminate secondary cam chain tension. For best results, place cam support plate in a vise using brass jaw inserts to prevent casting damage.
 - Place cup of CAM CHAIN TENSIONER UNLOADER (3) (Part No. HD-42313) over spring coil of secondary cam chain tensioner. Position finger (4) on tool between tensioner and shoe (1).
 - b. Rotate tool in a counterclockwise direction. Insert retention pin (2) through hole in boss on primary cam chain side of cam support plate. Pin engages hooks on tensioner to hold it in the retracted position.



Figure 3-139. Retract Secondary Cam Chain Tensioner

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- Remove retaining ring from groove at end of front camshaft. Discard retaining ring.
- Remove four T20 TORX screws to free bearing retainer plate from inboard side of cam support plate.
- Using a colored marker, mark one of the links of the secondary cam chain. Maintaining the original direction of rotation during assembly may prolong service life.
- See Figure 3-140. With primary cam chain side facing upward, place cam support plate on parallel blocks (5) under ram (4) of arbor press.

CAUTION

Since the bearing fit to the camshafts is tighter than its fit in the support plate, any attempt to remove the camshafts without the bearings will result in damage to the cam support plate and bearing retainer plate, if installed.

CAUTION

Cam bearings could be a loose fit in the cam support plate. To avoid possible damage, be aware that camshaft and bearing assemblies could drop out at start of press procedure.

- 6. Fit cups of camshaft driver (1) over ends of front and rear camshafts, so that contact is made with the bearing inner races. Centering driver under ram at a point midway between the camshafts, simultaneously press both camshafts (with attached bearings) from the cam support plate.
- 7. Remove secondary cam chain from cam sprockets.
- See Figure 3-141. If reusing front camshaft, remove bearing using WEDGE ATTACHMENT (Part No. HD-95637-46A).
 - Position wedge attachment (4) on inboard side of front camshaft bearing (6). Turn hex nuts an equal number of turns to draw halves of wedge together.
 - b. Obtain two 3/8-16 in. bolts (3.5 in. long) with flat washers (2). Install flat washers on bolts. Obtain bridge (3), forcing screw (1) and hardened plug (5) from MAINSHAFT BEARING INNER RACE PULLER/INSTALLER (Part No. HD-34902-B).
 - c. Slide one bolt into channel on each side of bridge so that flat washer is between bridge and bolt head. Thread bolts into wedge attachment an equal number of turns.
 - Sparingly apply graphite lubricant to threads of forcing screw to prolong service life and ensure smooth operation. Start forcing screw into center hole of bridge.

- 1. Camshaft driver
- 2. Support block
- 3. Bearing pilot/driver
- 4. Ram
- 5. Parallel blocks



3

Figure 3-140. Camshaft/Camshaft Bearing Remover/installer (Part No. HD-43644)



Figure 3-141. Camshaft Bearing Removal

Failure to use hardened plug could result in damage to forcing screw and/or camshaft.

- e. Place cupped side of hardened plug (5) against end of camshaft. Thread forcing screw into bridge until the steel ball at the end of the screw makes firm contact with hardened plug.
- f. Verify that the tool assembly is square so that the bearing is not cocked during removal. Turn forcing screw until bearing is pulled free of camshaft. Discard bearing.
- 9. If reusing rear camshaft, remove roller bearing assembly as follows:
 - Slide roller bearing from end of rear camshaft. Since bearing is a loose fit on cam, no pressing tools are required.
 - Install tools as you would to remove the bearing from the front camshaft, but position cup of wedge inboard of the thrust washer.
 - Wrap a shop rag around camshaft to get a firm grip and also to protect hand from sharp edges of sprocket.
 - d. See Figure 3-142. Using a 5/8 in. box wrench (1), turn forcing screw until bearing inner race (2) and thrust washer (3) are pulled free of camshaft. A light interference fit allows the parts to be removed with little effort. Discard inner race and thrust washer.
 - e. If present, remove O-ring from grinding relief groove in camshaft. Groove is on the splined end between the machined area and the secondary cam sprocket. Discard O-ring.

NOTES

- Since the O-ring is not used in production, it will only be found if the cams were serviced at the dealer level.
- Although the vane has been eliminated from the cam sprocket on production motorcycles, the service part retains the vane to retrofit earlier models having a camshaft position sensor.







Figure 3-143. Camshaft/Camshaft Bearing Remover/installer (Part No. HD-43644)

Installation

PART NO.	SPECIALTY TOOL
HD-42313	Cam chain tensioner unloader
HD-43644	Camshaft/camshaft bearing remover/installer

CAUTION

Always install new bearings. Only use genuine Harley-Davidson bearings. Reusing old bearings or using bearings from a supplier other than Harley-Davidson will result in engine damage.

- See Figure 3-144. Obtain new rear cam roller bearing kit (Part No. HD-8983).
- 2. Install O-ring, thrust washer and bearing inner race onto rear camshaft as follows:
 - a. To properly locate thrust washer (2), first install Oring (1) in grinding relief groove. Groove is on the splined end between the machined area and the secondary cam sprocket. Exercise caution to avoid stretching or breaking the O-ring. Since the O-ring is not sold separately, damage will require purchase of a new roller bearing kit.

CAUTION

The thrust washer will be offset to one side if the O-ring is not installed in the grinding relief groove. Damage to the bearing cage can occur if the thrust washer is not properly centered.

- Slide thrust washer (2) down rear camshaft until centered over O-ring (1) in grinding relief groove.
- c. Slide bearing inner race (4) down rear camshaft until contact is made with shoulder of machined area.
- Install primary cam sprocket spacer and sprocket on camshaft and secure using thicker flat washer and long flange bolt.

NOTE

If not enough of the splined shaft is exposed to install the sprocket, leave out the spacer and proceed to step 2(e). Once the bearing inner race has been started onto the machined area, remove the flange bolt, washer and sprocket, and then reassemble using the spacer. Repeat step 2(e) to fully install bearing inner race.

e. See Figure 3-143. Wrap a shop rag (4) around camshaft to get a firm grip and also to protect hand from sharp edges of sprocket. Using a 9/16 inch box wrench (1), turn flange bolt in a clockwise direction. Bearing inner race (2) is fully installed when it makes firm contact with the thrust washer (3).





- f. Verify that the thrust washer is locked in place and cannot be rotated. If necessary, install shaft in vise using brass jaw inserts, and further tighten flange bolt until the desired result is achieved.
- g. Remove flange bolt, flat washer, sprocket and spacer.

CAUTION

Always install new bearings. Only use genuine Harley-Davidson bearings. Reusing old bearings or using bearings from a supplier other than Harley-Davidson will result in engine damage.

- Obtain the CAMSHAFT/CAMSHAFT BEARING RE-MOVER/INSTALLER (Part No. HD-43644).
- 4. With the secondary cam chain side facing upward, place cam support plate on support block, so that outer races of bearings are properly supported. Note that one corner of the support block is contoured to accommodate the chain guide blocks cast into the front of the support plate.
- Center new bearing over bearing bore with the lettered side up. Slide pilot shaft of bearing driver through bearing into hole of support block.
NOTE

See Figure 3-145. Be aware that the front (2) and rear (1) cam bearings are no longer interchangeable. The rear bearing is now the roller type, while the front remains the ball bearing kind.

See Figure 3-146. Center bearing driver (3) under ram (4) of arbor press. Press on driver until bearing (5) makes firm contact with counterbore in cam support plate. Repeat steps to install second bearing.

NOTE

Bearings may be a press to loose fit. If deemed necessary, clean bearing OD and apply LOCTITE THREADLOCKER 243 (blue) before installation, but exercise caution to avoid getting compound on rollers or bearing ID.

- Apply LOCTITE THREADLOCKER 243 (blue) to threads of four bearing retainer plate screws. Using a T20 TORX drive head, secure bearing retainer plate to cam support plate. Tighten screws to 20-30 in-lbs (2.3-3.4 Nm) in a crosswise pattern. Verify that hole in retainer plate is properly aligned with secondary cam chain oiler.
- Place cam support plate back on support block (2), if removed. Block properly supports inner races of bearings as camshafts are installed.
- 9. See Figure 3-147. Align pin stamped timing lines on teeth of secondary cam sprockets (outboard faces). Using a colored marker, carefully mark the pin stamped timing line locations on the inboard side of the sprocket teeth. These marks are needed to observe proper orientation of the camshafts when they are pressed into the bearings.







Figure 3-146. Camshaft Bearing Installation



Figure 3-147. Camshaft Timing Lines

- 10. Place the secondary cam chain around the sprockets of both the front and rear camshafts. To maintain the original direction of rotation, be sure that the colored mark placed on the chain link during disassembly is facing opposite the cam support plate during installation.
- See Figure 3-148. Orient the camshafts so that they are positioned on opposite ends of the chain, and then verify that the colored marks placed on the inboard side of the sprocket teeth are still in alignment.
- See Figure 3-149. Maintaining the position of the camshafts on the chain with the colored marks in alignment, place the sprocket ends of the camshafts into the bearings.

NOTE

Do not mix camshafts during the press procedure. The rear camshaft, which can be identified by the splined shaft, must go into the roller bearing at the rear of the cam support plate.

 Place cup of camshaft driver (2) over end of front camshaft only.

CAUTION

Verify that splined end of rear camshaft has been started into support block. Damage to the camshaft and/or support block can occur if end of camshaft catches top of block during the press procedure.

NOTE

To reduce the likelihood of such contact occuring, use 7/8 inch drill bit to enlarge rear cam bore in support block. For best results, radius top inside edge of bore after drilling.

CAUTION

Be sure that the tensioner shoe is clear of the secondary cam chain during the press procedure. Contact can result in damage that requires replacement of the tensioner assembly.

 Center end of front camshaft under ram (1) and slowly apply pressure to driver (2) just to start front camshaft into bearing ID.

CAUTION

If rear camshaft is not properly aligned, edge of installed inner race can catch on bearing rollers. Bearing damage can result if contact occurs during the press procedure.

 See Figure 3-150. Slowly apply pressure to driver on front camshaft, while wiggling rear camshaft as necessary to guide inner race between bearing rollers.



Figure 3-148. Alignment Marks on Inside of Cams



Figure 3-149. Press Front Camshaft



Figure 3-150. Install Camshafts

- 16. When inner race on rear cam is started into roller bearing, apply pressure to driver until front camshaft is fully seated. If necessary, keep finger pressure at top of rear camshaft to ensure that assembly remains square and inner race moves to installed position in roller bearing.
- 17. See Figure 3-151. Since the pin stamped timing lines on the secondary sprockets cannot be observed once the camshafts are pressed into the bearings, note that the outboard ends of the shafts have a second set of timing lines. Using a straightedge, verify that these timing lines are in alignment. If they are not, then the camshafts must be removed and reinstalled (with a new bearing set).

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

18. With the sharp edge out, install **new** retaining ring in groove at end of front camshaft.



Figure 3-151. Verify Alignment of Timing Lines

CAM CHAIN TENSIONERS

Removal

PART NO.	SPECIALTY TOOL	
HD-42313	Cam chain tensioner unloader	

ACAUTION

Do not pull the retention pins from the primary or secondary cam chain tensioners with the chains and sprockets removed. With 35-40 pounds of spring pressure behind the tensioner, allowing it to accelerate through its full length of travel will cause spring stretching and/or cracking of the tensioner shoe, damage which requires replacement of the assembly. Furthermore, if the tensioner should contact fingers or other parts of the hand, minor or moderate injury could occur.

1. If retracted, hold the cam chain tensioner with the CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313). pull the retention pin and ease the assembly into the unloaded position.



- Retaining ring 3.



AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- 2. See Figure 3-152. Remove retaining ring (3) from groove in tensioner post. Discard retaining ring.
- 3. Slide cam chain tensioner assembly from post disengaging spring pin from hole in cam support plate. Inspect tensioner shoe (1) using information in Figure 3-153.



Installation

PART NO.	SPECIALTY TOOL	
HD-42313	Cam chain tensioner unloader	

1. See Figure 3-152. Slide cam chain tensioner assembly onto post inserting spring pin into hole in cam support plate.

- 2. With the sharp edge out, install new retaining ring (3) in groove of post. Verify that the ring is fully seated in the groove.
- 3. If retracted prior to disassembly, place cup of CAM CHAIN TENSIONER UNLOADER (Part No. HD-42313) over spring coil of cam chain tensioner assembly. Retract the tensioner inserting a retention pin through hole in boss on the primary cam chain side of cam support plate.

OIL PRESSURE RELIEF VALVE

Removal

- 1. Remove the primary cam chain tensioner assembly. See CAM CHAIN TENSIONERS earlier in this section.
- Secure the cam support plate in a vise with access to the roll pin. Be sure to install a pair of brass jaw inserts in the vise to avoid damage to the casting.
- See Figure 3-154. Using a 1/8 in. punch with a small hammer, carefully tap roll pin (1) from pin hole in cam support plate. Discard roll pin.
- 4. Remove spring (2) and valve body (3) from bypass port.

Cleaning

NOTE

If diagnosing low oil pressure, start with step 1. If diagnosing high oil pressure, then begin with step 2.

- Insert straight stiff wire into unplugged hole outboard of roll pin until it bottoms. Mark wire and measure distance from edge of cam support plate to inboard side of piston. With piston fully seated in the bore, depth should be approximately 2.25 inches (57.15 mm). If it is not, continue with step 2.
- Remove oil pressure relief valve. See OIL PRESSURE RELIEF VALVE, REMOVAL, in this section.
- 3. Inspect spring for stretching, kinking or distortion.
- Inspect piston and bore for burrs, scoring or other damage. Look for steel particles or aluminum chips. Replace cam support plate and piston if any of these conditions are found.
- Install piston in bore and measure running clearance. If running clearance exceeds 0.003 inch (0.076 mm), install new piston and remeasure. Replace cam support plate if running clearance still exceeds specification.

Installation

- Secure the cam support plate in a vise. Be sure to install a pair of brass jaw inserts to avoid damage to the casting.
- See Figure 3-154. Lubricate valve body (3) with clean H-D 20W50 engine oil. Slide valve body into bypass port of cam support plate with the open side facing outward.
- Slide spring (2) into bypass port until seated in open side of valve body.
- Start new roll pin (1) into hole in cam support plate. Compress spring in port using the blade of a small screwdriver.
- 5. Holding spring compressed, tap roll pin into cam support plate until it approaches pin hole on opposite side.
- Remove screwdriver to release spring. Verify that spring is straight and square in bore.
- Using a 1/8 in. punch with a small hammer, carefully tap roll pin until flush with casting.
- Install the primary cam chain tensioner assembly. See CAM CHAIN TENSIONERS earlier in this section.



Figure 3-154. Oil Pressure Relief Valve Assembly

CAM NEEDLE BEARINGS

Removal

PART NO.	SPECIALTY TOOL	
HD-42325	Camshaft needle bearing remover/installer	

- Obtain the CAMSHAFT NEEDLE BEARING REMOVER/ INSTALLER (Part No. HD-42325).
- 2. See Figure 3-156. Remove four thumb screws (1) from threaded holes in support plate (2), if installed.
- Sparingly apply graphite lubricant (9) to threads of collet (3) to prolong service life and ensure smooth operation.
- Slide collet through support plate so that threaded end exits stamped side of plate.
- Aligning two large holes in support plate with needle bearing bores, hang right side of plate on ring dowel in crankcase flange.
- Align four holes at corners of support plate with threaded holes in crankcase flange. Install thumb screws in these holes to secure support plate to crankcase.
- Center expandable end of collet in bearing bore and slide Nice bearing (7) and flat washer (5) on threaded end. Start hex nut (8) on threaded end.
- Push expandable end of collet through bearing bore into flywheel compartment. Feel for inside edge of needle bearing using end of collet and then back off slightly.



Figure 3-155. Expanding Collet By Turning Hex Clockwise

- Holding collet to prevent lateral movement, finger tighten hex nut until Nice bearing contacts support plate.
- See Figure 3-155. Using a 7/16 in. open end wrench, hold flat on collet to prevent rotation. Using a second 7/16 in. open end wrench, expand collet by turning hex at end of shaft in a clockwise direction. Expandable end of collet makes contact with needle bearing ID.



Figure 3-156. Camshaft Needle Bearing Remover/Installer (Part No. HD-42325)

- See Figure 3-157. Using a 15/16 in. open end wrench, turn hex nut in a clockwise direction until bearing is free. If necessary, hold flat on collet to prevent rotation.
- 12. Remove four thumb screws and pull support plate from crankcase.
- Holding flat on collet, turn hex at end of shaft in a counterclockwise direction to close collet. Remove and discard needle bearing.
- 14. Remove hex nut, flat washer and Nice bearing from threaded end of collet. Pull collet from support plate.
- 15. Return to step 1 to remove second needle bearing.

Installation

PART NO.	SPECIALTY TOOL	
HD-42325	Camshaft needle bearing remover/installer	

- 1. Obtain the CAMSHAFT NEEDLE BEARING RE-MOVER/INSTALLER (Part No. HD-42325).
- See Figure 3-156. Sparingly apply graphite lubricant (9) to threads of installer forcing screw (4) to prolong service life and ensure smooth operation.
- 3. Thread installer forcing screw into stamped side of support plate (2) until threads begin to emerge from opposite side.
- 4. Place installer (6) at end of installer forcing screw.
- 5. Place **new** needle bearing on installer with lettered side facing shoulder.
- See Figure 3-158. Aligning two large holes in support plate with needle bearing bores, hang right side of plate on ring dowel in crankcase flange.
- Align four holes at corners of support plate with threaded holes in crankcase flange. Install thumb screws in these holes to secure support plate to crankcase.



Figure 3-157. Turn Hex Nut Clockwise to Remove Bearing



Figure 3-158. Installer Forcing Screw Installation

- See Figure 3-159. Using 15/16 in. open end wrench, turn hex at end of installer forcing screw in a clockwise direction until resistance is felt.
- 9. Turn end of installer forcing screw in a counterclockwise direction until installer is free of needle bearing bore.
- 10. Remove four thumb screws and pull support plate and installer forcing screw from crankcase.
- 11. Remove installer from installer forcing screw. Unthread installer forcing screw from support plate.
- 12. Return to step 1 to install second needle bearing.
- Thread four thumb screws into threaded holes in support plate to prevent loss.

INSTALLATION OVERVIEW

- See 3.19 BOTTOM END OVERHAUL: ASSEMBLY. Begin with COVER AND CAM SUPPORT PLATE instructions on page 3-59.
- 2. Continue with 3.17 TOP END OVERHAUL: ASSEMBLY.



Figure 3-159. Turn Installer Forcing Screw Clockwise to Install Bearing

REMOVAL OVERVIEW

- 1. See 3.16 TOP END OVERHAUL: DISASSEMBLY.
 - a. Remove breather assembly.
 - b. Remove rocker arm support plate.
 - Remove push rods and push rod covers. Do not remove lifters or lifter covers.
- See 3.27 COVER AND CAM SUPPORT PLATE. Fashion lifter holding tool to prevent the hydraulic lifters from dropping into the cam compartment during cam support plate removal.
- See beginning of 3.18 BOTTOM END OVERHAUL: DIS-ASSEMBLY to remove cover and cam support plate. Remove oil pump after removing cam support plate.

CLEANING AND INSPECTION

 Clean all parts in a non-volatile cleaning solution or solvent.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 2. Blow parts dry with low pressure compressed air. Verify that all oil passages are clean and open.
- 3. Look for scoring, gouging or cracking caused by foreign material that may have passed through the oil pump.
- Look for grooves or scratches on the cam support plate, which serves as the outboard side of the oil pump.
- Check for excessive wear or damage on lobes of outer gerotor gears and between lobes on inner gerotor gears.



Figure 3-160. Assembling Oil Pump

- 6. See Figure 3-161. Check gerotor wear.
 - a. Mesh pieces of one gerotor set together.
 - b. Use a feeler gauge to determine clearance between tips of lobes on inner and outer gerotors.
 - Replace gerotors as a set if clearance exceeds 0.004 in. (0.10 mm). Inspect second gerotor set in the same manner.
- Measure thickness of inner gerotor of one set with a micrometer. Measure the outer gerotor of the same set. Replace the gerotor set if the difference exceeds 0.001 in. (0.025 mm). Inspect second gerotor set in the same manner.
- Assemble the oil pump. Verify that feed gerotors stand proud of the oil pump surface 0.080-0.090 in. (2.03-2.29 mm). If measurement is less than 0.080 in. (2.03 mm), remove feed gerotor set and reassemble using new wave washer. Repeat measurement and replace oil pump body if still not within specification.

INSTALLATION OVERVIEW

- See 3.19 BOTTOM END OVERHAUL: ASSEMBLY. Begin with COVER AND CAM SUPPORT PLATE instructions on page 3-59.
- 2. Continue with 3.17 TOP END OVERHAUL: ASSEMBLY.



Figure 3-161. Measure Gerotor Sets for Wear

REMOVAL OVERVIEW

- 1. Perform all steps under 3.16 TOP END OVERHAUL: DISASSEMBLY.
- 2. Perform all steps under 3.18 BOTTOM END OVER-HAUL: DISASSEMBLY.

RIGHT CRANKCASE HALF

Chain Guide Screen

See Figure 3-162. Remove, clean and reinstall screen (3). Replace screen O-ring with each removal.

Crankshaft Bearing

REMOVAL

PART NO.	SPECIALTY TOOL	
HD-44065-1	Crankshaft bearing REMOVAL/INSTALL pilot/driver	
HD-44065-4	Crankshaft bearing REMOVAL/INSTALL support tube	

AWARNING

Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

- 1. See Figure 3-163. Obtain CRANKSHAFT BEARING REMOVAL/INSTALL PILOT/DRIVER (Part No. HD-44065-1) and CRANKSHAFT BEARING REMOVAL/ INSTALL SUPPORT TUBE (Part No. HD-44065-4).
- Place support tube (2) on hydraulic press table with the REMOVAL end up. Note that the sides of the support tube are stamped to ensure proper orientation.
- 3. With the inboard side of the right crankcase half facing upward, position crankshaft bearing bore over support tube. During removal it is important that the curved edges on the pilot/driver (1) match the curved edges of the crankcase (4).
- 4. Slide pilot/driver (1) through bearing into support tube.
- 5. Center pilot/driver under ram (3) of press. Apply pressure to pilot/driver until bearing is free.
- 6. Remove crankcase, pilot/driver and bearing from support tube. Discard bearing.



Figure 3-162. Right Crankshaft (Roller) Bearing



Figure 3-163. Right Crankshaft (Roller) Bearing Removal

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-44065-1	Crankshaft (roller) bearing REMOVAL/INSTALL pilot/driver
HD-44065-4	Crankshaft (roller) bearing REMOVAL/INSTALL support tube

- See Figure 3-164. Obtain CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL PILOT/DRIVER (Part No. HD-44065-1) and CRANKSHAFT (ROLLER) BEAR-ING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-44065-4).
- Obtain new crankshaft (roller) bearing (4). Spread a thin film of clean H-D 20W50 engine oil on O.D. of new bearing.
- Place support tube (2) on hydraulic press table with the INSTALL end up. The sides of the support tube are stamped to ensure proper orientation.
- 4. With the outboard side of the right crankcase half facing upward, position crankshaft bearing bore over support tube. Lip on support tube (5) must contact edge of crankcase as shown. This allows the curved portion of the inboard crankcase to contact the top curved portion of the support tube (2).
- 5. Lubricate leading edge of **new** crankshaft (roller) bearing before placement. Start crankshaft (roller) bearing in bearing bore, letter side up.
- 6. Slide pilot/driver (1) through bearing into support tube.
- Center pilot/driver under ram (3) of press. Apply pressure to pilot/driver until resistance is felt. Tool is now bottomed against support tube flange and has properly positioned the crankshaft (roller) bearing in crankcase bearing bore.
- Remove pilot/driver and crankcase half from support tube.

Piston Jets

REMOVAL

- See Figure 3-165. Remove two T20 TORX screws (1) to free piston jet (2) from crankcase.
- Remove O-ring (3) from groove in mounting flange of jet. Discard O-ring.

INSTALLATION

CAUTION

O-rings that are missing, distorted, pinched or otherwise damaged will result in either oil leakage or low oil pressure. Use of the wrong O-ring will have the same results. Since many O-rings are similar in size and appearance, always use new O-rings keeping them packaged until use to avoid confusion.

 See Figure 3-165. Apply a very thin film of clean H-D 20W50 engine oil to **new** O-ring (3) for piston jet. Install **new** O-ring in groove of jet mounting flange.



Figure 3-164. Right Crankshaft (Roller) Bearing Installation



Figure 3-165. Piston Jets

 With jet pointed upward, start two T20 TORX screws (1) to secure piston jet (2) to crankcase. Tighten to 25-35 in-Ibs (2.8-3.9 Nm).

NOTE

If piston jet is being reused, apply LOCTITE THREAD-LOCKER 222 (purple) to threads of TORX screws before installation.

LEFT CRANKCASE HALF

Crankshaft (Roller) Bearing

REMOVAL

PART NO.	SPECIALTY TOOL
B-45655	Crankshaft (roller) bearing REMOVAL/INSTALL pilot/driver
HD-42720-5	Crankshaft (roller) bearing REMOVAL/INSTALL support tube

AWARNING

Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

WARNING

Do NOT rotate left crankcase half in the engine stand so the flywheel sprocket shaft is facing up. The flywheel assembly will fall out of the case, resulting in parts damage and could result in death or serious injury.

- While holding flywheel assembly so that it does not fall out of left crankcase half, rotate bottom end assembly in engine stand so assembly is upright and flywheel shafts are horizontal.
- 2. Carefully slide flywheel assembly out of left crankcase and place it in a clean safe place.
- Unbolt left crankcase half from stand and move it to bench area. Remove thrust washer from outboard side of crankcase half by pulling it past oil seal. Set thrust washer aside for inspection or reuse.
- See Figure 3-168. Obtain CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-42720-5) and CRANKSHAFT (ROLLER) BEAR-ING REMOVAL/INSTALL PILOT/DRIVER (Part No. B-45655).
- 5. Place support tube on work bench with "A" end up. Note that the sides of the support tube are stamped "A" and "B" to indicate proper orientation. With inboard side of left crankcase half facing upward, position crankshaft bearing bore over support tube.
- Use a suitable drift punch to tap oil seal from crankcase bore. Discard oil seal.
- 7. See Figure 3-166. The left crankshaft (roller) bearing (1) is press-fit into the crankshaft bearing bore (2) in the left crankcase and secured with a retaining ring (3) on the inboard side. See Figure 3-167. Using the tip of a flat blade screwdriver, carefully lift the edge of the retaining ring up out of its groove in the crankcase. Slide the screwdriver tip around the edge of the bearing, lifting the retaining ring up and out of the groove. Be careful not to damage the lip of the groove in the crankcase.



Figure 3-166. Left Crankshaft (Roller) Bearing Assembly



Figure 3-167. Removing Retaining Ring



Figure 3-168. Left Crankshaft (Roller) Bearing REMOVAL/INSTALL Tools



- 3. Support tube ("A" end up)

Figure 3-169. Left Crankshaft (Roller) Bearing Removal

- 8. See Figure 3-169. Place support tube (3) on hydraulic press table with the "A" end up. Note that the sides of the support tube are stamped "A" and "B" to ensure proper orientation.
- With the outboard side of the left crankcase half facing 9 upward, position crankshaft bearing bore over support tube.
- 10. Slide pilot/driver (2) through crankshaft (roller) bearing into support tube.
- 11. Center pilot/driver under ram (1) of press. Apply pressure to pilot/driver until bearing is free.
- 12. Remove crankcase half, pilot/driver and bearing from support tube. Discard bearing.

INSTALLATION

PART NO.	SPECIALTY TOOL
B-45655	Crankshaft (roller) bearing REMOVAL/INSTALL pilot/driver
HD-42720-5	Crankshaft (roller) bearing REMOVAL/INSTALL support tube

WARNING

Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

See Figure 3-168. Obtain CRANKSHAFT (ROLLER) 1. BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-42720-5) and CRANKSHAFT (ROLLER) BEAR-ING REMOVAL/INSTALL PILOT/DRIVER (Part No. B-45655).



4. Crankshaft (roller) bearing

Figure 3-170. Left Crankshaft (Roller) Bearing Installation

- 2. See Figure 3-170. Obtain new crankshaft (roller) bearing (4). Place a thin film of clean engine oil on outer diameter of bearing.
- Place support tube (3) on hydraulic press table with the 3. "A" end up.
- With the inboard side of the left crankcase half facing 4. upward, position crankshaft bearing bore over support tube.
- 5. Lubricate leading edge of new crankshaft (roller) bearing before placement. Start new crankshaft (roller) bearing in bearing bore, letter side down.
- Slide pilot/driver (2) through bearing into support tube. 6.
- 7. Center pilot/driver (2) under ram (1) of press. Apply pressure to pilot/driver until bearing is lightly bottomed in crankshaft bearing bore.
- Remove crankcase half and pilot/driver from support 8 tube.
- Obtain new retaining ring and install in bearing bore in 9. inboard side of crankcase half. Work retaining ring into groove, being careful not to damage edges of groove. Make sure retaining ring is fully seated in groove.

NOTE

If retaining ring will not fit into groove in bearing bore, it is a sign that the bearing is not fully seated in the bore. Examine the bearing and bore. If necessary, remove bearing, clean bore and reinstall bearing. Then install retaining ring.

Sprocket Shaft Bearing Inner Race

Removal

- 1. If reusing flywheel, remove bearing inner race and thrust washer as follows:
 - a. Obtain FLYWHEEL SUPPORT FIXTURE (HD-44358). See Figure 3-171. Install brass jaws or shop towels around teeth of vise to prevent damage to tool. Clamp tool in vise with the round hole topside.
 - Insert crankshaft end through hole resting flywheel assembly on fixture. Slide knurled locating pin down slot in tool to engage crank pin hole. Hand tighten locating pin.
 - c. Slide hold-down clamp down slot to engage inboard side of right flywheel half, and then hand tighten knurled nut at bottom to secure. Repeat step to secure hold-down clamp on opposite side of flywheel.

NOTE

See Figure 3-171. For proper clamping force, hold-down clamp must not be tilted. Rotate hex on outboard stud until clamp is level.

 Position WEDGE ATTACHMENT (HD-95637-46A) on inboard side of thrust washer and turn hex nuts an equal number of turns to draw halves of wedge together.

CAUTION

Install wedge attachment only so far as necessary to ensure positive contact with thrust washer. Installing tool with more contact than absolutely necessary will result in damage to flywheel.

- e. Obtain two 3/8-16 inch bolts 6-1/2 inches long (with flat washers). Install flat washers on bolts. Obtain bridge, forcing screw and hardened plug from MAIN-SHAFT BEARING INNER RACE PULLER/ INSTALLER (HD-34902B).
- f. Slide one bolt into channel on each side of bridge so that flat washer is between bridge and bolt head. Thread bolts into wedge attachment an equal number of turns.
- g. Sparingly apply graphite lubricant to threads of forcing screw to prolong service life and ensure smooth operation. Start forcing screw into center hole of bridge.



Figure 3-171. Flywheel Fixture (Part No. HD-44358)



Figure 3-172. Remove Inner Race From Sprocket Shaft

CAUTION

Failure to use hardened plug may result in damage to forcing screw and/or sprocket shaft.

- h. Place cupped side of hardened plug against end of sprocket shaft. Thread forcing screw into bridge until the steel ball at the end of the screw makes firm contact with hardened plug.
- Using the Robinair Heat Gun (HD-25070), uniformly heat the bearing inner race for about 30 seconds using a circular motion.

NOTE

To facilitate removal without heat, apply a light penetrating oil to shaft and leading edge of bearing inner race.

AWARNING

Do not use heating devices with penetrating oil. Penetrating oil is flammable which could result in death or serious injury. (00375a)

- Turn forcing screw until thrust washer and bearing inner race move approximately 1/8 inch (3.2 mm).
- k. Turn hex nuts an equal number of turns to separate halves of WEDGE ATTACHMENT.
- After bottoming thrust washer on shaft, reposition WEDGE ATTACHMENT (HD-95637-46A) on inboard side of bearing inner race. Turn hex nuts an equal number of turns to draw halves of wedge together.

CAUTION

Install wedge attachment only so far as necessary to ensure positive contact with bearing inner race. Installing tool with more contact than absolutely necessary will result in damage to flywheel.

- Werify that the tool assembly is square, so that the bearing inner race is not cocked during removal. See Figure 3-172.
- N. Using the Robinair Heat Gun (HD-25070), uniformly heat the bearing inner race for about 30 seconds using a circular motion.

NOTE

To facilitate removal without heat, apply a light penetrating oil to shaft and leading edge of bearing inner race.

- Turn forcing screw until bearing inner race is pulled free of sprocket shaft.
- p. Remove thrust washer from sprocket shaft.
- 2. Discard thrust washer and bearing inner race.



Figure 3-173. Sprocket Shaft Bearing Cone Installer (Part No. HD-97225-55B)

Installation

- Place new thrust washer over sprocket shaft with the ink stamp facing outside (and the chamfer on the ID inboard).
- Place new bearing inner race on bench top. Using the Robinair Heat Gun (HD-25070), uniformly heat bearing inner race for about 60 seconds using a circular motion.
- 3. Wearing suitable gloves to protect hands from burns, place heated bearing inner race over sprocket shaft.

NOTE

To facilitate installation without heat, apply a light penetrating oil to shaft and leading edge of bearing inner race.

AWARNING

Do not use heating devices with penetrating oil. Penetrating oil is flammable which could result in death or serious injury. (00375a)

- Obtain the SPROCKET SHAFT BEARING CONE INSTALLER (HD-97225-55B). See Figure 3-173. Assemble tool as described below.
 - Thread pilot onto sprocket shaft until contact is made with shoulder.
 - Sparingly apply graphite lubricant to threads of pilot shaft to prolong service life and ensure smooth operation.
 - c. Slide sleeve over pilot until it contacts bearing inner race.
 - d. Slide Nice bearing and large flat washer over pilot until contact is made with sleeve.
 - e. Thread handle onto pilot shaft. See Figure 3-174.
- Rotate handle of tool in a clockwise direction until bearing inner race bottoms against thrust washer. See Figure 3-175.
- Remove handle, flat washer, Nice bearing, sleeve and pilot from sprocket shaft.



Figure 3-174. Press Inner Race Onto Sprocket Shaft



Figure 3-175. Press Inner Race Onto Sprocket Shaft



Figure 3-176. Removing Balance Support Bearings

Balance Shaft Support Bearings

PART NO.	SPECIALTY TOOL
HD-44060	Wheel bearing remover/installer
HD-44066	Balance shaft inner/outer bearing remover/installer

REMOVAL

NOTE

Always replace all four bearings (crankcase and housing, front and rear) during a complete bottom end overhaul. See 3.30 COUNTERBALANCER ASSEMBLY to replace bearings in balance shaft support housings.

- 1. See Figure 3-176. Prepare tools for removal.
 - Sparingly apply graphite lubricant along threads of forcing screw (1) to prolong service life and ensure smooth operation.
 - Install nut (2), washer (3), Nice bearing (4) and plate (5) on forcing screw (1).
 - c. Place ball bearing inside collet (6). Attach collet to forcing screw.
- 2. Align tool over bearing in left crankcase half.
- Hold end on forcing screw (1) and turn collet (6) to expand collet.
- Remove bearing by holding forcing screw (1) and turning nut (2).
- 5. Repeat procedure for the other bearing.



Figure 3-177. Balance Support Bearing Pilot



Figure 3-178. Installing Bearing

INSTALLATION

CAUTION

Use caution when supporting crankcase half. Failure to have adequate support may cause damage to exterior finish.

- Support crankcase half in a press using wooden blocks covered with clean shop towels. Note that uneven surfaces on crankcase may need different size supports.
- 2. See Figure 3-177. Place pilot (1) over new bearing (2).
- See Figure 3-178. Center pilot under ram of press. Slowly lower ram until resistance is felt and bearing is fully seated.
- 4. Repeat procedure for the other bearing.

CYLINDER STUDS

Removal

- 1. Thread a 3/8"-16 nut onto cylinder stud.
- 2. Thread a second nut onto stud until it contacts the first.
- 3. Placing wrench on first nut installed, remove stud.

Installation

- Place a steel ball inside a head screw. Put the head screw on the end of the cylinder stud without the collar.
- See Figure 3-179. Start the stud in the cylinder deck with the collar side down. Tighten using air gun until collar reaches crankcase.
- 3. Hand tighten stud to 10-20 ft-lbs (13.6-27.1 Nm).

PIPE PLUG AND OIL FITTINGS

Removal/Installation

NOTE

See 3.32 OIL TANK for information on replacing O-rings and retainers within oil tank fittings.

- 1. See Figure 3-180. Remove parts.
 - a. Turn hex on oil fittings (1, 2, 3) in a counterclockwise direction until free.
 - b. Turn pipe plugs (4, 5) counterclockwise until free.
- 2. Apply LOCTITE PIPE SEALANT 565 to fitting threads.
- 3. See Figure 3-180. Install parts.
 - Turn hex on oil fittings (1, 2, 3) in a clockwise direction until snug. Tighten to oil fittings to 120-168 in-Ibs (13.6-19.0 Nm).
 - Install pipe plugs (4, 5). Tighten to 120-144 in-lbs (13.6-16.3 Nm).



Figure 3-179. Collar Side Down

Oil return fitting 1. Oil feed fitting 2. Oil vent fitting 3. Pipe plug 4. 5. Pipe plugs (2) 3 1 0 0 2 5 s0251x3x

Figure 3-180. Oil Fittings and Pipe Plugs

CLEANING AND INSPECTION

- Scrape old gasket material from the crankcase flanges. Old gasket material left on mating surfaces will cause leaks.
- Clean all parts in a non-volatile cleaning solution or solvent.

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 3. Blow parts dry with low pressure compressed air.
- Verify that all oil holes and passageways are clean and open.
- Check ring dowels for looseness, wear or damage. Replace as necessary.
- Use a file to carefully remove any nicks or burrs from machined surfaces.
- 7. Clean out tapped holes and clean up damaged threads.
- 8. Check the top of the crankcase for flatness with a straightedge and feeler gauge. Replace if warped.
- 9. Spray all machined surfaces with clean engine oil.

INSTALLATION OVERVIEW

- 1. Perform all steps under 3.19 BOTTOM END OVER-HAUL: ASSEMBLY.
- 2. Perform all steps under 3.17 TOP END OVERHAUL: ASSEMBLY.

REMOVAL OVERVIEW

- Perform all steps under 3.16 TOP END OVERHAUL: DISASSEMBLY.
- Perform all steps under 3.18 BOTTOM END OVER-HAUL: DISASSEMBLY.

CLEANING, INSPECTION AND REPAIR

General

 Clean all parts but bearings in a non-volatile cleaning solution or solvent.

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

2. Blow parts dry with low pressure compressed air.

Balance Shaft Support Bearings

PART NO.	SPECIALTY TOOL
HD-44065	Crankcase bearing remover
HD-44066	Balance shaft inner/outer bearing remover/installer

NOTE

See LEFT CRANKCASE HALF under 3.29 CRANKCASE to service bearings in left crankcase half.

REMOVAL

- Inspect bearing for rough spots or binding. Always replace all four bearings (crankcase and housing, front and rear) during a complete bottom end overhaul.
- See Figure 3-181. Place housing (2) upside down on a suitable support (4) such as the CRANKCASE BEAR-ING REMOVER (Part No. HD-44065).
- 3. Place pilot (3) over bearing.
- Center pilot under ram (1) of press. Slowly lower ram to remove bearing.
- 5. Discard retaining ring and bearing.



Figure 3-181. Removing Bearing From Housing



Figure 3-182. Installing Bearing In Housing

INSTALLATION

- See Figure 3-182. Place housing (5) with top surface upright on a suitable support.
- 2. Install a new retaining ring (3) around bearing (4).
- 3. Set bearing/retaining ring on housing with letters on bearing facing up. Place pilot (2) over bearing.
- Center pilot under ram (1) of press. Slowly lower ram to seat bearing until retaining ring fits flush against housing.

Front and Rear Balance Sprockets

- See Figure 3-183. Sprockets must be flat within 0.008 in. (0.203 mm).
- Inspect sprocket teeth for any irregular wear patterns or chipping.
 - a. The most common type of sprocket wear is polishing. This results from the chain contacting the sprocket surface and creating a shiny, mirror-like surface. Moderate polishing is not grounds for replacement.
 - b. Sprocket teeth may exhibit surface deformations or areas where the material has been compressed. This is known as brinelling. If small chunks of metal are removed from the surface, it is known as pitting. Replace sprockets showing pitting or brinelling.
 - c. Inspect base of each sprocket tooth for hooking. Hooking occurs when chain wears away the tooth in a scalloped shape pattern. Replace sprockets showing signs of severe hooking.
- Check the mating surface that fits around the balance shaft. Improperly installed sprockets may show wear on inside edges.
- Replace sprockets during a major bottom end overhaul. Always replace sprockets in sets, including the sprocket on the flywheel.

Hydraulic Tensioners

- Test hydraulic tensioners using the leakdown test for the chain guide bracket on an assembled engine. See CRANKCASE under 3.19 BOTTOM END OVERHAUL: ASSEMBLY.
- 2. Check to see if more air is flowing from the front or rear tensioner by placing your hand over the piston while applying compressed air to the interconnect passage. See Figure 3-184. Disassemble components and verify that the plastic vent cap (2) is on the spring (3) and seated under the tensioner piston (1). Minimum free length for spring (3) is 1.85 in. (47.0 mm).
- Inspect exterior surface of piston (1) for damage. While some moderate amount of polishing is normal, surface pitting is grounds for piston replacement.

Chain Tensioner Guides

Inspect tensioner guide surface. Replace any guide with grooves deeper than 0.080-0.090 in. (2.03-2.29 mm) or signs of melting, burning or cracking.

Chain Guide Bracket

Replace the rubber interconnect on the outside of the chain guide bracket each time the right crankcase is removed. Beyond the hydraulic tensioner piston, plastic vent cap and spring, there are no internal service parts available for the chain guide bracket. If the bracket fails the leak down test and the rubber interconnect has been replaced, replace the chain guide bracket as an assembly.



Figure 3-183. Sprocket Inspection



Figure 3-184. Hydraulic Tensioners

Balance Chain

- Check balance chain for missing bushings, side plates and turning marks. Inspect for tooth hooking or burn marks. Replace as necessary.
- Chains will darken in color as the result of wear and exposure to engine oil. This darkening will almost always be some hue of brown. If the chain turns blue, it may be the result of heat exposure.
- Replace balance chain any time the sprockets are replaced. Always apply a thin film of clean H-D 20W50 engine oil before installation.

INSTALLATION OVERVIEW

- 1. Perform all steps under 3.19 BOTTOM END OVER-HAUL: ASSEMBLY.
- Perform all steps under 3.17 TOP END OVERHAUL: ASSEMBLY.

REMOVAL OVERVIEW

- 1. Perform all steps under 3.16 TOP END OVERHAUL: DISASSEMBLY.
- 2. Perform all steps under 3.18 BOTTOM END OVER-HAUL: DISASSEMBLY.
- 3. Remove sprocket shaft bearing. See LEFT CRANK-CASE HALF on page 3-122.

INSPECTION

CAUTION

Do not attempt to straighten connecting rods. Straightening rods will damage both the upper bushing and lower bearing.

- 1. Replace the flywheel/connecting rod assembly if any of the following conditions are noted:
 - a. Connecting rods are bent or twisted.
 - b. Connecting rods do not fall under their own weight or are in a bind.
 - c. Sprocket teeth are worn in a irregular pattern or chipped.
 - d. The crankshaft (roller) bearing inner races are brinelled, burnt, scored, blued or damaged.

NOTE

Bluing on connecting rods is part of the hardening process and is considered a normal condition.

- 2. Check connecting rod bearing clearance. Orient the assembly as shown in Figure 3-185.
 - a. Holding the shank of each rod just above the bearing bore, pull up and down on the connecting rods.
 - b. Any discernible up and down movement indicates excessive lower bearing clearance. Replace the flywheel/connecting rod assembly.
- 3. See Figure 3-186. Check connecting rod side play.
 - a. Insert a feeler gauge between the thrust washer and the outboard side of the connecting rod.
 - b. Replace the assembly if rod side play exceeds 0.020 in. (0.51 mm).

NOTE

If the flywheel, connecting rods or right side bearing inner race need to be replaced, then replace the entire flywheel assembly.



Figure 3-185. Connecting Rod Bearing Clearance



Figure 3-186. Connecting Rod Side Play

INSTALLATION OVERVIEW

- 1. Perform all steps under 3.19 BOTTOM END OVER-HAUL: ASSEMBLY.
- 2. Perform all steps under 3.17 TOP END OVERHAUL: ASSEMBLY.

REMOVAL/DISASSEMBLY

Oil Tank

PART NO.	SPECIALTY TOOL
HD-44455	Oil line tool
HD-97087-65B	Hose clamp pliers

- Remove rear exhaust pipe. See 4.9 EXHAUST SYS-TEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- Remove plug to drain oil tank. See 1.4 ENGINE OIL AND FILTER.
- 3. Remove seat.

