2007 SOFTAIL SERVICE MANUAL

The information in this Service Manual applies to all 2007 Softail® models.

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FOREWORD

GENERAL

This Service Manual has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the Harley-Davidson product and assist in the performance of basic maintenance and repair. Secondly, it will introduce to the professional Harley-Davidson Technician the latest field-tested 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
- Appendix A–Tools
- Appendix B–Wiring
- Appendix C–Metric Conversions
- Appendix D–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 (MAINTENANCE) could be referred to as:

1.6 BRAKES

This cross reference directs the reader to section **1** (MAINTENANCE) 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. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. 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.

⚠DANGER

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

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

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 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.
4. Brake fluid level and condition. Hydraulic lines and fittings for leaks. Also, check brake pads and rotors for wear.
5. Cables for fraying, crimping and free operation.
6. Engine oil and transmission fluid levels.
7. Headlamp, 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.

Threadlocking Agents

Always follow specific service manual procedures when working with fasteners containing preapplied threadlocking agents when fastener replacement is recommended. When re-using fasteners containing threadlocking agents, be sure to completely remove all existing threadlocking agent from fastener threads with a wire brush or wire wheel. Also, be sure to remove residual threadlocking agent from fastener hole using an appropriate thread chasing device and compressed air when using new or existing fasteners. Always use the recommended threadlocking agent for your specific procedure.

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.

Exhaust System Leakage

In the event of an exhaust system leak at a muffler or header pipe connection location, disassemble and clean all mating surfaces. Replace any damaged components. If leak still exists, disassemble and repair the leak by applying a bead of Harley-Davidson High-Performance Sealant, part number 99650-02. Reassemble components, wipe off any excess sealant and allow adequate curing time following sealant product instructions before running vehicle.

Gaskets

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

Lip Type Seals

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

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

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

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

O-Rings (Preformed Packings)

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

Gears

Always check gears for damaged or worn teeth.

Lubricate mating surfaces before pressing gears on shafts.

Shafts

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

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

Clean all rust from the machined surfaces of new parts.

Part Replacement

Always replace worn or damaged parts with **new** parts.

CLEANING

Part Protection

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

Cleaning Process

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

Rust or Corrosion Removal

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

TOOL SAFETY

Air Tools

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

Wrenches

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

Pliers/cutters/prybars

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

Hammers

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

Punches/chisels

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

Screwdrivers

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

Ratchets and Handles

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

Sockets

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

Storage Units

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

FUEL

⚠WARNING

Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)

⚠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-4
- CG-4
- CH-4
- CI-4

The preferred viscosities for the diesel engine oils, in descending order, are:

- 20W-50
- 15W-40
- 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 tank. 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), 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 (FXST, FLSTC, FLSTF, FXSTB, FXSTD, FLSTN, FXSTC), 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.

Table 1-1. Regular Service Intervals For Softail Models

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	X	X	X	X	X	
Oil lines and brake system	Inspect for leaks	X	X	X	X	X	X	1
Air cleaner	Inspect, service as required	X	X	X	X	X	X	
Tires	Check pressure, inspect tread	X	X	X	X	X	X	
Wheel spokes	Check tightness	X	X			X		1, 4
Primary chaincase lubricant	Replace	X		X		X		
Transmission lubricant	Replace	X				X		
Clutch	Check adjustment	X	X	X	X	X	X	1
Rear belt and sprockets	Inspect, adjust belt	X	X	X	X	X	X	1
Throttle, brake and clutch controls	Check, adjust and lubricate	X	X	X	X	X	X	1
Jiffy stand	Inspect and lubricate	X		X		X		1
Fuel lines and fittings	Inspect for leaks	X	X	X	X	X	X	1
Fuel tank filter	Replace						X	1
Brake fluid	Check levels and condition	X	X	X	X	X	X	6
Brake pads and discs	Inspect for wear	X	X	X	X	X	X	
Spark plugs	Inspect	X	X	X	X		X	
	Replace					X		
Electrical equipment and switches	Check operation	X	X	X	X	X	X	
Engine idle speed	Check adjustment	X	X	X	X	X	X	1
Front fork oil	Replace	Replace at 50,000 miles (80,000 kilometers)						1

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 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.
7. Adjust at 500 miles (800 kilometers).

Table 1-1. Regular Service Intervals For Softail Models

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 (Softail models)	Adjust	X		X		X		1
	Lubricate			X		X		2
Steering head bearings (Springer models)		Adjust and lubricate every 2500 miles (4000 kilometers)						1, 5
Rear fork bearings (if applicable)	Repack					X		1
Windshield bushings	Inspect			X		X		1
Springer rocker bearings	Adjust	X		X		X		1, 7
Fuel door, tour-pak, saddle-bags	Lubricate hinges and latches	X	X	X	X	X		
Critical fasteners	Check tightness	X		X		X		1
Battery	Check battery and clean connections							3
Road test	Verify component and system functions	X	X	X	X	X	X	

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 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.
7. Adjust at 500 miles (800 kilometers).

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Engine oil and filter	Drain plug torque	14-21 ft-lbs (19-28 Nm)
	Oil capacity	3.0 qt. (2.85 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 lubricant	Lubricant capacity	32 oz. (0.95 mL)
	Primary chaincase drain plug torque	14-21 ft-lbs (19-28 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-lbs** (10-12 Nm)
Transmission lubricant	Lubricant level	Dipstick at FULL with motorcycle on jiffy stand and filler plug resting on threads
	Lubricant capacity	32 oz. (0.95 mL)
	Transmission drain plug torque	14-21 ft-lbs (19-28 Nm)
	Filler plug torque	25-75 **in-lbs** (3-9 Nm)
Spark plugs	Type	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	Type	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)

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Tire condition and pressure	Pressure for solo rider	FLSTC, FLSTSC, FLSTN Models: Front: 36 psi (248 kPa) Rear: 36 psi (248 kPa)
		FXST, FXSTC, FXSTB Models: Front: 30 psi (207 kPa) Rear: 38 psi (262 kPa)
		FLSTF Models: Front: 36 psi (248 kPa) Rear: 38 psi (262 kPa)
		FXSTD Model: Front: 30 psi (207 kPa) Rear: 36 psi (248 kPa)
	Pressure for rider and passenger	FLSTC, FLSTSC, FLSTN Models: Front: 36 psi (248 kPa) Rear: 40 psi (276 kPa)
		FXST, FXSTC, FXSTB Models: Front: 30 psi (207 kPa) Rear: 42 psi (290 kPa)
		FLSTF Models: Front: 36 psi (248 kPa) Rear: 42 psi (290 kPa)
		FXSTD Model: Front: 30 psi (207 kPa) Rear: 40 psi (276 kPa)
	Wear	Replace tire if 1/32 in. (0.8 mm) or less of tread pattern remains
Wheel spokes	Spoke nipple torque	Steel laced rim: 40-50 **in-lbs** (4.5-5.6 Nm)
		Chrome aluminum rim: 55 **in-lbs** (6.2 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 bottom of belt strand	10 lb. (4.5 kg)
	With motorcycle On jiffy stand without rider or luggage	FLSTN, FXSTD–1/4-5/16 in. (6.4-7.9 mm) FXST, FLSTC, FLSTF, FXSTB, FLSTSC, FXSTC–9/16-5/8 in. (14.3-15.9 mm)
	Vehicle upright with rear wheel in air	FLSTN, FXSTD–5/16-3/8 in. (7.9-9.5 mm) FXST, FLSTC, FLSTF, FXSTB, FLSTSC, FXSTC–11/16-3/4 in. (17.5-19.0 mm)

Table 1-2. Quick Reference Maintenance Chart

ITEM SERVICED	SPECIFICATION	DATA
Air cleaner	Air cleaner cover bracket screw torque	40-60 **in-lbs** (4.5-6.8 Nm)
	Air cleaner cover screw torquew	30-60 **in-lbs** (4.1-6.8 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)

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.
2. Shut motorcycle off and leave motorcycle **resting on jiffy stand**.
3. 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.

Table 1-3. Recommended Oil Grades

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

Figure 1-1. Checking Oil Tank Level

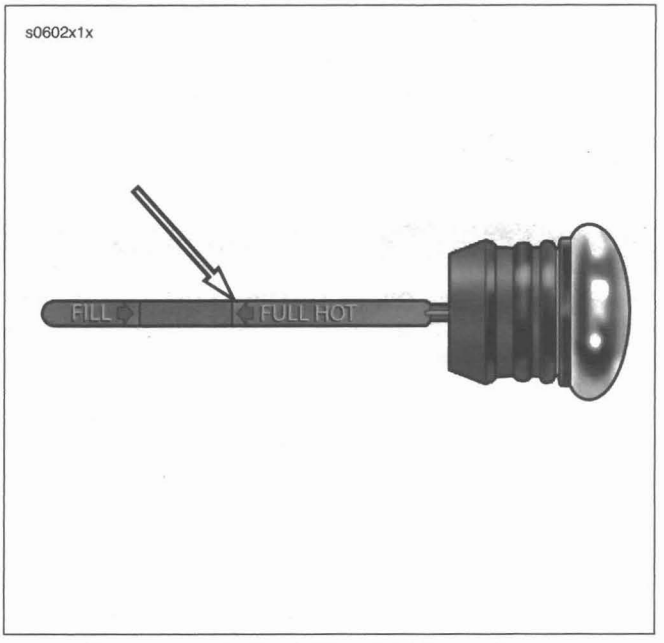


Figure 1-2. Oil Tank Dipstick Upper Groove

CHANGING OIL AND FILTER

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

NOTES

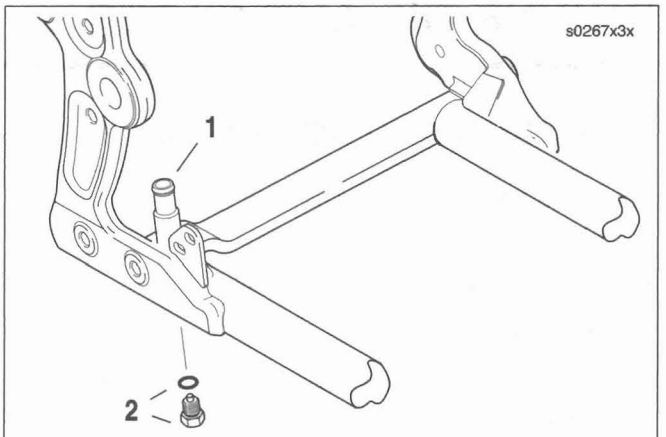
- *If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.*
- *All Softails are shipped from the factory with SAE 20W50 Harley-Davidson 360 Motor Oil.*
- *All Softails come equipped from the factory with a premium 5 micron synthetic 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 O-ring (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.

4. Remove the oil filter using the OIL FILTER WRENCH. Clean the oil filter mount flange of any old gasket material.
5. See Figure 1-5. 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).
7. See Figure 1-1. Fill oil tank with 3.0 quarts (2.85 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.



1. Frame connection for oil tank drain hose
2. Oil tank drain plug and O-ring

Figure 1-3. Oil Tank Drain Plug

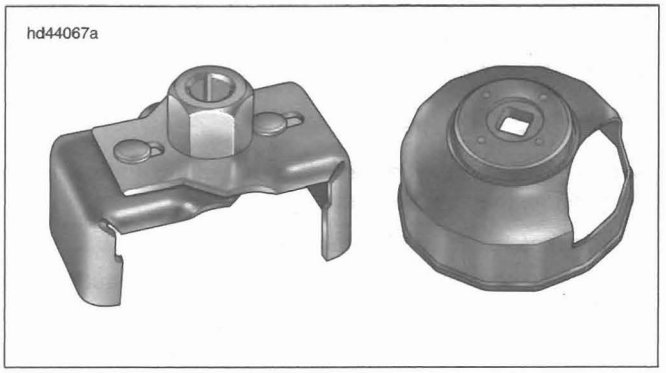


Figure 1-4. Oil Filter Wrench
Part No. HD-42311 (left), Part No. HD-44067 (right)

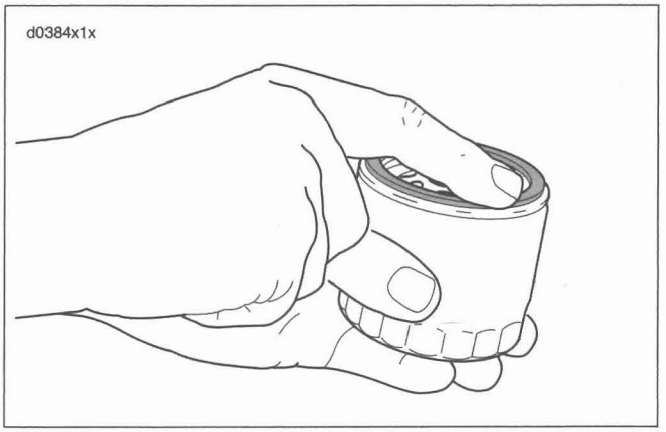


Figure 1-5. Lubing New Oil Filter

GENERAL

⚠WARNING

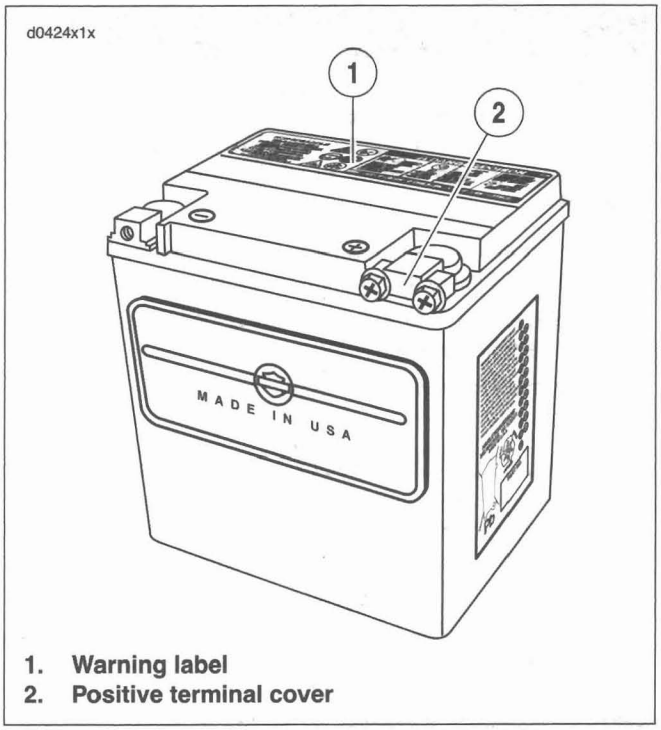
Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. KEEP BATTERIES AWAY FROM CHILDREN. (00063a)

⚠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. **Warning label**
2. **Positive terminal cover**

Figure 1-6. Battery

NOTE

See 8.15 BATTERY for charging and testing information.

Figure 1-7. Battery Warning Label

DISCONNECTION AND 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)

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

INSTALLATION AND CONNECTION

1. See Figure 1-9. 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.

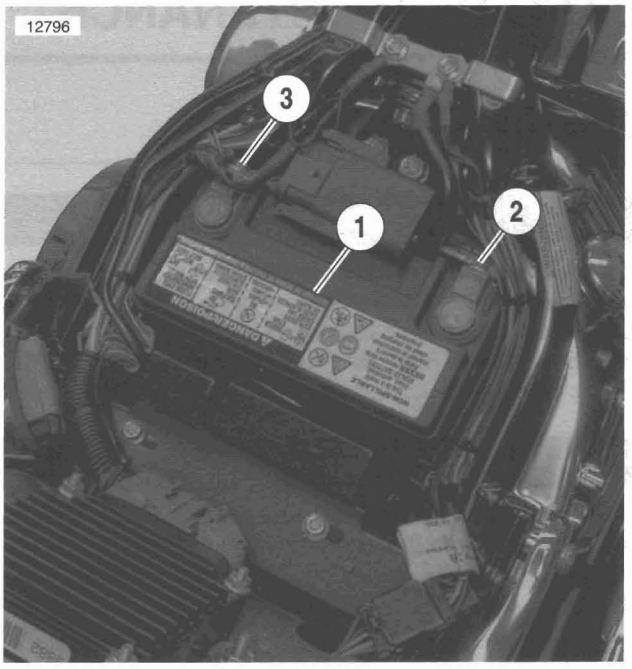
CAUTION

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)

2. See Figure 1-9. Verify that the positive battery cable (1) from the starter is routed at the angle shown. Verify positive battery cable and rear oxygen sensor wire (2) are parallel and do not cross.
3. 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

4. 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).
5. Apply a light coat of petroleum jelly or corrosion retardant material to both 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.

INSPECTION

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

STORAGE

⚠WARNING

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

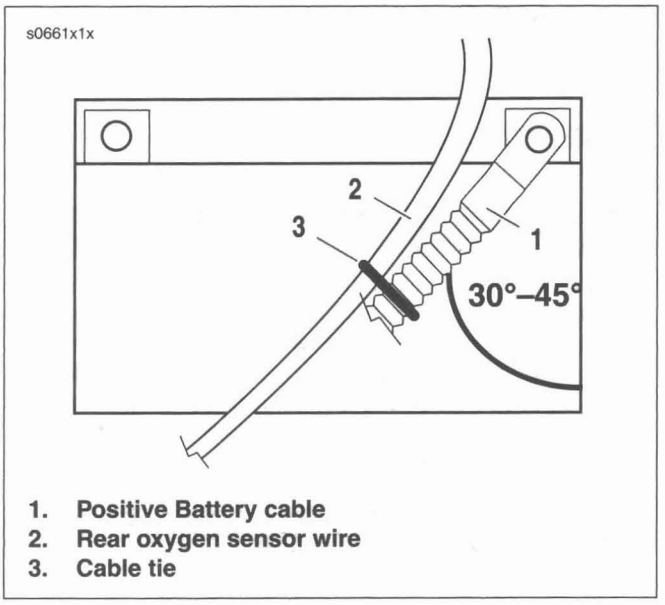
If the motorcycle will not be operated for several months, such as during the winter season, remove the battery from the motorcycle and fully charge. See 8.15 BATTERY.

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 8.15 BATTERY.*



1. **Positive Battery cable**
2. **Rear oxygen sensor wire**
3. **Cable tie**

Figure 1-9. Positive Battery Cable Routing

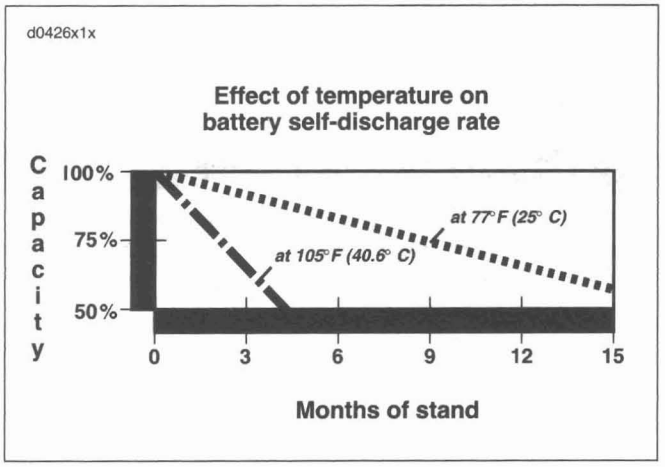


Figure 1-10. Battery Self-Discharge Rate

FLUID INSPECTION

⚠CAUTION

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)

1. 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)

2. 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)

4. Front brake hand lever and rear brake foot pedal must have a firm feel when applied. If not, bleed system using only D.O.T. 4 BRAKE FLUID. See 1.7 BLEEDING BRAKES.

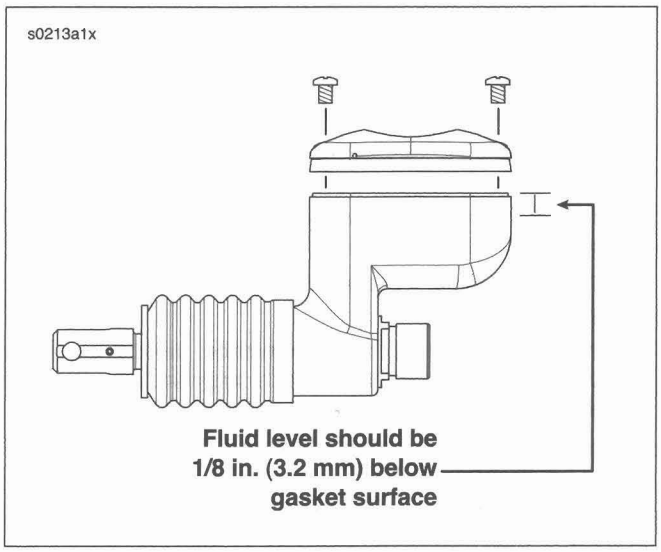


Figure 1-11. Rear Brake Master Cylinder Reservoir

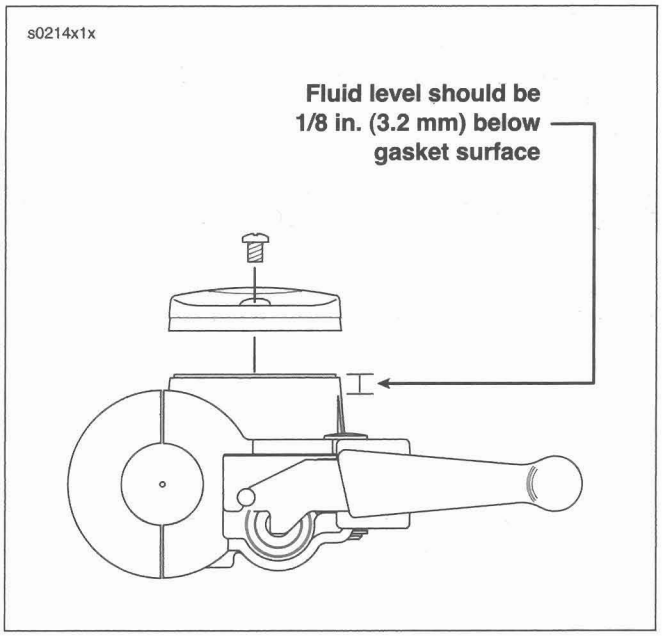


Figure 1-12. Front Brake Master Cylinder Reservoir

REAR BRAKE PEDAL

Pedal Height

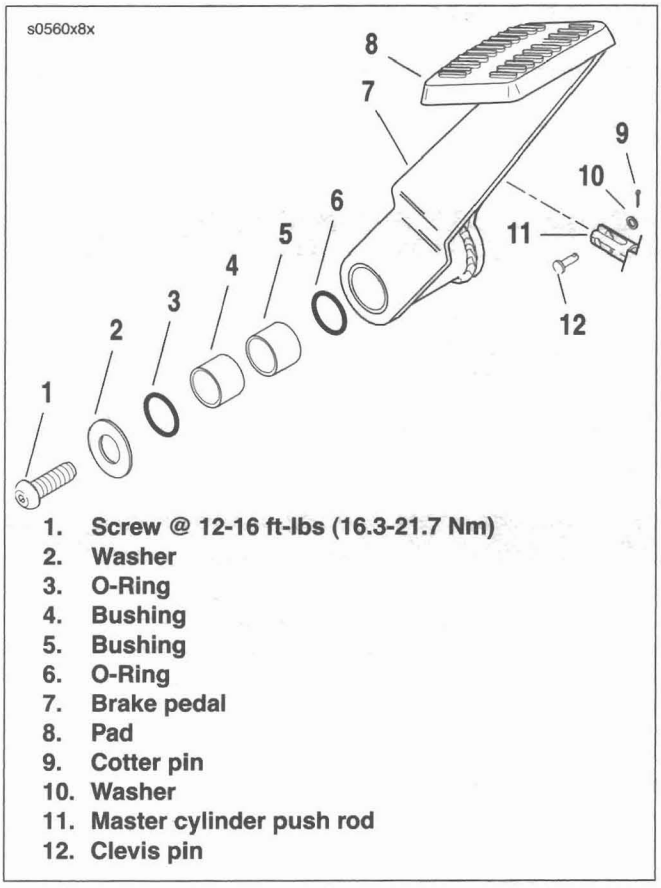
The rear brake pedal is nonadjustable. When brake system components are properly assembled, brake pedal is correctly adjusted.

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.



1. **Screw @ 12-16 ft-lbs (16.3-21.7 Nm)**
2. **Washer**
3. **O-Ring**
4. **Bushing**
5. **Bushing**
6. **O-Ring**
7. **Brake pedal**
8. **Pad**
9. **Cotter pin**
10. **Washer**
11. **Master cylinder push rod**
12. **Clevis pin**

Figure 1-13. Rear Brake Pedal (typical)

GENERAL

⚠CAUTION

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.

1. 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.
2. 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.
3. 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.

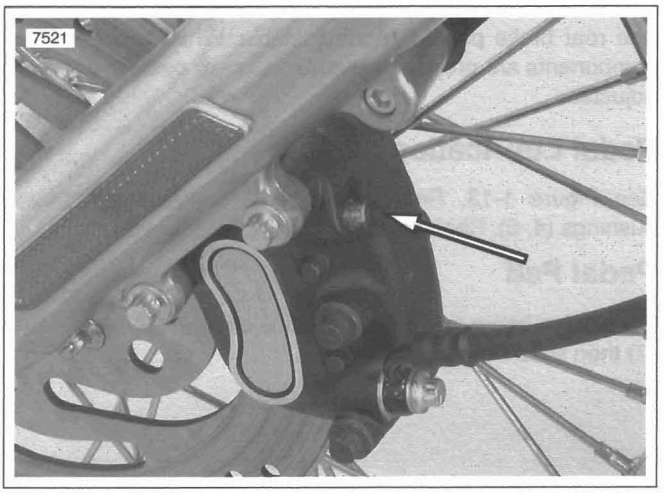


Figure 1-14. Front Brake Bleeder Valve

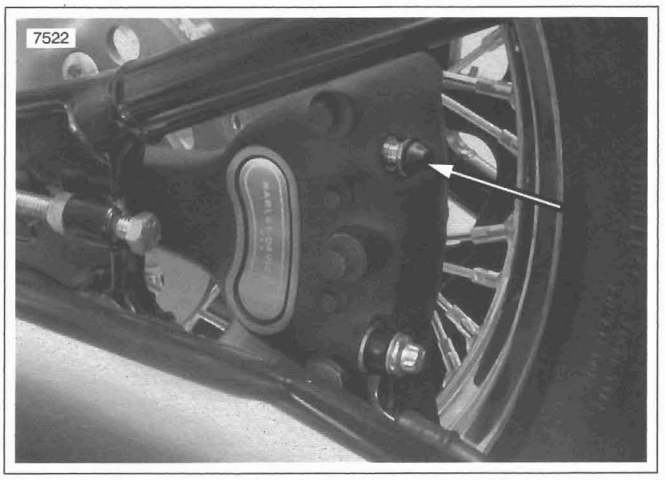


Figure 1-15. Rear Brake Bleeder Valve (typical)

4. Repeat Steps 2-3 until all air bubbles are purged.
5. 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)

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

INSPECTION

Check brake pads and discs:

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

Brake Pads

⚠CAUTION

Direct contact of D.O.T. 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)

⚠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)

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 **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.

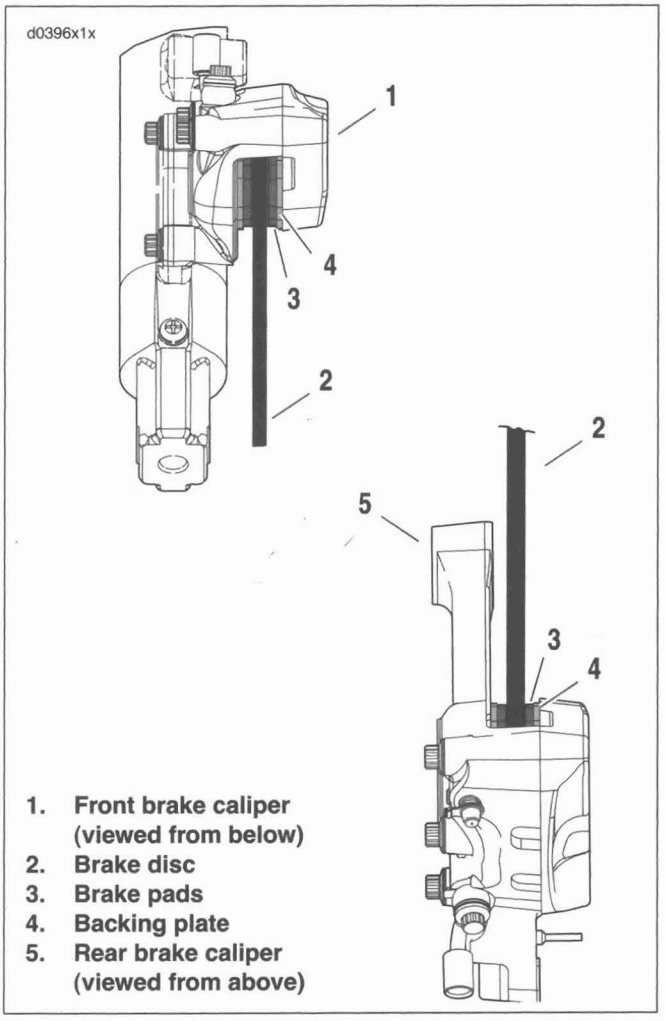


Figure 1-16. Brake Pad Inspection

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).

BRAKE PAD REPLACEMENT

Rear Brake Caliper

1. If present, remove right saddlebag.
2. 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.).
4. 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.

5. 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, FXSTC and FLSTF 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.*

6. 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.

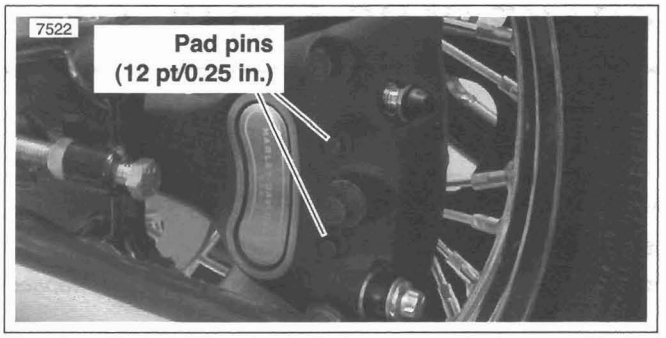
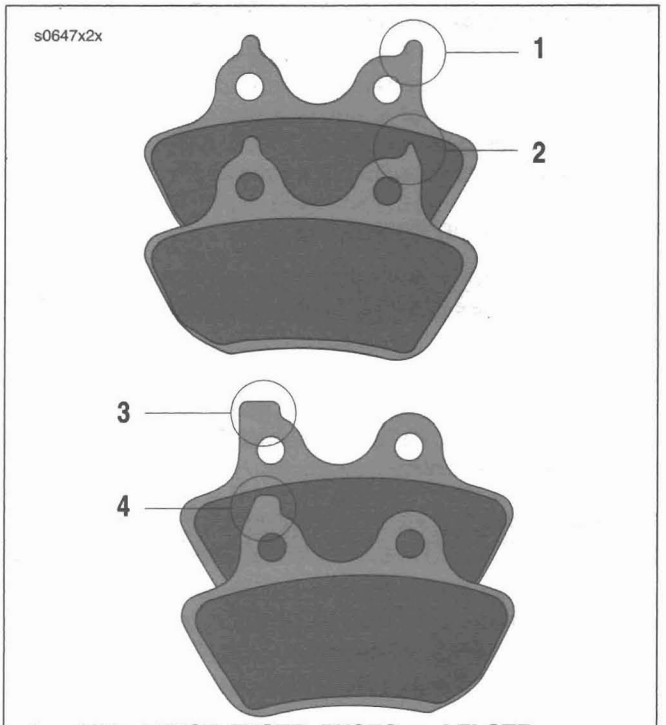
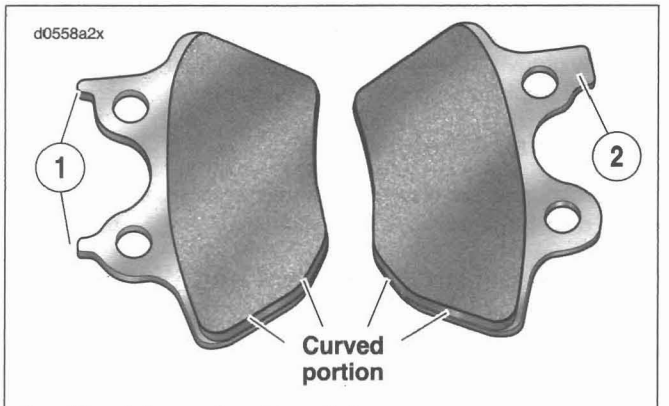


Figure 1-17. Pad Retaining Bolts (Rear Caliper Shown)



1. **All but FXST, FXSTB, FXSTC and FLSTF inboard pad**
2. **FXST, FXSTB, FXSTC and FLSTF inboard pad**
3. **All but FXST, FXSTB, FXSTC and FLSTF outboard pad**
4. **FXST, FXSTB, FXSTC and FLSTF outboard pad**

Figure 1-18. FXST and FXSTB Brake Pads



1. **Two tabs on backing plate**
2. **Single square tab on backing plate**

Figure 1-19. Brake Pad Orientation

8. Pump brake pedal lever to move inside pistons out until they contact inside brake pads.
9. Pry the outside pad back. Pry between the pad and the brake disc in order to push the caliper pistons back into their bores.
10. 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.
11. 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.
12. 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.
13. Install both pad pins through holes in inner and outer brake pads. Tighten 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)

14. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
15. 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.

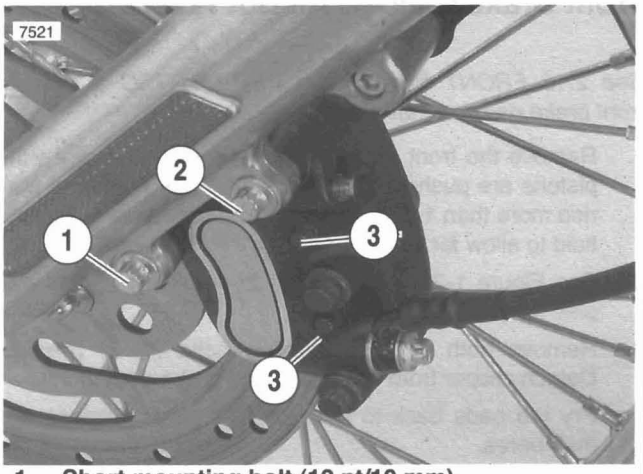
⚠WARNING

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)

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



1. **Short mounting bolt (12 pt/10 mm)**
2. **Long mounting bolt (12 pt/10 mm)**
3. **Pad pins (12 pt/0.25 in)**

Figure 1-20. Front Brake Caliper

Front Brake Caliper: All But FLSTSC

NOTE

See 2.18 FRONT BRAKE CALIPER: FLSTSC 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.
2. See Figure 1-20. Loosen, but do not remove, both pad pins (3) (12 pt/0.25 in.).
3. Remove both caliper mounting bolts (1, 2) (metric). Detach caliper from front forks and brake disc.
4. Pry the pads back to force all four caliper pistons into their bores.
5. With the pistons retracted, remove the pad pins and brake pads.
6. 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).
   e. 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)

10. 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).

⚠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)

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

⚠WARNING

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

- **In addition, using tires other than those specified may adversely affect motorcycle handling.**
- **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.
2. 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)

3. 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, FLSTSC, FLSTN	Front	36	248	36	248
	Rear	36	248	40	276
FXST, FXSTB, FXSTC	Front	30	207	30	207
	Rear	38	262	42	290
FLSTF	Front	36	248	36	248
	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.

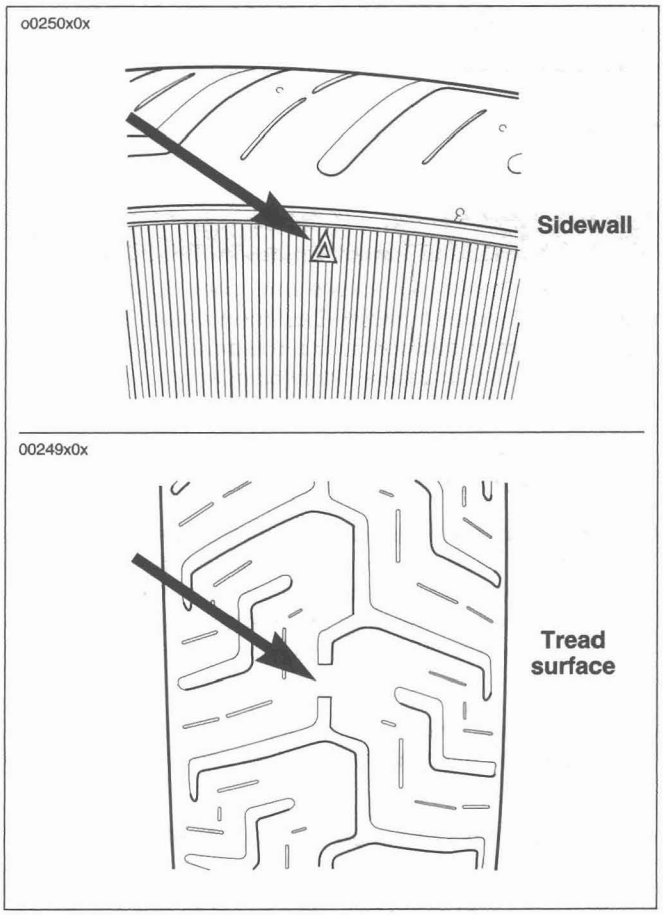


Figure 1-21. Tread Wear Indicators

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 2.8 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.

2. Lightly tap each spoke with a spoke wrench. Loose spokes will sound dull and must be tightened. Tighten spokes to 40-50 **in-lbs** (4.5-5.6 Nm). If more than a few spokes are loose, true the entire wheel following procedure under 2.11 TRUING LACED WHEEL.

PRIMARY CHAIN 1.10

GENERAL

NOTE

Softail models have an automatic chain tensioner. See 6.3 DRIVE COMPONENTS for primary chain procedures.

CHANGING LUBRICANT

1. See Figure 1-22. 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.
4. Install drain plug back into primary chaincase cover. Tighten plug to 14-21 **ft-lbs** (19.0-28.5 Nm).
5. See Figure 1-23. Remove five TORX screws with captive washers (1) to detach clutch inspection cover (2) from primary chaincase cover.
6. Remove the gasket. Wipe oil from groove in chaincase cover and mounting surface.

⚠WARNING

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

CAUTION

Do not overfill the primary chaincase with lubricant. Overfilling can cause rough clutch engagement, incomplete disengagement, clutch drag and/or difficulty in finding neutral at engine idle. (00199b)

7. Pour 32 oz. (0.95 liter) of primary chaincase lubricant in through the clutch inspection cover opening.

NOTE

- *Use only genuine Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 99851-05 (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.*

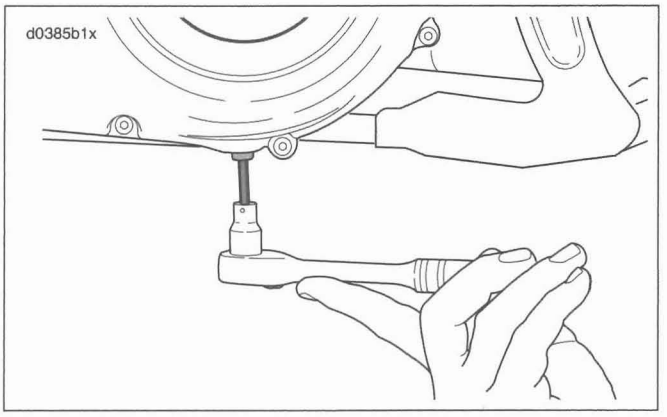
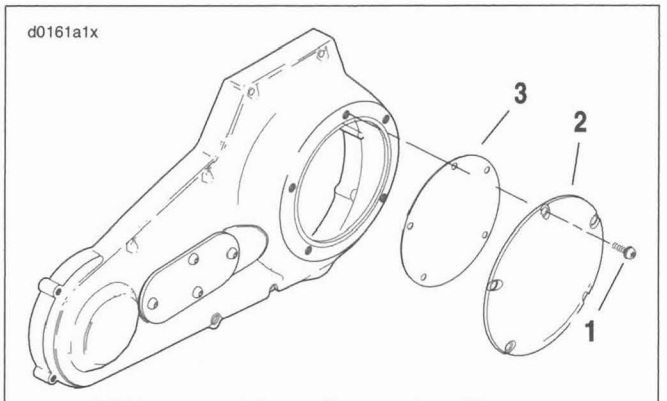


Figure 1-22. Removing Chaincase Drain Plug



1. **TORX screw with captive washer (5)**
2. **Clutch inspection cover**
3. **Gasket**

Figure 1-23. Clutch Cover

8. Install clutch inspection cover and seal as follows:
   a. Thoroughly wipe all lubricant from cover mounting surface and groove in chaincase.
   b. See Figure 1-23. Position seal (3) in groove in primary chaincase cover and press each of the nubs on seal into the groove. The nubs will retain seal in position.
   c. See Figure 1-24. Insert screw (with captive washer) through clutch inspection cover and carefully thread it into the top cover screw hole.
   d. Start the remaining four screws (with captive washers).
   e. Alternately tighten screws to 84-108 **in-lbs** (9.5-12.2 Nm) following torque sequence shown in Figure 1-24.

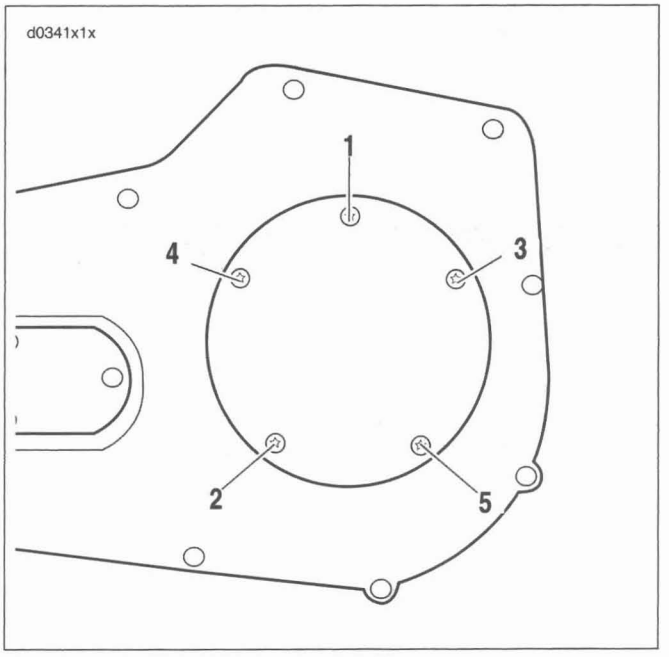


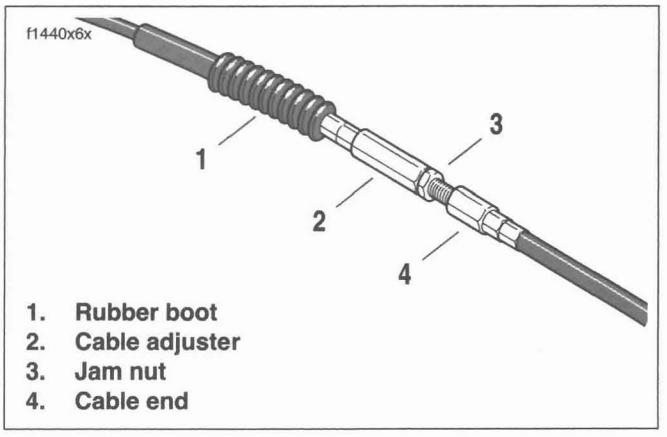
Figure 1-24. Clutch Cover Torque Sequence

ADJUSTMENT

CAUTION

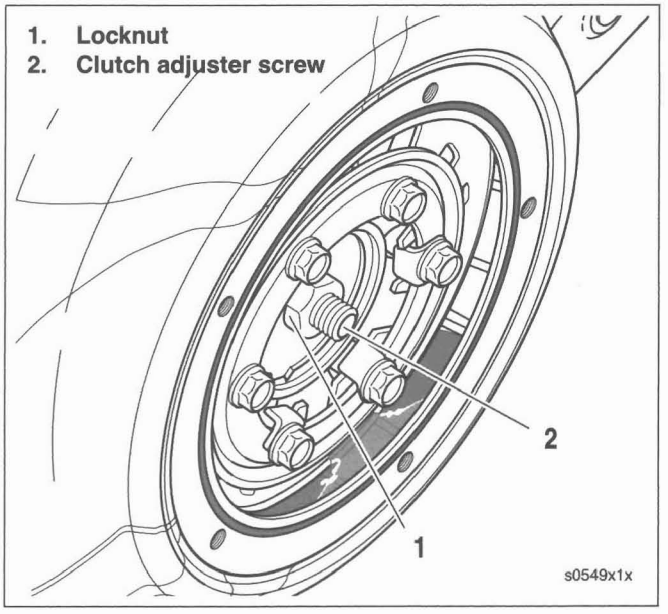
Perform the clutch adjustment with the motorcycle at room temperature. The clearance at the adjuster screw will increase as the powertrain temperature increases. If adjuster screw is adjusted with power train hot, clearance at push rod bearing could be insufficient with power train cold and clutch slippage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

1. Stand motorcycle upright and level. Point front wheel straight ahead.
2. Remove five TORX screws with captive washers to detach clutch inspection cover from primary chaincase cover.
3. Remove and discard gasket.
4. See Figure 1-25. 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.
5. See Figure 1-26. 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.
6. 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.
   b. See Figure 1-27. 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.
9. 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.



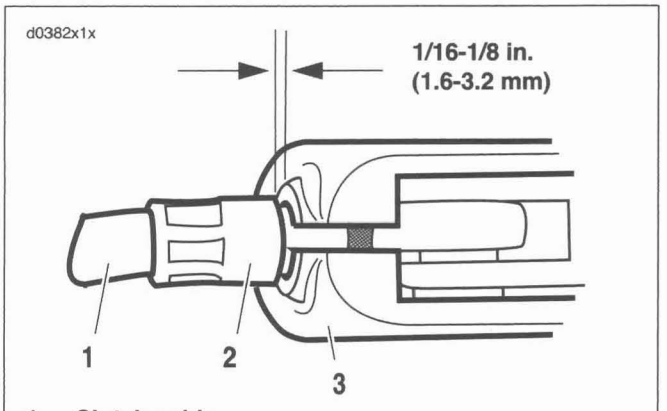
1. Rubber boot
2. Cable adjuster
3. Jam nut
4. Cable end

Figure 1-25. Clutch Cable Adjuster



1. Locknut
2. Clutch adjuster screw

Figure 1-26. Clutch Adjuster Screw



1. Clutch cable
2. Cable ferrule
3. Clutch lever bracket

Figure 1-27. Clutch Hand Lever

10. 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.
    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.
    d. 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 1-28.

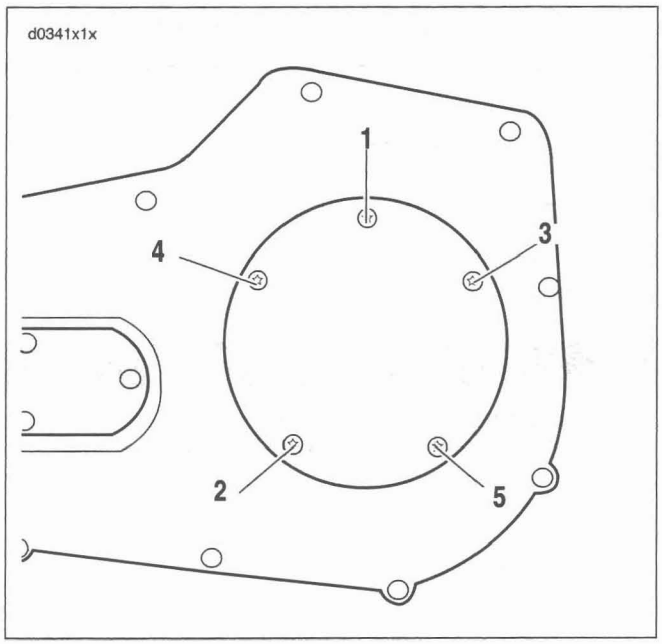


Figure 1-28. Clutch Cover Torque Sequence

CHANGING LUBRICANT

1. See Figure 1-29. Remove transmission filler plug.
2. See Figure 1-30. 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.
   a. Inspect O-ring on drain plug for tears or damage. Replace as 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). Do not over-tighten.

⚠WARNING

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

4. Fill the transmission with 32 oz. (0.95 liters) of Harley-Davidson FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT (Part No. 99851-05, quart size).
5. Check lubricant level.
   a. Place motorcycle on jiffy stand.
   b. Wipe dipstick clean. Place dipstick inside fill hole. Dipstick should rest on top thread of filler hole. Remove dipstick and check level.
   c. See Figure 1-31. Lubricant level should be at the F(ULL) mark (1) on dipstick when removed.
6. Install filler plug/dipstick.
   a. Check O-ring (3) on dipstick for tears or damage. Replace as required. Wipe any foreign material from plug.
   b. Install filler plug/dipstick. Tighten to 25-75 **in-lbs** (2.8-8.5 Nm).

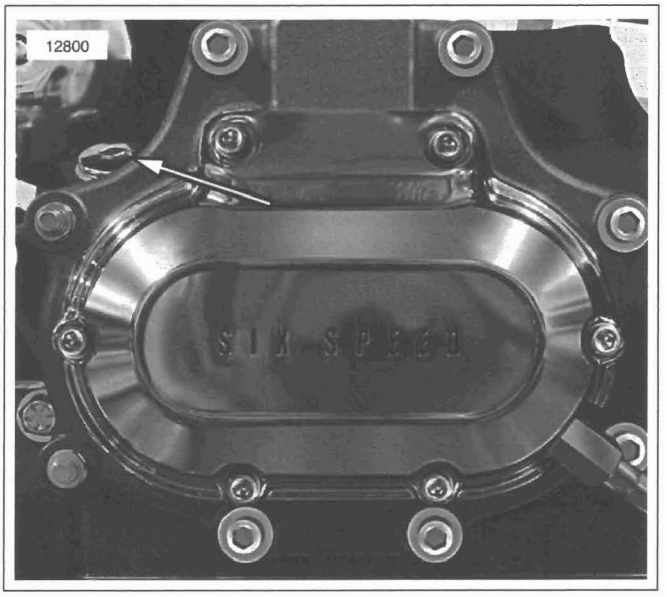


Figure 1-29. Transmission Lubricant Check/Fill

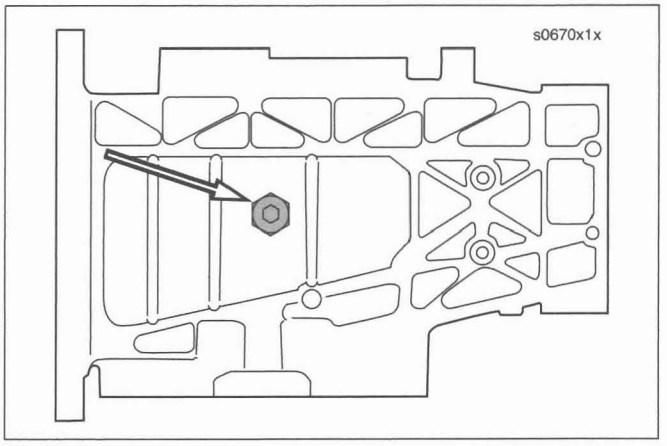
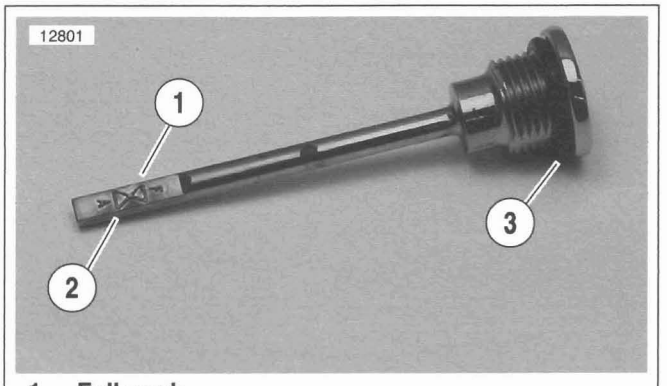


Figure 1-30. Transmission Drain Plug (Bottom View)



1. **Full mark**
2. **Add mark**
3. **O-ring**

Figure 1-31. Filler Plug/Dipstick

INSPECTION

NOTE

Do not rely on "feel" for the proper deflection as this typically results in belts which are under tensioned. Always use H-D BELT TENSION GAUGE (Part No. HD-35381) to determine the 10 lb. (4.5 Kg) deflection force. Loose belts will fail due to "ratcheting" (jumping a tooth) with resultant tensile cord crimping and breakage.

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.

NOTE

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

1. See Figure 1-32. Obtain BELT TENSION GAUGE (HD-35381-A).
2. To use the belt tension gauge:
   a. Slide O-ring (4) toward 0 lbs (0 kg) mark (3).
   b. Fit belt cradle (2) against **bottom** of drive belt halfway between drive pulleys (point A in Figure 1-33.)
   c. Press upward on knob (6) until O-ring slides down to 10 lbs (4.5 kg) mark (5).
3. See Figure 1-33. Check Drive belt deflection. Apply 10 lbs (4.5 kg) of force upward at point A.
4. Refer to Table 1-6. Compare drive belt deflection with specifications listed in the table.

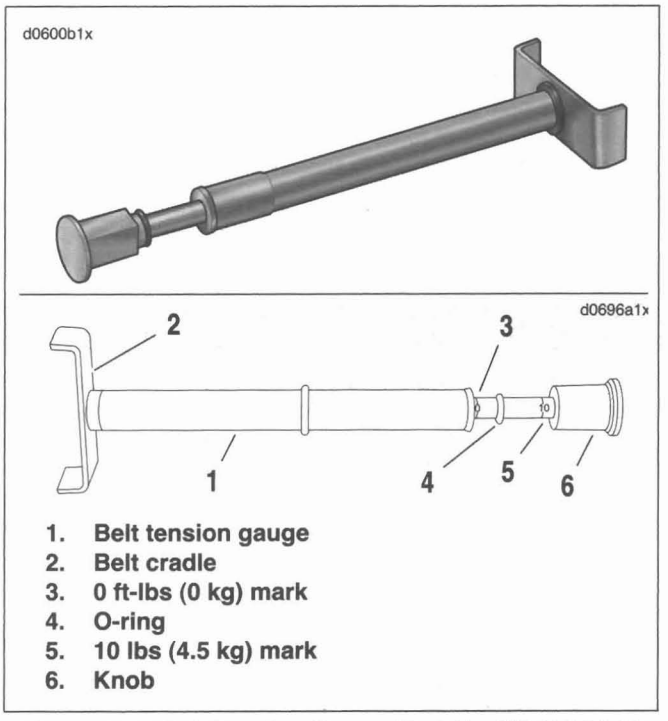


Figure 1-32. Belt Tension Gauge (Part No. HD-35381-A)

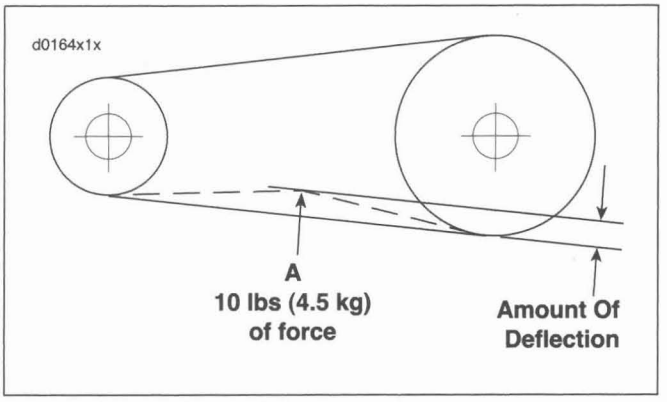


Figure 1-33. Checking Belt Deflection

Table 1-6. Rear Belt Deflection

VEHICLE	FLSTN/FXSTD	FXST/FLSTC/ FLSTF/FXSTB/ FLSTSC/FXSTC
With motorcycle on jiffy stand without rider or luggage	1/4-5/16 in. (6.4-7.9 mm)	9/16-5/8 in. (14.3-15.9 mm)
Vehicle upright with rear wheel in air	5/16-3/8 in. (7.9-9.5 mm)	11/16-3/4 in. (17.5-19.0 mm)

ADJUSTMENT

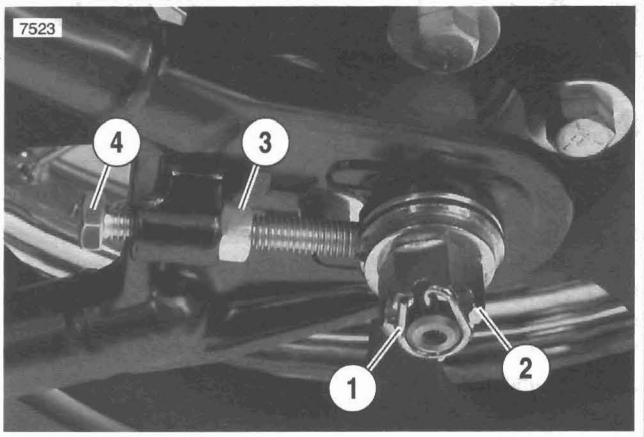
If belt adjustment is necessary, perform the following procedure:

1. See Figure 1-34. Remove spring clip (1) and loosen axle nut (2) and jam nut (3).
2. 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.
3. Tighten axle adjuster jam nuts (3) to 15-20 ft-lbs (20.3-27.1 Nm). Check that rear wheel is properly aligned. See 2.14 VEHICLE ALIGNMENT.

⚠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. 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).



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

Figure 1-34. 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.

1. See Figure 1-35. Inspect each tooth (1) of rear sprocket for:
   a. Major tooth damage.
   b. Large chrome chips with sharp edges.
   c. Gouges caused by hard objects.
   d. Excessive loss of chrome plating (see step 2).
2. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (2) (between two teeth) with medium pressure.
   a. If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
   b. If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
3. Replace rear sprocket if major tooth damage or loss of chrome exists.

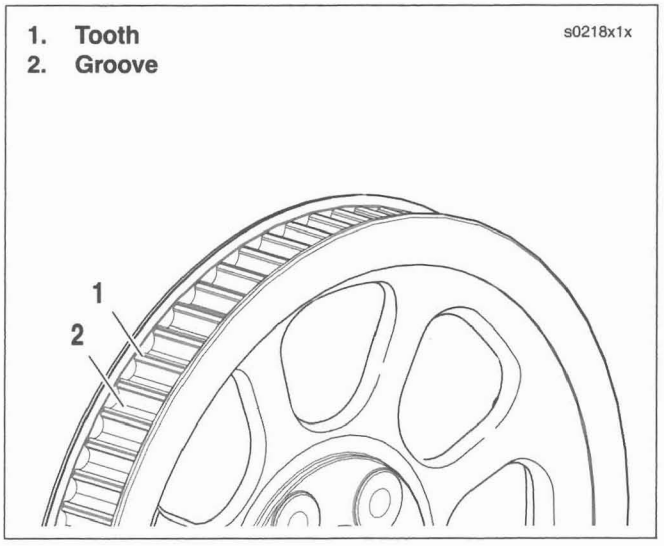


Figure 1-35. Rear Sprocket

Rear Belt

See Figure 1-36. 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.

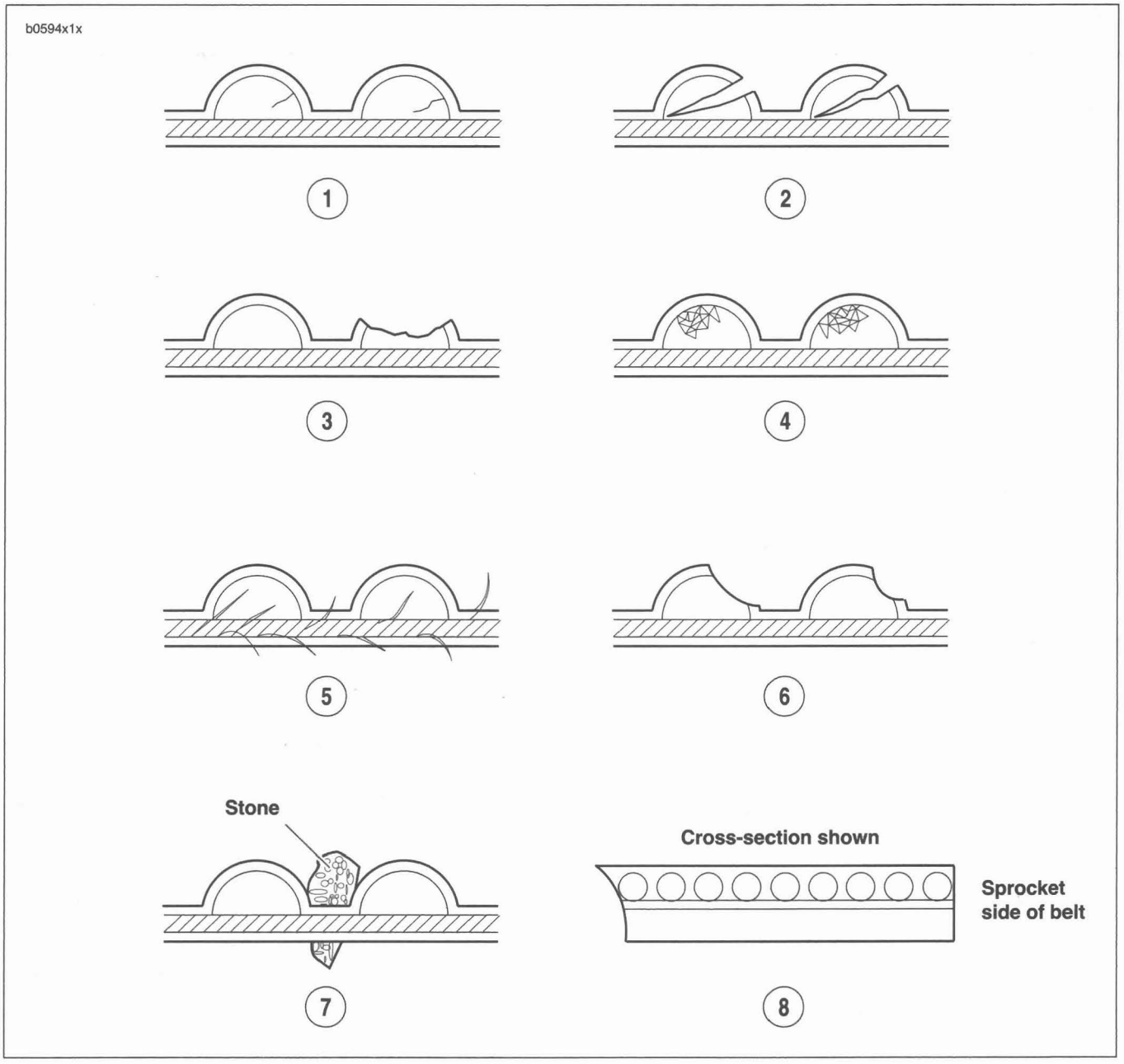


Figure 1-36. Drive Belt Wear Patterns

Table 1-7. Drive Belt Wear Analysis in Figure 1-36.

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

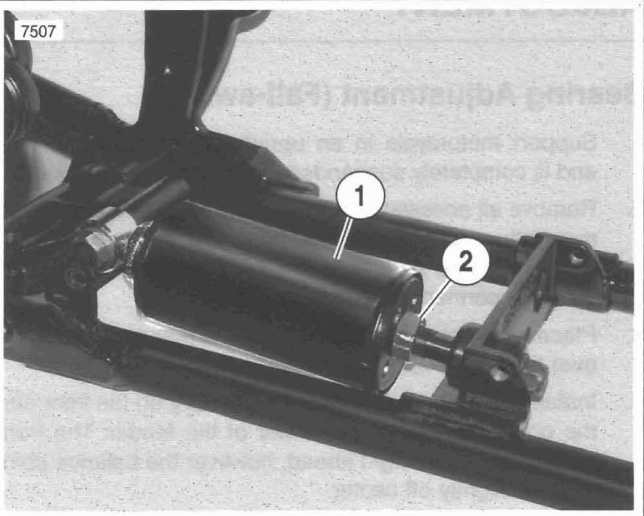
The Softail rear shock absorber springs can be adjusted for the weight the motorcycle is to carry. Use the spanner wrench for this purpose.

1. See Figure 1-37. Loosen the locknuts (2).

⚠WARNING

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

2. See Figure 1-38. 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.



1. **Rear shock canister**
2. **Locknut**

Figure 1-37. Rear Shock Adjustment

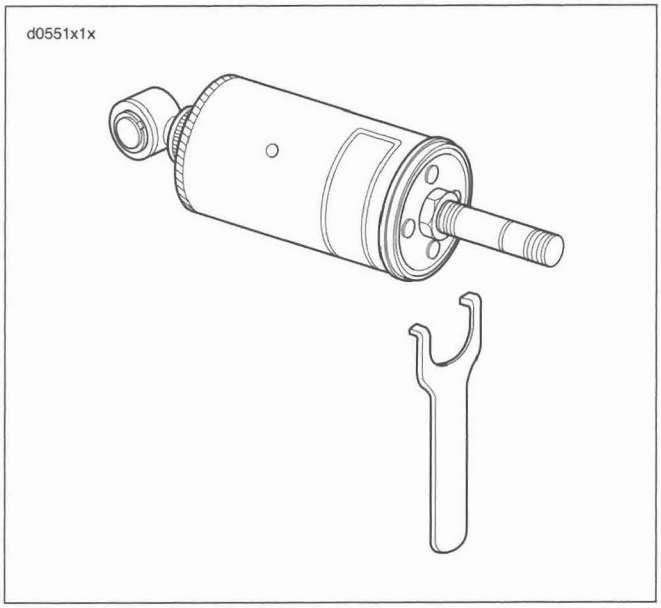


Figure 1-38. Spanner Wrench

ADJUSTMENT

Bearing Adjustment (Fall-away)

1. Support motorcycle in an upright position so the front end is completely suspended and the vehicle is level.
2. 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.
3. Place a suitable marking material, such as masking tape, over the fender tip.
4. Install a pointer so the base is stationary on the floor and the pointer indicates the center of the fender. The front end should be straight ahead, however the balance point may be slightly off center.
5. 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.
7. 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 1-39. 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).
9. Repeat the "fall-away" procedure to be sure the adjustment is correct.

LUBRICATION

See Figure 1-39. 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

⚠WARNING

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 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.*

⚠CAUTION

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 the 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.

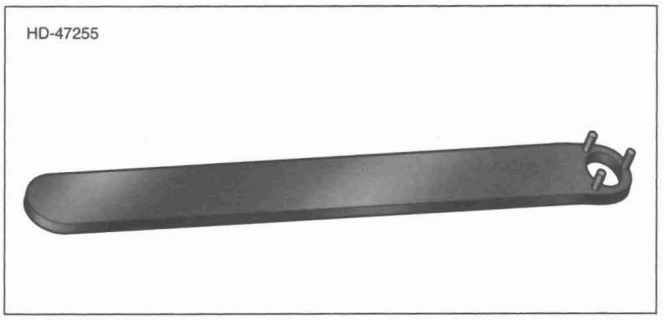


Figure 1-40. Springer Steering Head Bearing Tool

ADJUSTMENT

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.
4. See Figure 1-41. 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.
6. 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.
   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 the distance between marks.
10. 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.
11. Tighten the upper clamp pinch bolt (3) to 25-30 ft-lbs (33.9-40.7 Nm).
12. Install the rubber washer and acorn nut. Tighten acorn nut to 30-35 **in-lbs** (3.4-4.0 Nm).
13. Repeat the "fall-away" procedure to verify that adjustment is correct.

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

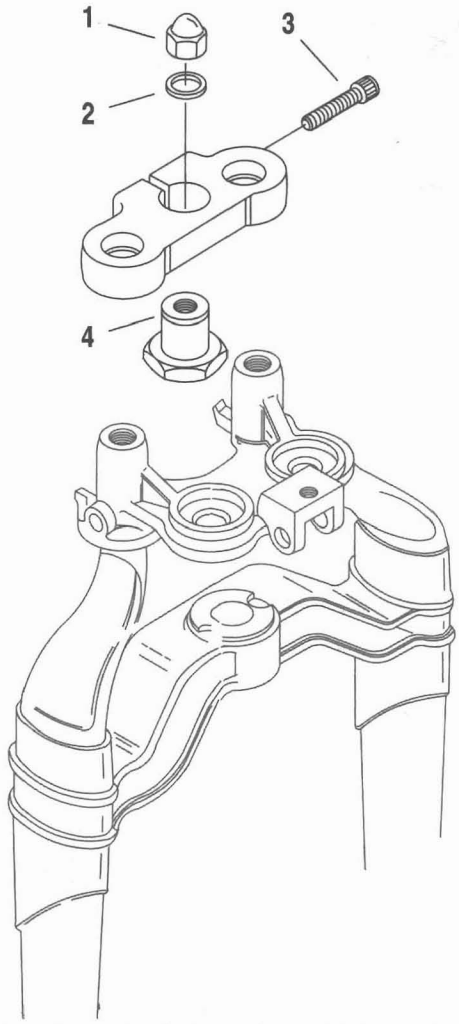


Figure 1-41. FLSTSC Fork Adjustment

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 1-42. The spring fork can be disconnected from the rockers without removing the front end from the motorcycle.

1. Remove front brake caliper and brake line. See 2.18 FRONT BRAKE CALIPER: FLSTSC.
2. Remove front wheel. See 2.6 FRONT WHEEL: FLSTSC.
3. On FLSTSC only, remove front fender. See 2.31 FRONT FENDER: FLSTSC.

⚠WARNING

See Figure 1-42. 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.

4. See Figure 1-42. Use cable ties to tie wrap the spring fork legs to the rigid fork legs.
5. See Figure 1-43. Loosen, but do not remove, the bearing retainer jam nuts (7) and bearing retainers (6) on the rockers.

NOTE

*The **threaded side** of the rocker and jam nut is installed **outboard** the rigid fork leg.*

6. Loosen spring fork pivot studs (5) (thick head) and remove the 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-lbs** (2.8-4.0 Nm).
8. 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).

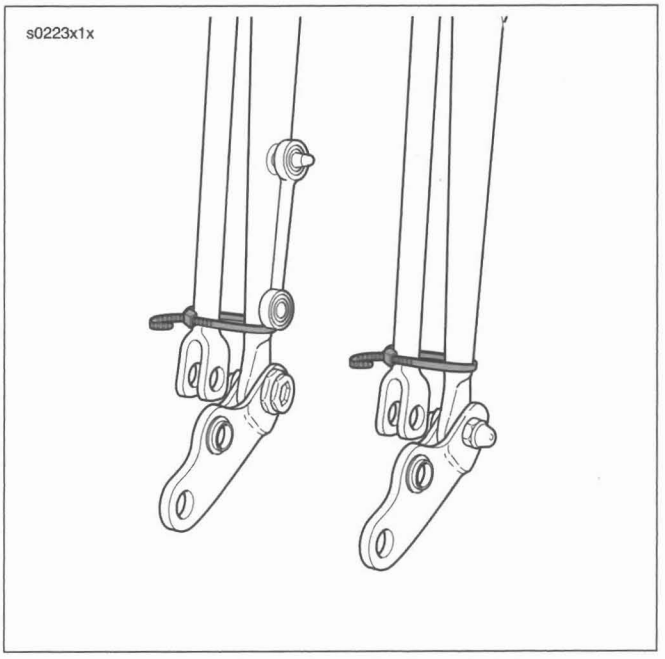
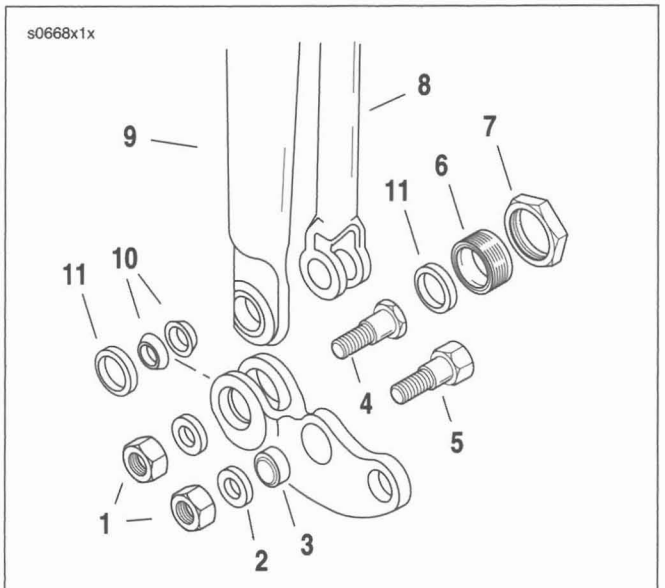


Figure 1-42. Cable Strap Spring Fork Legs



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))**

Figure 1-43. Rocker Assembly

10. See Figure 1-44. 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-lbs** (2.8-4.0 Nm).
11. If the torque reading in the previous step is out of specification, adjust the bearing retainer to obtain a 25-35 **in-lbs** (2.8-4.0 Nm) reading.

NOTE

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

12. See Figure 1-43. 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). Tighten nuts to 45-50 ft-lbs (61.0-67.8 Nm).
13. On FLSTSC only, install fender. See 2.31 FRONT FENDER: FLSTSC.
14. Install front wheel. See 2.6 FRONT WHEEL: FLSTSC.
15. Install front brake caliper and brake line. See 2.18 FRONT BRAKE CALIPER: FLSTSC.

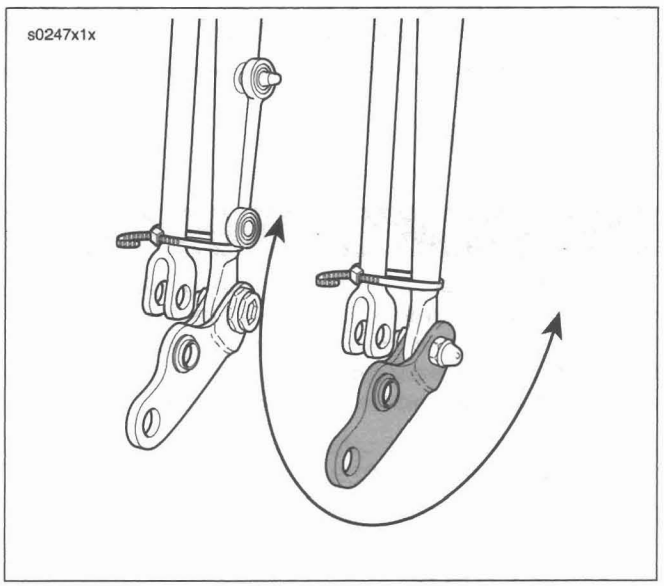


Figure 1-44. Rocker Rotation

REPLACING FORK OIL

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

⚠WARNING

The FLSTC and FLSTF 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 1-45. Remove the fork tube caps.
3. Drain fork oil.
   a. FXSTD models, see Figure 1-46. Remove the drain screws and washers from each fork and drain the fork oil.
   b. All models except FXSTD, see Figure 1-47. 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 **in-lbs** (1.4-2.0 Nm).
   b. All models except FXSTD, tighten drain screws to 52-78 **in-lbs** (5.9-8.9 Nm).

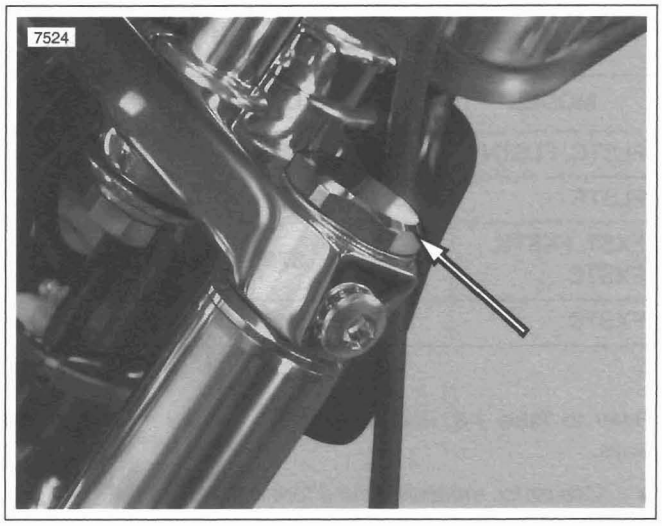


Figure 1-45. Fork Tube Cap

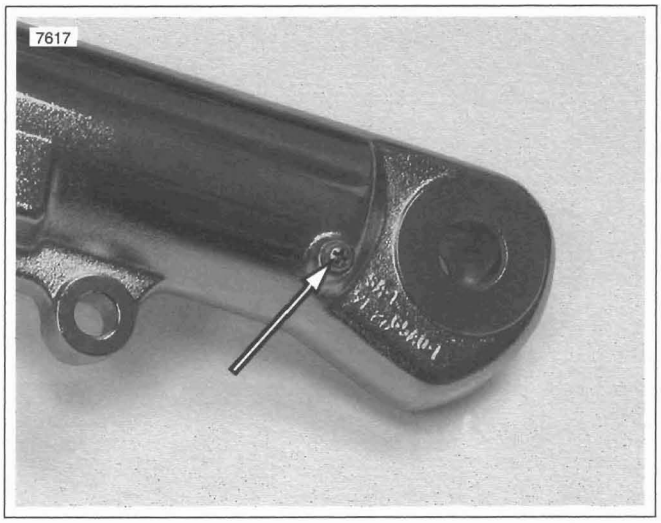


Figure 1-46. Fork Drain Screw: FXSTD (Left Side Shown)

5. Refer to Table 1-8. 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 1-8. Type E Fork Oil Amounts

MODEL	OZ	CC	IN.	MM
FLSTC, FLSTN	13.4	395	4.41	112.0
FLSTF	13.4	397	5.04	128.0
FXST, FXSTB, FXSTC	12.5	370	6.69	170.0
FXSTD	11.6	343	7.48	190.0

NOTE

Refer to Table 1-8. 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.*

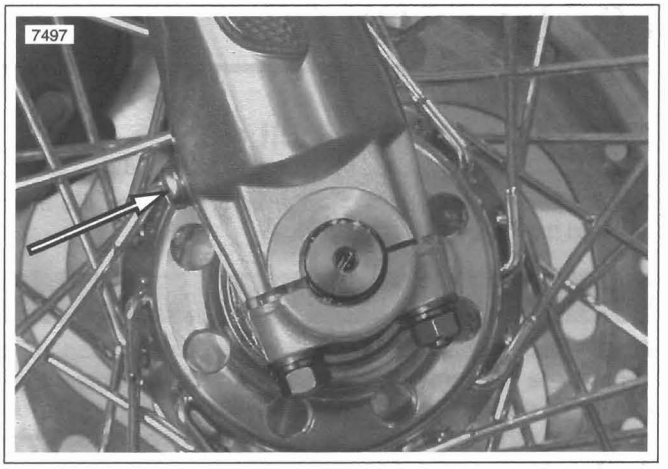


Figure 1-47. Fork Drain Screw: All Models Except FXSTD (Right Side Shown)

INSPECTION

1. After the engine has cooled to room temperature, disconnect cables from both spark plugs.
2. Remove spark plugs. If a plug has eroded electrodes, heavy deposits or a cracked insulator, discard it.
3. See Figure 1-48. Compare your observations of the plug deposits with the descriptions provided below.
   a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.
   b. A dry, fluffy or sooty black deposit indicates an air-fuel mixture that is too rich.
   c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.
   d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals.
4. If the plugs require cleaning between tune-ups, proceed as follows:
   a. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry plug with compressed air.
   b. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25-40% less firing voltage than one with rounded edges.
   c. If the plugs cannot be cleaned, replace with No. 6R12 spark plugs.

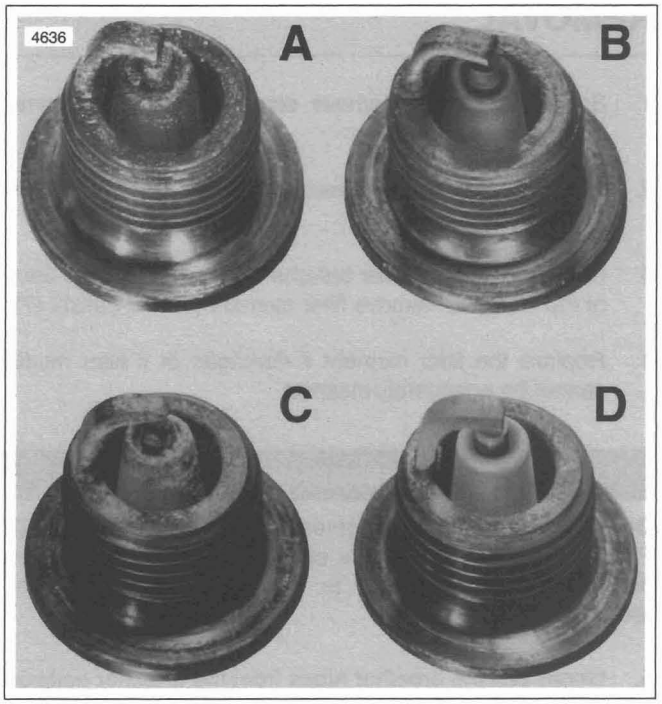


Figure 1-48. Typical Spark Plug Deposits

5. 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).
6. Check condition of threads on cylinder head and plug. If necessary to remove deposits, apply penetrating oil and clean out with a thread chaser.
7. Apply LOCTITE ANTI-SEIZE to plugs. Install and tighten to 12-18 ft-lbs (16.3-24.4 Nm).
8. 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

1. See Figure 1-49. Remove screw (1) and air cleaner cover (2).
2. Remove three TORX screws (4) and bracket (5) from filter element (6).
3. Gently pull both rubber breather tubes (9) from the back of the element. Remove filter element (6) and gasket (7).
4. Replace the filter element if damaged or if filter media cannot be adequately cleaned.

⚠WARNING

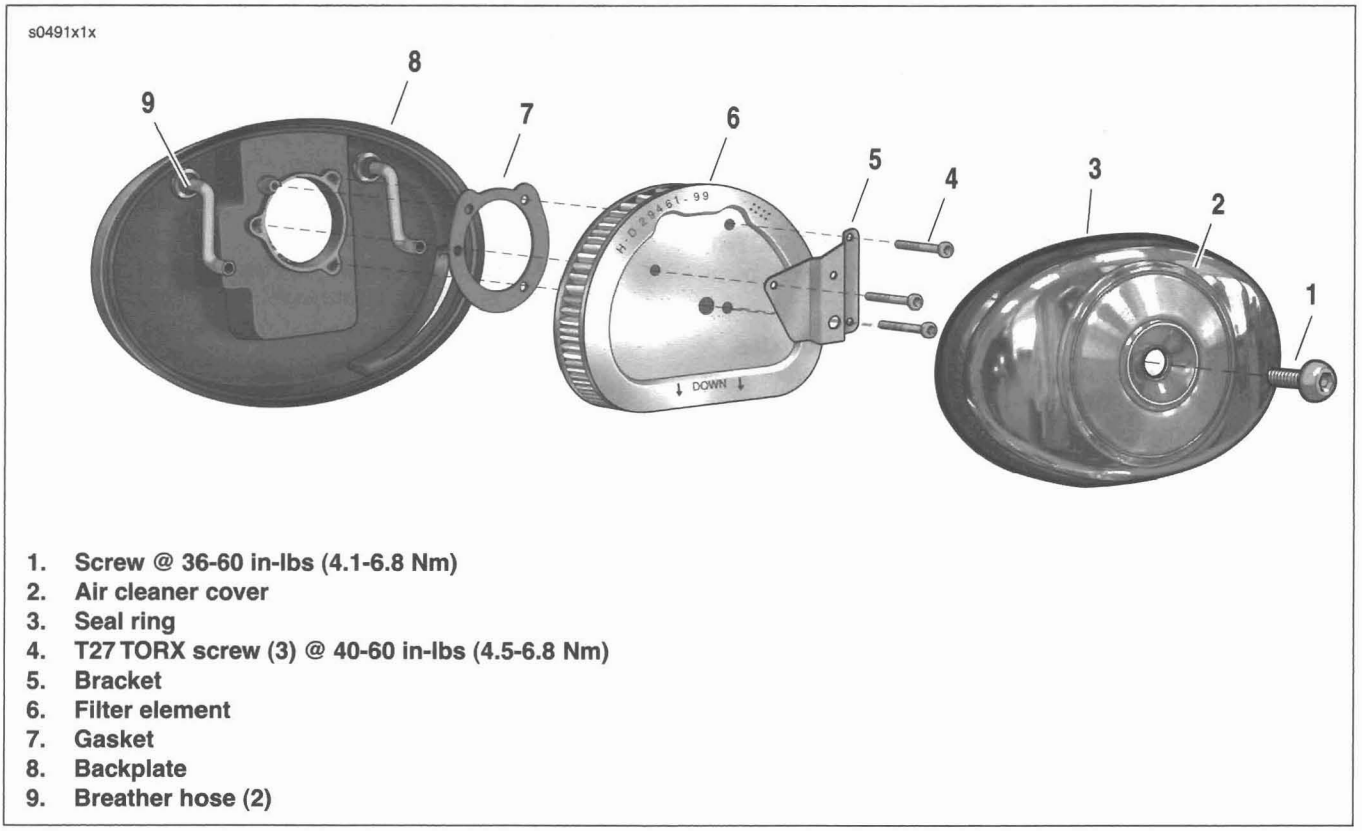
Do not use gasoline or solvents to clean filter element. Flammable cleaning agents can cause an intake system fire, which could result in death or serious injury. (00101a)

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.



1. **Screw @ 36-60 in-lbs (4.1-6.8 Nm)**
2. **Air cleaner cover**
3. **Seal ring**
4. **T27 TORX screw (3) @ 40-60 in-lbs (4.5-6.8 Nm)**
5. **Bracket**
6. **Filter element**
7. **Gasket**
8. **Backplate**
9. **Breather hose (2)**

Figure 1-49. Air Cleaner Assembly

8. 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 1-50. Position **new** gasket on backplate.
2. See Figure 1-51. 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 1-49. 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).
   b. Install air cleaner cover using screw. Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).

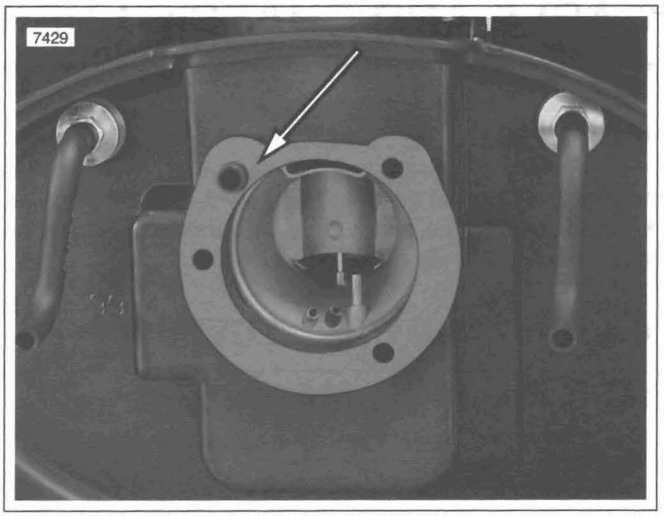


Figure 1-50. Gasket Installation

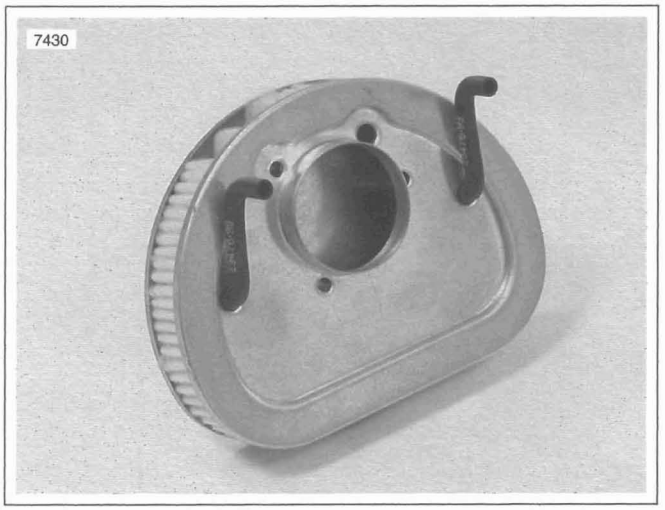


Figure 1-51. Breather Hose Holes on Backside of Filter

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

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:

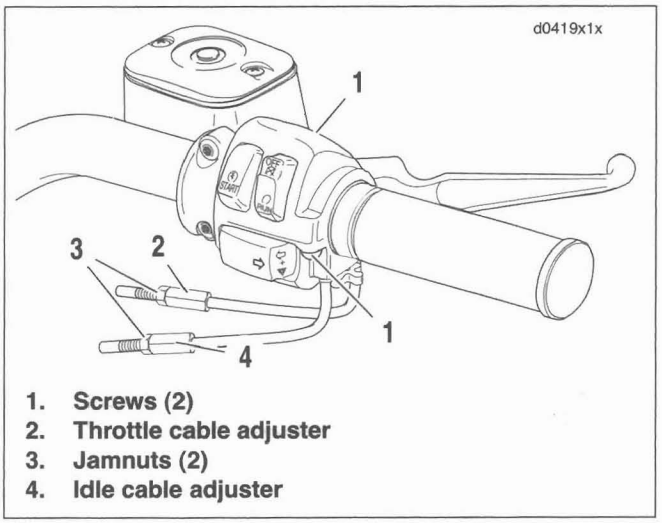
- At the first scheduled service interval.
- At every scheduled service interval.

If service is on muddy or dusty roads, clean and lubricate at shorter intervals. See 2.40 JIFFY STAND for more information.

CABLE INSPECTION, LUBRICATION AND ADJUSTMENT

Inspection and Lubrication

1. See Figure 1-52. 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.
4. Apply a light coat of graphite to the handlebar and replace throttle grip.
5. Put one or two drops of SUPER OIL (Part No. 94968-85TV) into the housing of each cable.
6. When assembling the handlebar housing, tighten both screws (1) to 35-45 **in-lbs** (4.0-5.1 Nm).



1. **Screws (2)**
2. **Throttle cable adjuster**
3. **Jamnuts (2)**
4. **Idle cable adjuster**

Figure 1-52. Throttle Cable Adjusters

Adjustment

1. See Figure 1-52. Turn the cable adjusters (2, 4) and jamnuts (3) as short as they will go. Both cables should have zero adjustment at the start of this procedure.
2. Point the front wheel straight ahead.
   a. Turn the throttle grip wide open and hold it there.
   b. See Figure 1-53. Turn the throttle cable adjuster, lengthening the sleeve, until the throttle cam (2) just touches the cam stop (5).
   c. Tighten the adjuster jamnut and release the throttle.
3. Turn the front wheel full right.
4. 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.

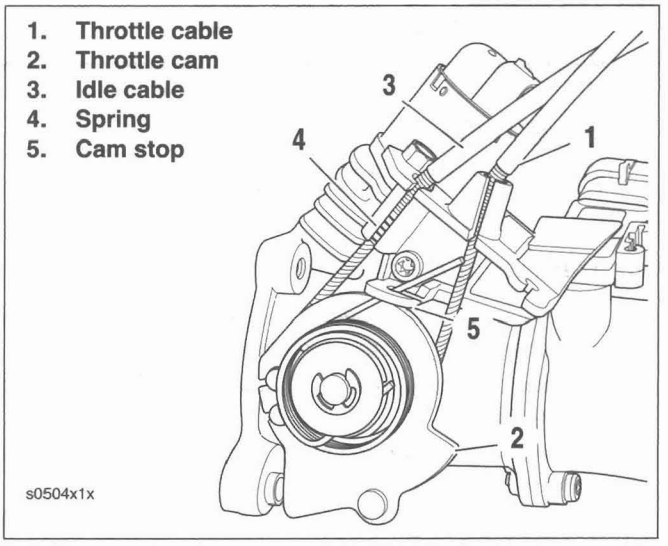


Figure 1-53. Idle Cable Connection

INSPECTION

1. See Figure 1-54. Tighten the rear fork pivot nut to 90-110 ft-lbs (122.0-149.1 Nm).
2. See Figure 1-55. Tighten front engine mounting nuts (1) to 70-80 ft-lbs (94.9-108.5 Nm).
3. Tighten the upper engine mounting to cylinder head bolts (2) to 28-35 ft-lbs (38.0-47.5 Nm)
4. 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.

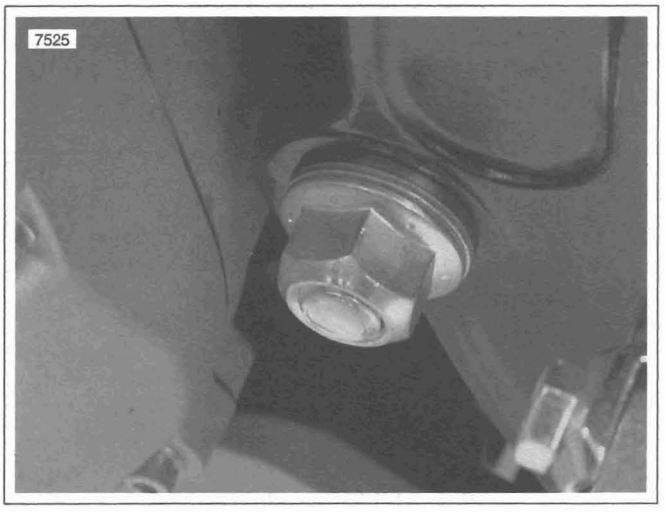
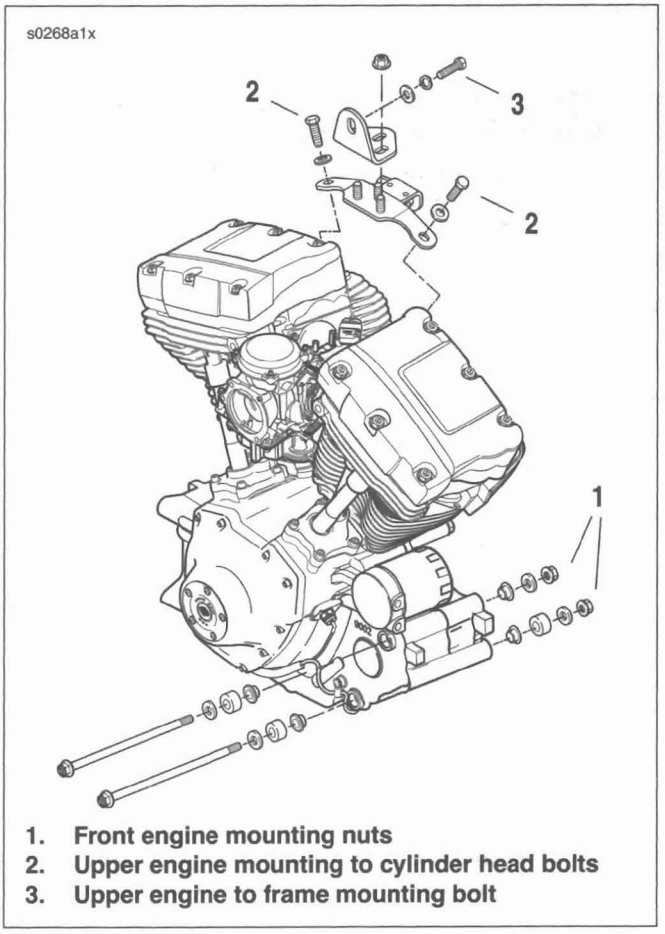


Figure 1-54. Pivot Nut



1. **Front engine mounting nuts**
2. **Upper engine mounting to cylinder head bolts**
3. **Upper engine to frame mounting bolt**

Figure 1-55. Engine Mounts

INSPECTION

⚠WARNING

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.)

1. Verify correct front and rear tire pressure. See 1.9 TIRES AND WHEELS.
2. Place motorcycle on level floor (or pavement) in an area with minimum light.
3. 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 1-56. For FXST, FXSTB, FXSTD, FXSTC, FLSTSC and (and HDI FLSTC/FLSTF) vehicles, draw a horizontal line 35 in. (0.9 m) above floor on screen/wall.
   b. See Figure 1-57. For FLSTC, FLSTF and FLSTN vehicles, draw a horizontal line level with the center of the headlamp.
5. Load vehicle with rider, passenger (if normally present) and any cargo. Weight will compress vehicle suspension slightly.
6. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
7. See Figure 1-58. 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.

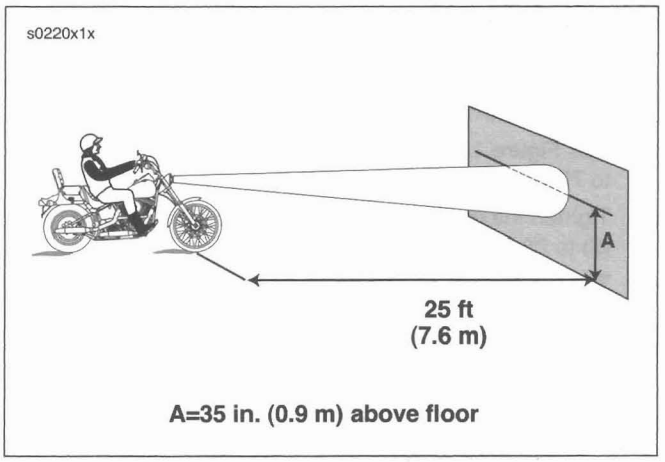


Figure 1-56. Headlamp Alignment

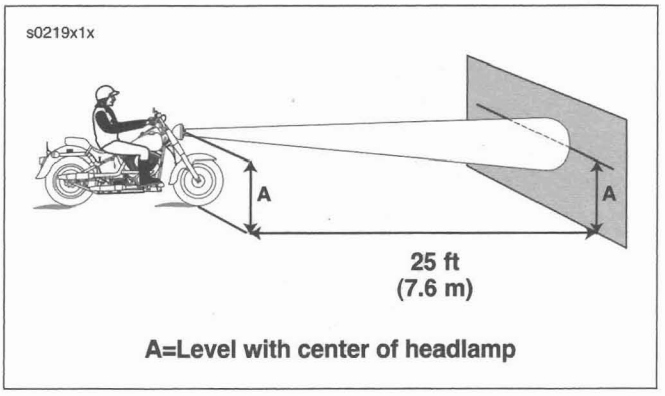


Figure 1-57. Headlamp Alignment: FLSTC/FLSTF/FLSTN (Domestic Models)

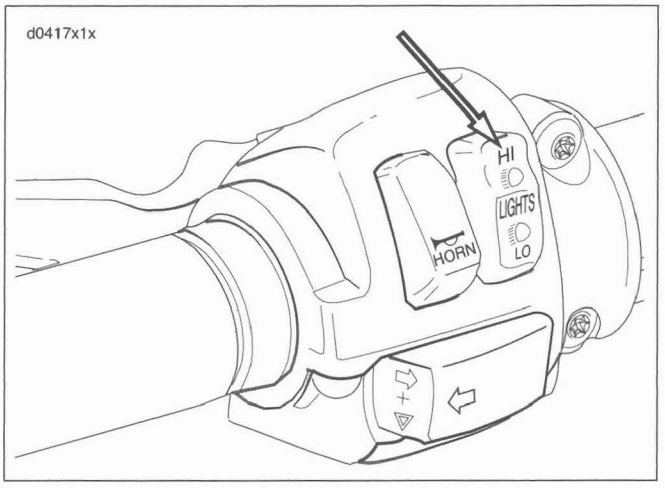


Figure 1-58. High Beam Setting

ADJUSTMENT

FLSTSC Models

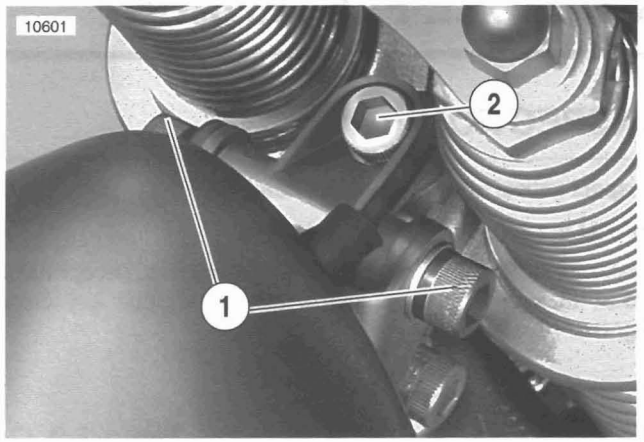
1. See Figure 1-59. Set vertical adjustment.
   a. Loosen the two vertical adjustment fasteners (1).
   b. Tilt headlamp up or down in relationship to the horizontal line from the headlamp alignment inspection.
   c. Tighten both fasteners to 25-35 ft-lbs (33.9-47.5 Nm).
2. Set horizontal adjustment.
   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/FXST/FXSTB/FXSTC MODELS

1. See Figure 1-60. 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).
3. Loosen vertical adjusting bolt (1) to adjust headlamp up or down.
4. Tighten fastener to 35-45 ft-lbs (47.5-61.0 Nm).

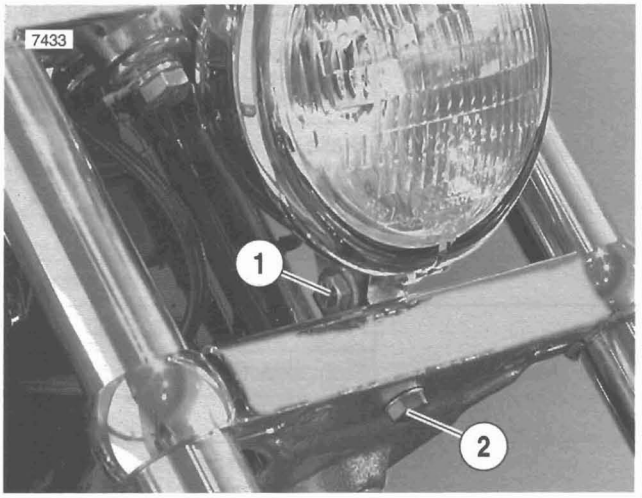
FXSTD MODELS

1. See Figure 1-61. 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).
3. Loosen vertical adjusting bolt (1) to adjust headlamp up or down.
4. Tighten fastener to 25-30 ft-lbs (33.9-40.7 Nm).



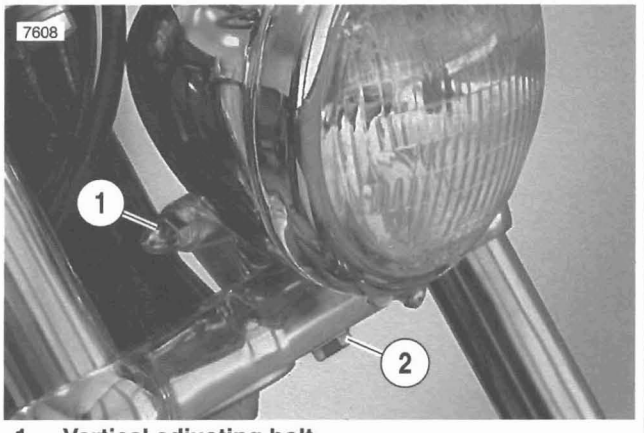
1. Vertical adjusting fastener (2)
2. Horizontal adjusting fastener

Figure 1-59. Headlamp Adjustment: FLSTSC



1. Vertical adjusting bolt
2. Horizontal adjusting bolt

Figure 1-60. Headlamp Adjustment: FLSTC, FLSTF, FLSTN, FXST, FXSTB, FXSTC



1. Vertical adjusting bolt
2. Horizontal adjusting bolt

Figure 1-61. Headlamp Adjustment: FXSTD

INSPECTION

Inspect critical fasteners, except head bolts:

- At the scheduled service intervals.

Refer to Table 1-9. Torque all critical fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

Table 1-9. Critical Fasteners

SYSTEM	FASTENER	TORQUE	
Hand controls	Upper and lower switch housings	35-45 **in-lbs**	4.0-5.1 Nm
	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
Brakes	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
	Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm
	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
Axle nuts	Front axle: all but FLSTSC	60-65 ft-lbs	81.3-88.1 Nm
	Front axle: FLSTSC	60-65 ft-lbs	81.3-88.1 Nm
	Rear axle	60-65 ft-lbs	81.3-88.1 Nm
Front fork/handlebars	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
	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

GENERAL

⚠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 fuel system.

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

1. Run motorcycle until engine is at normal operating temperature. Stop the engine then drain the oil 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)

⚠WARNING

Use care when refueling. Pressurized air in fuel tank can force gasoline to escape through filler tube. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00029a)

2. Prepare your fuel system by filling fuel tank and adding a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions.
3. Remove the spark plugs, inject a few squirts of engine oil into each cylinder and crank the engine 5-6 revolutions. Reinstall spark plugs.
4. Inspect rear belt deflection. See 1.14 REAR BELT DEFLECTION.
5. Inspect rear belt and sprockets. See 1.15 REAR BELT AND SPROCKETS.
6. Inspect air cleaner filter. See 1.22 AIR CLEANER FILTER.
7. Lubricate controls. See 1.23 CABLE AND CHASSIS LUBRICATION.
8. Inspect operation of all electrical equipment and switches.
9. Check tire inflation. and inspect tires for wear and damage. See 1.9 TIRES AND WHEELS. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.

⚠WARNING

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)

10. 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)**

11. 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.

⚠CAUTION

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)

12. 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.
2. 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.
5. Start the engine and run until it reaches normal operating temperature.
6. Check engine oil level. Check the transmission lubricant level. Fill to proper levels with correct fluids, if required.
7. Perform all of the checks in the PRE-RIDING CHECKLIST in the Owner's Manual.

GENERAL

⚠WARNING

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.
3. Discharged battery, loose or corroded connections (solenoid chatters).
4. Starter control circuit, relay, or solenoid faulty.
5. 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.
2. Fouled spark plugs.
3. Discharged battery, loose or broken battery terminal connections.
4. Engine lubricant too heavy (winter operation).

NOTE

For cold weather starts, always disengage clutch.

5. Spark plug cables in bad condition and shorting, cable connections loose or cables connected to incorrect cylinders.
6. Loose wire connection at coil, battery, or ECM connector.
7. Ignition timing incorrect due to faulty coil, ECM or sensors.
8. Bank Angle Sensor tripped and ignition switch not cycled OFF then ON.
9. Fuel filter clogged.
10. Sticking or damaged valve or wrong length push rod.
11. Cam primary gear key sheared or missing the spacer.

Starts Hard

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

NOTE

For cold weather starts, always disengage clutch.

9. Ignition not functioning properly (possible sensor failure).
10. Faulty ignition coil.
11. 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, ECM, or sensor.
5. Battery nearly discharged.
6. Damaged wire or loose connection at battery terminals, coil or ECM connector.
7. Intermittent short circuit due to damaged wire insulation.
8. Water or dirt in fuel system.
9. Fuel tank vent system plugged.
10. Air leak at intake manifold or air cleaner.
11. Loose or dirty ECM connector.
12. Faulty Sensor(s): Manifold Absolute Pressure (MAP), Crank Position (CKP) or Oxygen (O2).
13. Incorrect valve timing.
14. Weak or broken valve springs.
15. Damaged intake or exhaust valve.

A Spark Plug Fouls Repeatedly

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

Pre-Ignition or Detonation (Knocks or Pings)

1. Fuel octane rating too low.
2. Faulty spark plugs.
3. Incorrect spark plug for the kind of service.
4. Excessive carbon deposit on piston head or in combustion chamber.
5. Ignition timing advanced due to faulty sensor inputs (MAP and/or 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.
6. 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. Oil pump misaligned or in poor condition.
6. 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. Oil pump misaligned or in poor condition.
6. Piston rings badly worn or broken.
7. Valve guides or seals worn.
8. O-ring damaged or missing from oil pump/crankcase junction (also results in poor engine performance).
9. 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.
6. 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

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

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.
7. Corners worn off transmission gear dogs (inside transmission).

Jumps Out Of Gear

1. Shifter rod improperly adjusted.
2. Shifter drum (inside transmission) improperly adjusted or damaged.
3. 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.

HANDLING

Irregularities

1. Improperly loaded motorcycle. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage tends to cause unstable handling.
2. Damaged tire(s) or improper front-rear tire combination.
3. Irregular or peaked front tire tread wear.
4. Incorrect tire pressure. See 1.9 TIRES AND WHEELS.
5. Shock absorber not functioning normally.
6. Loose wheel axle nuts. Tighten to recommended torque specification.
7. Excessive wheel hub bearing play.
8. Rear wheel out of alignment with frame and front wheel.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC or 1.18 STEERING HEAD BEARINGS: FLSTSC.
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.

BRAKES

Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid.
2. Brake system contains air bubbles.
3. 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.
7. Brake drags – brake pedal and master cylinder piston not returning completely.
8. Brake fades due to heat build up – brake pads dragging or excessive braking.
9. Brake fluid leak when under pressure.

CHASSIS 2

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MODEL	FUEL TANK TOTAL*		OIL TANK W/FILTER		TRANSMISSION (APPROX.)		PRIMARY CHAINCASE	
	gal.	liter	qt.	liter	qt.	liter	qt.	liter
FLSTC	5.0	18.92	3.0	2.85	1.0	0.95	1.0	0.95
FLSTF								
FLSTSC								
FLSTN								
FXST								
FXSTB								
FXSTC								
FXSTD	4.9	18.55	3.0	2.85	1.0	0.95	1.0	0.95

* Low fuel warning light on 1.0 gal/3.8 Liters

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	39.2	996.0	5.1	129.5	44.1	1120.0	25.5	647.7
FLSTF	64.5	1638.3	94.3	2395.2	39.2	996.0	5.1	129.5	44.5	1130.3	25.4	645.2
FLSTSC	64.5	1638.3	94.5	2400.3	39.2	996.0	4.9	124.5	44.1	1120.0	25.9	657.9
FLSTN	64.5	1638.3	94.7	2405.4	38.6	980.4	4.8	121.9	44.3	1125.2	24.5	622.3
FXST	64.5	1638.3	94.5	2400.3	36.2	919.5	5.1	129.5	46.4	1178.0	26.1	662.9
FXSTB	66.9	1699.3	95.0	2413.0	30.9	785.0	5.1	129.5	44.8	1140.0	25.2	640.1
FXSTC	64.5	1638.3	94.5	2400.3	36.5	927.1	5.1	129.5	51.7	1313.2	26.4	670.6
FXSTD	66.6	1691.6	95.4	2423.2	35.9	911.9	4.8	122.0	46.0	1168.0	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	725	329	1160	527	430	195	730	331
FLSTF	694	315	1160	527	430	195	730	331
FLSTSC	708	321	1160	527	430	195	730	331
FLSTN	695	315	1160	527	430	195	730	331
FXST	654	297	1125	510	415	188	710	322
FXSTB	656	298	1125	510	415	188	710	332
FXSTC	672	305	1125	510	415	188	710	322
FXSTD	663	301	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

TIRES

⚠WARNING

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

Tire sizes are molded on the sidewall. Refer to the TIRE FITMENT 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 & POSITION	RIM SIZE & CONTOUR	RIM VALVE HOLE DIA.	TIRE SIZE
			DUNLOP D407
17 in. – Front	T17 x 3.50 MT	0.35 in.	140/75R17 78V
			DUNLOP D205
17 in. - Rear (FXST/FXSTB/FXSTC/ FLSTF)	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

STEEL LACED RIM			
WHEEL SIZE & POSITION	**RIM SIZE & CONTOUR**	**TUBE SIZE**	**TIRE SIZE**
		Center Valve Tube	**DUNLOP D402**
21 in. - Front	T21x 2.15 TLA	MH90x21	MH90 - 21 54H
		Side Valve Tube	
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 ALUMINUM PROFILE LACED RIM			
			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

Table 2-3. Tire Pressure – All Models

2007 DUNLOP HARLEY-DAVIDSON TIRES ONLY	TIRE PRESSURE (Cold)			
	Front		Rear	
FLSTC/N/SC	**PSI**	**kPa**	**PSI**	**kPa**
Solo rider	36	248	36	248
Rider & one passenger	36	248	40	276
FXST/C/B	**PSI**	**kPa**	**PSI**	**kPa**
Solo rider	30	207	38	262
Rider & one passenger	30	207	42	290
FLSTF	**PSI**	**kPa**	**PSI**	**kPa**
Solo rider	36	248	38	262
Rider & one passenger	36	248	42	290
FXSTD				
Solo rider	30	207	36	248
Rider & one passenger	30	207	40	276

ITEM	TORQUE		NOTES
Belt sprocket screws	55-60 ft-lbs	74.6-81.3 Nm	page 2-19
Brake caliper bleeder valve	80-100 **in-lbs**	9.0-11.3 Nm	front and rear, page 2-52, page 2-63, page 2-69
Brake caliper bridge bolts	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC, page 2-52, page 2-63
Brake caliper bridge bolts	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC/FXSTD, page 2-11, page 2-69
Brake disc screws, front	16-24 ft-lbs	21.7-32.5 Nm	all but FLSTSC/FXSTD, 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	FXSTD, page 2-13
Brake disc screws, rear	30-45 ft-lbs	40.7-61.0 Nm	page 2-19
Brake master cylinder clamp screw	70-80 **in-lbs**	7.9-9.0 Nm	T27 TORX, page 2-40
Brake pad pins	180-200 **in-lbs**	20.3-22.6 Nm	all but FLSTSC, 12 pt/0.25 in., page 2-53, page 2-64, page 2-70
Brake reaction link acorn lock-nuts	35-40 ft-lbs	47.5-54.2 Nm	FLSTSC, discard upon removal, page 2-58
Brake reservoir cover screws, front	6-8 **in-lbs**	0.7-0.9 Nm	page 2-41, page 2-42, page 2-53, page 2-57
Clutch lever handlebar clamp screw	108-132 **in-lbs**	12.2-14.9 Nm	page 2-98
Fender screws	12-15 ft-lbs	16.3-20.3 Nm	FXSTD, inside of fender, page 2-114
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	all but FXSTD/FLSTS/FLSTN, page 2-108, page 2-110, page 2-112
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	FLSTN, page 2-119
Fender support hardware	21-27 ft-lbs	28.5-36.6 Nm	FLSTSC, page 2-116
Fender support screws	14-16 ft-lbs	19.0-21.7 Nm	FXSTD, LOCTITE THREADLOCKER 243 (blue), near oil tank, page 2-114
Fork leg bracket screws	35-40 ft-lbs	47.5-54.2 Nm	FLSTSC, page 2-58
Fork rocker bearing retainer jam nut	95-105 ft-lbs	128.8-142.4 Nm	FLSTSC, page 2-84
Fork rocker bearing retainer	25-35 **in-lbs**	2.8-4.0 Nm	FLSTSC, LOCTITE ANTI-SEIZE, page 2-84
Fork rocker nut	45-50 ft-lbs	61-68 Nm	FLSTSC, LOCTITE THREADLOCKER 243 (blue), page 2-84
Fork stem acorn nut	30-35 **in-lbs**	3.4-4.0 Nm	FLSTSC, page 2-79
Fork stem bracket pinch bolt	30-35 ft-lbs	40.7-47.5 Nm	all but FXSTD, page 2-75
Fork stem bracket pinch bolt	35-40 ft-lbs	47.5-54.2 Nm	FXSTD, LOCTITE ANTI-SEIZE, page 2-75
Fork stem nut	35-45 ft-lbs	47.5-61.0 Nm	FXSTD/FXST/FXSTB, page 2-89
Fork stem upper bracket pinch bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTC/FLSTF, page 2-89
Fork tube caps	40-60 ft-lbs	54.2-81.3 Nm	all but FLSTSC, page 2-75
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	FXST, FXSTB, FLSTC, FLSTF, FLSTN, FXSTC, page 2-11

ITEM	TORQUE		NOTES
Front axle nut	60-65 ft-lbs	81.3-88.1 Nm	FXSTD, page 2-13
Front axle slider cap nuts	11-15 ft-lbs	14.9-20.3 Nm	All but FLSTSC, FXSTD, 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 2-57
Front brake caliper lower mounting bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC, short bolt, 12 pt/10 mm, page 2-11, page 2-13, page 2-53
Front brake caliper top mounting bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC, long bolt, 12 pt/10 mm, page 2-11, page 2-13
Front brake caliper top mounting bolt	28-38 ft-lbs	38.0-51.5 Nm	all but FLSTSC, long bolt, 12 pt/10 mm, page 2-53
Front brake hose bracket bolt	96-120 **in-lbs**	10.8-13.6 Nm	FLSTC/FLSTF, page 2-89
Front brake hose bracket bolt	96-120 **in-lbs**	10.8-13.6 Nm	FXSTD/FXST/FXSTB, page 2-89
Front brake master cylinder clamp screw	108-132 **in-lbs**	12.2-14.9 Nm	page 2-98
Front caliper banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	FLSTSC, page 2-57
Front caliper bleeder valve	80-100 **in-lbs**	9.0-11.3 Nm	FLSTSC, page 2-57
Front caliper retaining pad screw	40-50 **in-lbs**	4.5-5.6 Nm	FLSTSC, page 2-56
Front caliper upper mounting bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTSC, page 2-57
Front fender acorn nuts	15-21 ft-lbs	20.3-28.5 Nm	FXST/FXSTB, page 2-103
Front fender nut	18-22 ft-lbs	24.4-29.8 Nm	FLSTS, page 2-106
Front fender nuts	15-21 ft-lbs	20.3-28.5 Nm	FLSTC, page 2-103
Front fender nuts	15-21 ft-lbs	20.3-28.5 Nm	FLSTF, page 2-104
Front fender screws	15-21 ft-lbs	20.3-28.5 Nm	FXSTD, page 2-104
Front luggage rack fastener	96-120 **in-lbs**	10.8-13.6 Nm	FLSTN, page 2-131
Front master cylinder banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	page 2-41
Front shock acorn nuts	45-50 ft-lbs	61.0-67.8 Nm	FLSTSC, LOCTITE THREADLOCKER 243 (blue), page 2-78
Hand control clamp screw	35-45 **in-lbs**	4.0-5.1 Nm	page 2-98
Handlebar riser locknuts	25-35 ft-lbs	33.9-47.5 Nm	FLSTSC, page 2-76
Handlebar riser screws	144-180 **in-lbs**	16.3-20.3 Nm	FLSTSC, page 2-76
Handlebar upper clamp screws	144-180 **in-lbs**	16.3-20.3 Nm	FXSTD, page 2-97
License plate bracket screws	144-180 **in-lbs**	16.3-20.3 Nm	FXSTD, page 2-114
Lower handlebar clamp fastener	30-40 ft-lbs	40.7-54.2 Nm	FXDWG, page 2-101
Lower handlebar clamp fasteners	30-40 ft-lbs	40.7-54.3 Nm	all but FXSTD/FLSTSC/FXSTS, page 2-97
Lower handlebar clamp fasteners	30-40 ft-lbs	40.7-54.3 Nm	FXSTD, page 2-97
Pivot shaft nut	90-110 ft-lbs	122-149.1 Nm	page 2-91
Rear axle nut	60-65 ft-lbs	81.3-88.1 Nm	do not exceed 65 ft-lbs (88.1 Nm), page 2-19
Rear luggage rack fastener	12-14 ft-lbs	16.3-19.0 Nm	FLSTN, page 2-131
Rear master cylinder banjo bolt	17-22 ft-lbs	23.0-29.8 Nm	page 2-42

ITEM	TORQUE		NOTES
Rear master cylinder nut	30-40 ft-lbs	40.7-54.2 Nm	page 2-42
Rear shock bolt	121-136 ft-lbs	164.0-184.4 Nm	LOCTITE THREADLOCKER 243 (blue), page 2-92
Rear shock locknut	32-39 ft-lbs	43.4-52.9 Nm	page 2-92
Rigid fork leg studs	60-65 ft-lbs	81.3-88.1 Nm	FLSTSC, 3 step process, page 2-79
Rocker pivot stud nut	45-50 ft-lbs	61.0-67.8 Nm	FLSTSC, page 2-82
Saddlebag acorn nut	120-144 **in-lbs**	13.6-16.3 Nm	FLSTC, page 2-132
Saddlebag mounting flange nut	120-144 **in-lbs**	13.6-16.3 Nm	FLSTC, inside saddlebag, page 2-132
Saddlebag stud nut	21-27 ft-lbs	28.5-36.6 Nm	FLSTC, page 2-132
Seat fasteners (FXSTC)	60-80 **in-lbs**	6.8-9.0 Nm	page 2-128
Spoke nipples: chrome aluminum profile laced rim	55 **in-lbs**	6.2 Nm	16 in., page 2-24, page 2-27
Spoke nipples: steel laced rim	40-50 **in-lbs**	4.5-5.6 Nm	16 in., page 2-24, page 2-27
Spring bridge acorn nuts	30-35 ft-lbs	40.7-47.5 Nm	FLSTSC, page 2-83
Spring rod acorn nut	20-25 ft-lbs	27.1-33.9 Nm	FLSTSC, page 2-82
Throttle housing screws	35-45 **in-lbs**	4.0-5.1 Nm	page 2-93
Upper handlebar clamp fasteners	12-18 ft-lbs	16.3-24.4 Nm	FXDWG, page 2-101
Upper triple clamp pinch bolt	25-30 ft-lbs	33.9-40.7 Nm	FLSTSC, page 2-79
Valve stem nut	12-15 **in-lbs**	1.4-1.7 Nm	page 2-35

GENERAL

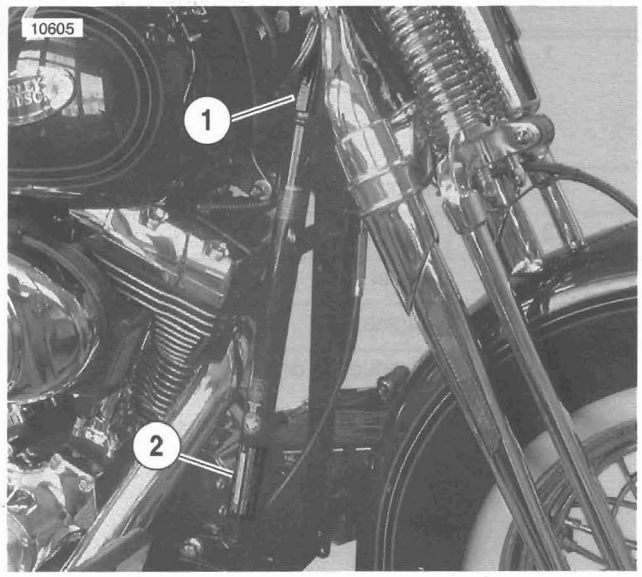
See Figure 2-1. The full 17 digit serial, or Vehicle Identification Number (V.I.N.) is stamped on the right side of the steering head and on a label located on the right side down tube.

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: **1HD1BV5137Y111000**
Sample abbreviated V.I.N. as it appears on the left crankcase: **BV57111000**

NOTE

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



1. **Stamping**
2. **Label**

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

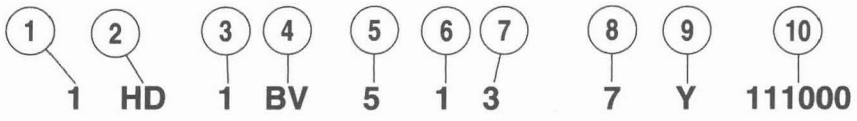


Figure 2-2. Softail Vehicle Identification Number (typical)

Table 2-4. Harley-Davidson 2007 Softail Model V.I.N. Description

ITEM	DESCRIPTION	POSSIBLE VALUES
1	Market destination	1=Originally manufactured for sale within the United States 5=Originally manufactured for sale outside 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	5=1584cc 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 introductory date 6=California/mid-year
7	VIN check digit	Can be 0-9 or X
8	Model year	7=2007
9	Plant of manufacture	Y=York, PA.
10	Sequential number (last 6 digits)	varies

Table 2-5. 2007 Softail Model V.I.N. Codes

CODE	MODEL NAME	CODE	MODEL NAME	CODE	MODEL NAME
BV	FXST	JB	FXSTD	JG	FLSTF (Shrine)
BW	FLSTC	JA	FXSTB	JH	FLSTC (Shrine)
JL	FXSTC	JD	FLSTN		
BX	FLSTF	BY	FLSTSC		

REMOVAL

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect wheel bearing end play and service bearings if necessary. See 2.8 SEALED WHEEL BEARINGS.
3. 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).
5. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
6. 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

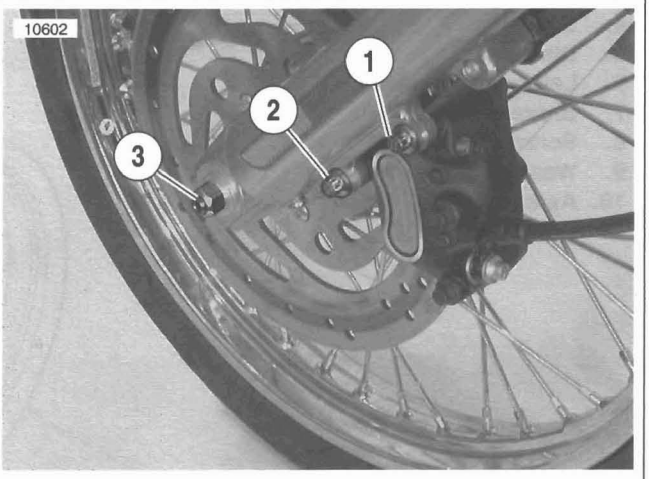
See 2.13 TIRES to service tire or valve stem assembly.

Disc Wheel

1. See Figure 2-5. Remove spacers (2, 6) from left and right sides.
2. If necessary, remove brake disc (7). On left side of wheel, remove five screws (5) to detach left brake disc (9). Discard screws.

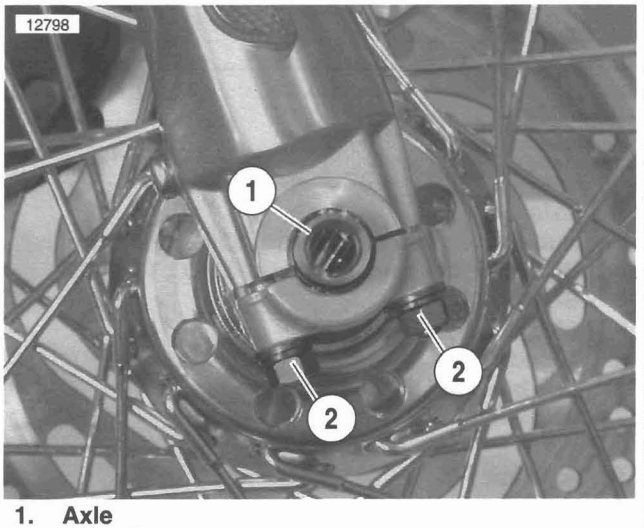
Laced Wheel

1. 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.
2. If necessary, remove brake disc (8). On left side of wheel, remove five screws (11) to detach left brake disc. Discard screws.
3. To disassemble FLSTC hub cap, remove snap ring from hub spacer. Discard snap ring.



1. **Long mounting bolt (12 pt/10 mm)**
2. **Short mounting bolt (12 pt/10 mm)**
3. **Axle nut, lockwasher and washer**

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



1. **Axle**
2. **Slider cap nuts and washers**

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

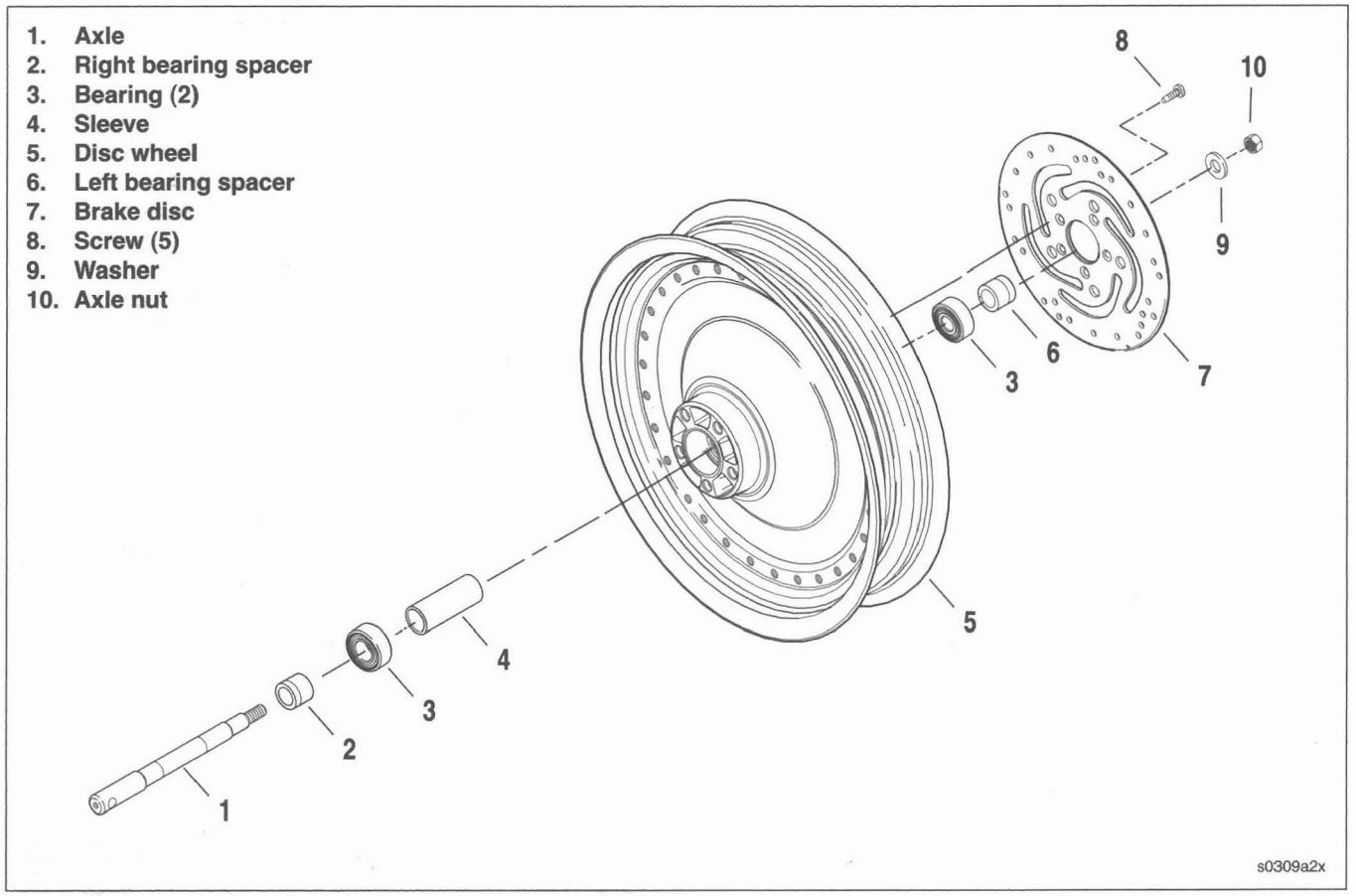


Figure 2-5. Disc Front Wheel: FLSTF

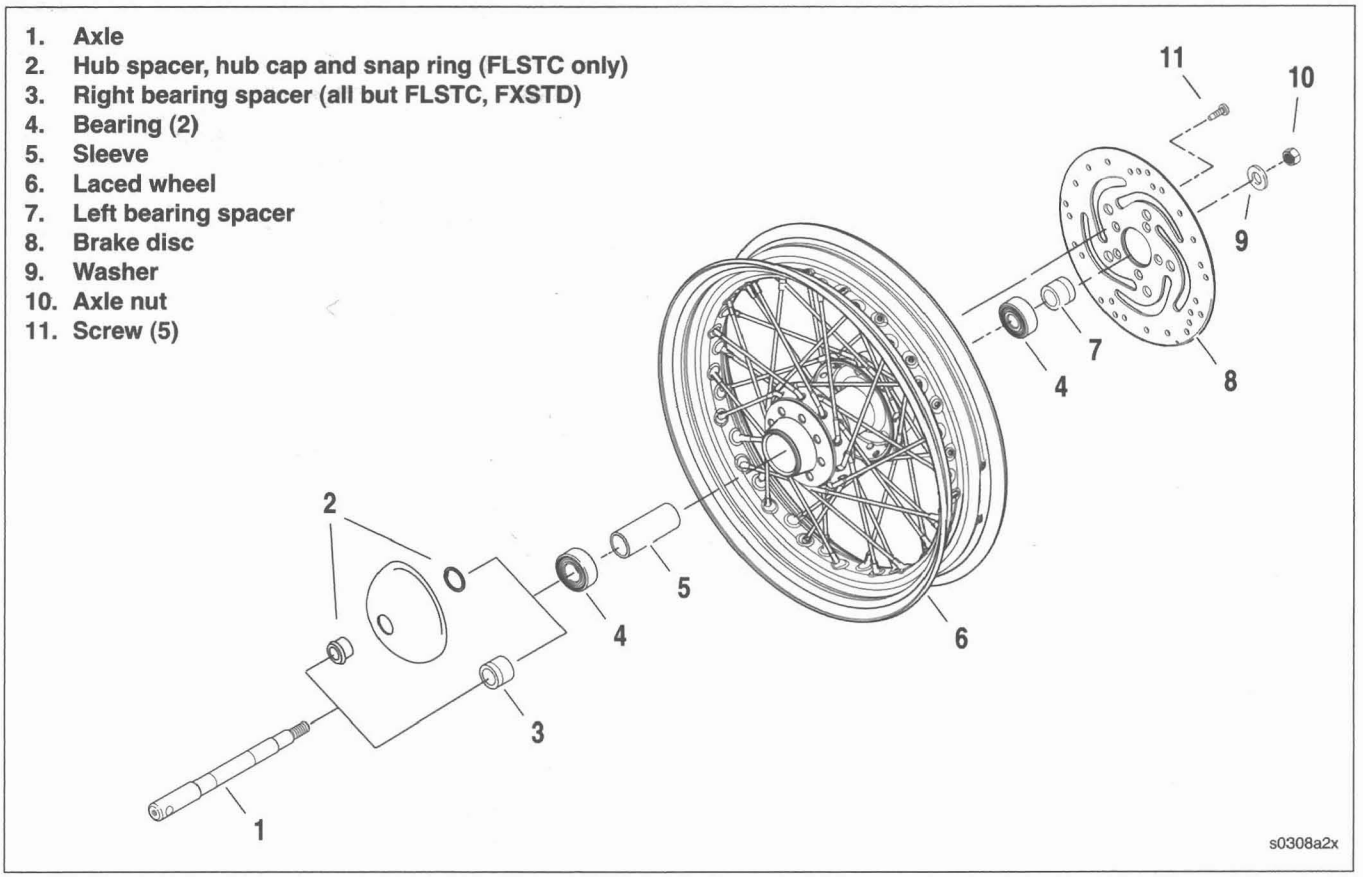


Figure 2-6. Laced Front Wheel: All But FLSTF, FXSTD

CLEANING AND INSPECTION

1. Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.8 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.

ASSEMBLY

Disc Wheel

1. Verify that wheel and tire are true. See 2.12 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)

2. See Figure 2-5. If necessary, install brake disc (7). Verify that brake disc is clean. Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm). On left side of wheel, install five **new** screws (8) to attach left brake disc.
3. Install spacers (2, 6) with largest chamfered end facing away from wheel.

Laced Wheel

1. If hub and rim were disassembled, see 2.9 WHEEL LACING: 16 IN. RIM or 2.10 WHEEL LACING: 21 IN. RIM.
2. Verify that wheel and tire are true. See 2.11 TRUING LACED WHEEL.
3. 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)

4. 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 (11) to attach brake disc (8). Tighten fasteners to 16-24 ft-lbs (21.7-32.5 Nm).
5. Install hub assembly (2) or spacers (3, 7) with largest chamfered end facing away from wheel.

INSTALLATION

1. Apply a light coat of LOCTITE ANTI-SEIZE LUBRICANT to the axle.
2. Place wheel into front fork and install axle. Verify that axle spacers on right and left side are properly installed.
3. Install the washer 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 60-65 ft-lbs (81.3-88.1 Nm).

NOTE

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

4. 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.
   a. Loosely install long mounting bolt (1) (12 pt/10 mm) into top hole on fork leg.
   b. 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).

⚠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)

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

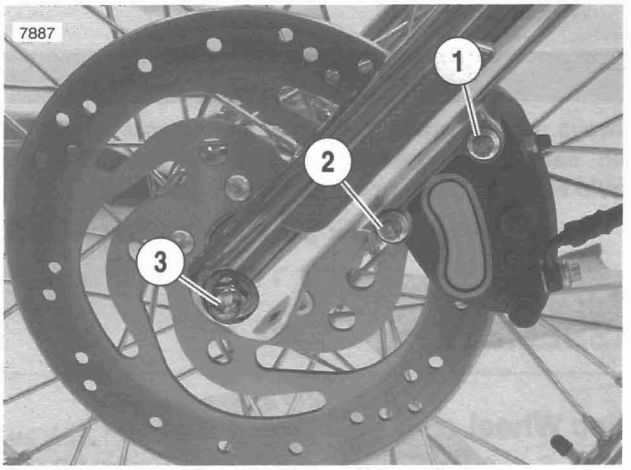
REMOVAL

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect wheel bearing end play and service bearings if necessary. See 2.8 SEALED WHEEL BEARINGS.
3. 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.



1. Long mounting bolt (12 pt/10 mm)
2. Short mounting bolt (12 pt/10 mm)
3. Left Axle nut, lockwasher and washer

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

DISASSEMBLY

NOTE

See 2.13 TIRES to service tire or valve stem assembly.

1. See Figure 2-9. Remove spacers (3, 7) from left and right sides.
2. If necessary, remove brake disc (8). On left side of wheel, remove five screws (11) to detach brake disc. Discard screws.

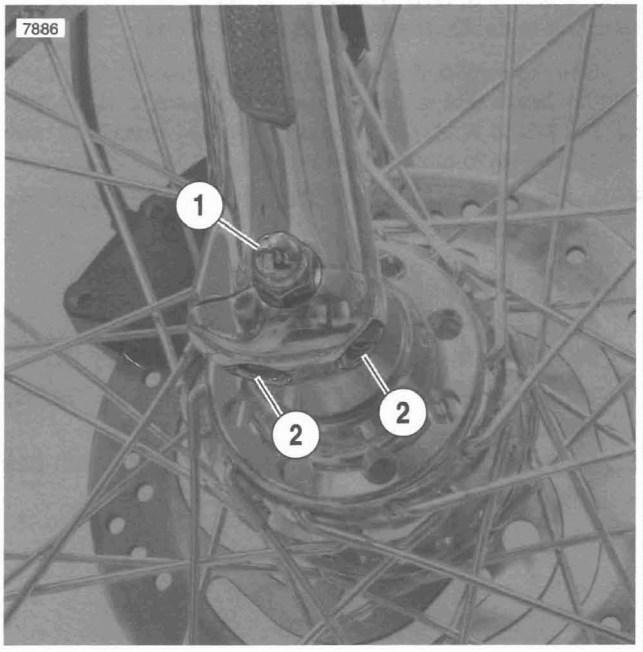
CLEANING AND INSPECTION

1. Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.8 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.



1. Axle nut @ 60-65 ft-lbs (81.3-88.1 Nm)
2. Slider cap screws

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

ASSEMBLY

1. If hub and rim were disassembled, see 2.10 WHEEL LACING: 21 IN. RIM.
2. Verify that wheel and tire are true. See 2.11 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)

3. See Figure 2-9. If necessary, install brake disc (8). Verify that brake disc is clean. On left side of wheel, install five **new** screws (10) to attach 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

1. Apply a light coat of LOCTITE ANTI-SEIZE LUBRICANT to the axle.
2. Verify that axle spacers on right and left side are properly installed. Place wheel into front fork and install axle.
3. Install the washer and left axle nut. Hold right side axle nut with wrench then tighten left axle nut to 60-65 ft-lbs (81.3-88.1 Nm).
4. See Figure 2-8. Tighten front slider cap screw to 11-15 ft-lbs (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.
   b. 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).

⚠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)

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

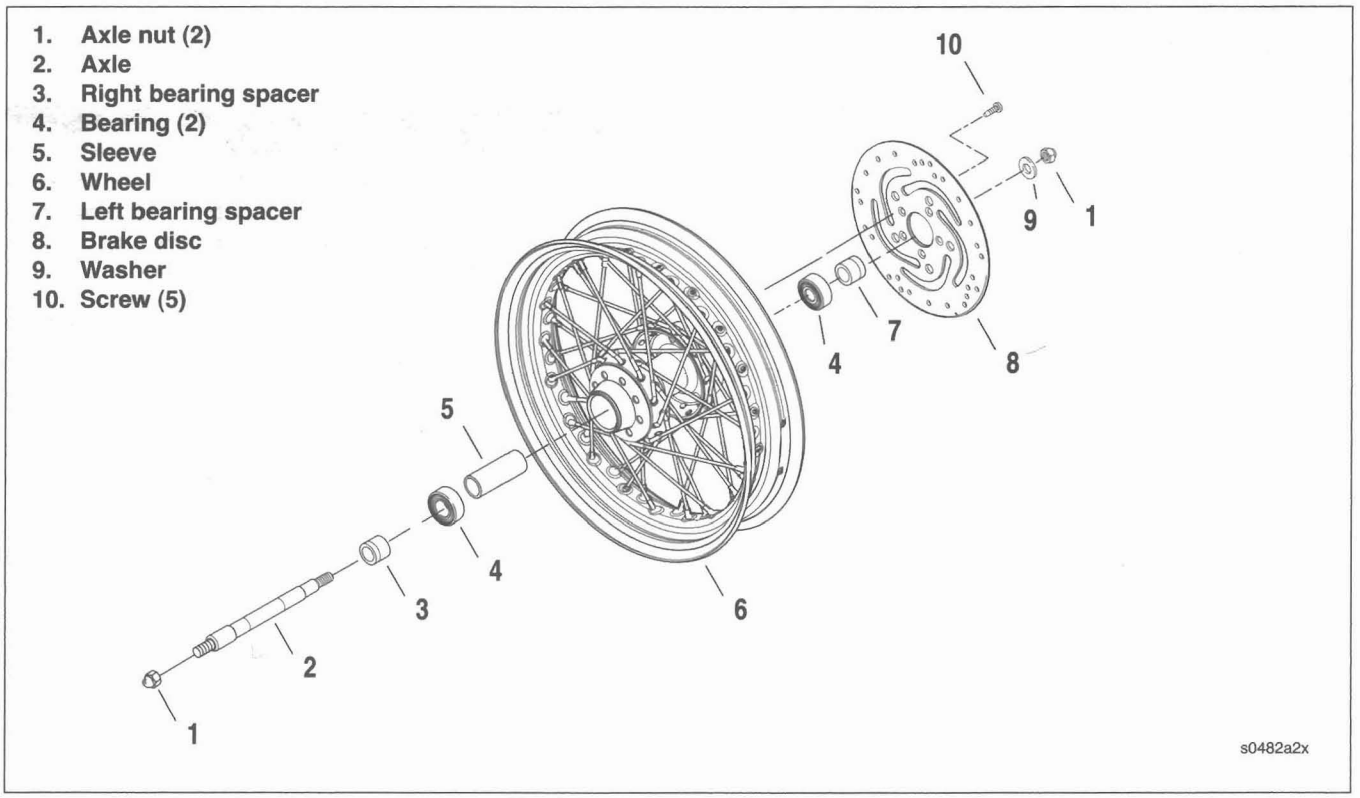


Figure 2-9. Front Wheel FXSTD

REMOVAL

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

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. Inspect wheel bearing end play and service bearings if necessary. See 2.8 SEALED WHEEL BEARINGS.
3. Remove front brake caliper. See 2.18 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.

4. 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 2.13 TIRES to service tire or valve stem assembly.

1. See Figure 2-10. Remove spacers (8, 13).
2. If necessary, remove brake disc. On left side of wheel, remove five screws to detach brake disc. Discard screws.

NOTE

See 2.22 SPRINGER FORK: FLSTSC to service fork rockers.

CLEANING AND INSPECTION

1. Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.8 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.
   b. 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).

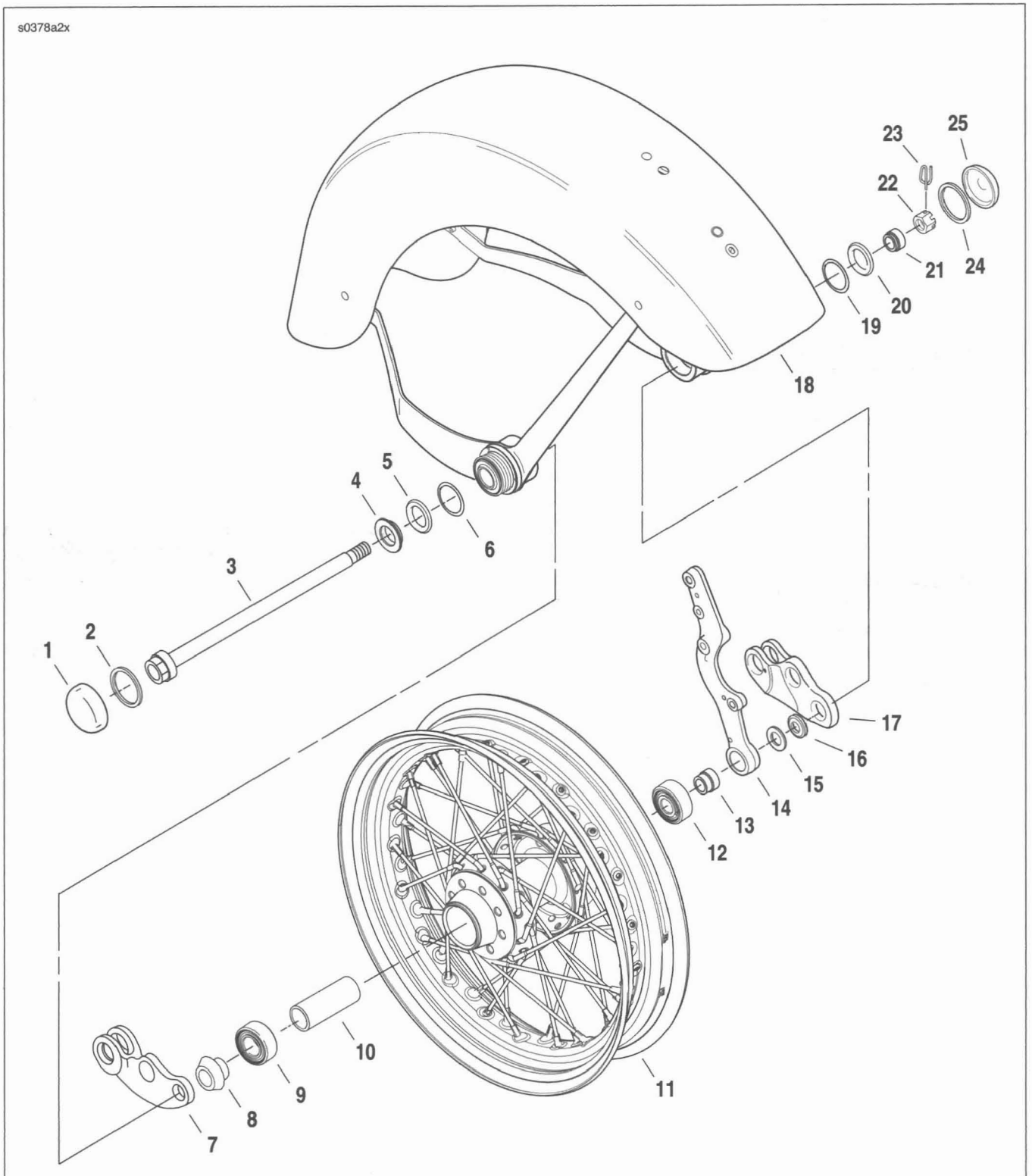
ASSEMBLY

1. If hub and rim were disassembled, see 2.9 WHEEL LACING: 16 IN. RIM.
2. Verify that wheel and tire are true. See 2.11 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)

3. If necessary, install brake disc. 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).
4. See Figure 2-10. If bearings were removed, verify that sleeve (10) is installed. Install spacers (8, 13) next to bearings.