AWARNING

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

- Disconnect both battery cables, negative cable first, and remove battery. See 1.5 BATTERY MAINTENANCE.
- 5. Detach fender extension.
 - a. Remove two bolts from bottom of extension.
 - B. Rotate upper right corner of extension towards rear wheel. Lift extension over frame tab and then lower to remove.
- 6. Remove two bolts attaching electrical panel to back of oil tank.
- See Figure 3-187. Detach vent (1) and return (2) oil lines at front of tank using OIL LINE REMOVING TOOL (Part No. HD-44455).
 - a. Slide cover (3) away from oil line.
 - b. Insert tool (4) inside retainer (5).
 - c. Pull oil line straight out from tank leaving oil line retainer (5) inside tank.
- 8. See Figure 3-188. Remove two bolts (1) from behind fuse block (2). Lift fuse block bracket and set aside.
- 9. Remove two bolts with washers (3) on top front bracket.
- See Figure 3-189. Remove flange nuts (27) and two screws with washers (26). Remove rubber battery tray pad.
- 11. Undo lower drain hose clamp (2) from frame.
- Cut clamp (7) from either side of oil feed hose (8) using HOSE CLAMP PLIERS (Part No. HD-97087-65B).
- 13. Thread positive battery cable through oil tank as tank is removed from the right side.



- 2. Return line
- 3. Cover
- 4. Oil line removing tool
- 5. Oil line retainer

Figure 3-187. Line Cover



- 1. Fuse block bracket bolts
- 2. Fuse block and cover
- 3. Top bracket bolts

Figure 3-188. Top View of Oil Tank



Figure 3-189. Oil Tank

Oil Line Fittings/Retainers

NOTES

There are two sizes of oil line retainers and fittings. Use the appropriate sized oil line tool for all service procedures. See Figure 3-190.

- See Figure 3-191. Small retainers connect the vent (1) and return lines (2) to the oil tank. A small retainer and fitting also connects the vent line (3) to the engine.
- Large retainers and fittings attach the return (4) and feed lines (5) to the engine.
- See Figure 3-192. Do not remove oil line retainers from engine fittings or oil tank unless retainers, o-rings, and/or spacers are damaged.
- See Figure 3-193. O-rings (1) and spacer (2) are not sold separately. If either o-rings or spacer are damaged, oil line retainer assembly must be replaced.
- 1. Insert OIL LINE O-RING TOOL (4) (Part No. HD-44455) inside retainer (3).
- Squeeze tabs on retainer and withdraw tool, retainer, both O-rings and spacer. Discard retainer, O-rings and spacer
- 3. Insert tool (4) through new retainer (3).
- Insert tool, retainer, spacer and o-rings into engine fitting or oil tank until tabs on retainer lock into place. Do not damage O-rings during installation.
- 5. Carefully withdraw tool leaving retainer assembly in place.



Figure 3-190. Oil Line Tools



- 1. Vent line to oil tank (small retainer)
- 2. Return line to oil tank (small retainer)
- 3. Vent line to engine (small retainer and fitting)
- 4. Return line to engine (large retainer and fitting)
- 5. Feed line to engine (large retainer and fitting)

Figure 3-191. Oil Line Fittings/Retainers



Figure 3-192. Oil Line Retainers (Parts Removed from Engine For Clarity of Illustration)



Figure 3-193. O-rings and Spacer

INSTALLATION

- 1. See Figure 3-189. Slide oil tank into position within frame. Install two bolts and washers (22) through top bracket (21) to hold tank in place.
- Install two screws and washers (26) from back side of tank. Secure with flange nuts (27).
- 3. Install new clamp (7) to attach oil feed hose (8).
- Position drain hose outboard of the electrical panel and inboard of the brake line and frame harness. Attach drain hose clamp (2) to frame.
- Install the two bolts which attach the electrical panel to the frame.
- 6. See Figure 3-194. Install two bolts (1) to attach fuse block bracket.
- Place rubber battery tray (2) inside oil tank. Route positive battery cable (3) through hole in tray as shown in Figure 3-195.
- See Figure 3-187. Connect vent and return lines to tank. No tools are necessary for this step. Insert lines straight into fittings without digging or gouging O-rings. Remove any labels used to identify lines during removal process.
- Install fender extension using two bolts. Extension must mount over frame tab.
- Install rear exhaust pipe. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.

WARNING

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

11. Install battery and connect cables, positive cable first.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

- 12. Install seat.
- Fill oil tank and check oil level after running motorcycle on side stand. See 1.4 ENGINE OIL AND FILTER.



Figure 3-194. Positive Battery Cable



Figure 3-195. Battery Tray Hole

FUEL SYSTEM

SUBJECT

PAGE NO.

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FUEL TANK CAPACITY	GALLONS	LITERS
Total (all but FXSTD)	5.0	18.92
Total (FXSTD)	4.9	18.55
Reserve (all models)	0.5	1.89

CARBURETOR	MAIN FUEL JET	SLOW FUEL JET
All models, all markets	190	45

TORQUE VALUES

ITEM	TOR	QUE	NOTES
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	LOCTITE THREADLOCKER 243 (blue), page 4-23
Air filter bracket screws	40-60 in-lbs	4.5-6.8 Nm	T27 TORX, page 4-23
Breather bolts	120-144 in-lbs	13.6-16.3 Nm	metric, page 4-23
Carburetor top screws	17-23 in-lbs	1.9-2.6 Nm	FXSTD, replace upon removal (preferred) or use LOC- TITE THREADLOCKER 243 (blue), page 4-10
Cylinder head stud nuts	special mea	ns to tighten	page 4-25, page 4-27, page 4-29, page 4-31
Exhaust bracket carriage bolt	30-33 ft-lbs	40.7-44.7 Nm	FLSTN, page 4-29
Exhaust bracket carriage bolt	30-33 ft-lbs	40.7-44.7 Nm	FXSTD/FLSTF, page 4-27
Exhaust bracket screws	15-19 ft-lbs	20.3-25.8 Nm	FLSTN, page 4-29
Exhaust bracket screws	15-19 ft-lbs	20.3-25.8 Nm	FXSTD/FLSTF, page 4-27
Fuel tank console nut	14-18 in-lbs	19.0-24.4 Nm	all but FXSTD, page 4-21
Fuel tank front screw	28-32 ft-lbs	38.0-43.4 Nm	all but FXSTD, page 4-21
Fuel tank front screw	28-32 ft-lbs	38.0-43.4 Nm	FXSTD, page 4-21
Fuel tank rear bolt	18-22 ft-lbs	24.4-29.8 Nm	T40 TORX ,all but FXSTD, page 4-21
Fuel tank rear mounting nut	14-18 ft-lbs	19.0-24.4 Nm	FXSTD, page 4-21
Interconnect tube flange lock- nuts	30-33 ft-lbs	40.7-44.7 Nm	all but FXSTD/FLSTF/FLSTN/FLSTSC, page 4-25
Manifold mounting screws	8-12 ft-lbs	10.8-16.3 Nm	page 4-8
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	all but FXSTD/FLSTF/FLSTN/FLSTSC, page 4-25
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FLSTN, page 4-29
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FLSTSC, page 4-31
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FXSTD/FLSTF, page 4-27
Muffler to exhaust bracket screws	96-120 in-lbs	10.8-13.6 Nm	FLSTN, page 4-29
Muffler to interconnect bolts	96-120 in-lbs	10.8-13.6 Nm	all but FXSTD/FLSTF/FLSTN/FLSTSC, page 4-25

CARBURETOR

Table 4-1. Overflow Troubleshooting

CHECK FOR	REMEDY	
Damaged or restricted fuel tank venting system.	Unclog system.	
Loose float bowl screws.	Tighten screws.	
Damaged float bowl O-ring.	Replace O-ring.	
Improper fuel level in float bowl.	Adjust float tab for correct fuel level.	
Worn or dirty inlet valve or seat.	Clean or replace valve and clean seat.	
Damaged or leaking float assembly.	Replace float assembly.	
Particle contamination in inlet fitting cavity.	Clean and clear cavity and fuel supply tract.	

Table 4-2. Poor Idling

CHECK FOR	REMEDY	
Idle speed improperly adjusted.	Adjust idle speed.	
Inlet system air leak.	Correct as required.	
Leaking accelerator pump.	Repair.	
Loose low speed jet.	Tighten jet.	
Plugged low speed jet.	Clean contaminants and clear passages.	
Contaminated or plugged low speed system.	Clean contaminants and clear passages.	
Enrichener valve not seated or leaking.	Adjust, clean or replace.	

Table 4-3. Poor Fuel Economy

CHECK FOR	REMEDY
Excessive enrichener use.	Instruct rider.
High speed riding style.	Modify riding habits.
Idle speed improperly adjusted.	Adjust operating idle speed.
Dirty air cleaner element (may also affect idle speed).	Clean or replace as required.
Vacuum piston assembly malfunction.	See VACUUM PISTON ASSEMBLY which follows.
Excessive accelerator pump output.	Replace accelerator pump nozzle.
Plugged or restricted bowl vent.	Clean and clear passages.
Fuel level too high.	Adjust float level.
Loose jets.	Tighten jets.
Worn or damaged needle or needle jet.	Replace needle or needle jet.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Plugged air jets or passages.	Clean and clear passages.

CHECK FOR	REMEDY
Throttle cables misaligned or misrouted (may also affect idle speed).	Adjust throttle cables.
Damaged or restricted fuel tank venting system.	Unclog system.
Inlet system air leak.	Correct as required.
Vacuum piston malfunction.	See VACUUM PISTON ASSEMBLY which follows.
Accelerator pump leaking or no output.	Repair as necessary.
Plugged bowl vent.	Clean and clear passages.
Fuel level (float chamber) too low.	Adjust float level.
Restricted fuel supply passages.	Correct and clear restriction.
Plugged jets or passages.	Clean and clear as required.
Worn or damaged needle or needle jet.	Replace assembly.
Enrichener valve not seated or leaking.	Adjust, clean or replace.

Table 4-4. Poor Acceleration

Table 4-5. Hard Starting

CHECK FOR	REMEDY
Enrichener system plugged, not properly functioning or improperly operated.	Clean, adjust, replace or read Owner's Manual.
Fuel overflow.	See Table 4-1. Overflow Troubleshooting.
Restricted fuel supply.	Correct fuel supply or passages.
Plugged slow jet or passages.	Clean and clear jet or passages.
Inlet system air leak.	Correct as required.

Table 4-6. Poor Performance On Road

CHECK FOR	REMEDY	
Idle speed improperly adjusted.	Adjust idle speed.	
Inlet system air leak.	Correct as required.	
Damaged or restricted fuel tank venting system.	Unclog system.	
Dirty or damaged air cleaner element.	Clean or replace.	
Accelerator pump inoperative.	Repair as required.	
Vacuum piston assembly malfunction.	See VACUUM PISTON ASSEMBLY which follows.	
Restricted fuel supply tract.	Correct and clear restriction.	
Plugged bowl vent.	Clean and clear passages.	
Loose or plugged fuel and air jets or passages.	Clean, clear and correct as required.	
Worn or damaged needle or needle jet.	Replace assembly.	
Enrichener valve not seated or leaking.	Adjust, clean or replace.	

CHECK FOR	REMEDY
Inlet system air leak.	Clean or replace.
Damaged or restricted fuel tank venting system.	Unclog system.
Dirty or damaged air cleaner element.	Clean or replace.
Accelerator pump inoperative.	Repair as required.
Vacuum piston assembly malfunction.	See VACUUM PISTON ASSEMBLY which follows.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Restricted fuel supply tract.	Correct and clear restriction.
Plugged bowl vent.	Clean and clear passages.
Improper fuel level.	Adjust float level.
Loose or plugged main jets or passages.	Tighten, clean, clear as required.
Worn or damaged needle or needle jet.	Replace assembly. –

Table 4-7. Poor High Speed Performance

VACUUM PISTON ASSEMBLY

Table 4-8. Piston Does Not Raise Properly

CHECK FOR	REMEDY	
Piston atmosphere vent blocked.	Clear vent.	
Piston binding.	Clean piston slides and body or replace piston.	
Spring binding.	Correct or replace spring.	
Diaphragm cap loose, damaged or leaking.	Tighten or replace cap.	
Diaphragm pinched at lip groove.	Reposition diaphragm lip.	
Torn diaphragm.	Replace piston diaphragm assembly.	
Piston vacuum passage plugged.	Clean and clear passage.	
Enrichener valve open, not seated or leaking.	Adjust, clean or replace.	

Table 4-9. Piston Does Not Close Properly

CHECK FOR	REMEDY
Piston binding.	Clean piston slides and body or replace piston.
Piston diaphragm ring dirty or damaged.	Clean or replace piston.
Spring damaged.	Replace spring.

GENERAL

CAUTION

You must pay close attention to warm-up time. Either excessive or insufficient use of the enrichener may cause poor performance, erratic idle, poor fuel economy and spark plug fouling.

The enrichener knob, labeled CHOKE, and located under the left side fuel tank, controls the opening and closing of the enrichener circuit in the carburetor. The enrichener knob can be adjusted to any position, from full-in to full-out.

See 1.24 THROTTLE CABLES for more information.

NOTE

The following starting and operating instructions for all Harley-Davidson motorcycles are recommendations. They may be modified for individual vehicles.

OPERATION

Cool Engine

Outside Temperature Less than 60° F (15.6° C)

See Figure 4-1. **BE SURE THROTTLE IS CLOSED**. Pull enrichener knob to full-out position (3). Turn the ignition switch ON and press starter switch to operate the electric starter.

- After initial 15-30 second warm-up, ride for 3 minutes or 2 miles (3.2 km) with the enrichener knob in full-out position (3).
- After 3 minutes or 2 miles (3.2 km), push the enrichener knob in to the 1/2 way position (2). Ride 2 minutes or 2 miles (3.2 km).
- 3. After 2 minutes or 2 miles (3.2 km), push the enrichener knob fully in to the normal running position (1).

NOTE

If outside temperature is cooler than 20° F (-6.7° C) it may be necessary to pump the throttle 2 or 3 times.



Figure 4-1. Enrichener Operation

Outside Temperature Warmer than 60° F (15.6° C)

See Figure 4-1. **BE SURE THROTTLE IS CLOSED**. Pull enrichener knob to full-out position (3). Turn the ignition switch ON and press starter switch to operate the electric starter.

- After initial 15-30 second warm-up, ride for 1 minute or 0.5 mile (0.8 km) with the enrichener knob in full-out position (3).
- After 1 minute or 0.5 mile (0.8 km), push the enrichener knob in to the 1/2 way position (2). Ride 1 minute or 0.5 mile (0.8 km).
- After 1 minute or 0.5 mile (0.8 km), push the enrichener knob fully in to the normal running position (1).

Warm Climate or Hot Engine

Open throttle 1/8-1/4. Turn on ignition switch and operate electric starter. **DO NOT USE ENRICHENER**.

NOTE

If the engine does not start after a few turns or if one cylinder fires weakly but engine does not start, it is usually because of an over-rich (flooded) condition. This is especially true of a hot engine. If the engine is flooded, push enrichener knob in all the way, turn ignition on and operate starter with throttle wide open. DO NOT "pump" the throttle while turning the engine over.

REMOVAL

 Remove the air cleaner cover and backplate. See 4.8 AIR CLEANER: CARBURETED.

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- Turn the fuel supply valve OFF. Disconnect fuel line from carburetor.
- Detach enrichener knob from bracket above horn. See 1.24 THROTTLE CABLES.
- 4. See Figure 4-2. Disconnect the throttle cables (1, 2) from the carburetor.
- See Figure 4-3. Remove vacuum hose from the carburetor. Pull carburetor free of seal ring (13) and manifold (9).
- 6. Remove enrichener cable (52, 53, and 54), enrichener valve (50) and spring (51).
- If the manifold or manifold seals need to be removed, remove the screws (10) that hold the manifold in place and detach MAP sensor connector from wiring harness. See 8.7 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP).



Throttle control cable

Idle control cable

1.

s0090x1x

Figure 4-2. Throttle Cables

- 1. Screw, top (3)
- 2. Top
- Collar
- 4. Spring
- 5. Spring seat
- 6. Jet needle
- 7. Vacuum piston
- 8. Flange
- 9. Manifold
- 10. Screw (4) @ 8-12 ft-lbs (10.9-16.3 Nm)
- 11. Flange
- 12. Seal, intake manifold
- 13. Seal ring
- 14. Screw (idle speed adjust)
- 15. Spring
- 16. Screw (throttle cable bracket)
- 17. Bracket, throttle cable
- 18. Screw (throttle cable bracket)
- 19. Rod
- 20. Washer
- 21. Spring

22. Collar

- 23. Collar
- 24. E-clip
- 25. Washer
- 26. Cotter pins (2)
- 27. Washer
- 28. Lever
- 29. Washer
- 30. Cotter pins (2)
- 31. Slow jet
- 32. Pin
- 33. Float
- 34. Boot
- 35. Rod
- 36. O-ring
- 37. Float bowl
- 38. Diaphragm
- 39. Spring
- 40. Pump housing
- 41. Lockwashers (3)
- 42. Screws (3)
- 42. Oring
- 43. O-ring

Legend for Figure 4-3. Carburetor

- 44. Accelerator pump nozzle
- 45. Screw
- 46. Main jet
- 47. Needle jet holder
- 48. Needle jet
- 49. Fuel inlet valve with clip
- 50. Enrichener valve
- 51. Spring
- 52. Cable sealing cap
- 53. Starter cap
- 54. Cable guide

2



Figure 4-3. Carburetor

INSTALLATION

NOTE

When you position the manifold on the cylinder head studs, be sure the flanges are installed correctly on the manifold. Be sure the rubber seals are in place.

- See Figure 4-3. Place the intake manifold seal (12), flanges (11), and manifold (9) in position. Flanges are marked with "F" for forward and "R" for rear cylinder. Install the manifold mounting screws (10) finger tight.
- 2. Install seal ring (13) on inlet end of manifold.

NOTE

For ease of installation, lubricate carburetor body spigot and inside surface of seal ring with liquid dish soap or tire mounting lube.

- 3. Push carburetor body into seal ring.
- Connect throttle cables and fuel line to carburetor. See 1.24 THROTTLE CABLES.
- 5. Install air cleaner backplate. See 4.8 AIR CLEANER: CARBURETED.
- See Figure 4-4. Tighten manifold mounting screws (1) to 8-12 ft-lbs (10.8-16.3 Nm).
- Attach MAP sensor connector to wiring harness. See 8.7 MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP).
- 8. Install air cleaner filter and cover.
- 9. Install enrichener cable in mounting bracket and adjust enrichener. See 4.3 ENRICHENER: CARBURETED.

DISASSEMBLY

Vacuum Piston Chamber

- 1. See Figure 4-3. Remove screws (16, 18) and bracket (17).
- 2. Remove screws (1). Remove top (2), collar (3) and spring (4).
- Lift out vacuum piston (7) with needle (6) and spring seat (5). Remove loose parts from vacuum piston.



- 2. Manifold flange
- 3. Open side of manifold flange

4. MAP sensor

Figure 4-4. Flange Screws

Carburetor Body

- 1. See Figure 4-3. Remove screws (45) to detach float bowl assembly.
- 2. Remove pin (32), float (33) and valve (49).
- Unscrew main jet (46) and needle jet holder (47). Needle jet (48) is now free to be removed from bottom end of passage.
- 4. Insert thin bladed screw driver into slow jet passage and turn out slow jet (31).

Accelerator Pump

See Figure 4-3. Remove screws (42), lockwashers (41), accelerator pump housing (40), spring (39) and diaphragm (38). Remove O-ring (43) from housing.
CLEANING AND INSPECTION

Vacuum Piston Components

- Hold vacuum piston up to strong light. Examine diaphragm at top of vacuum piston for evidence of pinching, holes or tears. Replace if damaged.
- 2. Examine vacuum passage through bottom of piston. Clean passage if restricted.
- 3. See Figure 4-3. Examine spring (4) for stretching, crimping or any distortion or damage. Replace if damaged.
- Examine slide on sides of piston to be sure surface is smooth and clean. Clean or buff out any rough surfaces.
- Examine needle (6) for evidence of bending or damage. Examine tip of float needle for grooves. Needle should be straight and surface of taper smooth and even.

Carburetor Body Components

 See Figure 4-3. Check float bowl O-ring (36) for any distortion or damage. Replace if seating surfaces are damaged.

CAUTION

Do not submerge inlet valve in cold acid dip. The valve's alloy will be etched/damaged.

- Examine fuel inlet valve (49) and inlet valve seat. Clean with carburetor cleaner. Replace if seating surfaces are damaged.
- Clean slow jet (31) with carburetor cleaner. Check to be sure all orifices are open.
- Check enrichener valve (50). Be sure needle guide is clean, straight and undamaged. Check seat surface and spring (51) for wear or damage. Replace if damaged.
- Check enrichener valve chamber. Clean with carburetor cleaner. Check that all passages are open and free of obstruction.
- 6. Clean needle jet (48). Replace if damaged.
- Clean all internal fuel/air passages and jets. Check that all passages and jets are open and free of obstruction.
- Check needle jet holder (47). Clean bleed tube orifices. Replace holder if damaged.
- Check float (33) for cracks or other leaks. Replace if damaged. See Float Replacement which follows.
- Clean main jet (46) with carburetor cleaner and inspect for damage. Replace if damaged.



Figure 4-5. Float Pin Pedestal

CAUTION

When removing or installing the float pin, be careful not to break the pedestal. If the pedestal is broken, the carburetor will have to be replaced.

See Figure 4-5. A cast-in arrow (2) points at the rounded pedestal (1) that has the interference fit float pin.

The arrow indicates direction of removal.

- Tap pin out from INTERFERENCE SIDE pedestal (direction of arrow).
- Install pin from LOOSE SIDE pedestal (opposite arrow).

Accelerator Pump

Float Replacement

- See Figure 4-3. Inspect the accelerator pump diaphragm (38) for holes, cracks or deformation. Replace as necessary.
- Replace the pump rod (35) if it is bent and replace the boot (34) if it is cracked.

Carburetor Body

Vacuum Piston Chamber

- See Figure 4-3. Place needle (6) through center hole in vacuum piston (7). Place spring seat (5) over top of needle.
- Insert vacuum piston into carburetor body. The slides on the piston are off-center and the piston will fit into the slide track grooves only one way. If piston does not fit, rotate 180 degrees.
- 3. Check to be sure diaphragm is seated evenly into groove at top of carburetor body.
- Place spring (4) over spring seat and carefully lower top (2). Keep spring straight while lowering top.
- 5. After top is seated, hold top while lifting up on vacuum piston. Piston should rise to top smoothly. If piston movement is restricted, spring is cocked. Lift up on top and lower carefully, keeping spring coils straight.
- Once top is installed correctly, install collar (3) and screws (1). On FXSTD models, Apply LOCTITE THREADLOCKER 243 (blue) to the four carburetor top screws before installation. Tighten to 17-23 in-lbs (1.9-2.6 Nm).

NOTE

If the proper adhesive is not available, consult your parts catalog and order **new** screws. New screws have an adhesive patch.

 Place bracket (17) in position with idle screw resting on top of throttle cam stop. Install body screw and washer (18) first, then top screw (16), to prevent bending bracket or throttle cam.

CAUTION

Slow fuel jets from fixed venturi carburetors look the same as the slow jet of the C.V. carburetor. However, the air bleed hole sizes are different on fixed venturi carburetors and they must not be installed on C.V. carburetors.

- 1. See Figure 4-3. Screw slow jet (31) into slow jet passage with narrow bladed screwdriver.
- 2. Turn carburetor upside down. Place needle jet (48) in main jet passage with needle passing through center hole. Be sure end of jet with larger opening and chamfered surface enters passage first.
- 3. Insert needle jet holder (47) into main jet passage with needle inserted into center of holder. Thread holder into passage and tighten. Thread main jet (46) into tapped hole in holder and tighten.
- 4. Place float assembly (33) into position with fuel inlet valve (49) inserted into valve seat and pivot arm aligned with holes in mounting posts at bottom of carburetor body. Insert pin (32) through float pivot arm and float mounting posts.
- Place float bowl over float and onto carburetor body flange. Bowl will only fit in one position. Install screws (45) and tighten.
- 6. Install enrichener valve (50) and spring (51). Install enrichener cable (52, 53, and 54) on carburetor.

Accelerator Pump

See Figure 4-3. Install diaphragm (38), spring (39), O-ring (43) and housing (40). Secure with three screws (42) and lockwashers (41).

OPERATION CHECK – VACUUM PISTON

Opening Malfunction

AWARNING

While observing piston slide movement be sure to maintain a safe distance from the carburetor and wear suitable eye protection. An unexpected engine backfire could result in death or serious injury.

- With air cleaner cover off and engine running, partially open and close throttle control several times to see if vacuum piston has upward movement. If piston does not rise, see 4.2 FUEL SYSTEM TROUBLESHOOTING and Table 4-8.
- With engine not running, lift vacuum piston with finger. Feel whether piston lifts fully and smoothly or whether it binds.

Closing Malfunction

- With engine not running, lift vacuum piston to full open position, then release. See if piston slides downward smoothly and fully to stop.
- See Figure 4-6. Observe position of piston slide at its lowest downward point. Lower edge of slide should rest at horizontal groove (2) at lower end of slide track. If problems are observed, see 4.2 FUEL SYSTEM TROU-BLESHOOTING and Table 4-9.

FLOAT BOWL

NOTE

For engine idle speed and enrichener adjustments, see 1.24 THROTTLE CABLES and 1.26 IDLE SPEED AND IGNITION TIMING: CARBURETED.

Float Bowl Inlet (Needle) Valve Replacement

NOTE

Four sided inlet valves may be used in any Keihin carburetor. Three sided inlet valves should not be used in C.V. carburetors because they may cause carburetor overflow.

- 1. Remove carburetor. See REMOVAL under 4.4 CARBU-RETOR.
- 2. Remove float bowl and inlet valve. See DISASSEMBLY.
- 3. Install new inlet valve.
- Perform float level adjustment. See Float Level which follows.
- 5. Install float bowl. See ASSEMBLY.
- 6. Install carburetor. See INSTALLATION.



Figure 4-6. Vacuum Piston At Rest

Float Level

- 1. Remove the carburetor. See REMOVAL under 4.4 CAR-BURETOR.
- 2. See Figure 4-7. Remove four screws to detach float bowl.
- See Figure 4-9. Place the carburetor on a flat, clean surface on the engine manifold side. This is the "base". Tilt the carburetor 15° to 20° from base.

NOTE

If you tilt the carburetor to less than 15° or more than 20°, your measurements will be incorrect.

- Use a vernier or dial caliper depth gauge to measure from the carburetor O-ring flange face to the perimeter of the float. Be careful not to push on float while measuring.
- See Figure 4-8. If measurement is not within 0.413-0.453 in. (10.49-11.51 mm), carefully bend float tab (1) to position float at proper level.
- 6. Install float bowl. See ASSEMBLY.
- 7. Install carburetor. See INSTALLATION.



Figure 4-7. Float Bowl Screws



Figure 4-8. Carburetor Float Tab



Figure 4-9. Adjusting Carburetor Float

GENERAL

See Figure 4-10. The fuel supply valve is located under the left side of the fuel tank. The gasoline supply to the carburetor is turned off when the handle is in the horizontal position. Turning the handle down to the vertical position turns on the main supply. Turning the handle up to the vertical position turns on the reserve supply. The valve is vacuum-operated and will open and close when the engine is turned ON or OFF.

CAUTION

The fuel supply valve should be turned off when the engine is not running. If the fuel supply valve is not turned off when the engine is not running, it is possible for fuel to drain into the engine, dilute the engine oil and cause engine damage.

OPERATION

The gasoline supply to the carburetor is controlled by the valve handle positions and an internal vacuum operated valve. No gasoline will flow through the valve until the following conditions are met:

- 1. Handle must be in ON or RES position.
- A vacuum of approximately 0.5-1.0 in. (12.7-25.4 mm) of 2 Mercury (Hg) must be applied to the vacuum nipple.

NOTE

In service, the vacuum nipple is connected to the carburetor. When the engine is running, there will be a vacuum at the nipple.

- Fuel tank filter 1
- 2. Hex fitting @ 15-20 ft-lbs (20.3-27.1 Nm)
- 3. Gasket
- 4. Vacuum nipple
- 5. Vent to atmosphere nipple
- Fuel outlet nipple 6.
- 7. Clamp
- Fuel hose 8.
- 9. Fuel valve adapter @ 22-26 ft-lbs (29.8-35.2 Nm)



Figure 4-10. Fuel Supply Valve Assembly

REMOVAL, INSPECTION AND INSTALLATION

See 1.27 FUEL SUPPLY VALVE FILTER: CARBURETED.

TROUBLESHOOTING

Refer to Table 4-10. For diaphragm replacement and vacuum testing information, see the next page.

PROBLEM	.EM CAUSE S	
	Vacuum hose not connected to vacuum nipple. See Figure 4-10.	Connect hose to vacuum nipple.
Vacuum valve not opening.	Leaking diaphragm.	Replace valve assembly.
	Vacuum hose assembly pinched or cracked.	Replace vacuum hose assembly.
Vacuum valve does not close.	Damaged sealing surface on valve side of diaphragm.	Replace valve assembly.
	Broken or missing internal spring.	Replace valve assembly.
Valve leaks gasoline at bottom nipple.	Leaking diaphragm.	Replace valve assembly.
	Loose diaphragm housing screws.	Tighten screws.

Table 4-10. Troubleshooting Fuel Supply Valve

Vacuum Test

PART NO.	SPECIALTY TOOL	
HD-23738-A	Plastic Mity-vac® Hand Pump	

Vacuum test the valve using the procedure below:

- See Figure 4-11. Connect PLASTIC MITY-VAC® HAND PUMP (Part No. HD 23738A), vacuum line and suitable vacuum fitting to the vacuum port of the fuel supply valve.
- 2. Run a section of clear fuel line from the fitting on the fuel supply valve to a gas can.
- Pull 25 in. Hg vacuum and release. Check for fuel flow while applying vacuum and check that fuel stops flowing shortly after vacuum is released.
- Repeat step 3 five times, each time checking for fuel flow at vacuum and no fuel flow shortly after vacuum is released. On fifth application of vacuum, pause with vacuum applied, and check for slow leaks. Release vacuum.
- 5. If no leaks were present, go to Step 6. If leaks were present, repeat replacement procedure.
- 6. Disconnect hand held vacuum pump and fuel line.
- 7. Loosen fuel valve hex fitting 1/8 turn and rotate valve to the left. Tighten hex fitting.
- 8. Position **new** hose clamp on fuel hose and install fuel hose to outlet fitting on valve body.
- 9. Install vacuum hose to valve nipple.



Figure 4-11. Mity-Vac Hand Pump

GENERAL

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

The fuel tank is treated to resist rusting. However, when the motorcycle is not operated for a long period of time, see 1.31 STORAGE for specific information regarding fuel tank and carburetor treatment.

For information on the tank-mounted fuel gauge, see 8.28 FUEL GAUGE and Softail Models Electrical Diagnostic Manual.

REMOVAL

All But FXSTD Models

- See Figure 4-12. Remove acorn nut (1) and washer (2) on instrument console to separate console from fuel tank.
- See Figure 4-13. Disconnect the fuel gauge sender connector [86] (3) on top plate.
- If tank is to be disassembled, remove all T20 TORX screws (2) from top plate. Remove plate and attached sending unit. See 8.28 FUEL GAUGE.
- 4. Remove seat.
- See 1.27 FUEL SUPPLY VALVE FILTER: CARBU-RETED. Check to be sure fuel supply valve is in "OFF" position. Remove fuel line from the fuel supply valve. Drain fuel into adequately sized, approved gasoline container.
- See Figure 4-15. Remove the rear T40 TORX bolt and washer (1).
- 7. See Figure 4-16. Disconnect crossover line (5) and continuous venting vent line (12) and vacuum hose (11).
- 8. Remove the acorn nut (6), flat washers (2), and front mounting screw (1).
- See Figure 4-14. Slide fuel tank to the rear and disconnect fuel gauge connector [117] located under left side of fuel tank.
- See Figure 4-16. Remove fuel tank from motorcycle. Remove rubber trim (13) to access connectors along frame. Remove bushings and grommets (3) if necessary.



Figure 4-12. Instrument Console: All But FXSTD



- 2. T20 TORX screw (10)
- 3. Fuel gauge sender connector [86]

Figure 4-13. Top Plate (typical)

FXSTD Models

- 1. Remove seat.
- See 1.27 FUEL SUPPLY VALVE FILTER: CARBU-RETED. Check to be sure fuel supply valve is in OFF position. Remove fuel line from the fuel supply valve. Drain fuel into an adequately sized, approved gasoline container.
- Remove instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- 4. See Figure 4-13. Disconnect the fuel gauge sender connector [86] (3) on top plate.
- 5. If tank is to be disassembled, remove all T20 TORX screws (2) from top plate. Remove plate and attached sending unit. See 8.28 FUEL GAUGE.
- 6. Remove nut and washer on rear mounting tab.
- 7. See Figure 4-17. Remove acorn nut (6), flat washers (2) and front mounting screw (1).
- 8. Detach crossover line (5), continuous venting vent line (12) and vacuum hose (11) from fuel supply valve.
- See Figure 4-14. Slide fuel tank to the rear and disconnect fuel gauge connector [117] located under left side of fuel tank.
- 10. Remove fuel tank from motorcycle.

CLEANING AND INSPECTION

- 1. 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

All fuel are must be removed before repairing tank. An open flame can cause a tank explosion which could result in death or serious injury.

- Inspect the interconnect lines, evaporative emissions system vent line (California models) and fuel line for cuts, cracks or holes. Replace lines as needed.
- Inspect the tank for leaks and other damage. If a damaged tank cannot be successfully repaired, replace it.



Figure 4-14. Fuel Gauge Connector [117] Location



- 5. Rubber grommet
- 6. Metal insert for grommet

Figure 4-15. Rear Tank Mount





16. Fuel valve adapter @ 22-26 ft-lbs (29.8-35.2 Nm)

Figure 4-17. Fuel Tank: Carbureted, FXSTD

INSTALLATION

All But FXSTD Models

PART NO.	SPECIALTY TOOL	
HD-97087-65B	Hose clamp pliers	

- See Figure 4-16. Install continuous venting system vent line (12) to nipple on front of tank. Make sure vent line runs along right side of frame backbone under rubber trim (13).
- 2. See Figure 4-14. Connect the fuel gauge connector [117] located under left side of fuel tank.
- 3. Attach tank mounts.
 - a. See Figure 4-16. Place a washer (2) over front screw (1). Starting on left side, loosely install screw and washer through tank, bushings and grommets (3) and frame. Place washer (2) and acorn locknut (6) on right side.
 - See Figure 4-15. Verify that rubber grommet (5) and metal insert (6) are protruding through frame (4). Metal insert has flats on bottom for positioning. Place rubber ring (3) around grommet/insert and lower fuel tank tab (2).
 - Install washer and rear T40 TORX bolt (1) through fuel tank tab. Tighten to 18-22 ft-lbs (24.4-29.8 Nm).
 - d. Tighten the front screw to 28-32 ft-lbs (38.0-43.4 Nm).
- See Figure 4-16. Connect crossover line (5) with new clamps (4).
- Connect the fuel feed line. Install new hose clamp using HOSE CLAMP PLIERS (Part No. HD-97087-65B). Attach vacuum hose (11).
- See Figure 4-13. Connect the fuel gauge sender connector [86] on top plate to wiring harness.
- See Figure 4-12. Install instrument console with acorn nut and washer. Tighten to 14-18 ft-lbs (19.0-24.4 Nm).
- 8. Fill tank with gasoline and check for leaks.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat.

FXSTD Models

PART NO.	SPECIALTY TOOL	
HD-97087-65B	Hose clamp pliers	

 See Figure 4-17. Install continuous venting system vent line (12) to nipple on front of tank. Make sure vent line runs along right side of frame backbone.



Figure 4-18. Rear Mount FXSTD

- 2. See Figure 4-14. Connect the fuel gauge connector [117] located under left side of fuel tank.
- 3. Attach tank mounts.
 - a. See Figure 4-16. Place a washer (2) over front screw (1). Starting on left side, loosely install screw and washer through tank, bushings and grommets (3) and frame. Place washer and acorn locknut (6) on right side.
 - See Figure 4-18. Align end of tank over stud (3) on frame. Install nut and washer. Tighten to 14-18 ft-lbs (19.0-24.4 Nm).
 - c. Tighten front screw to 28-32 ft-lbs (38.0-43.4 Nm).
- 4. See Figure 4-17. Connect crossover line (5) with new clamps.
- Connect the fuel feed line. Install new hose clamp using HOSE CLAMP PLIERS (Part No. HD-97087-65B).
- If top plate and fuel tank sending unit were removed, reinstall. See 8.28 FUEL GAUGE.
- See Figure 4-13. Connect the fuel gauge sender connector [86] on top plate to wiring harness.
- Install instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- 9. Fill tank with gasoline and check for leaks.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

10. Install seat.

VAPOR VALVE

WARNING

Excessive pressure can build in the fuel tank if vapor valve is not mounted vertically with long fitting to top. Leaks due to excessive pressure can cause a fire or explosion, which could result in death or serious injury. (00265a)

See Figure 4-19. The vapor valve is mounted on the electrical panel. Mark the two hoses connected to the upper and lower fittings of the vapor valve before removing it 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 California models, the hose from the vapor valve bottom fitting goes to the charcoal EVAP canister. On non-California models, the bottom fitting hose is vented to the atmosphere.



Figure 4-19. Vapor Valve

REMOVAL

- See Figure 4-20. Remove screw (1) and air cleaner cover (2).
- 2. Remove three TORX screws (4) and bracket (5) from filter element (6).
- Gently pull both rubber breather tubes (9) from the back of the element. Remove filter element (6) and gasket (7).
- Replace the filter element if damaged or if filter media cannot be adequately cleaned.
- Gently pull breather tubes (9) from breather bolts (10) on the backplate.
- 6. Check filter element. See 1.22 AIR CLEANER FILTER.
- 7. Inspect seal ring (3) for cracks or tears. Verify that it seals tightly to backplate. Replace as required.
- Alternately back out both breather bolts (10) (metric) a few turns a time while pulling backplate (8) away from carburetor.
- Continue previous step until breather bolts are clear. Remove backplate (8), O-rings (11) and gasket (12). Discard gasket. On California models, disconnect clean air hose from backplate.
- 10. Wipe inside of air cleaner cover (2) and backplate (8) with damp cloth to remove dust.
- On California models, make sure trap door swings freely. See Figure 4-21.

INSTALLATION

- See Figure 4-20. Position new gasket (12) and two new o-rings (11) on backplate.
- 2. On California models, attach clean air hose to rear of backplate.
- Insert two breather bolts (10) (metric) into backplate. Thread bolts loosely into each cylinder head. Final tighten bolts to 120-144 in-Ibs (13.6-16.3 Nm).
- Insert two breather tubes (9) into the holes in back of the filter element. Place the element back into position and attach breather tubes to breather bolts.
- 5. Install air filter element (6) and bracket (5).
 - Make sure gasket (7) holes are aligned with backplate holes.
 - b. Use three TORX screws (4) to secure bracket and filter element. Tighten to 40-60 in-lbs (4.5-6.8 Nm).
- 6. Install air filter cover (2).
 - a. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to threads of air cleaner cover screw (1).
 - Install screw to secure air cleaner cover. Tighten to 36-60 in-lbs (4.1-6.8 Nm).



Figure 4-20. Air Cleaner Assembly

BACKPLATE ASSEMBLY-CALIFORNIA MODELS

See Figure 4-21. California models have unique backplates. These parts may be distinguished by:

- A different intake with a gravity-operated trap door assembly (2) at the mouth of the intake.
- An additional fitting (1) on the backplate for the charcoal canister clean air hose.

Perform the same routine maintenance on California models, but also check that the trap door swings freely.



Figure 4-21. Backplate: California Models

EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS 4.9

REMOVAL

NOTE

See DISASSEMBLY for removing mufflers without removing exhaust pipes from cylinder heads.

- 1. See Figure 4-22. Remove heat shields (2, 4) by opening muffler shield clamps (5).
- 2. Remove nuts (6) from front and rear cylinder head exhaust studs.
- Remove four bolts (19) and washers (20) attaching mufflers (11) to interconnect tube assembly (15).
- Remove exhaust system as an assembly. Check condition of interconnect gaskets (13). Replace if necessary.

INSTALLATION

NOTE

Replacement cylinder head exhaust port gaskets (9) are tapered internally. Be sure the tapered side is facing exhaust pipes. Also check condition of retaining ring (8) before installation.

- Install new gaskets (9) in both the front and rear cylinder heads with the tapered side facing exhaust pipes.
- Position ends of exhaust pipes into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (7) over cylinder head exhaust studs. Loosely thread on flange nuts (6).
- Loosely install bolts (19) and washers (20) to attach mufflers (11) to interconnect tube assembly (15).
- Align exhaust system and tighten all nuts and bolts; beginning at cylinder head exhaust ports and working backwards. Tighten interconnect bolts (19) to 96-120 inlbs (10.8-13.6 Nm).
- 5. Tighten nuts (6) at cylinder studs as follows:
 - a. Install upper nut and tighten finger tight.
 - Install lower nut and tighten to 9-18 in-lbs (1.0-2.0 Nm).
 - c. Tighten upper nut to 100-120 in-Ibs (11.3-13.6 Nm).
 - d. Tighten lower nut to 100-120 in-lbs (11.3-13.6 Nm).
- Open the muffler shield clamps (5) and install front and rear heat shields (2, 4).

DISASSEMBLY

- 1. Remove front and rear mufflers as an assembly.
- Remove two flange locknuts (18) to detach interconnect tube (15) from frame.
- Remove muffler shield clamps (14) to detach heat shields (12) from muffler.
- Remove muffler clamps (10) to separate mufflers (11) from exhaust pipes (1, 3). Discard clamps.

ASSEMBLY

 Install new muffler clamps (10) to attach mufflers (11) to exhaust pipes (1, 3). Tighten clamps to 45-60 ft-lbs (61.0-81.3 Nm).

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

- Open muffler shield clamps (14) and install the muffler heat shields (12). Position clamps so the screws are on the outboard side in the most accessible position.
- Attach interconnect tube (15) to frame using two flange locknuts (18) and washers (17). Tighten to 30-33 ft-lbs (40.7-44.7 Nm).



Figure 4-22. Exhaust System: FXST, FLST, FLSTC, FXSTB, FXSTS

REMOVAL

Mufflers Only

- 1. See Figure 4-23. Loosen clamps (3, 15).
- Apply penetrating oil to seams of mufflers (4, 28) and exhaust pipes (1, 14).
- 3. Loosen flange locknut (16) on carriage bolt (18).
- Remove screws and washers (23) on both muffler brackets (22, 27).
- Leaving mufflers attached at the interconnect, pull assembly straight back to remove.

Exhaust System

- On FLSTF models, remove two bolts and nuts to detach right side floorboard from mount.
- See Figure 4-23. Detach heat shields (2, 12, 13) from both exhaust pipes (1, 14) by removing clamps (11).
- Remove screws and washers (23) on both muffler brackets (22, 27).
- 4. Remove all four exhaust header nuts (10).
- Remove flange locknut (16) from carriage bolt (18). Detach exhaust pipe clamp (17) from the exhaust bracket (19).
- 6. Remove mufflers and exhaust pipes as an assembly.
- Remove two screws (20) to detach muffler support (21) from frame if necessary.

NOTE

If mufflers are detached at the crossover disconnect, replace washer (24) and exhaust interconnect seal (25).

INSTALLATION

Mufflers Only

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

- 1. Place new clamps (3, 15) over exhaust pipes (1, 14).
- Slide mufflers (4, 28), attached at interconnect, onto exhaust pipes.
- Loosely install screws and washers (23) to attach muffler brackets (22, 27) to muffler support.

- 4. Loosely tighten flange locknut (16) on carriage bolt (18).
- 5. Tighten all muffler fasteners.
 - a. Tighten clamps to 45-60 ft-lbs (61.0-81.3 Nm).
 - Tighten flange locknut (16) on carriage bolt (18) to 30-33 ft-lbs (40.7-44.7 Nm).
 - c. Tighten screws and washers (23) to 15-19 ft-lbs (20.3-25.8 Nm).

Exhaust System

1. If necessary, attach muffler support (21) to frame using two screws (20). Tighten to 35-45 ft-lbs (47.5-61.0 Nm).

NOTE

Replacement cylinder head exhāust port gaskets (7) are tapered internally. Be sure the tapered side is facing exhaust pipes. Also check condition of retaining ring (8) before installation.

- Install new gaskets (7) in both the front and rear cylinder heads with the tapered side facing exhaust pipes.
- Position ends of exhaust pipes into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (9) over cylinder head exhaust studs. Loosely thread on flange nuts (10).

NOTE

Replacement cylinder head exhaust gaskets (7) are tapered internally. Be sure the thin end goes over the exhaust pipe. Also check condition of retaining ring (8) before installation.

- Loosely install screws and washers (23) to attach exhaust system to muffler support (21).
- Loosely attach exhaust pipe clamp (17) to exhaust bracket (19) using flange locknut (16) and carriage bolt (18).
- Align exhaust system and tighten all nuts and bolts; beginning at cylinder head exhaust ports and working backwards.
 - a. Install upper nut and tighten finger tight.
 - Install lower nut and tighten to 9-18 in-lbs (1.0-2.0 Nm).
 - c. Tighten upper nut to 100-120 in-lbs (11.3-13.6 Nm).
 - d. Tighten lower nut to 100-120 in-lbs (11.3-13.6 Nm).
- Tighten flange locknut (16) on carriage bolt (18) to 30-33 ft-lbs (40.7-44.7 Nm).
- Tighten screws and washers (23) to 15-19 ft-lbs (20.3-25.8 Nm).
- 9. Open clamps (11) and install heat shields (2, 12, 13).
- 10. On FLSTF models, install right side floorboard with two bolts and nuts.



Figure 4-23. Exhaust System: FXSTD, FLSTF

REMOVAL

Mufflers Only

- 1. See Figure 4-24. Loosen clamps (11).
- Apply penetrating oil to seams of mufflers (16) and cylinder exhaust pipe (2).
- 3. Remove screws (20) from muffler brackets (21).
- 4. Pull each muffler from cylinder exhaust pipe.

Exhaust System

- 1. Remove two bolts and nuts to detach right side floorboard from mount.
- See Figure 4-24. Detach heat shields (1, 8, 9) from cylinder exhaust pipe (2) by removing clamps (7).
- Remove screws (23) and washers (22) on both muffler brackets (21).
- 4. Remove all four exhaust header nuts (6).
- Remove flange locknut (12) from carriage bolt (14). Detach exhaust pipe clamp (13) from the exhaust bracket (15).
- 6. Remove mufflers and exhaust pipes as an assembly.
- Remove screws (18) to detach muffler support (19) from frame if necessary.

INSTALLATION

Mufflers Only

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

- 1. Place new clamps (11) over exhaust pipe (2).
- 2. Slide mufflers (16) onto exhaust pipe.
- Loosely install screws (20) to attach mufflers to muffler brackets (21).
- 4. Tighten all muffler fasteners.
 - a. Tighten clamps to 45-60 ft-lbs (61.0-81.3 Nm).
 - b. Tighten screws (20) to 96-120 in-lbs (10.8-13.6 Nm).

Exhaust System

 If necessary, attach muffler support (19) to frame using screws (18). Tighten to 35-45 ft-lbs (47.5-61.0 Nm).

NOTE

Replacement cylinder head exhaust port gaskets (3) are tapered internally. Be sure the tapered side is facing exhaust pipe. Also check condition of retaining ring (4) before installation.

- Install new gaskets (3) in both the front and rear cylinder heads with the tapered side facing exhaust pipe.
- Position ends of exhaust pipe into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (5) over cylinder head exhaust studs. Loosely thread on flange nuts (6).
- Loosely install screws (23) and washers (22) to attach exhaust system to muffler supports (19).
- Loosely attach exhaust pipe clamp (13) to exhaust bracket (15) using flange locknut (12) and carriage bolt (14).
- Align exhaust system and tighten all nuts and bolts; beginning at cylinder head exhaust ports and working backwards.
 - a. Install upper nut and tighten finger tight.
 - Install lower nut and tighten to 9-18 in-lbs (1.0-2.0 Nm).
 - c. Tighten upper nut to 100-120 in-lbs (11.3-13.6 Nm).
 - d. Tighten lower nut to 100-120 in-lbs (11.3-13.6 Nm).
- Tighten flange locknut (12) on carriage bolt (14) to 30-33 ft-lbs (40.7-44.7 Nm).
- 8. Tighten screws (23) to 15-19 ft-lbs (20.3-25.8 Nm).
- 9. Open clamps (7) and install heat shields (1, 8, 9).
- 10. Install right side floorboard with two bolts and nuts.



Figure 4-24. Exhaust System: FLSTN

REMOVAL

- See Figure 4-25. Open muffler shield clamps to remove the five heat shields (1 through 5) from exhaust pipes. Mark the location of heat shields to ensure proper assembly.
- 2. Loosen the three TORCA clamps (6, 7) as follows:
 - On right side, loosen front header pipe to rear header pipe and rear header pipe to right side muffler.
 - D. On left side, loosen crossover pipe to left side muffler (9).
- Remove the four bolts (10), lockwashers (11), and washers (12) to detach the mufflers (13 and 14) from the muffler support brackets (15).
- 4. Remove left side and right side mufflers.
- Remove screw (16) and washer (17) that hold crossover pipe (19) to passenger footrest.
- 6. Remove crossover pipe.
- Remove the nuts (26) to release the rear header pipe from the cylinder head studs.
- 8. Remove the two flange nuts (20 and 21) and screw (23) that hold the bottom of the rear header pipe (24) in position.
- 9. Remove the rear header pipe (24).
- 10. Remove the nuts (26) to release the front header pipe from the cylinder head studs.
- 11. Remove the front header pipe (25).
- Remove and discard cylinder head gaskets. Discard TORCA clamp bolt assemblies which are one time use only.

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

INSTALLATION

- 1. See Figure 4-25. Assemble front and rear header pipes with **new** TORCA clamp, but leave clamp loose.
- Install new gaskets (27) in both the front and rear cylinder heads with the tapered side out.
- Install header pipes by placing exhaust flanges (28) in position and starting flange nuts onto cylinder studs.
- Install finger tight the screws and flange washers that hold the bottom of the rear header pipe in position.
- Place new TORCA clamp onto right side muffler and slip muffler onto rear header pipe. Finger tighten bolts and washers to attach muffler to muffler support bracket.
- Install new gasket and washer (8) on crossover pipe and install crossover pipe onto remaining end of rear header pipe.

- 7. Install clamp (18), washer (17), and screw (16) that holds crossover pipe to passenger footrest.
- Place new TORCA clamp onto left side muffler and slip muffler onto crossover pipe. Finger tighten bolts and washers to attach muffler to muffler support bracket.
- 9. Tighten the exhaust system as follows:
 - Tighten the top nut of the front cylinder head exhaust flange to 9-18 in-lbs (1.0-2.0 Nm). Tighten the lower nut to 100-120 in-lbs (11.3-13.6 Nm). Final tighten the top nut to 100-120 in-lbs (11.3-13.6 Nm).
 - b. Repeat the previous step on the exhaust flange nuts of the rear cylinder.
 - c. Tighten the four screws (10) that hold the mufflers to the muffler support brackets.
 - d. Tighten the screw (16) that holds the crossover pipe to the passenger footrest.
 - e. Tighten the nuts (20 and 21) that hold the bottom of the rear header pipe in position.
 - f. Tighten the TORCA clamps (7 and 9) that hold the mufflers on to 45-60 ft-lbs (61.0-81.3 Nm).
 - g. Tighten TORCA clamp (6) that connects the header pipes together to 45-60 ft-lbs (61.0-81.3 Nm).
- 10. Open muffler shield clamps and install the five heat shields. Position clamps so the screws are on the outboard side in the most accessible position.



Figure 4-25. Exhaust System: FLSTSC

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. Failure to follow this alert can result in death or serious injury.

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.

NOTES

- To prevent false readings, keep airbox cover installed when performing test.
- Do not direct propane into air cleaner, false readings will result.

LEAK TESTER

Parts List

- Standard 14 oz. propane cylinder.
- Propane Enrichment Kit (Part No. HD-41417).

Tester Assembly

- 1. See Figure 4-26. Make sure valve knob (6) is closed (fully clockwise).
- 2. Screw valve assembly (5) onto propane bottle (1).

Tester Adjustment

- 1. See Figure 4-26. Press and hold trigger button (8).
- 2. Slowly open valve knob (6) until pellet in flow gauge (7) rises to between 5 and 10 SCFH on gauge.
- 3. Release trigger button.



9. Hanger

Figure 4-26. Leak Tester

PROCEDURE

- 1. Start engine.
- 2. Warm engine to operating temperature.

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. Failure to follow this alert can result in death or serious injury.

NOTE

Do not direct propane stream toward front of engine. If propane enters air cleaner, a false reading will be obtained.

- 3. See Figure 4-27. Aim nozzle (3) toward possible sources of leak such as intake manifold mating surfaces.
- 4. Push trigger button (2) to release propane. Tone of engine will change when propane enters source of leak.
- 5. When test is finished, release trigger button and close valve knob (turn knob fully clockwise).



Figure 4-27. Checking for Leaks

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.
- On all models, when the engine is running, intake venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the charcoal canister through the canister-to-intake purge hose. These vapors pass through the intake and are burned as part of normal combustion in the engine.

- On carbureted models, when the engine is not running, the gravity-operated trap door blocks the inlet port of the air cleaner backplate. This prevents hydrocarbon vapors emanating from the carburetor throat from escaping into the atmosphere.
- On carbureted models, when the engine is running, the vacuum created in the inlet pulls the gravity-operated trap door open allowing air to enter.
- On carbureted models, the long, nylon canister-to-air cleaner hose (canister clean air inlet hose) supplies the canister with fresh air from the air cleaner.

WARNING

Keep evaporative emissions vent lines away from exhaust and engine. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00266a)

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.



Figure 4-28. Schematic-CA Evaporative Emissions Control System (EFI models)





CHARCOAL CANISTER

Removal

WARNING

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

See Figure 4-30. The EVAP charcoal canister is mounted below the rear fork pivot.

- Support motorcycle so rear wheel is off the floor. Remove the cotter pin from the rear wheel axle, loosen the axle nut and turn the axle adjusting bolts all the way forward.
- Move the wheel forward and slip the drive belt off the sprocket. Then move the wheel as far as it will go towards the rear of the motorcycle.
- Remove two bolts on rear splash guard. Lift splash guard up and over rear tire.
- On carbureted models, pull breather hose connection (1) from air cleaner backplate off nipple on right side of charcoal canister.
- With a screwdriver, lift up the tang on the left side of the canister bracket. Slide the canister to the left until it drops free from the bracket.
- See Figure 4-31. Note the two hose connections on the left side of the canister. To ensure correct assembly, mark the hose to match the stamps on the canister. After hoses are marked, gently pull hoses off the canister.
- 7. Remove canister.

Installation

- 1. See Figure 4-30. Slide canister into mounting bracket until canister clicks in place.
- See Figure 4-31. Attach hoses to left side canister nipples as marked.
- See Figure 4-30. On carbureted models, attach breather hose connection (1) from air cleaner backplate to nipple on right side of charcoal canister.
- Move rear wheel forward and place belt on sprocket. Then move wheel back and make sure brake disc is centered between brake pads.
- Tighten axle nut and adjust belt tension. See 1.14 REAR BELT DEFLECTION.
- 6. Install the splash guard using two bolts.







Figure 4-31. Charcoal Canister Connections

HOSE ROUTING/REPLACEMENT

NOTE

Record location of cable ties before removal. Install cable ties in same location when installing.

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- Remove console and fuel tank. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- 2. Route vacuum or purge hose.
 - a. See Figure 4-29. Attach the preformed purge hose to the intake purge fitting.
 - b. Route purge hose under fuel tank along backbone. Route purge hose down frame to canister.
 - c. See Figure 4-31. Attach the purge hose to the canister fitting marked CARB on left side of canister.
- 3. Route fuel tank vent hose.
 - Route fuel tank vent hose along left side of frame (cable tie loosely to frame) to vapor valve on transmission housing.
 - b. Attach one end of the hose to the top (long) fitting on the vapor valve.
 - c. See Figure 4-31. Connect hose attached to bottom end of vapor valve to fitting marked TANK on left side of canister.
- 4. On Carbureted models, route clean air hose.
 - See Figure 4-29. Attach the large (0.5 in./12.7 mm ID), preformed, clean air inlet hose to the backplate fitting.
 - B. Route hose along frame backbone, down and inside oil tank and connect to large fitting on right side of canister.
 - c. Cable tie hose loosely to frame.
- Install fuel tank and attach the fuel tank vent hose to the fuel tank vent nipple. Install console. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- 6. Install new EVAP system label on front frame down tube.

ELECTRIC STARTER

5

SUBJECT

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STARTER		
Free speed	3000 RPM (min.) @ 11.5 V	
Free current	90 amp (max.) @ 11.5 V	
Cranking current	200 amp (max.) @ 68°F	

SERVICE WEAR LIMITS	IN.	MM
Brush length minimum	0.433	11.0
Commutator diameter minimum	1.141	28.981

TORQUE VALUES

ITEM	TORQUE		ITEM TOR		NOTES
Jackshaft bolt	60-80 in-lbs	6.8-9.0 Nm	bend locking tab after tightening, page 5-8, page 5-16		
Starter mounting bolts	13-20 ft-lbs	17.6-27.1 Nm	page 5-8		
Starter positive terminal nut	60-85 in-lbs	6.8-9.6 Nm	metric, page 5-8		

GENERAL

The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear and a clutch gear in the drive housing. The idler gear is supported by rollers. The clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagrams in Appendix B.

Starter Relay

The starter relay is not repairable. Replace the unit if it fails.

OPERATION

See Figure 5-1. When the starter switch is pushed, the starter relay is activated, then the starter solenoid is activated allowing current to flow into the pull-in winding (10) and the hold-in winding (11), to ground.

The magnetic forces of the pull-in and hold-in windings in the solenoid push the plunger (7) causing it to shift to the left. This action engages the pinion gear (1) with the clutch ring gear (13). At the same time, the main solenoid contacts (8) are closed, so battery current flows directly through the field windings (3) to the armature (4) and to ground. Simultaneously, the pull-in winding (10) is shorted.

The current continues flowing through the hold-in winding (11) keeping the main solenoid contacts (8) closed. At this point, the starter begins to crank the engine.

After the engine has started, the pinion gear (1) turns freely on the pinion shaft through the action of the overrunning clutch (12). The overrunning clutch prevents the clutch ring gear (13) (which is now rotating under power from the engine) from turning the armature (4) too fast.

When the starter switch is released, the current of the hold-in winding (11) is fed through the main solenoid contacts (8) and the direction of the current in the pull-in winding (10) is reversed. The solenoid plunger (7) is returned to its original position by the return spring, which causes the pinion gear (1) to disengage from the clutch ring gear (13).

NOTE

For troubleshooting and diagnostic information see Softail Models Electrical Diagnostic Manual.



Figure 5-1. Starter Operation



Figure 5-2. Starting Circuit: Carbureted Models



Figure 5-3. Starting Circuit: EFI Models

REMOVAL

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 5-4. Pull cover away from fuse block.
- 4. See Figure 5-5. Replace starter relay (2).

INSTALLATION

- 1. Place cover over fuse block.
- 2. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat.



Figure 5-4. Fuse Block Cover: Carbureted Shown



- 1. Fuse block
- 2. Starter relay
- 3. System relay (EFI only)
- 4. Spare fuses
- 5. Battery

Figure 5-5. Starter Relay
REMOVAL

AWARNING

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

- 1. Disconnect negative battery cable.
- Remove primary cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.
- See Figure 5-6. Bend tab on lockplate (1) away from head of jackshaft bolt. Hold pinion gear (3) in place and remove jackshaft bolt (2), lockplate and thrust washer.
- Remove rear exhaust pipe. See 4.9 EXHAUST SYS-TEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- 5. See Figure 5-7. Remove screw and end cover from starter.
- Remove oil tank to provide clearance for starter removal. See 3.32 OIL TANK.
- See Figure 5-8. Remove both starter mounting bolts and washers. This includes detaching the engine ground cable.
- See Figure 5-9. Remove protective boot. Remove nut with washer (1) (metric).
 - a. Remove positive battery cable ring terminal (2).
 - b. Remove circuit breaker wire ring terminal (3).
 - c. Detach solenoid wire (4).
- 9. Remove starter from right side of motorcycle.

NOTE

Jackshaft-to-starter shaft coupling will stay on starter shaft.

10. Before disassembling the starter, perform diagnostics listed in the Softail Models Electrical Diagnostic Manual.



Figure 5-6. Lockplate on Jackshaft Bolt



Figure 5-7. Starter Cover Screw



Figure 5-8. Starter Mounting

INSTALLATION

1. Install starter from right side of motorcycle.

NOTE

Be sure jackshaft coupling engages starter shaft.

AWARNING

Be sure the starter solenoid terminal that is connected to the positive (+) battery cable is securely covered by the rubber boot. An uncovered terminal could short against other components resulting in sparks. These sparks may cause a fire or battery explosion which could result in death or serious injury.

- See Figure 5-9. Attach positive battery cable (2), circuit breaker wire (3) and solenoid wire (4). Tighten nut (1) (metric) to 60-85 in-lbs (6.8-9.6 Nm). Place rubber boot securely over terminal.
- See Figure 5-8. Install the two starter mounting bolts and washers. Tighten to 13-20 ft-lbs (17.6-27.1 Nm).

NOTE

Be sure the lockplate protrusion is sticking into the keyway on jackshaft.

 See Figure 5-6. Install lockplate and thrust washer (1) and jackshaft bolt (2). Hold pinion gear (3) in place and tighten bolt to 60-80 in-lbs (6.8-9.0 Nm). Bend tab on lockplate against flat of bolt head to secure.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.



Figure 5-9. Starter Wires

- Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.
- 6. See Figure 5-7. Attach starter end cover using screw.
- 7. Install oil tank. See 3.32 OIL TANK.
- Install rear exhaust pipe. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.
- 9. Connect negative battery cable.

DISASSEMBLY, INSPECTION AND REPAIR

- 1. Remove two nuts with washers to detach end cover mount from thru-bolts.
- See Figure 5-10. Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).
- See Figure 5-11. Remove both thru-bolts (1, 3), field coil and cap.
- Remove both end cover screws with O-rings (2) and end cover (4).
- Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm).

NOTE

Brushes not available separately. Purchase a **new** field frame and brush holder to replace brushes.

- See Figure 5-12. Use a wire hook to pull upward on brush springs (3), and lift brushes out of holder (2). Remove brush holder.
- 7. Remove armature (4).
- 8. Place armature in lathe or truing stand and check commutator runout and diameter.
 - a. If commutator runout is more than 0.015 in. (0.38 mm), machine commutator on a lathe or replace armature.
 - Replace armature if diameter of commutator is less than 1.141 in. (28.981 mm)
 - c. Check armature bearings. Replace if necessary.

CAUTION

Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.

 Check depth of mica on commutator. If undercut is less than 0.008 in. (0.203 mm), use an undercutting machine to undercut the mica to 0.031 in. (0.794 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.

NOTE

See Figure 5-13. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs.



Figure 5-10. Field Wire



Figure 5-11. Removing the Thru-Bolts



Figure 5-12. Starter Components



Figure 5-13. Undercutting Mica Separators

- 10. See Figure 5-14. Check for SHORTED ARMATURE with a growler.
 - a. Place armature on growler (1).
 - b. Hold a thin steel strip (2) (hacksaw blade) against armature core and slowly turn armature.
 - c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace shorted armatures.
- 11. See Figure 5-15. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
 - a. Touch one probe to any commutator segment (1).
 - b. Touch the other probe to the armature core (2).
 - c. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace grounded armatures.



Figure 5-14. Shorted Armature Test Using Growler



Figure 5-15. Grounded Armature Test

- See Figure 5-16. Check for OPEN ARMATURE with an ohmmeter or continuity tester.
 - Check for continuity between all commutator segments (1).
 - b. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.



Figure 5-16. Open Armature Test

- See Figure 5-17. Check for GROUNDED FIELD COIL with an ohmmeter or continuity tester.
 - a. Touch one probe to the frame (1).
 - b. Touch the other probe to each of the brushes (2) attached to the field coil.
 - c. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field coil(s) are grounded and the field frame must be replaced.
- See Figure 5-18. Check for OPEN FIELD COILS with an ohmmeter or continuity tester.
 - a. Touch one probe to the field wire (1).
 - b. Touch the other probe to each of the brushes attached to the field coil(s) (2).
 - c. There should be continuity (0 ohms). If there is no continuity at either brush, then the field coil(s) are open and the field frame must be replaced.
- 15. See Figure 5-19. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.
 - a. Touch one probe to holder plate (1).
 - Touch the other probe to each of the positive (insulated) brush holders (2).
 - c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the brush holder assembly.
 - d. Touch one probe to the non insulated brush holders and touch the other probe to the holder plate. If you measure any resistance, replace brush holder.



Figure 5-17. Grounded Field Test



Figure 5-18. Open Field Test



Figure 5-19. Brush Holder Insulation Test

 See Figure 5-20. Remove two drive housing mounting screws (1) and washers (2). Remove drive housing (3) from solenoid housing (4).



- 17. See Figure 5-21. Remove drive (1), idler gear (2) and idler gear bearing (3). Remove O-ring from groove in drive housing (4).
- 18. Remove spring (5) and shaft (6).

ASSEMBLY

1. See Figure 5-23. Replace both O-rings (23).

CAUTION

Do not use solvents to clean drive assembly/overrunning clutch (15). It is lubricated and sealed. If you use a solvent to clean it, the lubricant will be washed out and the clutch will fail.

- Clean, inspect and lubricate drive assembly components. Lubricate parts with high temperature grease such as LUBRIPLATE 110.
- 3. When installing drive assembly components, open end of idler bearing cage (17) faces toward solenoid.
- When installing drive housing (13) to solenoid housing (14) use **new** O-ring (18). Be sure to install return spring (21) and ball (22).
- 5. Lubricate armature bearings (10) with high temperature grease such as LUBRIPLATE 110. Install armature (9) and field coil (3) to solenoid housing (14).
- Replace brush springs (6), if necessary. Install brushes (7) and brush holder (8).
- 7. Install end cap (4) with screws (5).
- 8. Install thru-bolts (2). Connect field wire (1) to terminal.
- 9. See Figure 5-22. Attach end cover mount (1) using two nuts with washers (2).



Figure 5-21. Clutch Assembly



- 1. End cover mount
- 2. Nuts with washers (2)

Figure 5-22. End Cover Mount (Shown Installed For Orientation Purposes)



Figure 5-23. Starter Assembly

GENERAL

CAUTION

See Figure 5-24. Do not tighten nut (7) without removing items 1-5. The contact will move and be destroyed.

The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

- 1. See Figure 5-24. Remove screws (1) and clip (2).
- 2. Remove cover (3) and gasket (4). Discard gasket.
- 3. Remove plunger (5) from solenoid housing (6).

ASSEMBLY

- 1. See Figure 5-24. Replace wire connection hardware as necessary.
- 2. Apply a light coat of LUBRIPLATE 110 to plunger shaft. Install plunger (5) in solenoid housing (6).
- 3. Install new gasket (4) onto cover (3).
- 4. Position cover with gasket onto solenoid housing. Install clip (2) and screws (1).



Figure 5-24. Starter Solenoid

REMOVAL/DISASSEMBLY

WARNING

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

- 1. Disconnect negative battery cable.
- Remove primary cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.

NOTE

See Figure 5-26. If you are only going to service the items from the bolt through the spring (1-5), it is not necessary to remove clutch.

- Remove clutch assembly. See 6.3 DRIVE COMPO-NENTS.
- See Figure 5-25. Hold pinion gear (3) in place and remove the jackshaft bolt (2), lockplate and thrust washer (1).
- 5. Remove jackshaft from inner primary as an assembly.
- 6. See Figure 5-26. Remove pinion gear (4) from jackshaft.
- Remove coupling (7) and spring (5). Spring and retaining ring (6) are inside coupling. Replace retaining ring if necessary.





CAUTION

If you want to replace the coupling (10) and/or retaining ring (9), you will have to remove the starter. See REMOVAL under 5.4 STARTER. If you force coupling through the primary case oil seal, the seal will be destroyed and will have to be replaced.

 Remove coupling (10) from the starter shaft. Replace retaining ring (9), if necessary.



Figure 5-26. Starter Jackshaft

ASSEMBLY/INSTALLATION

NOTE

See Figure 5-26. When you install the coupling (7), be sure the shallow side goes toward the jackshaft. Make sure coupling is installed on the starter motor output shaft before installing jackshaft assembly.

- See Figure 5-26. If removed, insert retaining ring (9) in coupling (10). Install coupling on starter output shaft with counter bore facing jackshaft. Shallow side of coupling faces jackshaft splines. Continue with 5.4 STARTER installation.
- 2. Place spring (5) inside coupling (7).
- 3. Install pinion gear (4) on shaft.
- 4. Place lockplate (2) and thrust washer (3) on bolt (1). Insert bolt into jackshaft (8).
- 5. Install retaining ring (6) if removed, on shaft. Slide jackshaft assembly into position in inner primary.

NOTE

Be sure the lockplate tab is in the keyway. This will hold lockplate and thrust washer in place.

- Align lockplate tab and thrust washer slot with jackshaft keyway. Screw the jackshaft bolt into the starter shaft.
- Hold the pinion gear in position and tighten the bolt to 60-80 in-lbs (6.8-9.0 Nm).
- 8. Bend locking tab against bolt head.
- 9. Install clutch assembly. See 6.3 DRIVE COMPONENTS.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

- Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.
- 11. Connect negative battery cable.

DRIVE

SUBJECT

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SPECIFICATIONS

SPROCKETS	NUMBER OF TEETH
Compensating	25
Clutch	36
Transmission	32
Rear wheel (all models and markets)	70

GEAR	OVERALL GEAR RATIO
First (low)	10.110
Second	6.958
Third	4.953
Fourth	3.862
Fifth (high)	3.150

NOTE

Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

CLUTCH	DESCRIPTION
Туре	Wet-multiple disc
Clutch lever free play	1/16-1/8 in.
(after internal adjustment)	1.6-3.2 mm

TORQUE VALUES

ITEM	TORQUE		NOTES
Chain tensioner shoe top cen- ter nut	21-29 ft-lbs	29-39 Nm	page 6-11
Clutch diaphragm spring retainer bolts	90-110 in-lbs	10.2-12.4 Nm	metric, page 6-12, page 6-16
Clutch hub nut	70-80 ft-lbs	94.9-108.5 Nm	left hand threads, apply two drops of LOCTITE THREADLOCKER 262 (red) to last few threads, page 6-9
Compensating sprocket nut	75 ft-lbs	101.7 Nm	initial torque only, LOCTITE THREADLOCKER 262 (red), page 6-9
Inner primary-to-engine bolts	15-19 ft-lbs	20.3-25.8 Nm	special sequence to tighten, bend locktabs, page 6-6
Primary chaincase cover screws	108-120 in-lbs	12.2-13.6 Nm	special sequence to tighten, page 6-3
Primary chaincase inspection cover screws	84-108 in-lbs	9.5-12.2 Nm	page 6-3
Primary-to-transmission bolts	15-19 ft-lbs	20.3-25.8 Nm	special sequence to tighten, bend locktabs, page 6-6
Transmission lockplate screws	84-108 in-lbs	9.5-12.2 Nm	LOCTITE patch, use 3-5 times, page 6-18
Transmission sprocket nut	60 ft-lbs	81.4 Nm	left hand threads, initial torque only, LOCTITE THREADLOCKER 262 (red), page 6-18

GENERAL

The primary chaincase is a sealed housing containing the primary chain, clutch, engine compensating sprocket, chain adjuster, alternator, and starter drive mechanism.

For information on primary chain adjustment and lubrication, see Section 1.

- 1.10 PRIMARY CHAIN.
- 1.11 PRIMARY CHAINCASE LUBRICANT.

PRIMARY CHAINCASE COVER

Removal

WARNING

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

- 1. Disconnect negative battery cable.
- Drain the primary chaincase lubricant. See 1.11 PRI-MARY CHAINCASE LUBRICANT.

CAUTION

See Figure 6-1. The inspection cover is fastened to the inner primary chaincase at the top and rear screws (13, 14). Before removing the primary cover, be sure you remove the inspection cover's top and rear screws or the cover, primary cover and inner primary will be damaged.

- 3. When lubricant has drained, remove cover.
 - a. See Figure 6-1. First remove the top and rear inspection cover screws (13, 14).
 - b. Continue by removing remaining hardware.



Figure 6-1. Primary Chaincase Cover



Figure 6-2. Inspection Cover Gaskets

Installation

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

NOTE

See Figure 6-2. In next step, make sure tower gaskets (2) are the same thickness as the cover gasket (1).

- Install new cover gasket (1). Install new tower gaskets (2) on the two inner primary case towers.
- See Figure 6-1. Tighten primary cover screws (1-12) to 108-120 in-lbs (12.2-13.6 Nm) in the sequence shown. Tighten inspection cover screws (13, 14) to 84-108 inlbs (9.5-12.2 Nm).

CAUTION

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

- Place motorcycle in an upright position and fill primary chaincase. See 1.11 PRIMARY CHAINCASE LUBRI-CANT.
- 4. Connect negative battery cable.

PRIMARY CHAINCASE HOUSING

Removal

AWARNING

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

- 1. Disconnect negative battery cable.
- 2. Remove primary chaincase cover.
- Remove primary chain, clutch and compensating sprocket as an assembly. See 6.3 DRIVE COMPO-NENTS.
- Remove the starter jackshaft and two starter mounting bolts. See 5.6 STARTER JACKSHAFT.
- See Figure 6-3. Remove primary-to-engine mounting bolts.
- See Figure 6-4. Remove primary-to-transmission mounting bolts.
- Remove primary chaincase and discard the crankcase lip O-ring.



Figure 6-3. Primary-to-Engine Mounting Bolts



Figure 6-4. Primary-to-Transmission Mounting Bolts

Inspection And Repair

NOTE

See Figure 6-5. If replacing chain tensioner anchor plate (2), tighten chain tensioner anchor plate fasteners (1) to 12-14 ft lbs (16.3-19.0 Nm).

- Inspect primary chaincase for cracks or damaged gasket surfaces.
- 2. Check primary chaincase and primary cover jackshaft bushings and replace if they are rough or stick.

NOTE

The edge of jackshaft bushings in the primary chaincase and the primary cover must be flush with the edge of their holes.

 Check primary chaincase jackshaft oil seal. Replace if necessary. Drive in oil seal from inside.

NOTE

See Figure 6-6. The primary chaincase has a shoulder for the jackshaft oil seal. When replacing the oil seal, be sure the oil seal seats against the shoulder.

- Check the mainshaft bearing. Replace if bearing does not rotate freely.
- Check primary chaincase mainshaft oil seal. Replace if worn, scored or damaged. Install seal flush with chaincase surface.

Mainshaft Bearing and Oil Seal

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- Pull oil seal from bearing bore on transmission side of primary chaincase. Use a seal remover or rolling head pry bar for best results. Remove retaining ring from groove.
- 2. Turn the primary chaincase over.
- Remove retaining ring from groove on clutch side of bearing.

CAUTION

Support inner primary chain case area on clutch side while pressing bearing out of primary chain case. The force needed to remove bearing may cause damage to primary chain case.

- Support inner primary chain case on clutch side of bearing.
- Place primary chaincase in arbor press. Press out bearing from pulley side applying pressure to the outer race.







Figure 6-6. Primary Chaincase Jackshaft Oil Seal

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- Inspect the bearing bore to verify that it is clean and smooth. Install retaining ring in groove on pulley side of primary chaincase. Verify that the ring is fully seated in the groove.
- Place primary chaincase in arbor press with the clutch side up.

CAUTION

Support the retaining ring area on pulley side while pressing bearing into bore. The force needed to press bearing into position may force an unsupported primary chain case to become damaged.

- Support the retaining ring case area on the pulley side of the primary chaincase.
- Applying pressure to the outer race, press new bearing, lettered side up, into bore until it makes solid contact with the installed retaining ring.
- 10. Install second retaining ring to lock position of bearing in bore. Verify that the ring is fully seated in the groove.

NOTES

- The lip garter spring side of the oil seal is also identified by the words "OIL SIDE".
- Install oil seal with a seal driver that will press only against outer rim of oil seal, NOT against the inner area.
- The minimum allowable depth of the seal is reached when the outer edge of the seal carrier is flush with the machined surface of the primary housing. The maximum allowable depth of the seal is reached when the seal carrier contacts the mainshaft bearing snap ring.
- 11. Install mainshaft oil seal:
 - Lubricate the O.D. of the new seal with clean engine oil.
 - b. See Figure 6-7. With the lip garter spring side (stamped "oil side") facing toward the bearing, press squarely on the outer edge of a **new** oil seal until outer edge of seal is flush with machined surface of inner primary housing.
- 12. Lubricate the bearing and seal lip with multi-purpose grease or clean engine oil.



Figure 6-7. Oil Seal

Installation

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

- Be sure the O-ring is in position on the crankcase around the alternator surface.
- Oil both seal lips and install primary case. Be careful not to damage mainshaft seal when installing chaincase over the primary bearing inner race on the mainshaft.
- Lay a bead of silicone sealant on the backside mating surfaces.
- Place the primary chaincase in position on the motorcycle.

NOTE

Wherever the primary chaincase bolts are to be resused, clean threads and apply two drops of Loctite Medium Strength Threadlocker 243 (blue) before installation

- See Figure 6-3. Attach the inner primary-to-the-engine using bolts and washers in the sequence shown. Tighten bolts to 15-19 ft-lbs (20.3-25.8 Nm).
- See Figure 6-4. Tighten primary-to-transmission bolts in the sequence shown to 15-19 ft-lbs (20.3-25.8 Nm).
- 7. Install starter. See 5.4 STARTER.
- 8. Install starter jackshaft. See 5.6 STARTER JACKSHAFT.
- Install the primary chain, clutch and compensating sprocket as an assembly. See 6.3 DRIVE COMPO-NENTS.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

10. Install primary chaincase cover and fill with lubricant.

11. Connect negative battery cable.

PRIMARY CHAIN AND COMPENSATING SPROCKET

Removal

PART NO.	SPECIALTY TOOL
HD-41214	Primary drive locking tool

To remove the primary chain, remove compensating sprocket, clutch assembly, and primary chain as an assembly.

NOTE

Check sprocket alignment before removing assembly. See Sprocket Alignment in this section.

1. Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAIN-CASE.

CAUTION

Loosen top center nut from chain tensioner before performing any service procedures on primary chain and compensating sprocket. Failure to do so may result in damage to chain tensioner shoe.

- 2. See Figure 6-8. Loosen top center nut from chain tensioner.
- 3. See Figure 6-9. Pull chain tensioner shoe outward.
 - a. Slide chain tensioner shoe downward.
 - b. Verify chain tensioner shoe is resting on bottom lip of primary chaincase.

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- See Figure 6-10. Loosen jam nut (3). 4.
- 5. Remove retaining ring (1) and release plate (2).



Figure 6-8. Top Center Nut





Figure 6-10. Clutch

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.

NOTES

- See Figure 6-11. When removing the clutch hub mainshaft nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-41214) must be placed between upper strand of primary chain and clutch hub sprocket.
- The mainshaft nut has left handed threads. Turn clockwise to remove.
- See Figure 6-11. Using a breaker bar, remove clutch hub mainshaft nut.

NOTE

See Figure 6-12. When removing the compensating sprocket nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-41214) must be placed between upper strand of primary chain and compensating sprocket.

- See Figure 6-12. Using a breaker bar, remove the compensating sprocket nut.
- 8. See Figure 6-13. Remove nut (6), sprocket cover (5) and sliding cam (4).
- Remove clutch assembly, primary chain and compensating sprocket as a single assembly.

Installation

PART NO.	SPECIALTY TOOL	
HD-41214	Primary drive locking tool	

The primary chain, compensating sprocket and clutch assembly must be installed as an assembly.

- See Figure 6-8. Loosely install chain tensioner and top center nut to fasten chain tensioner assembly onto captured bolt inside of primary chaincase. Verify chain tensioner shoe is resting on bottom lip of primary chaincase.
- Place drive components (primary chain, compensating sprocket, and clutch assembly) into position. The clutch hub and compensating sprocket are splined, so a slight rotation of the chain drive will aid installation.
- See Figure 6-13. Slide compensating sprocket (3), sliding cam (4) and sprocket cover (5) over shaft extension (2).
- Clean and prime threads of nut (6). Apply two drops of LOCTITE THREADLOCKER 262 (red) to the threads. Install nut hand tight.



Figure 6-11. Removing Clutch Hub Mainshaft Nut



Figure 6-12. Removing Compensating Sprocket Nut



Figure 6-13. Compensating Sprocket

NOTE

Clutch hub mainshaft nut has left handed threads. Turn counterclockwise to install.

 Clean and prime threads of nut. Apply two drops of LOC-TITE THREADLOCKER 262 (red) to the threads of the clutch hub mainshaft nut. Start nut onto mainshaft and tighten hand tight.

NOTE

See Figure 6-14. When installing the compensating sprocket nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-41214) must be placed between upper strand of primary chain and clutch hub sprocket.

- Tighten compensating sprocket nut to 75 ft-lbs (101.7 Nm). Remove primary drive locking tool.
- See Figure 6-15. Scribe a line (3) on the sprocket shaft nut (1). Continue the line on the sprocket cover (2) as shown.
- Tighten the sprocket shaft nut an additional 45° to 50° (50° MAXIMUM).

NOTE

See Figure 6-16. When installing the clutch hub mainshaft nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-41214) must be placed between upper strand of primary chain and compensating sprocket.

- Tighten clutch hub mainshaft nut to 70-80 ft-lbs (94.9-108.5 Nm). Remove primary drive locking tool.
- See Figure 6-17. Install release plate (5) with jam nut (2) and adjuster screw (3) into clutch hub bore. The word "OUT" stamped on the release plate should face outward.



Figure 6-14. Installing Compensating Sprocket Nut







Figure 6-16. Installing Clutch Hub Mainshaft Nut

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- 11. Inspect retaining ring (4) and replace if necessary. Install retaining ring in clutch hub bore to lock release plate in position. Verify that the retaining ring is completely seated in the groove.
- 12. Adjust clutch and primary chain tension. See 1.12. CLUTCH and 1.10 PRIMARY CHAIN.
- 13. Verify sprocket alignment. See Sprocket Alignment in this section.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

 Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.

Sprocket Alignment

Check the sprocket alignment before the primary drive components are removed. A spacer located behind the compensating sprocket shaft extension aligns the compensation sprocket with the clutch sprocket.

- 1. To align the sprockets, snug the chain tension and push primary chain inward as far as it will go at both the engine compensating sprocket and clutch sprocket.
- 2. Check sprocket alignment.
 - a. Place a straightedge across the chain sideplates.
 - b. With a dial caliper, measure the distance from the straightedge to the gasket surface of the case. Measure as close to the engine compensating sprocket as possible. Record this measurement.
 - c. Repeat the procedure near the clutch sprocket.

NOTE

The difference in the two measurements will be the spacer thickness that needs to be added or subtracted (if necessary).

- 3. Refer to Table 6-1. Calculate spacer thickness.
 - The difference between the two measurements must be within 0.030 in. (0.76 mm) for proper primary chain alignment.
 - b. A difference greater than 0.030 in. (0.76 mm) indicates a variable thickness spacer should be removed or installed on the engine sprocket shaft between the alternator rotor and the shaft extension.



Figure 6-17. Clutch

Table 6-1. Spacer Thickness

PART NO.	IN.	ММ
35850-84	0.010	0.25
35851-84	0.020	0.51
35852-84	0.030	0.76
24032-70	0.060	1.52
24033-70	0.090	2.29
24034-70	0.120	3.05
24035-70	0.150	3.81
24036-70	0.180	4.57
24037-70	0.210	5.33

CHAIN TENSIONER SHOE

If the chain tensioner shoe is worn to the point where proper adjustment cannot be obtained, replace the shoe as follows:

- Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAIN-CASE.
- 2. See Figure 6-18. Verify chain tensioner shoe is resting on bottom lip of primary chaincase.
- 3. Remove retaining ring (4) and discard.
- 4. Remove shoe (5) from chain tensioner (1).
- 5. Install new shoe (5).
- 6. Install new retaining ring (4).
- Adjust primary chain tension. See 1.10 PRIMARY CHAIN.
- 8. Tighten top center nut (3) to 21-29 ft-lbs (29-39 Nm).

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

 Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.



Figure 6-18. Chain Tensioner Shoe

REMOVAL/INSTALLATION

To remove or install the clutch without disassembly, see 6.3 DRIVE COMPONENTS.

CLUTCH PACK ONLY

Partial Disassembly

This procedure can be performed on the motorcycle without removing the clutch shell or hub.

- Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAIN-CASE.
- See Figure 6-20. Remove six bolts (1) (metric) to release diaphragm spring retainer (2) from clutch hub. Loosen each bolt gradually and in a star sequence around the hub.
- Remove diaphragm spring retainer, diaphragm spring (3) and pressure plate (4) from clutch hub.
- Remove friction plates (5, 7), steel plates (6), damper spring (8) and damper spring seat (9) from clutch hub (11). Continue with CLEANING AND INSPECTION.

Assembly

- See Figure 6-19. Install the narrow friction plate on the clutch hub. Engage tabs on plate with slots in clutch shell.
- 2. See Figure 6-20. Install damper spring seat (9) on clutch hub (11). It must sit inboard of narrow friction plate (7).
- Install damper spring (8) on clutch hub with the concave side out (facing away from damper spring seat).
- Install a steel plate (6) with round edge outward and then a friction plate (5) on the clutch hub. Install seven remaining sets in the same manner, alternating between steel plates and friction plates.
- Install pressure plate (4) on clutch hub aligning holes in plate with threaded bosses on hub.
- Seat diaphragm spring (3) in recess of pressure plate with the concave side inward.



Figure 6-19. Friction Plates

- Align holes in diaphragm spring retainer (2) with threaded bosses on clutch hub. Tabs on spring retainer contact flats on inboard side of bosses.
- Install six bolts (1) (metric) to secure diaphragm spring retainer to clutch hub. Alternately tighten the bolts to 90-110 in-lbs (10.2-12.4 Nm).

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

 Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.



Figure 6-20. Clutch Shell Assembly

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 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:
 - 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 0.143 in.
 (3.62 mm), discard all friction plates and replace with an entirely **new** set.
 - 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 in primary chaincase lubricant before installation.

- 3. Check the steel plates as follows:
 - 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 0.006 in. (0.15 mm).
- Holding the clutch hub, rotate the clutch shell to check bearing for smoothness. Replace the bearing if it runs rough or binds or has any end play.
- Check the primary chain sprocket and the starter ring gear on the clutch shell. Replace the clutch shell if either sprocket or ring gear are badly worn or damaged.
- 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.
- Check the diaphragm spring and diaphragm spring retainer for cracks or bent tabs. Obtain a **new** diaphragm spring or diaphragm spring retainer if either condition exists.

Complete Disassembly

 Follow all partial disassembly information under CLUTCH PACK ONLY.

CAUTION

To avoid possible bearing damage, do not disassemble the clutch shell and hub assembly unless the bearing, hub or shell require replacement. Replace the bearing if disassembled.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

 See Figure 6-21. With the sprocket side up, remove retaining ring from clutch hub groove.



Figure 6-21. Clutch Hub Retaining Ring



Figure 6-22. Pressing Clutch Hub From Bearing

- See Figure 6-22. Supporting clutch shell in same orientation, use arbor press and a suitable press plug to press hub from bearing in clutch shell.
- See Figure 6-23. Turn clutch shell over so that the sprocket side is down. Remove retaining ring from groove in clutch shell bore.
- See Figure 6-24. Turn clutch shell over so that sprocket side is up. Using arbor press and a suitable press plug, press on inner race to remove bearing from clutch shell bore.
- 6. Continue with CLEANING AND INSPECTION.

Assembly

 Orient clutch shell in arbor press with sprocket side down. Be sure to support clutch shell bore on sprocket side. Using a suitable press plug, press against outer race until bearing contacts shoulder in clutch shell bore.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- See Figure 6-23. Install retaining ring in groove of clutch shell bore. Place flat side of ring against bearing.
- Center hub in bearing. Be sure that bearing inner race is supported with sleeve on sprocket side. Press hub into bearing until hub shoulder contacts bearing inner race.



Figure 6-23. Clutch Shell Retaining Ring with Flat Side Against Bearing



Figure 6-24. Pressing Bearing From Clutch Shell

- 4. See Figure 6-21. Turn assembly over so that the sprocket side is up. Install retaining ring in groove of clutch hub.
- Place clutch assembly on bench oriented with the sprocket side down.
- Soak all friction and steel plates in FORMULA+ TRANS-MISSION AND PRIMARY CHAINCASE LUBRICANT for at least 5 minutes.