1. Fender hub cap
2. Hub cap seal
3. Axle
4. Right spacer
5. Nylon insert
6. O-ring
7. Right rocker
8. Right side bearing spacer
9. Right side bearing
10. Sleeve
11. Wheel
12. Bearing
13. Left side bearing spacer
14. Brake caliper mount with bushing
15. Washer
16. Rubber spacer
17. Left rocker
18. Fender
19. O-ring
20. Nylon insert
21. Left side spacer
22. Castle nut
23. Retaining pin
24. Hub cap seal
25. Fender hub cap

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 LUBRICANT 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).

⚠WARNING

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.

2. 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.

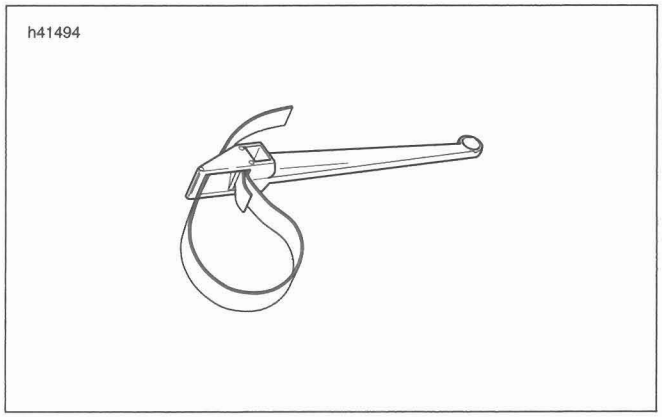


Figure 2-11. Hub Cap Tool

3. 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 2.18 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)

5. 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.
2. Remove saddlebags for extra working clearance if necessary.
3. See 2.39 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 2.8 SEALED WHEEL BEARINGS.
5. Label wheel spacers for location (left or right) and orientation (fork side or wheel side).
6. Remove rear brake pads. See 1.8 BRAKE PADS AND DISCS
7. See Figure 2-12. 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.
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.

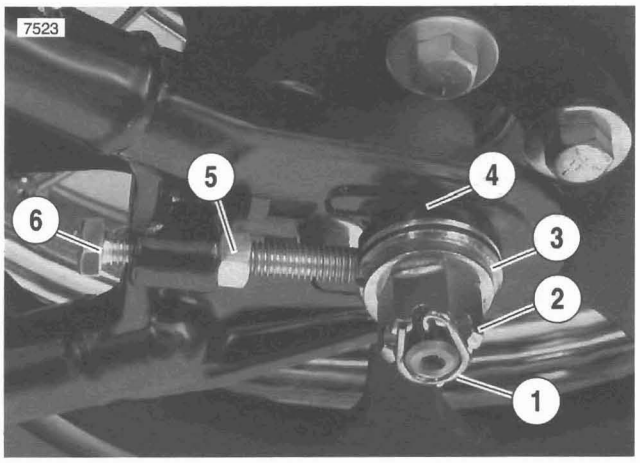
DISASSEMBLY

1. See Figure 2-14. Remove spacers (2, 10) from left and right sides.

NOTE

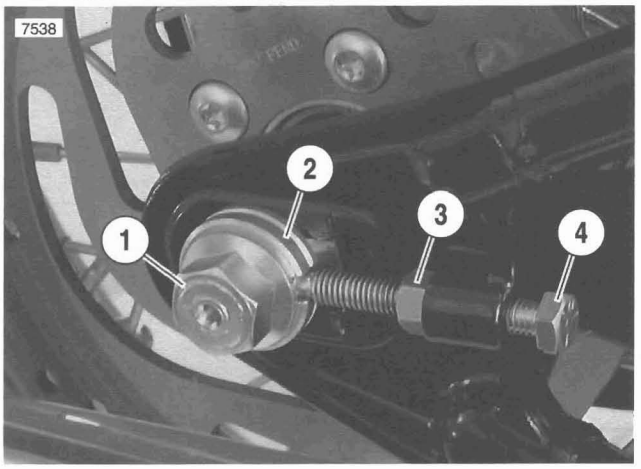
On FXSTD models, inspect seal ring (15). Replace if damaged.

2. If necessary, remove brake disc and/or rear sprocket.
   a. On left side of wheel, remove five screws (14) to detach rear sprocket (9). Discard screws.
   b. On right side of wheel, remove five screws (3) to remove rear brake disc (4). Discard screws.



1. **Spring clip**
2. **Axle nut**
3. **Washer**
4. **Collar**
5. **Jam nut**
6. **Adjuster**

Figure 2-12. Rear Axle: Left Side



1. **Rear axle**
2. **Collar**
3. **Jam nut**
4. **Adjuster**

Figure 2-13. Rear Axle: Right Side

1. Axle
2. Right bearing spacer
3. Screw (5)
4. Rear brake disc
5. Bearing (2)
6. Sleeve
7. Disc wheel
8. Laced wheel hub and rim
9. Rear sprocket
10. Left bearing spacer
11. Washer
12. Axle nut
13. Spring clip
14. Screw (5)
15. Seal ring (FXSTD only)

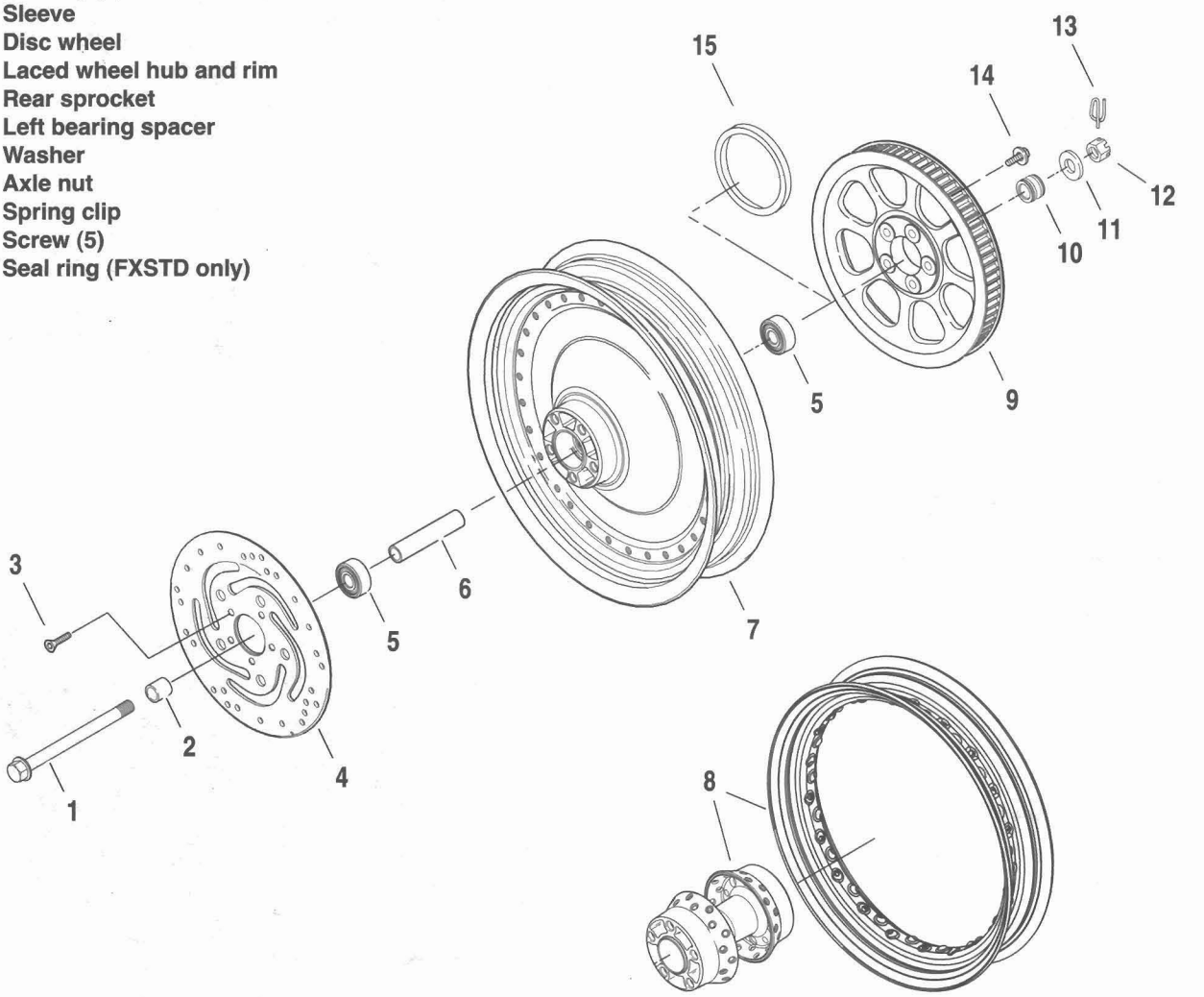


Figure 2-14. Rear Wheel/Hub

CLEANING AND INSPECTION

1. Inspect all parts for damage or excessive wear. If sealed wheel bearings must be serviced, see 2.8 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.
3. Inspect rear belt and sprocket. See 1.15 REAR BELT AND SPROCKETS.

ASSEMBLY

1. See Figure 2-14. If hub and rim (8) were disassembled, see 2.9 WHEEL LACING: 16 IN. RIM.
2. Verify that wheel and tire are true.
   a. For laced wheels, see 2.11 TRUING LACED WHEEL.
   b. For disc wheels, see 2.12 DISC RIM RUNOUT.
3. Using **new** screws (3), install brake disc (4) on valve stem side of wheel if removed. Tighten screws 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.

CAUTION

Do not re-use sprocket mounting screws. Re-using sprocket mounting screws can result in torque loss and damage to the sprocket and/or belt assembly. (00480b)

4. Using **new** screws (14), install belt sprocket (9) if removed.
5. Tighten screws (14) to 55-65 ft-lbs (74.6-88.1 Nm).
6. Install spacers (2, 10) into hub with largest chamfered end facing away from wheel.
7. Verify that wheel and tire are true.
   a. For laced wheels, see 2.11 TRUING LACED WHEEL.
   b. For cast wheels, see 2.12 DISC RIM RUNOUT.

INSTALLATION

1. Roll wheel into rear fork and position brake disc side spacer between wheel and fork.
2. Slide drive belt over drive sprocket.
3. 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 2-12. 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)

7. Pump brake pedal to move pistons out until they contact both brake pads. Verify piston location against pads.
8. Verify correct axle alignment (2.14 VEHICLE ALIGNMENT) and then check belt deflection (1.14 REAR BELT DEFLECTION).

INSPECTION

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

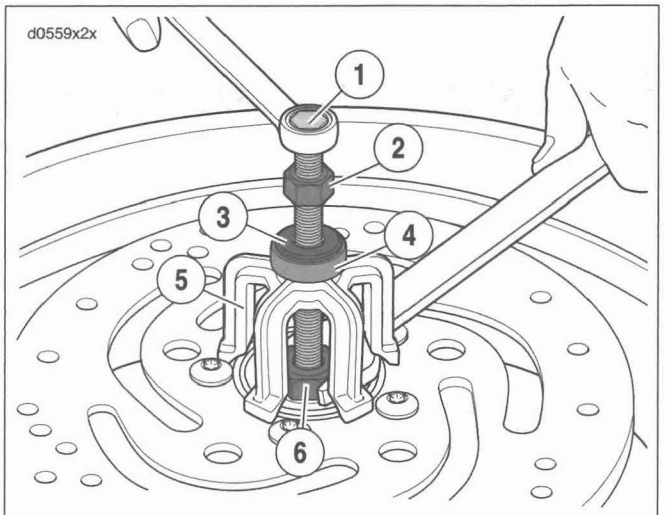
REMOVAL

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

NOTE

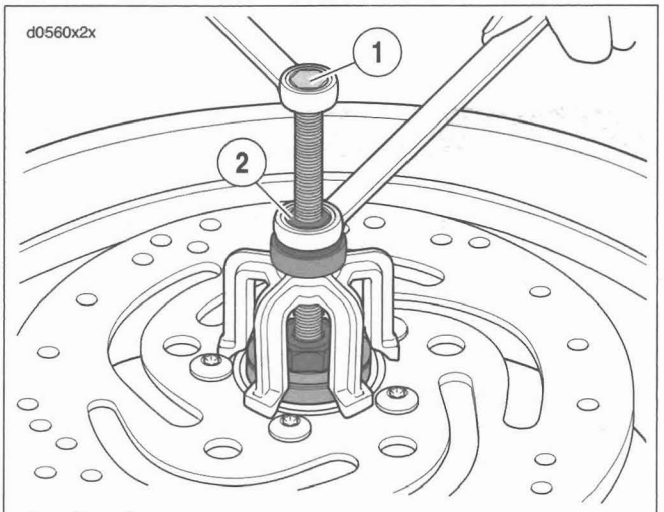
Front wheel on models with hydraulic forks use 25 mm collet.

1. Remove wheel from motorcycle.
2. See Figure 2-15. Obtain WHEEL BEARING INSTALLER/ REMOVER (Part No. HD-44060A) and assemble.
   a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
   b. Install nut (2), washer (3) and Nice bearing (4) on screw. Insert assembly through hole in bridge (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.
4. See Figure 2-16. 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.
6. Repeat procedure for opposite side bearing. Discard all bearings upon removal.



1. Forcing screw
2. Nut
3. Washer
4. Nice bearing
5. Bridge
6. Collet with ball bearing inside

Figure 2-15. Removal Tool



1. Forcing screw
2. Nut

Figure 2-16. 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-44060A) and assemble.
   a. Sparingly apply graphite lubricant to threads of threaded rod to prolong service life and ensure smooth operation.
   b. See Figure 2-17. Place threaded rod through support plate. Insert assembly through wheel.
   c. See Figure 2-18. 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.

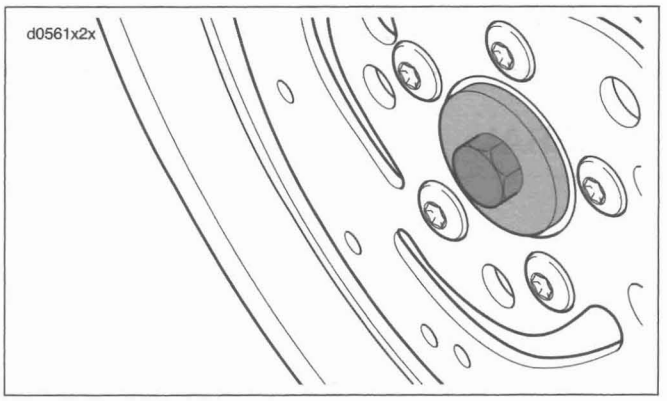
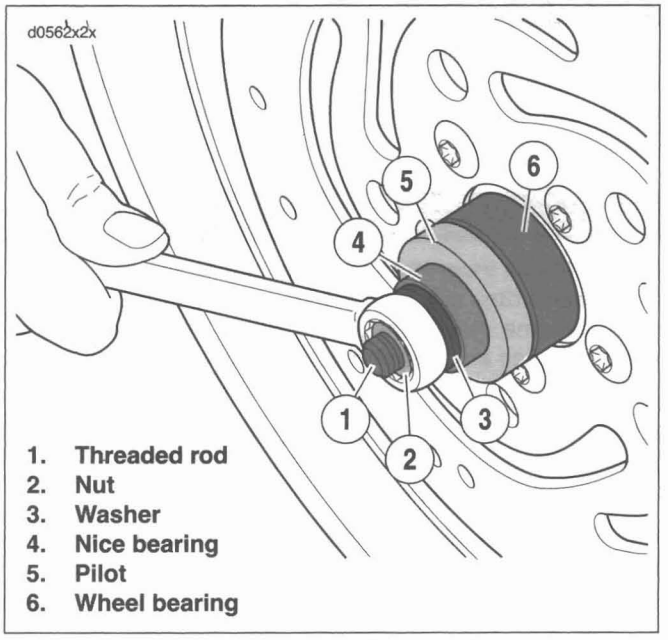
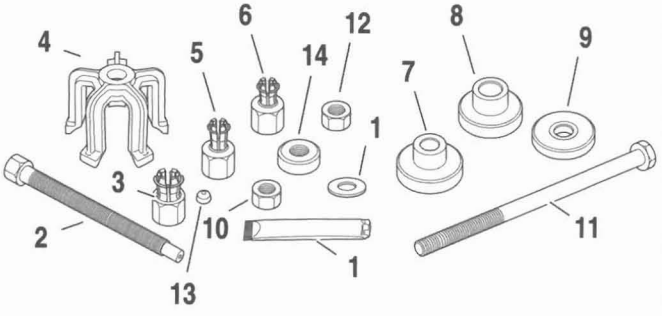


Figure 2-17. Installation Tool Support Plate



1. **Threaded rod**
2. **Nut**
3. **Washer**
4. **Nice bearing**
5. **Pilot**
6. **Wheel bearing**

Figure 2-18. Installing Bearing



NO.	DESCRIPTION	PART NO.
1	Thread lube	J-23444-A
2	6" Forcing screw	HD-44060-4
3	1" remover	HD-44060-7A
4	Bridge	HD-44060-5
5	3/4" bearing remover	HD-44060-3A
6	25mm. bearing remover	HD-44060-10
7	3/4" bearing installer	HD-44060-6
8	1" and 25mm. bearing installer	HD-44060-8
9	Back-up plug	HD-44060-1
10	1/2-20 UNF nut	222413
11	11" Forcing screw	280856
12	1/2-13 UNC nut	215654
13	Steel ball	12547
14	Nice bearing	217801
15	Washer	12004

Figure 2-19. 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 2-20. 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

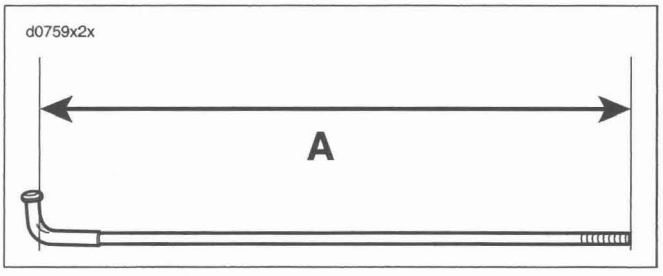


Figure 2-20. Spoke Length

See Figure 2-21. Torx head spokes, the 16 in. laced wheel hub and the 16 in. wheel are shown below.

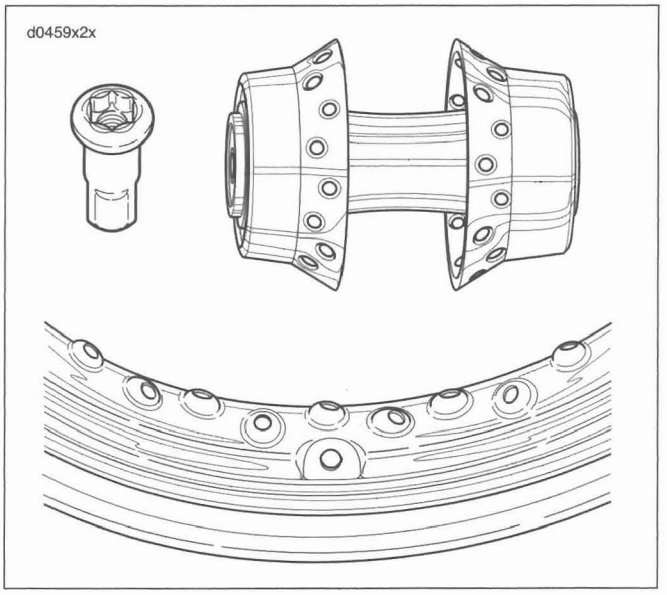


Figure 2-21.

PROCEDURE

1. 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.

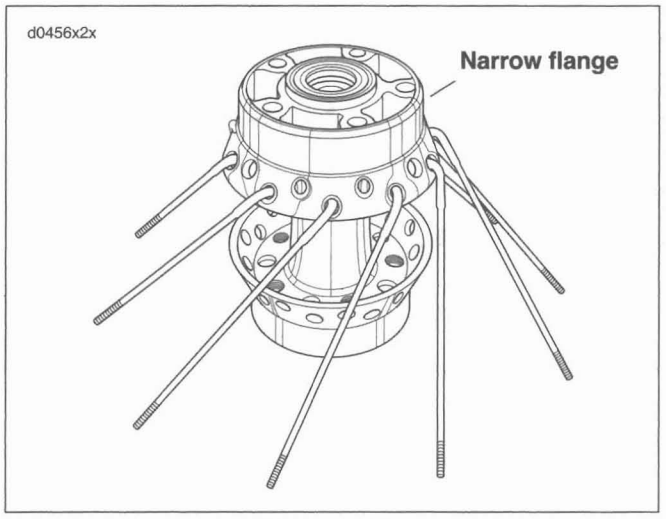


Figure 2-22.

2. Center the rim over the hub assembly with the valve stem hole facing upward.
3. 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.

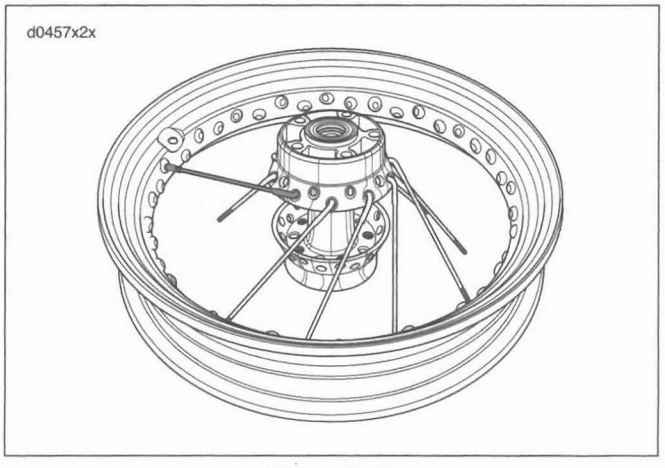


Figure 2-23.

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

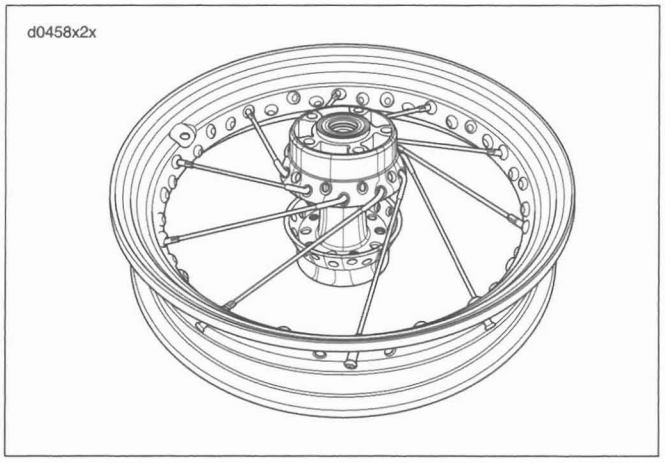


Figure 2-24.

5. 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.

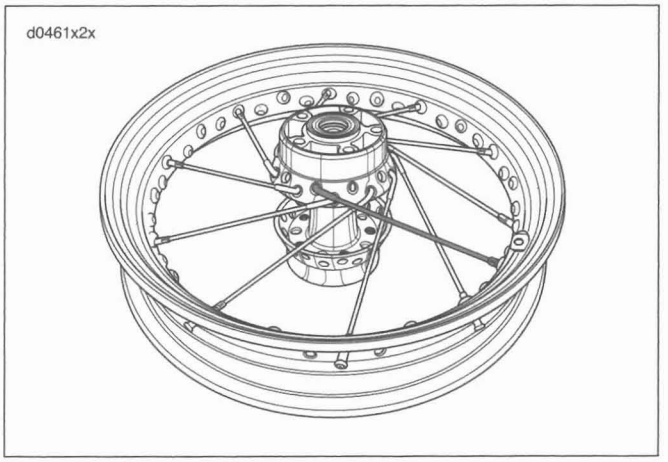


Figure 2-25.

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

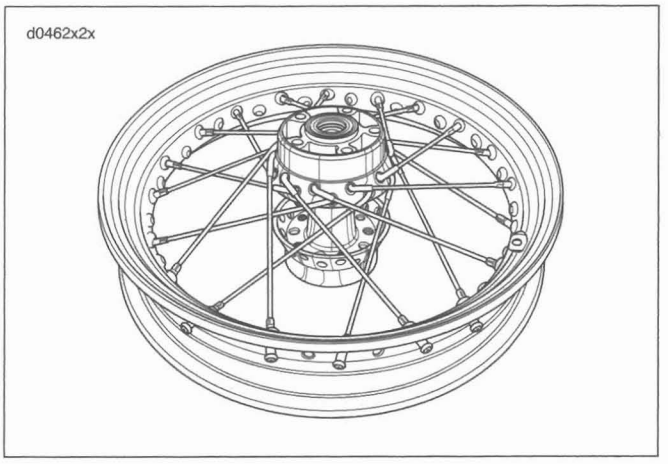


Figure 2-26.

7. 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.

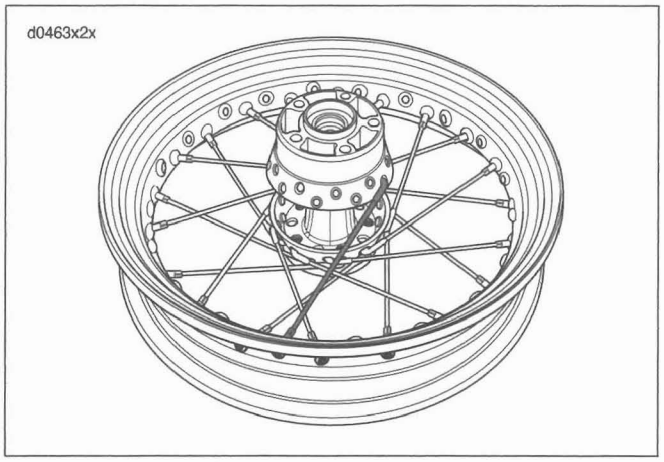


Figure 2-27.

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

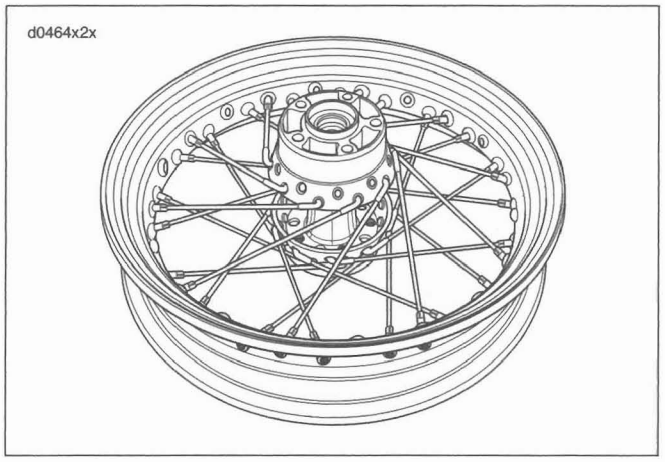


Figure 2-28.

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

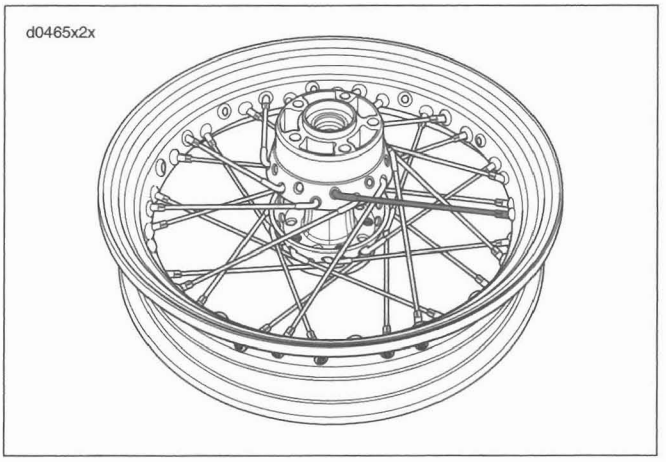


Figure 2-29.

10. Install remaining nine upper row spokes.

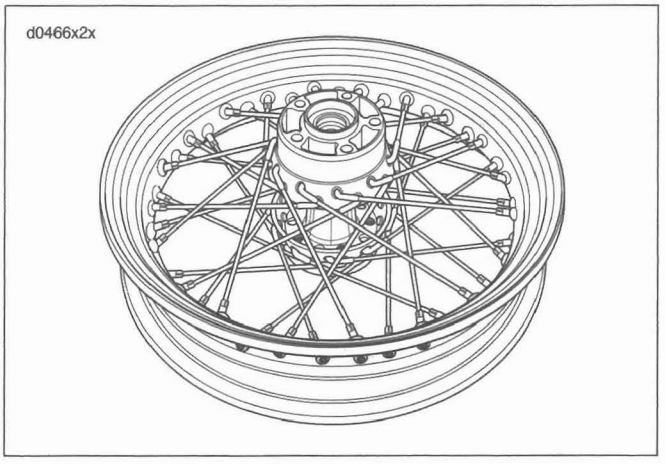


Figure 2-30.

11. Tighten spoke nipples:
    a. Tighten steel laced rim spoke nipples to 40-50 **in-lbs** (4.5-5.6 Nm).
    b. Tighten chrome aluminum laced profile rim spoke nipples to 55 **in-lbs** (6.2 Nm).
12. True wheel. See 2.11 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 2-31. Measure distance "A" to determine spoke length.

Table 2-7. 21 In. Rim 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

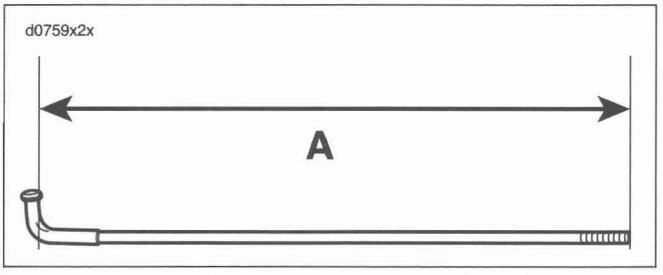


Figure 2-31. Spoke Length

1. See Figure 2-32. 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.
2. Center the rim over the hub assembly with the valve stem hole facing upward.
3. See Figure 2-33. 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.

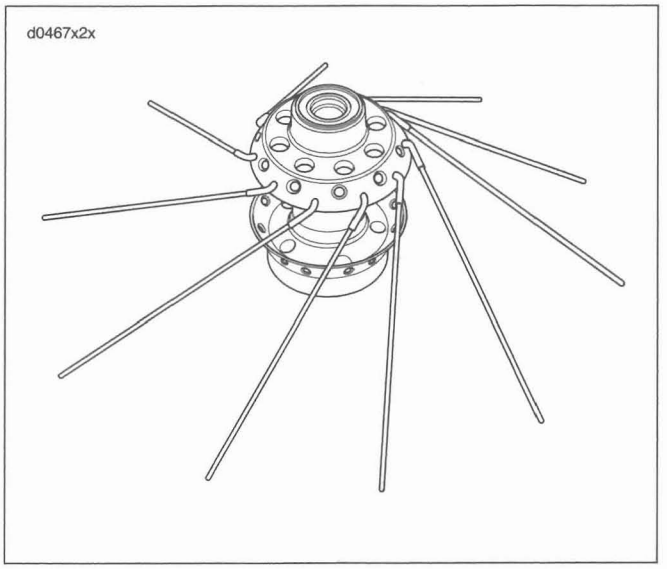


Figure 2-32.

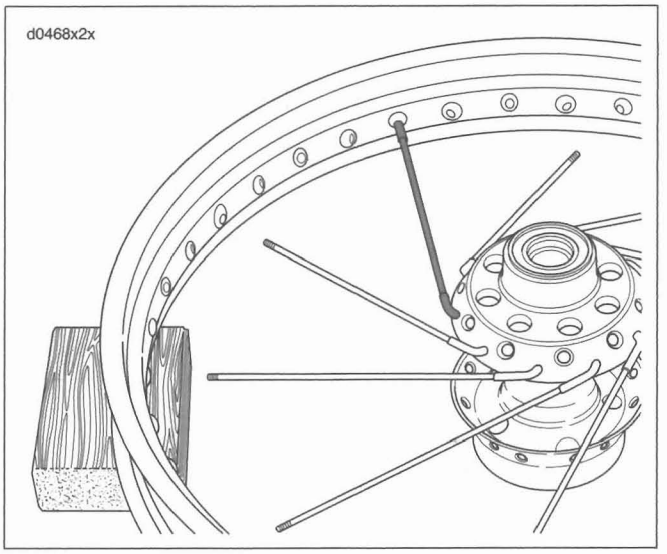


Figure 2-33.

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

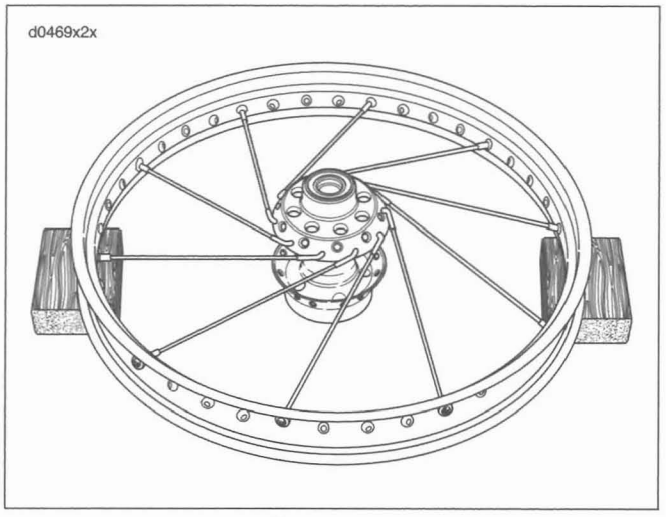


Figure 2-34.

5. 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 right of the valve stem hole.

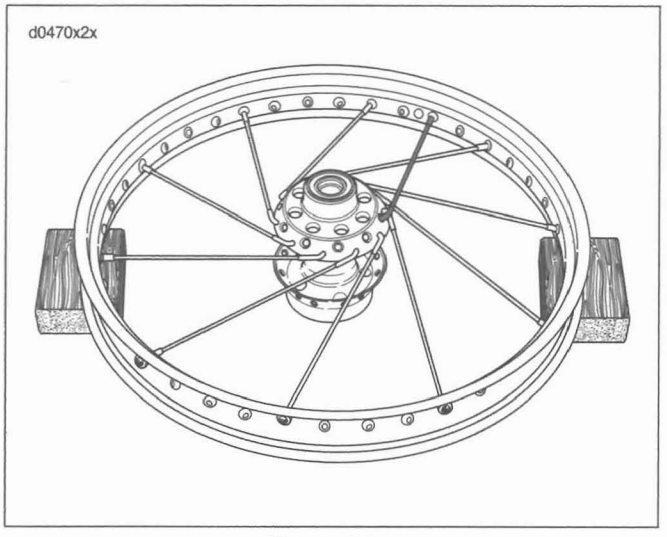


Figure 2-35.

6. Install the remaining nine upper row spokes into every fourth remaining hole above the rim centerline. This completes spoke installation on this side.

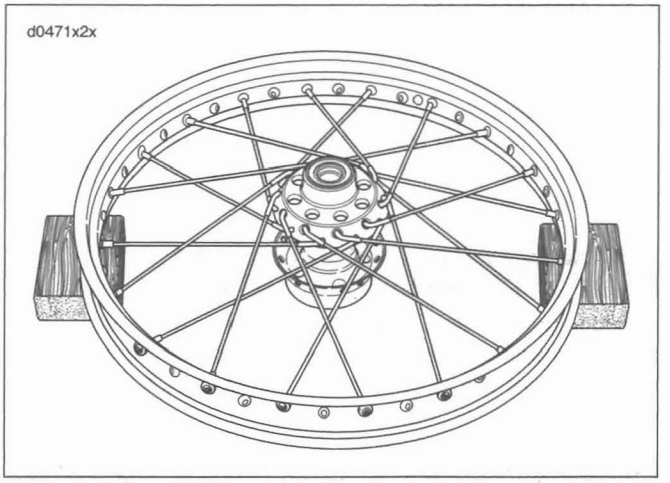


Figure 2-36.

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.

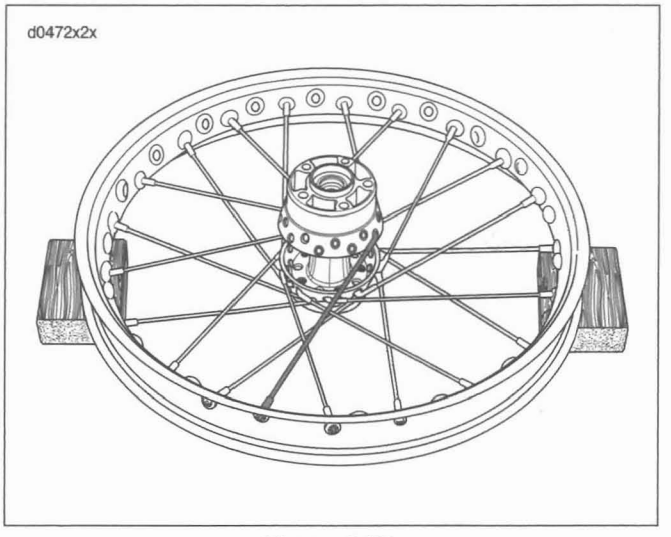


Figure 2-37.

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

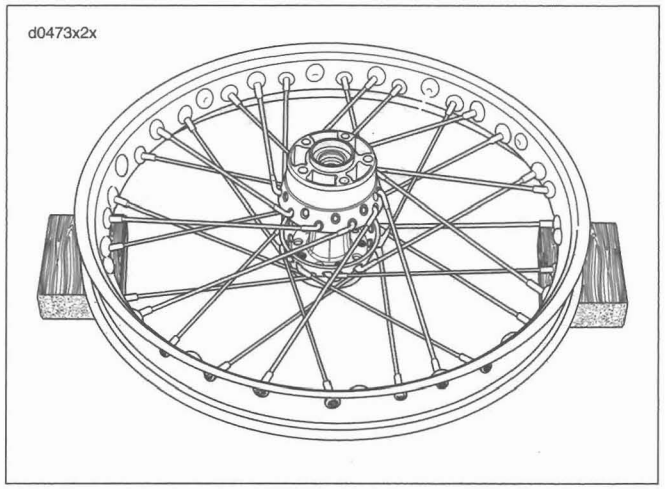


Figure 2-38.

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

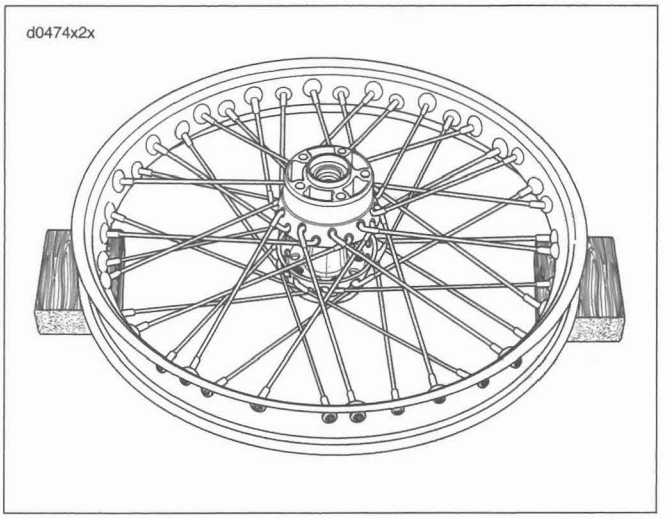


Figure 2-39.

10. Tighten spoke nipples:
    a. Tighten steel laced rim spoke nipples to 40-50 **in-lbs** (4.5-5.6 Nm).
    b. Tighten chrome aluminum laced profile rim spoke nipples to 55 **in-lbs** (6.2 Nm).
11. True wheel. See 2.11 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

1. See Figure 2-40. Divide the wheel spokes into four groups of ten 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.
3. See Figure 2-41. Place wheel in WHEEL TRUING STAND (Part No. HD-95500-80). Tighten arbor screws so hub will turn on its bearings.
4. 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 2-42.

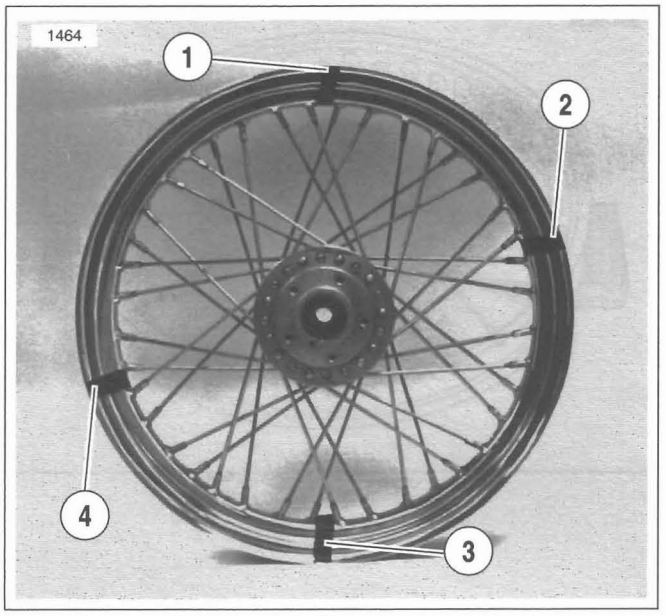


Figure 2-40. Marking Spoke Groups

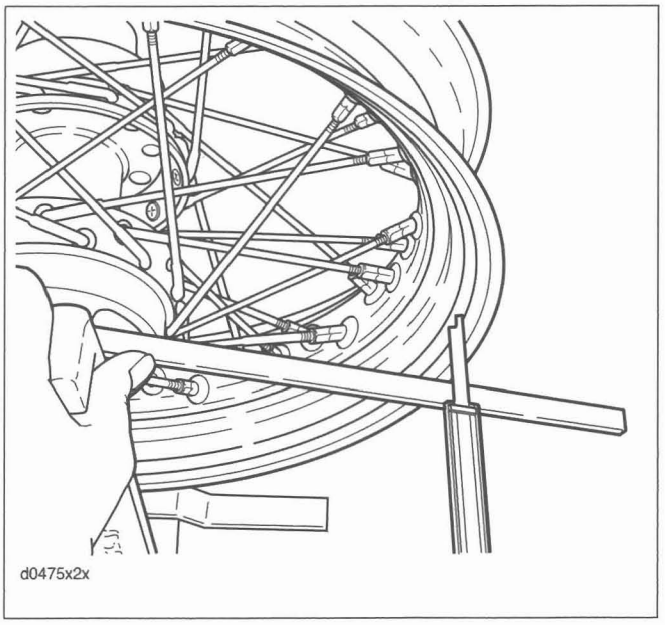


Figure 2-41. Check Laced Hub Offset Dimension (Rear Wheel Shown)

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, FXSTC models are not equipped with laced rear wheels.

Table 2-8. Wheel Offset Dimensions

MODEL	WHEEL	IN.	MM
STEEL LACED RIM			
FXST, FXSTD, FXSTB, FXSTC	Front	1.665-1.685	42.291-42.800
FLSTC, FLSTN FLSTSC	Front	1.272-1.292	32.309-32.817
FLSTC, FLSTN, FLSTSC	Rear	1.392-1.412	35.357-35.864
CHROME ALUMINUM PROFILE LACED RIM			
FXST, FXSTB, FXSTC	Front	1.695-1.715	43.053-43.561
FLSTC, FLSTF, FLSTSC, FLSTN	Front	0.990-1.010	25.146-25.654
FLSTC, FLSTF, FLSTSC, FLSTN	Rear	1.110-1.130	28.194-28.702

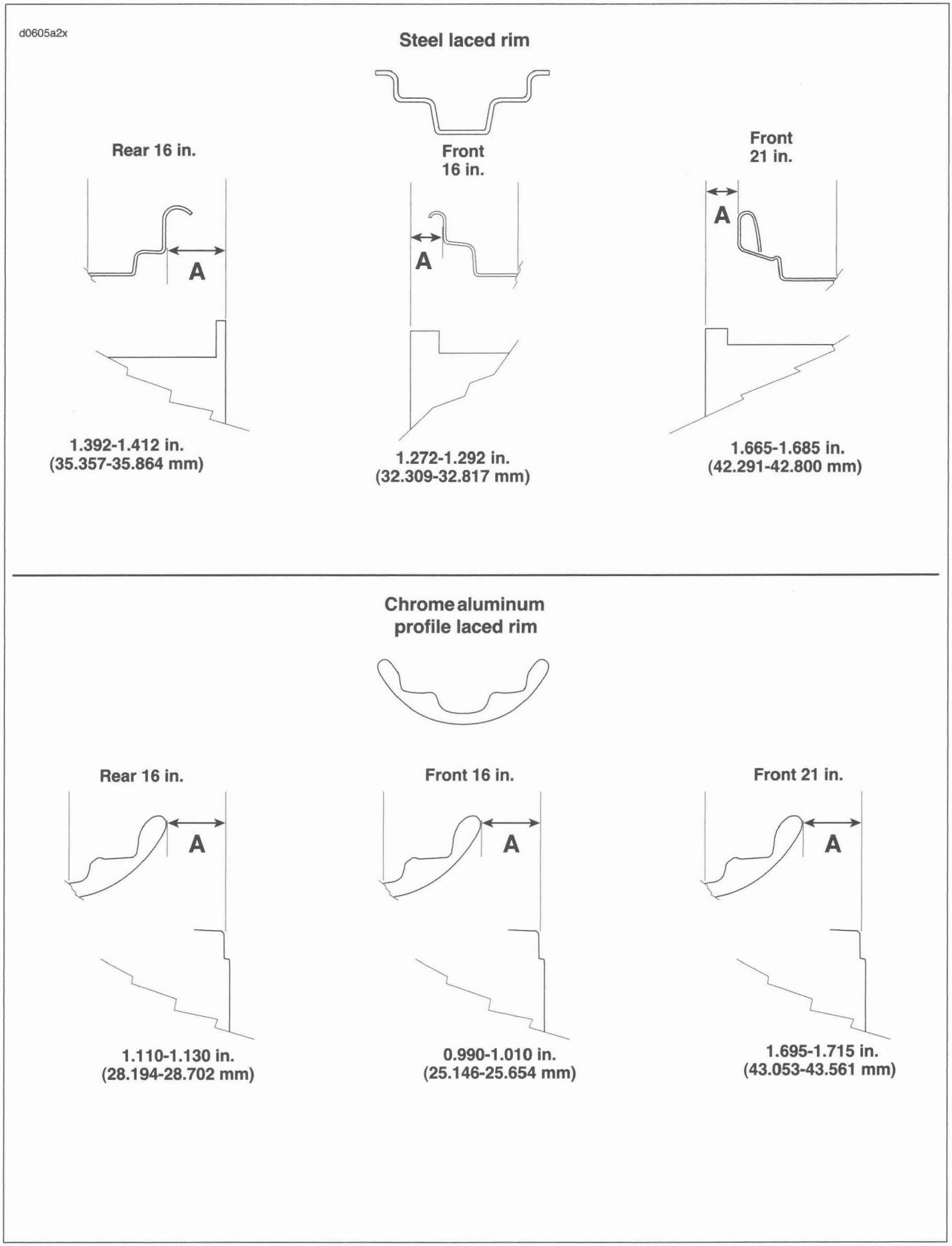


Figure 2-42. Laced Hub Offset Dimension

RADIAL TRUING

1. See Figure 2-43. 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).
2. 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.
3. 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.
5. 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.

6. 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.

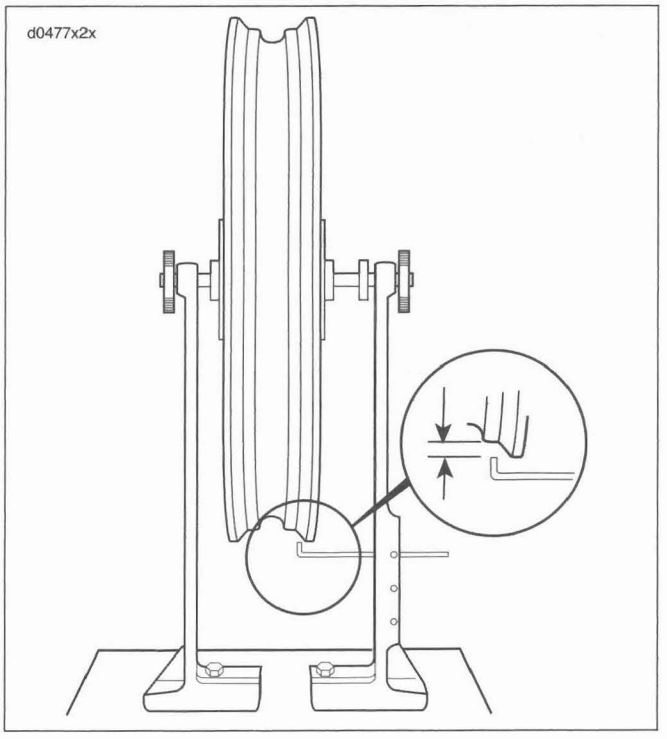


Figure 2-43. Truing Rim Radially

GENERAL

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

LATERAL RUNOUT

See Figure 2-44. 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.

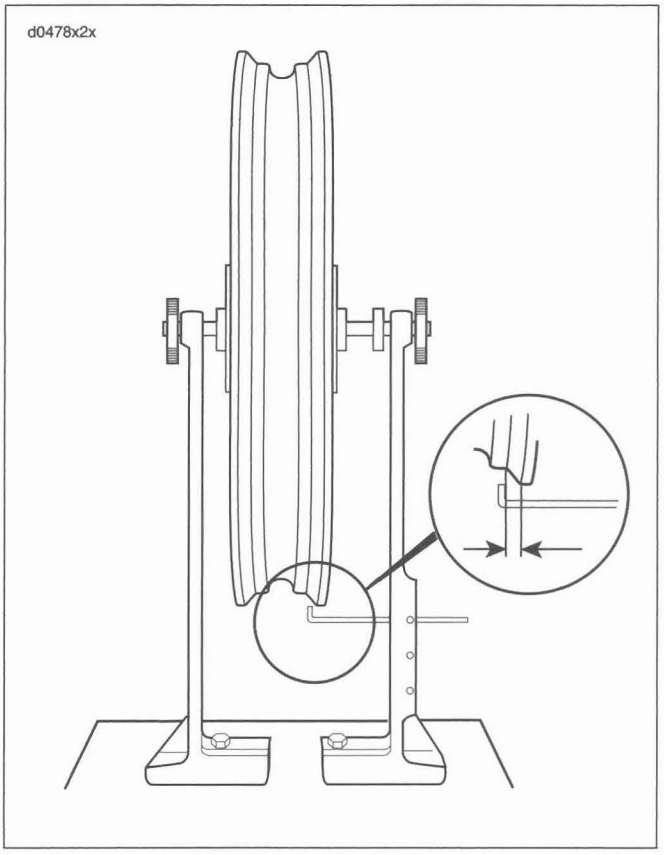


Figure 2-44. Checking Lateral Runout

RADIAL RUNOUT

See Figure 2-45. Check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).

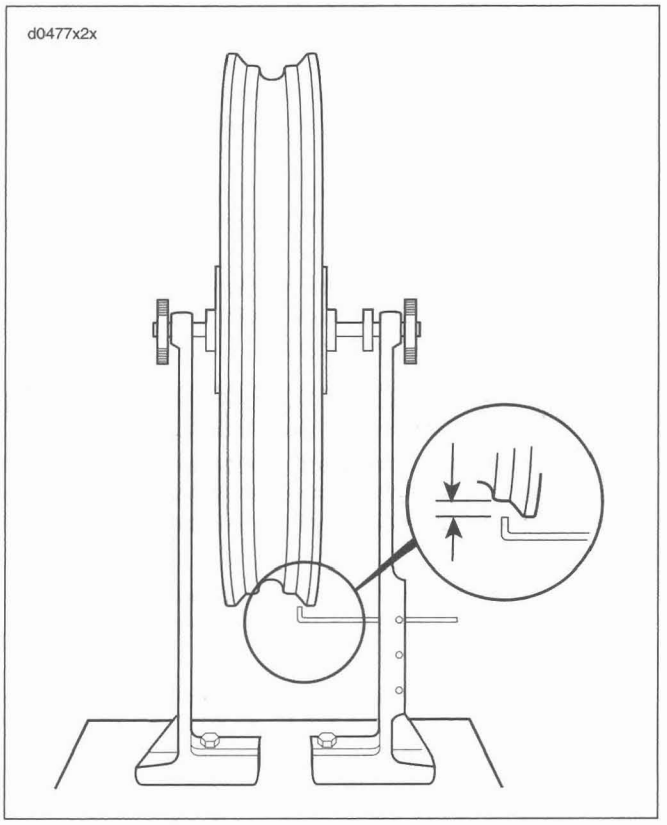


Figure 2-45. Checking Radial Runout

GENERAL

WARNING

Use only Harley-Davidson approved tires. See a Harley-Davidson dealer. Using non-approved tires can adversely affect stability, which could result in death or serious injury. (00024a)

WARNING

Be sure tires are properly inflated, balanced and have adequate tread. Inspect your tires regularly and see a Harley-Davidson dealer for replacements. Riding with excessively worn, unbalanced or under-inflated tires can adversely affect stability and handling, which could result in death or serious injury. (00014a)

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

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

See Figure 2-46. Tread wear indicator bars will appear on tire tread surfaces when 1/32 inch (0.8 mm) or less of tread remains. Arrows on tire sidewalls pinpoint location of wear bar indicators. Always remove tires from service before they reach the tread wear indicator bars (1/32 of an inch/0.8 mm tread pattern depth remaining).

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

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

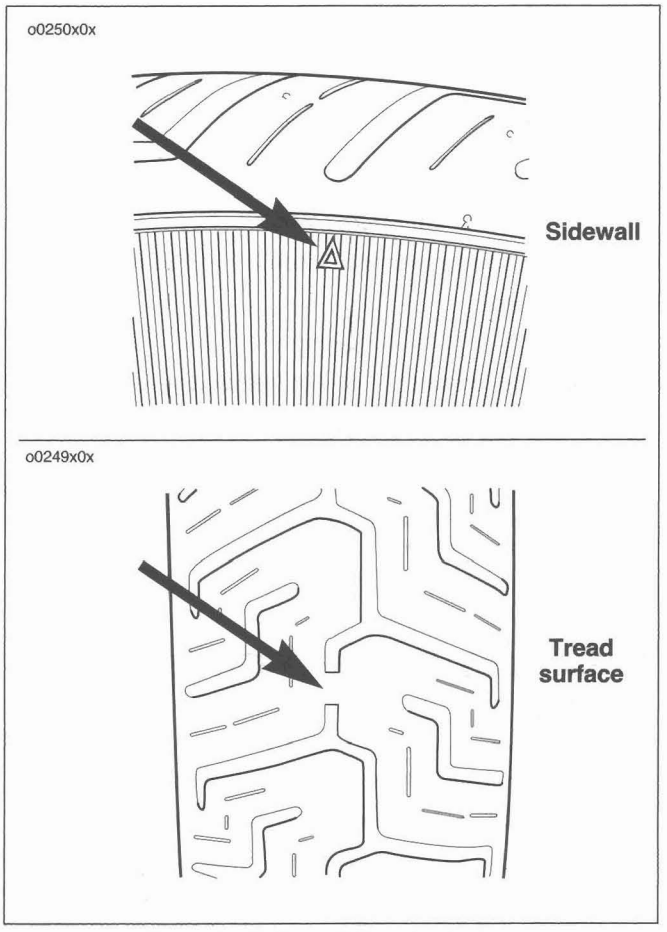


Figure 2-46. Tread Wear Indicators

REMOVAL

NOTE

Care must be taken when removing and installing tire to prevent cosmetic damage to wheel. This is especially true with wheels that feature painted surfaces.

1. Remove wheel from motorcycle:
   a. If removing front wheel, see 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTD, 2.5 FRONT WHEEL: FXSTD or 2.6 FRONT WHEEL: FLSTSC.
   b. If removing rear wheel, see 2.7 REAR WHEEL.
2. Deflate tire.

NOTE

On tube type wheels, it is not necessary to completely remove tire from rim. Removing one side allows the tube to be replaced and allows for inspection of tire.

3. Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to loosen the beads from the rim.
4. Remove tire.

CLEANING, INSPECTION AND REPAIR

1. Clean the inside of tire and outer surface of tube.
2. If rim is dirty or rusty, clean with a stiff wire brush.
3. Wheels should be checked for lateral and radial runout before installing a new tire. On models with laced wheels, see 2.11 TRUING LACED WHEEL. On models with cast wheels, see 2.12 DISC RIM RUNOUT.
4. Inspect the tire and tube for wear and damage. Inspect tread depth. Replace worn tires. Replace damaged tubes.

⚠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)

5. 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.
6. Acceptable repair method involves the use of a patch and plug combination.

Figure 2-47. Installing Rim Strip

INSTALLATION

⚠WARNING

Harley-Davidson front and rear tires are not the same. Interchanging front and rear tires can cause tire failure, which could result in death or serious injury. (00026a)

⚠WARNING

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)

⚠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)

NOTE

Some tires have arrows molded into the tire sidewall. These tires should be mounted on the rim with the arrow pointing in the direction of forward rotation. The colored dot on the sidewall is a balance mark and should be located next to the valve stem hole.

Tube Type Tires

⚠WARNING

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

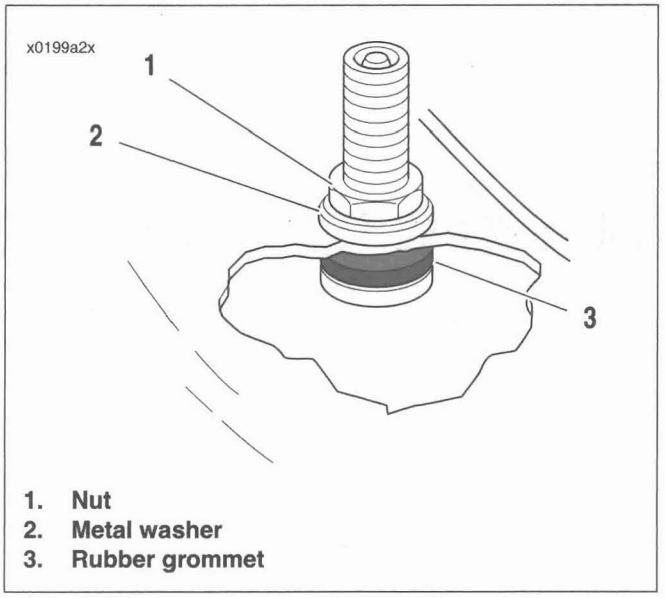
⚠WARNING

Use inner tubes on laced (wire spoked) wheels. Using tubeless tires on laced wheels can cause air leaks, which could result in death or serious injury. (00025a)

NOTES

- *For correct tire and tube types, see TIRES under 2.1 SPECIFICATIONS.*
- *Whenever a tube type tire is replaced, the tube should also be replaced. Inner tubes should be patched only as an emergency measure. Replace a damaged or patched tube as soon as possible. Rim bands must be used on all laced wheels.*

1. See Figure 2-47. On laced wheels, install a rim strip into the rim well. Make sure no spokes protrude through nipples, and be sure to align the valve stem hole in rim strip with valve stem hole in rim.
2. Install tube and tire.



1. **Nut**
2. **Metal washer**
3. **Rubber grommet**

Figure 2-48. Tubeless Tire Valve Stem

Tubeless Tires

⚠WARNING

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)

1. See Figure 2-48. On tubeless wheels, damaged or leaking valve stems must be replaced. Install rubber grommet (3) on valve stem.
   a. Insert valve stem into rim hole.
   b. Install metal washer (2).
   c. Install nut and tighten to 12-15 **in-lbs** (1.4-1.7 Nm).
2. Install tire.

INSPECTION

⚠WARNING

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 2.11 TRUING LACED WHEEL or 2.12 DISC RIM RUNOUT.
2. Check steering head bearing adjustment and adjust if necessary. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC or 1.18 STEERING HEAD BEARINGS: FLSTSC.
3. 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 2-49. 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.

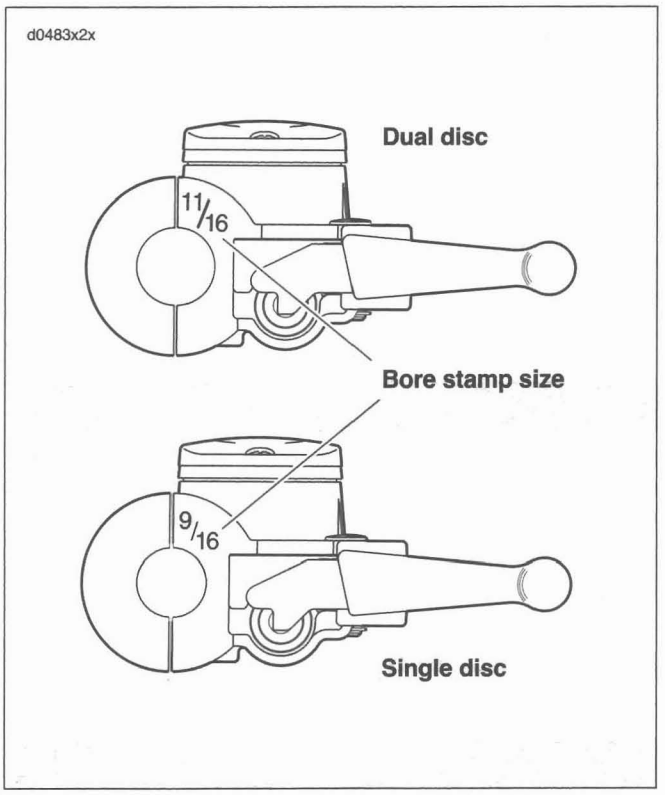


Figure 2-49. Bore Sizes

REMOVAL/DISASSEMBLY

1. 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.

2. 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)

3. See Figure 2-52. Place the cardboard insert between the brake lever and lever bracket.
4. See Figure 2-51. Remove the two T27 TORX screws with flat washers (9) to detach the handlebar clamp (8) from the master cylinder reservoir (14).

⚠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)

5. 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

⚠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)

1. 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)

2. 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.

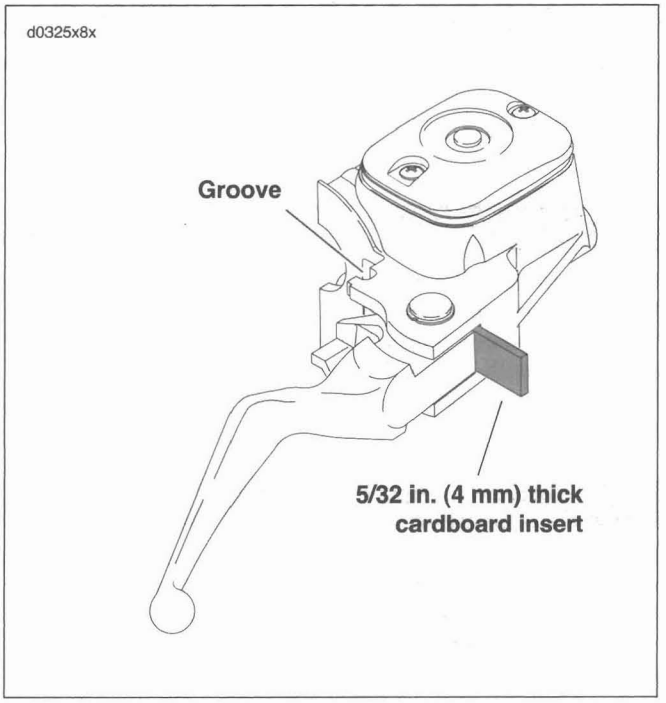
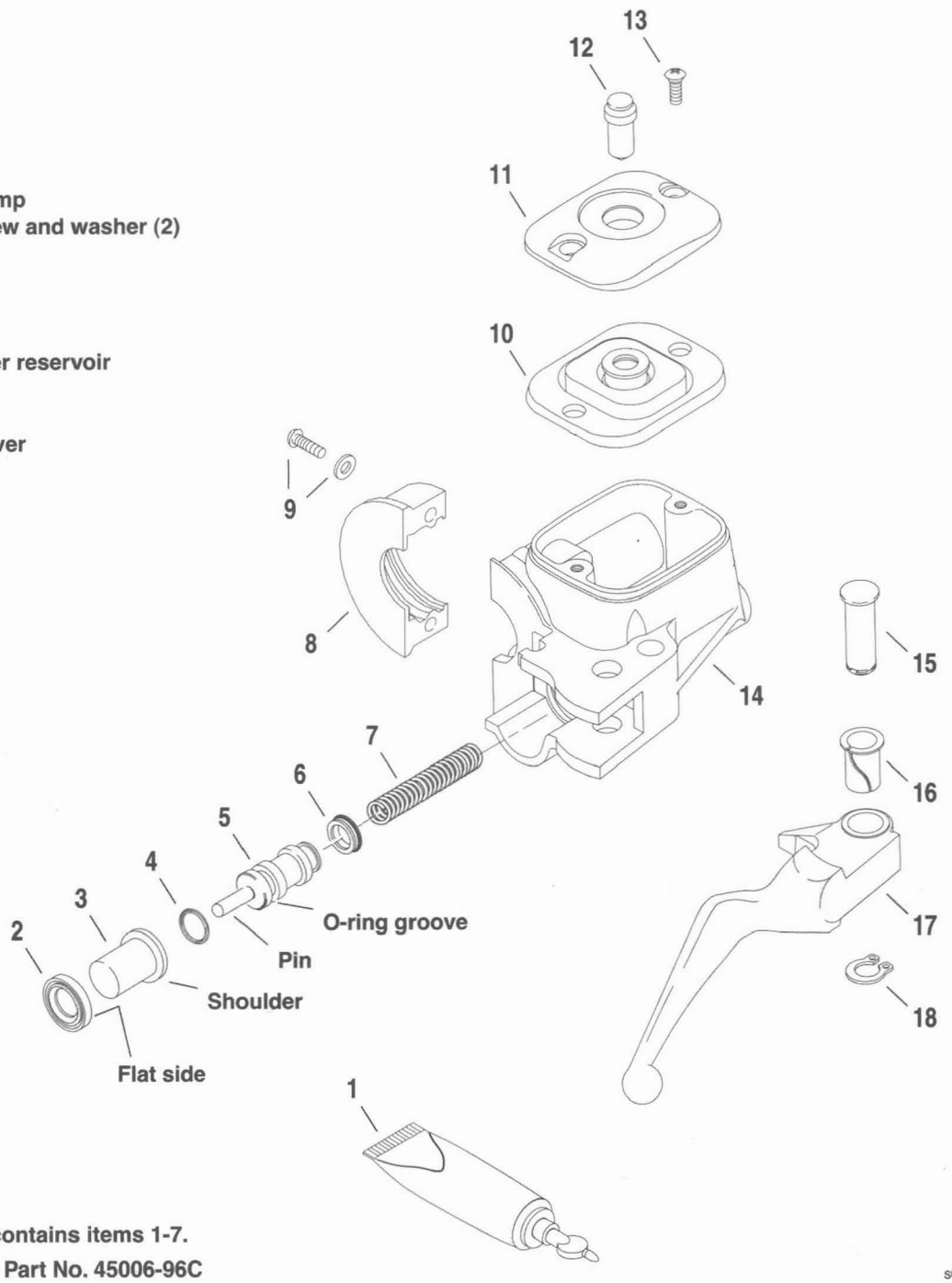


Figure 2-50. Cardboard Insert

3. Carefully inspect all parts for wear or damage and replace as necessary.
4. Inspect the piston bore in the master cylinder housing for scoring, pitting or corrosion. Replace the housing if any of these conditions are found.
5. 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.
6. Inspect the cover gasket for cuts, tears or general deterioration. Replace as necessary.

1. Lubricant
2. Wiper
3. Piston cap
4. O-ring
5. Piston
6. Primary cup
7. Spring
8. Handlebar clamp
9. T27 TORX screw and washer (2)
10. Gasket
11. Cover
12. Site glass
13. Screw (2)
14. Master cylinder reservoir
15. Pivot pin
16. Bushing
17. Brake hand lever
18. Retaining ring



Service parts kit contains items 1-7.

- 9/16 in. bore - Part No. 45006-96C

s0501x2x

Figure 2-51. Front Brake Master Cylinder

ASSEMBLY/INSTALLATION

1. See Figure 2-51. 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.
3. 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).
8. 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.
9. 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.
10. 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.

⚠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. 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)

12. See Figure 2-53. 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).
13. 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).

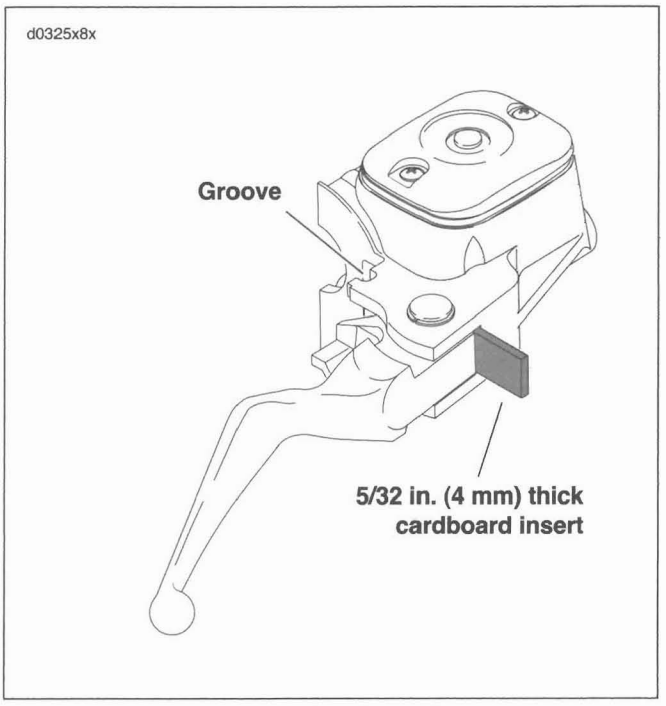
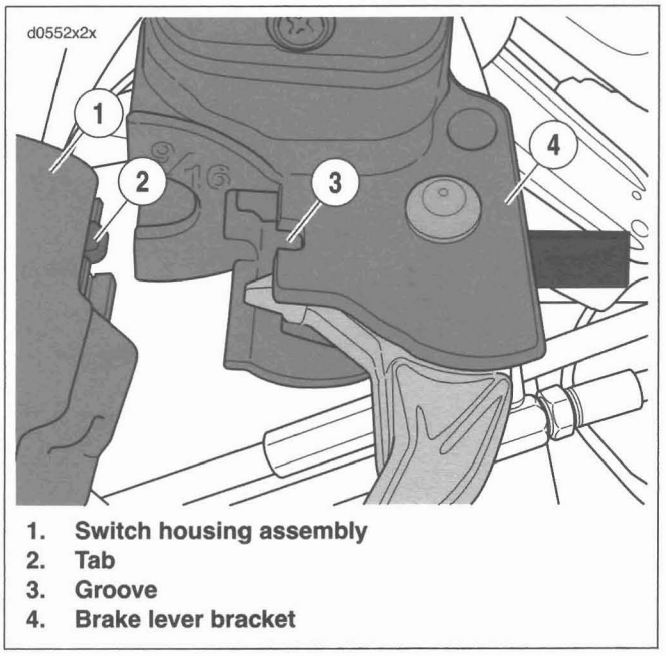


Figure 2-52. Cardboard Insert



1. **Switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

Figure 2-53. 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)

14. 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).
15. Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
16. Stand the motorcycle upright so that the master cylinder is in a level position. Remove the master cylinder cover.

⚠CAUTION

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)

17. 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.

⚠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)

19. 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.
20. 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.
    b. 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)

1. See Figure 2-54. 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.
3. See Figure 2-55. Remove cotter pin (4) and washer (5) from clevis pin (6). Remove master cylinder assembly from brake pedal.
4. If disassembling master cylinder, remove retaining ring (3).

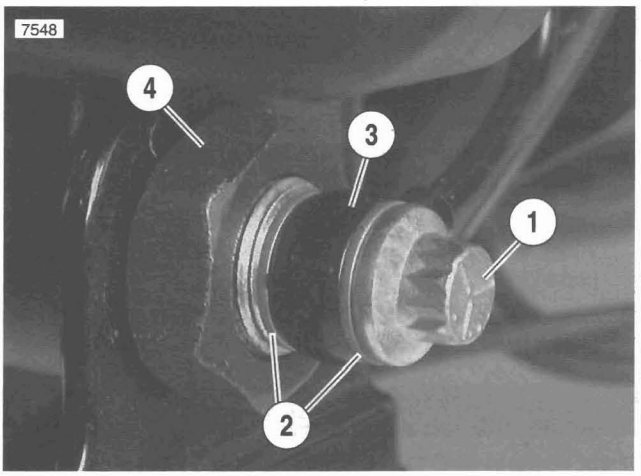
INSTALLATION

1. See Figure 2-55. If master cylinder was disassembled, install **new** retaining ring (3).
2. Install master cylinder assembly on brake pedal. Install washer (5) and **new** cotter pin (4) on clevis pin (6).
3. See Figure 2-54. 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 30-40 ft-lbs (40.7-54.2 Nm).

CAUTION

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

4. 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).
5. Grease fitting with WHEEL BEARING GREASE (Part No. 99856-92) until a small amount of grease is visible around edges of brake lever.
6. Install length of clear plastic tubing over caliper bleeder valve. Place free end of tube in a clean container.
7. Stand the motorcycle upright so that the master cylinder is in a level position. Remove the master cylinder cover.



1. **Banjo bolt**
2. **Steel/rubber washers (2)**
3. **Brake line**
4. **Nut**

Figure 2-54. Rear Brake Control: Front Mount

⚠CAUTION

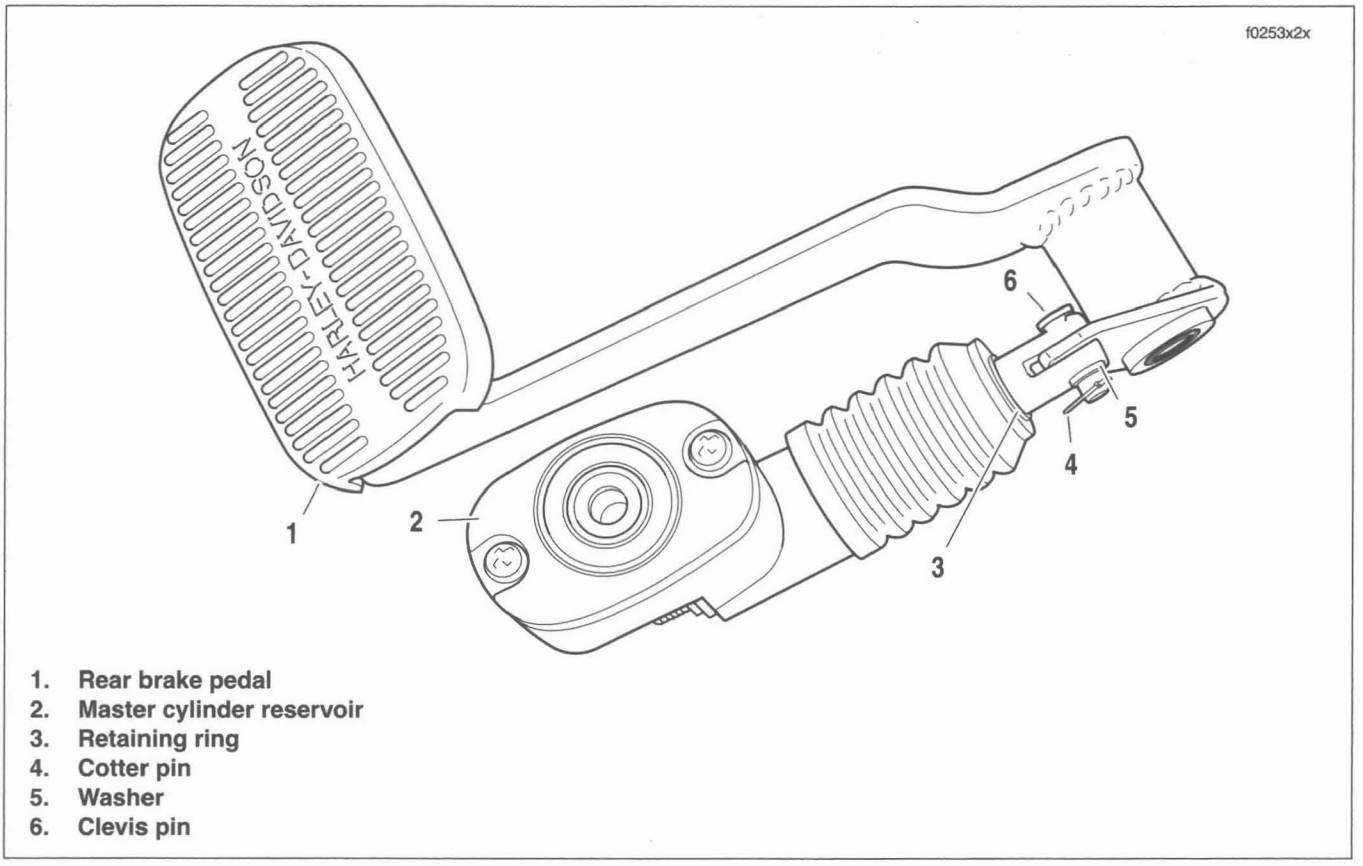
Direct contact of D.O.T. 4 brake fluid with eyes can cause irritation. Avoid eye contact. In case of eye contact flush with large amounts of water and get medical attention. Swallowing large amounts of D.O.T. 4 brake fluid can cause digestive discomfort. If swallowed, obtain medical attention. Use in well ventilated area. KEEP OUT OF REACH OF CHILDREN. (00240a)

8. 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)

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



1. Rear brake pedal
2. Master cylinder reservoir
3. Retaining ring
4. Cotter pin
5. Washer
6. Clevis pin

Figure 2-55. Rear Brake Control: Rear Mount

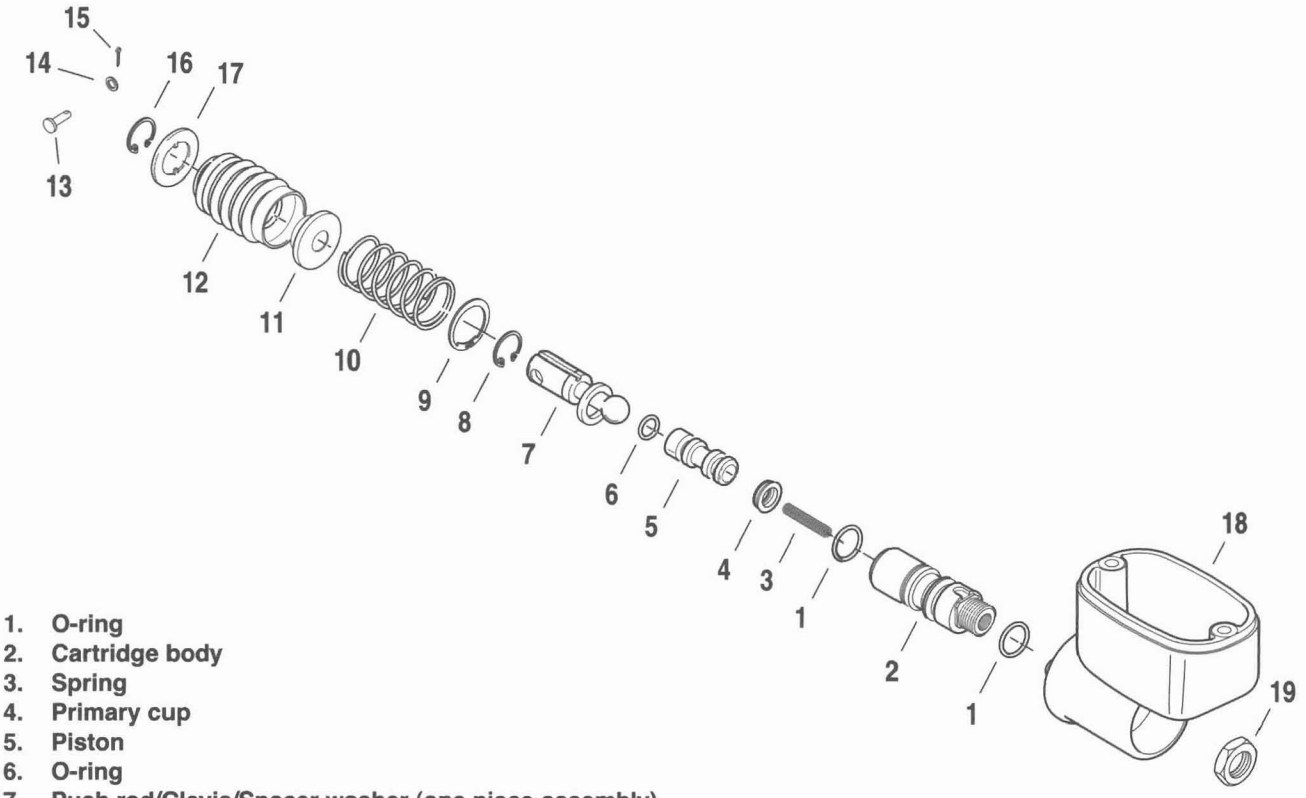
⚠WARNING

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)

11. Test brake system.
    a. Turn ignition switch ON. Pump brake foot pedal to verify operation of the brake lamp.
    b. 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.



1. **O-ring**
2. **Cartridge body**
3. **Spring**
4. **Primary cup**
5. **Piston**
6. **O-ring**
7. **Push rod/Clevis/Spacer washer (one piece assembly)**
8. **Retaining ring**
9. **Retaining ring**
10. **Spring**
11. **Spring retainer**
12. **Dust boot**
13. **Clevis pin**
14. **Flat washer**
15. **Cotter pin**
16. **Retaining ring**
17. **Washer**
18. **Reservoir**
19. **Hex nut**

Figure 2-56. Rear Master Cylinder Assembly

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.

2. 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.

⚠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)

3. See Figure 2-57. 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.

4. Remove the large flat washer, dust boot and spring from push rod end of cartridge body. Remove spring and spring retainer from dust boot.

5. See Figure 2-58. 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.

6. Carefully remove two O-rings from outside of cartridge body. Exercise caution to avoid scratching O-ring grooves.

7. 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.

8. Remove push rod with captured spacer washer from cartridge body. Remove small retaining ring from push rod, if attached. Discard retaining ring.

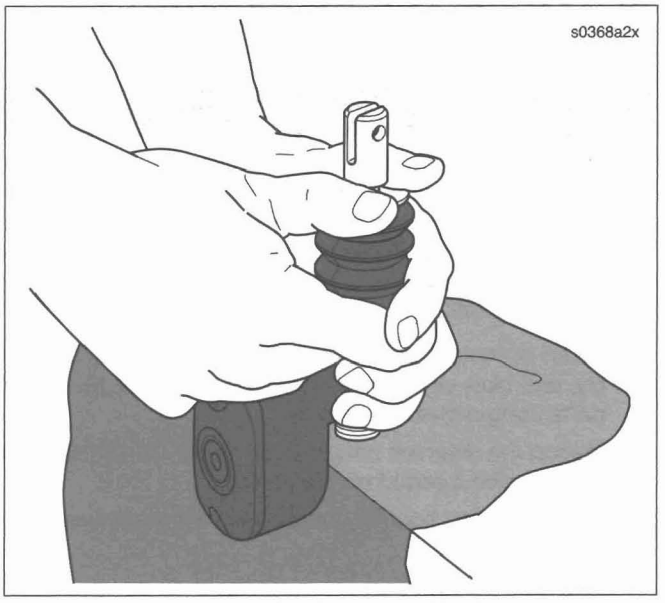


Figure 2-57. Removing Clevis

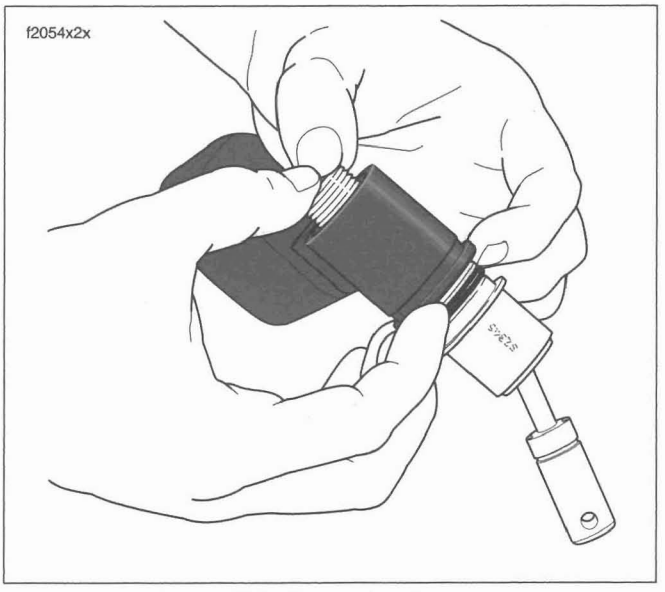


Figure 2-58. Removing Cartridge

CLEANING AND INSPECTION

⚠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)

1. 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.
3. 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.
5. Inspect the spring for cracks or broken coils. Replace as necessary.
6. 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.
7. 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:
   a. Install small spring into cartridge body making sure that spring is seated in counterbore.
   b. Lightly lubricate primary cup and O-ring on piston with D.O.T. 4 BRAKE FLUID.
   c. Install piston over spring.
2. Install **new** large retaining ring in groove on push rod side of cartridge body.
3. Position **new** retaining ring on push rod between spacer washer and clevis, or on clevis inboard of the retaining ring groove.

Figure 2-59. Compress Spring and Retaining Ring

NOTE

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

4. See Figure 2-59. Stand cartridge body upright on banjo sealing surface. Lay down a clean shop cloth to protect the sealing surface from damage.

⚠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)

5. 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.
6. Verify that retaining ring is completely seated in groove and that push rod rotates freely.
7. Lubricate **new** O-rings with D.O.T. 4 BRAKE FLUID and carefully install in grooves on outside of cartridge body.

8. Wipe bore of reservoir adapter with D.O.T. 4 BRAKE FLUID.
9. 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.
10. 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 2-60. 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.
16. Pull down dust boot as necessary to seat over lip on reservoir adapter.
17. 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.

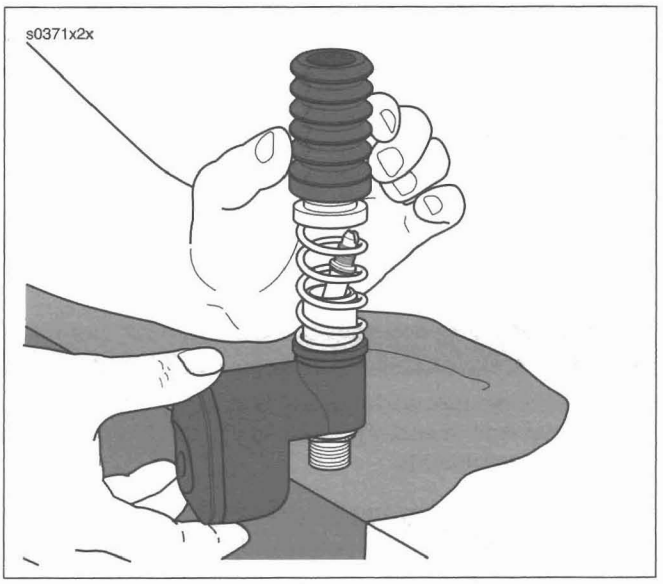


Figure 2-60. Master Cylinder Assembly

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)

1. See Figure 2-61. Remove the banjo bolt (1) and both steel/rubber washers (2) to detach front brake line (3) from caliper. Discard washers.
2. Remove both the upper (4) and lower (5) mounting bolts (12 pt/10 mm). Lift caliper upward to remove from brake disc.

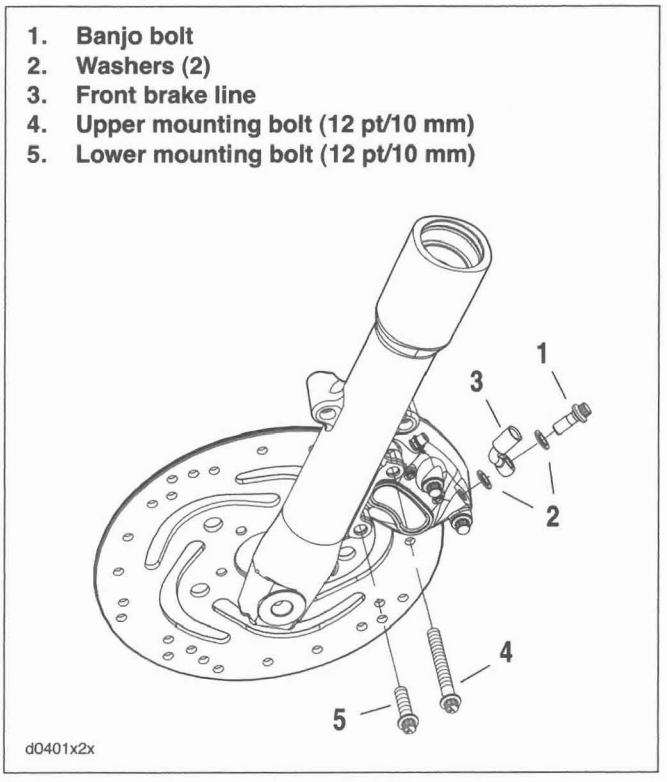


Figure 2-61. Front Caliper Mount

DISASSEMBLY

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

1. See Figure 2-62. 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).

1. Inside caliper housing
2. Square seal (4)
3. Wiper (4)
4. Piston (4)
5. Crossover O-ring (2)
6. Anti-rattle spring
7. Brake pads (2)
8. Outside caliper housing
9. Decal
10. Pad pin (2) (12 pt/0.25 in.)
11. Bridge bolt (2) (12 pt/10 mm)
12. Bleeder valve

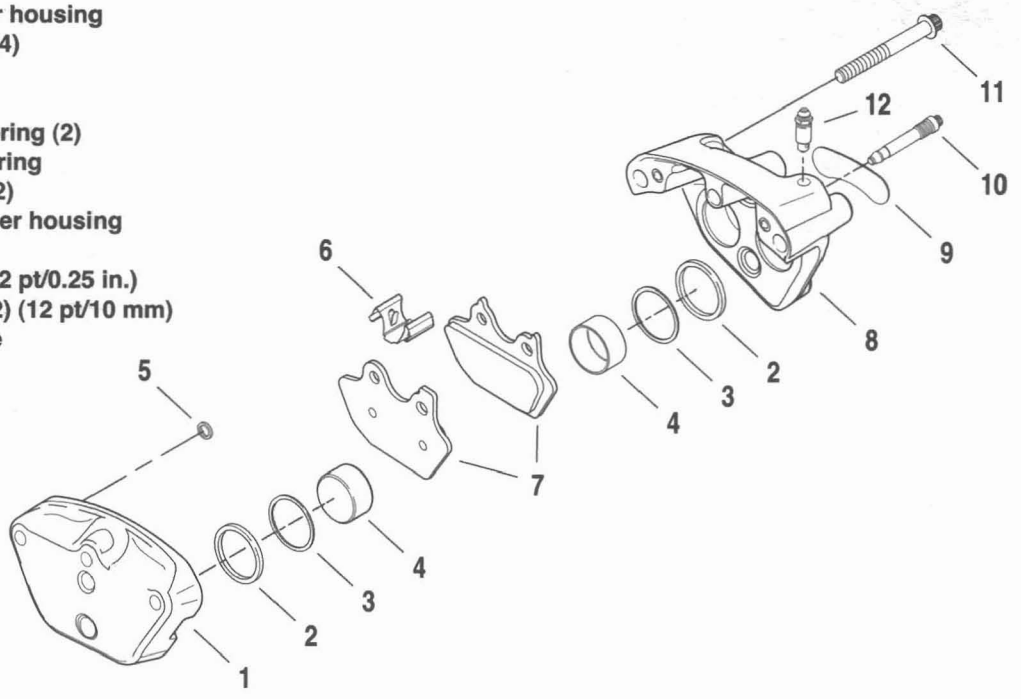


Figure 2-62. Front Brake Caliper

⚠WARNING

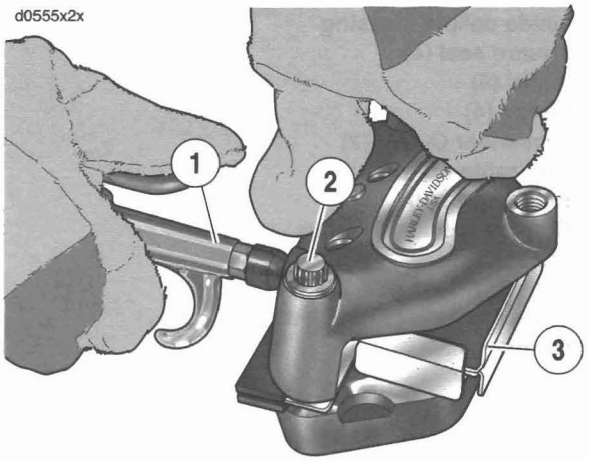
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

3. See Figure 2-63. Remove pistons.
   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.
   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 2-64. Remove and discard both crossover O-rings (1) from inside caliper housing.
5. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

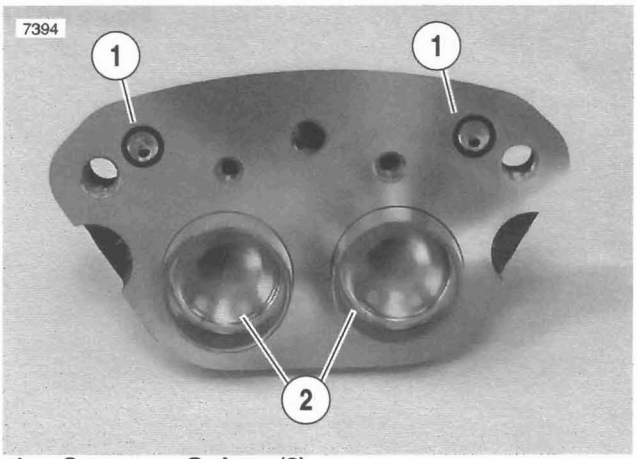
Damaged pistons or piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

6. See Figure 2-65. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



1. **Low pressure air hose**
2. **Bridge bolt (12 pt/10 mm)**
3. **Brake caliper piston remover (Part No. HD-43293-A)**

Figure 2-63. Removing Pistons



1. **Crossover O-rings (2)**
2. **Pistons (2)**

Figure 2-64. Crossover O-rings and Inside Housing

CLEANING, INSPECTION AND REPAIR

⚠WARNING

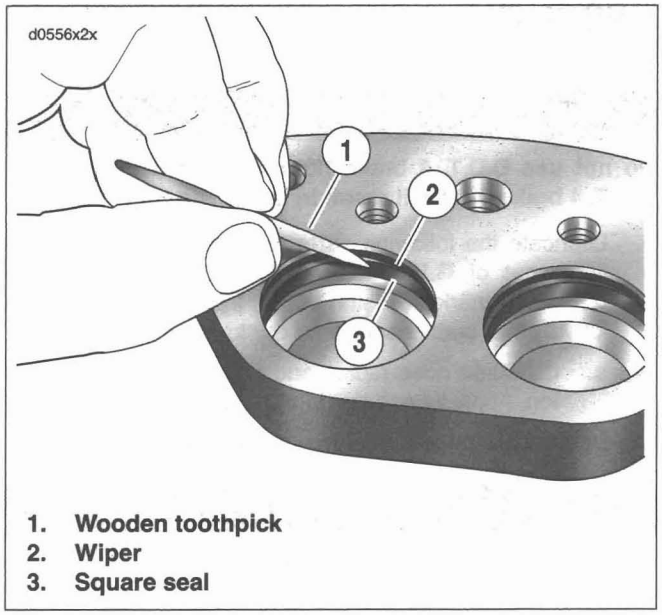
Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

1. 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, scratching or corrosion on face and also on ground surfaces.
   b. 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.
3. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

⚠WARNING

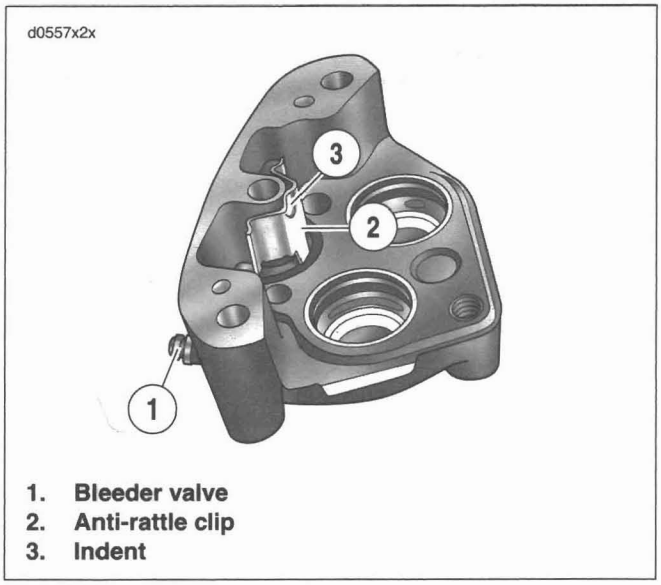
Always replace brake pads in complete sets for correct and safe brake operation. Improper brake operation could result in death or serious injury. (00111a)

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



1. **Wooden toothpick**
2. **Wiper**
3. **Square seal**

Figure 2-65. Wipers and Square Seals



1. **Bleeder valve**
2. **Anti-rattle clip**
3. **Indent**

Figure 2-66. 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.

1. 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.

CAUTION

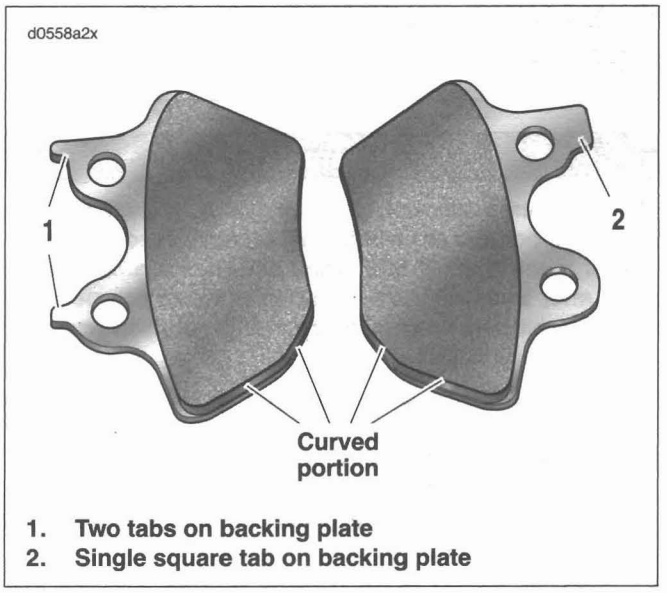
Damaged piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

2. See Figure 2-65. Install a **new** square seal (3) and a **new** wiper (2) into each piston bore.
3. Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
4. See Figure 2-64. Place two **new** crossover O-rings (1) on inside caliper housing.
5. Assemble caliper housings.
   a. See Figure 2-66. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm).
   b. 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 2-67. Install pad with two tabs (1) on the inboard side of the rear caliper.

6. 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.



1. Two tabs on backing plate
2. Single square tab on backing plate

Figure 2-67. Brake Pad Alignment

7. 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 2-66.*

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

INSTALLATION

1. See Figure 2-61. Attach caliper to fork leg.
   a. Place caliper over brake disc with bleeder valve facing upwards.
   b. 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).
   d. 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)

2. 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).

⚠CAUTION

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)

3. 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.

⚠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)

5. 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.
6. 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.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
   b. Test ride the motorcycle. If the brakes feel spongy, bleed the system 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

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)

1. See Figure 2-70. 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.
3. 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.

4. 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.

DISASSEMBLY

1. See Figure 2-68. Remove retainer screw (10), retaining pad (9) and inside pad (11).
2. 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.
3. Pry out the piston retaining ring (8) by inserting a small screwdriver into the notched groove at the bottom of the piston bore.

⚠CAUTION

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.

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

CLEANING AND INSPECTION

⚠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)

1. 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.
   b. 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)

3. 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.

1. Lower mounting bolt
2. O-ring (3)
3. Caliper
4. Bleeder valve
5. Piston seal
6. Piston
7. Piston dust boot
8. Piston retaining ring
9. Retaining pad
10. Screw
11. Brake pad set
12. Cotter pin
13. Washer
14. Spring clip
15. Dust boot
16. Guide pin
17. Caliper mounting bracket
18. Washer
19. Upper mounting bolt

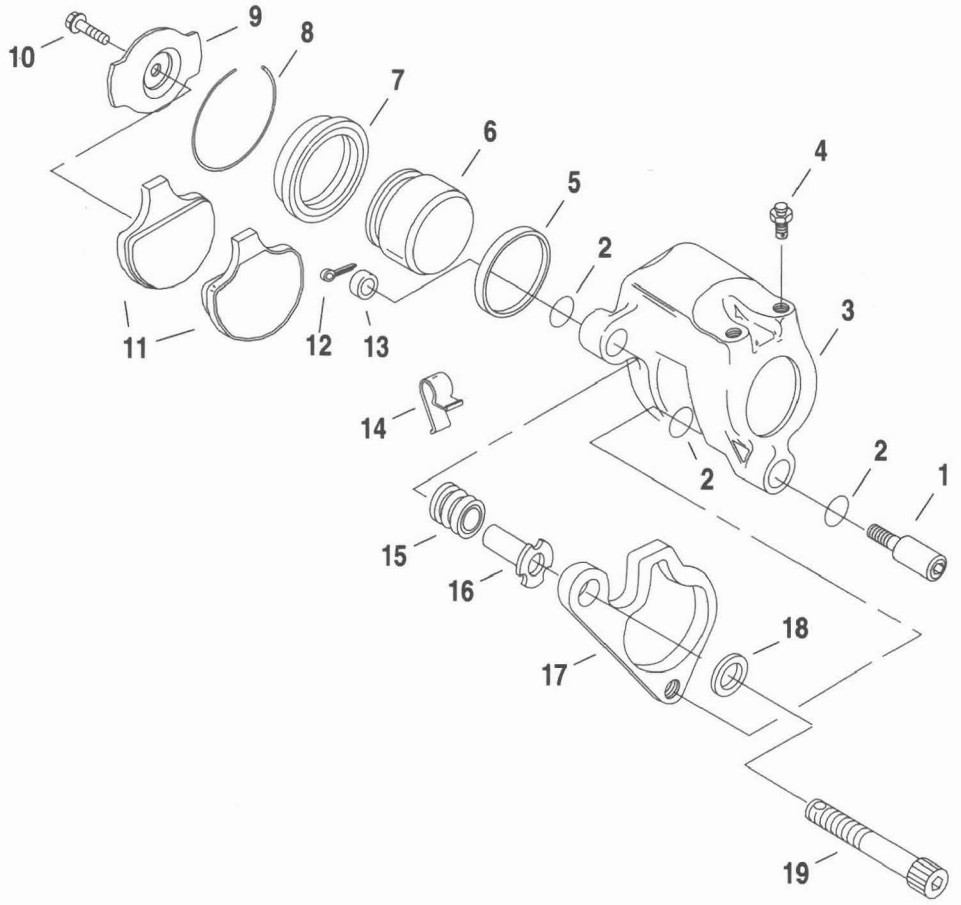


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Figure 2-68. Front Brake Caliper: FLSTSC

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.

1. See Figure 2-68. 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.
2. 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.
3. 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.*

4. 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.
5. Lightly coat the bores of the caliper mounting lugs with Dow Corning MOLY 44 grease (Part No. 94674-99).
6. 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.
7. 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.
9. 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).

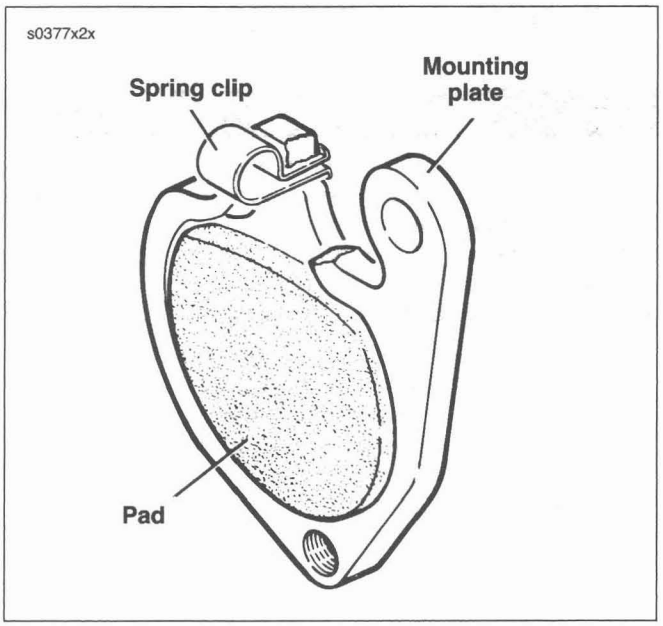


Figure 2-69. Spring Clip Installation

10. Lay the mounting bracket (17) down on a firm flat surface. The upper mounting bolt hole must be positioned at the upper right.
11. See Figure 2-69. Install the spring clip at the top of mounting plate as shown.
12. See Figure 2-68. 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.
13. 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

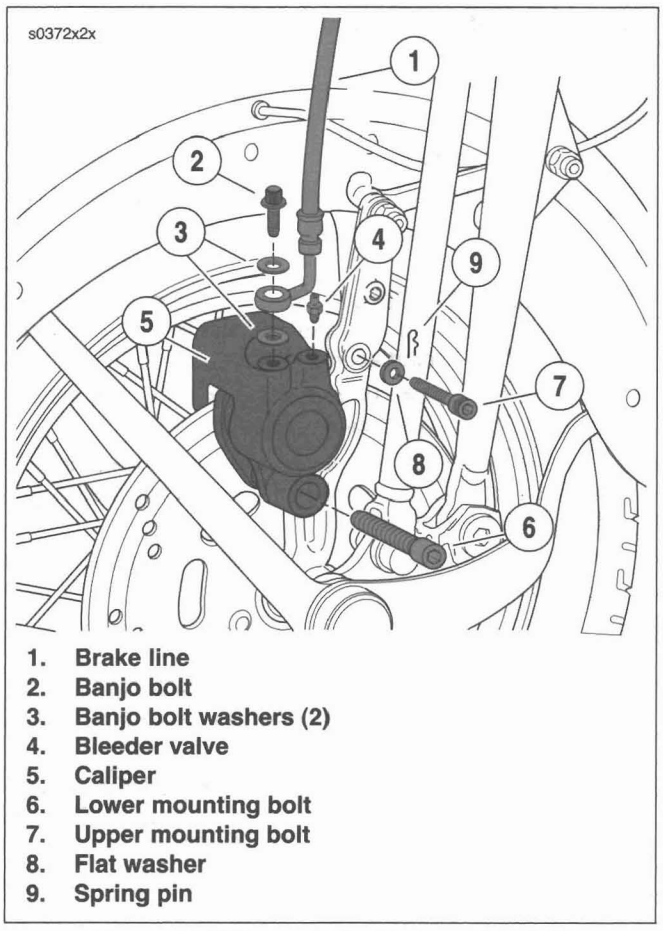
The spring clip loop and friction material must always face away from the piston. If it is wrong, the pad must be removed, the mounting plate reversed and the parts assembled again.

Installation

1. See Figure 2-70. 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 2-71. The Springer brake bracket has a cast-in nub that engages a hole in the mounting plate.



1. **Brake line**
2. **Banjo bolt**
3. **Banjo bolt washers (2)**
4. **Bleeder valve**
5. **Caliper**
6. **Lower mounting bolt**
7. **Upper mounting bolt**
8. **Flat washer**
9. **Spring pin**

Figure 2-70. Front Brake Caliper: FLSTSC

4. 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.
5. See Figure 2-70. 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.
6. Insert the lower mounting bolt (6) through the caliper (5) and the bracket hole.
7. See Figure 2-71. 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).
8. See Figure 2-70. Tighten the upper mounting bolt (7) to 25-30 ft-lbs (33.9-40.7 Nm). Install washer and **new** spring pin (9).
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)

10. 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.

⚠CAUTION

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)

11. 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

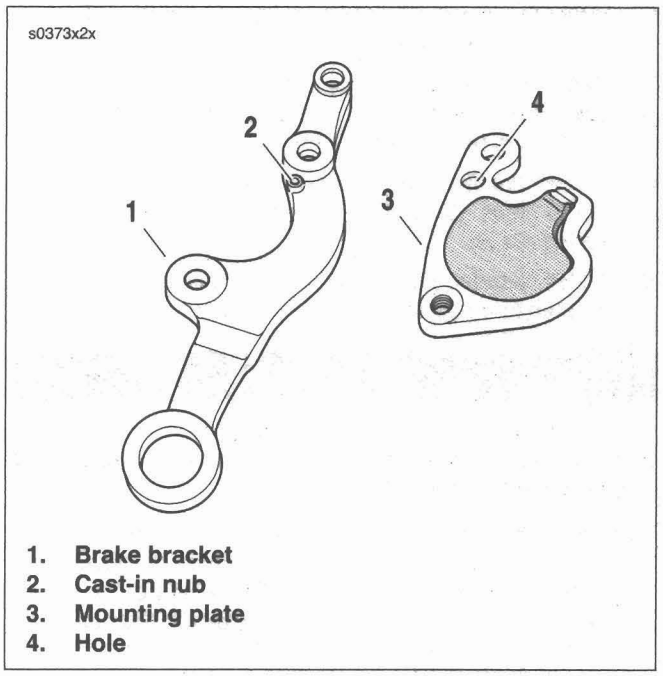
After servicing brakes and before moving motorcycle, pump brakes to build brake system pressure. Insufficient pressure can adversely affect brake performance, which could result in death or serious injury. (00279a)

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.
14. Install gasket and cover on master cylinder. Tighten cover screws to 6-8 **in-lbs** (0.7-0.9 Nm).



1. **Brake bracket**
2. **Cast-in nub**
3. **Mounting plate**
4. **Hole**

Figure 2-71. Springer Brake Bracket

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.
    b. Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 1.7 BLEEDING BRAKES.

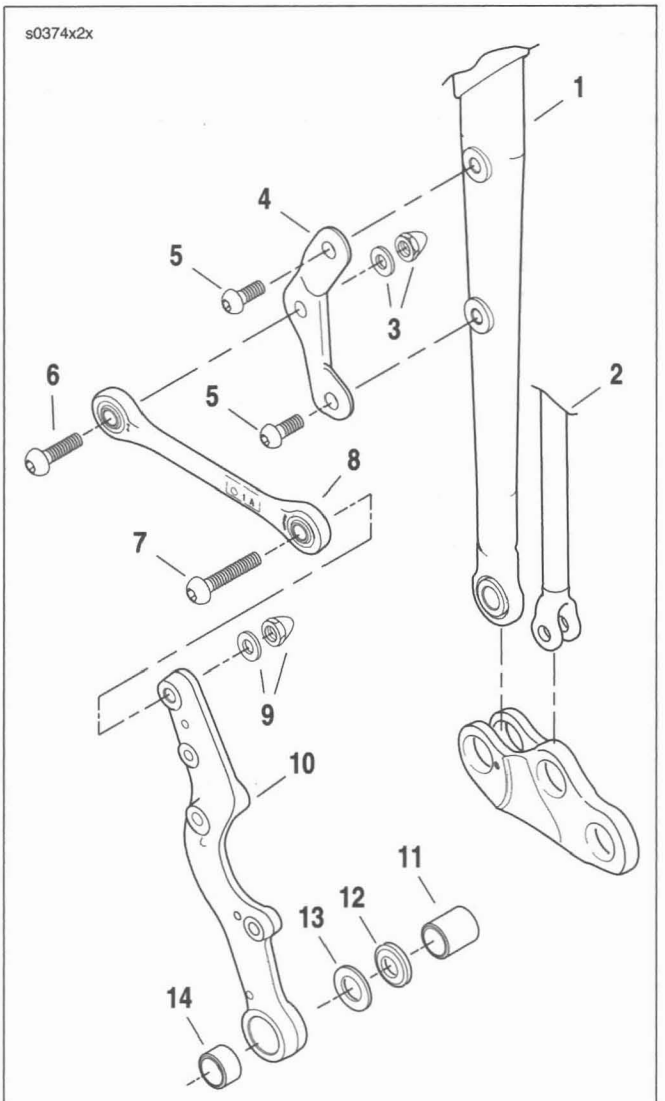
BRAKE REACTION LINK

Removal

1. Remove brake caliper.
2. Remove front wheel. See 2.6 FRONT WHEEL: FLSTSC.
3. Remove front fender. See 2.31 FRONT FENDER: FLSTSC.
4. See Figure 2-72. Remove screw (7), acorn locknut and washer (9) connecting brake reaction link (8) to caliper bracket (10). Discard acorn locknut.
5. Remove the caliper bracket (10), washer (13), rubber spacer (12) and pivot sleeve (11) from rocker.
6. Remove screw (6) and acorn locknut and washer (3) connecting brake reaction link (9) to fork leg bracket (4). Discard acorn locknut.
7. Remove screws (5) connecting fork leg bracket (4) to rigid fork leg (1).

Installation

1. See Figure 2-72. Attach fork leg bracket (4) to rigid fork (1) using two screws (5). Tighten to 35-40 ft-lbs (47.5-54.2 Nm).
2. 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).
3. Insert **new** pivot sleeve (11) for caliper bracket assembly into left rocker, if required.
4. 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).
7. 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 2.31 FRONT FENDER: FLSTSC.
9. Install front wheel. See 2.6 FRONT WHEEL: FLSTSC.
10. Install front brake caliper.



1. Rigid fork leg, left side
2. Spring fork leg, left side
3. Acorn locknut and washer
4. Fork leg bracket
5. Screw (2)
6. Screw
7. Screw, long
8. Brake reaction link
9. Acorn locknut and washer
10. Caliper bracket
11. Left pivot sleeve
12. Rubber spacer
13. Front axle washer
14. Caliper mounting bushing

Figure 2-72. Brake Reaction Link: FLSTSC

REAR BRAKE CALIPER: ALL BUT FXST/FXSTB/FXSTC/FLSTF 2.19

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 2-73. 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 2.7 REAR WHEEL.
4. Lift rear caliper away from axle and rear fork. Notch (4) in caliper mount must clear tab on rear fork.

1. **Banjo bolt**
2. **Washers (2)**
3. **Rear brake line**
4. **Notch**

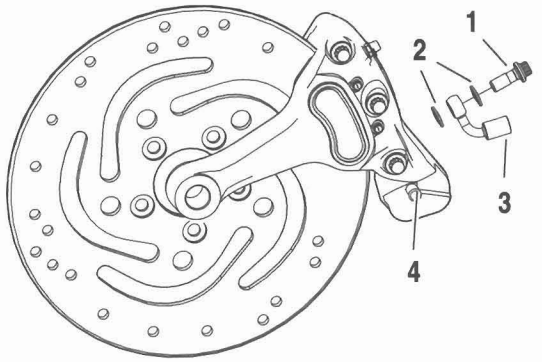


Figure 2-73. Rear Caliper Mount

DISASSEMBLY

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

1. See Figure 2-74. 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).
3. If necessary, cut rubber bumper (13) to remove.

1. Inside caliper housing
2. Square seal (4)
3. Wiper (4)
4. Piston (4)
5. Crossover O-ring (2)
6. Anti-rattle spring
7. Brake pads (2)
8. Outside caliper housing
9. Decal
10. Pad pin (2) (12 pt/0.25 in.)
11. Bridge bolt (3) (12 pt/10 mm)
12. Bleeder valve
13. Rubber bumper

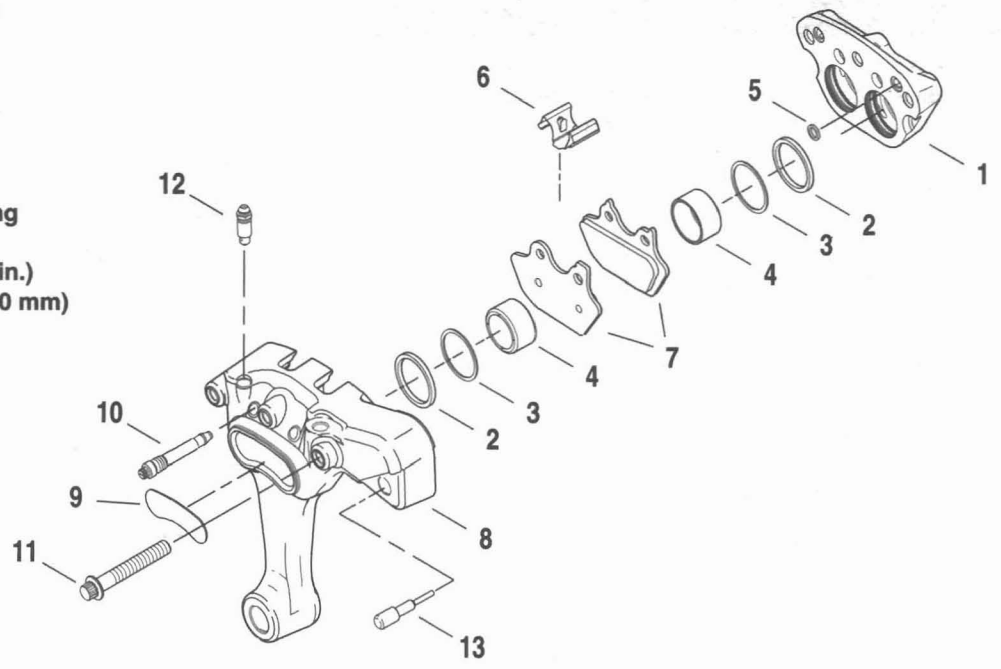


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Figure 2-74. Rear Brake Caliper

⚠WARNING

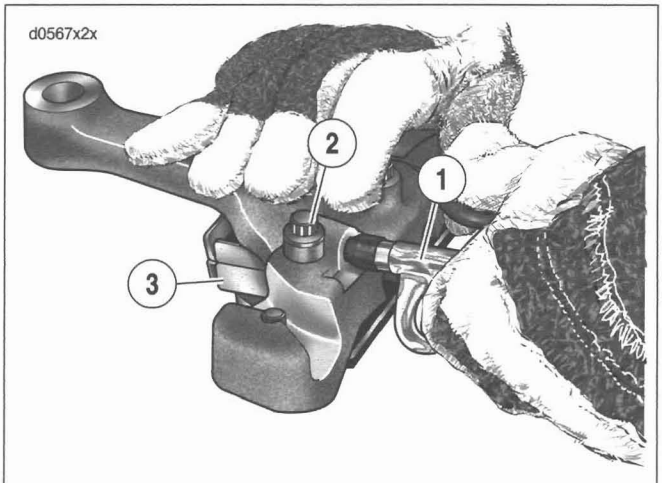
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

4. See Figure 2-75. 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 2-76. Remove and discard both crossover O-rings (1) from inside caliper housing.
6. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

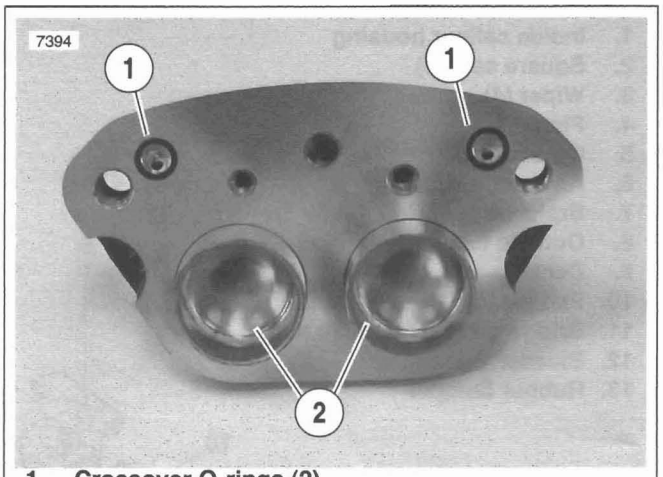
Damaged pistons or piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

7. See Figure 2-77. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



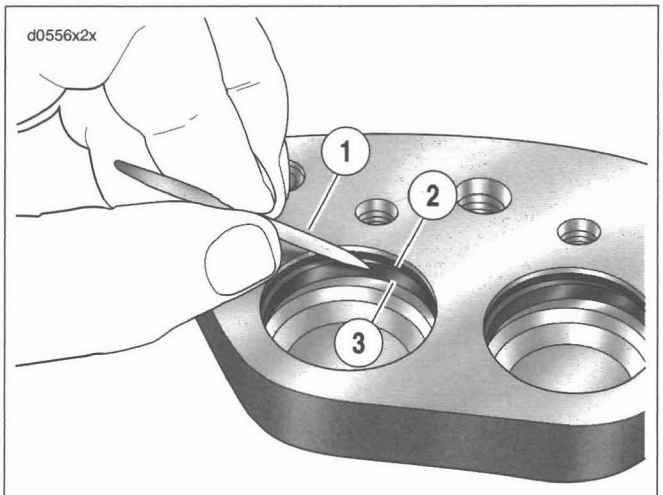
1. **Low pressure air hose**
2. **Bridge bolt (12 pt/10 mm)**
3. **Brake caliper piston remover (Part No. HD-43293-A)**

Figure 2-75. Removing Pistons



1. **Crossover O-rings (2)**
2. **Pistons (2)**

Figure 2-76. Crossover O-rings and Inside Housing



1. **Wooden toothpick**
2. **Wiper**
3. **Square seal**

Figure 2-77. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

⚠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)

1. 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.
   b. 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.
3. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

⚠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)

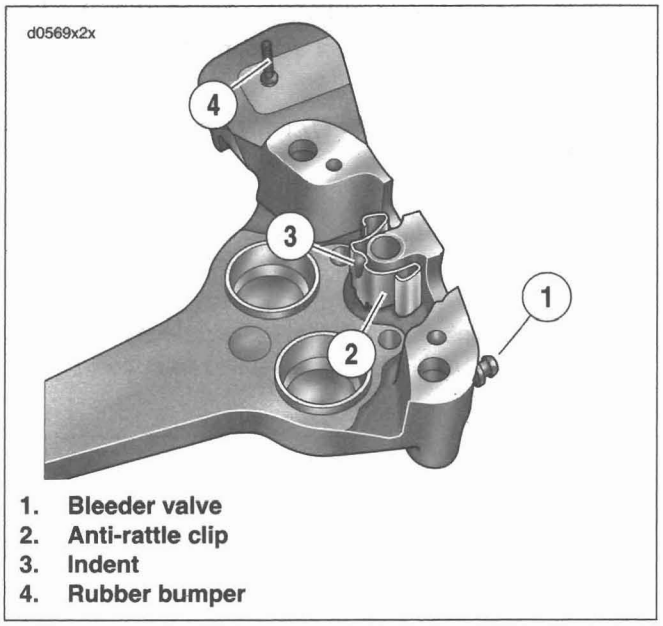
4. Inspect brake pads and brake disc. See 1.8 BRAKE PADS AND DISCS.

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.

1. 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.



1. **Bleeder valve**
2. **Anti-rattle clip**
3. **Indent**
4. **Rubber bumper**

Figure 2-78. 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 2-77. Install a **new** square seal (3) and a **new** wiper (2) into each piston bore.
3. Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
4. See Figure 2-76. Place two **new** crossover O-rings (1) on inside caliper housing.
5. Assemble caliper housings.
   a. See Figure 2-78. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm).
   b. 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 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 2-79. The front and rear brake calipers use the same exact brake pad set.*
- *Install pad with two tabs (1) on the inboard side of the rear caliper.*

6. 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.
7. 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 2-78.*

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

INSTALLATION

1. See Figure 2-73. 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 2.7 REAR WHEEL.

CAUTION

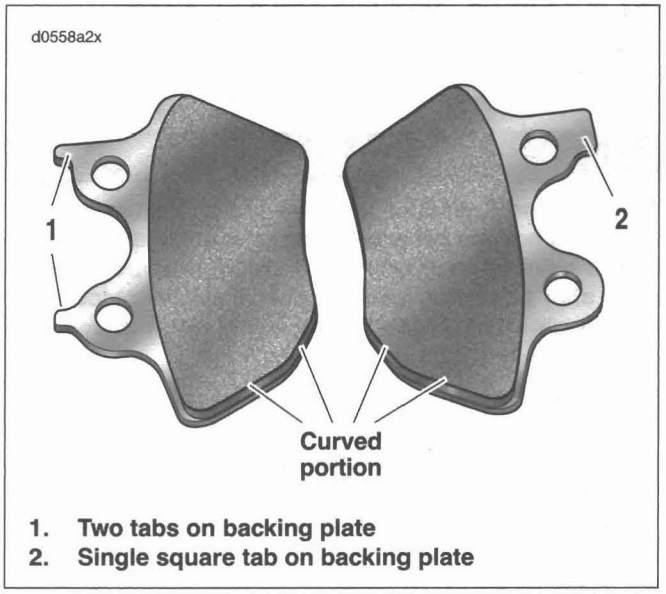
To avoid leakage, verify that the washers, banjo bolt, brake line and caliper bore are completely clean.

2. 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).

⚠CAUTION

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)

3. 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.



1. **Two tabs on backing plate**
2. **Single square tab on backing plate**

Figure 2-79. 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.
   b. 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.w*

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.

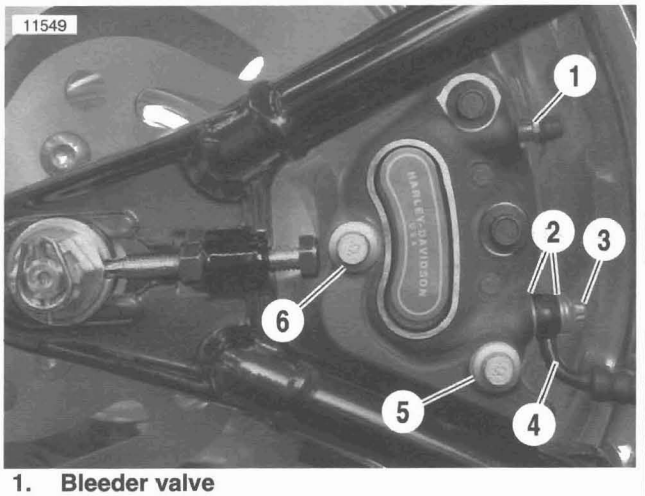
CAUTION

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)

1. See Figure 2-80. Remove the banjo bolt (3) and both 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.
3. To remove rear caliper mount:
   a. Pull axle from rear wheel. See 2.7 REAR WHEEL.
   b. Lift rear caliper mount away from axle and rear fork. Notch in caliper mount must clear tab on rear fork.



1. **Bleeder valve**
2. **Washers (2)**
3. **Banjo bolt**
4. **Rear brake line**
5. **Lower mounting bolt**
6. **Upper mounting bolt**

Figure 2-80. Rear Caliper Mount

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

1. Inside caliper housing
2. Square seal (4)
3. Wiper (4)
4. Piston (4)
5. Crossover O-ring (2)
6. Anti-rattle spring
7. Brake pads (2)
8. Outside caliper housing
9. Decal
10. Pad pin (2) (12 pt/0.25 in.)
11. Bridge bolt (2) (12 pt/10 mm)
12. Bleeder valve

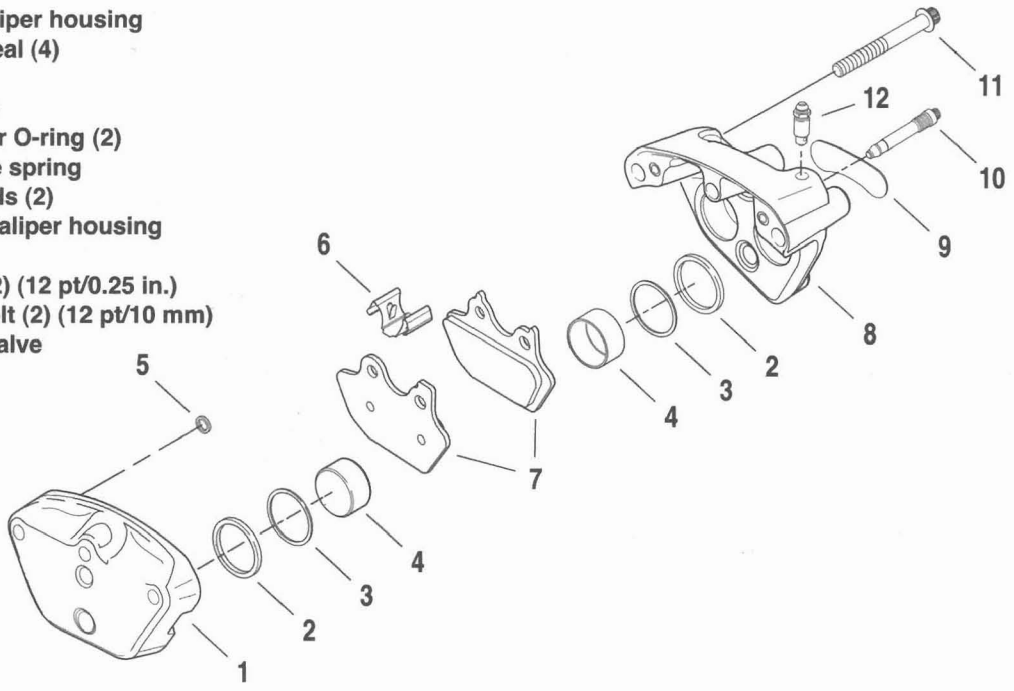


Figure 2-81. Rear Brake Caliper

⚠WARNING

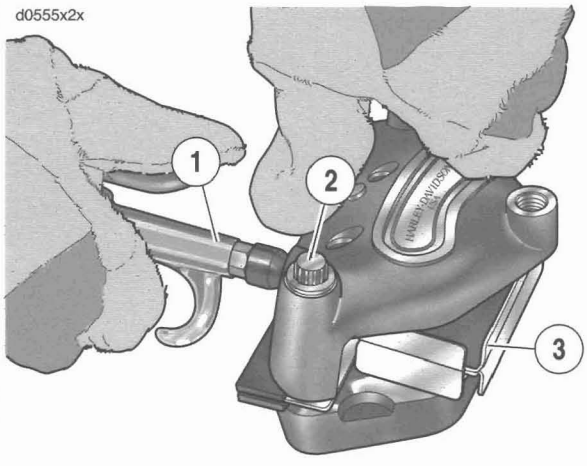
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

4. See Figure 2-82. Remove pistons.
   a. Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293-A) between caliper housings.
   b. Insert 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.
5. See Figure 2-83. Remove and discard both crossover O-rings (1) from inside caliper housing.
6. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

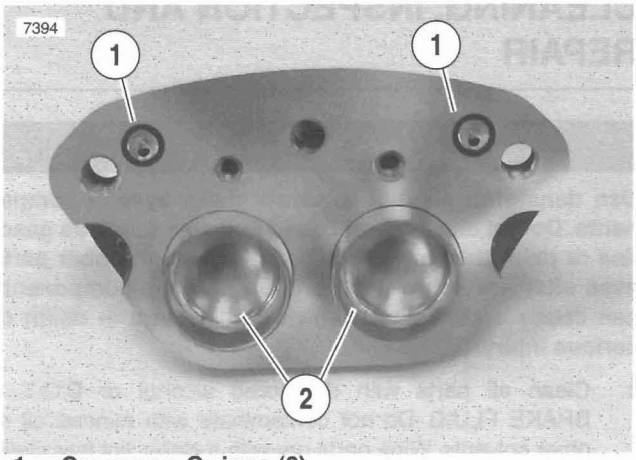
Damaged pistons or piston bores will leak when reassembled. Do not use metal objects to remove or install objects from piston bores. Prevent damage to bores by only using a wooden toothpick when servicing calipers.

7. See Figure 2-84. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



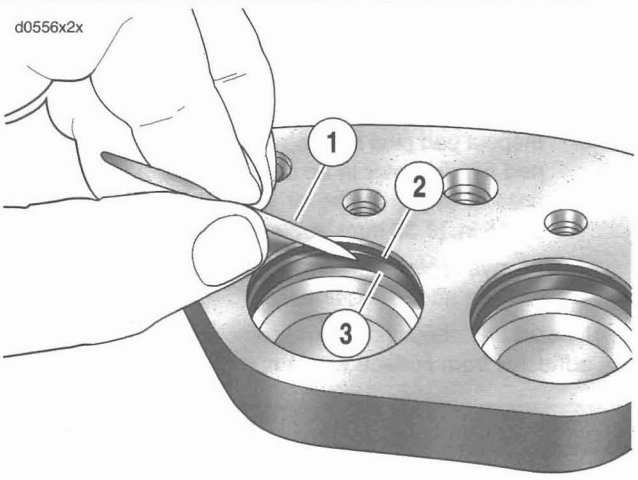
1. **Low pressure air hose**
2. **Bridge bolt (12 pt/10 mm)**
3. **Brake caliper piston remover (Part No. HD-43293-A)**

Figure 2-82. Removing Pistons



1. **Crossover O-rings (2)**
2. **Pistons (2)**

Figure 2-83. Crossover O-rings and Inside Housing



1. **Wooden toothpick**
2. **Wiper**
3. **Square seal**

Figure 2-84. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

⚠WARNING

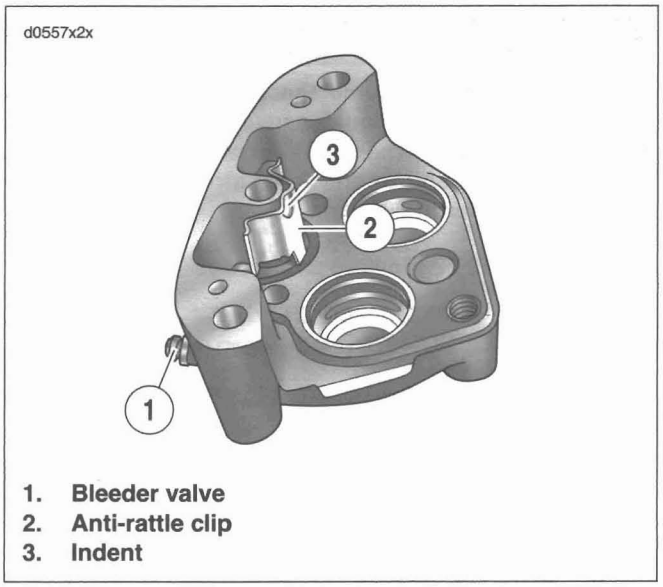
Use denatured alcohol to clean brake system components. Do not use mineral-based solvents (such as gasoline or paint thinner), which will deteriorate rubber parts even after assembly. Deterioration of these components can cause brake failure, which could result in death or serious injury. (00291a)

1. 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.
   b. 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.
3. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

⚠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)

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



1. **Bleeder valve**
2. **Anti-rattle clip**
3. **Indent**

Figure 2-85. 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.

1. 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.

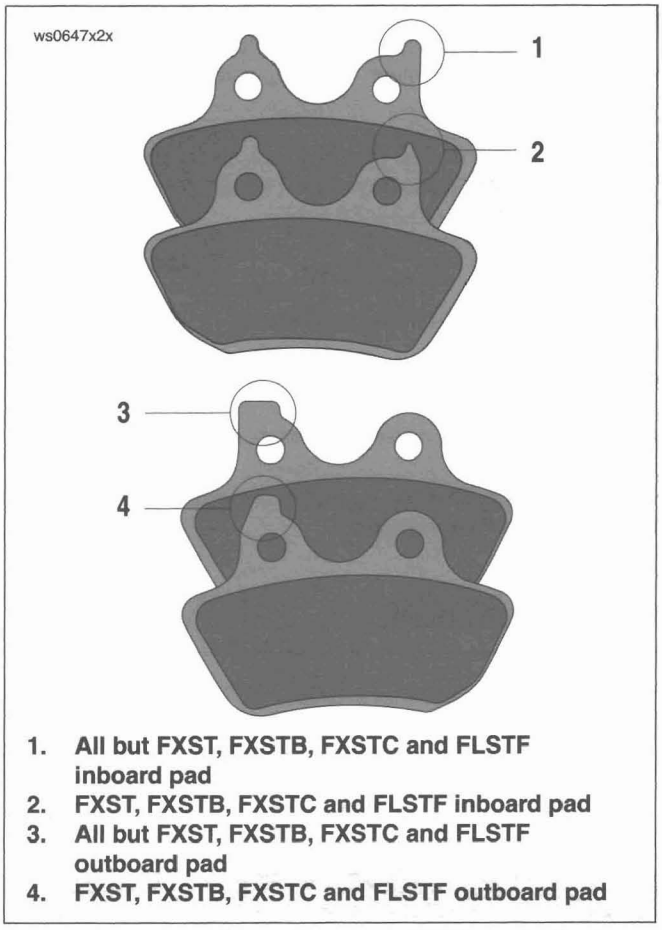
CAUTION

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.
3. Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
4. See Figure 2-83. Place two **new** crossover O-rings (1) on inside caliper housing.
5. Assemble caliper housings.
   a. 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).
   b. 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 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 2-86. The rear brake pads on FXST, FXSTB FXSTC and FLSTF models are different then the pads on other models.*
- *See Figure 2-87. Install pad with two tabs (1) on the inboard side of the rear caliper.*



1. **All but FXST, FXSTB, FXSTC and FLSTF inboard pad**
2. **FXST, FXSTB, FXSTC and FLSTF inboard pad**
3. **All but FXST, FXSTB, FXSTC and FLSTF outboard pad**
4. **FXST, FXSTB, FXSTC and FLSTF outboard pad**

Figure 2-86. FXST, FXSTB and FXSTC Brake Pads

6. 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.

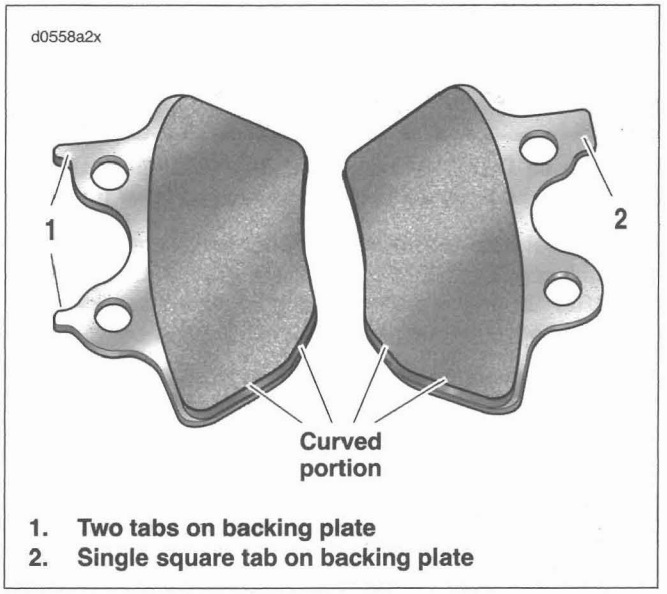
7. Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 **in-lbs** (20.3-22.6 Nm).

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.



1. **Two tabs on backing plate**
2. **Single square tab on backing plate**

Figure 2-87. Brake Pad Alignment

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 2.7 REAR WHEEL.

CAUTION

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

2. 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).

⚠CAUTION

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)

3. 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.

⚠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.
   b. 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 and FLSTN Softail models use the type shown in Figure 2-88.
- All FXST, FXSTB and FXSTC Softail models use the type shown in Figure 2-89.
- FXSTD Softail models use the type shown in Figure 2-90.

Use the following information to service the models listed above. For other vehicles, see 2.22 SPRINGER FORK: FLSTSC.

REMOVAL

1. Remove front wheel and brake caliper. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTD or 2.5 FRONT WHEEL: FXSTD
2. Remove front fender. See 2.30 FRONT FENDER: ALL BUT FLSTSC.
3. Remove the slider tube cap (1), spacer (2) and oil seal (3) from the top of one fork side.
4. 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 2-88. The FLSTC/FLSTF and FLSTN 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.

1. Support the vehicle so the front end is off floor and the forks are fully extended.
2. 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.
3. See Figure 2-89. On FXST/FXSTB/FXSTC, remove dust cover (23)and dust shield (47).
4. See Figure 2-90. 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).
5. See Figure 2-88. 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.

6. 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.
8. 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.
9. 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 replaced.

1. Inspect damper tube rings (22) on damper tube (15) and replace if worn excessively or damaged.
2. On FXSTD models, check dust shield where it rubs on slider tube. 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).