- 7. See Figure 6-25. Install the narrow friction plate on the clutch hub engaging tabs on plate with slots in clutch shell.
- 8. Install damper spring seat on clutch hub so that it seats inboard of narrow friction plate.
- Install damper spring on clutch hub with the concave 9. side up (facing opposite damper spring seat).
- 10. Install a steel plate and then a friction plate on the clutch hub. Install seven remaining sets in the same manner, alternating between steel plates and friction plates.
- 11. Install pressure plate on clutch hub aligning holes in plate with threaded bosses on hub.
- 12. See Figure 6-26. Seat diaphragm spring (1) in recess of pressure plate with the concave side down.
- 13. Align holes in diaphragm spring retainer with threaded bosses on clutch hub. Tabs on spring retainer contact flats on inboard side of bosses.
- 14. Install six bolts (5) (metric) to secure diaphragm spring retainer to clutch hub. Alternately tighten the bolts to 90-110 in-lbs (10.2-12.4 Nm).

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

15. Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRI-MARY CHAINCASE.



Figure 6-25. Clutch Stackup



Figure 6-26. Assembled Clutch

TRANSMISSION SPROCKET

REMOVAL

PART NO.	SPECIALTY TOOL	
HD-41184	Transmission sprocket tool	
HD-94660-37B	Mainshaft locknut wrench	

 Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAIN-CASE.

- 2. Remove transmission sprocket.
 - See Figure 6-27. Remove both screws (1) and lockplate (2).
 - b. See Figure 6-28. Secure sprocket using TRANS-MISSION SPROCKET TOOL (Part No. HD-41184).
 - Remove the sprocket nut using MAINSHAFT LOCK-NUT WRENCH (Part No. HD-94660-37B).

NOTE

Sprocket nut has a left hand thread.

 See Figure 6-29. Loosen rear axle and adjusters so rear wheel can be moved all the way forward. Remove belt from sprocket as you remove sprocket.

CLEANING AND INSPECTION

- 1. Clean sprocket of all grease and dirt using solvent. Clean and prime main drive gear threads.
- Inspect belt and sprocket. See 1.15 REAR BELT AND SPROCKETS.
- 3. Inspect both main drive gear seals.

INSTALLATION

PART NO.	SPECIALTY TOOL	
HD-41184	Transmission sprocket tool	
HD-94660-37B	Mainshaft locknut wrench	

1. Place transmission sprocket in position.

- See Figure 6-27. Apply LOCTITE THREADLOCKER 262 (red) to sprocket nut (3) threads. Thread the sprocket nut counterclockwise onto main drive gear, with flanged side facing transmission sprocket.
- See Figure 6-28. Lock transmission sprocket with the TRANSMISSION SPROCKET LOCKING TOOL (2) (Part No. HD-41184). Attach tool to sprocket with tool handle below pivot shaft. Snug thumbscrew to lock tool on sprocket.
- Screw pilot of MAINSHAFT LOCKNUT WRENCH (1) (Part No. HD-94660-37B) onto threaded end of mainshaft.



Figure 6-27. Transmission Sprocket



Figure 6-28. Transmission Sprocket Tools



Figure 6-29. Axle Adjusters (Left Side Shown)

5. Using locknut wrench, tighten sprocket nut to 60 ft-lbs (81.4 Nm) initial torque.

CAUTION

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 60 ft-lbs torque. Do not loosen sprocket nut while attempting to align the screw holes. Tightening too much or little may cause the nut to come loose during vehicle operation, causing damage to drive components.

- 6. See Figure 6-30. Scribe a line (3) on the transmission sprocket nut (1). Continue the line on the transmission sprocket (2) as shown.
- Tighten the transmission sprocket nut an additional 35° to 40° (45° MAXIMUM).
- Install lockplate over transmission sprocket nut so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's two tapped holes.
- 9. See Figure 6-27. Install screws (1) through two of the four holes in lockplate (2), then into two corresponding tapped holes in sprocket (4).

NOTE

The lockplate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally TIGHT-ENED until the screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

CAUTION

To ensure the lockplate's security, you must use BOTH screws when you install the lockplate.

10. Tighten screws to 84-108 in-lbs (9.5-12.2 Nm).

NOTE

The screws have LOCTITE patches. With LOCTITE THREADLOCKER 243 (blue) reapplied before installation, the screws can be re-used 3-5 times.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

- 11. Install primary chain assembly and primary chaincase cover. Fill primary chaincase with lubricant. See 6.3 DRIVE COMPONENTS.
- 12. Align vehicle and tighten rear axle. See 2.15 VEHICLE ALIGNMENT.
- 13. Adjust belt tension. See 1.14 REAR BELT DEFLEC-TION.



Figure 6-30. Transmission Sprocket Nut Final Tightening

DRIVE BELT

REMOVAL

- 1. Remove rear wheel. See 2.8 REAR WHEEL.
- Remove primary chain, clutch, engine compensating sprocket, and chain adjuster as an assembly. See 6.3 DRIVE COMPONENTS.
- Remove primary chaincase housing. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAIN-CASE.
- 4. Place a support under rear fork and engine. Remove pivot shaft and spacer. See 2.26 REAR FORK.
- 5. See Figure 6-32. Slip drive belt (2) from transmission sprocket (1).

INSPECTION

See 1.15 REAR BELT AND SPROCKETS.



Figure 6-31. Proper Drive Belt Handling

INSTALLATION

CAUTION

See Figure 6-31. All belts, used or new, must never be formed into a loop smaller than 5.0 in. (130 mm), and must never be bent backwards. Sharp bending can weaken the belt. Used belts must be reinstalled so they rotate in the same direction as they originally did.

NOTE

FXST, FXSTB and FXSTS models use a 20 mm wide belt.

- 1. See Figure 6-32. Install belt (2) over transmission sprocket (1).
- 2. Install pivot shaft and spacer. Remove support holding engine and rear fork. See 2.26 REAR FORK.
- Install the primary chaincase housing. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAIN-CASE.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

- Install primary chain assembly and primary chaincase cover. Fill primary chaincase with lubricant. See 6.3 DRIVE COMPONENTS.
- 5. Install rear wheel. See 2.8 REAR WHEEL.
- 6. Align vehicle. See 2.15 VEHICLE ALIGNMENT.
- 7. Adjust belt tension. See 1.14 REAR BELT DEFLEC-TION.



Figure 6-32. Belt and Transmission Sprocket

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TRANSMISSION

7

SPECIFICATIONS

TRANSMISSION	DATA
Туре	5-speed forward constant mesh
Transmission lubricant type (qt)	Part No. 99891-84 (gal) 99892-84 (qt)
Capacity (dry)	24 oz.
	709.8 ml
Capacity (wet)	20-24 oz.
	591.5-709.8 ml

MAINSHAFT TOLERANCE	IN.	ММ	
Mainshaft runout	0.000-0.003	0.00-0.08	
Mainshaft end play	none	none	
1st gear clearance	0.0000-0.0080	0.000-0.203	
2nd gear clearance	0.0000-0.0800	0.000-2.032	
3rd gear end play	0.0050-0.0420	0.127-1.067	
3rd gear clearance	0.0003-0.0019	0.008-0.048	
4th gear end play	0.0050-0.0310	0.127-0.787	
4th gear clearance	0.0003-0.0019	0.008-0.048	

GEAR	FINAL DRIVE RATIO	
First (low)	3.21	
Second	2.21	
Third	1.57	
Fourth	1.23	
Fifth (high)	1.00	

SHIFTER DOG GEARS	MINIMUM CLEARANCE	MAXIMUM CLEARANCE	
2nd-5th	0.035 in.	0.139 in.	
	0.089 mm	3.353 mm	
2nd-3rd	0.035 in.	0.164 in.	
	0.089 mm	4.17 mm	
1st-4th	0.035 in.	0.152 in.	
	0.089 mm	3.86 mm	
1st-3rd	0.035 in.	0.157 in.	
	0.089 mm	3.99 mm	

SIDE DOOR BEARING	IN.	MM	
Fit in side door (tight)	0.0014-0.0001	0.036-0.0025	
Fit on countershaft (tight)	0.0007	0.018	
Fit on countershaft (loose)	0.00001	0.00025	
Fit on mainshaft (tight)	0.0007	0.018	
Fit on mainshaft (loose)	0.001	0.0025	

NOTE

Final gear ratios indicate the number of mainshaft revolutions required to drive the output sprocket one revolution.

MAIN DRIVE GEAR (5TH)	IN.	MM	
Bearing fit in transmission case (loose)	0.0003-0.0017	0.0076-0.043	
Fit in bearing (tight)	0.0009	0.023	
Fit in bearing (loose)	0.0001	0.0025	
Fit on mainshaft	0.0001-0.0009	0.0025-0.023	
End play	none	none	

COUNTERSHAFT TOLERANCE	IN.	MM
Countershaft runout	0.000-0.003	0.00-0.08
Countershaft end play	none	none
1st gear clearance	0.003-0.0019	0.008-0.048
1st gear end play	0.0050-0.0039	0.127-0.099
2nd gear clearance	0.0003-0.0019	0.008-0.048
2nd gear end play	0.0050-0.0440	0.127-1.118
3rd gear clearance	0.0000-0.0080	0.000-0.0203
4th gear clearance	0.0000-0.0080	0.000-0.0203
4th gear end play	0.0050-0.0390	0.127-0.991
5th gear clearance	0.0000-0.0080	0.000-0.203
5th gear end play	0.0050-0.0040	0.127-0.102

SHIFTER FORKS	IN.	MM 0.043-0.048	
Shifter fork to cam groove end play	0.0017-0.0019		
Shifter fork to gear groove end play	0.0010-0.0110	0.025-0.0279	

TORQUE VALUES

ITEM	TOR	QUE	NOTES
Clutch cable fitting	36-60 in-lbs	4.1-6.8 Nm	page 7-13
Clutch release cover screws	84-108 in-lbs	9.5-12.2 Nm	page 7-13
Engine/transmission mount fasteners	30-35 ft-lbs	40.7-47.5 Nm	special sequence to tighten, page 7-27
Mainshaft/countershaft nuts	45-55 ft-lbs	61.0-74.6 Nm	page 7-16, page 7-24
Shifter cam detent pivot screw	84-108 in-lbs	9.5-12.2 Nm	page 7-8
Shifter lever screw	18-22 ft-lbs	24.4-29.8 Nm	page 7-29
Shifter rod locknuts	80-120 in-lbs	9.0-13.6 Nm	page 7-5
Support blocks	84-108 in-lbs	9.5-12.2 Nm	fit on dowel pins, page 7-9
Top cover screws	84-108 in-lbs	9.5-12.2 Nm	page 7-9
Transmission case, 1/4 in. hardware	84-108 in-Ibs	9.5-12.2 Nm	page 7-16
Transmission case, 5/16 in. hardware	13-16 ft-lbs	17.6-21.7 Nm	page 7-16
Transmission drain plug	14-21 ft-lbs	19.0-28.5 Nm	clean before installation, page 7-17, page 7-27

See Figure 7-1. The 5-speed transmission consists of two parallel shafts supporting five gears each. The longer, or mainshaft, also supports the clutch and serves as the input shaft. The shorter shaft is called the countershaft.

Each gear on the mainshaft is in constant mesh with a corresponding gear on the countershaft. Each of these five pairs of gears makes up a different speed in the transmission.

The transmission gears are divided into two types, gears that are splined and rotate with the shaft, and freewheeling gears that ride on bearings and spin freely on the shaft. A splined gear always meshes with a freewheeling gear. Also, three of the splined gears are able to slide sideways on the shaft. These sliding gears are used to change transmission speeds. The dogs, or projections, on the sides of the sliding gears, engage dogs on adjacent freewheeling gears, transmitting power through the transmission.

Gear shifting is accomplished by three forks which fit into grooves machined into the hubs of the three sliding gears. The position of the shifter forks is controlled by a drumshaped shifter cam located on the top of the transmission.

When operating problems develop in a transmission, see 1.32 TROUBLESHOOTING and perform the following adjustments. If these adjustments fail to correct the problem, proceed to the disassembly and repair procedures in this section.

Neutral

Power is introduced to the transmission through the clutch. In neutral, with the clutch engaged, the mainshaft 1st and 2nd gears are rotating, but no power is transferred to the counter-shaft since countershaft 1st and 2nd are freewheeling gears.

1st Gear

When the transmission is shifted into first gear, countershaft 3rd, which rotates with the countershaft, engages countershaft 1st, which has been spinning freely on the countershaft driven by mainshaft 1st.

Now countershaft 3rd is no longer freewheeling, but locked to the countershaft causing the countershaft and countershaft 5th to turn. Countershaft 5th transmits the power to the main drive gear and the sprocket.

2nd Gear

Second gear is engaged when countershaft 3rd is shifted out of countershaft 1st and engages countershaft 2nd. This locks countershaft 2nd to the countershaft to complete the power flow as shown.

3rd Gear

Two shifter forks are used to make the shift from second to third. One fork moves countershaft 3rd out of countershaft 2nd to its neutral position, while another fork engages mainshaft 2nd with mainshaft 3rd. This locks mainshaft 3rd to the mainshaft to complete the power flow as shown.

4th Gear

The shift into fourth is made when mainshaft 2nd is disengaged from mainshaft 3rd and mainshaft 1st engages mainshaft 4th, locking it to the mainshaft.

5th Gear

The shift from fourth to fifth gear occurs when mainshaft 1st is shifted out of mainshaft 4th, and mainshaft 2nd is shifted directly into the main drive gear. Mainshaft 2nd lock the main drive gear to the mainshaft resulting in a direct one-to-one drive ratio from the clutch to the sprocket.




SHIFTER LINKAGE ADJUSTMENT

The foot shift linkage is set at the factory and normally should need no adjustment. However, if gears do not engage fully or toe shifter travel is incorrect, adjust linkage rod as follows:

- 1. See Figure 7-2. Disconnect one end of shifter rod.
- 2. Loosen locknuts (1). Adjust rod (2) as necessary and connect loose end of shifter rod.
- 3. Tighten locknuts to 80-120 in-lbs (9.0-13.6 Nm).

NOTE

Internal transmission components allow no other adjustments to the shifter assembly.



Figure 7-2. Shifter Rod

REMOVAL/DISASSEMBLY

WARNING

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

- 1. Disconnect negative battery cable.
- 2. Remove battery and oil tank. See 3.32 OIL TANK.
- 3. Remove starter. See 5.4 STARTER.
- 4. See Figure 7-3. Disconnect neutral indicator switch (1). See 8.36 NEUTRAL SWITCH.
- 5. Remove vent hose (4) from fitting (5) on cover to provide additional clearance for removal if needed.
- 6. Remove top cover.
 - a. Remove the screws and washers (2, 3).
 - b. Remove the top cover (6) and cover gasket (7).
 - c. Discard gasket.



- 4. Vent hose
- 5. Vent hose fitting
- 6. Top cover
- 7. Gasket



- See Figure 7-4. Remove four bolts and washers (1) to free the right (2) and left (3) support blocks.
- 8. Lift shifter cam pawl (4) over cam pins to free assembly.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- 9. See Figure 7-5. Disassemble shifter cam assembly if necessary.
 - Right support block (3) is a slip fit over the shifter cam (4). Remove retaining ring (1) to remove bearing (2). Discard retaining ring.
 - Remove small retaining ring (6) to free left support block (5) from shifter cam. Remove retaining ring (1) to free bearing (2). Discard retaining rings.
 - c. Remove detent pivot screw (7) to free the detent spring (8), spring sleeve (9) and detent follower (10).



4. Shifter cam pawl

Figure 7-4. Support Block Fasteners



Figure 7-5. Shifter Cam Assembly

CLEANING AND INSPECTION

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- See Figure 7-5. Clean all parts except bearings (2) with solvent. Blow parts dry with low pressure compressed air.
- Inspect bearings (2) and shifter cam ends. If ends of shifter cam are pitted or grooved, replace the shifter cam and bearings. Install new bearings in support blocks by pressing on the side of the bearing with letters stamped on it. Stamped side of bearing should face outward when support block is installed on cam.
- Inspect shifter cam (4) for cracks or wear and replace if necessary.
- Inspect neutral indicator switch in top cover. Depress plunger. It should spring back without binding. The switch is a non-repairable item and must be replaced if damaged.

ASSEMBLY/INSTALLATION

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- 1. Assemble shifter cam components if necessary.
 - a. See Figure 7-5. Place a bearing (2) inside left support block (5) by pressing on the side of the bearing with letters stamped on it. This side should face out.

NOTE

See Figure 7-6. When installing new retaining ring verify the tab is on the right side and opening is towards bottom when you are looking at the end of the shifter drum.

- See Figure 7-5. Secure bearing by installing a new retaining ring (1) with the beveled side facing out. Place assembly on shifter cam and install a new small retaining ring (6).
- c. Place a bearing (2) inside right support block by pressing on the side of the bearing with letters stamped on it. This side should face out. Secure bearing by installing a **new** retaining ring (1) with the beveled side facing out. Slip right support block (3) over shifter cam (4).
- d. See Figure 7-7. Slide spring sleeve (1) inside the spring (2). Place follower (4) under sleeve and use pivot screw (3) to attach assembly to right support block. Tighten to 84-108 in-lbs (9.5-12.2 Nm).



Figure 7-6. Retaining Ring Orientation



Figure 7-7. Detent Arm Assembly

- See Figure 7-8. Lift shifter cam pawl (3) over the cam pins (4). Place shifter cam assembly (1) on transmission case with shifter forks (2) positioned in the slots.
- See Figure 7-9. The transmission case has dowel pins which fit into the mounting holes of **BOTH** support blocks. Align the cam assembly by positioning the support blocks on the dowel pins. Install support block bolts and tighten to 84-108 in-Ibs (9.5-12.2 Nm).

NOTE

Check the gear engagement and clearance in every gear to be sure assembly and alignment is correct.

- See Figure 7-3. Install the top cover (6) with a new gasket (7) placing long screw (3) next to vent hose fitting (5). Tighten screws (2, 3) to 84-108 in-lbs (9.5-12.2 Nm).
- If neutral switch was removed, it must be installed in the top cover with the transmission shifter in the NEUTRAL position to properly engage slot on shifter cam. See 8.36 NEUTRAL SWITCH.
- 6. Connect vent hose (4) to vent hose fitting (5).
- 7. Install starter. See 5.4 STARTER.
- 8. Install oil tank and battery. See 3.32 OIL TANK.
- 9. Connect negative battery cable.



- 1. Shifter cam assembly
- 2. Shifter forks
- 3. Shifter cam pawl
- 4. Cam pins

Figure 7-8. Shifter Cam Alignment



Figure 7-9. Dowel Pin Locations

SHIFTER FORKS

REMOVAL

- 1. Remove the transmission top cover and shifter cam assembly. See 7.3 SHIFTER CAM ASSEMBLY.
- 2. Remove the transmission side cover. See 7.5 TRANS-MISSION CLUTCH RELEASE COVER.
- See Figure 7-10. Slide fork shaft out through the hole and remove the shifter forks. Continue with CLEANING AND INSPECTION.

CLEANING AND INSPECTION

AWARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 1. Clean all parts with solvent. Blow parts dry with low pressure compressed air.
- 2. Check the shifter fork shaft and replace it if bent or damaged.
- See Figure 7-11. Check to see if fork is square on the shaft using a small carpenter's square. If fork does not rest directly on the square, it is bent and must be replaced.
- 4. Inspect the forks for wear. Replace forks worn thinner than 0.165 in. (4.19 mm) at mating surfaces.



Figure 7-10. Fork Shaft



Figure 7-11. Checking Fork For Squareness

INSTALLATION

- 1. See Figure 7-12. The forks are different from each other and are identified as shown.
- See Figure 7-13. Insert shifter fork (1) into the slot of the mainshaft 1st gear. Insert shifter fork (2) into the slot of the countershaft 3rd gear and insert shifter fork (3) into the slot of the mainshaft 2nd gear.
- See Figure 7-10. Slide fork shaft through the transmission case hole, through the forks and into the hole in the opposite side of the case.
- 4. Install transmission side cover and drain plug. See 7.5 TRANSMISSION CLUTCH RELEASE COVER.
- Check the sliding movement of forks and gears. All parts should move freely.
- 6. Assemble shifter cam and top cover. See 7.3 SHIFTER CAM ASSEMBLY.



Figure 7-12. Shifter Fork Identification



Figure 7-13. Fork Position In Transmission

REMOVAL/DISASSEMBLY

1. Drain transmission. See 1.13 TRANSMISSION LUBRI-CANT.

NOTE

Actuating the clutch hand lever after removing the six screws will help break the cover free.

 See Figure 7-14. Remove the six screws that hold the clutch release cover in place. Remove the clutch release cover and discard the gasket.



Figure 7-14. Cover Screws

 Loosen clutch cable adjuster so clutch cable is slack. See 1.12 CLUTCH.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

- See Figure 7-15. Note position of retaining ring opening. Remove retaining ring (1). Lift inner ramp (2) and coupling (3) out of clutch release cover. Disconnect clutch cable end (4) from the ball and ramp coupling (3).
- 5. Unscrew cable fitting (5) from clutch release cover.
- 6. See Figure 7-16. Remove balls (2) and outer ramp (3). Continue with CLEANING AND INSPECTION.



Figure 7-15. Clutch Cable Connection



Figure 7-16. Coupling and Ramp Assembly

CLEANING AND INSPECTION

- 1. See Figure 7-17. Wash the ball and ramp mechanism components in cleaning solvent.
- Inspect the three balls (2) and ball socket surfaces on ramps (1, 3) for wear, pitting, surface breakdown and other damage. Replace damaged parts.
- Check fit of the ramp coupling (4) on inner ramp (1). Replace both parts if there is excessive wear.
- 4. Check clutch cable end for frayed or worn ends. Replace cable if damaged or worn.
- Check the bore in the cover (5) where the ramps (1, 3) are retained. There should be no wear. Lips worn into the bore can catch the ramps and cock them, causing improper clutch adjustment.

ASSEMBLY/INSTALLATION

1. See Figure 7-15. Screw clutch cable fitting (5) into clutch release cover. Do not tighten at this time.

NOTE

Replace cable fitting O-ring if damaged or deformed.

- See Figure 7-17. Place outer ramp (3) in side cover (5) and place balls (2) in slots. Be sure tab is in clutch release cover slot.
- Connect cable end to ramp coupling (4). Install coupling on inner ramp (1) and place inner ramp and coupling in position in clutch release cover (5).

WARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

4. Install retaining ring (6).

NOTE

See Figure 7-18. Retaining ring opening must be installed to the right of the outer ramp tab slot.

- See Figure 7-14. Install new gasket and replace clutch release cover. Tighten all six screws to 84-108 in-lbs (9.5-12.2 Nm).
- Tighten clutch cable fitting to 36-60 in-lbs (4.1-6.8 Nm).
- Fill transmission to proper level with fresh transmission fluid. See 1.13 TRANSMISSION LUBRICANT.
- 8. Adjust clutch cable. See 1.12 CLUTCH.



Figure 7-17. Release Mechanism Assembly



Figure 7-18. Retaining Ring Installation

NOTES

6

GENERAL

NOTE

Check the eight digit number stamped on the transmission case just above the side door. If the third digit is "9," then the transmission was built for Japan only. If the digit is "0," then it was built for all countries except Japan. If servicing a Japanese transmission, follow the steps under REMOVAL below and then see Appendix D.1 JAPANESE MAINSHAFT/COUN-TERSHAFT for disassembly and assembly instructions.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-34902-B	Bearing race puller and installation tool

NOTE

Leave the transmission case on the frame unless the case itself requires replacement. For illustration purposes, some photographs may show the case removed.

 Remove exhaust system. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

- Remove primary cover, clutch assembly and primary chaincase. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAINCASE.
- Remove transmission top cover, shifter cam assembly, and shifter forks. See 7.4 SHIFTER FORKS.
- See Figure 7-19. Remove the bearing inner race from the transmission mainshaft using BEARING RACE PULLER AND INSTALLATION TOOL (Part No. HD-34902-B).
- 5. Remove transmission drain plug to drain lubricant.
- 6. Remove the side cover from the transmission side door. See 7.5 TRANSMISSION CLUTCH RELEASE COVER.
- 7. Lock the transmission by meshing the gears into two speeds at the same time.
- See Figure 7-20. If dissembling, remove retaining ring (1) to free thrust washers (2), push rod bearing (3) and oil slinger (4) from mainshaft. Otherwise, remove components as an assembly.



Figure 7-19. Pulling Mainshaft Inner Bearing Race



Figure 7-20. Push Rod Assembly

- 9. See Figure 7-21. Remove locknuts (1) and spacers (2) from the shafts.
- If main drive gear (1, Figure 7-31.) is to be removed, lock transmission as described above and remove transmission sprocket nut. See 6.5 TRANSMISSION SPROCKET. Inspect seals for damage.

NOTE

The main drive gear bearing must be replaced if the main drive gear is removed. The bearing will be damaged during the removal procedure.

 See Figure 7-22. Remove the transmission side door mounting hardware. Pry the side door loose and remove side door, mainshaft and countershaft from transmission case as an assembly.

CAUTION

Do not attempt to remove shafts by tapping them out from opposite side. If you try to remove the shafts by tapping them with a hammer, you will damage the side door bearings.

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-34902-B	Bearing race puller and installation tool

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear oil seal.

- 1. See Figure 7-24. Install the assembly in the transmission case using a **new** gasket (2).
 - a. See Figure 7-22. Tighten all 5/16 in. screws (1) to 13-16 ft-lbs (17.6-21.7 Nm).
 - b. On FLSTSC and FLSTF models, place the longer 5/ 16 in. screw (1*) into forward hole to accommodate muffler mount.
 - c. Tighten all 1/4 in. screws (2) to 84-108 in-lbs (9.5-12.2 Nm).
- Lock the transmission by engaging two gears. Tighten new mainshaft and countershaft nuts to 45-55 ft-lbs (61.0-74.6 Nm).



Figure 7-21. Side Door Bearings



Figure 7-22. Transmission Mounting Hardware

- See Figure 7-23. The bearing race must be positioned on the shaft a precise distance to properly align with the bearing outer race in the primary chaincase. To install the bearing inner race, use those parts of the combination bearing race, PULLER AND INSTALLATION TOOL (Part No. HD-34902-B).
 - a. Slide bearing inner race (1), chamfer edge first, onto mainshaft.
 - b. Thread sleeve pilot (2) onto end of mainshaft (left hand thread).
 - c. Position sleeve (3) over sleeve pilot (2) and against bearing race (1).
 - Place washer (4) over threaded portion of sleeve pilot (2) and install nut (5).

NOTE

Measure the length of the bearing inner race (1). The race must be 0.9950-1.000 in. (25.27-25.40 mm) long.

- Tighten nut (5) while holding sleeve pilot (2) stationary with wrench on flats at end of screw threads.
 Press race (1) onto shaft so inside edge is 0.100-0.150 in. (2.540-3.810 mm) from main drive gear.
- See Figure 7-20. Install push rod assembly (2-5) in mainshaft hole. Secure with new retaining ring (1) if disassembled.
- 5. Install the side cover, using a **new** gasket. See 7.5 TRANSMISSION CLUTCH RELEASE COVER
- Install the shifter forks, shifter cam and top cover. See 7.4 SHIFTER FORKS.
- Install transmission sprocket nut. See 6.5 TRANSMIS-SION SPROCKET.
- Install primary chaincase, clutch assembly and primary cover. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAINCASE.

CAUTION

Do not overtighten drain plug. When draining or adding lubricant, do not allow dirt, debris or other contaminants to enter transmission drain case. These actions may result in damage to the motorcycle.

- Clean and install transmission drain plug. Tighten to 14-21 ft-lbs (19.0-28.5 Nm).
- 10. Fill transmission to proper level with fresh transmission fluid. See 1.13 TRANSMISSION LUBRICANT.
- Install exhaust system. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.



Figure 7-23. Installing Bearing Race

5. Nut

DISASSEMBLY

PART NO.	SPECIALTY TOOL	
J-5586-A	Retaining ring pliers	

- See Figure 7-24. Remove the 2-piece push rod (21) from the hole in the mainshaft. Use RETAINING RING PLI-ERS (Part No. J-5586-A) to remove retaining rings (12).
- With access door on end (shafts pointing upward), remove the retaining ring (12) from the countershaft (6). Remove the countershaft 5th gear (19) and countershaft 2nd gear (18).
- 3. Remove the bearings (9), retaining ring (12) and countershaft 3rd gear (16).
- 4. Remove mainshaft 2nd gear (20).

NOTE

To remove the mainshaft 3rd gear (17), move the retaining ring on the access door side of 3rd gear out of the slot and slide it on the shaft away from 3rd gear. The gear will move down the shaft for easy access to the upper retaining ring.

5. Remove the upper retaining ring, thrust washer (11), mainshaft 3rd gear (17), bearings and retaining ring.

CAUTION

Supporting the gears in the following step is necessary to provide support for the inner bearing races. Failure to support the gears will damage the bearings.

- 6. Support countershaft 1st gear and press out countershaft.
- 7. Support mainshaft 4th gear and press out mainshaft.
- 8. Remove the remaining spacers and retaining rings.

CLEANING AND INSPECTION

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 1. Clean all parts with solvent. Blow parts dry with low pressure compressed air.
- Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.
- 3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, battered or chipped.
- 4. See Figure 7-21. Inspect the bearings (4) in the side door (5). If bearings are pitted, grooved, feel rough when turned or have any end play, replace the bearings.

Replacing Side Door Bearings

1. See Figure 7-21. Remove the retaining rings (3) and press the bearings out of the side door.

CAUTION

To perform the next step, you must use a plate for support or the bearing door will be damaged.

- 2. When pressing **new** bearings into side door, press on the outside diameter of the bearing side with the numbers stamped on it. This side should face toward the outside of the door. Support the door from the opposite side at the bearing bores with a flat plate.
- 3. Install beveled retaining ring (3) with the flat side next to the bearing.



Figure 7-24. Mainshaft/Countershaft Assembly

ASSEMBLY

PART NO.	SPECIALTY TOOL
J-5586-A	Retaining ring pliers

NOTE

Replace all retaining rings and gear roller bearings with **new** parts during assembly.

- See Figure 7-24. Slip thrust washers (11) and retaining rings (12) on mainshaft and countershaft. Slip mainshaft 4th gear on mainshaft and countershaft 1st gear on countershaft.
- 2. Lightly coat bearings (9) with oil and install the bearings on the mainshaft (5) bottom race. Slide mainshaft 4th

gear (10) over the bearings. Install one thrust washer (11) on top of the gear and secure with a retaining ring (12). Install mainshaft 1st gear (13) with the shifter fork slot facing the side door.

- Slide countershaft 4th gear (14) onto the countershaft (6).
- 4. Place bearing in countershaft race and install the countershaft 1st gear (15) with the lip on the gear resting on the spacer and the pockets in the gear facing away from the side door. Install a thrust washer (11) on top of the gear and secure with a retaining ring (12).
- Slip spacers (3, 4) on the shafts with the tapers facing the access door bearings. The mainshaft spacer has a shoulder while the countershaft spacer does not.



Figure 7-25. 4th and 1st Gears on Shafts

CAUTION

Failure to support inner bearing races while pressing shafts through the bearings will damage the bearings.

 Place side door (1) in an arbor press. Support inner bearing races with a suitable socket. Starting with mainshaft, press the shafts into the bearings. With the shafts properly pressed into the side door, spacers (3, 4) will have no end play. The mainshaft (5) is installed to the left of the transmission top cover access cover hole when viewing the side door from the top.

- 7. Install one spacer (7) and nut (8) on each shaft and tighten the nuts finger tight. Do not tighten at this time.
- Install a retaining ring (12) in the mainshaft groove just above 1st gear. Insert a thrust washer (11) on top of the retaining ring and place the bearings into the mainshaft race.
- Place mainshaft 3rd gear (17) over bearings and secure 3rd gear with a thrust washer (11) and retaining ring (12).



Figure 7-26. 3rd Gear on Mainshaft

- 10. Install the mainshaft 2nd gear (20) on the shaft with the shifter fork slot towards the side door.
- 11. Install countershaft 3rd gear (16) with shifter fork slot facing away from the side door.



Figure 7-27. 2nd, 3rd Gear on Mainshaft

- 12. Install a retaining ring (12) in the countershaft groove above 3rd gear (16). Slide a thrust washer (11) on top of the ring and place the bearings in the countershaft race.
- 14. Install the countershaft 5th gear (19) on the countershaft. Secure 5th gear with a retaining ring.

13. Install the countershaft 2nd gear (18) over the bearings.



Figure 7-28. 3rd Gear on Countershaft

If main drive gear was removed, install it now. See Main Drive Gear and Bearing under 7.7 TRANSMISSION CASE.

15. Lock the transmission by engaging two gears. Tighten mainshaft and countershaft nuts (8) to 45-55 ft-lbs (61.0-74.6 Nm).

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear oil seal.

16. Install the assembly in the transmission case.



Figure 7-29. Side Door, Mainshaft and Countershaft - Final Assembly

REMOVAL

PART NO.	SPECIALTY TOOL
HD-35316-B	Main drive gear remover and installer

General

See 3.14 REMOVING ENGINE FROM CHASSIS for information on pulling transmission case from frame.

Main Drive Gear and Bearing

NOTE

Main drive gear and bearing can be removed with the transmission case in the frame after removing door assembly. Use MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-B).

1. See Figure 7-31. Remove retaining ring (7).

NOTE

The main drive gear bearing and retaining ring must be replaced if the main drive gear is removed. The bearing will be damaged during the removal procedure.

- 2. Pull main drive gear (1) using MAIN DRIVE GEAR REMOVER AND INSTALLER.
- Gently remove bearing (6) from case using a block of wood and a hammer. Discard bearing.

INSTALLATION

Main Drive Gear and Bearing

PART NO.	SPECIALTY TOOL	
HD-35316-B	Main drive gear remover and installer	

CAUTION

Failure to use the MAIN DRIVE GEAR AND BEARING INSTALLATION TOOL will cause premature failure of bearing and related parts.

 See Figure 7-31. Install main drive gear bearing (6) using new retaining ring (7). Install main drive gear (1) from inside the case using MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316-B). Follow instructions provided with tool.

NOTE

See Figure 7-30. Bearing retaining ring must be installed with the flat side facing the bearing and the opening in the ninety degree window as shown.

 See Figure 7-31. Install the quad seal (8), spacer (10) and sprocket (11) on the main drive gear (1). Apply LOC-TITE THREADLOCKER 262 (red) to the threads of sprocket nut (12) and install on the main drive gear.

NOTES

- Sprocket nut (12) has left-hand thread.
- Place belt on transmission sprocket as sprocket is placed in position.



Figure 7-30. Retaining Ring Opening



Figure 7-31. Transmission Case, Sprocket and Main Drive Gear



Figure 7-32. Shifter Shaft Lever, Exterior View



Figure 7-33. Shifter Shaft Lever Spring

- Slide the countershaft and mainshaft assembly into the transmission case. Lock the gear sets in place.
- 4. Install shifter cam and shifter forks. See 7.4 SHIFTER FORKS.
- Install top cover, right side cover, primary chaincase housing, starter, oil tank, clutch, primary chain and sprocket.
- See Figure 7-34. Verify that transmission dowels are seated. Tighten all transmission mounting bolts in the sequence shown. Connect foot shifter rod to shifter arm.
 - a. Tighten finger tight.
 - b. Tighten to 15 ft-lbs (20.3 Nm).
 - c. Tighten to 30-35 ft-lbs (40.7-47.5 Nm).
- 7. Install the pivot shaft and side mounting plates.
- Adjust drive belt tension. See 1.14 REAR BELT DEFLECTION.
- 9. Align vehicle. See 2.15 VEHICLE ALIGNMENT.
- 10. Adjust primary chain. See 1.10 PRIMARY CHAIN.

CAUTION

The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

- 11. Install primary chaincase cover. See PRIMARY CHAIN-CASE COVER under 6.2 PRIMARY CHAINCASE.
- Install the exhaust system. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/FLSTF, 4.11 EXHAUST SYSTEM: FLSTN or 4.12 EXHAUST SYSTEM: FLSTSC as appropriate.

CAUTION

Do not overtighten drain plug. When draining or adding lubricant, do not allow dirt, debris or other contaminants to enter transmission drain case. These actions may result in damage to the motorcycle.

 Clean transmission drain plug and install. Tighten to 14-21 ft-lbs (19.0-28.5 Nm). Place motorcycle in an upright position. Fill transmission to proper level with fresh transmission fluid. See 1.13 TRANSMISSION LUBRICANT.



Figure 7-34. Transmission Mounting Bolts

CAUTION

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

14. Fill primary chaincase. See 1.11 PRIMARY CHAINCASE LUBRICANT.

DISASSEMBLY

Shifter Arm Assembly

- See Figure 7-35. After removing door assembly, remove screw (8) and shifter lever (9) from the shifter shaft pawl/ lever (1).
- Remove retaining ring (7), washer (6) and seal (5). Discard retaining ring and seal. Pull shifter shaft assembly out of the transmission case.
- 3. Inspect sleeve (2) inside transmission case.

CLEANING AND INSPECTION

PART NO.	SPECIALTY TOOL	
HD-37842-A	Main drive gear bearing and seal installation tool (if replacing)	

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

 Clean all parts in solvent except the case and needle bearings. Blow parts dry with low pressure compressed air.

NOTE

The transmission case and needle bearings must not be cleaned because it is impossible to clean a needle bearing. Normal cleaning methods will wash dirt or other contaminates into the bearing case (behind the needles) and lead to bearing failure.

- When replacing seals, lightly coat outside diameter of seal with LOCTITE RETAINING COMPOUND No. 601. Use MAIN DRIVE GEAR INSTALLER (Part No. HD-41405) to install main drive gear seal.
- 3. Inspect the main drive gear for pitting and wear. Replace if necessary.
- Replace the sprocket if the teeth are rounded or damaged.
- 5. See Figure 7-35. Inspect the shifter shaft pawl/lever (1) for wear. If pawl ends are damaged, replace.
- 6. Inspect the springs (3, 4). Replace if necessary.
- Inspect the needle bearings on the inside of the main drive gear. If mainshaft race surface appears pitted or grooved, replace these bearings.



Figure 7-35. Shifter Shaft Assembly



Figure 7-36. Installing Clutch Side Needle Bearing in Main Drive Gear



Figure 7-37. Pressing in Seal

NOTE

If the main drive gear needle bearings and/or seal need to be replaced, continue as follows. Otherwise, proceed to ASSEMBLY.

8. Remove seal and old needle bearings.

NOTE

To install the inner main drive gear needle bearings and seal, use MAIN DRIVE GEAR BEARING and SEAL INSTALLA-TION TOOL (Part No. HD-37842-A).

- See Figure 7-36. Install clutch side needle bearing using an arbor press and the 0.315 in. step end of tool as shown. Press until tool is flush.
- 10. See Figure 7-37. Turn over tool and press in seal using the 0.090 in. step.
- See Figure 7-38. Turn over the main drive gear in the arbor press. With the tool at the 0.090 in. step, press in inner bearing.

ASSEMBLY

Shifter Pawl/Lever Assembly

- See Figure 7-35. Verify that sleeve (2) is inside transmission case.
- See Figure 7-39. Slide shifter shaft lever spring (3) over shifter shaft lever (2). Align opening on spring with tab on lever.

NOTE

In next step, do not bend spring (4) more than necessary for assembly.

3. Place shifter shaft pawl spring (4) on shifter shaft pawl.



Figure 7-38. Installing Transmission Side Needle Bearing in Main Driver Gear



Figure 7-39. Shifter Arm Assembly

- See Figure 7-32. Insert the assembly into the transmission case. Verify that screw sits inside shifter shaft lever spring. See Figure 7-33.
- See Figure 7-32. Install a new seal. Install washer (1) and a new retaining ring (2).
- See Figure 7-35. Install shifter lever (9) on the shifter shaft end using screw (8). Tighten to 18-22 ft-lbs (24.4-29.8 Nm).

NOTES

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SPECIFICATIONS

IGNITION	DATA
Idle speed	950 to 1050 RPM
Spark plug size	12 mm
Spark plug gap	0.038-0.043 in
	0.97-1.09 mm
Spark plug type	Harley-Davidson No. 6R12 (no substitute)
Ignition coil primary resistance	0.5-0.7 ohms
Ignition coil secondary resistance	5500-7500 ohms

CHARGING SYSTEM	DATA
Battery	19 amp hour/270 CCA
Alternator AC voltage output	16-20 VAC per 1000 RPM
Alternator stator coil resistance	0.1-0.3 ohms
Regulator voltage output @ 3600 RPM	14.3-14.7 @ 75° F (24° C)
Regulator amperes @ 3600 RPM	34-38 amps

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.

CIRCUIT BREAKER/FUSES	RATING (AMPERES)
Main circuit breaker	30
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Instruments fuse	15
Battery fuse	15
Headlamp	15

TORQUE VALUES

ITEM	TORQUE		NOTES	
Auxiliary lamp bracket hard- ware	72-120 in-lbs	10.8-13.6 Nm	FLSTC, page 8-40	
Auxiliary lamp bracket hard- ware	72-120 in-lbs	10.8-13.6 Nm	FLSTN, page 8-42	
Auxilliary lamp nut	15-18 ft-lbs	20.3-24.4 Nm	I.4 Nm FLSTN, page 8-45	
Auxilliary lamp nut	18 ft-lbs	24.4 Nm	Nm FLSTC, page 8-45	
CKP sensor screw	90-120 in-lbs	10.2-13.6 Nm	page 8-15	
Console mount, front screw	30-40 in-lbs	3.4-4.5 Nm	-4.5 Nm T27 TORX, tighten last during assembly, page 8-63	
Console mount, rear screws	30-40 in-lbs	3.4-4.5 Nm	T25 TORX, tighten before front screw, page 8-63	
Electrical panel mounting fas- teners	60-108 in-lbs	6.8-12.2 Nm	page 8-8	
Front turn signal lamp screws	30-60 in-lbs	4.1-6.8 Nm	FLSTC, page 8-45	

ITEM	TORQUE		NOTES	
Fuel gauge sending unit plate screws	18-22 in-lbs	2.0-2.5 Nm	page 8-62	
Fuel tank console nut	14-18 ft-lbs	19.0-24.4 Nm	page 8-21, page 8-62, page 8-64, page 8-67	
Handlebar clamp screw	60-80 in-lbs 6.8-9.0 Nr		T27 TORX, page 8-79, page 8-83	
Handlebar switch housing screws	35-45 in-lbs	4.0-5.1 Nm	T25 TORX, page 8-79, page 8-83	
Horn bracket mounting nut	80-100 in-lbs	9.0-11.3 Nm	page 8-72	
Horn mounting nut	80-100 in-lbs	9.0-11.3 Nm	page 8-13, page 8-72	
Horn mounting screws	35-55 in-lbs	4.0-62 Nm	page 8-72	
Ignition coil screws	120-180 in-lbs	13.6-20.3 Nm	page 8-17	
Ignition module mounting plate nuts	70-80 i n-lbs	7.9-9.0 Nm	FXST/FXSTB/FXSTS/FXSTD, page 8-10	
Ignition module mounting screws	15-21 in-lbs	1.7-2.4 Nm	all but FXST/FXSTB/FXSTS/FXSTD, page 8-10	
Ignition module nuts	30-35 in-lbs	3.4-4.0 Nm	FXST/FXSTB/FXSTS/FXSTD, page 8-10	
License plate bracket fasteners	30-50 in-lbs	3.4-5.6 Nm	page 8-38	
License plate support	60-90 in-lbs	6.8-10.2 Nm	FLSTSC/FLSTN, page 8-38	
MAP sensor screw	25-35 in-lbs	2.8-4.0 Nm	T20 TORX , page 8-13	
Neutral switch	120-180 in-lbs	13.6-20.3 Nm	apply transmission oil to O-ring, page 8-69	
Oil pressure switch	96-144 in-lbs	10.8-16.3 Nm	LOCTITE PIPE SEALANT WITH TEFLON, page 8-70	
Rear stop light switch	12-15 ft-lbs	16.3-20.3 Nm LOCTITE PIPE SEALANT WITH TEFLON, page 8-7		
Rear turn signal bar mounting fasteners	84-144 in-lbs	9.5-16.3 Nm	FLSTN models, page 8-51	
Speedometer sensor mounting bolt	84-108 in-lbs	9.5-12.2 Nm	page 8-66	
Sprocket nut	150-165 ft-lbs	203.4-223.7 Nm	LOCTITE THREADLOCKER 262 (red), page 8-22	
Starter terminal nut	65-80 in-lbs	7.3-9.0 Nm	cover with protective boot, page 8-30	
Stator screws	55-75 in-lbs	6.2-8.5 Nm	T27 TORX, use only once, page 8-22	
Tail lamp connector cover fas- tener	60-90 i n-lbs	6.8-10.2 Nm	FLSTSC/FLSTN, page 8-38, page 8-51	
Tail lamp lens screws	20-24 in-lbs	2.3-2.7 Nm	page 8-33, page 8-34	
Tail lamp to fender fasteners	60-90 in-lbs	6.8-10.2 Nm	FLSTSC/FLSTN, page 8-38	
Turn signal housings setscrew	50-70 in-lbs	5.7-7.9 Nm	page 8-49	
Turn signal screw, rear	96-120 in-lbs	10.8-13.6 Nm	page 8-50	
Voltage regulator bracket bolt	70-100 in-lbs	7.9-11.3 Nm	page 8-24	
Voltage regulator mounting bolts	50-80 in -lbs	5.6-9.0 Nm	page 8-24	

GENERAL

Refer to Table 8-1. This table gives the location and bulb requirements for all Harley-Davidson Softail motorcycles.

• See Softail models parts catalog for part numbers.

- All Softail model speedometers, tachometers indicator lamps and odometers are illuminated with LEDs.
- LEDs are non-repairable. Entire assembly must be replaced if LED fails.

LAMP DESCRIPTION (ALL LAMPS 12 VOLT)	NO. OF BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	WATTAGE	
Headlamp			Schultzerre i Sincert In	
High beam/low beam	1	4.7/4.3	60/55 60/55	
Position lamp (HDI)	Sale of the state of			
Position lamp	1	0.32	4	
Tail/stop lamp				
Tail lamp	1	0,59	7	
Stop lamp	1	2.10	25	
Tail lamp (HDI)	1	0.59	7	
Stop lamp (HDI)	1	2.10	25	
Turn signal lamps				
Front turn signal/ running lamps	2	2.25/0.59	27/7	
Front turn signal (HDI)	2	1.75	21	
Rear turn signal	2	2.25	27	
Rear turn signal (HDI)	2	1.75	21	
Auxiliary lamps				
FLSTC/N	2	2.50	30	
Fog Lamp (HDI)	2	2.92	35	
License plate lamps				
FLSTSC	1	0.35	4.2	
FLSTSC (HDI)	1	0.07	5	
FXSTD	2	0.37		
Fender tip lamps	A PERMIT			
FLSTC	2	0.10	1	
FLSTSC	1	0.35	4.2	

Table 8-1. Softail Bulb Chart

GENERAL

The ignition system consists of four components: the ignition control module, crank position sensor (CKP), manifold absolute pressure (MAP) sensor and bank angle sensor (BAS).

The ignition control module is mounted underneath the seat. It computes the spark advance for proper ignition timing based on sensor input (from CKP, MAP and BAS) and regulates the low-voltage circuits between battery and ignition coil. The scan tool can access the information received by and stored in the ignition control module.

The ignition control module 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 keep battery drain to a minimum and yet give adequate spark duration at all speeds. (The ignition control module has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ignition control module is fully enclosed in a polyurethane material 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 in the front left side of the crankcase. It takes readings off the 30 teeth on the left side flywheel (two teeth are missing to establish a reference point). The CKP generates an AC signal which is sent to the ignition control module where it is used to reference engine position (TDC) and speed.

The MAP sensor is located on top of the intake manifold. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ignition control module where the module adjusts the timing advance curve for optimum performance.

The bank angle sensor is located within the turn signal/turn signal security module. If the vehicle lean angle exceeds 45 degrees for longer than one second, 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.

Front and rear coils fire each spark plug independently (one cylinder at a time - no wasted spark).

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°.

TROUBLESHOOTING

See the Softail Models Electrical Diagnostic Manual for troubleshooting information.



Figure 8-1. Ignition System Circuit: Carbureted Models

2006 Softail: Electrical 8-5



Figure 8-2. Ignition System Circuit: EFI Models

8-6 2006 Softail: Electrical

GENERAL

See Figure 8-3. All Softail models use a panel under the rear fender to mount important electrical components. This electrical panel contains:

- Vehicle speed sensor: VSS (3) [65].
- Turn signal module (TSM) or turn signal security module (TSSM) and connector (5) [30].
- Master circuit breaker (2).
- Security siren connector (6) [142].

Use the following removal and installation information to service electrical panel components.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. Remove right side saddlebag if present.

NOTE

Rear wheel may have to be raised slightly to allow for inner fender removal.

- See Figure 8-5. Remove two bolts (1) from rear inner fender. Bend upper right corner of fender towards rear tire and lift upward to clear hole in fender (2) from tab on rear fork (3).
- See Figure 8-3. Remove circuit breaker (2), speedometer sensor (3), turn signal/turn signal security module (5) and vapor valve (7) from tabs in electrical panel.

NOTE

If security siren is not installed, remove security siren connector [142] from receptacle in electrical panel.

- If installed, remove security siren (6) from tabs in electrical panel.
- On California models, remove canister tubing from electrical panel.
- 8. Cut electrical panel cable strap (4).
- Remove electrical panel fasteners (1) and remove electrical panel by disengaging tab at bottom of panel from slot in transmission case.



Figure 8-3. Electrical Panel

INSTALLATION

- See Figure 8-3. Place electrical panel into position by installing tab on panel into slot in bottom of transmission case.
- Install electrical panel fasteners (1). Tighten fasteners to 60-108 in-lbs (6.8-12.2 Nm).

NOTE

On California models, connect canister tubing to electrical panel before installing vapor valve. Canister tubing is installed to the right of vapor valve tubing.

- 3. Install vapor valve (7).
- 4. Install speedometer sensor (3).
- Install circuit breaker (2). For more information on circuit breaker, see 8.13 MAIN CIRCUIT BREAKER.
- 6. Install turn signal/turn signal security module (5).

NOTE

See Figure 8-4. If security siren is not installed, install security siren connector [142] into receptacle in electrical panel.

- 7. See Figure 8-3. If vehicle is equipped with a security siren, install security siren (6).
- 8. Install new electrical panel cable strap (4).
- 9. See Figure 8-5. Install the rear inner fender using two bolts (1) at the bottom. Hole in fender (2) must fit over a tab on rear fork (3).
- 10. Install right side saddlebag if removed.
- 11. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

12. Install seat.



Figure 8-4. Siren Connector Receptacle



Figure 8-5. Inner Fender
The ignition control module is mounted under the seat. See Softail Models Electrical Diagnostic Manual for information on the function and testing of the ignition control module.

NOTE

The ignition control module cannot be repaired. Replace the unit if it fails.

IGNITION TIMING

Ignition timing is controlled by the ignition control module based on input from:

- Manifold absolute pressure sensor (MAP).
- Crank position sensor (CKP).

There is no adjustment required. Should a sensor fail, the resulting diagnostic trouble code will identify the problem. See Softail Models Electrical Diagnostic Manual for more information.

REMOVAL

All But FXST/FXSTB/FXSTS/FXSTD

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- See Figure 8-6. Remove two screws (2) to free ignition control module from mounting bracket.
- 4. Unplug ignition control module connector [10].
 - a. Depress external latches on the socket housing side.
 - b. Use a rocking motion to separate pin and socket halves.



Ignition control module connector [10]
Screw (2)

Figure 8-6. Ignition Control Module: All But FXST, FXSTB, FXSTS, FXSTD

FXST/FXSTB/FXSTS/FXSTD

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- See Figure 8-7. Remove two nuts and washers (1) to free ignition control module from mounting bracket.
- 4. Unplug ignition control module connector [10].
 - a. Depress external latches on the socket housing side.
 - b. Use a rocking motion to separate pin and socket halves.

All But FXST/FXSTB/FXSTS/FXSTD

- 1. See Figure 8-6. Attach ignition control module connector.
 - Align tabs on connector socket housing with grooves on pin housing. Push connector halves together until the latches click.
 - b. If the 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.
- 2. Attach ignition control module to bracket.
 - a. Align holes on module with holes on bracket.
 - Secure ignition control module using two screws (3). Tighten to 15-21 in-Ibs (1.7-2.4 Nm).
- 3. Connect negative battery cable.

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat.

FXST/FXSTB/FXSTS/FXSTD

- 1. See Figure 8-7. Attach ignition control module connectors.
 - Align tabs on connector socket housing with grooves on pin housing. Push connector halves together until the latches click.
 - b. If the 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.
- 2. Attach ignition control module to bracket.
 - a. Align holes on module with studs on mounting plate.
 - b. Attach ignition control module to bracket under seat using two nuts and washers (1). Tighten nuts and washers (1) to 30-35 in-lbs (3.4-4.0 Nm). If mounting plate nuts and washers (4) holding mounting plate (3) are removed, tighten to 70-80 in-lbs (7.9-9.0 Nm).
- 3. Connect negative battery cable.

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat.



Figure 8-7. Ignition Control Module: FXST, FXSTB, FXSTS, FXSTD

The bank angle sensor (BAS) is located inside either the turn signal module (TSM) or turn signal security module (TSSM). The bank angle sensor performs two functions.

- Emergency engine shutdown: Monitors vehicle lean and will provide engine shutdown when lean exceeds 45° from vertical for more than one second.
- Emergency outputs disable: Monitors vehicle lean and will disable turn signal lamps and starter motor when lean exceeds 45° from vertical for more than one second.

The turn signals, starter motor, ignition controller (ECM/EFI), fuel pump (EFI models) and coil will be disabled in the event the vehicle tilts more than 45 degrees from vertical for longer than one second.

If TSM/TSSM is accidentally reconfigured for use with sidecar, correct using the method in the Softail Models Electrical Diagnostic Manual.

OPERATION

The engine will shut off automatically if the vehicle tilts more than 45 degrees from vertical for longer than one second. The engine will automatically shut off even if the tilt occurs at a very slow speed.

To restart the motorcycle after shutdown has occurred:

- 1. Return the motorcycle to an upright position.
- Cycle the ignition key OFF-ON before restarting the vehicle.

TESTING

For diagnostic information, refer to the Softail Models Electrical Diagnostic Manual.

REMOVAL/INSTALLATION

Refer to removal/installation instructions under 8.26 TURN SIGNAL/TURN SIGNAL SECURITY MODULE.



Figure 8-8. TSM/TSSM

Carbureted Models

The manifold absolute pressure (MAP) sensor generates the engine load signal by measuring pressure (vacuum) in the intake manifold. The engine load signal is sent to the ignition control module where it is used to help select the correct timing curve. Voltage readings decrease as manifold vacuum increases.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. Gain access to intake manifold by removing fuel tank hardware. Carefully pivot tank upward and prop in position. See 4.7 FUEL TANK: CARBURETED.
- 4. See Figure 8-9. Remove acorn nut (1) and washer (2) to detach horn from mount. Push horn aside.
- 5. Remove connector [80] from MAP sensor.
- Remove vacuum hose from rear of carburetor to allow access to MAP sensor.
- See Figure 8-10. Using a T20 TORX bit, extension and universal socket, remove screw (1) and clip (2) from top of MAP sensor (3).
- Using appropriate tool gently remove (push up) MAP sensor and attached seal (4) from intake manifold.

NOTE

If the original sensor is re-installed, the seal must be inspected. Seals not in good condition could cause vacuum leaks.



Figure 8-9. Horn Mount

INSTALLATION

- 1. Plug connector [80] into new MAP sensor.
- See Figure 8-10. Install (push) MAP sensor (3) and seal 2. (4) to intake manifold.
- Position clip (2) in slot on MAP sensor and install T20 3. TORX screw (1). Tighten to 25-35 in-lbs (2.8-4.0 Nm).
- Install vacuum hose to rear of carburetor. 4.
- See Figure 8-9. Attach horn with washer (2) and acorn 5. nut (1). Tighten to 80-100 in-lbs (9.0-11.3 Nm).
- Secure fuel tank. See 4.7 FUEL TANK: CARBURETED. 6.
- Connect negative battery cable. 7.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

Install seat. 8.

- 1. T20 TORX screw @ 25-35 in-lbs (2.8-4.0 Nm)
- 2. Clip



Figure 8-10. MAP Sensor

CRANK POSITION SENSOR (CKP)

GENERAL

See Figure 8-11. The crank position sensor is a variable reluctance (VR) sensor that generates an AC signal by sensing the passing of the 30 teeth machined in the left side flywheel. Two consecutive teeth are missing in the flywheel to establish a reference point. The crank position sensor sends a signal to the ignition control module which is used to reference engine position (TDC) and engine speed.

NOTE

CKP sensor connector is not serviceable. If connector or sensor fails, the entire assembly must be replaced.

REMOVAL

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- 3. Detach wiring behind regulator bracket.
 - a. Disengage small end of slot on attachment clip from T-stud on bracket. Lift connector off T-stud.
 - See Figure 8-11. Disconnect the 2-place Mini-Deutsch CKP connector (3) [79].
- Remove screw and captive washer (2) to detach CKP sensor and O-ring (1) from crankcase. Carefully remove crank position sensor.

NOTE

Before removing wiring, carefully note wire routing. In particular, pay close attention to the locations of cable straps which must be replaced.



Figure 8-11. CKP Sensor Assembly



Figure 8-12. CKP Sensor

INSTALLATION

- 1. See Figure 8-11. Lubricate CKP sensor O-ring (1) with clean engine oil.
- See Figure 8-13. Install new CKP sensor with screw and captive washer. Tighten screw to 90-120 in-lbs (10.2-13.6 Nm).
- 3. Route wiring to connector behind regulator bracket.
- 4. Attach wiring.
 - a. Mate connector [79].
 - Place large end of slot on attachment clip over Tstud on bracket. Push connector to engage small end of slot.
- 5. Install negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.



Figure 8-13. Installed CKP Sensor

Resistor-type high-tension spark plug cables have a carbonimpregnated fabric core, instead of solid wire, for radio noise suppression and improved reliability of electronic components. Use the exact replacement cable for best results.

NOTE

See 1.21 SPARK PLUGS for spark plug information.

REMOVAL

AWARNING

Never disconnect a spark plug cable with the engine running. If you disconnect a spark plug cable with the engine running, you may receive an electric shock from the ignition system which could result in death or serious injury.

CAUTION

When disconnecting each spark plug cable from its spark plug terminal, always grasp and pull on the rubber boot at the end of the cable assembly (as close as possible to the spark plug terminal). Do not pull on the cable portion itself. Pulling on the cable will damage the cable's carbon core.

- Disconnect spark plug cables from ignition coil and spark plug terminals. Inspect all removed cables for damage.
- 2. See Figure 8-14. Remove cable straps on horn bracket for front spark plug cable.

INSPECTION

- Inspect spark plug cables. Replace cables that are worn or damaged.
 - a. Check for cracks or loose terminals.
 - b. Check for loose fit on ignition coil and spark plugs.
- Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.
- See Figure 8-15. Check spark plug cable resistance with an ohmmeter. Replace cables not meeting resistance specifications.
 - a. 4750-11,230 ohms for 19.0 in. (483 mm) cable.
 - b. 1812-4375 ohms for 7.25 in. (184 mm) cable.



Figure 8-14. Spark Plug Cable Routing



Figure 8-15. Testing Resistance

INSTALLATION

- See Figure 8-14. Connect spark plug cables to ignition coil and spark plugs. Rear cylinder plug cable attaches to top coil terminal. Fasten boots/caps securely. Tight connections provide the necessary moisture-proof environment for the ignition coil and spark plug terminals.
- Secure front spark plug cable to horn bracket with new cable straps.

REMOVAL

AWARNING

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

- 1. Disconnect negative battery cable.
- See Figure 8-16. Remove plug wires from coil towers. 2.

NOTE

Coil removal/installation on FLSTSC models requires swivel sockets and ball ended hex wrenches. Rear exhaust pipe removal is not necessary.

- 3. See Figure 8-17. Remove screw and washer (5) to detach cover (6, 7, 8, or 11) from coil (1, 2).
- 4. Remove two mounting screws (3) to detach coil from seat post.
- Detach connector [83] from backside of coil. 5.

INSTALLATION

- 1. See Figure 8-17. Attach connector [83] to backside of coil
- Position coil on seat post. Install two screws (3) and 2. tighten to 120-180 in-lbs (13.6-20.3 Nm).
- Fasten cover (6, 7, 8, or 11) to coil with screw and 3. washer (5).
- 4. See Figure 8-16. Attach plug wires to coil towers. Rear cylinder plug wire attaches to upper coil tower.
- Connect negative battery cable. 5.



- Rear cylinder coil tower
- Front cylinder coil tower -2.

Figure 8-16. Coil Towers



Figure 8-17. Coil

See Figure 8-18. The fuse block is below the seat and behind the battery. The block on carbureted models contains five 15 ampere replaceable fuses. The block on EFI models contains seven 15 ampere replaceable fuses. Additional spare fuses (4) may be carried if the rider chooses to do so.

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.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 8-19. Pull cover away from fuse block.
- 4. See Figure 8-20. Replace suspect fuse.

INSTALLATION

- 1. Place cover over fuse block.
- 2. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat.



5. Battery





Figure 8-19. Fuse Block Cover: Carbureted Shown



Figure 8-20. Fuse Block: Top View, All Fuses 15 Amp

See Figure 8-21. The starter relay and EFI system relay are located in the fuse block which is below the seat and behind the battery.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 8-22. Pull cover away from fuse block.
- 4. See Figure 8-21. Replace suspect relay (1) or (2).

INSTALLATION

- 1. Place cover over fuse block.
- 2. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

3. Install seat.



- 2. System relay (EFI only)
- 3. Battery

.

Figure 8-21. Relays



Figure 8-22. Fuse Block Cover

See Figure 8-23. The main circuit breaker is on the electrical panel behind the fender extension. If the electrical circuit should overload, the bimetallic breaker contacts automatically open to stop current flow. As soon as the contacts have cooled down, they automatically close, completing the circuit. This opening and closing of the breaker contacts continues as long as the current circuit overload condition exists.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. Follow removal instructions under 8.4 ELECTRICAL PANEL to gain access to the master circuit breaker.
- 4. See Figure 8-23. Remove nuts and wires (2, 4, 5) from studs (1, 3) on circuit breaker.
- 5. Pull circuit breaker from electrical panel tabs.

INSTALLATION

- 1. Push circuit breaker into tabs.
- 2. See Figure 8-23. Attach wiring using nuts.
 - Place wire from starter (2) on copper stud (1) and install nut.
 - Place wire from voltage regulator (5) on silver stud (3).
 - c. Place wire from ignition switch (4) on silver stud and install nut.



Figure 8-23. Main Circuit Breaker Wiring

- Complete installation instructions under 8.4 ELECTRI-CAL PANEL.
- 4. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat.

AWARNING

DO NOT modify the ignition/light switch wiring to circumvent the automatic-on headlight feature. High visibility is an important safety consideration for motorcycle riders. Failure to have proper headlamp operation could result in death or serious injury.

Softail model ignition/light/key switches are non-repairable. If a switch is damaged, it must be replaced. Key switch functions and locations are listed in Table 8-2.

REPLACEMENT

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. Remove instrument panel/console.
 - a. For all models except FXSTD, see Figure 8-24. Remove acorn nut and washer (1) from instrument panel (2) and remove panel. Note position and color of the switch wire connectors. Disconnect wires.
 - For FXSTD, remove instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD. Remove wiring for ignition switch from wiring clip on back of console. Disconnect wires.
- 4. Remove mounting screws (4). Replace switch.
- Reconnect switch wire connectors in their original positions.
- 6. Install instrument panel/console.
 - a. For all models except FXSTD, See Figure 8-24. Install instrument panel (2) using acorn nut and washer (1). Tighten to 14-18 ft-lbs (19.0-24.4 Nm).
 - For FXSTD, install instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- 7. Connect negative battery cable.



Figure 8-24. Ignition Switch

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

- 8. Install seat.
- 9. Refer to Table 8-2. Test vehicle operation.

NOTE

Harley-Davidson recommends removing key from lock before operating motorcycle. If you do not remove key, key can fall out during operation.

MODEL AND LOCATION	DOMESTIC SWITCH	HDI SWITCH
Softail models Tank console. Switch is locked or	OFF - Ignition and lights are off. Key may be removed.	Same
unlocked by lifting switch cover, insert- ing key and turning key counterclock- wise to lock clockwise to unlock	ACC Instrument lights are on. Brake light and horn can be activated.	Same; in addition, position lamp, tail lamp are ON.
Key may be removed in any position.	IGNITION - Hazard warning flasher can be turned on. Ignition, lights and accessories are on.	Same; in addition, position lamp is ON.

Table 8-2. Key Switch Functions and Positions

REMOVAL/DISASSEMBLY

NOTE

For diagnostic information see Softail Models Electrical Diagnostic Manual.

WARNING

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

1. Disconnect negative battery cable.

NOTE

It is not necessary to remove the inner primary chaincase to remove the alternator.

- Remove primary cover, primary drive and clutch. See 6.3 DRIVE COMPONENTS.
- 3. See Figure 8-25. Pull off the alternator rotor (5) using two bolts inserted through the holes in the rotor face.
- 4. Remove the T27 TORX screws (4). Unplug the voltage regulator and remove the stator (3).
- 5. Remove screws holding regulator bracket.
- On vehicles with footboards, remove footboard support assembly to reduce risk of damaging parts during removal process. Disconnect Deutsch connector [46].
- Remove secondary locks and wires (pull) from connector (1) [46B].

NOTE

Contact cleaner, alcohol or glass cleaner sprayed on rubber grommet will provide lubrication when pulling it through crankcase hole.

- Move grommet (2) to one side and spray contact cleaner into gap. Repeat for other side. Pull rubber grommet through crankcase hole.
- 9. Pull wires through crankcase hole.

CLEANING/INSPECTION

The rotor and stator can be replaced individually if either is damaged.

- 1. Remove all foreign particles from the rotor magnets.
- 2. Clean the rotor and stator in clean, soapy water.

ASSEMBLY/INSTALLATION

NOTE

Stator Torx fasteners are not re-usable. They **must** be replaced.

1. Insert wires through crankcase hole.



Figure 8-25. Rotor and Stator Mounting

- See Figure 8-25. Push rubber grommet (2) through crankcase hole. If necessary, apply the same lubricant used during removal.
- 3. Insert wires into connector [46B] (1).
- 4. Install secondary lock to connector.
- Mate connector [46]. Position under regulator bracket before tightening regulator bracket screws.
- Install the stator (3) on the crankcase and fasten in place using new TORX screws. Tighten to 55-75 in-lbs (6.2-8.5 Nm).
- 7. Install the rotor (5) on the sprocket shaft.
- Apply LOCTITE THREADLOCKER 262 (red) to sprocket nut threads. Tighten sprocket nut to 150-165 ft-lbs (203.4-223.7 Nm).
- Install clutch, primary drive and primary cover. See 6.3 DRIVE COMPONENTS.
- 10. Connect negative battery cable.

VOLTAGE REGULATOR

REMOVAL

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails. For diagnostic information see Softail Models Electrical Diagnostic Manual

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 8-26. See 8.4 ELECTRICAL PANEL to gain access to main circuit breaker.
- Disconnect the voltage regulator lead (1) from the main circuit breaker.
 - a. Remove nut from silver terminal post.
 - b. Remove ignition switch wire.
 - c. Remove voltage regulator wire.

NOTE

Before removing voltage regulator wires, carefully note wire routing. In particular pay close attention to the locations of cable straps that must be replaced to keep wires from being damaged by vibration.

- 5. Detach regulator from engine.
 - a. If replacing regulator, see Figure 8-27. Remove two bolts (3) to detach regulator from bracket (1). Detach ground wire (2) from bracket.
 - b. If temporarily removing regulator and bracket, see Figure 8-28. Remove two bolts (6) to free bracket (7) from engine.
- See Figure 8-28. Disengage Deutsch connector (1) [46] from back of regulator bracket. Separate connector halves.
- 7. Free wire retainer (4) from bracket.



Figure 8-26. Main Circuit Breaker



Figure 8-27. Voltage Regulator Bracket

INSTALLATION

- 1. Mate Deutsch connector (1) [46]. Clip connector to back of mounting bracket.
- Install regulator. 2.
 - a. If installing a new regulator, see Figure 8-27. Attach regulator to bracket (1) using two bolts (3). Tighten to 50-80 in-lbs (5.6-9.0 Nm). Attach ground wire between bracket mounting bolt and bracket (1). Tighten regulator bracket bolt to 70-100 in-lbs (7.9-11.3 Nm).
 - If regulator and bracket were temporarily removed, b. see Figure 8-28. Attach assembly to engine using two bolts (6). Verify that ground wire is installed between bolt (6) and bracket (7). Tighten bolts to 70-100 in-lbs (7.9-11.3 Nm).
- 3. Replace wire retainer (4) if removed and attach to bracket (7).
- 4. Route wire (3) to silver post on main circuit breaker.
- 5. Place wire from ignition switch to silver post on main circuit breaker and install nut.
- 6. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat.



Figure 8-28. Voltage Regulator Assembly



Figure 8-29. Charging System Circuit

BATTERY TESTING

General

See 1.5 BATTERY MAINTENANCE for removal, installation, inspection and storage information.

Three different procedures may be performed to provide a good indicator of battery condition: a voltage test, a conductance test, or a load test.

A battery may be tested, whether fully charged or not, via conductance test. In order to perform a load test, however, the battery must be fully charged.

Voltmeter Test

Refer to Table 8-3. The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform the load test described in this section.

Table 8-3. Voltmeter Test For Battery Charge Conditions

VOLTAGE (OCV)	STATE OF CHARGE		
12.7	100%		
12.6	75%		
12.3	50%		
12.0	25%		
11.8	0%		

Conductance Test

Test the battery using the MCR-101 HD ADVANCED BAT-TERY CONDUCTANCE AND ELECTRICAL SYSTEM ANA-LYZER. Perform a battery test as follows:

- 1. Connect the MCR-101 HD analyzer leads to the vehicle's battery.
- 2. Follow the instructions in the analyzer's instruction manual to perform a battery test.

The test results will include a decision on the battery's condition, the measured state of charge and the measured CCA.

See Figure 8-30. The analyzer's printer will provide you with a printout including one of five possible test results:

- GOOD BATTERY-return the battery to service.
- GOOD-RECHARGE-fully charge the battery and return to service.
- CHARGE & RETEST–Fully charge the battery and retest.
- REPLACE BATTERY-replace the battery and retest.
- BAD CELL-REPLACE-replace the battery and retest.

NOTE

A REPLACE BATTERY test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.

MCR-101 HD V1.0	
(C) MIDTRONICS	
MON 02/21/05	
3:45 PM	
LAST 6 OF VIN	
012345	
DATE CODE	
B5	
BATTERY TEST	
RATING:	
295 CCA	
65958-94	
12.32V 95CCA	
REPLACE BATTERY	
WARRANTY CODE	
9.T9G9N-0132N8	
\sim \sim \sim \sim \sim	

Figure 8-30. Battery Test Results-Printout

Load Test

The load test measures battery performance under full current load. To load test the battery, proceed as follows:

1. Remove battery from motorcycle.

CAUTION

Load testing a discharged battery can result in permanent battery damage.

- Always fully charge the battery before testing or test readings will be incorrect. See CHARGING BATTERY which follows. Load testing a discharged battery can also result in permanent battery damage.
- After charging, allow battery to stand for at least one hour before testing.

WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

 See Figure 8-31. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

CAUTION

To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

 See Table 8-4. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 70°F. (21°C).



Figure 8-31. Load Test Battery

Table 8-4. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
Softail models	270	135

WARNING

Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

6. Install the battery on the motorcycle.

CHARGING BATTERY

Safety Precautions

Never charge a battery without first reviewing the instructions for the charger being used. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear proper eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger "OFF" before connecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery; red positive (+) lead to the positive (+) terminal and black negative (-) lead to the negative (-) terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.
- Make sure that the charger leads to the battery are not broken, frayed or loose.
- If the battery becomes hot, reduce the charging rate or turn off the charger temporarily.
- Always turn the charger "OFF" before removing charger leads from the battery to avoid dangerous sparks.

Using a Battery Charger

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.

WARNING

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

CAUTION

If the battery releases an excessive amount of gas during charging, decrease the charging rate. If the battery gets hotter than 110°F. (43°C) during charging, discontinue charger and allow the battery to cool. Overheating may result in plate distortion, internal shorting, dryout or other damage.

1. Perform a voltmeter test to determine the state of charge. See Voltmeter Test in the Softail Models Electrical Diagnostic Manual. If battery needs to be charged, proceed to step 2.

NOTE

The figures listed in the table assume that the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.

BATTERY AMP HOUR	STATE OF CHARGE		0.0400	CAMD	10 410	00 4140
	VOLTAGE	% OF CHARGE	CHARGER	CHARGER	CHARGER	CHARGER
19	12.8	100%	-			-
	12.6	75%	1.75 hours	50 minutes	30 minutes	15 minutes
	12.3	50%	3.5 hours	1.75 hours	1 hour	30 minutes
	12.0	25%	5 hours	2.5 hours	1.5 hours	45 minutes
	11.8	0%	6 hours, 40 minutes	3 hours, 20 minutes	2 hours	1 hour

Table 8-5. Battery Charging Rates/Times (Approximate)

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.

CAUTION

Always remove the battery from the motorcycle before charging. Accidental electrolyte leakage will damage motorcycle parts.

WARNING

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

Remove the battery from the motorcycle and place on a level surface.

AWARNING

Unplug or turn OFF battery charger before connecting charger cables to battery. Connecting cables with charger ON can cause a spark and battery explosion, which could result in death or serious injury. (00066a)

CAUTION

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged.

- Connect the red battery charger lead to the positive (+) terminal of the battery.
- Connect the black battery charger lead to the negative (-) terminal of the battery.

If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.

 Step away from the battery and turn on the charger. See the charging instructions in Table 8-5.

WARNING

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

- After the battery is fully charged, disconnect the black battery charger lead to the negative (-) terminal of the battery.
- Disconnect the red battery charger lead to the positive (+) terminal of the battery.
- 8. Mark the charging date on the battery.
- Perform either a conductance test or load test to determine the condition of the battery. See Conductance Test or Load Test in this section.
- If charging battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See Voltmeter Test in this section.

ROUTING PROCEDURE

- 1. Remove seat.
- 2. Install battery. See 1.5 BATTERY MAINTENANCE.
- See Figure 8-34. Route positive cable down from battery positive terminal down past tab on battery tray to starter post on right side of chassis.



Figure 8-32. Battery Tray: Shown From Front

WARNING

Make sure the starter solenoid terminal that is connected to the positive (+) battery cable is securely covered by the rubber boot. An uncovered terminal could short against other components resulting in sparks. These sparks could cause a fire or battery explosion which could result in death or serious injury.

- 4. See Figure 8-33. Install positive cable.
 - Install positive cable to starter post with nut. Orient terminal so cable faces away (towards left side of motorcycle).
 - b. Tighten nut to 65-80 in-lbs (7.3-9.0 Nm).
 - c. Cover nut with protective rubber boot.
- 5. See Figure 8-34. Install negative cable.
 - a. Route negative battery cable (1) towards front of vehicle as shown.
 - b. Install negative cable to frame with bolt.



Figure 8-33. Positive Cable Routing



3. Battery positive terminal

Figure 8-34. Battery Terminals

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.

CAUTION

The use of any other headlamp bulb, other than what is specified, could result in damage to the electrical system or battery discharge.

If either headlamp bulb filament burns out, the bulb must be discarded and a **new** bulb installed. Use only direct replacement bulbs as specified in the Parts Catalogs and 8.2 BULB REQUIREMENTS.

NOTE

When reassembling headlamp, make sure slots and tabs in headlamp, mounting ring, and trim ring are aligned.

REMOVAL/INSTALLATION

CAUTION

Never touch the quartz bulb with your fingers. Fingerprints will etch the glass and cause the bulb to fail. Always wrap the bulb in paper or a clean dry cloth during handling.

AWARNING

The bulb contains Halogen gas under pressure. Handle bulb carefully and wear eye protection. Failure to follow adequate safety precautions could result death or serious injury.

FXSTD, FXSTS and FLSTSC Models

- 1. See Figure 8-36. Remove trim ring screw (13) and trim ring (6).
- 2. Pull wiring connector block from bulb prongs.
- Remove rubber boot (2) from back of headlamp assembly (4).
- 4. See Figure 8-35. Squeeze wire retaining clip ends to unhook them from notches in headlamp assembly.
- Pivot wire retaining clip away from bulb. Replace old bulb with new bulb.
- Assemble headlight components. See 1.29 HEADLAMP ALIGNMENT to adjust light beam.

FXST and FXSTB Models

- 1. See Figure 8-36. Loosen trim ring screw (13) and remove trim ring (6).
- 2. Pull wiring connector block from bulb prongs.
- Remove rubber boot (2) from back of headlamp assembly (4).
- 4. See Figure 8-35. Squeeze wire retaining clip ends to unhook them from notches in headlamp assembly.
- Pivot wire retaining clip away from bulb. Replace old bulb with new bulb.
- Assemble headlight components. See 1.29 HEADLAMP ALIGNMENT to adjust light beam.

FLSTC, FLSTF, FLSTN and FLST Models

- See Figure 8-36. Remove trim ring screw (13) and trim ring (6). Be careful not to bend the two tabs that hold the top of the trim ring in place.
- 2. Remove mounting ring screws (20) and mounting ring that holds sealed beam headlamp in place.
- 3. Pull wiring connector block from bulb prongs.
- Remove rubber boot (2) from back of headlamp assembly (4).
- See Figure 8-35. Squeeze wire retaining clip ends to unhook them from notches in headlamp assembly.
- Pivot wire retaining clip away from bulb. Replace old bulb with **new** bulb.
- Assemble headlight components. See 1.29 HEADLAMP ALIGNMENT to adjust light beam.



Figure 8-35. Wire Retaining Clip



FLSTC, FLSTF and FLST Softail models are equipped with a tail lamp that uses a mini harness and circuit board to simplify replacement.

The FXSTS, FXST and FXSTB use the same type assembly, but the lens and base are oriented 180 degrees different from the other models. These models also use a different mini-harness than the other models.

BULB REPLACEMENT

- 1. See Figure 8-37. Remove two screws and lens from base.
- Depress locking tab and remove 4-Pin multilock connector from circuit board.
- Rotate bulb socket 1/4 turn in a counterclockwise direction and remove from tail lamp assembly. Gently pull bulb from socket.
- Coat base of new bulb with ELECTRICAL CONTACT GREASE (Part No. 99861-90). Install new bulb in socket.
- 5. Install **new** bulb into socket. Insert socket into tail lamp assembly and rotate 1/4 turn in a clockwise direction
- 6. Connect 4-Pin multilock connector to circuit board
- Install lens to base with two screws. Tighten screws to 20-24 in-lbs (2.3-2.7 Nm).

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

8. Turn ignition on and test for proper tail lamp operation.

BASE REPLACEMENT

PART NO.	SPECIALTY TOOL	
HD-41475-100	Terminal pick tool	

- 1. Remove two screws and lens from base.
- Depress locking tab and remove 4-Pin multilock connector from circuit board.
- See Figure 8-38. Using a terminal pick, depress locking tabs and remove two 2-Pin turn signal connectors and 6-Pin Power In connector from circuit board.
- See Figure 8-39. Remove screw, pin housing and circuit board from base.
- 5. Remove base from rear fender.



Figure 8-37. Tail Lamp: FLSTC, FLSTF, FLST



Figure 8-38. Removing 2-Pin Connectors



Figure 8-39. Pin Housing and Circuit Board

- Install new base to rear fender. Install circuit board/pin housing to base with screw, nut and washer. Tighten screw to 40-48 in-Ibs (4.5-5.4 Nm).
- 7. See Figure 8-40. Install connectors to circuit board.
- Install lens to base with two screws. Tighten screws to 20-24 in-lbs (2.3-2.7 Nm).

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

Turn ignition on and test for proper tail lamp and turn signal operation.



Figure 8-40. Wire Location at Connectors

NOTE

Refer to Table 8-6. Cavity numbers are on back side of secondary locks. All FXST/S/B components are oriented 180 degrees from above and the turn signal connectors are reversed.

FUNCTION	NO.	TYPE	WIRE COLOR	CAVITY
Right turn signal	[19]	2-pin Multilock	V/BN	1
			ВК	2
Loft turn signal	[10]	2-pin Multilock	V/BN	1
Len turn signai	[10]		ВК	2
	[93]	4-pin Multilock	BE	1
Tail lamp			HDI only-O/W or open on domestic models	2
			R/Y	3
			ВК	4
			O/W	1
Power in	[94]	6-pin Multilock	BN (V on FXST/S/B)	2
			BE	3
			R/Y	4
			V (BN ON FXST/S/B)	5
			ВК	6

Table 8-6. Tail Lamp Wires

REMOVAL

- See Figure 8-41. Insert a small screwdriver into middle hole of license plate light cover. Push forward to release clip.
- 2. See Figure 8-42. Lift tail lamp assembly upward.
- 3. Replace components as necessary.
 - a. Tail lamp bulb: Turn bulb housing (2) counterclockwise and pull outward. Remove bulb by turning counterclockwise and pulling from socket. Push new bulb into socket and turn clockwise. Place bulb housing inside tail lamp and turn clockwise to install.
 - b. License plate bulbs: Remove license plate bulbs (4) by turning housing counterclockwise. Tab on bulb housing must clear tab on license plate light housing. Pull bulb from socket and replace with **new** bulb. Install housing by aligning tabs and turning clockwise.
 - c. Detach connector (1) to replace entire tail lamp assembly.



Figure 8-41. Removing Tail Lamp



Figure 8-42. Tail Lamp Wiring

INSTALLATION

CAUTION

See Figure 8-43. Do not operate FXSTD vehicles without tail lamp resistor installed. Failure to operate vehicle with resistor installed can cause tail lamp overheating and electrical system malfunction.

1. Route all electrical connectors and wiring to either side of opening, away from tail lamp bulb housing.

NOTE

When installing tail lamp assembly, make sure the tail lamp bulb is pointed toward the rear of the vehicle.

- 2. See Figure 8-42. Install tail lamp assembly as follows.
 - Starting with the top clip, install clip under edge of fender to lock in place.
 - b. Push tail lamp assembly toward front of vehicle.
 - c. Engage the rear clip with edge of bottom opening in the fender. Push down on assembly until an audible click is heard.

NOTE

The spring clips must engage the rear fender opening for the tail lamp to remain locked into position in the rear fender.

WARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

Turn ignition ON and test for proper tail lamp and brake lamp operation.



Figure 8-43. Tail Lamp Resistor

BULB REPLACEMENT

See Figure 8-44. To change a bulb, remove the lens, turn the bulb 1/4 turn while pressing the bulb into the housing, and remove the bulb. Replace the bulb and install the lens.

NOTE

If after replacing a bulb, the tail lamp will not light, check the wiring, the ground at the socket, and/or the switch.

TAIL LAMP REPLACEMENT

- Remove rear fender. See 2.37 REAR FENDER: FLSTSC or 2.38 REAR FENDER: FLSTN.
- 2. See Figure 8-45. Remove reflector (1). Remove license plate bracket fasteners (6).
- 3. Remove bolt (2), washer (4) and nut (5) securing clamp to license plate bracket.
- 4. See Figure 8-46. Remove fastener (1). Disengage tail lamp connector cover (2) from clip (3).



Figure 8-44. Tail Lamp Assembly: FLSTSC



Figure 8-45. License Plate Bracket



Figure 8-46. Tail Lamp Connector Cover

- 5. See Figure 8-47. Disconnect tail lamp connector (2).
- 6. See Figure 8-48. Remove plastic covers (3) from tail lamp threads. Remove fasteners (1).
- 7. Push grommet (2) to outside of fender.
- See Figure 8-49. If license plate support (1) was removed, install clip on inside of fender and tighten fasteners (2) to 60-90 in-lbs (6.8-10.2 Nm).

NOTE

Before removing tail lamp wires from connector, or harness from fender clips, carefully note routing for reinstallation.

- Remove tail lamp wire terminals from connectors. See B.1 AMP MULTILOCK ELECTRICAL CONNECTORS in the appendix.
- Install new terminals into connector. See B.1 AMP MUL-TILOCK ELECTRICAL CONNECTORS in the appendix.
- 11. See Figure 8-48. To install tail lamp, route harness through hole in fender and lubricate rubber grommet (2) with alcohol or glass cleaner. Place grommet into position.
- Place tail lamp into position and install fasteners (1). Tighten fasteners to 60-90 in-lbs (6.8-10.2 Nm). Install plastic covers (3).
- 13. See Figure 8-47. Connect tail lamp connector (2).
- Figure 8-46. Slide tail lamp connector cover (2) into clip (3). Install fastener (1) and tighten to 60-90 in-lbs (6.8-10.2 Nm).
- See Figure 8-45. Place license plate bracket in place on tail lamp. Install but do not tighten license plate bracket fasteners (6). Install clamp (3). Install bolt (2), washer (4) and nut (5).
- Tighten license plate bracket fasteners to 30-50 in-lbs (3.4-5.6 Nm).



3. Right rear turn signal connector [18]

Figure 8-47. Tail Lamp Connector



Figure 8-48. Tail Lamp



1. License plate support

2. fasteners

Figure 8-49. License Plate Support

AUXILIARY LAMP BULB

Removal

- See Figure 8-50. Loosen trim ring fastener (1) as required to pull trim ring (2) from lip of auxiliary lamp housing (5).
- 2. Disconnect auxiliary lamp connector (4) from bulb (6).
- 3. Remove nesting ring (7) at back of auxiliary lamp (8).

WARNING

The bulb contains Halogen gas under pressure. Wear adequate eye protection and handle the bulb carefully. Inadequate safety precautions could result in death or serious injury.

 See Figure 8-51. Rotate bulb/pin housing 1/4 turn in a counterclockwise direction and remove from auxiliary lamp. Discard bulb/pin housing.

Installation

CAUTION

Never touch the quartz bulb with your fingers. Fingerprints will etch the glass and cause premature bulb failure. Always wrap the bulb in paper or a clean dry cloth during handling.

- 1. See Figure 8-51. Install **new** bulb/pin housing in auxiliary lamp and rotate 1/4 turn in a clockwise direction.
- See Figure 8-50. Place nesting ring (7) at back of auxiliary lamp (8) with the concave side up.
- 3. Connect auxiliary lamp connector (4) to bulb (6).
- Place nesting ring over edge of lamp housing (5). Rotate nesting ring until index tab engages slot at bottom of lamp housing.
- 5. Holding nesting ring in place, rotate auxiliary lamp so that index tabs at back engage slots in nesting ring.
- Install trim ring (2) over lip of lamp housing. Rotate trim ring so that fastener (1) is centered at bottom, and then tighten fastener until snug.



Figure 8-50. Auxiliary Lamp Bulb: Typical



Figure 8-51. Auxiliary Lamp Bulb/Pin Housing

FLSTC MODELS

Auxiliary Lamp Bracket Removal

- Detach quick release windshield. See 2.50 WIND-SHIELD: FLSTC.
- 2. Detach wiring.
 - Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.7 FUEL TANK: CARBU-RETED or 9.5 FUEL TANK: EFI.
 - b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
 - Disconnect 6-place Multilock front turn signal connector [31] under fuel tank.
- See Figure 8-52. Remove upper and lower bracket hardware (6, 7) and spacer (8). Remove auxiliary lamp bracket (9).

NOTE

See Auxiliary Lamp Housing Removal in this section to disassemble auxiliary lamp housings from bracket.

Auxiliary Lamp Bracket Installation

- See Figure 8-52. Place auxiliary lamp bracket (9) in position. Loosely install upper and lower bracket hardware (6, 7). Verify that spacers (8) are installed on upper fasteners.
- Attach auxiliary lamp housings (11) to bracket if necessary. See Auxiliary Lamp Housing Installation in this section.
- Connect wiring for front turn signals [31] and auxiliary lamps [73].
- Tighten the auxiliary lamp bracket hardware (6, 7) to 72-120 in-lbs (10.8-13.6 Nm).
- Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- Place windshield in position. Adjust windshield height so that top of windshield is at rider's eye level while seated on motorcycle and fasten securely. See 2.50 WIND-SHIELD: FLSTC.

Auxiliary Lamp Housing Removal

- 1. See Figure 8-52. Remove screws (5) that secure the turn signal lamps (1) to the mounting bracket (3).
- 2. Detach auxiliary lamp connector [73].
 - Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.7 FUEL TANK: CARBU-RETED or 9.5 FUEL TANK: EFI.
 - b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
 - c. Remove auxiliary lamp terminals. See B.1 AMP MULTILOCK ELECTRICAL CONNECTORS in the appendix.
- 3. Remove appropriate terminal(s) from socket housing.
- Use a flare nut socket to remove the nuts (2) that secure the auxiliary lamp housings (11) to bracket. Remove auxiliary lamp and pull wires through vinyl conduit.

Auxiliary Lamp Housing Installation

- 1. See Figure 8-52. Place auxiliary lamps housings (11) in position. Use a flare nut socket to snug the nut (2) that secures the lamp to the bracket.
- Push lamp wires back into the vinyl conduit. Insert wire terminals into connector. Route the harness back into position and mate connectors.
- Aim auxiliary lamps. See ADJUSTMENT: FLSTC/ FLSTN MODELS in this section.
- 4. Install the screws (5) that secure the turn signal lamps to the mounting bracket (3).





Auxiliary Lamp Bracket Removal

- 1. Detach wiring.
 - Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.7 FUEL TANK: CARBU-RETED or 9.5 FUEL TANK: EFI.
 - b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
 - c. Disconnect 6-place Multilock front turn signal connector [31] under fuel tank.
- 2. See Figure 8-54. Remove upper and lower bracket hardware (8, 9) Remove auxiliary lamp bracket.