1. Slider tube cap (2)
2. Spacer (2)
3. Oil seal (2)
4. Bolt (2)
5. Fork tube plug (2)
6. Fork tube plug O-ring (2)
7. Spring (2)
8. Slider tube (2)
9. Drain screw (2)
10. Washer (2)
11. Oil seal retaining ring (2)
12. Slider
13. Screw (2)
14. Washer (2)
15. Damper tube (2)
16. Upper slider tube bushing (2)
17. Seal spacer
18. Slider oil seal (2)
19. Lower slider bushing
20. Damper tube spring (2)
21. Lower stop (2)
22. Damper tube ring (2)
23. Clip nut
24. Stem & bracket
25. Fork stem cap
26. Bolt
27. Screw (2)
28. Fork stem washer
29. Upper bracket
30. Upper dust shield
31. Lower dust shield
32. Roller bearing (2)
33. Bearing cup (2)
34. Adjusting nut
35. Screw (4)
36. Screw (4)
37. Screw (4)
38. Washer (2)
39. Lockwasher (2)
40. Lockwasher (4)
41. Nut (2)
42. Warning label
43. Fork stem retaining ring
44. Axle cap (2)
45. Fork slider & tube assy. right
46. Fork slider & tube assy. left
47. Reflector (2)
48. Slider cover (2)
49. Stud (4)
50. Front panel bracket (2)
51. Front panel
52. Left rear back panel
53. Trim strip (2)
54. Right rear back panel
55. Bolt (2)

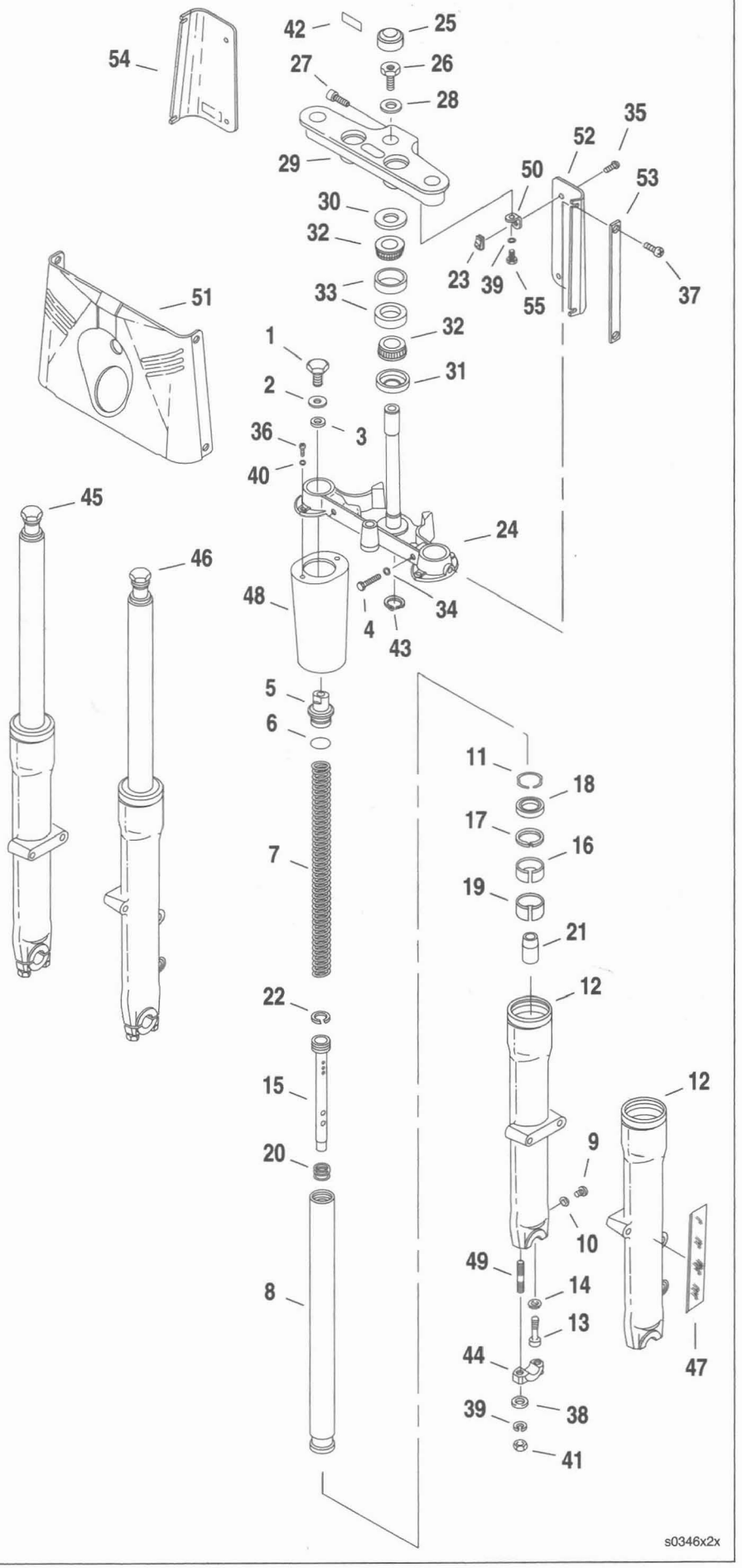
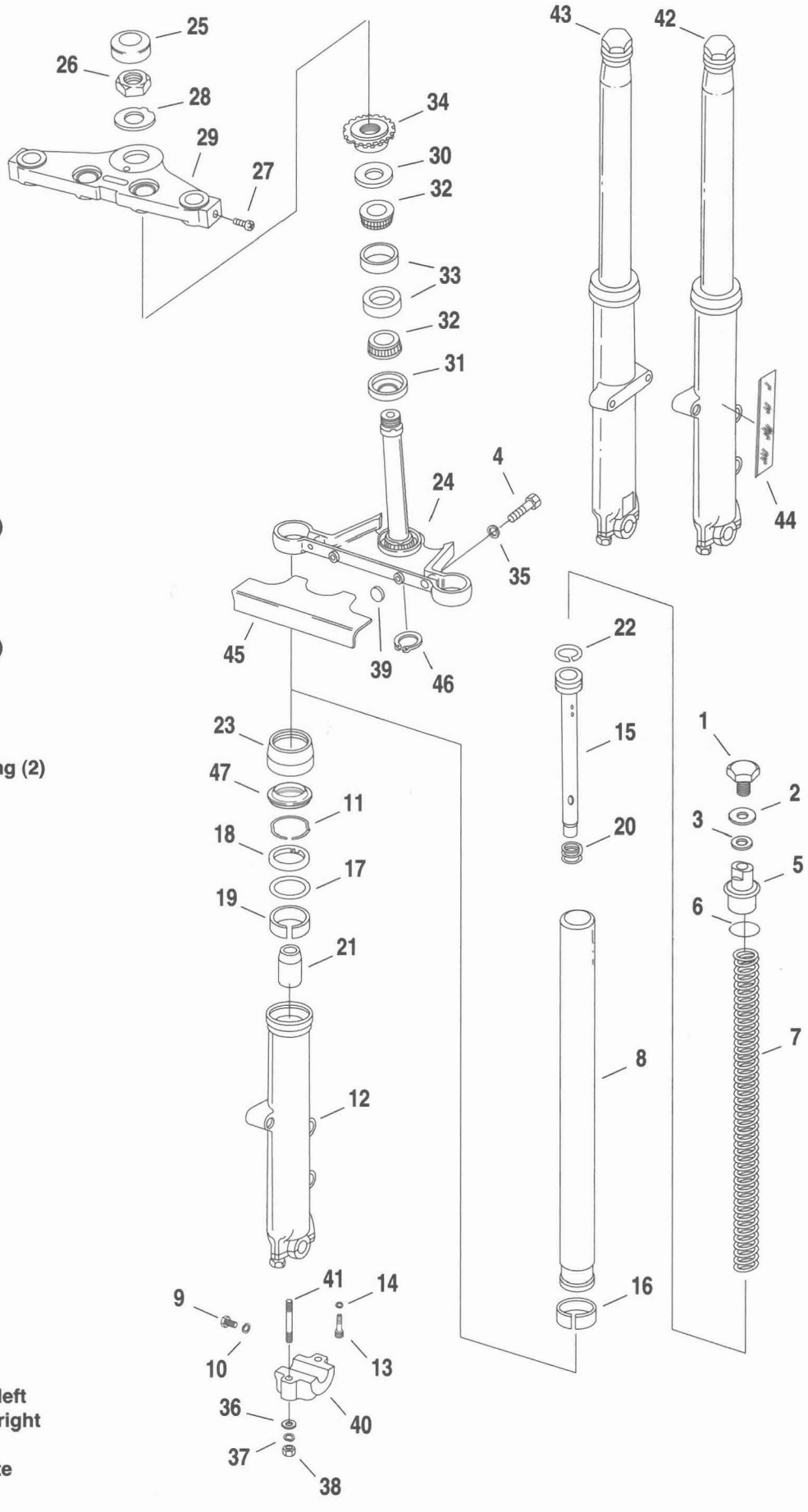


Figure 2-88. Front Forks: FLSTC, FLSTF, FLSTN



1. Slider tube cap (2)
2. Spacer (2)
3. Oil seal (2)
4. Bolt (2)
5. Fork tube plug (2)
6. Fork tube plug O-ring (2)
7. Spring (2)
8. Slider tube (2)
9. Drain screw (2)
10. Washer (2)
11. Oil seal retaining ring (2)
12. Slider
13. Screw (2)
14. Washer (2)
15. Damper tube (2)
16. Upper slider tube bushing (2)
17. Seal spacer
18. Slider oil seal (2)
19. Lower slider bushing
20. Damper tube spring (2)
21. Lower stop (2)
22. Damper tube ring (2)
23. Dust cover (2)
24. Stem & bracket
25. Fork stem cap
26. Fork stem nut
27. Screw (2)
28. Fork stem lockwasher
29. Upper bracket
30. Upper dust shield
31. Lower dust shield
32. Roller bearing (2)
33. Bearing race (2)
34. Adjusting nut
35. Lockwasher (2)
36. Washer (2)
37. Lockwasher (2)
38. Nut (2)
39. Pad (2)
40. Axle cap
41. Stud (2)
42. Fork slider & tube assy. left
43. Fork slider & tube assy. right
44. Reflector (2)
45. Headlamp mounting plate
46. Fork stem retaining ring
47. Dust shield (2)

Figure 2-89. Front Forks: FXST, FXSTB and FXSTC

1. Slider tube cap (2)
2. Spacer (2)
3. Oil seal (2)
4. Bolt (2)
5. Fork tube plug (2)
6. Fork tube plug O-ring (2)
7. Spring (2)
8. Slider tube (2)
9. Drain screw (2)
10. Washer (2)
11. Oil seal retaining ring (2)
12. Slider
13. Screw (2)
14. Washer (2)
15. Damper tube (2)
16. Upper slider tube bushing (2)
17. Seal spacer
18. Slider oil seal (2)
19. Lower slider bushing
20. Damper tube spring (2)
21. Lower stop (2)
22. Damper tube ring (2)
23. Fork Cap (2)
24. Stem & bracket
25. Fork stem cap
26. Fork stem nut
27. Screw (2)
28. Fork stem lockwasher
29. Upper bracket
30. Upper dust shield
31. Lower dust shield
32. Roller bearing (2)
33. Bearing race (2)
34. Adjusting nut
35. Lockwasher (2)
36. Dust shield (2)
37. Lockwasher (2)
38. Axle cap
39. Fork slider & tube assy. left
40. Fork slider & tube assy. right
41. Reflector left
42. Reflector right
43. Fork stem retaining ring

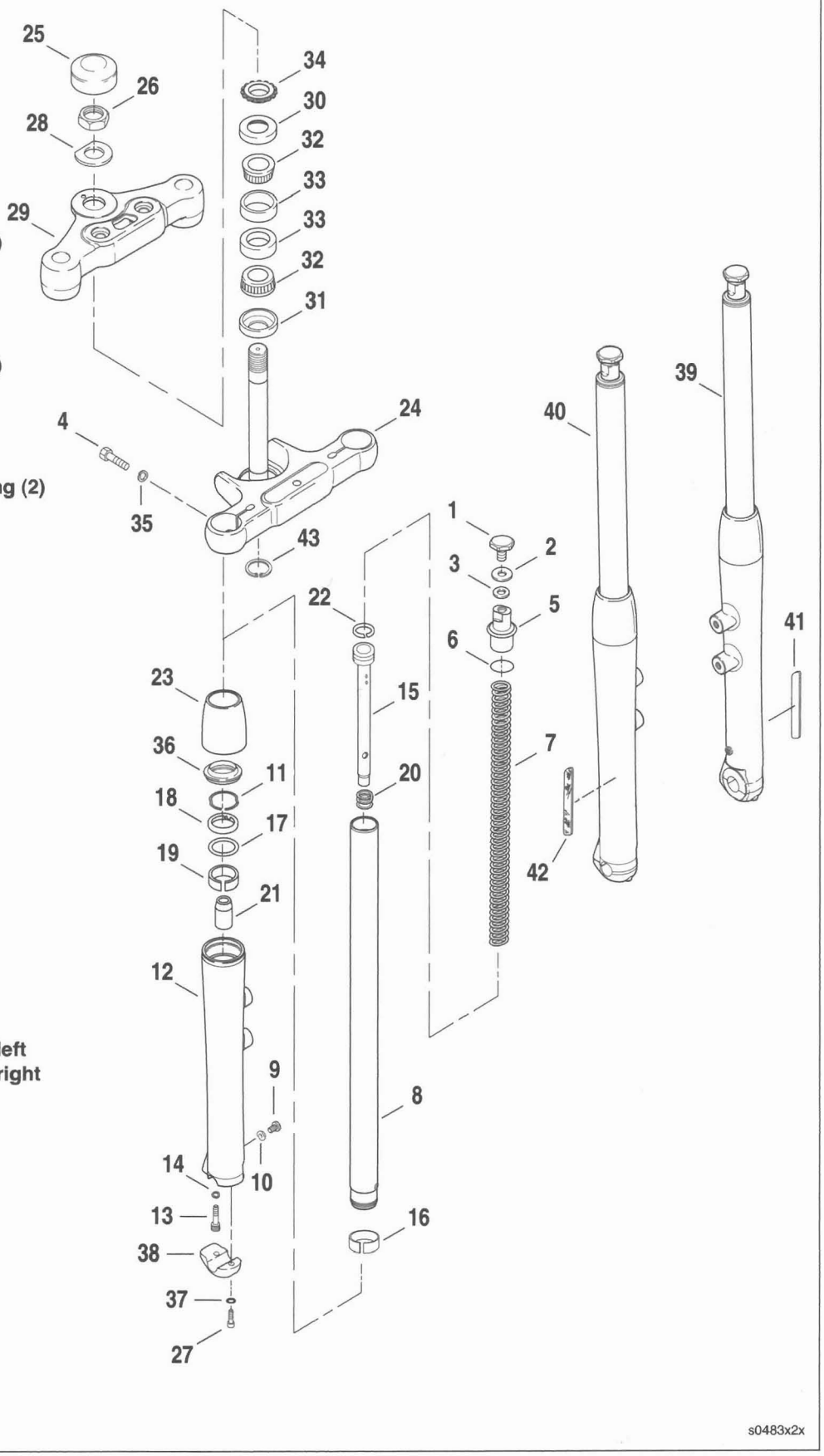


Figure 2-90. Front Forks: FXSTD

ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-34634	Fork seal installer

1. Install damper tube rings (22). Place damper tube spring (20) on damper tube (15). Insert damper tube into slider tube (8).
2. 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).
3. 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).
4. 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.
5. 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/FXSTC models, install dust cover (23) and dust shield (47).
8. 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.

INSTALLATION

1. Insert both fork side assemblies up through the fork stem and bracket (24) and upper bracket (29).
2. 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.
3. 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).
   a. 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).
5. Check steering head bearing adjustment if fork stem was removed. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC.

GENERAL

This topic is divided as follows:

- Handlebars and risers: page 2-76.
- Front shock absorber: page 2-78.
- Rigid fork: page 2-79.
- Spring fork: page 2-80.
- Fork rockers: page 2-84.
- Fork stem bearings: page 2-85.

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

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

HANDLEBAR AND RISERS

Removal

1. See Figure 2-91. Remove handlebar riser screws (1) and riser clamp (2). Remove handlebars.
2. 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

1. See Figure 2-91. 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.

3. 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.
4. 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).

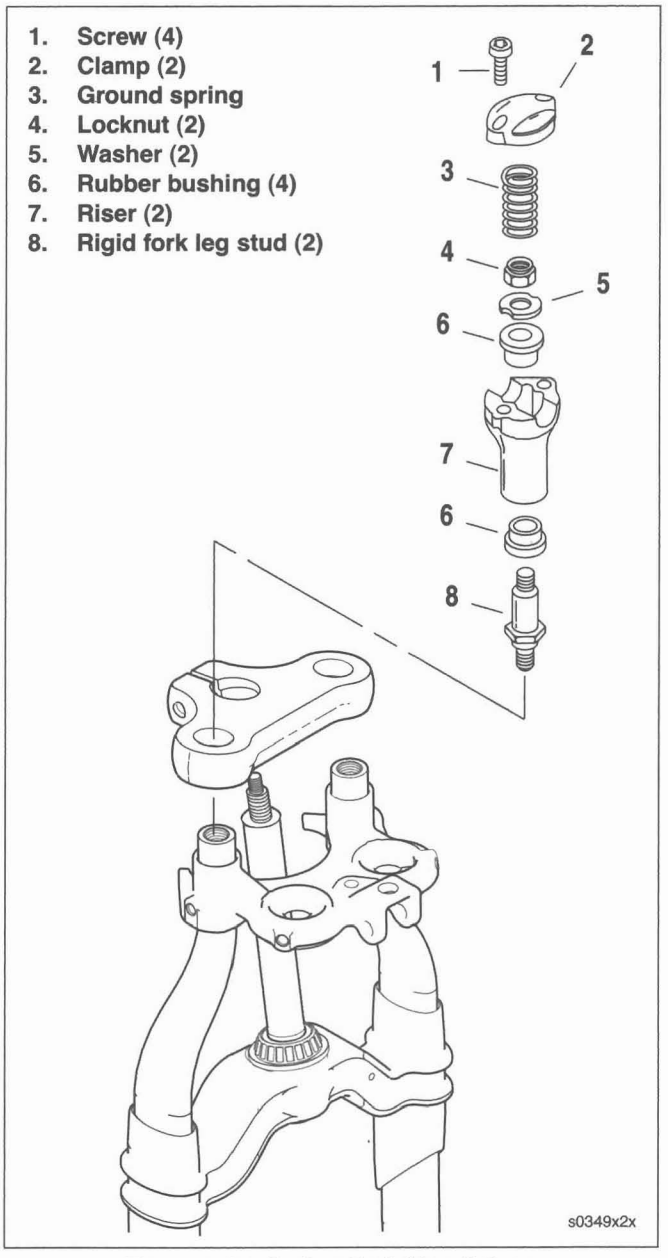


Figure 2-91. Spring Fork Handlebars

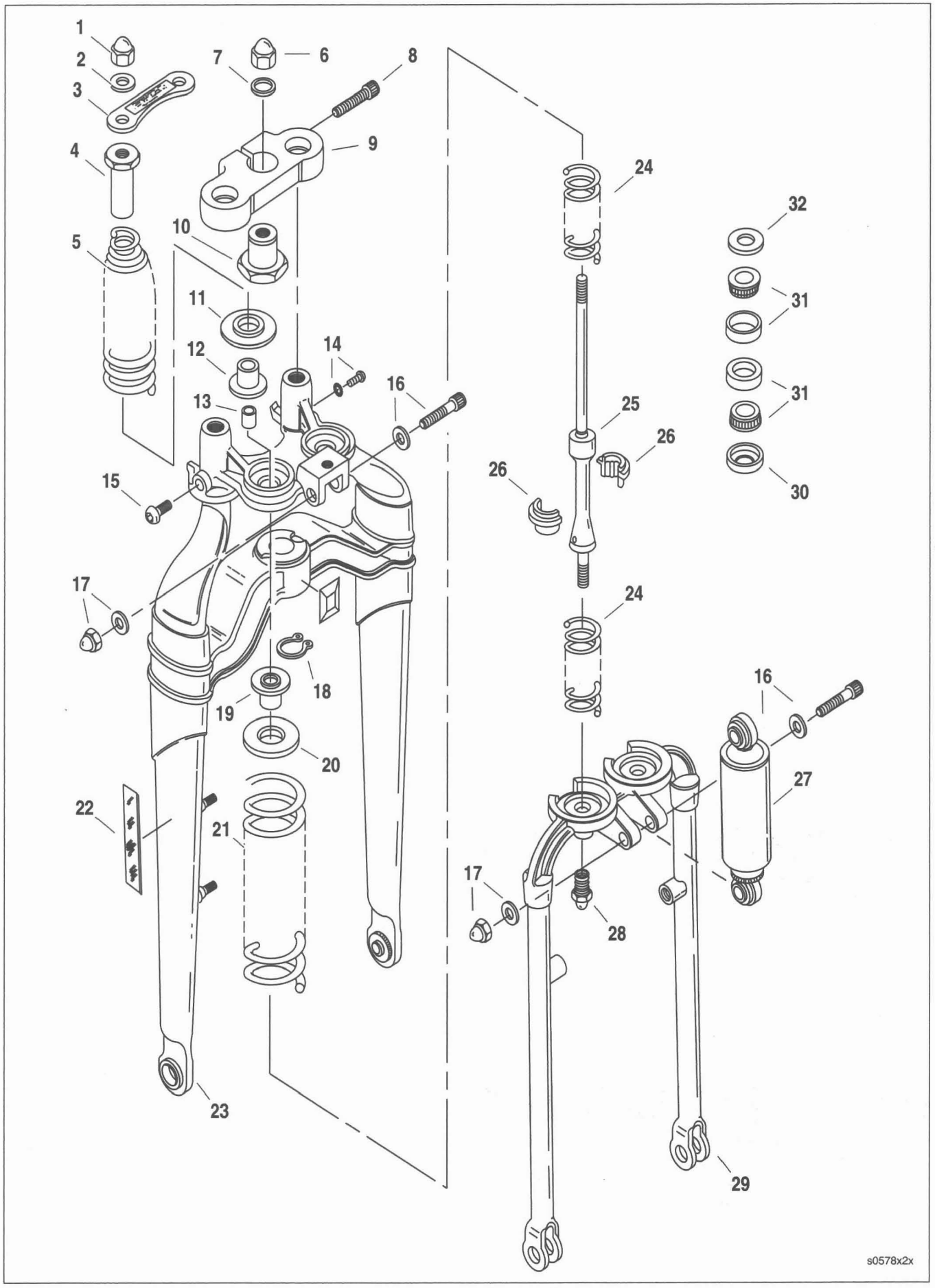


Figure 2-92. Front Fork: FLSTSC

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 2-92. Front Fork: FLSTSC

FRONT SHOCK ABSORBER

Removal

NOTE

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

1. See Figure 2-93. Remove acorn nuts and washers (1).
2. Remove both screws and washers (2). Remove front shock absorber (3).

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)

1. See Figure 2-93. 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.

1. Acorn nuts and washers
2. Screws and washers
3. Front shock absorber

s0350x2x

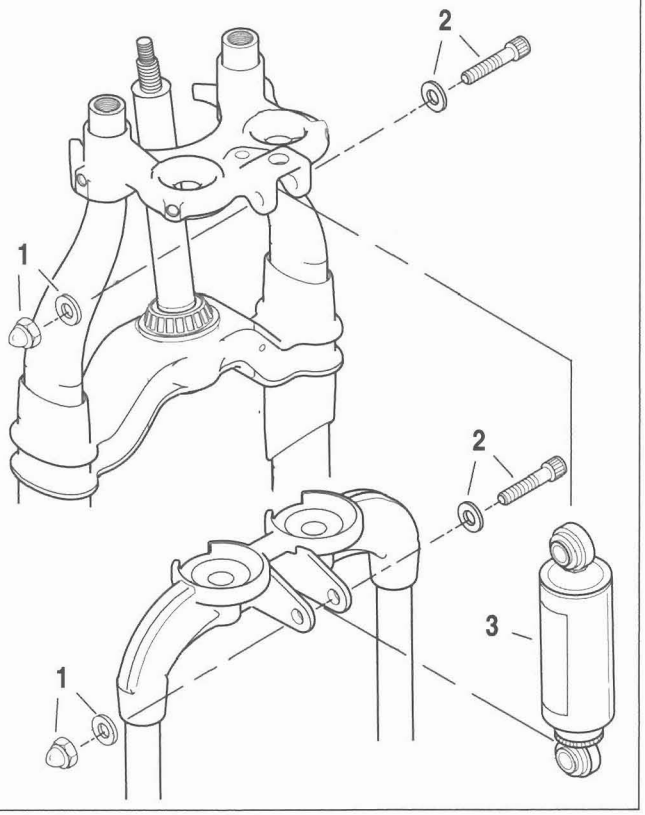


Figure 2-93. Shock Absorber

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.

1. Remove headlamp and mounting block. See 8.17 HEADLAMP. Move headlamp out of the way and let wire support it.
2. Remove handlebars and risers. See HANDLEBAR AND RISERS on page 2-76.
3. Remove front brake caliper and brake line. See 2.18 FRONT BRAKE CALIPER: FLSTSC.
4. Remove wheel. See 2.6 FRONT WHEEL: FLSTSC.
5. Remove front fender. See 2.31 FRONT FENDER: FLSTSC.
6. See Figure 2-94. 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 2.41 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 2-94. Install upper dust shield (7) and hex bearing retainer (6).
3. Seat steering head bearing by tightening bearing retainer (6) to 40 ft-lbs (54.2 Nm). Loosen and then re-torque bearing retainer to 72 **in-lbs** (8.1 Nm).
4. 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**

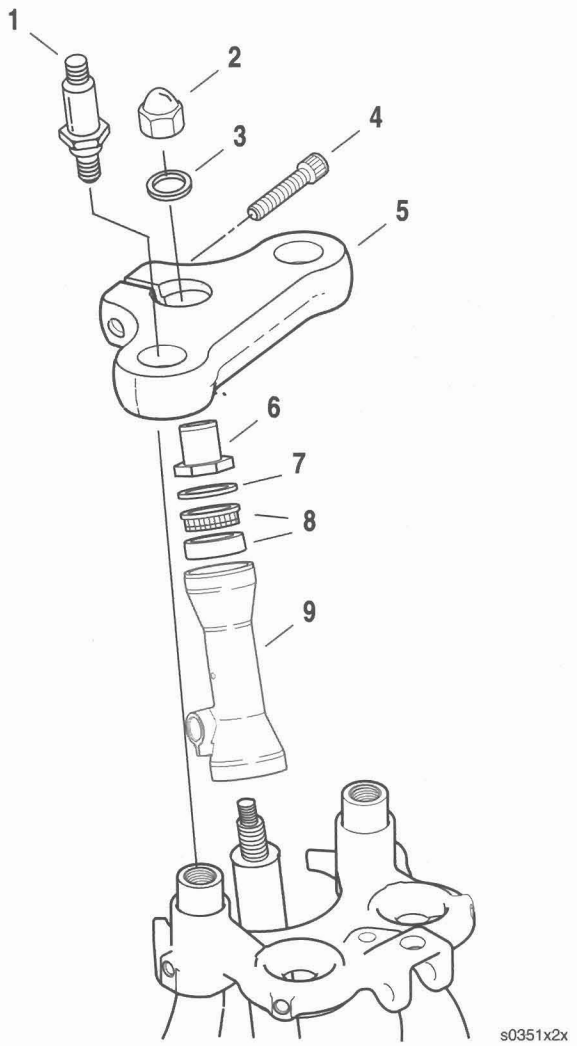


Figure 2-94. Steering Head/Fork Stem Assembly

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

SPRING FORK

Disassembly

⚠WARNING

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 2-96. 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 2-95. 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 2-95. Use cable ties to tie wrap the fork legs in place as shown.

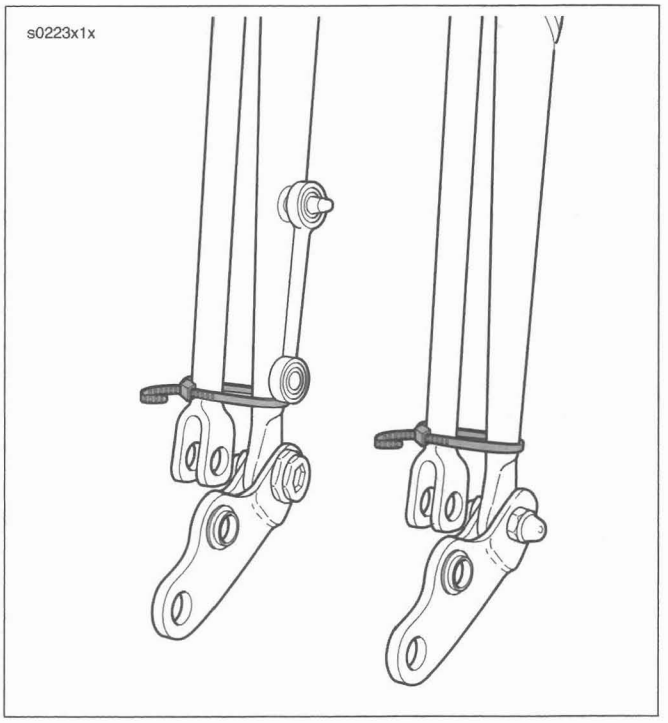


Figure 2-95. Nylon Ties on Fork Legs

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.

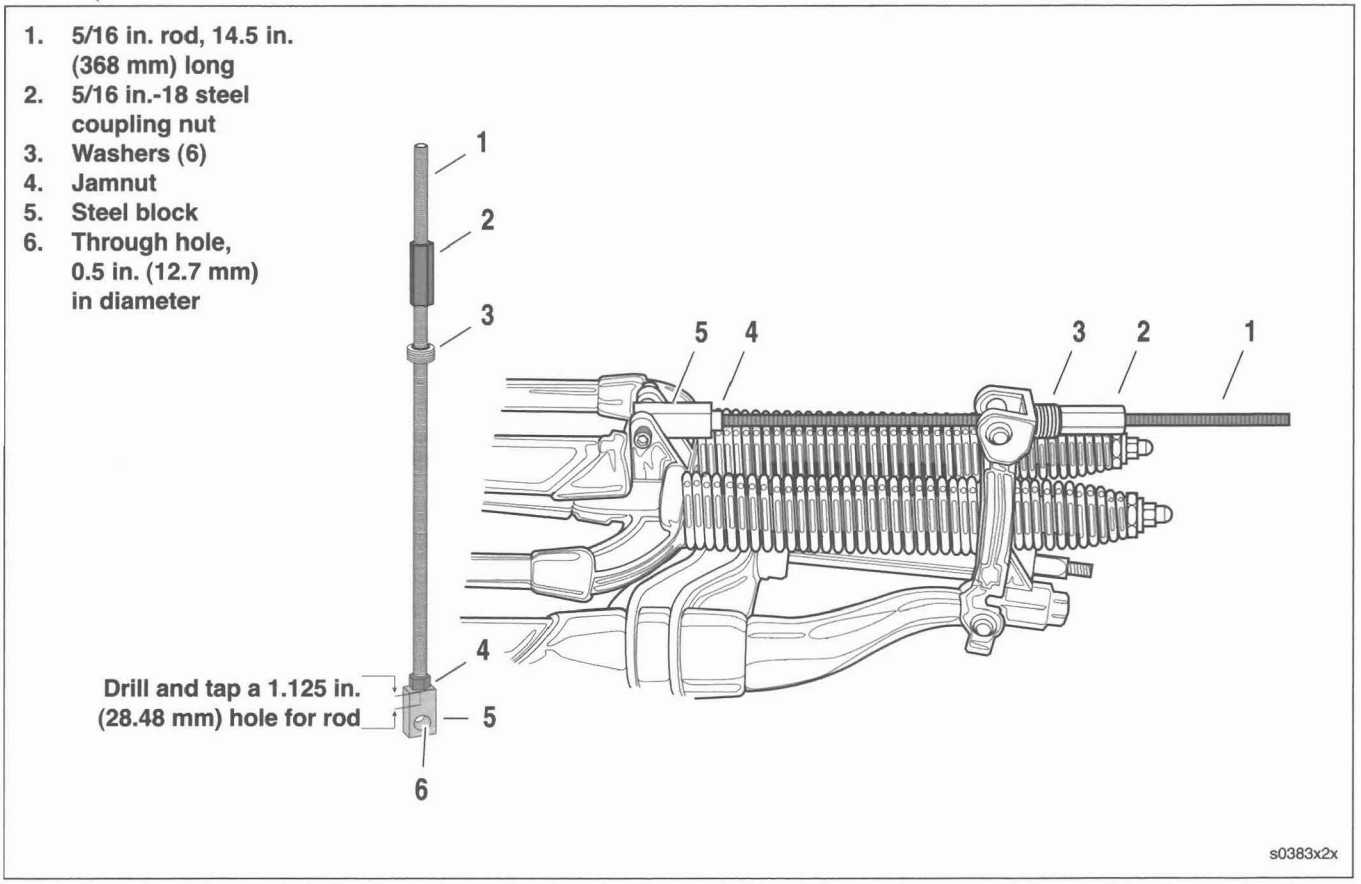


Figure 2-96. Fork Spring Compression Tool

5. See Figure 2-97. 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 2-98. 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

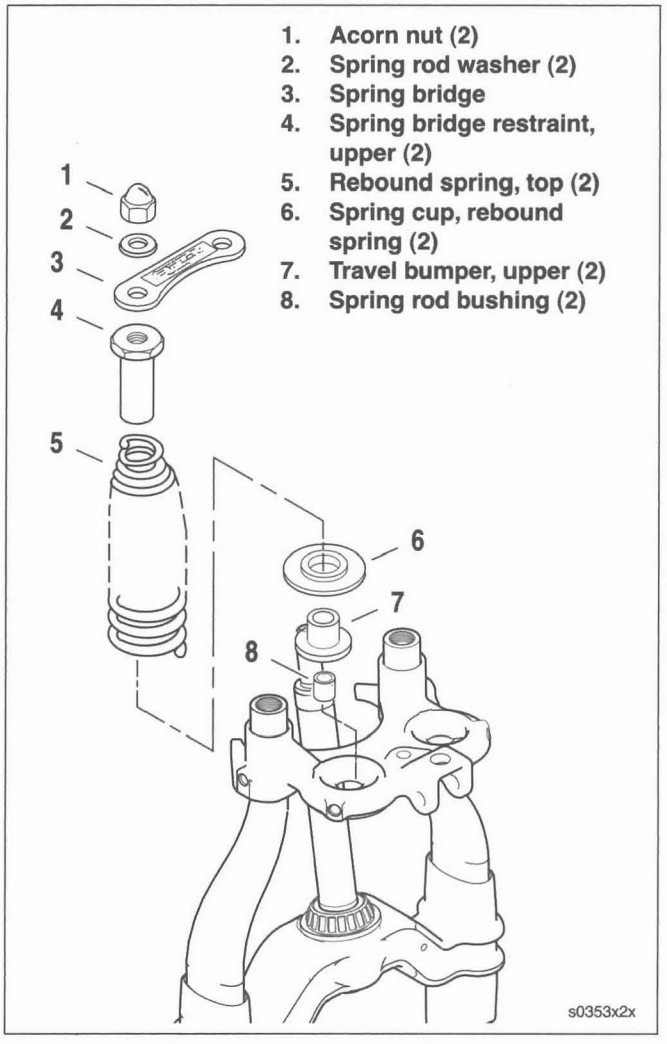


Figure 2-97. Rebound Spring: Disassembly

14. See Figure 2-99. 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.

16. 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.

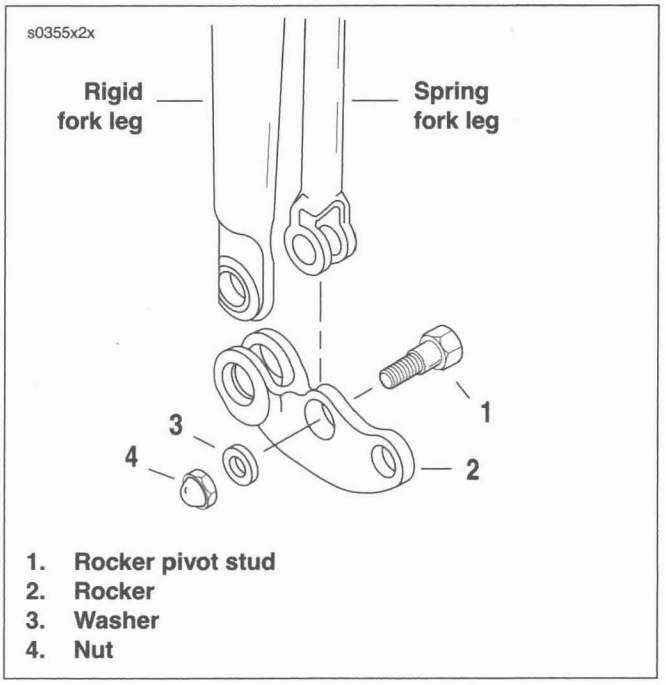


Figure 2-98. Rocker Assembly

Assembly

1. See Figure 2-99. 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).
5. 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.
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 2-98. 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).

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)**

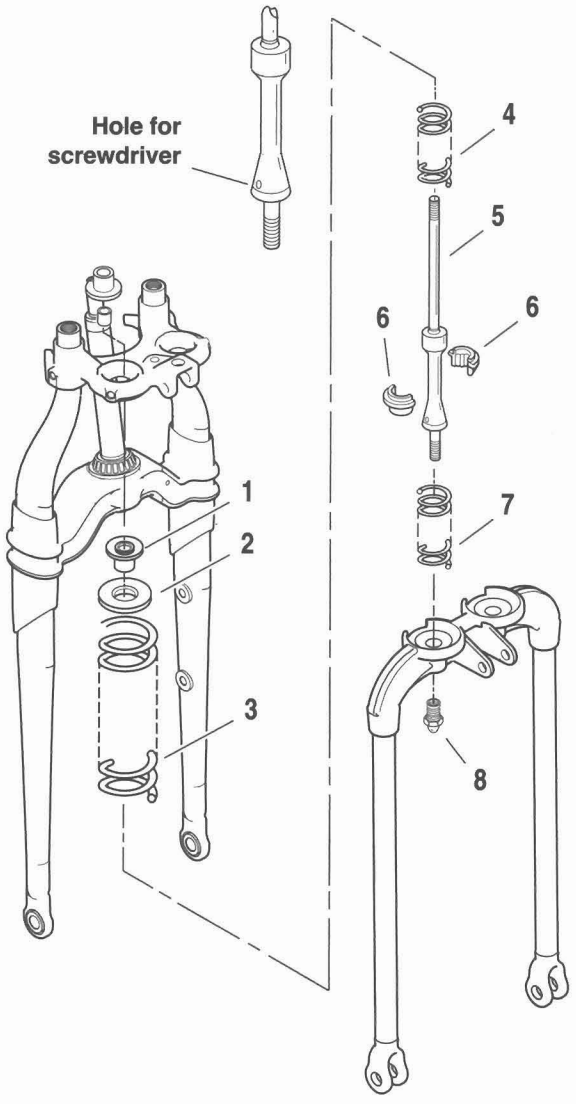


Figure 2-99. Compression Spring

15. See Figure 2-100. 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.
20. Apply LOCTITE ANTI-SEIZE to top 0.5 in. (12.7 mm) of upper spring rods.

⚠WARNING

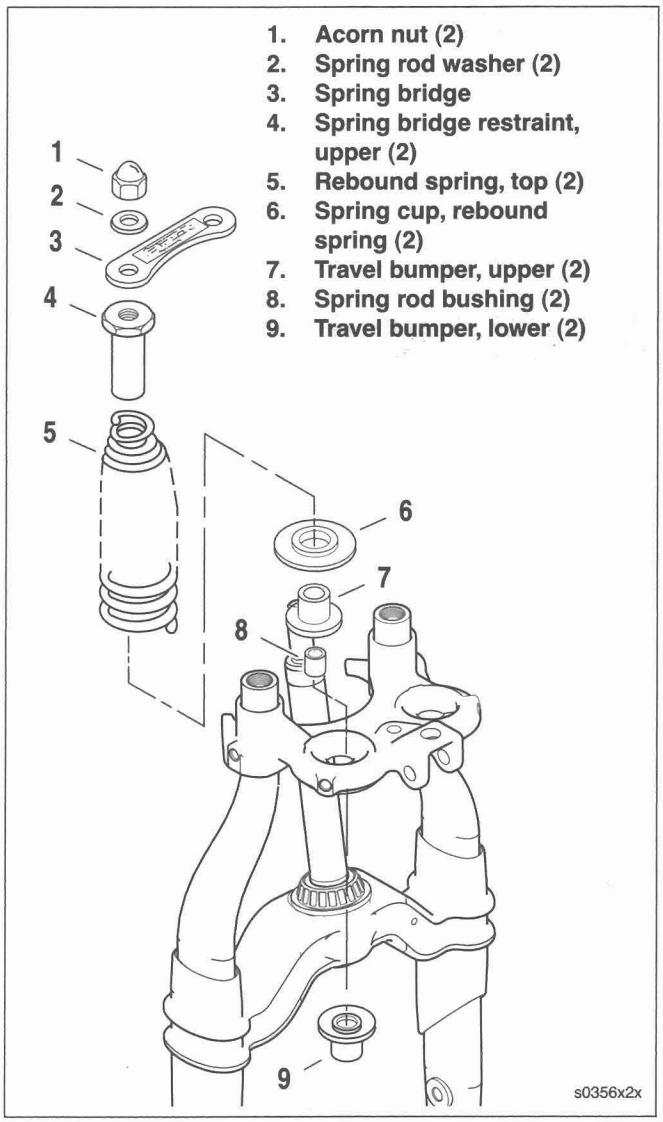
Tighten both spring restraints evenly. Not having the same amount of exposed spring rod on each side could adversely affect handling. This could lead to loss of control of the vehicle which could result in death or serious injury.

21. See Figure 2-101. 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

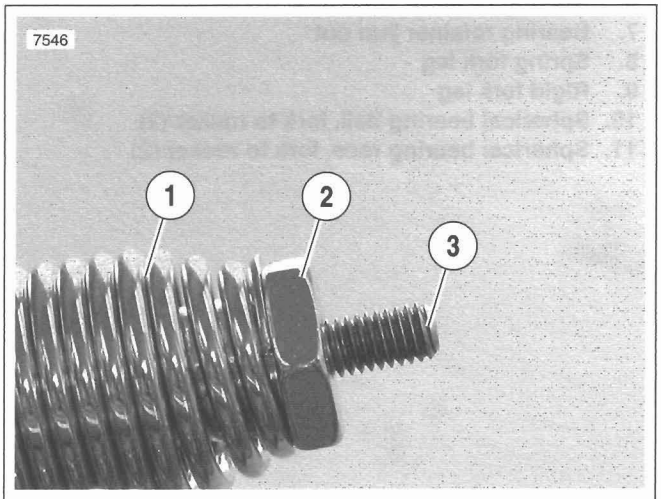
- *Be sure headlamp wire is between rebound springs before installing upper triple clamp or spring bridge.*
- *Curved edge of spring bridge goes forward.*

22. See Figure 2-100. 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 2.31 FRONT FENDER: FLSTSC.
25. Install wheel. See 2.6 FRONT WHEEL: FLSTSC.
26. Install front brake caliper and brake line. See 2.18 FRONT BRAKE CALIPER: FLSTSC.
27. Install handlebars and risers. See HANDLEBAR AND RISERS on page 2-76.
28. Install headlamp and mounting block. See 8.17 HEADLAMP.



1. **Acorn nut (2)**
2. **Spring rod washer (2)**
3. **Spring bridge**
4. **Spring bridge restraint, upper (2)**
5. **Rebound spring, top (2)**
6. **Spring cup, rebound spring (2)**
7. **Travel bumper, upper (2)**
8. **Spring rod bushing (2)**
9. **Travel bumper, lower (2)**

Figure 2-100. Rebound Spring: Assembly



1. **Rebound spring, top**
2. **Spring bridge restraint, upper**
3. **Exposed end of spring rod**

Figure 2-101. Checking Spring Rod

FORK ROCKERS

Removal

1. Remove front brake caliper. See 2.18 FRONT BRAKE CALIPER: FLSTSC.
2. Remove front wheel. See 2.6 FRONT WHEEL: FLSTSC.

⚠WARNING

See Figure 2-95. 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 2-95. Use cable ties to tie wrap the fork legs in place as shown.
4. See Figure 2-102. 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).
7. 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.
2. See Figure 2-102. 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.
4. Place rocker in position in rigid fork leg, with rocker facing forward.
5. Install pivot stud (thin head) assembly, from bearing retainer side, through rigid fork leg, bearing and other side of rocker.
6. 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).
7. 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).
8. 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.

9. To adjust rockers, see 1.19 ROCKER BEARINGS: FLSTSC.

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)**

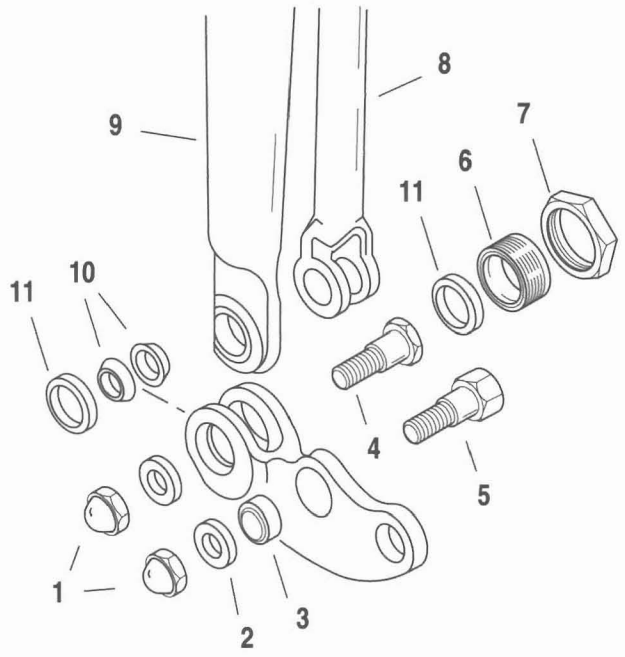


Figure 2-102. Fork Rocker

FORK STEM BEARINGS

Removal/Installation

CAUTION

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

1. See Figure 2-103. 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 2.23 STEERING HEAD to replace lower bearing race within steering neck.

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

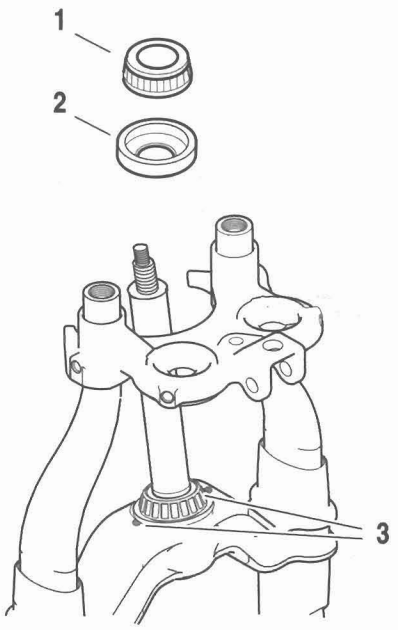


Figure 2-103. Fork Stem Bearings

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 Models

1. Remove fork shrouds.
2. Remove the fork sides. See 2.21 FRONT FORKS: ALL BUT FLSTSC.
3. Remove the headlamp and headlamp bracket.
4. See Figure 2-104. 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, FXSTC, FXSTB Models

1. Remove the fork sides. See 2.21 FRONT FORKS: ALL BUT FLSTSC.
2. Remove the headlamp and headlamp bracket.
3. See Figure 2-105. 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).
5. 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).

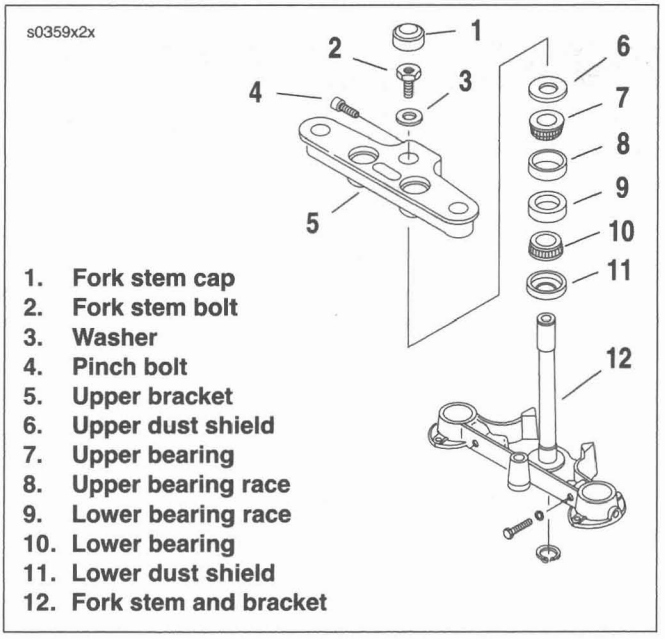


Figure 2-104. Steering Head: FLSTC, FLSTF, FLSTN

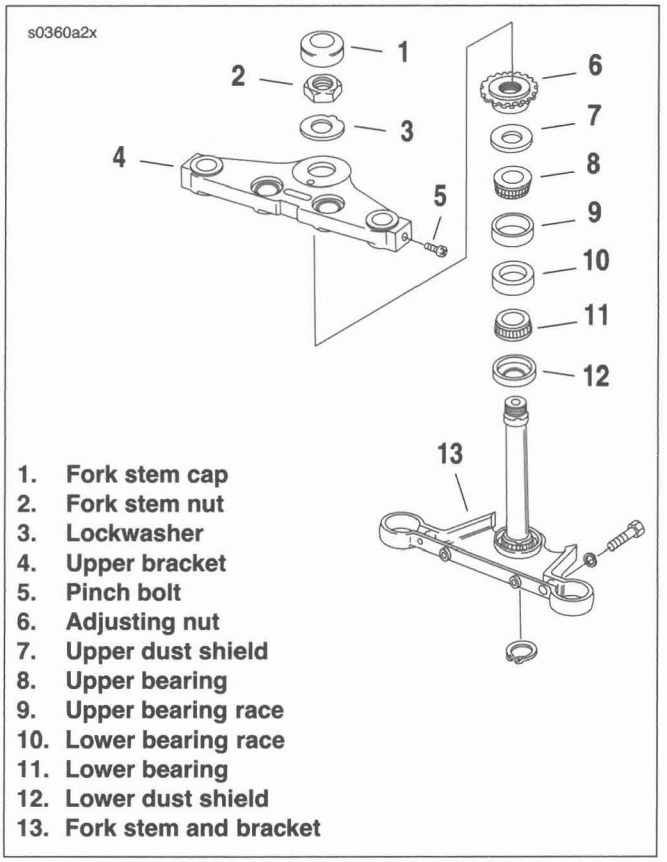


Figure 2-105. Steering Head: FXSTD/FXST/FXSTC/FXSTB

FLSTSC Models

1. Remove fork from steering head. See 2.22 SPRINGER FORK: FLSTSC.
2. See Figure 2-106. Remove upper bearing dust shield (1).
3. Remove upper bearing (2).

CLEANING AND INSPECTION

All Models

1. Check upper and lower bearing races in steering head. If they are pitted or grooved, replace the bearings and races in sets.
2. 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

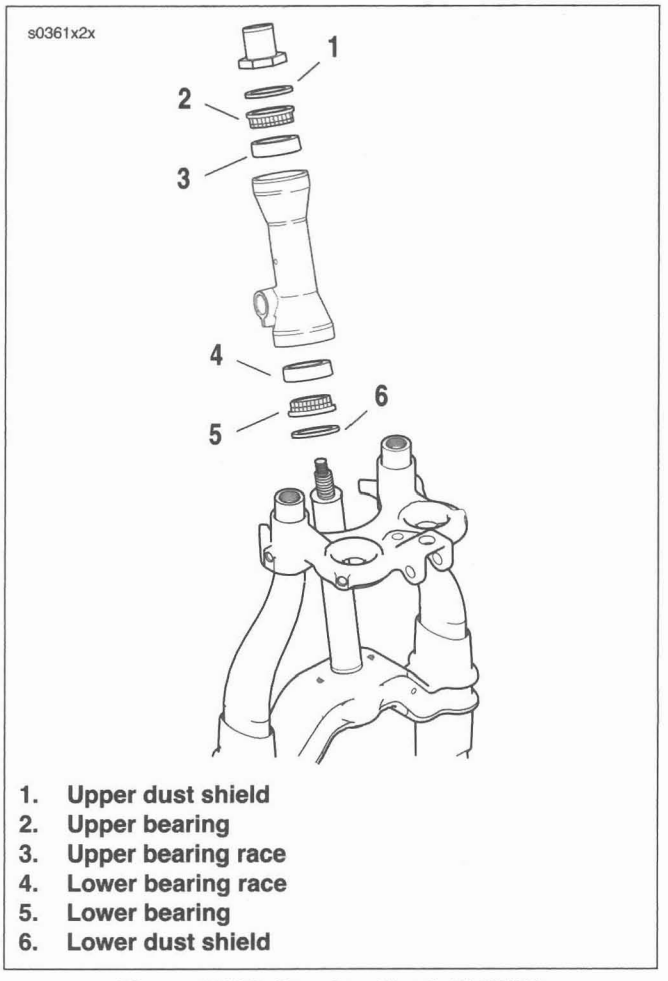
NOTE

Cover rigid fork legs when prying bearing off.

1. Chisel cage that holds rollers on bearing.
2. 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 2-107. 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.



1. **Upper dust shield**
2. **Upper bearing**
3. **Upper bearing race**
4. **Lower bearing race**
5. **Lower bearing**
6. **Lower dust shield**

Figure 2-106. Steering Head: FLSTSC

Figure 2-107. Pry Points: FLSTSC

Steering Head Bearing Race Removal

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

1. See Figure 2-108. 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.
3. 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).

⚠WARNING

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

3. 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.

4. 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.

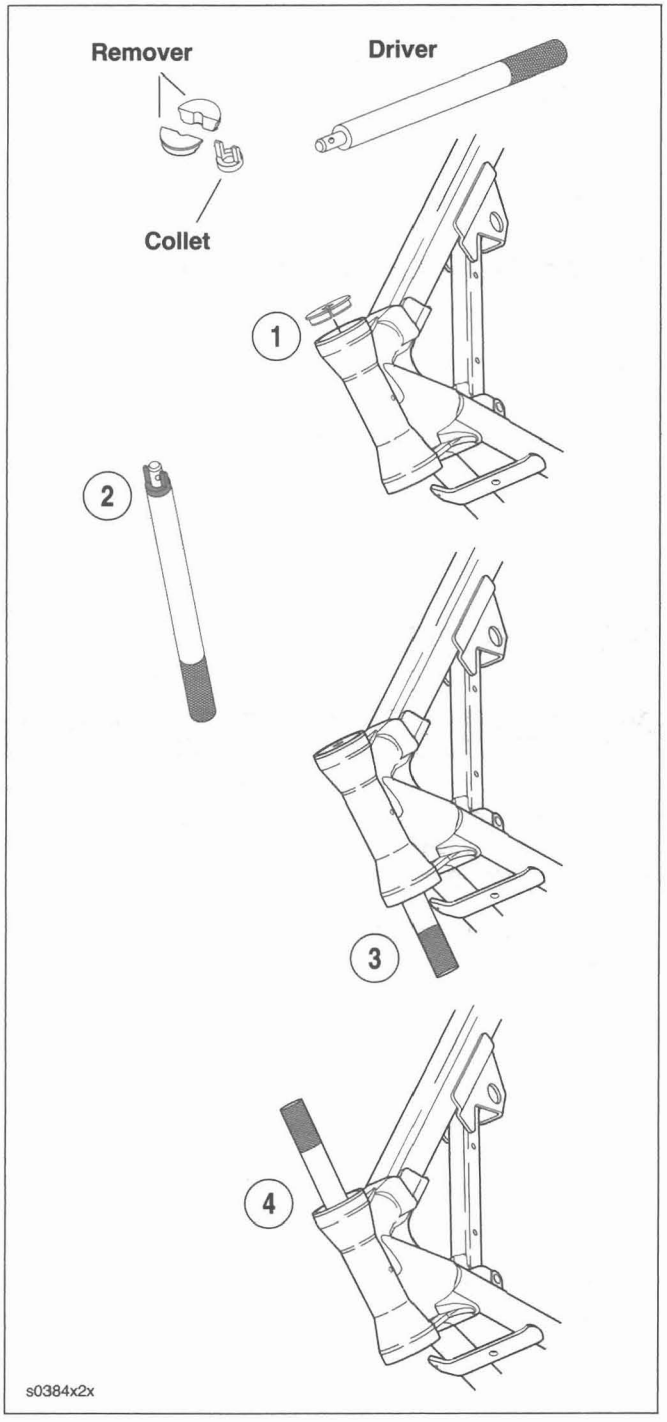


Figure 2-108. Remove Upper and Lower Steering Head Bearing Races

INSTALLATION

FLSTC, FLSTF, FLSTN Models

1. See Figure 2-104. Insert the fork stem and bracket assembly (12) into the frame steering head. Install the upper bearing (7) and dust shield (6).
2. 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.

3. 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.

⚠WARNING

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

7. Adjust fall-away. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC.
8. 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, FXSTC, FXSTB Models

1. See Figure 2-105. 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.

2. 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.
3. 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.

⚠WARNING

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

7. Adjust fall-away. See 1.17 STEERING HEAD BEARINGS: ALL BUT FLSTSC.
8. 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 Models

See 2.22 SPRINGER FORK: FLSTSC.

REMOVAL

1. Remove the rear wheel. See 2.7 REAR WHEEL.
2. Remove the belt guard. Remove rear brake caliper and mounting bracket. See 2.20 REAR BRAKE CALIPER: FXST/FXSTB/FXSTC/FLSTF.
3. See Figure 2-109. Remove two bolts (1) from splash guard (2). Lift upper right corner of fender towards rear tire and lift upward.
4. Remove the rear shock absorber bolts and washers (8) only. See 2.25 REAR SHOCK ABSORBERS.
5. On California models, detach evaporative canister from transmission.
6. 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.

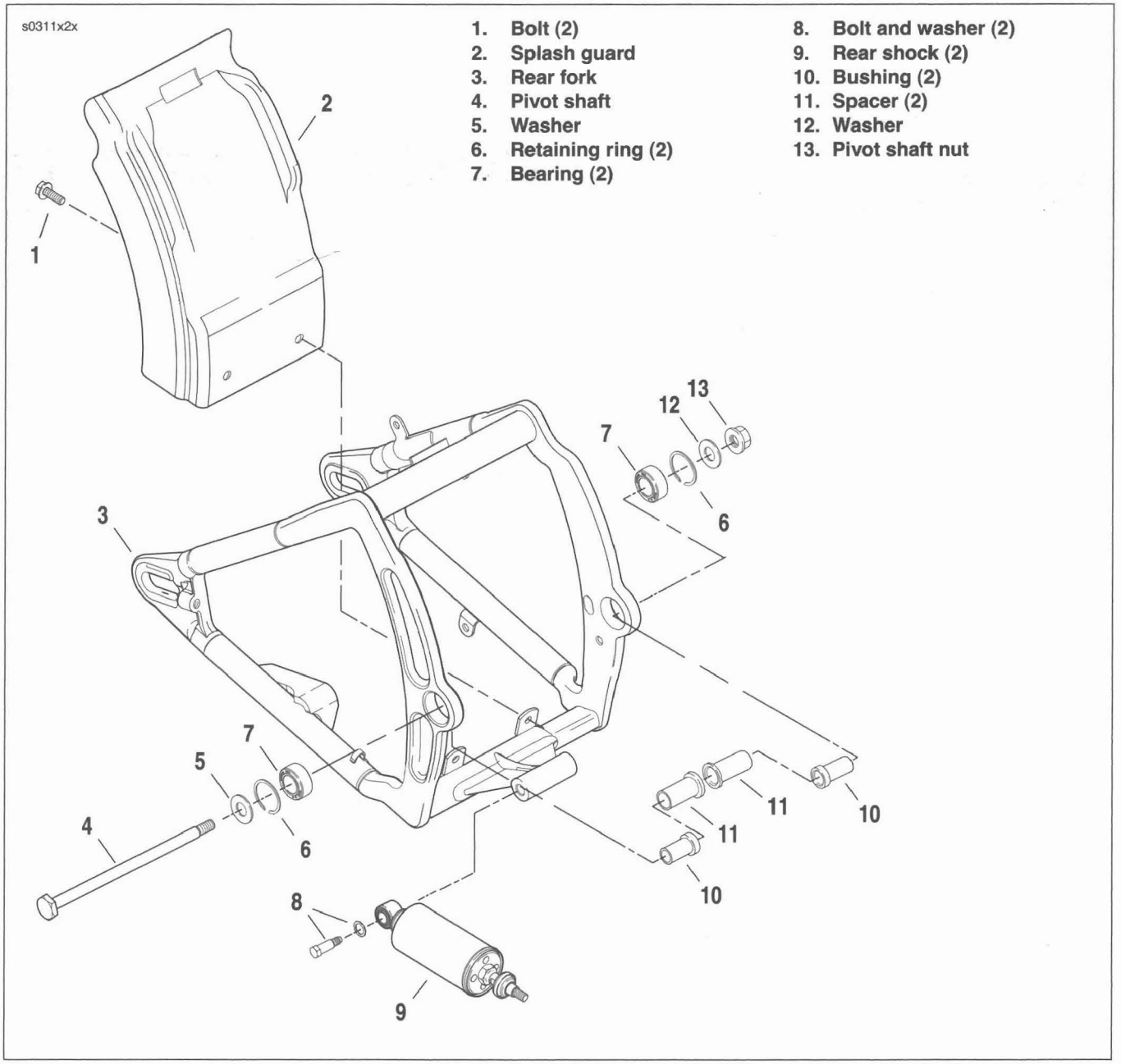


Figure 2-109. Rear Fork

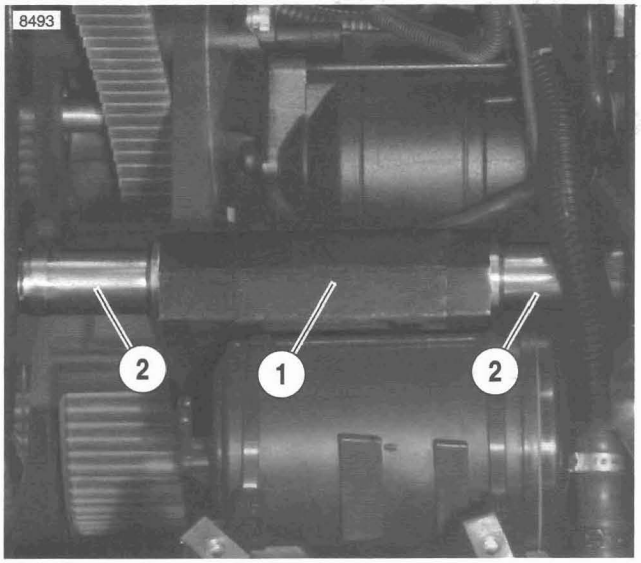
INSTALLATION

1. See Figure 2-109. 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).
   b. From the right side, install pivot shaft and spacers with spacer collars facing transmission case. See Figure 2-110.
   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.

3. 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 2-109. Install the canister (California models), fender extension (2), brake caliper and rear wheel.
5. Install both rear shock absorbers (9) using bolts and washers (8). See 2.25 REAR SHOCK ABSORBERS.



1. Back of transmission
2. Spacer collar against transmission

Figure 2-110. 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

1. Using a suitable lift, support motorcycle under frame until rear tire is slightly off the ground.
2. See Figure 2-111. 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.

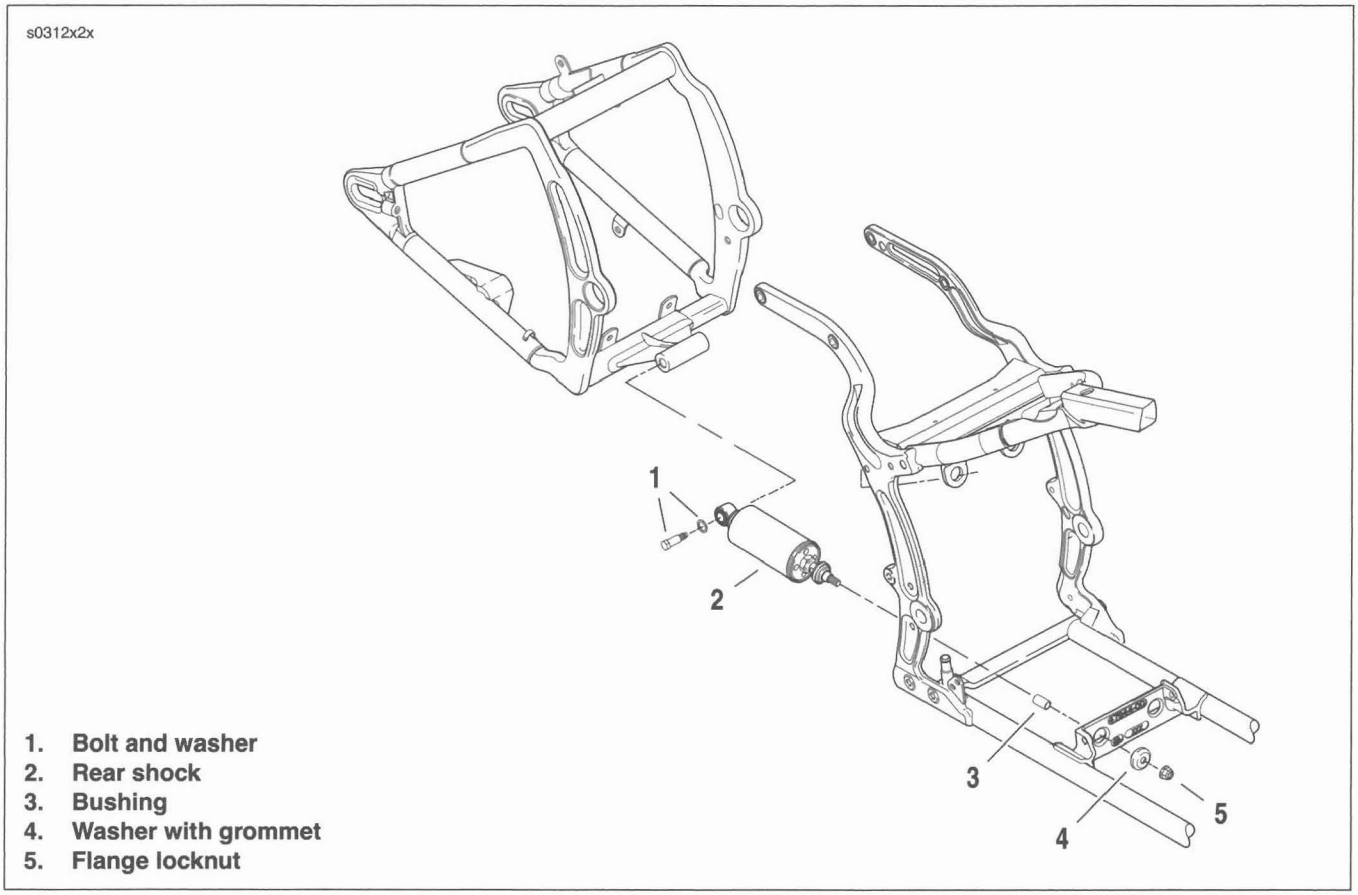
INSTALLATION

1. See Figure 2-111. 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).
2. 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).
   b. Tighten the flange locknut (5) to 32-39 ft-lbs (43.4-52.9 Nm).
4. Adjust both shock absorbers equally. See 1.16 SUSPENSION ADJUSTMENTS.



1. **Bolt and washer**
2. **Rear shock**
3. **Bushing**
4. **Washer with grommet**
5. **Flange locknut**

Figure 2-111. Rear Shocks

REMOVAL/DISASSEMBLY

1. See Figure 2-112. 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.
2. Unhook the ferrules and cables from the throttle grip and lower housing.
3. Remove air cleaner assembly. See 4.4 AIR CLEANER.
4. Disconnect throttle cables from throttle body. See 1.24 THROTTLE CABLES.
5. See Figure 2-113. 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

⚠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. 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.
3. 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.
2. See Figure 2-113. Attach the control cable assemblies to the lower housing.
   a. Push the silver insert of the throttle cable housing into the hole in front of the tension adjuster screw.
   b. 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.
3. 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.

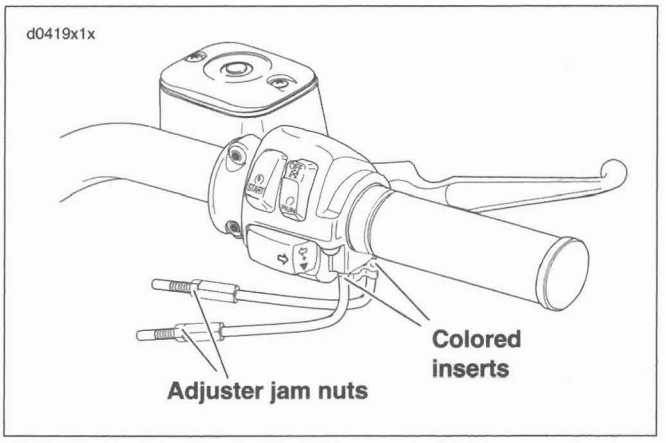
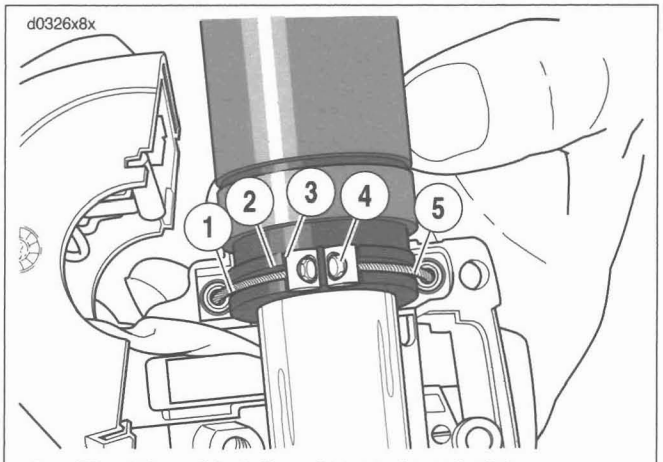


Figure 2-112. Handlebar Throttle Control



1. **Throttle cable (silver insert, front hole)**
2. **Groove in throttle grip**
3. **Notch**
4. **Brass ferrule**
5. **Idle cable (gold insert, rear hole)**

Figure 2-113. 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)

4. Fasten upper housing to lower housing using two screws. Tighten to 35-45 **in-lbs** (4.0-5.1 Nm).
5. Check throttle cable routing. See CABLE ROUTING which follows.
6. Install throttle cables on throttle body and adjust. See 1.24 THROTTLE CABLES.
7. Install air cleaner. See 4.4 AIR CLEANER.

CABLE ROUTING

All Models Except FLSTSC/FXSTD

On all models except 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 throttle body.

FLSTSC Models

On FLSTSC 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 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 throttle body.

REMOVAL

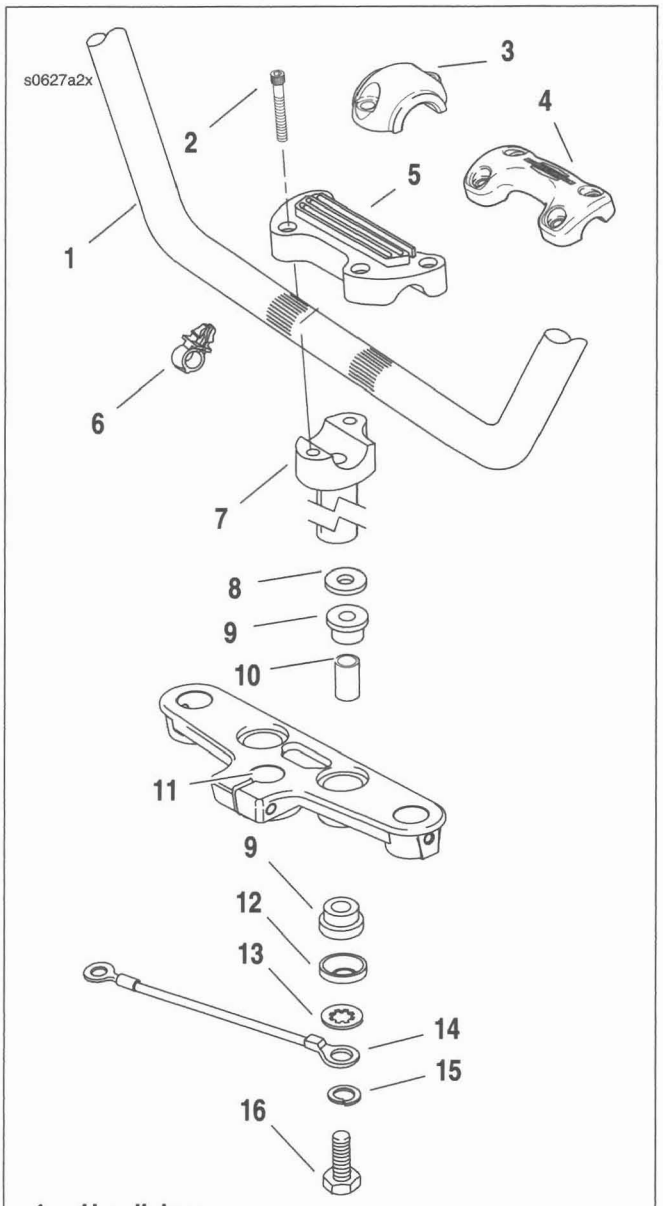
NOTE

For FLSTSC models, see HANDLEBAR AND RISERS under 2.22 SPRINGER FORK: 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.
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 2.15 FRONT BRAKE MASTER CYLINDER.
4. Remove two screws securing clutch control assembly to left side of handlebar. See 2.29 CLUTCH HAND CONTROL.
5. Remove right handlebar switch assembly and throttle. See 8.39 RIGHT HANDLEBAR SWITCH.
6. Remove left handlebar switch assembly. See 8.40 LEFT HANDLEBAR SWITCH.
7. Remove left handlebar grip.
8. See Figure 2-114. Remove upper handlebar clamp fasteners (2).
   a. For FLSTC/FLSTF/FXST/FXSTB models, remove upper handlebar clamp (5).
   b. For FLSTN models, remove upper handlebar clamp (4).
   c. For FXSTC models, remove upper handlebar clamp (3).
9. Remove handlebar (1).
10. If removing lower handlebar clamps (7), 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 (11). Replace bushings (9) if necessary.



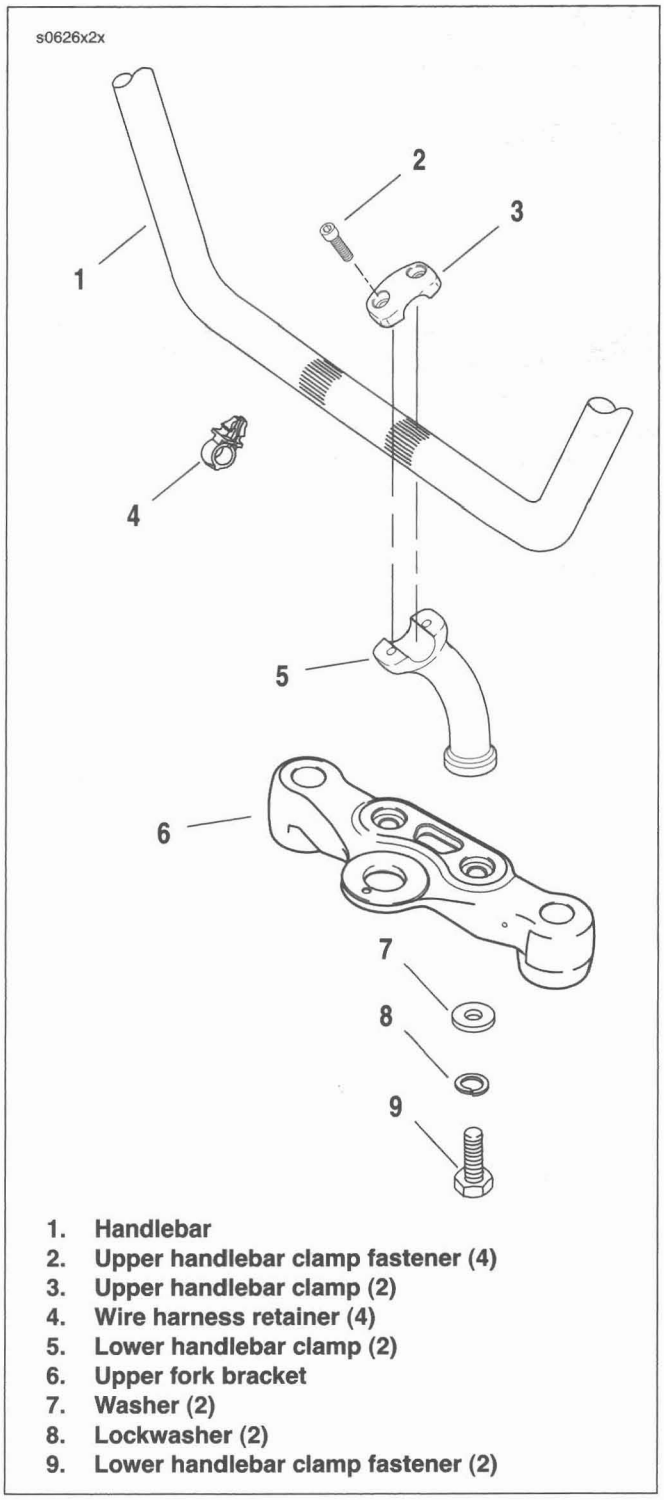
1. **Handlebar**
2. **Upper handlebar clamp fastener (4)**
3. **Upper handlebar clamp (FXSTC)**
4. **Upper handlebar clamp (FLSTN)**
5. **Upper handlebar clamp (FLSTC/FXST/FXSTB)**
6. **Wire harness retainer (4)**
7. **Lower handlebar clamp (2)**
8. **Upper cup washer (2)**
9. **Bushing (2)**
10. **Spacer (2)**
11. **Upper fork bracket (typical)**
12. **Lower cup washer (2)**
13. **Ground cable washer (right side only)**
14. **Ground cable (right side only)**
15. **Lockwasher (2)**
16. **Lower handlebar clamp fastener (2)**

Figure 2-114. Handlebars: All but FXSTD, 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.
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.
4. Remove two screws securing clutch control assembly to left side of handlebar. See 2.29 CLUTCH HAND CONTROL.
5. Remove right handlebar switch assembly and throttle. See 8.42 RIGHT HANDLEBAR SWITCH.
6. Remove left handlebar switch assembly. See 8.43 LEFT HANDLEBAR SWITCH.
7. Remove left handlebar grip.
8. See Figure 2-114. 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.



1. **Handlebar**
2. **Upper handlebar clamp fastener (4)**
3. **Upper handlebar clamp (2)**
4. **Wire harness retainer (4)**
5. **Lower handlebar clamp (2)**
6. **Upper fork bracket**
7. **Washer (2)**
8. **Lockwasher (2)**
9. **Lower handlebar clamp fastener (2)**

Figure 2-115. Handlebars: FXSTD

INSTALLATION

1. See Figure 2-114. If lower handlebar clamps (7) 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 (8, 12), bushings (9) and spacer (10) are in position in upper fork bracket (11).

2. Slide lower handlebar clamp fasteners through upper fork bracket.
3. Loosely install lower handlebar clamps to upper fork bracket using lower handlebar clamp fasteners.
4. See Figure 2-116. Place handlebars on lower handlebar clamps. Install upper handlebar clamps. Install but do not tighten clamp fasteners.
5. Using knurled areas of handlebar as a guide, center handlebars between lower handlebar clamps.

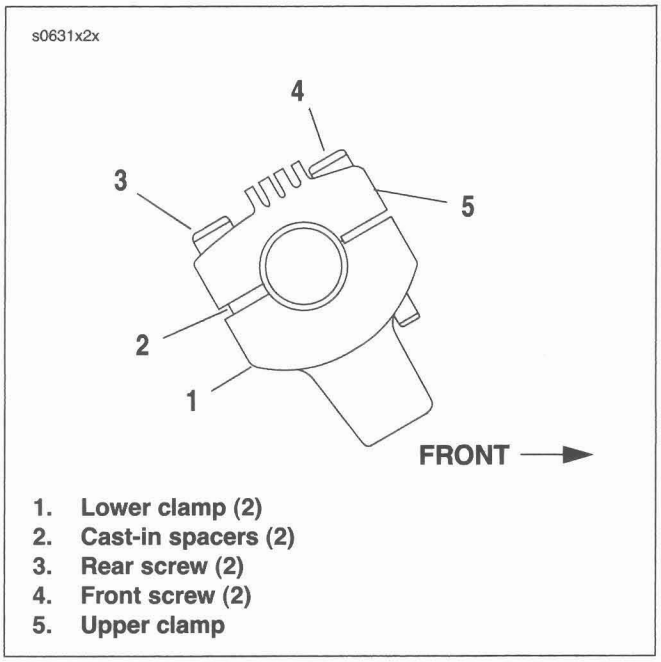
NOTE

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.

6. Raise handlebars to normal riding position and hold in position.
7. Secure handlebars in clamp:
   a. Tighten two front screws (4).
   b. Tighten rear fasteners (3) to 12-15 ft-lbs (16.3-20.3 Nm).
   c. Final tighten front fasteners to 12-15 ft-lbs (16.3-20.3 Nm). Slight gap between upper and lower clamps should exist at front.
8. See Figure 2-114. Tighten lower handlebar clamp fasteners (16) to 30-40 ft-lbs (40.7-54.3 Nm).

FXSTD

1. See Figure 2-117. If lower handlebar clamps (5) were removed, loosely install clamp to upper fork bracket (6) with two fasteners (9), lockwashers (8) and washers (7).
2. Using knurled areas of handlebar as a guide, center handlebars between lower handlebar clamps.
3. 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).
4. Tighten lower handlebar clamp fasteners to 30-40 ft-lbs (40.7-54.3 Nm).



1. **Lower clamp (2)**
2. **Cast-in spacers (2)**
3. **Rear screw (2)**
4. **Front screw (2)**
5. **Upper clamp**

Figure 2-116. Handlebar Riser

5. Install front master cylinder assembly. See 2.15 FRONT BRAKE MASTER CYLINDER.
6. Install **new** left hand grip in place as follows:
   a. 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.

   b. 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.

7. Position left hand control and loosely install hand control clamp screws. See 8.40 LEFT HANDLEBAR SWITCH.
8. Attach clutch control assembly to left side of handlebar. Tighten screws to 108-132 **in-lbs** (12.2-14.9 Nm). See 2.29 CLUTCH HAND CONTROL.
9. Tighten left hand control clamp screws to 35-45 **in-lbs** (4.0-5.1 Nm).
10. Tighten right hand control clamp screws to 35-45 **in-lbs** (4.0-5.1 Nm).
11. Attach front brake master cylinder assembly with torx screws. Tighten to 108-132 **in-lbs** (12.2-14.9 Nm).
12. Wrap four **new** wiring harness retainers around handlebar wiring harnesses and push retainers into holes in handlebar.
13. Connect negative battery cable.

⚠CAUTION

Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

14. 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.

REMOVAL

⚠WARNING

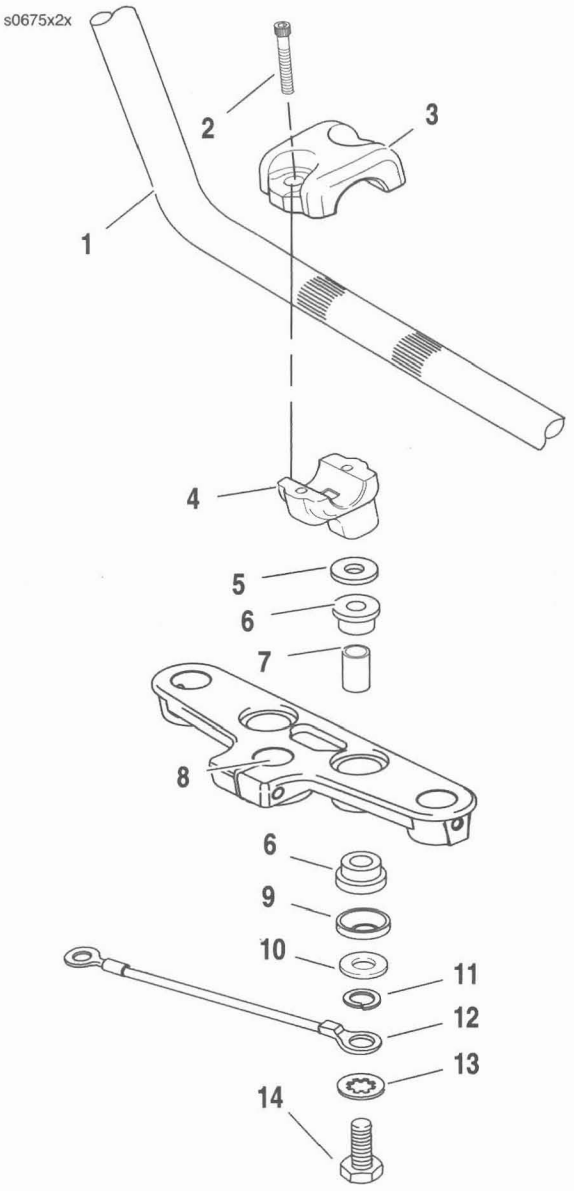
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

1. Disconnect negative battery cable. See 1.5 BATTERY MAINTENANCE.
2. Remove instrument console. 8.26 INSTRUMENT CONSOLE: FXSTD.
3. Unplug fuel gauge connector.
4. Remove fuel tank fasteners, vent, fuel supply fitting and slide fuel tank back. See 4.5 FUEL TANK.
5. Place blanket or protective cover over front of fuel tank to protect against scratches and other damage.
6. Disconnect all left and right side hand control connectors from connectors on main harness.

NOTE

Make note of wire colors and locations in connector before removal. This will ensure proper wire location in connector during installation.

7. Identify wire leads and remove socket side housings from socket terminal wires (left hand control connector [24], right hand control connector [22]). See B.17 MOLEX for connector information.
8. Remove turn signal lamp multilock connector from socket terminal wires. See B.2 AMP MULTILOCK for connector information.
9. Remove front master cylinder assembly. See 2.15 FRONT BRAKE MASTER CYLINDER.
10. Remove two screws securing clutch control assembly to left side of handlebar. See 2.25 CLUTCH CONTROL.
11. Separate right handlebar switch assembly and remove throttle. See 8.39 RIGHT HANDLEBAR SWITCH.
12. Remove left handlebar grip.
13. Remove switch housings, turn signals and wiring from handlebars.
14. See Figure 2-117. Remove upper handlebar clamp fasteners (2) and upper handlebar clamps (3).
15. If removing lower handlebar clamps (5), remove two lower handlebar clamp fasteners (9), lockwashers (8), washers (7) and lower handlebar clamps from upper fork bracket (6).



1. **Handlebar**
2. **Upper handlebar clamp fastener (4)**
3. **Upper handlebar clamp**
4. **Lower handlebar clamp (2)**
5. **Upper cup washer (2)**
6. **Bushing (2)**
7. **Spacer (2)**
8. **Upper fork bracket**
9. **Lower cup washer (2)**
10. **Washer**
11. **Ground cable washer (right side only)**
12. **Ground cable (right side only)**
13. **Lockwasher (2)**
14. **Lower handlebar clamp fastener (2)**

Figure 2-117. Handlebars: FLSTF

INSTALLATION

NOTE

The turn signal wires enter the switch housings through a relief grommet in the housing. The turn signals must be supported throughout this procedure to prevent pulling the grommet or the turn sign wires out of the housing.

1. Repair and replace switch, turn signal, and socket wires and grommets as necessary.

NOTE

For handlebar switch repair procedures, see 8.38 HANDLEBAR SWITCH ASSEMBLIES.

2. Using mechanics wire, neatly wrap the socket terminals, wires and conduits with a few twists to form leaders for turn signal wires.
3. See Figure 2-118. String wire along the wires. String sufficient wire to pull conduits through handlebars.
4. Wrap socket wires with electrical tape and wrap open ends of conduit.

⚠WARNING

Grommets in each of the wiring holes in the handlebar must in position after routing the wiring through the handlebar. Operation without the grommets in place can damage wires, causing a short circuit which could result in death or serious injury. (00416c)

5. If necessary, replace grommets on handlebars wire openings.
6. Lubricate wire conduits with glass cleaner.
7. Thread the wire leaders through the handlebar grommets to the center hole.
8. Pull wire bundles through hand grip grommets to the handlebars center hole.
9. Loosely install left and right switch housings.
10. Final pull wire leaders and unwrap the tape and mechanics wire.

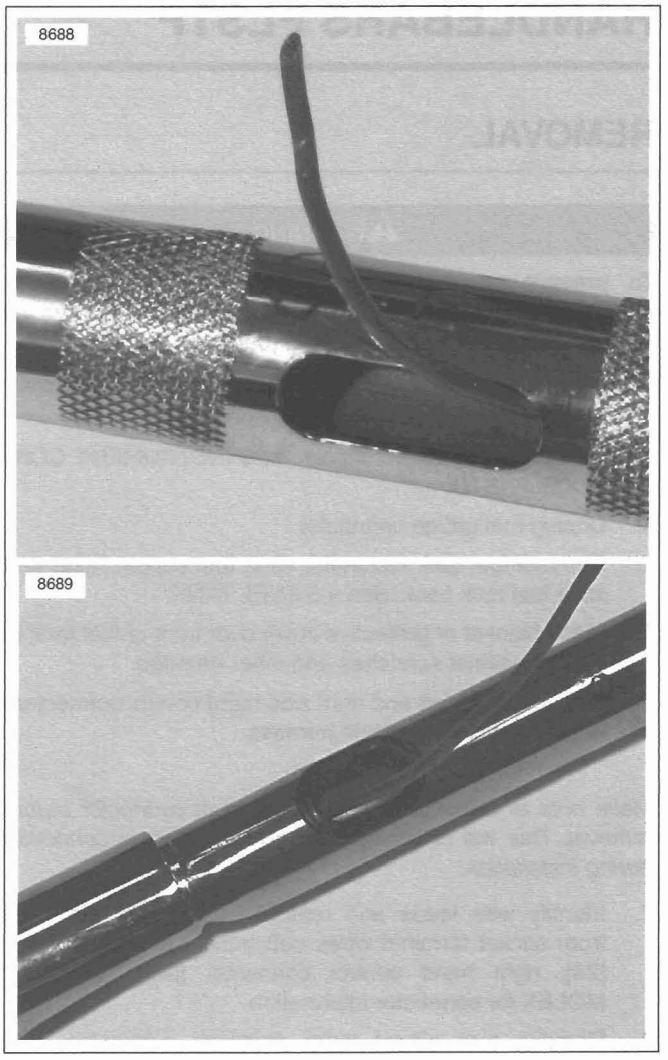


Figure 2-118. Wire Leader in Handlebars (handlebars removed from motorcycle)

11. See Figure 2-117. If lower handlebar clamps (5) were removed, install washers (7) and lockwashers (8) on lower handlebar clamp fasteners (9).
12. Slide lower handlebar clamp fasteners through upper fork bracket (6).
13. Loosely install lower handlebar clamps to upper fork bracket using lower handlebar clamp fasteners.
14. Place handlebars (1) on lower handlebar clamps. Install upper handlebar clamps (3). Install but do not tighten clamp fasteners.
15. Insert wires into proper locations in wire connector housings. See the wiring diagrams in Appendix B.
16. Replace hand control brackets and switch housings.
17. Connect turn signal connectors [22, 24].
18. Connect turn signal connector [31].
19. Connect fuel gauge connector [117].
20. Slide fuel tank into position and install fuel tank fasteners, vent, fuel supply fitting. See 4.5 FUEL TANK.
21. Replace instrument console. 8.25 FUEL GAUGE.
22. 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.

23. Raise handlebars to normal riding position and hold in position.

NOTE

Gap between upper and lower clamps should be equal front and rear.

24. Tighten front and rear fasteners to 12-18 ft-lbs (16.3-24.4 Nm).
25. See Figure 2-117. Remove one lower handlebar clamp fastener (9). Apply Loctite High Strength Threadlocker 271 (red) to fastener threads.
26. Install fastener and tighten to 30-40 ft-lbs (40.7-54.2 Nm). Repeat for other fastener.
27. Connect negative battery cable to battery.
28. Test front brake lever for pressure and operation.
29. Test for correct operation. Adjust as required. See Adjustment under 1.24 THROTTLE CABLES.
30. Turn the ignition/light key switch to IGNITION and test switches for proper operation.
31. Apply brake lever to test stop light lamp.

REMOVAL

1. Loosen clutch adjuster so clutch cable is fully slack. See 1.12 CLUTCH.
2. See Figure 2-119. Remove remove the retaining ring (2) and pivot pin (4). Remove the clutch cable anchor pin (1) from the hand lever.
3. Drain transmission lubricant and remove fill plug dipstick. Remove transmission side cover. See 7.4 TRANSMISSION CLUTCH RELEASE COVER.
4. See Figure 2-120. Note position of retaining ring opening. Retaining ring opening must be positioned in approximately the same location during assembly. Remove retaining ring (1).
5. Pull inner ramp (2) and coupling (3) out of side cover. Hold inner and outer ramps together to keep balls from falling free.
6. 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.

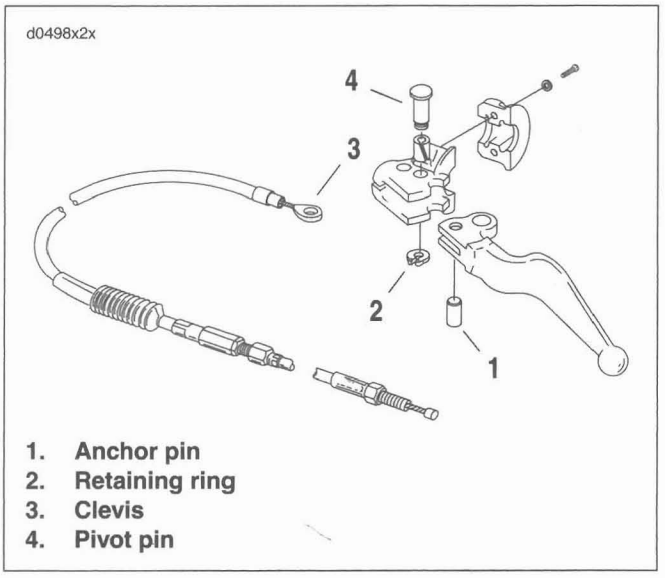
INSTALLATION

1. See Figure 2-120. Install **new** O-ring on end of clutch cable threads. Thread clutch cable fitting (5) into side cover. Do not tighten at this time.
2. 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.
3. Install retaining ring (1). Position retaining ring opening to the right of the outer ramp tang (the stop that prevents rotation).
4. Place **new** gasket on side cover and install, fully tightening the clutch cable fitting. See 7.4 TRANSMISSION CLUTCH RELEASE COVER.
5. Place a few drops of oil inside cable housing.

NOTE

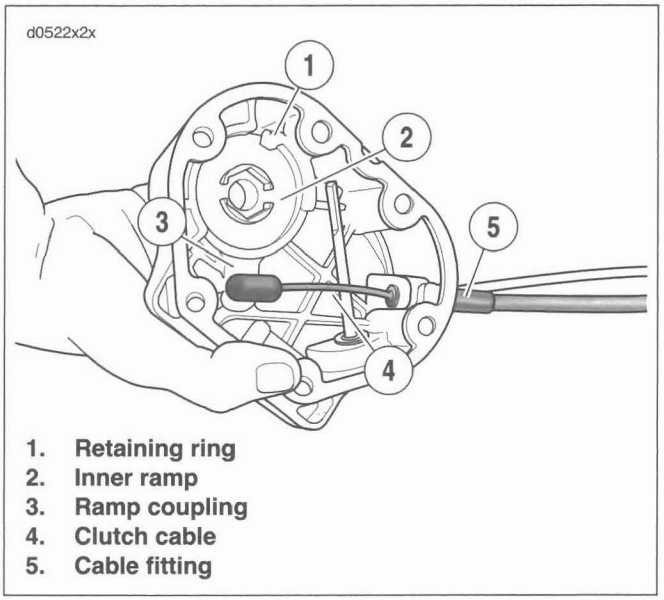
Anchor pin does not require lubrication.

6. Check that clutch cable is properly routed.
   a. Route clutch cable across the front of handlebars for the following models: FXSTD, FXSTC, FXST, FXSTB. Route clutch cable behind handlebars for the following models: FLSTF, FLSTC, FLSTN.
   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.



1. **Anchor pin**
2. **Retaining ring**
3. **Clevis**
4. **Pivot pin**

Figure 2-119. Clutch Cable Installation



1. **Retaining ring**
2. **Inner ramp**
3. **Ramp coupling**
4. **Clutch cable**
5. **Cable fitting**

Figure 2-120. Clutch Cable Connection

7. See Figure 2-119. 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, FXSTC 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 2-121. Remove the acorn nuts, washers and screws to detach fender.

Installation

See Figure 2-121. 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).

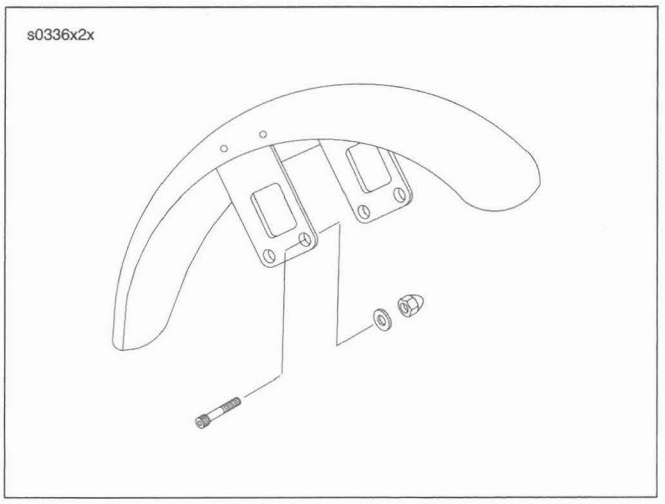


Figure 2-121. Front Fender: FXST, FXSTB and FXSTC

FLSTC, FLSTN, 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

1. Remove front wheel. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTD.
2. Disconnect fender tip lamp.
3. See Figure 2-122. Remove screws and nuts that hold fender in place and remove fender.

Installation

1. 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.

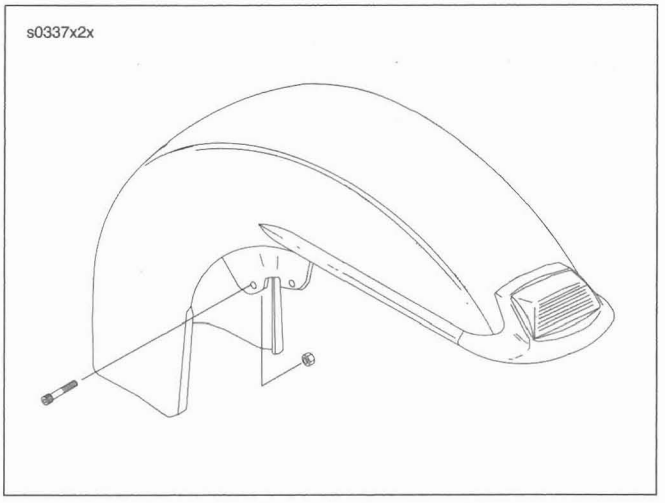


Figure 2-122. Front Fender: FLSTC

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

1. Remove front wheel. See 2.4 FRONT WHEEL: ALL BUT FLSTSC/FXSTD.
2. See Figure 2-123. Remove screws and nuts that hold fender in place and remove fender.

Installation

1. See Figure 2-123. 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.

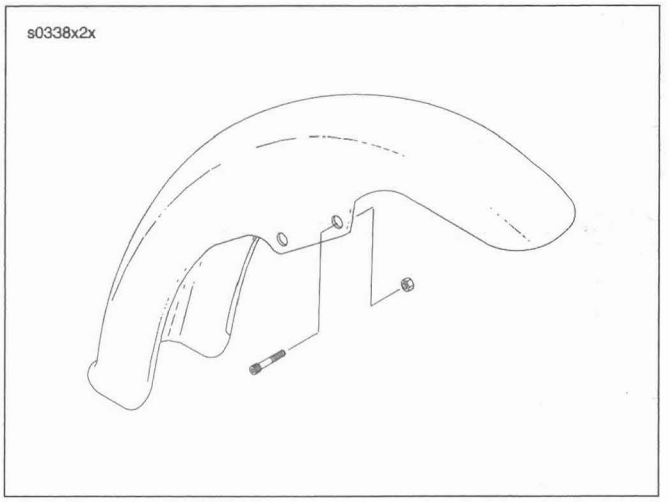


Figure 2-123. Front Fender: FLSTF

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 2-124. Remove the four screws and washers to detach fender.

Installation

See Figure 2-124. Place fender into position. Secure with four screws and washers. Tighten mounting hardware to 15-21 ft-lbs (20.3-28.5 Nm).

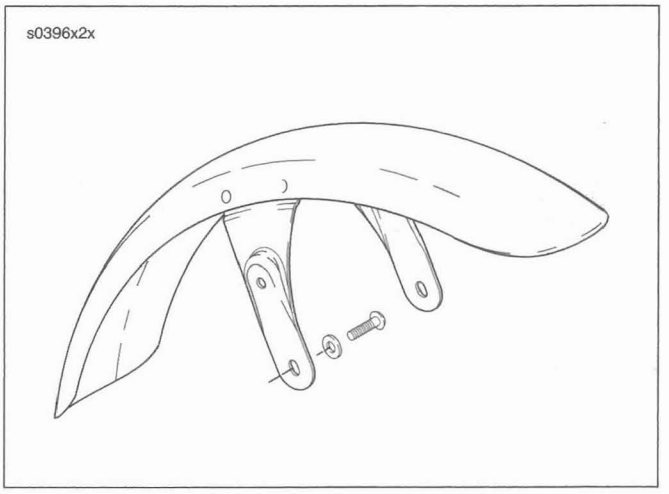
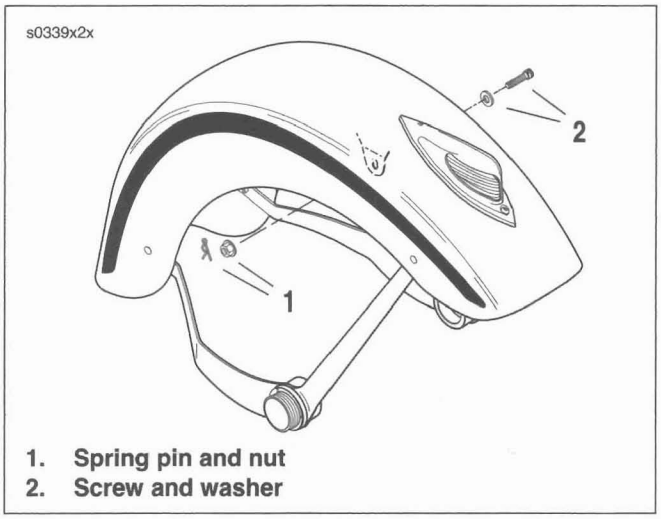


Figure 2-124. Front Fender: FXSTD

REMOVAL

Front Fender

1. Remove front wheel and brake caliper. See 2.6 FRONT WHEEL: FLSTSC.



1. **Spring pin and nut**
2. **Screw and washer**

Figure 2-125. FLSTSC Fender Hardware

2. See Figure 2-125. 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:
   a. See Figure 2-126. Slide fender down until mounting bracket is just in front of the rigid fork leg.
   b. See Figure 2-127. 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.
2. See Figure 2-128. 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 2-126. FLSTSC Front Fender Bracket

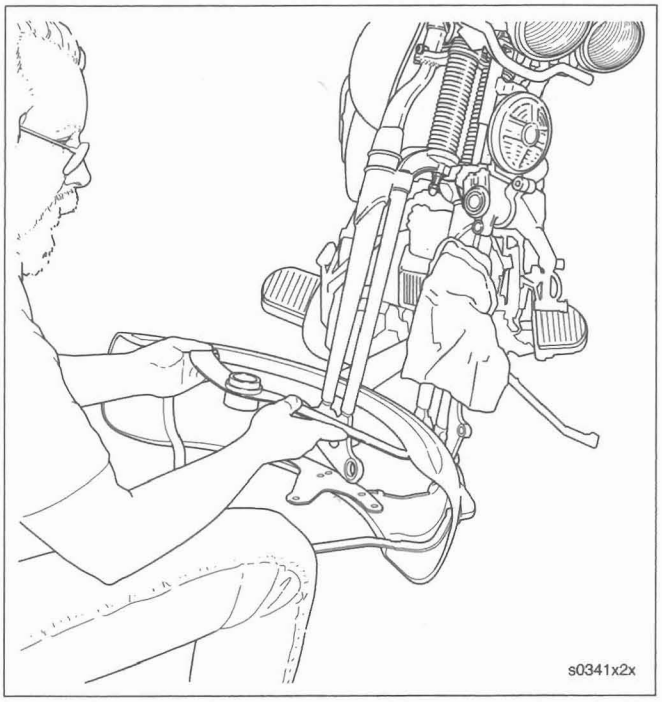


Figure 2-127. FLSTSC Fender Replacement

3. 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.
4. 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

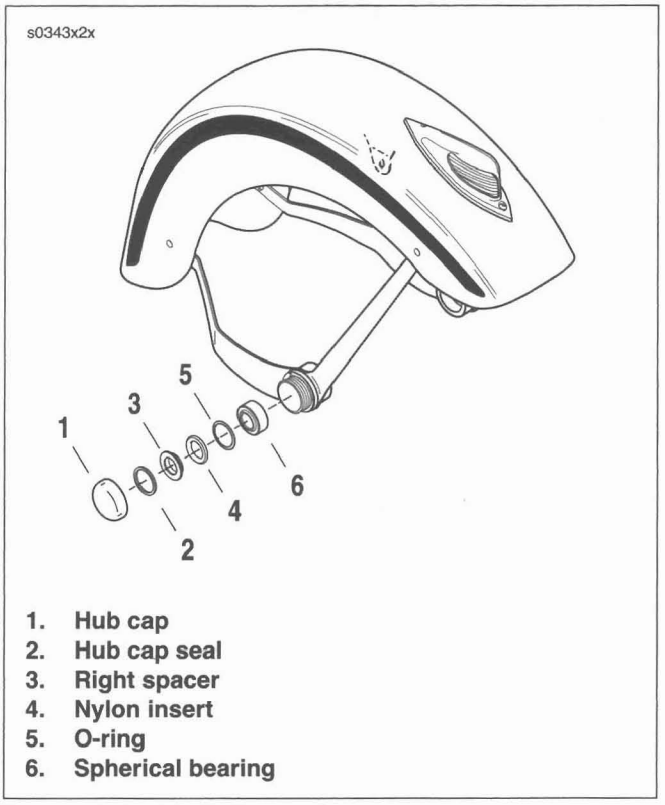
Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)

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:
   a. See Figure 2-127. Install fender by keeping right fork leg between fender and struts and rotating fender towards the left leg position.
   b. See Figure 2-126. Raise fender until fender holes are aligned with fork holes for axle.
2. While holding fender, slide axle through the fender and front forks to support assembly.
3. See Figure 2-125. 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.

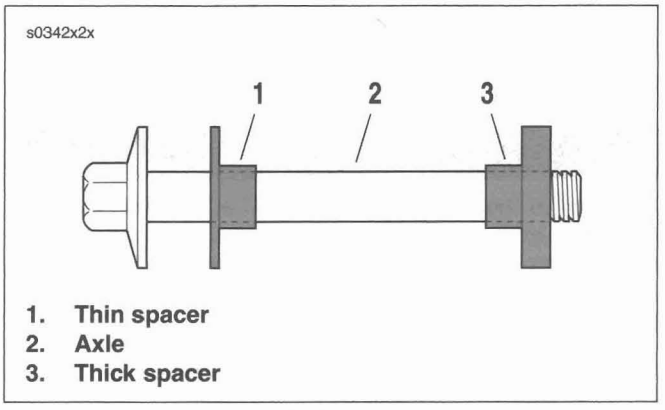


1. **Hub cap**
2. **Hub cap seal**
3. **Right spacer**
4. **Nylon insert**
5. **O-ring**
6. **Spherical bearing**

Figure 2-128. FLSTSC Fender Bearings

NOTE

See Figure 2-128. Parts 1-5 are shown for reference only. They are normally removed as the wheel is pulled from the vehicle.



1. **Thin spacer**
2. **Axle**
3. **Thick spacer**

Figure 2-129. FLSTSC Spacer Alignment

6. See Figure 2-129. Install spacers to axle with step towards the front wheel.

NOTE

The thick spacer (3) goes on the left (brake disc) side.

7. Install front wheel and brake caliper. See 2.6 FRONT WHEEL: FLSTSC.

REMOVAL

1. Remove seat.

⚠WARNING

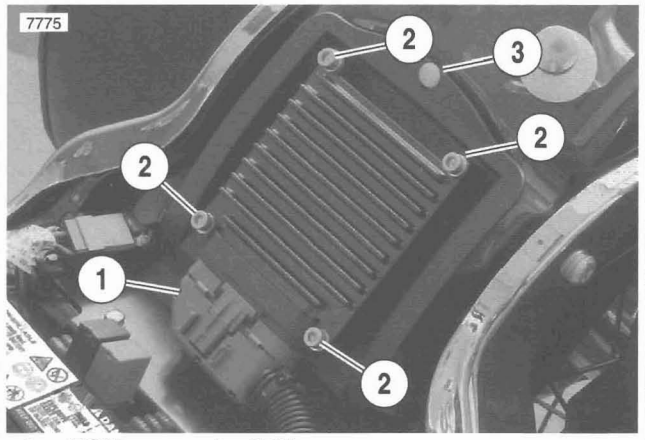
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Disconnect negative battery cable.
3. Remove saddlebags, See 2.48 SADDLEBAGS: FLSTC

NOTE

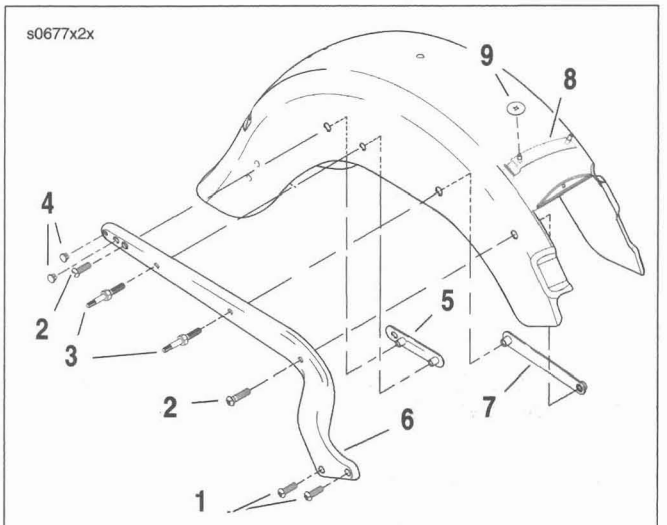
To ensure proper installation, make note of fender wire routing and hardware locations before removal.

4. Disconnect rear wiring harness connector under seat.
5. Disconnect left and right turn signal connectors from within tail lamp. See 8.18 TAIL LAMP: ALL BUT FXSTD/FLSTSC/FLSTN.
6. See Figure 2-130. Remove nylon fastener (3) from electrical box (2).
7. See Figure 2-131. Remove screws (2) and saddlebag support studs (3) from front (7) and rear (5) fender mounting brackets.
8. Lift fender from frame.



1. **ECM connector [78]**
2. **Screw (4)**
3. **Nylon fastener**

Figure 2-130. ECM Mount



1. **Fender support fasteners (4)**
2. **Fastener**
3. **Saddlebag stud (4)**
4. **Plug**
5. **Fender mounting bracket (rear, 2)**
6. **Fender support (2)**
7. **Fender mounting bracket (front, 2)**
8. **Stud plate**
9. **Plastic washer**

Figure 2-131. Rear Fender: FLSTC

INSTALLATION

1. Route turn signal wires through holes in fender. Install wires inside connector terminals.
2. 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 2-131.
3. Connect the turn signal wiring harness at connector [7] under the seat. Also attach wiring for left and right turn signals.
4. See Figure 2-130. Install nylon fastener (3) into electrical box (2) and fender.Install saddlebags if equipped.
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.

REMOVAL

1. Remove seat.

⚠WARNING

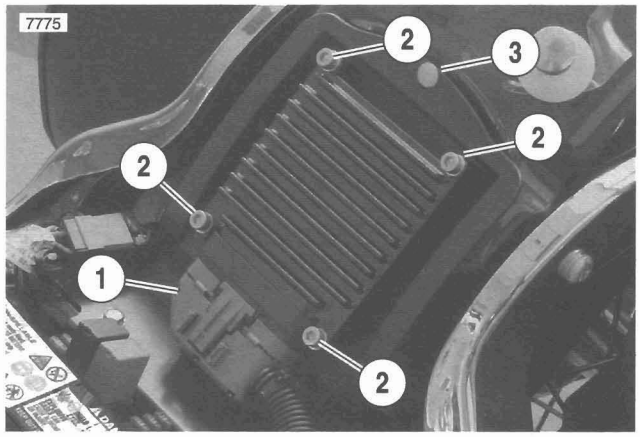
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Disconnect negative battery cable.

NOTE

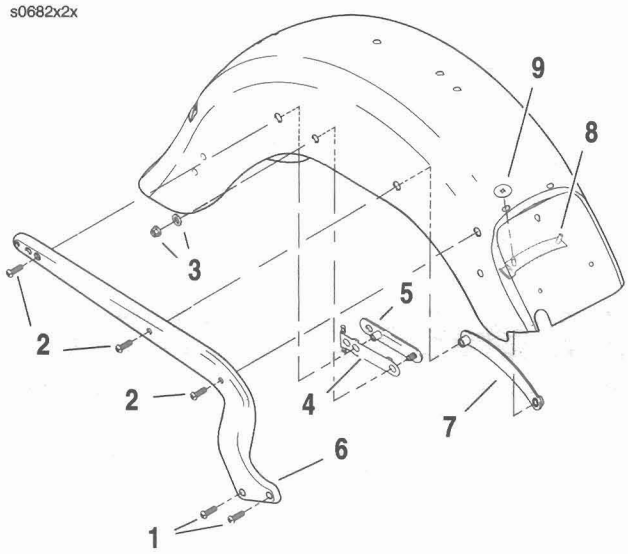
To ensure proper installation, make note of fender wire routing and hardware locations before removal.

3. Disconnect rear wiring harness connector [7] under seat.
4. Disconnect left and right turn signal connectors from within tail lamp. See 8.18 TAIL LAMP: ALL BUT FXSTD/ FLSTSC/FLSTN.
5. See Figure 2-132. Remove nylon fastener (3) from electrical box (2).
6. See Figure 2-133. Remove fasteners (2) from front fender mounting brackets (7), rear fender mounting brackets (5) and wire retainer plates (4).
7. Lift fender from frame.



1. **ECM connector [78]**
2. **Screw (4)**
3. **Nylon fastener**

Figure 2-132. ECM Mount



1. **Fender support fasteners (4)**
2. **Fastener**
3. **Locknut and washer (2)**
4. **Wire retainer plate**
5. **Fender mounting bracket (rear, 2)**
6. **Fender support (2)**
7. **Fender mounting bracket (front, 2)**
8. **Stud plate**
9. **Plastic washer**

Figure 2-133. Rear Fender: FLSTF

INSTALLATION

1. Route turn signal wires through holes in fender. Install wires inside connector terminals.
2. Carefully place the fender into position. Install fender supports using hardware shown. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
3. Connect the turn signal wiring harness at connector [7] under the seat. Also attach wiring for left and right turn signals.
4. See Figure 2-132. Install nylon fastener (3) into electrical box (2) and fender.
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.

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 saddlebags, if equipped.

NOTE

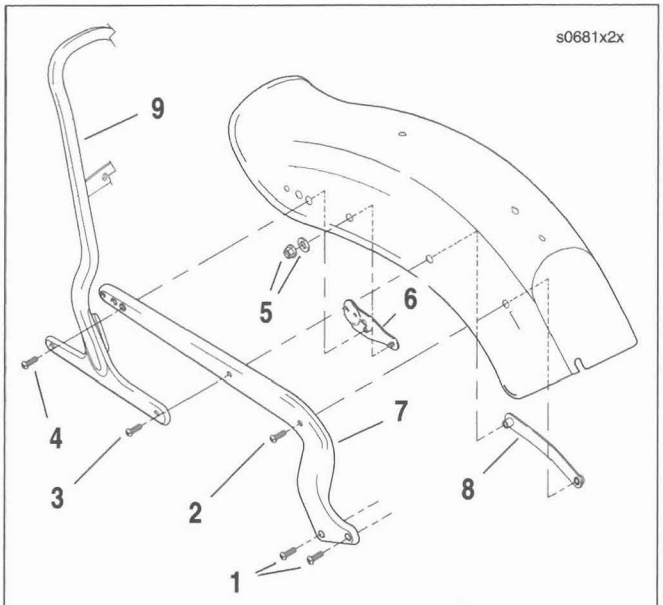
To ensure proper installation, make note of fender wire routing and hardware locations before removal.

4. Disconnect rear wiring harness connector [7] under seat.
5. Disconnect left and right turn signal connectors from within tail lamp. See 8.18 TAIL LAMP: ALL BUT FXSTD/FLSTSC/FLSTN.
6. Remove electronic control module. See 8.4 ELECTRONIC CONTROL MODULE (ECM).
7. See Figure 2-134. 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. On FXSTC models, remove sissy bar.
12. Remove fender support fasteners and fender support (7).
13. Repeat for opposite side.

NOTE

After removing both fender support brackets, support fender by installing a long screwdriver through frame and fender holes.

14. Remove locknuts and washers (5) from rear fender mounting bracket.
15. Lift fender from frame.



1. **Fender support fasteners (4)**
2. **Screw, front (1.25 in. /31.7 mm) long**
3. **Screw, middle (0.875 in./22.2 mm) long**
4. **Screw rear (0.875 in./22.2 mm) long**
5. **Locknut and washer (2)**
6. **Fender mounting bracket (rearward, 2)**
7. **Fender support (2)**
8. **Fender mounting bracket (forward, 2)**
9. **Sissy bar (FXSTC models)**

Figure 2-134. Rear Fender: FXST, FXSTB and FXSTC

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.
2. See Figure 2-134. Carefully place the fender into position.
3. Place fender supports into position.
4. On FXSTC models, place sissy bar into position.
5. Install fender supports hardware. Tighten to 21-27 ft-lbs (28.5-36.6 Nm).
6. Connect the turn signal wiring harness at connector [7] under the seat. Also attach wiring for left and right turn signals.
7. Install ignition control module.
8. Install saddlebags if equipped.
9. 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)

10. 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)

11. Check turn signal and lamp operation.

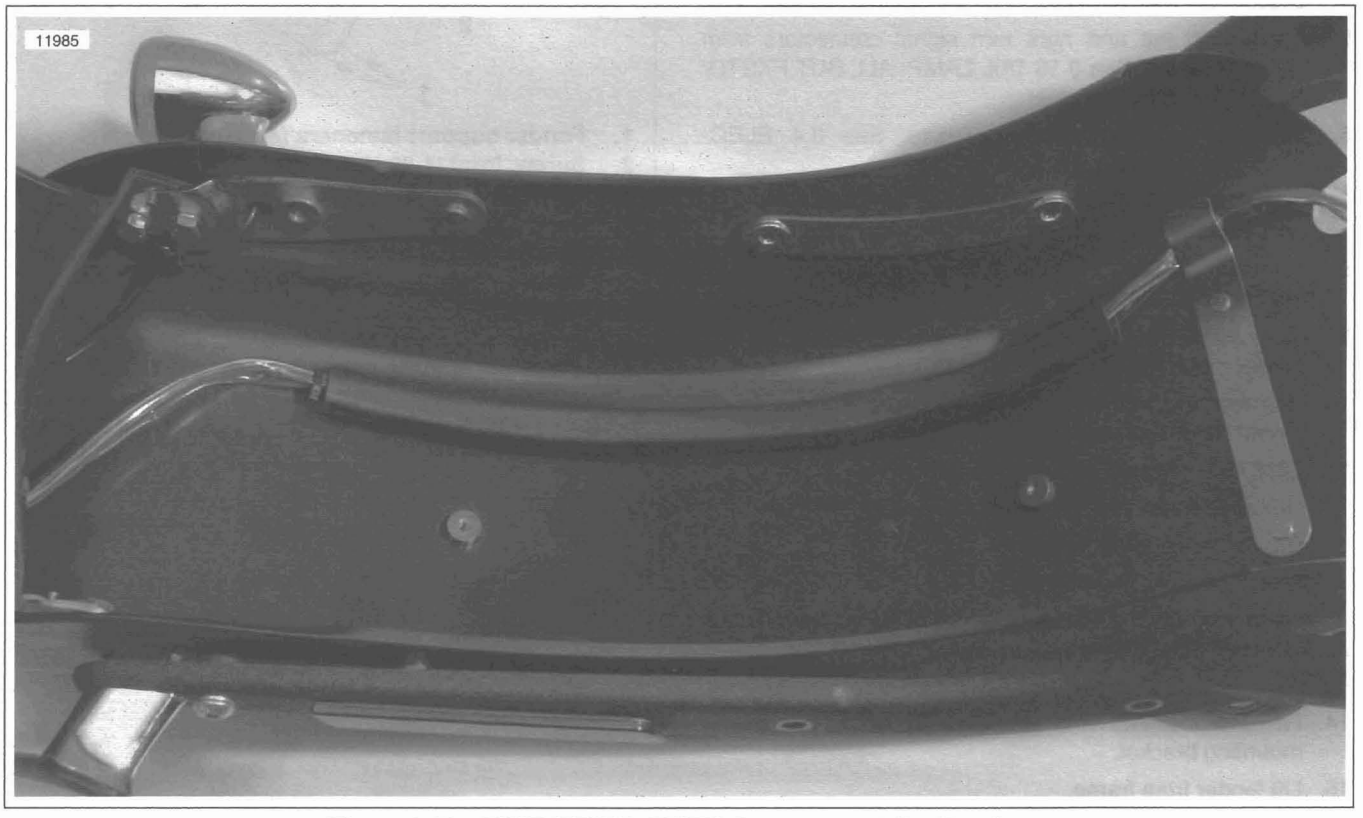


Figure 2-135. FXST, FXSTB, FXSTC Rear Fender Wire Routing

REMOVAL

1. Block motorcycle underneath frame so rear wheel is raised off the ground. This will provide extra clearance for fender removal.
2. Remove seat.

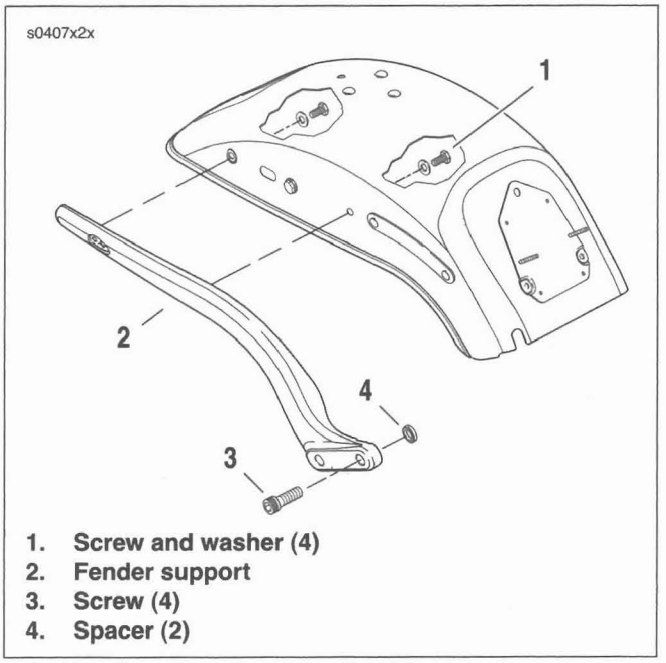
⚠WARNING

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.
4. See Figure 2-136. 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.
5. Remove tail lamp. Disconnect and detach rear turn signals. See 8.19 TAIL LAMP: FXSTD and 8.23 TURN SIGNALS/RUNNING LIGHTS.
6. Disconnect both ignition control module connectors and rear lighting harness.
7. See Figure 2-137. Remove nuts (3) from both fender mounting brackets (1).
8. Lift fender away from frame.

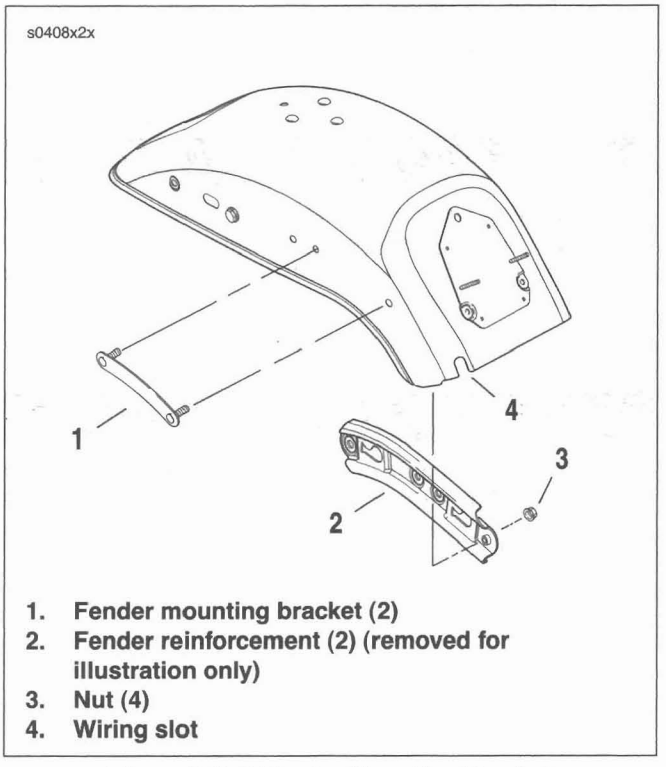
DISASSEMBLY

1. See Figure 2-138. Remove two screws and washers (2) to detach license plate bracket (1) from rear fender.
2. Remove tail lamp harness (4) from behind bracket (3) if necessary.



1. **Screw and washer (4)**
2. **Fender support**
3. **Screw (4)**
4. **Spacer (2)**

Figure 2-136. Rear Fender Support



1. **Fender mounting bracket (2)**
2. **Fender reinforcement (2) (removed for illustration only)**
3. **Nut (4)**
4. **Wiring slot**

Figure 2-137. Fender Mounting Bracket and Reinforcement

ASSEMBLY

1. See Figure 2-138. Place tail lamp harness (4) behind bracket (3) if removed. Harness runs along same side as wiring slot (5).
2. Secure license plate bracket (1) using two screws and washers (2). Tighten to 144-180 **in-lbs** (16.3-20.3 Nm).

INSTALLATION

1. See Figure 2-137. Place fender over rear tire and inside frame tubes. Verify wiring for tail lamp harness and ECM connectors are not pinned under fender.
2. 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).
3. See Figure 2-136. 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 8.23 TURN SIGNALS/RUNNING LIGHTS.
5. Loosely install screws and washers (1) from inside of fender. Tighten to 12-15 ft-lbs (16.3-20.3 Nm).
6. Connect both ignition control module connectors and rear lighting harness.
7. Install tail lamp. See 8.19 TAIL LAMP: FXSTD.
8. Connect negative battery cable.

⚠WARNING

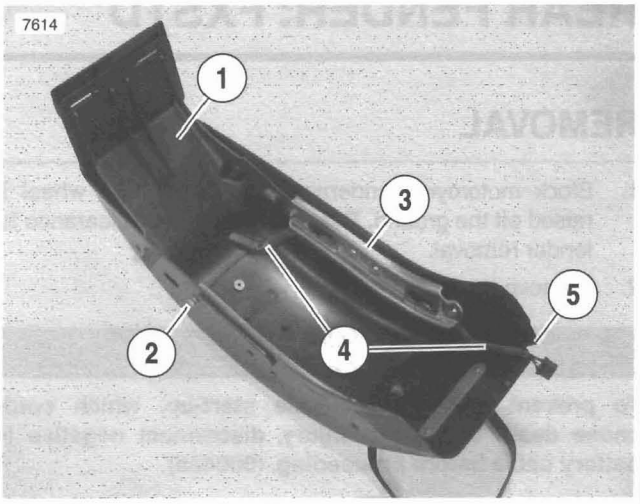
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

9. Install seat.

⚠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)

10. Check turn signal and lamp operation.



1. **License plate bracket**
2. **Screw and washer (2)**
3. **Bracket (2)**
4. **Tail lamp harness**
5. **Wiring slot**

Figure 2-138. Rear Fender

REMOVAL

1. Remove seat. see 2.46 SEAT: FLSTSC/FLSTN/FLSTF/FLSTC.

⚠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 2-139. Disconnect rear wiring harness connector (1) [7] under seat.
4. Remove nylon fastener (3) from electrical box (2).

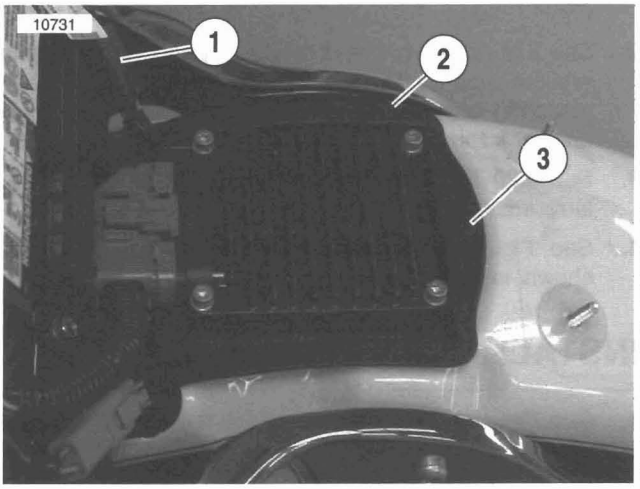
NOTE

Note location of hardware for correct installation.

5. See Figure 2-140. 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.
8. Slide fender towards rear of vehicle to disengage fender from frame rails.

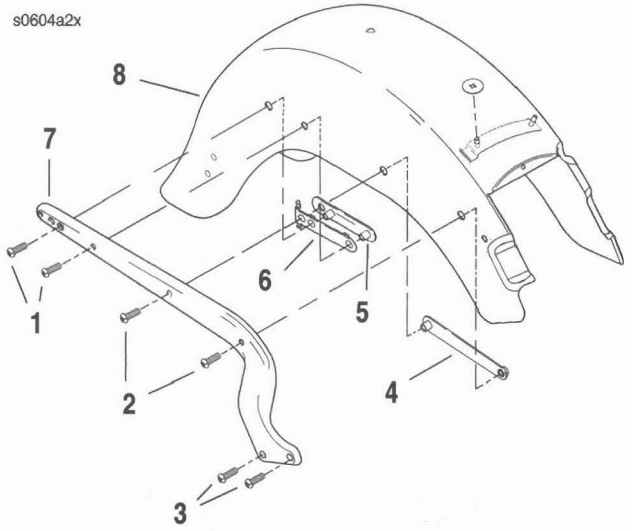
DISASSEMBLY

1. If rear fender is to be completely disassembled, perform the following:
   a. See Figure 2-141. Remove fastener (1). Disengage tail lamp connector cover (2) from clip (3).
   b. Remove wire terminals from turn signal connectors. See B.5 DEUTSCH for connector disassembly.
   c. See Figure 2-140. Detach fender supports (7) by removing fender mounting fasteners (1).
   d. See Figure 2-142. Remove screw and washer (1) from inside fender support to detach turn signal from mount (2).
2. See 8.20 TAIL LAMP: FLSTSC/FLSTN for FLSTSC tail lamp removal.



1. **Rear wiring harness connector [7]**
2. **Electronic control module tray**
3. **Nylon fastener**

Figure 2-139. Electrical Box: Typical



1. **Fender mounting fasteners (rear, 4)**
2. **Fender mounting fasteners (center, 4)**
3. **Fender mounting fasteners (front, 4)**
4. **Fender mounting bracket (front, 2)**
5. **Fender mounting bracket (rear, 2)**
6. **Wire retainer plate**
7. **Fender support**
8. **Fender**

Figure 2-140. Rear Fender: FLSTSC/FLSTN

ASSEMBLY

1. See Figure 2-142. Install screw and washer (1) to inside of fender support to connect turn signal (3) and mount (2).
2. See Figure 2-140. 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.
3. See 8.20 TAIL LAMP: FLSTSC/FLSTN for FLSTSC tail lamp installation.
4. See Figure 2-143. Route rear turn signal wiring as shown. Install cable tie (4).

INSTALLATION

1. See Figure 2-140. 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 2-139. Install nylon fastener (3) into electrical box (2) and fender.
3. Connect the harness at connector (1) [7].
4. Connect negative battery cable.

⚠WARNING

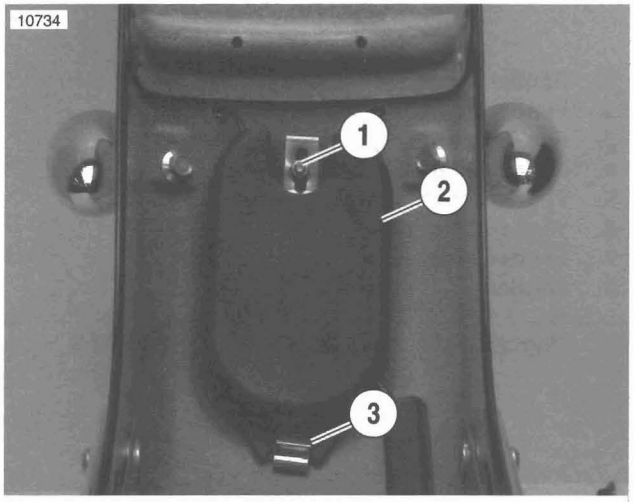
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

5. Install seat.

⚠WARNING

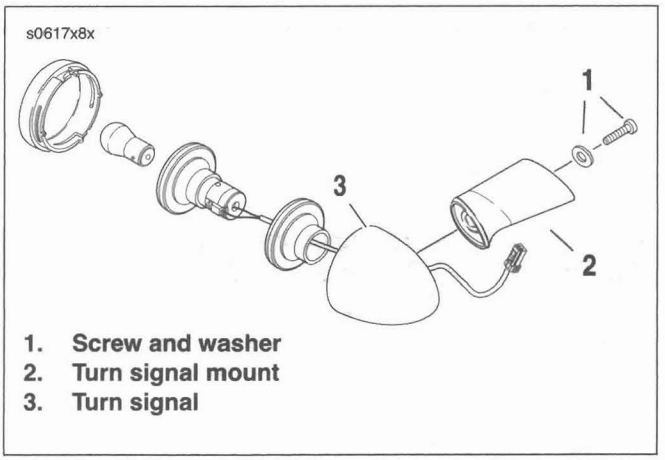
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

6. Check turn signal and lamp operation.



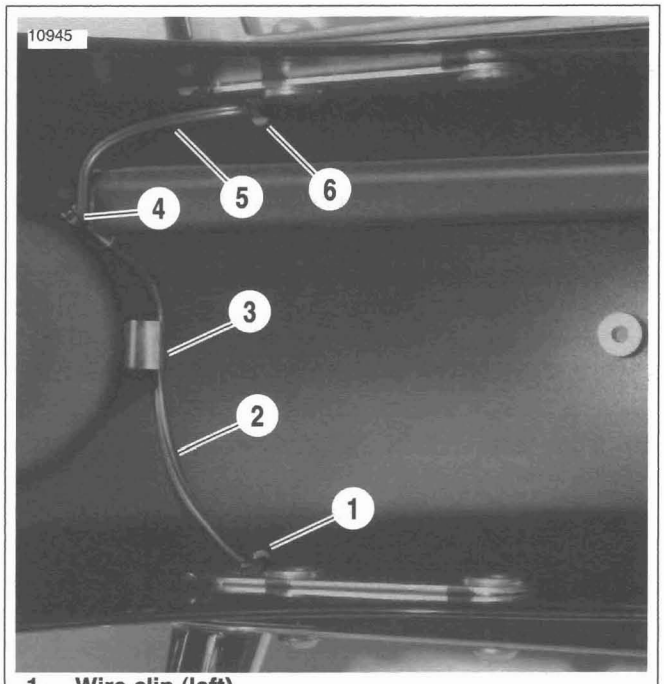
1. **Fastener**
2. **Tail lamp connector cover**
3. **Clip**

Figure 2-141. Tail Lamp Connector Cover: Typical



1. **Screw and washer**
2. **Turn signal mount**
3. **Turn signal**

Figure 2-142. 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 2-143. Rear Turn Signal Routing: FLSTSC

REMOVAL

1. Remove seat. see 2.46 SEAT: FLSTSC/FLSTN/FLSTF/FLSTC.

⚠WARNING

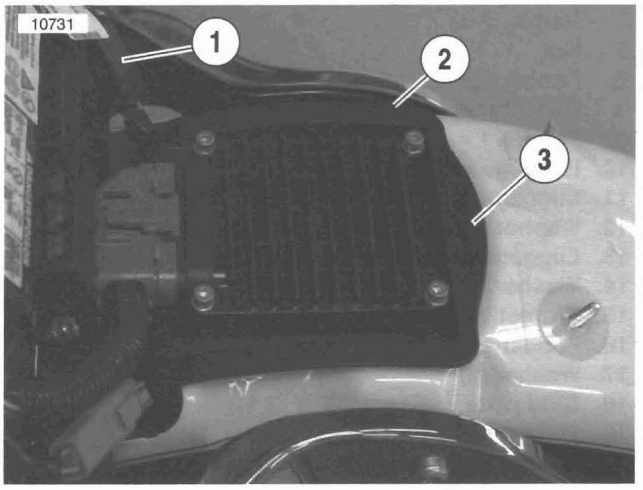
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Disconnect negative battery cable.
3. See Figure 2-144. 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.

5. See Figure 2-145. Remove fender mounting bracket (19) by removing fender mounting fasteners (3). 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.
8. Slide fender towards rear of vehicle to disengage fender from frame rails.



1. **Rear wiring harness connector [7]**
2. **Electrical box**
3. **Nylon fastener**

Figure 2-144. Electrical Box: Typical

DISASSEMBLY

1. See Figure 2-145. If rear fender is to be completely disassembled, detach fender supports (1) by removing fender mounting fasteners (4).
2. Remove fender support (16) and fender mounting brackets (20).
3. See 8.20 TAIL LAMP: FLSTSC/FLSTN for tail lamp removal.
4. See 8.23 TURN SIGNALS/RUNNING LIGHTS for turn signal bracket removal.
5. See 2.47 LUGGAGE RACK: FLSTN for FLSTN luggage rack removal.

1. Fender support
2. Fender mounting fasteners (front, 4)
3. Fender mounting fasteners (center 4)
4. Fender mounting fasteners (rear, 4)
5. Plugs
6. Nut
7. Fender tip
8. Turn signal grommet (2)
9. Fender
10. Luggage rack
11. Luggage rack fastener (rear)
12. Washer
13. Luggage rack fastener (front, 2)
14. Washer
15. Protective tape
16. Fender support
17. Washer (2)
18. Stud plate
19. Fender mounting bracket (front, 2)
20. Fender mounting bracket (rear, 2)

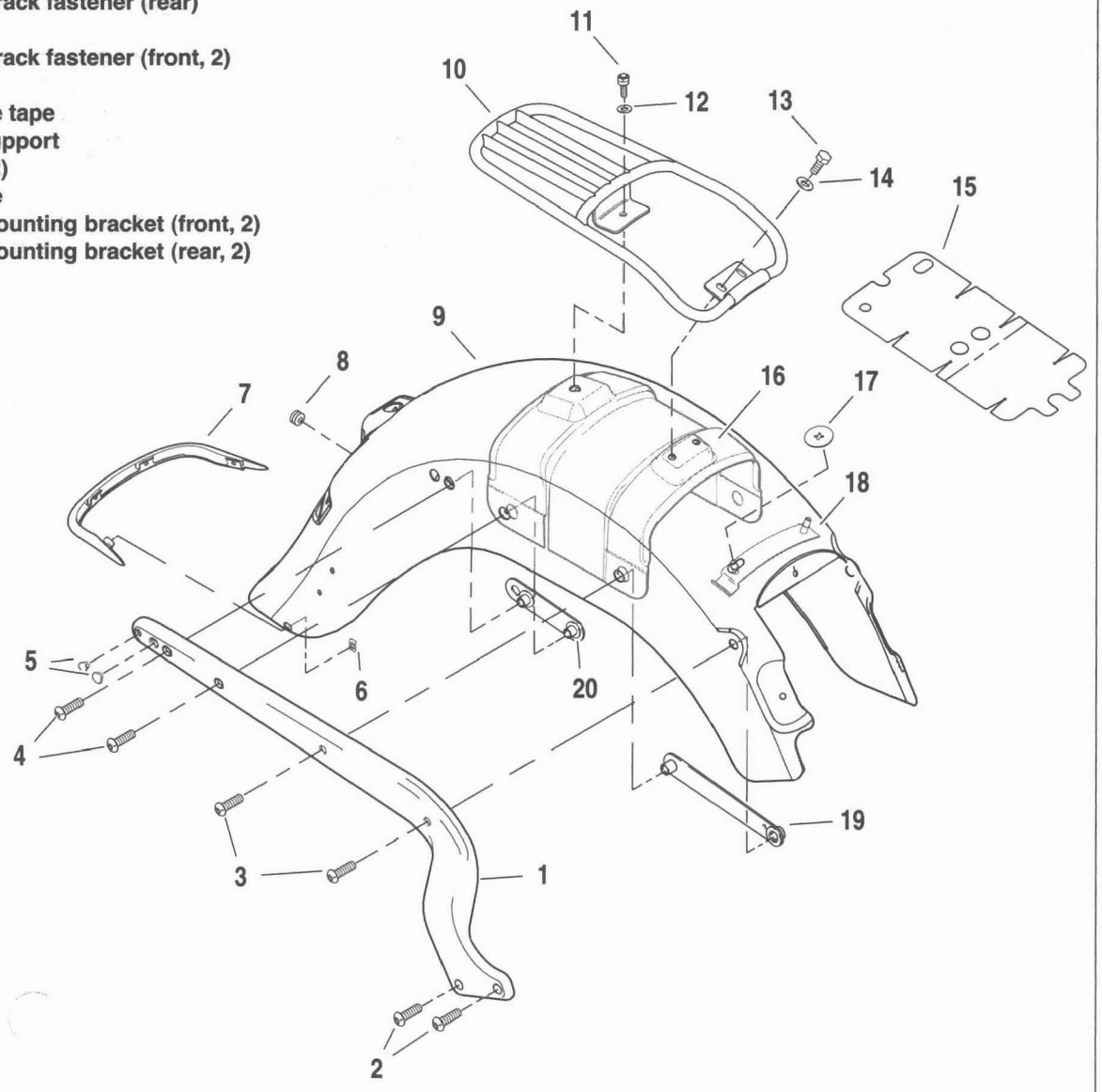


Figure 2-145. Rear Fender: FLSTN

ASSEMBLY

1. See 8.20 TAIL LAMP: FLSTSC/FLSTN for tail lamp assembly.
2. See 8.23 TURN SIGNALS/RUNNING LIGHTS for turn signal bracket assembly.

NOTE

See Figure 2-146. If fender support (2) has been removed, do not tighten luggage rack hardware until rest of fender has been installed.

3. Assemble fender:
   a. See Figure 2-145. Place fender support (16) into position in fender (9).
   b. Install but do not tighten luggage rack hardware. See 2.47 LUGGAGE RACK: FLSTN.
4. Install fender supports (1) using fender mounting fasteners (4). Snug but do not fully tighten fasteners at this time.

INSTALLATION

1. See Figure 2-145. 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 2.47 LUGGAGE RACK: FLSTN.
3. See Figure 2-144. Install nylon fastener (3) into electrical box (2) and fender.
4. Connect the harness at connector (1) [7].
5. Connect negative battery cable.

⚠WARNING

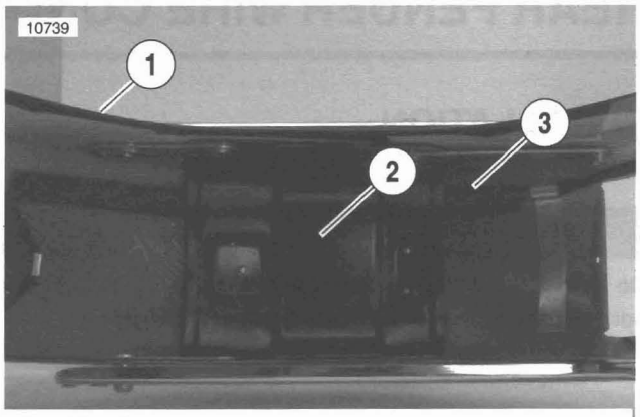
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

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.



1. **Fender**
2. **Fender support**
3. **Wire conduit**

Figure 2-146. Rear Fender Wire Routing: FLSTN

INSTALLATION

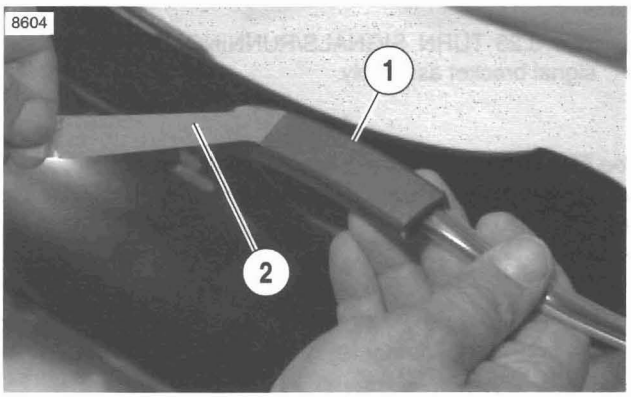
CAUTION

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.
3. Thoroughly clean inside surface of fender with soap and water until it is free of dirt, oil, or other debris.
4. Dry the surface, then wipe the area where conduit will be placed with Isopropyl Alcohol. Allow to dry completely.
5. Slide tail lamp wiring harness through **new** conduit and plug connectors into appropriate sockets. See B.20 CONNECTOR LOCATIONS and the wiring diagrams in the appendix for more information.
6. See Figure 2-147. Remove protective strip covering adhesive on conduit.
7. See Figure 2-149. Lightly position the conduit in place.
8. See Figure 2-148. 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.

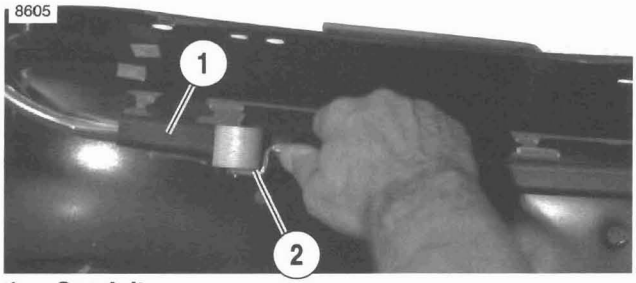
NOTES

- *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.*



1. **Conduit**
2. **Protective strip**

Figure 2-147. Removing Protective Strip From Conduit



1. **Conduit**
2. **Wallpaper corner roller**

Figure 2-148. Purging Air Between Adhesive and Fender

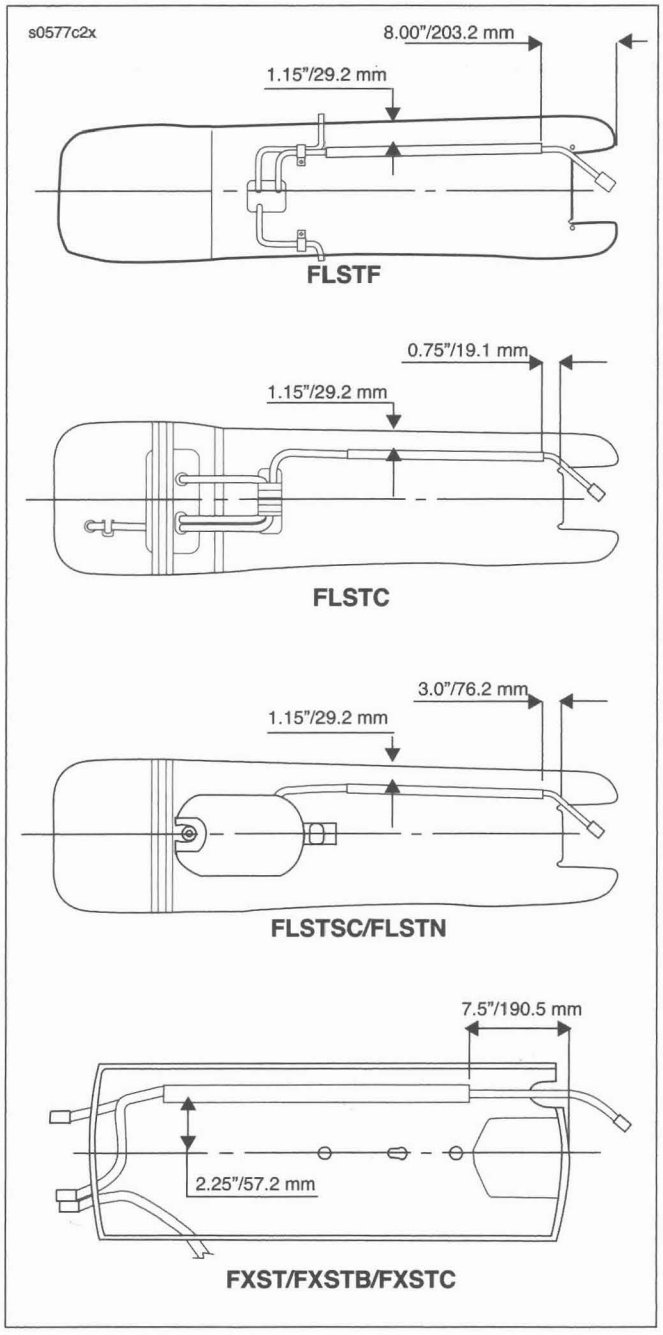


Figure 2-149. Conduit Placement

REMOVAL

Belt Guard

1. Remove left saddlebag if present.
2. See Figure 2-150. 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).
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.

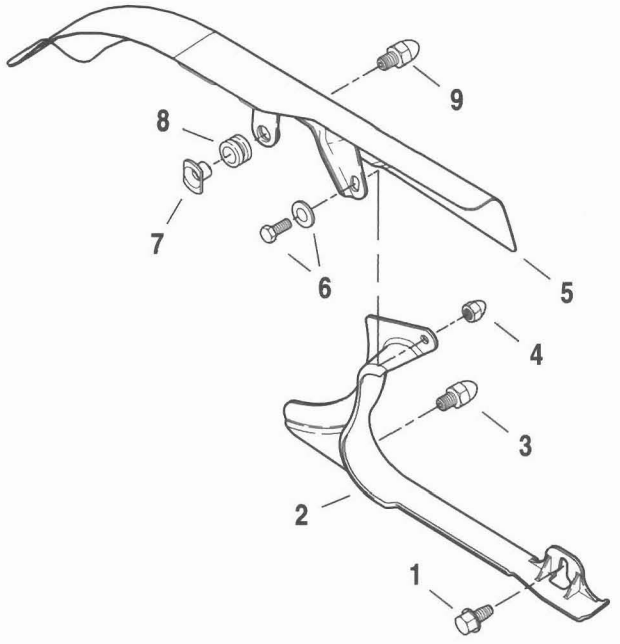
INSTALLATION

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).
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

1. Place debris deflector (2) into position. Slotted opening on front of deflector slides over bolt (1). Do not tighten bolt at this time.
2. Install bolt and washer (6) through belt guard (5), debris deflector (2) and rear fork. Install acorn nut (4) securely.
3. Install lower acorn bolt (3) and tighten bolt (1) at front of deflector.
4. Install left saddlebag if removed.



1. **Bolt**
2. **Debris deflector**
3. **Acorn bolt**
4. **Acorn nut**
5. **Belt guard**
6. **Bolt and washer**
7. **Tee nut**
8. **Grommet**
9. **Acorn bolt (same as item 3)**

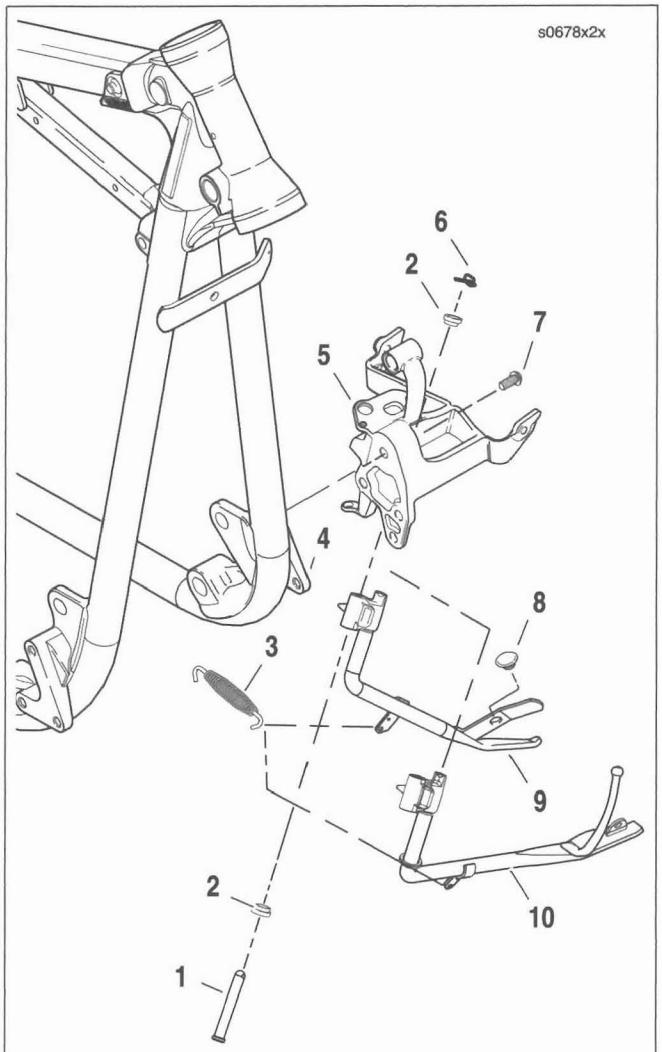
Figure 2-150. Belt Guard/Debris Deflector

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.
2. See Figure 2-151. Inspect clevis pin (1) and bushings (2). If covered with dirt, wipe dirt off with a shop towel and spray clevis pin and bushings with LOCTITE AEROSOL ANTI-SEIZE.
3. Move jiffy stand (9, 10) forward and back to infuse anti-seize into mating parts.
4. Check that jiffy stand operates correctly before using.



1. Clevis pin
2. Bushing (2)
3. Spring
4. Spring bracket
5. Jiffy stand bracket
6. Pretzel clip
7. Fastener (3)
8. Bumper
9. Jiffy stand (all but FLSTN)
10. Jiffy stand (FLSTN)

Figure 2-151. Jiffy Stand

REMOVAL

1. Block motorcycle underneath frame so both wheels are raised off the ground.
2. Detach shifter linkage.
3. See Figure 2-151. Remove the three screws (7) from jiffy stand bracket (5).
4. Detach spring (3) from jiffy stand and spring bracket (4).
5. Remove pretzel clip (6) from clevis pin (1).
6. Remove clevis pin and bushings (2) to free jiffy stand from jiffy stand bracket.