NOTE

See Auxiliary Lamp Housing Removal in this section to disassemble auxiliary lamp housings from bracket.

Auxiliary Lamp Bracket Installation

- See Figure 8-54. Place auxiliary lamp bracket (5) in position. Loosely install upper and lower bracket hardware (8, 9).
- Attach auxiliary lamps to bracket if necessary. See Auxiliary Lamp Housing Installation in this section.
- 3. Connect wiring for front turn signals [31] and auxiliary lamps [73].
- 4. Tighten the auxiliary lamp bracket hardware (9, 10) to 72-120 **in-lbs** (10.8-13.6 Nm).
- 5. Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.



Figure 8-53. Auxiliary Lamp Bulb: Typical



Figure 8-54. Auxiliary Lamp Bracket: FLSTN

Auxiliary Lamp Housing Removal

- 1. Remove auxiliary lamp bulb. See AUXILIARY LAMP BULB in this section.
- 2. Detach auxiliary lamp connector [73].
 - Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.7 FUEL TANK: CARBU-RETED or 9.5 FUEL TANK: EFI.
 - b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
 - Remove auxiliary lamp terminals. See B.1 AMP MULTILOCK ELECTRICAL CONNECTORS in the appendix.
- 3. Remove appropriate terminal(s) from auxiliary lamp bulb socket housing.
- See Figure 8-54. Remove nut (11) that secures auxiliary lamp housing (10) and turn signal lamp (3) to auxiliary lamp bracket (5). Remove auxiliary lamp and turn signal lamp.
- 5. Remove adapter (4) from turn signal lamp.

Auxiliary Lamp Housing Installation

- See Figure 8-54. Install adapter (4) on turn signal lamp (3). Install turn signal lamp in auxiliary lamp bracket (5).
- 2. Install auxiliary lamp housing (10) over turn signal lamp threads.

NOTE

See Figure 8-55. In next step, be sure top of collar (1) is facing up.

- 3. See Figure 8-54. Install collar (12) and nut (11) over turn signal lamp wire. Tighten nut finger tight. Do not fully tighten nut at this time.
- 4. Place auxiliary lamp ring at back of **new** lamp with the concave side up.
- 5. Install terminals into auxiliary lamp bulb socket housing.
- Install lamp fitting auxiliary lamp ring over edge of lamp housing. Rotate auxiliary lamp ring so that index tab engages slot at bottom of lamp housing.
- 7. Holding auxiliary lamp ring in place, rotate lamp so that index tab at back engages slot in auxiliary lamp ring.
- 8. Install lamp door over lip of lamp housing. Rotate lamp door so that screw is centered at bottom, and then tighten door screw until snug.
- 9. Adjust auxiliary lamps. See ADJUSTMENT below.



Figure 8-55. Collar
ADJUSTMENT: FLSTC/FLSTN MODELS

- Check headlamp alignment. Adjust if necessary. See 1.29 HEADLAMP ALIGNMENT.
- With a rider seated on the motorcycle and the front wheel pointed straight ahead, turn on the headlamp high beam.
- 3. See Figure 8-56. Mark the center of the headlamp high beam by making a vertical line through the horizontal line already drawn on the wall. Properly adjusted, the beam should project an equal area of light to the left and right of the vertical centerline (1).
- 4. Turn the headlamp off and move to the front of the motorcycle.
- Measure the distance from the headlamp horizontal centerline down to the horizontal centerline of the left side auxiliary lamp. Now measure the distance from the headlamp vertical centerline out to the vertical centerline of the same lamp.
- Repeat measurements performed in previous step on right side auxiliary lamp.
- From the headlamp high beam centerlines, perform the measurements taken in previous steps to locate the left and right side auxiliary lamp centerlines on the wall (2, 3).
- Turn on the headlamp high beam again, and with a rider seated on the motorcycle, verify that it is still aligned with the horizontal and vertical centerlines.
- Turn on the headlamp low beam and then cover both the headlamp and the right side auxiliary lamp. Adjust the left side auxiliary lamp as necessary so that the entire high intensity zone is both below and to the right of the left side auxiliary lamp centerlines (4).

- Leaving the headlamp covered, remove cover from right side auxiliary lamp and place over left side auxiliary lamp. Adjust the right side auxiliary lamp as necessary so that the entire high intensity zone is both below and to the right of the right side auxiliary lamp centerlines (5).
- 11. Tighten auxiliary lamps on FLSTC models.
 - See Figure 8-52. Loosen screws (5) to detach turn signal lamps (1) from mounting bracket (3).
 - Insert flare nut socket at bottom of turn signal mounting bracket and tighten locknut to 18 ft-lbs (24.4 Nm).
 - c. Start two screws to secure turn signal lamp to mounting bracket. Verify that conduit fits in slot at back of bracket and is not pinched. Alternately tighten screws to 36-60 in-lbs (4.1-6.8 Nm).
- 12. Tighten auxiliary lamps on FLSTN models.
 - See Figure 8-54. Loosen screw (23) and remove bezel (16) from auxiliary lamp (24).

NOTE -

In next step, be sure to minimize auxiliary lamp movement while tightening. If excessive movement is permitted, auxiliary lamp aim will be incorrect.

- While holding auxiliary lamp steady, tighten nut (12) to 15-18 ft-lbs (20.3-24.4 Nm).
- c. Install lamp fitting auxiliary lamp ring over edge of lamp housing. Rotate auxiliary lamp ring so that index tab engages slot at bottom of lamp housing.
- d. Start two screws to secure turn signal lamp to mounting bracket. Verify that conduit fits in slot at back of bracket and is not pinched. Alternately
 tighten screws to 36-60 in-lbs (4.1-6.8 Nm).
- 13. Recheck auxiliary lamp alignment.



REMOVAL

WARNING

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

- 1. Remove seat and disconnect negative battery cable.
- 2. Remove the instrument console.
- Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.

NOTE

Before removing wires from connector, or harness from frame, carefully note routing for reinstallation.

- Disconnect connector [32B] and remove socket terminals from connector. See B.1 AMP MULTILOCK ELEC-TRICAL CONNECTORS in the appendix.
- 5. Cut cable straps as necessary and pull harness free.
- See Figure 8-57. Remove rear lamp screw (1), then remove front screw (2) while holding crimp nut (5) from inside of fender.
- 7. Remove lamp housing as an assembly, and pull rubber grommet (3) through fender.
- 8. Use a long screwdriver to carefully pry the metal clip away from the inside of the fender.
- 9. Push small wire harness grommet on side of fender through fender and remove lamp assembly.

INSTALLATION

- 1. Feed wire harness back into fender top hole and out through side hole.
- Place harness into metal clip inside of fender and carefully close clip to hold harness in place.
- See Figure 8-57. Using alcohol, or glass cleaner, lubricate the rubber grommet (3) and place it back into position in hole in top of fender. Install small grommet in side of fender.
- 4. Loosely install rear lamp screw (1).
- 5. Install front lamp screw (2) while holding nut (5) from inside of fender. Tighten screw securely.



Figure 8-57. Fender Tip Lamp: FLSTSC

- 6. Tighten rear lamp screw (1) securely.
- Gently pull the wire harness out the side of the fender until there is a minimum of slack under the fender. Be sure that there is as much wire harness to tire clearance as possible.
- 8. Route wire harness back into original position and secure with cable straps as required.
- Insert terminals into connector and mate connector halves. See B.1 AMP MULTILOCK ELECTRICAL CON-NECTORS in the appendix.
- 10. Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- 11. Connect positive battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

- 12. Install seat.
- 13. Check lamp for proper operation.

BULB REPLACEMENT: ALL BUT FLST/FLSTC

- 1. Locate notch on front or rear turn signal lens cap.
- See Figure 8-58. Insert coin in notch. Carefully twist coin until lens cap 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.
 - Push new light bulb in and turn clockwise to lock in place.
- 4. Snap lens cap back into turn signal housing.

BULB REPLACEMENT: FLST/FLSTC

To change a bulb, remove the lens, turn the bulb 1/4 turn while pressing the bulb into the housing, and remove the bulb. Replace the bulb and install the lens.

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

NOTE

See 8.23 AUXILIARY LAMPS: FLSTC/FLSTN for front turn signal replacement on FLSTC and FLSTN models. For all other models, follow the instructions below.

AWARNING

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

- 1. Disconnect negative battery cable.
- Change turn signal following steps under Front Turn Signals: All But FLSTC, FLSTN, FLSTSC, FXSTS, Front Turn Signals: FLSTSC, FXSTS, Rear Turn Signals: All But FXSTD, FLSTSC, FLSTN or Rear Turn Signals: FXSTD.
- 3. Connect negative battery cable.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

4. Turn ignition on and test for proper turn signal operation.



Figure 8-58. Lens Cap Removal



Figure 8-59. Front Turn Signal Connector [31]

Front Turn Signals: All But FLSTC, FLSTN, FLSTSC, FXSTS

 Follow preliminary steps listed under LAMP REPLACE-MENT, GENERAL.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

- Remove fuel tank fasteners and slide tank back to reveal front turn signal connector [31]. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI. Disconnect [31] and remove terminals.
- 3. Detach front turn signals from mounting point.
 - For FXSTB models, see Figure 8-60. Remove two screws (4) from each mounting clamp. Hold jam nut (2) and remove screw (5) to detach turn signal.
 - b. For all models except FXSTB see Figure 8-61. On right side, hold retainer (6) and loosen ball stud clamp (4) to remove turn signal. On left side, remove nut (5) from mirror, loosen jam nut and remove ball stud clamp (4) to detach turn signal.
 - For all models, remove wire terminals from turn signal connectors.
- 4. Install new front turn signal.
 - Attach signal to mounting point as appropriate to model being serviced.
 - b. Route wiring to connector [31] location and install terminals in connector. Attach connectors.
 - c. Verify that turn signal points straight ahead.
- 5. Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.



Figure 8-60. Front Turn Signals: FXSTB



FLST

Front Turn Signals: FLSTSC, FXSTS

 Follow preliminary steps listed under LAMP REPLACE-MENT, GENERAL.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

- Remove fuel tank fasteners and slide tank back to reveal front turn signal connector [31]. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI. Disconnect [31] and remove terminals.
- 3. Detach front turn signals from mounting point.
 - a. See Figure 8-62. Remove set screw (1) from turn signal bracket (3).
 - b. Loosen jam nut (4).
 - c. Use a ball Allen wrench to remove ball stud (2) from turn signal (5) and turn signal bracket.
- 4. Install new front turn signal.
 - Install ball stud through signal bracket from inboard side.
 - b. Thread on jam nut all the way onto ball stud.
 - c. Thread ball stud into turn signal.
 - d. Finger tighten jam nut against turn signal.
 - e. Install but do not tighten set screw into bracket.
 - Position turn signal to point lens (7) straight ahead. Tighten each set screw to 50-70 in-lbs (5.7-7.9 Nm).

NOTE

After set screw is tightened, it is not necessary, nor desirable, to completely remove set screw to adjust housing. Loosen set screw 1/8 turn, adjust housing and tighten set screw to 50-70 **in-lbs** (5.7-7.9 Nm). Nylon lock pellet on set screw maintains locking ability after many adjustments. If set screw is completely removed, replace.

- g. Hold each turn signal and tighten jam nut.
- Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.



Figure 8-62. Front Turn Signals: FLSTS, FXSTS

Rear Turn Signals: All But FXSTD, FLSTSC, FLSTN

 Follow preliminary steps listed under LAMP REPLACE-MENT, GENERAL.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

- Disconnect turn signal wiring.
 - Disconnect right turn signal [18] and left turn signal [19] connectors from within tail lamp. See 8.20 TAIL LAMP: ALL BUT FXSTD/FLSTSC/FLSTN.
 - b. Remove wire terminals from turn signal connectors.
- 3. Detach turn signal from mount.
 - For FLSTC models, see Figure 8-63. Remove the screw (1) to detach turn signal from mount (2).
 - For all other models, see Figure 8-64. Detach fender support hardware. See 2.35 REAR FENDER: FXST/ FXSTS/FXSTB. Remove screw and washer (1) from inside fender support to detach turn signal from mount (2).
- 4. Install new rear turn signal.
 - Attach signal to mounting point as appropriate to model being serviced. On all models but FLSTC, install rear fender support.
 - b. Route wiring to connector location and install terminals in connector. Attach connectors.
 - c. Verify that turn signal points straight behind.
- Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

Rear Turn Signals: FXSTD

 Follow preliminary steps listed under LAMP REPLACE-MENT, GENERAL.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

- 2. Disconnect turn signal wiring.
 - Remove tail lamp and disconnect the right and left 2-place turn signal connectors. See 8.21 TAIL LAMP: FXSTD.
 - b. Remove wire terminals from turn signal connectors.
- Remove fender support. See 2.36 REAR FENDER: FXSTD.



Figure 8-63. Rear Turn Signals: FLSTC, FLST





- See Figure 8-64. Detach turn signal from mount (2) by removing screw and washer (1) from inside of fender support.
- 5. Install new rear turn signal.
 - Attach signal to fender support using screw and washer (1). Tighten screw to 96-120 in-lbs (10.8-13.6 Nm).
 - b. Install fender support. See 2.36 REAR FENDER: FXSTD.
 - Route wiring to connector location and install terminals in connector. Attach connectors.
 - d. Verify that turn signal points straight behind.
- Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

Rear Turn Signals: FLSTSC

See 2.37 REAR FENDER: FLSTSC

Rear Turn Signals: FLSTN

- Remove rear fender. See 2.38 REAR FENDER: FLSTN. 1.
- See Figure 8-65. Remove fastener (1). Disengage tail 2. lamp connector cover (2) from clip (3).
- 3. See Figure 8-66. Disconnect left (1) [19] and right (3) [18] turn signal connectors.
- 4. Remove wire terminals from turn signal connectors. See B.2 DEUTSCH ELECTRICAL CONNECTORS for connector disassembly.
- 5. See Figure 8-67. Remove screws (1) to release turn signal bar (2) from fender.
- 6. Install new turn signal bar. Tighten screws (1) to 84-144 in-lbs (9.5-16.3 Nm).
- 7. Install wire terminals into turn signal connectors. See B.2 DEUTSCH ELECTRICAL CONNECTORS for connector assembly.
- 8. See Figure 8-66. Connect left (1) [19] and right (3) [18] turn signal connectors.
- 9. See Figure 8-65. Slide tail lamp connector cover (2) into clip (3). Install fastener (1) and tighten to 60-90 in-Ibs (6.8-10.2 Nm).



Clip

Figure 8-65. Tail Lamp Connector Cover



- 2. Tail lamp connector [93]
- 3. Right rear turn signal connector [18]

Figure 8-66. Turn Signal Connectors



Figure 8-67. Rear Turn Signals: FLSTN

Refer to the Softail Models Electrical Diagnostic Manual for further information on the turn signal module (TSM) and turn signal security module (TSSM).

NOTE

Before replacing turn signal security module (TSSM), verify security lamp is not blinking (vehicle is disarmed).

REMOVAL/

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 8-68. Follow removal instructions under 8.4 ELECTRICAL PANEL.
- 4. Unplug turn signal module connector [30].

INSTALLATION

- See Figure 8-68. Connect turn signal module connector [30]. Follow installation instructions under 8.4 ELECTRI-CAL PANEL.
- 2. Connect negative battery cable.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

- 3. Test for correct operation.
- Perform steps listed under TSM/TSSM Configuration below.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat.



Figure 8-68. Turn Signal/Security Module Location



Figure 8-69. TSM/TSSM

TSM/TSSM CONFIGURATION

been replaced by a TSM, password learn is necessary.

- After replacing TSSM, check if a password learning process is necessary. For more information, refer to Table 8-7.
- After replacement of TSM/TSSM, always perform key fob assignment and personal code entry. See 8.27 TSM/ TSSM KEY FOB AND CODE ASSIGNMENT.

Table 8-7. Password Learning Needed?

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
ICM	Yes
TSM	No *
TSSM	Yes

PASSWORD LEARNING

Digital Technician

One method of mating the TSM/TSSM and ECM/ICM after replacement is by employing a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). When finished, continue with all instructions under 8.27 TSM/ TSSM KEY FOB AND CODE ASSIGNMENT.

Without Digital Technician

If DIGITAL TECHNICIAN is not available, refer to Table 8-8. When finished, continue with all instructions under 8.27 TSM/ TSSM KEY FOB AND CODE ASSIGNMENT.

IMPORTANT NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

* If a TSM has been replaced by a TSSM, or a TSSM has

Table 8-8. Setting TSM/TSSM and ICM/ECM Password Without Digital Technician

NO.	ACTION	CONFIRMATION	NOTES
	Ignition must be turned off for at least 15 seconds.	With ignition turned off, Check Engine Lamp and Security Lamp will be off.	
1	Install new TSM/TSSM or ECM/ICM. Perform all steps under 8.27 TSM/TSSM KEY FOB AND CODE ASSIGNMENT.		
2	Set RUN/OFF switch to RUN.		
3	Turn IGN key ON.	Verify Check Engine Lamp and Security Lamp illuminate and then turn off.	TSM/TSSM enables starter relay.
4	Attempt normal start one time.	Engine starts and stalls. Check Engine Lamp illuminates and stays on.	Password has not been learned. ICM sets DTC P1009.
5	Wait ten seconds. Security lamp will illu- minate and stay on.	Security Lamp illuminates.	ECM/ICM enters Password Learning mode for ten min- utes. Do not cycle ignition switch or interrupt vehicle power or Password Learn will be unsuccessful.
6	Wait until Security Lamp turns off.		This takes ten minutes
7	Quickly (within two seconds) turn IGN key OFF-ON.		ECM/ICM must not be allowed to shutdown.
8	Wait until Security Lamp turns off.		This takes ten minutes.
9	Quickly (within two seconds) turn IGN key OFF- ON.		ECM/ICM must not be allowed to shutdown.
10	Wait until Security Lamp turns off.		This takes ten minutes.
11	Quickly (within two seconds) turn IGN key OFF-ON.		ECM/ICM must not be allowed to shutdown.
12	Turn IGN key OFF. Wait 15 seconds before turning IGN on. Turn IGN switch ON and start engine to confirm success- ful Password Learn procedure. Clear trouble codes. See Softail Models Electri- cal Diagnostic Manual.		
13	Perform all steps under 8.27 TSM/TSSM KEY FOB AND CODE ASSIGNMENT.		

Refer to the Softail Models Electrical Diagnostic Manual for further information on the turn signal module (TSM) and turn signal security module (TSSM).

- 1. Configure the TSM/TSSM for sidecar or solo configuration. If no sidecar is installed, skip this step.
- 2. See Figure 8-70. Configure TSSM motorcycles by assigning **both** key fobs to the vehicle.
- Configure TSSM motorcycles by entering a personal code picked by the owner. The personal code allows the owner to operate the system if the key fob is lost or inoperable. Record this code in the owner's manual and instruct the customer to carry a copy.

IMPORTANT NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

Changes to TSM/TSSM settings are made by a series of programming operations involving the ignition key, left/right turn signal switches and key fob (security systems).

At certain steps in the programming sequence, the motorcycle may provide confirmation of settings by flashing the turn signals, turn signal indicators and/or security lamp.

All programming operations are listed in table format. Follow the numbered steps to configure the system. If a confirmation response is listed, wait for the confirmation before continuing to the next step. Important information pertaining to certain actions will be found in the NOTES column.

POWER DISRUPTION AND CONFIGURING

The TSM/TSSM will not enter configuration mode on the first attempt after battery voltage has been removed from Pin 1. This will occur after any of the following situations:

- Battery disconnect or power drain.
- Security fuse removal.
- Connecting Breakout Box to TSM/TSSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows.

- 1. Set run switch to **OFF**, cycle ignition key **ON**-OFF-**ON**-OFF-**ON** and press left turn signal switch **twice**.
- 2. Repeat step listed above.
- 3. Continue with configuration sequence listed.



Figure 8-70. Key Fob

KEY FOB ASSIGNMENT

The key fob on TSSM motorcycles must be set so it will operate the alarm system on the vehicle. This assignment **must** be completed with no pauses between steps greater than 10 seconds. Turn the ignition OFF after all key fobs have been assigned. The programming mode will also exit after 60 seconds has elapsed without detecting any fob signup messages or turn signal activity.

Two key fobs may be assigned to the TSSM. The first successful attempt to program a fob will disable all previously assigned fobs. If a second fob is to be programmed, it must be done in the same programming sequence as the initial fob.

To assign a key fob to a motorcycle, refer to Table 8-9.

PERSONAL CODE ENTRY

First Time Code Entry: TSSM Only

IMPORTANT NOTE

Do not forget to enter a personal code for TSSM vehicles. If a code is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

The TSSM personal code consists of five digits. Each digit can be any number from 1-9. The personal code **must** be used to disarm the security system in case the key fob becomes unavailable.

To set a personal code on a motorcycle with no code previously installed, refer to Table 8-10. The procedure listed uses 3-1-3-1-3 as the desired personal code.

For better security, do not use 3-1-3-1-3 as a personal code. It is shown as an example only.

Decide what five digit code the owner would like to use. The code will be programmed using the turn signal switches and key fob. Keep a record of the code in a secure place such as your wallet or the owner's manual.

- When programming the personal code, the digits will be displayed on the odometer.
- When programming the personal code, the security lamp will also flash to provide feedback when entering each digit.
- The number of security lamp flashes corresponds to the number currently selected for a given digit. Therefore, the lamp may flash 1-9 times depending on the number entered.
- Press the left turn switch one time to increment each digit of the code.
- Quickly press the key fob butten twice to advance to the next digit of the code.

NOTE

The programming mode exits upon turning the key switch to OFF or if no turn signal switch/key fob button activity occurs for 60 seconds. No data is saved for partial configuration attempts.

Modifying Existing Codes: TSSM Only

If a code was previously entered, the lamp will flash the equivalent digit. Each additional press of the left turn switch will increment the digit.

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).

Table 8-9. TSSM Key Fob Assignment

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
			Verify that security lamp is not blinking (vehicle is dis- armed)
1	Set RUN/OFF switch to OFF		This assignment procedure must be completed with no pauses between steps greater than 10 seconds
2	Turn IGN key ON-OFF-ON-OFF-ON		
		1-3 flashes turn signals & indicators	1 flash-Worldwide TSM, no security
3	Press left turn switch 2 times and release	eft turn switch 2 times and depending on vehicle configuration (See section under 8.17 BATTERY	2 flashes-North American/ Domestic configuration TSSM
		regarding battery disconnects.)	3 flashes-European/HDI con- figuration TSSM
4	Press right turn switch 1 time and release	1 flash turn signals & indicators	
5	Press left turn switch 1 time and release	2 flashes turn signals & indicators	
6	Press and hold key fob button until confirmation is received	2 flashes turn signals & indicators	This may take 10-25 seconds
7	If you have two key fobs, press and hold button on second key fob until confirmation is received	2 flashes turn signals & indicators	optional step
8	Turn IGN key OFF		

Table 8-10. Programming A TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set RUN/OFF switch to OFF		Verify that security lamp is not blinking (vehicle is dis- armed)
2	Turn IGN key ON-OFF-ON-OFF-ON		
3	Press left turn switch 2 times and release	1-3 flashes turn signals & indicators depending on vehicle configuration (See section under 8.17 BATTERY regarding battery disconnects)	1 flash-Worldwide TSM, no security 2 flashes-North American/ Domestic configuration TSSM 3 flashes-European/HDI con- figuration TSSM
4	Quickly press key fob button 2 times and release	One flash turn signals and indicators Odometer displays current five-digit per- sonal code (five dashes if no code entered), first digit blinks	Vehicle is in personal code entry mode ready to enter or modify first digit
5	Press left turn switch 1 time and release	Security lamp flashes 1 - 9 times if code was previously entered	A lack of confirmation flashes indicates no digit is entered
6	Press and release left turn switch to advance through the digits In this example, you will press and release three times	Blinking digit in odometer display incre- ments, security lamp flashes to indicate each digit selected In this example, the blinking digit dis- played is 3 and the security lamp will flash three times	You've selected 3 as a num- ber for the first digit
7	Quickly press key fob button 2 times and release	Two flashes turn signals and indicators second digit in odometer display blinks	You've confirmed 3 as a num- ber for the first digit and have advanced to entering the sec- ond digit
8	Press left turn switch 1 time and release	none	A lack of confirmation flashes indicates no digit is entered
9	Press and release left turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display incre- ments, security lamp flashes to indicate each digit selected In this example, the blinking digit dis- played is 1 and the security lamp will flash one time	You've selected 1 as a num- ber for the second digit
10	Quickly press key fob button 2 times and release	Three flashes turn signals and indicators third digit in odometer display blinks	You've confirmed 1 as a num- ber for the second digit and have advanced to entering the third digit
11	Press left turn switch 1 time and release	none	A lack of confirmation flashes indicates no digit is entered
12	Press and release left turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display incre- ments, security lamp flashes to indicate each digit selected In this example, the blinking digit dis- played is 3 and the security lamp will flash three times	You've selected 3 as a num- ber for the third digit
13	Quickly press key fob button 2 times and release	Four flashes turn signals and indicators fourth digit in odometer display blinks	You've confirmed 3 as a num- ber for the third digit and have advanced to entering the fourth digit

Table 8-10. Programming A TSSM Personal Code (Example: 3-1-3-1-3) With No Code Previously Installed

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
14	Press left turn switch 1 time and release	none	A lack of confirmation flashes indicates no digit is entered
15	Press and release left turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display incre- ments, security lamp flashes to indicate each digit selected In this example, the blinking digit dis- played is 1 and the security lamp will flash one time	You've selected 1 as a num- ber for the fourth digit
16	Quickly press key fob button 2 times and release	Five flashes turn signals and indicators fifth digit in odometer display blinks	You've confirmed 1 as a num- ber for the fourth digit and have advanced to entering the fifth digit
17	Press left turn switch 1 time and release	none	A lack of confirmation flashes indicates no digit is entered
18	Press and release left turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display incre- ments, security lamp flashes to indicate each digit selected In this example, the blinking digit dis- played is 3 and the security lamp will flash three times	- You've selected 3 as a num- ber for the fifth digit
19	Quickly press key fob button 2 times and release	One flash turn signals and indicators first digit in odometer display blinks	You've confirmed 3 as a num- ber for the fifth digit and have gone back to the first digit
20	Turn IGN key OFF		
21	Write down code in owner's manual		
22	Arm the security system and attempt to disarm using personal code entry. See Softail Models Electrical Diagnostic Man- ual or owner's manual		

FUEL GAUGE

- The fuel gauge is mounted in a simulated left fuel tank cap. Remove by gently pulling upward. Do not twist.
- See Figure 8-71. Three wires attach to the bottom of the gauge (1).
- The fuel gauge sending unit is under a console on the middle of the tank.

REMOVAL

1. Remove seat.

WARNING

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

2. Disconnect negative battery cable.

NOTE

The gauge wires are routed through a tube in the tank and are secured at the bottom of the tank.

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

- Check to be sure fuel supply valve is in OFF position. Remove fuel line from the fuel supply valve. Drain fuel into an adequately sized, approved gasoline container.
- Remove fuel tank fasteners and slide tank back to reveal fuel gauge connector [117]. See 4.7 FUEL TANK: CAR-BURETED or 9.5 FUEL TANK: EFI. Disconnect connector [117] and remove terminals.
- See Figure 8-72. Disconnect wiring harness from connector [117]. See APPENDIX B–WIRING.
- Remove fuel gauge wiring from clamp at bottom of fuel tank.

NOTE

Do not twist gauge and wiring during removal.

 See Figure 8-71. Pull up on gauge (1). Remove gauge, gasket (2) and wiring from fuel tank. Discard gasket.



Figure 8-71. Fuel Gauge (Carbureted): Typical

INSTALLATION

- 1. See Figure 8-71. Install wiring harness (3) through **new** gasket (2).
- 2. Push wiring harness through tube in fuel tank.
- While gently pulling on wiring harness, install gauge (1) and gasket by carefully moving gauge back and forth while pushing down at the same time.
- 4. See Figure 8-72. Install wiring into connector (4) [117]. Mate connector halves.
- 5. Slide fuel tank into position and install fasteners. See 4.7 FUEL TANK: CARBURETED or 9.5 FUEL TANK: EFI.
- 6. Secure wire at bottom of fuel tank.
- 7. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat.



Figure 8-72. Fuel Gauge Connector [117] Location

FUEL GAUGE SENDING UNIT: CARBURETED MODELS

REMOVAL

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- 3. Remove instrument console.
 - All but FXSTDI, remove acorn nut and washer on instrument console to separate console from fuel tank.
 - b. For FXSTD models see 8.30 INSTRUMENT CON-SOLE: FXSTD.
- 4. Disconnect console wiring.
- See Figure 8-73. Disconnect the fuel gauge sending unit connector (3) [86].
- 6. Remove all fasteners (2) from top plate. Lift top plate from fuel tank.
- See Figure 8-75. Pull tab (2) towards top of fuel tank to release fuel gauge sending unit (2) from mounting tabs (3).
- 8. See Figure 8-74. While pushing tab (2) in direction shown, pull top plate connector (1) from top plate.

CAUTION

Exercise care to avoid bending float rod of fuel level sender. A bent float rod will result in erroneous gauge readings.

CAUTION

Do not replace the special teflon coated fuel pump/fuel level sender wiring with ordinary bulk wire. Ordinary insulation materials may deteriorate when in contact with gasoline.

NOTE

Damaged fuel level sending unit wiring requires replacement of the fuel level sender unit.

- 9. Remove sending unit from fuel tank.
- 10. Remove and discard top plate gasket.

- 1. Top plate
- 2. Fasteners (10)
- 3. Fuel gauge sending unit connector [86]

Figure 8-73. Top Plate



Figure 8-74. Top Plate Connector

INSTALLATION

1. See Figure 8-74. Connect top plate connector (1).

NOTE

Do not apply any type of sealant to gasket.

- 2. install new gasket under top plate.
- On carbureted models, secure fuel pump harness to wiring at base of sending unit.

CAUTION

Exercise care to avoid bending float rod of fuel level sender. A bent float rod will result in erroneous gauge readings.

- See Figure 8-75. Install fuel gauge sending unit (1) into mounting tabs (3). Push down on sending unit until it is seated in tabs.
- 5. On carbureted models, be sure cable tie is installed fuel gauge sender unit to secure unused fuel pump harness
- See Figure 8-76. Place gasket and top plate on tank. Using the pattern shown, tighten T20 TORX screws to 18-24 in-lbs (2.0-2.7 Nm).
- 7. Attach fuel gauge sending unit connector [86].
- 8. Install instrument console.
 - All but FXSTDI, Make sure console fastener is installed in top plate. Attach console to fuel tank with nut and washer. Tighten to 14-18 ft lbs (19.0-24.4 Nm).
 - b. For FXSTD models see 8.30 INSTRUMENT CON-SOLE: FXSTD.
- 9. Fill tank with gasoline and check for leaks.
- 10. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

11. Install seat.



Figure 8-75. Fuel Gauge Sender



Figure 8-76. Top Plate Torque Sequence

INSTRUMENT CONSOLE: FXSTD

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- 3. See Figure 8-77. Remove T27 TORX screw from front console mount.
- 4. See Figure 8-78. Remove two T25 TORX screws and washers (2) from rear mount (1).
- 5. See Figure 8-79. Lift console away from tank. Disconnect wiring if necessary.
 - a. Ignition switch connector (1) [33].
 - b. Indicator lamp connector (2) [21].
 - c. Speedometer connector (3) [39].
 - d. Remove reset switch (4) from console.
 - e. Remove cable straps (5).

INSTALLATION

NOTE

When installing console, do not pinch wires. Improper installation may cause electrical component malfunction.

- See Figure 8-79. Connect wiring if necessary. Lay console over center of tank.
 - a. Ignition switch connector (1) [33].
 - b. Indicator lamp connector (2) [21].
 - c. Speedometer connector (3) [39].
 - d. Install reset switch (4) inside console.
 - e. Install cable straps (5).
- 2. Install mounting hardware.
 - See Figure 8-78. Loosely install two T25 TORX screws and washers (2) in rear mount (1).
 - See Figure 8-77. Loosely install T27 TORX screw in front console mount.
 - c. Tighten both rear screws before tightening front screw. Torque to 30-40 in-Ibs (3.4-4.5 Nm).
 - d. Tighten the front screw to 30-40 in-lbs (3.4-4.5 Nm).
- 3. Check ignition switch functions and indicator lights.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat.



Figure 8-77. Front Console Screw



2. T25 TORX screw and washer (2)

Figure 8-78. Rear Console Mount



- 1. Ignition switch connector [33]
- 2. Indicator lamp connector [21]
- 3. Speedometer connector [39]
- 4. Odometer reset switch
- 5. Cable Strap

Figure 8-79. Console Wiring

REMOVAL

- 1. See Figure 8-80. Remove nut and washer (4) and lift console (5) from fuel tank.
- 2. Position clean shop rags on fuel tank and flip console over to expose underside.
- 3. Depress connector tab and disconnect 12-place harness connector (2) [39] from speedometer under console.
- Unscrew the rubber boot from the odometer reset switch
 (6) on the left side of the console.
- 5. Remove the odometer reset switch from hole in console.
- 6. See Figure 8-81. Pry between three tabs and speedometer with a screwdriver to raise and release back clamp from speedometer. Remove back clamp from speedometer.
- 7. See Figure 8-80. Remove speedometer from console.
- 8. Remove gasket (3) from speedometer.

INSTALLATION

- 1. See Figure 8-80. Install gasket (3) to speedometer.
- 2. Position speedometer in console (5).
- 3. See Figure 8-81. Press on back clamp (3) until three tabs engage on back of speedometer.
- 4. See Figure 8-80. Insert odometer reset switch (6) through hole in console and install rubber boot.
- 5. Connect 12-place connector (2) [39] to speedometer under console.
- Remove shop rags. Attach console to fuel tank with nut and washer (4). Tighten to 14-18 ft lbs (19.0-24.4 Nm).
- 7. Test speedometer for proper operation.



Figure 8-80. Speedometer: All But FXSTD



Figure 8-81. Connector [39]

REMOVAL

- 1. Remove seat.
- Remove instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- 3. See Figure 8-82. Remove wiring for indicator lamps from cable straps (2) on back of speedometer.
- 4. Detach speedometer connector (3) [39].
- Disengage retention clips (1) holding speedometer back clamp to instrument console.
- See Figure 8-83. Disengage clips (1) to free speedometer from back clamp (2). Remove seal (3).

INSTALLATION

- 1. See Figure 8-83. Secure the speedometer inside back clamp (2) using clips (1). Install seal (3).
- See Figure 8-82. Secure the speedometer back clamp to instrument console using retention clips (1).
- 3. Fasten wiring with cable straps (2).
- 4. Attach speedometer connector (3) [39].
- Install instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.



- 1. Retention clip (3) on console
- 2. Cable strap (2)
- 3. Speedometer connector [39]

Figure 8-82. Speedometer Mount: FXSTD



Figure 8-83. Speedometer Clips

The speedometer speed sensor is a hall effect sensor that takes readings off 4th gear in the transmission.

The speedometer speed sensor is located on the transmission just behind the transmission top cover.

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- See Figure 8-84. Follow removal instructions under 8.4 ELECTRICAL PANEL to gain access to the 3-place speedometer sensor connector [65]. Detach connector.
- 4. See Figure 8-85. Remove sensor mounting bolt and lift sensor from crankcase.

NOTE

Before removing sensor wire, carefully note wire routing. It is a good idea to lay the new sensor wire next to the old wire and remove and replace the wires together, one cable strap at a time, to ensure proper routing.

INSTALLATION

- See Figure 8-85. Install sensor into transmission case using mounting bolt. Tighten bolt to 84-108 in-lbs (9.5-12.2 Nm).
- 2. See Figure 8-84. Mate connector halves and attach 3place connector [65] to t-stud on frame. Complete installation instructions under 8.4 ELECTRICAL PANEL.
- 3. Connect negative battery cable.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat.



Figure 8-84. Vehicle Speed Sensor Connector [65]



Figure 8-85. Vehicle Speed Sensor

Softails are equipped with Light Emitting Diode (LED) indicators. The indicator lamp assembly is not serviceable. If one LED is bad, the entire assembly must be replaced.

See the Softail Models Electrical Diagnostic Manual for troubleshooting procedures.

REMOVAL

- 1. See Figure 8-86. Remove nut and washer (1). Raise console (2) from fuel tank. Place shop rags on tank and flip console over to expose underside.
- 2. See Figure 8-87. Squeeze clips together (2) and gently pry indicator lamp assembly (1) out of console from the side with a screwdriver.
- Disconnect 8-place connector (3) [21] from indicator 3. lamp assembly.

INSTALLATION

- 1. See Figure 8-87. Install indicator lamp assembly (1) into console. Make sure clips (2) engage to secure assembly in place.
- 2. Connect connector (3) [21] to main wiring harness.
- 3. See Figure 8-86. Place console (2) in position. Install nut and washer (1). Tighten to 14-18 ft-lbs (19.0-24.4 Nm).

Table 8-11. Connector [21] Pins

PIN ON [21]	WIRE COLOR	FUNCTION
1	Violet	left turn
2	White	high beam
3	Green/yellow	oil pressure
4	Brown	right turn
5	Tan	neutral
6	Orange	neutral/oil pressure
7	Black	left turn/high beam
8	Not used	n/a

Table 8-12. Indicator Lamp **Assembly Wiring**

INDICATOR LAMP	CONNECTION
Oil pressure	ground through switch
Neutral	ground through switch
High beam	12 VDC when active
Right/left turn	12 VDC when active



Figure 8-86. Indicator Lamp Assembly: All But FXSTD



- 2. Clips (2 pair) 3.
 - Connector [21]

Figure 8-87. Connector [21]

Softails are equipped with Light Emitting Diode (LED) indicators. The indicator lamp assembly is not serviceable. If one LED is bad, the entire assembly must be replaced.

See the Softail Models Electrical Diagnostic Manual for troubleshooting procedures.

REMOVAL

- 1. Remove seat.
- Remove instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- 3. See Figure 8-88. Remove wiring for indicator lamps from cable strap (2) on back of speedometer.
- 4. Detach indicator lamp connector (3) [21].
- 5. Disengage all four retention clips (1) to free indicator lamps (4) from lamp bezel.
- 6. Pull lamp bezel out from front side of console.

INSTALLATION

- 1. Push light bezel into console from front side.
- 2. See Figure 8-88. Secure the indicator lamps inside.
- 3. Fasten wiring for indicator lamps with cable strap (2).
- 4. Attach indicator lamp connector (3) [21].
- Install instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.



- 1. Retention clips (4) on lamp bezel
- 2. Cable strap
- 3. Indicator lamp connector [21]
- 4. Indicator lamps

Figure 8-88. Indicator Lamp Mounting: FXSTD

See Figure 8-89. The neutral switch is located on the transmission top cover. The two terminal switch is normally open. When the transmission shifter is in neutral and the ignition switch is in the IGNITION position, the switch causes the NEUTRAL indicator light to illuminate.

REMOVAL

CAUTION

Cover transmission top cover with masking tape while performing this task to prevent scratching chrome parts.

- For all models except FLSTSC, remove rear exhaust pipe. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/ FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/ FLSTF or 4.11 EXHAUST SYSTEM: FLSTN as appropriate.
- 2. Make sure transmission shifter is in NEUTRAL.
- See Figure 8-90. Using fingers, remove connectors from switch studs.
- 4. Using 7/8 in. box and open end wrench, remove neutral switch and O-ring from transmission top cover.

NOTE

To replace connectors, use heat-sealed butt splice connectors. See B.4 SEALED BUTT SPLICE CONNECTORS in the appendix.

INSTALLATION

NOTE

The transmission shifter must be in the NEUTRAL position when installing the switch to allow the bottom ball on the switch to engage the ramp on the shifter cam.

- 1. See Figure 8-90. Lubricate O-ring with transmission oil.
- 2. Install switch with O-ring to transmission top cover.
- 3. Tighten to 120-180 in-lbs (13.6-20.3 Nm).

NOTE

The neutral switch is not polarity sensitive, so either connector can be attached to either stud.

 Using fingers and a flat tip screwdriver, install connectors to switch studs.



Figure 8-89. Neutral Switch Location



Figure 8-90. Neutral Switch

- 5. Test neutral switch for proper operation.
 - a. Turn ignition switch to IGNITION position.
 - b. Verify that transmission shifter is in NEUTRAL.
 - c. Check to see that NEUTRAL indicator light illuminates.
- For all models except FLSTSC, install rear exhaust pipe. See 4.9 EXHAUST SYSTEM: FXST/FLST/FLSTC/ FXSTB/FXSTS, 4.10 EXHAUST SYSTEM: FXSTD/ FLSTF or 4.11 EXHAUST SYSTEM: FLSTN as appropriate.

See Figure 8-91. The oil pressure switch monitors oil pressure in the crankcase. If the oil pressure drops below 3 psi (20.6 kPa), the oil pressure switch is tripped and illuminates the low oil pressure indicator light. The oil pressure switch is located on the right side of the crankcase.

REMOVAL

- See Figure 8-91. Remove connector jumper (2) from oil pressure switch (1).
- Using a 15/16 in. open end wrench, remove switch (1) from crankcase.

INSTALLATION

NOTE

Perform step 1 only if original switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin at step 2.

- 1. Coat threads of oil pressure switch with LOCTITE PIPE SEALANT WITH TEFLON (PST).
- 2. See Figure 8-91. Install oil pressure switch (1) to crankcase.
- 3. Tighten switch to 96-144 in-Ibs (10.8-16.3 Nm).
- 4. Attach connector jumper (2) to oil pressure switch.
- 5. Test oil pressure switch for proper operation.

NOTES

If connector jumper (2) requires replacement, see B.4 SEALED BUTT SPLICE CONNECTORS in the appendix.



2. Connector jumper

Figure 8-91. Oil Pressure Switch

See Figure 8-92. The rear stop light switch monitors brake fluid pressure in the rear brake line. When pressure in the line reaches a preset level, the rear stop light switch is tripped and illuminates the tail light/stop light. The rear stop light switch is located on the rear brake line T-fitting.

REMOVAL

- 1. See Figure 8-92. Remove terminal boot (1) from rear stop light switch (4).
- Place a clean container under the rear stop light switch and brake line to catch escaping fluid.
- 3. Remove switch from rear brake line (5).

INSTALLATION

NOTES

See Figure 8-92. Rear brake line mounting fastener (6) torque is 80-100 **in-lbs** (9.0-11.3 Nm).

Perform step 1 only if original switch is being re-installed. New switches have a sealant contact patch on the threads. If new switch is being installed, begin at step 2.

- Coat threads of stop light switch with LOCTITE PIPE SEALANT WITH TEFLON (PST).
- See Figure 8-92. Install rear stop light switch (4) to rear brake line (5). Tighten switch to 12-15 ft-lbs (16.3-20.3 Nm).
- Align wire harness terminals in terminal boot (1) to terminals (3) by using alignment marks (2) as a guide.
- 4. Push terminal boot on to stop light switch.

AWARNING

After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a).

5. Bleed brake system. See 1.7 BLEEDING BRAKES.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

6. Check tail lamp/stop light for proper operation.



- 1. Terminal boot
- 2. Alignment marks
- 3. Terminals
- 4. Stop light switch
- 5. Rear brake line
- 6. Rear brake line mounting fastener

Figure 8-92. Rear Stoplight Switch

INSPECTION

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed or damaged wires leading to horn terminal, discharged battery or corroded ground.

The horn it is permanently sealed and non-repairable. Only the mounting hardware is replaceable.

NOTE No tonal adjustments may be made to this horn.

REPLACEMENT

- 1. See Figure 8-93. Remove nut (4) and washer (5) to detach horn bracket (6) from vehicle.
- 2. Disconnect wires from posts on back side of horn.
- Remove screws (8) and nut (10) to detach horn from bracket. Free wires from clamp (9).
- 4. Install new horn on bracket.
 - a. Secure with screws (8), and push nuts (3). Tighten screws to 35-55 in-lbs (4.0-6.2 Nm).
 - b. Install nut (10) and tighten to 80-100 in-lbs (9.0-11.3 Nm). Fold wires under clamp (9).
- 5. Attach wiring.
- Attach horn bracket to vehicle using washer (5) and nut (4). Tighten nut to 80-100 in-lbs (9.0-11.3 Nm). When tightening fasteners, be sure the horn does not contact the horn cover or other parts.



Figure 8-93. Horn

MAIN WIRING HARNESS

NOTE

See Appendix B for the main wiring harness schematic and a description of all connector locations.

NOTE

Disarm TSSM before removal.