INSTALLATION

1. See Figure 2-151. Install bracket.
   a. Apply LOCTITE ANTI-SEIZE to clevis pin (1).
   b. Place jiffy stand into position.
   c. Install lower bushing on clevis pin.
   d. Install clevis pin through jiffy stand and jiffy stand bracket.
   e. Place top bushing on clevis pin.
   f. Install pretzel clip in clevis pin.
   g. Attach spring (3) to jiffy stand (9,10) and spring bracket (4). When properly installed, hook on spring side connected to bracket faces upward.
   h. Install jiffy stand and bracket assembly with three screws (7).
   i. Tighten to 25-30 ft-lbs (33.9-40.7 Nm).
2. Attach shifter linkage.
3. Check that jiffy stand operates correctly before using.

REMOVAL

1. Remove fork stem. See 2.23 STEERING HEAD.
2. See Figure 2-152. 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.
5. 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 2-153. 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 2.23 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 2-152. 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.
7. Finish fork stem installation including installing upper triple clamp and handlebars. See 2.23 STEERING HEAD.

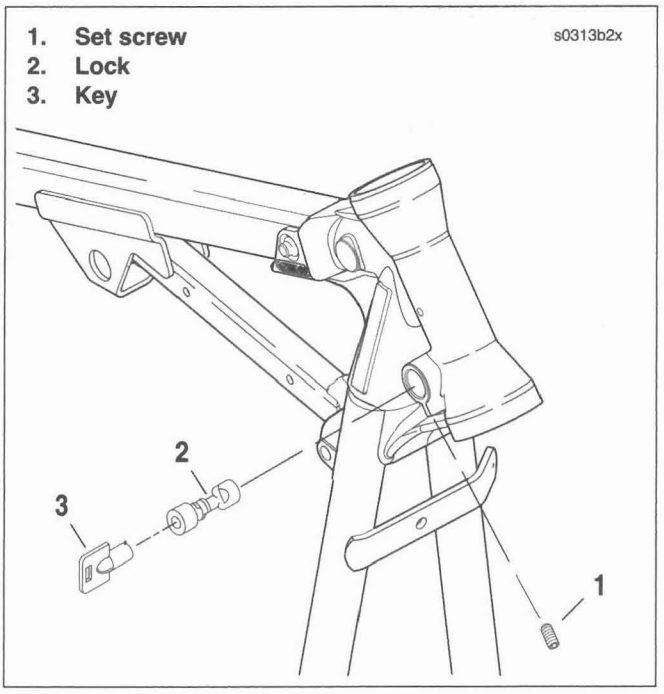


Figure 2-152. Fork Lock Installation

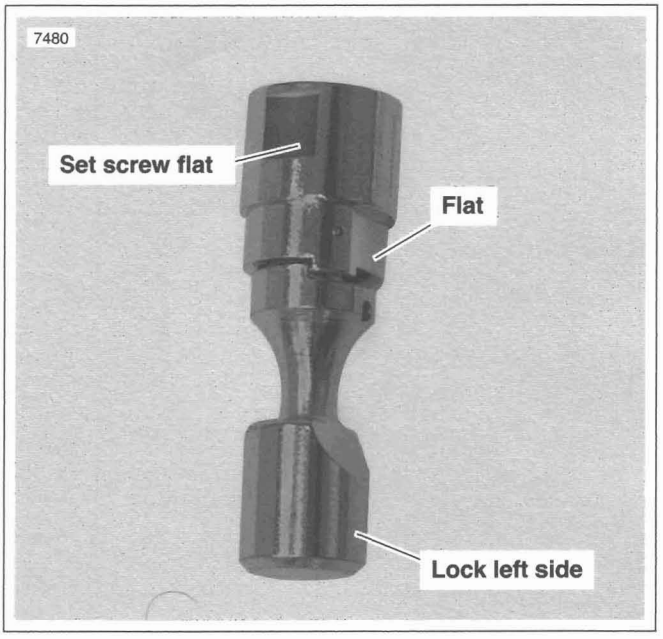


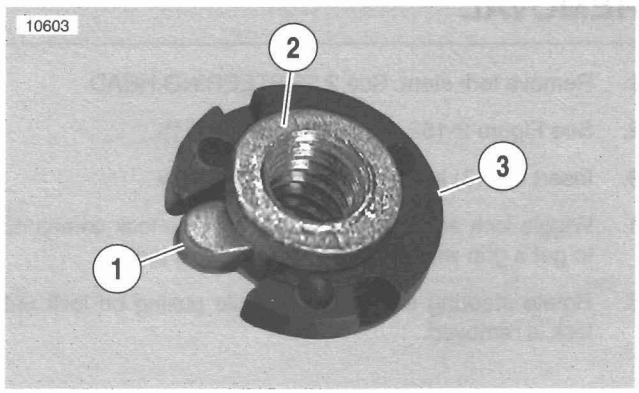
Figure 2-153. Fork Lock

REPLACEMENT

NOTE

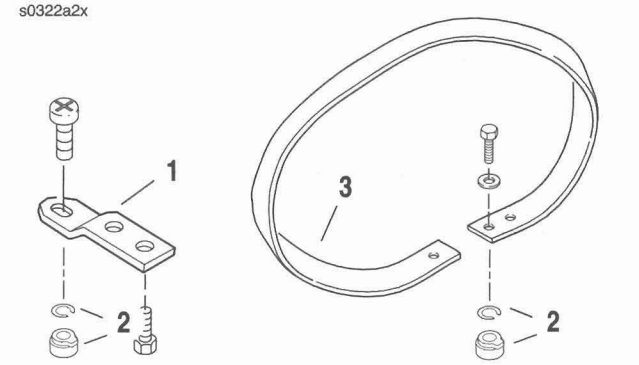
If the retention washer is removed the retention nut will fall through the fender. The procedure below lifts the retention nut up through the fender on the cable strap for ease of replacement.

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.
3. See Figure 2-154. 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.



1. **Tab**
2. **Retention nut**
3. **Retention washer**

Figure 2-154. Seat Retention Nut



1. **Bracket for seat/pillion**
2. **Retention nut and retention nut washer**
3. **Seat strap (FXST/C/B/D style shown)**

Figure 2-155. Retention Nut In Use

REMOVAL/INSTALLATION

Seat Strap

Seat strap installation depends upon model being serviced. Install bolt in appropriate hole according to Figure 2-156.

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 2-157. 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.

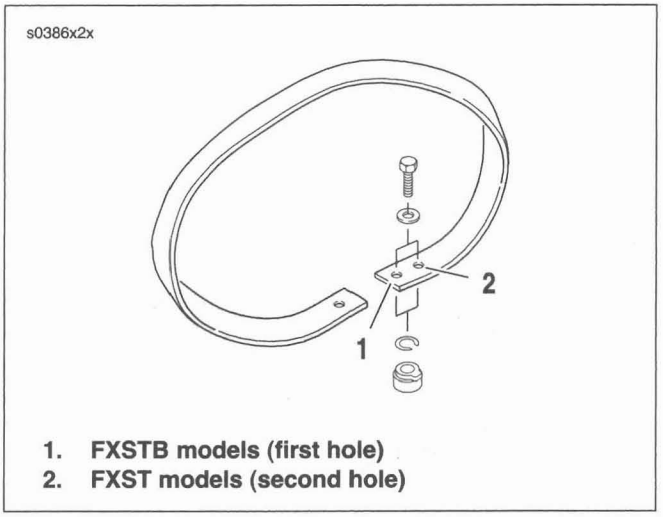


Figure 2-156. Seat Strap: FXST and FXSTB

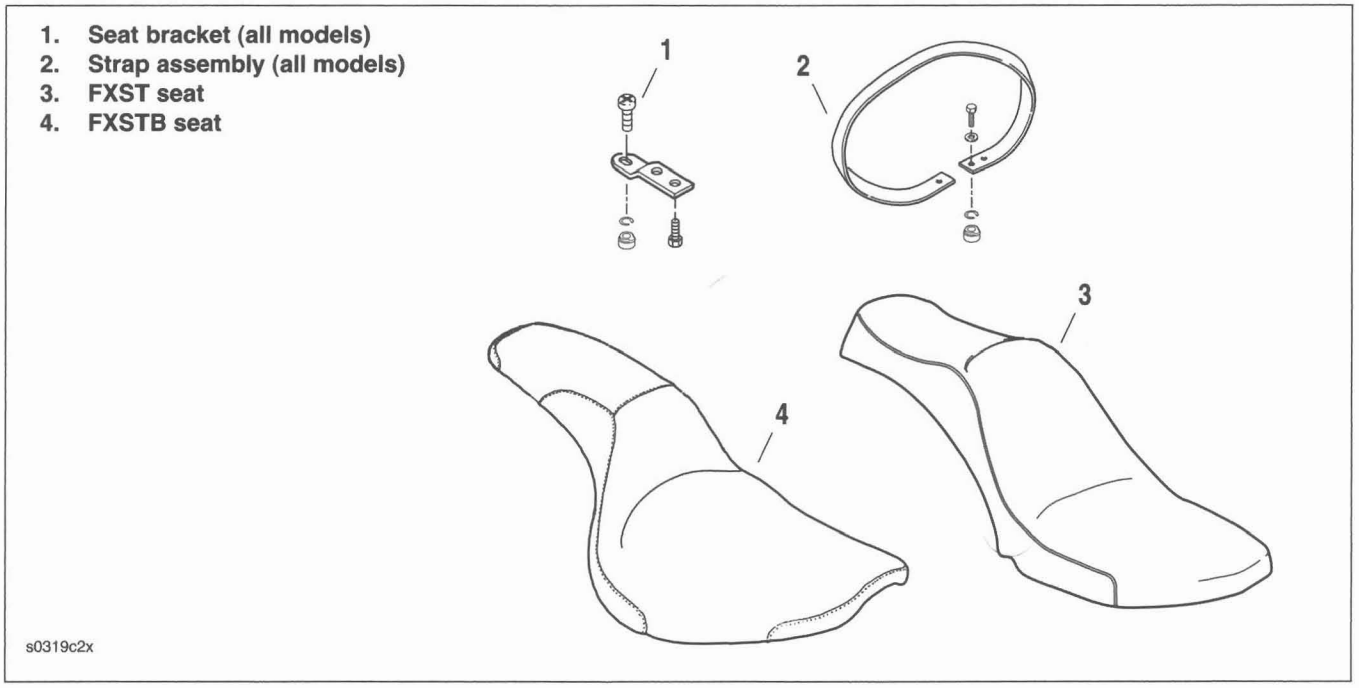


Figure 2-157. Seat: FXST and FXSTB

REMOVAL/INSTALLATION

Seat Strap

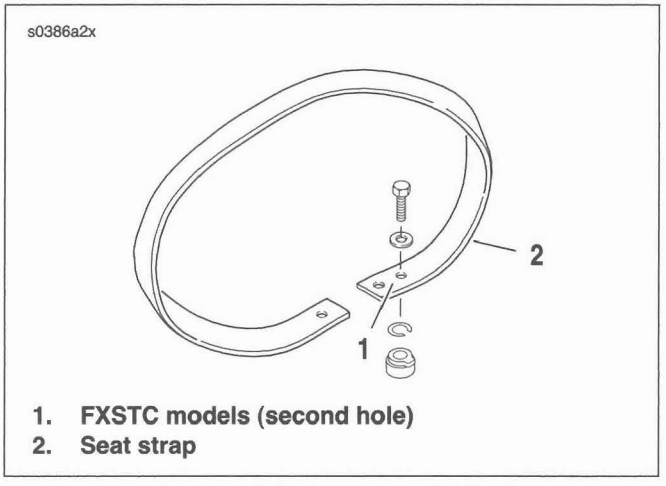
Seat strap installation depends upon model being serviced. Install bolt in appropriate hole according to Figure 2-158.

Seat

⚠WARNING

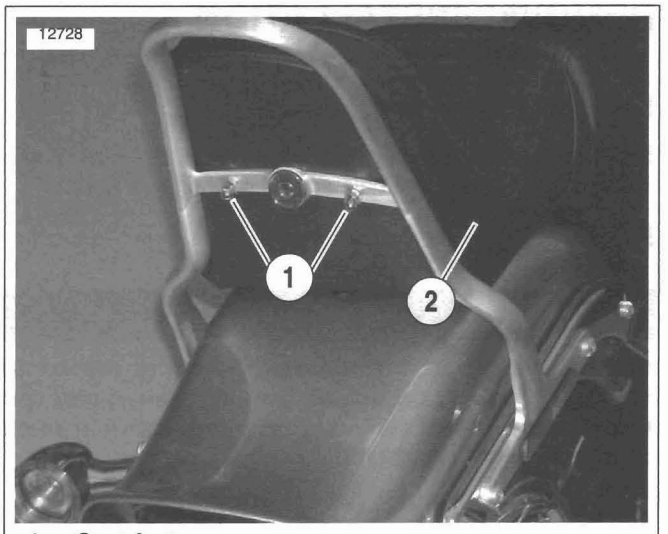
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

See Figure 2-159. Seat (2) attaches with two fasteners (1) through the sissy bar. When installing seat, insert tang at front of seat into the channel in the frame and install rear fasteners through sissy bar. Tighten fasteners to 60-80 in-lbs (6.8-9.0 Nm).



1. FXSTC models (second hole)
2. Seat strap

Figure 2-158. Seat Strap: FXSTC



1. Seat fasteners
2. Seat

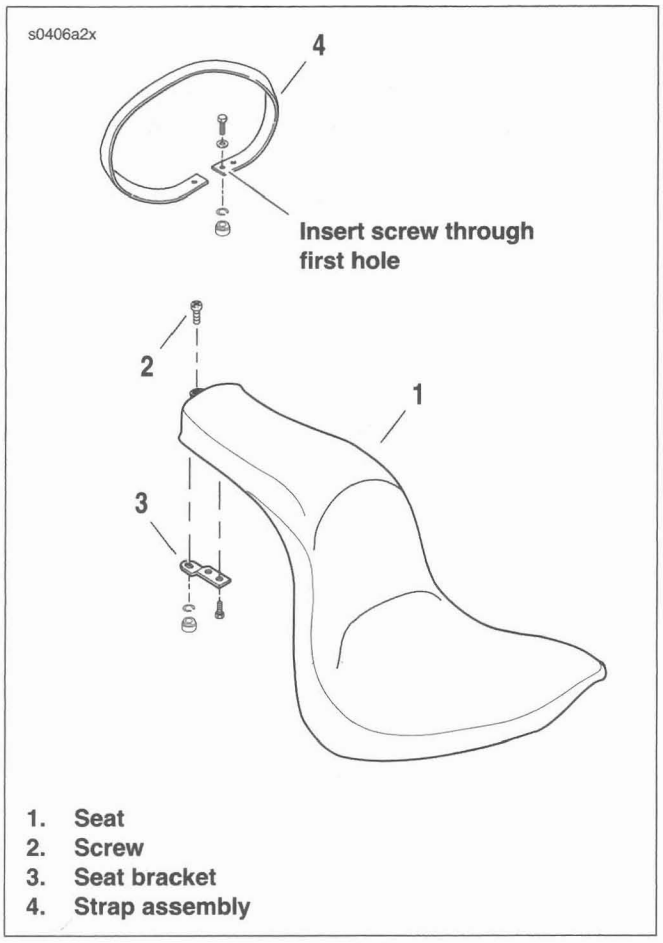
Figure 2-159. Seat: FXSTC

REMOVAL/INSTALLATION

⚠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)

See Figure 2-160. Seat (1) attaches with a single screw (2) through the seat bracket (3). When installing seat, insert tang at front of seat into the channel in the frame and install screw.



1. Seat
2. Screw
3. Seat bracket
4. Strap assembly

Figure 2-160. Seat

REMOVAL/INSTALLATION

⚠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)

See Figure 2-161. The passenger seat attaches with a single screw (1) at the rear and engages the seat mounting fasteners (7) at the front.

To remove seat (8, 9, 10, 11), remove passenger seat (2, 3, 4, 5) and seat mounting fasteners (7). When installing seat, insert tang at front of seat into the channel in the frame and install seat mounting nuts. Install passenger seat.

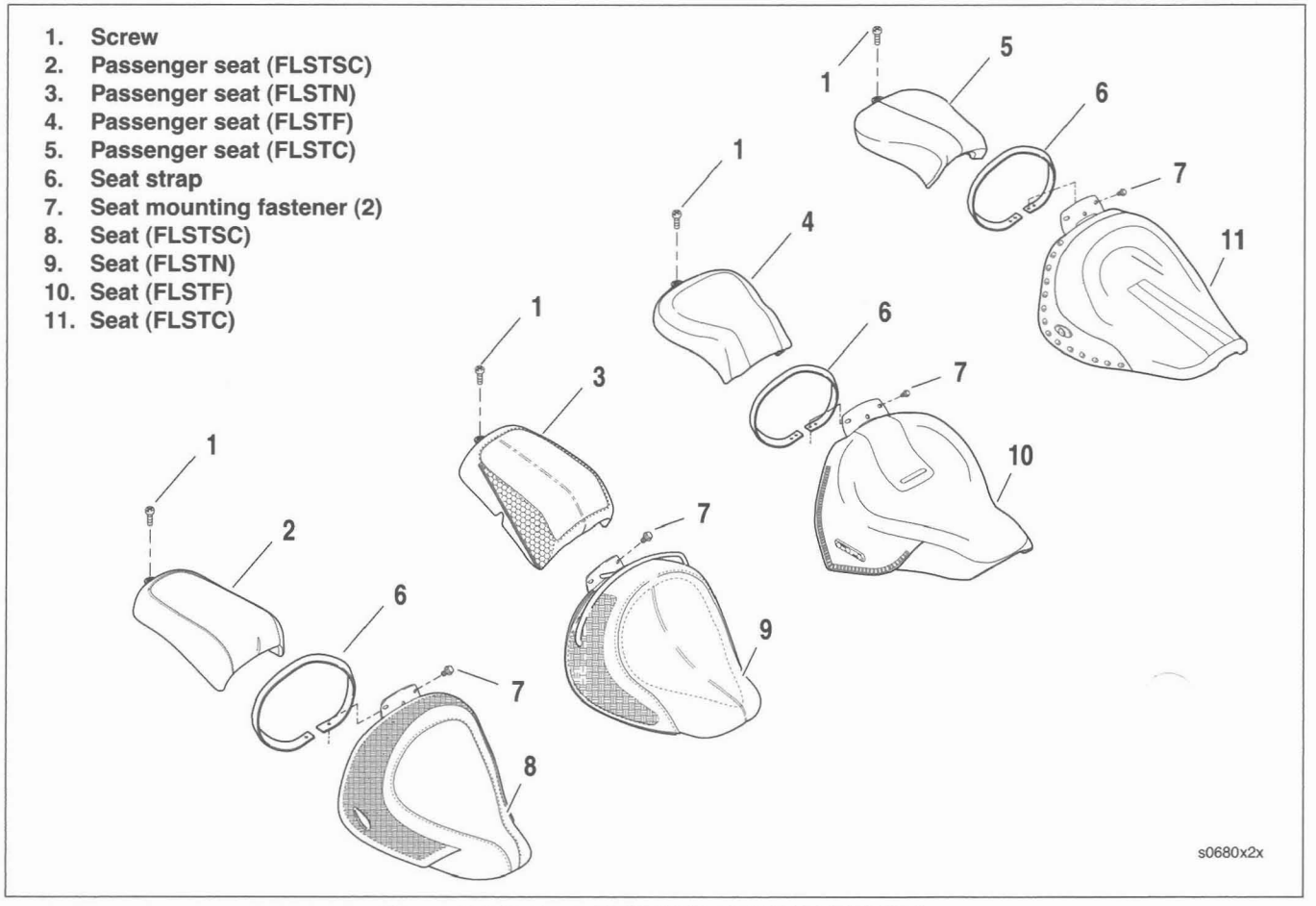
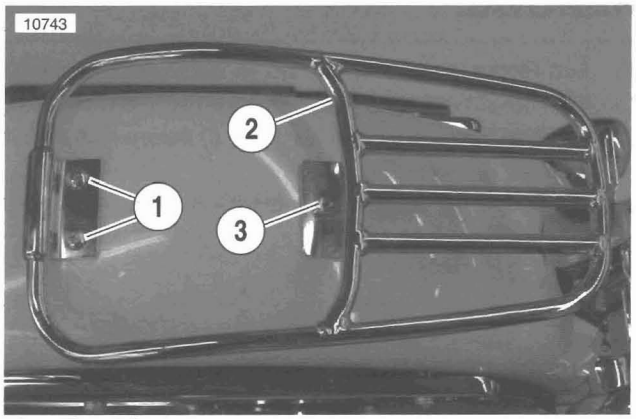


Figure 2-161. Seat: FLSTSC/FLSTN/FLSTF/FLSTC

REMOVAL/INSTALLATION

1. Remove seat. See 2.46 SEAT: FLSTSC/FLSTN/FLSTF/FLSTC.
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.
5. Install rear fastener. Tighten to 12-14 ft-lbs (16.3-19.0 Nm).
6. Tighten front fasteners to 96-120 **in-lbs** (10.8-13.6 Nm).



1. **Front fasteners**
2. **Luggage rack**
3. **Rear fastener**

Figure 2-162. Luggage Rack

REMOVAL

1. See Figure 2-163. Remove acorn nut (7) and washer (8) from lower support.
2. Remove flange nuts and washers (5) from inside saddlebag.
3. 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.*

1. See Figure 2-163. If removed, install studs (4) and tighten nuts (1) behind fender support (2) to 21-27 ft-lbs (28.5-36.6 Nm).
2. Install flange nuts and washers (5) inside saddlebags. Tighten to 120-144 **in-lbs** (13.6-16.3 Nm).
3. Install lower bracket acorn nut (7) and washer (8). Tighten to 120-144 **in-lbs** (13.6-16.3 Nm).

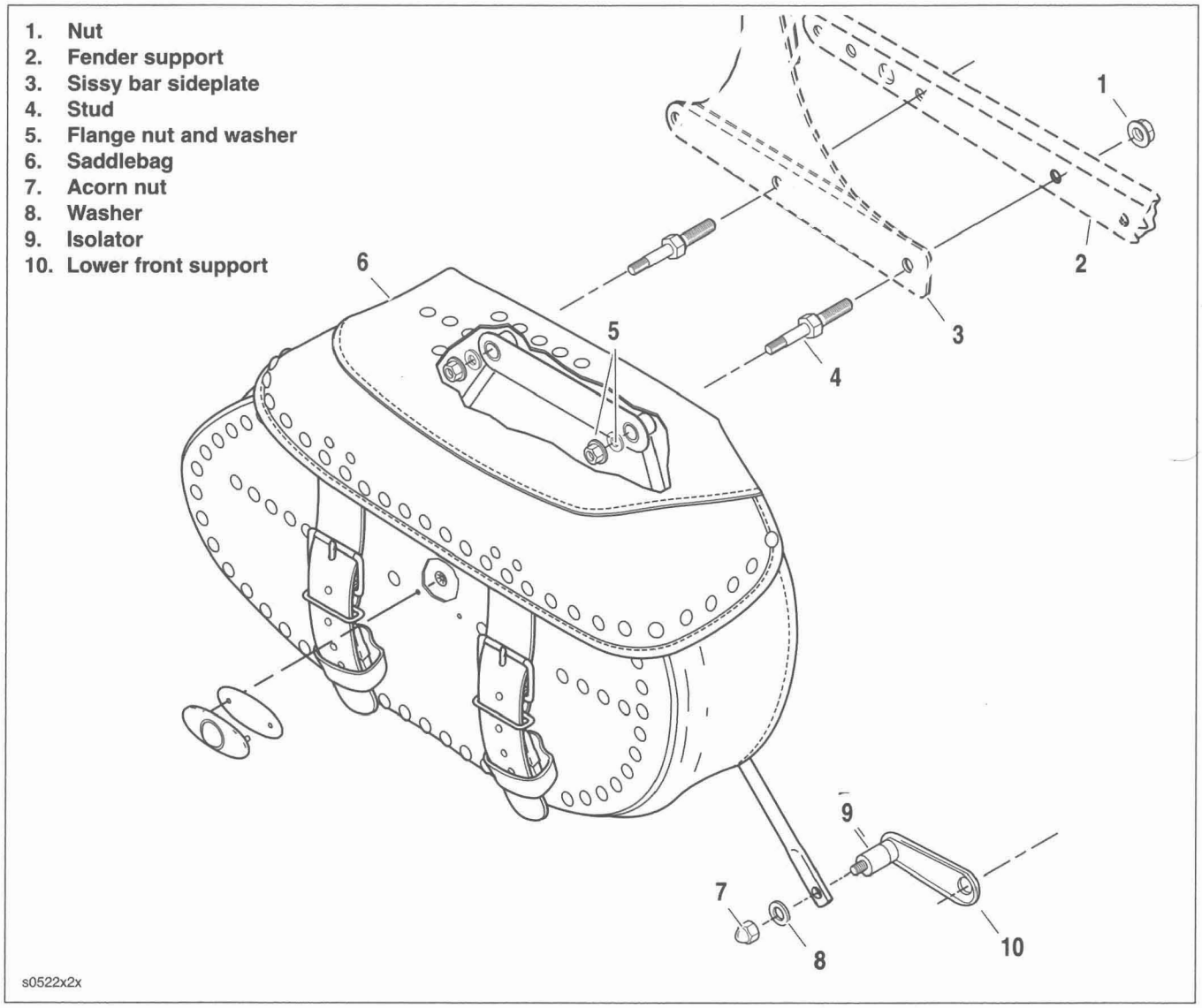


Figure 2-163. Saddlebags: FLSTC

REMOVAL

1. See Figure 2-164. Use a finger to raise the wireform latch springs on each side of the windshield.
2. 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 2-164. 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.
3. 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.

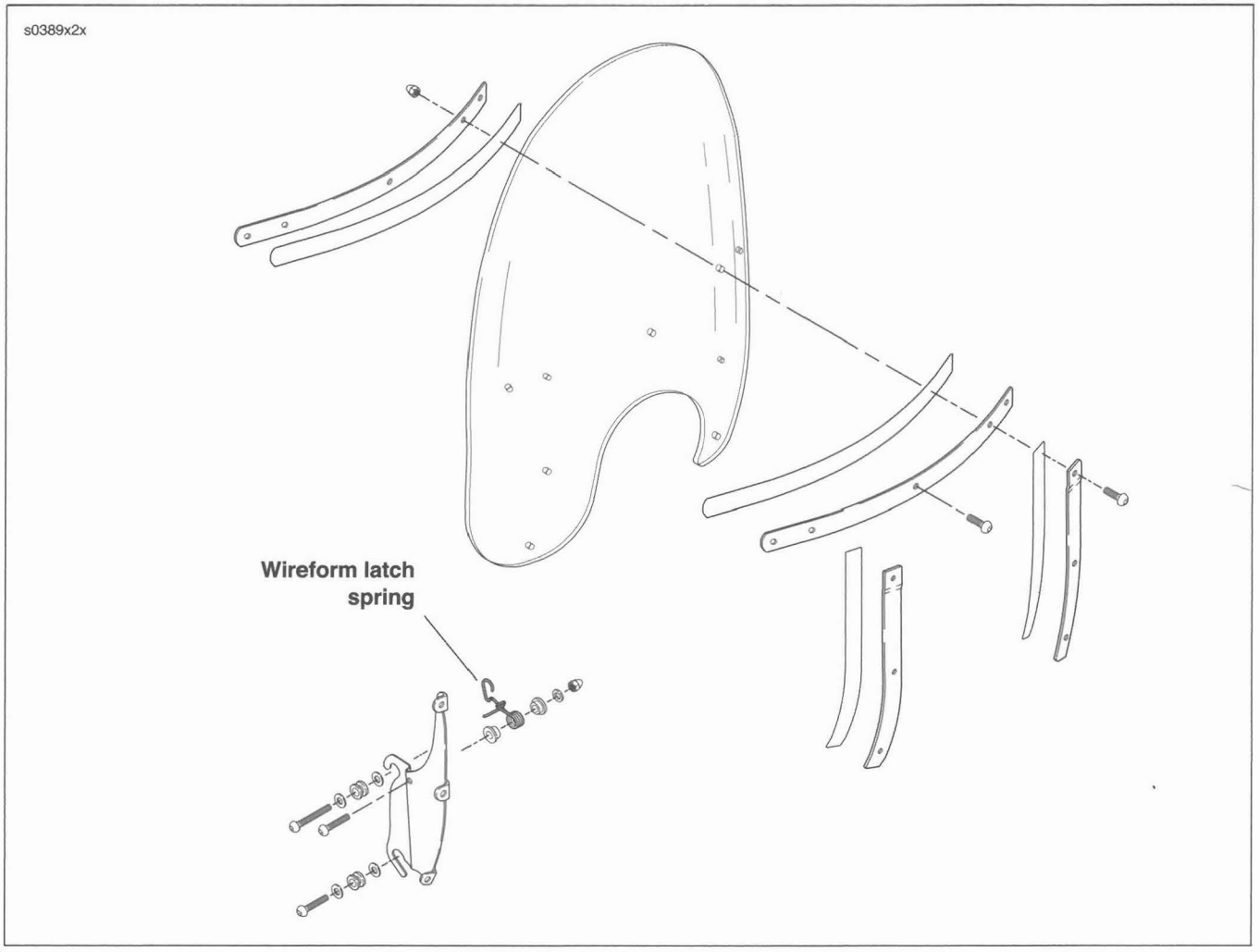


Figure 2-164. Windshield: FLSTC

NOTES

ENGINE 3

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GENERAL	DATA
Number of cylinders	2
Type	4-cycle, 45 degree, air cooled V-twin
Torque (domestic models at crank)	91 ft-lbs @ 3000 RPM
	123 Nm @ 3000 RPM
Bore	3.75 in.
	95.25 mm
Stroke	4.375 in.
	111.13 mm
Piston displacement (approx.)	96 cubic in.
	1584 cc
Maximum sustained engine speed	5500 RPM
Idle speed	1000 RPM +/- 50

OIL PUMP	DATA
Type	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	5 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

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

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 2nd compression ring Oil control ring	 0.010-0.020 0.014-0.024 0.010-0.050	 0.254-0.508 0.356-0.610 0.254-1.27
Ring side clearance: Top compression ring 2nd compression ring Oil control ring	 0.0012-0.0037 0.0012-0.0037 0.0031-0.0091	 0.030-0.094 0.030-0.094 0.079-0.231
Piston pin fit (loose)	0.0002-0.0005	0.005-0.013

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

FLYWHEELS	IN.	MM
Runout (flywheels at rim)	0.000-0.010	0.0-0.254
Runout (shaft at flywheel)	0.000-0.003	0.0-0.076
End play	0.003-0.010	0.076-0.254

CRANKSHAFT/ SPROCKET SHAFT BEARINGS	IN.	MM
Roller bearing fit (loose)	0.0002-0.0015	0.005-0.038
Pinion shaft runout	0.0-0.003	0.0-0.076
Bearing fit in crankcase (tight)	0.0038-0.0054	0.097-0.137
Bearing inner race on crankshaft (tight)	0.0004-0.0014	0.010-0.036

ENGINE TORQUE VALUES 3.2

ITEM	TORQUE		NOTES
Balance shaft bearing fastener	40-70 **in-lbs**	4.5-7.9 Nm	page 3-116
Balancer chain sprocket bolts	42-47 ft-lbs	56.9-63.7 Nm	replace if possible, use LOCTITE THREADLOCKER 271 (red) otherwise, page 3-54
Balancer shaft housing screws	18-22 ft-lbs	24.4-29.8 Nm	T40 TORX, LOCTITE THREADLOCKER 262 (red), special sequence to tighten, page 3-53
Breather cover bolts	90-120 **in-lbs**	10.2-13.6 Nm	page 3-43
Cam chain tensioner fasteners	100-120 **in-lbs**	11.3-13.6 Nm	page 3-63, page 3-102
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 3-60
Crank sprocket bolt	See NOTES	See NOTES	Special method to tighten, replace if possible. Apply several drops of LOCTITE THREADLOCKER 262 (red) to last few threads. page 3-63
Crankcase bolts	15-19 ft-lbs	20.3-25.8 Nm	special pattern to tighten, page 3-57
Crankcase pipe plug	120-144 **in-lbs**	13.6-16.3 Nm	LOCTITE PIPE SEALANT 565, page 3-113
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 3-113
Engine mounting bolts, front	70-80 ft-lbs	94.9-108.5 Nm	page 3-25
Engine/transmission bracket bolts	30-35 ft-lbs	40.7-47.5 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 3-113
Oil pump screws, final torque	90-120 **in-lbs**	10.2-13.6 Nm	Special tools and pattern to tighten, page 3-60
Piston jet screws	25-35 **in-lbs**	2.8-4.0 Nm	replace if possible, use LOCTITE THREADLOCKER 222 (purple) otherwise, page 3-110
Pivot shaft nut	90-110 ft-lbs	122-149.1 Nm	page 3-25
Rear cam sprocket bolt	See NOTES	See NOTES	Special method to tighten. Replace if possible. Apply several drops of LOCTITE THREADLOCKER 262 (red) to last few threads. page 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 pattern to tighten, page 3-43
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.

ROCKER ARMS	REPLACE IF WEAR EXCEEDS	
	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

HYDRAULIC LIFTERS	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Fit in crankcase	0.003	0.076
Roller fit	0.0015	0.038
Roller end clearance	0.015	0.38

CAM SUPPORT PLATE	REPLACE IF	
	IN.	MM
Cam chain tensioner shoe	More than 0.090	More than 2.29
	1/2 thickness of shoe	
Crankshaft bushing maximum ID	More than 0.8545	More than 21.704
Camshaft bore in plate	More than 1.10225	27.997

CYLINDER HEADS	REPLACE IF	
	IN.	MM
Valve guide in head (tight)	Less than 0.002	Less than 0.051
Valve seat in head (tight)	Less than 0.002	Less than 0.051
Head warpage	More than 0.006	More than 0.15

CYLINDERS	REPLACE IF WEAR EXCEEDS	
	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

PISTONS		REPLACE IF WEAR EXCEEDS	
		IN.	MM
Fit in cylinder (loose)		0.003	0.076
Piston pin fit (loose)		0.0008	0.020
Ring end gap	Top compression	0.030	0.76
	2nd compression	0.034	0.86
	Oil control rails	0.050	1.27
Ring side clearance	Top compression	0.0045	0.11
	2nd compression	0.0045	0.11
	Oil control rails	0.010	0.25

BALANCE CHAIN GUIDES	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Front and rear	0.090	2.29
	1/2 thickness of guide	
Lower	0.090	2.29
	1/2 thickness of guide	

BREATHER ASSEMBLY	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Breather Cover Warpage	0.005	0.13
Breather Baffle Warpage	0.005	0.13

VALVE STEM TO GUIDE	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Intake	0.0038	0.0965
Exhaust	0.0038	0.0965

CONNECTING RODS	REPLACE IF WEAR EXCEEDS	
	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

FLYWHEELS	REPLACE IF WEAR EXCEEDS	
	IN.	MM
Runout (flywheels at rim)	0.015	0.381
Runout (shaft at flywheel)	0.010	0.254
End play	0.010	0.254

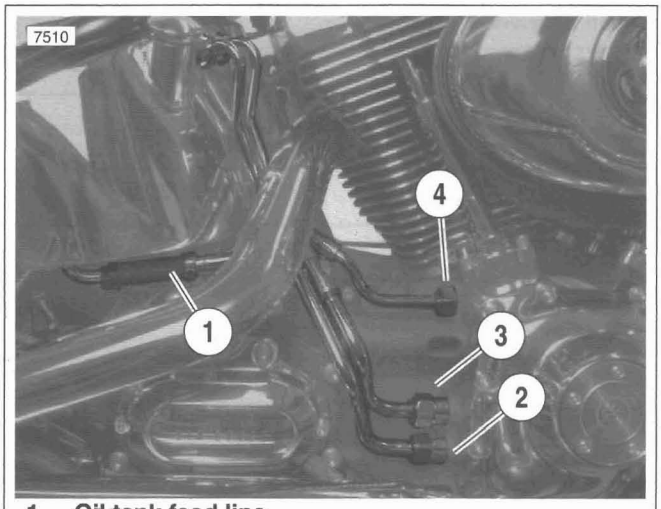
CRANKSHAFT ROLLER BEARING	REPLACE IF	
	IN.	MM
Roller bearing fit (loose)	More than 0.0015	More than 0.038
Crankshaft runout	More than 0.010	More than 0.254
Bearing fit in crankcase (tight)	Less than 0.0038	Less than 0.097
Inner race on crankshaft (tight)	Less than 0.0004	Less than 0.010

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.



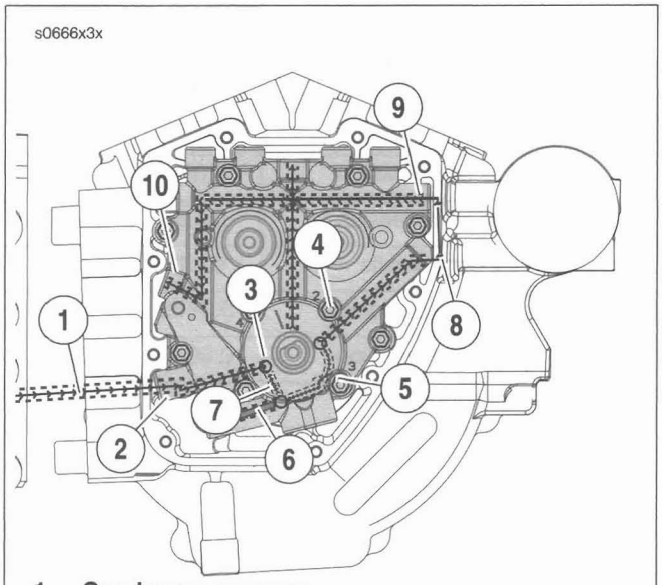
1. Oil tank feed line
2. Feed connection on engine
3. Return line
4. Vent line

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 OPERATION. 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.



1. Crankcase passage
2. Cam support plate/crankcase connection
3. Feed side of oil pump
4. Oil pump output
5. Overflow passage
6. Pressure relief valve
7. Bypass passage
8. Oil pressure sending unit
9. Return from oil filter into cam support plate
10. Feed to chain guide bracket

Figure 3-2. Cam Support Plate Oil Flow

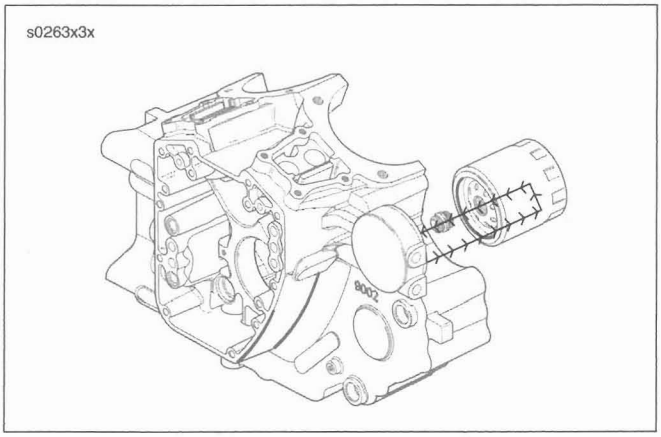


Figure 3-3. Oil Filter Flow

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 slots in each pin boss (O30) for lubrication of the piston pin.

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).

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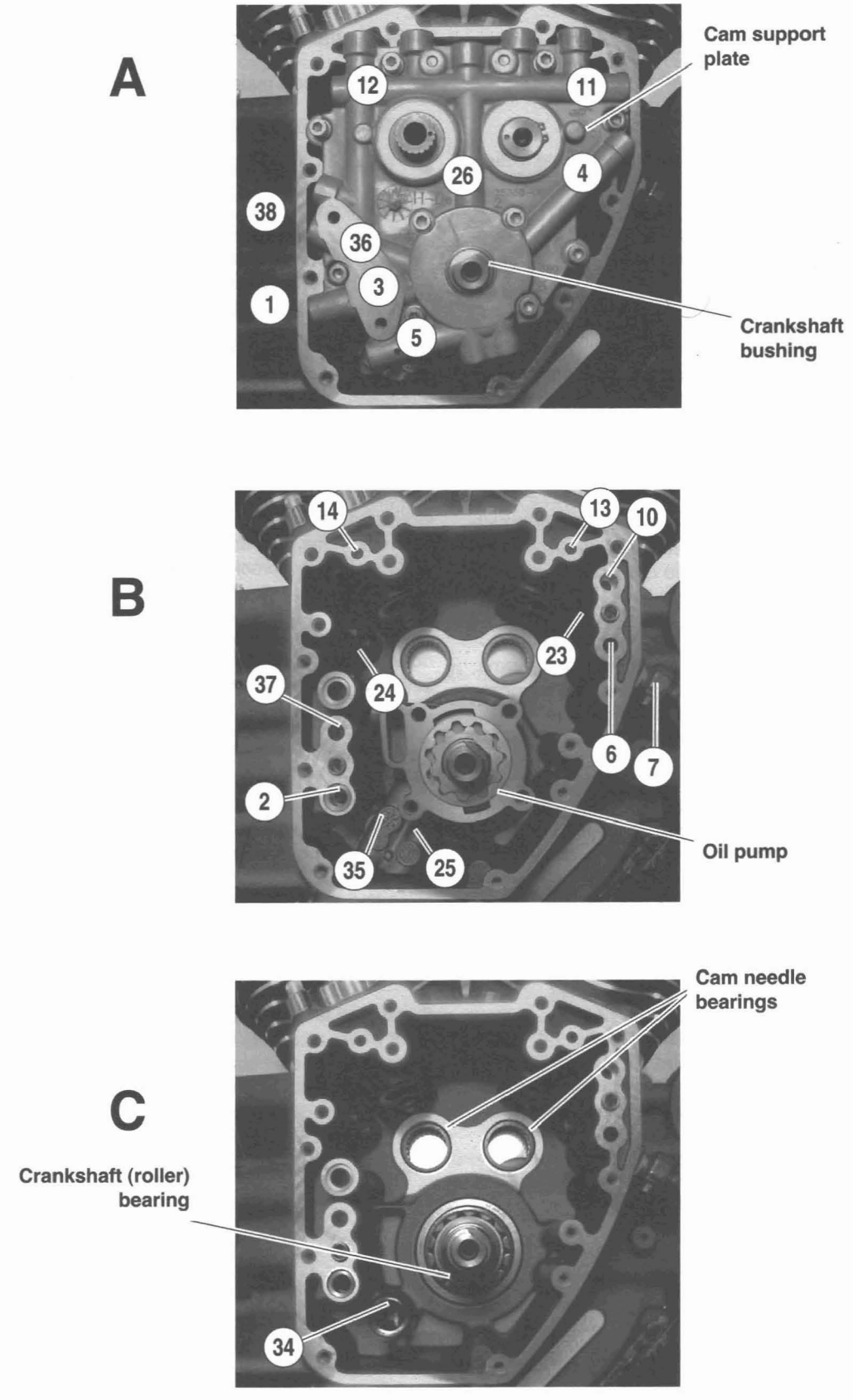


Figure 3-4. Engine Oil Flow: Cam Support Plate/Right Crankcase Half

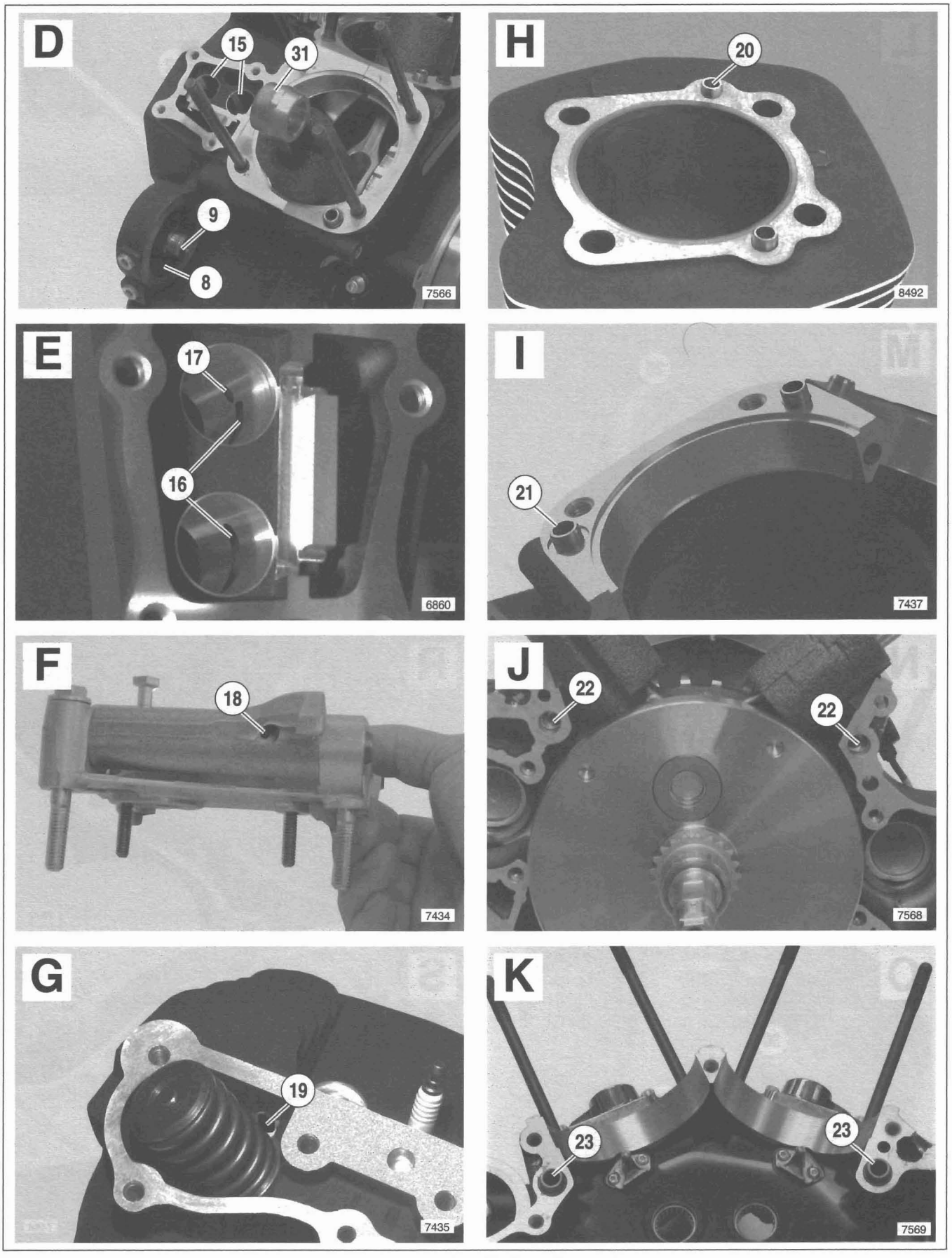


Figure 3-5. Engine Oil Flow: Top End

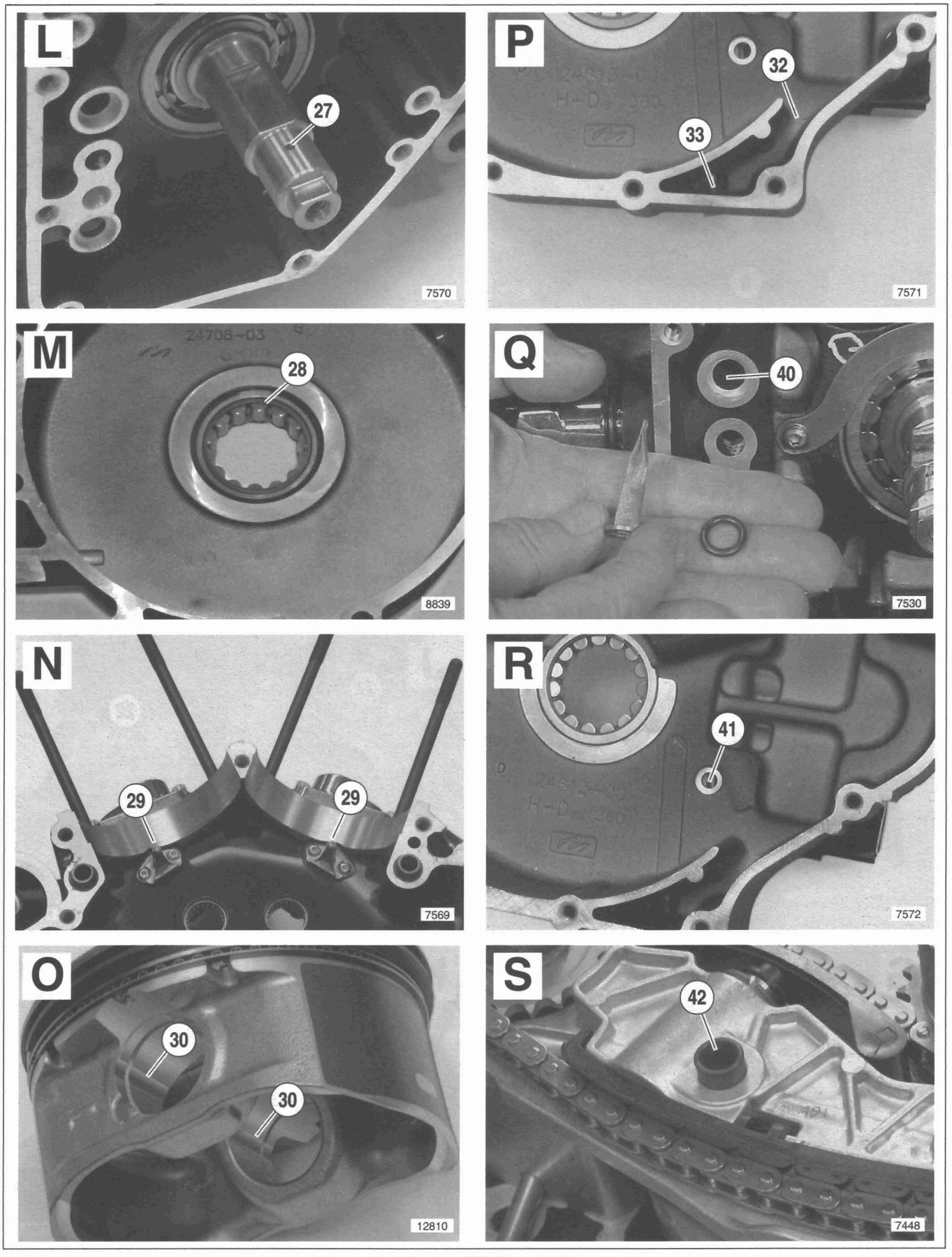


Figure 3-6. Engine Oil Flow: Bottom End

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.

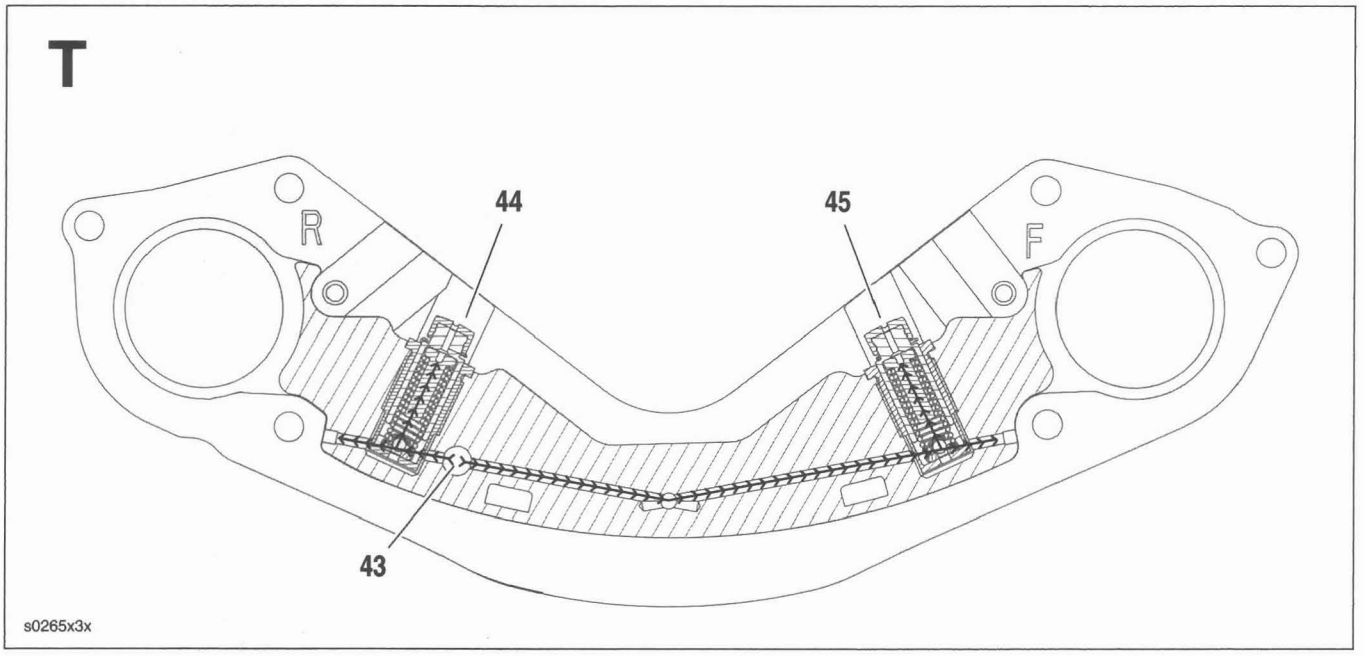


Figure 3-7. Engine Oil Flow: Chain Guide Bracket

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.

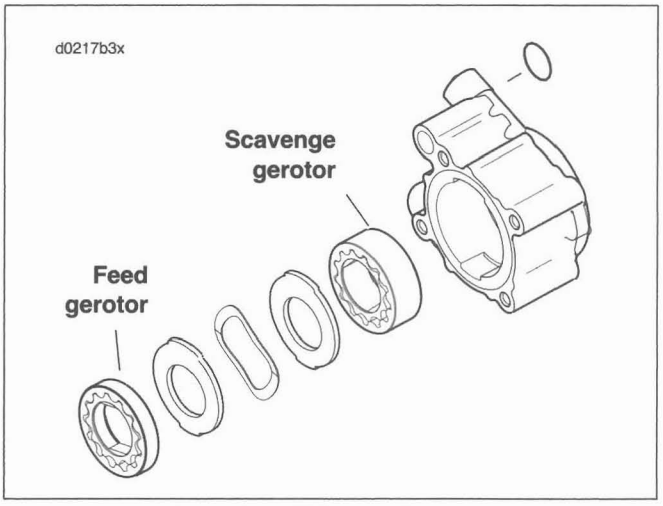


Figure 3-8. Oil Pump Gerotors

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.

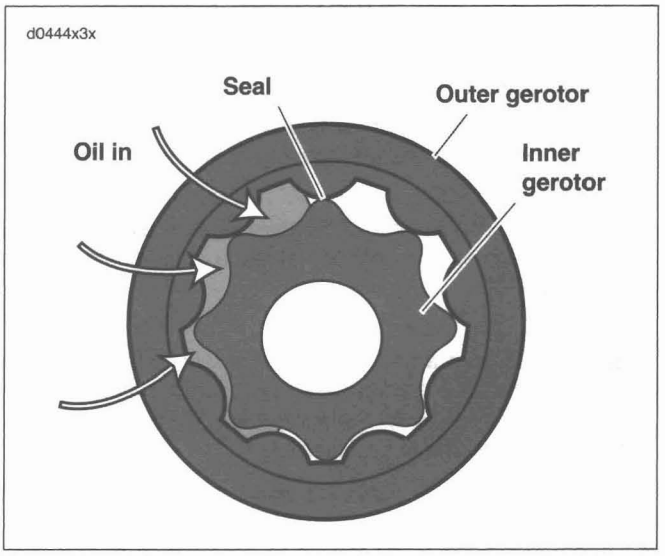


Figure 3-9. Inlet Side Oil Flow

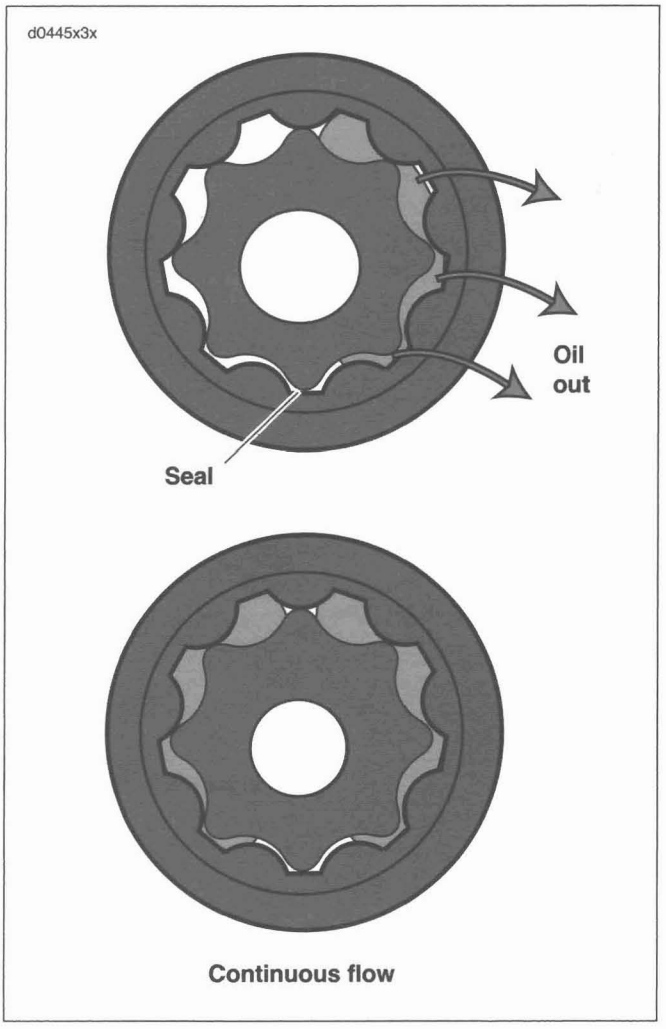


Figure 3-10. Outlet Side Oil Flow

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.

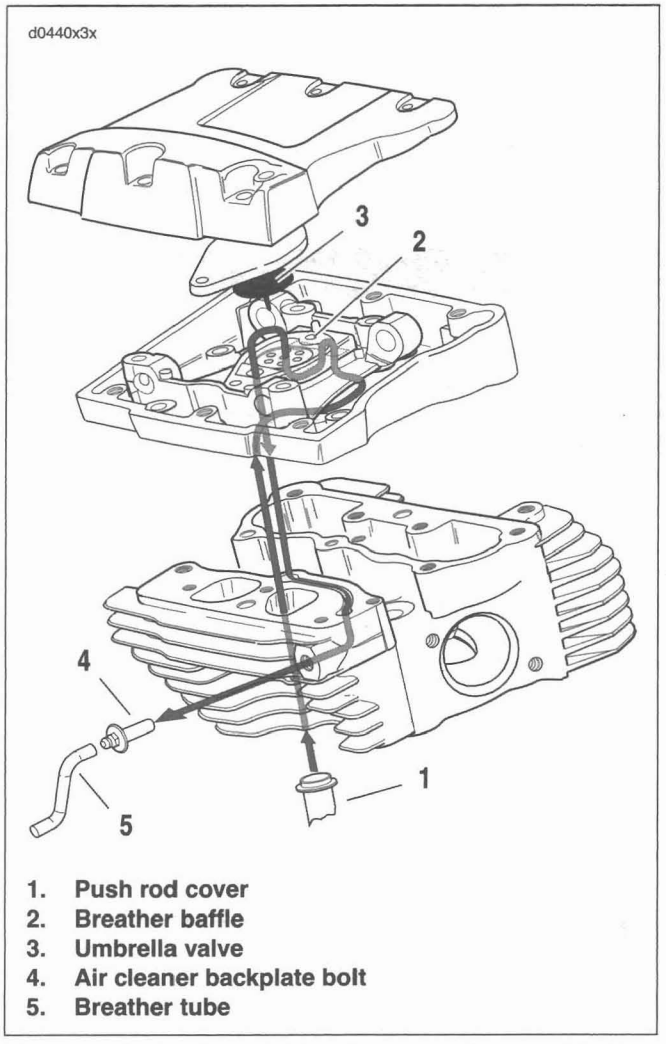
Passing through the oil filter gauze, the flow of air passes through the umbrella valve (3) into the breather compartment. The flaps of the umbrella valve only allow air to be vented one way, rising to allow the passage of air, but then falling back into place to seal the vent holes as the flow of air 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.



1. **Push rod cover**
2. **Breather baffle**
3. **Umbrella valve**
4. **Air cleaner backplate bolt**
5. **Breather tube**

Figure 3-11. Breather Air Flow (breather disassembled for 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.

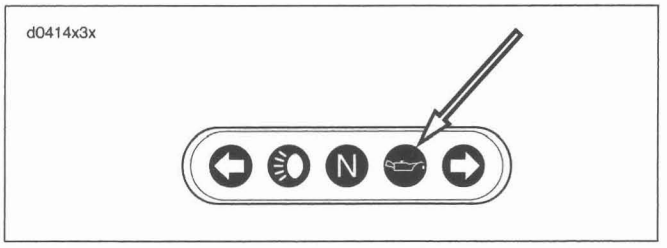


Figure 3-12. Oil Pressure Indicator Lamp

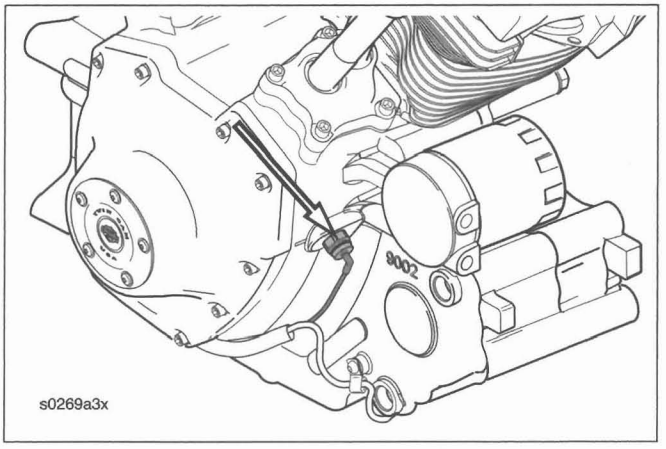


Figure 3-13. Oil Pressure Switch

CHECKING OIL PRESSURE

PART NO.	SPECIALTY TOOL
HD-96921-52B	Oil pressure gauge
HD-96921-110	Oil pressure gauge adapter

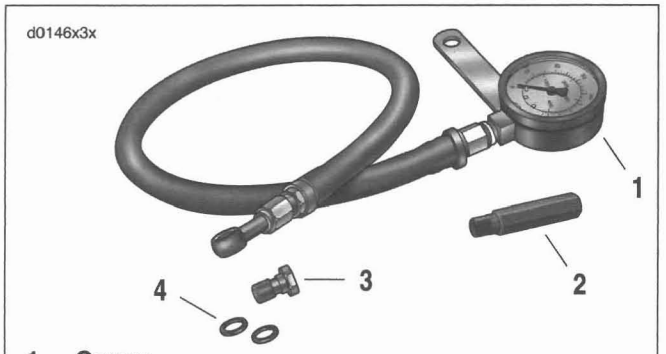
Check operating oil pressure as follows:

1. Fill oil tank to proper level. See 1.4 ENGINE OIL AND FILTER.
2. See Figure 3-13. Remove oil pressure switch from crankcase. See 8.33 OIL PRESSURE SWITCH.
3. See Figure 3-14. Install adapter (2) in oil pressure switch mounting hole. Tighten adapter until snug.
4. 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.
7. Stop engine. Remove oil pressure gauge assembly from oil pressure switch mounting hole in crankcase.
8. Reinstall oil pressure switch. See 8.33 OIL PRESSURE SWITCH.



1. **Gauge**
2. **Adapter**
3. **Banjo bolt**
4. **Washers (2)**

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 1.29 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.

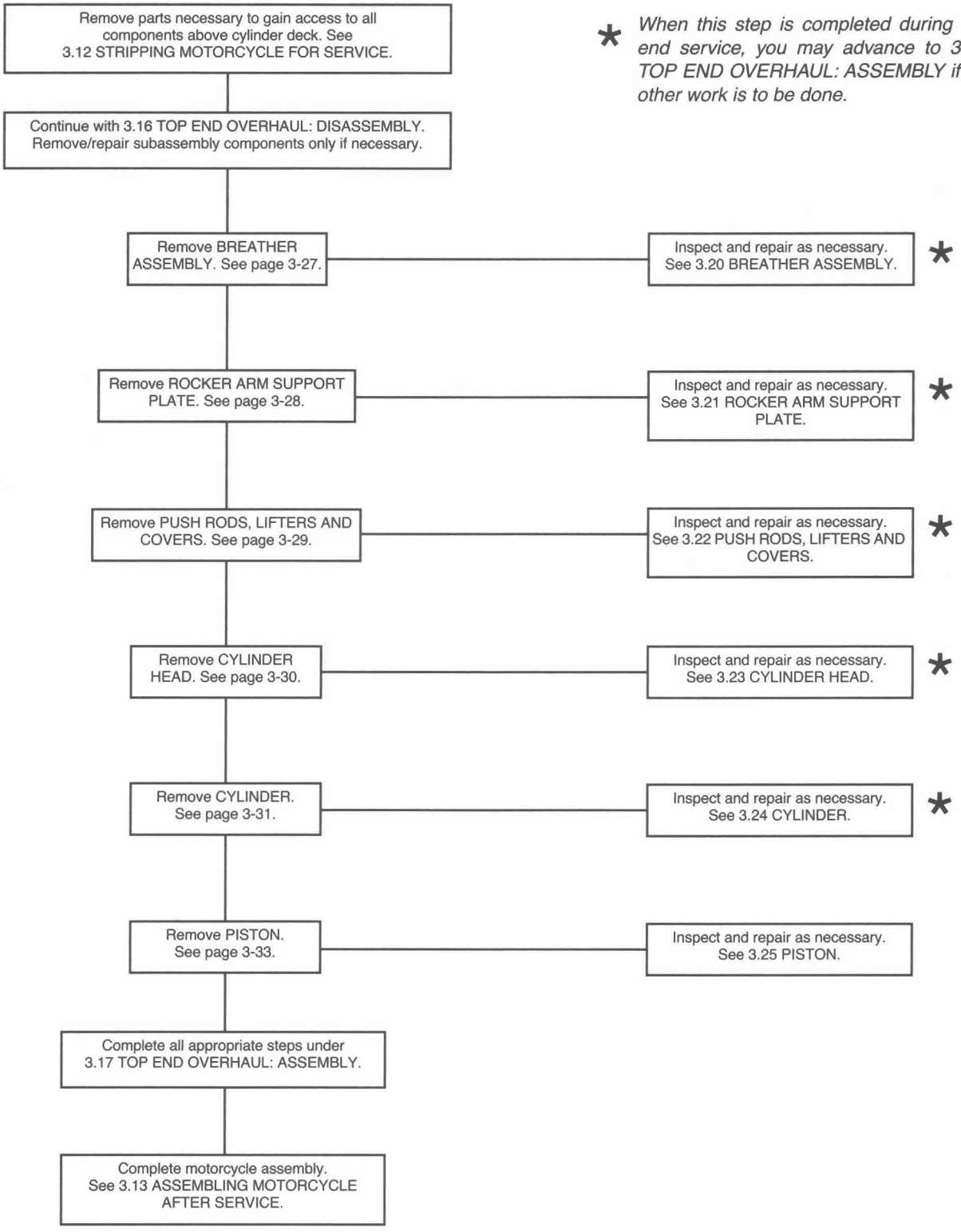
Certain "knocking" noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both out of tolerance, allowing the piston to slap from front to rear of the cylinder as it moves up and down.

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.

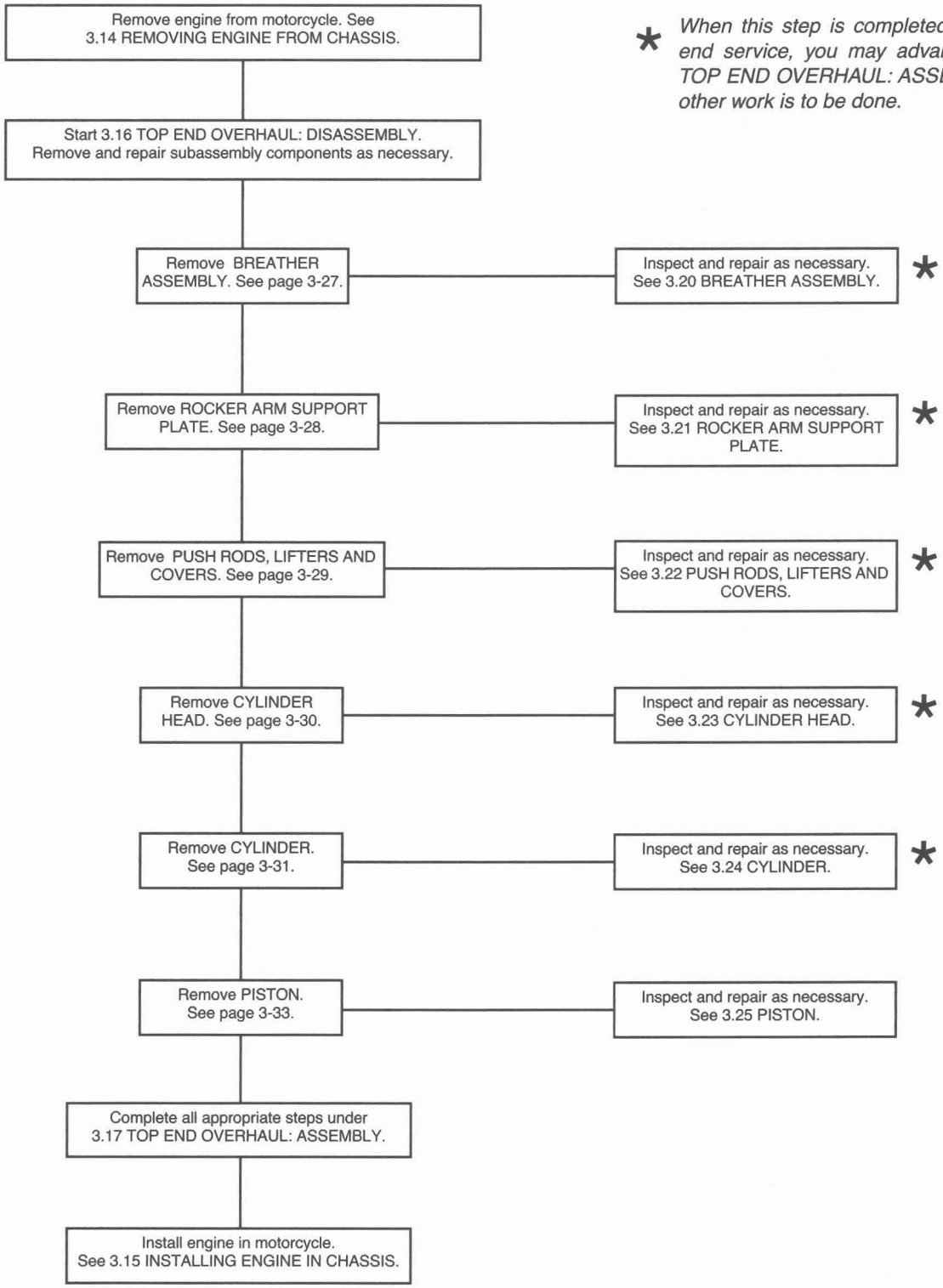
NOTE

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.

ENGINE IN CHASSIS

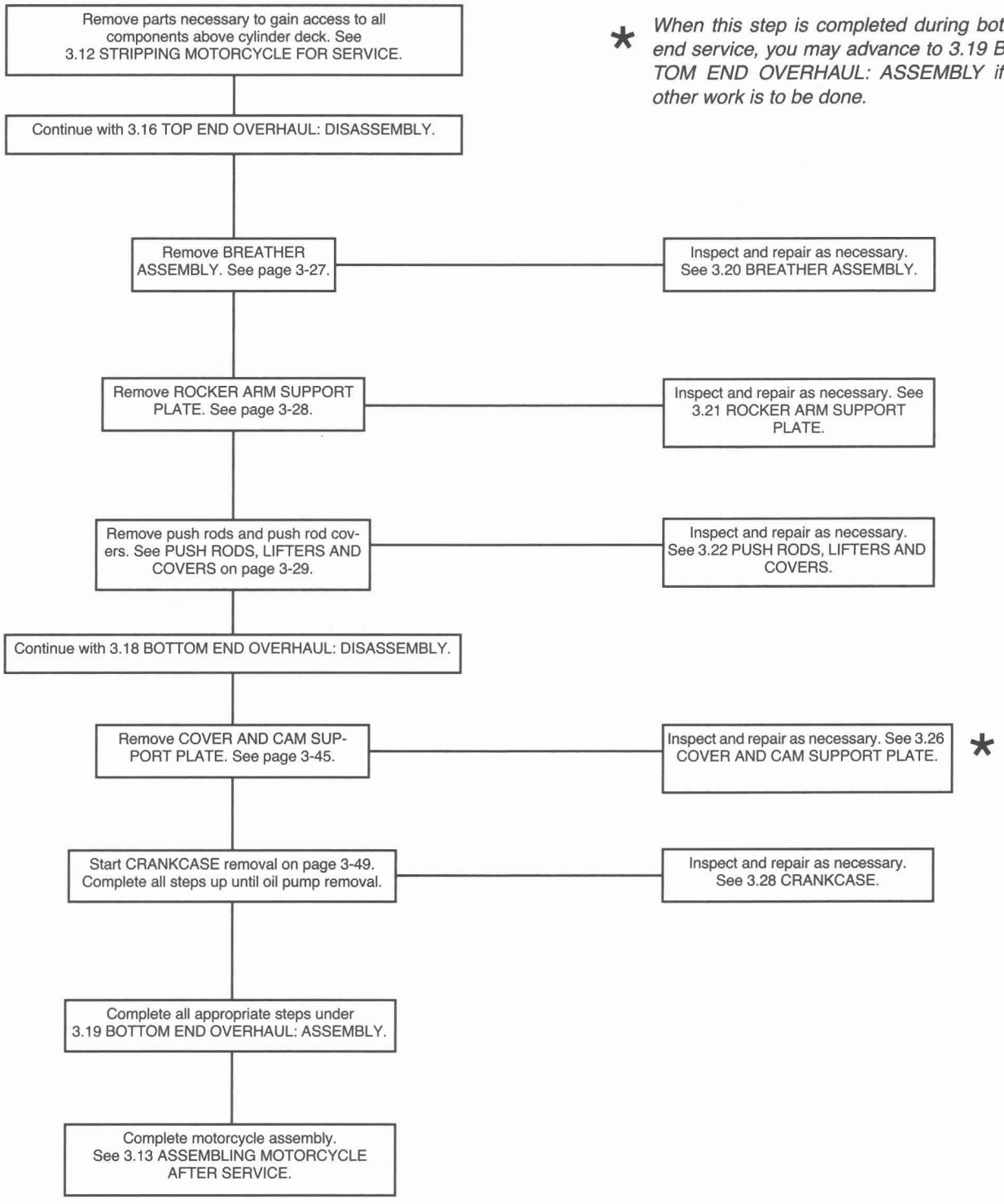


ENGINE REMOVED FROM CHASSIS

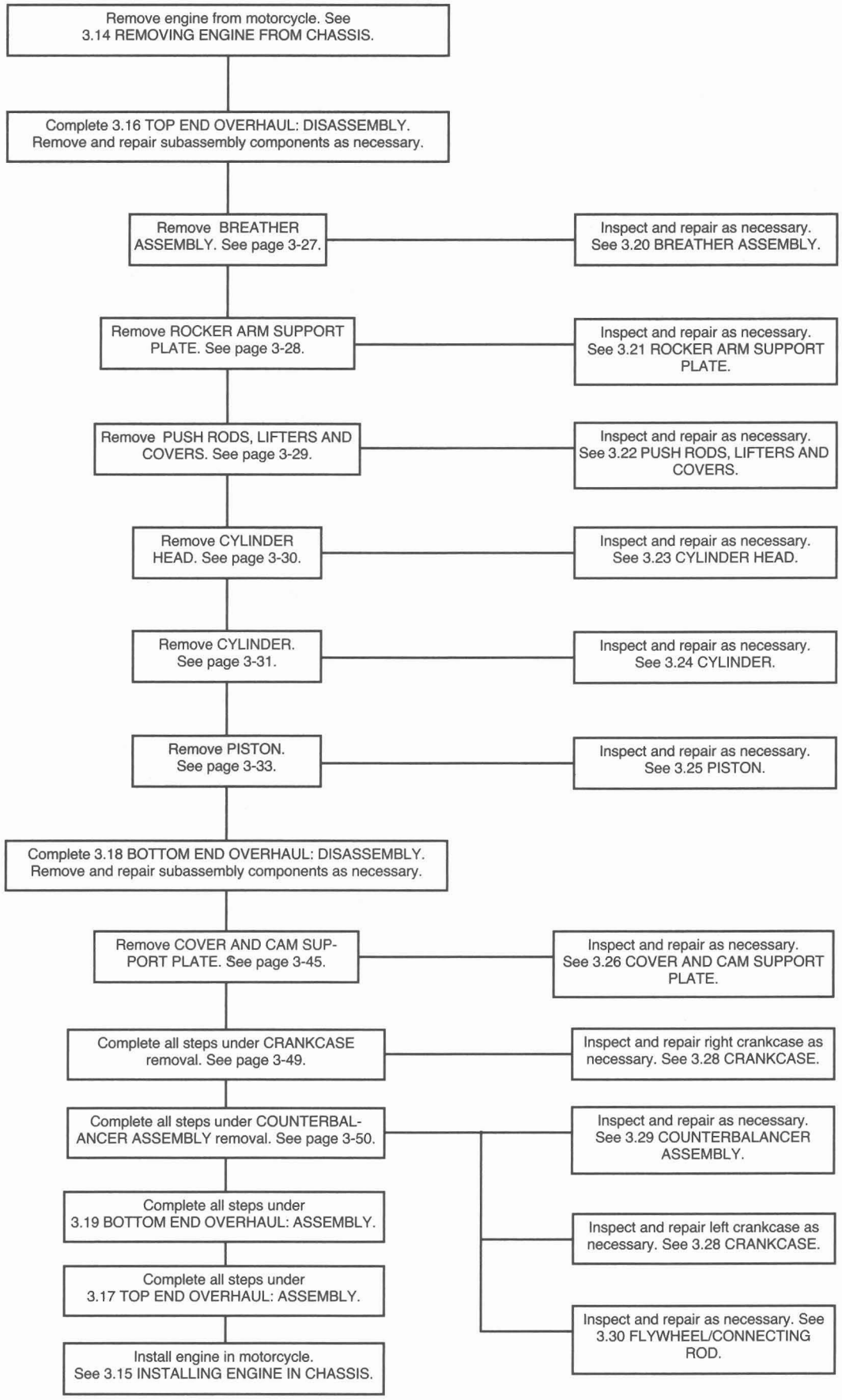


* *When this step is completed during top end service, you may advance to 3.17 TOP END OVERHAUL: ASSEMBLY if no other work is to be done.*

ENGINE IN CHASSIS: CAM COMPARTMENT SERVICE



ENGINE REMOVED: FLYWHEEL COMPARTMENT SERVICE OR COMPLETE ENGINE OVERHAUL



CYLINDER LEAKAGE TEST

NOTE

This procedure should not be used on vehicles with an automatic compression release.

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.
4. The piston in the cylinder being tested must be at top dead center of compression stroke (both valves closed) during the test.
5. 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.

6. 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.
7. Listen for air leaks at throttle body intake, exhaust pipe, and head gasket. Air escaping through the throttle body indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve.

NOTE

If air is escaping through valves, 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.
5. Cylinder head casting's porosity allowing oil to drain into combustion chamber.
6. O-ring damaged or missing from oil pump/crankcase junction.

PROCEDURE

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.

⚠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.
4. Drain engine oil. See 1.4 ENGINE OIL AND FILTER.
5. Remove right floorboard.
6. Remove heat shields and exhaust. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
7. Remove air cleaner cover and backplate. See 4.4 AIR CLEANER.

⚠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)

8. Drain fuel tank. See 4.5 FUEL TANK.
9. Disconnect fuel gauge connector. Remove fuel tank and instrument console. See 4.5 FUEL TANK.
10. Loosen and remove throttle control cables from induction module.
11. Remove spark plug cables from spark plugs. Remove spark plugs to avoid damaging them.
12. Remove bolts from top engine mount and frame. Remove top engine mount and horn bracket as an assembly.
13. Remove induction module connectors and induction module. See 4.9 INDUCTION MODULE.

PROCEDURE

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.

1. Install induction module. See 4.9 INDUCTION MODULE. Install induction module connectors.
2. Install horn bracket assembly to frame tab and cylinder heads.
   a. Tighten two cylinder head bracket bolts to 35-40 ft-lbs (47.5-54.2 Nm).
   b. Tighten the upper engine to frame mounting bolt to 45-50 ft-lbs (61.0-67.8 Nm).
3. Install spark plugs to cylinder heads. Connect spark plug cables to spark plugs. See 1.21 SPARK PLUGS.
4. Install throttle cables to induction module.
5. Connect fuel hose to fuel tank.
6. Install instrument console, fuel tank, fuel gauge connector, and fuel tank crossover tube. See 4.5 FUEL TANK.
7. Fill fuel tank with fuel.
8. Install backplate and air cleaner cover. See 4.4 AIR CLEANER.
9. Install heat shields and exhaust. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
10. Install right floorboard.
11. Fill engine oil to proper level. See 1.4 ENGINE OIL AND FILTER.
12. 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)

13. Install seat.
14. Remove motorcycle from lift.

PROCEDURE

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.
4. Disconnect rear oxygen sensor connector underneath oil tank.
5. Drain primary chaincase and oil tank. See 1.4 ENGINE OIL AND FILTER and 1.11 PRIMARY CHAINCASE LUBRICANT.

⚠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)

6. Drain fuel tank. See 4.5 FUEL TANK.
7. Remove instrument panel and fuel tank. See 4.5 FUEL TANK.
8. Remove left and right floorboards.
9. Remove front electrical caddy See 8.14 FRONT ELECTRICAL CADDY.
10. Remove heat shields and exhaust. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
11. Remove two bolts from the bottom of slash guard. Lift the splash guard off the mounting tab at the top of the frame.
12. Loosen, but do not remove, front bolt from slotted hole on lower belt guard. Remove belt guard and loosen rear axle.
13. Unplug TSM/TSSM/HFSM connector.
14. If installed, unplug siren connector.
15. Remove the two bolts at the top of the electrical panel. Remove electrical panel.
16. Remove oil lines from crankcase and oil tank. Remove oil tank. See 3.31 OIL TANK.
17. Remove starter. See 5.4 STARTER.
18. Unplug the vehicle speed sensor (VSS).
19. Remove primary chaincase cover and primary chaincase. See 6.2 PRIMARY CHAINCASE.
20. Remove upper and lower fasteners from seat post. Disconnect coil connector and remove the post with the coil attached.
21. Position a jack with a wooden block under the engine. Remove the shift arm.
22. Remove the bracket (right side) connecting the frame to the transmission case.
23. Remove the four fasteners connecting the engine to the transmission.
24. 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.
25. Remove hose bracket from the rear of the transmission. On California models, remove the three hoses from the evaporative emissions canister.
26. Remove the pivot shaft. Disconnect neutral switch wires and slide the transmission back and then out the right side.
27. Remove bolts from horn bracket and cylinder heads. Remove bracket as an assembly. Disconnect horn wire.
28. Remove induction module connectors. Remove air cleaner cover and backplate. See 4.4 AIR CLEANER. Disconnect throttle cables.
29. Detach oil pressure sending unit connector.
30. Remove two bolts on front engine mount. Lift engine out from right side of frame.

PROCEDURE

1. Using a suitable hoist, position engine in chassis from the right side.
2. 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.
3. 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.
4. Attach throttle cables. Adjust throttle cables. Connect fuel hose to fuel tank.
5. Install air cleaner backplate and cover. See 4.4 AIR CLEANER.
6. Install front electrical caddy See 8.14 FRONT ELECTRICAL CADDY.
7. Move the panel into position and tighten the two upper bolts. Verify that all wiring is in place and not twisted or kinked.
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 34-39 ft-lbs (46.1-52.9 Nm).
9. Apply LOCTITE ANTI-SEIZE to pivot shaft. From the right side, install pivot shaft and spacers with spacer collars facing transmission case.
10. 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).
11. Apply LOCTITE THREADLOCKER 262 (red) to both front mounting bolts. Tighten bolts to 70-80 ft-lbs (94.9-108.5 Nm).
12. 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.
   a. Tighten two cylinder head bracket bolts to 35-40 ft-lbs (47.5-54.2 Nm).
   b. Tighten the upper engine to frame mounting bolt to 45-50 ft-lbs (61.0-67.8 Nm).

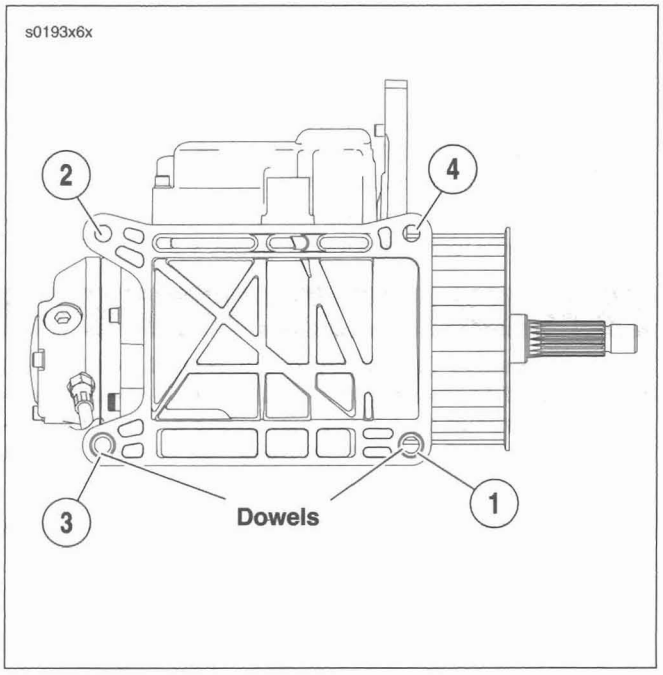


Figure 3-15. Transmission Case Hardware

14. Attach vapor valve bracket to rear of transmission case. On California models, see 4.21 EVAPORATIVE EMISSIONS 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.

15. 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.
16. Install the left floorboard.
17. Install the seat post. Connect the coil connector and the neutral switch wires.
18. Connect vehicle speed sensor to transmission.
19. Remove Starter. See 5.4 STARTER.
20. Install oil tank and connect all oil lines. See 3.31 OIL TANK.

21. Raise the rear of the motorcycle and install splash guard. Splash guard uses two bolts at the bottom and fits over a frame tab at the top.
22. Install belt guard.
23. Tighten axle nut.
24. Install heat shields, exhaust and right floorboard. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
25. Install instrument console, fuel tank, fuel gauge connector, and fuel tank crossover tube. See 4.5 FUEL TANK.

⚠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)

26. 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)

27. Install seat.
28. Install **new** oil filter and fill oil tank to proper level. See 1.4 ENGINE OIL AND FILTER.
29. Remove motorcycle from lift.
30. Verify vehicle alignment. See 2.14 VEHICLE ALIGNMENT.
31. Check rear belt deflection and alignment. See 1.14 REAR BELT DEFLECTION.
32. Check rear brakes, clutch and throttle for proper operation.
33. Check oil level after running motorcycle on side stand. See 1.4 ENGINE OIL AND FILTER.

GENERAL

To perform a complete top end overhaul, follow all steps listed in this section including inspection and repair procedures.

BREATHER ASSEMBLY

CAUTION

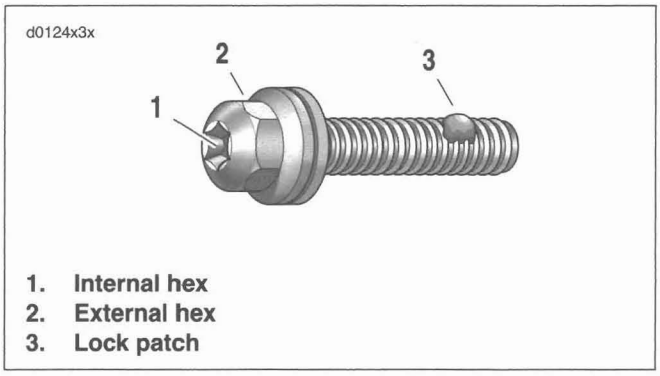
Dirt caked on cooling fins and other areas can fall into crankcase bore or stick to subassemblies as parts are removed. Abrasive particles can damage machined surfaces or plug oil passageways. Remove all dirt and particles before disassembly to prevent component damage.

1. Use low pressure spray to thoroughly clean exterior surfaces of engine prior to disassembly.

NOTE

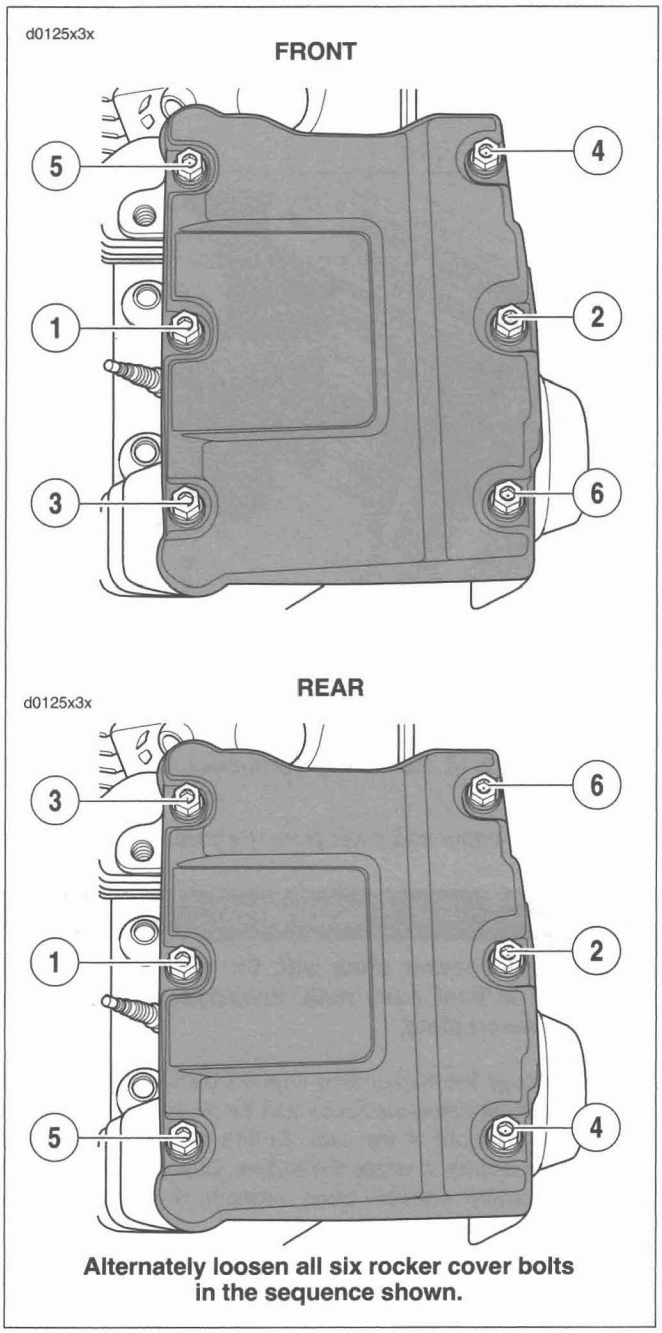
- *See Figure 3-16. If the engine is left in the chassis for service, use the ROCKER COVER WRENCH (HD-47258) and ROCKER HOUSING WRENCH (HD-47248) to remove the rocker cover and rocker housing bolts, respectively. These tools are especially useful when removing the bolts on the left side of the engine (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.*

2. 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.
4. 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.



1. **Internal hex**
2. **External hex**
3. **Lock patch**

Figure 3-16. Rocker Cover Bolt (Rocker Housing Bolt Similar)



Alternately loosen all six rocker cover bolts in the sequence shown.

Figure 3-17. Rocker Cover Bolt Removal

ROCKER ARM SUPPORT PLATE

1. 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.

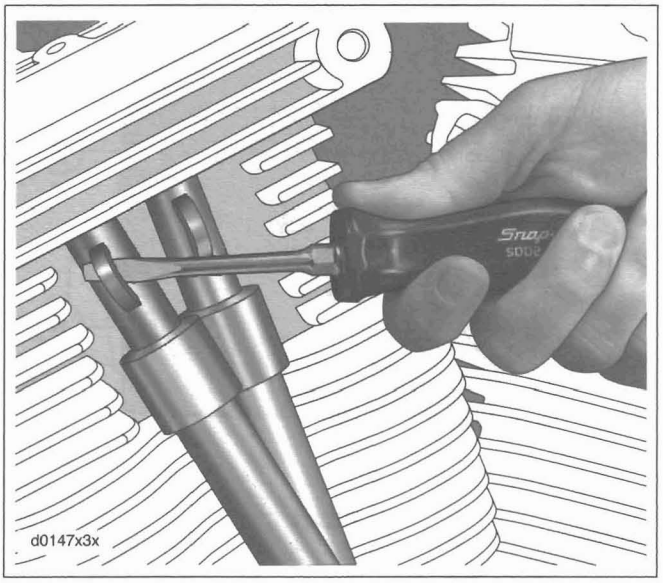


Figure 3-18. Removing Spring Cap Retainer

2. Collapse upper and lower push rod covers.

CAUTION

Removing the rocker arms with the valve train loaded can result in bent push rods, damaged bushings or a warped support plate.

3. 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.

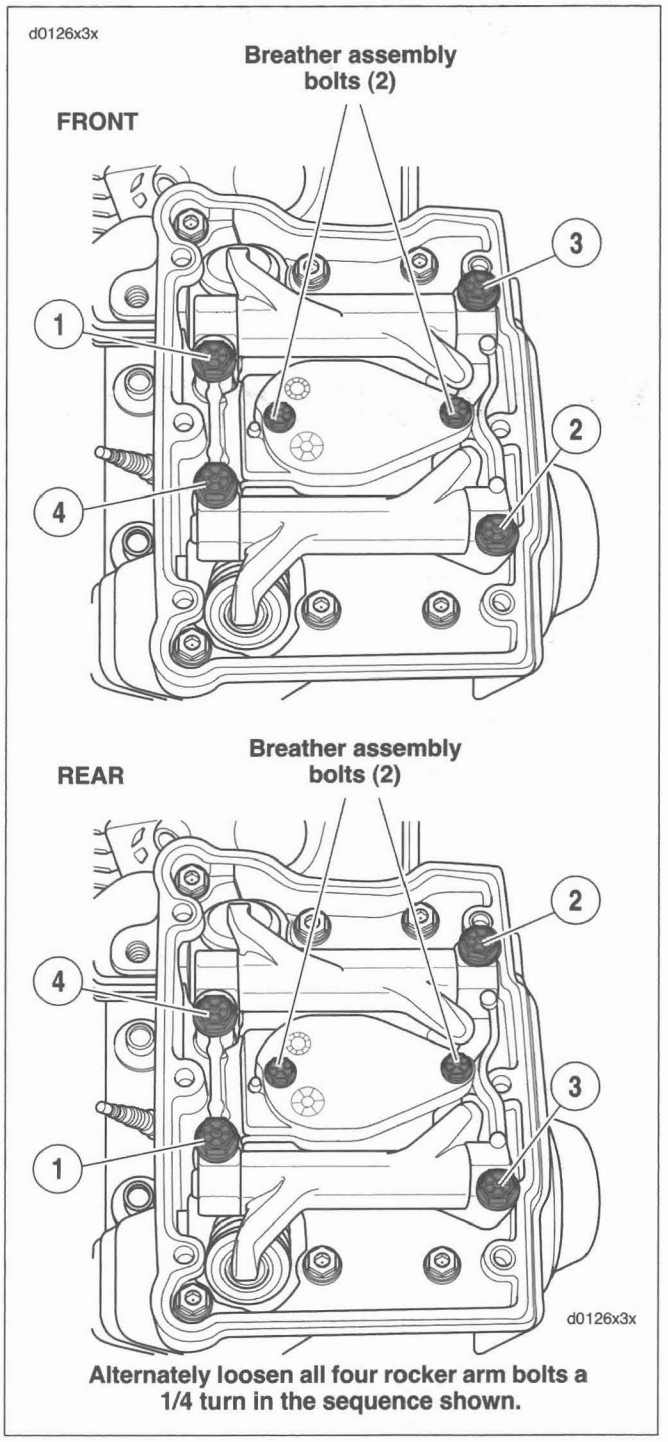


Figure 3-19. Breather Bolts and Rocker Arm Bolts

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-48283	Engine Rotation Wrench

c. **With engine mounted in engine stand** - Install ENGINE ROTATION WRENCH (HD-48283) on sprocket shaft and rotate in a counterclockwise direction until the base circle is found. Continue with step 4.

4. Using one of the methods above, rotate engine until piston is at top dead center (TDC) of compression stroke.
   a. To accomplish this, first raise lower push rod cover to access intake lifter (inside hole of lifter cover).
   b. 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.
5. 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.
6. 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.

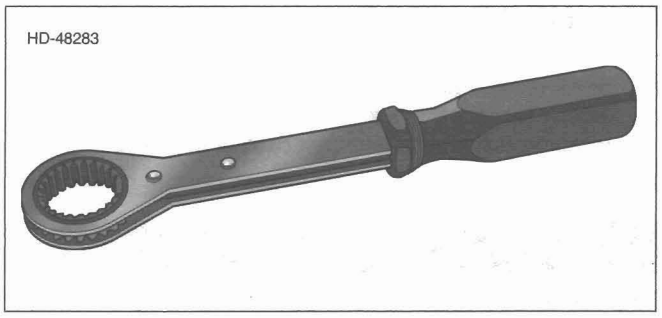


Figure 3-20. Sprocket Shaft Engine Rotation Wrench

PUSH RODS, LIFTERS AND COVERS

1. 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.
   b. 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.
   a. 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.
   b. Tag the lifters for location (front/rear cylinder) and function (intake/exhaust) as they are removed. This will simplify installation.
   c. Place the lifters in clean plastic bags to keep out dust, dirt and debris.
4. 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

1. 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

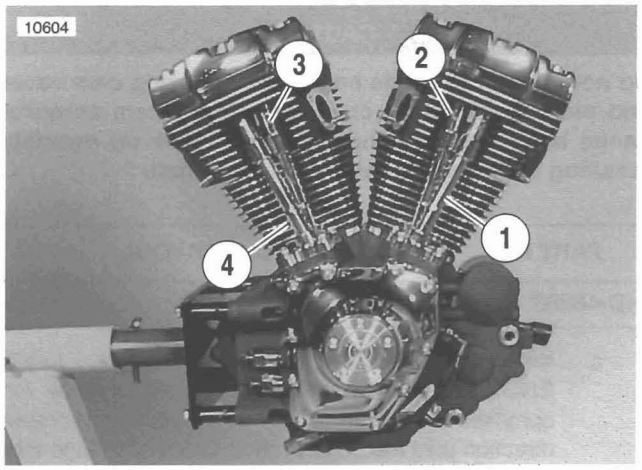
To prevent distortion of the cylinder head, cylinder and cylinder studs, gradually loosen the cylinder head bolts in the specified sequence.

3. See Figure 3-24. Remove cylinder head bolts.
   a. 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.
4. See Figure 3-25. Remove cylinder head and head gasket (2). Discard gasket.

NOTE

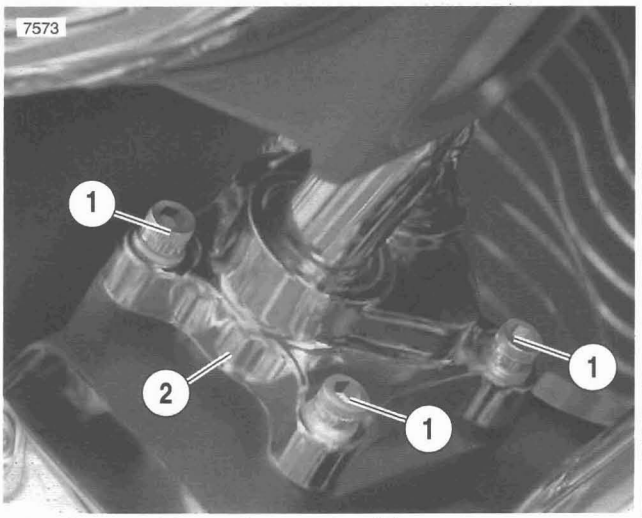
Save the cylinder head gasket (if salvageable) and ring dowel O-rings for use with the CYLINDER TORQUE PLATES (Part No. HD-42324-A) when measuring, boring or honing of the cylinder is required.

5. See 3.23 CYLINDER HEAD for inspection and repair information.



1. **Front cylinder exhaust push rod**
2. **Front cylinder intake push rod**
3. **Rear cylinder intake push rod**
4. **Rear cylinder exhaust push rod**

Figure 3-21. Push Rod Locations



1. **Screw with captive washer (4)**
2. **Lifter cover**

Figure 3-22. Lifter Cover

CYLINDER

1. 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.

2. 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.
3. 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.
4. 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.
6. See 3.24 CYLINDER for inspection and repair information.

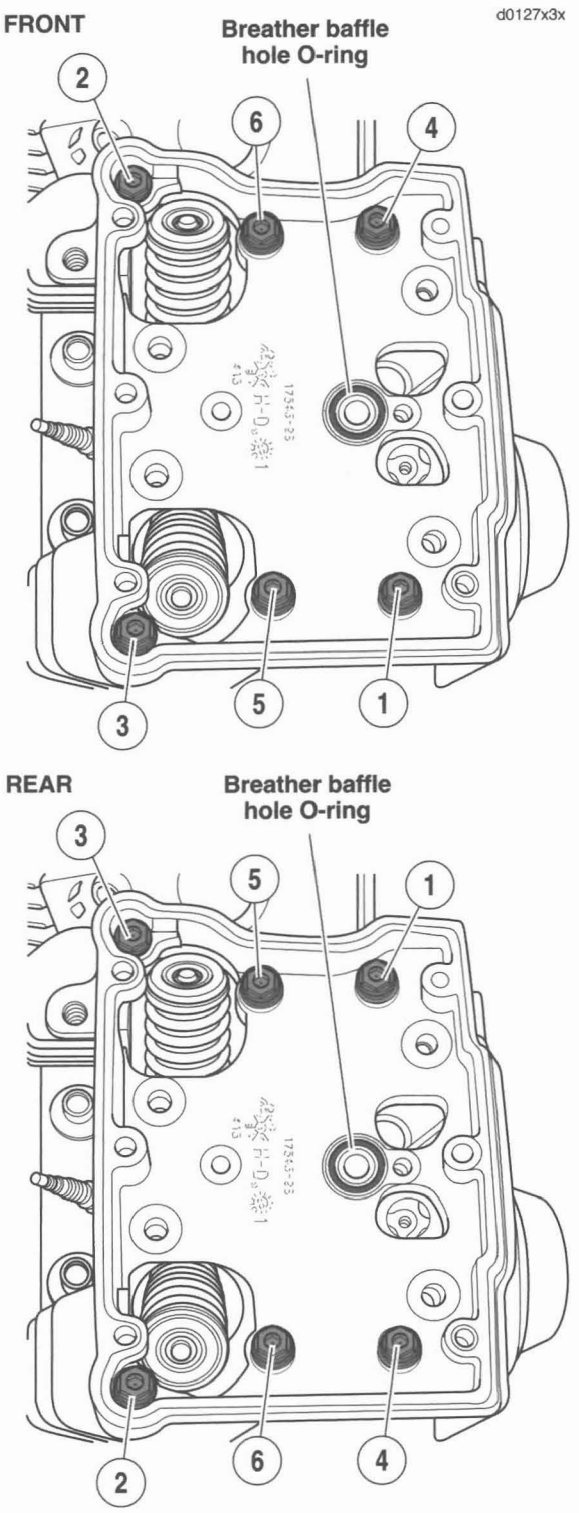


Figure 3-23. Rocker Housing Bolts

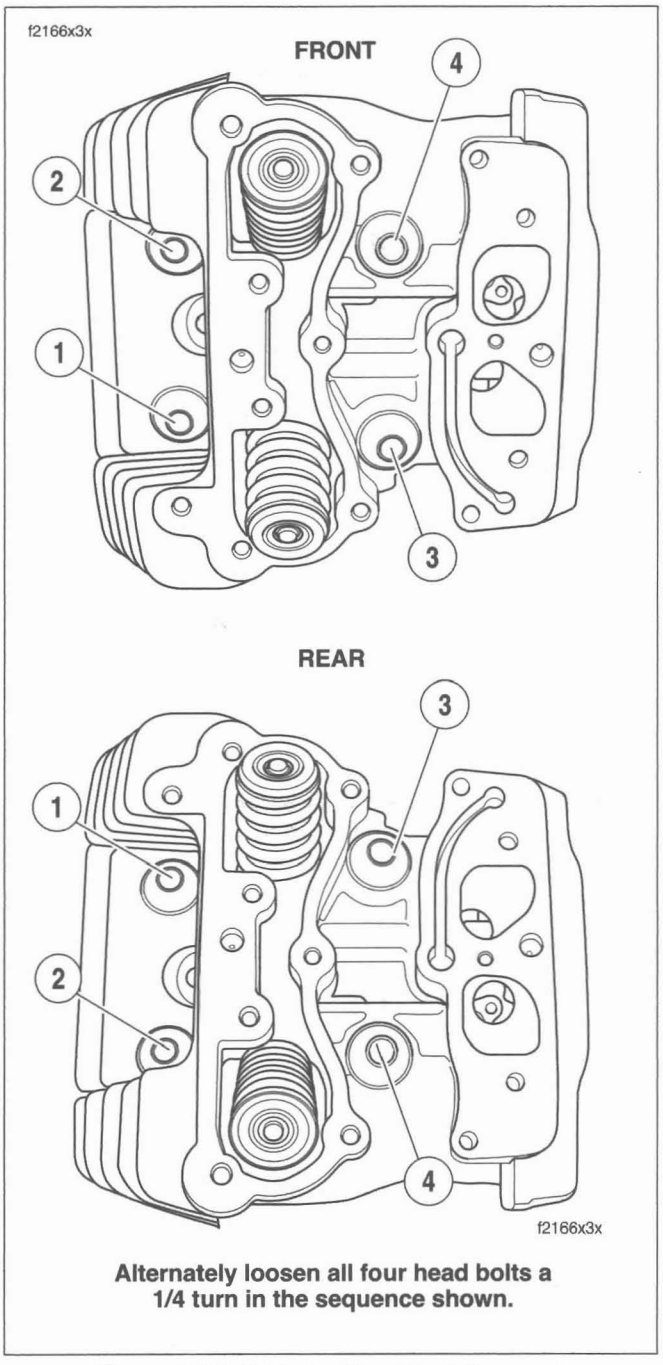


Figure 3-24. Cylinder Head Bolt Removal

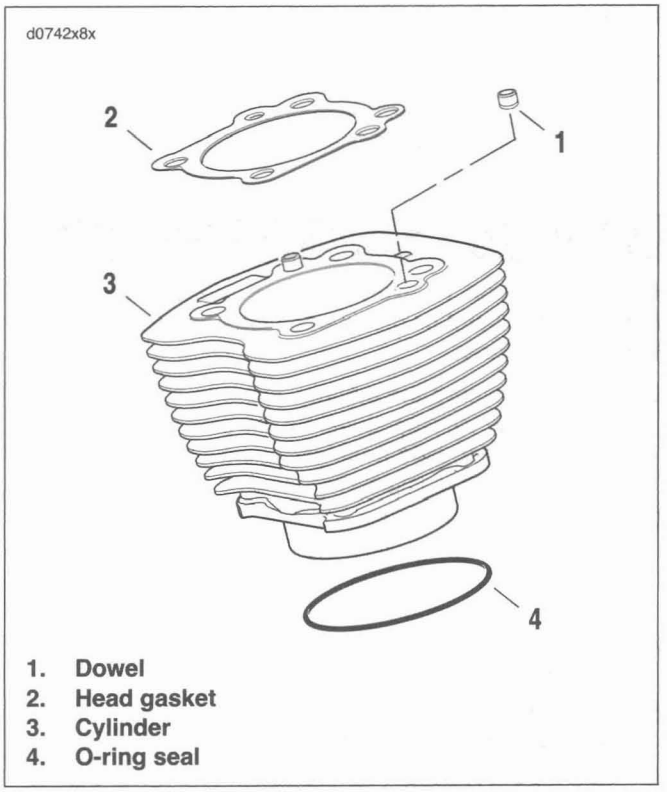


Figure 3-25. Cylinder Assembly

PISTON

PART NO.	SPECIALTY TOOL
HD-42317-A	Piston pin circlip remover/installer
HD-42320-A	Piston pin remover

1. Verify that clean shop towels are properly positioned over the crankcase bore to prevent the piston pin circlip from falling into the crankcase.

⚠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)

2. See Figure 3-26. Remove the piston pin circlip.
   a. 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.

3. 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.
   b. 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.
5. Turn the piston over. Mark the pin boss with the letters "F(ront)" or "R(ear)" to identify location.

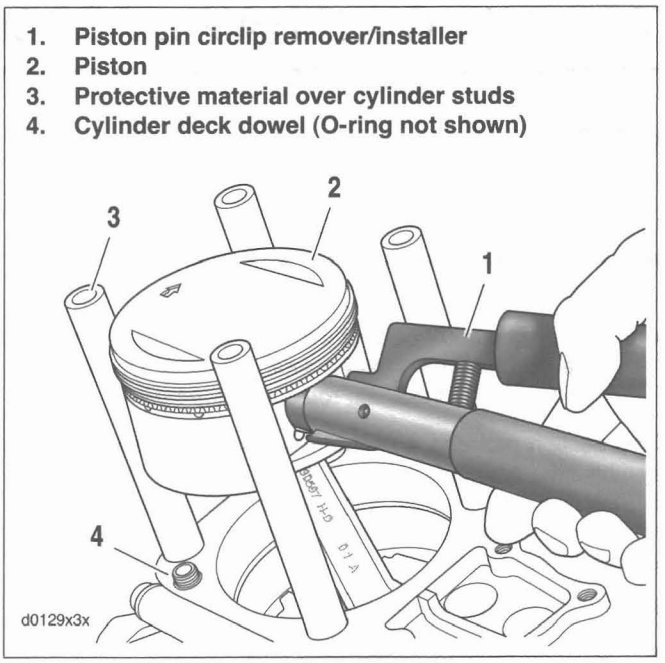


Figure 3-26. Piston Pin Circlip Removal (Part No. HD-42317-A)

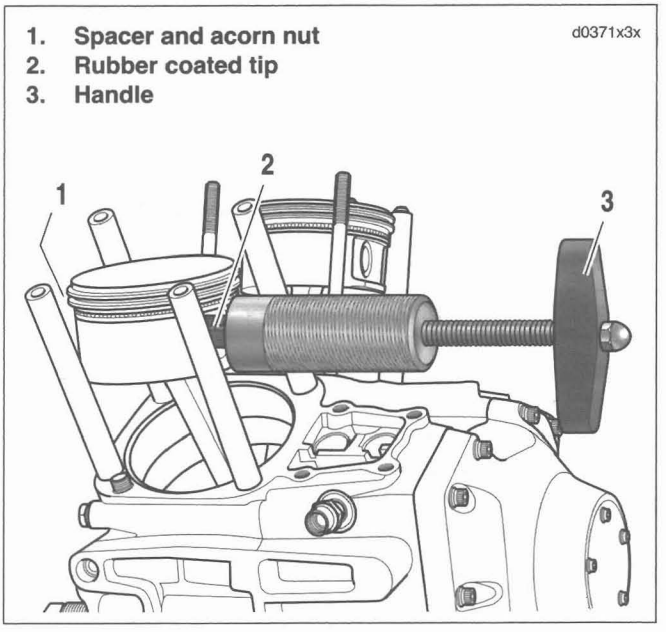


Figure 3-27. Piston Pin Remover (Part No. HD-42320-A)

6. Service as needed. See 3.25 PISTON for inspection and repair information.
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

NOTES

- *It is assumed that each step performed on one cylinder is automatically repeated on the other.*
- *Do not mix 2007 pistons with earlier style pistons. New style pistons have tapered wrist pin boss. The wrist pin portion of the connecting rod is also tapered.*

This section provides a sequential process for engine reassembly after a complete 3.16 TOP 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.

- 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.
2. Apply clean H-D 20W50 engine oil to piston pin, piston bosses and upper connecting rod bushing.
3. Remove water pipe insulation from connecting rod shank.
4. 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.
5. 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).
6. 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.

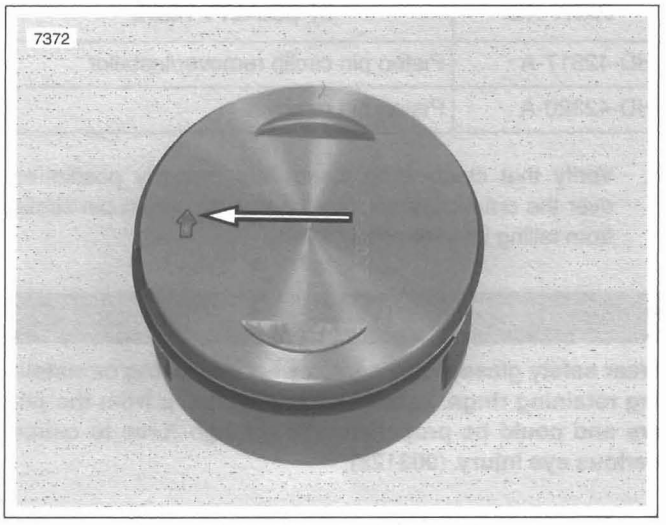
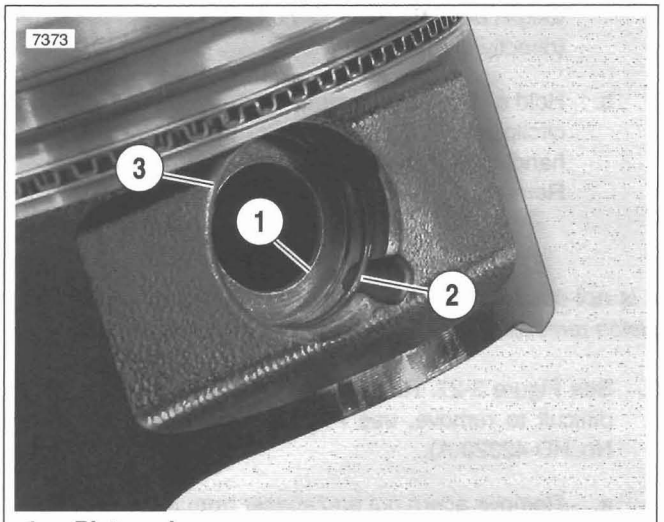


Figure 3-28. Piston Installation Arrow



1. **Piston pin**
2. **Circlip opening**
3. **End gap location**

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.

7. Install **new** piston pin circlip with the PISTON PIN CIRCLIP REMOVER/INSTALLER (Part No. HD-42317-A).
   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.
   b. 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.

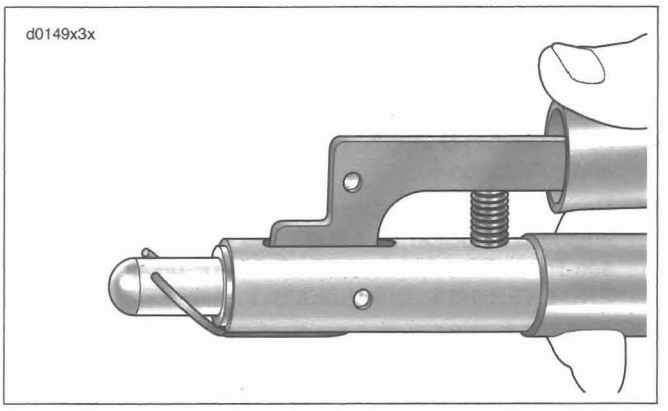


Figure 3-30. Aligning Circlip

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.

1. 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.
2. 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.

1. **Piston pin circlip remover/installer**
2. **Slot**
3. **Cylinder deck dowel (O-ring not shown)**

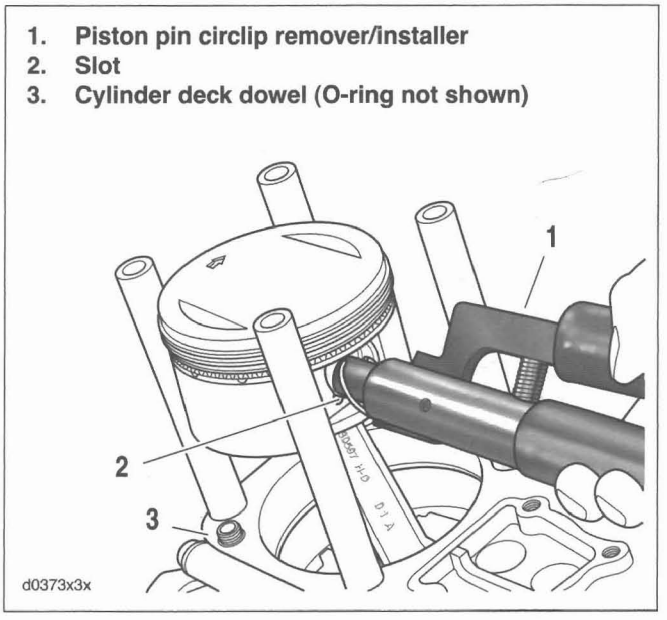


Figure 3-31. Pin Circlip Remover/Installer (Part No. HD-42317-A)

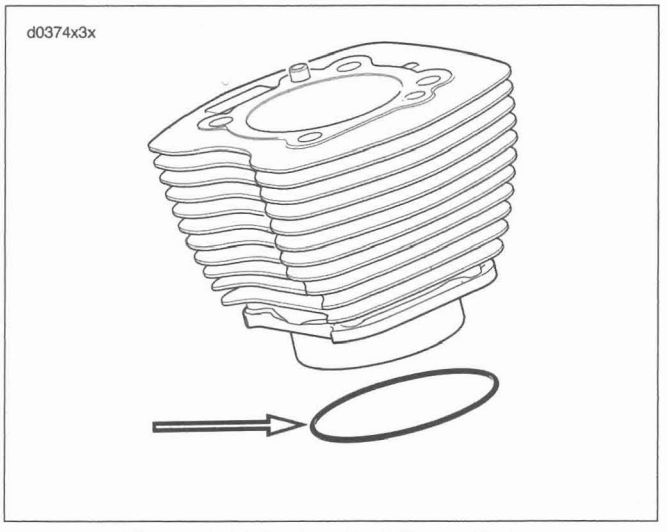
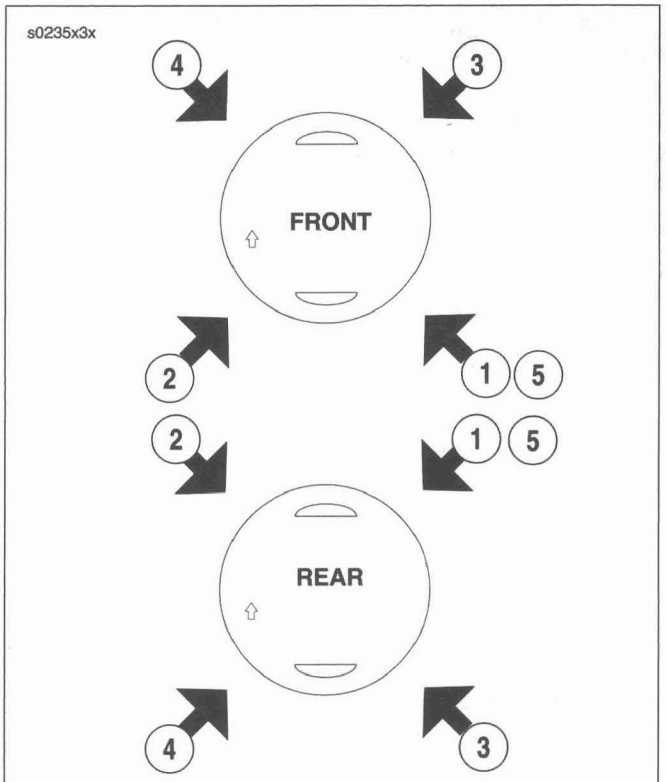


Figure 3-32. O-ring Seal For Cylinder

3. 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.
5. 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.
9. 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

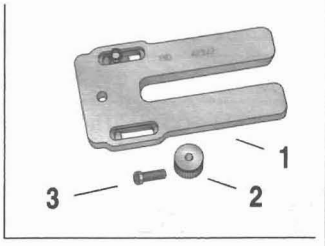
See Figure 3-36. To hold the first cylinder in position while installing the second, install THREADED CYLINDERS (Part No. HD-95952-1) from CONNECTING ROD CLAMPING TOOL (Part No. HD-95952-33C) onto cylinder studs with the knurled side down. This will prevent the piston rings from raising the cylinder as the engine is rotated to bring the other piston into position for installation of the second cylinder.



1. **Expander spring**
2. **Bottom oil rail**
3. **Top oil rail**
4. **Second compression ring**
5. **Top compression ring**

Figure 3-33. Piston Ring Alignment

1. **Support plate**
2. **Knobs**
3. **Screw**



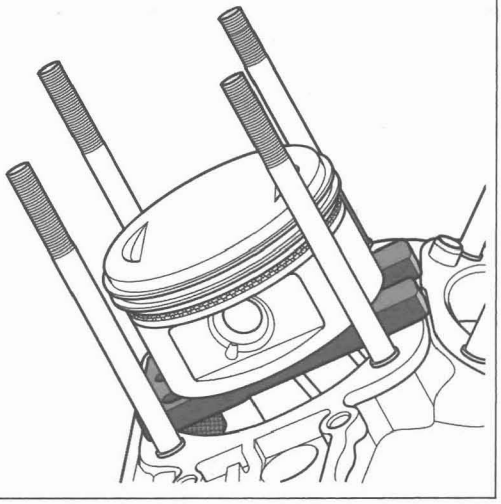


Figure 3-34. Piston Support Plate (Part No. HD-42322)

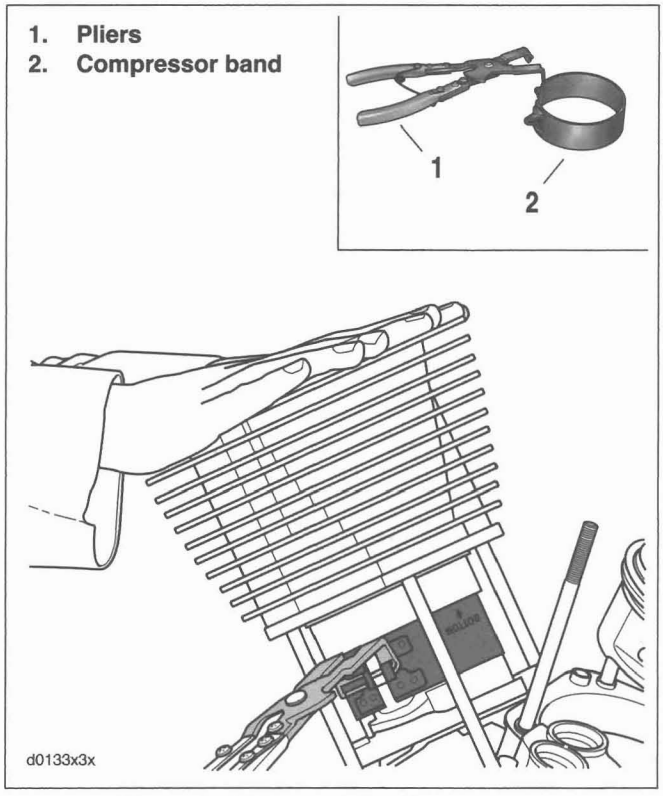


Figure 3-35. Piston Ring Compressor
(Part No. 96333-51C)

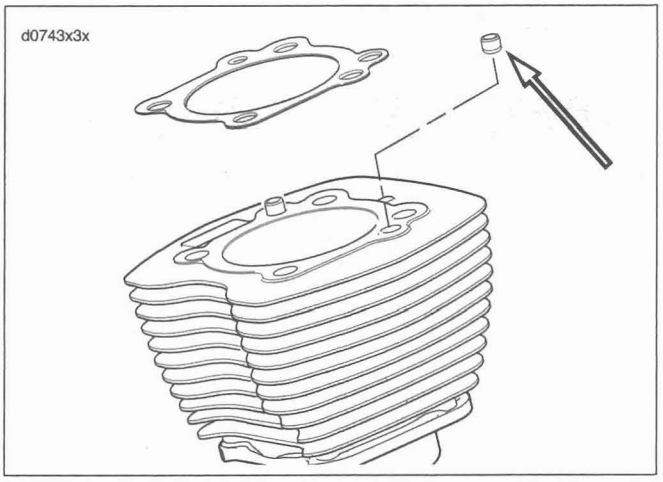


Figure 3-37. Cylinder Dowels

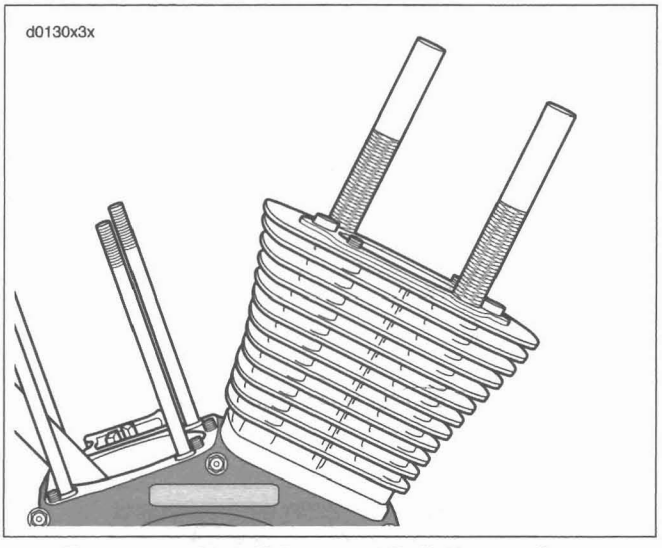


Figure 3-36. Install Threaded Cylinders to Studs
(Part No. HD-95952-1)

CAUTION

To ensure proper head gasket alignment, install new O-rings over cylinder ring dowels before installing the head gasket. Improper head gasket alignment will cause leaks.

1. 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.

3. Lightly coat the threads and bottom face of the cylinder head bolts in clean H-D 20W50 engine oil. Wipe off any excess oil.
4. 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.
   b. Following the same sequence, tighten the cylinder head bolts to 120-144 **in-lbs** (13.5-16.2 Nm).
   c. 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.

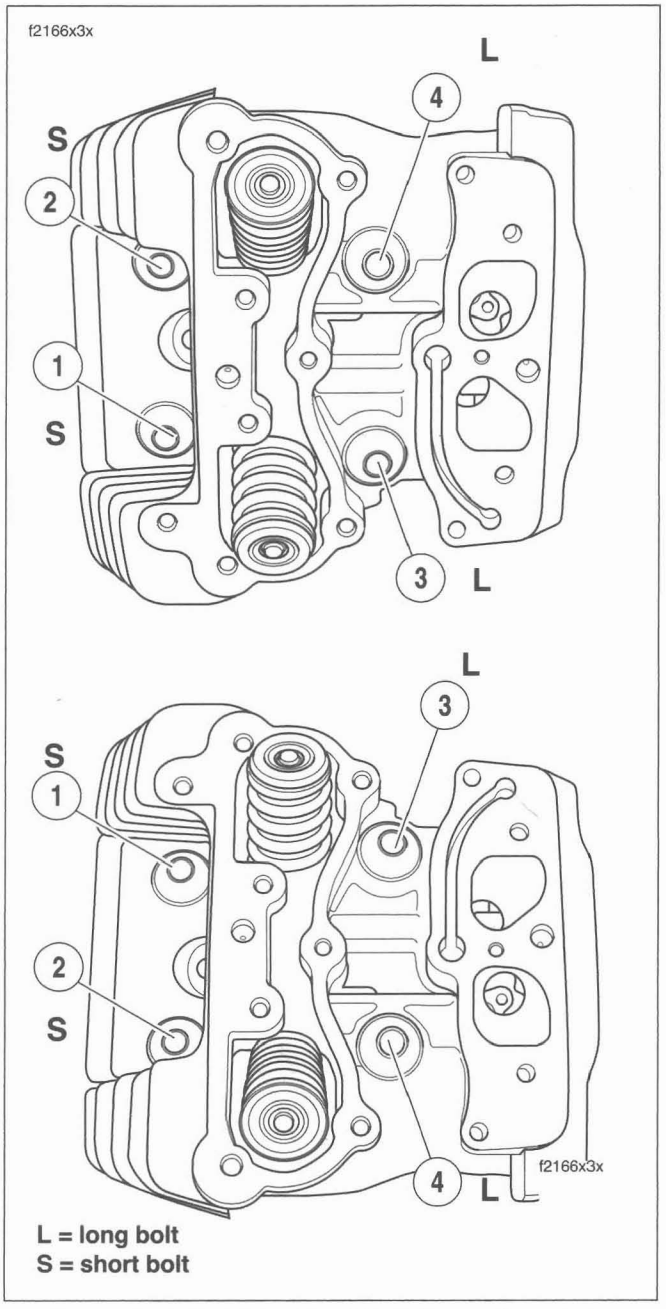


Figure 3-38. Cylinder Head Bolt Torque Sequence

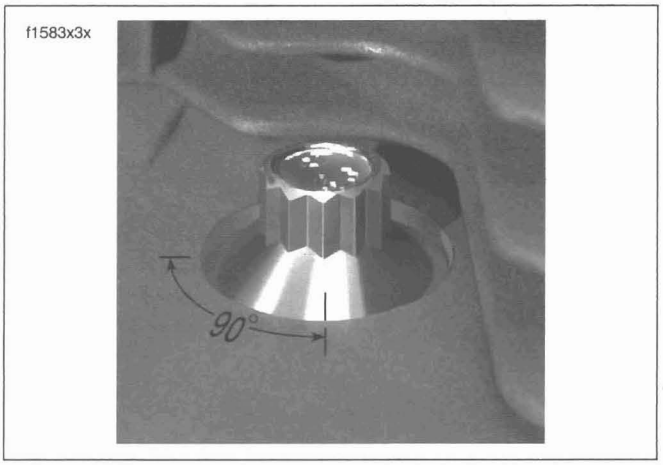


Figure 3-39. Final Tightening For Cylinder Head Bolts

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.

6. 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.
7. 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.
8. 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.

9. 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).

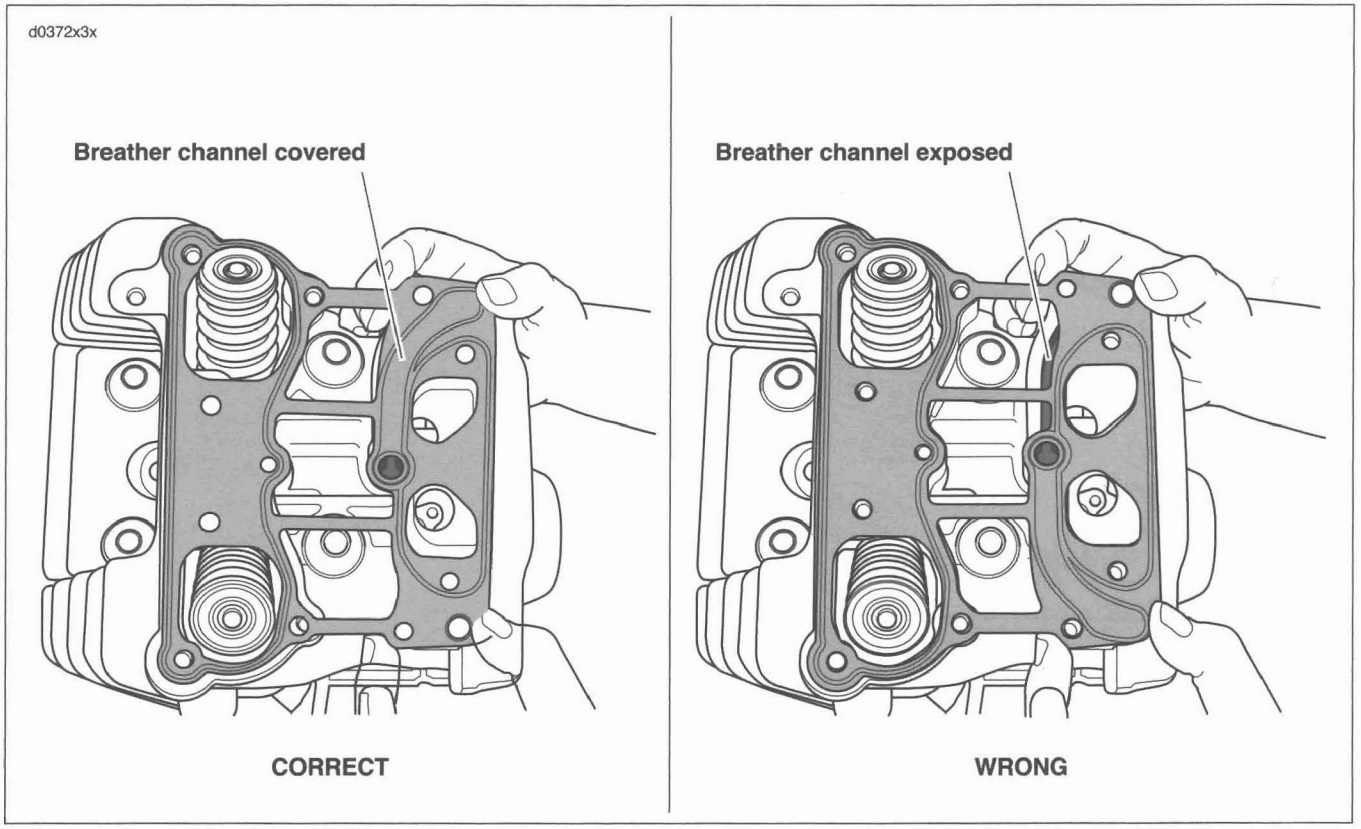
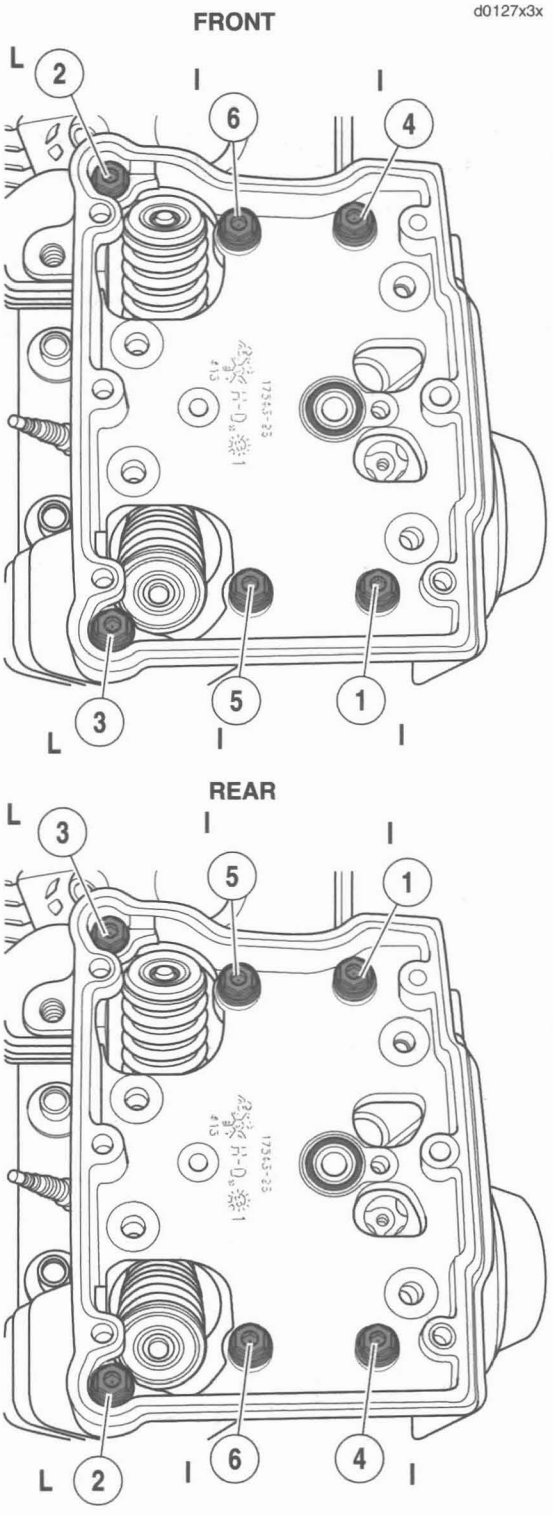
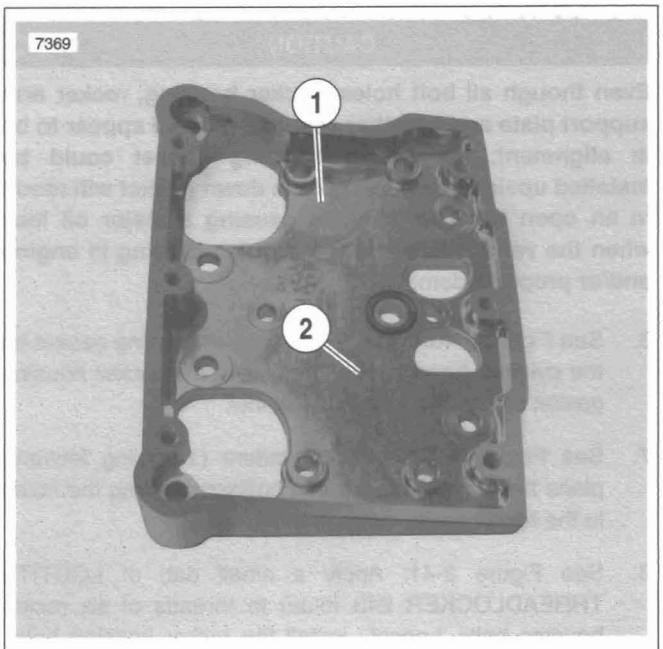


Figure 3-40. Install Rocker Housing Gasket (Rear Cylinder Shown)



S = short bolt, 1.0 in. (25.4 mm)
I = intermediate bolt, 1.25 in. (31.8 mm)
L = long bolt, 1.75 in. (44.5 mm)

Figure 3-41. Rocker Housing Torque Sequence and Bolt Size (Rear Cylinder Shown)



1. Indent
2. Breather baffle hole O-ring

Figure 3-42. Rocker Housing Alignment

PUSH RODS, LIFTERS AND COVERS

1. 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.
2. 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-lbs** (10.2-13.6 Nm) in a crosswise pattern.
5. Install push rod covers.
   a. 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. Extending 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.

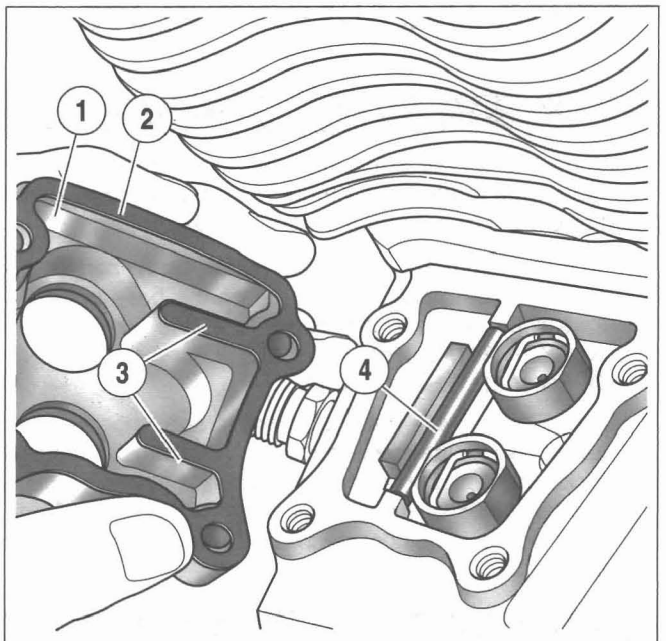
NOTE

See ROCKER ARM SUPPORT PLATE which follows to install spring cap retainers.

6. 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.

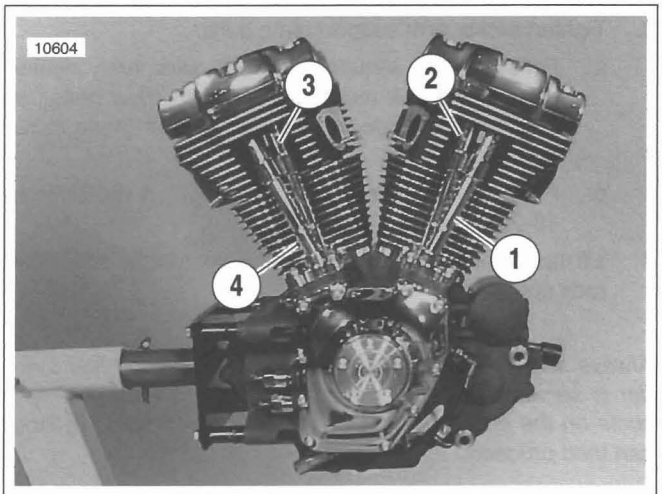
Table 3-2. Push Rod/Lifter Locations

CYLINDER	COVER & PUSH ROD	LIFTER BORE COVER	CYLINDER HEAD/ ROCKER HOUSING BORE
Front	Intake	Inside	Rear
	Exhaust	Outside	Front
Rear	Intake	Inside	Front
	Exhaust	Outside	Rear



1. **Cover**
2. **Gasket**
3. **Ribs on cover**
4. **Anti-rotational pin**

Figure 3-43. Installing Lifters



1. **Front cylinder exhaust push rod**
2. **Front cylinder intake push rod**
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.

1. 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.
2. 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.
   a. 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.
   b. 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.

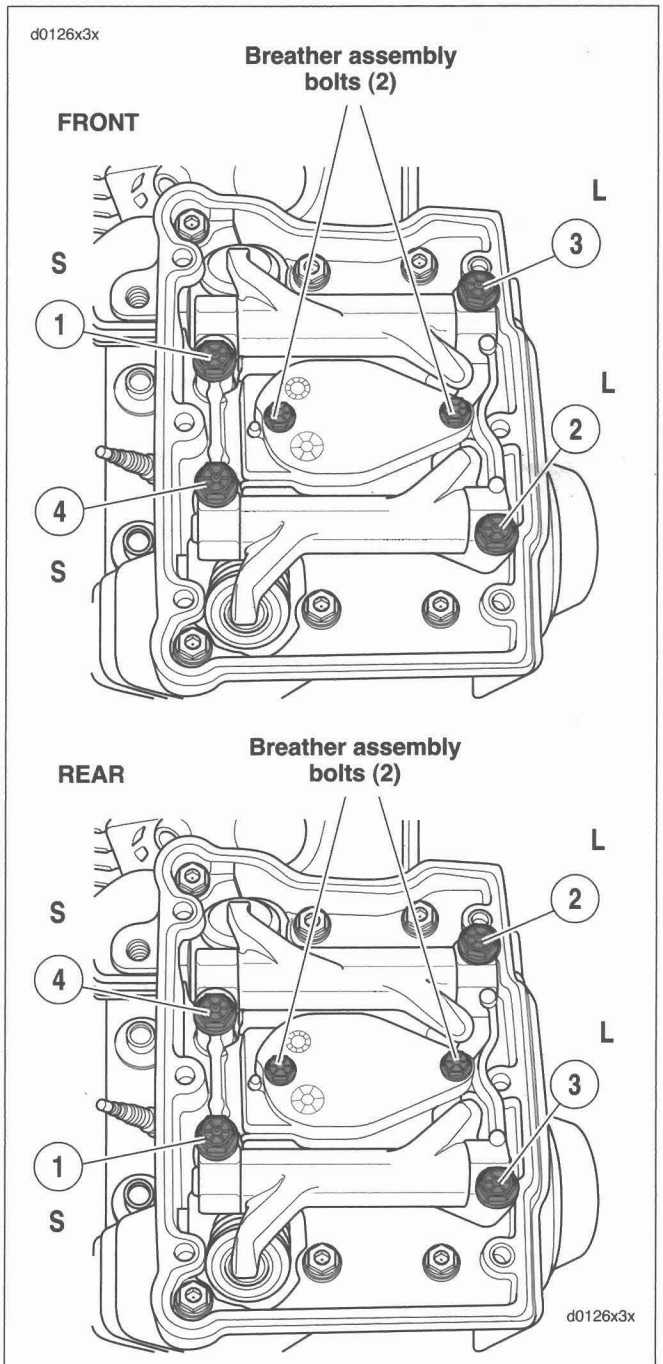
NOTE

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.
   a. 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. Insert 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.



Alternately tighten all four rocker arm bolts 1/4 turn in the sequence shown.

S = short bolt, 1.0 in. (25.4 mm)
I = intermediate bolt, 1.25 in. (31.8 mm)
L = long bolt, 1.75 in. (44.5 mm)

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.

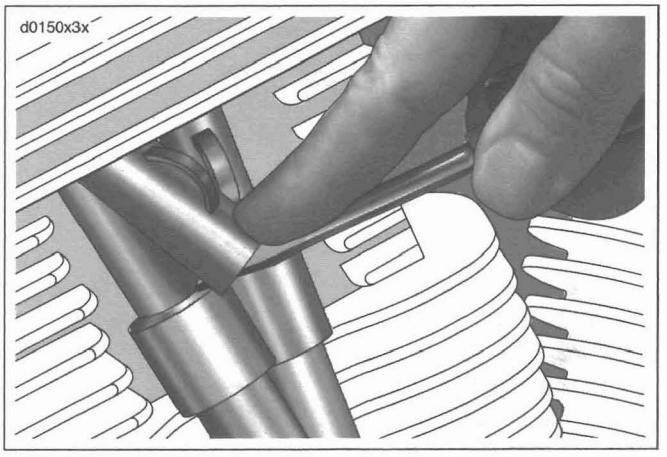


Figure 3-46. Install Spring Cap Retainers

BREATHER ASSEMBLY

NOTE

See 3.20 BREATHER ASSEMBLY for breather assembly service procedures.

1. See Figure 3-45. Alternately tighten the two bolts to secure breather assembly to 90-120 **in-lbs** (10.2-13.6 Nm).
2. 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.
   a. Apply a small dab of LOCTITE THREADLOCKER 243 (blue) to threads of six rocker cover bolts.
   b. Loosely install three short bolts on the left side of the engine.
   c. Loosely install three long bolts on the right.
   d. Following the sequence shown, tighten bolts to 15-18 ft-lbs (20.3-24.4 Nm).
4. Complete motorcycle assembly.
   a. 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.

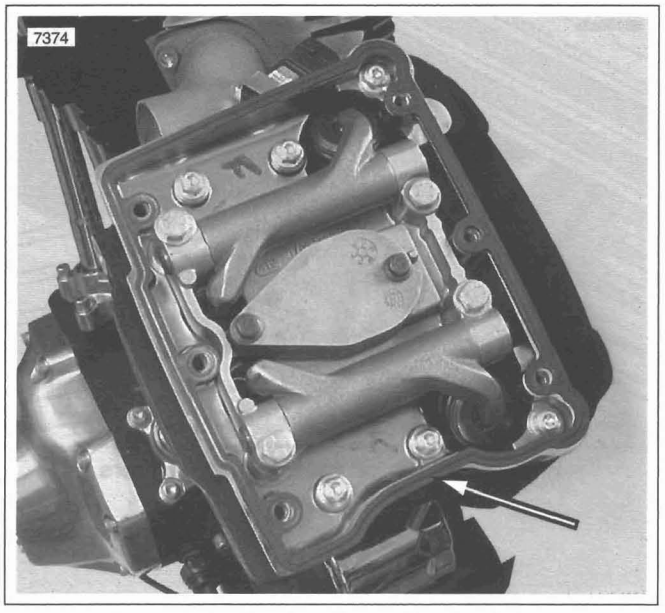
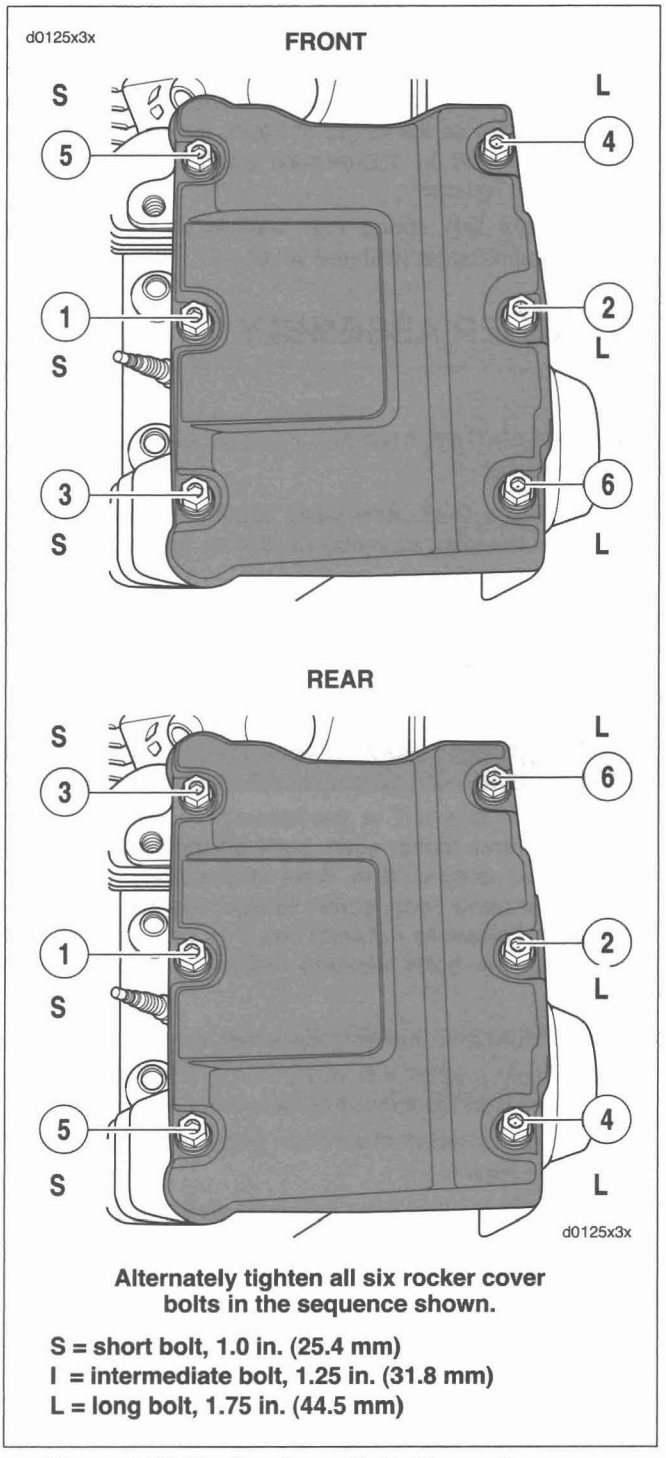


Figure 3-47. Rocker Cover Gasket Indent (Front Cylinder Shown)



Alternately tighten all six rocker cover bolts in the sequence shown.

S = short bolt, 1.0 in. (25.4 mm)
I = intermediate bolt, 1.25 in. (31.8 mm)
L = long bolt, 1.75 in. (44.5 mm)

Figure 3-48. Rocker Cover Bolts Torque Sequence

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.
   a. If performing a complete engine overhaul, perform all steps under 3.16 TOP END OVERHAUL: DISASSEMBLY.
   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 3.26 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.

2. 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.

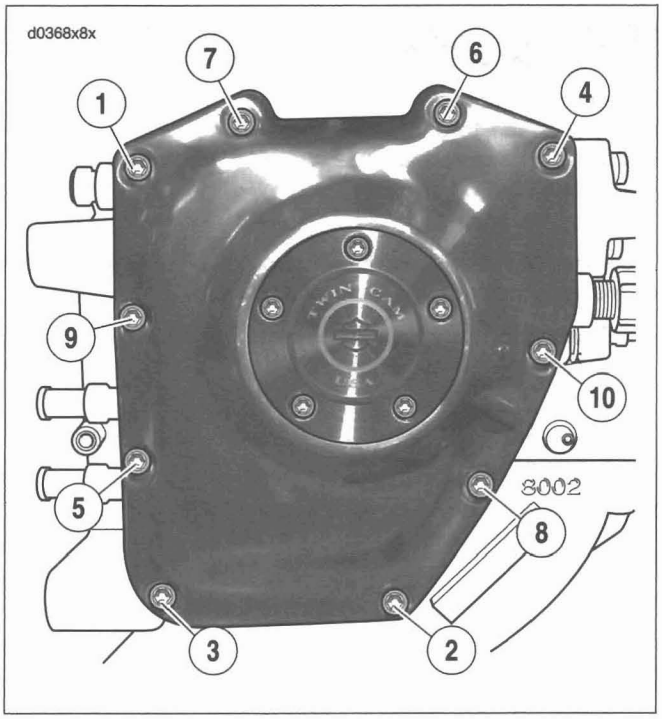


Figure 3-49. Cam Cover Screws

3. 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.

⚠WARNING

Be sure to follow manufacturer's instructions when using propane torches. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00465b)

NOTE

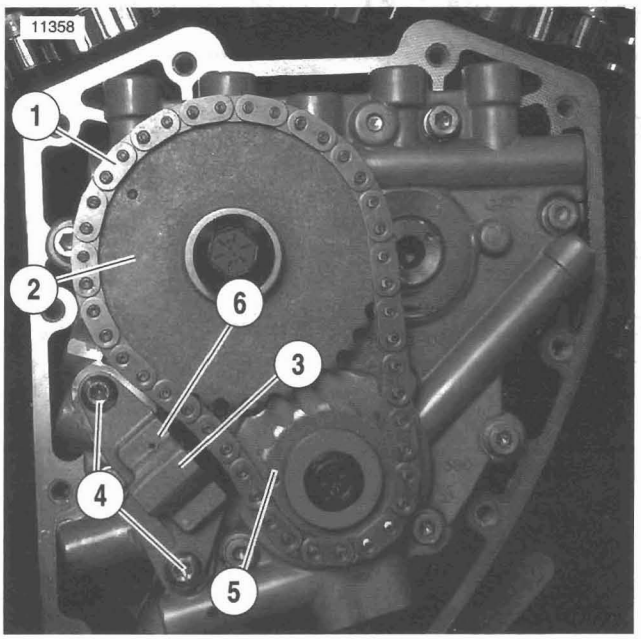
A piece of wire can be inserted into retention hole (6) to keep cam chain tensioner components assembled.

4. Remove primary cam chain tensioner fasteners (4) and primary cam chain tensioner (3).

NOTE

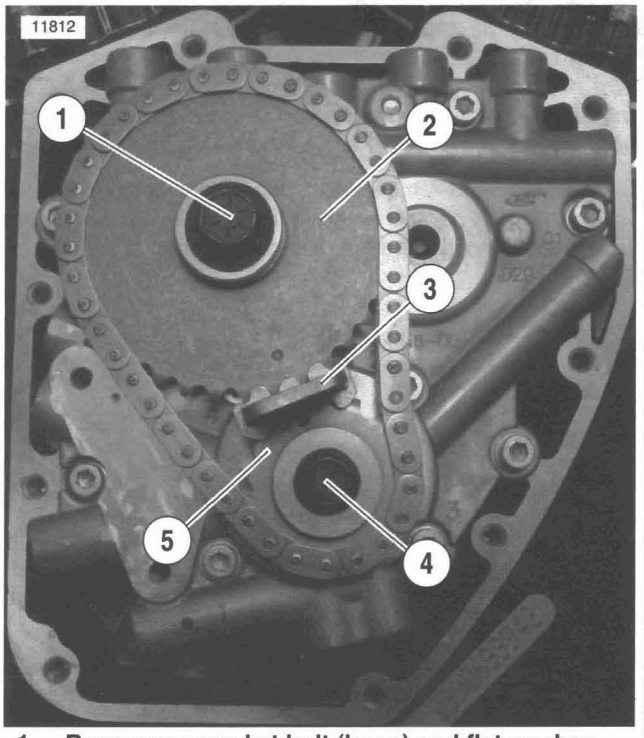
In next step, be sure side of tool labeled "crank side" faces crank sprocket.

5. See Figure 3-51. Install CAMSHAFT LOCKING TOOL (3) (HD-47941) between cam sprocket (2) and crank sprocket (5).



1. **Link**
2. **Rear cam sprocket**
3. **Primary cam chain tensioner**
4. **Primary cam chain tensioner fasteners**
5. **Crank sprocket**
6. **Retention hole**

Figure 3-50. Cam Support Plate Assembly



1. **Rear cam sprocket bolt (large) and flat washer**
2. **Rear cam sprocket**
3. **Camshaft locking tool (HD-47941)**
4. **Crank sprocket bolt (small) and flat washer**
5. **Crank sprocket**

Figure 3-51. Cam Support Plate Assembly

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.

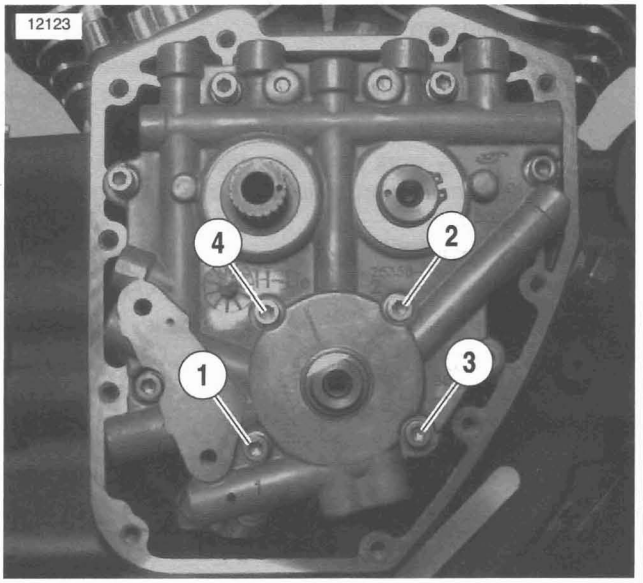
CAUTION

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

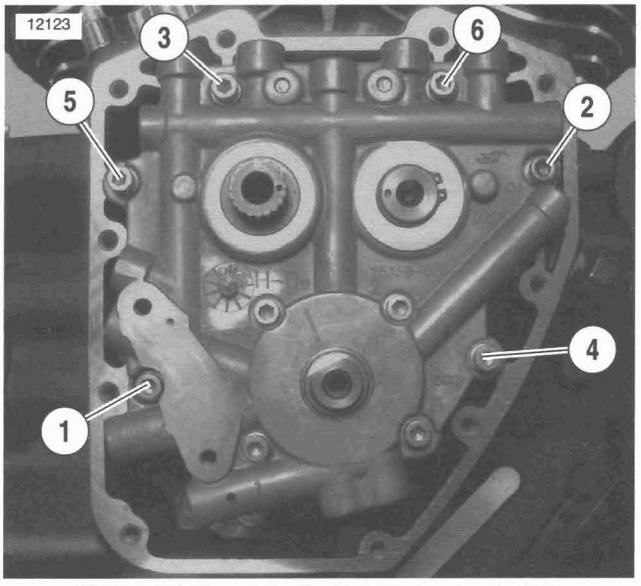
If too much LOCTITE or perhaps the wrong LOCTITE was used to install the rear cam bolt, it may be very difficult to remove. In these cases, break down LOCTITE by using heat from a small propane torch. Apply flame evenly around bolt in a circular motion, but not for so long as to turn bolt blue.

6. Remove the rear cam sprocket bolt and flat washer (1) from the rear cam sprocket (2).
7. Remove the crank sprocket bolt and flat washer (4) from the crank sprocket (5).
8. Remove CAMSHAFT LOCKING TOOL.
9. 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.
10. Ease off crank sprocket with a slightly smaller pry bar (seal remover). Remove the rear cam sprocket, primary cam chain and crank sprocket.
11. See Figure 3-52. 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.
12. See Figure 3-53. 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.



Alternately loosen all four oil pump screws in the sequence shown.

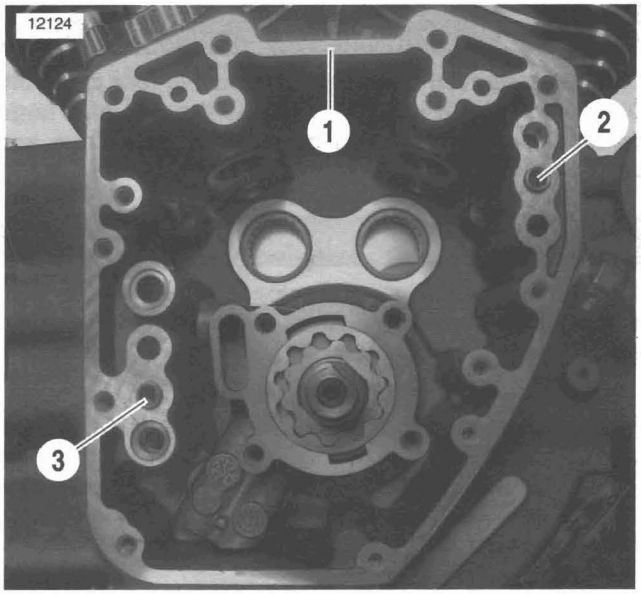
Figure 3-52. Oil Pump Torque Sequence



Alternately loosen all six cam support plate screws in the sequence shown.

Figure 3-53. Cam Support Plate Torque Sequence

13. See Figure 3-54. Two ring dowels (2, 3) in crankcase flange locate cam support plate.
    a. Insert small pry bar (seal remover) between inboard side of cam support plate and crankcase flange in area adjacent to ring dowels.
    b. Alternately work each side free and then carefully ease cam support plate and camshafts from end of crankshaft.
14. See Figure 3-55. Remove O-ring (1) from groove around oil feed hole in crankcase flange. Discard O-ring.
15. Remove and discard O-ring (2) from crankcase post.
16. See 3.26 COVER AND CAM SUPPORT PLATE for inspection and repair information.



1. **Right crankcase half**
2. **Forward ring dowel**
3. **Rear ring dowel**

Figure 3-54. Ring Dowels

CRANKCASE

PART NO.	SPECIALTY TOOL
HD-42310-25	Softail engine cradle

1. Carefully pull oil pump from crankshaft.
2. See Figure 3-55. Remove O-ring (2) from outboard side of oil pump housing. Remove O-ring from scavenge port stub. Discard O-rings. See 3.27 OIL PUMP for inspection and repair information.

⚠WARNING

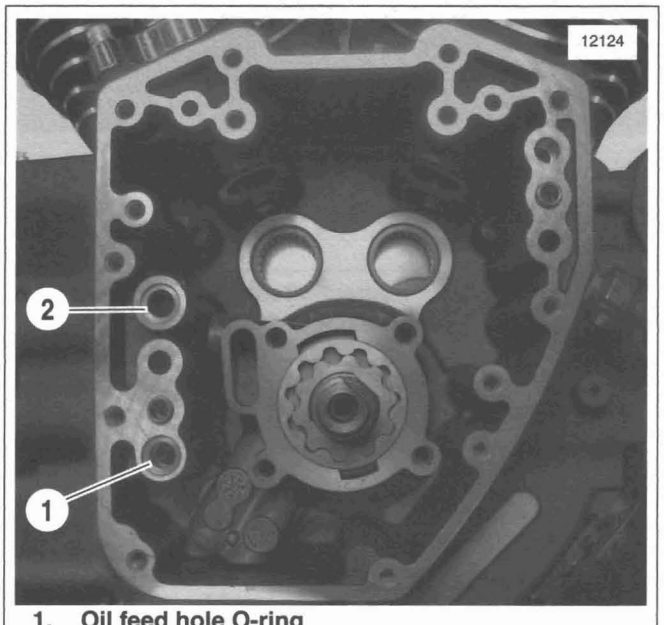
Do NOT rotate left crankcase half in the engine stand so the flywheel sprocket shaft is facing up. The flywheel assembly will fall out of the case, resulting in parts damage and could result in death or serious injury.

3. Rotate crankcase in the engine stand so that the cam cover flange is facing straight upward.
4. See Figure 3-56. Remove the nine crankcase bolts in the sequence shown.

⚠WARNING

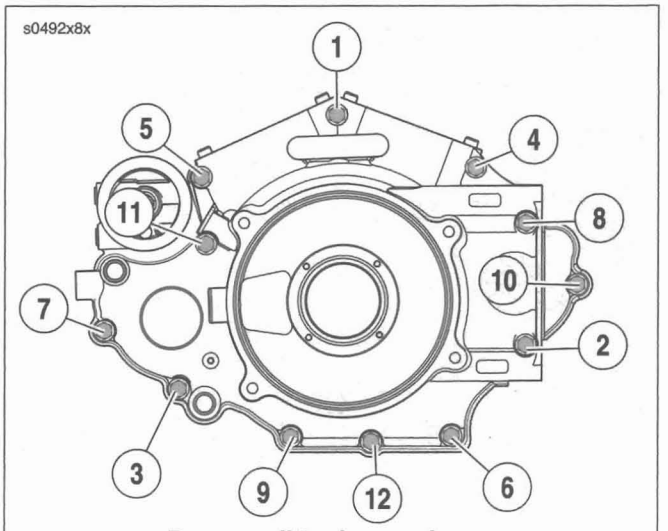
Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and may be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

5. Using pry points, loosen case halves. Lift right crankcase half off end of crankshaft.
6. See Figure 3-57. Remove O-rings (1) from two dowel pins (2) in split line face of right case half. Discard O-rings.
7. See 3.28 CRANKCASE for inspection and repair information.



1. **Oil feed hole O-ring**
2. **O-ring on crankcase post**

Figure 3-55. Oil Pump O-rings



Remove all twelve crankcase bolts in the sequence shown.

Figure 3-56. Crankcase Bolt Sequence

1. **O-ring**
2. **Dowel ring**

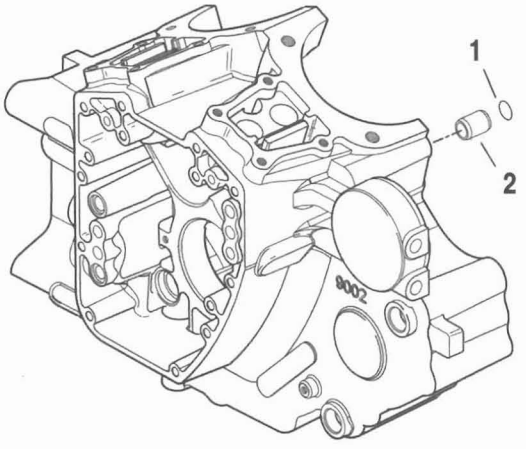


Figure 3-57. Right Crankcase Forward Dowel Ring (Rear Dowel Ring Not Shown)

8. See Figure 3-58. Remove and discard rubber interconnect from chain guide bracket assembly.
9. See 3.28 CRANKCASE for right crankcase inspection and repair information. Continue with COUNTERBALANCER ASSEMBLY removal to service flywheel or any of the left crankcase components.

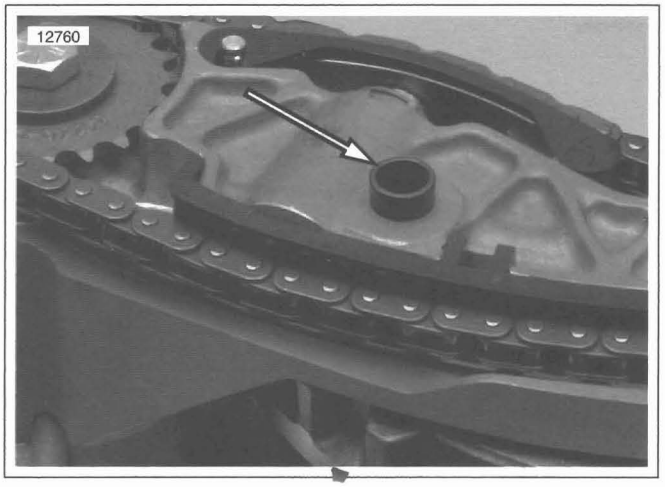
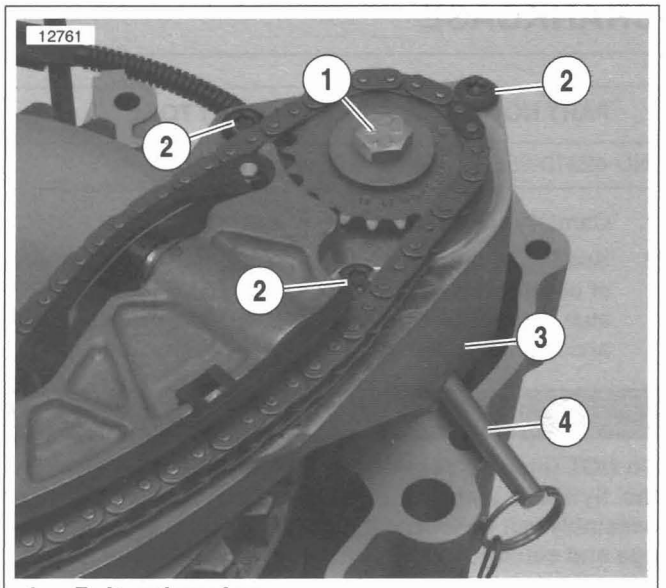


Figure 3-58. Rubber Interconnect

COUNTERBALANCER ASSEMBLY

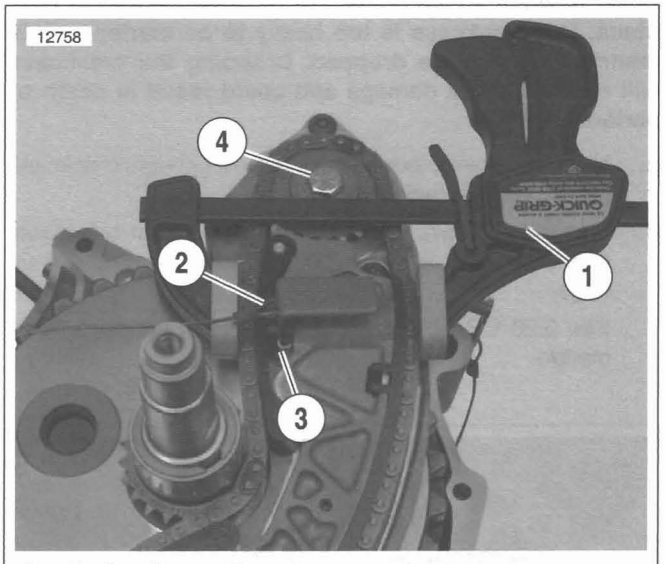
PART NO.	SPECIALTY TOOL
HD-44062	Balance shaft retention pins
HD-44063	Hydraulic tensioner compressor
HD-44408	Hydraulic tensioner retainers

1. See Figure 3-59. Rotate flywheel assembly to align holes in balance shafts with holes in balance shaft housing (3). Insert BALANCE SHAFT RETENTION PINS (4) (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 3-60. Compress both hydraulic tensioners.
   a. 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.



1. **Bolt and washer**
2. **T40 TORX screws (3)**
3. **Balance shaft housing**
4. **Retention pin**

Figure 3-59. Balance Shaft Support (Front Balance Assembly Shown)



1. **Hydraulic tensioner compressor**
2. **Hydraulic tensioner retainers**
3. **Hydraulic tensioner**
4. **Bolt and washer**

Figure 3-60. 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.

3. Loosen the bolts (4) on the front and rear balance shafts.

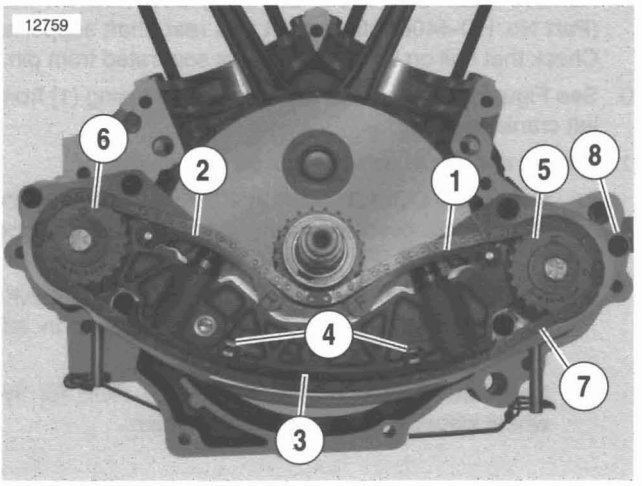
NOTE

If too much LOCTITE or perhaps the wrong LOCTITE was used to install the bolts, 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 bolt in a circular motion, but not for so long as to turn bolt blue.

4. See Figure 3-61. Pry tab on front tensioner guide (1) clear of locking post. Use a small screwdriver to pry front chain tensioner guide upward from locking post. Repeat procedure on rear chain tensioner guide (2).
5. 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.
6. See Figure 3-60. Remove the bolts and washers (4) on the front and rear balance shafts.
7. See Figure 3-61. Pry front (5) and rear (6) sprockets away from chain guide bracket assembly to release balance chain (7). Remove spacers from front and rear balance shafts.
8. Remove six T40 TORX screws (8) from balance shaft housing to free chain guide bracket assembly.

CAUTION

See Figure 3-62. 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.



1. **Front tensioner guide**
2. **Rear tensioner guide**
3. **Lower guide**
4. **Retention tabs**
5. **Front sprocket**
6. **Rear sprocket**
7. **Balance chain**
8. **T40 TORX screws (6)**

Figure 3-61. Chain Tensioner Guides

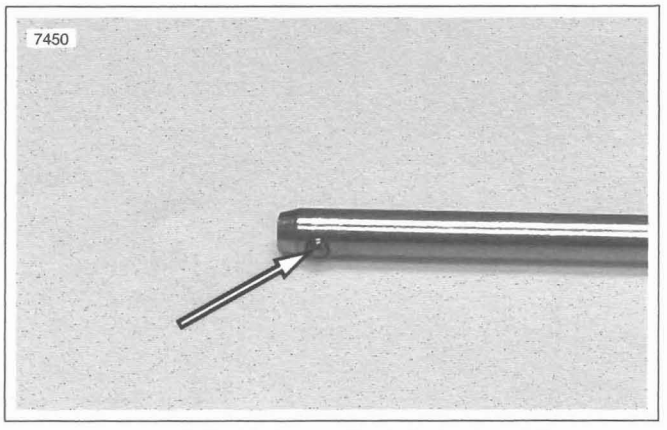
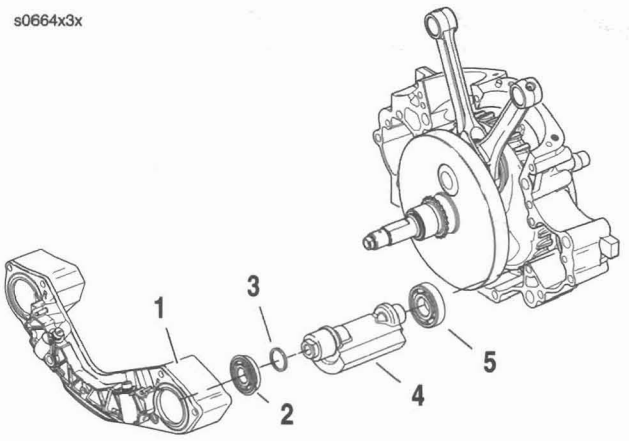


Figure 3-62. Balance Shaft Retention Pin

9. 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.
10. See Figure 3-63. Remove balance shaft housing (1) from left crankcase half.
11. Inspect and repair components as necessary.
    a. See 3.29 COUNTERBALANCER ASSEMBLY for chain guide bracket assembly and outside balance shaft bearings (2).
    b. See LEFT CRANKCASE HALF under 3.28 CRANKCASE for balance shaft support bearings in left crankcase half.
    c. See 3.30 FLYWHEEL/CONNECTING ROD for flywheel inspection and repair information.



1. **Balance shaft housing**
2. **Outside bearing**
3. **Washer**
4. **Balance shaft**
5. **Inside bearing**

Figure 3-63. 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 3-56.
- Cover and cam support plate installation-see page 3-60.

COUNTERBALANCER ASSEMBLY

PART NO.	SPECIALTY TOOL
HD-42310-25-A	Softail engine cradle
HD-44062	Balance shaft retention pins
HD-44063	Hydraulic tensioner compressor
HD-48615	Balance shaft sprocket alignment tool
HD-44408	Hydraulic tensioner retainers

⚠WARNING

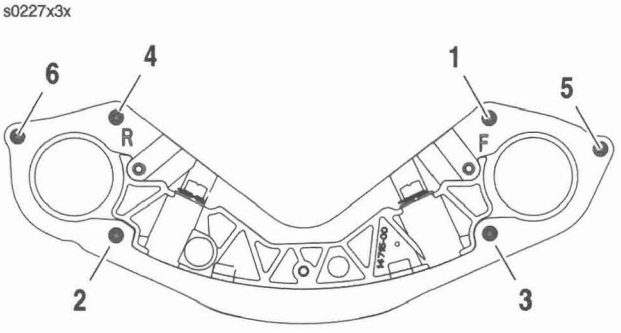
Never move or lift the crankcase by grasping the cylinder studs. The crankcase is too heavy to be carried in this manner and could be dropped. Dropping the crankcase will result in parts damage and could result in death or serious injury.

1. Rotate left crankcase in the engine stand so that the balance sprocket on the flywheel is facing straight upward.

CAUTION

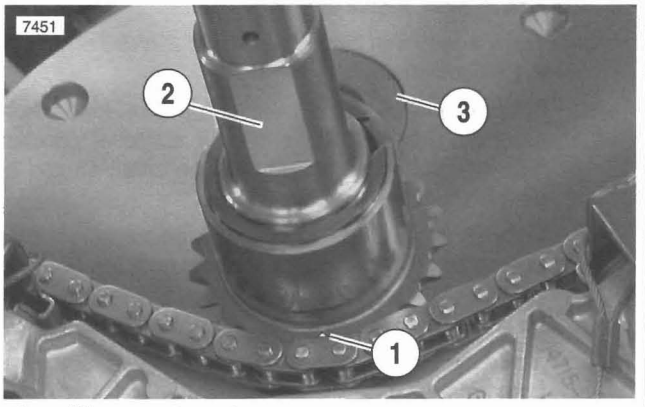
Do not apply crankcase sealant to edge surface of balance shaft housing. Improper preparation of housing could cause balance sprocket misalignment and result in engine damage.

2. Install balance shafts and bearing. See 3.29 COUNTERBALANCER ASSEMBLY for balancer shaft installation information.



Tighten all six screws in the sequence shown to 18-22 ft-lbs (24.4-29.8 Nm)

Figure 3-64. Balance Shaft Housing Torque Sequence



1. **Alignment mark**
2. **Crankshaft flat**
3. **Crankpin hole**

Figure 3-65. Flywheel Alignment Mark

3. See Figure 3-64. Install chain guide bracket assembly.
   a. With hydraulic tensioners compressed, slide chain guide bracket assembly over front and rear balance shafts.
   b. 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.
4. See Figure 3-65. Rotate flywheel assembly to align the mark (1) on flywheel balance sprocket to be directly below (6 o'clock position) the crankpin hole (3).
5. 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.
7. 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 bolt and washer on each balance shaft.
9. See Figure 3-66. Check flywheel sprocket to balance shaft alignment using BALANCE SHAFT SPROCKET ALIGNMENT TOOL (Part No. HD-48615).
   a. 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 0.019 in. (0.48 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.
   d. Remove bolts, washers and front and rear sprockets from balance shafts.
10. See Figure 3-67. Install balance chain.
    a. 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.
    d. Verify that marks on sprockets and chain face away from balance shaft housing.
    e. Check that the middle chain mark is directly below alignment mark on flywheel balance sprocket.
11. Install **new** bolt and washer in each balance shaft. Tighten both bolts to 42-47 ft-lbs (56.9-63.7 Nm).
12. Verify correct position of all three timing marks on chain and timing mark on flywheel balance sprocket.
13. See Figure 3-68. 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 3-69. Release both hydraulic tensioners.
    a. 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 3-70. 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.

15. 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.
14784-00	0.170	4.318
14785-00	0.180	4.572
14786-00	0.190	4.826

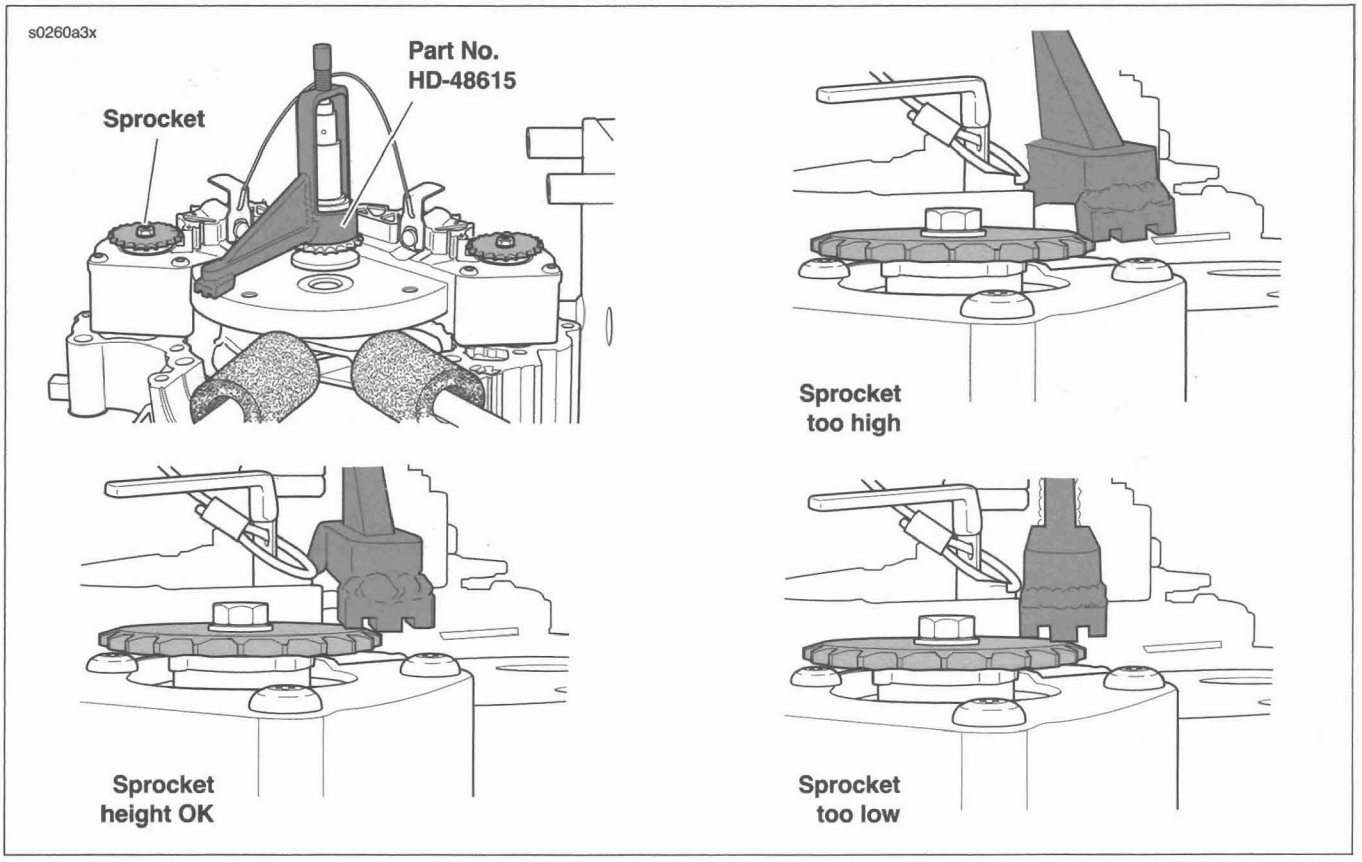


Figure 3-66. Sprocket Alignment

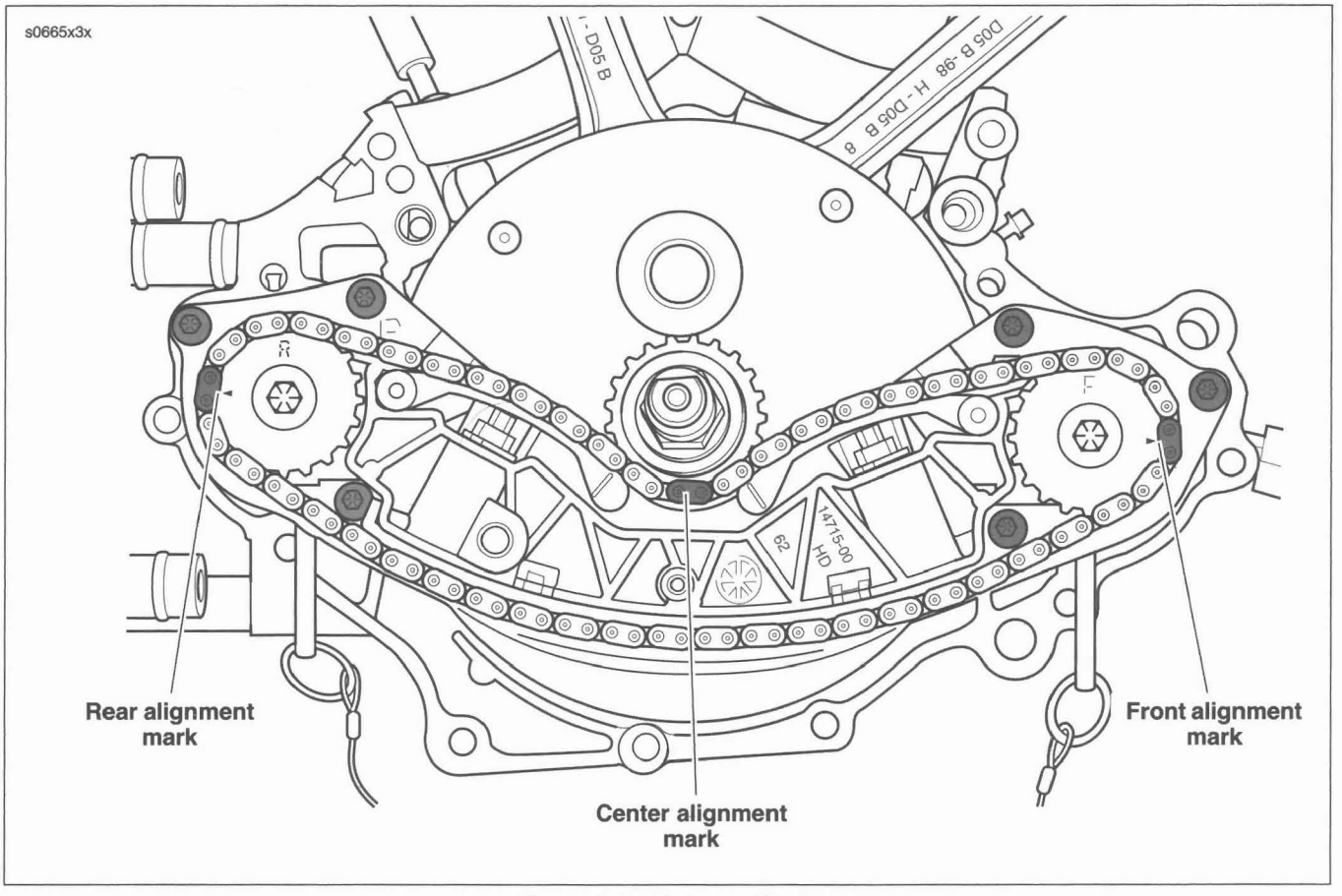
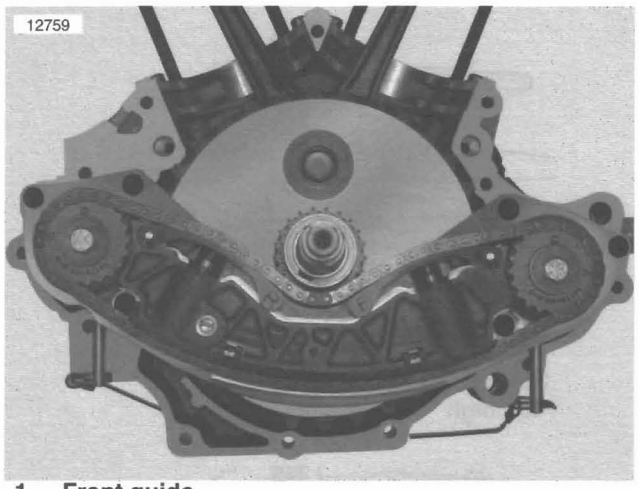
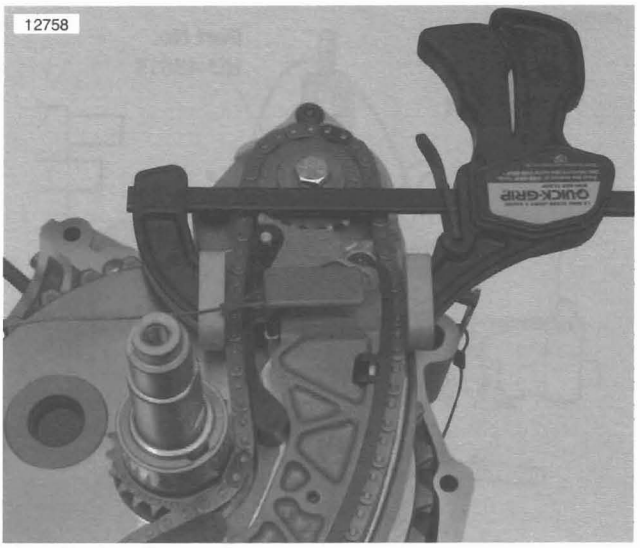


Figure 3-67. Balance Chain



1. Front guide
2. Rear guide
3. Lower guide
4. Retention tabs
5. Rubber interconnect

Figure 3-68. Chain Tensioner Guides



1. Hydraulic tensioner compressor
2. Hydraulic tensioner retainers
3. Hydraulic tensioner

Figure 3-69. Hydraulic Tensioner Tools (Front Tensioner Shown)

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.
2. 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.
3. Slide flywheel assembly into left crankcase half. Remove CRANKSHAFT GUIDE tool.
4. Tip crankcase assembly in engine stand so that flywheel pinion shaft is pointing straight up.
5. 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.

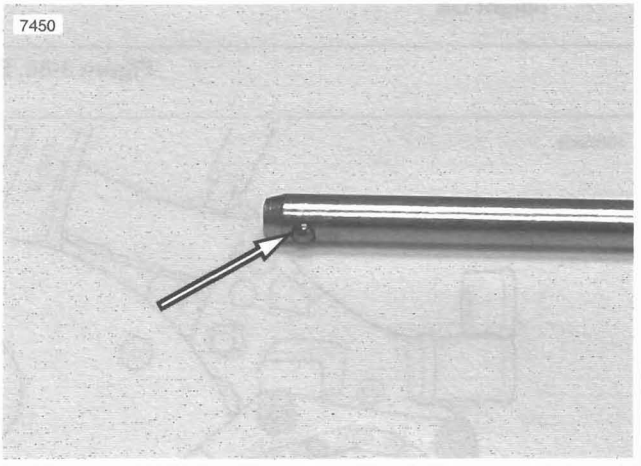
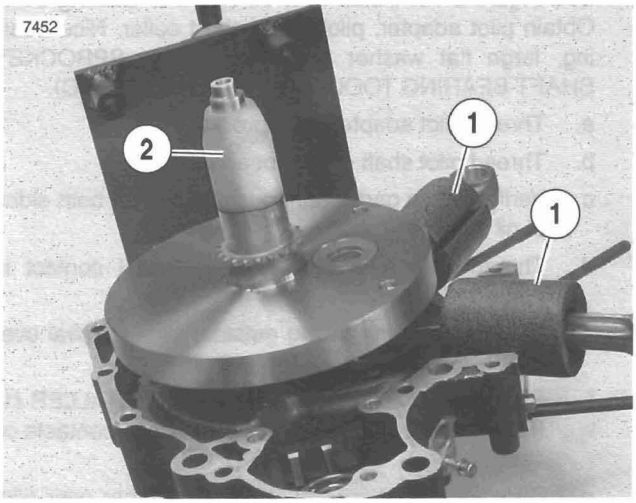


Figure 3-70. Balance Shaft Retention Pin

6. See Figure 3-68. Install **new** rubber interconnect (5) on chain guide bracket assembly.
7. See Figure 3-67. Verify correct position of all three timing marks on chain and timing mark on flywheel balance sprocket.
8. 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).
9. See Figure 3-71. 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.
10. Mate case halves sliding bearing roller in right crankcase half over end of crankshaft. Remove tool.
11. See Figure 3-72. Start the twelve crankcase bolts and tighten in the following sequence.
    a. Alternately turn each crankcase bolt until finger tight.
    b. 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.
13. Install thrust washer on sprocket shaft with "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 3-71. Crankshaft Guide (Part No. HD-42326-A)

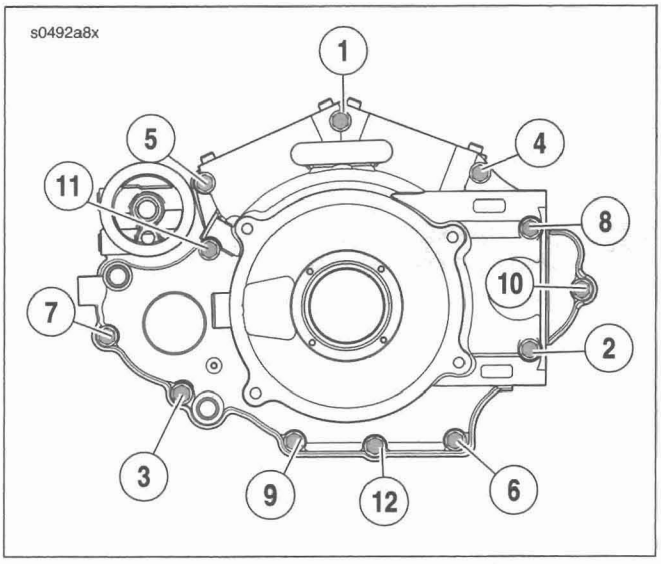


Figure 3-72. Tighten In Sequence Shown

14. See Figure 3-73. Install **new** oil seal into bearing bore. Obtain pilot adapter, pilot shaft, short collar, Nice bearing, large flat washer and handle from SPROCKET SHAFT BEARING TOOL (Part No. HD-97225-55C).
    a. Thread pilot adapter into sprocket shaft.
    b. Thread pilot shaft onto pilot adapter.
    c. Verify that lip garter spring is in place on both sides of oil seal.
    d. Thread pilot onto sprocket shaft until contact is made with shoulder.
    e. With the lettering facing outside, slide oil seal over pilot until it contacts bearing bore.
    f. Set SPROCKET SHAFT OIL SEAL INSTALLER (1) (Part No. HD-39361-B) over pilot until it contacts oil seal.
    g. Slide Nice bearing and large flat washer over pilot until contact is made with seal installer.
    h. Thread handle onto pilot shaft.
    i. Rotate handle in a clockwise direction until oil seal installer makes firm contact with crankcase stator mount.
    j. Remove handle, flat washer, Nice bearing, seal installer and pilot from sprocket shaft.
15. Rotate handle in a clockwise direction until oil seal installer makes firm contact with crankcase stator mount.
16. Remove handle, flat washer, Nice bearing, short collar, seal installer, pilot shaft and pilot adapter from sprocket shaft.

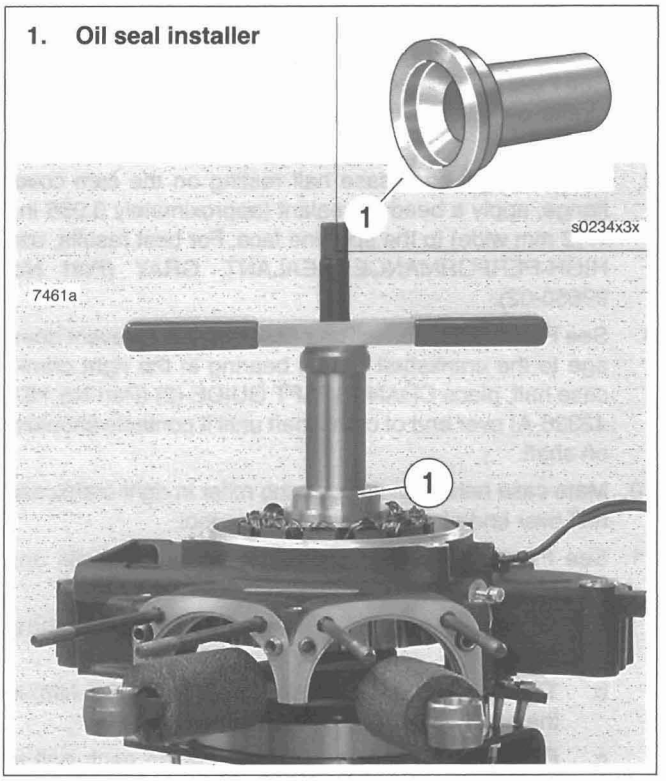


Figure 3-73. Sprocket Shaft Oil Seal Installer (Part No. HD-39361-A)

⚠WARNING

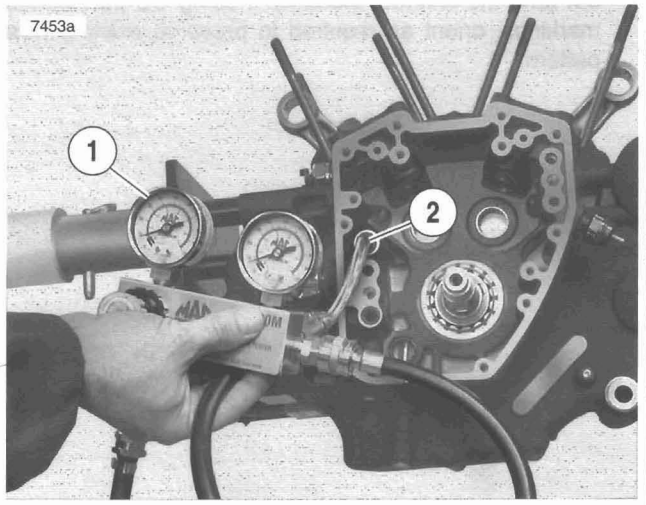
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

17. See Figure 3-74. 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/m^2). 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/m^2) using a remote pressure regulator if necessary.*
- *All SNAP-ON meters will use a baseline of a 50% change when outlet is plugged.*

    d. 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/m^2) drop on a MAC meter or a 6-16% drop (SNAP-ON meter reads 56-66) from 35 PSI (241 kN/m^2).



1. **Leakdown tester**
2. **Chain guide oil passage**

Figure 3-74. Leakdown Test

f. If a leak rate higher than 11 PSI (75 kN/m^2) 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.

18. See Figure 3-75. Assemble and install oil pump. Lubricate parts with clean H-D 20W50 engine oil during assembly.

    a. Apply a very thin film of clean H-D 20W50 engine oil to **new** scavenge port stub O-ring (6). Install **new** O-ring on scavenge port stub of oil pump housing.

    b. Slide oil pump housing (5) onto crankshaft fitting O-ring 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.

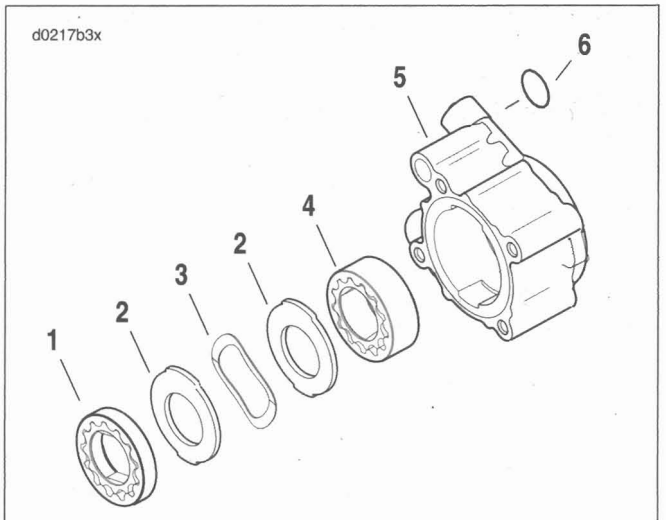
    c. Separate the gerotor gears into two sets, one wide (4) (scavenge) and the other narrow (1) (feed).

    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).

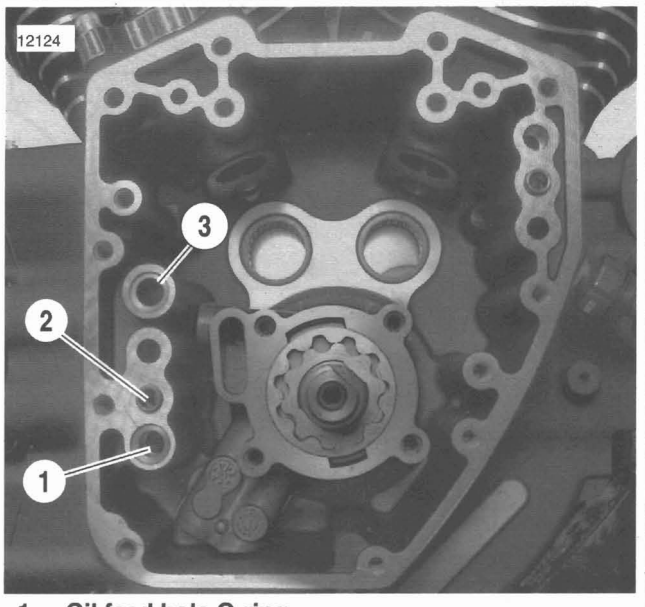
    f. Fit the smaller of the narrow gerotor gears into the larger. Slide the narrow gerotor set (1) down the crankshaft until it contacts the outside separator plate (2).

    g. See Figure 3-76. Apply a very thin film of clean H-D 20W50 engine oil to **new** O-ring (3) for crankcase post. Install **new** O-ring in groove on crankcase post.



1. **Narrow gerotor set (feed)**
2. **Separator plate**
3. **Wave washer**
4. **Wide gerotor set (scavenge)**
5. **Oil pump housing**
6. **Scavenge port O-ring**

Figure 3-75. Assembling Oil Pump



1. **Oil feed hole O-ring**
2. **Rear ring dowel**
3. **O-ring on crankcase post**

Figure 3-76. Oil Feed Hole

COVER AND CAM SUPPORT PLATE

PART NO.	SPECIALTY TOOL
HD-47941	Camshaft locking tool

NOTE

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. See Figure 3-76. 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).
2. Lubricate cam needle bearings with clean H-D 20W50 engine oil.
3. See Figure 3-77. Using a straightedge, verify that the timing marks on the ends of the front and rear camshafts are in alignment. If necessary, rotate camshafts in order to make this observation.

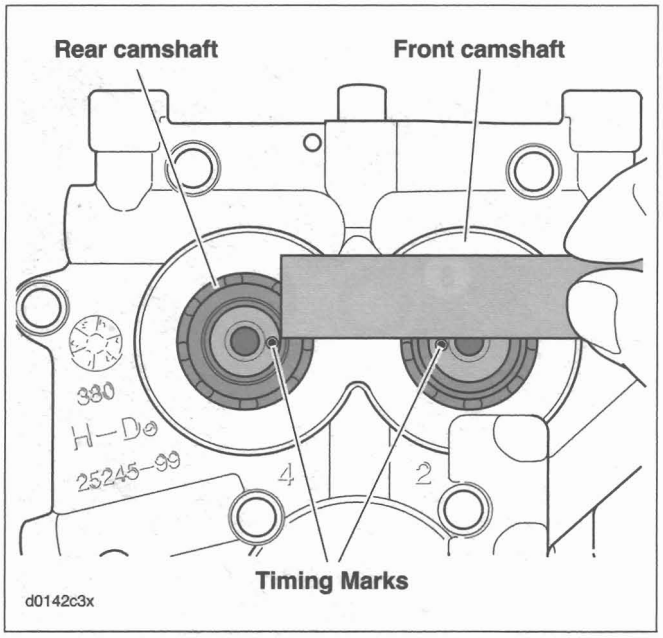


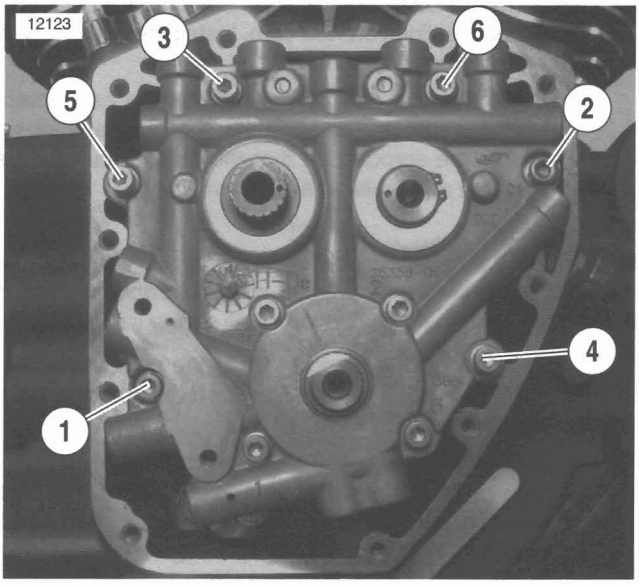
Figure 3-77. Checking Camshaft Alignment

4. 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.
5. See Figure 3-78. 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.
6. See Figure 3-79. Install oil pump. Start two screws (1/4 x 1.0 in.) into holes 3 and 4.

NOTE

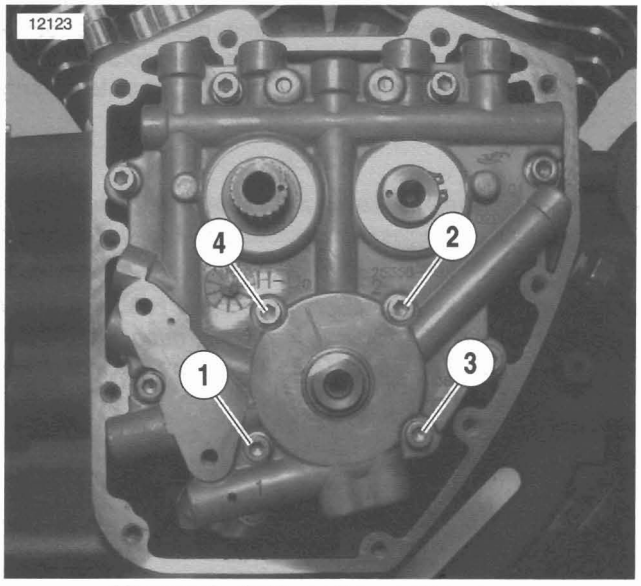
For methods of engine rotation, see ROCKER ARM SUPPORT PLATE under 3.16 TOP END OVERHAUL: DISASSEMBLY.

   c. While rotating the engine, enabling the pump to find its natural center, alternately tighten screws until snug.
   d. Alternately tighten screws in holes #3 and #4 to 40-45 **in-lbs** (4.5-5.1 Nm).
   e. Final tighten all four 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.
   f. With the lettering facing inboard, install rear cam sprocket spacer onto the rear camshaft.



Alternately tighten all six cam support plate screws in the sequence shown.

Figure 3-78. Cam Support Plate Torque Sequence



Alternately tighten all four oil pump screws in the sequence shown.

Figure 3-79. Oil Pump Torque Sequence

7. 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:

   a. Install primary cam sprocket onto splines of rear camshaft. Install long flange bolt with thicker flat washer to secure sprocket to end of camshaft.

   b. 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 11(e).

   c. See Figure 3-80. To prevent rotation, position the CRANKSHAFT/CAMSHAFT SPROCKET LOCKING TOOL (Part No. HD-47941) 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.

NOTE

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.

NOTES

- *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.*

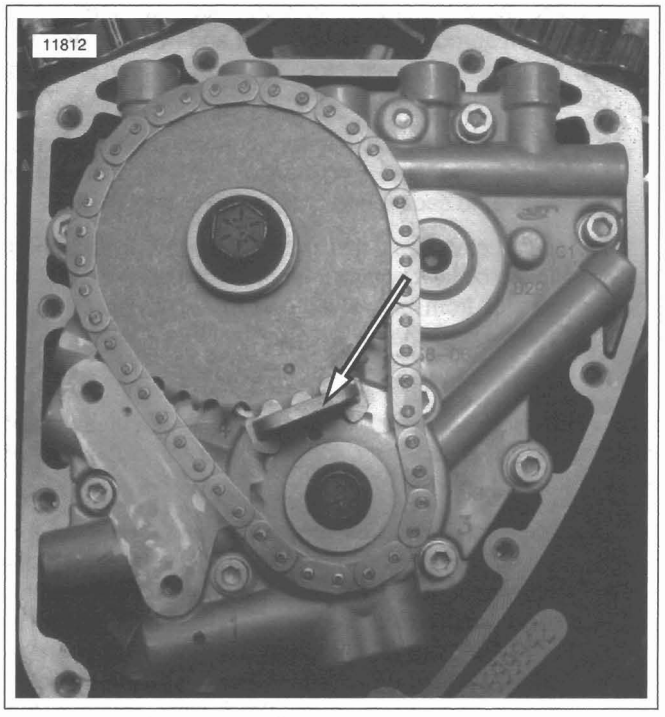


Figure 3-80. Camshaft Locking Tool

Figure 3-81. Check Alignment of Crank and Rear Cam Sprocket Faces

Table 3-4. Rear Cam Sprocket Spacers

PART NO.	IN.	MM
25729-06	0.100	2.54
25731-06	0.110	2.79
25734-06	0.120	3.05
25736-06	0.130	3.30
25737-06	0.140	3.56
25738-06	0.150	3.81

8. See Figure 3-82. Apply a light amount of clean H-D 20W50 oil to splines on rear cam. Install the primary cam chain and sprocket assembly.
   a. 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.

NOTE

To maintain the original direction of rotation, verify that the colored mark placed on the chain link and crank sprocket is facing away from the cam support plate during installation.

   b. 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.
9. See Figure 3-83. 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. Locate alignment mark (5) on cam support plate 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 build-up of LOCTITE THREADLOCKER from the bolt holes with the proper sized thread chaser.*

10. See Figure 3-83. 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.
11. 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 LOCTITE THREADLOCKER 262 (red) before installation. The crank and rear cam sprocket flange bolts and flat washers are **not** interchangeable.*

12. Position the CRANKSHAFT/CAMSHAFT SPROCKET LOCKING TOOL (Part No. HD-47941) 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 ft-lbs (46.1 Nm).
    d. Final tighten the crank sprocket bolt (3) to 24 ft-lbs (32.5 Nm).
    e. Remove the sprocket locking tool.
13. Install primary cam chain tensioner. Tighten fasteners to 100-120 in-lbs (11.3-13.6 Nm).
14. Apply clean H-D 20W50 engine oil to crank and rear cam sprockets.
15. See Figure 3-84. Align holes in **new** cam cover gasket with those in the crankcase flange.

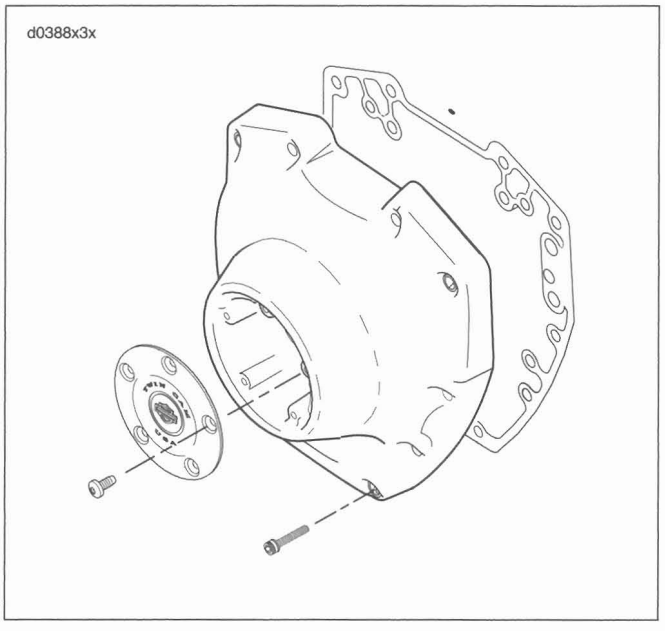
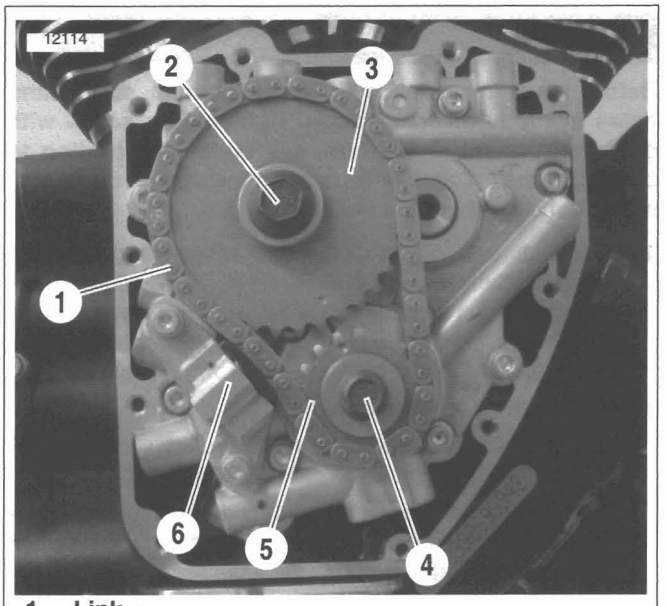
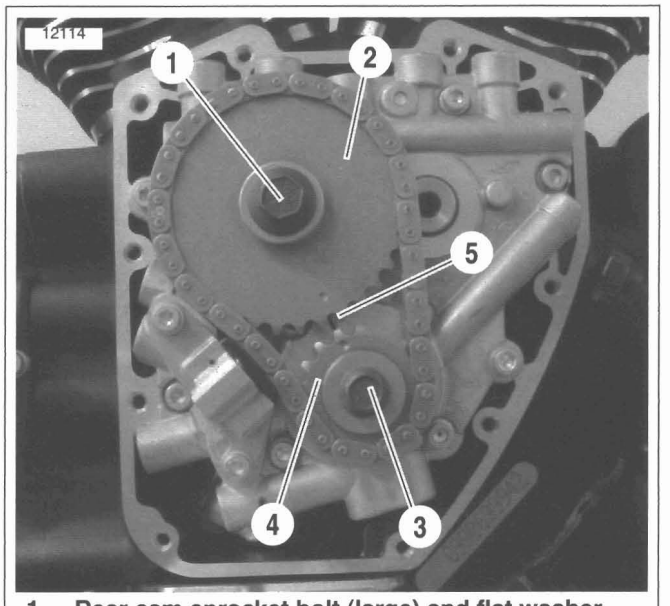


Figure 3-84. Cam Cover Gasket



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**
6. **Primary cam chain tensioner**

Figure 3-82. Cam Support Plate Assembly



1. **Rear cam sprocket bolt (large) and flat washer**
2. **Rear cam sprocket**
3. **Crank sprocket bolt (small) and flat washer**
4. **Crank sprocket**
5. **Alignment mark**

Figure 3-83. Flange Bolts

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.

16. See Figure 3-85. Install the cam cover using ten allen head socket screws (1/4 x 1-1/4 in.). Following the sequence shown, alternately tighten the screws to 125-155 **in-lbs** (14.1-17.5 Nm). If cam cover assembly was completely removed continue as follows.
17. 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.

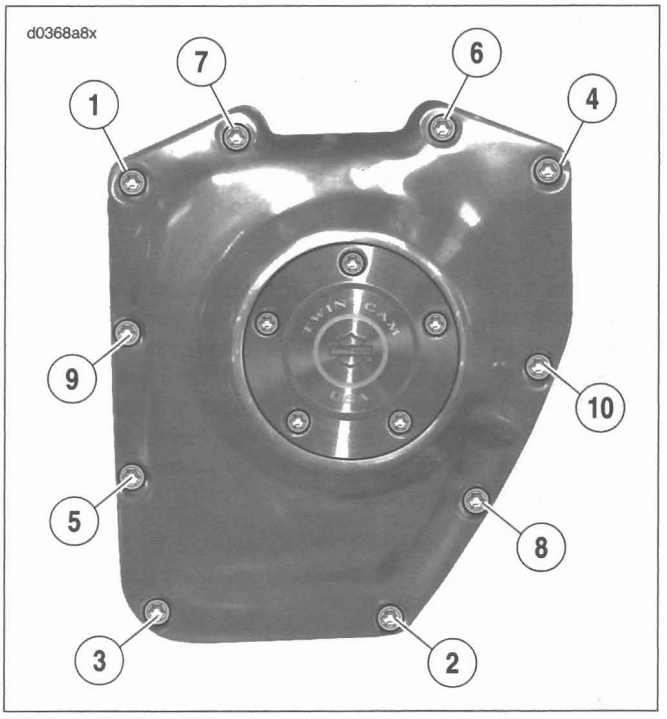


Figure 3-85. Cam Cover Installation: Alternately tighten cover screws to 125-155 in-lbs (14.1-17.5 Nm) in the sequence shown.

REMOVAL OVERVIEW

See beginning of 3.16 TOP END OVERHAUL: DISASSEMBLY to remove breather assembly.

DISASSEMBLY

1. See Figure 3-86. Remove two fasteners (1) from the breather assembly cover (2) and remove breather assembly from rocker arm support plate (8).
2. 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

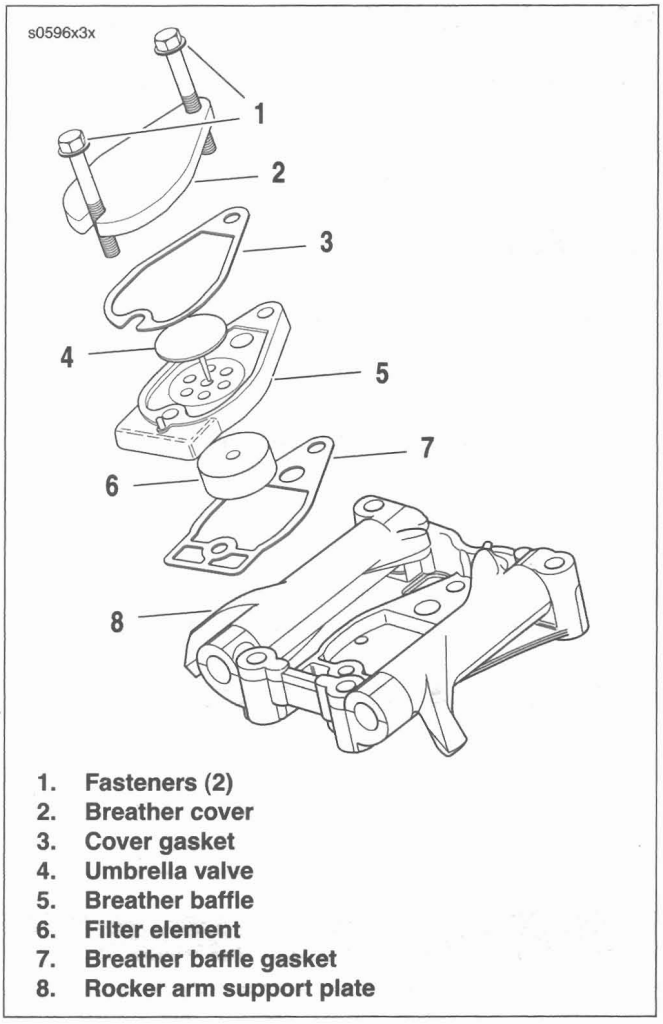
⚠WARNING

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 a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air.
2. See Figure 3-86. 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).
3. 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

1. See Figure 3-86. 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.
2. Press **new** filter element (6) into bore at bottom of baffle. Hole in filter element accommodates umbrella valve stem.



1. **Fasteners (2)**
2. **Breather cover**
3. **Cover gasket**
4. **Umbrella valve**
5. **Breather baffle**
6. **Filter element**
7. **Breather baffle gasket**
8. **Rocker arm support plate**

Figure 3-86. Breather Assembly

3. Place breather baffle gasket (7) on a clean flat surface.
   a. Aligning holes, place breather baffle (5), cover gasket (3) and breather cover (2) on top of breather baffle gasket.
   b. Slide two fasteners (1) through stackup to keep assembly together until time of installation.

INSTALLATION OVERVIEW

See BREATHER ASSEMBLY under 3.17 TOP END OVERHAUL: ASSEMBLY.

1. Install breather assembly.
2. 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.

DISASSEMBLY

1. See Figure 3-87. 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.
2. 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.
3. Remove the rocker arms from the rocker arm support plate. Mark the rocker arms to indicate location.

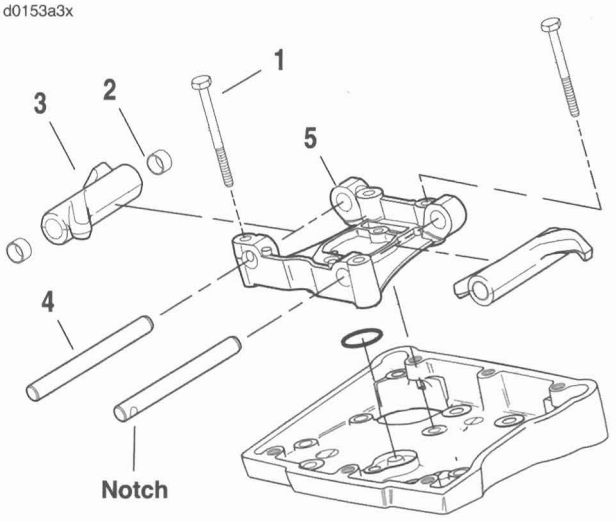
CLEANING AND INSPECTION

PART NO.	SPECIALTY TOOL
HD-94804-57	Rocker arm bushing reamer

⚠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 a non-volatile cleaning solution or solvent. Blow parts dry with low pressure compressed air.
2. See Figure 3-87. 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.



1. **Bolt with flat washer**
2. **Rocker arm bushings**
3. **Rocker arm**
4. **Rocker arm shaft**
5. **Rocker arm support plate**

Figure 3-87. Rocker Arm Assembly

5. Check support plate to rocker shaft fit.
   a. See Figure 3-88. Measure the inside diameter of the rocker arm support plate bore.
   b. See Figure 3-89. Measure the outside diameter of the rocker arm shaft where it fits in the bore.
   c. 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 3-90. Measure the inside diameter of the rocker arm bushing.
   b. See Figure 3-91. Measure the outside diameter of the rocker arm shaft where it rides in the bushing.
   c. 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).

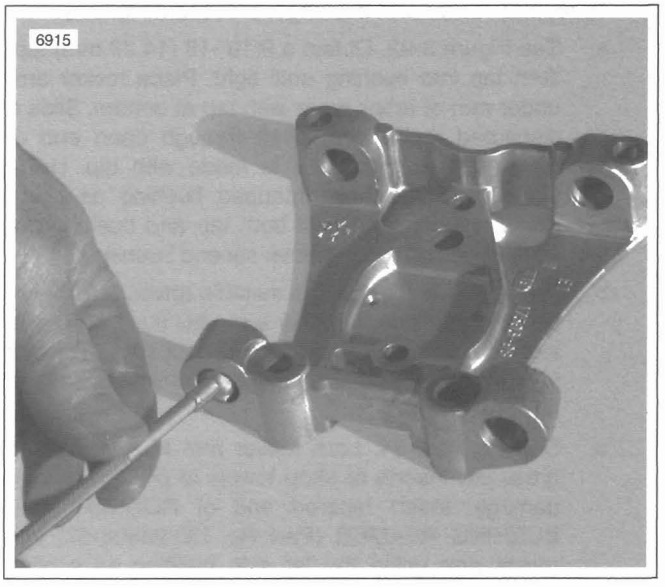


Figure 3-88. Checking Support Plate Bore

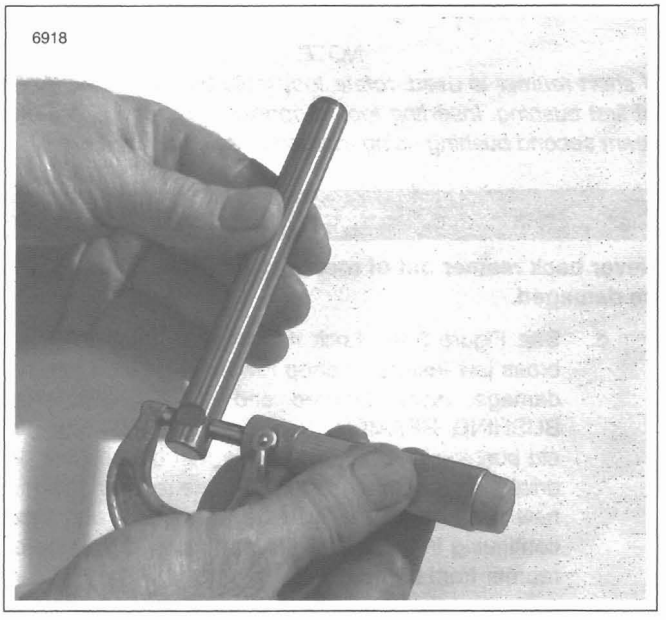


Figure 3-89. Checking Shaft to Support Plate Fit

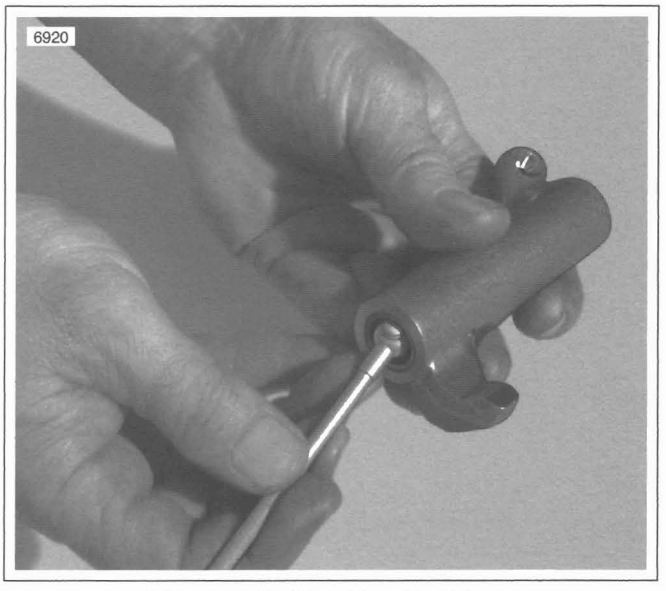


Figure 3-90. Checking Bushings

7. To replace rocker arm bushings, proceed as follows:
   a. See Figure 3-92. 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 3-93. 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 3-94. 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.

NOTE

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 3-94. 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.

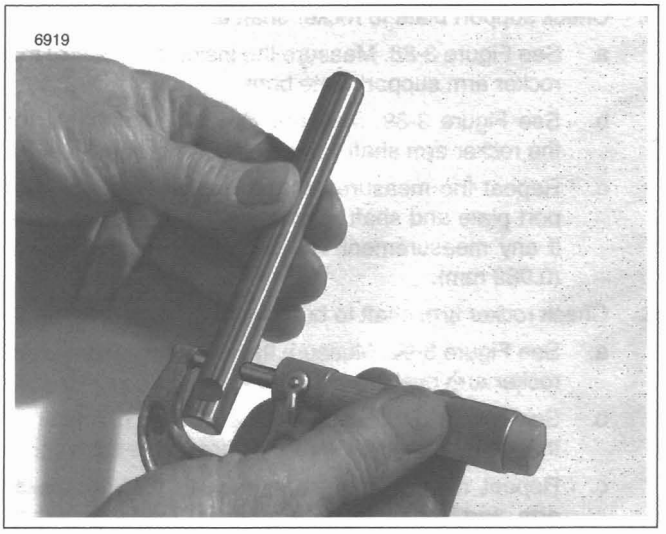


Figure 3-91. Checking Shaft to Bushing Fit

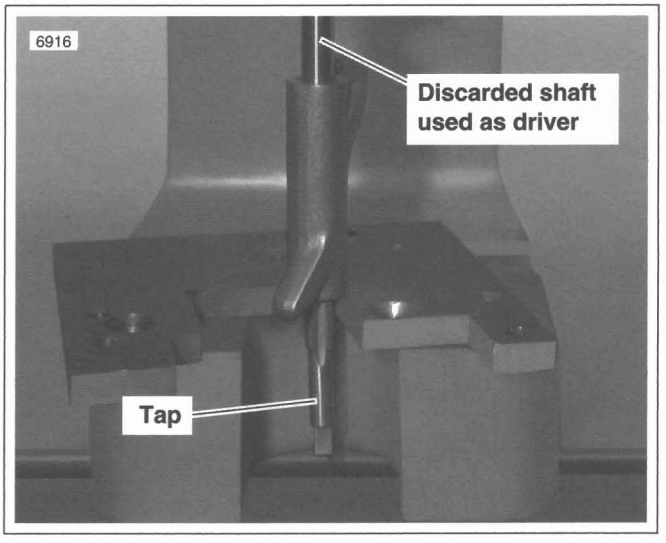


Figure 3-92. Removing Bushings

ASSEMBLY

1. Place the rocker arms into position on the rocker arm support plate.
2. 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 3-95. Check for proper end play.
   a. 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).
4. 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.

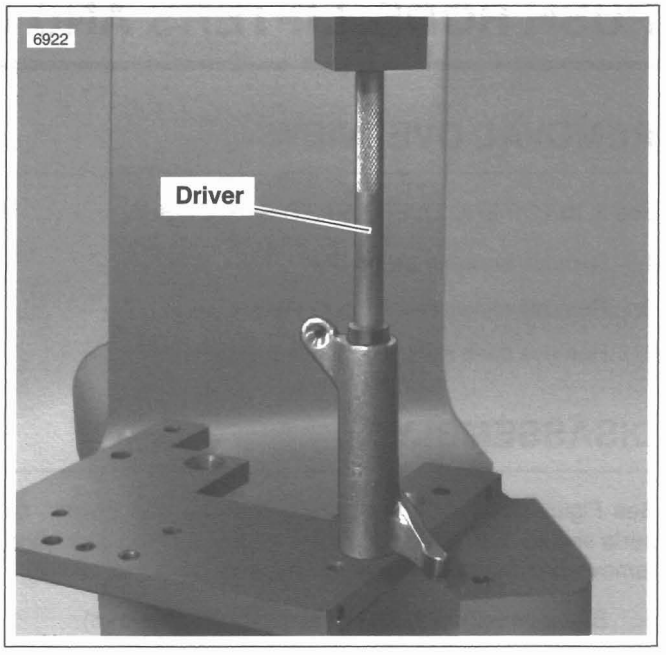


Figure 3-93. Install Bushings

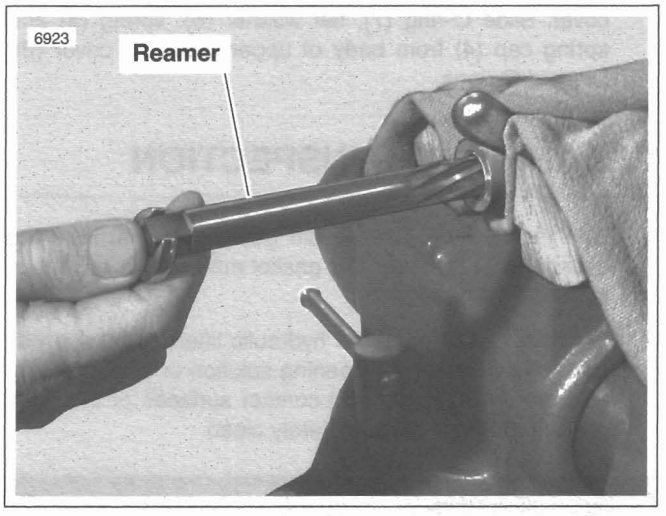


Figure 3-94. Ream Bushings

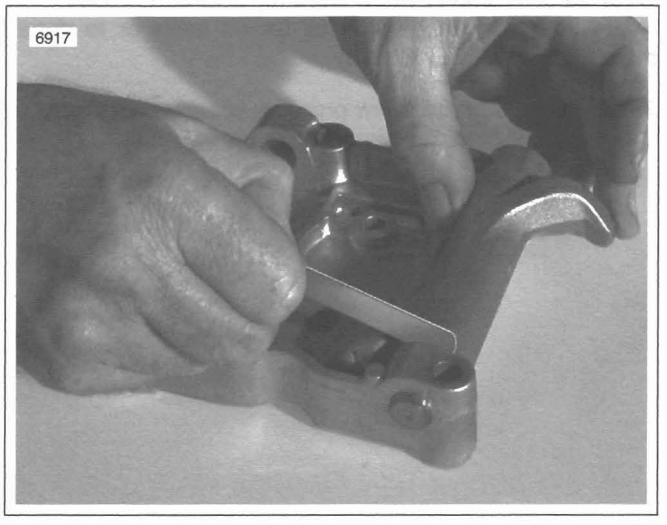


Figure 3-95. Check End Play

REMOVAL OVERVIEW

See 3.16 TOP END OVERHAUL: DISASSEMBLY.

1. Remove breather assembly.
2. Remove rocker arm support plate.
3. Remove push rods, lifters and covers.

DISASSEMBLY

See Figure 3-96. 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.

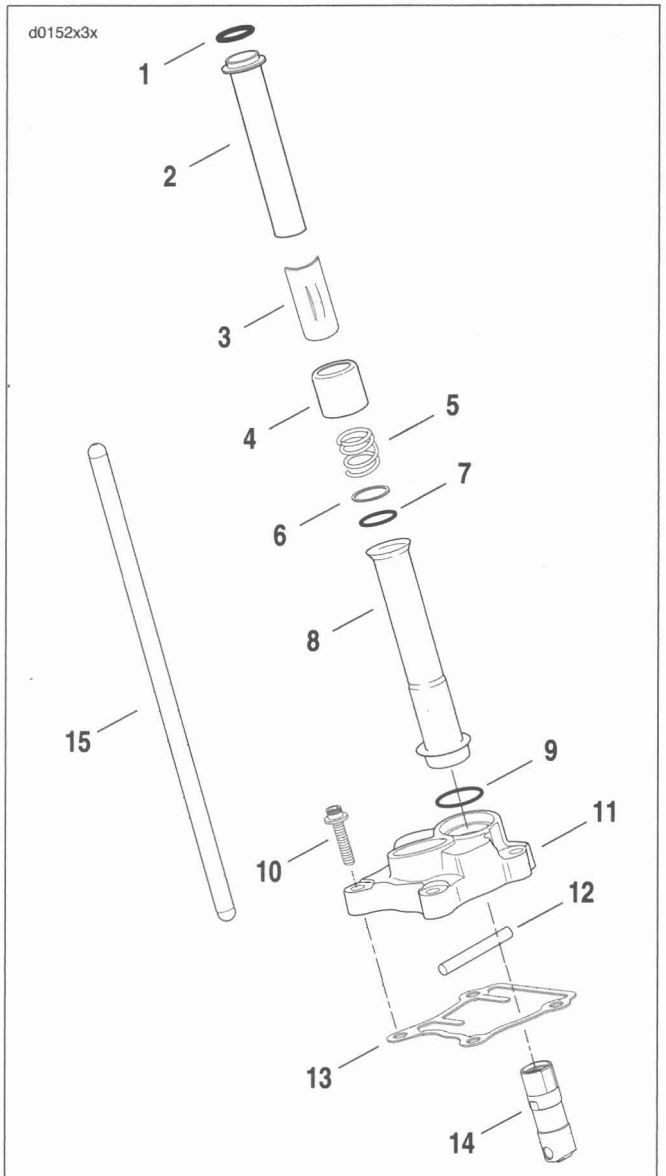
CLEANING AND INSPECTION

1. See Figure 3-96. 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.

⚠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. Blow parts dry with low pressure compressed air. Verify that all oil holes are clean and open.



1. **Upper O-ring (small)**
2. **Upper push rod cover**
3. **Spring cap retainer**
4. **Spring cap**
5. **Spring**
6. **Flat washer**
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 3-96. Push Rods, Lifters and Covers

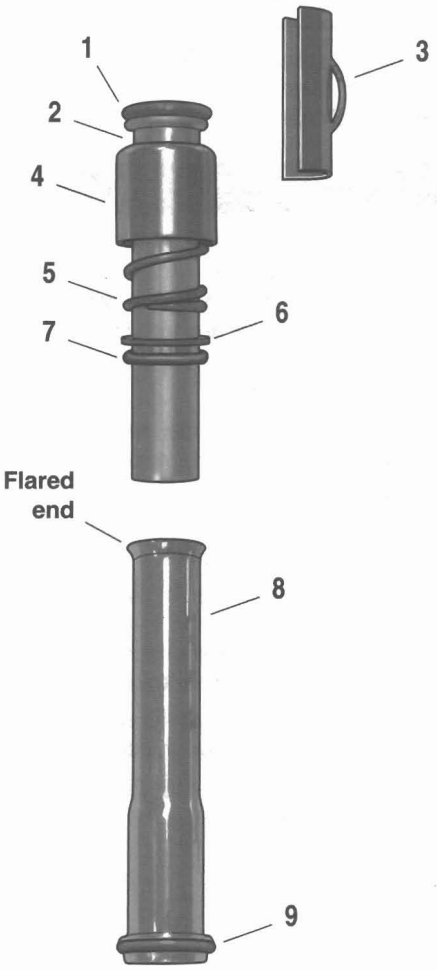
4. Verify that the hydraulic lifter rollers turn freely and are free of flat spots, scuff marks and pitting. If flat spots exist, examine the cam lobe on which the lifter operates.
5. Inspect the lifter socket for signs of wear. Verify that the plunger of the hydraulic lifter is fully extended up against the C-clip. Use index finger to pump plunger to verify lifter operation.
6. 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.

1. Inspect lifters for excessive clearance in bores. Accurately measure tappet bore inner diameter with a gauge.
   a. Clearance should be within 0.0008-0.0020 in. (0.0203-0.0508 mm).
   b. Fit a **new** lifters and/or replace crankcases if clearance exceeds SERVICE WEAR LIMIT of 0.0030 in. (0.076 mm).
2. Check lifter radial play.
   a. Roller clearance on pin should be within 0.0006-0.0010 in. (0.0152-0.0254 mm).
   b. Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.0015 in. (0.0381 mm).
3. Check lifter roller end clearance.
   a. End clearance should be within 0.008-0.022 in. (0.203-0.559 mm).
   b. Replace lifters showing any sign of up or down movement on roller.
   c. Replace lifters if clearance exceeds SERVICE WEAR LIMIT of 0.026 in. (0.660 mm).
4. Soak lifters in clean engine oil. Keep covered until assembly.



1. **Upper O-ring (small)**
2. **Upper push rod cover**
3. **Spring cap retainer**
4. **Spring cap**
5. **Spring**
6. **Flat washer**
7. **Middle O-ring (intermediate)**
8. **Lower push rod cover**
9. **Lower O-ring (large)**

Figure 3-97. 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.

1. See Figure 3-97. 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.
2. Install **new** small O-ring (1) on seat at the top of the upper push rod cover (2).
3. 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.
3. 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 3-98. 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.
   b. Clamp tool in vise at a 45 degree angle or one that offers a comfortable working position.

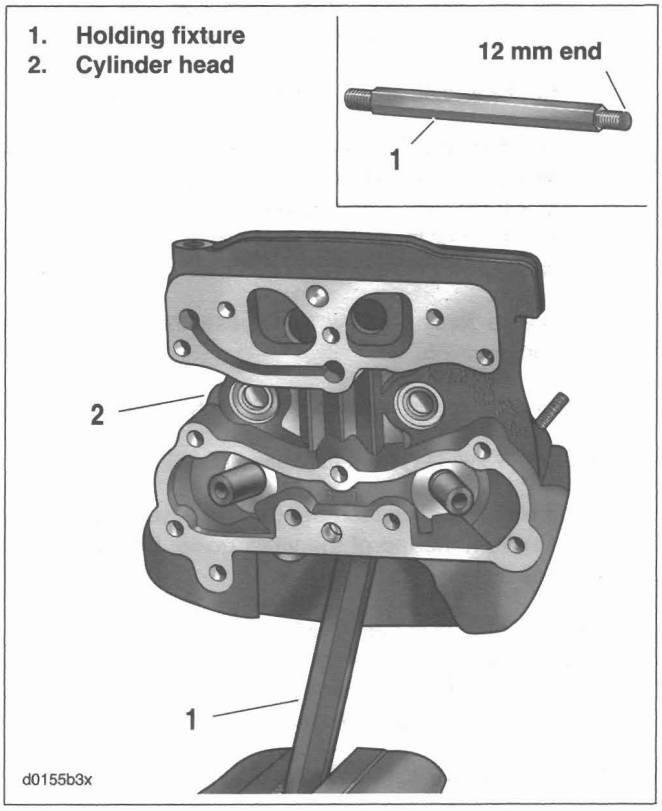


Figure 3-98. Cylinder Head Holding Fixture (Part No. HD-39786-A)

3. See Figure 3-99. 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 3-100. 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).
6. 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.
7. 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.

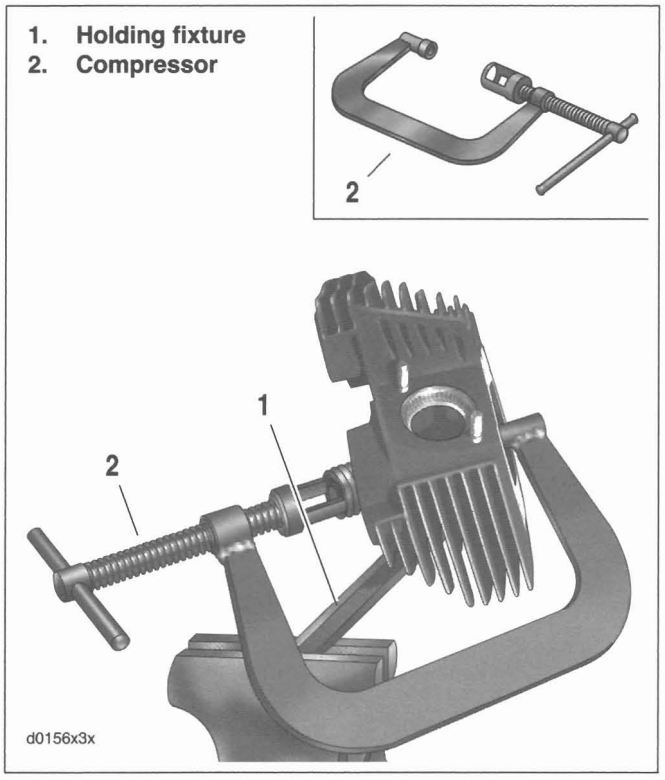
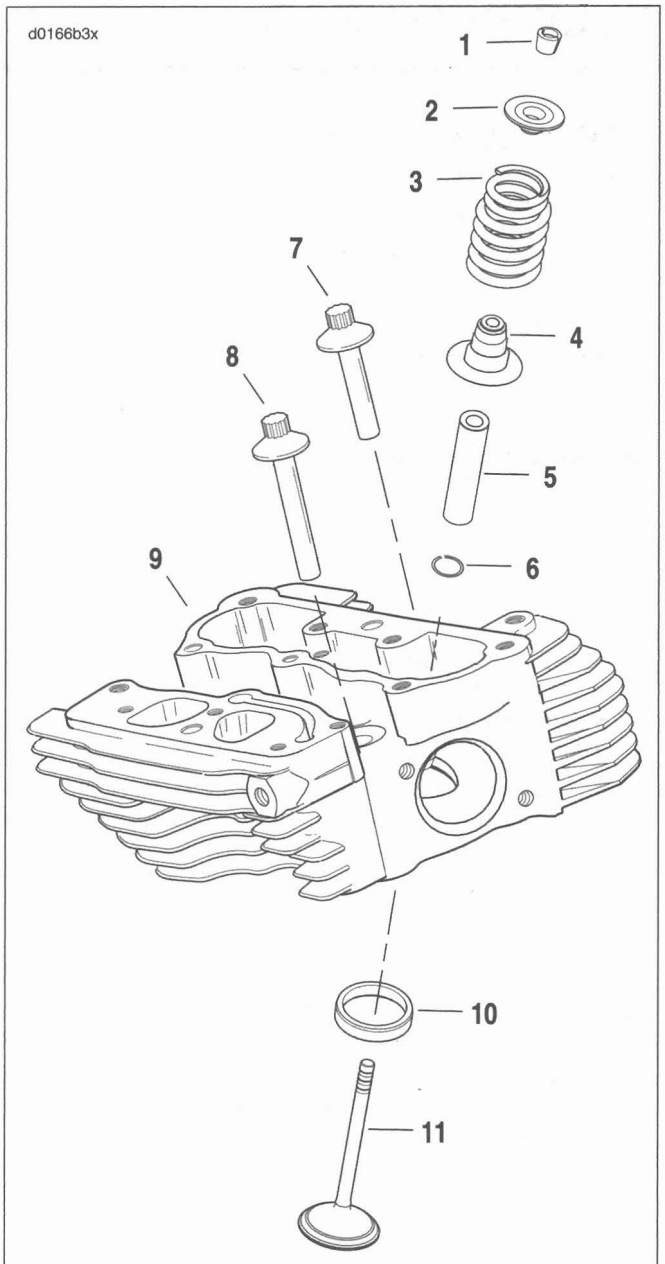


Figure 3-99. Valve Spring Compressor (Part No. HD-34736-B)



1. Tapered keepers
2. Spring retainer
3. Valve spring
4. Spring seat/valve stem seal
5. Valve guide
6. Lock ring
7. Cylinder head bolt, short
8. Cylinder head bolt, long
9. Cylinder head
10. Valve seat
11. Valve

Figure 3-100. Cylinder Head Assembly

CLEANING

1. See Figure 3-100. 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 non-damaging 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.**

2. 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.
3. 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.
4. 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

1. 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.
   b. 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 TOOL
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

1. Replace the valve if there is evidence of burning or cracking.
2. Inspect the end of the valve stem for pitting or uneven wear. Replace the valve if either of these conditions are found.
3. Inspect for burrs around the valve stem keeper groove. Remove burrs with a fine tooth file if found.
4. 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

1. Inspect springs for broken or discolored coils. Replace springs if either of these conditions are found.
2. 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.
3. 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.
2. 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.
2. 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 3-101. 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).
   b. 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.

2. At top of the cylinder head, insert valve guide driver (1) into valve guide bore until stopped by shoulder.
3. See Figure 3-102. Center valve guide driver under ram of arbor press. Apply pressure until valve guide drops free of cylinder head. Discard valve guide.
4. 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-39782-3)**
4. **Exhaust seat adapter (Part No. HD-39782-4)**
5. **Valve guide installer sleeve (Part No. B-45524-2A)**

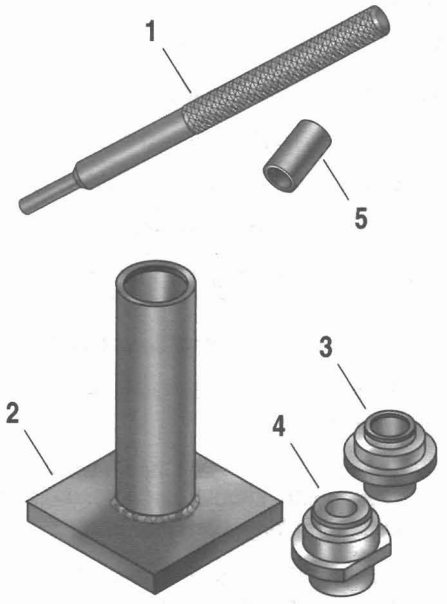
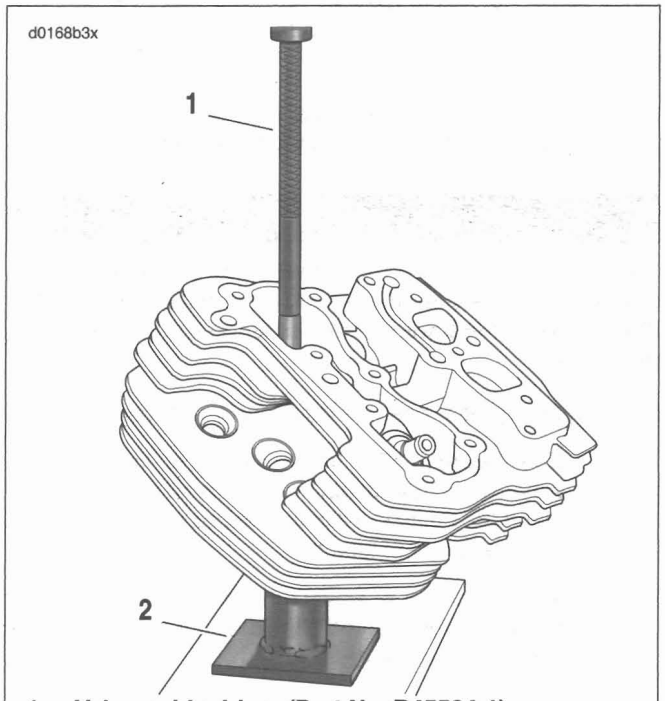


Figure 3-101. Valve Guide Replacement Tools



1. **Valve guide driver (Part No. B45524-1)**
2. **Cylinder head stand (Part No HD-39782-A)**

Figure 3-102. 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.
   b. 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 3-101. 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.
   b. 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.

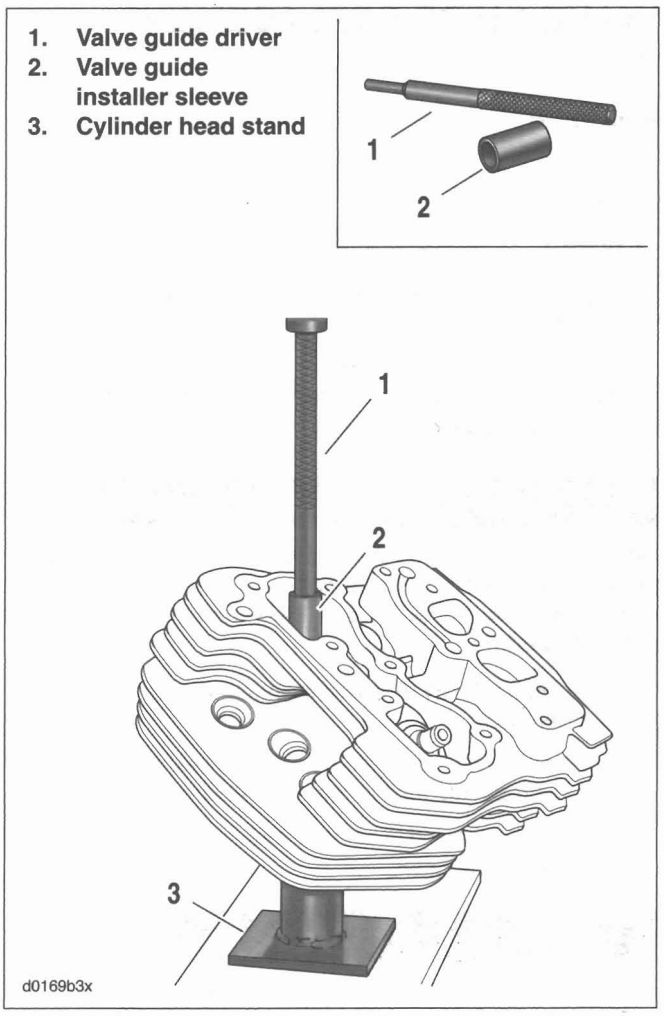


Figure 3-103. Install Valve Guide

d. See Figure 3-103. 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.

CAUTION

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.

h. 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.

a. 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.

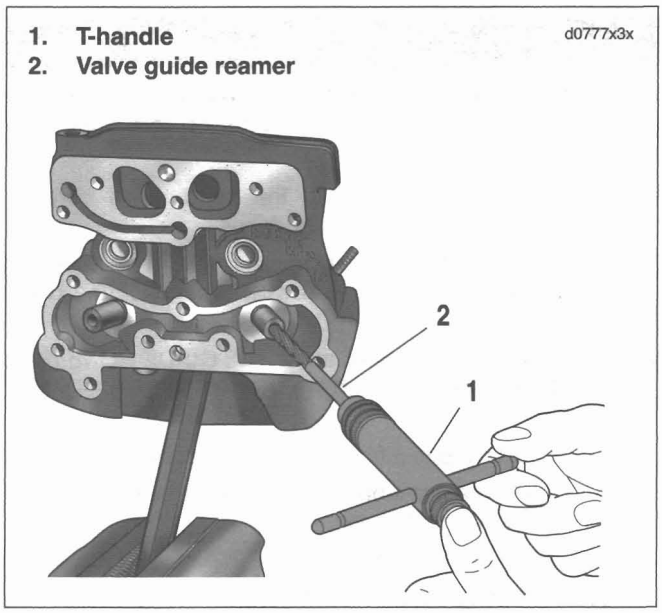


Figure 3-104. Reaming Valve Guide Bore

5. See Figure 3-104. 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).

b. 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.

d. 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.

e. Remove T-handle from reamer, and carefully pulling on bit, draw shaft of reamer out combustion chamber side of valve guide.

CAUTION

Abrasive particles can damage machined surfaces and plug oil passageways possibly resulting in engine failure.

6. Direct compressed air into the valve guide bore to remove any metal shavings or debris.
7. See Figure 3-105. Clean valve guide bore with the VALVE GUIDE CLEANING BRUSH (Part No. HD-34751-A).
8. See Figure 3-106. 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.

9. 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.
    a. Measure the inside diameter of the valve guide with an inside ball micrometer.
    b. 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.

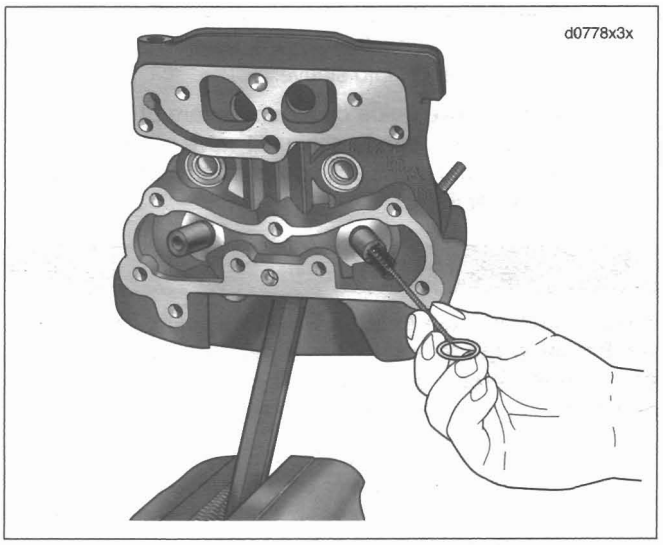


Figure 3-105. Scrubbing Valve Guide Bore

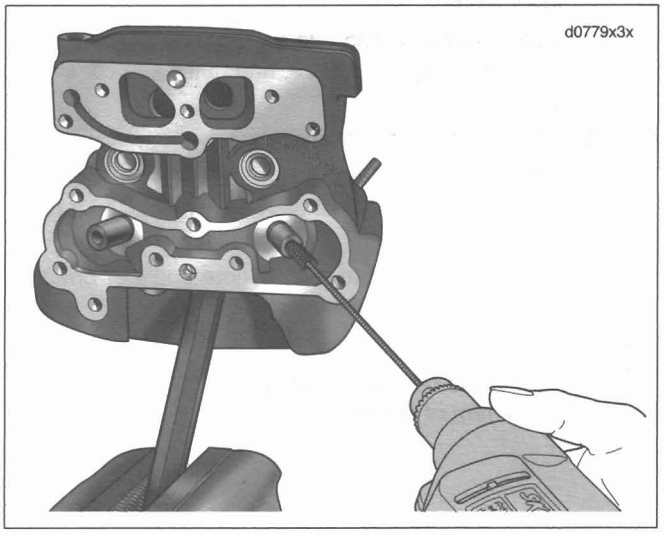


Figure 3-106. Honing Valve Guide Bore

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.

⚠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)

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°.*

1. 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 3-107. 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.
   b. 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.
4. 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.

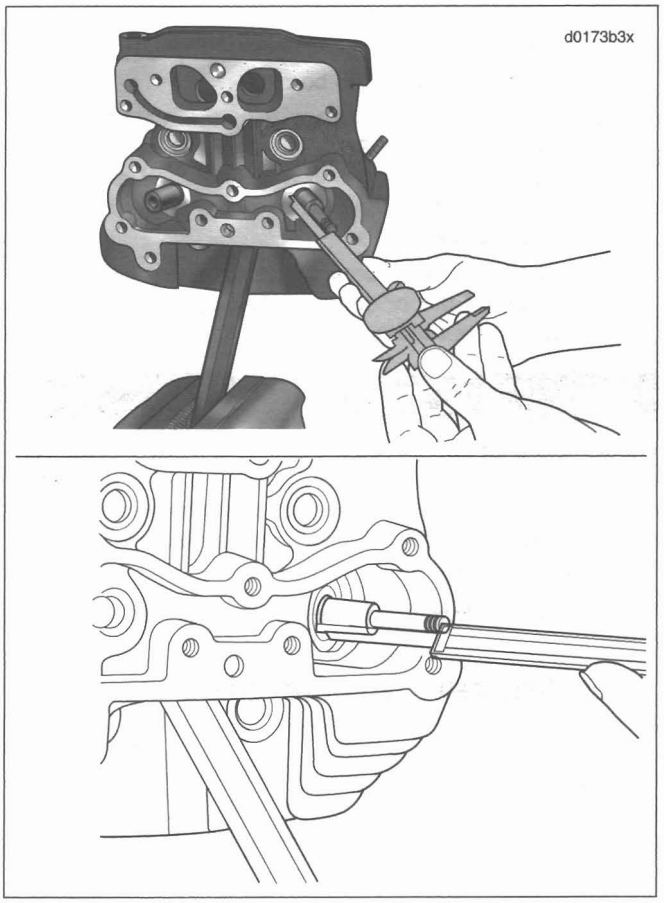


Figure 3-107. Checking Valve Stem Protrusion

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).*

7. See Figure 3-108. 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.
8. 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 clean-up 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.

10. 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.
    b. 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.*

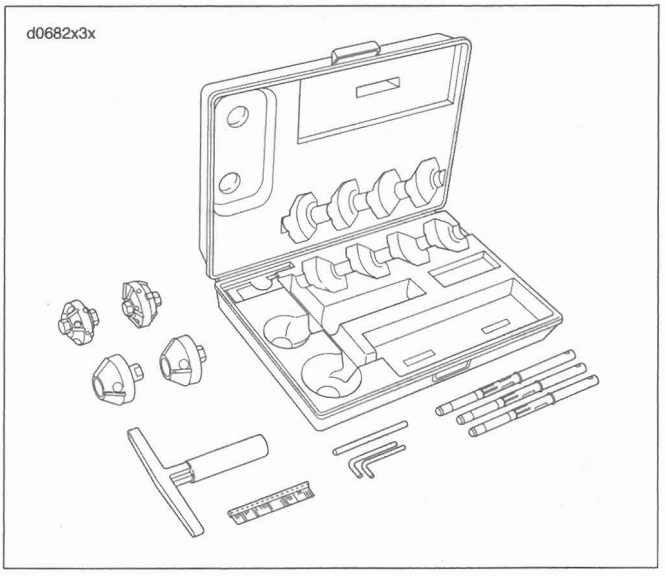


Figure 3-108. Neway Valve Seat Cutter Set

11. If the location of the valve seat is not correct, repeat steps 8 and 9.
12. 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.
13. 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.
18. Clean valves, cylinder head and valve seats in 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)

19. Blow parts dry with low pressure compressed air.

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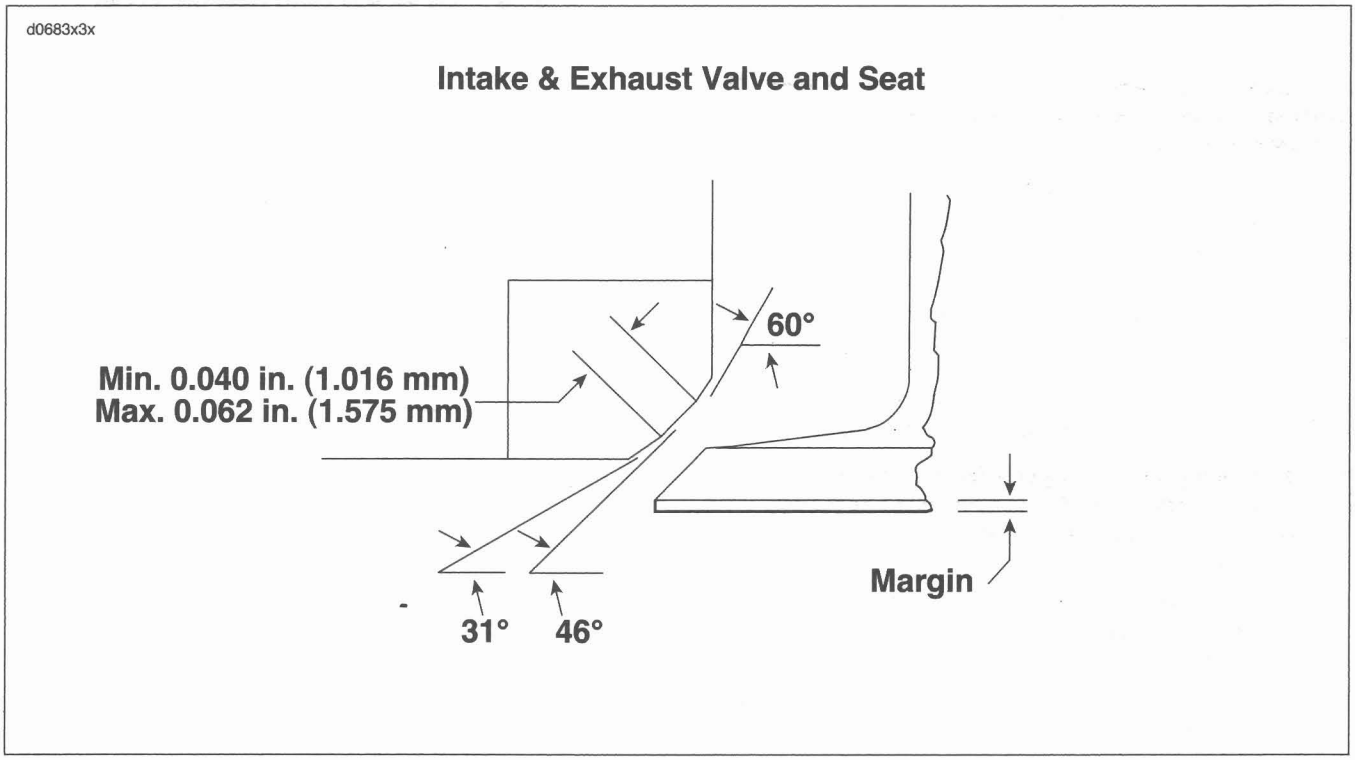


Figure 3-109. Valve and Seat Dimensions

ASSEMBLY

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.
   a. 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).

2. 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.
5. 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.
6. 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.

7. See Figure 3-110. 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.
8. Apply a very thin film of clean H-D 20W50 engine oil to capsule.
9. See Figure 3-111. Obtain **new** valve stem seal.
10. 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.

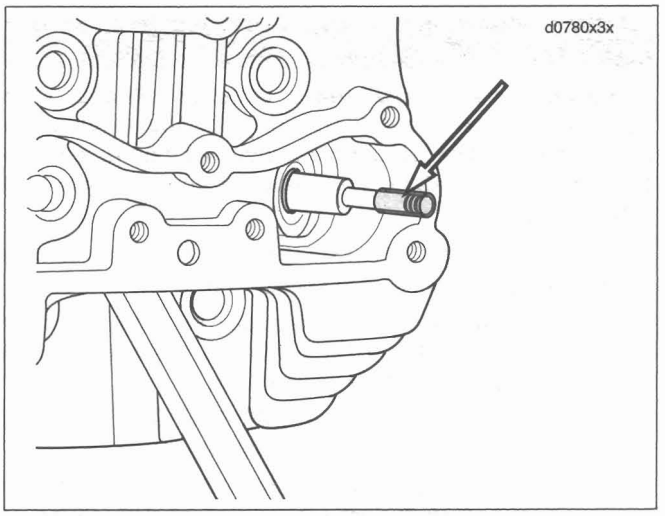


Figure 3-110. Plastic Capsule

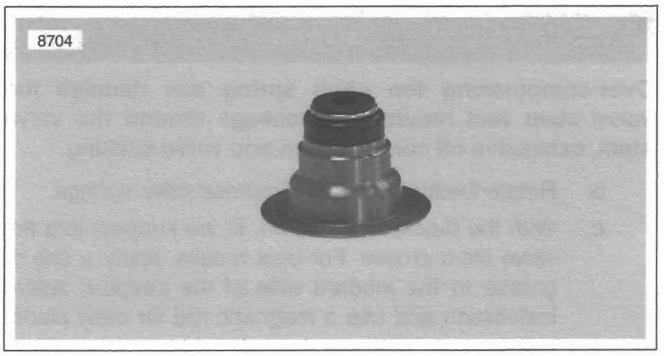


Figure 3-111. Valve Stem Seal

CAUTION

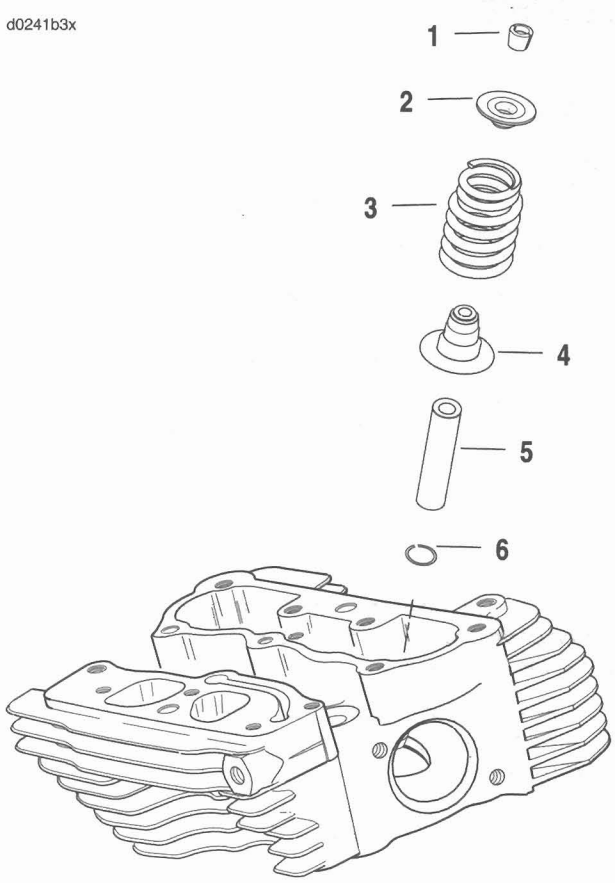
Removing the valve after seal installation will cause the valve stem seal to catch the edge of the valve stem keeper groove. The resulting damage will lead to leakage around the valve stem, excessive oil consumption and valve sticking.

11. See Figure 3-112. 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.



1. **Tapered keepers**
2. **Spring retainer**
3. **Valve spring**
4. **Spring seat/valve stem seal**
5. **Valve guide**
6. **Lock ring**

Figure 3-112. Valve Assembly

14. 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.

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.

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

1. See Figure 3-113. 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.

⚠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. 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.
3. Inspect the cylinder bore for defects or damage in the ring travel area. Replace cylinders that are severely scored, scuffed, scratched, burnt or gouged.
4. 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.
6. See Figure 3-114. Check the machined surfaces for flatness using a feeler gauge and CYLINDER TORQUE PLATES (Part No. HD-42324-A) as follows:
   a. 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.
   c. 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).

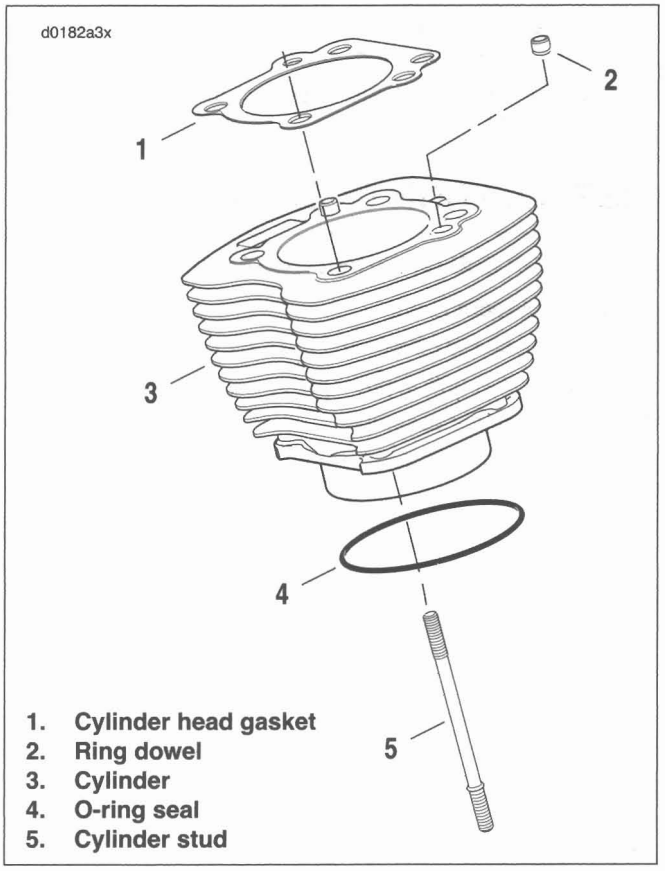


Figure 3-113. Cylinder Assembly

   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

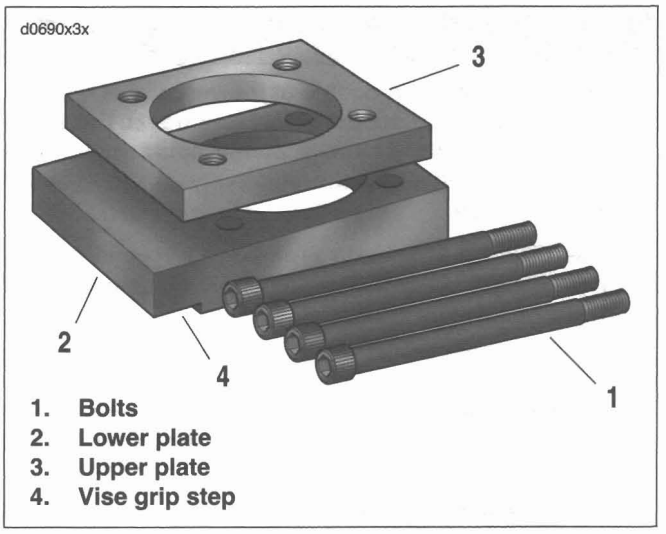
Failure to use cylinder torque plates can produce measurements that vary by as much as 0.001 in. (0.025 mm), possibly resulting in the use of parts that are not suitable for service.

1. See Figure 3-115. 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 torque plates as follows:
   a. 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.
   e. 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).
   i. 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.
   j. 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 3-115.

NOTE

For best results, obtain Snap-On® Torque Angle Gauge TA360.

   k. For purposes of inspection, remove the assembly from the vise and place on bench top.



1. **Bolts**
2. **Lower plate**
3. **Upper plate**
4. **Vise grip step**

Figure 3-114. Cylinder Torque Plates (Part No. HD-42324-A)

CAUTION

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.

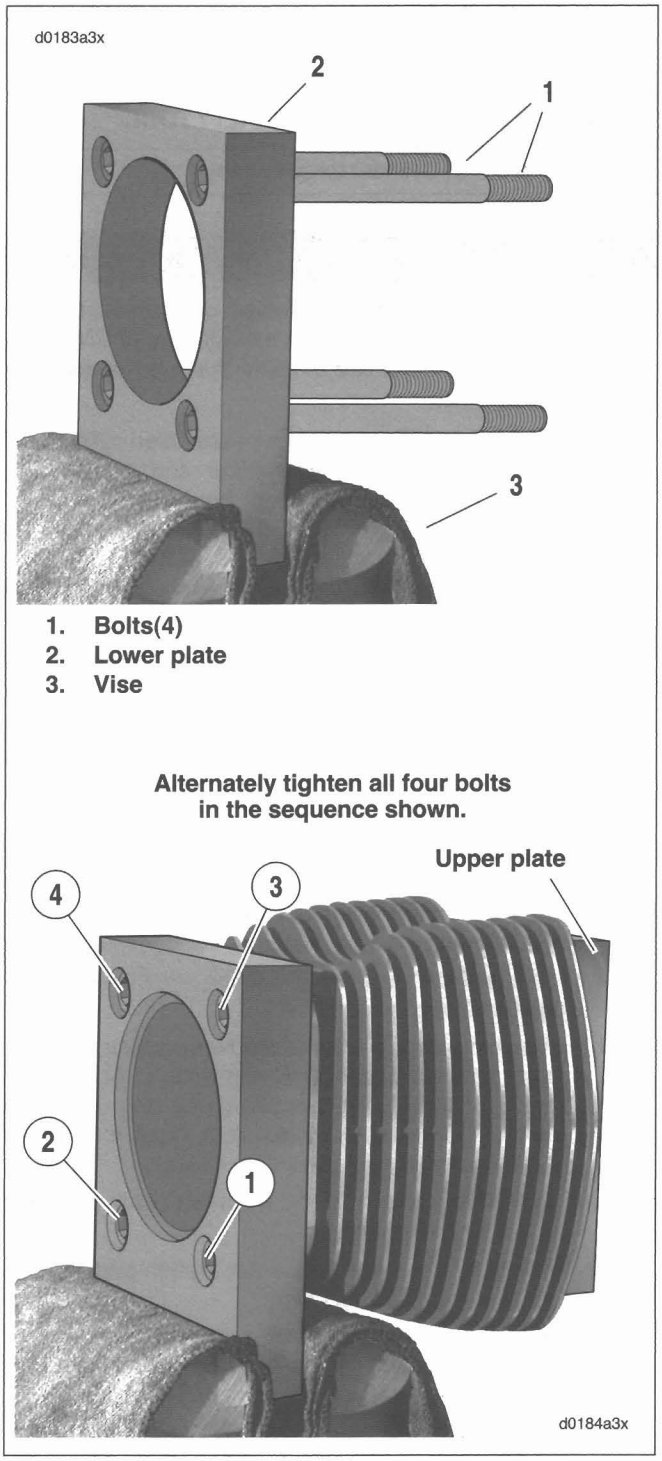
2. See Figure 3-116. Using an inside micrometer or dial bore gauge, check cylinder bore for out-of-round and taper. Proceed as follows:
   a. At the top of the piston ring travel zone (starting about 0.50 in. or 12.70 mm from the top of the cylinder), measure the cylinder diameter at two locations; parallel and perpendicular to the crankshaft. Record the readings.
   b. 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.
   a. 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.
2. 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.
3. 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.



1. **Bolts(4)**
2. **Lower plate**
3. **Vise**

Figure 3-115. Attaching Cylinder Torque Plates

4. 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.
5. 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.

CAUTION

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.

6. 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.
7. 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.

8. 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.

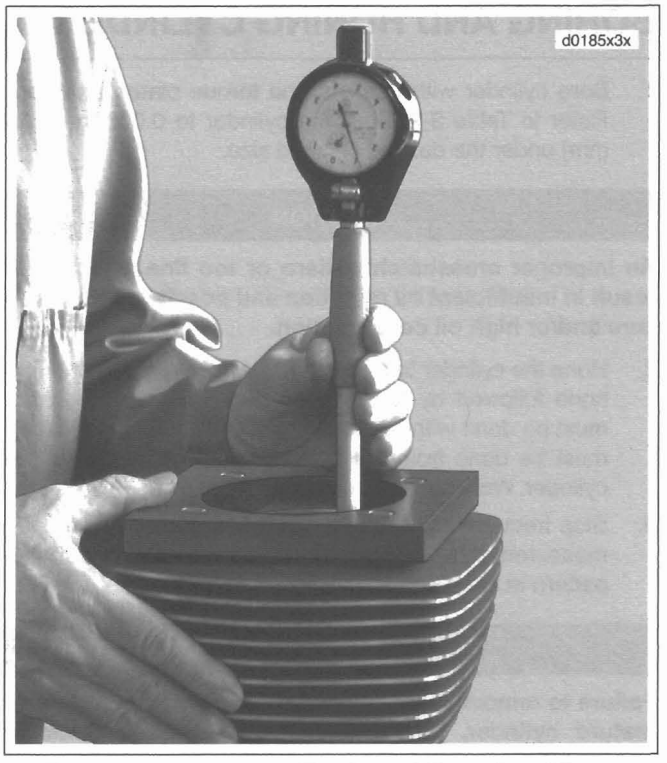


Figure 3-116. Measure For Out-of-Round and Taper

BORING AND HONING CYLINDER

1. 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.

2. Hone the cylinder to its finished size using a 280 grit rigid hone followed by a 240 grit flexible ball hone. Honing must be done with the torque plates attached. All honing must be done from the bottom (crankcase) end of the cylinder. Work for a 60° crosshatch pattern.
3. 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.

4. 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.
6. 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 BORE FINISHED SIZE	
SIZE	IN.	MM	IN.	MM
Standard	N/A	N/A	3.7500-3.7505	95.250-95.263
Oversize	0.005	0.13	3.7550-3.7555	95.377-95.390
	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

NOTE

Do not mix 2007 pistons with earlier style pistons. New style pistons have tapered wrist pin boss. The wrist pin portion of the connecting rod is also tapered.

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.
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.

1. See Figure 3-117. 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

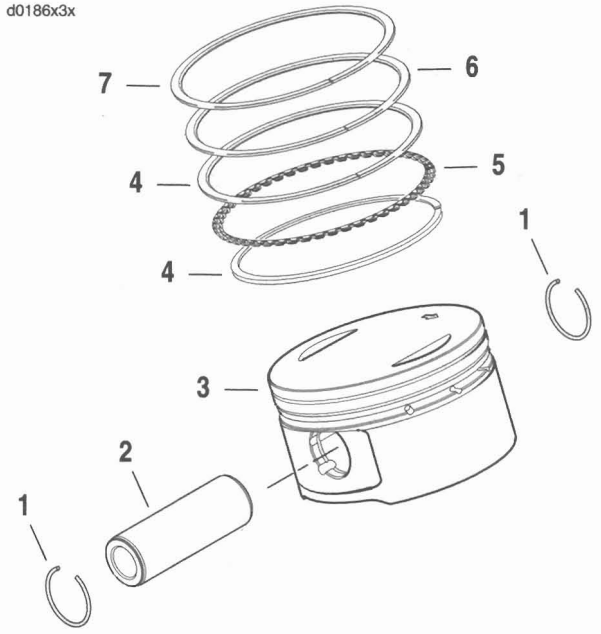
Do not sand blast or glass bead blast pistons. Bead blasting rounds off ring lands and will result in oil contamination leading to accelerated wear.

1. 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)

2. Thoroughly rinse the pistons. Blow parts dry with moisture free compressed air.



1. **Circlip**
2. **Piston pin**
3. **Piston**
4. **Oil rail (2)**
5. **Oil rail spacer**
6. **Second compression ring**
7. **Top compression ring**

Figure 3-117. Piston Assembly

3. 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.

5. 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.
6. 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 3-118. 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.
3. 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 3-119. 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.
   b. Since the grooves wear unevenly, repeat this check at several locations around the piston groove circumference.
   c. Discard the piston if the side clearance of either compression ring exceeds 0.0045 in. (0.11 mm).
   d. 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.

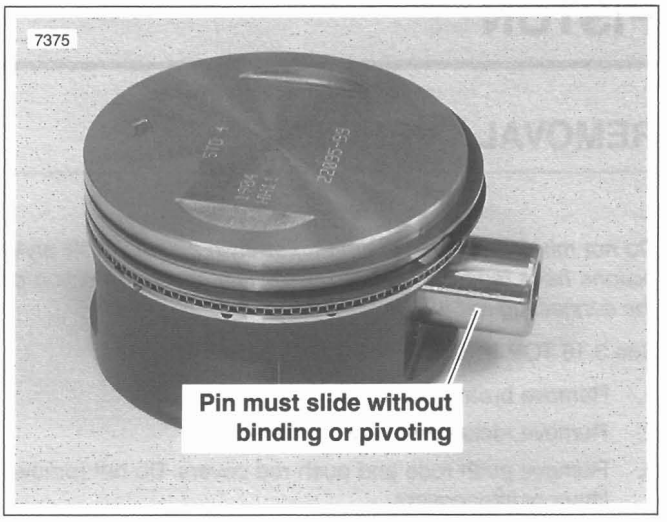


Figure 3-118. Piston Pin Clearance

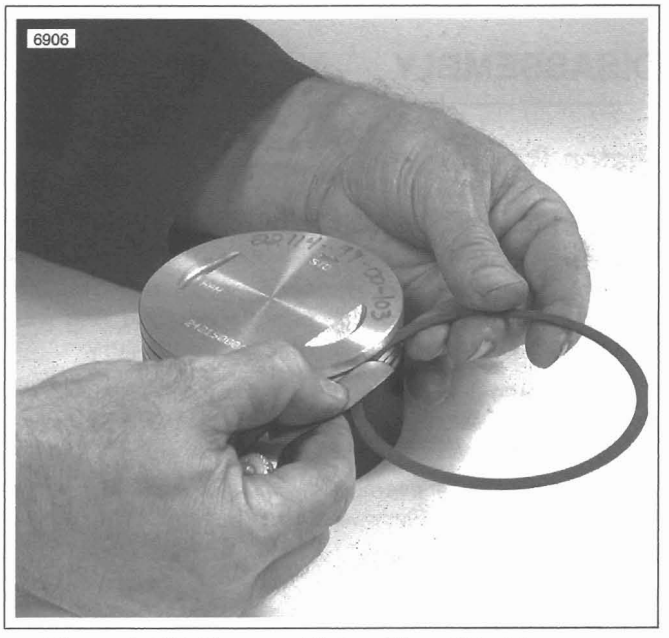


Figure 3-119. Measure Piston Ring Side Clearance

CAUTION

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 3-120. 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 3-120.

5. See Figure 3-120. 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.
   b. 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).

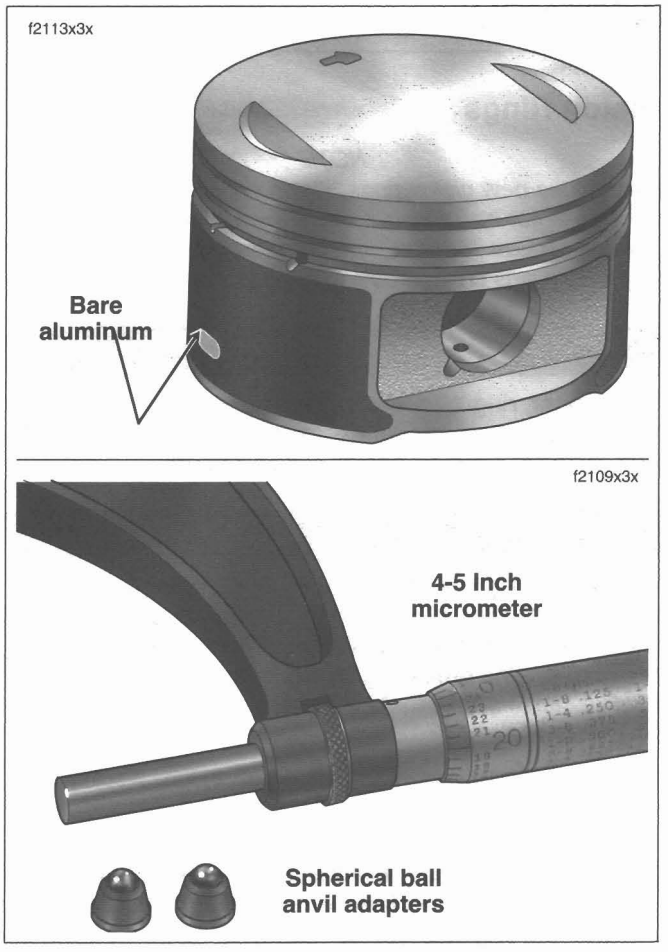


Figure 3-120. Measuring Running Clearance Piston

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.

1. See Figure 3-121. 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.
   b. 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 3-121. 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)

2. Use compressed air to remove any dirt or dust that may have settled in the oil drain holes and piston ring grooves.

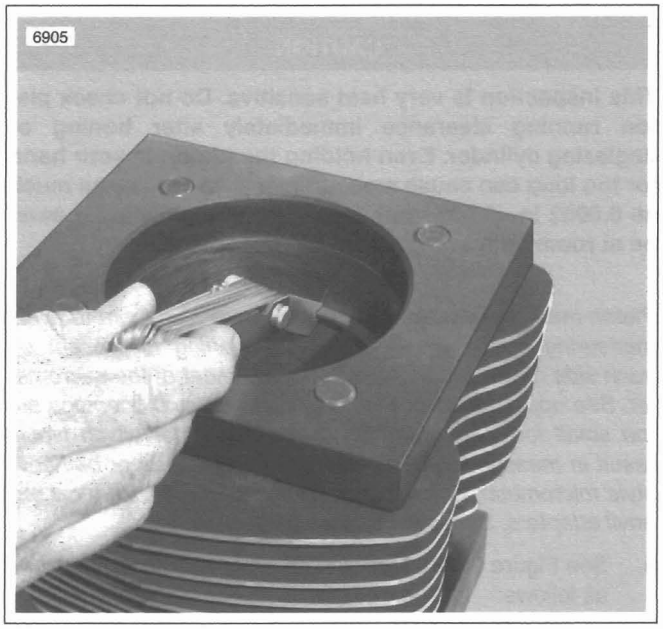


Figure 3-121. Measure Ring Gap

3. See Figure 3-122. Install piston rings.
   a. 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.
   d. Spiral upper oil rail (3) into space above expansion ring (4). Position gap 180 degrees from the gap in the expansion ring.

⚠WARNING

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

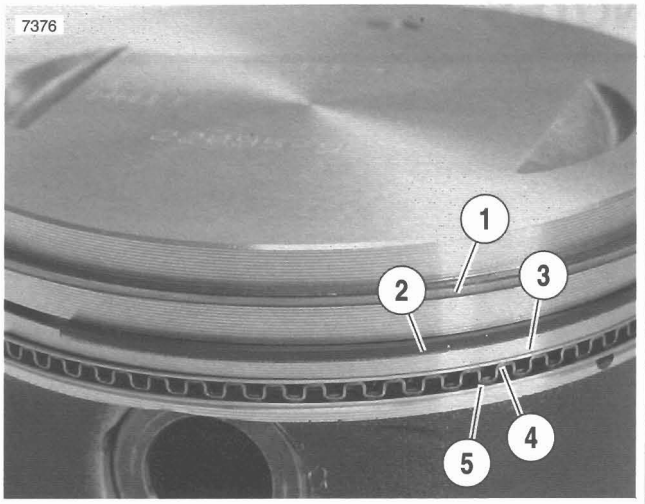
Installing the second compression ring upside down will cause oil to be scraped up into the combustion chamber resulting in excessive oil consumption and low service life on valves and other components.

   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 3-123. Verify the ring gaps are still properly staggered.

INSTALLATION OVERVIEW

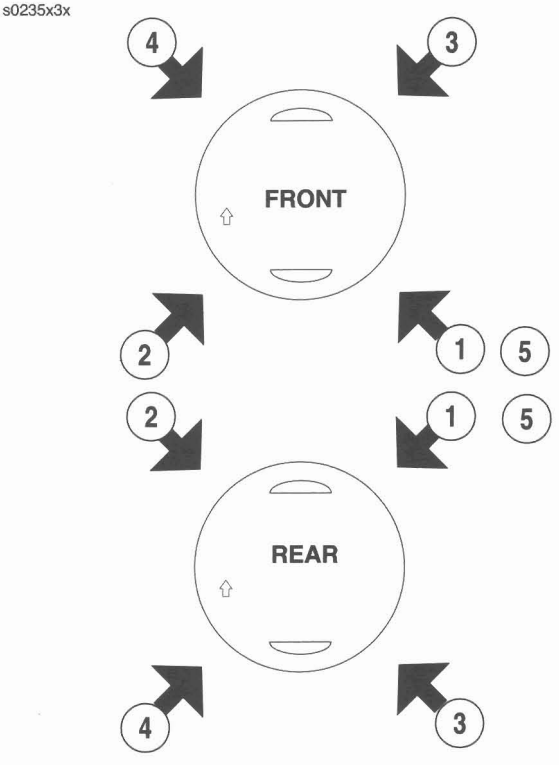
See 3.17 TOP END OVERHAUL: ASSEMBLY.

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**
4. **Expansion ring**
5. **Bottom oil rail spacer**

Figure 3-122. Piston Rings



1. **Expander spring**
2. **Bottom oil rail**
3. **Top oil rail**
4. **Second compression ring**
5. **Top compression ring**

Figure 3-123. Piston Ring Alignment

NOTES

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.
2. See Figure 3-124. Fashion lifter holding tool to prevent the hydraulic lifters from dropping into the cam compartment during cam support plate removal:
   a. 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.
3. See beginning of 3.18 BOTTOM END OVERHAUL: DISASSEMBLY to remove cover and cam support plate.

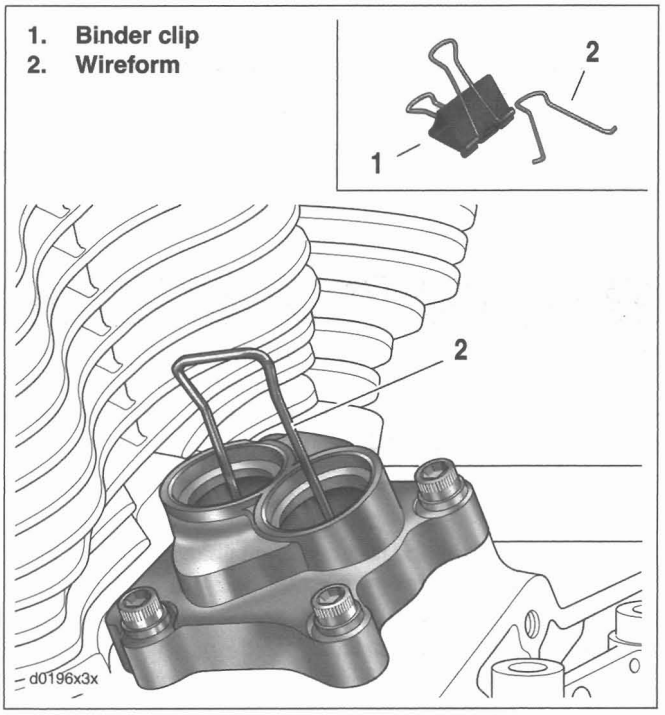


Figure 3-124. Hydraulic Lifter Holding Tool

1. Ignition cover fastener
2. Ignition cover
3. Cam cover fastener
4. Cam cover
5. Cam cover gasket
6. Primary cam chain
7. Flange bolt, large
8. Flat washer
9. Rear cam sprocket
10. Fastener
11. Primary cam chain tensioner
12. Flange bolt, small
13. Flat washer
14. Crank sprocket
15. Crankshaft bushing
16. Roll pin
17. Cam support plate fastener (8)
18. Fastener
19. Secondary cam chain tensioner
20. Cam support plate
21. Oil pressure relief valve
22. Valve spring

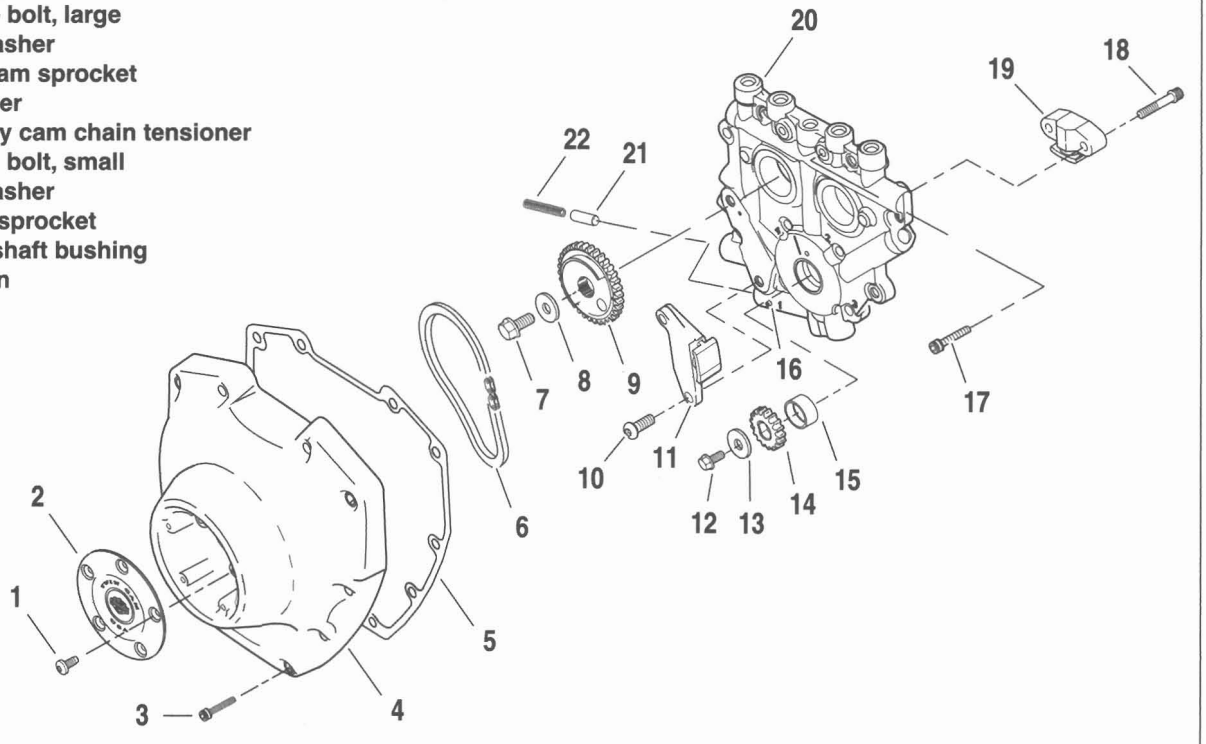


Figure 3-125. Cover and Cam Support Plate Assembly

CAMSHAFTS

Removal

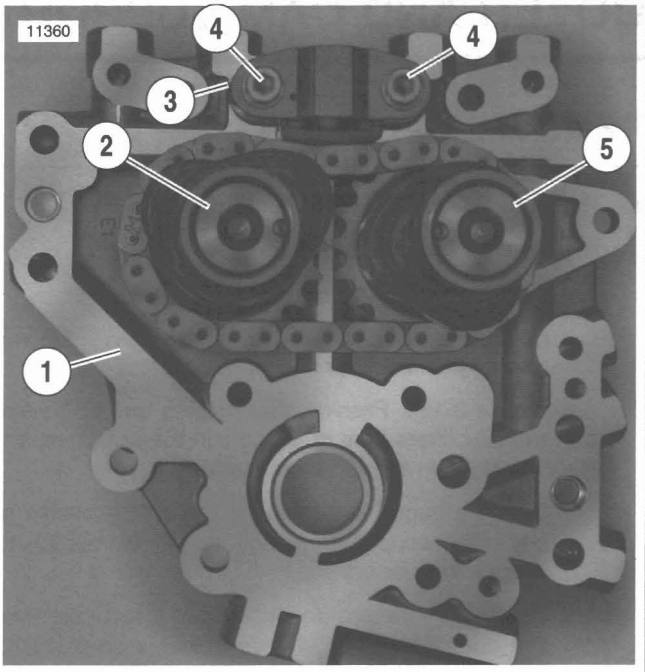
PART NO.	SPECIALTY TOOL
HD-42325-A	Camshaft needle bearing remover/installer

1. See Figure 3-126. Remove screws (4) and remove secondary cam chain tensioner (3).

⚠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)

2. Remove retaining ring from groove at end of front camshaft. Discard retaining ring.
3. Do not mix front and rear camshaft spacers. Front spacer is 0.100 in. (2.54 mm) thick.
4. 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.
5. Slide camshafts and secondary cam chain out of cam support plate.
6. Remove secondary cam chain from cam sprockets.