1. Remove seat.

WARNING

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

- Disconnect battery cables, negative cable first. Remove battery.
- Remove rear inner fender to access electrical panel. See 8.4 ELECTRICAL PANEL.
- Remove instrument console. See 8.31 SPEEDOMETER: ALL BUT FXSTD or 8.32 SPEEDOMETER: FXSTD. This includes detaching speedometer connector [39] and indicator lamp connector [21].
- Remove fuel tank. See 4.7 FUEL TANK: CARBURETED. or 9.5 FUEL TANK: EFI. This includes detaching fuel gauge connector [117].
- See Figure 8-94. On all but FXSTD, remove push-in fastener (2) from rubber trim (1) on frame. Disconnect connectors:
 - a. MAP sensor connector [80].
 - b. Right handlebar controls [22].
 - c. Left handlebar controls [24].
 - d. Front turn signals [31].
 - e. Front fender tip lamp [32] (FLSTSC, FLSTC only).
 - f. Headlamp [38].
 - g. Spotlamp switch (if present).
 - h. Horn wires.
 - i. IAT sensor connector (EFI) [89].
 - j. ET sensor connector (EFI) [90].
 - k. IAC connector (EFI) [87].
 - I. TP sensor connector (EFI) [88].
 - m. Front [84] and rear [85] fuel injector connectors (EFI).
- Open clamps around harness along frame tubes. Cut cable strap from harness as necessary.
- 8. Disconnect connectors:
 - a. ignition control module connector [10] (carbureted models).
 - b. Electronic control module (EFI) [78].
 - c. Brake lamp switch.
 - d. Crank position sensor [79].

- 1. Rubber trim
- 2. Push-in fastener



Figure 8-94. Rubber Trim

- e.. Oil pressure switch [140].
- f. Starter solenoid.
- g. Tail lamp [7].
- h. TSM/TSSM connector. [30].
- i. Vehicle speed sensor [65].
- j. Main circuit breaker.
- 9. Detach data link connector [91A] from fuse block bracket.
- 10. Detach fuse block wiring
 - a. Remove fuse block bracket from frame.
 - Depress tab located on fuse block bracket and slide the fuse block out of the mounting slots. Repeat for other block.
- 11. Disconnect coil connector [83] and neutral indicator switch.
- Remove harness clips and any remaining cable straps. Disconnect all ground wires.
- Slowly remove harness from frame taking note of wire routings.

INSTALLATION

NOTE

Be sure to securely attach ground terminals to their proper frame locations and replace all cable straps.

- 1. Place harness wires into their original positions.
- 2. Attach the following connectors:
 - a. Brake lamp switch.
 - b. Crank position sensor [79].
 - c. Oil pressure switch [140].
 - d. Turn signal/turn signal security module [30].
 - e. Speedometer sensor connector [65].
 - f. Main circuit breaker.
 - g. Neutral indicator switch.
 - h. Starter solenoid.
 - i. Coil [83].
- 3. Install fuse and relay blocks on bracket.
- 4. See Figure 8-95. Attach connectors under seat.
 - a. Tail lamp [7].
 - b. Ignition control module connector [10] (carbureted models).
 - c. Electronic control module (EFI) [78].
 - d. Secure data link connector [91A] to frame.
- 5. Attach connectors under fuel tank trim.
 - a. MAP sensor connector [80].
 - b. Right handlebar controls [22].
 - c. Left handlebar controls [24].
 - d. Front turn signals [31].
 - e. Front fender tip lamp [32] (FLSTS, FLSTC only).
 - f. Headlamp [38].
 - g. Spotlamp switch (if present).
 - h. Horn wires.
 - i. IAT sensor connector (EFI) [89].
 - j. ET sensor connector (EFI) [90].
 - k. IAC connector (EFI) [87].
 - I. TP sensor connector (EFI) [88].
 - m. Front [84] and rear [85] fuel injector connectors (EFI).
- See Figure 8-96. Attach ground wires to frame in front of battery. Negative battery cable attaches to right side post (2).
- See Figure 8-94. On all but FXSTD, insert push-in fastener (2) into rubber trim (1) on frame.
- 8. Install rear inner fender over electrical panel. See 8.4 ELECTRICAL PANEL.
- Install fuel tank. See 4.7 FUEL TANK: CARBURETED. or 9.5 FUEL TANK: EFI.
- 10. Install instrument console. See 8.31 SPEEDOMETER: ALL BUT FXSTD. or 8.32 SPEEDOMETER: FXSTD.



- 2. Ignition control module [10]
- 3. Data link connector [91A]

Figure 8-95. Connectors Under Seat: Carbureted Shown



2. Ground wire and negative battery cable

Figure 8-96. Ground Wires and Negative Battery Cable

AWARNING

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

11. Install battery and connect battery cables, positive cable first.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

12. Install seat.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

- 13. Turn ignition ON. Test switches for correct operation.
 - a. Left and right turn signals, front and rear.
 - b. Four-way hazard warning flashers.
 - c. Rear brake lamp.
 - d. Headlamp.
 - e. Horn.
 - f. Indicator lamps.
 - g. Starter.
 - h. Speedometer.

The left handlebar switches include the headlamp HI - LO switch, horn and left turn signal switch. The right handlebar switches include the engine start and RUN - OFF switch and right turn signal switch. The individual switches are non-repairable and must be replaced if they malfunction.

NOTE

To replace or repair individual switches in either the right or left handlebar switch assemblies, see SWITCH REPAIR/ REPLACEMENT following the REMOVAL/INSTALLATION procedures.

REPAIR PROCEDURES

See 8.42 RIGHT HANDLEBAR SWITCH and 8.43 LEFT HANDLEBAR SWITCH. The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

The information below is useful when repairing handlebar switch assemblies.

- 1. To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 7.0 in. (177.8 mm) cable strap in kit.
- Strip 0.5 in. (12.7 mm) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.
- 3. Cut dual wall heat-shrink tubing, supplied in repair kit into 1.0 in. (25.4 mm) segments. Slide tubing over each wire of **new** switch assembly.
- Splice existing and new switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.
- 5. Center the heat-shrink tubing over the soldered splices.

WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

6. Using the UltraTorch UT-100 Robinair Heat Gun with heatshrink attachment or other suitable radiant heating device, uniformly heat the heat-shrink tubing to insulate and seal the soldered connections. Apply heat just until the meltable sealant exudes out both ends of tubing and it assumes a smooth cylindrical appearance.

CAUTION

Electrically connected solder outside the tubing may cause a short to ground.

7. Inspect the melted sealant for solder beads. Excess solder or heat may force some solder out with the melted sealant. Use a small needle nose pliers to remove any solder found. Briefly heat the connection to reseal the tubing if solder beads were removed. Use less solder or reduce heating time or intensity when doing subsequent splices.

RIGHT HANDLEBAR SWITCH

REMOVAL

NOTE

The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

CAUTION

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

- See Figure 8-97. Place the cardboard insert between the brake lever and lever bracket.
- Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the master cylinder housing. Remove the brake lever/master cylinder assembly and clamp from the handlebar.
- Using a T25 TORX drive head, remove the upper and lower switch housing screws.
- Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

- Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
- Remove the throttle control grip from the end of the handlebar.
- Pull the crimped inserts at the end of the throttle and idle control cable housings from the lower switch housing. For best results, use a rocking motion while pulling. Place a drop of light oil on the retaining rings, if necessary. Remove the cables from the switch housing.

INSTALLATION

 With the concave side facing upward, install the friction shoe so that the pin hole is over the point of the adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.



Figure 8-97. Install Cardboard Insert



3. Tension adjuster screw

Figure 8-98. Right Lower Switch Housing

- See Figure 8-98. Push the throttle and idle control cables into the lower switch housing until they snap in place. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.
 - Push the silver insert (2) of throttle cable housing into the hole in front of tension adjuster screw (3).
 - b. Push the gold insert (1) of idle cable housing into the hole at the rear of tension adjuster screw (3).



Figure 8-99. Route Cable to Upper Switch Housing

NOTE

To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.

- 3. See Figure 8-99. Route the cable (2) to the upper switch housing as shown.
- 4. Slide the throttle control grip over the end of the right handlebar until it bottoms against the closed end. Rotate the grip so that the ferrule notches are at the top. To prevent binding, pull the grip back about 1/8 inch (3.2 mm).
- 5. See Figure 8-100. Position lower switch housing beneath the throttle control grip. Install the brass ferrules (4) onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches (3) on the throttle control grip. Verify that the cables are captured in the grooves (2) molded into the grip.
- 6. Position the upper switch housing over the handlebar and lower switch housing.
- Verify that the wire harness conduit runs in the depression at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
- 8. Start the upper and lower switch housing screws, but do not tighten.

CAUTION

See Figure 8-101. Do not remove the 5/32 in. (4 mm) thick cardboard insert wedged between the brake lever and lever bracket. Removal will result in damage to the rubber boot and plunger of the front stoplight switch during installation of the master cylinder assembly.



Figure 8-100. Throttle Cable Installation



Figure 8-101. Leave Cardboard Insert in Place

- See Figure 8-102. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab (2) on the lower switch housing in the groove (3) at the top of the brake lever bracket.
- 10. Align the holes in the handlebar clamp with those in the master cylinder housing and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
- Using a T25 TORX drive head, tighten lower and upper switch housing screws to 35-45 in-lbs (4.0-5.1 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.

12. Remove the cardboard insert between the brake lever and lever bracket.

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

- 13. Test the switches for proper operation.
- If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4.0-5.0 in. (100-127 mm) from handlebar clamp. Cut any excess cable strap material.

DISASSEMBLY



See Figure 8-101. Do not remove the switch housing assembly without first placing a 5/32 in. (4 mm) cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the front stoplight switch.

- Place the cardboard insert between the brake lever and lever bracket.
- 2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
- If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
- See Figure 8-103. Using a T27 TORX drive head, loosen the upper screw (1) securing the handlebar clamp to the master cylinder housing. Remove the lower clamp screw with flat washer (2).



Figure 8-102. Switch Housing Alignment



Figure 8-103. Handlebar Clamp Screws

- Remove the brass ferrules from the notches on the inboard side of the throttle control grip. Remove the ferrules from the cable end fittings.
- 6. Remove the friction shoe from the end of the tension adjuster screw.

NOTE

The friction shoe is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

Remove the throttle control grip from the end of the handlebar.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

- See Figure 8-104. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove the bracket and switch assembly from the housing.
- Move cable conduit (3) from beneath wing of bracket. Cut wires 0.25 in. (6.4 mm) from old switches (1, 2). Discard old switch and bracket assembly.
- Slide conduit forward over cut ends of switch wires and cut off 0.5 in. (12.7 mm) of conduit (3) material. Push conduit back to access switch wires.
- Separate new engine stop switch (2) and engine start switch (1) wires into two bundles.

NOTE

Replacement stop switch and start switch wires are cut to length (2.5 in./63.5 mm and 2.0 in./50.8 mm, respectively) and partially stripped.

- 5. See 8.41 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
- Loop switch wires so that spliced lengths are positioned as shown in Figure 8-105. Route wires downstream of splices beneath wing on engine stop switch side of bracket as seen in Figure 8-104.
- See Figure 8-105. Install a new 7.0 in. (177.8 mm) cable strap (5) beneath wing on engine start switch side (1) of bracket and capture wire splices (4).
- 8. Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
- See Figure 8-104. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on engine stop switch (2) side of bracket captures edge of conduit (3) as shown.
- Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
- 11. Continue with ASSEMBLY on page 8-82.



5. Bracket

Figure 8-104. Upper Housing Without Splices



Figure 8-105. Upper Housing With Splices
Lower Housing Repair

- 1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
- Remove the screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.

TURN-RIGHT SIGNAL SWITCH

 Cut wire 1.5 in. (38.1 mm) from old switch. Discard old switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length (1.5 in./38.1 mm) and partially stripped.

- See 8.41 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
- 3. Continue with ASSEMBLY on page 8-82.

FRONT STOPLIGHT SWITCH

- Carefully remove the wedge between the switch and switch housing, if present. To remove the switch from the housing, depress the plunger and slowly rotate switch upward while rocking slightly.
- Cut wires 1.0 in. (25.4 mm) from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length (2.5 in./ 63.5 mm) and partially stripped.

- 3. See 8.41 HANDLEBAR SWITCH ASSEMBLIES for information on repair practices.
- 4. Carefully depress plunger against inside wall of switch housing. With thumb over plunger bore, move switch into the installed position in the switch housing cavity. When plunger is positioned against thumb, slowly rotate switch downward while rocking slightly. Release the plunger only after switch is properly positioned in the cavity.
- Verify that the plunger is square in the bore and that the boot is not compressed, collapsed or torn. If necessary, gently work the plunger in and out until boot is fully extended.



Figure 8-106. Install Stoplight Switch

- See Figure 8-106. Push down on switch (1) so that it bottoms against housing and wires (3) run in groove at base of cavity. With the concave side facing outward, insert wedge (2) between switch and outboard side of switch housing.
- Push wedge down until it also bottoms against housing. Verify that the plunger is still square in the bore and then place a drop of RTV Silicone Sealant on upper corner of wedge.
- 8. Continue with ASSEMBLY on page 8-82.

ASSEMBLY

 See Figure 8-107. Insert tapered end of new 7.0 in. (177.8 mm) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

- Place the turn signal switch assembly into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
- Start screw with lockwasher to secure bracket inside housing.

CAUTION

If routed incorrectly, wires may be pinched by casting or handlebar resulting in switch failure.

- 4. Loop switch wires so that spliced lengths are positioned across bracket.
- Capturing conduit about 0.25 in. (6.4 mm) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
- Install second 7.0 in. (177.8 mm) cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.
- 7. Tighten screw to secure bracket inside housing.
- Route wire bundle to upper switch housing by gently pressing conduit into channel next to angular arm of bracket. Secure bundle to arm using third cable strap. Cut any excess cable strap material. If necessary, bend angular arm of bracket downward to firmly secure front stoplight switch in position.
- 9. See INSTALLATION on page 8-77.
 - a. If lower housing switches were replaced, perform the whole procedure.
 - b. If upper housing switches were replaced, begin with step 11.



3. Right turn signal switch



LEFT HANDLEBAR SWITCH

REMOVAL

NOTE

The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.

- 1. Using a T27 TORX drive head, remove the two screws with flat washers securing the handlebar clamp to the clutch lever bracket. Remove the clutch hand lever assembly and clamp from the handlebar.
- 2. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
- 3. Remove the grip sleeve from the end of the handlebar if damaged.

INSTALLATION

- 1. If the grip sleeve was removed, thoroughly clean handlebar to remove all adhesive residue. Pour adhesive into new grip. Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.
- 2. See Figure 8-108. Install upper and lower switch housings on handlebar. Be sure that ribs (2) on outboard side of switch housings fit in grooves (3) molded into grip.
- 3. Verify that the wire harness conduit runs in the groove at the bottom of the handlebar. Be sure that the upper switch housing harness will not be pinched under the handlebar when the switch housing screws are tightened.
- 4. Start the upper and lower switch housing screws, but do not tighten.
- 5. See Figure 8-109. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab (3) on the lower switch housing in the groove (2) at the bottom of the clutch lever bracket.
- 6. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the two screws (with flat washers). Position for rider comfort. Beginning with the top screw, tighten screws to 60-80 in-lbs (6.8-9.0 Nm) using a T27 TORX drive head.
- 7. Using a T25 TORX drive head, tighten lower and upper switch housing screws to 35-45 in-lbs (4.0-5.1 Nm).

NOTE

Always tighten the lower switch housing screw first so that any gap between the upper and lower housings is at the front of the switch.



Figure 8-108. Left Handlebar Switch Housings



- 1.
- Groove 2.
- Tab 3.
- Switch housing assembly 4.

Figure 8-109. Clutch Lever Bracket

AWARNING

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

- Test the switches for proper operation. 8.
- If necessary, secure wire harness conduit to handlebar 9. using new cable strap. Position cable strap approximately 4-5 in. (100-127 mm) from handlebar clamp. Cut any excess cable strap material.

DISASSEMBLY

- 1. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
- If replacing lower housing switches, perform step 3 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
- Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the clutch lever bracket. Remove the lower clamp screw with flat washer.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

Replace the horn switch and high/low beam switch as a single assembly even if only one switch is determined to be faulty.

- 1. See Figure 8-110. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
- Move cable conduit (3) from beneath wing of bracket. Cut wires 0.25 in. (6.4 mm) from old switches (1, 2). Discard old switch and bracket assembly.
- 3. Slide conduit forward over cut ends of switch wires and cut off 0.5 in. (12.7 mm) of conduit (3) material. Push conduit back to access switch wires.
- 4. Separate the **new** horn switch (1) and high/low beam switch (2) wires into two bundles.

NOTE

Replacement high/low beam switch and horn switch wires are cut to length (2.5 in./63.5 mm and 2.0 in./50.8 mm, respectively) and partially stripped.

- 5. See 8.41 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
- Loop switch wires so that spliced lengths are positioned as shown in Figure 8-111. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as seen in Figure 8-110.
- See Figure 8-111. Install a new 7.0 in. (177.8 mm) cable strap (5) beneath wing on horn switch side (1) of bracket and capture wire splices (4).
- Place switch assembly into upper housing aligning hole in bracket with threaded hole in boss. Be sure that bracket is fully seated. The step at the edge of the boss captures the bottom edge of the bracket, while tabs on each side of the bracket fit in slots cast into the housing.
- See Figure 8-110. Install screw and lockwasher (4) to secure bracket (5) inside housing. Verify that wing on high/low switch (2) side of bracket captures edge of conduit (3) as shown.
- 10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
- 11. Continue with ASSEMBLY on page 8-85.



5. Bracket

Figure 8-110. Upper Housing Without Splices



Figure 8-111. Upper Housing With Splices

Lower Housing Repair

- 1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
- Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
- Cut wires 1.5 in. (38.1 mm) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.
- 4. See 8.41 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
- 5. Continue with ASSEMBLY which follows.

ASSEMBLY

 See Figure 8-112. Insert tapered end of new 7.0 in. (177.8 mm) cable strap (1) into round hole in turn signal switch bracket (2) and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

NOTE

Be sure that all splices are positioned above the turn signal switch bracket.

- Place the turn signal switch assembly (3) into the housing, aligning the oblong hole in the bracket with the threaded hole in the boss. Be sure that the bracket is fully seated. Tabs on each side of bracket are captured in slots cast into switch housing.
- Start screw with lockwasher to secure bracket inside housing.
- Loop switch wires so that spliced lengths are positioned across bracket.
- Capturing conduit about 0.25 in. (6.4 mm) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
- 6. Tighten screw to secure bracket inside housing.
- Route wire bundle to upper switch housing below and then forward of the main wire harness, positioning conduit in channel next to angular arm of bracket. Secure bundle to arm using **new** cable strap. Cut any excess cable strap material.
- 8. See INSTALLATION on page 8-83.
 - If lower housing switches were replaced, perform the whole procedure.
 - b. If upper housing switches were replaced, begin with step 7.



Figure 8-112. Insert Cable Strap in Switch Bracket

NOTES

SUBJECT

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FUEL INJECTION

9

-

Table 9-1. Spark Specifications

IGNITION	DATA	
Idle speed	1000 ± 50 RPM	
Spark plug size	12 mm	
Onesti alum and	0.038-0.043 in	
Spark plug gap	0.97-1.09 mm	
Spark plug type	Harley-Davidson No. 6R12 (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 9-2. Circuit Breaker/Fuse Specifications

ITEM	RATING (AMPERES)
Main circuit breaker	30
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Gauges fuse	15
Security fuse	15
Fuel pump fuse	15
ECM power fuse	15

TORQUE VALUES

ITEM	TOR	QUE	NOTES
Air cleaner cover screw	36-60 in-lbs	4.1-6.8 Nm	LOCTITE THREADLOCKER 243 (blue), page 9-6
Air filter bracket screws	40-60 in-lbs	4.5-6.8 Nm	T27 TORX, page 9-6
Breather bolts	120-144 in-lbs	13.6-16.3 Nm	metric, page 9-6
Electronic control module (ECM) nuts	30-35 in-lbs	3.4-4.0 Nm	FXSTDI, page 9-13
Electronic control module (ECM) screws	30-40 in-lbs	3.4-4.5 Nm	all but FXSTI/FXSTBI/FXSTSI/FXSTDI, page 9-13
Engine temperature sensor	10-15 ft-lbs	13.6-20.3 Nm	hand start 2-3 turns, page 9-17
Fuel gauge sending unit plate screws	18-22 in-lbs	2.0-2.5 Nm	page 9-32

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.

Table 9-3. Charging Specifications

ITEM	DATA	
Battery	19 amp hour/270 CCA	
Alternator AC voltage output	16-20 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	34-38 amps	

ITEM	TORQUE		NOTES
Fuel level sending unit screw	25-45 in-lbs	2.8-5.1 Nm	page 9-29
Fuel supply tube fastener	90-110 in-lbs	10.2-12.4 Nm	page 9-24
Fuel tank acorn nut	28-32 ft-lbs	38.0-43.4 Nm	FXSTDI, page 9-12
Fuel tank check valve	22-26 ft-lbs	29.8-35.2 Nm	page 9-9, page 9-10
Fuel tank console nut	80-100 in-lbs	9.0-11.3 Nm	all but FXSTDI, page 9-12
Fuel tank front screw	28-32 ft-lbs	38.0-43.4 Nm	all but FXSTDI, page 9-11
Fuel tank quick connect fitting	18 ft-lbs	24.4 Nm	page 9-31
Fuel tank rear bolt	18-22 ft-lbs	24.4-29.8 Nm	T40 TORX ,all but FXSTDI, page 9-11
Fuel tank rear mounting nut	14-18 ft-lbs	19.0-24.4 Nm	FXSTDI, page 9-12
Intake air temperature sensor fastener	15-20 in-lbs	1.7-2.3 Nm	page 9-15
Intake manifold mounting screws	96-144 in-lbs	10.8-16.3 Nm	page 9-20
Throttle cable bracket fasten- ers	20-35 in-lbs	2.3-4.0 Nm	use new screws, page 9-21, page 9-22
Throttle position sensor fasten- ers	18 in-Ibs	2.0 Nm	page 9-14

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 temperature sensor (ET).
- 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). Both include an integrated bank angle sensor (BAS).
- Ignition coil.

The ECM is mounted below the seat. It computes the spark advance for proper ignition timing based on sensor inputs (from CKP, MAP and TP) and regulates the low-voltage circuits between battery and ignition coil.

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 in the front left side of the crankcase. 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 30 teeth on the left side flywheel (two teeth are missing to establish a reference point).

The MAP sensor is located on top of the 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 curve 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, ET and TP sensors are used to provide information to the ECM to fine tune spark and fuel delivery. The VSS is used as an input for idle speed control.

For Information on Related Topics See:

- 8.8 CRANK POSITION SENSOR (CKP)
- 8.10 IGNITION COIL
- 8.26 TURN SIGNAL/TURN SIGNAL SECURITY MOD-ULE
- 8.28 FUEL GAUGE
- 8.33 VEHICLE SPEED SENSOR: VSS

TROUBLESHOOTING

See the Softail Models Electrical Diagnostic Manual for troubleshooting and diagnostic information.



Figure 9-1. EFI System Circuit

Idle speed can only be set using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). See your dealer.

AIR CLEANER: EFI

REMOVAL

- See Figure 9-2. Remove screw (1) and air cleaner cover (2).
- Remove three TORX screws (4) and bracket (5) from filter element (6).
- Gently pull both rubber breather tubes (9) from the back of the element. Remove filter element (6) and gasket (7).
- Replace the filter element if damaged or if filter media cannot be adequately cleaned.
- 5. Gently pull breather tubes (9) from breather bolts (10) on the backplate.
- 6. Check filter element. See 1.22 AIR CLEANER FILTER.
- Inspect seal ring (3) for cracks or tears. Verify that it seals tightly to backplate. Replace as required.
- Alternately back out both breather bolts (10) (metric) a few turns a time while pulling backplate (8) away from induction module.
- Continue previous step until breather bolts are clear. Remove backplate (8), O-rings (11) and gasket (12). Discard gasket.
- 10. Wipe inside of air cleaner cover (2) and backplate (8) with damp cloth to remove dust.

INSTALLATION

- See Figure 9-2. Position **new** gasket (12) and two **new** O-rings (11) on backplate. Insert two breather bolts (10) (metric) into backplate. Thread bolts loosely into each cylinder head. Final tighten bolts to 120-144 **in-lbs** (13.6-16.3 Nm).
- Insert two breather tubes (9) into the holes in back of the filter element. Place the element back into position and attach breather tubes to breather bolts.
- 3. Install air filter element (6) and bracket (5).
 - Make sure gasket (7) holes are aligned with backplate holes.
 - b. Use three TORX screws (4) to secure bracket and filter element. Tighten to 40-60 in-lbs (4.5-6.8 Nm).
- 4. Install air filter cover (2).
 - a. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to threads of air cleaner cover screw (1).
 - Install screw to secure air cleaner cover. Tighten to 36-60 in-lbs (4.1-6.8 Nm).



Figure 9-2. Air Cleaner Assembly

FUEL TANK: EFI

GENERAL

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

The fuel tank is treated to resist rusting. However, when the motorcycle is not operated for a long period of time, see 1.31 STORAGE for specific information regarding fuel tank treatment.

For information on the tank-mounted fuel gauge, see 8.28 FUEL GAUGE and Softail Models Electrical Diagnostic Manual

REMOVAL

AWARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

- 1. Remove seat.
- 2 Remove fuse block cover.
- 3. Purge the fuel supply line of high pressure gasoline.
 - a. See Figure 9-3. Disconnect the fuel pump fuse from the main wiring harness.
 - 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.

AWARNING

Gasoline can drain from guick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

4. See Figure 9-4. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line (2) to disconnect.



Figure 9-3. Fuel Pump Fuse: View From Top



Fuel supply line

Figure 9-4. Fuel Supply Line Fitting

WARNING

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

- 5. Disconnect negative battery cable.
- 6. Remove instrument console.
 - All but FXSTDI, see Figure 9-5. Remove acorn nut (1) and washer (2) on instrument console to separate console from fuel tank.
 - b. For FXSTDI, see 8.30 INSTRUMENT CONSOLE: FXSTD.
- 7. Disconnect console wiring.
- See Figure 9-6. Unplug fuel pump module connector [86].

AWARNING

Gasoline can drain from the crossover line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00259a)

- 9. Drain fuel tank.
 - Obtain a short section of hose (5/16 inch I.D.). Insert bolt in one end of hose and install hose clamp to ensure that end is securely plugged.
 - b. Cut clamp from one end of crossover hose). Quickly replace crossover hose on fuel tank fitting with open end of short hose while directing flow of gasoline from free end of crossover hose into suitable container.
- 10. All but FXSTDI. Remove fuel tank.
 - a. See Figure 9-8. Remove the rear T40 TORX screw and washer (7).
 - b. Remove the acorn nut (6), washers (2), and front mounting screw (1).
 - c. Remove continuous vent line (12) from nipple on front of tank.
 - d. See Figure 9-7. Disconnect fuel gauge connector [117] located under left side of fuel tank.
 - e. See Figure 9-8. Remove fuel tank from motorcycle. Remove rubber trim (13) to access connectors along frame. Remove bushings and grommets (3) if necessary.
- 11. FXSTDI. Remove fuel tank.
 - a. See Figure 9-9. Remove nut and washer (14) on rear mounting tab.
 - b. Remove the acorn nut (6), washers (2), and front mounting screw (1).
 - c. Remove continuous vent line (12) from nipple on front of tank.
 - d. See Figure 9-7. Disconnect fuel gauge connector [117] located under left side of fuel tank.
 - e. Remove fuel tank from motorcycle.



Figure 9-5. Instrument Console: All But FXSTDI



Figure 9-6. Fuel Pump Module Connector



Figure 9-7. Fuel Gauge Connector Location



Figure 9-8. Fuel Tank: EFI, All But FXSTDI



CLEANING AND INSPECTION

- 1. Remove fuel pump. See 9.14 FUEL PUMP/FUEL GAUGE SENDING UNIT.
- 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

All fuel are must be removed before repairing tank. An open flame can cause a tank explosion which could result in death or serious injury.

- Inspect the interconnect lines, evaporative emissions system vent line (California models) and fuel line for cuts, cracks or holes. Replace lines as needed.
- Inspect the tank for leaks and other damage. If a damaged tank cannot be successfully repaired, replace it.
- Install fuel pump. See 9.14 FUEL PUMP/FUEL GAUGE SENDING UNIT.





INSTALLATION

All But FXSTDI

- See Figure 9-8. Install continuous vent line (12) to nipple on front of tank. Make sure vent line runs along right side of frame backbone under rubber trim (13).
- 2. See Figure 9-7. Connect the fuel gauge connector [117] located under left side of fuel tank.
- 3. Attach tank mounts.
 - a. See Figure 9-8. Place a washer (2) over front screw (1). Starting on left side, loosely install screw and washer through tank, bushings and grommets (3) and frame. Place washer (2) and acorn locknut (6) on right side.
 - b. See Figure 9-10. Verify that rubber grommet (5) and metal insert (6) are protruding through frame (4). Metal insert has flats on bottom for positioning. Place rubber ring (3) around grommet/insert and lower fuel tank tab (2).
 - Install washer and rear T40 TORX screw (1) through fuel tank tab. Tighten to 18-22 ft-lbs (24.4-29.8 Nm).
 - Tighten the front screw to 28-32 ft-lbs (38.0-43.4 Nm).

- 4. See Figure 9-8. Connect crossover line (5) with new clamps (4).
- See Figure 9-4. Connect fuel supply line (2). 5.
- 6. See Figure 9-6. Connect fuel pump module connector [86].
- Install instrument console wiring. 7.
- 8. See Figure 9-5. Install instrument console with acorn nut and washer. Tighten to 80-100 in-lbs (9.0-11.3 Nm).
- 9. See Figure 9-3. Connect the fuel pump fuse to the main wiring harness.
- 10. Connect negative battery cable.
- 11. Fill tank with gasoline and check for leaks.

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

12. Install seat.

FXSTDI

- 1. See Figure 9-9. Install continuous venting system vent line (12) to nipple on front of tank. Make sure vent line runs along right side of frame backbone.
- 2. See Figure 9-7. Connect the fuel gauge connector [117] located under left side of fuel tank.
- 3 Attach tank mounts.
 - a. Place a washer over front screw. Starting on left side, loosely install screw and washer through tank, bushings and grommets and frame. Place washer and acorn locknut on right side.
 - See Figure 9-11. Align end of tank over stud (3) on b. frame. Install nut and washer. Tighten to 14-18 ft-lbs (19.0-24.4 Nm).
 - See Figure 9-9. Tighten acorn nut (6) to 28-32 ft-lbs C (38.0-43.4 Nm).
- Connect crossover line with new clamps. 4.
- Connect fuel gauge connector [117] located under left 5. side of fuel tank.
- See Figure 9-6. Connect fuel pump module connector. 6.
- 7. See Figure 9-4. Connect fuel supply line (2).



- Mount
- 3. Stud

Figure 9-11. Rear Mount: FXSTDI

- Install instrument console. See 8.30 INSTRUMENT CONSOLE: FXSTD.
- See Figure 9-3. Connect the fuel pump fuse to the main 9. wiring harness.
- 10. Connect negative battery cable.
- 11. Fill tank with gasoline and check for leaks.

WARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

12. Install seat.

The electronic control module (ECM) is mounted under the seat. Refer to the Softail Models 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

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- Remove electronic control module from mounting bracket.
 - a. For all but FXSTI/FXSTBI/FXSTSI/FXSTDI, see Figure 9-12. Remove four screws (2) holding ECM to mounting bracket. Depress latch on connector [78] and disconnect from ECM.
 - For FXSTI/FXSTBI/FXSTSI/FXSTDI, see Figure 9-13. Remove four nuts and washers holding ECM to mounting bracket. Depress latch on connector [78] and disconnect from ECM.

INSTALLATION

- 1. Attach ECM connector [78] to ECM.
- 2. Install ECM on mounting bracket.
 - For all but FXSTI/FXSTBI/FXSTSI/FXSTDI, see Figure 9-12. Install four screws (2) that secure ECM to mounting bracket. Tighten to 30-40 in-lbs (3.4-4.5 Nm).
 - For FXSTI/FXSTBI/FXSTSI/FXSTDI, see Figure 9-13. Install four nuts and washers that secure ECM to mounting bracket. Tighten to 30-35 in-Ibs (3.4-4.0 Nm).
- 3. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

4. Install seat.

NOTE

After installing ECM, the password learning procedure must be performed. See PASSWORD LEARNING under 8.26 TURN SIGNAL/TURN SIGNAL SECURITY MODULE.



Figure 9-12. ECM Mount: All But FXSTI/FXSTBI/FXSTSI/ FXSTDI



Figure 9-13. ECM Mount: FXSTI/FXSTBI/FXSTSI/FXSTDI

THROTTLE POSITION SENSOR (TP)

GENERAL

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the throttle position sensor (TP sensor).

REMOVAL

1. Remove seat.

AWARNING

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

- 2. Disconnect negative battery cable.
- Remove air cleaner back plate. See 9.4 AIR CLEANER: EFI.
- See Figure 9-14. Unplug TP sensor connector [88].
- Remove two fasteners to detach TP sensor from throttle body. discard fasteners.

INSTALLATION

NOTE

- Throttle must be closed for proper installation of throttle position sensor.
- See Figure 9-15. Inspect O-ring (2) in groove of throttle position sensor for cuts, tears or signs of deterioration. Install new O-ring if necessary.
- Fit pocket (3) of throttle position sensor over throttle shaft while engaging index pin (1) with hole on machined flange of induction module
- Install two new fasteners (4) to fasten throttle position sensor to induction module. Tighten screws to 18 in-Ibs (1.7-2.3 Nm)
- Using the throttle lever mechanism, open and close the throttle plates to check for proper operation. Be sure that the mechanism operates smoothly without binding or sticking.
- 5. Connect TP sensor connector [88].
- Install air cleaner assembly. See 9.4 AIR CLEANER: EFI.
- 7. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat.



Figure 9-14. Throttle Position Sensor



Figure 9-15. Throttle Position Sensor Installation

INTAKE AIR TEMPERATURE SENSOR (IAT)

GENERAL

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the intake air temperature sensor (IAT sensor).

REMOVAL

1. Remove seat.

WARNING

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

- 2. Disconnect negative battery cable.
- Remove air cleaner back plate. See 9.4 AIR CLEANER: EFI.
- 4. See Figure 9-16. Unplug IAT sensor connector [89].
- 5. Remove fastener to detach IAT sensor. Discard fastener.

INSTALLATION

- See Figure 9-17. Inspect O-ring (1) in groove of intake air temperature sensor for cuts, tears or signs of deterioration. Install new O-ring if necessary.
- See Figure 9-16. Insert sensor into induction module with electrical connector facing toward the left side of the motorcycle.
- See Figure 9-17. Install fastener (2) and tighten to 15-20 in-lbs (1.7-2.3 Nm).
- 4. Connect IAT sensor connector [89].
- 5. Install air cleaner assembly. See 9.4 AIR CLEANER: EFI.
- 6. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

7. Install seat.



Figure 9-16. Intake Air Temperature Sensor Location



Figure 9-17. Intake Air Temperature Sensor

AWARNING.

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the engine temperature sensor (ET sensor).

REMOVAL

1. Remove seat.

AWARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

- 2. Purge the fuel supply line of high pressure gasoline.
 - a. See Figure 9-18. Disconnect the fuel pump fuse from the main wiring harness.
 - Start the engine and allow the vehicle to run. b.
 - When the engine stalls, operate the starter for 3 sec-C onds to remove any remaining fuel from the fuel lines.

WARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

3. See Figure 9-19. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line (2) to disconnect.

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Figure 9-18. Fuel Pump Fuse: View From Top



- 2. Fuel supply line

Figure 9-19. Fuel Supply Line Fitting

AWARNING

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

4. Disconnect negative battery cable.

NOTE

On some models, horn may have to be removed to ease removal/installation.

- See Figure 9-20. Pull back boot to reveal ET sensor at back of front cylinder.
- Unplug ET sensor connector [90] by pulling external latch outward and using rocking motion to remove.
- 7. See Figure 9-21. Loosen ET sensor using socket. When sensor starts to turn easily, finish removing by hand.

INSTALLATION

- Hand start new ET sensor into cylinder head bore 2-3 turns.
- 2. Tighten sensor to 10-15 ft-lbs (13.6-20.3 Nm).
- 3. Connect ET sensor connector [90].
- 4. Pull boot over connector.
- 5. See Figure 9-19. Install fuel line fitting.
- 6. See Figure 9-18. Install fuel pump fuse.
- 7. Connect negative battery cable.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

8. Install seat.



Figure 9-20. Engine Temperature Sensor



Figure 9-21. Engine Temperature Sensor Removal

REMOVAL

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

1. On all but FXSTDI, gain access to the induction module by removing fuel tank hardware and fuel line. Carefully pivot tank upward and prop in position. See 9.5 FUEL TANK: EFI.

- 2. On FXSTDI, remove fuel tank See 9.5 FUEL TANK: EFI.
- 3. Remove air cleaner back plate. See 9.4 AIR CLEANER: EFI.
- 4. See Figure 9-22. Pull purge hose from fitting (5) at top of induction module (California models only).
- 5. See Figure 9-23. Pull idle cable barrel (1) from upper hole in throttle wheel. Pull throttle cable barrel (2) from lower hole. Using slots, release idle and throttle cables from guides in throttle cable bracket.
- See Figure 9-22. Remove idle air control connector (3) [87] and manifold absolute pressure sensor connector (7) [80].



Figure 9-22. Induction Module

- Remove front fuel injector connector (1) [84] and rear fuel injector connector (8) [85].
- Remove throttle position sensor connector (4) [88] and intake air temperature sensor connector (6) [89].
- 9. On left side of vehicle, loosen two hex screws holding front and rear mounting flanges (9, 11) to cylinder head.
- 10. On right side of vehicle, remove two Allen screws holding front and rear mounting flanges to cylinder head. Remove induction module from vehicle.

AWARNING

Gasoline can drain from the fuel line when disconnected from induction module. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00269a)

- See Figure 9-24. If fuel supply line (2) is being replaced, depress tab (1) and pull to release from fuel supply tube (3).
- 12. Remove seals from flange adapters. Discard seals. Remove flange adapters from outlet ports of induction module



Figure 9-23. Throttle/Idle Cables

INSTALLATION

1. See Figure 9-22. Place a **new** seal in each mounting flange (9, 11) with the beveled side in against the counterbore.

NOTE

When induction module is positioned on manifold mounting screws, be sure the mounting flanges are installed correctly on the manifold. Be sure the rubber seals are in place.

- Place intake manifold seal, flanges, and induction module in position. Install the manifold mounting screws finger tight.
- See Figure 9-24. Slide fuel supply line (2) onto fuel supply tube (3).
- 4. See Figure 9-23. Install sleeve on throttle cable housing into cable guide at top of throttle cable bracket (4). Drawing throttle cable downward, fit barrel end (2) into lower hole in throttle wheel (3). Install sleeve and spring on idle cable housing into cable guide at bottom of throttle cable bracket inserting barrel end (1) into upper hole in throttle wheel.
- 5. See Figure 9-22. On California models, attach purge hose to fitting (5) on throttle body.
- Connect front (1) and rear (8) fuel injector connectors, IAC (3) connector, MAP sensor (7) connector, TP sensor (4) connector and IAT (6) sensor connector.
- 7. Install air cleaner back plate. See 9.4 AIR CLEANER: EFI.
- Tighten manifold mounting screws to 96-144 in-Ibs (10.8-16.3 Nm).
- Turn the Ignition/Light Key Switch to ON and then back to OFF to reset idle air control to park position.
- 10. Install air cleaner filter and cover.
- 11. Secure fuel tank. See 9.5 FUEL TANK: EFI.
- 12. Check throttle and idle cable adjustment.



Figure 9-24. Fuel supply line

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the idle air control (IAC).

REMOVAL

- Remove induction module. See 9.10 INDUCTION MOD-1. ULE.
- 2. See Figure 9-25. Remove two fasteners (2) to release throttle cable bracket (1) from induction module. Discard fasteners.
- See Figure 9-26. Pull IAC (1) and o-ring (2) from throttle 3 body.

INSTALLATION

- See Figure 9-26. Apply clean engine oil to IAC o-ring (2). 1. Install o-ring in counterbore of induction module.
- With the electrical connector facing the rear left side of 2. the induction module, install idle air control into bore.
- 3. Place idle air control and o-ring into throttle body. Be sure o-ring is properly seated in throttle body groove.
- 4. See Figure 9-27. Insert index pin (2) at bottom of throttle cable bracket (1) into hole in boss at top of induction module.
- See Figure 9-25. Install new throttle cable bracket fas-5. teners (2). Tighten to 20-35 in-lbs (2.3-4.0 Nm).
- 6. Install induction module. See 9.10 INDUCTION MOD-ULE.



- 1.
- 2. Fasteners
- 3. Idle air control (IAC)

Figure 9-25. Idle Air Control Location



Figure 9-26. Idle Air Control



Figure 9-27. Throttle Cable Bracket

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the manifold absolute pressure sensor (MAP).

REMOVAL

- 1. Remove induction module. See 9.10 INDUCTION MOD-ULE.
- See Figure 9-28. Remove two fasteners (2) to release throttle cable bracket (1) from induction module. Discard fasteners.
- 3. Using appropriate tool, gently push up on MAP sensor and attached seal to remove from intake manifold.

INSTALLATION

NOTE

See Figure 9-29. If the original sensor is re-installed, the seal (1) must be inspected. Seals not in good condition could cause vacuum leaks. Install **new** seal if necessary

- 1. Push MAP sensor and seal into intake manifold.
- With the electrical connector facing toward the rear of the induction module (side opposite throttle wheel), insert MAP sensor into hole in induction module.
- See Figure 9-30. Insert index pin (2) at bottom of throttle cable bracket into hole in boss at top of induction module.
- See Figure 9-28. Install new throttle cable bracket fasteners (2). Tighten to 20-35 in-Ibs (2.3-4.0 Nm).
- 5. Install induction module. See 9.10 INDUCTION MOD-ULE.



- 1. Throttle cable bracket
- 2. Fasteners
- 3. Manifold Absolute Pressure Sensor (MAP)

Figure 9-28. Throttle Cable Bracket Location



Figure 9-29. MAP Sensor



Figure 9-30. Throttle Cable Bracket

FUEL INJECTORS

GENERAL

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the fuel injectors.

REMOVAL

1. Remove induction module. See 9.10 INDUCTION MOD-ULE.

NOTE

If not replacing fuel supply tube or o-rings, do not remove.

- 2. See Figure 9-31. Remove fastener (1) retaining fuel supply tube (2).
- Pull fuel supply tube from fuel rail. Remove sealing washer (4) and o-ring (3) from fuel supply tube. Remove second o-ring from fuel rail bore. Discard sealing washer and o-rings.
- See Figure 9-32. Pull fuel injectors with attached fuel rail from induction module. To overcome the resistance of the bottom o-ring on both fuel injectors, gently rock assembly back and forth while pulling.
- See Figure 9-33. Remove spring clips (2) from fuel injectors. Pull fuel injectors from fuel rail. To overcome the resistance of the top o-ring, gently rock each fuel injector while pulling.
- 6. Remove o-rings (1) from fuel injectors. Discard O-rings.



Figure 9-31. Fuel Supply Tube



Figure 9-32. Fuel Rail

INSTALLATION

- 1. See Figure 9-33. Apply a thin coat of clean engine oil to **new** fuel injector o-rings (1). Install on fuel injectors.
- 2. See Figure 9-32. Push electrical connector side of fuel injectors into fuel rail.
- With the concave side toward the fuel rail, install spring clip into slot on fuel injector. In the installed position, openings (3) in sides of clip engage lip (2) on fuel rail, while fork (1) at back of clip captures rail tab (4) on fuel injector.
- Rotate fuel injectors, so that the electrical connectors are on the outboard side. Push fuel injectors into induction module bores until tab on fuel rail engages machined slot at top of induction module.
- See Figure 9-31. Slide **new** o-ring (3) down shorter neck of the fuel supply tube until it contacts the collar. Slide **new** sealing washer (4) down tube until it contacts o-ring. Install second o-ring (3) in fuel rail bore.
- Push fuel supply tube (2) into fuel rail bore until clamp is seated on round step of fuel rail. Install fastener (1) and tighten to 90-110 in-lbs (10.2-12.4 Nm).
- 7. Install induction module. 9.10 INDUCTION MODULE.



Figure 9-33. Fuel Injector

AWARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the fuel pump.

REMOVAL

1. Remove seat.

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

- 2. Purge the fuel supply line of high pressure gasoline.
 - a. See Figure 9-34. Disconnect the fuel pump fuse from the main wiring harness.
 - 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.

AWARNING

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

- 3. Disconnect negative battery cable.
- 4. Remove instrument console.
 - All but FXSTDI, see Figure 9-35. Remove acorn nut and washer on instrument console to separate console from fuel tank.
 - b. For FXSTDI, see 8.30 INSTRUMENT CONSOLE: FXSTD.
- 5. Disconnect console wiring.