1. **Cam support plate**
2. **Front cam**
3. **Secondary cam chain tensioner**
4. **Secondary cam chain tensioner fasteners**
5. **Rear cam**

Figure 3-126. Camshafts

Assembly

PART NO.	SPECIALTY TOOL
HD-47956	Camshaft assembly tool

1. See Figure 3-127. Align timing marks on teeth of secondary cam sprockets (outboard faces).

NOTE

Do not mix camshafts during the installation procedure. The rear camshaft, which can be identified by the splined shaft, must go into the hole at the rear of the cam support plate.

2. 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.
3. See Figure 3-128. Orient the camshafts so that they are positioned on opposite ends of the chain, and then verify that the alignment marks (6) are still in alignment.

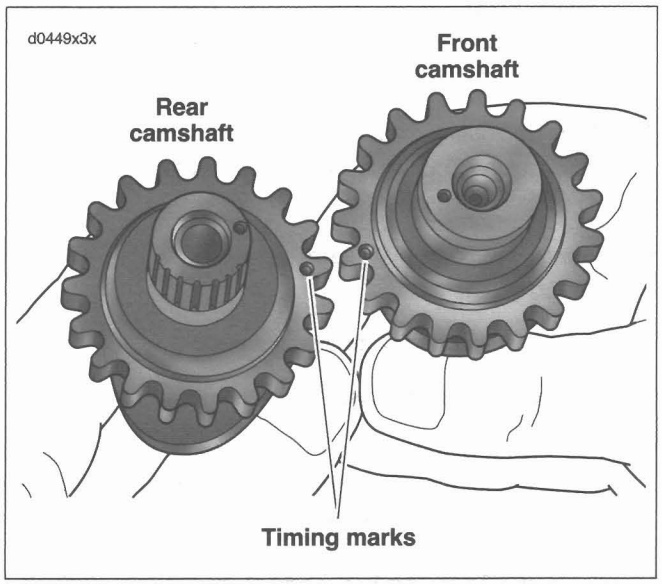
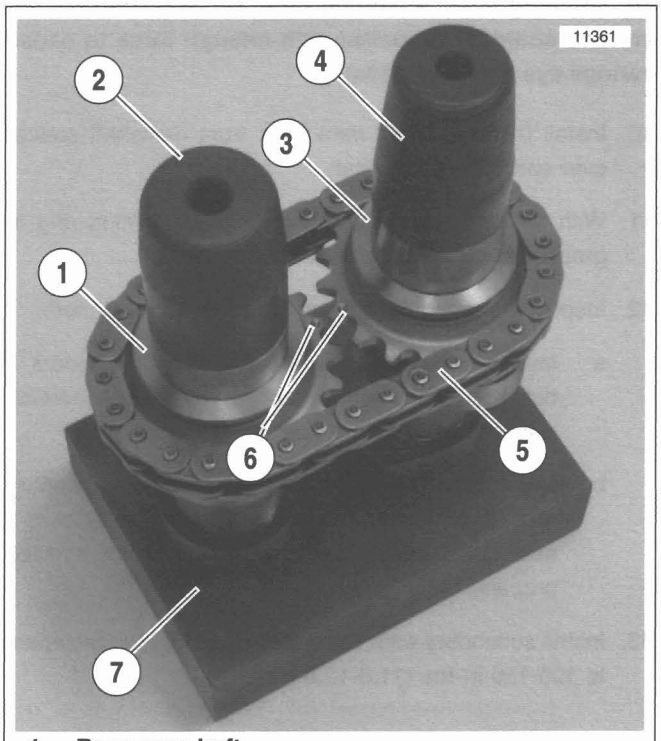


Figure 3-127. Camshaft Timing Lines



1. **Rear camshaft**
2. **Small guide (HD-47956-2)**
3. **Front camshaft**
4. **Large guide (HD-47956-1)**
5. **Cam chain**
6. **Alignment marks**
7. **Base (HD-47956-3)**

Figure 3-128. Camshaft Assembly Tool (HD-47956)

4. Obtain CAMSHAFT ASSEMBLY TOOL (HD-47956). Place crankcase side of camshaft/cam chain assembly into base (7).
5. While maintaining cam timing mark alignment, place small guide (2) on rear camshaft (1). Place large guide (4) on front camshaft (3).
6. Lubricate support plate camshaft cavities with clean H-D 20W50 engine oil.
7. Install cam support plate over guides.
8. Remove guides and base.
9. See Figure 3-129. Using a straightedge, verify that the timing marks are in alignment. If they are not, then the camshafts must be removed, realigned and reinstalled.

⚠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)

10. Install 0.100 in (2.54 mm) thick front camshaft spacer over end of front camshaft.
11. With the sharp edge out, install **new** retaining ring in groove at end of front camshaft.
12. Inspect primary and secondary cam chain tensioners.
    a. Inspect tensioners for wear. replace tensioners if damaged or if chain contact portion of shoe material is less than 0.060 in. (1.52 mm) thick.
    b. See Figure 3-130. Be sure primary and secondary cam chain tensioners are assembled as shown. If assembled incorrectly, tensioners will not function properly.
13. Install secondary cam chain tensioner. Tighten fasteners to 100-120 **in-lbs** (11.3-13.6 Nm).

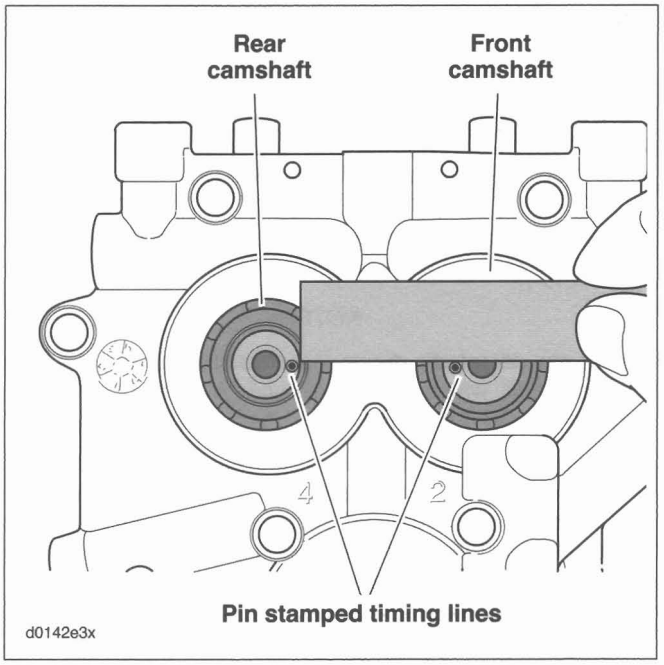
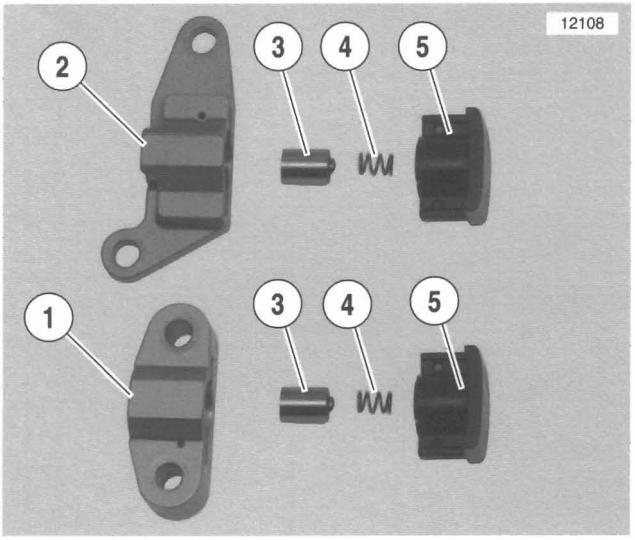


Figure 3-129. Verify Alignment of Punch Marks



1. **Secondary cam chain tensioner**
2. **Primary cam chain tensioner**
3. **Piston**
4. **Spring**
5. **Shoe**

Figure 3-130. Camshaft Assembly Tool (HD-47956)

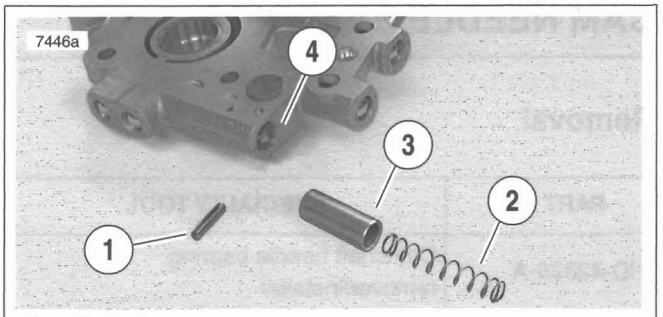
OIL PRESSURE RELIEF VALVE

Removal

1. Before removal, see CLEANING AND INSPECTION in this section.
2. 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.
3. See Figure 3-131. 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.

Installation

1. Secure the cam support plate in a vise. Be sure to install a pair of brass jaw inserts to avoid damage to the casting.
2. See Figure 3-131. 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.
3. Slide spring (2) into bypass port until seated in open side of valve body.
4. 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.
6. Remove screwdriver to release spring. Verify that spring is straight and square in bore.
7. Using a 1/8 in. punch with a small hammer, carefully tap roll pin until flush with casting.



1. **Roll pin**
2. **Spring**
3. **Valve body**
4. **Bypass port**

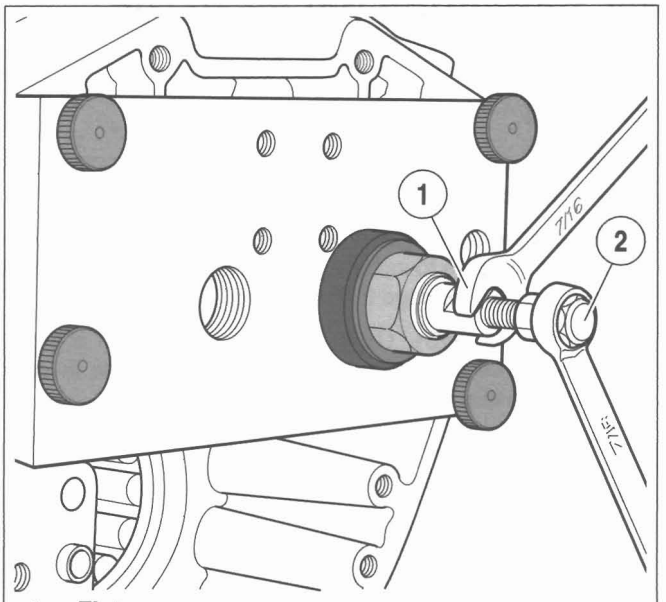
Figure 3-131. Oil Pressure Relief Valve Assembly

CAM NEEDLE BEARINGS

Removal

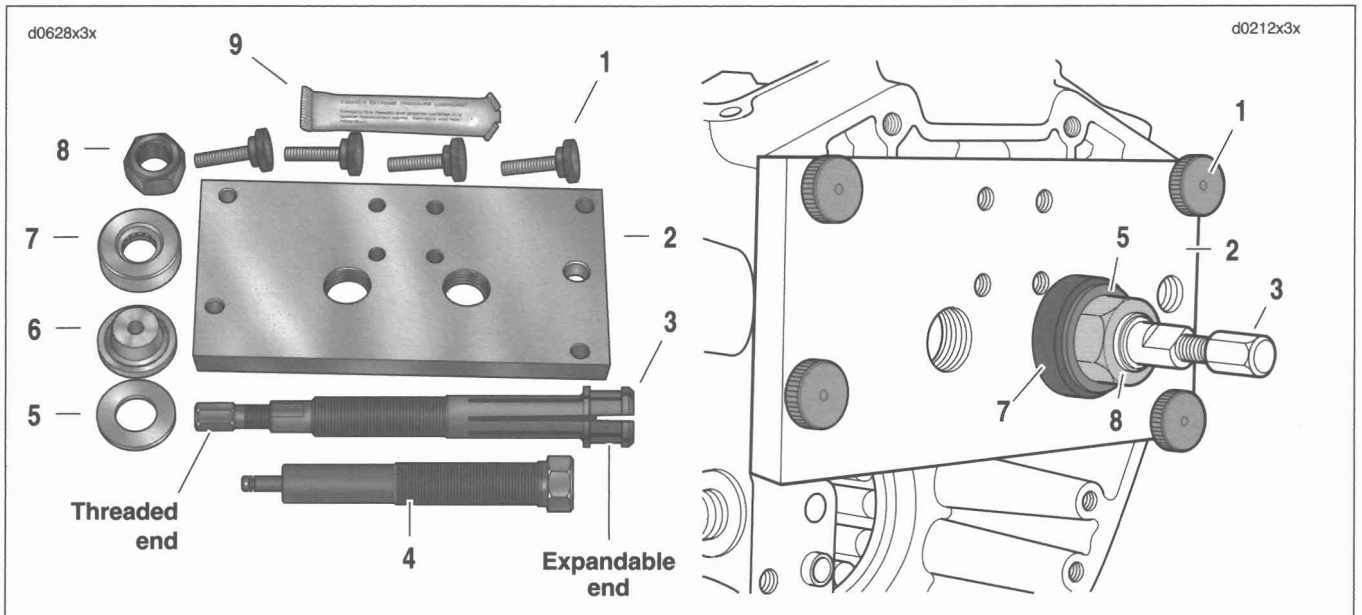
PART NO.	SPECIALTY TOOL
HD-42325-A	Camshaft needle bearing remover/installer

1. Obtain the CAMSHAFT NEEDLE BEARING REMOVER/INSTALLER (Part No. HD-42325-A).
2. See Figure 3-133. Remove four thumb screws (1) from threaded holes in support plate (2), if installed.
3. Sparingly apply graphite lubricant (9) to threads of collet (3) to prolong service life and ensure smooth operation.
4. Slide collet through support plate so that threaded end exits stamped side of plate.
5. Aligning two large holes in support plate with needle bearing bores, hang right side of plate on ring dowel in crankcase flange.
6. 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.
7. 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.
8. 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.



1. Flat
2. Hex

Figure 3-132. Expanding Collet By Turning Hex Clockwise



1. Thumb screw
2. Support plate
3. Removal collet
4. Installer forcing screw
5. Flat washer
6. Installer (1", 25.4 mm)
7. Nice bearing
8. Hex nut
9. Graphite lubricant

Figure 3-133. Camshaft Needle Bearing Remover/Installer (Part No. HD-42325)

9. Holding collet to prevent lateral movement, finger tighten hex nut until Nice bearing contacts support plate.
10. See Figure 3-132. 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.
11. See Figure 3-134. 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.
13. 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-A	Camshaft needle bearing remover/installer

1. Obtain the CAMSHAFT NEEDLE BEARING REMOVER/INSTALLER (Part No. HD-42325-A).
2. See Figure 3-133. 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.
6. See Figure 3-135. Aligning two large holes in support plate with needle bearing bores, hang right side of plate on ring dowel in crankcase flange.
7. 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.

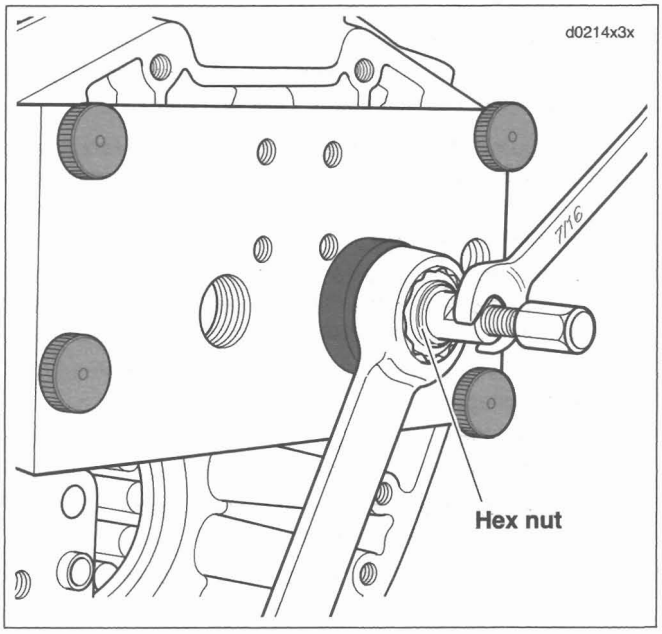


Figure 3-134. Bearing Removal

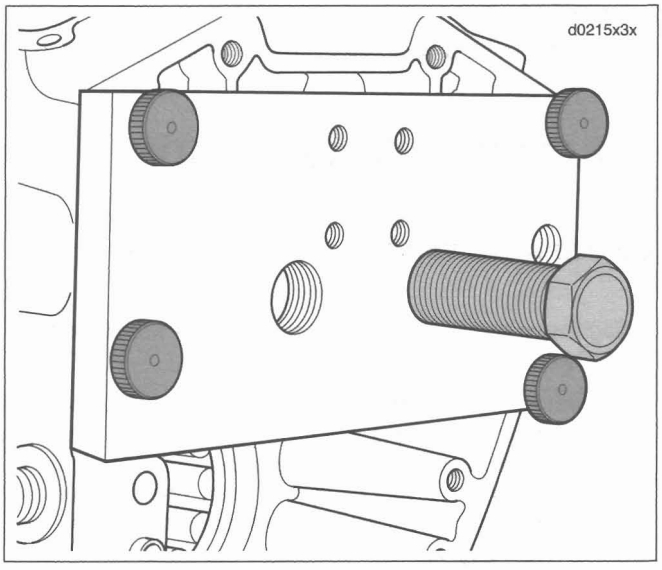


Figure 3-135. Installer Forcing Screw Installation

Note

In next step, do not exceed 25 ft-lbs (33.9 Nm) to install bearing. If this specification is exceeded, bearing could push through case causing damage to case and bearing.

8. See Figure 3-136. Using torque wrench, turn hex at end of installer forcing screw in a clockwise direction until bearing is at a depth of 3.100 in. (78.7 Nm) from cam cover gasket surface.
9. Measure from the head of installer forcing screw to the support plate with a dial calipers. Use this measurement as a reference when installing second needle bearing.
10. Install other bearing using measurement described in previous step.
11. Turn end of installer forcing screw in a counterclockwise direction until installer is free of needle bearing bore.
12. Remove four thumb screws and pull support plate and installer forcing screw from crankcase.
13. Remove installer from installer forcing screw. Unthread installer forcing screw from support plate.
14. Return to step 1 to install second needle bearing.
15. Verify installed depth of front and rear bearings. Depth of bearings should be 3.100 in. (78.7 Nm) from cam cover gasket surface.
16. Thread four thumb screws into threaded holes in support plate to prevent loss.

CLEANING AND INSPECTION

Oil Pressure Valve

NOTE

If diagnosing low oil pressure, start with step 1. If diagnosing high oil pressure, then begin with step 2.

1. 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.
2. Remove oil pressure relief valve. See OIL PRESSURE RELIEF VALVE, REMOVAL, in this section.
3. Inspect spring for stretching, kinking or distortion.
4. 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.
5. 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.

Cam Support Plate

CAUTION

Exercise caution to avoid enlarging the oil holes or oil pressure will be adversely affected.

1. Verify that all oil holes are clean and open.

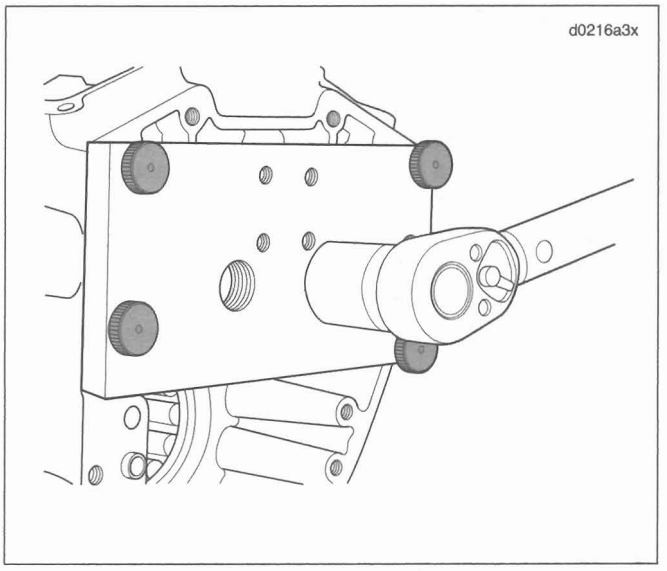


Figure 3-136. 1 Inch (25.4 mm) Bearing Installation

INSTALLATION OVERVIEW

1. See 3.19 BOTTOM END OVERHAUL: ASSEMBLY. Begin with COVER AND CAM SUPPORT PLATE instructions on page 3-60.
2. Continue with 3.17 TOP END OVERHAUL: ASSEMBLY.

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.
2. See 3.26 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.
3. See beginning of 3.18 BOTTOM END OVERHAUL: DISASSEMBLY to remove cover and cam support plate. Remove oil pump after removing cam support plate.

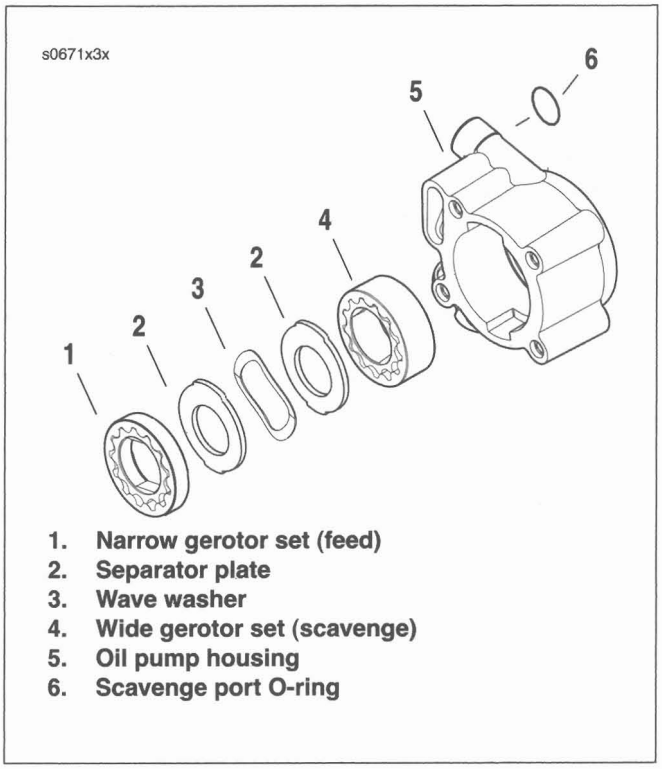
CLEANING AND INSPECTION

1. Clean all parts 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. 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.
4. Look for grooves or scratches on the cam support plate, which serves as the outboard side of the oil pump.
5. Check for excessive wear or damage on lobes of outer gerotor gears and between lobes on inner gerotor gears.



1. **Narrow gerotor set (feed)**
2. **Separator plate**
3. **Wave washer**
4. **Wide gerotor set (scavenge)**
5. **Oil pump housing**
6. **Scavenge port O-ring**

Figure 3-137. Assembling Oil Pump

6. See Figure 3-138. 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.
   c. Replace gerotors as a set if clearance exceeds 0.004 in. (0.10 mm). Inspect second gerotor set in the same manner.
7. 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.
8. 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.

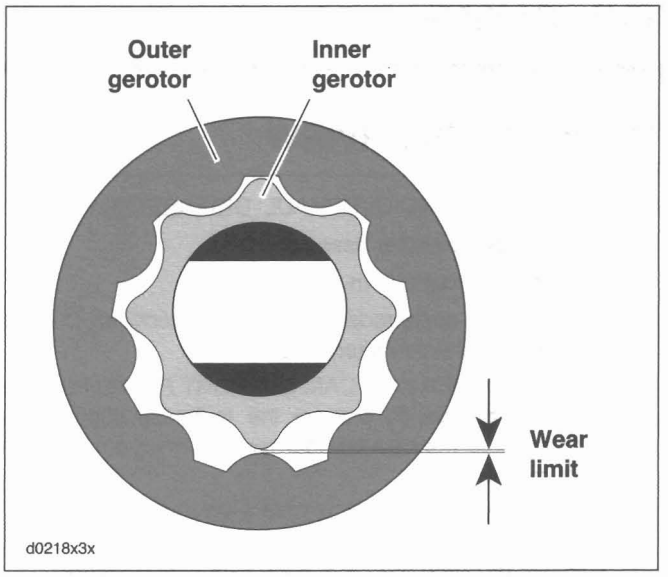


Figure 3-138. Measure Gerotor Sets for Wear

INSTALLATION OVERVIEW

1. See 3.19 BOTTOM END OVERHAUL: ASSEMBLY. Begin with COVER AND CAM SUPPORT PLATE instructions on page 3-60.
2. Continue with 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 OVERHAUL: DISASSEMBLY.

RIGHT CRANKCASE HALF

Chain Guide Screen

See Figure 3-139. Remove, clean and reinstall screen (3). Replace screen O-ring with each removal.

Crankshaft Bearing

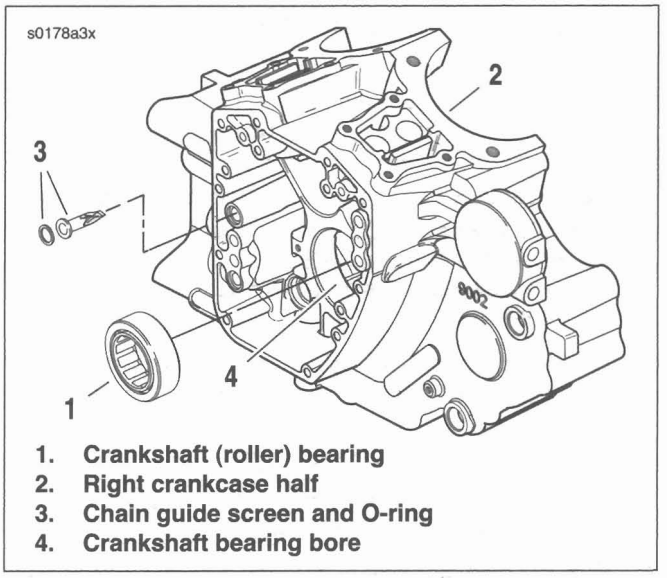
REMOVAL

PART NO.	SPECIALTY TOOL
HD-44065-1	Crankshaft bearing REMOVAL/INSTALL pilot/driver
HD-44065-4	Crankshaft bearing REMOVAL/INSTALL support tube

⚠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.

1. See Figure 3-140. Obtain CRANKSHAFT BEARING REMOVAL/INSTALL PILOT/DRIVER (Part No. HD-44065-1) and CRANKSHAFT BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-44065-4).
2. 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.



1. Crankshaft (roller) bearing
2. Right crankcase half
3. Chain guide screen and O-ring
4. Crankshaft bearing bore

Figure 3-139. Right Crankshaft (Roller) Bearing

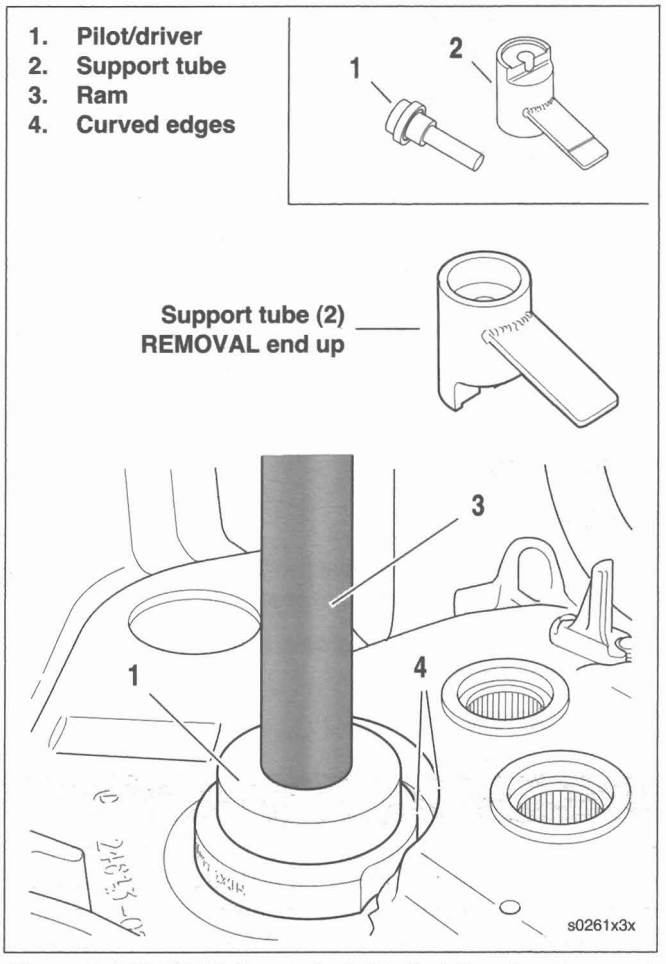


Figure 3-140. Right Crankshaft (Roller) Bearing Removal

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

1. See Figure 3-141. Obtain CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL PILOT/DRIVER (Part No. HD-44065-1) and CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-44065-4).
2. Obtain **new** crankshaft (roller) bearing (4). Spread a thin film of clean H-D 20W50 engine oil on O.D. of **new** bearing.
3. 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.
7. 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.
8. Remove pilot/driver and crankcase half from support tube.

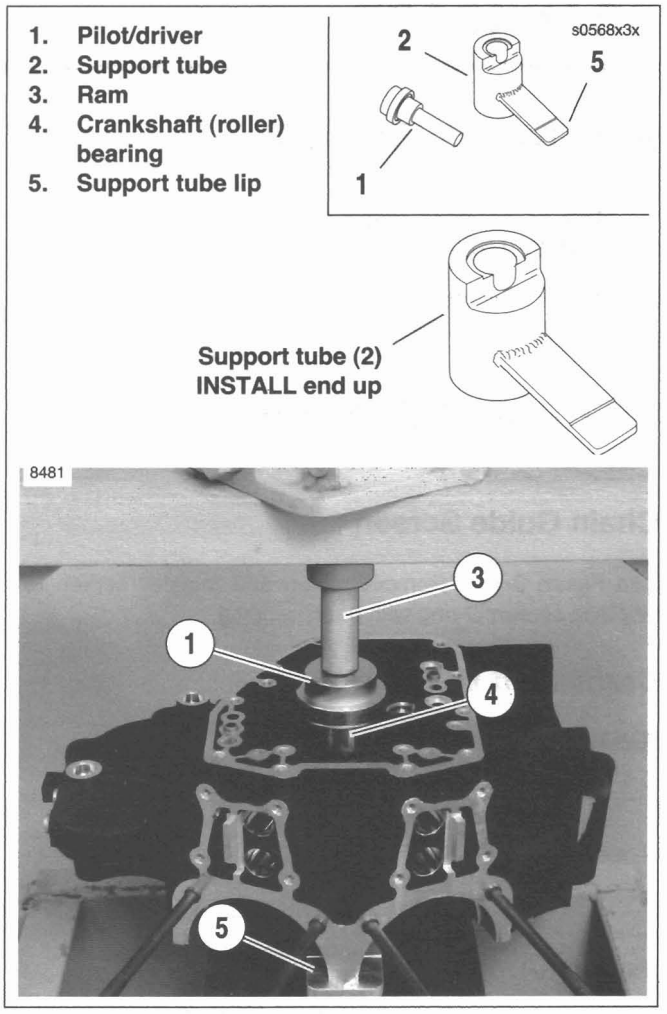


Figure 3-141. Right Crankshaft (Roller) Bearing Installation

Piston Jets

REMOVAL

1. See Figure 3-142. Remove two T20 TORX screws (1) to free piston jet (2) from crankcase.
2. 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.

1. See Figure 3-142. 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.

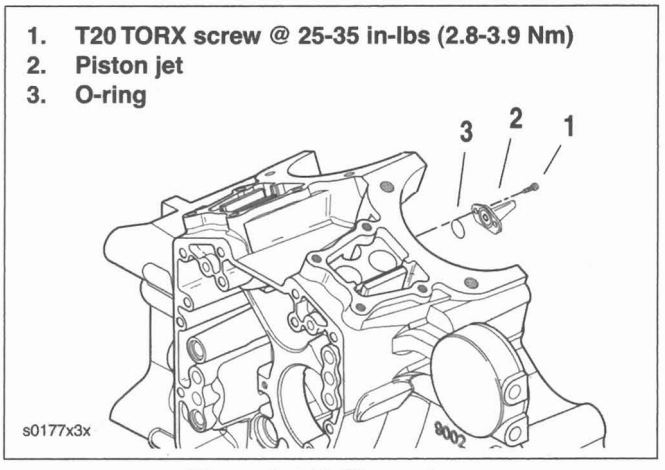


Figure 3-142. Piston Jets

2. With jet pointed upward, start two T20 TORX screws (1) to secure piston jet (2) to crankcase. Tighten to 25-35 **in-lbs** (2.8-3.9 Nm).

NOTE

If piston jet is being reused, apply LOCTITE THREADLOCKER 222 (purple) to threads of TORX screws before installation.

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

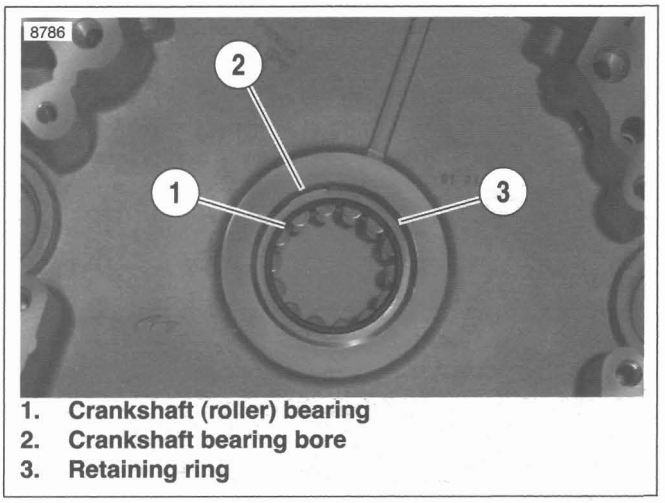
⚠WARNING

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.

⚠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.

1. 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.
3. 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.
4. See Figure 3-145. Obtain CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-42720-5) and CRANKSHAFT (ROLLER) BEARING 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.
6. Use a suitable drift punch to tap oil seal from crankcase bore. Discard oil seal.
7. See Figure 3-143. 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 3-144. 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.



1. **Crankshaft (roller) bearing**
2. **Crankshaft bearing bore**
3. **Retaining ring**

Figure 3-143. Left Crankshaft (Roller) Bearing Assembly

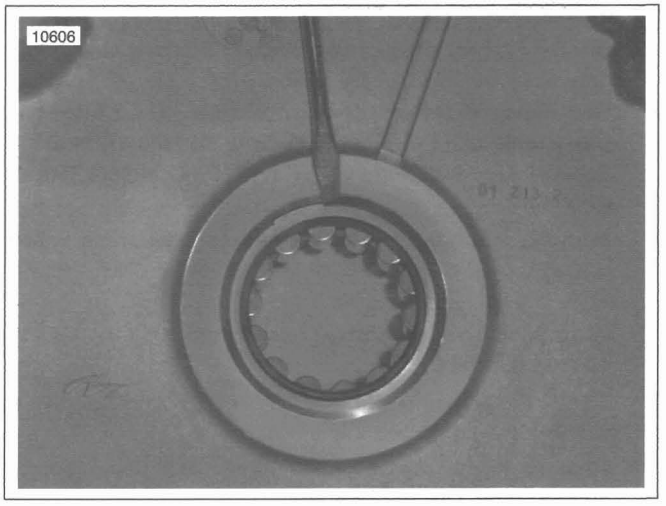


Figure 3-144. Removing Retaining Ring

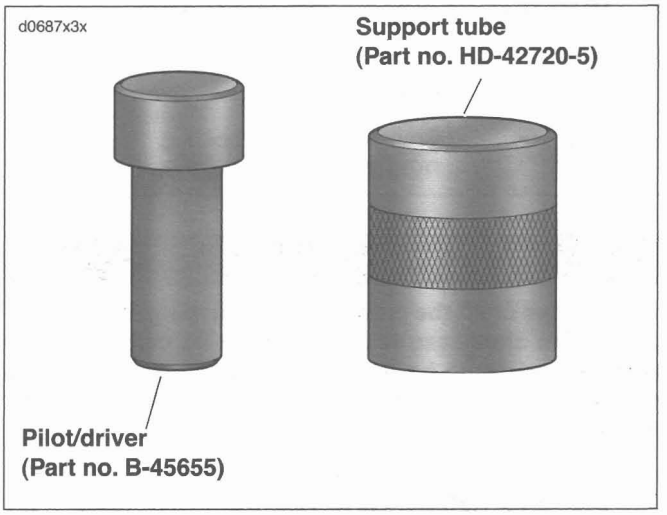
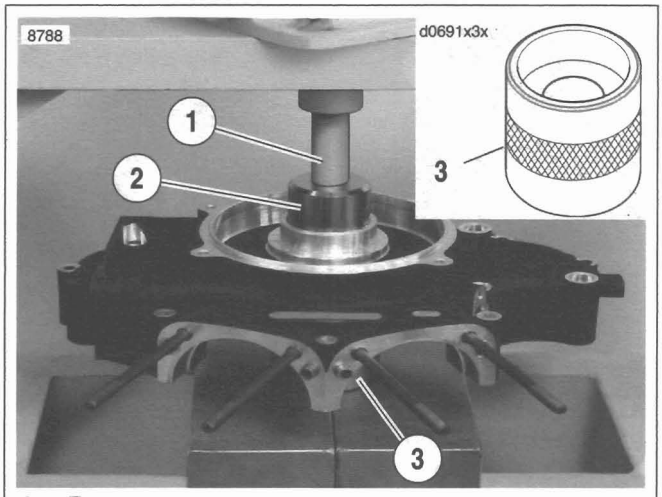


Figure 3-145. Left Crankshaft (Roller) Bearing REMOVAL/INSTALL Tools



1. **Ram**
2. **Pilot/driver**
3. **Support tube ("A" end up)**

Figure 3-146. Left Crankshaft (Roller) Bearing Removal

8. See Figure 3-146. 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.
9. With the outboard side of the left crankcase half facing 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.

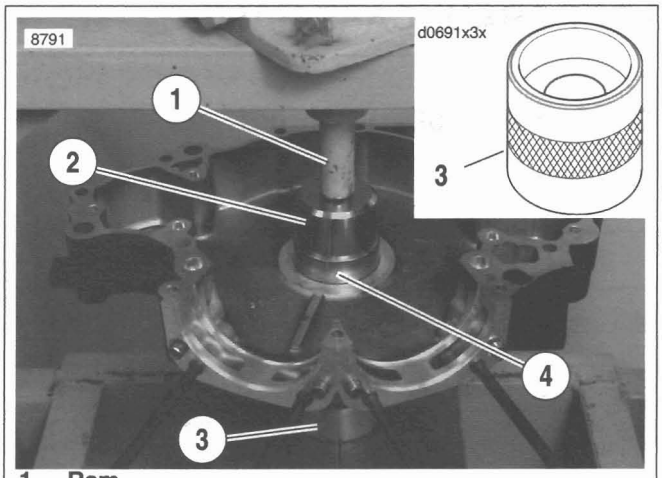
INSTALLATION

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.

1. See Figure 3-145. Obtain CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL SUPPORT TUBE (Part No. HD-42720-5) and CRANKSHAFT (ROLLER) BEARING REMOVAL/INSTALL PILOT/DRIVER (Part No. B-45655).



1. **Ram**
2. **Pilot/driver**
3. **Support tube ("A" end up)**
4. **Crankshaft (roller) bearing**

Figure 3-147. Left Crankshaft (Roller) Bearing Installation

2. See Figure 3-147. Obtain **new** crankshaft (roller) bearing (4). Place a thin film of clean engine oil on outer diameter of bearing.
3. Place support tube (3) on hydraulic press table with the "A" end up.
4. With the inboard side of the left crankcase half facing 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.
6. Slide pilot/driver (2) through bearing into support tube.
7. Center pilot/driver (2) under ram (1) of press. Apply pressure to pilot/driver until bearing is lightly bottomed in crankshaft bearing bore.
8. Remove crankcase half and pilot/driver from support tube.
9. Obtain **new** retaining ring and install in bearing bore in 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.

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

1. Place a steel ball inside a head screw. Put the head screw on the end of the cylinder stud without the collar.
2. See Figure 3-148. 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).

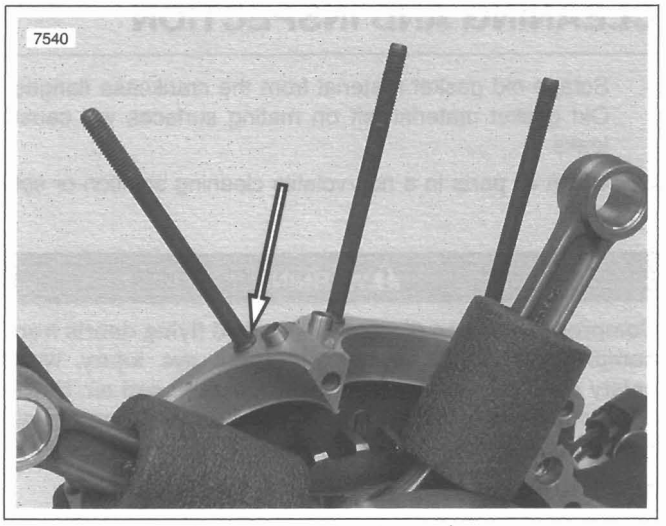


Figure 3-148. Collar Side Down

PIPE PLUG AND OIL FITTINGS

Removal/Installation

NOTE

See 3.31 OIL TANK for information on replacing O-rings and retainers within oil tank fittings.

1. See Figure 3-149. 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 3-149. Install parts.
   a. Turn hex on oil fittings (1, 2, 3) in a clockwise direction until snug. Tighten to oil fittings to 120-168 **in-lbs** (13.6-19.0 Nm).
   b. Install pipe plugs (4, 5). Tighten to 120-144 **in-lbs** (13.6-16.3 Nm).

1. **Oil return fitting**
2. **Oil feed fitting**
3. **Oil vent fitting**
4. **Pipe plug**
5. **Pipe plugs (2)**

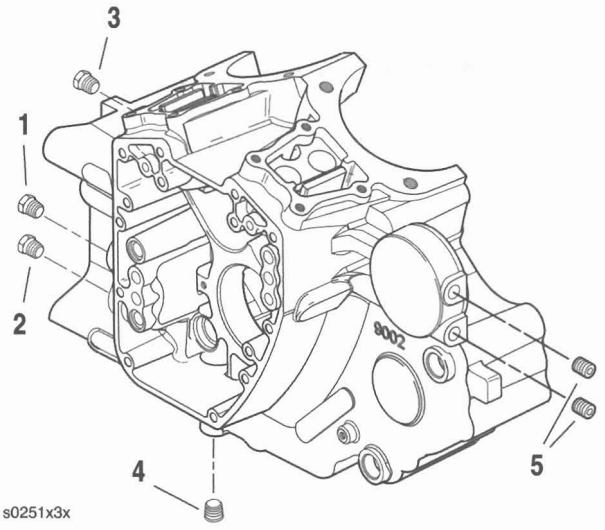


Figure 3-149. Oil Fittings and Pipe Plugs

CLEANING AND INSPECTION

1. Scrape old gasket material from the crankcase flanges. Old gasket material left on mating surfaces will cause leaks.
2. Clean all parts 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)

3. Blow parts dry with low pressure compressed air.
4. Verify that all oil holes and passageways are clean and open.
5. Check ring dowels for looseness, wear or damage. Replace as necessary.
6. 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 OVERHAUL: ASSEMBLY.
2. Perform all steps under 3.17 TOP END OVERHAUL: ASSEMBLY.

REMOVAL OVERVIEW

NOTE

Always replace all four bearings (crankcase and housing, front and rear) during a complete bottom end overhaul.

1. Perform all steps under 3.16 TOP END OVERHAUL: DISASSEMBLY.
2. Perform all steps under 3.18 BOTTOM END OVERHAUL: DISASSEMBLY.

CLEANING, INSPECTION AND REPAIR

General

1. Clean all parts but bearings in a non-volatile cleaning solution or solvent.

⚠WARNING

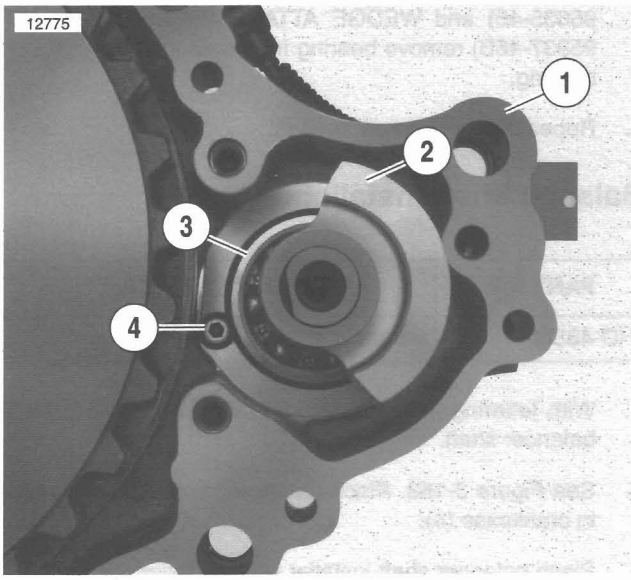
Compressed air can pierce the skin and flying debris from compressed air could cause serious eye injury. Wear safety glasses when working with compressed air. Never use your hand to check for air leaks or to determine air flow rates. (00061a)

2. Blow parts dry with low pressure compressed air.

Balance Shaft Removal

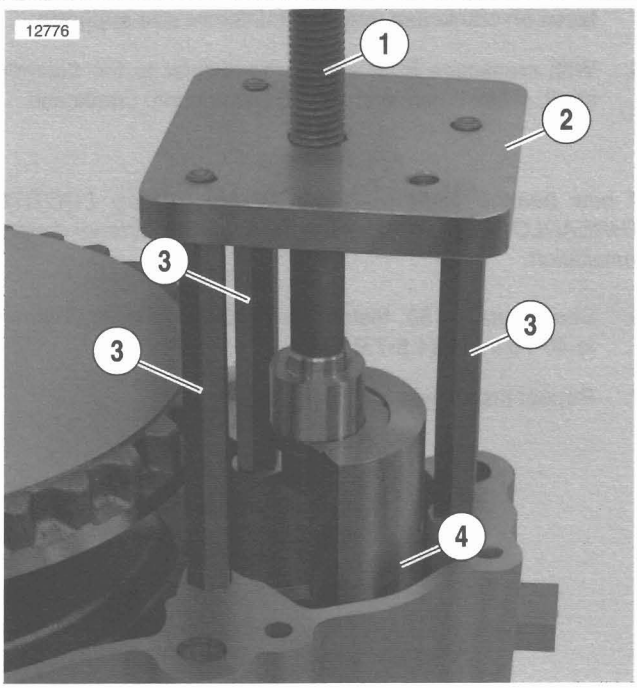
PART NO.	SPECIALTY TOOL
HD-48457	Balancer shaft remover
HD-95635-46	All purpose claw puller
HD-95637-46B	Wedge attachment

1. See Figure 3-150. Remove bearing fastener (4) from crankcase (1).
2. See Figure 3-151. Assemble balancer shaft remover.
   a. Sparingly apply graphite lubricant along threads of forcing screw (1) to prolong service life and ensure smooth operation.
   b. Install support shafts (3) in crankcase.
   c. If replacing front shaft, install plate (2) over support shafts with side marked "Front" facing up. If replacing rear shaft, install plate over support shafts with side marked "Rear" facing up.
   d. Install forcing screw in balance shaft (4).
   e. Install washer, Nice bearing and nut on forcing screw.



1. **Crankcase**
2. **Balance shaft**
3. **Balance shaft bearing**
4. **Bearing fastener**

Figure 3-150. Balance Shaft Bearing



1. **Forcing screw**
2. **Plate**
3. **Support shaft**
4. **Balance shaft**

Figure 3-151. Balance Shaft Remover

3. See Figure 3-152. While holding forcing screw (1) from turning, turn nut (2) to remove balance shaft (4) and bearing from crankcase.

4. Using ALL-PURPOSE CLAW PULLER (Part no. HD-95635-46) and WEDGE ATTACHMENT (Part no. HD-95937-46B) remove bearing from balance shaft. Discard bearing.

5. Repeat removal on other shaft.

Balance Shaft Installation

PART NO.	SPECIALTY TOOL
HD-48309	Balancer shaft installer

1. With lettering side facing up, press **new** bearing on to balancer shaft.

2. See Figure 3-153. Place balancer shaft (3) and bearing in crankcase (4).

3. Place balancer shaft installer (2) over balancer shaft.

CAUTION

Use caution when supporting crankcase half. Failure to have adequate support may cause damage to crankcase.

4. 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.

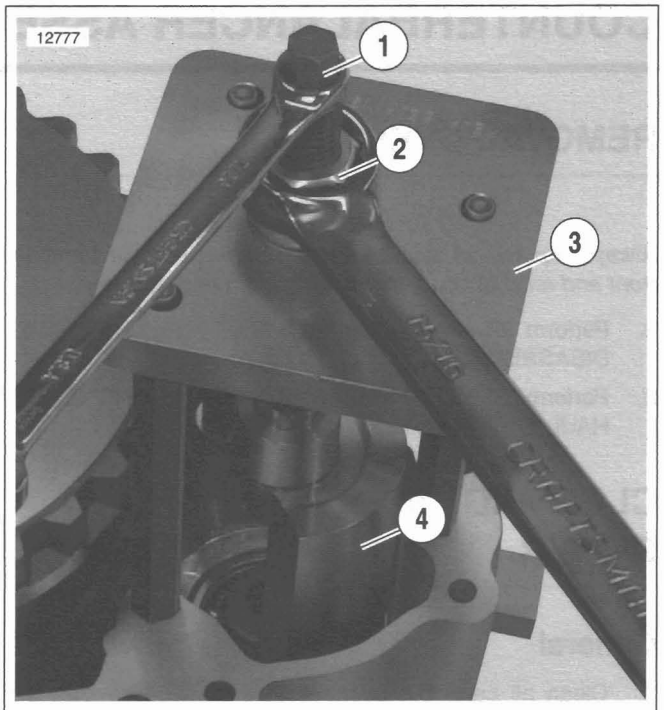
5. With crankcase level and perpendicular to the balance shaft, press balance shaft and bearing into crankcase.

NOTE

If new bearing fastener is not available, apply LOCTITE THREADLOCKER 243 (blue) to threads of fastener before installation.

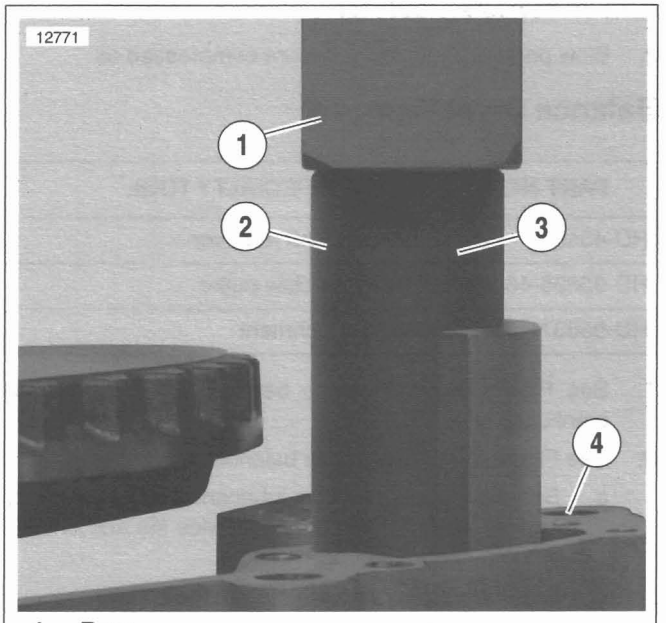
6. See Figure 3-150. Install **new** bearing fastener. Tighten to 40-70 in-lbs (4.5-7.9 Nm)

7. Repeat installation on other shaft.



1. **Forcing screw**
2. **Nut**
3. **Plate**
4. **Balance shaft**

Figure 3-152. Removing Balance Shaft



1. **Ram**
2. **Balancer shaft installer**
3. **Balancer shaft**
4. **Crankcase**

Figure 3-153. Balance Shaft Installation

Balance Shaft Support Bearings

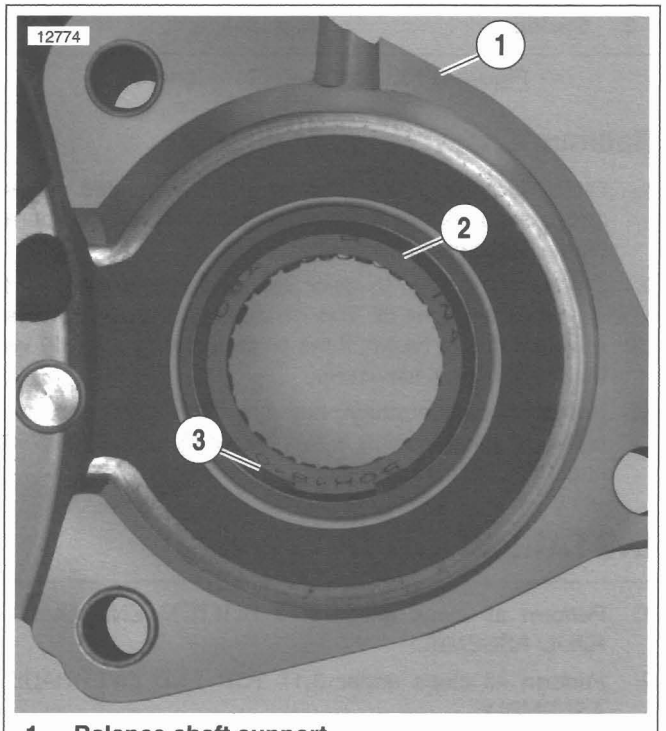
PART NO.	SPECIALTY TOOL
HD-48474	Balance shaft support bearing remover/ installer

REMOVAL

1. Inspect bearing for rough spots or binding. Always replace all four bearings (crankcase and housing, front and rear) during a complete bottom end overhaul.
2. See Figure 3-154. Remove retaining ring (3)
3. See Figure 3-155. Place housing (3) on a suitable support with top surface facing up.
4. Place bearing remover (2) over bearing.
5. Center bearing remover under ram (1) of press. Slowly lower ram to remove bearing.
6. Discard retaining ring and bearing.

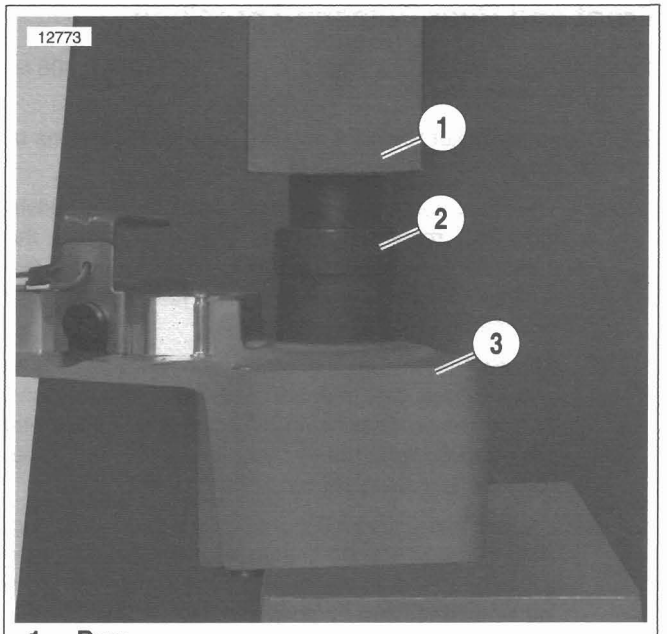
INSTALLATION

1. See Figure 3-156. Place balance shaft support (4) upside down on a suitable support.
2. Set bearing on housing with letters on bearing facing up. Place bearing installer (2) over bearing (3).
3. Center installer under ram (1) of press. Slowly lower ram to seat bearing until it fits flush against support.
4. See Figure 3-154. Install a **new** retaining ring (3).



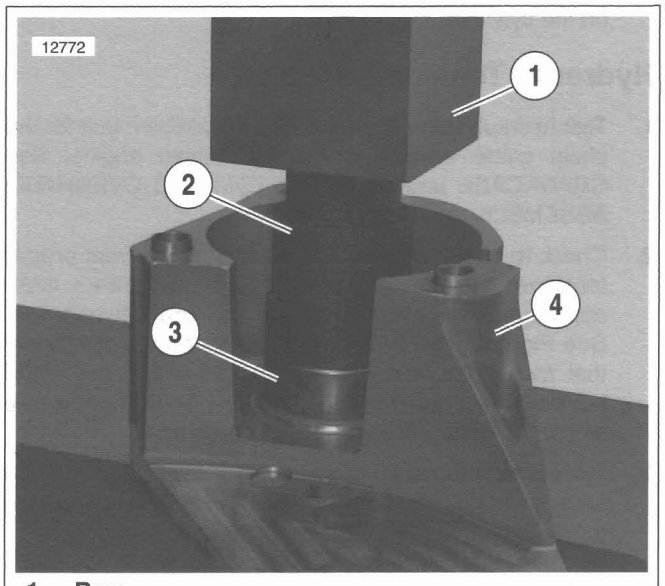
1. **Balance shaft support**
2. **Bearing**
3. **Retaining ring**

Figure 3-154. Balance Shaft Support Bearing



1. **Ram**
2. **Bearing remover**
3. **Balance shaft support**

Figure 3-155. Removing Bearing from Shaft Support



1. **Ram**
2. **Bearing installer**
3. **Bearing**
4. **Balance shaft support**

Figure 3-156. Installing Bearing In Shaft Support

Front and Rear Balance Sprockets

1. See Figure 3-157. Sprockets must be flat within 0.008 in. (0.203 mm).
2. 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.
3. Check the mating surface that fits around the balance shaft. Improperly installed sprockets may show wear on inside edges.
4. Replace sprockets during a major bottom end overhaul. Always replace sprockets in sets, including the sprocket on the flywheel.

Hydraulic Tensioners

1. 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 3-158. 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).
3. 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.

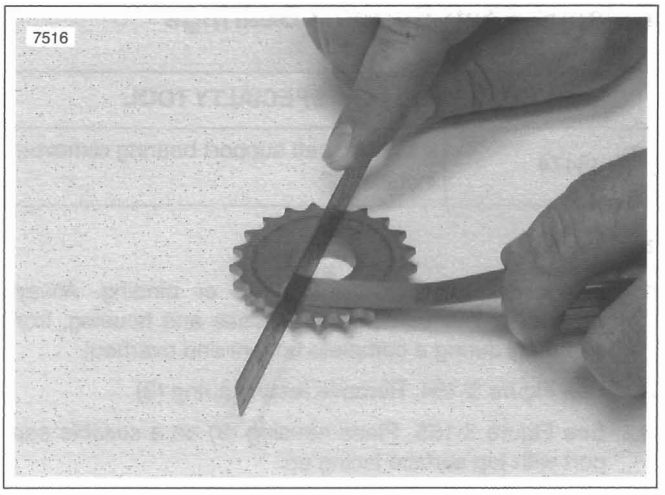
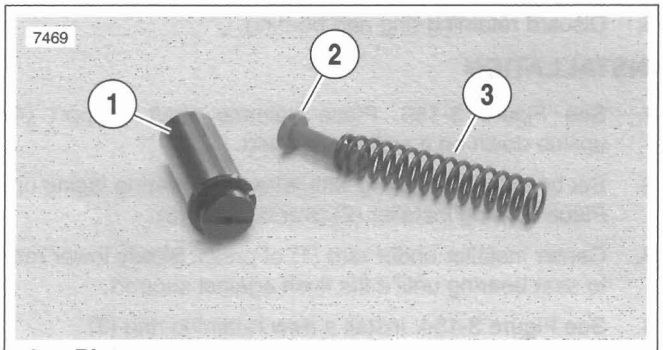


Figure 3-157. Sprocket Inspection



1. **Piston**
2. **Plastic vent cap**
3. **Spring**

Figure 3-158. Hydraulic Tensioners

Balance Chain

1. Check balance chain for missing bushings, side plates and turning marks. Inspect for tooth hooking or burn marks. Replace as necessary.
2. 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.
3. 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 OVERHAUL: ASSEMBLY.
2. 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 OVERHAUL: DISASSEMBLY.
3. Remove sprocket shaft bearing. See LEFT CRANKCASE HALF on page 3-111.

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 3-159.
   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 3-160. 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.

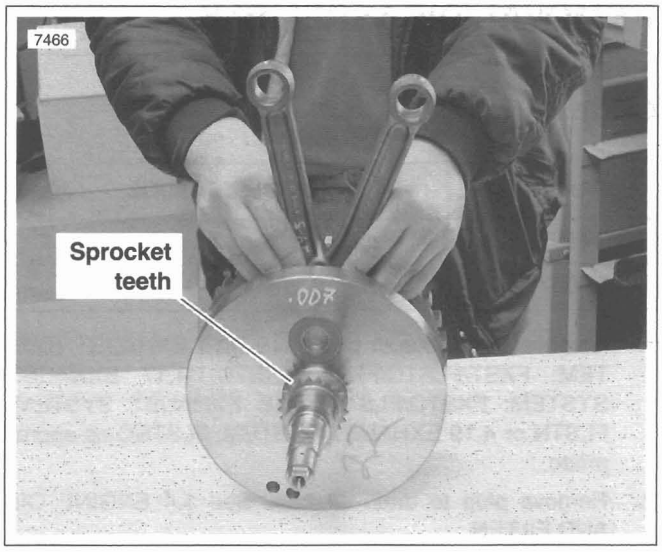


Figure 3-159. Connecting Rod Bearing Clearance

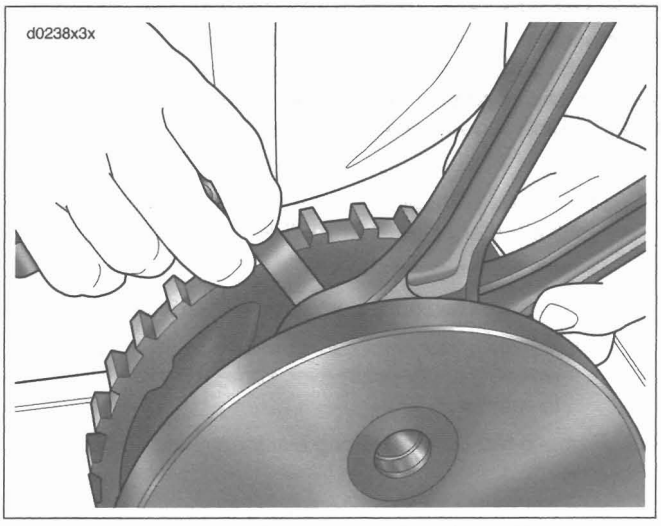


Figure 3-160. Connecting Rod Side Play

INSTALLATION OVERVIEW

1. Perform all steps under 3.19 BOTTOM END OVERHAUL: ASSEMBLY.
2. Perform all steps under 3.17 TOP END OVERHAUL: ASSEMBLY.

REMOVAL/DISASSEMBLY

Oil Tank

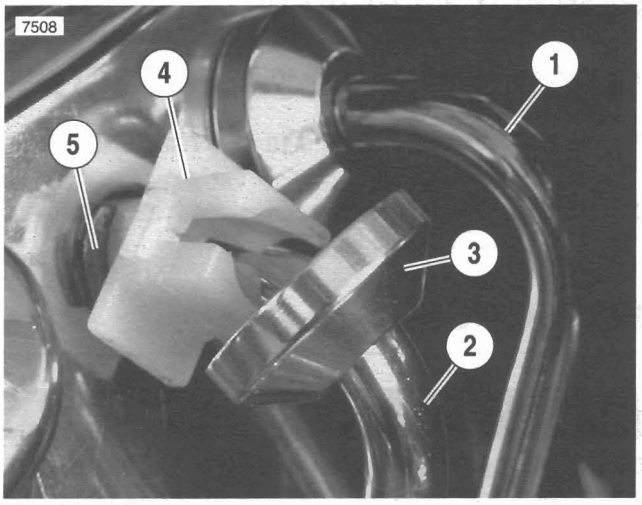
PART NO.	SPECIALTY TOOL
HD-44455	Oil line tool
HD-97087-65B	Hose clamp pliers

1. Remove rear exhaust pipe. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
2. Remove plug to drain oil tank. See 1.4 ENGINE OIL AND FILTER.
3. Remove seat.

⚠WARNING

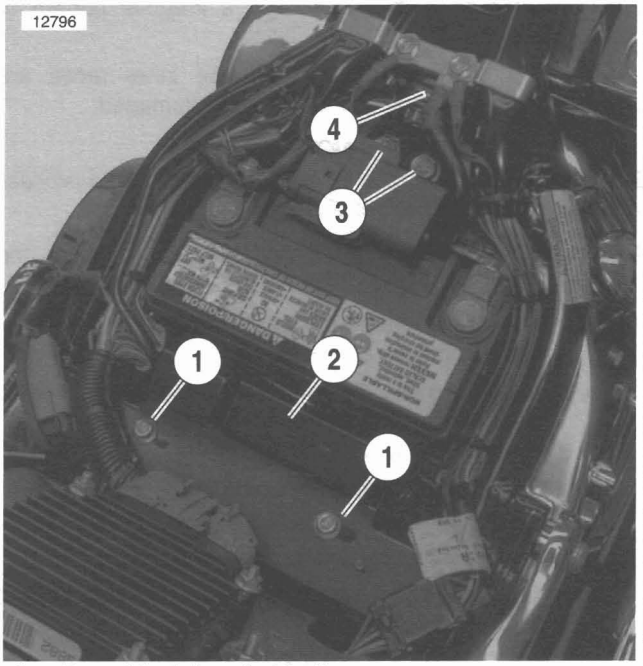
Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

4. 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.
7. See Figure 3-161. 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 3-162. 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.
10. See Figure 3-163. Remove two screws (25).
11. Cut lower drain hose clamp (2) from frame.
12. Cut clamp (7) from either side of oil feed hose (8) using HOSE CLAMP PLIERS (Part No. HD-97087-65B).
13. Remove positive battery cable.



1. Vent line
2. Return line
3. Cover
4. Oil line removing tool
5. Oil line retainer

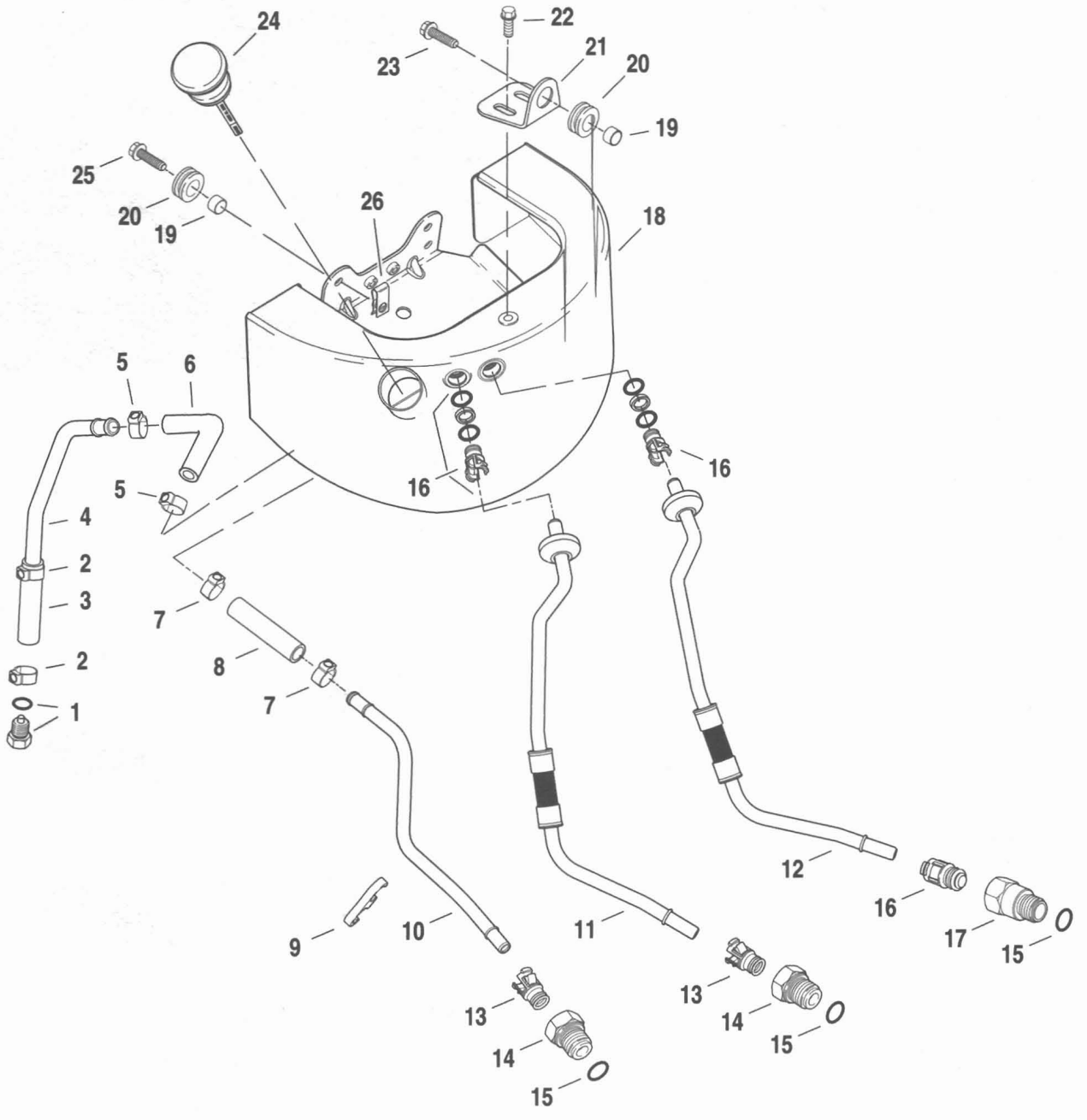
Figure 3-161. Line Cover



1. Fuse block bracket bolts
2. Fuse block and cover
3. Top bracket bolts
4. Front bracket bolt

Figure 3-162. Top View of Oil Tank

s0250x3x



1. Drain plug and O-ring
2. Clamp (2)
3. Lower drain hose
4. Drain hose
5. Clamp (2)
6. Oil drain elbow
7. Clamp (2)
8. Oil feed hose
9. Oil line clip
10. Feed line
11. Return line
12. Vent line
13. Oil line retainer (large) (2)
14. Oil line fitting (large) (2)
15. O-ring (3)
16. Oil line retainer (small) (3)
17. Oil line fitting (small)
18. Oil tank
19. Spacer (3)
20. Grommet (3)
21. Top bracket
22. Bolt
23. Bolt
24. Dipstick
25. Screw (2)
26. Clip nut (2)

Figure 3-163. 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 3-164.

- *See Figure 3-165. 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 3-166. Do not remove oil line retainers from engine fittings or oil tank unless retainers, o-rings, and/or spacers are damaged.*
- *See Figure 3-167. 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).
2. 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).
4. 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.

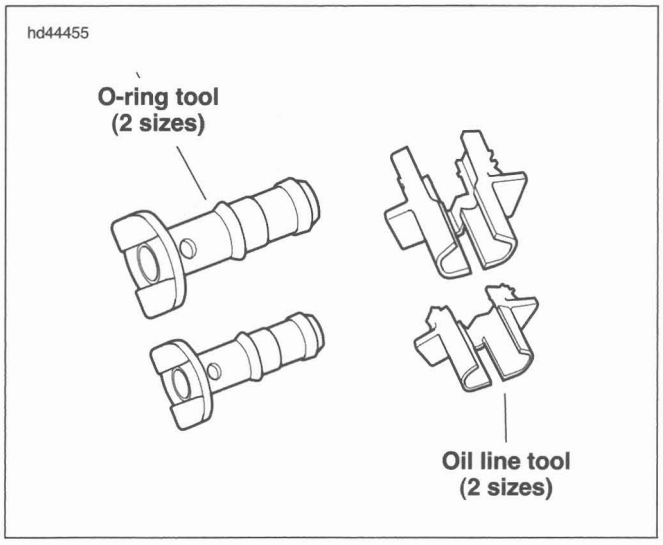
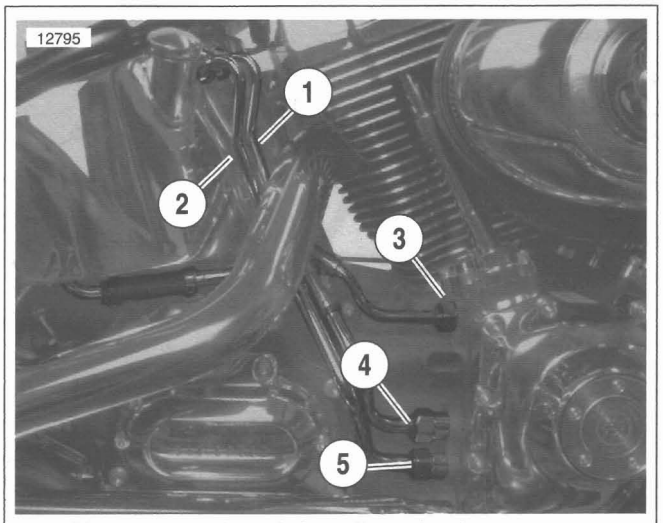
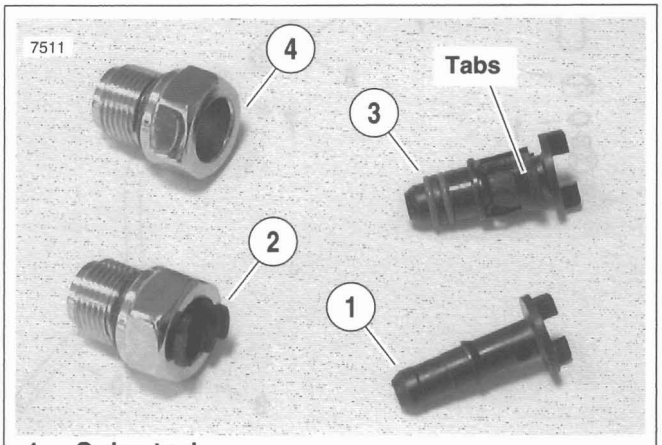


Figure 3-164. Oil Line Tools



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 3-165. Oil Line Fittings/Retainers



1. **O-ring tool**
2. **Engine fitting and retainer**
3. **Tool, retainer, O-rings and spacer**
4. **Engine fitting without retainer**

Figure 3-166. Oil Line Retainers
(Parts Removed from Engine For Clarity of Illustration)

1. **O-rings (2)**
2. **Spacer**
3. **Retainer**
4. **Tool**

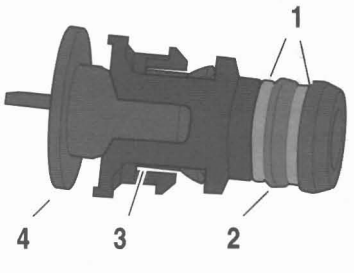


Figure 3-167. O-rings and Spacer

INSTALLATION

1. See Figure 3-163. Slide oil tank into position within frame. Install two bolts (22) through top bracket to hold tank in place.
2. Install two screws (25) from back side of tank.
3. Install **new** clamp (7) to attach oil feed hose (8).
4. Position drain hose outboard of the electrical panel and inboard of the brake line and frame harness. Attach drain hose clamp (2) to frame.
5. Install the two bolts which attach the electrical panel to the frame.
6. See Figure 3-168. Install two bolts (1) to attach fuse block bracket.
7. See Figure 3-161. 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.
8. Install splash guard using two bolts. Splash guard must mount over frame tab.
9. Install exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
10. Install positive battery cable to starter. See 8.16 BATTERY CABLES.

⚠WARNING

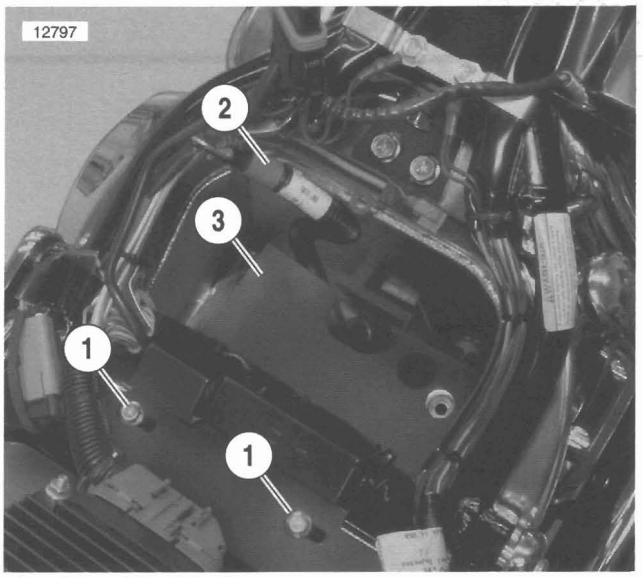
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

11. Install battery and connect cables, positive cable first.

⚠WARNING

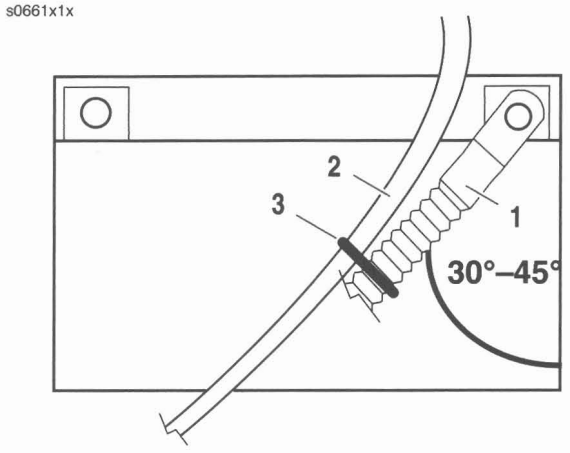
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

12. Install seat.
13. Fill oil tank and check oil level after running motorcycle on side stand. See 1.4 ENGINE OIL AND FILTER.



1. **Fuse block bolts**
2. **Battery tray pad**
3. **Positive battery cable**

Figure 3-168. Positive Battery Cable



1. **Positive Battery cable**
2. **Rear oxygen sensor wire**
3. **Cable tie**

Figure 3-169. Positive Battery Cable Routing

NOTES

FUEL SYSTEM 4

SUBJECT	PAGE NO.
4.1 Specifications	4-1
4.2 Electronic Fuel Injection (EFI) System	4-3
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SPECIFICATIONS 4.1

Table 4-1. Spark Specifications

IGNITION	DATA
Idle speed	1000 ± 50 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 at room temperature	0.3-0.5 ohms
Ignition coil secondary resistance at room temperature	2750-3250 ohms

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

TORQUE VALUES

ITEM	TORQUE		NOTES
Air cleaner cover screw	36-60 **in-lbs**	4.1-6.8 Nm	LOCTITE THREADLOCKER 243 (blue), page 4-6
Air filter bracket screws	40-60 **in-lbs**	4.5-6.8 Nm	TORX, page 4-6
Breather bolts	120-144 **in-lbs**	13.6-16.3 Nm	metric, page 4-6
Cylinder head stud nuts	special means to tighten		page 4-39, page 4-42, page 4-45, page4-48
Engine temperature sensor	10-15 ft-lbs	13.6-20.3 Nm	hand start 2-3 turns, page 4-17
Exhaust bracket carriage bolt	20-25 ft-lbs	27.1-33.9 Nm	FXSTD/FLSTF, page 4-41, page 4-44
Fuel gauge sending unit plate screws	18-22 **in-lbs**	2.0-2.5 Nm	page 4-34
Fuel level sending unit screw	25-45 **in-lbs**	2.8-5.1 Nm	page 4-31
Fuel supply tube fastener	90-110 **in-lbs**	10.2-12.4 Nm	page 4-26
Fuel tank acorn nut	28-32 ft-lbs	38.0-43.4 Nm	FXSTD, page 4-13
Fuel tank check valve	22-26 ft-lbs	29.8-35.2 Nm	page 4-10, page 4-11
Fuel tank console nut	14-18 **in-lbs**	19.0-24.4 Nm	all but FXSTD, page 4-13
Fuel tank front screw	28-32 ft-lbs	38.0-43.4 Nm	all but FXSTD, page 4-12
Fuel tank quick connect fitting	18 ft-lbs	24.4 Nm	page 4-33
Fuel tank rear bolt	18-22 ft-lbs	24.4-29.8 Nm	T40 TORX ,all but FXSTD, page 4-12
Fuel tank rear mounting nut	14-18 ft-lbs	19.0-24.4 Nm	FXSTD, page 4-13
Intake air temperature sensor fastener	15-20 **in-lbs**	1.7-2.3 Nm	page 4-15
Intake manifold mounting screws	96-144 **in-lbs**	10.8-16.3 Nm	page 4-20
Interconnect tube locknuts	30-33 ft-lbs	40.7-44.7 Nm	FXST/FLSTC/FXSTB/FXSTC, page 4-38

ITEM	TORQUE		NOTES
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FXST/FLSTC/FXSTB/FXSTC, page 4-38
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FXSTD/FLSTF, page 4-41
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FLSTN, page 4-44
Muffler clamps	45-60 ft-lbs	61.0-81.3 Nm	FLSTSC, page 4-48
Muffler support locknuts	20-25 ft-lbs	27.1-33.9 Nm	FXSTD/FLSTF, page 4-42
Muffler support locknuts	20-25 ft-lbs	27.1-33.9 Nm	FLSTN, page 4-45
Muffler to interconnect fasteners	96-120 **in-lbs**	10.8-13.6 Nm	FXST/FLSTC/FXSTB/FXSTC, page 4-39
Muffler to muffler support fasteners	96-120 **in-lbs**	10.8-13.6 Nm	FXSTD/FLSTF, page 4-41
Muffler to muffler support fasteners	96-120 **in-lbs**	10.8-13.6 Nm	FLSTN, page 4-44
Oxygen sensor	29-44 ft-lbs	39.3-59.7 Nm	page 4-23
Throttle cable bracket fasteners	20-35 **in-lbs**	2.3-4.0 Nm	use new screws, page 4-21, page 4-22
Throttle position sensor fasteners	18 **in-lbs**	2.0 Nm	page 4-14

GENERAL

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 an optional factory-installed turn signal module with integrated security system. Depending on destination, the security module consists of either a turn signal security module (TSSM) or a hands free security module (HFSM). Each of these modules include an integrated bank angle sensor (BAS).
- Ignition coil.
- Oxygen sensor (domestic models only)
- Active intake solenoid (HDI only)
- Active exhaust solenoid (HDI only)

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 sensor) 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 TSM/TSSM/HFSM. The TSM/TSSM/HFSM will shut the engine down if the vehicle is tipped over. 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 bus.

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.

The oxygen sensor (O2, domestic models only) monitors the exhaust gas for oxygen content. The fuel/air mixture is then adjusted to maintain a 14.6:1 air/fuel ratio.

O2 sensor diagnostic codes may be seen during the vehicle break-in period. The O2 sensor diagnostic codes will not illuminate the check engine lamp for current or historic codes and will only be indicated by Digital Technician or speedometer self diagnostics. If the diagnostic codes are reported during the break-in period, clear or ignore the codes until the break-in period is completed.

The active intake solenoid (HDI models) opens a valve in the air cleaner to allow more air to enter at speeds greater than 70 KPH with a throttle opening greater than 50%.

The active exhaust system (HDI models) utilizes an actuator valve located in the rear exhaust pipe which is connected to an actuator via a cable. The valve position automatically adjusts to enhance engine performance.

TROUBLESHOOTING

See the Softail Models Electrical Diagnostic Manual for troubleshooting and diagnostic information.

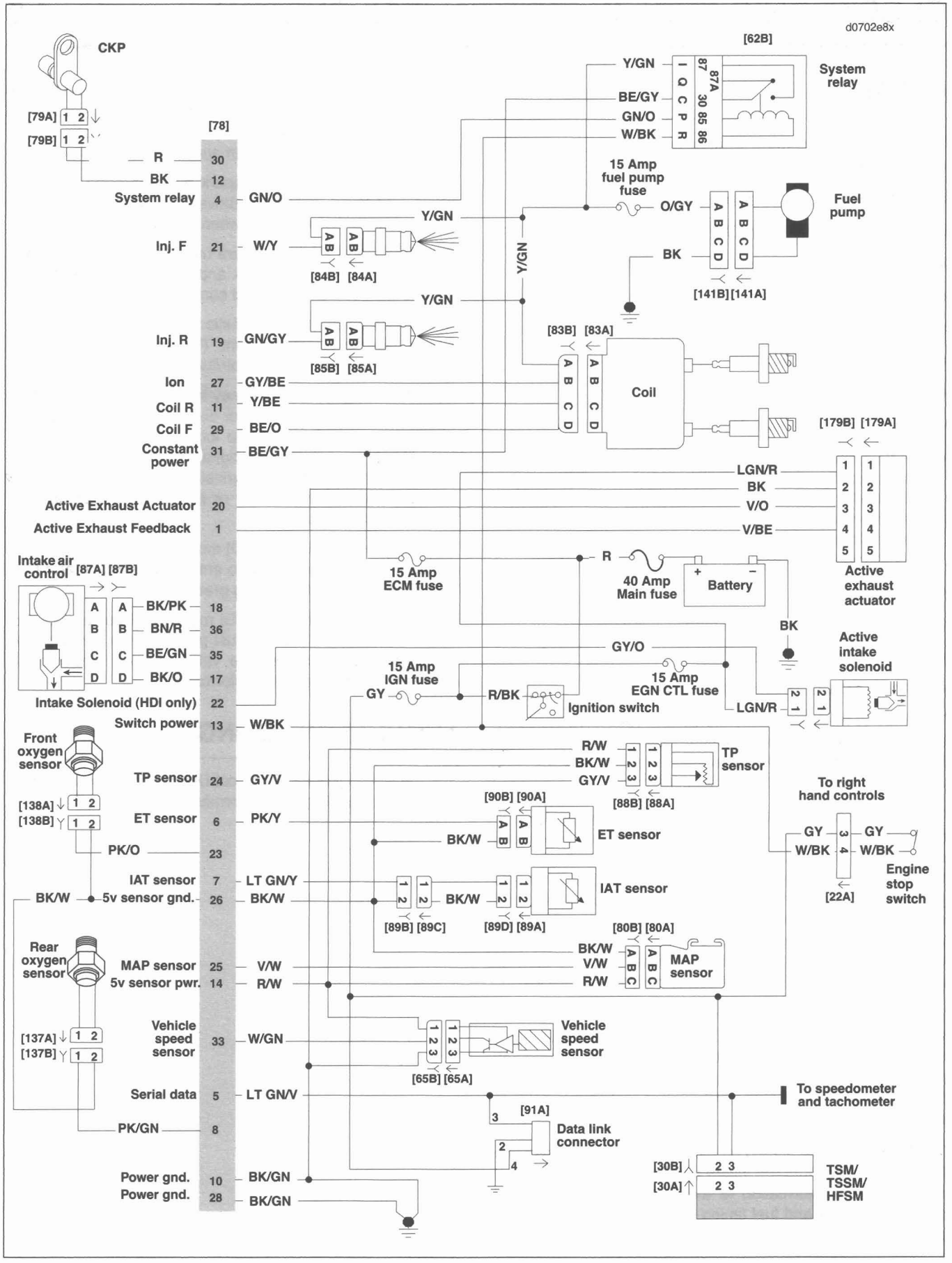


Figure 4-1. EFI System Circuit

IDLE SPEED 4.3

GENERAL

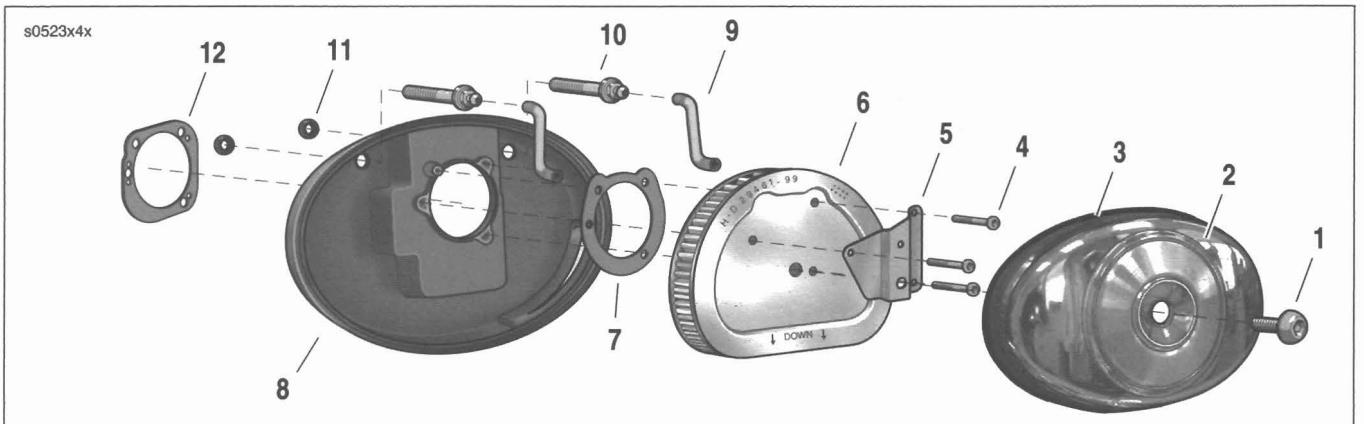
Idle speed can only be set using a computer based diagnostic package called DIGITAL TECHNICIAN (Part No. HD-44750). See your Harley-Davidson dealer.

REMOVAL

1. See Figure 4-2. Remove screw (1) and air cleaner cover (2).
2. Remove three TORX screws (4) and bracket (5) from filter element (6).
3. Gently pull both rubber breather tubes (9) from the back of the element. Remove filter element (6) and gasket (7).
4. 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.
7. Inspect seal ring (3) for cracks or tears. Verify that it seals tightly to backplate. Replace as required.
8. Alternately back out both breather bolts (10) (metric) a few turns a time while pulling backplate (8) away from induction module.
9. 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

1. See Figure 4-2. 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).
2. 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).
   a. 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).
   b. Install screw to secure air cleaner cover. Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).



1. **Screw @ 36-60 in-lbs (4.1-6.8 Nm)**
2. **Air cleaner cover**
3. **Seal ring**
4. **T27 TORX screw (3) @ 40-60 in-lbs (4.5-6.8 Nm)**
5. **Bracket**
6. **Filter element**
7. **Gasket**
8. **Backplate**
9. **Breather hose (2)**
10. **11 mm breather bolt (2) @ 120-144 in-lbs (13.6-16.2 Nm)**
11. **O-ring (2)**
12. **Gasket**

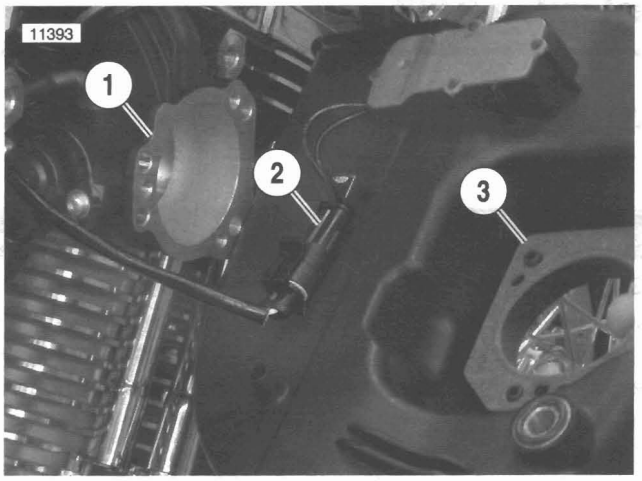
Figure 4-2. Air Cleaner Assembly

BACKPLATE ASSEMBLY: HDI MODELS

See Figure 4-3. HDI models have unique backplates. These parts may be distinguished by:

- A different intake with a solenoid-operated trap door assembly at the mouth of the intake.
- An intake solenoid connector (2) on the backplate.

Perform the same routine maintenance on HDI models, but also check that the trap door in the backplate operates properly.



1. **Intake module**
2. **Intake solenoid connector [178]**
3. **Air cleaner backing plate**

Figure 4-3. Backplate-HDI Models

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)

The fuel tank is treated to resist rusting. However, when the motorcycle is not operated for a long period of time, see 1.28 STORAGE for specific information regarding fuel tank treatment.

For information on the tank-mounted fuel gauge, see 8.25 FUEL GAUGE and Softail Models Electrical Diagnostic Manual.

REMOVAL

⚠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)

1. Remove seat.
2. Remove fuse block cover.
3. Purge the fuel supply line of high pressure gasoline.
   a. See Figure 4-4. 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.

⚠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)

4. See Figure 4-5. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line (2) to disconnect.

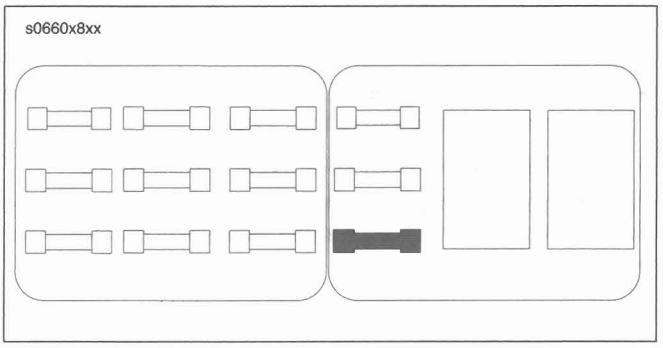
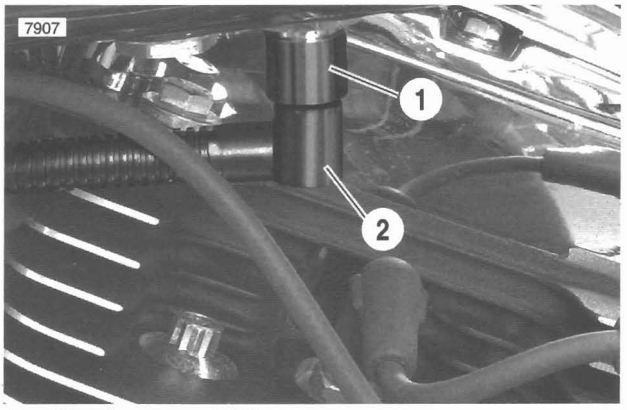


Figure 4-4. Fuel Pump Fuse: View From Top



1. **Quick connect fitting**
2. **Fuel supply line**

Figure 4-5. Fuel Supply Line Fitting

⚠WARNING

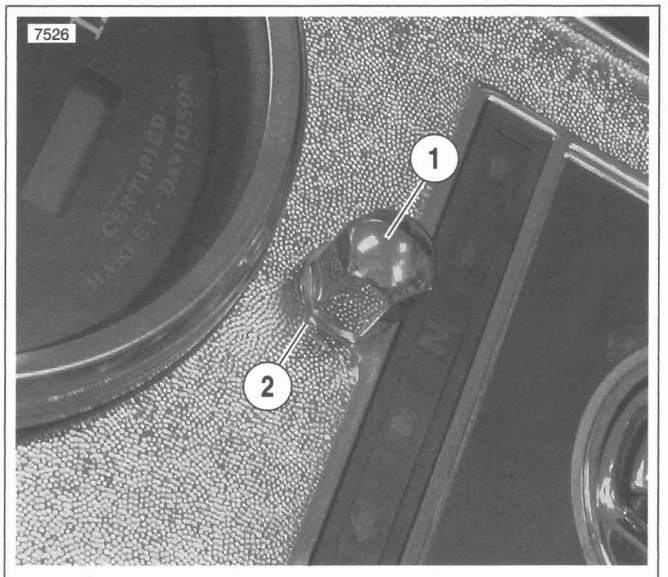
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

5. Disconnect negative battery cable.
6. Remove instrument console.
   a. All but FXSTD, see Figure 4-6. Remove acorn nut (1) and washer (2) on instrument console to separate console from fuel tank.
   b. For FXSTD, see 8.26 INSTRUMENT CONSOLE: FXSTD.
7. Disconnect console wiring.
8. See Figure 4-7. Unplug fuel pump module connector [86].

⚠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)

9. 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. 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 FXSTD. Remove fuel tank.
    a. See Figure 4-9. 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 4-8. Disconnect fuel gauge connector [117] located under left side of fuel tank.
    e. See Figure 4-9. Remove fuel tank from motorcycle. Remove rubber trim (13) to access connectors along frame. Remove bushings and grommets (3) if necessary.
11. FXSTD. Remove fuel tank.
    a. See Figure 4-10. 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 4-8. Disconnect fuel gauge connector [117] located under left side of fuel tank.
    e. Remove fuel tank from motorcycle.



1. **Acorn nut**
2. **Washer**

Figure 4-6. Instrument Console: All But FXSTD

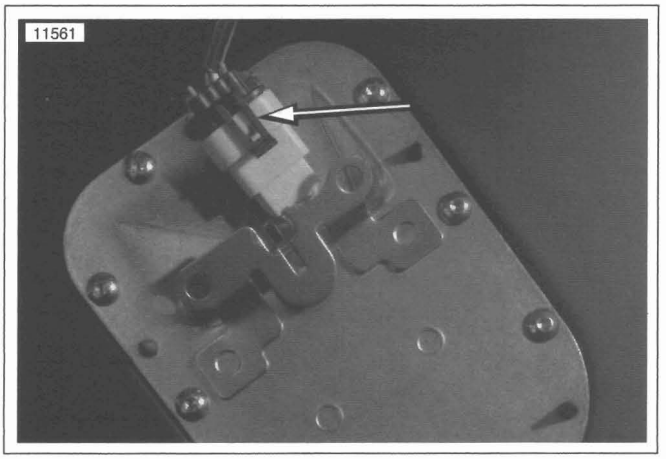


Figure 4-7. Fuel Pump Module Connector

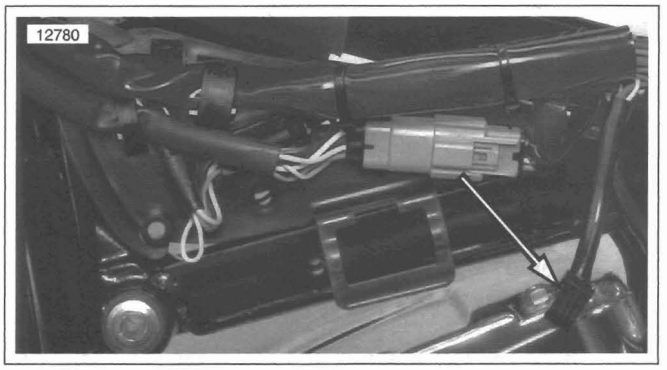
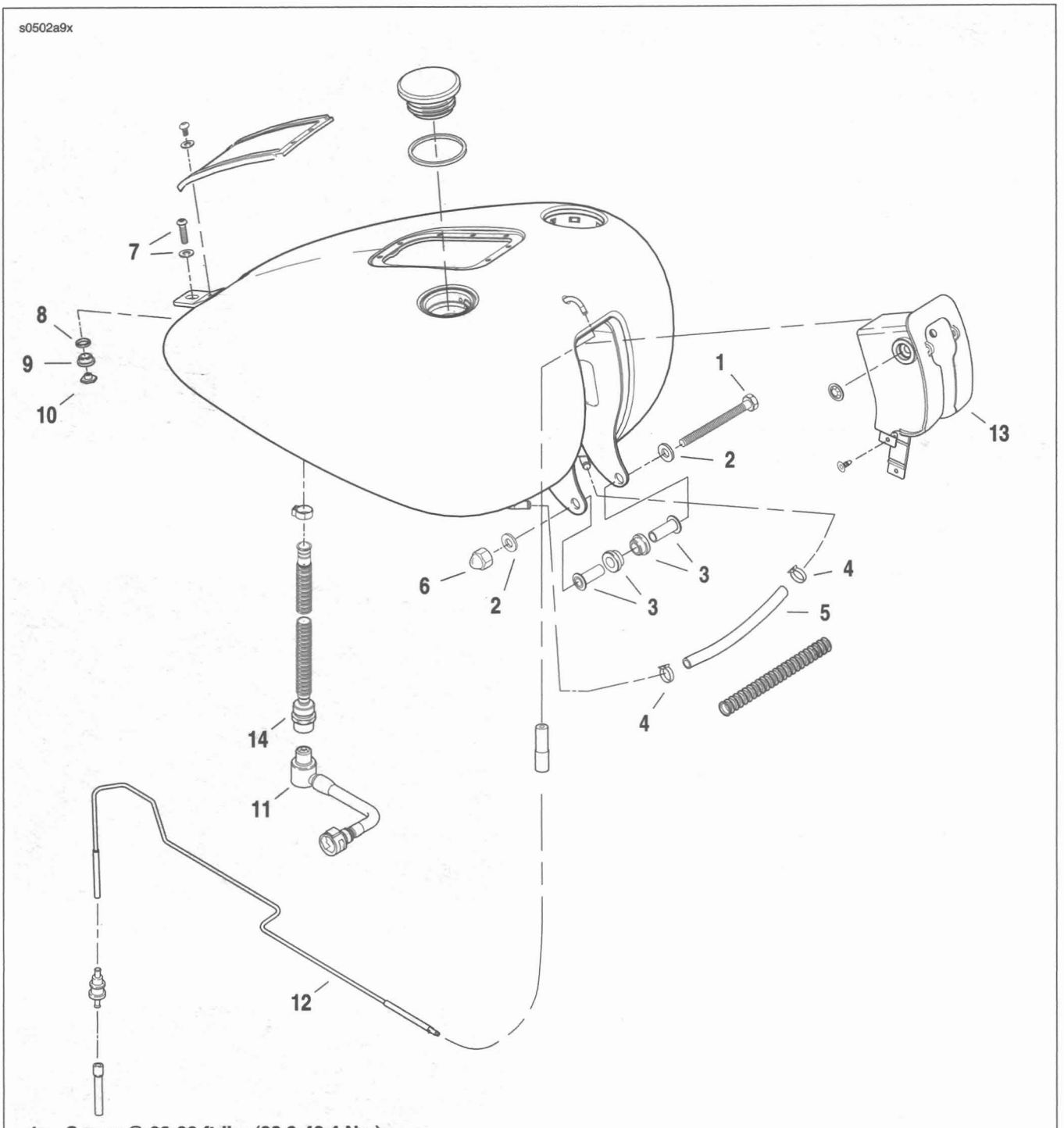
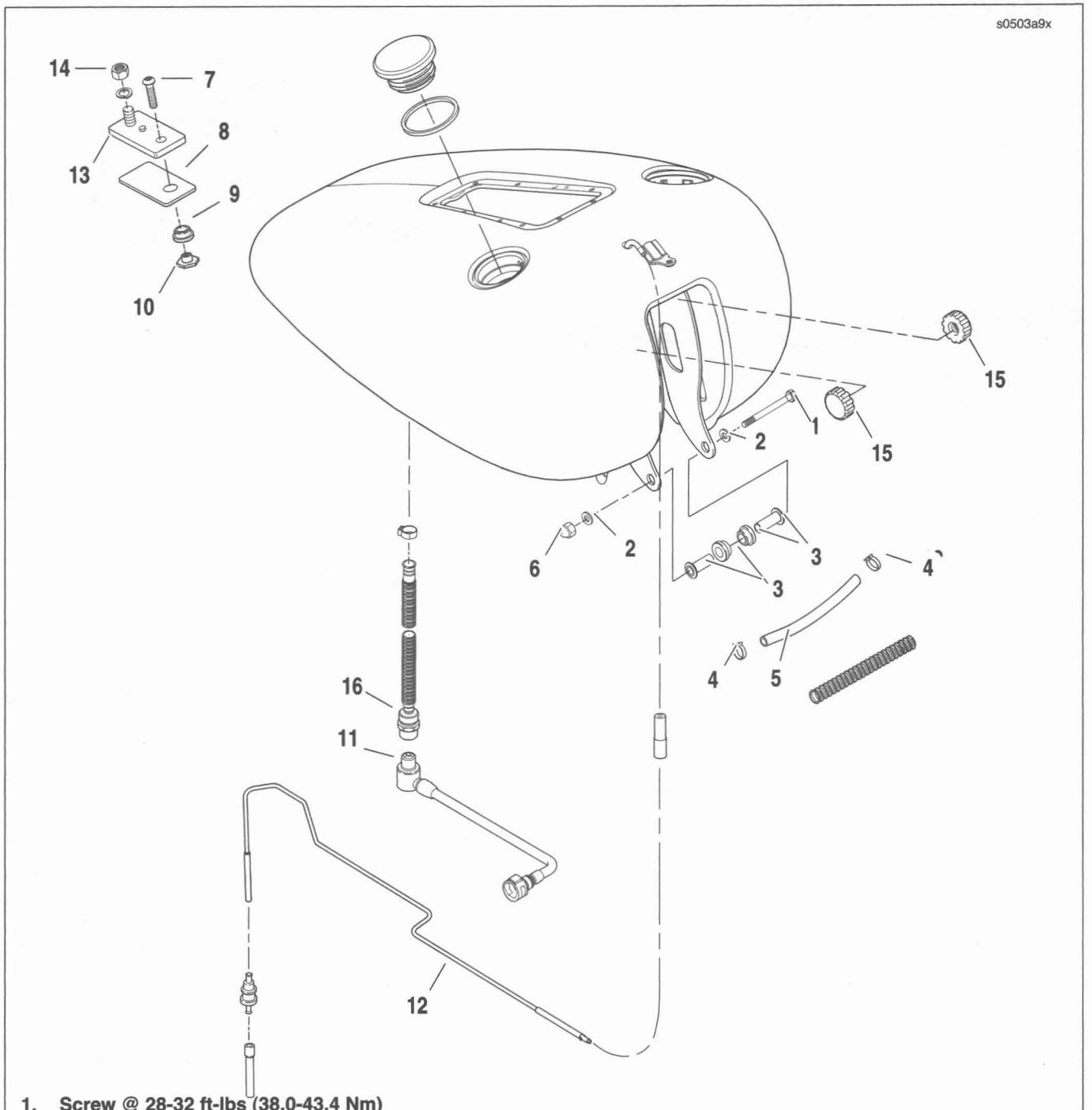


Figure 4-8. Fuel Gauge Connector Location



1. Screw @ 28-32 ft-lbs (38.0-43.4 Nm)
2. Washer
3. Bushing and grommet
4. Clamp
5. Crossover line
6. Acorn nut
7. Rear T40 TORX screw @ 18-22 ft-lbs (24.4-29.8 Nm)
8. Rubber ring
9. Grommet (same as grommet #3)
10. Tee nut
11. Fuel line
12. Continuous vent line
13. Rubber trim
14. Check valve @ 22-26 ft-lbs (29.8-35.2)

Figure 4-9. Fuel Tank: All But FXSTD



1. Screw @ 28-32 ft-lbs (38.0-43.4 Nm)
2. Washer
3. Bushing and grommet
4. Clamp
5. Crossover line
6. Acorn nut
7. Rear T40 TORX bolt @ 16-20 ft-lbs (21.7-27.1 Nm)
8. Rubber ring
9. Grommet (same as grommet #3)
10. Tee nut
11. Fuel line
12. Continuous vent line
13. Mount
14. Nut @ 14-18 ft-lbs (19.0-24.4 Nm)
15. Front tank mount
16. Check valve @ 22-26 ft-lbs (29.8-35.2)

Figure 4-10. Fuel Tank: FXSTD

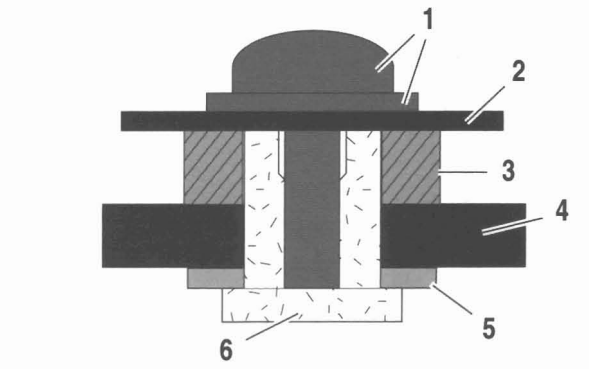
CLEANING AND INSPECTION

1. Remove fuel pump. See 4.14 FUEL PUMP/FUEL GAUGE SENDING UNIT.
2. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent.
3. 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.

4. Inspect the interconnect lines, evaporative emissions system vent line (California models) and fuel line for cuts, cracks or holes. Replace lines as needed.
5. Inspect the tank for leaks and other damage. If a damaged tank cannot be successfully repaired, replace it.
6. Install fuel pump. See 4.14 FUEL PUMP/FUEL GAUGE SENDING UNIT.



1. **T40 TORX screw and washer**
2. **Fuel tank tab**
3. **Rubber ring**
4. **Frame**
5. **Rubber grommet**
6. **Metal insert for grommet**

Figure 4-11. Rear Tank Screw

INSTALLATION

All But FXSTD

1. See Figure 4-9. 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 4-8. Connect the fuel gauge connector [117] located under left side of fuel tank.
3. Attach tank mounts.
   a. See Figure 4-9. 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 4-11. 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).
   c. Install washer and rear T40 TORX screw (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).

4. See Figure 4-9. Connect crossover line (5) with **new** clamps (4).
5. See Figure 4-5. Connect fuel supply line (2).
6. See Figure 4-7. Connect fuel pump module connector [86].
7. Install instrument console wiring.
8. See Figure 4-6. Install instrument console with acorn nut and washer. Tighten to 80-100 **in-lbs** (9.0-11.3 Nm).
9. See Figure 4-4. Connect the fuel pump fuse to the main wiring harness.
10. Connect negative battery cable.
11. Fill tank with gasoline and check for leaks.

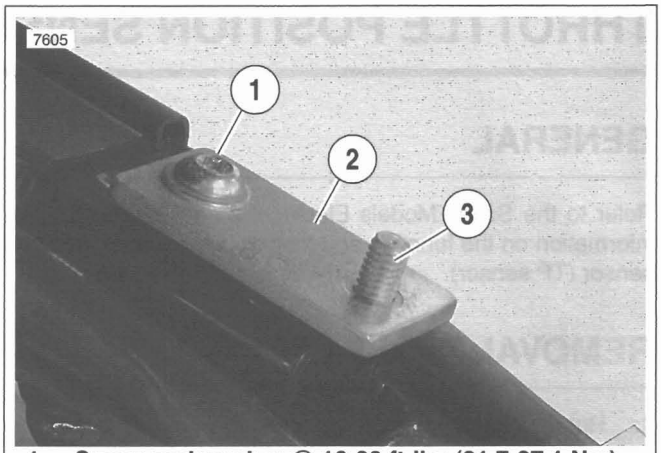
⚠WARNING

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.

FXSTD

1. See Figure 4-10. 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 4-8. 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.
   b. See Figure 4-12. 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. See Figure 4-10. Tighten acorn nut (6) to 28-32 ft-lbs (38.0-43.4 Nm).
4. Connect crossover line with **new** clamps.
5. Connect fuel gauge connector [117] located under left side of fuel tank.
6. See Figure 4-7. Connect fuel pump module connector.
7. See Figure 4-5. Connect fuel supply line (2).



1. **Screw and washer @ 16-20 ft-lbs (21.7-27.1 Nm)**
2. **Mount**
3. **Stud**

Figure 4-12. Rear Mount: FXSTDI

8. Install instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD.
9. See Figure 4-4. Connect the fuel pump fuse to the main 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.

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.

⚠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 air cleaner backplate. See 4.4 AIR CLEANER.
4. See Figure 4-13. Unplug TP sensor connector [88].
5. 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.*

1. See Figure 4-14. Inspect O-ring (2) in groove of throttle position sensor for cuts, tears or signs of deterioration. Install **new** O-ring if necessary.
2. Fit pocket (3) of throttle position sensor over throttle shaft while engaging index pin (1) with hole on machined flange of induction module
3. Install two **new** fasteners (4) to fasten throttle position sensor to induction module. Tighten screws to 18 **in-lbs** (1.7-2.3 Nm)
4. 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].
6. Install air cleaner assembly. See 4.4 AIR CLEANER.
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.

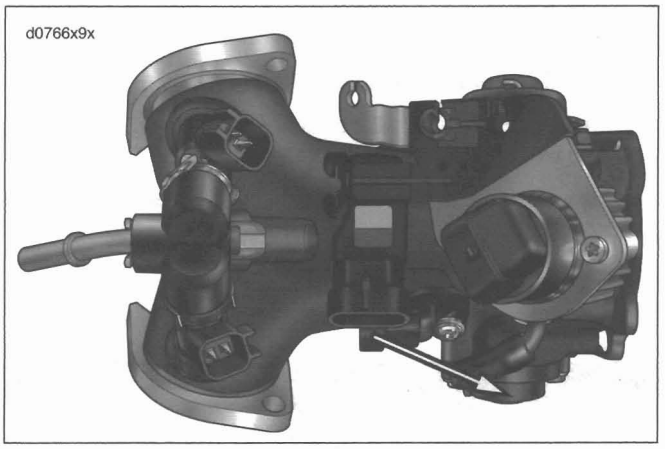
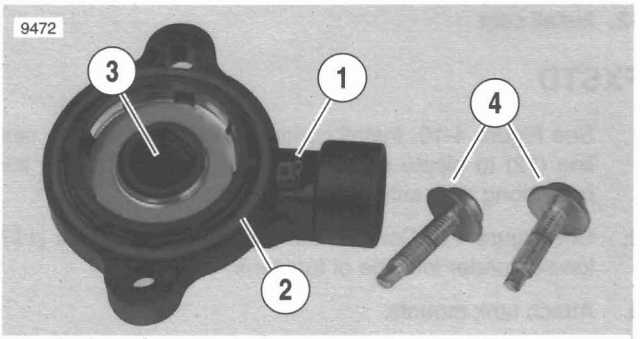


Figure 4-13. Throttle Position Sensor



1. **Index pin**
2. **O-ring**
3. **Pocket**
4. **Fasteners**

Figure 4-14. Throttle Position Sensor Installation

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.
3. Remove air cleaner backplate. See 4.4 AIR CLEANER.
4. See Figure 4-15. Unplug IAT sensor connector [89].
5. Remove fastener to detach IAT sensor. Discard fastener.

INSTALLATION

1. See Figure 4-16. Inspect O-ring (1) in groove of intake air temperature sensor for cuts, tears or signs of deterioration. Install **new** O-ring if necessary.
2. See Figure 4-15. Insert sensor into induction module with electrical connector facing toward the left side of the motorcycle.
3. See Figure 4-16. 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 4.4 AIR CLEANER.
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.

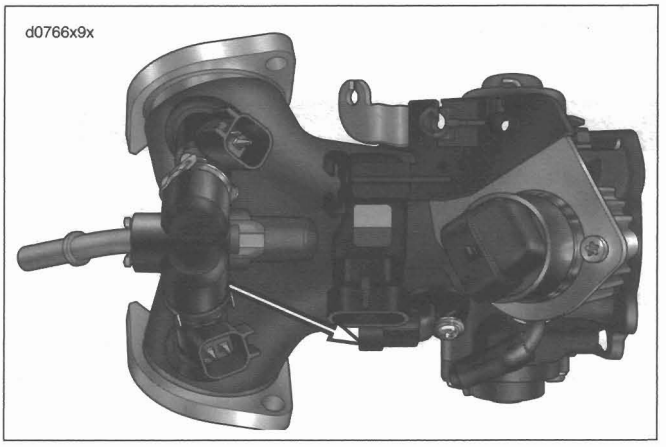
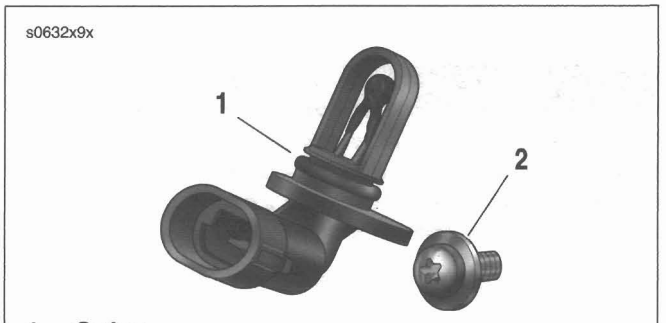


Figure 4-15. Intake Air Temperature Sensor Location



1. O-ring
2. Fastener

Figure 4-16. Intake Air Temperature Sensor

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 engine temperature sensor (ET sensor).

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 4-17. 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.

⚠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 4-18. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line (2) to disconnect.

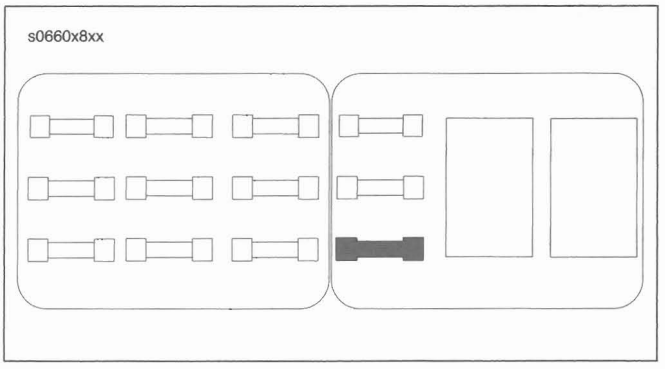
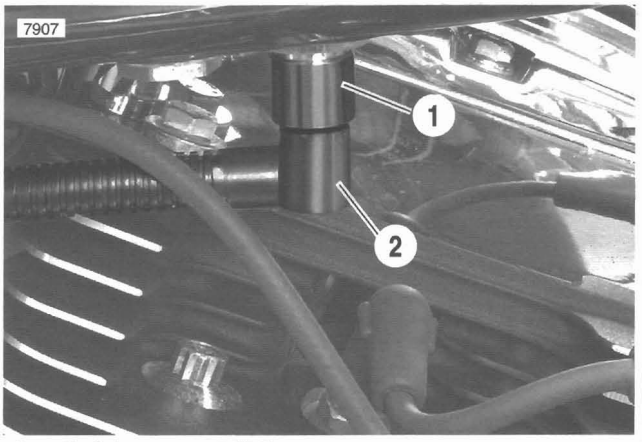


Figure 4-17. Fuel Pump Fuse: View From Top



1. **Quick connect fitting**
2. **Fuel supply line**

Figure 4-18. 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)

4. Disconnect negative battery cable.

NOTE

On some models, horn may have to be removed to ease removal/installation.

5. See Figure 4-19. Pull back boot to reveal ET sensor at back of front cylinder.
6. Unplug ET sensor connector [90] by pulling external latch outward and using rocking motion to remove.
7. See Figure 4-20. Loosen ET sensor using socket. When sensor starts to turn easily, finish removing by hand.

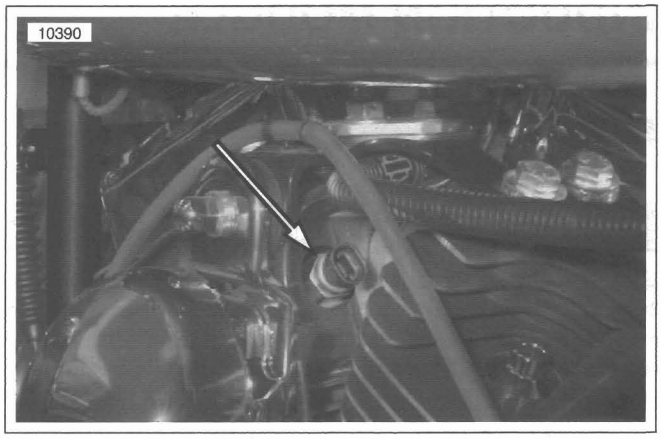


Figure 4-19. Engine Temperature Sensor

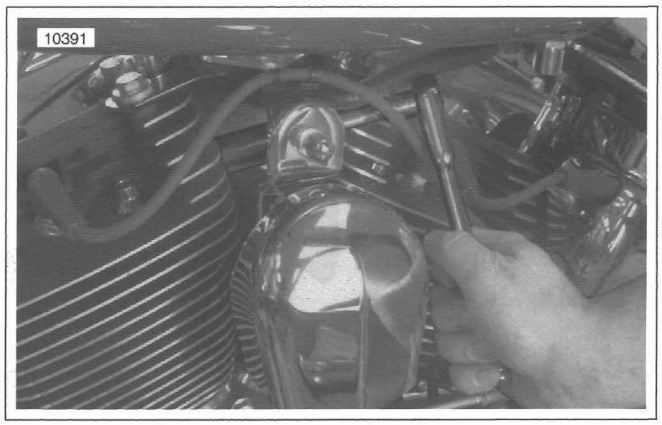


Figure 4-20. Engine Temperature Sensor Removal

INSTALLATION

1. 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 4-18. Install fuel line fitting.
6. See Figure 4-17. Install fuel pump fuse.
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)

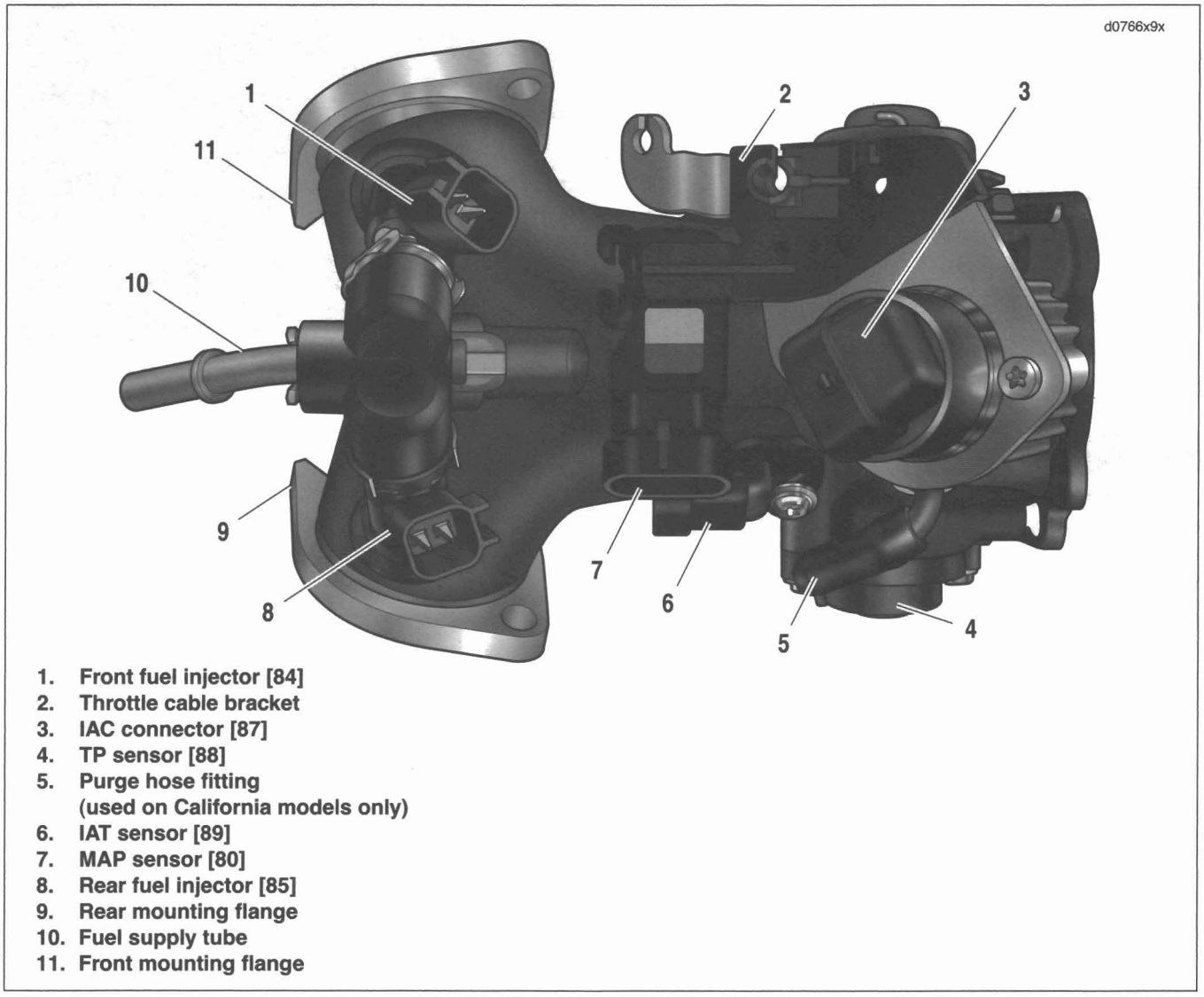
8. Install seat.

REMOVAL

⚠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)

1. On all but FXSTD, gain access to the induction module by removing fuel tank hardware and fuel line. Carefully pivot tank upward and prop in position. See 4.5 FUEL TANK.
2. On FXSTD, remove fuel tank See 4.5 FUEL TANK.
3. Remove air cleaner backplate. See 4.4 AIR CLEANER.
4. See Figure 4-21. Pull purge hose from fitting (5) at top of induction module (California models only).
5. See Figure 4-22. 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.
6. See Figure 4-21. Remove idle air control connector (3) [87] and manifold absolute pressure sensor connector (7) [80].



1. **Front fuel injector [84]**
2. **Throttle cable bracket**
3. **IAC connector [87]**
4. **TP sensor [88]**
5. **Purge hose fitting (used on California models only)**
6. **IAT sensor [89]**
7. **MAP sensor [80]**
8. **Rear fuel injector [85]**
9. **Rear mounting flange**
10. **Fuel supply tube**
11. **Front mounting flange**

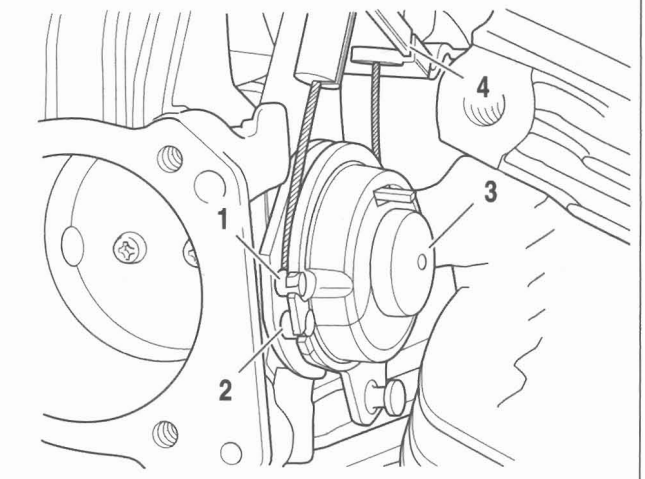
Figure 4-21. Induction Module

7. Remove front fuel injector connector (1) [84] and rear fuel injector connector (8) [85].
8. 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.

⚠WARNING

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)

11. See Figure 4-23. 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



1. **Idle cable barrel**
2. **Throttle cable barrel**
3. **Throttle wheel**
4. **Throttle cable bracket**

Figure 4-22. Throttle/Idle Cables

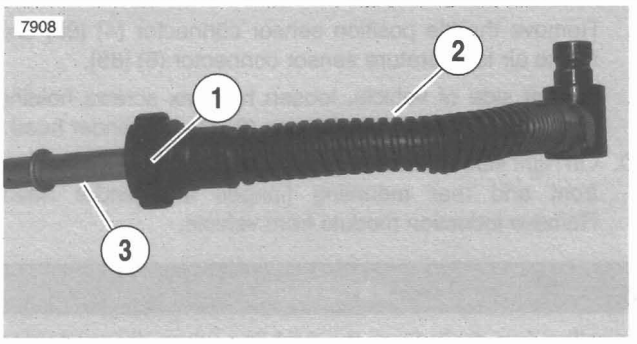
INSTALLATION

1. See Figure 4-21. 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.

2. Place intake manifold seal, flanges, and induction module in position. Install the manifold mounting screws finger tight.
3. See Figure 4-23. Slide fuel supply line (2) onto fuel supply tube (3).
4. See Figure 4-22. 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 4-21. On California models, attach purge hose to fitting (5) on throttle body.
6. 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 backplate. See 4.4 AIR CLEANER.
8. Tighten manifold mounting screws to 96-144 **in-lbs** (10.8-16.3 Nm).
9. 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 4.5 FUEL TANK.
12. Check throttle and idle cable adjustment.



1. **Tab**
2. **Fuel supply line**
3. **Fuel supply tube**

Figure 4-23. Fuel supply line

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)

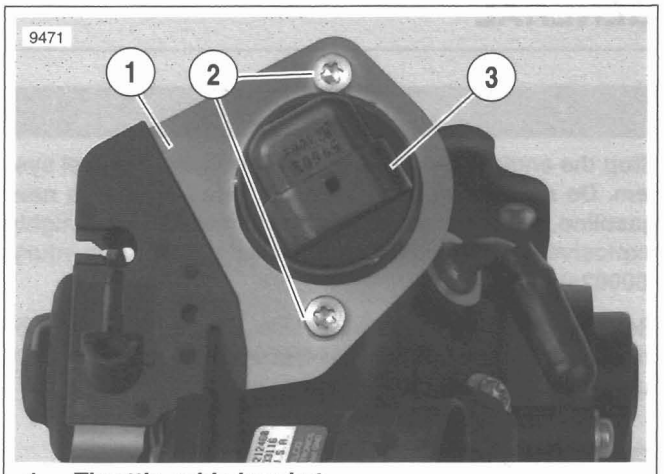
Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the idle air control (IAC).

REMOVAL

1. Remove induction module. See 4.9 INDUCTION MODULE.
2. See Figure 4-24. Remove two fasteners (2) to release throttle cable bracket (1) from induction module. Discard fasteners.
3. See Figure 4-25. Pull IAC (1) and o-ring (2) from throttle body.

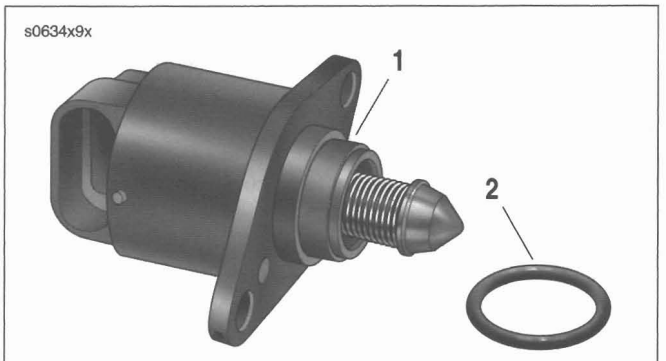
INSTALLATION

1. See Figure 4-25. Apply **clean** engine oil to IAC o-ring (2). Install o-ring in counterbore of induction module.
2. With the electrical connector facing the rear left side of 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 4-26. Insert index pin (2) at bottom of throttle cable bracket (1) into hole in boss at top of induction module.
5. See Figure 4-24. Install **new** throttle cable bracket fasteners (2). Tighten to 20-35 **in-lbs** (2.3-4.0 Nm).
6. Install induction module. See 4.9 INDUCTION MODULE.



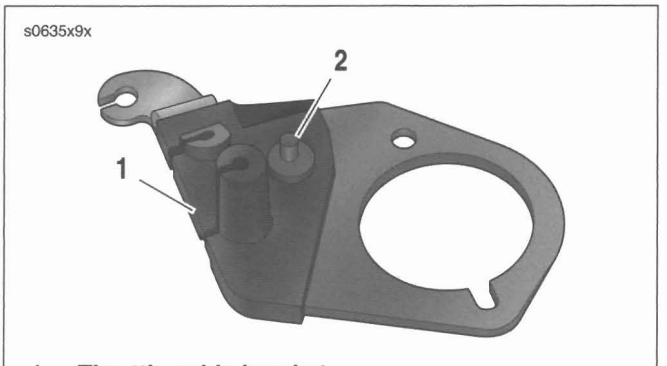
1. **Throttle cable bracket**
2. **Fasteners**
3. **Idle air control (IAC)**

Figure 4-24. Idle Air Control Location



1. **Idle air control (IAC)**
2. **O-ring**

Figure 4-25. Idle Air Control



1. **Throttle cable bracket**
2. **Index pin**

Figure 4-26. Throttle Cable Bracket

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 manifold absolute pressure sensor (MAP).

REMOVAL

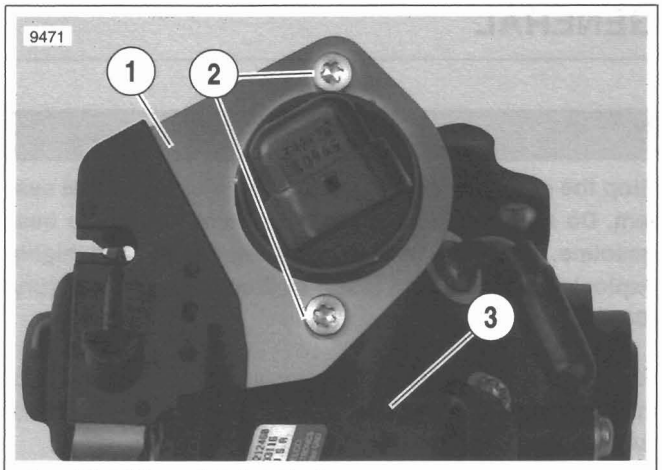
1. Remove induction module. See 4.9 INDUCTION MODULE.
2. See Figure 4-27. Remove two fasteners (2) to release throttle cable bracket (1) from induction module. Discard fasteners.
3. Using appropriate tool, gently push up on MAP sensor and attached seal to remove from intake manifold.

INSTALLATION

NOTE

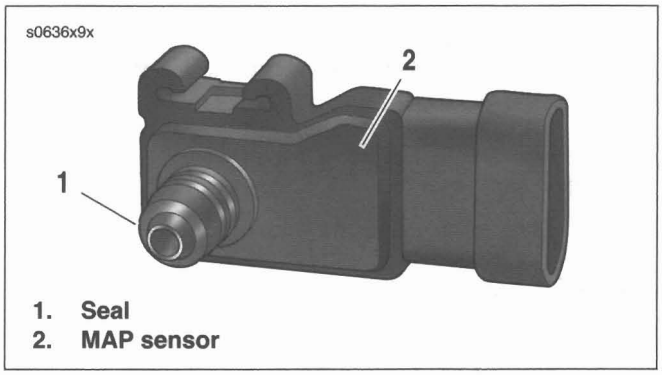
*See Figure 4-28. If the original sensor is re-installed, the seal (1) must be inspected. Seals not in good condition could cause vacuum leaks. Install **new** seal if necessary*

1. Push MAP sensor and seal into intake manifold.
2. With the electrical connector facing toward the rear of the induction module (side opposite throttle wheel), insert MAP sensor into hole in induction module.
3. See Figure 4-29. Insert index pin (2) at bottom of throttle cable bracket into hole in boss at top of induction module.
4. See Figure 4-27. Install **new** throttle cable bracket fasteners (2). Tighten to 20-35 **in-lbs** (2.3-4.0 Nm).
5. Install induction module. See 4.9 INDUCTION MODULE.



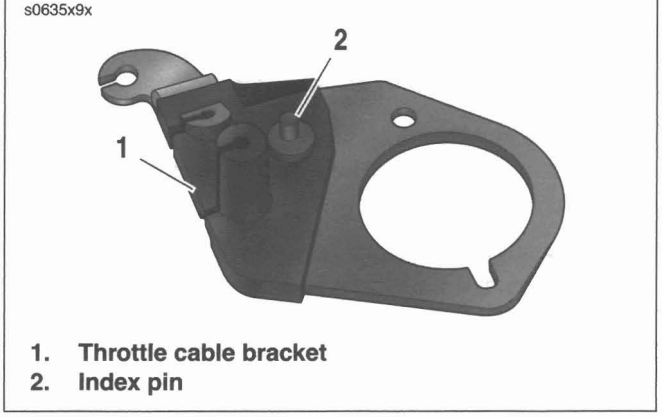
1. **Throttle cable bracket**
2. **Fasteners**
3. **Manifold absolute pressure sensor (MAP)**

Figure 4-27. Throttle Cable Bracket Location



1. **Seal**
2. **MAP sensor**

Figure 4-28. MAP Sensor



1. **Throttle cable bracket**
2. **Index pin**

Figure 4-29. Throttle Cable Bracket

GENERAL

Refer to the Softail Models Electrical Diagnostic Manual for information on the function and testing of the oxygen sensor (O2).

REMOVAL

PART NO.	SPECIALTY TOOL
HD-48262	Oxygen sensor socket

1. See Figure 4-30. The (O2) sensors are installed in threaded bosses on the inboard side of front and rear exhaust pipes.
2. Disconnect front O2 sensor connector. See 8.14 FRONT ELECTRICAL CADDY for front O2 sensor connector information.
3. Use OXYGEN SENSOR SOCKET (Part No. HD-48262) to remove front O2 sensor.
4. Disconnect rear O2 sensor connector. Rear O2 sensor is located underneath oil tank on right side of vehicle.
5. Use OXYGEN SENSOR SOCKET (Part No. HD-48262) to remove rear O2 sensor.

INSTALLATION

NOTE

Do not install sensors that have been dropped or impacted by other components. Damage to the sensing element may have occurred. Replacement sensor assemblies have threads coated with anti-seize lubricant and new seal rings.

1. If sensor is being reinstalled, replace seal ring and coat threads on sensor with LOCTITE® ANTI-SEIZE.
2. Thread sensor into threaded boss on exhaust pipe and tighten to 29-44 ft-lbs (39.3-59.7 Nm).
3. Route sensor harness to mating connector and connect. Install any cable straps that were removed during removal.
4. Repeat above for other sensor.

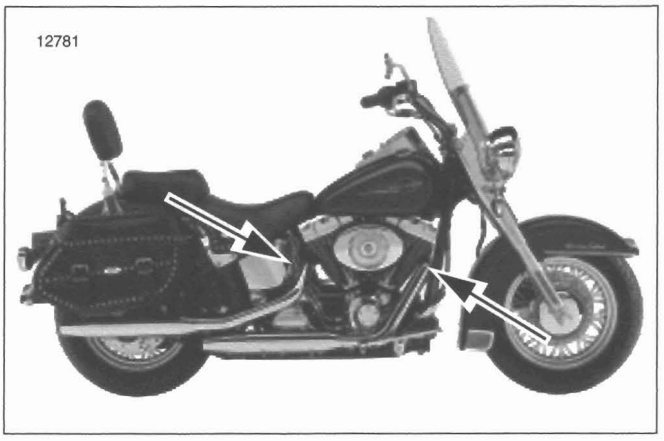


Figure 4-30. Oxygen Sensors (Inboard Side Of Exhaust Pipes)

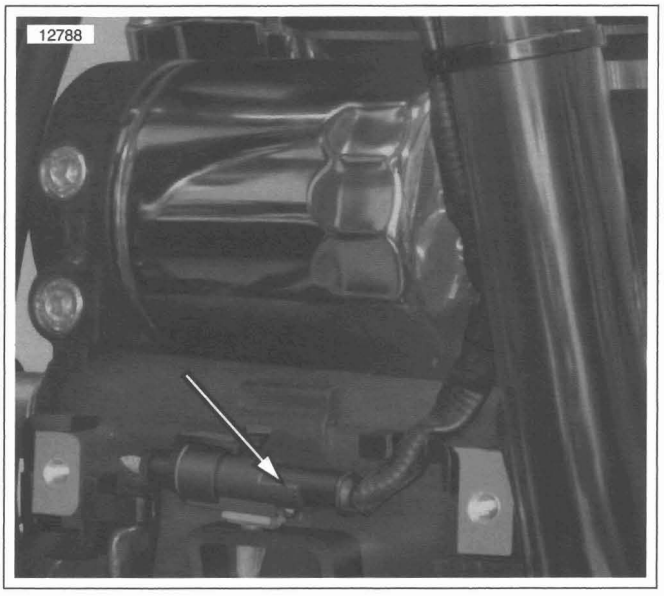


Figure 4-31. Front O2 Connector Location

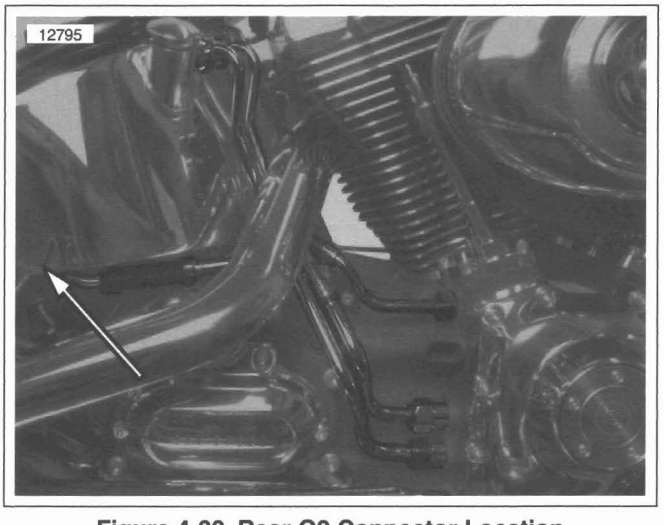


Figure 4-32. Rear O2 Connector Location

NOTES

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.

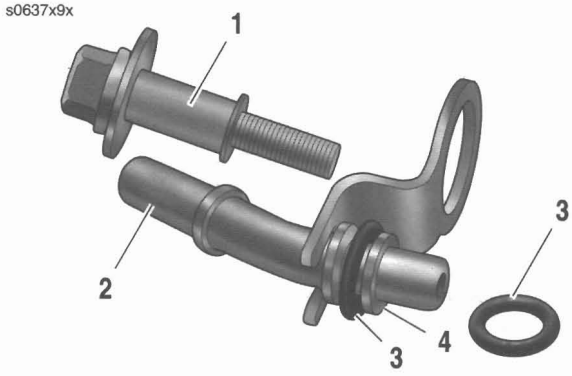
REMOVAL

1. Remove induction module. See 4.9 INDUCTION MODULE.

NOTE

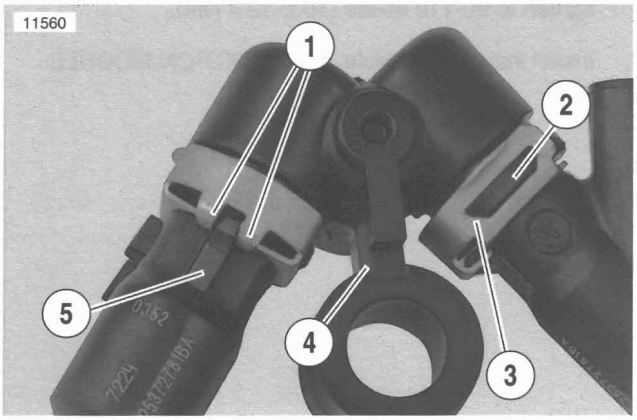
If not replacing fuel supply tube or o-rings, do not remove.

2. See Figure 4-33. Remove fastener (1) retaining fuel supply tube (2).
3. 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.
4. See Figure 4-34. 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.
5. See Figure 4-35. 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.



1. **Fastener**
2. **Fuel supply tube**
3. **O-ring (2)**
4. **Sealing washer**

Figure 4-33. Fuel Supply Tube

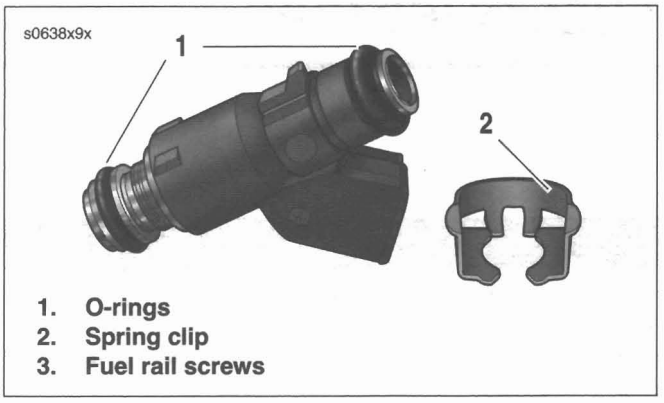


1. **Fork**
2. **Lip**
3. **Opening**
4. **Rail tab**
5. **Injector tab**

Figure 4-34. Fuel Rail

INSTALLATION

1. See Figure 4-35. Apply a thin coat of clean engine oil to **new** fuel injector o-rings (1). Install on fuel injectors.
2. See Figure 4-34. Push electrical connector side of fuel injectors into fuel rail.
3. 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.
4. 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.
5. See Figure 4-33. 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.
6. 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. 4.9 INDUCTION MODULE.



1. **O-rings**
2. **Spring clip**
3. **Fuel rail screws**

Figure 4-35. Fuel Injector

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 pump.

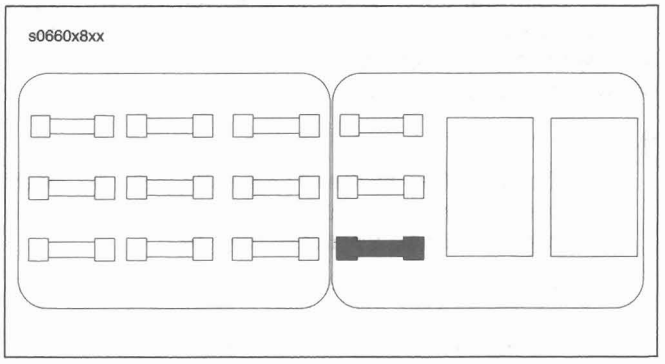


Figure 4-36. Fuel Pump Fuse: View From Top

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 4-36. 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.

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.
4. Remove instrument console.
   a. All but FXSTD, see Figure 4-37. Remove acorn nut and washer on instrument console to separate console from fuel tank.
   b. For FXSTD, see 8.26 INSTRUMENT CONSOLE: FXSTD.
5. Disconnect console wiring.

Figure 4-37. Acorn Nut And Washer: All But FXSTD

⚠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 4-38. 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.
7. See Figure 4-39. Unplug fuel pump module connector (3) [86].
8. Remove top plate screws (2) and discard.
9. See Figure 4-40. Pull top plate (2) out of fuel tank enough to expose fuel hose and clamp (1).

CAUTION

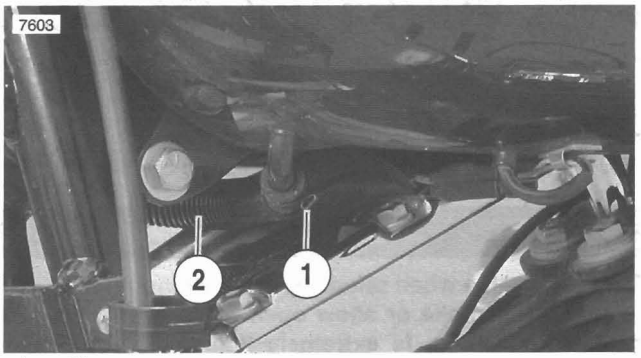
Carefully inspect end of hose for cuts, tears, holes or other damage. Replace hose if any damage is found. Even the smallest hole can cause a reduction in fuel pressure.

10. Cut clamp and remove hose from regulator housing fitting.

CAUTION

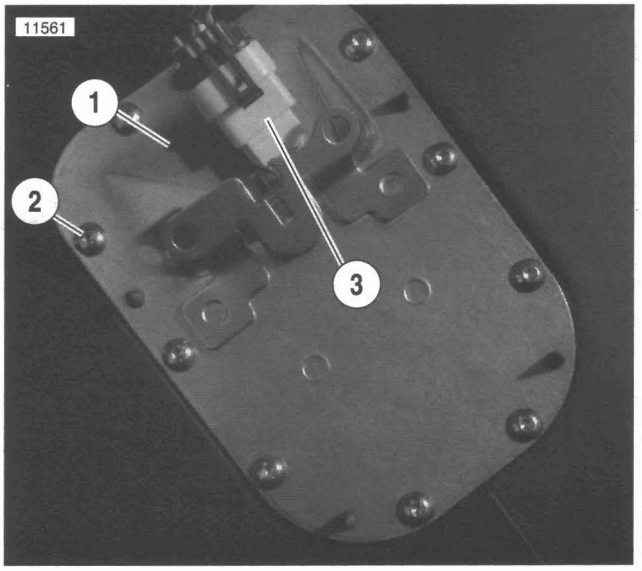
Exercise care to avoid bending float rod of fuel level sender. A bent float rod will result in erroneous gauge readings.

11. See Figure 4-41. Reach into fuel tank and push fuel pump housing (16) to disengage it from end cap (14).
12. See Figure 4-42. 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 4-41. Pull tab (19) towards top of fuel tank to release fuel gauge sending unit (20) from mounting tabs.
14. Remove top plate, fuel pump and fuel gauge sending unit from fuel tank.



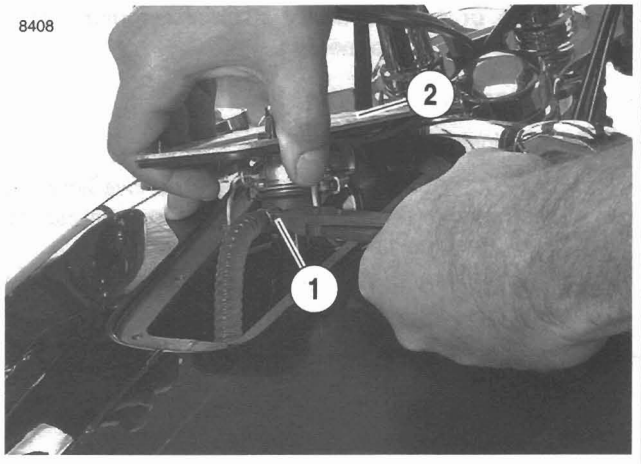
1. Clamp
2. Crossover hose

Figure 4-38. Crossover Hose



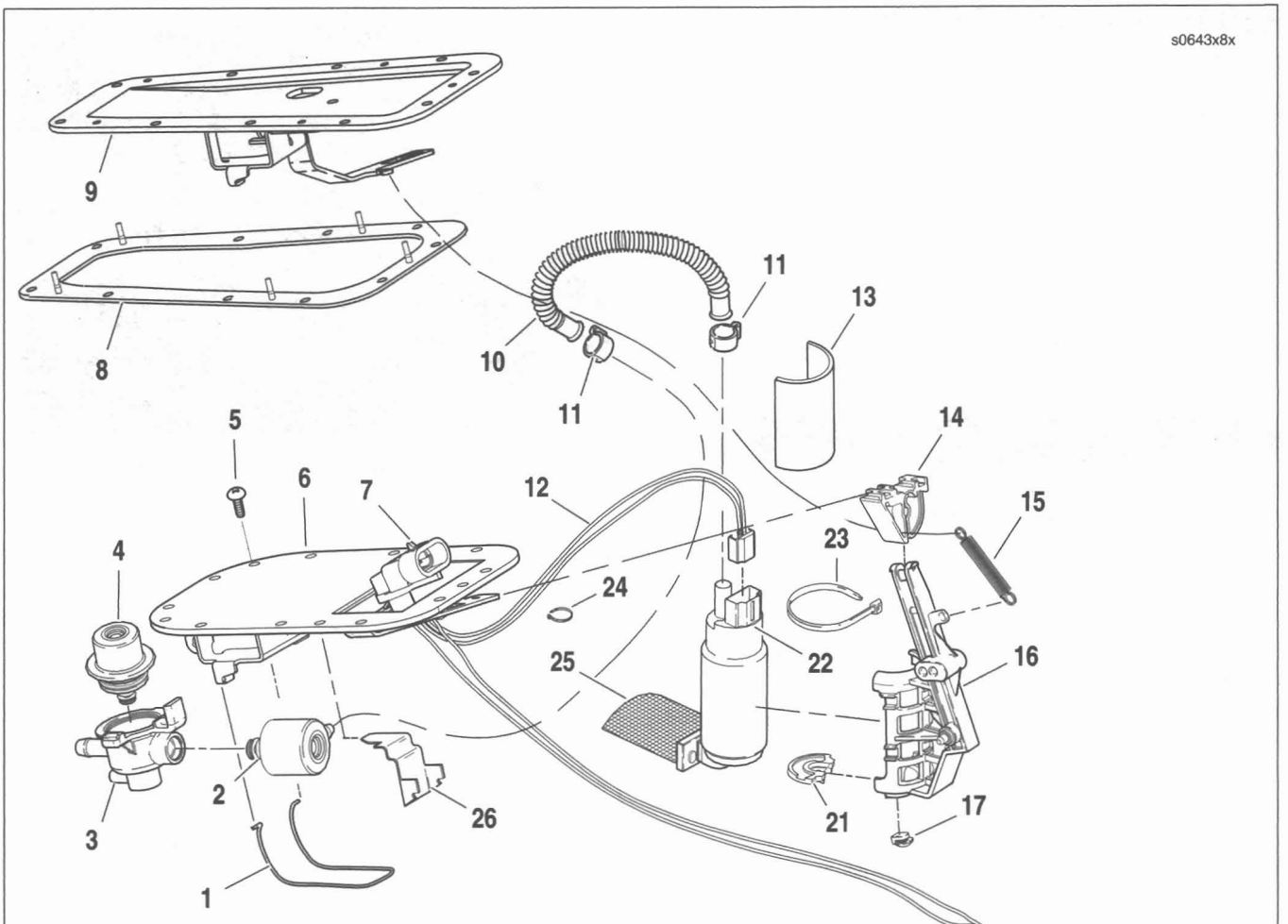
1. Top plate
2. Fasteners (10)
3. Fuel pump module connector [86]

Figure 4-39. Top Plate Fasteners



1. Clamp
2. Top plate

Figure 4-40. Fuel Line Clamp



1. Bail
2. Fuel filter
3. Regulator housing
4. Regulator
5. Sealing screw @ 18-24 in-lbs (2.0-2.7 Nm)
6. Top plate: all but FXSTDI
7. Fuel pump module connector
8. Top plate gasket
9. Top plate: FXSTDI
10. Hose
11. Clamp
12. Wire assembly
13. Rubber sleeve
14. End cap
15. Spring
16. Fuel pump housing
17. Rubber spacer
18. Float
19. Tab
20. Fuel level sender
21. Rubber cushion
22. Fuel pump
23. Cable strap
24. Cable strap
25. Fuel pump inlet filter
26. Bail bracket

Figure 4-41. Fuel Pump/Fuel Gauge Sending Unit

DISASSEMBLY/ASSEMBLY

Fuel Filter

1. See Figure 4-41. Disengage bail (1) from bail bracket (28).
2. See Figure 4-43. Remove bail bracket from top plate.
3. See Figure 4-44. Remove fuel filter (2) from regulator housing (1).
4. 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.

5. 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 4-44. Insert filter into fuel pressure regulator housing, so that inlet port is on fuel pump side.
7. See Figure 4-43. 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

1. Remove fuel pump from regulator housing. See Fuel Filter under DISASSEMBLY/ASSEMBLY.
2. See Figure 4-45. Slide fuel pressure regulator assembly forward to free arms from top plate.
3. Pull regulator from regulator housing by using rocking motion.
4. See Figure 4-46. 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.
7. Install fuel filter. See Fuel Filter under DISASSEMBLY/ASSEMBLY.

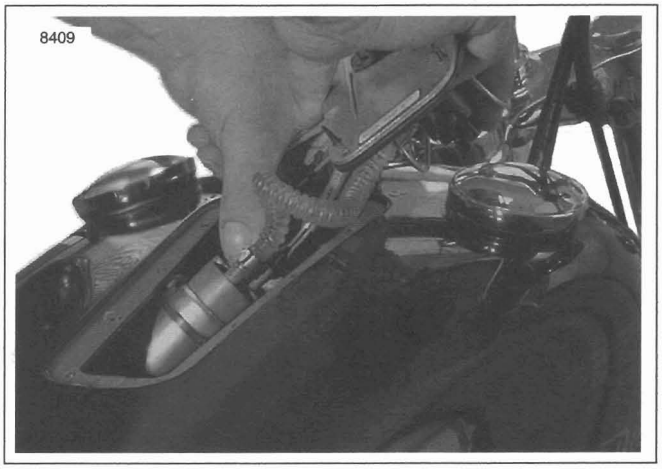


Figure 4-42. Fuel Pump Removal

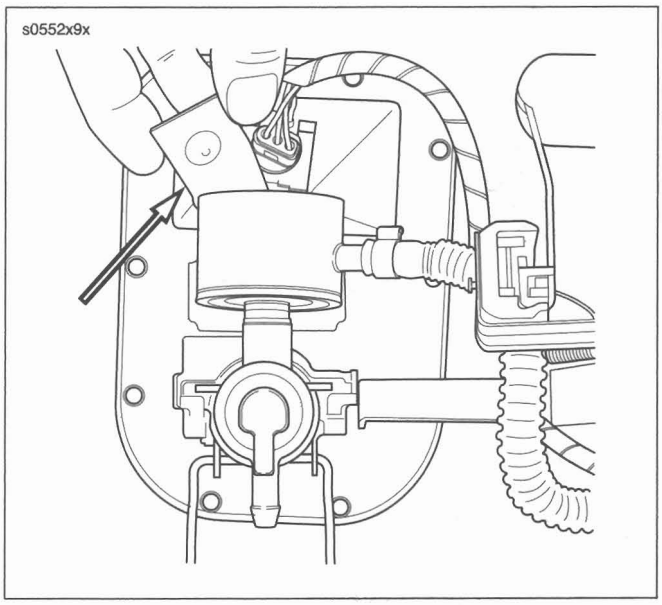


Figure 4-43. Bail Bracket

Fuel Pump

1. See Figure 4-41. 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

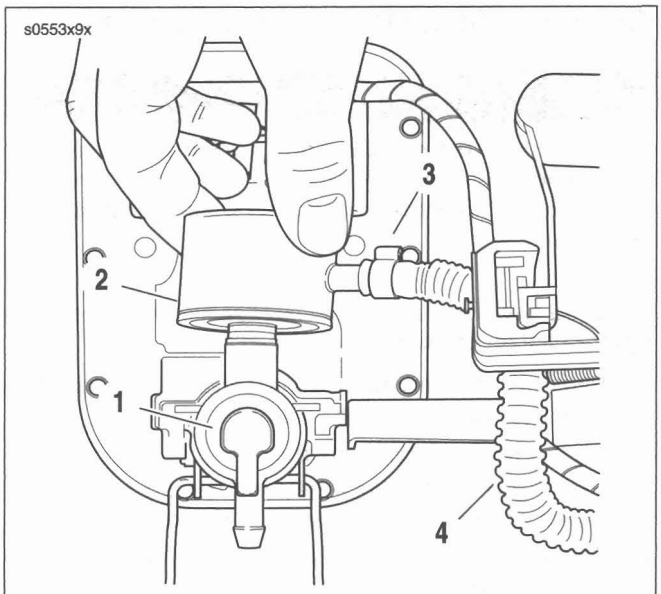
Be absolutely certain fuel pump is faulty before removing hinge from support arm. Hinge is damaged during removal and requires replacement of the fuel pump and bracket assembly.

4. See Figure 4-47. 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.

5. See Figure 4-41. Inspect fuel pump wiring, (12) replace if damaged.
6. Install **new** end cap on top plate arm. Make sure tab engages end cap.
7. Install spring on fuel pump housing hook.
8. 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-lbs** (2.8-5.1 Nm).
9. Connect fuel pump wiring.
10. Install **new** clamp over fuel pump hose and attach to **new** fuel pump using side of HOSE CLAMP PLIERS (Part No. HD-41137).



1. **Regulator housing**
2. **Fuel filter**
3. **Clamp**
4. **Hose**

Figure 4-44. Fuel Filter

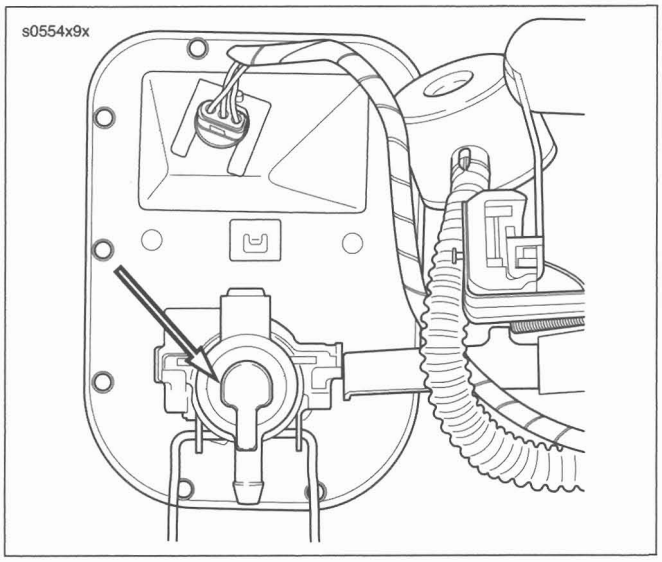
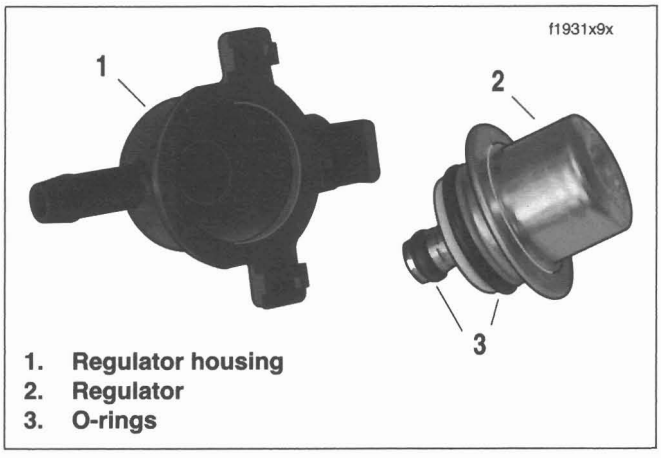


Figure 4-45. Regulator Housing



1. **Regulator housing**
2. **Regulator**
3. **O-rings**

Figure 4-46. 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 4-48. 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.

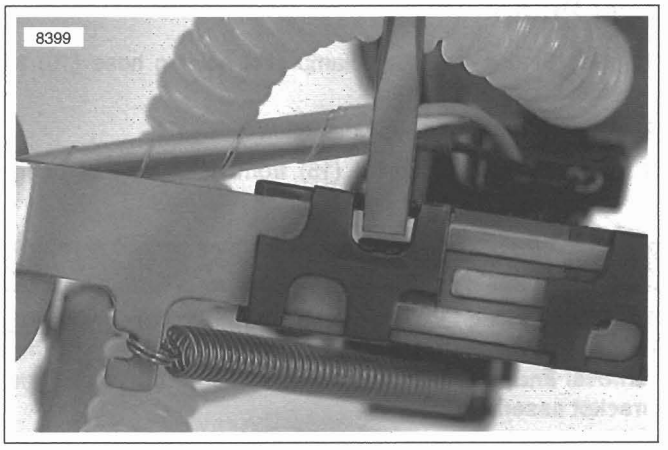
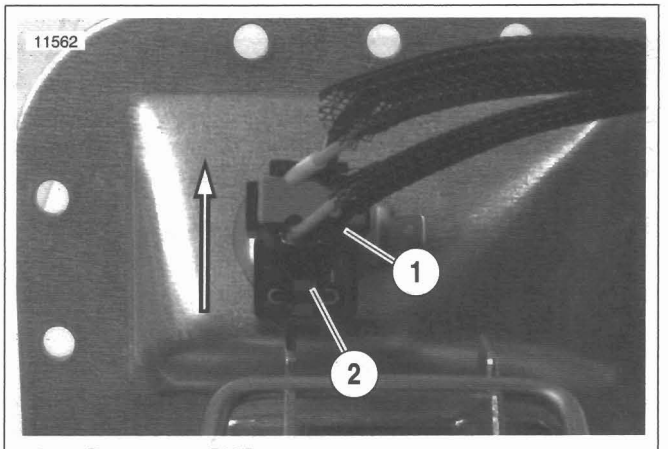


Figure 4-47. End Cap Removal



1. **Connector [86]**
2. **Tab**

Figure 4-48. 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.

⚠WARNING

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)

2. See Figure 4-49. Pull up on chrome sleeve of quick-connect fitting (1) and pull down on fuel supply line fitting to disconnect.

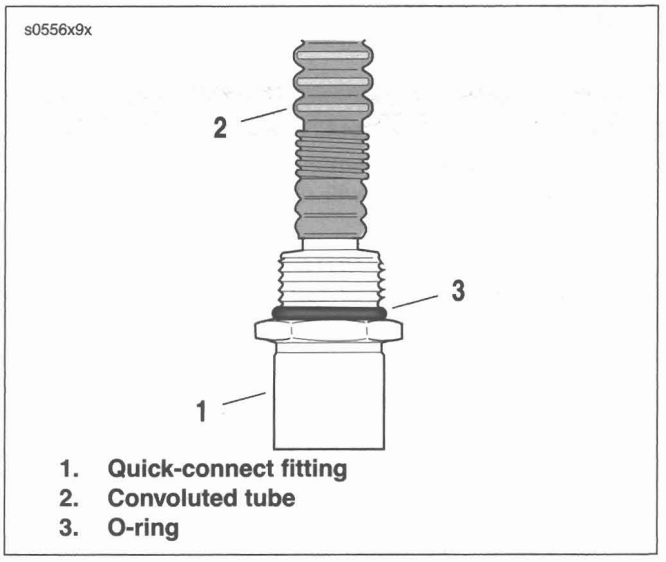
⚠WARNING

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. 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.



1. **Quick-connect fitting**
2. **Convoluted tube**
3. **O-ring**

Figure 4-49. Quick-Connect Fitting

4. Apply a thin film of engine oil to **new** O-ring (3). Slide O-ring down convoluted tube (2) until contact is made with hex on new quick-connect fitting.
5. Feed convoluted tube through hole at bottom of fuel tank. Secure fitting to fuel tank. Tighten fitting to 18 ft-lbs (24.4 Nm).
6. 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

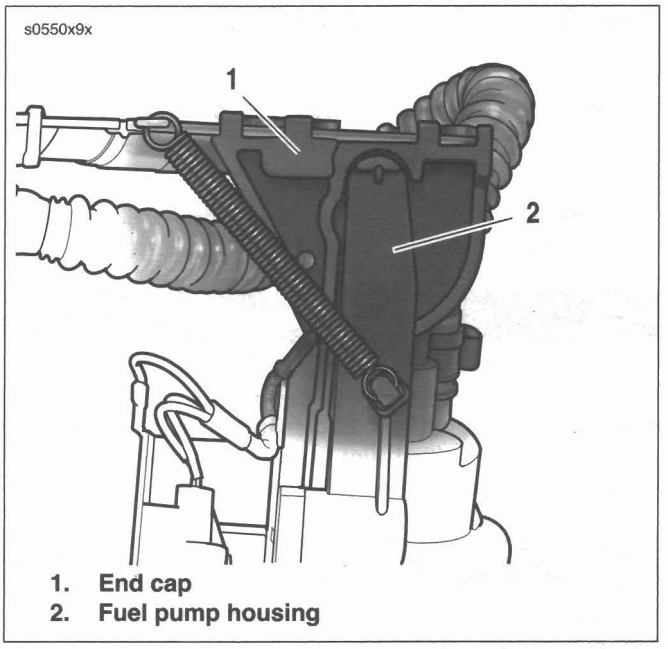
Do not apply any type of sealant to gasket.

1. Install **new** gasket under top plate.
2. Install fuel gauge sender into mounting tabs. Push down on sender until it is seated in tabs.
3. See Figure 4-42. 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 4-50. Pivot top plate and push down so end cap (1) engages fuel pump housing (2).
6. See Figure 4-51. Place gasket and top plate on tank. loosely install new sealing screws.
7. Using the pattern shown, tighten T20 TORX screws to 18-24 **in-lbs** (2.0-2.7 Nm).
8. See Figure 4-39. Connect fuel pump module connector (3) [86].
9. Connect console wiring and install console.
10. See Figure 4-38. Connect crossover hose (2) with **new** clamps (1).
11. See Figure 4-36. 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 4.15 FUEL PRESSURE TEST.

⚠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)

15. Install seat.



1. **End cap**
2. **Fuel pump housing**

Figure 4-50. End Cap Engaged

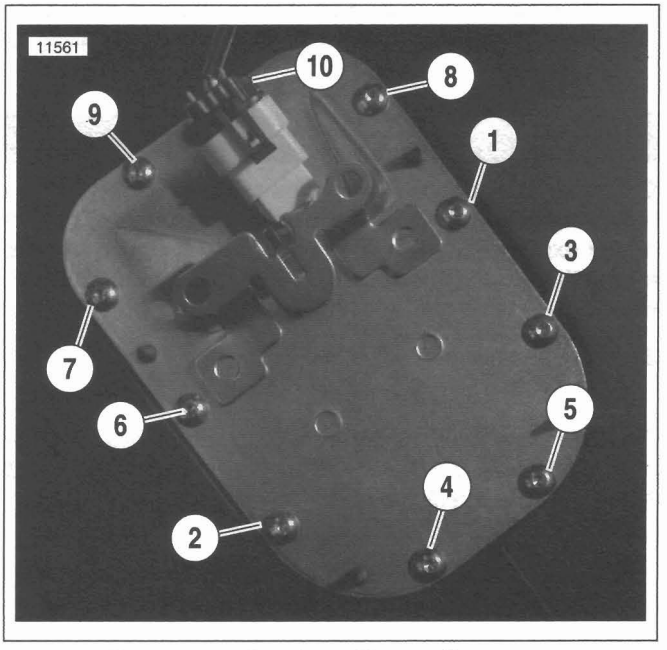


Figure 4-51. Top Plate Torque Sequence

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 4-52. 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 4-52. 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.

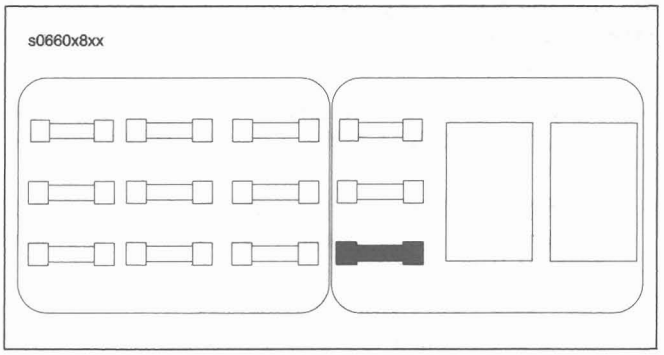


Figure 4-52. Fuel Pump Fuse: View From Top

⚠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. 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 4-53. Install a second adapter in series with the first.
   b. See Figure 4-54. Pull up on chrome sleeve of quick-connect 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 4-55. 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)

5. Verify that the fuel valve and air bleed petcock on the FUEL PRESSURE GAUGE (Part No. HD-41182) are closed.
6. See Figure 4-53. Remove protective cap from free end of fuel pressure gauge adapter. Connect fuel pressure gauge to Schroeder valve.
7. See Figure 4-52. Install fuel pump fuse.
8. 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.
10. 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.

11. 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.

⚠WARNING

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.

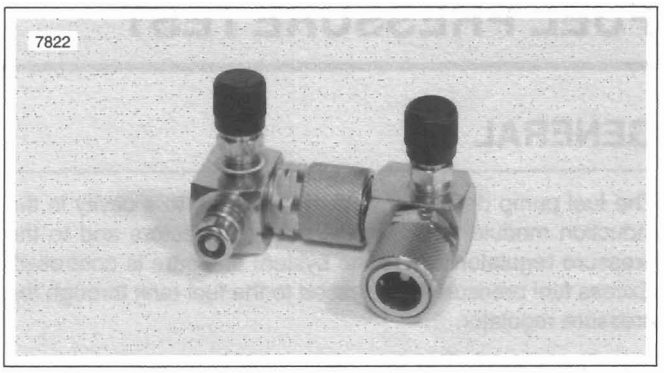
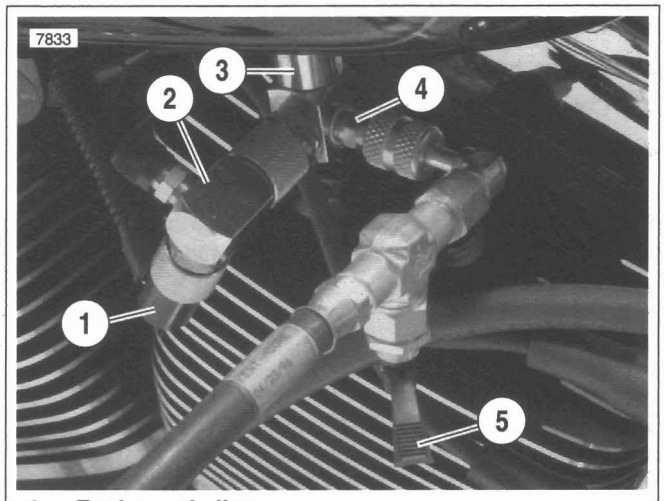


Figure 4-53. Fuel Pressure Gauge Adapters



1. **Fuel supply line**
2. **Adapter to fuel line**
3. **Adapter to fuel tank**
4. **Pressure adapter/Schroeder valve union**
5. **Fuel valve (closed position)**

Figure 4-54. Fuel Line

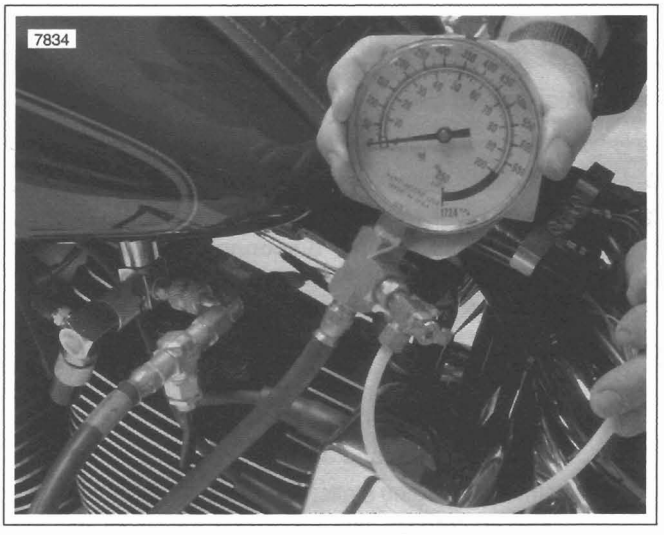


Figure 4-55. Fuel Pressure Gauge Installed

⚠WARNING

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)

13. 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.

⚠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)

15. Install seat.

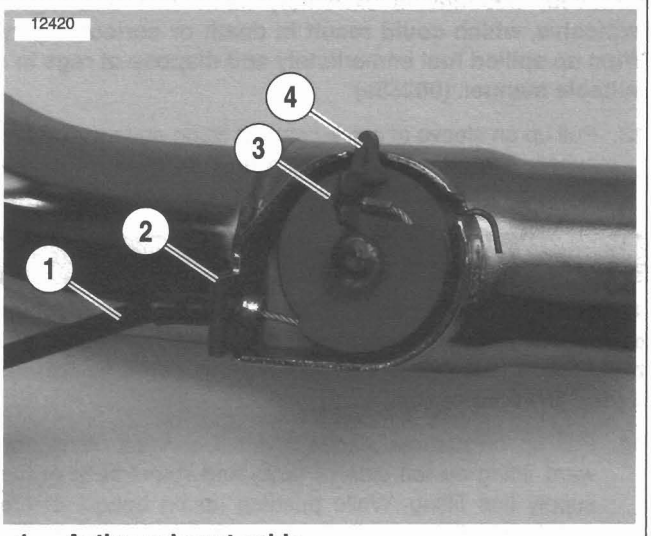
MUFFLERS

Removal

1. See Figure 4-56. On vehicles with active exhaust, remove active exhaust cable (1) from bellcrank (4).
   a. Remove cable retainer (2) from rear exhaust pipe.
   b. Disconnect ferrule (3) from bellcrank.
2. See Figure 4-57. Remove front (1) and rear (28) mufflers as an assembly.
   a. Apply penetrating oil to seams of mufflers and exhaust pipes (7, 23).
   b. Remove two locknuts (25) to detach interconnect tube (26) from spacer stud (15).
   c. Remove muffler shield clamps (30) to detach muffler shields (29) from mufflers.
   d. Remove muffler clamps (3) to separate mufflers from exhaust pipes (7, 23). Discard clamps.

Assembly

1. Install **new** muffler clamps (3) to attach front (1) and rear (28) mufflers to exhaust pipes. Tighten clamps to 45-60 ft-lbs (61.0-81.3 Nm).
2. Open muffler shield clamps (30) and install the muffler shields (29). Position clamps so the screws are on the outboard side in the most accessible position.
3. Attach interconnect tube (26) to spacer studs (15) using locknuts (25). Tighten to 30-33 ft-lbs (40.7-44.7 Nm).
4. See Figure 4-56. On vehicles with active exhaust, install active exhaust cable to bellcrank.
   a. Install ferrule (3) into slot as shown. Wrap cable around bellcrank (4).
   b. Clip cable retainer (2) on to rear exhaust pipe.



1. **Active exhaust cable**
2. **Cable retainer**
3. **Ferrule**
4. **Bellcrank**

Figure 4-56. Bellcrank

SYSTEM

Removal

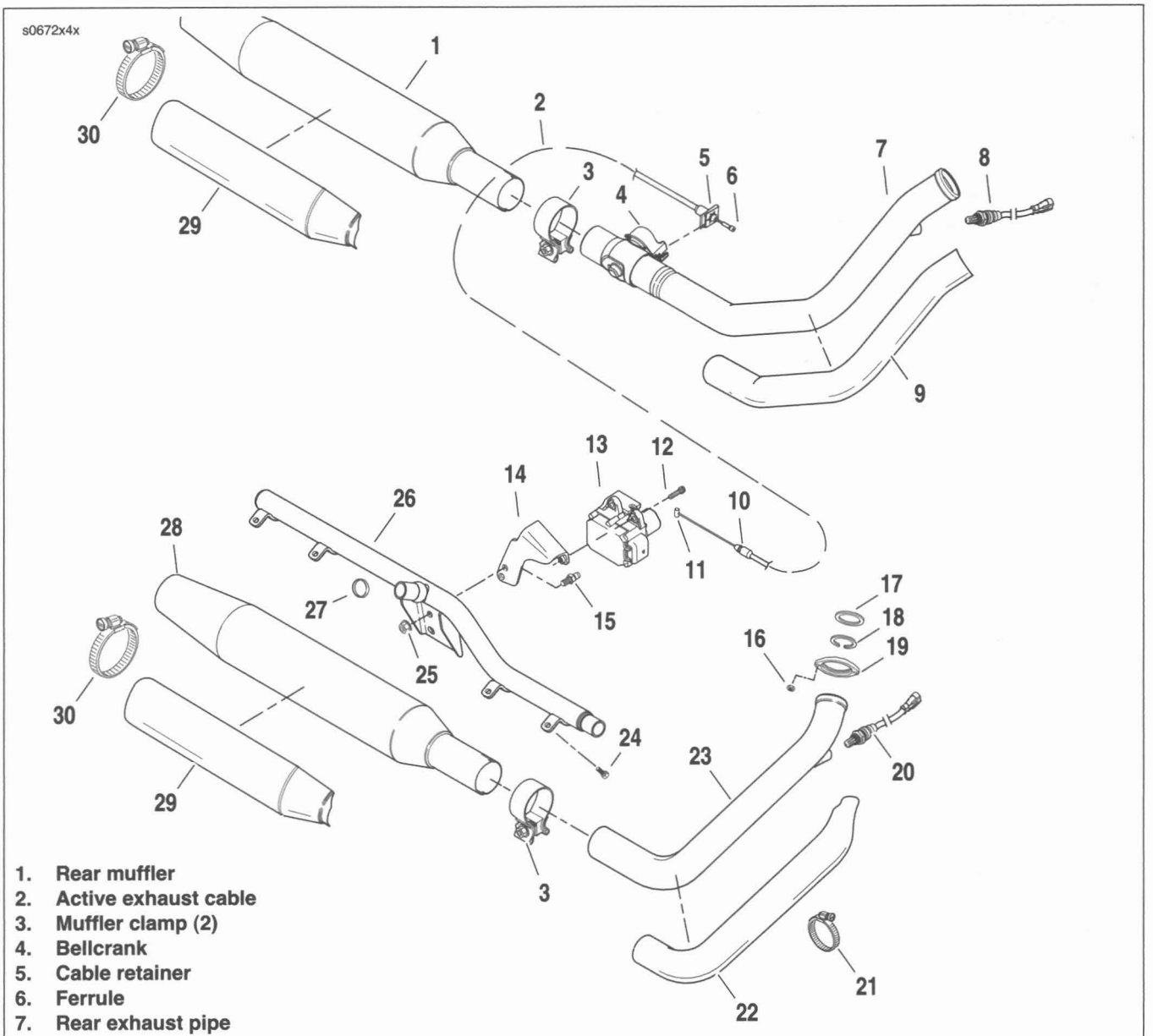
1. On vehicles with O2 sensor, disconnect O2 sensor wiring. See 4.12 OXYGEN SENSOR.
2. See Figure 4-56. On vehicles with active exhaust, remove active exhaust cable from bellcrank.
   a. Remove cable retainer (2) from rear exhaust pipe.
   b. Disconnect ferrule (3) from bellcrank (4).
3. See Figure 4-57. Remove heat shields (9, 22) by opening exhaust shield clamps (21).
4. Remove nuts (16) from front and rear cylinder head exhaust studs.
5. Remove four fasteners (24) attaching rear muffler (1) and front muffler (28) to interconnect tube assembly (26).
6. Remove exhaust system as an assembly. Check condition of interconnect gaskets (27). Replace if necessary.

Installation

NOTE

Replacement cylinder head exhaust port gaskets (17) are tapered internally. Be sure the tapered side is facing exhaust pipes. Also check condition of retaining ring (18) before installation.

1. Install **new** gaskets in both the front and rear cylinder heads with the tapered side facing exhaust pipes.
2. Position ends of exhaust pipes into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (19) over cylinder head exhaust studs. Loosely thread on flange nuts (16).
3. Loosely install fasteners (24) to attach mufflers (1, 28) to interconnect tube assembly (26).
4. Align exhaust system and tighten all nuts and bolts; beginning at cylinder head exhaust ports and working backwards. Tighten interconnect fasteners to 96-120 **in-lbs** (10.8-13.6 Nm).
5. Tighten nuts (16) at cylinder studs as follows:
   a. Install upper nut and tighten finger tight.
   b. 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).
6. Open the muffler shield clamps (21) and install front and rear heat shields (9, 22).
7. See Figure 4-56. On vehicles with active exhaust, install active exhaust cable to bellcrank.
   a. Install ferrule (3) into slot as shown. Wrap cable around bellcrank (4).
   b. Clip cable retainer (2) on to rear exhaust pipe.
8. On vehicles with O2 sensor, connect O2 sensor wiring. See 4.12 OXYGEN SENSOR.



1. Rear muffler
2. Active exhaust cable
3. Muffler clamp (2)
4. Bellcrank
5. Cable retainer
6. Ferrule
7. Rear exhaust pipe
8. Rear oxygen sensor
9. Rear exhaust shield
10. Cable housing
11. Ferrule
12. Fastener
13. Active exhaust module
14. Active exhaust module bracket
15. Spacer stud (2)
16. Nut (4)
17. Exhaust port gasket (2)
18. Exhaust gasket retaining ring (2)
19. Exhaust manifold clamp (2)
20. Front oxygen sensor
21. Exhaust shield clamp (4)
22. Front exhaust shield
23. Front exhaust pipe
24. Fastener
25. Locknut (2)
26. Interconnect tube assembly
27. Exhaust interconnect gasket (2)
28. Front muffler
29. Muffler shield (2 on HDI vehicles)
30. Muffler shield clamp (2, 4 on HDI vehicles)

Figure 4-57. Exhaust System: FXST, FLSTC, FXSTB, FXSTC

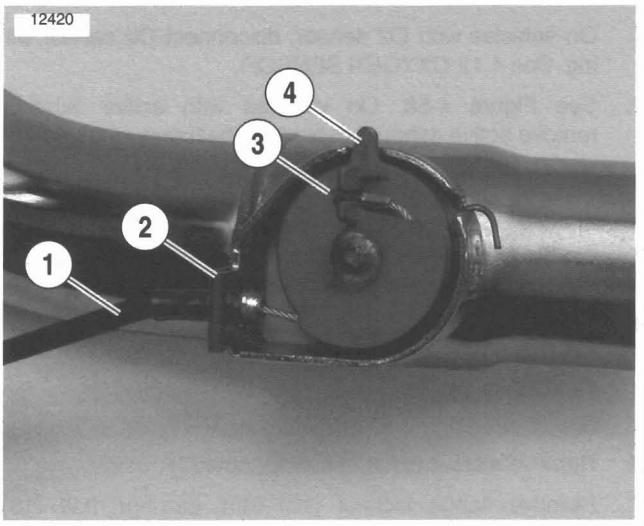
MUFFLERS

Removal

1. See Figure 4-59. Loosen clamps (19).
2. Apply penetrating oil to seams of mufflers and exhaust pipe (2).
3. Loosen flange locknut (12) on carriage bolt (15).
4. Remove muffler fasteners (27) to detach mufflers from muffler support (28).
5. Remove muffler shield clamps (21) to detach muffler shields (20, 24) from mufflers.
6. Remove mufflers. Discard clamps.

Assembly

1. See Figure 4-59. Place **new** clamps (19) over exhaust pipe (2).
2. Slide mufflers (22, 23), onto exhaust pipe.
3. Loosely attach mufflers to muffler support (28) using muffler fasteners (27).
4. Loosely install flange locknut (12) on carriage bolt (15).
5. Tighten all muffler fasteners.
   a. Tighten muffler clamps to 45-60 ft-lbs (61.0-81.3 Nm).
   b. Tighten flange locknut (12) on carriage bolt (15) to 20-25 ft-lbs (27.1-33.9 Nm).
   c. Tighten muffler support fasteners to 96-120 in-lbs (10.8-13.6 Nm).
6. Open muffler shield clamps (21) and install the muffler shields (20, 24). Position clamps so the screws are on the outboard side in the most accessible position.



1. **Active exhaust cable**
2. **Cable retainer**
3. **Ferrule**
4. **Bellcrank**

Figure 4-58. Bellcrank

SYSTEM

Removal

1. On vehicles with O2 sensor, disconnect O2 sensor wiring. See 4.12 OXYGEN SENSOR.
2. See Figure 4-58. On vehicles with active exhaust, remove active exhaust cable from bellcrank.
   a. Remove cable retainer (2) from rear exhaust pipe.
   b. Disconnect ferrule (3) from bellcrank (4).
3. On FLSTF models, remove two bolts and nuts to detach right side floorboard from mount.
4. See Figure 4-59. Detach heat shields (1, 10, 13) from exhaust pipe (2) by removing clamps (9).
5. Remove muffler fasteners (27) from both mufflers (22, 23).
6. Remove all four exhaust header nuts (7).
7. Remove flange locknut (12) from carriage bolt (15). Detach exhaust pipe clamp (14) from the exhaust bracket (11).
8. Remove mufflers and exhaust pipe as an assembly.
9. Remove two locknuts (25) to detach muffler support (28) from frame if necessary.

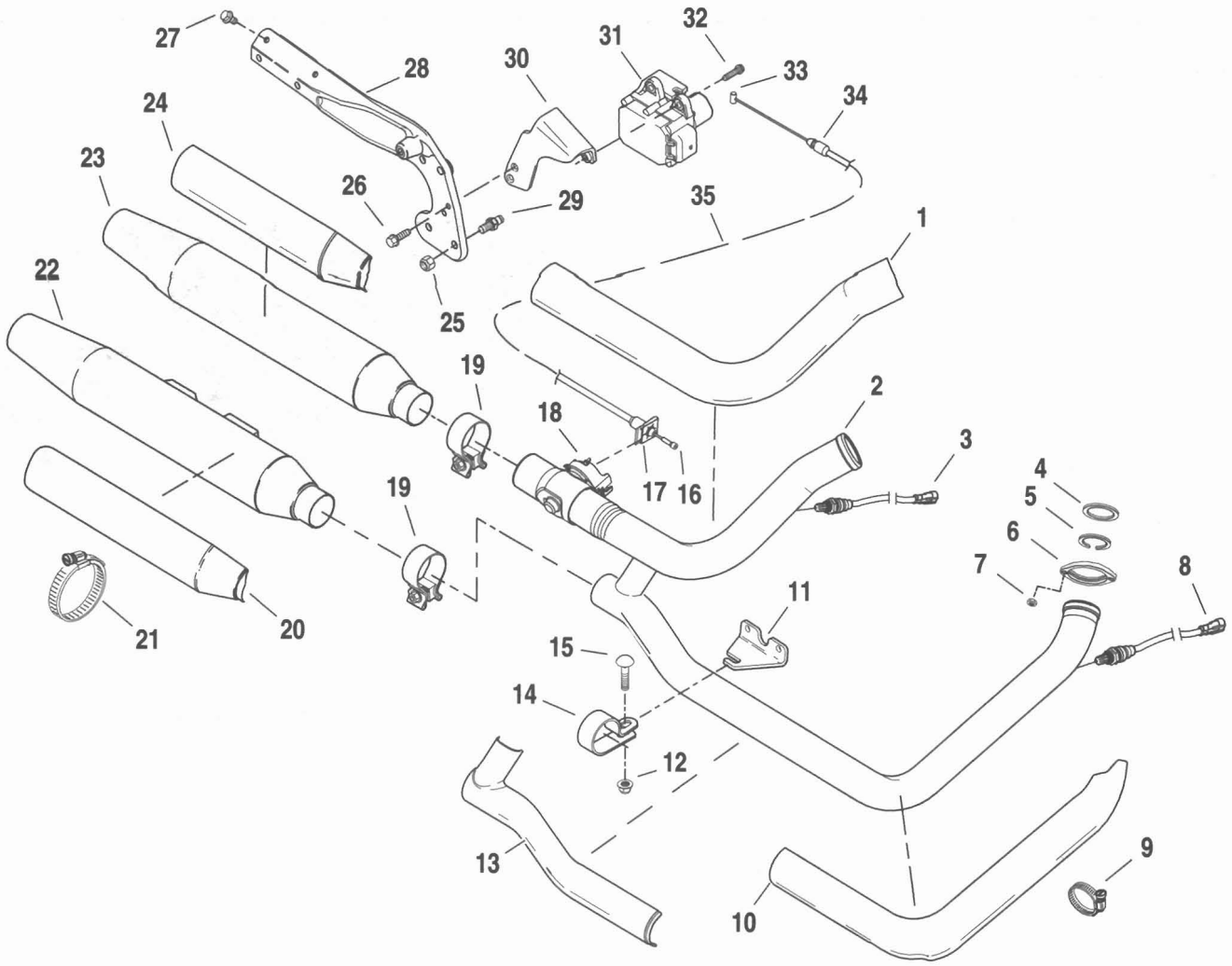
Installation

1. See Figure 4-59. If necessary, attach muffler support (28) to frame using two locknuts (25). Tighten to 20-25 ft-lbs (27.1-33.9 Nm).

NOTE

Replacement cylinder head exhaust port gaskets (4) are tapered internally. Be sure the tapered side is facing exhaust pipes. Also check condition of retaining ring (5) before installation.

2. Install **new** gaskets (4) in both the front and rear cylinder heads with the tapered side facing exhaust pipes.
3. Position ends of exhaust pipes into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (6) over cylinder head exhaust studs. Loosely thread on flange nuts (7).
4. Loosely attach mufflers to muffler support (28) using muffler fasteners (27).
5. Loosely attach exhaust pipe clamp (14) to exhaust bracket (11) using flange locknut (12) and carriage bolt (15).
6. 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.
   b. 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).
7. Tighten flange locknut (16) on carriage bolt (18) to 20-25 ft-lbs (27.1-33.9 Nm).
8. Tighten muffler support fasteners (27) to 96-120 in-lbs (10.8-13.6 Nm).
9. Open clamps (9) and install heat shields (1, 10, 13).
10. On FLSTF models, install right side floorboard with two bolts and nuts.
11. See Figure 4-58. On vehicles with active exhaust, install active exhaust cable to bellcrank.
    a. Install ferrule (3) into slot as shown. Wrap cable around bellcrank (4).
    b. Clip cable retainer (2) on to rear exhaust pipe.
12. On vehicles with O2 sensor, connect O2 sensor wiring. See 4.12 OXYGEN SENSOR.



1. Rear cylinder exhaust pipe shield
2. Exhaust pipe
3. Rear oxygen sensor
4. Exhaust port gasket (2)
5. Exhaust gasket retaining ring (2)
6. Exhaust manifold clamp (2)
7. Nut (4)
8. Front oxygen sensor
9. Exhaust shield clamp (7)
10. Front exhaust shield
11. Exhaust bracket
12. Flange locknut
13. Crossover heat shield
14. Exhaust pipe clamp
15. Carriage bolt
16. Ferrule
17. Cable retainer
18. Bellcrank
19. Clamp (2)
20. Front muffler shield
21. Muffler shield clamp
22. Front muffler
23. Rear muffler
24. Rear muffler shield
25. Locknut (2)
26. Muffler support fastener
27. Muffler fastener
28. Muffler support
29. Spacer stud (2)
30. Active exhaust module bracket
31. Active exhaust module
32. Fastener
33. Ferrule
34. Cable housing
35. Active exhaust cable

Figure 4-59. Exhaust System: FXSTD, FLSTF

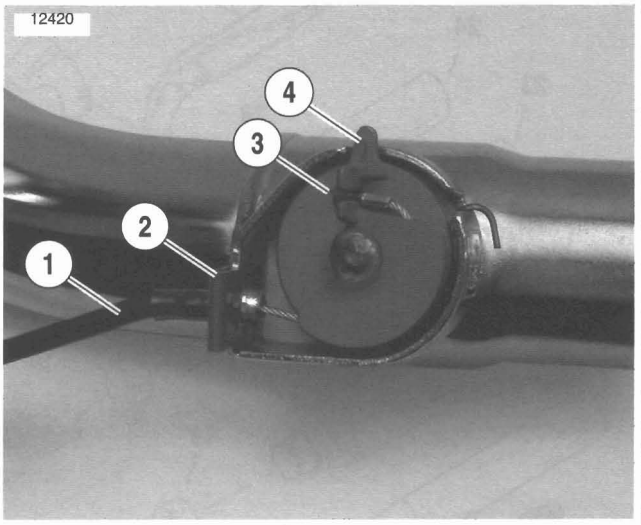
MUFFLERS

Removal

1. See Figure 4-61. Loosen clamps (16).
2. Apply penetrating oil to seams of mufflers and exhaust pipe (2).
3. Loosen flange locknut (18) on carriage bolt (20).
4. Remove muffler fasteners (27) to detach mufflers from muffler support (28).
5. Remove muffler shield clamps (22) to detach muffler shields (21) from mufflers.
6. Remove mufflers. Discard clamps.

Assembly

1. See Figure 4-61. Place **new** clamps (16) over exhaust pipe (2).
2. Slide mufflers (23, 24), onto exhaust pipe.
3. Loosely attach mufflers to muffler support (28) using muffler fasteners (27).
4. Loosely install flange locknut (18) on carriage bolt (20).
5. Tighten all muffler fasteners.
   a. Tighten muffler clamps to 45-60 ft-lbs (61.0-81.3 Nm).
   b. Tighten flange locknut (12) on carriage bolt (15) to 20-25 ft-lbs (27.1-33.9 Nm).
   c. Tighten muffler support fasteners to 96-120 in-lbs (10.8-13.6 Nm).
6. Open muffler shield clamps (22) and install the muffler shields (21). Position clamps so the screws are on the outboard side in the most accessible position.



1. **Active exhaust cable**
2. **Cable retainer**
3. **Ferrule**
4. **Bellcrank**

Figure 4-60. Bellcrank

SYSTEM

Removal

1. On vehicles with O2 sensor, disconnect O2 sensor wiring. See 4.12 OXYGEN SENSOR.
2. See Figure 4-60. On vehicles with active exhaust, remove active exhaust cable from bellcrank.
   a. Remove cable retainer (2) from rear exhaust pipe.
   b. Disconnect ferrule (3) from bellcrank (4).
3. Remove two bolts and nuts to detach right side floorboard from mount.
4. See Figure 4-61. Detach heat shields (1, 10, 12) from exhaust pipe (2) by removing clamps (9).
5. Remove muffler fasteners (27) from both mufflers (23, 24).
6. Remove all four exhaust header nuts (7).
7. Remove flange locknut (18) from carriage bolt (20). Detach exhaust pipe clamp (19) from the exhaust bracket (17).
8. Remove mufflers and exhaust pipe as an assembly.
9. Remove two locknuts (25) to detach muffler support (28) from frame if necessary.

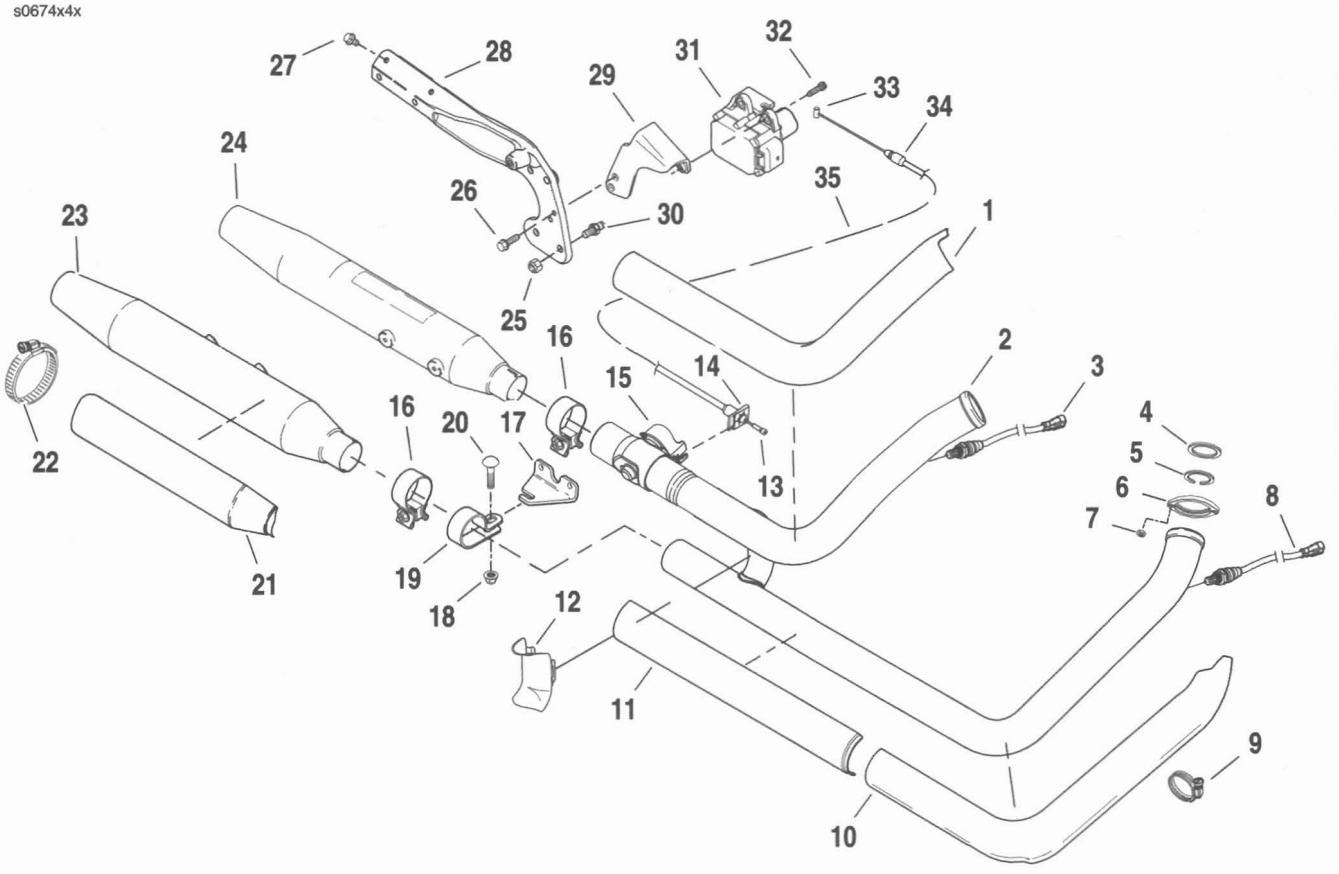
Installation

1. See Figure 4-61. If necessary, attach muffler support (28) to frame using two locknuts (25). Tighten to 20-25 ft-lbs (27.1-33.9 Nm).

NOTE

Replacement cylinder head exhaust port gaskets (4) are tapered internally. Be sure the tapered side is facing exhaust pipes. Also check condition of retaining ring (5) before installation.

2. Install **new** gaskets (4) in both the front and rear cylinder heads with the tapered side facing exhaust pipes.
3. Position ends of exhaust pipes into front and rear cylinder head exhaust ports placing holes in exhaust manifold clamp (6) over cylinder head exhaust studs. Loosely thread on flange nuts (7).
4. Loosely attach mufflers to muffler support (28) using muffler fasteners (27).
5. Loosely attach exhaust pipe clamp (19) to exhaust bracket (17) using flange locknut (18) and carriage bolt (20).
6. 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.
   b. 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).
7. Tighten flange locknut (18) on carriage bolt (20) to 20-25 ft-lbs (27.1-33.9 Nm).
8. Tighten muffler support fasteners (27) to 96-120 in-lbs (10.8-13.6 Nm).
9. Open clamps (9) and install heat shields (1, 10, 12).
10. Install right side floorboard with two bolts and nuts.
11. See Figure 4-58. On vehicles with active exhaust, install active exhaust cable to bellcrank.
    a. Install ferrule (3) into slot as shown. Wrap cable around bellcrank (4).
    b. Clip cable retainer (2) on to rear exhaust pipe.
12. On vehicles with O2 sensor, connect O2 sensor wiring. See 4.12 OXYGEN SENSOR.

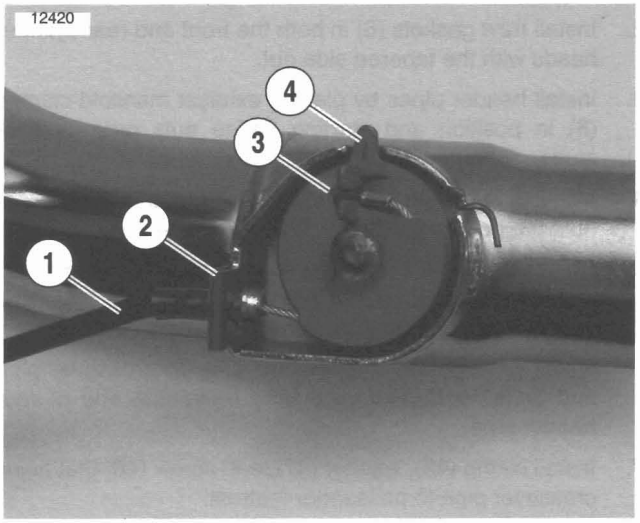


1. Rear cylinder exhaust pipe shield
2. Exhaust pipe
3. Rear oxygen sensor
4. Exhaust port gasket (2)
5. Exhaust gasket retaining ring (2)
6. Exhaust manifold clamp (2)
7. Nut (4)
8. Front oxygen sensor
9. Exhaust shield clamp (7)
10. Front exhaust shield
11. Clamp (2)
12. Interconnect shield
13. Ferrule
14. Cable retainer
15. Bellcrank
16. Clamp (2)
17. Exhaust bracket
18. Flange locknut
19. Exhaust pipe clamp
20. Carriage bolt
21. Front muffler shield (2)
22. Muffler shield clamp
23. Front muffler
24. Rear muffler
25. Locknut (2)
26. Muffler support fastener
27. Muffler fastener
28. Muffler support
29. Active exhaust module bracket
30. Spacer stud (2)
31. Active exhaust module
32. Fastener
33. Ferrule
34. Cable housing
35. Active exhaust cable

Figure 4-61. Exhaust System: FLSTN

REMOVAL

1. On vehicles with O2 sensor, disconnect O2 sensor wiring. See 4.12 OXYGEN SENSOR.
2. See Figure 4-62. On vehicles with active exhaust, remove active exhaust cable from bellcrank.
   a. Remove cable retainer (2) from rear exhaust pipe.
   b. Disconnect ferrule (3) from bellcrank (4).
3. See Figure 4-63. 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.
4. Loosen the three TORCA clamps (13, 25, 45) as follows:
   a. On right side, loosen front header pipe (12) to rear header pipe (15) and rear header pipe to right side muffler (26).
   b. On left side, loosen crossover pipe (16) to left side muffler (39).
5. Remove the four bolts (41), lockwashers (42), and washers (40) to detach the mufflers from the muffler support brackets (36).
6. Remove left side and right side mufflers.
7. Remove screw (46) and washer (47) that hold crossover pipe (48) to passenger footrest.
8. Remove crossover pipe.
9. Remove the nuts (9) to release the rear header pipe from the cylinder head studs.
10. Remove the two flange nuts (20 and 30) and screw (21) that hold the bottom of the rear header pipe (15) in position.
11. Remove the rear header pipe.
12. Remove the nuts (9) to release the front header pipe from the cylinder head studs.
13. Remove the front header pipe (12).
14. Remove and discard cylinder head gaskets. Discard TORCA clamp bolt assemblies which are one time use only.

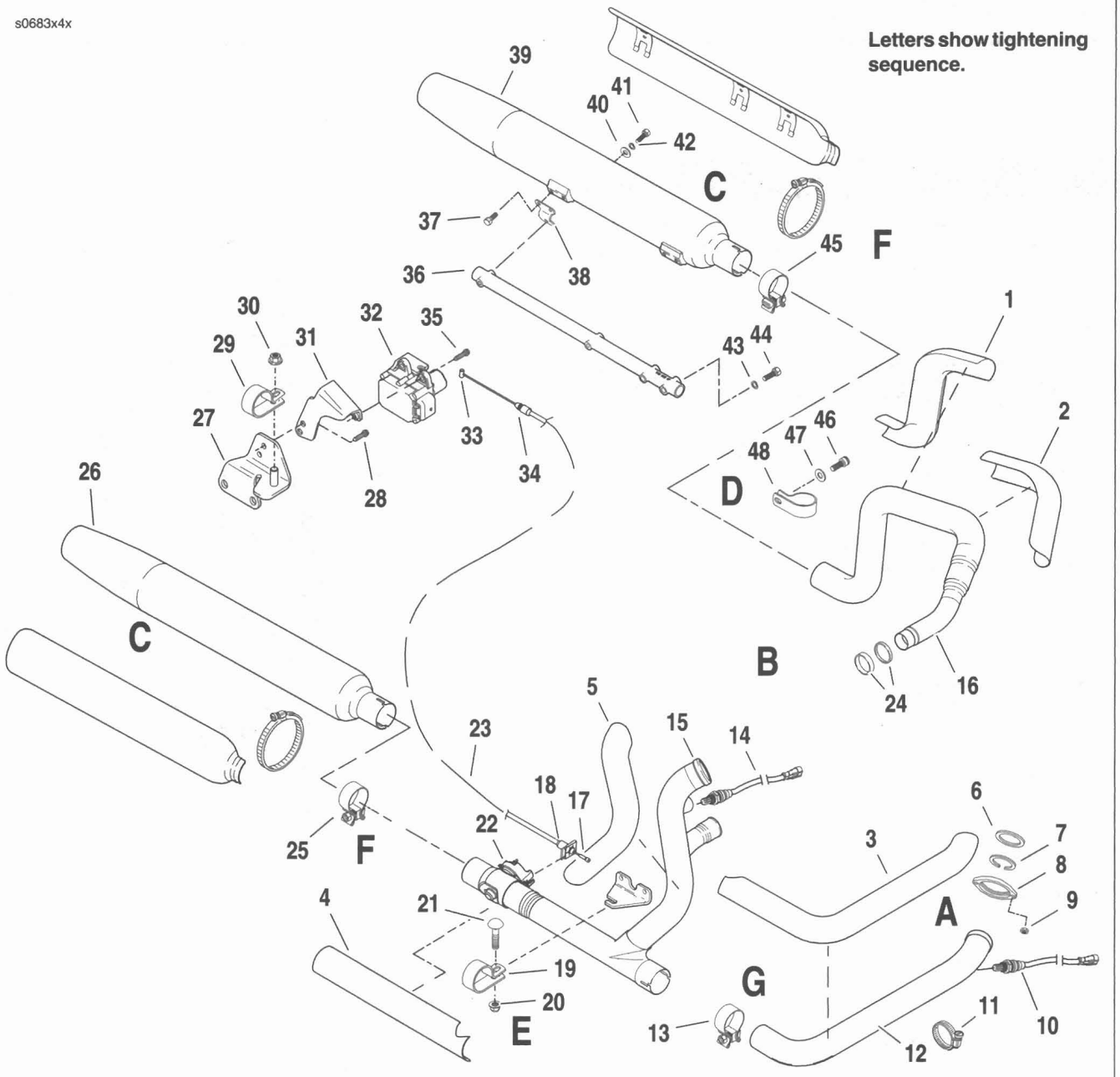


1. **Active exhaust cable**
2. **Cable retainer**
3. **Ferrule**
4. **Bellcrank**

Figure 4-62. Bellcrank

INSTALLATION

1. See Figure 4-63. Assemble front and rear header pipes with **new** TORCA clamp, but leave clamp loose.
2. Install **new** gaskets (6) in both the front and rear cylinder heads with the tapered side out.
3. Install header pipes by placing exhaust manifold clamps (8) in position and starting flange nuts onto cylinder studs.
4. Install finger tight the screws and flange washers that hold the bottom of the rear header pipe in position.
5. 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.
6. Install **new** gasket and washer (24) on crossover pipe and install crossover pipe onto remaining end of rear header pipe.
7. Install clamp (48), washer (47), and screw (46) that holds crossover pipe to passenger footrest.
8. 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:
   a. 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 (41) that hold the mufflers to the muffler support brackets.
   d. Tighten the screw (46) that holds the crossover pipe to the passenger footrest.
   e. Tighten the nuts (20 and 30) that hold the bottom of the rear header pipe in position.
   f. Tighten the TORCA clamps (25 and 45) that hold the mufflers on to 45-60 ft-lbs (61.0-81.3 Nm).
   g. Tighten TORCA clamp (13) 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.
11. See Figure 4-62. On vehicles with active exhaust, install active exhaust cable to bellcrank.
    a. Install ferrule (3) into slot as shown. Wrap cable around bellcrank (4).
    b. Clip cable retainer (2) on to rear exhaust pipe.
12. On vehicles with O2 sensor, connect O2 sensor wiring. See 4.12 OXYGEN SENSOR.



1. Heat shield
2. Heat shield
3. Heat shield
4. Heat shield
5. Heat shield
6. Exhaust port gasket (2)
7. Exhaust gasket retaining ring (2)
8. Exhaust manifold clamp (2)
9. Nut (4)
10. Front oxygen sensor
11. Exhaust shield clamp
12. Front header pipe
13. TORCA clamp
14. Rear oxygen sensor
15. Rear header pipe
16. Crossover pipe
17. Ferrule
18. Cable retainer
19. Clamp
20. Locknut
21. Carriage bolt
22. Bellcrank
23. Active exhaust cable
24. Gasket and washer
25. TORCA clamp
26. Right muffler
27. Rear mounting bracket
28. Fastener
29. Clamp
30. Locknut
31. Active exhaust module bracket
32. Active exhaust module
33. Ferrule
34. Cable housing
35. Fastener
36. Muffler support bracket (2)
37. Muffler bracket fastener
38. Muffler bracket
39. Left muffler
40. Washer
41. Bolt
42. Lockwasher
43. Washer
44. Fastener
45. TORCA clamp
46. Screw
47. Washer
48. Clamp

Figure 4-63. Exhaust System: FLSTSC

GENERAL

⚠DANGER

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 air cleaner cover installed when performing test.*
- *Do not direct propane into air cleaner, false readings will result.*

LEAK TESTER

Parts List

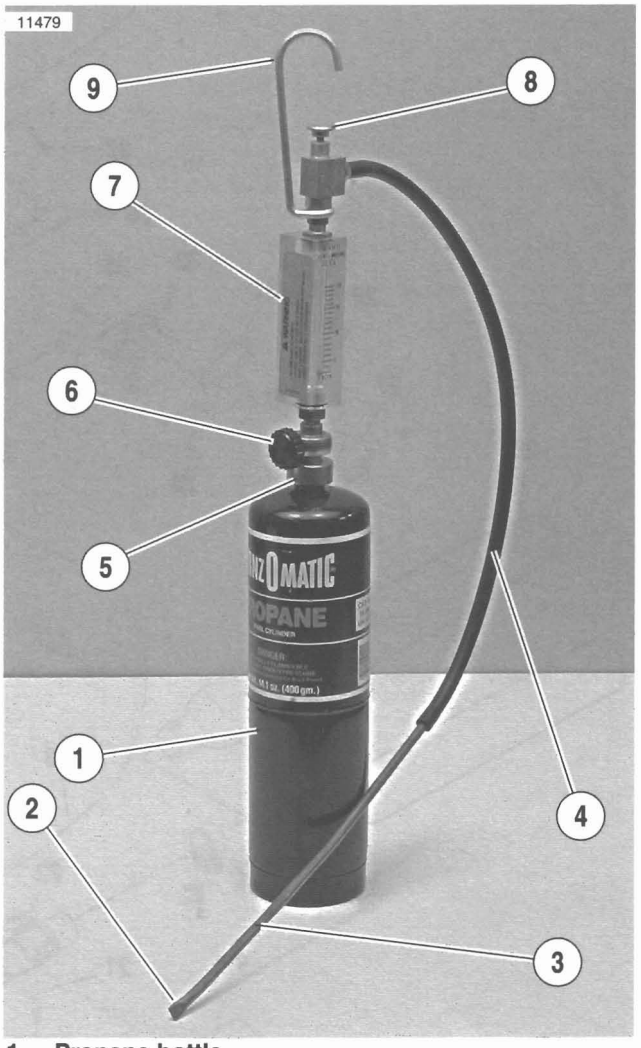
- Standard 14 oz. propane cylinder.
- Propane Enrichment Kit (Part No. HD-41417).

Tester Assembly

1. See Figure 4-64. Make sure valve knob (6) is closed (fully clockwise).
2. Screw valve assembly (5) onto propane bottle (1).

Tester Adjustment

1. See Figure 4-64. 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.



1. **Propane bottle**
2. **Nozzle**
3. **Copper tube**
4. **Hose**
5. **Valve assembly**
6. **Valve knob**
7. **Flow gauge**
8. **Trigger button**
9. **Hanger**

Figure 4-64. Leak Tester

PROCEDURE

1. Start engine.
2. Warm engine to operating temperature.

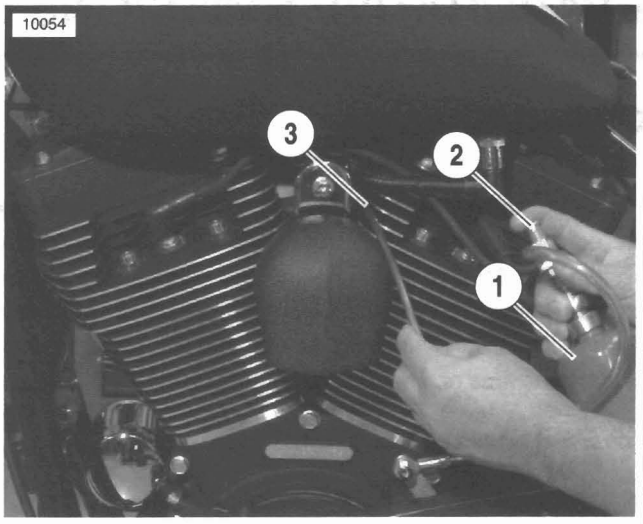
⚠DANGER

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 4-65. 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).



1. **Propane bottle**
2. **Trigger button**
3. **Nozzle**

Figure 4-65. 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:

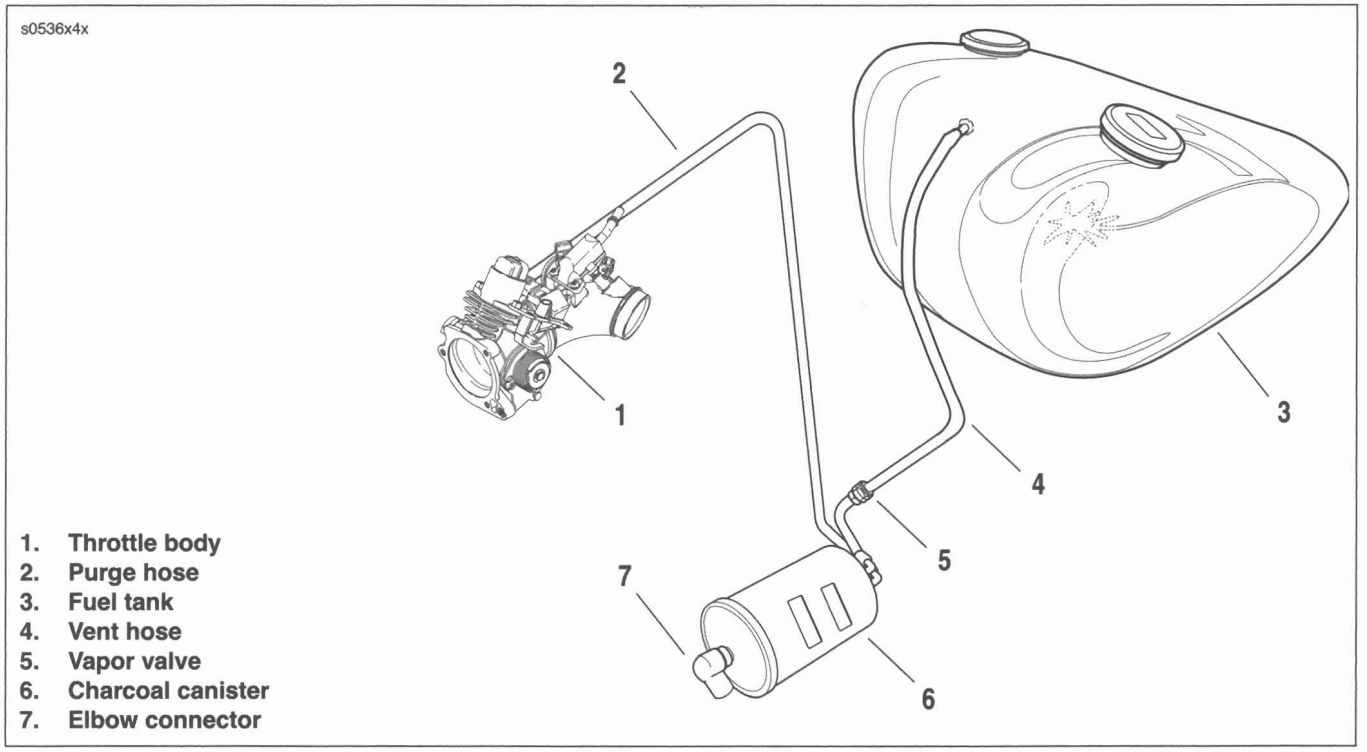
- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- On all models, when the engine is 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.

⚠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.



1. **Throttle body**
2. **Purge hose**
3. **Fuel tank**
4. **Vent hose**
5. **Vapor valve**
6. **Charcoal canister**
7. **Elbow connector**

Figure 4-66. Schematic-CA Evaporative Emissions Control System

CHARCOAL CANISTER

Removal

⚠WARNING

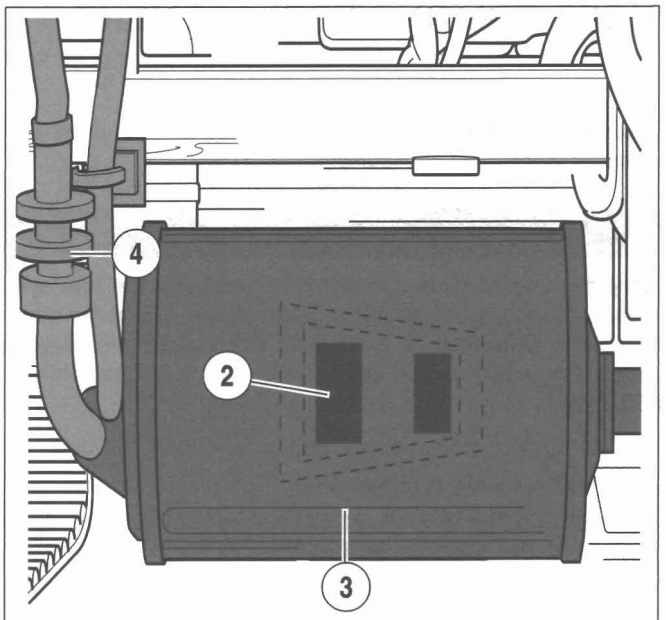
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

See Figure 4-67. The EVAP charcoal canister is mounted below the rear fork pivot.

1. 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.
2. 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.
3. Remove two bolts on rear splash guard. Lift splash guard up and over rear tire.
4. 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.
5. See Figure 4-68. 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.
6. Remove canister.

Installation

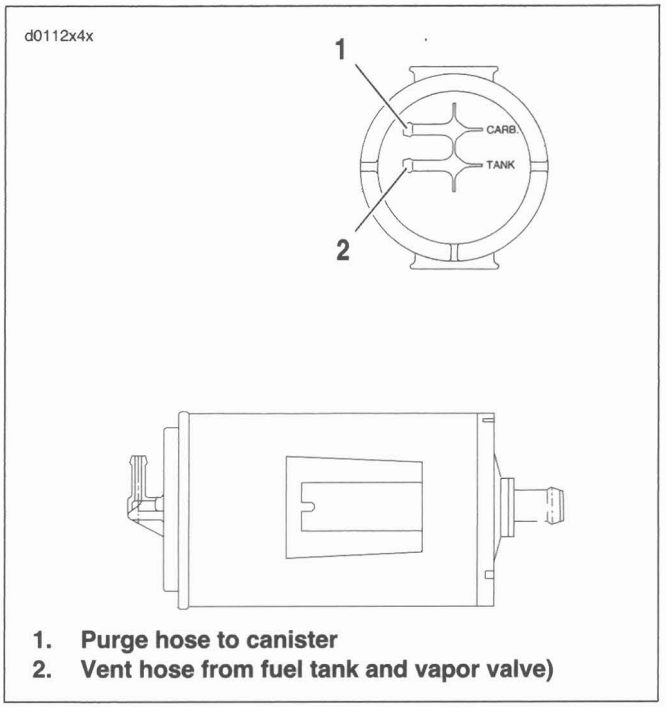
1. See Figure 4-67. Slide canister into mounting bracket until canister clicks in place.
2. See Figure 4-68. Attach hoses to left side canister nipples as marked.
3. Move rear wheel forward and place belt on sprocket. Then move wheel back and make sure brake disc is centered between brake pads.
4. Tighten axle nut and adjust belt tension. See 1.14 REAR BELT DEFLECTION.
5. Install the splash guard using two bolts.



1. **Mount (on back side)**
2. **Canister**
3. **Vapor valve**

s0187x4x

Figure 4-67. EVAP Canister Mount (Rear Wheel Removed For Clarity)



1. **Purge hose to canister**
2. **Vent hose from fuel tank and vapor valve)**

Figure 4-68. 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)

1. Remove console and fuel tank. See 4.5 FUEL TANK.
2. Route vacuum or purge hose.
   a. See Figure 4-66. 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 4-68. Attach the purge hose to the canister fitting marked CARB on left side of canister.
3. Route fuel tank vent hose.
   a. 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 4-68. Connect hose attached to bottom end of vapor valve to fitting marked TANK on left side of canister.
4. Install fuel tank and attach the fuel tank vent hose to the fuel tank vent nipple. Install console. See 4.5 FUEL TANK.
5. Install **new** EVAP system label on front frame down tube.

ELECTRIC STARTER 5

SUBJECT	PAGE NO.
5.1 Specifications	5-1
5.2 Electric Starter System	5-2
5.3 Starter Relay	5-5
5.4 Starter	5-6
5.5 Starter Solenoid	5-12

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		NOTES
Starter mounting bolts	13-20 ft-lbs	17.6-27.1 Nm	page 5-6

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

See Figure 5-1. The starting circuit wiring diagram contains information about wiring configuration. 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. See 5.3 STARTER RELAY for starter relay location and replacement procedure.

OPERATION

See Figure 5-2. 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.

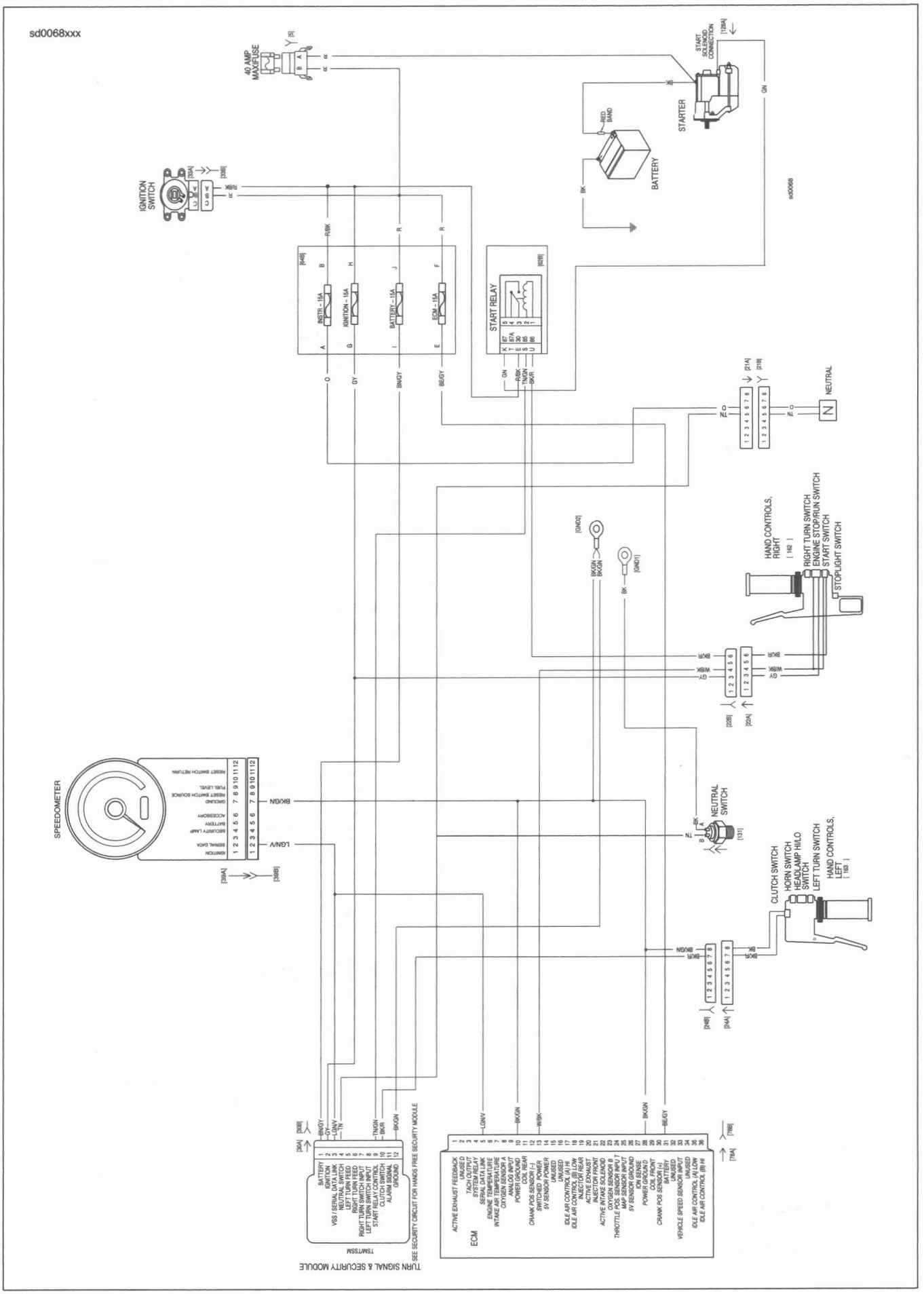


Figure 5-1. Starting Circuit

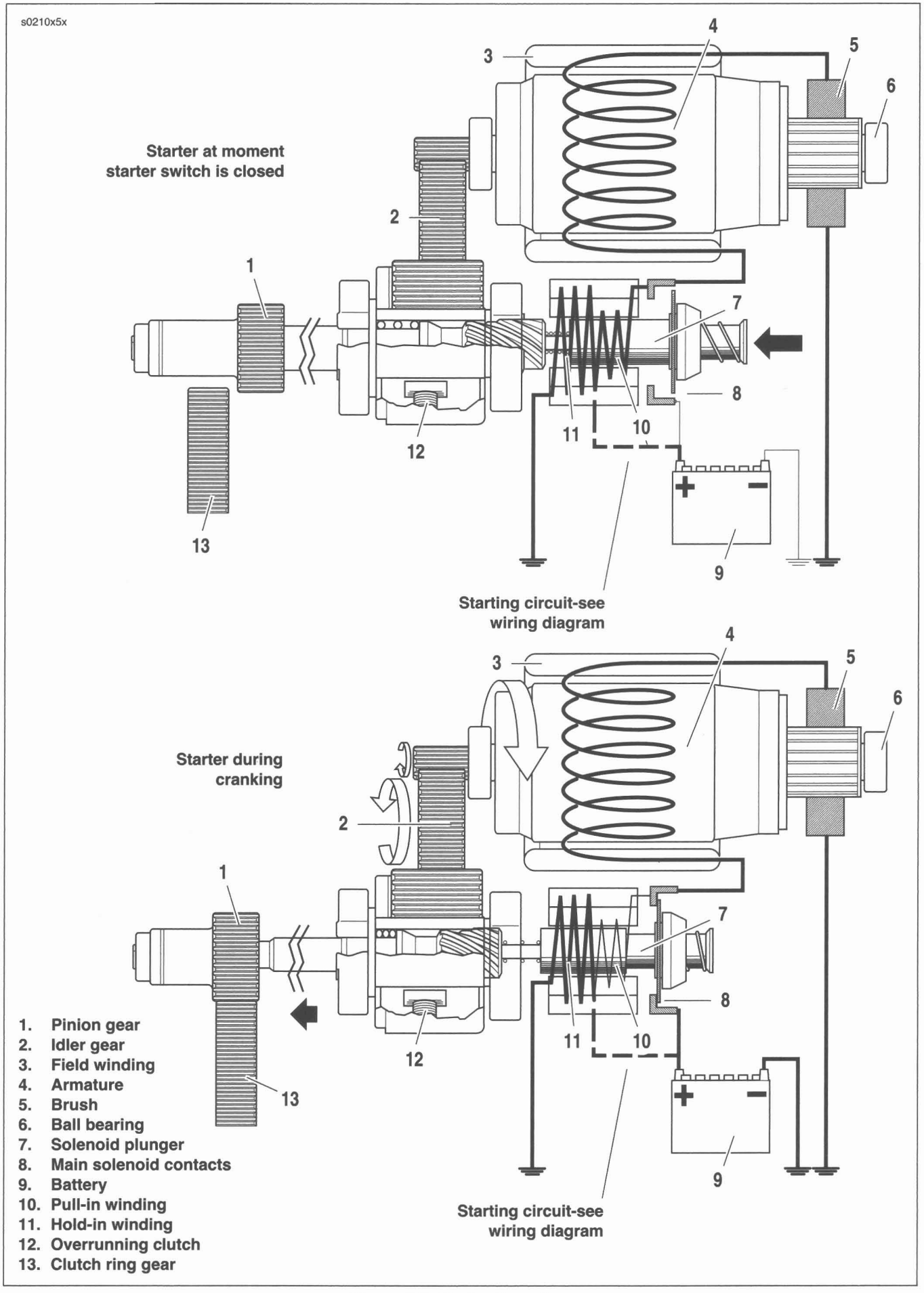


Figure 5-2. Starter Operation

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 5-3. Pull cover away from fuse block.
4. See Figure 5-4. Replace starter relay (3).

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.

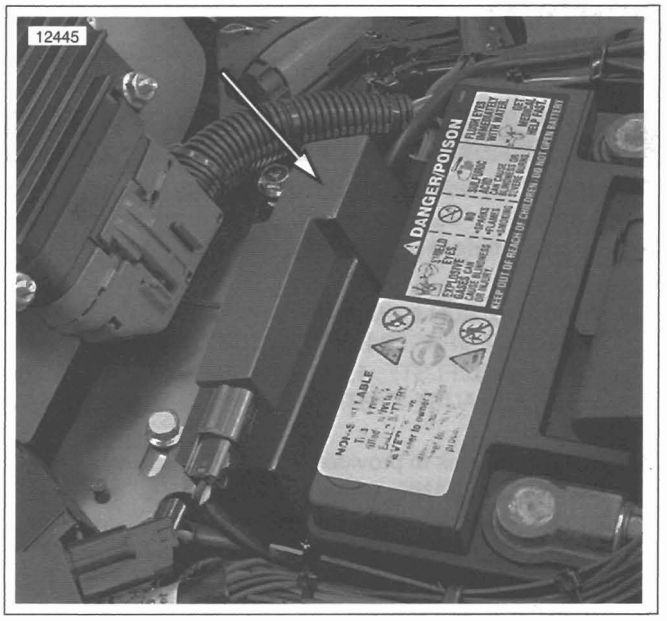
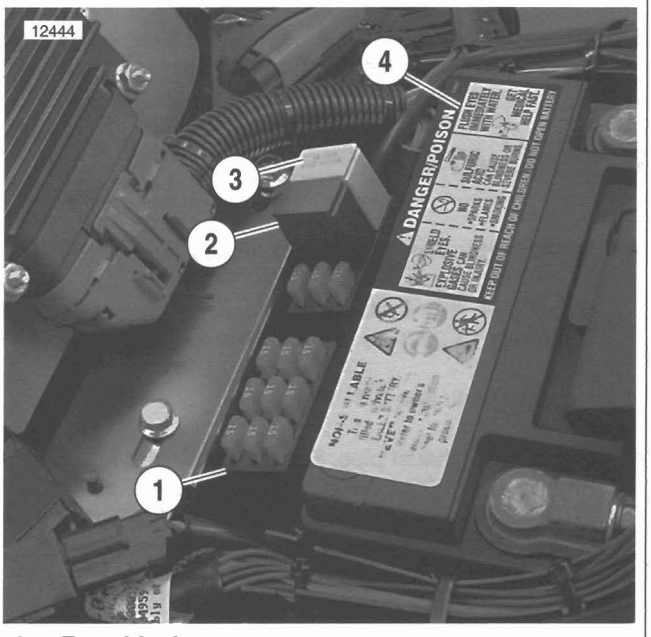


Figure 5-3. Fuse Block Cover



1. **Fuse block**
2. **System relay**
3. **Starter relay**
4. **Battery**

Figure 5-4. Starter Relay

REMOVAL

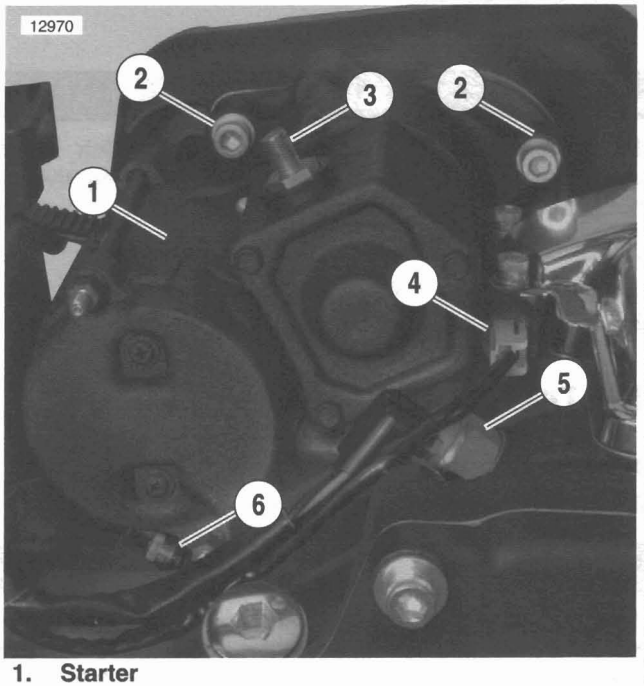
⚠WARNING

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

1. Remove exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.
2. Remove oil tank to provide clearance for starter removal. See 3.31 OIL TANK.
3. See Figure 5-5. Remove both starter mounting bolts (2).
4. Detach solenoid wire (4).
5. Remove starter (1) from right side of motorcycle.
6. Before disassembling the starter, perform diagnostics listed in the Softail Models Electrical Diagnostic Manual.

INSTALLATION

1. Install starter from right side of motorcycle.
2. See Figure 5-5. Install the two starter mounting bolts. Tighten to 13-20 ft-lbs (17.6-27.1 Nm).
3. Install oil tank. See 3.31 OIL TANK.
4. Install rear exhaust pipe. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF, 4.18 EXHAUST SYSTEM: FLSTN or 4.19 EXHAUST SYSTEM: FLSTSC as appropriate.



1. **Starter**
2. **Starter mounting fasteners**
3. **Positive battery cable post**
4. **Solenoid wire**
5. **Neutral switch**
6. **Vehicle speed sensor location**

Figure 5-5. Starter

DISASSEMBLY, INSPECTION AND REPAIR

1. Remove two nuts with washers to detach end cover mount from thru-bolts.
2. See Figure 5-6. Lift rubber boot (1). Remove field wire nut with washer (2) (metric) to detach field wire (3).
3. See Figure 5-7. Remove both thru-bolts (1, 3), field coil and cap.
4. Remove both end cover screws with O-rings (2) and end cover (4).
5. 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.*

6. See Figure 5-8. 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.
   b. Replace armature if diameter of commutator is less than 1.141 in. (28.981 mm)
   c. Check armature bearings. Replace if necessary.

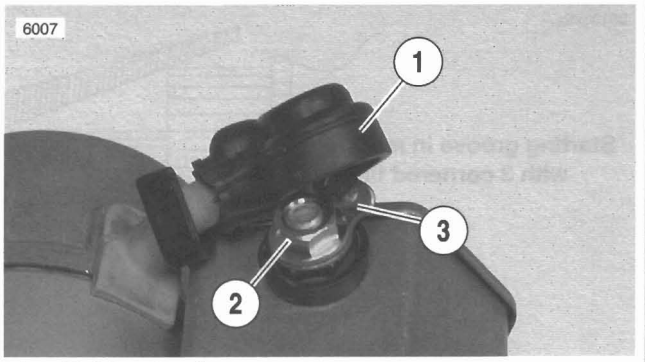
CAUTION

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.

9. 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.

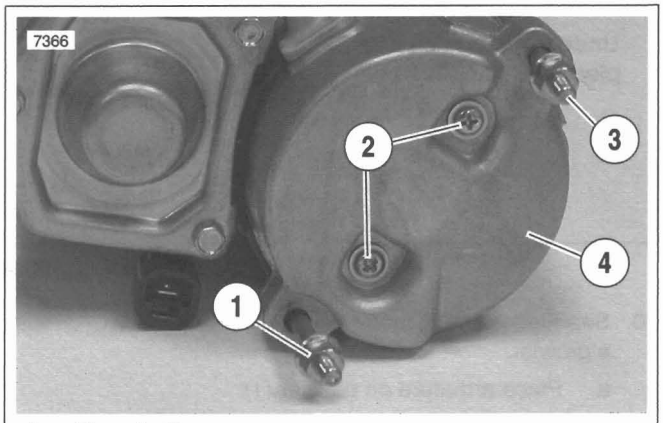
NOTE

See Figure 5-9. 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.



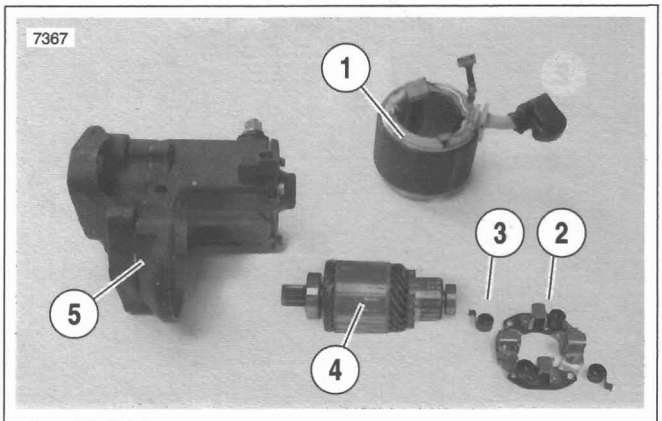
1. **Rubber boot**
2. **Field wire nut with washer (metric)**
3. **Field wire**

Figure 5-6. Field Wire



1. **Thru-bolt**
2. **Screw w/o-ring (2)**
3. **Thru-bolt**
4. **End cover**

Figure 5-7. Removing the Thru-Bolts



1. **Field frame**
2. **Brush holder**
3. **Brush spring (4)**
4. **Armature**
5. **Solenoid housing**

Figure 5-8. Starter Components

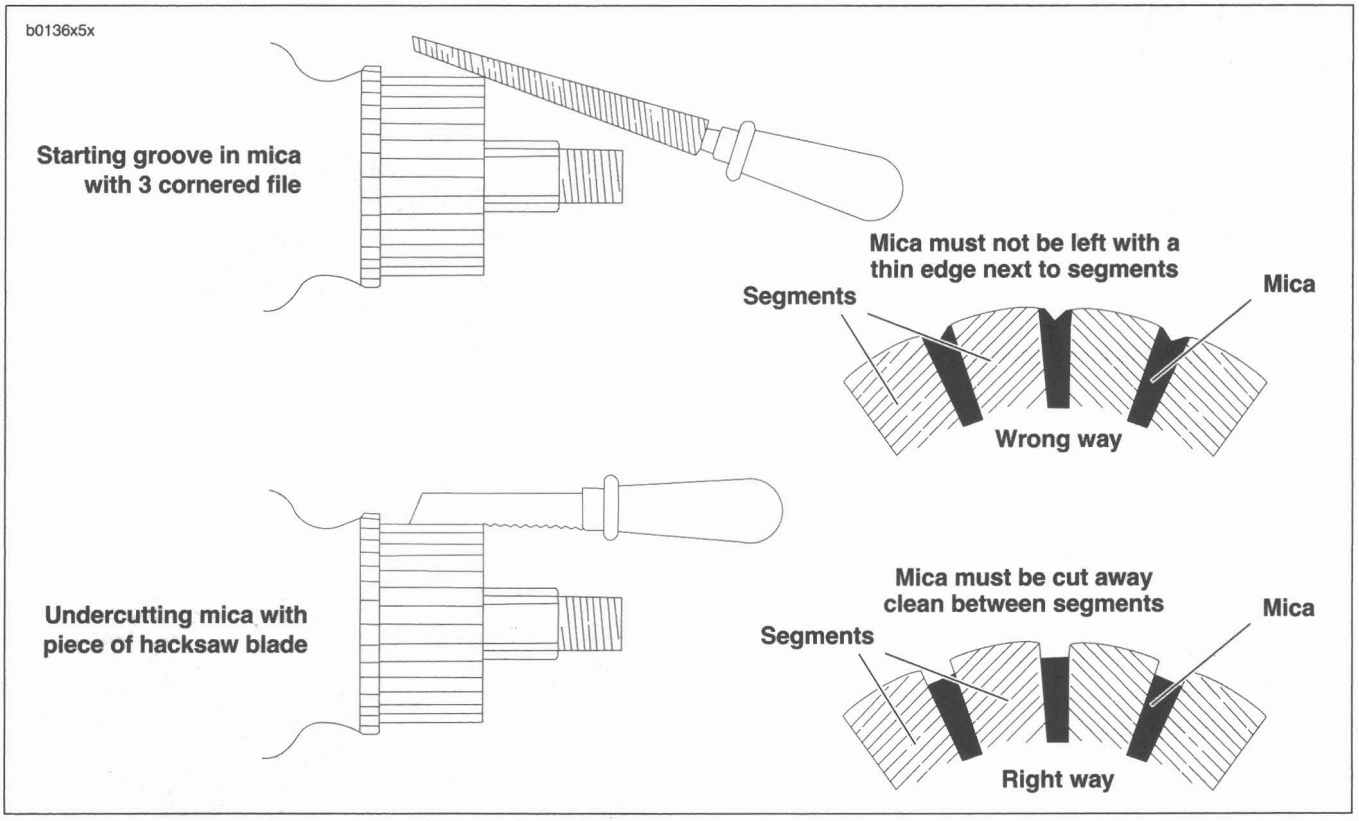


Figure 5-9. Undercutting Mica Separators

10. See Figure 5-10. 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 5-11. 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.

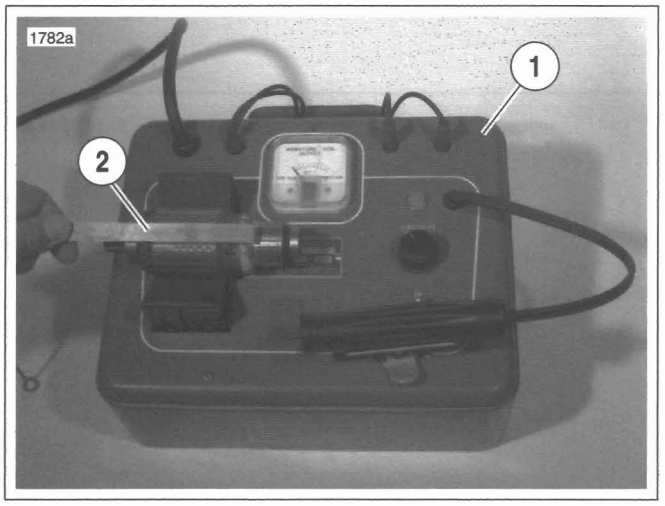


Figure 5-10. Shorted Armature Test Using Growler

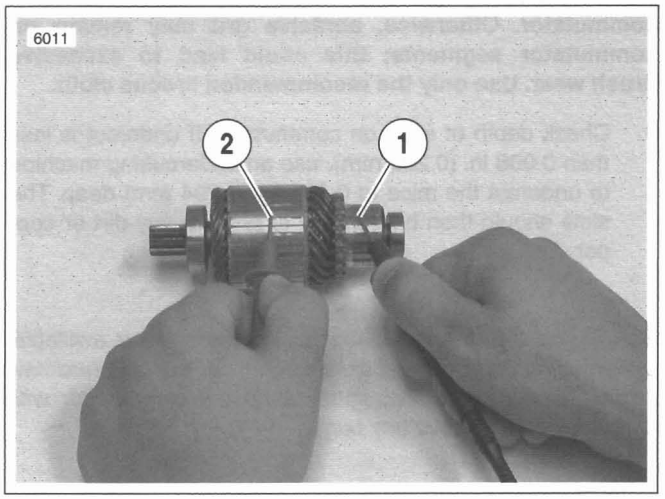


Figure 5-11. Grounded Armature Test

12. See Figure 5-12. Check for OPEN ARMATURE with an ohmmeter or continuity tester.
    a. 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.

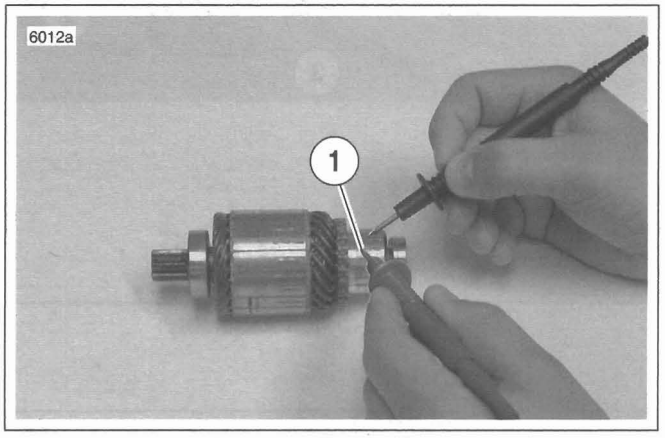


Figure 5-12. Open Armature Test

13. See Figure 5-13. 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.
14. See Figure 5-14. 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 5-15. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.
    a. Touch one probe to holder plate (1).
    b. 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.

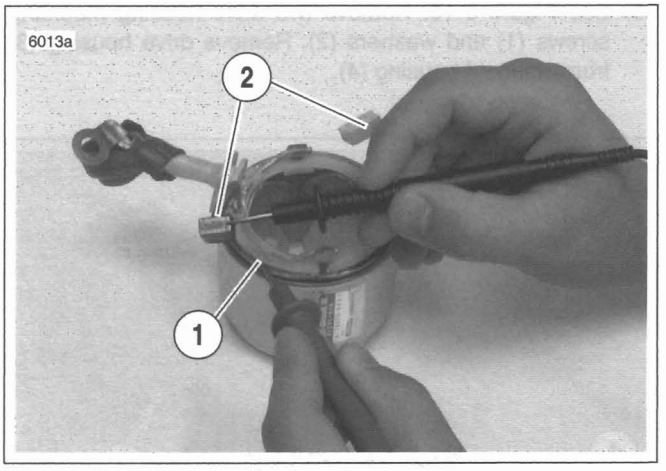


Figure 5-13. Grounded Field Test

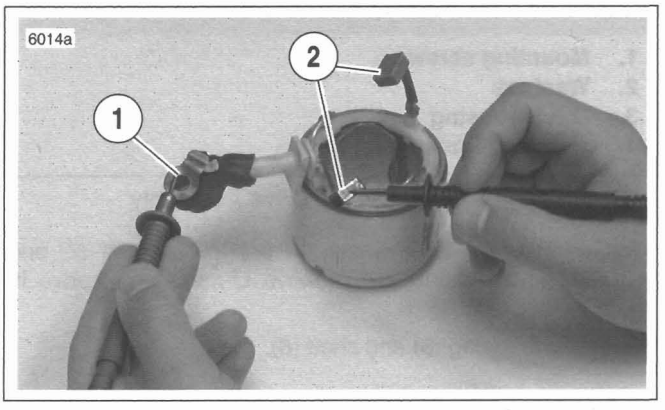


Figure 5-14. Open Field Test

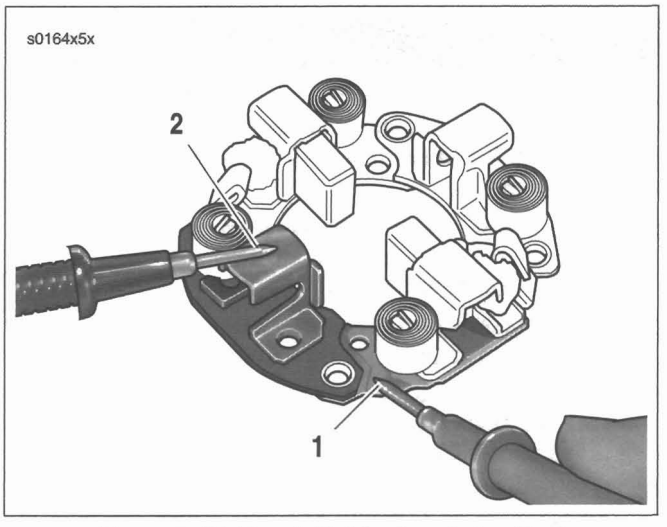
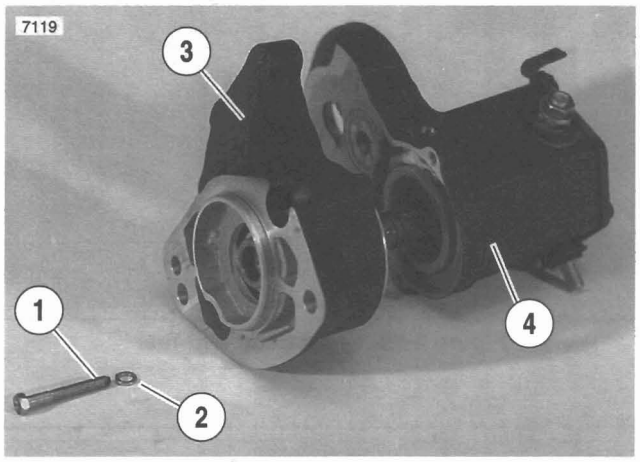


Figure 5-15. Brush Holder Insulation Test

16. See Figure 5-16. Remove two drive housing mounting screws (1) and washers (2). Remove drive housing (3) from solenoid housing (4).



1. **Mounting screws**
2. **Washers**
3. **Drive housing**
4. **Solenoid housing**

Figure 5-16. Starter Drive Assembly

17. See Figure 5-17. 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).

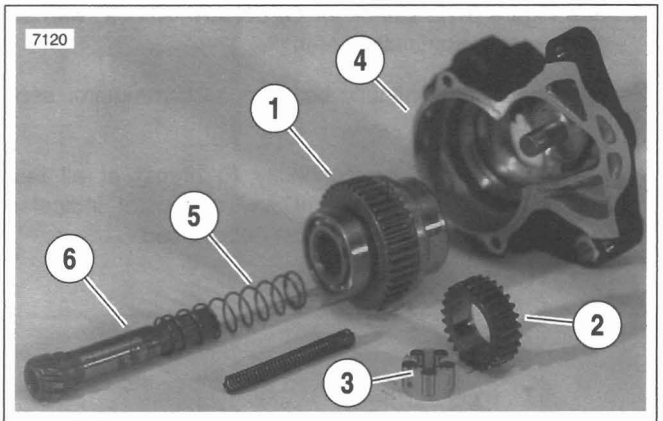
ASSEMBLY

1. See Figure 5-19. Replace both O-rings (23).

CAUTION

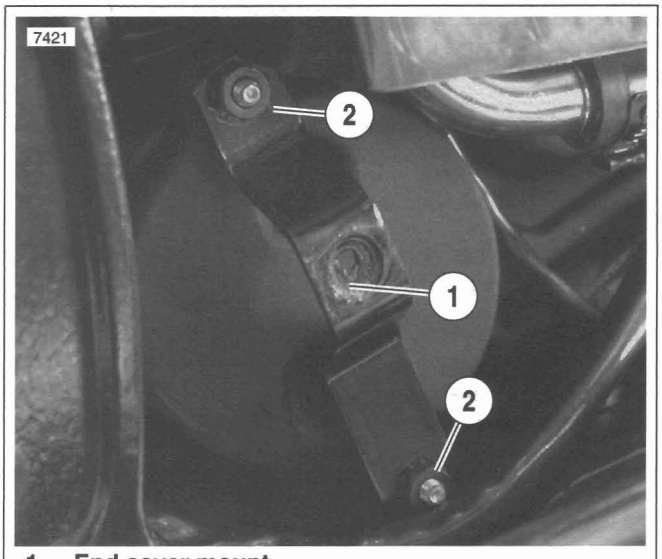
Do not use solvents to clean drive assembly/overrunning clutch (15). It is lubricated and sealed. If you use a solvent to clean it, the lubricant will be washed out and the clutch will fail.

2. 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.
4. 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).
6. 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 5-18. Attach end cover mount (1) using two nuts with washers (2).



1. **Drive**
2. **Idler gear**
3. **Idler gear bearing**
4. **Drive housing**
5. **Spring**
6. **Shaft**

Figure 5-17. Clutch Assembly



1. **End cover mount**
2. **Nuts with washers (2)**

Figure 5-18. End Cover Mount (Shown Installed For Orientation Purposes)

1. Field wire
2. Thru-bolt (2)
3. Field coil
4. End cap
5. End cap screw (2)
6. Brush spring (4)
7. Brushes
8. Brush holder
9. Armature
10. Armature bearings (2)
11. Drive housing mounting screw (2)
12. Lockwasher (2)
13. Drive housing
14. Solenoid housing
15. Drive assembly/overrunning clutch
16. Idler gear
17. Idler gear bearing & cage
18. O-ring
19. Spring
20. Shaft
21. Return spring
22. Ball
23. O-ring (2)

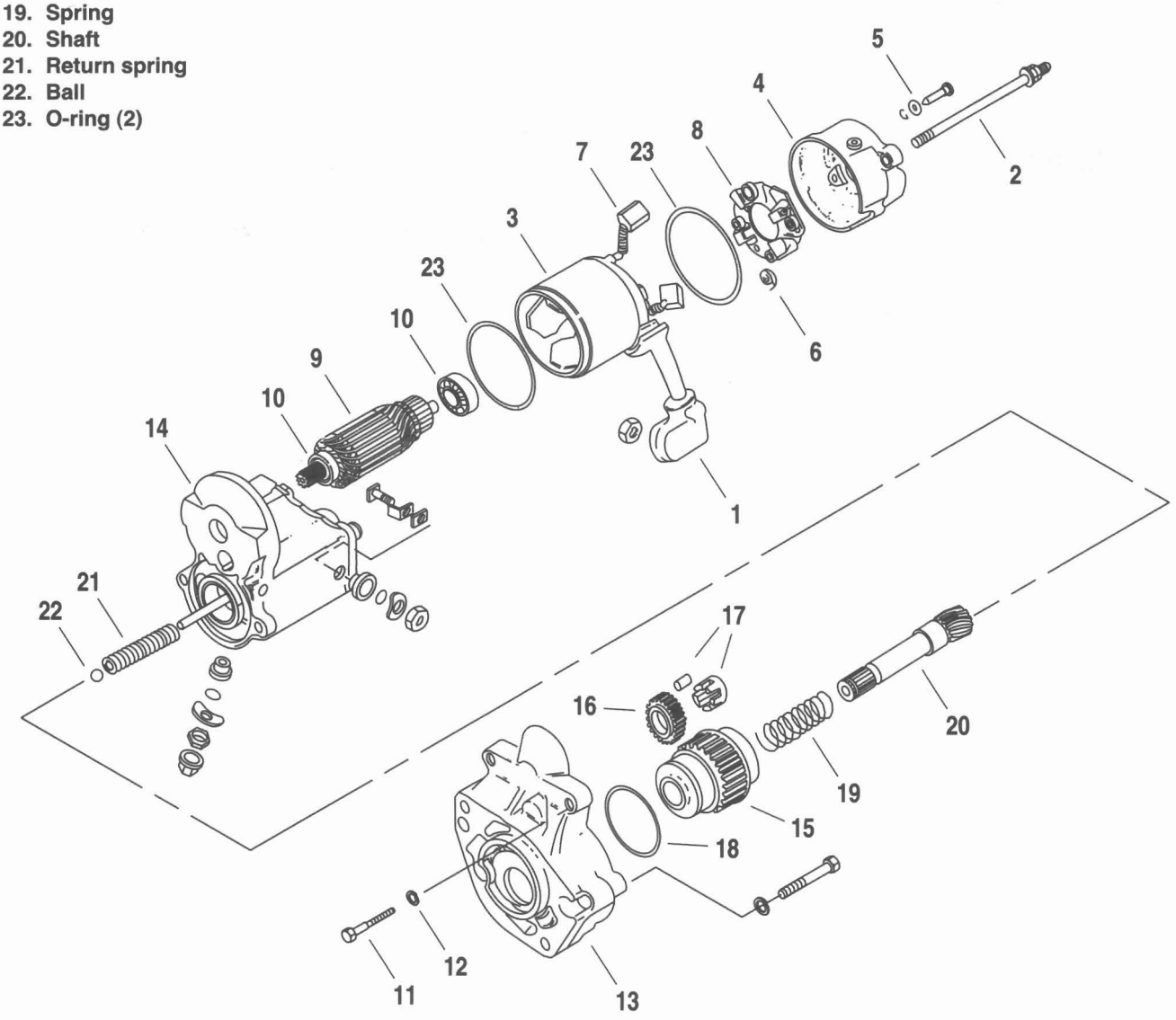


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Figure 5-19. Starter Assembly

GENERAL

CAUTION

See Figure 5-20. Do not tighten nut (7) without removing items 1-5. The contact will move and be destroyed.

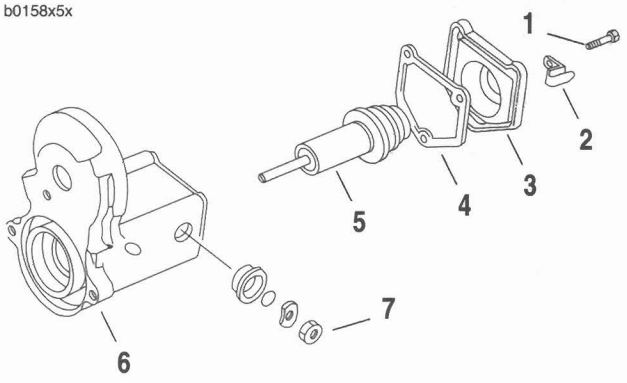
The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See Figure 5-20. 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 5-20. 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).



1. **Screw (3)**
2. **Clip**
3. **Cover**
4. **Gasket**
5. **Plunger**
6. **Solenoid housing**
7. **Nut**

Figure 5-20. Starter Solenoid

DRIVE 6

SUBJECT	PAGE NO.
6.1 Specifications	6-1
6.2 Primary Chaincase	6-2
6.3 Drive Components	6-8
6.4 Clutch	6-14
6.5 Transmission Sprocket	6-20
6.6 Drive Belt	6-23

SPECIFICATIONS 6.1

SPROCKETS	NUMBER OF TEETH	
	DOM/HDI	Japan
Compensating	34	34
Clutch	46	46
Transmission	32	32
Rear wheel	66	64

CLUTCH	DESCRIPTION
Type	Wet-multiple disc
Clutch lever freeplay (after internal adjustment)	1/16-1/8 in.
	1.6-3.2 mm

GEAR	OVERALL GEAR RATIO	
	DOM	HDI
First (low)	9.31	9.03
Second	6.42	6.23
Third	4.77	4.63
Fourth	3.93	3.81
Fifth	3.28	3.18
Sixth (high)	2.79	2.71

NOTE

Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.

TORQUE VALUES

ITEM	TORQUE		NOTES
Clutch diaphragm spring retainer bolts	90-110 **in-lbs**	10.2-12.4 Nm	metric, page 6-14, page 6-19
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 6-11
Compensating sprocket bolt	155-165 ft-lbs	210.1-223.7 Nm	apply two drops of LOCTITE THREADLOCKER 262 (red) to threads, page 6-10
Primary chain tensioner fasteners	21-24 ft-lbs	28.5-32.5 Nm	page 6-13
Primary chaincase sealing fasteners	25-27 ft-lbs	33.9-36.6 Nm	Special sequence to tighten, page 6-5
Primary cover fasteners	108-120 **in-lbs**	12.2-13.6 Nm	special sequence to tighten, page 6-3
Transmission lockplate screws	84-108 **in-lbs**	9.5-12.2 Nm	LOCTITE patch, use 3-5 times, page 6-22
Transmission sprocket nut	100 ft-lbs	135.6 Nm	right hand threads, initial torque only, apply several drops of LOCTITE THREADLOCKER 271 (red) to last few threads. page 6-21

GENERAL

The primary chaincase is a sealed housing containing the primary chain, clutch, engine compensating sprocket, chain adjuster, and alternator.

For information on primary chain adjuster and lubrication, see Section 1.

- 1.10 PRIMARY CHAIN.
- 1.11 PRIMARY CHAINCASE LUBRICANT.

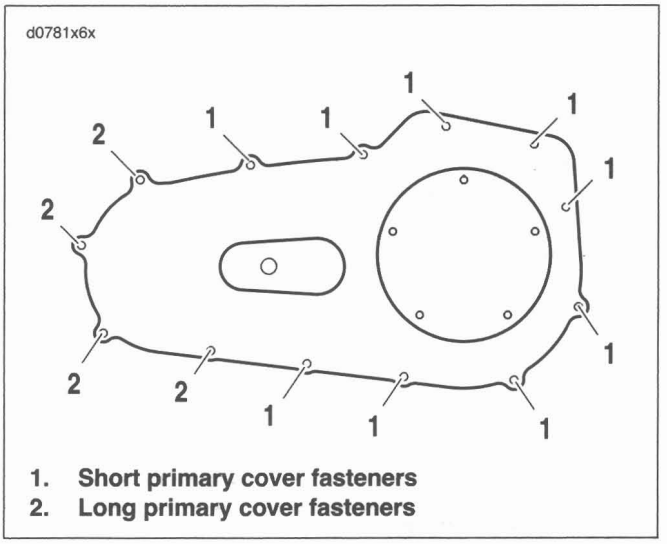
PRIMARY CHAINCASE COVER

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.
2. Drain the primary chaincase lubricant. See 1.11 PRIMARY CHAINCASE LUBRICANT.
3. See Figure 6-1. When lubricant has drained, remove short (1) and long (2) cover fasteners and cover.



1. **Short primary cover fasteners**
2. **Long primary cover fasteners**

Figure 6-1. Primary Chaincase Cover

Installation

CAUTION

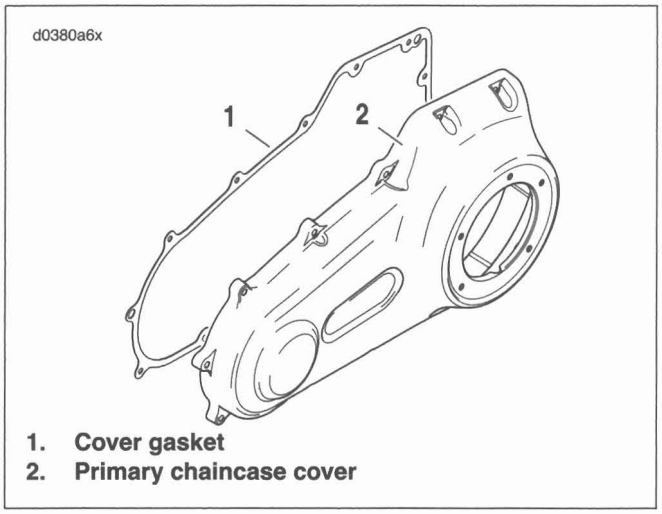
The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

1. See Figure 6-2. Install **new** cover gasket (1).
2. See Figure 6-1. Install short (1) and long (2) primary cover fasteners in positions shown. Snug fasteners.
3. See Figure 6-4. Tighten primary cover fasteners (1-13) to 108-120 **in-lbs** (12.2-13.6 Nm) in the sequence shown.

CAUTION

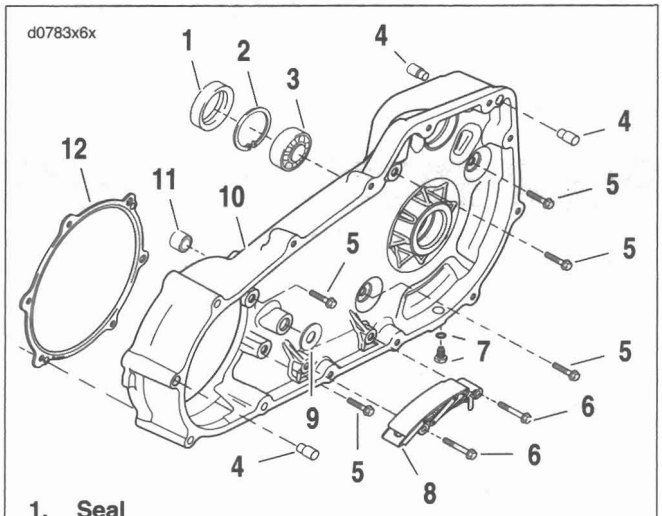
Do not overfill the primary chaincase with lubricant. Overfilling may cause rough clutch engagement, incomplete disengagement, clutch drag and/or difficulty in finding neutral at engine idle.

4. Place motorcycle in an upright position and fill primary chaincase. See 1.11 PRIMARY CHAINCASE LUBRICANT.
5. Connect negative battery cable.



1. **Cover gasket**
2. **Primary chaincase cover**

Figure 6-2. Primary Chaincase Cover Gasket



1. **Seal**
2. **Lock ring**
3. **Bearing**
4. **Dowel pin**
5. **Sealing fastener**
6. **Chain tensioner fasteners**
7. **Drain plug and o-ring**
8. **Chain tensioner**
9. **Tower gasket**
10. **Primary chaincase housing**
11. **Shifter shaft bushing**
12. **Crankcase gasket**

Figure 6-3. Primary Chaincase Housing

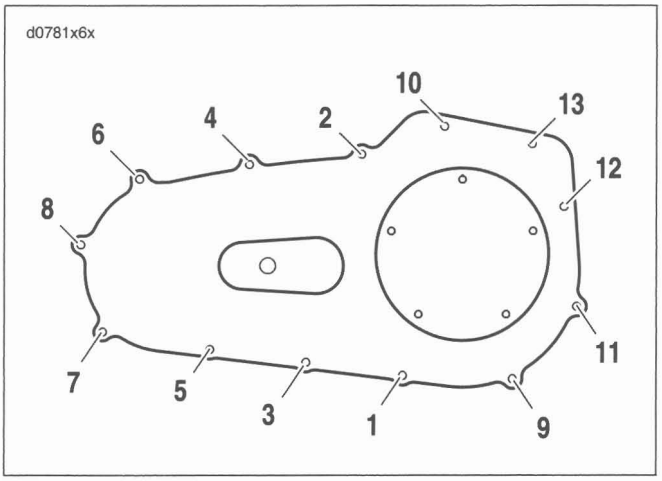


Figure 6-4. Primary Chaincase Cover Torque Sequence

PRIMARY CHAINCASE HOUSING

Removal

⚠WARNING

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

1. Disconnect battery cable, negative cable only.
2. Remove primary chaincase cover. See PRIMARY CHAINCASE COVER in this section.
3. Remove starter. See 5.4 STARTER.
4. Remove primary chain, clutch, and compensating sprocket. See 6.3 DRIVE COMPONENTS.
5. See Figure 6-3. Remove sealing fasteners (5) securing primary chaincase housing (10) to crankcase and transmission. Discard the crankcase gasket (12) and sealing fasteners.

Inspection

1. Inspect primary chaincase for cracks or damaged gasket surface.
2. Check the mainshaft bearing. Replace if bearing does not rotate freely. Replace the lip seal. See MAINSHAFT BEARING AND LIP SEAL in this section.

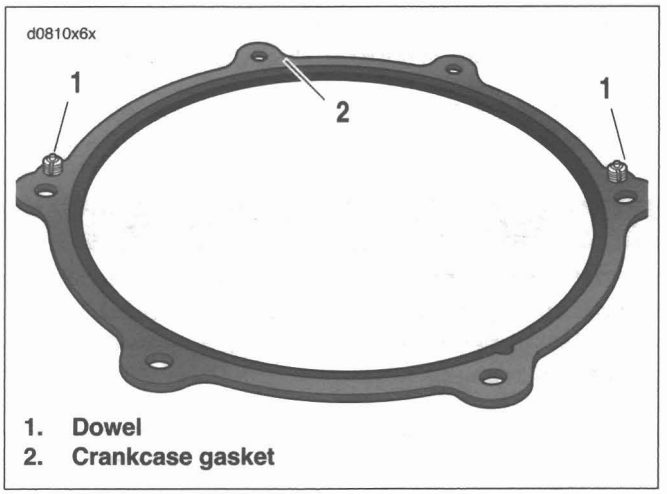
Installation

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

NOTE

See Figure 6-5. In next step, be sure dowels (1) in crankcase gasket (2) engage holes in crankcase.



1. **Dowel**
2. **Crankcase gasket**

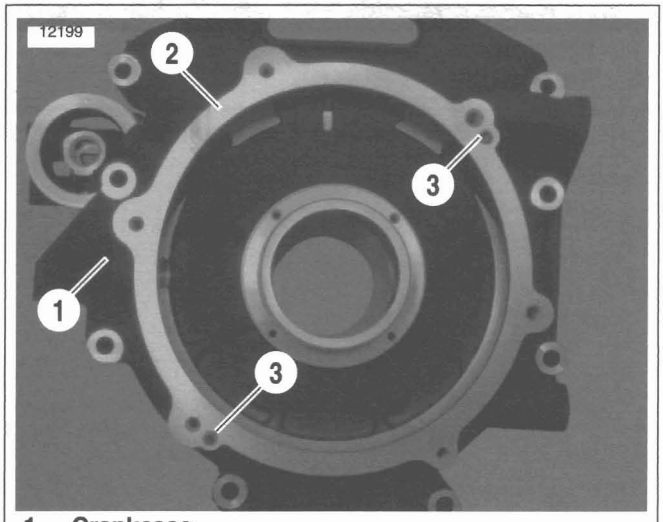
Figure 6-5. Crankcase Gasket

1. Verify pivot shaft torque. See 2.24 REAR FORK.
2. See Figure 6-6. Place crankcase gasket in place on gasket surface (2). Be sure dowels in gasket engage dowel holes (3).
3. Spread a thin film of oil on mainshaft oil seal lip and rubber portion of crankcase gasket. Be careful not to damage mainshaft seal when installing chaincase over the primary bearing inner race on the mainshaft.
4. See Figure 6-7. Insert **new** sealing fasteners.
5. See Figure 6-8. Tighten fasteners in sequence shown to 25-27 ft-lbs (33.9-36.6 Nm).
6. Install chain tensioner assembly.
7. Install the primary chain, clutch, and compensating sprocket as an assembly. See 6.3 DRIVE COMPONENTS.
8. Install starter. See 5.4 STARTER.

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.

9. Install primary chaincase cover. See PRIMARY CHAINCASE COVER in this section.
10. Fill primary chaincase with lubricant. See 1.11 PRIMARY CHAINCASE LUBRICANT.
11. Adjust rear belt tension.
12. Connect negative battery cable.



1. **Crankcase**
2. **Gasket surface**
3. **Dowel holes**

Figure 6-6. Crankcase

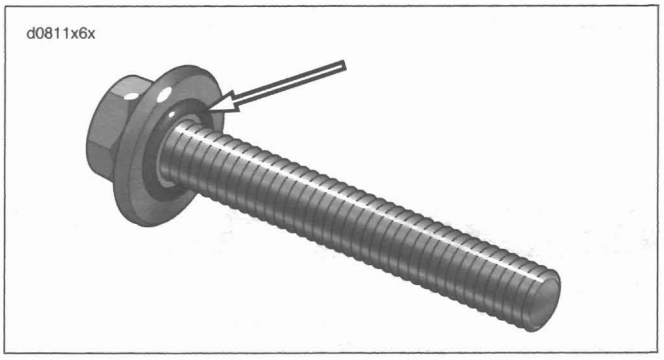


Figure 6-7. Sealing Fastener

S

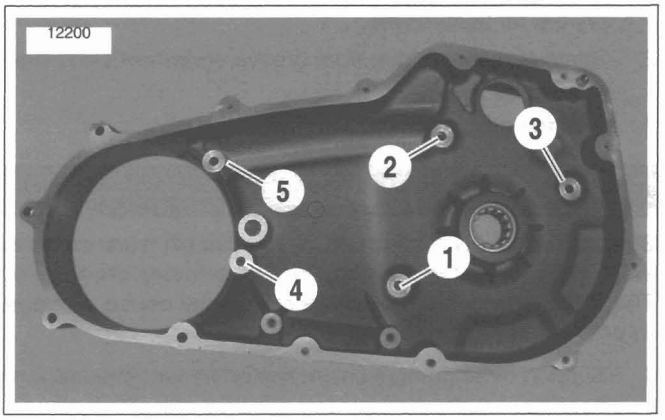


Figure 6-8. Sealing Fastener Torque Sequence

MAINSHAFT BEARING AND LIP SEAL

Removal

⚠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)

1. Pull lip seal from bearing bore on transmission side of primary chaincase. Use a seal remover or rolling head pry bar for best results.
2. Remove retaining ring from groove on transmission side of bearing.
3. Turn the primary chaincase over.

CAUTION

Support inner primary chain case area on transmission side while pressing bearing out of primary chaincase. The force needed to remove bearing may cause damage to primary chain case.

4. Support inner primary chaincase on transmission side of bearing.
5. Place primary chaincase in arbor press. Press out bearing from clutch side applying pressure to the outer race.

⚠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)

6. Inspect the bearing bore to verify that it is clean and smooth. Install retaining ring in groove on pulley side of primary chaincase.
7. Place primary chaincase in arbor press with the transmission side up.

CAUTION

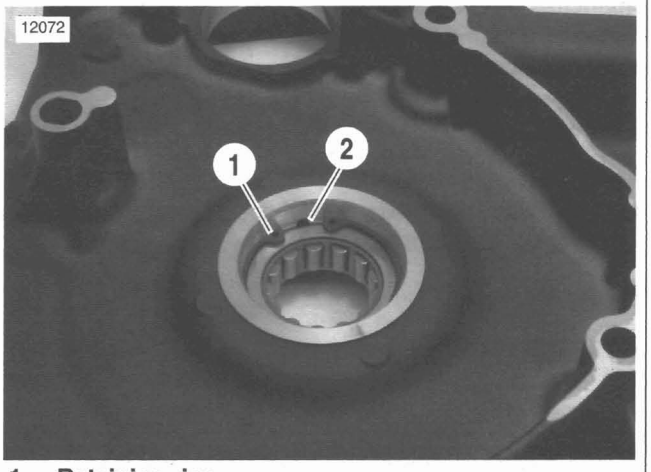
Support the bearing support area on clutch side while pressing bearing into bore. The force needed to press bearing into position may force an unsupported primary chain case to become damaged.

8. Support the bearing support area on the clutch side of the primary chaincase.
9. Apply a thin film of oil to outer diameter of bearing
10. Applying pressure to the outer race, press **new** bearing letter side up, into bore until it makes solid contact with the bearing support area.

⚠CAUTION

Mainshaft bearing retaining ring must be installed using proper orientation. Failure to do so will cause blockage of oil passage which will result in damage to bearing.

11. See Figure 6-9. Retaining ring (1) must be oriented as shown to prevent blocking of oil passage (2). Install retaining ring to lock position of bearing in bore. Verify that the ring is fully seated in the groove and is in proper orientation.



1. **Retaining ring**
2. **Oil passage**

Figure 6-9. Retaining Ring Orientation

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.*

12. Install mainshaft oil seal:
    a. Lubricate the O.D. of the new seal with clean engine oil.
    b. See Figure 6-10. 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.
13. Lubricate the bearing and seal lip with multi-purpose grease or clean engine oil.

SHIFTER SHAFT BUSHING

1. Press out old bushing from clutch side of housing. Inspect the bushing bore to verify that it is clean and smooth.
2. Press **new** bushing into bore from transmission side of housing. Installed bushing must be flush to 0.020 inch (0.51 mm) below edge of bore.

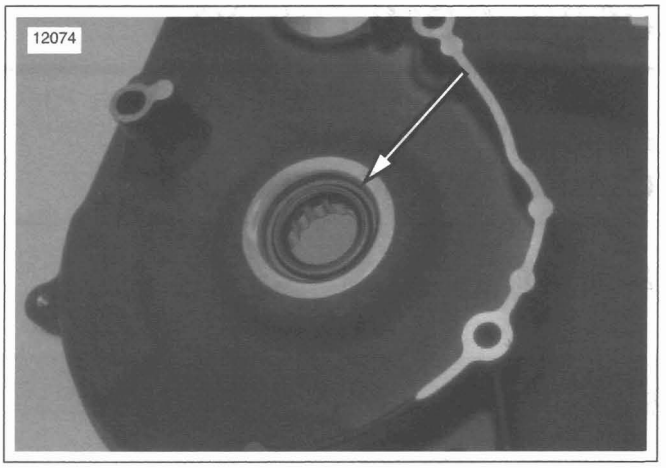


Figure 6-10. Oil Seal

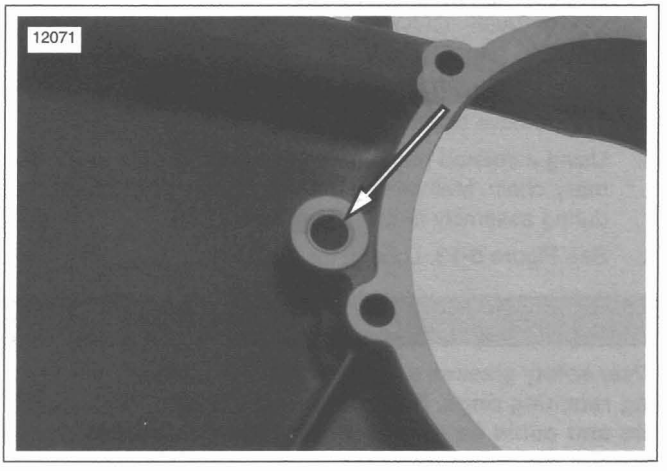


Figure 6-11. Shifter Shaft Bushing

PRIMARY CHAIN AND COMPENSATING SPROCKET

Removal

PART NO.	SPECIALTY TOOL
HD-47977	Primary drive locking tool

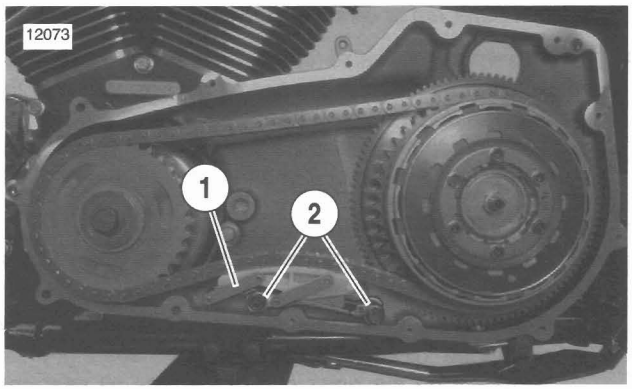
To remove the primary chain, remove compensating sprocket, clutch assembly and primary chain as an assembly:

1. Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.
2. See Figure 6-12. Remove chain tensioner fasteners (2) then remove chain tensioner (1).
3. Using a colored marker, mark one of the links of the primary chain. Maintaining the original direction of rotation during assembly may prolong service life.
4. See Figure 6-13. Loosen locknut (3).

⚠WARNING

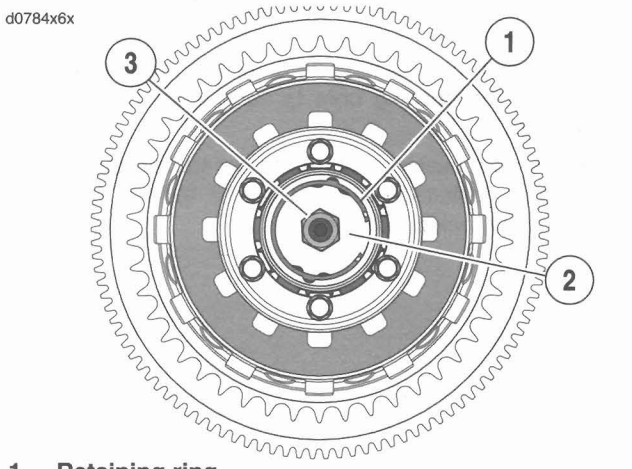
Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

5. Remove retaining ring (1) and release plate (2).



1. **Chain tensioner**
2. **Chain tensioner fasteners**

Figure 6-12. Chain Tensioner



1. **Retaining ring**
2. **Release plate**
3. **Locknut**

Figure 6-13. 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.

CAUTION

Do not use HD-41214 Primary Drive Locking Tool to remove or install components. Damage to components can occur if this tool is used. Use only HD-47977 Primary drive locking tool to remove and install components.

NOTES

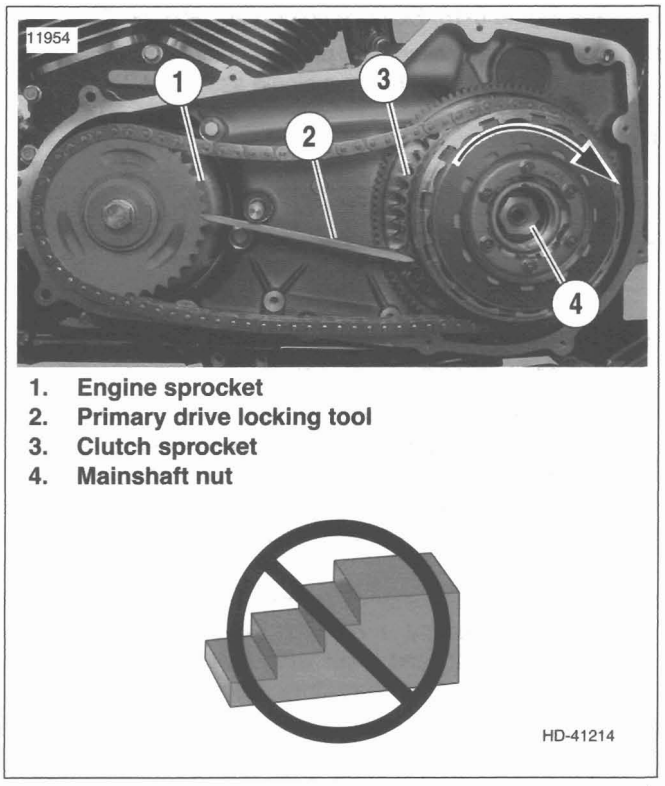
- *See Figure 6-14. When removing the clutch hub mainshaft nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-47977) must be placed between the teeth of the engine and clutch sprockets.*
- *The mainshaft nut has left handed threads, so turn clockwise to remove.*

6. Using a breaker bar, rotate clutch hub mainshaft nut in direction shown to remove.

NOTE

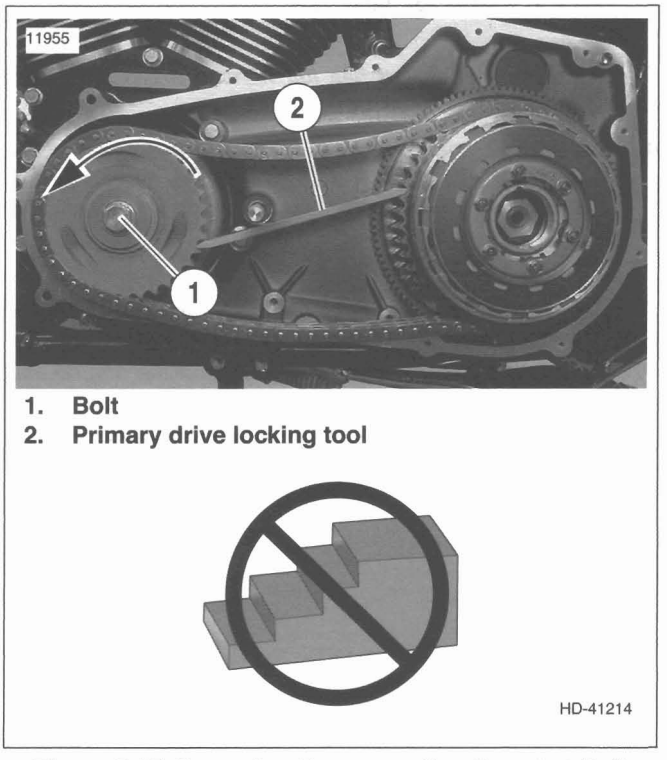
See Figure 6-15. When removing the compensating sprocket bolt, the PRIMARY DRIVE LOCKING TOOL (Part No. HD-47977) must be placed between the teeth of the engine and clutch sprockets.

7. Using a breaker bar, rotate compensating sprocket bolt in direction shown to remove.



1. **Engine sprocket**
2. **Primary drive locking tool**
3. **Clutch sprocket**
4. **Mainshaft nut**

Figure 6-14. Removing Clutch Hub Mainshaft Nut



1. **Bolt**
2. **Primary drive locking tool**

Figure 6-15. Removing Compensating Sprocket Bolt

8. See Figure 6-16. Remove bolt (6) and washer (5).
9. Remove clutch assembly, primary chain and compensating sprocket assembly as a single assembly.

Installation

PART NO.	SPECIALTY TOOL
HD-47977	Primary drive locking tool

NOTES

The primary chain, compensating sprocket and clutch assembly must be installed as an assembly.

1. See Figure 6-16. Apply a thin layer of primary chaincase oil, to the inner diameter of the compensating sprocket (3) and splines of the shaft extension (4). Assemble shaft extension, compensating sprocket and sliding cam (2). Place primary chain over compensating sprocket assembly.
2. Place drive components (primary chain, compensating sprocket assembly, and clutch assembly) into position. The clutch hub and shaft extension are splined, so a slight rotation of the chain drive will aid installation.
3. If reusing bolt (6), remove thread locking material from bolt and engine sprocket shaft. Clean and prime threads of bolt and sprocket shaft. Apply two drops of LOCTITE THREADLOCKER 262 (red) to the threads of bolt. Install bolt and washer (5) hand tight.

NOTE

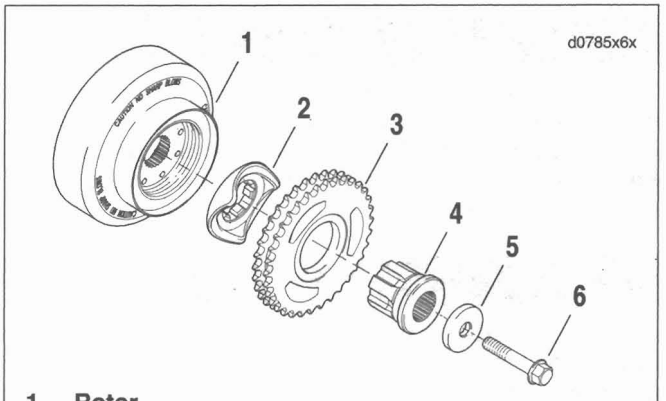
Clutch hub mainshaft nut has left handed threads, so turn counterclockwise to install.

4. Clean and prime threads of nut. Apply two drops of LOCTITE THREADLOCKER 262 (red) to the threads of the clutch hub mainshaft nut. Start nut onto mainshaft and tighten hand tight.

NOTE

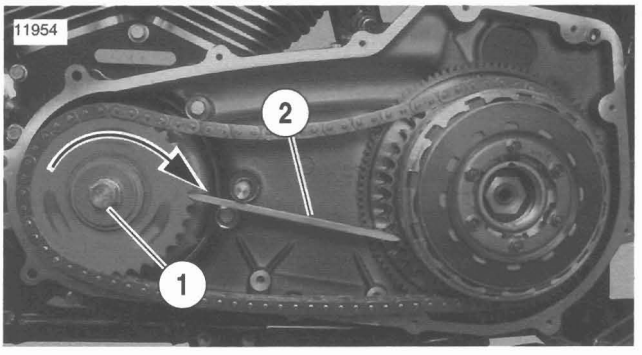
See Figure 6-17. When tightening the compensating sprocket bolt, the PRIMARY DRIVE LOCKING TOOL (Part No. HD-47977) must be placed between the teeth of the engine and clutch sprockets.

5. Tighten compensating sprocket bolt to 155-165 ft-lbs (210.1-223.7 Nm). Remove primary drive locking tool.



1. **Rotor**
2. **Sliding cam**
3. **Compensating sprocket**
4. **Shaft extension**
5. **Washer**
6. **Bolt**

Figure 6-16. Compensating Sprocket



1. **Bolt**
2. **Primary drive locking tool**

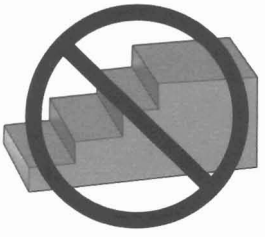


Figure 6-17. Installing Compensating Sprocket Bolt

NOTE

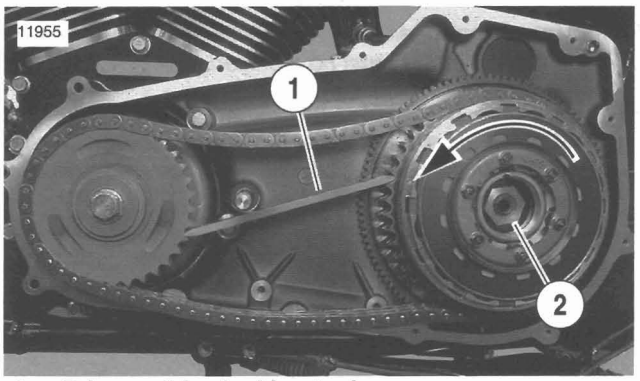
See Figure 6-18. When tightening the clutch hub mainshaft nut the PRIMARY DRIVE LOCKING TOOL (Part No. HD-47977) must be placed between the teeth of the engine and clutch sprockets.

6. Tighten clutch hub mainshaft nut to 70-80 ft-lbs (94.9-108.5 Nm). Remove primary drive locking tool.
7. See Figure 6-19. Install release plate (5) with locknut (2) and adjuster screw (3) into clutch hub bore. The word "OUT" stamped on the release plate should face outward.

⚠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)

8. 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.
9. Adjust clutch. See 1.12 CLUTCH.



1. **Primary drive locking tool**
2. **Mainshaft nut**

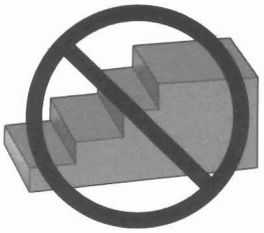
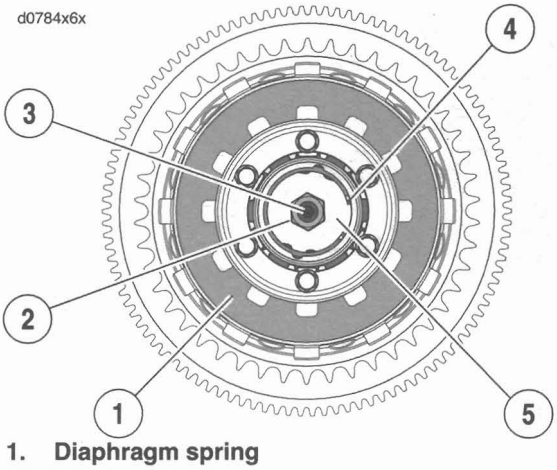


Figure 6-18. Installing Clutch Hub Mainshaft Nut



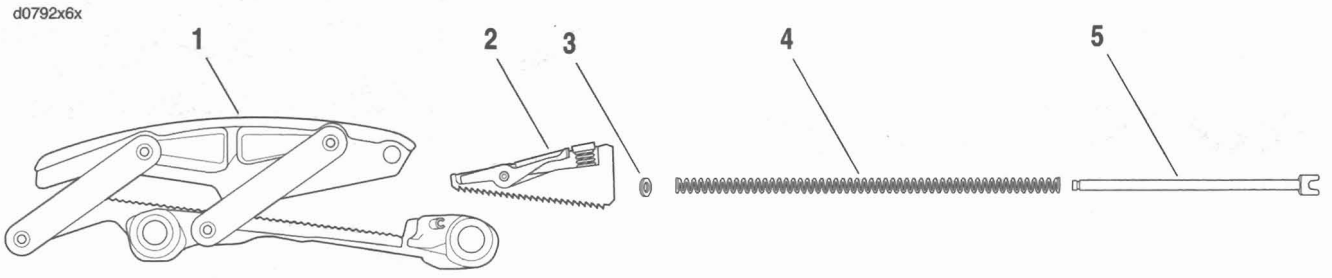
1. **Diaphragm spring**
2. **Locknut**
3. **Adjuster screw**
4. **Retaining ring**
5. **Release plate**

Figure 6-19. Clutch

NOTE

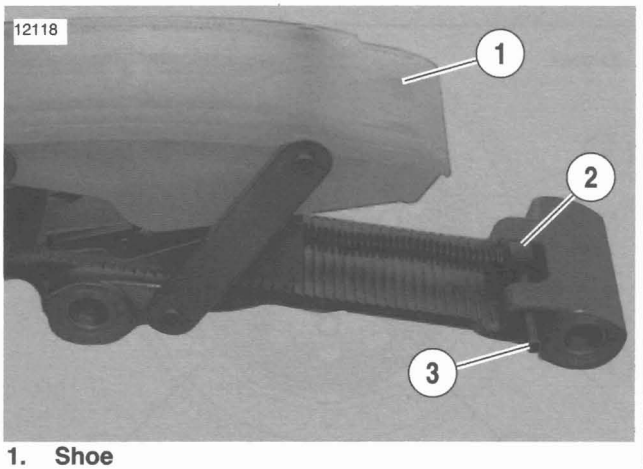
Primary chain tensioner is non-repairable. If tensioner is worn or damaged, assembly must be replaced.