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Figure 9-34. Fuel Pump Fuse: View From Top



Figure 9-35. Acorn Nut And Washer: All But FXSTDI

WARNING

Gasoline can drain from the crossover line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00259a)

- 6. Drain fuel tank.
 - a. Obtain a short section of hose (5/16 inch I.D.). Insert bolt in one end of hose and install hose clamp to ensure that end is securely plugged.
 - b. See Figure 9-36. Cut clamp (1) from one end of crossover hose (2). Quickly replace crossover hose on fuel tank fitting with open end of short hose while directing flow of gasoline from free end of crossover hose into suitable container.
- See Figure 9-37. Unplug fuel pump module connector (3) [86].
- 8. Remove top plate screws (2) and discard.
- See Figure 9-38. Pull top plate (2) out of fuel tank enough to expose fuel hose and clamp (1).

CAUTION

Carefully inspect end of hose 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.

 Cut clamp and remove hose from regulator housing fitting.

CAUTION

Exercise care to avoid bending float rod of fuel level sender. A bent float rod will result in erroneous gauge readings.

- See Figure 9-39. Reach into fuel tank and push fuel pump housing (16) to disengage it from end cap (14).
- See Figure 9-40. Pull fuel pump out of fuel tank enough to gain access to fuel gauge sending unit on right side of fuel tank.
- 13. See Figure 9-39. Pull tab (19) towards top of fuel tank to release fuel gauge sending unit (20) from mounting tabs.
- Remove top plate, fuel pump and fuel gauge sending unit from fuel tank.



Figure 9-36. Crossover Hose



2. Fasteners (10)

Fuel pump module connector [86]

Figure 9-37. Top Plate Fasteners



Figure 9-38. Fuel Line Clamp





DISASSEMBLY/ASSEMBLY

Fuel Filter

- See Figure 9-39. Disengage bail (1) from bail bracket (28).
- 2. See Figure 9-41. Remove bail bracket from top plate.
- See Figure 9-42. Remove fuel filter (2) from regulator housing (1).
- Cut hose clamp (3) and remove hose (4) from fuel filter. Exercise caution to avoid cutting or damaging hose. Discard fuel filter.

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.

- Slide new hose clamp onto free end of hose (from fuel pump). Install hose onto inlet port at side of fuel filter. If necessary, use a little denatured alcohol or glass cleaner to aid installation. Crimp clamp.
- 6. See Figure 9-42. Insert filter into fuel pressure regulator housing, so that inlet port is on fuel pump side.
- See Figure 9-41. Slide tab on bail bracket into slot of top plate until bump on bracket engages depression at side of filter.
- 8. Rotate bail over bail bracket until it fully engages slots on bracket.

NOTE

Carefully inspect end of hose for cuts, tears, holes or other damage. Replace hose if any damage is found. Even a small hole can cause a reduction in fuel pressure.

Regulator

- Remove fuel pump from regulator housing. See Fuel Filter under DISASSEMBLY/ASSEMBLY.
- See Figure 9-43. Slide fuel pressure regulator assembly forward to free arms from top plate.
- Pull regulator from regulator housing by using rocking motion.
- See Figure 9-44. Apply a thin coat of clean engine oil to new regulator O-rings.
- 5. Install fuel pressure regulator into housing.
- 6. Fit fuel pressure regulator assembly into top plate.
- Install fuel filter. See Fuel Filter under DISASSEMBLY/ ASSEMBLY.



Figure 9-40. Fuel Pump Removal



Figure 9-41. Bail Bracket
Fuel Pump

- See Figure 9-39. Cut clamp (11) holding hose (10) to fuel pump (22).
- 2. Disconnect fuel pump connector.
- 3. Release end of spring (15) from hook on fuel pump housing.

CAUTION

Be absolutely certain fuel pump is faulty before removing hinge from support arm. Hinge is damaged during removal and requires replacement of the fuel pump and bracket assembly.

 See Figure 9-45. Insert flat tip screwdriver and carefully crack plastic webbing at top of end cap. Remove end cap from top plate arm. Discard fuel pump and bracket assembly.

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.

- See Figure 9-39. Inspect fuel pump wiring, (12) replace if damaged.
- Install new end cap on top plate arm. Make sure tab engages end cap.
- 7. Install spring on fuel pump housing hook.
- Align two holes in fuel level sender with threaded hole and post on fuel pump housing. Attach fuel level sending unit to fuel pump housing. Tighten screw to 25-45 in-Ibs (2.8-5.1 Nm).
- 9. Connect fuel pump wiring.
- Install new clamp over fuel pump hose and attach to new fuel pump using side of HOSE CLAMP PLIERS (Part No. HD-41137).



Figure 9-42. Fuel Filter



Figure 9-43. Regulator Housing



Figure 9-44. Fuel Pressure and Housing

Fuel Level Sending Unit Wire Harness

CAUTION

Do not replace the special teflon coated fuel pump/fuel level sender wiring with ordinary bulk wire. Ordinary insulation materials may deteriorate when in contact with gasoline.

NOTE

Damaged fuel pump and/or fuel level sender wiring requires replacement of the fuel level sender unit.

- 1. Remove fuel pump/fuel gauge sending unit from fuel tank. See REMOVAL in this section.
- 2. Disconnect fuel pump connector.
- 3. See Figure 9-46. While pushing tab (2) in direction shown, pull top plate connector (1) from top plate.
- 4. Discard fuel level sending unit and wiring harness.
- 5. Obtain new fuel level sending unit and wiring harness.
- 6. Install fuel level sending unit. See INSTALLATION in this section.
- 7. Connect top plate connector.
- 8. Install fuel pump connector on fuel pump.
- 9. Install fuel pump into fuel tank. See INSTALLATION in this section.



Figure 9-45. End Cap Removal



Figure 9-46. Top Plate Connector

Fuel Supply Check Valve/Tube

NOTE

The in-tank check valve is housed in the quick-connect fitting. The check valve prevents the fuel tank from draining when the external supply line is disconnected.

1. Remove fuel pump/fuel gauge sending unit from fuel tank. See REMOVAL in this section.

AWARNING

Gasoline can drain from the fuel line when disconnected from fuel tank. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00260a)

WARNING

Do not twist fuel line fitting, as fuel line can crack causing a fuel leak. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00274a)

 See Figure 9-47. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line fitting to disconnect.

AWARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

3. Unthread fitting from fuel tank.

NOTE

Carefully inspect end of hose for cuts, tears, holes or other damage. Replace hose if any damage is found. Even a small hole can cause a reduction in fuel pressure.



Figure 9-47. Quick-Connect Fitting

- Apply a thin film of engine oil to new O-ring (3). Slide Oring down convoluted tube (2) until contact is made with hex on new quick-connect fitting.
- Feed convoluted tube through hole at bottom of fuel tank. Secure fitting to fuel tank. Tighten fitting to 18 ft-lbs (24.4 Nm).
- Pull up on chrome sleeve of quick-connect fitting and insert neck of fuel supply line fitting. While pushing up on bottom of fitting, pull down on chrome sleeve until it "clicks" into the locked position.

WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

INSTALLATION

CAUTION

Exercise care to avoid bending float rod of fuel level sender. A bent float rod will result in erroneous gauge readings.

NOTE

Fuel pump sits in left side of fuel tank. Fuel gauge sending unit sits in right side of fuel tank.

NOTE

Do not apply any type of sealant to gasket.

- 1. Install new gasket under top plate.
- Install fuel gauge sender into mounting tabs. Push down on sender until it is seated in tabs.
- 3. See Figure 9-40. Install fuel pump until rubber spacer rests on bottom of fuel tank.
- 4. Install hose and new fuel line clamp on fuel filter fitting.
- 5. See Figure 9-48. Pivot top plate and push down so end cap (1) engages fuel pump housing (2).
- 6. See Figure 9-49. Place gasket and top plate on tank. loosely install new sealing screws.
- Using the pattern shown, tighten T20 TORX screws to 18-24 in-lbs (2.0-2.7 Nm).
- See Figure 9-37. Connect fuel pump module connector (3) [86].
- 9. Connect console wiring and install console.
- 10. See Figure 9-36. Connect crossover hose (2) with **new** clamps (1).
- 11. See Figure 9-34. Install the fuel pump fuse in the main wiring harness.
- 12. Connect negative battery cable.
- 13. Fill tank with gasoline and check for leaks.
- 14. Check fuel system pressure. See 9.15 FUEL PRES-SURE TEST.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

15. Install seat.



Figure 9-48. End Cap Engaged



Figure 9-49. Top Plate Torque Sequence

GENERAL

The fuel pump delivers fuel to the fuel line, to a cavity in the induction module that supplies the fuel injectors and to the pressure regulator, where the system pressure is controlled. Excess fuel pressure is bypassed to the fuel tank through the pressure regulator.

See Figure 9-50. The fuel pump fuse is located under the seat. The fuel pump can be turned on by applying battery voltage to the fuel pump fuse.

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 Softail Models 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. A special adapter allows the gauge to be attached to the external fuel supply line.

CAUTION

Be sure to avoid crimping of fuel line when installing/ removing fuel pressure gauge and adapter.

PART NO.	SPECIALTY TOOL
HD-41182	Fuel pressure gauge
HD-44061	Fuel pressure gauge adapters (2)

1. Remove seat.

WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

- 2. Purge the fuel supply line of high pressure gas.
 - a. See Figure 9-50. Disconnect the fuel pump fuse from the main wiring harness.
 - 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.



Figure 9-50. Fuel Pump Fuse: View From Top

AWARNING

Gasoline can drain from quick-connect fitting when removing fuel line. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00267a)

 Pull up on chrome sleeve of quick-connect fitting (fitting on left side of fuel tank) and pull down on fuel supply line to disconnect.

CAUTION

The next step requires two fuel pressure gauge adapters. Failure to use two adapters will cause the fuel line to twist. This may result in a broken fuel line or fuel line fitting.

- 4. Attach fuel line to gauge assembly.
 - a. See Figure 9-51. Install a second adapter in series with the first.
 - See Figure 9-52. Pull up on chrome sleeve of quickconnect fitting and insert neck of FUEL PRESSURE GAUGE ADAPTER (Part No. HD-44061) into fuel supply line.
 - c. While pushing up on bottom of adapter, pull down on chrome sleeve until it "clicks" into the locked position. Tug on adapter to be sure that it will not come free.
 - d. See Figure 9-53. In the same manner, install neck of second fuel supply line fitting into quick-connect fitting on fuel tank. Tug on fuel supply line to be sure that it will not come free.

WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a)

- Verify that the fuel valve and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.
- 6. See Figure 9-51. Remove protective cap from free end of fuel pressure gauge adapter. Connect fuel pressure gauge to Schroeder valve.
- 7. See Figure 9-50. Install fuel pump fuse.
- 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 55-62 psi (380-425 kPa).

NOTE

If fuel pressure gauge reading is not within specifications, see Softail Models Electrical Diagnostic Manual for further diagnosis.

 Turn the engine off. Position the air bleed tube in a suitable container. Open the air bleed petcock to relieve the fuel system pressure and purge the pressure gauge of gasoline.

AWARNING

Gasoline can drain from the adapter when gauge is removed. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00254a)

12. Remove fuel pressure gauge from the adapter. Install protective cap over Schroeder valve.



Figure 9-51. Fuel Pressure Gauge Adapters



- 2. Adapter to fuel line
- Adapter to fuel tank
- 4. Pressure adapter/Schroeder valve union
- 5. Fuel valve (closed position)

Figure 9-52. Fuel Line



Figure 9-53. Fuel Pressure Gauge Installed

AWARNING

Gasoline can drain from the fuel line and adapter when removed. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. Wipe up spilled fuel immediately and dispose of rags in a suitable manner. (00255a)

 Pull up on sleeve of quick-connect fitting and remove fuel supply line from fuel pressure gauge adapter. Release adapter from fuel tank in the same manner.

WARNING

To prevent spray of fuel, be sure quick-connect fittings are properly mated. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00268a).

14. Pull up on chrome sleeve of quick-connect fitting (forward fitting on left side of tank) and insert neck of fuel supply line fitting. While pushing up on bottom of fuel supply line fitting, pull down on chrome sleeve until it "clicks" into the locked position. Tug on fuel supply line to be sure that it will not come free.

AWARNING

After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

15. Install seat.

SUBJECT

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APPENDIX

APPENDIX A-TOOLS



Part No. B-45525 Valve Guide Hone (7mm)

Part No. HD-23738-A Vacuum Pump



Part No. HD-25070 Robinair Heat Gun



Part No. HD-33223-1 Cylinder Compression Gauge







Part No. HD-34634 Fork Bushing and Seal Installer

Part No. HD-34902-B Mainshaft Primary Bearing Race Remover And Installer



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



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



Part No. HD-34736-B Valve Spring Compressor



Part No. HD-35381 Belt Tension Gauge



Part No. HD-34751 Nylon Valve Guide Cleaning Brush



Part No. HD-35457 Black Light Leak Detector (Use with HD-28431-B)



Part No. HD-35500-B Digital Multimeter (Fluke 23)



Part No. HD-35801 Intake Manifold Screw Wrench





Part No. HD-35667-A Cylinder Leakdown Tester



Part No. HD-38125-6 Packard Terminal Crimp Tool



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



Part No. HD-38125-7 Packard Terminal Crimp Tool



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



Part No. HD-39565 Engine Sound Probe



Part No. HD-39617 Inductive Amp Probe. (Used with HD-35500-B, HD-39978 and HD-39200)



Race Remove. (Used with HD-33416)

Part No. HD-39302 Steering Head Bearing Race Installer



Part No. HD-39754 Fender link Tool



Part No. HD-39361-A Sprocket Shaft Seal Installation Tool (Use with HD-97225-55A)



Part No. HD-39782-A Cylinder Head Support



Part No. HD-39786-A Cylinder Head Holding Fixture



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



Part No. HD-39800 Oil Filter Crusher (Small)



Part No. HD-39965 Deutsch Terminal Crimp Tool



Part No. HD-39823 25 Ton Oil Filter Crusher



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



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



Part No. HD-39978 Multi-Meter (FLUKE 78) (Used with HD-39617)



Part No. HD-39994 Paint Repair Kit



Part No. HD-41182 Fuel Pressure Gauge



Part No. HD-41025-A Tool Organizational System



Part No. HD-41183 Robinair Heat Gun Shrink Tool Attachment. Used with HD-25070.



Part No. HD-41137 Hose Clamp Pliers



Part No. HD-41184 Sprocket Holding Tool



Part No. HD-41177 Fork Tube Holder



Part No. HD-41185 Hose Cutting Tool



Part No. HD-41185-1 Hose Cutter Blade



Part No. HD-41404 EFI Harness Connector Test Kit



Part No. HD-41199-3 Idle Speed Control Actuator Test Lamp



Part No. HD-41405 Main Drive Gear Seal Installer



Part No. HD-41214 Primary Drive Locking Tool



Part No. HD-41417 Propane Enrichment Kit



Part No. HD-41354 Speedometer Tester



Part No. HD-41475 Deutsch Connector Service Kit Includes HD-41475-100



Part No. HD-41475-100 Deutsch Connector Pick Tool



Part No. HD-42135 Spoke Nipple Driver



Part No. HD-41494 Hubcap Remover and Installer



Part No. HD-42310 Engine/Transmission Stand. (Used With Engine Cradle HD-42310-25)



Part No. HD-41496 Main Drive Gear Large Seal Installer



Part No. HD-42310-25 Engine Cradle.



Part No. HD-41609 Amp Multilock Electrical Crimp Tool



Part No. HD-42310-150 Drip Tray. Used with HD-42310.



Part No. HD-42311 Oil Filter Wrench



Part No. HD-42316 Crankshaft Bushing Reamer. Used with HD-43645.



Part No. HD-42313 Cam Chain Tensioner Unloader With Retention Pins



Part No. HD-42317-A Piston Pin Circlip Remover/Installer



Part No. HD-42314 Crankshaft/Camshaft Sprocket Locking Tool



Part No. HD-42318 Connecting Rod Bushing Reamer



Part No. HD-42315 Crankshaft Bushing Remover/Installer



Part No. HD-42320-A Piston Pin Remover/Installer



Part No. HD-42322 Piston Support Plate



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



Part No. HD-42324-A Cylinder Torque Plates



Part No. HD-42569 Connecting Rod Bushing Hone



Part No. HD-42325 Camshaft Needle Bearing Remover/Installer



Part No. HD-42682 Breakout Box (Carbureted) (Use with HD-39978)



Part No. HD-42326-A Crankshaft Guide



Part No. HD-42720-5 Left Crankcase Bearing Remover/Installer



Part No. HD-42879 Deutsch Solid Barrel Contact Crimp Tool



Part No. HD-43645 Reamer Handle/Drive Socket



Part No. HD-42962 Breakout Box Adapters



Part No. HD-43646-A Rolling Engine Stand



Part No. HD-43293-A Brake Caliper Piston Remover



Part No. HD-43646-10 Drip Pan. (Use with H-D 43646)



Part No. HD-43644 Camshaft/Camshafts Bearing Remover/Installer



Part No. HD-43876 Breakout Box (EFI)



Part No. HD-44060 Wheel Bearing Remover







Part No. HD-44061 Fuel Pressure Gauge Adapter



Part No. HD-44065 Right Cranckcase Bearing Remover and Installer



Part No. HD-44062 Balancer Shaft Retention Pins



Part No. HD-44066 Balancer Shaft Inner/outer Bearing Remover/Installer. (Used with HD-44060)



Part No. HD-44063 Hydraulic Tensioner Compressor



Part No. HD-44067 Oil Filter Remover





Part No. HD-44358 Flywheel Fixture





Part No. HD-44408 Hydraulic Tensioner Retainers

Part No. HD-44695 Mini Amp Multilock Electrical Terminal Crimp Tool



Part No. HD-44455 Oil Line Remover and Replacement Tool



Part No. HD-44720 TSSM Diagnostic Interface Harness



Part No. HD-44567 Universal Driver Handle (7 Inch Length)



Part No. HD-44750-P28 (Panasonic Toughbook)





Part No. HD-45928 Packard Micro 64 Terminal Remover



Part No. HD-46601 Instrument Harness Adapters



Part No. HD-45929 Packard Micro 64 Terminal Crimper



Part No. HD-47183 Black Light Leak Detector Penlight



Part No. HD-47184 Black Light Leak Detector Flashlight



Part No. HD-47248 Rocker Housing Wrench



Part No. HD-47187 Technician's Penlight



Part No. HD-47250 Intake Manifold Wrench



Part No. HD-47188 Technician's Flex Light



Part No. HD-47255 Springer Steering Stem Bearing Tool



Part No. HD-47190 Seat Mounting Screw Tool



Part No. HD-47257 Engine Rotation Wrench



Part No. HD-47258 Rocker Cover Wrench



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



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



Part No. HD-94681-80 Spoke Nipple Wrench



Part No. HD-96216-49 Large Internal Retaining Ring Pliers



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



Part No. HD-94455-89 Shock Spanner Wrench



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



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



Part No. HD-95970-32D Piston Pin Bushing Tool. (Used with Body HD-95984-99 and Remover/Installer HD-95986-99)



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



Part No. HD-96333-51D Piston Ring Compressor (Used with Band HD-96333-103)



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



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



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



Part No. HD-96796-47 Valve Spring Tester



Part No. HD-96921-52B Oil Pressure Gauge. Used with HD-96921-120.







Part No. HD-96921-120 Oil Pressure Gauge Adapter







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



Part No. HD-97225-55B Sprocket Shaft Bearing 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

inadvertently 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 Multi lock 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-1. 10-Place Amp Multilock Connector



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.
- 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 inline with the groove (inline 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

- 1. 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.
- 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.



(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.
- 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.
- 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

NOTE

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. See Crimping Instructions below for details.



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.



Figure B-15. Selector Knob



Figure B-16. Indentor Points

- 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).

- 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

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. Refer to 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.

AWARNING,

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

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.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

 Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.









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

GENERAL

Use these instructions to service the following connectors:

- Ignition Coil [83B]
- Front Fuel Injector [84B]
- Rear Fuel Injector [85B]
- IAC [87B]
- TP Sensor [88B]
- IAT Sensor [89B]
- ET Sensor [90B]
- Security Siren [142B]

REMOVING SOCKET TERMINALS

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all. The only exception is the oil pressure sender connector [139B], the terminals of which are removed like the Packard push-toseat connectors. Therefore, see Section B.6 PACKARD ELECTRICAL CONNECTORS, 150 METRI-PACK SERIES, to remove/install terminals in this connector.

- 1. Bend back the external latch(es) slightly and separate pin and socket halves of connector.
- If present, free one side of wire lock from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing. See Figure B-20.
- Use a fingernail to pry colored terminal lock loose and then remove from mating end of socket housing. See Figure B-21.
- 4. Using a thin flat blade, like the unsharpened edge on an X-Acto knife, gently pry tang outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove. See Figure B-22.



Figure B-20. Remove Wire Lock



Figure B-21. Remove Terminal Lock



Figure B-22. Gently Pry Away Tang

INSTALLING SOCKET TERMINALS

NOTE

For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

- Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
- Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
- 3. Install colored terminal lock onto mating end of socket housing. See Figure B-21.
- If present, seat wires in separate channels of wire lock and then push channels <u>inside</u> chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing. See Figure B-20.
- Push pin and socket halves of connector together until external latch(es) engage.

150 METRI-PACK SERIES

Disassembly

- Remove the connector from the retaining device, if present.
- 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-24. 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. See Figure B-25.
- 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 (3.2 mm), 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-24. 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.

NOTE

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.

NOTE

When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.



Figure B-23. Packard External Latch Type Connectors (Socket Sides)



Figure B-24. Depress Tang and Extract Terminal From Mating End of Connector

- 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-24. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.
- 6. If necessary, crimp new terminals on wires. See CRIMP-ING INSTRUCTIONS at the end of this section.

Assembly

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

- Using a thin flat blade, like that on an X-Acto knife, carefully bend the tang outward away from the terminal body. See D in Figure B-24.
- 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."



Figure B-25. Packard Pull-to-Seat Terminal Connector With Locking Ear

280 METRI-PACK SERIES

Fuel Injectors

Disassembly

- 1. Depress the wireform and use a rocking motion to detach the electrical connector.
- Pry rubber seal from wire end of connector and move seal down wires toward conduit.
- Hold the connector so that the wireform is facing down, and looking into the wire end of the connector, insert the point of a safety pin between the top of the terminal and the inside chamber wall.
- 4. Push safety pin completely into chamber while watching terminal on mating end of connector. When terminal is

observed moving forward slightly, then tang is depressed. See 1 in Figure B-26. Remove safety pin.

NOTE

Repeat steps 3 and 4 as necessary until the desired result is achieved.

- Push on wire end of the lead to extract the terminal from the mating end of the connector. See 2 in Figure B-26.
- If necessary, crimp new terminals on wires. See CRIMP-ING INSTRUCTIONS at the end of this section.



Figure B-26. Extract/Install Socket Terminal at Mating End of Connector

Assembly

- Using a thin flat blade, like that on an X-Acto knife, carefully bend the tang outward away from the terminal body. See 3 in Figure B-26.
- Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. Be sure that the tang faces opposite the wireform as it enters the chamber. A "click" is heard when the terminal is properly seated. See 4 in Figure B-26.
- 3. Push on lead to verify that terminal is locked in place.
- 4. Fit rubber wire seal back into wire end of connector.
- Push the pin and socket halves of the connector together until the latch "clicks." The groove in the socket housing must be aligned with the tab in the pin housing.

Disassembly

1. Remove seat.

WARNING

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

- Unthread bolt and remove battery negative cable (black) from battery negative (-) terminal.
- Unthread bolt and remove battery positive cable (red) from battery positive (+) terminal.
- Using a T40 TORX drive head, loosen bolt to move lip of hold-down clamp off edge of battery. Remove battery from battery box.
- Cut anchored cable strap to release accessory connector and B+ connector from left side of frame crossmember (in front of battery box). See Figure B-27.
- Using small flat blade screwdriver, depress button on pin housing (red wire) side of the connector and pull apart the pin and socket halves. See A of Figure B-28.
- 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 terminal in chamber of connector housing. See B of Figure B-28.
- 8. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening between the tang and the chamber wall until it stops. Pivot the end of the pin toward the terminal body to depress the tang. Remove the pin and then pull terminal out wire end of connector housing. See C of Figure B-28.
- 9. If necessary, crimp new terminals on wires. See CRIMP-ING INSTRUCTIONS at the end of this section.



Figure B-27. B+ Connector Location

Assembly

- 1. Carefully bend the tang outward away from the terminal body.
- With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it "clicks" in place.
- Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
- 4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.
- 5. Mate pin and socket halves of connector.
- Install new anchored cable strap in lower hole on left side of frame crossmember (in front of battery box). Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately one inch from connector housings. See Figure B-28.
- 7. Place battery in battery box, terminal side forward.

AWARNING

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

- Insert bolt through battery positive cable (red) into threaded hole of battery positive (+) terminal. Tighten bolt to 60-96 in-lbs (6.8-10.9 Nm).
- Insert bolt through battery negative cable (black) into threaded hole of battery negative (-) terminal. Tighten bolt to 60-96 in-Ibs (6.8-10.9 Nm).
- Rotate hold-down clamp so that the lip (with rubber pad) rests on the edge of the battery. Using a T40 TORX drive head, tighten the clamp bolt to 15-20 ft-lbs (20-27 Nm).
- 11. Install seat.



Figure B-28. Remove Socket Terminal

PACKARD MICRO 64

Disassembly

1. Bend back the external latches slightly and separate the pin and socket halves of the connector.

NOTE

To differentiate between the speedometer and tachometer connectors, note that the speedometer connector has a second length of conduit leading to the odometer reset switch.

- Locate the head of the secondary lockpin on one side of the connector housing. See Figure B-30.
- Insert the blade of a small screwdriver between the center ear of the lockpin and the connector housing and gently pry out lockpin. When partially removed, pull lockpin from connector housing.
- Obtain the Packard Micro 64 Terminal Remover (HD-45928). See Figure B-29. Proceed as follows:
 - Locate small hole between terminals on mating end of connector. See Figure B-30.
 - Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms. See upper frame of Figure B-31.
 - c. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. See lower frame of Figure B-31. Remove tool.
- If necessary, crimp new terminals on wires. See Crimping Instructions.

Assembly

 Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

For wire location purposes, the corners of the socket housing are stamped with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other. See Figure B-30.

Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.







Figure B-30. Mating End of Connector

NOTE

Once the terminal is removed it may not lock in place when first reinstalled. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.

- Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.
- With the center ear on the head of the secondary lockpin facing the mating end of the connector, push lockpin in until head is flush with the connector housing.
- Push the pin and socket halves of the connector together until the latches "click."

Crimping Instructions

- 1. Strip lead removing 1/8 inch (3.0 mm) of insulation.
- Obtain the Packard Micro 64 Terminal Crimper (HD-45929). See Figure B-32.
- 3. Squeeze the handles to cycle the tool to the fully open position.
- 4. Obtain **new** contact (socket terminal). Verify that contact and crimp tails are not bent or deformed.
- 5. Raise locking bar and barrel holder by pushing up on bottom tab with index finger. See Figure B-33.
- With the crimp tails facing upward, insert contact through locking bar into front hole in barrel holder (20-22 gauge wire).
- 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 and the closed side of the terminal rests on the outer nest of the crimp tool. See Figure B-34.
- Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
- Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. See Figure B-35.
- 10. Raise locking bar and barrel holder to remove contact.
- 11. Inspect the quality of the core and insulation crimps. Distortion should be minimal.



Figure B-31. Insert Tool and Remove Terminal



Figure B-32. Packard Micro 64 Terminal Crimper (Part No. HD-45929)



Figure B-33. Raise Locking Bar and Barrel Holder



Figure B-34. Position Contact in Crimper



Figure B-35. Crimp Terminal Onto Wire

Disassembly

- See Figure B-36. Depress tabs (3) on the sides of connector and remove clear plastic cover (4).
- 2. Remove cable strap (2).
- 3. See Figure B-37. Pry three connector tabs (1) to separate connector halves.
- 4. Lift retainer tab (2). to release terminal.
- Pull on wire from back side 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-36. 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.



Figure B-36. ECM Connector



Figure B-37. Connector Tabs

CRIMPING INSTRUCTIONS

- 1. Strip wire lead removing 5/32 inch (4.0 mm) of insulation.
- 2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

- 3. See Figure B-38. Determine the correct dye or nest for the core crimp.
- 4. Position the core crimp on the appropriate nest. Be sure the core crimp tails are facing the forming jaws.
- 5. Gently apply pressure to handles of tool until crimpers just 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 is positioned over the insulation or seal material.
- Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
- 8. See Figure B-38. Determine the correct dye or nest for the insulation/seal crimp.



Figure B-39. Inspect Core and Insulation/Seal Crimps



Figure B-38. Packard Terminal Crimp Tools

- Position the insulation/seal crimp on the appropriate nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
- 10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspect the quality of the core and insulation/seal crimps. Distortion should be minimal. See Figure B-39.

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION		
[5]	main circuit breaker	ring terminals	electrical panel behind fender extension		
[7]	tail lamp harness to main harness	8-place Multilock	under seat		
[10]	ignition control module (ICM): carbu- reted models	12-place Deutsch	under seat		
[18]	left rear turn signal	2-place Multilock	inside tail lamp lens		
[19]	right rear turn signal	2-place Multilock	inside tail lamp lens		
[21]	indicator lamps	8-place Mini-Deutsch	under fuel tank console		
[22]	right hand controls	6-place Deutsch	under fuel tank, right side		
[24]	left hand controls and horn	6-place Deutsch	under fuel tank, left side		
[30]	turn signal/security module	12-place Deutsch	electrical panel behind fender extension		
[31]	front turn signals	6-place Multilock	under fuel tank, right side		
[32]	front fender tip lamp	2-place Multilock	under fuel tank, left side		
[33]	ignition key switch	3-place Packard	under fuel tank console		
[38]	headlamp	4-place Multilock	under fuel tank, left side		
[39]	speedometer	12-place Packard	back of speedometer		
[46]	voltage regulator to stator	4-place Deutsch	back of voltage regulator bracket		
[62]	starter relay	5-place Amp	under seat, in fuse block		
[62]	system relay	5-place Amp	under seat, in fuse block		
[65]	vehicle speed sensor (VSS)	3-place Deutsch	electrical panel behind fender extension		
[73]	auxiliary lamp	2-place Multilock	under fuel tank, left side		
[78]	electronic control module (ECM): EFI models	36-place Packard	under seat		
[79]	crank position sensor (CKP)	2-place Mini-Deutsch	back of voltage regulator bracket		
[80]	manifold air pressure sensor (MAP)	3-place Packard	top of manifold		
[83]	ignition coil	3-place Packard (carbureted) 4-place Packard (EFI)	back of coil		
[84]	front injector: EFI	2-place Packard	beneath fuel tank		
[85]	rear injector: EFI	2-place Packard	beneath fuel tank		
[86]	fuel pump (EFI) and sender (EFI and carbureted)	3-place Mini-Deutsch	top of fuel tank		
[87]	idle air control (IAC): EFI	4-place Packard	beneath fuel tank		
[88]	throttle position sensor (TP): EFI	3-place Packard	behind air cleaner backing plate		
[89]	intake air temperature sensor (IAT): EFI	2-place Packard	behind air cleaner backing plate		
[90]	engine temperature sensor (ET): EFI	2-place Packard	back of front cylinder, left side		
[91]	data link connector	4-place Deutsch	under seat		
[93]	tail lamp	4-place Multilock	inside tail lamp lens		
[94]	tail lamp power in	6-place Multilock	inside tail lamp lens		

Table B-2. Softail Connector Locations

B.7

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION		
[117]	fuel gauge	4-place Multilock	left front side of fuel tank		
[120]	oil pressure switch	post terminal	on oil pressure switch, front of right crank- case		
[122]	horn	spade terminals	between cylinders, left side		
[128]	starter solenoid	spade terminal	top of starter		
[142]	security siren (optional)	3-place Packard	electrical panel behind fender extension		
	fuse block	spade terminals	under seat		
-	harness grounds (2)	ring terminals	under seat		
-	neutral switch	post terminals	top of transmission		
-	rear stoplight switch	spade terminals	behind transmission		

Table B-2. Softail Connector Locations

INDEX TO WIRING DIAGRAMS

MODEL	DIAGRAM	PAGE	
	Main harness	B-27	
	Lights, Fuel gauge & Indicators	B-29	
	Ignition circuit	B-31	
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Softail: carbureted (Domestic and International)	Lighting circuit (continued)	B-35	
(Domootio and monatoria)	Horn and instruments	B-37	
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	Ignition circuit	B-51	
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Softail: EFI (Domestic and International	Lighting circuit (continued)	B-55	
(Domodilo and mornalonal	Horn and instruments	B-57	
	Starting circuit	B-59	
	Charging circuit	B-61	
	Security circuit	B-63	
	Security circuit (continued)	B-65	

Table B-3. Softail Wiring Diagrams

APPENDIX C-METRIC CONVERSIONS

MILLIMETERS to INCHES (mm x 0.03937 = inches)								INCH (in	IES to M ches x 2	IILLIME1 5.40 = m	TERS nm)				
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	37/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 ³ / ₁₆	30.16	2 ⁹ /16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 ¹⁵ / ₁₆	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 ¹ /4	31.75	2 ⁵ /8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 ¹ /16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 ³ /4	69.85	4 ¹ /8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 ³ / ₁₆	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 ⁷ /16	36.51	2 ¹³ /16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 ⁹ /16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 ¹⁵ /16	74.61	4 ⁵ /16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 ⁵ /8	41.27	3	76.20	4 ³ /8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 ¹ / ₁₆	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 ⁷ / ₁₆	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 ¹ /2	114.30
21	.8268	54	2.126	87	3.425	120	4,724	.4	10.160	1.8	45.72	3 ³ / ₁₆	80.96	4 ⁹ /16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 ¹³ /16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 ¹ /4	82.55	4 ⁵ /8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

Table C-1. Metric Conversions

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.)

JAPANESE MAINSHAFT/COUNTERSHAFT

GENERAL

NOTE

Check the eight digit number stamped on the transmission case just above the side door. If the third digit is "9," then the transmission was built for Japan only. If the digit is "0," then it was built for all countries except Japan. See the instructions which follow if servicing a Japanese transmission. For all other transmissions, see Section 7.6 MAINSHAFT AND COUNTERSHAFT.

DISASSEMBLY

NOTES

- Perform all steps if completely overhauling the transmission assembly.
- Perform steps 1-11 and 17-18 if replacing <u>only</u> the countershaft or one or more countershaft gears.
- Perform steps 1-5 and 12-18 if replacing <u>only</u> the mainshaft or one or more mainshaft gears.
- Perform steps 1-6, 12, and 17-18 if replacing <u>only</u> the side door bearings.
- Position the side door assembly on a bench with the shafts pointing straight up, the mainshaft on the left hand side. The mainshaft is the longer of the two shafts. See Figure D-3.
- 2. Slide off the mainshaft 2nd gear (spur).

NOTE

To facilitate reassembly, label each gear as it is removed. See Figure D-1.

 Obtain the TRANSMISSION SHAFT RETAINING RING PLIERS, Part No. J-5586.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

4. Locate retaining ring just above the mainshaft 3rd gear (spur). Move the retaining ring up approximately 3/8 inch (9.5 mm) towards the free end of the shaft. Turn side door assembly upside down and verify that mainshaft 3rd gear is still partially engaged with countershaft 3rd gear.



Figure D-1. Note Gear Location During Disassembly



menter preg

Figure D-2. Press Out Countershaft



- 1. Mainshaft
- 2. Mainshaft 2nd
- 3. Retaining ring/Thrust washer
- 4. Mainshaft 3rd-split cage bearing
- 5. Thrust washer/Retaining ring
- 6. Mainshaft 1st
- 7. Retaining ring/Thrust washer
- 8. Mainshaft 4th-split cage bearing
- 9. Gold spacer
- 10. Countershaft
- 11. Countershaft 5th
- 12. Countershaft 2nd-split cage bearing
- 13. Thrust washer/Retaining ring
- 14. Countershaft 3rd
- 15. Retaining ring/Thrust washer
- 16. Countershaft 1st-split cage bearing
- 17. Thrust washer/Retaining ring
- 18. Countershaft 4th
- 19. Blue spacer

Figure D-3. Fully Assembled Side Door

CAUTION

Failure to move the retaining ring on the mainshaft can cause countershaft 1st gear to contact mainshaft 3rd gear when the countershaft is pressed out. On the other hand, if the retaining ring is moved too far, loss of engagement between mainshaft 3rd gear and countershaft 3rd gear can result in hard contact between these two gears. Any hard contact can result in gear tooth damage.

- With the outboard side up, rest side door on parallel blocks under ram of arbor press. Be sure that assembly is flat and does not rest on dowel on inboard side.
- Center countershaft under ram. Install mainshaft plug into hole at end of countershaft. Slowly apply pressure until countershaft is free. See Figure D-2. Remove mainshaft plug.
- Slide blue spacer and countershaft 4th gear (helical) off threaded end of countershaft.
- Secure countershaft in a vise with the threaded end topside. Be sure to install a pair of aluminum or brass jaw inserts in vise to avoid parts damage. See Figure D-4.
- Remove retaining ring just above the countershaft 1st gear (spur with single row of indents on teeth). Remove thrust washer and countershaft 1st gear. Gently pull apart the split cage bearing and remove. Remove second thrust washer.
- 10. Remove retaining ring above the countershaft 3rd gear (spur). Remove countershaft 3rd gear.
- Remove retaining ring just above the countershaft 2nd gear (spur). Remove thrust washer and countershaft 2nd gear. Gently pull apart the split cage bearing and remove.
- Center mainshaft under ram of arbor press. Install mainshaft plug into hole at end of mainshaft. Slowly apply pressure until mainshaft is free. Remove mainshaft plug.
- Slide gold spacer, mainshaft 4th gear (helical), split cage bearing and thrust washer off end of mainshaft.
- Secure the mainshaft in a vise with the longer splined end at the top. Be sure to install a pair of aluminum or brass jaw inserts in vise to avoid parts damage. See Figure D-5.



Figure D-4. Disassemble/Assemble Countershaft

- Remove retaining ring above the mainshaft 1st gear (spur with double row of indents on teeth). Remove mainshaft 1st gear.
- 16. Remove retaining ring just above the mainshaft 3rd gear (spur). Remove the thrust washer and mainshaft 3rd gear. Gently pull apart the split cage bearing and remove. Remove the second thrust washer. Remove the last retaining ring, which was moved out of the groove before the countershaft was pressed out.
- 17. Set the side door on a bench with the outboard side up. Remove retaining ring from the bearing bore.

NOTE

Depending upon whether one or both shafts were removed, replace one or both side door bearings. Always replace the bearing if the shaft was pressed out.

 Turn side door over so that the inboard side is up and place on flat plate under ram of arbor press. Apply pressure to outer race to press bearing from bore.

CLEANING AND INSPECTION



Figure D-5. Disassemble/Assemble Mainshaft

WARNING

Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

- 1. Clean all parts in cleaning solvent and blow dry with compressed air.
- 2. Check gear teeth for damage. Replace the gears if they are pitted, scored, rounded, cracked or chipped.
- Inspect the engaging dogs on the gears. Replace the gears if the dogs are rounded, battered or chipped.
- Inspect the side door bearings. Bearings must rotate freely without drag. Replace the bearings if pitted, grooved, or if the shafts were removed.

ASSEMBLY

NOTES

- Perform all steps if the transmission assembly was completely overhauled.
- Perform steps 1-5 and 12-24 if <u>only</u> the countershaft or one or more countershaft gears were replaced.
- Perform steps 1-11 and 20-24 if <u>only</u> the mainshaft or one or more mainshaft gears were replaced.
- Perform steps 1-4, 11, and 18-24 if <u>only</u> the side door bearings were replaced.
- 1. With the outboard side up, place side door on flat plate under ram of arbor press.

NOTE

Note the two drill points between the bearing bores on the side door. See Figure D-7. Two drill points indicate that the side door must be fitted with the new style 12mm wide bearings. Installation of the old style 14mm wide bearings would cover the retaining ring grooves.

- Position new bearing over bore with the number stamp topside.
- Applying pressure to outer race, press bearing into bore until firm contact is made with the counterbore.

AWARNING

Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

With the flat side in towards the bearing (beveled side out), install new retaining ring in bearing bore.

NOTE

Depending upon the level of disassembly, replace one or both side door bearings. Always replace the bearing if the shaft was pressed out.

 Obtain the TRANSMISSION SHAFT RETAINING RING PLIERS, Part No. J-5586.



Figure D-6. Press In Countershaft

WARNING

Always use new retaining rings when assembling the mainshaft and countershaft. Reusing retaining rings can cause the transmission to become "locked" during motorcycle operation, a situation which could result in death or serious injury.

- Secure the mainshaft in a vise with the longer splined end at the top. Be sure to install a pair of aluminum or brass jaw inserts in vise to avoid parts damage.
- 7. Install **new** retaining ring approximately 3/8 inch (9.5 mm) below the bottom retaining ring groove.
- 8. Slide thrust washer down mainshaft until it contacts retaining ring. Lightly coat split cage bearing with oil and install in race just above thrust washer. Install mainshaft 3rd gear (spur) with the shifter dogs down. Install second thrust washer. Install **new** retaining ring in groove just above the bearing race.
- With the fork groove up, slide mainshaft 1st gear (spur with double row of indents on teeth) down mainshaft until it contacts retaining ring. Install **new** retaining ring in groove above the gear. See Figure D-5.

CAUTION

Verify that the mainshaft 1st gear has the <u>double</u> row of indents on teeth. Using a gear with a single row of indents will result in transmission damage.

- 10. Slide thrust washer down the mainshaft until it contacts the retaining ring. Lightly coat the split cage bearing (double roller) with oil and install in race above the thrust washer. Install mainshaft 4th gear (helical) over the bearing with the shifter dogs down. Install gold spacer.
- 11. With the inboard side up, place side door on flat plate under ram of arbor press. Holding mainshaft assembly together, remove from vise and position over bearing bore in side door. Install mainshaft plug into hole at end of mainshaft. Supporting inner race of bearing, press mainshaft into bearing bore. Remove mainshaft plug.
- Secure the countershaft in a vise with the threaded end topside. Be sure to install a pair of aluminum or brass jaw inserts in vise to avoid parts damage.
- Lightly coat split cage bearing with oil and install in race next to the countershaft 5th gear.



Figure D-7. Install Mainshaft/Countershaft Locknuts

- Install countershaft 2nd gear (spur) over the bearing with the shifter dogs up. Install thrust washer and new retaining ring.
- Install countershaft 3rd gear (spur) with the fork groove down. Install **new** retaining ring in groove above the gear.
- 16. Slide the thrust washer down the countershaft until it contacts the retaining ring. Lightly coat the split cage bearing with oil and install in the race just above the thrust washer. Install countershaft 1st gear (spur with single row of indents on teeth) with the taper up. Install second thrust washer and **new** retaining ring. See Figure D-4.
- 17. Install countershaft 4th gear (helical) with the sleeve down. Install blue spacer with the taper up.
- With the inboard side up, place side door on flat plate under ram of arbor press. Support inner race of bearing.
- 19. Holding countershaft assembly together, remove from vise. Raising mainshaft 3rd gear until it contacts partially installed retaining ring, position countershaft over bearing bore. Verify that taper on blue spacer is facing towards the bearing.
- Place mainshaft plug at end of countershaft. Be sure that mainshaft and countershaft gears mesh and that assembly is square. Press countershaft into bearing bore. Remove mainshaft plug. See Figure D-6.
- Return side door assembly to bench. Position with the shafts pointing straight up, the mainshaft on the left hand side.
- 22. Move partially installed retaining ring into groove just above the mainshaft 3rd gear.
- 23. Install mainshaft 2nd gear (spur) with the fork groove down.

The final assembly appears as shown in Figure D-3.

 Install spacer and locknut on the threaded end of each shaft and tighten the nuts until finger tight. See Figure D-7.

NOTE

For final tightening of the locknuts and installation of the side door, see Section INSTALLATION under 7.6 MAINSHAFT AND COUNTERSHAFT.

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
AMP	Ampere
AWG	American Wire Gauge
B+	Battery voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
С	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
CV	Constant Velocity
DC	Direct Current
DIC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
FCT	Engine Coolant Temperature
EEPBOM	Electrically Erasable Programmable Read Only Memory
FFI	Electronic Fuel Injection
FT	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
floz	Fluid Ounce
0	Gram
GAL	Gallon
GAWB	Gross Ayle Weight Bating
GND	Ground (electrical)
GVW/B	Gross Vehicle Weight Bating
HDI	Harley-Davidson International
Ha	Maraury
	Idle Air Control
IAT	
IAI	Intake Air Temperature
	Ignition Control Module
ID .	Inside Diameter

Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IGN	Ignition Light/Key Switch
IM	Instrument Module
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	number
02	oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
OZ	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds Per Square Inch
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TDC	Top Dead Center
TP	Throttle Position
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor

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