10. See Figure 6-20. Although primary chain tensioner is sold as an assembly, tensioner parts can be dissassembled. If primary chain tensioner becomes disassembled, assemble in order shown.
11. See Figure 6-21. Locate end of spring rod (2) on roll pin (3).
12. See Figure 6-22. Slide wedge (2) of primary chain tensioner in direction of arrow until all travel is removed.
13. Push shoe (1) down until it contacts wedge. Keep tension on shoe so wedge stays in place.



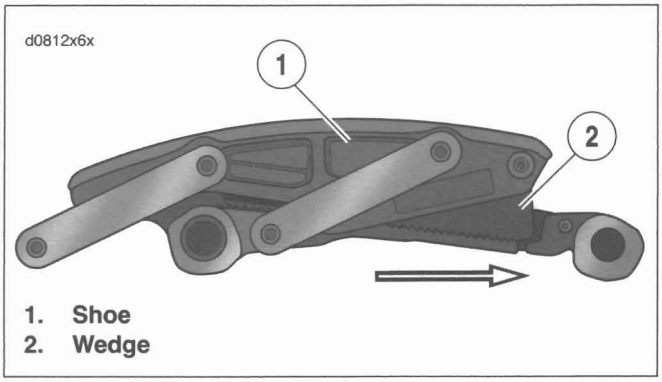
1. **Shoe assembly**
2. **Wedge**
3. **Washer**
4. **Spring**
5. **Spring rod**

Figure 6-20. Primary Chain Tensioner Assembly



1. **Shoe**
2. **Spring rod**
3. **Roll pin**

Figure 6-21. Spring Rod Location



1. **Shoe**
2. **Wedge**

Figure 6-22. Primary Chain Tensioner

14. See Figure 6-23. Insert cable tie (2) as shown to hold wedge in place. Make sure end of cable tie is located below primary chain tensioner. If cable tie is installed this way, it will hang below primary cover gasket surface and serve as a reminder to remove cable tie before installing primary cover.

NOTE

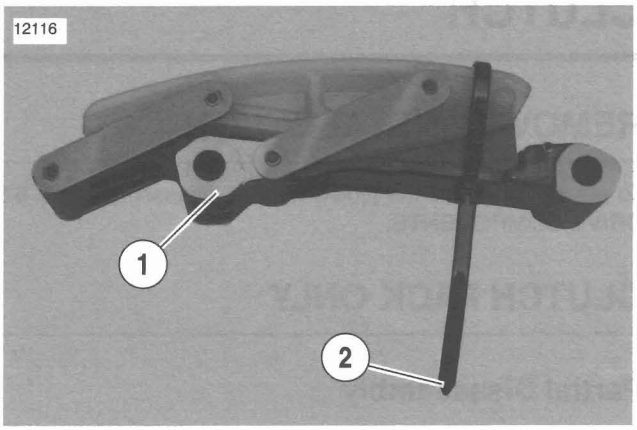
Primary chain tensioner will not complete chain adjustment until vehicle is ridden. Vehicle must be test ridden after tensioner removal/installation to ensure proper adjustment.

15. See Figure 6-12. Install primary chain tensioner (1) into place. Install chain tensioner fasteners (2) and tighten to 21-24 ft-lbs (28.5-32.5 Nm). Remove cable tie.

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.

16. Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.



1. **Primary chain tensioner**
2. **Cable tie**

Figure 6-23. Securing Primary Chain Tensioner

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.

1. Remove primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.
2. See Figure 6-25. 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.
3. Remove diaphragm spring retainer, diaphragm spring (3) and pressure plate (4) from clutch hub.
4. 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

NOTE

Submerge and soak all friction plates in FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 998851-05 (quart) for at least five minutes.

1. See Figure 6-24. Install the narrow friction plate on the clutch hub. Engage tabs on plate with slots in clutch shell.
2. See Figure 6-25. Install damper spring seat (9) on clutch hub (11). It must sit inboard of narrow friction plate (7).
3. Install damper spring (8) on clutch hub with the concave side out (facing away from damper spring seat).
4. 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.
5. Install pressure plate (4) on clutch hub aligning holes in plate with threaded bosses on hub.
6. Seat diaphragm spring (3) in recess of pressure plate with the concave side inward.

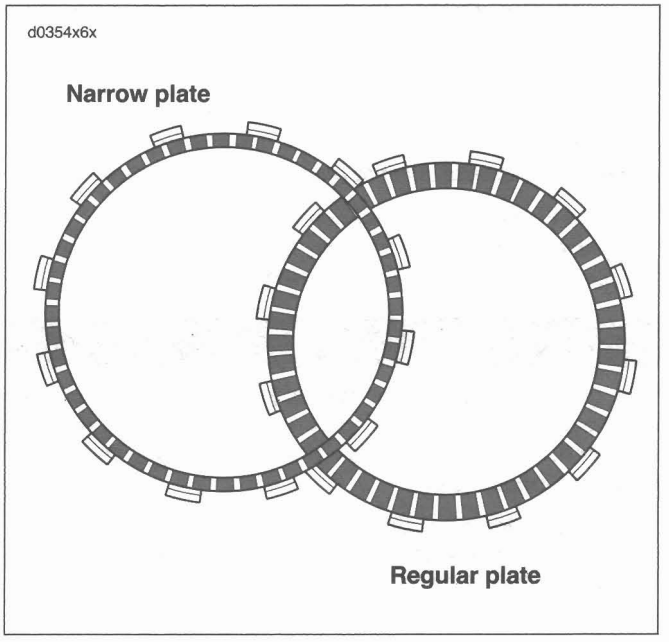


Figure 6-24. Friction Plates

7. Align holes in diaphragm spring retainer (2) with threaded bosses on clutch hub. Tabs on spring retainer contact flats on inboard side of bosses.
8. 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.

9. Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.

1. Bolt (6) (metric)
2. Diaphragm spring retainer
3. Diaphragm spring
4. Pressure plate
5. Friction plate (9)
6. Steel plate (8)
7. Narrow friction plate
8. Damper spring
9. Damper spring seat
10. Mainshaft nut (metric)
11. Clutch hub
12. Retaining ring
13. Bearing
14. Clutch shell
15. Retaining ring

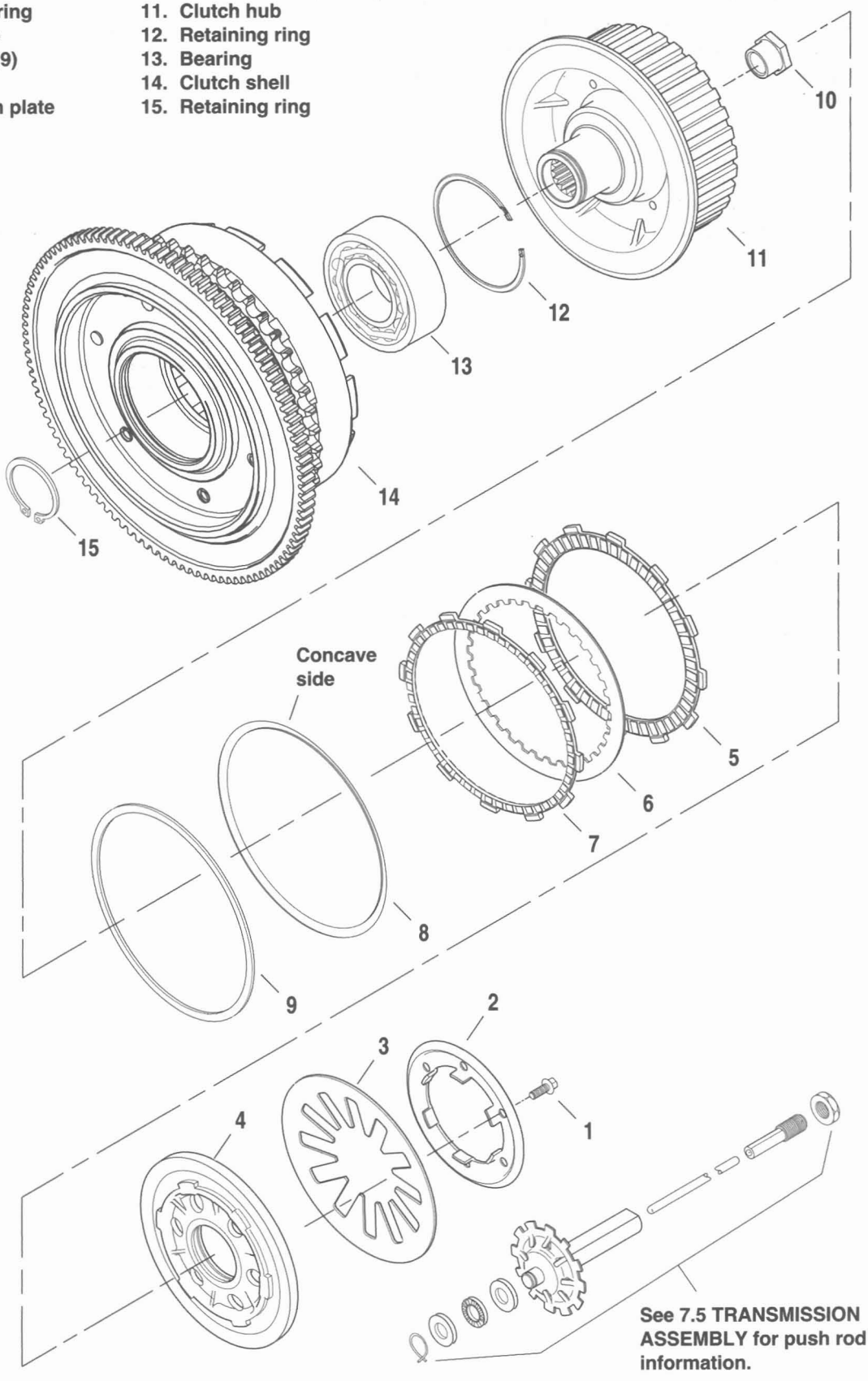


Figure 6-25. Clutch Shell Assembly

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. (00061)

1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Blow parts dry with low pressure compressed air.
2. Check **friction plates** as follows:
   a. Blow off all lubricant from the friction plates. Do not wipe off with a rag.
   b. 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.
   d. Look for worn or damaged fiber surface material (both sides).

NOTE

Replace all nine friction plates with an entirely new set if any individual plate shows evidence of wear or damage. Submerge and soak all friction plates in FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT, Part No. 998851-05 (quart) LUBRICANT for at least five minutes.

3. Check the **steel plates** as follows:
   a. Discard any plate that is grooved or bluish in color. Blue plates are likely warped or distorted.
   b. Check each plate for distortion. Lay the plate on a precision flat surface. Insert a feeler gauge between the plate and the flat surface in several places. Replace any steel plate that is warped more than 0.006 in. (0.15 mm).
4. Holding the clutch hub, rotate the clutch shell to check bearing for smoothness. Replace the bearing if it runs rough, binds or has any end play.
5. 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.
6. 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.
7. 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.

CLUTCH PACK AND BEARING

Complete Disassembly

1. 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.

⚠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)

2. See Figure 6-26. With the transmission side up, remove retaining ring from clutch hub groove.

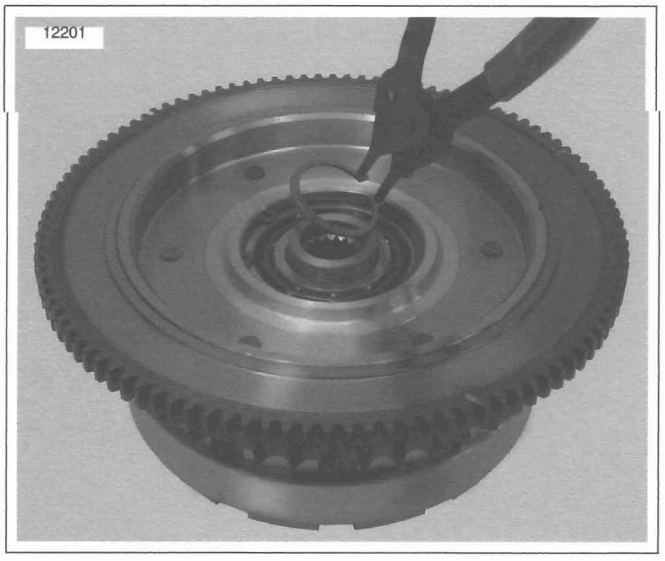


Figure 6-26. Clutch Hub Retaining Ring

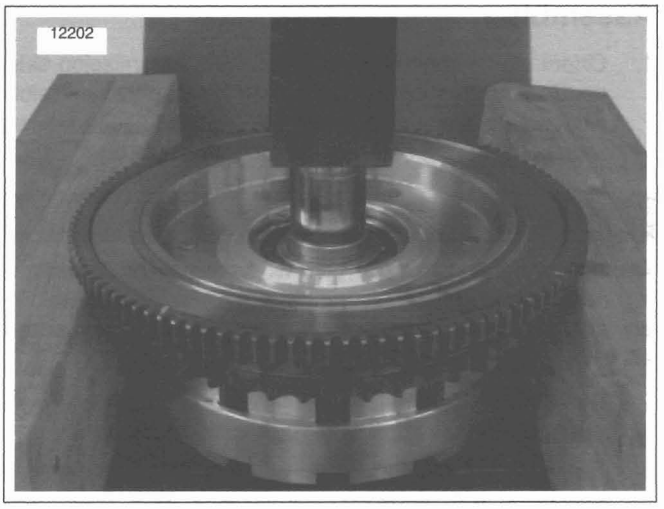


Figure 6-27. Pressing Clutch Hub From Bearing

3. See Figure 6-27. Supporting clutch shell in same orientation, use arbor press and a suitable press plug to press hub from bearing in clutch shell.
4. See Figure 6-28. With the transmission side up, remove retaining ring from groove in clutch shell bore.
5. See Figure 6-29. Turn clutch shell over so that transmission side is down. 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

1. Orient clutch shell in arbor press with transmission side up. Be sure to support clutch shell bore on transmission side. Using a suitable press plug, press against outer race until bearing contacts shoulder in clutch shell bore.

⚠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)

2. See Figure 6-28. Install retaining ring in groove of clutch shell bore. Place flat side of ring against bearing.
3. Center hub in bearing. Be sure that bearing inner race is supported with sleeve on transmission side. Press hub into bearing until hub shoulder contacts bearing inner race.
4. See Figure 6-26. Turn assembly over so that the transmission side is up. Install retaining ring in groove of clutch hub.
5. Place clutch assembly on bench oriented with the transmission side down.
6. Soak all friction and steel plates in FORMULA PLUS LUBRICANT for at least 5 minutes.

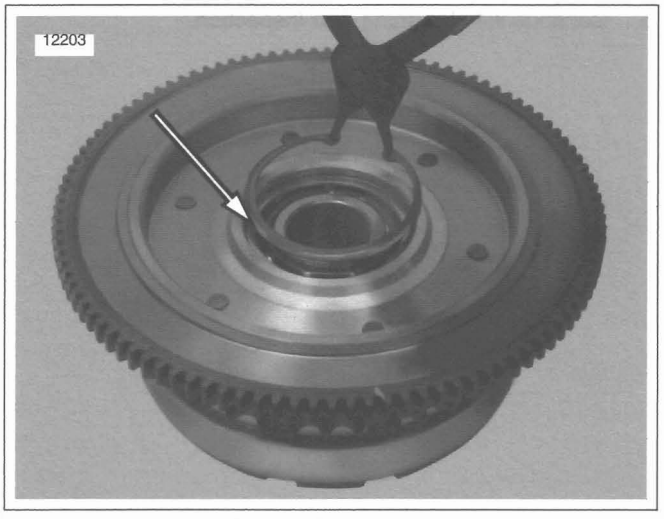


Figure 6-28. Install Clutch Shell Retaining Ring with Flat Side Against Bearing

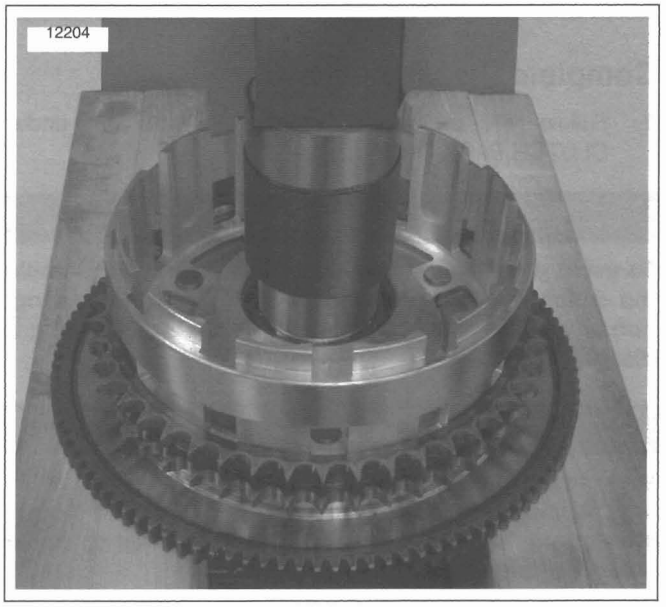


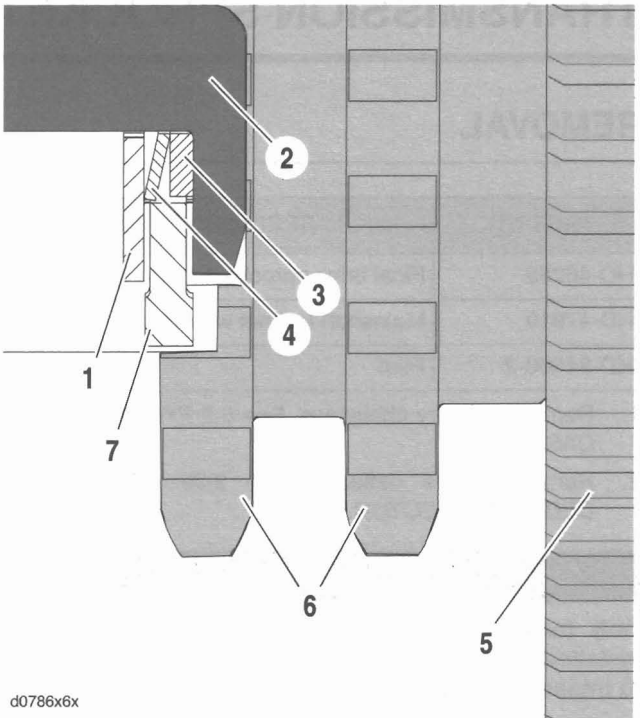
Figure 6-29. Pressing Bearing From Clutch Shell

7. See Figure 6-30. 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.
9. Install damper spring on clutch hub with the concave 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 6-31. 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 bolts to 90-110 **in-lbs** (10.2-12.4 Nm).

CAUTION

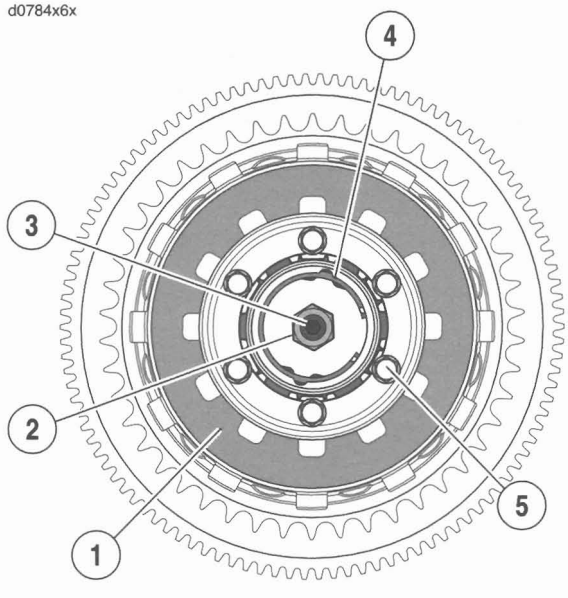
The gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed. Failure to replace this gasket may cause primary chaincase leaks.

15. Install primary chaincase cover and fill with lubricant. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.



1. **Steel plate**
2. **Clutch hub**
3. **Damper spring seat**
4. **Damper spring**
5. **Starter ring gear**
6. **Primary chain sprocket**
7. **Narrow friction plate**

Figure 6-30. Clutch Stackup



1. **Diaphragm spring**
2. **Jam nut**
3. **Adjuster screw**
4. **Retaining ring**
5. **Bolts (6) (metric) @ 90-110 in-lbs (10.2-12.4 Nm)**

Figure 6-31. Assembled Clutch

REMOVAL

PART NO.	SPECIALTY TOOL
HD-46282	Final drive sprocket locking tool
HD-47910	Mainshaft locknut wrench
HD-94660-2	Pilot

1. Remove primary chaincase. See 6.2 PRIMARY CHAINCASE.
2. Remove debris deflector. See 2.39 BELT GUARD/ DEBRIS DEFLECTOR.

CAUTION

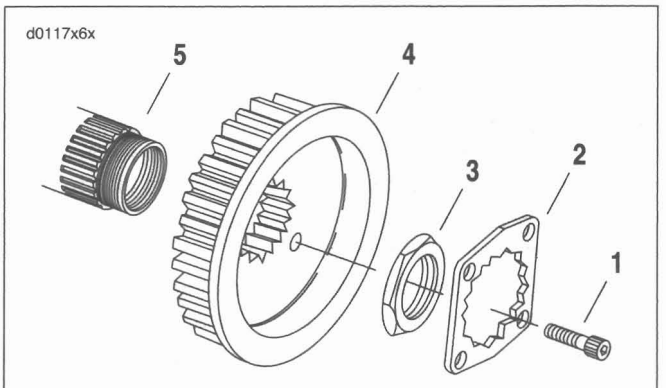
Only remove mainshaft locknut while transmission is installed in frame. Failure to do so will result in damage to transmission and/or transmission stand.

3. Remove transmission sprocket.
   a. See Figure 6-32. Remove both screws (1) and lockplate (2).
   b. See Figure 6-33. Secure sprocket using FINAL DRIVE SPROCKET LOCKING TOOL (3) (Part No. HD-46282). Final drive sprocket locking tool must rest against lower portion of swingarm pivot nut (2).

NOTE

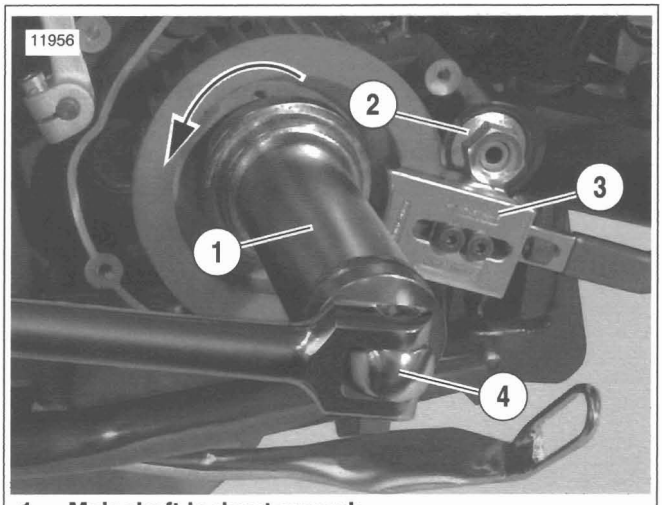
*Sprocket nut has a **right-hand** thread.*

   c. Install PILOT (Part No. HD-94660-2) on mainshaft.
   d. Remove the sprocket nut using MAINSHAFT LOCKNUT WRENCH (1) (Part No. HD-47910).
4. See Figure 6-35. Loosen rear axle and adjusters so rear wheel can be moved all the way forward. Remove belt from sprocket as you remove sprocket.



1. **Screw (2) @ 84-108 in-lbs (9.5-12.2 Nm)**
2. **Lockplate**
3. **Sprocket nut**
4. **Sprocket**
5. **Main drive gear**

Figure 6-32. Transmission Sprocket



1. **Mainshaft locknut wrench**
2. **Swingarm pivot nut**
3. **Final drive sprocket locking tool**
4. **3/4 inch breaker bar**

Figure 6-33. Mainshaft Locknut Removal: Typical

CLEANING AND INSPECTION

1. Clean sprocket of all grease and dirt using solvent. Clean and prime sprocket threads.
2. Inspect belt and sprocket. See 1.15 REAR BELT AND SPROCKETS.
3. Inspect both main drive gear and mainshaft seals. Replace if damaged.

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-46282	Final drive sprocket locking tool
HD-47910	Mainshaft locknut wrench
HD-94660-2	Pilot

CAUTION

Only install mainshaft locknut while transmission is installed in frame. Failure to do so will result in damage to transmission and/or transmission stand.

1. Place transmission sprocket in position.

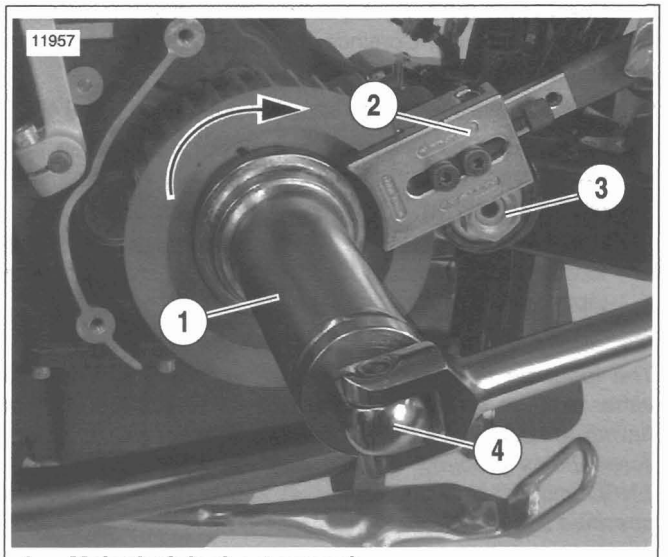
CAUTION

Exercise caution to avoid getting oil on the threads of the sprocket nut or the integrity of the lock patch may be compromised.

NOTE

*The transmission sprocket nut has **right-handed** threads. Turn the nut **clockwise** to install on the main drive gear.*

2. See Figure 6-32. Apply Loctite High Strength Threadlocker 271 (red) to the threads of the sprocket nut. Also spread a small quantity of clean engine oil on the inside face of the sprocket nut and the outside face of the sprocket. Limit the application to where the surfaces of the two parts contact each other. Install the sprocket nut until finger tight.
3. See Figure 6-34. Lock transmission sprocket with the FINAL DRIVE SPROCKET LOCKING TOOL (3) (Part No. HD-46282). Final drive sprocket locking tool must rest against upper portion of swingarm pivot nut (2).



1. **Mainshaft locknut wrench**
2. **Final drive sprocket locking tool**
3. **Swingarm pivot nut**
4. **3/4 inch breaker bar**

Figure 6-34. Mainshaft Locknut Installation: Typical

4. Install PILOT (Part No. HD-94660-2) on mainshaft.
5. Using MAINSHAFT LOCKNUT WRENCH (1) (Part No. HD-47910), tighten sprocket nut to 100 ft-lbs (135.6 Nm) initial torque.
6. Loosen sprocket nut to remove initial torque.
7. Tighten sprocket locknut to 35 ft-lbs (47.5 Nm).

CAUTION

Maximum allowable tightening of sprocket nut is 45° of clockwise rotation, after initially tightening to 35 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.

8. See Figure 6-36. Scribe a line (3) on the transmission sprocket nut (1). Continue the line on the transmission sprocket (2) as shown.
9. Tighten the transmission sprocket nut an additional 45°.
10. Install lockplate over transmission sprocket nut so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's two tapped holes.
11. See Figure 6-32. 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 TIGHTENED until the screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

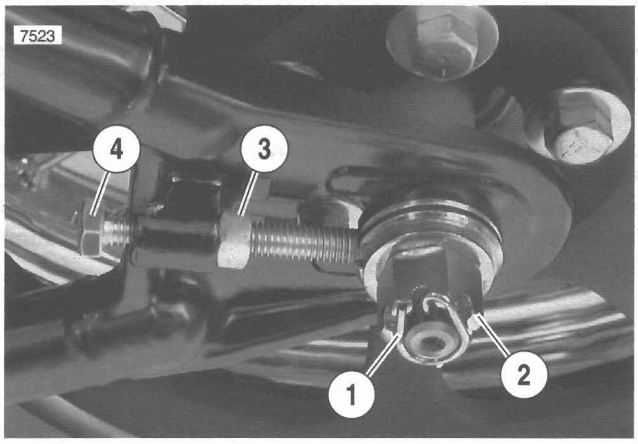
CAUTION

To ensure the lockplate's security, you must use BOTH screws when you install the lockplate.

12. Tighten screws to 84-108 **in-lbs** (9.5-12.2 Nm).

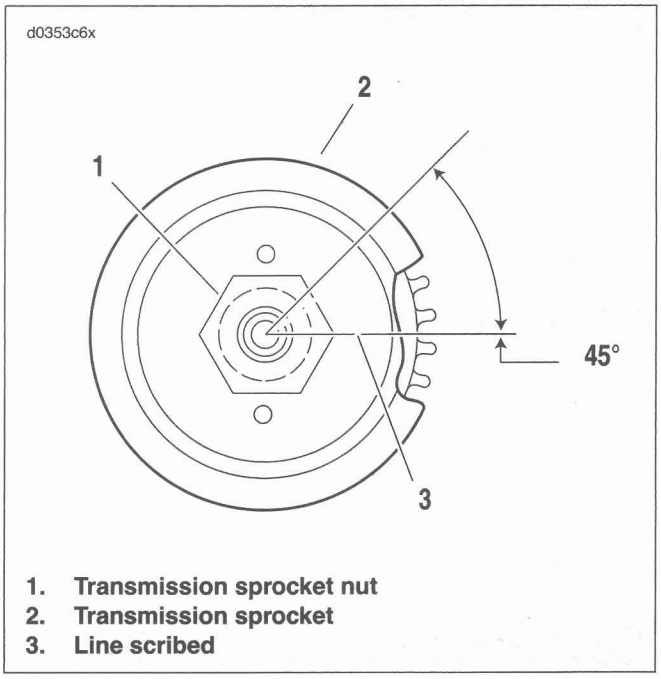
NOTE

The screws have LOCTITE patches. With LOCTITE High Strength Threadlocker 271 (red) reapplied before installation, the screws can be re-used 3-5 times.



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

Figure 6-35. Axle Adjusters (Left Side Shown)



1. **Transmission sprocket nut**
2. **Transmission sprocket**
3. **Line scribed**

Figure 6-36. Transmission Sprocket Nut Final Tightening

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.

13. Install primary chain assembly and primary chaincase cover. Fill primary chaincase with lubricant. See 6.3 DRIVE COMPONENTS.
14. Verify pivot shaft torque. See 2.24 REAR FORK.
15. Verify vehicle alignment and tighten rear axle. See 2.14 VEHICLE ALIGNMENT.
16. Adjust belt tension. See 1.14 REAR BELT DEFLECTION.
17. Install debris deflector. See 2.39 BELT GUARD/DEBRIS DEFLECTOR.

REMOVAL

1. Remove rear wheel. See 2.8 REAR WHEEL.
2. Remove primary chain, clutch, engine compensating sprocket, and chain adjuster as an assembly. See 6.3 DRIVE COMPONENTS.
3. Remove primary chaincase housing. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAINCASE.
4. Place a support under rear fork and engine. Remove pivot shaft and spacer. See 2.26 REAR FORK.
5. See Figure 6-38. Slip drive belt (2) from transmission sprocket (1).

INSPECTION

See 1.15 REAR BELT AND SPROCKETS.

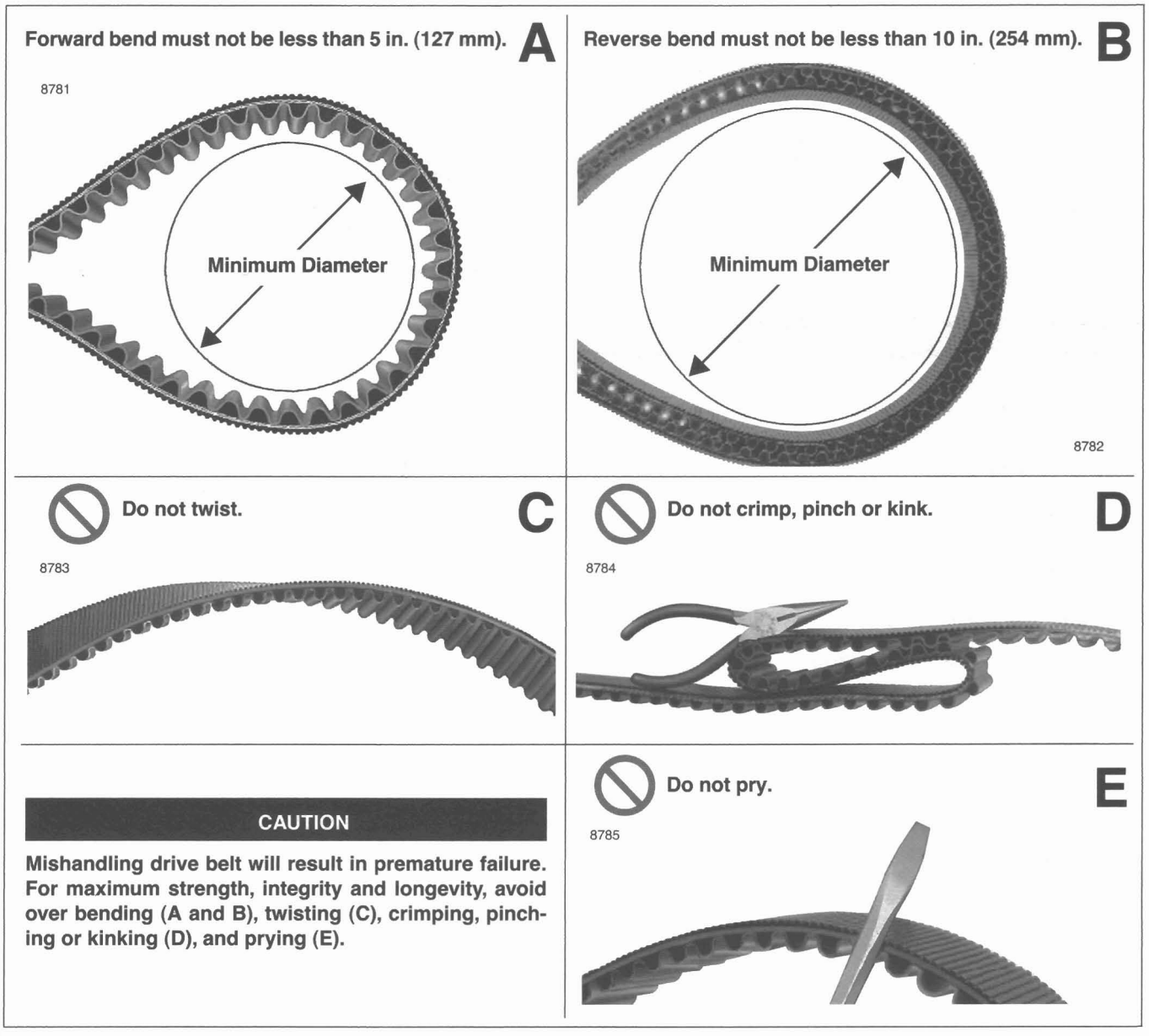


Figure 6-37. Proper Drive Belt Handling

INSTALLATION

CAUTION

See Figure 6-37. 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

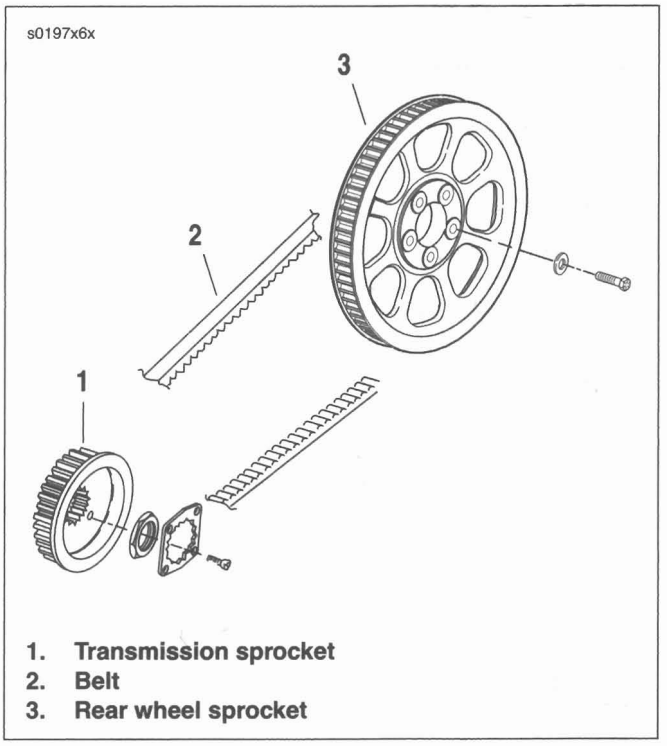
FXST, FXSTB, FXSTC and FLSTF models use a 20 mm wide belt.

1. See Figure 6-38. 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.
3. Install the primary chaincase housing. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAINCASE.

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.

4. 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 DEFLECTION.



1. **Transmission sprocket**
2. **Belt**
3. **Rear wheel sprocket**

Figure 6-38. Belt and Transmission Sprocket

SUBJECT	PAGE NO.
7.1 Specifications	7-1
7.2 Transmission	7-3
7.3 Shifter Forks	7-6
7.4 Transmission Clutch Release Cover	7-7
7.5 Transmission Assembly	7-9
7.6 Main Drive Gear And Bearing	7-24
7.7 Transmission Case	7-34

TRANSMISSION 7

TRANSMISSION	DATA
Type	6-speed forward constant mesh
Transmission lubricant type (Formula+)	Part No. 99851-05 (qt)
Capacity	32 oz.
	946.4 ml

GEAR	FINAL DRIVE RATIO
First (low)	3.34
Second	2.31
Third	1.72
Fourth	1.39
Fifth	1.18
Sixth (high)	1.00

NOTE

Final gear ratios indicate the number of mainshaft revolutions required to drive the output sprocket one revolution.

MAIN DRIVE GEAR (6TH)	IN.	MM
Bearing fit in transmission case (loose)	0.0003-0.0017	0.0076-0.043
Fit in bearing (press-fit)	none	none
Fit on mainshaft	0.0009-0.0022	0.023-0.056
End play	none	none

MAINSHAFT TOLERANCE	IN.	MM
Mainshaft runout	0.000-0.003	0.00-0.08
Mainshaft end play	none	none
5th gear end play	0.002-0.026	0.05-0.66
5th gear clearance	0.0004-0.0015	0.010-0.038

COUNTERSHAFT TOLERANCE	IN.	MM
Countershaft runout	0.000-0.003	0.00-0.08
Countershaft end play	none	none
1st gear end play	0.002-0.023	0.05-0.58
1st gear clearance	0.0004-0.0015	0.010-0.038
2nd gear end play	0.002-0.40	0.05-1.02
2nd gear clearance	0.0001-0.0012	0.003-0.030
3rd gear end play	0.002-0.042	0.05-1.07
3rd gear clearance	0.0004-0.0015	0.010-0.038
4th gear end play	0.001-0.028	0.03-0.71
4th gear clearance	0.0004-0.0015	0.010-0.038

SHIFTER DOG TOLERANCE	IN	MM
1st	0.015-0.112	0.381-2.845
2nd	0.021-0.136	0.533-3.454
3rd	0.014-0.118	0.356-2.997
4th	0.033-0.115	0.838-2.921
5th	0.016-0.115	0.406-2.921
6th	0.026-0.123	0.660-3.124

SIDE DOOR BEARING	IN.	MM
Fit in side door (tight)	0.0001-0.0014	0.0025-0.0356
Fit on countershaft (tight)	0.0007	0.018
Fit on countershaft (loose)	0.001	0.025
Fit on mainshaft (tight)	0.0007	0.018
Fit on mainshaft (loose)	0.001	0.025

SHIFTER FORKS	IN.	MM
Shifter fork to cam groove end play	0.004-0.012	0.102-0.305
Shifter fork to gear groove end play	0.004-0.013	0.102-0.330
First and second gear shift fork wear limit	0.258 in.	6.55 mm
Third and fourth gear shift fork wear limit	0.198 in.	5.03 mm
Fifth and sixth gear shift fork wear limit	0.258 in.	6.55 mm

TORQUE VALUES

ITEM	TORQUE		NOTES
Clutch cable fitting	36-60 **in-lbs**	4.1-6.8 Nm	page 7-8
Clutch release cover screws	84-108 **in-lbs**	9.5-12.2 Nm	page 7-8
Engine/transmission mount fasteners	30-35 ft-lbs	40.7-47.5 Nm	special sequence to tighten, page 7-34
Mainshaft/countershaft nuts	45-55 ft-lbs	61.0-74.6 Nm	page 7-21
Shift drum detent arm fastener	120-150 **in-lbs**	13.6-17.0 Nm	page 7-11
Shift drum lock plate fasteners	57-63 **in-lbs**	6.4-7.1 Nm	page 7-21
Shifter rod lever screw	18-22 ft-lbs	24.4-29.8 Nm	page 7-37
Shifter rod locknuts	80-120 **in-lbs**	9.0-13.6 Nm	page 7-5
Transmission case, 5/16 in. hardware	13-18 ft-lbs	17.6-24.4 Nm	page 7-22
Transmission drain plug	14-21 ft-lbs	19.0-28.5 Nm	Clean plug before installation, page 7-23, page 7-34
Transmission top cover	84-132 **in-lbs**	9.5-14.9 Nm	page 7-23

GENERAL

See Figure 7-1. The 6-speed transmission consists of two parallel shafts supporting six 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 six pairs of gears makes up a different speed in the transmission.

The transmission gears are divided into two types, gears that rotate with the shaft, and freewheeling gears that ride on bearings and spin freely on the shaft. A gear that rotates with the shaft always meshes with a freewheeling gear. Also, three dog rings are able to slide sideways on the shaft. These dog rings are used to change transmission speeds. The dogs, or projections, on the sides of the dog rings, 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 dog rings that slide on the guide hubs. The position of the shifter forks is controlled by a drum-shaped shifter cam located in the transmission side door.

Neutral

Power is introduced to the transmission through the clutch. In neutral, with the clutch engaged, the mainshaft 1st, 2nd, 3rd and 4th gears are rotating, but no power is transferred to the countershaft since countershaft 1st, 2nd, 3rd and 4th gears are freewheeling gears.

1st Gear

When the transmission is shifted into first gear, the dog ring between countershaft 1st and 2nd, which rotates with the countershaft, engages countershaft 1st, which has been spinning freely on the countershaft driven by mainshaft 1st.

Now countershaft 1st is no longer freewheeling, but locked to the countershaft causing the countershaft and countershaft 6th to turn. Countershaft 6th transmits the power to the main drive gear and the sprocket.

2nd Gear

Second gear is engaged when the dog ring between countershaft 1st and 2nd 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 the dog ring between countershaft 1st and 2nd to its neutral position, while another fork engages the dog ring between countershaft 3rd and 4th with countershaft 3rd. This locks countershaft 3rd to the countershaft to complete the power flow as shown.

4th Gear

Fourth gear is engaged when the dog ring between countershaft 3rd and 4th is shifted out of countershaft 3rd and engages countershaft 4th. This locks countershaft 4th to the countershaft to complete the power flow as shown.

5th Gear

Two shifter forks are used to make the shift from fourth to fifth. One fork moves the dog ring between countershaft 3rd and 4th to its neutral position, while another fork engages the dog ring between mainshaft 5th and 6th with mainshaft 5th. This locks mainshaft 5th to the mainshaft to complete the power flow as shown.

6th Gear

The shift from fifth to sixth gear occurs when the dog ring between mainshaft 5th and 6th is shifted out of mainshaft 5th, and is shifted directly into the main drive gear (6th gear). The main drive gear is locked to the mainshaft resulting in a direct one-to-one drive ratio from the clutch to the sprocket.

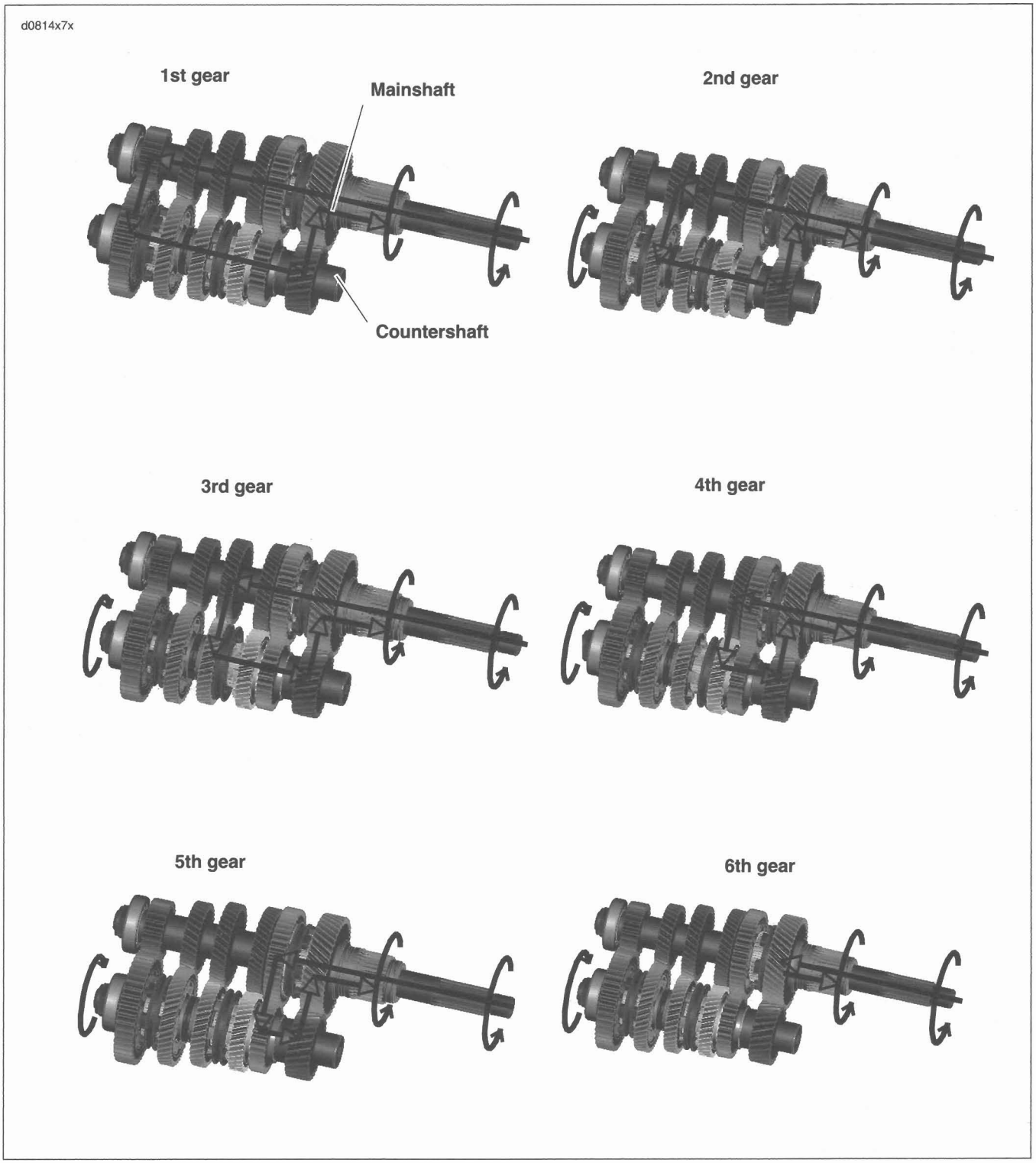


Figure 7-1. Transmission Power Flow

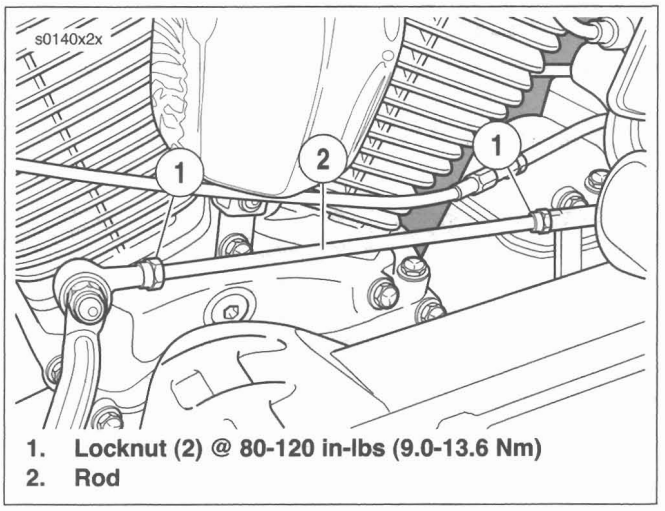
SHIFTER LINKAGE ADJUSTMENT

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.



1. **Locknut (2) @ 80-120 in-lbs (9.0-13.6 Nm)**
2. **Rod**

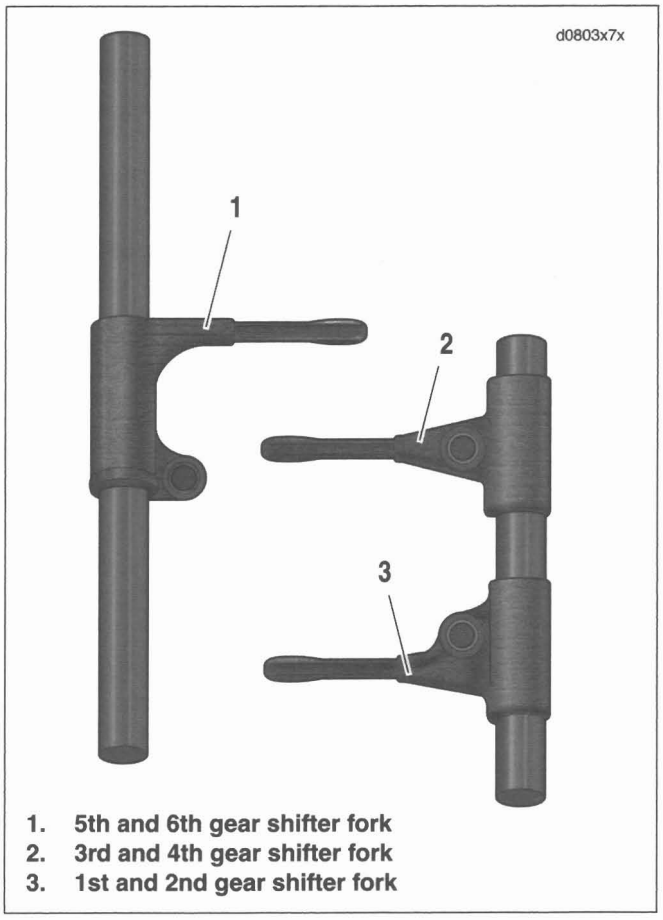
Figure 7-2. Shifter Rod

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.
2. Check the shifter fork shafts and replace it if bent or damaged.
3. See Figure 7-4. 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. Refer to table at beginning of section for shifter fork wear limits.



1. 5th and 6th gear shifter fork
2. 3rd and 4th gear shifter fork
3. 1st and 2nd gear shifter fork

Figure 7-3. Shift Forks

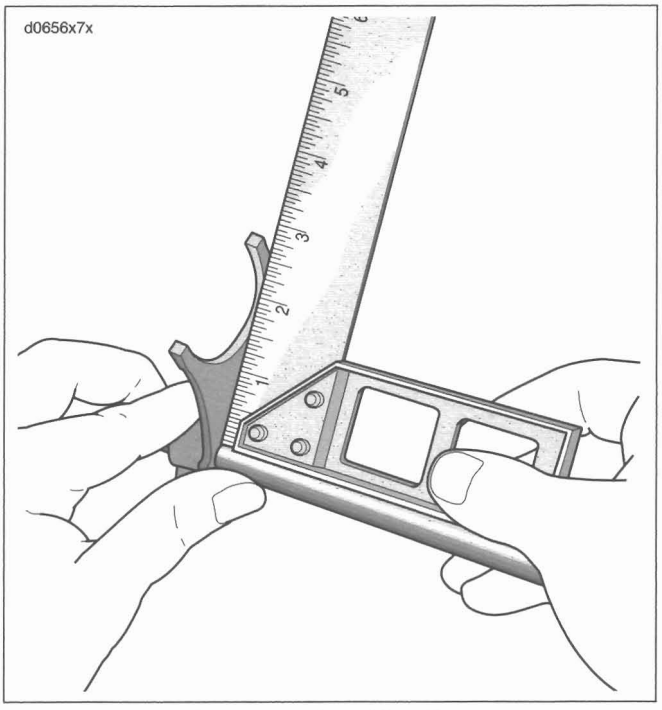


Figure 7-4. Checking Fork

REMOVAL/DISASSEMBLY

1. Drain transmission. See 1.13 TRANSMISSION LUBRICANT.

NOTE

Actuating the clutch hand lever after removing the six screws will help break the cover free.

2. See Figure 7-5. Remove the six screws that hold the clutch release cover in place. Remove the clutch release cover and discard the gasket.

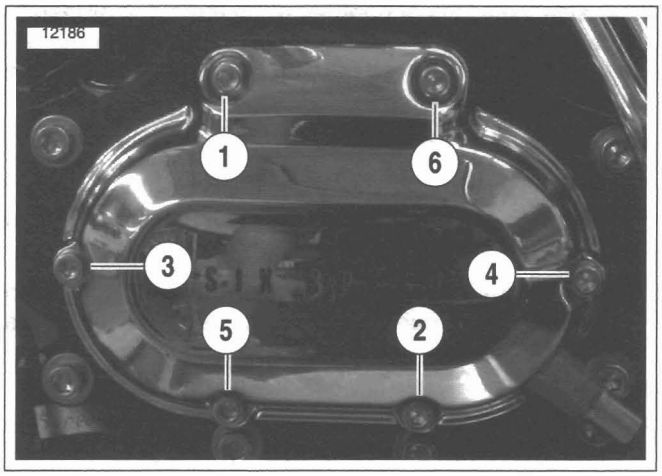


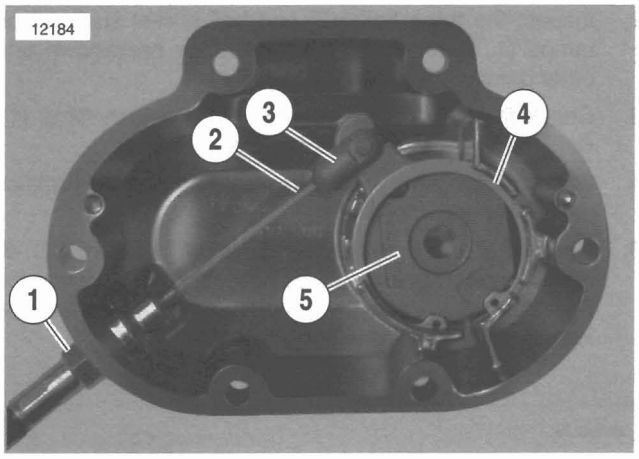
Figure 7-5. Cover Screws

3. Loosen clutch cable adjuster so clutch cable is slack. See 1.12 CLUTCH.

⚠WARNING

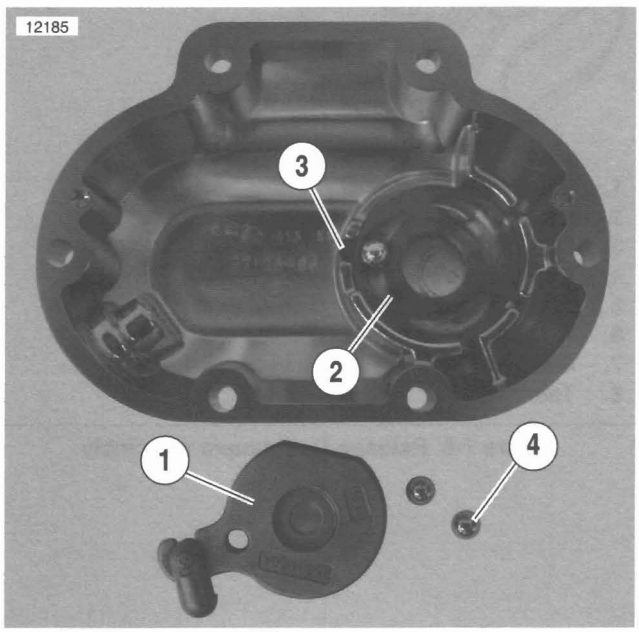
Wear safety glasses or goggles when removing or installing retaining rings. Retaining rings can slip from the pliers and could be propelled with enough force to cause serious eye injury. (00312a)

4. See Figure 7-6. Note position of retaining ring opening. Remove retaining ring (4). Lift inner ramp (5) and ramp coupling (3) out of clutch release cover. Disconnect clutch cable end (2) from the ball and ramp coupling.
5. Unscrew cable fitting (1) from clutch release cover.
6. See Figure 7-7. Remove balls (4) and outer ramp (2). Continue with CLEANING AND INSPECTION in this section.



1. **Cable fitting**
2. **Clutch cable end**
3. **Ramp coupling**
4. **Retaining ring**
5. **Inner ramp**

Figure 7-6. Clutch Cable Connection

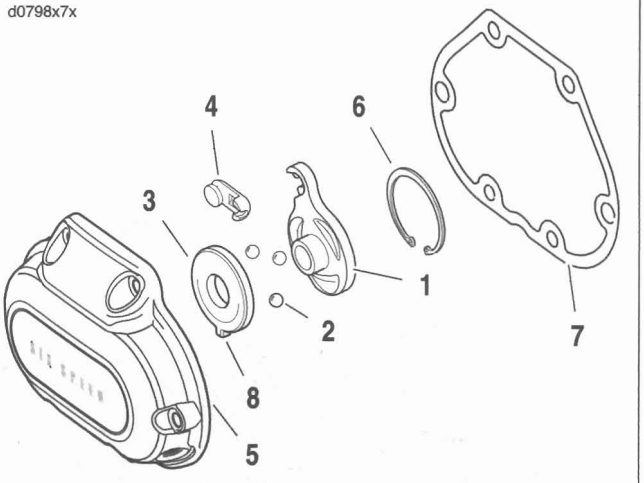


1. **Inner ramp**
2. **Outer ramp**
3. **Outer ramp tab**
4. **Balls (3)**

Figure 7-7. Coupling and Ramp Assembly

CLEANING AND INSPECTION

1. See Figure 7-8. Wash the ball and ramp mechanism components in cleaning solvent.
2. Inspect the three balls (2) and ball socket surfaces on ramps (1, 3) for wear, pitting, surface breakdown and other damage. Replace damaged parts.
3. 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.
5. Check the bore in the cover (5) where the ramps (1, 3) are retained. There should be no wear. Lips worn into the bore that would catch the ramps and cock them, causing improper clutch adjustment.



1. **Inner ramp**
2. **Balls (3)**
3. **Outer ramp**
4. **Ramp coupling**
5. **Clutch release cover**
6. **Retaining ring**
7. **Gasket**
8. **Tab**

Figure 7-8. Release Mechanism Assembly

ASSEMBLY/INSTALLATION

NOTE

Replace cable fitting O-ring if damaged or deformed.

1. See Figure 7-6. Screw clutch cable fitting (1) into clutch release cover. Do not tighten at this time.
2. See Figure 7-8. Place outer ramp (3) in clutch release cover and place balls (2) in slots. Be sure tab (8) is in clutch release cover slot.
3. 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 7-7. Retaining ring opening must be installed to the right of the outer ramp tab slot.

5. See Figure 7-5. Install **new** gasket and replace clutch release cover. Tighten all six screws to 84-108 **in-lbs** (9.5-12.2 Nm).
6. Tighten clutch cable fitting to 36-60 **in-lbs** (4.1-6.8 Nm).
7. Fill transmission to proper level with fresh transmission fluid. See 1.13 TRANSMISSION LUBRICANT.
8. Adjust clutch cable. See 1.12 CLUTCH.

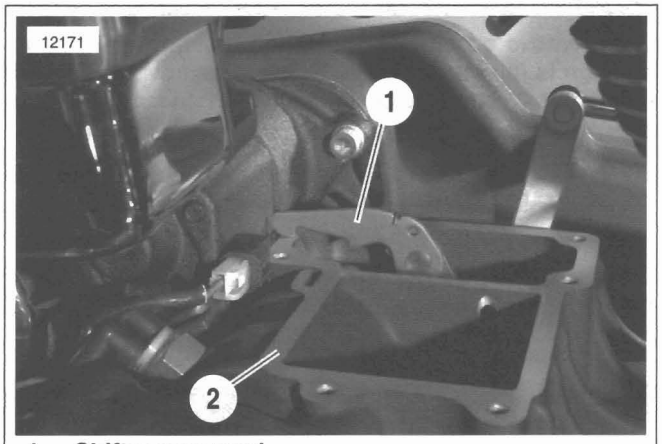
REMOVAL

PART NO.	SPECIALTY TOOL
HD-34902-B	Bearing race puller and installation tool

NOTE

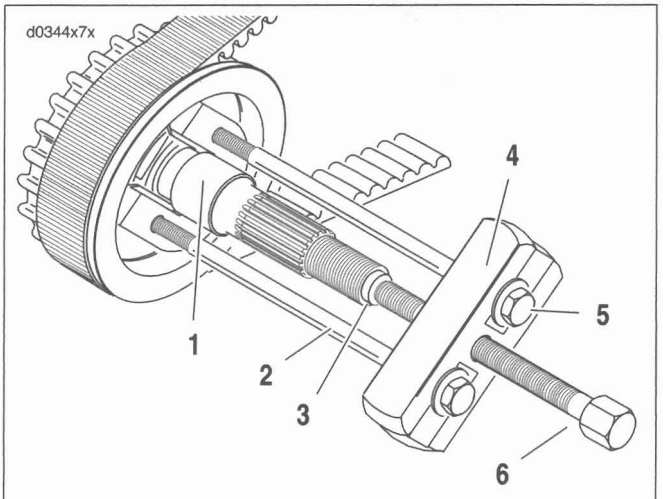
Leave the transmission case in the frame unless the case itself requires replacement. For illustration purposes, some photographs may show the case removed. For information on case removal see 7.7 TRANSMISSION CASE.

1. Drain fluids from primary housing. When drained, drain fluids from transmission.
2. Remove exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF,4.18 EXHAUST SYSTEM: FLSTN, or 4.19 EXHAUST SYSTEM: FLSTSC.
3. Remove primary cover, clutch assembly and primary chaincase. See PRIMARY CHAINCASE HOUSING under 6.2 PRIMARY CHAINCASE.
4. See Figure 7-9. Remove transmission top cover, place shifter cam pawl (1) on top cover gasket surface (2).
5. See Figure 7-10. Remove the bearing inner race from the transmission mainshaft using BEARING RACE PULLER AND INSTALLATION TOOL (Part No. HD-34902-B).
6. Remove the side cover from the transmission side door. See 7.4 TRANSMISSION CLUTCH RELEASE COVER.



1. **Shifter cam pawl**
2. **Top cover gasket surface**

Figure 7-9. Pulling Mainshaft Inner Bearing Race



1. **Bearing inner race**
2. **Leg**
3. **Pilot**
4. **Center disc**
5. **Nut**
6. **Puller screw**

Figure 7-10. Pulling Mainshaft Inner Bearing Race

7. See Figure 7-11. Remove oil slinger assembly from mainshaft.

CAUTION

Only remove and install mainshaft locknut while transmission is in vehicle frame. Trying to remove and install mainshaft locknut with transmission in transmission stand may cause damage to transmission or stand.

8. If main drive gear (1, Figure 7-55.) is to be removed, see 7.6 MAIN DRIVE GEAR AND BEARING.

NOTE

The main drive gear bearing and retainer must be replaced if the main drive gear is removed. The bearing will be damaged during the removal procedure.

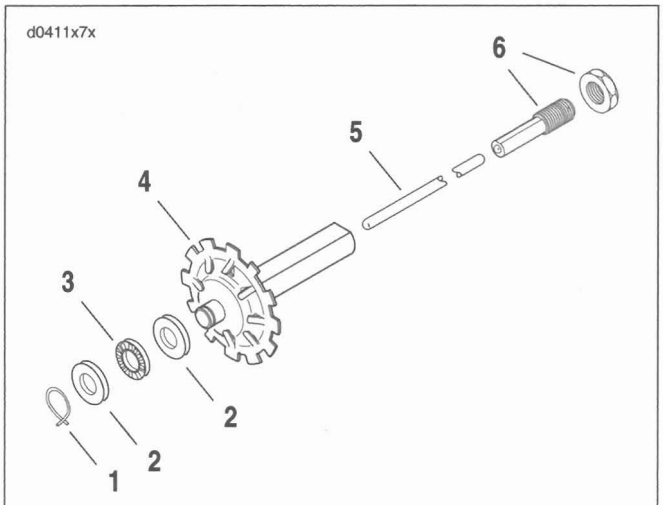
CAUTION

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.

CAUTION

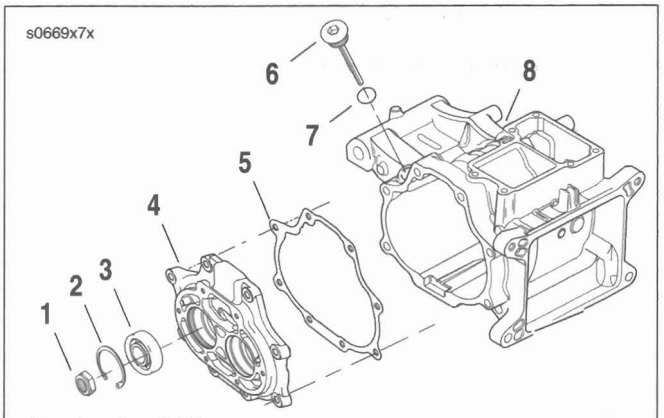
Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear bearings.

9. See Figure 7-13. Remove the transmission side door mounting hardware. Pry the side door loose and remove side door, mainshaft, countershaft and shifter cam from transmission case as an assembly. Discard gasket.



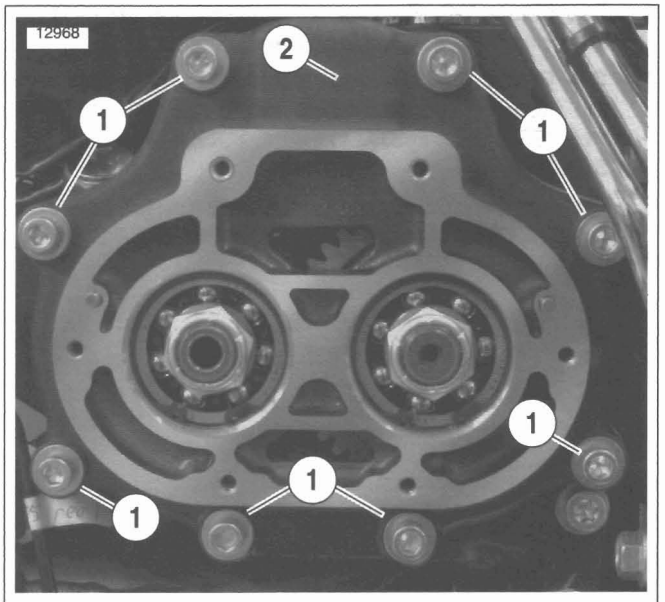
1. Retaining ring
2. Thrust washer (2)
3. Throw out bearing
4. Oil slinger
5. Push rod
6. Push rod end, left side

Figure 7-11. Push Rod Assembly



1. Locknut (2)
2. Retaining ring
3. Bearing
4. Side door
5. Side door gasket
6. Transmission dipstick
7. O-ring
8. Transmission case

Figure 7-12. Side Door Bearings



1. Bolt @
   13-18 ft-lbs (17.6-24.4 Nm)
2. Side door

Figure 7-13. Side Door Hardware

DISASSEMBLY

PART NO.	SPECIALTY TOOL
J-5586-A	Retaining ring pliers

1. See Figure 7-11. Remove the push rod (5) from the hole in the mainshaft.
2. See Figure 7-14. In next step use of a screw extractor is employed to remove shift shafts.
3. See Figure 7-18. With access door on end (shafts pointing upward), Remove shift fork shafts using easy out twist extractor–not flute design. Shafts have slight interference fit. Shafts can be reused, do not damage end of shaft. Mark end of shaft so same end can be reinserted during reassembly.
4. Remove shift forks from shafts. Inspect shift forks. See CLEANING AND INSPECTION under 7.3 SHIFTER FORKS.
5. See Figure 7-19. Remove lock plate fasteners from lock plate. Discard fasteners.
6. See Figure 7-20. Insert screwdriver (1) and gently pry back detent arm (4) to remove detent spring (3) tension from shift cam (5). Remove shift cam.
7. Inspect shift drum and bearing, Replace shift drum assembly if drum or bearing are damaged.
8. Clean shift cam lock plate mounting holes in transmission bearing housing.
9. See Figure 7-16. If servicing detent assembly:
   a. Remove detent screw (1), detent arm (2), sleeve (3), and detent spring (4). Discard detent screw.
   b. Clean detent screw mounting hole in transmission side door.
   c. Assemble **new** detent screw, detent arm, sleeve and detent spring. Mount detent assembly in bearing housing as shown. Make certain to orient spring and detent arm as shown in the figure. Tighten screw to 120-150 **in-lbs** (13.6-17.0 Nm).

NOTE

Although many transmission parts can be installed in either direction, make sure parts are installed in same direction as removal.

10. Using dog rings, lock two gears in place. Temporarily place transmission assembly into transmission case.
11. See Figure 7-15. Remove mainshaft and countershaft locknuts.
12. Remove transmission assembly from transmission case.
13. See Figure 7-21. Remove retaining ring. Remove dog ring (3), guiding hub (2), mainshaft 5th gear (4) and bearing.

NOTE

If removing countershaft only, hold countershaft 3rd and 4th gear shift dog up while pressing countershaft out of side door bearings.

14. Place transmission assembly in arbor press and press mainshaft out of side door bearings.
15. Press countershaft out of side door bearings.
16. See Replacing Side Door Bearings in this section for side door bearing replacement.

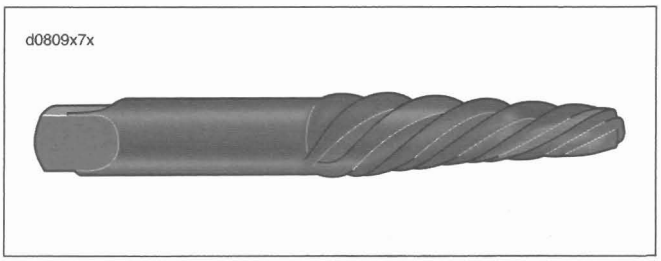
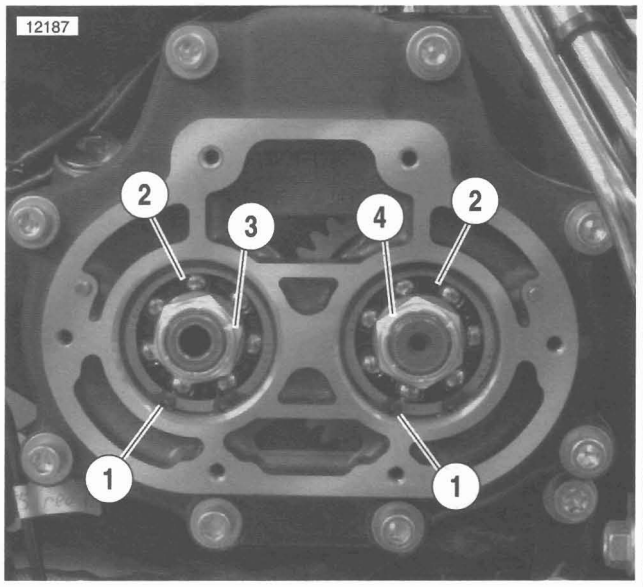
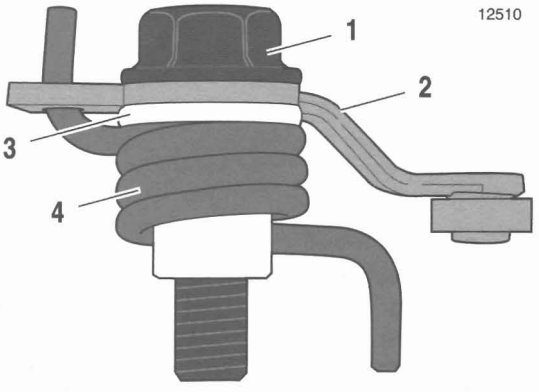


Figure 7-14. Screw Extractor



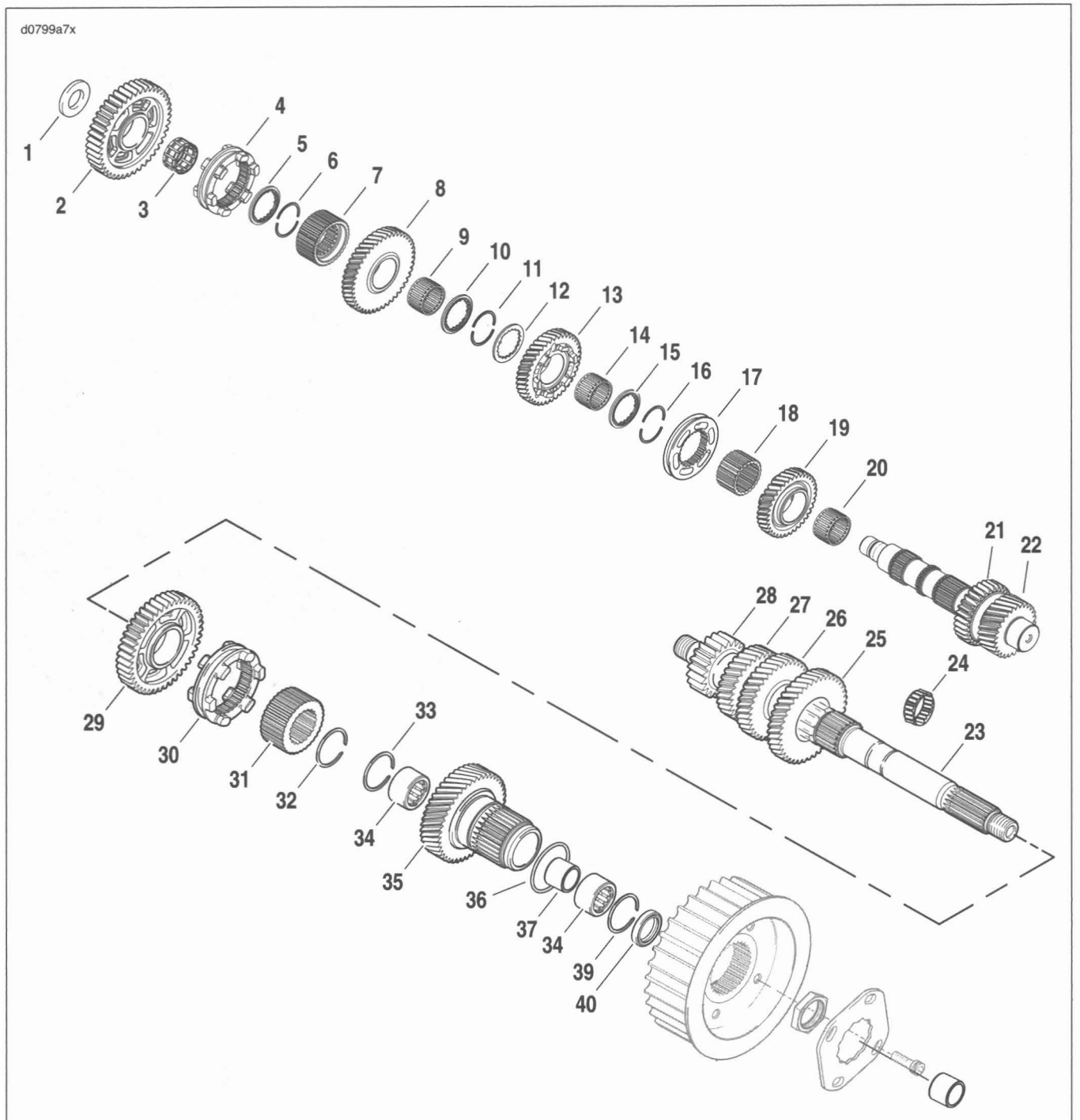
1. **Retaining ring (2)**
2. **Bearing (2)**
3. **Mainshaft locknut**
4. **Countershaft locknut**

Figure 7-15. Side Door Locknuts



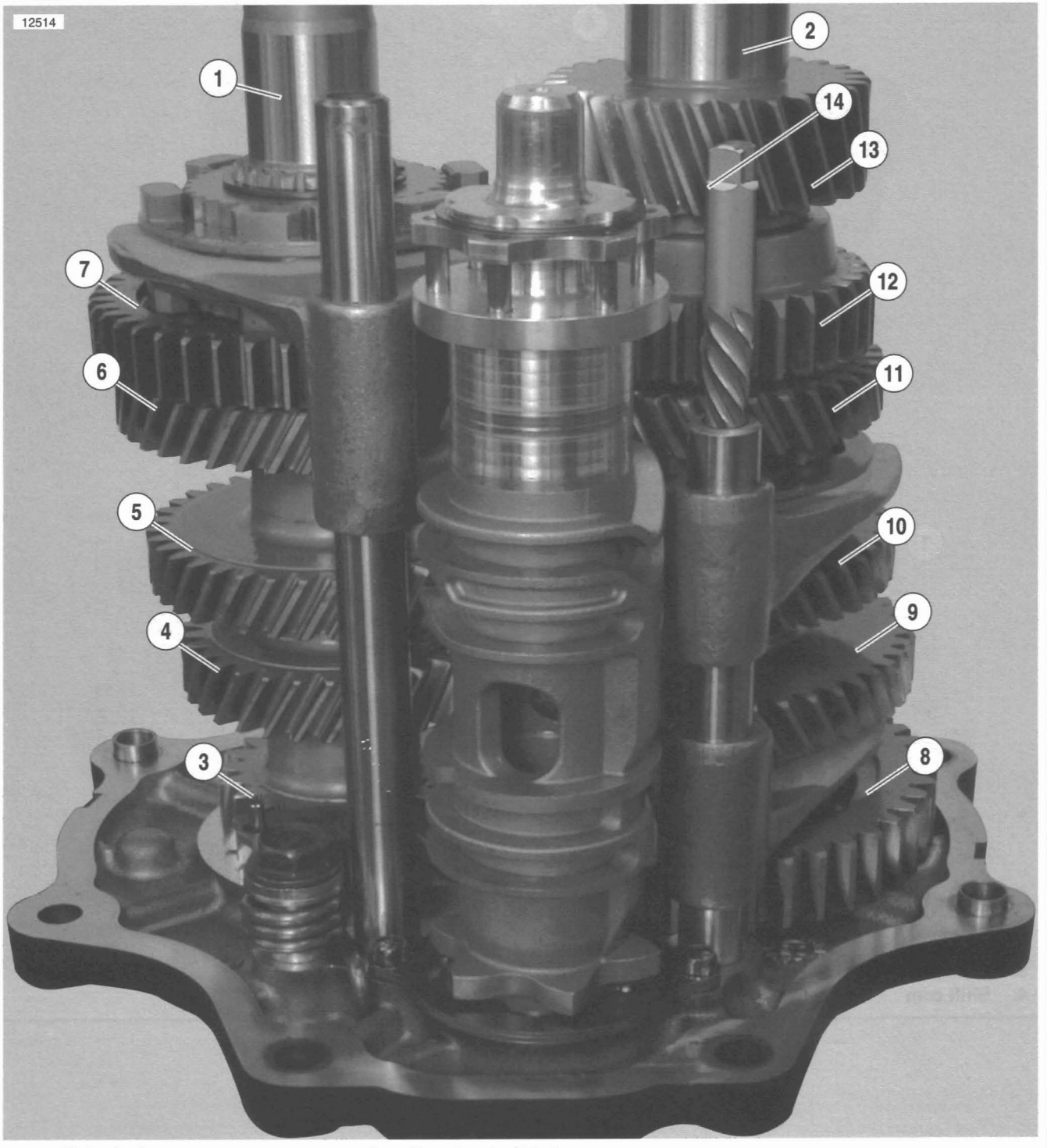
1. **Detent screw**
2. **Detent arm**
3. **Sleeve**
4. **Detent spring**

Figure 7-16. Detent assembly



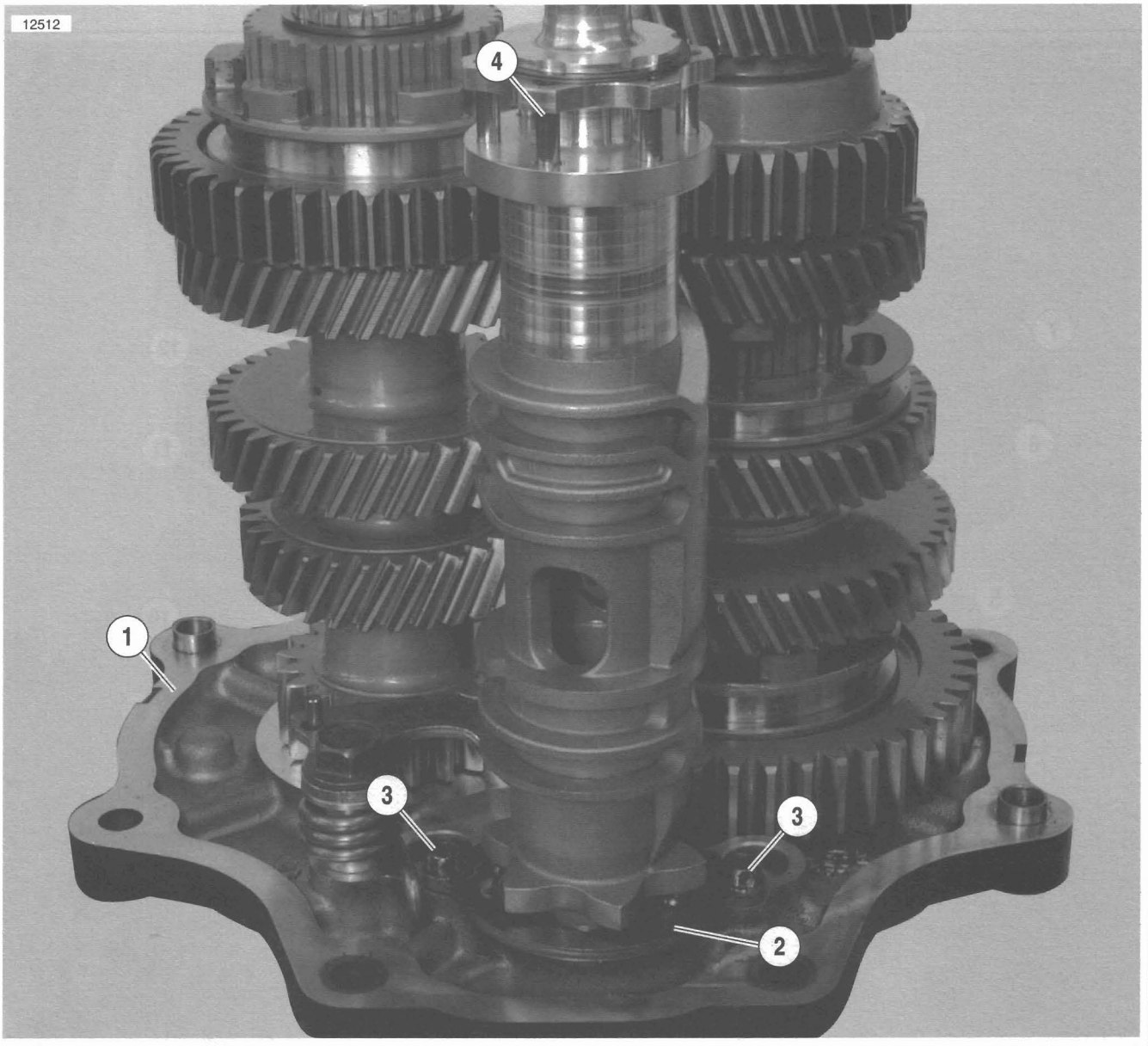
1. Spacer
2. Countershaft 1st gear
3. Bearing
4. Dog ring
5. Lock ring
6. Securing segment (2)
7. Guiding hub
8. Countershaft 2nd gear
9. Bearing
10. Lock ring
11. Securing segment (2)
12. Internal spline washer
13. Countershaft 3rd gear
14. Bearing
15. Lock ring
16. Securing segment (2)
17. Dog ring
18. Guiding hub
19. Countershaft 4th gear
20. Bearing
21. Countershaft 5th gear (part of countershaft)
22. Countershaft 6th gear (part of countershaft)
23. Mainshaft
24. Bearing
25. Mainshaft 4th gear
26. Mainshaft 3rd gear
27. Mainshaft 2nd gear
28. Mainshaft 1st gear
29. Mainshaft 5th gear
30. Dog ring
31. Guiding hub
32. Retaining ring
33. Retaining ring
34. Main drive gear bearing (2)
35. Main drive gear
36. O-ring
37. Bearing spacer
38. Retaining ring
39. Oil seal

Figure 7-17. Mainshaft/Countershaft Assembly



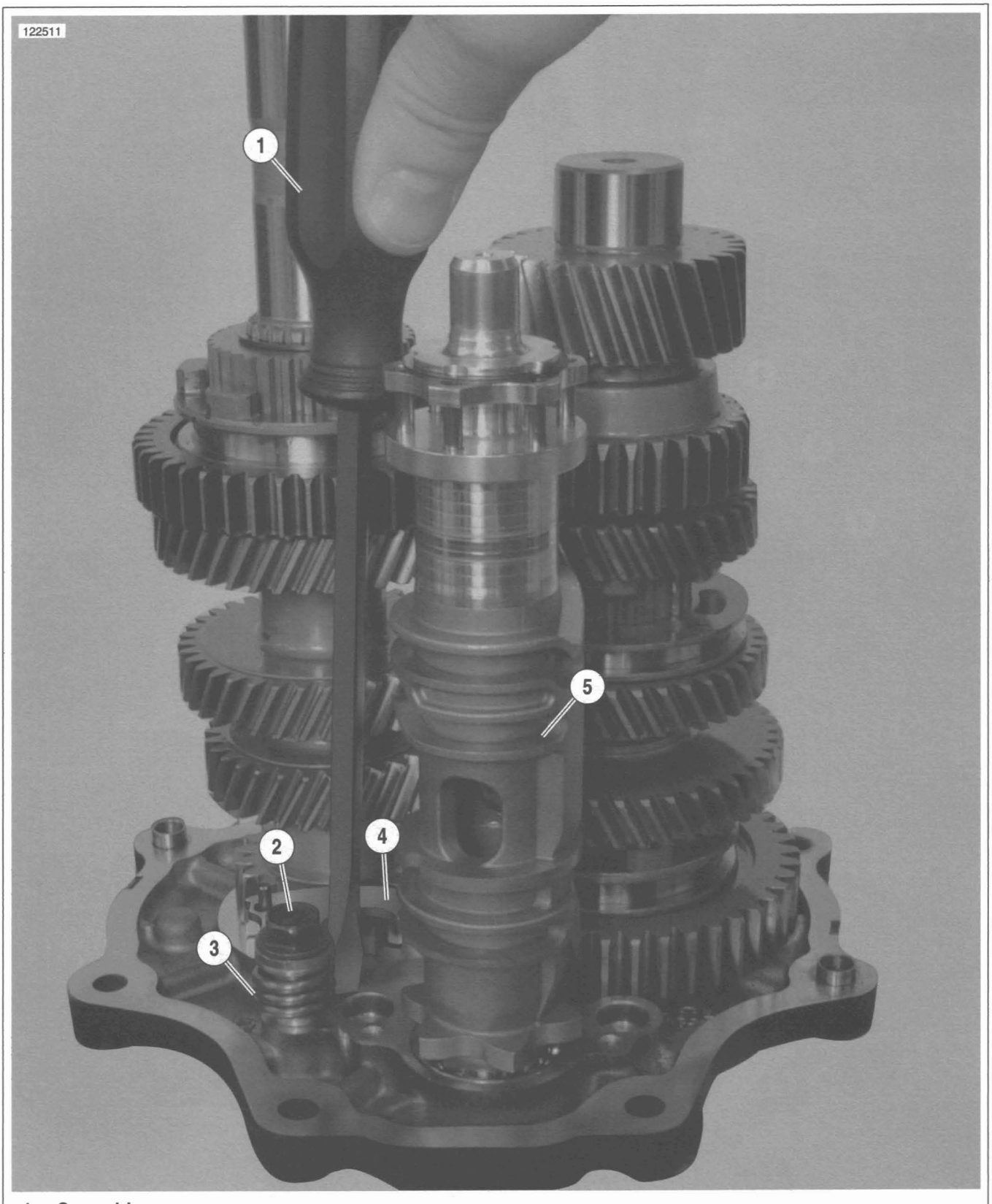
1. Mainshaft
2. Countershaft
3. Mainshaft 1st gear
4. Mainshaft 2nd gear
5. Mainshaft 3rd gear
6. Mainshaft 4th gear
7. Mainshaft 5th gear
8. Countershaft 1st gear
9. Countershaft 2nd gear
10. Countershaft 3rd gear
11. Countershaft 4th gear
12. Countershaft 5th gear
13. Countershaft 6th gear
14. Screw extractor

Figure 7-18. Gear Set



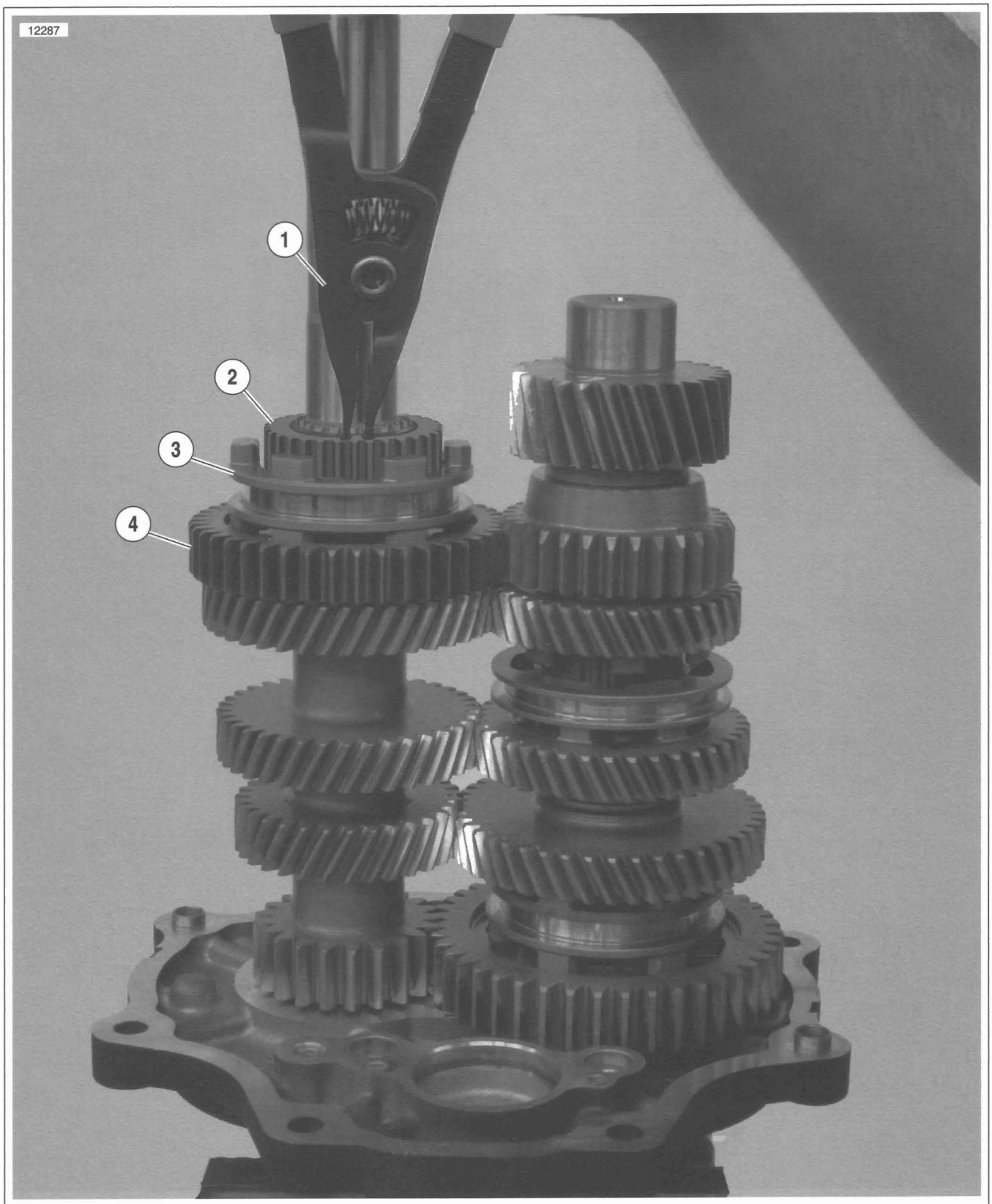
1. Side door
2. Lock plate
3. Lock plate fastener
4. Shift cam

Figure 7-19. Shift Drum



1. Screwdriver
2. Detent fastener
3. Detent spring
4. Detent arm
5. Shift cam

Figure 7-20. Detent Assembly

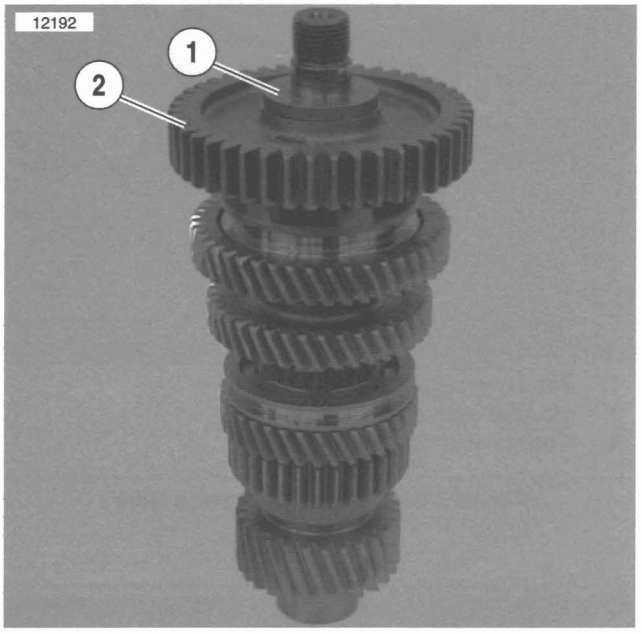


1. Retaining ring pliers
2. Guiding hub
3. Dog ring
4. Mainshaft 5th gear

Figure 7-21. Mainshaft Retaining Ring

Countershaft

1. See Figure 7-22. Remove washer (1), countershaft 1st gear (2) and bearing.
2. See Figure 7-23. Remove countershaft 2nd gear lock ring.
3. See Figure 7-24. Remove securing segments (1). Remove dog ring (3), guiding hub (2), countershaft 2nd gear (4) and bearing.



1. Washer
2. Countershaft 1st gear

Figure 7-22. Countershaft 1st Gear

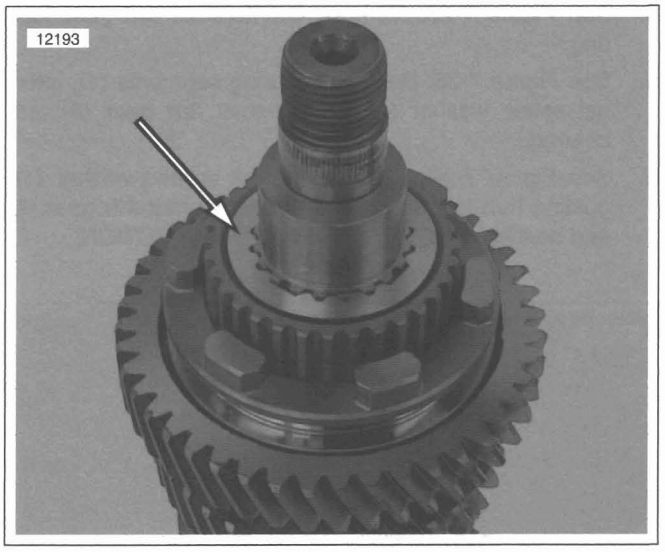
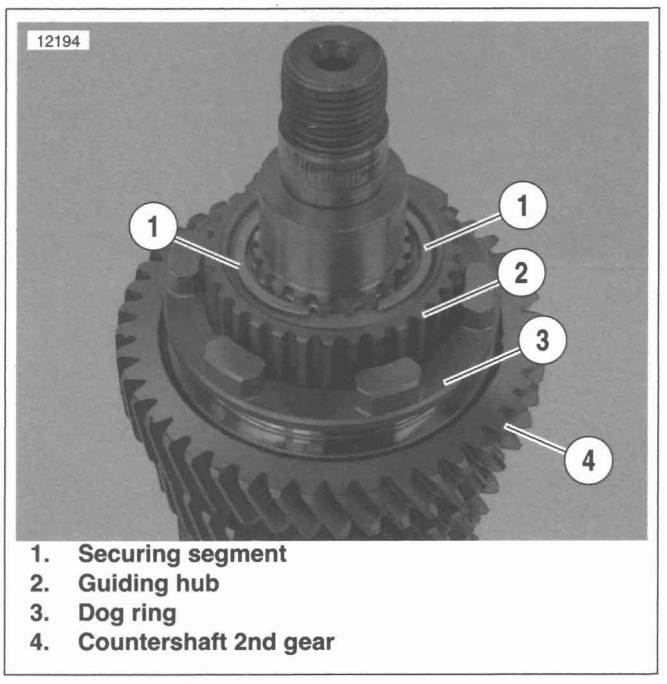


Figure 7-23. Lock Ring



1. Securing segment
2. Guiding hub
3. Dog ring
4. Countershaft 2nd gear

Figure 7-24. Securing Segment

4. See Figure 7-25. Remove countershaft 3rd gear lock ring.
5. See Figure 7-26. Remove securing segments (1), internal spline washer (2), countershaft 3rd gear (3) and bearing
6. See Figure 7-27. Remove internal splined washer (1), guiding hub (2), dog ring (3), countershaft 4th gear (4) and bearing. See CLEANING AND INSPECTION.

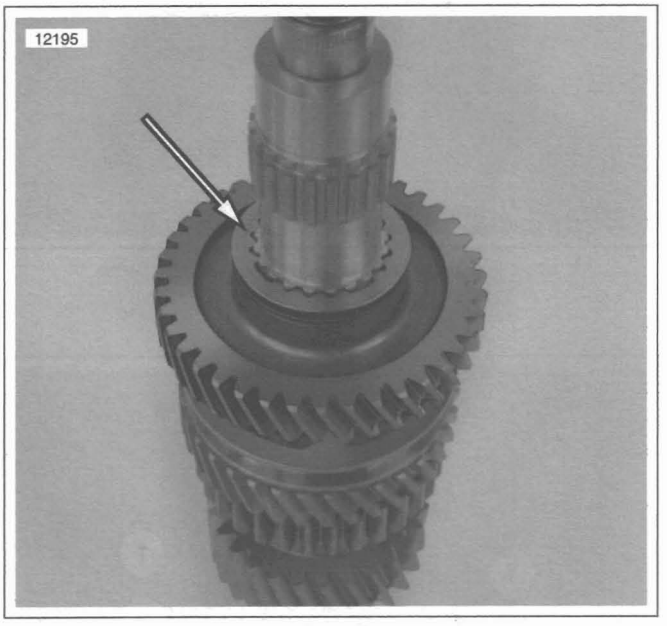
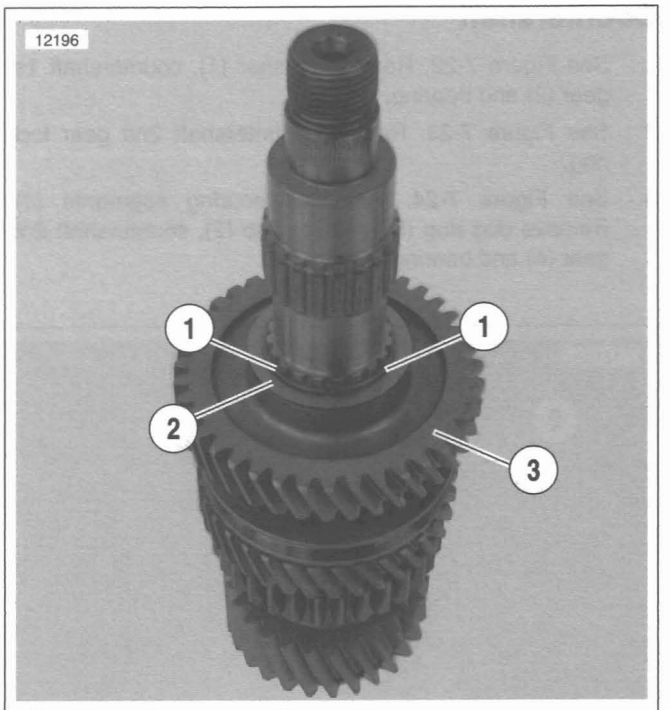
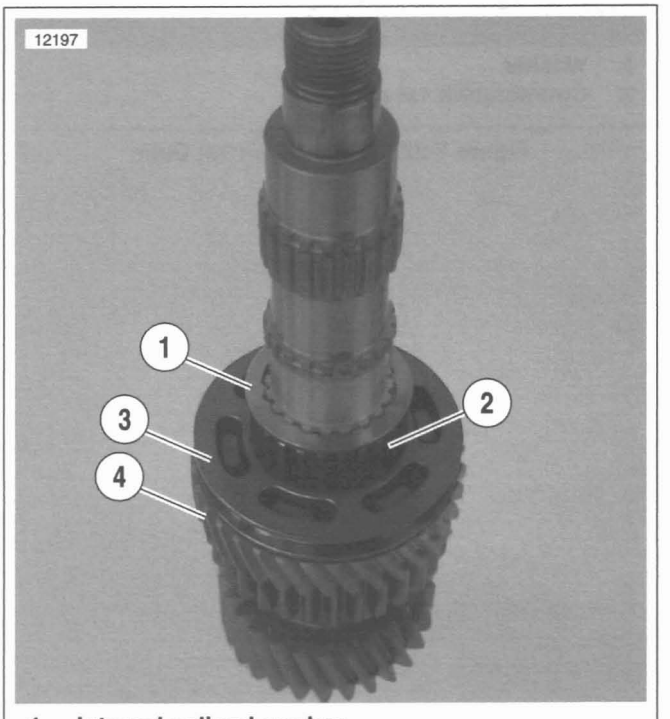


Figure 7-25. Third Gear Lock Ring



1. **Securing segment**
2. **Internal spline washer**
3. **Countershaft 3rd gear**

Figure 7-26. Countershaft Third Gear



1. **Internal splined washer**
2. **Guiding hub**
3. **Dog ring**
4. **Countershaft 4th gear**

Figure 7-27. Countershaft Assembly

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.
2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.
3. Inspect the engaging dogs and pockets on the dog rings. Replace the dog rings if dogs and/or pockets are rounded, battered or chipped.
4. Inspect guiding hubs. Replace guiding hubs if splines are rounded, battered or chipped.
5. Inspect shift forks. Replace a shift fork if it is excessively worn or shows signs of overheating.

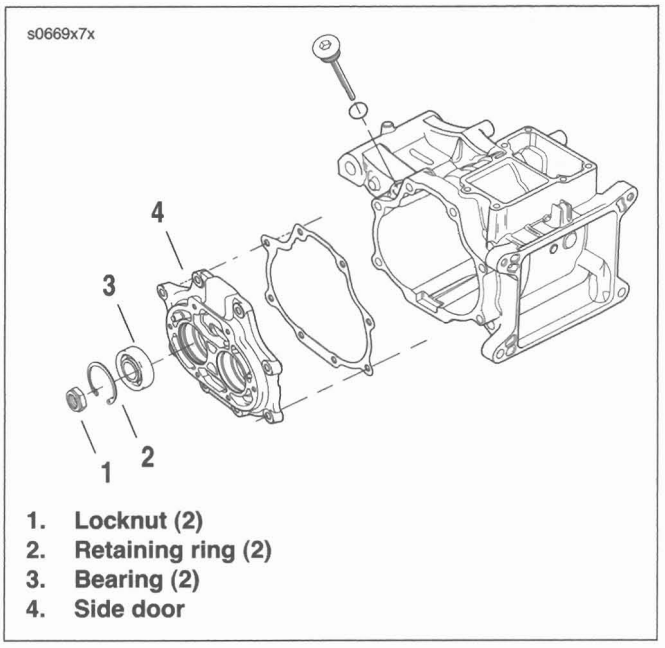
Replacing Side Door Bearings

1. See Figure 7-28. Remove the retaining rings (2) 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 (2) with the flat side next to the bearing.



1. **Locknut (2)**
2. **Retaining ring (2)**
3. **Bearing (2)**
4. **Side door**

Figure 7-28. Side Door Bearings

ASSEMBLY

PART NO.	SPECIALTY TOOL
J-5586-A	Retaining ring pliers

NOTES

- *Replace retaining ring and all gear roller bearings with **new** parts during assembly.*
- *One side of the lock rings have a stepped face. The stepped face always faces the securing segments.*

1. See Figure 7-27. Install bearing, countershaft 4th gear (4), guiding hub (2), dog ring (3) securing segments and lock ring (1) on countershaft.
2. See Figure 7-26. Install bearing, countershaft 3rd gear (3), internal spline washer (2) and securing segments (1).
3. See Figure 7-25. Place countershaft 3rd gear lock ring over securing segments.

NOTES

- *In next step, the side of the guiding hub with the deeper counterbore, faces countershaft 2nd gear.*
- *Countershaft 2nd gear bearing is wider than other bearings on the countershaft*

4. See Figure 7-24. Install bearing, countershaft 2nd gear (4), guiding hub (2), dog ring (3) and securing segments (1) on countershaft.
5. See Figure 7-23. Place lock ring over securing segments.
6. See Figure 7-22. Install bearing, countershaft 1st gear (2) and washer (1).

CAUTION

Failure to press on inner bearing races while pressing bearings on the shafts will damage the bearings.

NOTE

If installing countershaft only, hold countershaft 3rd and 4th gear shift dog up while pressing side door bearing on to countershaft.

7. See Figure 7-29. Place countershaft in an arbor press supporting countershaft 6th gear. Using a suitable socket, press on inner bearing race until side door bearing contacts countershaft 1st gear washer. The mainshaft is installed to the left of the transmission top cover access cover hole when viewing the side door from the top.
8. Place mainshaft in an arbor press, supporting mainshaft 4th gear.
9. Place rear side door bearing over mainshaft. Using a suitable socket, press on inner bearing race until side door bering contacts mainshaft 1st gear.
10. See Figure 7-21. With side door on end (shafts pointing upward), install bearing and mainshaft 5th gear (4).
11. Be sure guiding hub counterbore is facing mainshaft 5th gear and install guiding hub (2) and dog ring (3).
12. Install retaining ring using retaining ring pliers (1).

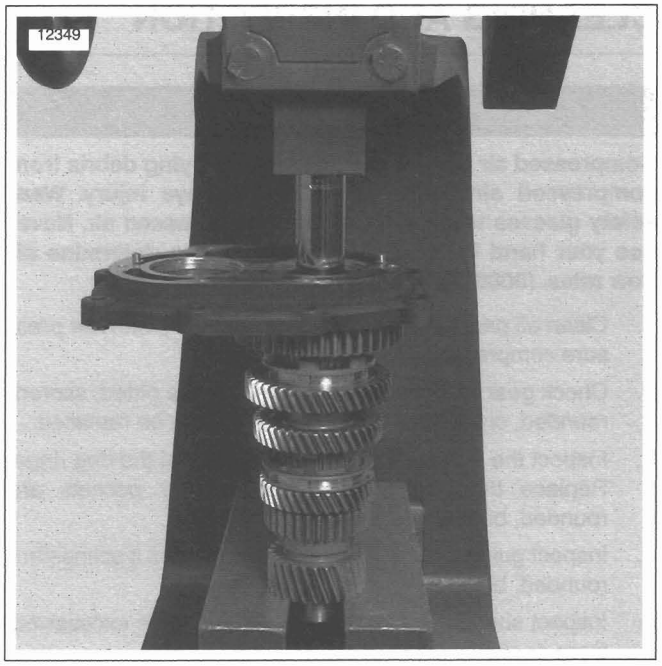
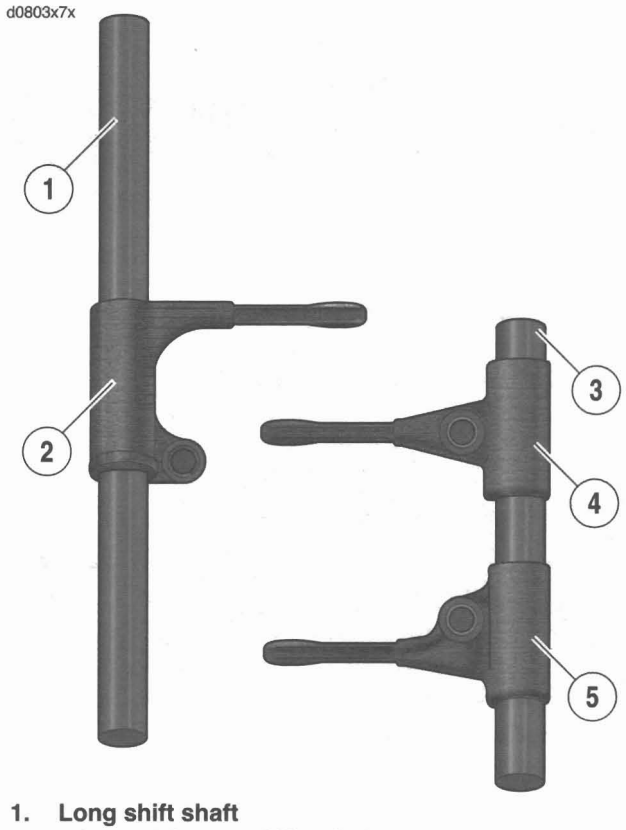


Figure 7-29. Installing Countershaft

13. Using dog rings, lock two gears in place. Temporarily place transmission assembly into transmission case.
14. Install **new** nut on each shaft. Tighten nuts to 45-55 ft-lbs (61.0-74.6 Nm).
15. Remove transmission assembly from case.
16. See Figure 7-21. Place side door on end (shafts pointing upward).
17. See Figure 7-20. Using screwdriver (1), pull detent arm back to allow installation of shift cam assembly.
18. Install shift cam assembly.
19. See Figure 7-19. Install lock plate (2) and new lock plate fasteners (3). Tighten fasteners to 57-63 **in-lbs** (6.4-7.1 Nm).
20. See Figure 7-30. The forks are different from each other and are identified as shown.
21. See Figure 7-31. Insert shifter fork (2) into the slot of the dog ring in between mainshaft 5th and 6th gear. Slide long shift shaft through 5th and 6th gear shifter fork and install shaft in hole in side door.
22. Insert shifter fork (6) into the slot of the dog ring in between countershaft 3rd and 4th gear. Insert shifter fork (9) into the slot of the dog ring in between countershaft 1st and 2nd gear. Slide short shift shaft through countershaft shifter forks and install shaft in hole in side door.

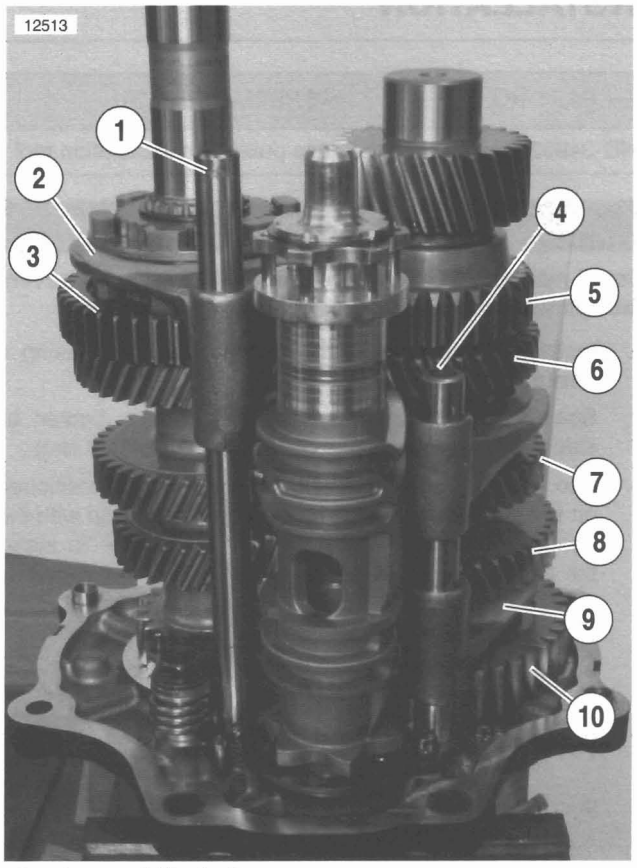
NOTE

If main drive gear was removed, install it now. See 7.6 MAIN DRIVE GEAR AND BEARING.



1. **Long shift shaft**
2. **5th and 6th gear shifter fork**
3. **Short shift shaft**
4. **3rd and 4th gear shifter fork**
5. **1st and 2nd gear shifter fork**

Figure 7-30. Shifter Forks



1. **Long shift shaft**
2. **5th and 6th gear shifter fork**
3. **5th gear**
4. **Short shift shaft**
5. **4th gear**
6. **3rd and 4th gear shifter fork**
7. **3rd gear**
8. **2nd gear**
9. **1st and 2nd gear shifter fork**
10. **1st gear**

Figure 7-31. Shifter Forks

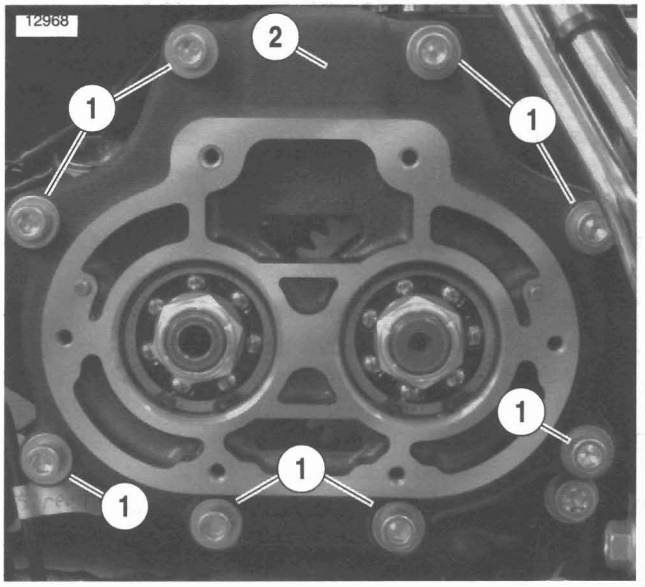
INSTALLATION

PART NO.	SPECIALTY TOOL
HD-34902-B	Bearing race puller and installation tool

CAUTION

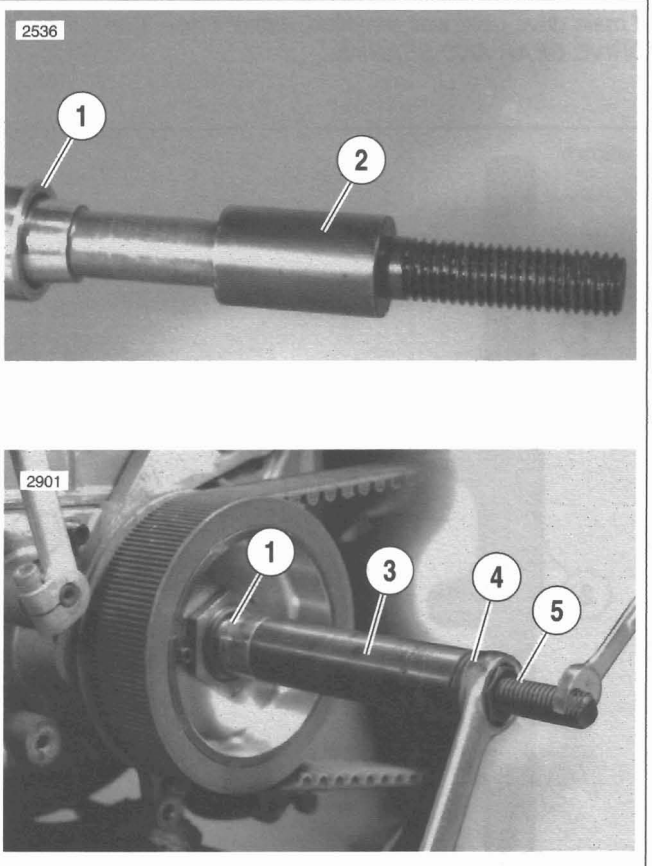
Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear oil seal.

1. Install the assembly in the transmission case using a **new** gasket.
2. See Figure 7-32. Using crosswise pattern, tighten all side door hardware (1) to 13-18 ft-lbs (17.6-24.4 Nm).
3. See Figure 7-33. 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).
   d. Place washer (4) over threaded portion of sleeve pilot (2) and install nut (5).
   e. 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 0.100-0.125 in. (2.540-3.180 mm) from main drive gear.



1. **Bolt @ 13-18 ft-lbs (17.6-24.4 Nm)**
2. **Side door**

Figure 7-32. Side Door Hardware



1. **Bearing inner race**
2. **Sleeve pilot**
3. **Sleeve**
4. **Washer**
5. **Nut**

Figure 7-33. Installing Bearing Race

4. See Figure 7-11. Install push rod assembly (2-5) in mainshaft hole. Secure with **new** retaining ring (1) if removed.

NOTE

The two top side cover fasteners are shorter in length than the others.

5. Install the side cover, using a **new** gasket. See 7.4 TRANSMISSION CLUTCH RELEASE COVER.
6. Remove shfter cam pawl from top cover gasket surface and place on shift cam. Install **new** transmission top cover gasket. Install transmission top cover. Install top cover fasteners and tighten to 84-132 **in-lbs** (9.5-14.9 Nm).
7. Install transmission sprocket nut. See 6.5 TRANSMISSION SPROCKET.
8. 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.

9. Replace O-ring on plug. 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.
11. Install exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF,4.18 EXHAUST SYSTEM: FLSTN, or 4.19 EXHAUST SYSTEM: FLSTSC.

REMOVAL

PART NO.	SPECIALTY TOOL
HD-35316-C	Main drive gear/bearing remover and installer

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-C).

1. See Figure 7-34. Remove retaining ring (6).

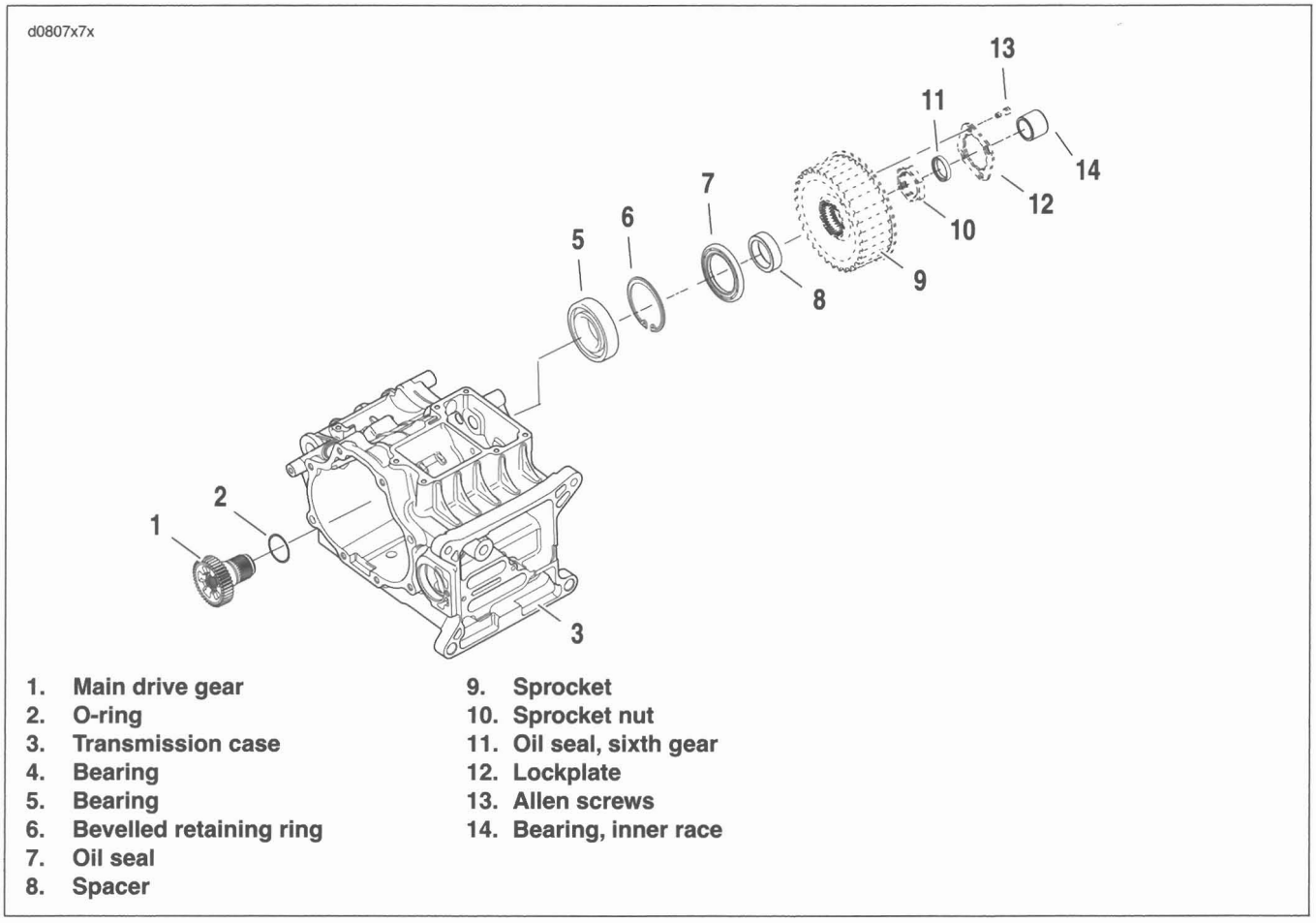
NOTE

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.

NOTE

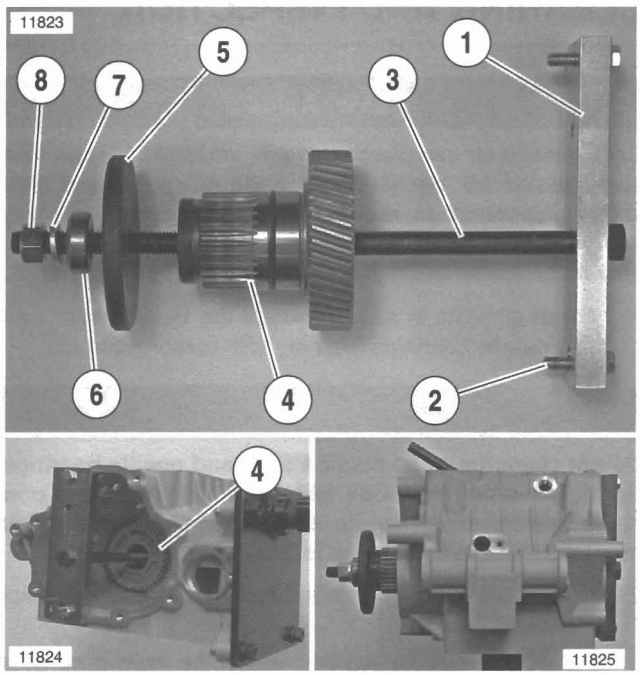
CROSS PLATE (Part No. HD-35316-3A) is stamped, "UP 6 SPEED". Mount cross plate with this end pointing up for 2007 Softail models.

2. See Figure 7-35. Place CROSS PLATE (Part No. HD-35316-3A) (1) on right side of transmission case as shown, and secure with two screws (2). Position cross plate so that large bolt hole in cross plate is lined up with center of main drive gear (4).
3. Insert 12 IN. BOLT (Part No. HD-35316-5) (3) through cross plate and main drive gear.
4. At left side of transmission case, place WASHER (Part No. HD-35316-7) (5), NICE BEARING (Part No. RS-25100-200) (6), FLAT WASHER (7) and NUT (8) over end of bolt. Tighten nut until main drive gear is free.



1. **Main drive gear**
2. **O-ring**
3. **Transmission case**
4. **Bearing**
5. **Bearing**
6. **Bevelled retaining ring**
7. **Oil seal**
8. **Spacer**
9. **Sprocket**
10. **Sprocket nut**
11. **Oil seal, sixth gear**
12. **Lockplate**
13. **Allen screws**
14. **Bearing, inner race**

Figure 7-34. Sprocket and Main Drive Gear



1. Cross plate (Part No. HD-35316-3A)
2. Screw (2)
3. 12 in. bolt (Part No. HD-35316-5)
4. Main drive gear
5. Washer (Part No. HD-35316-7)
6. Nice bearing (Part No. RS-25100-200)
7. Flat washer
8. Nut

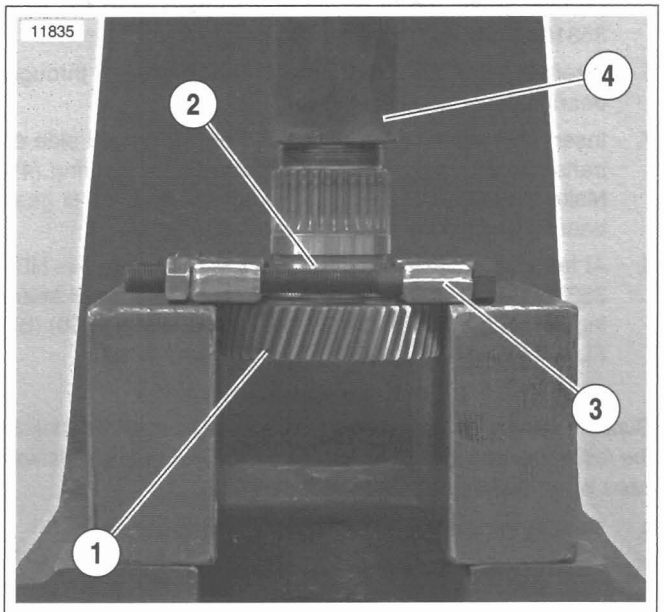
Figure 7-35. Removing Main Drive Gear

NOTES

- *When removing the main drive gear, the gear is pressed out against the resistance of the bearing inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing must also be replaced.*
- *See Figure 7-36. When the main drive gear is removed, a portion of the bearing inner race remains attached to the main drive gear. If the main drive gear is to be re-used, this inner race must be removed first.*

NOTE

If not already done, remove large main drive gear oil seal and retaining ring.



1. Main drive gear
2. Inner bearing race (not visible in this photo)
3. Bearing race puller (Part no. HD-95637-46B)
4. Press ram

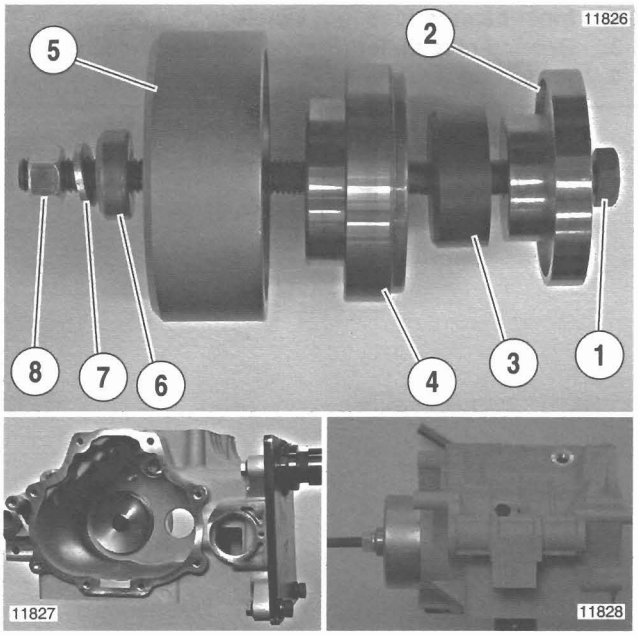
Figure 7-36. Removing Inner Bearing Race From Main Drive Gear

5. See Figure 7-37. Slide PILOT (Part No. HD-35316-10) (3) over small end of BEARING DRIVER (Part No. HD-35316-9) (2).
6. Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through bearing driver and pilot.
7. Insert bolt with bearing driver and pilot into right side of transmission case, through main drive gear bearing (4). Make sure bearing driver fits up against main drive gear bearing and pilot is centered in bearing bore.
8. At left side of case, slide RECEIVER CUP (Part No. HD-35316-11) (5) onto bolt and over main drive gear bearing. Install NICE BEARING (Part No. RS-25100-200) (6), FLAT WASHER (7) and NUT (8) over end of bolt.

NOTE

Support bearing remover assembly as you remove bearing in the following step. Entire assembly will fall out of transmission case when bearing comes free.

9. Tighten nut until main drive gear bearing is free.
10. Discard main drive gear bearing.



1. **8 in. Bolt (Part No. HD-35316-4A)**
2. **Bearing driver (Part No. HD-35316-9)**
3. **Pilot (Part No. HD-35316-10)**
4. **Main drive gear bearing**
5. **Receiver cup (Part No. HD-35316-11)**
6. **Nice bearing (Part No. RS-25100-200)**
7. **Flat washer**
8. **Nut**

Figure 7-37. Removing Main Drive Gear Bearing

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 in solvent except the transmission case and needle bearings. Blow dry with compressed air.

CAUTION

Do not clean the transmission case and needle bearings. Normal cleaning methods will wash dirt and other contaminants into the bearing case and behind the needle bearings leading to bearing failure.

2. Inspect the main drive gear for pitting and wear. Replace if necessary.
3. Inspect the needle bearings inside the main drive gear. Replace the needle bearings if the mainshaft race is pitted or grooved.
4. Replace the sprocket if teeth are cracked or worn. See 6.5 TRANSMISSION SPROCKET, for more information.
5. Inspect the needle bearings on the inside of the main drive gear. If mainshaft race surface appears pitted or grooved, replace these bearings.

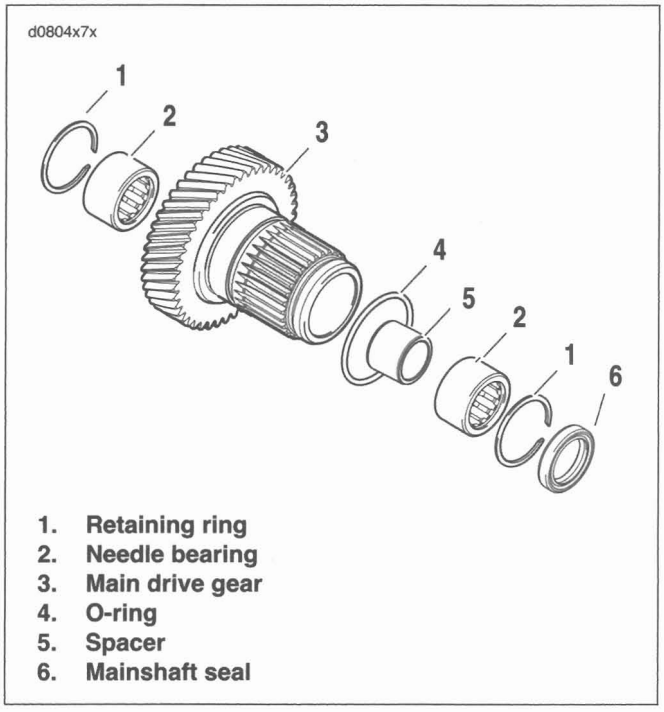
NOTE

If the main drive gear needle bearings and/or seal need to be replaced, continue as follows. Otherwise, proceed to ASSEMBLY.

Needle Bearing Replacement

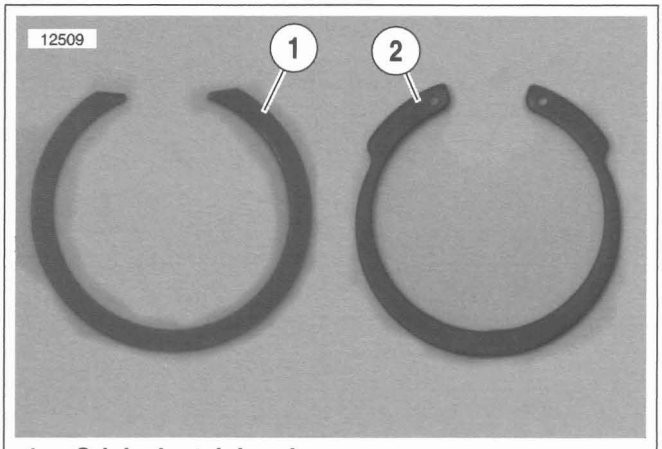
PART NO.	SPECIALTY TOOL
HD-47932	Main drive gear bearing and seal installation tool (if replacing)

1. See Figure 7-38. Remove mainshaft seal (6). Remove retaining rings (1), needle bearings (2) and spacer (5) from main drive gear (3). Discard retaining rings.



1. **Retaining ring**
2. **Needle bearing**
3. **Main drive gear**
4. **O-ring**
5. **Spacer**
6. **Mainshaft seal**

Figure 7-38. Main Drive Gear Assembly



1. **Original retaining ring**
2. **Replacement retaining ring**

Figure 7-39. Installing Clutch Side Needle Bearing in Main Drive Gear

NOTES

- *See Figure 7-39. When replacing needle bearings, discard original retaining rings (1) and install replacement retaining rings (2).*
- *To install the inner main drive gear needle bearings and mainshaft seal, use MAIN DRIVE GEAR BEARING and SEAL INSTALLATION TOOL (Part No. HD-47932).*

2. See Figure 7-40. Install clutch side needle bearing using an arbor press and the 0.400 in. step end of tool as shown. Press until tool is flush.

NOTES

- *An alternative method is provided which allows the mainshaft seal to be pressed into place after installation of the main drive gear. For detailed information, refer to steps that follow.*
- *If a serviceable mainshaft seal is already installed, then skip next step.*

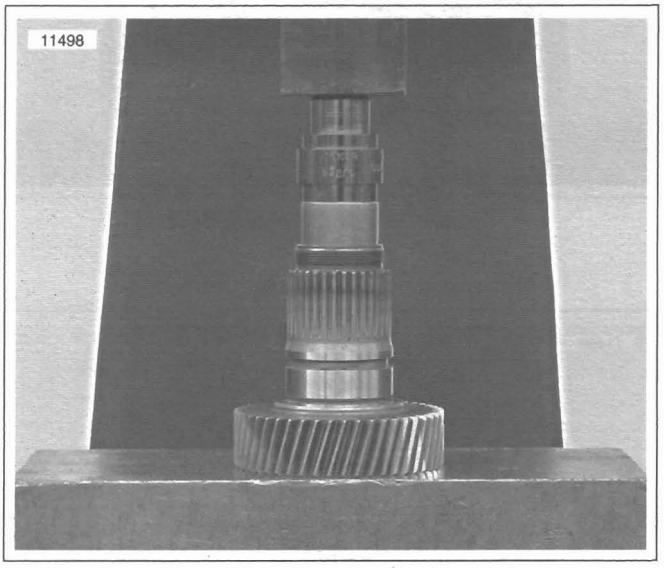


Figure 7-40. Installing Clutch Side Needle Bearing in Main Drive Gear

3. Install mainshaft seal:
   a. See Figure 7-41. Turn over tool and press in mainshaft seal using the 0.090 in. step.
   b. Install spacer.
   c. See Figure 7-42. Turn over the main drive gear in the arbor press. With the tool at the 0.188 in. step, press in inner bearing.
   d. Install retaining rings.

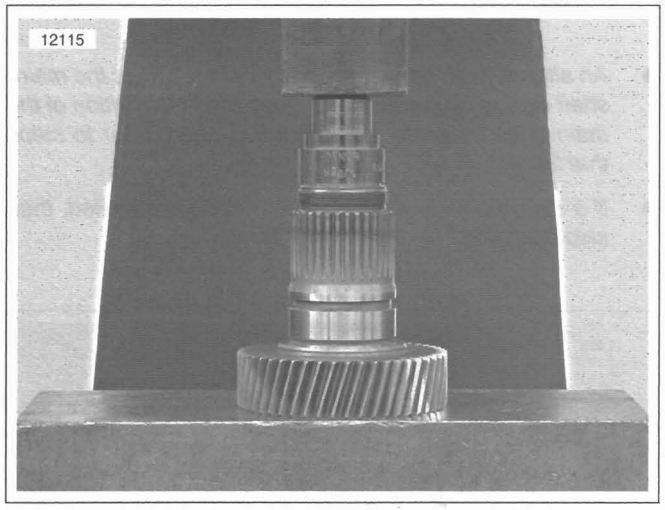


Figure 7-41. Pressing in Seal

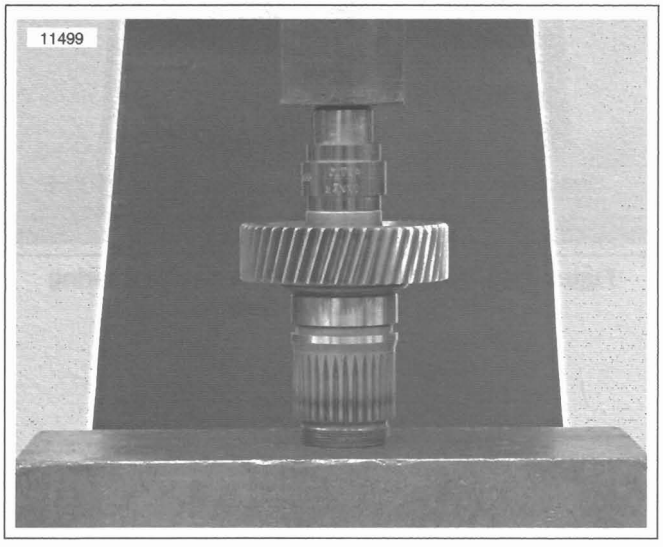
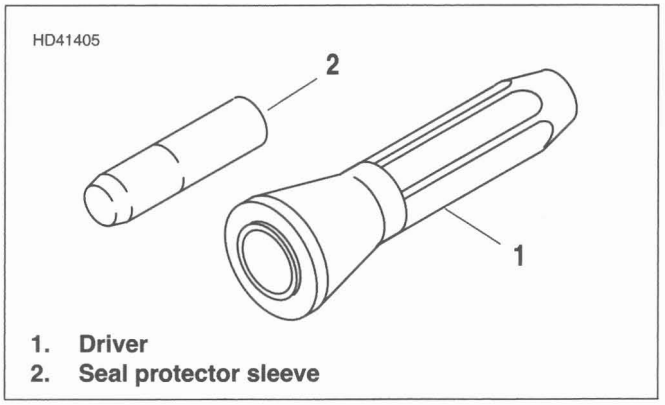


Figure 7-42. Installing Transmission Side Needle Bearing in Main Driver Gear

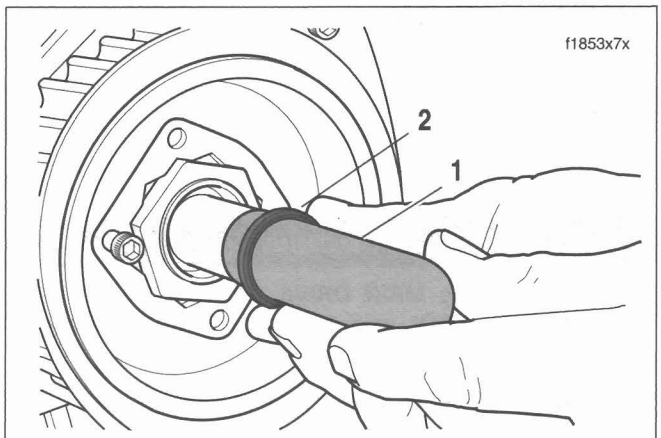
4. See Figure 7-43. If the mainshaft seal was not installed with the needle bearings (or if a faulty seal is discovered with the main drive gear installed in the transmission case), an alternative method is provided using the MAIN DRIVE GEAR SEAL INSTALLER (Part No. HD-47933).



1. **Driver**
2. **Seal protector sleeve**

Figure 7-43. Main Drive Gear Seal Installer (Part No. HD-47933)

5. To install the mainshaft seal with the main drive gear in the transmission case, proceed as follows:
   a. Verify that the garter spring is in place on the lip of the oil seal.
   b. See Figure 7-44. Place the seal protector sleeve (1) over the end of the mainshaft. Lightly lubricate the protector sleeve and seal ID with clean transmission oil.
   c. Squarely seat the mainshaft seal (2) on the seal protector sleeve with the garter spring facing the trans-mission case.
   d. See Figure 7-45. Using seal driver, hand press seal onto mainshaft and into end of main drive gear. A rubber mallet may be used to lightly tap driver, if necessary. Seal is properly installed when seal driver bottoms out against end of main drive gear.



1. **Seal protector sleeve**
2. **Seal**

Figure 7-44. Seal Protector Sleeve

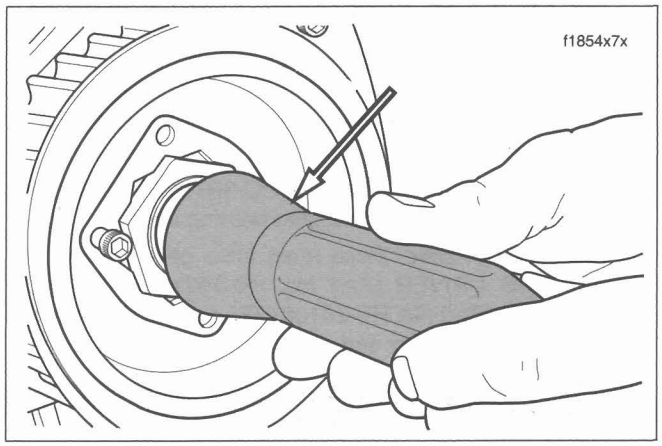


Figure 7-45. Seal Driver

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-35316-C	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.

Installing Main Drive Gear Bearing

NOTE

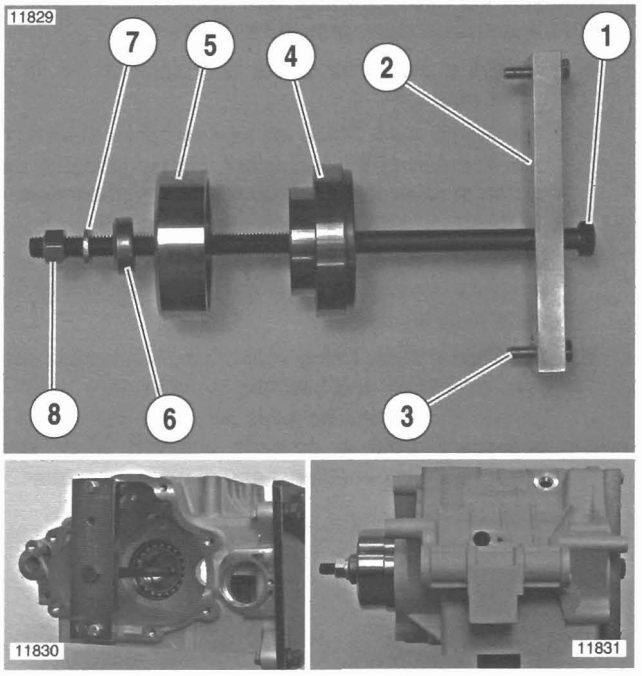
CROSS PLATE (Part No. HD-35316-3A) will retrofit to earlier Softail model transmissions. Note that one end of cross plate is stamped, "UP 6 SPEED". Mount cross plate with this end pointing up for 2007 Softail models.

1. See Figure 7-46. Place CROSS PLATE (Part No. HD-35316-3A) (2) on right side of transmission case as shown, and secure with two screws (3). Position cross plate so that large bolt hole in cross plate is lined up with center of main drive gear bearing bore in left side of transmission case.
2. Insert 12 IN. BOLT (Part No. HD-35316-5) (1) through cross plate and main drive gear bearing bore.
3. At outside of case, place main drive gear bearing (4), BEARING DRIVER (Part No. HD-35316-8) (5), NICE BEARING (Part No. RS-25100-200) (6), FLAT WASHER (7) and NUT (8) over end of bolt.

CAUTION

Do not continue to tighten nut after bearing bottoms against lip in crankcase bearing bore. Tightening nut too much can break lip in bearing bore casting.

4. Tighten nut until main drive gear bearing bottoms against lip cast into transmission case bearing bore.



1. **12 in. bolt (Part No. HD-35316-5)**
2. **Cross plate (Part No. HD-35316-3A)**
3. **Screw (2)**
4. **Main drive gear bearing**
5. **Bearing driver (Part No. HD-35316-8)**
6. **Nice bearing (Part No. RS-25100-200)**
7. **Flat washer**
8. **Nut**

Figure 7-46. Installing Main Drive Gear Bearing–Typical

Installing Main Drive Gear

NOTE

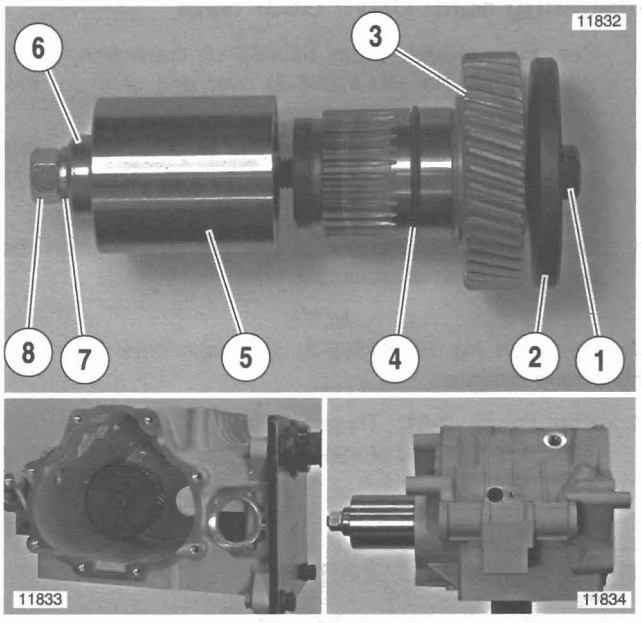
See Figure 7-47. Make sure to install ***new*** *O-ring (4) onto main drive gear (3) and lubricate O-ring with clean engine oil before installing drive gear into transmission case.*

1. See Figure 7-47. Insert 8 IN. BOLT (Part No. HD-35316-4A) (1) through WASHER (Part No. HD-35316-7) (2) and main drive gear (3). Insert assembly into transmission case, through main drive gear bearing.
2. At outside of case, place INSTALLER CUP (Part No. HD-35316-12) (5), NICE BEARING (Part No. RS-25100-200) (6), FLAT WASHER (7) and NUT (8) over end of bolt. Tighten nut until main drive gear bottoms against main drive gear bearing.

NOTE

See Figure 7-48. In next step, Bearing retaining ring must be installed with the flat side facing the bearing and the opening in the ninety degree window as shown.

3. See Figure 7-49. Install **new** retaining ring (2).



1. **8 in. bolt (Part No. HD-35316-4A)**
2. **Washer (Part No. HD-35316-7)**
3. **Main drive gear**
4. **O-ring**
5. **Installer cup (Part No. HD-35316-12)**
6. **Nice bearing (Part No. RS-25100-200)**
7. **Flat washer**
8. **Nut**

Figure 7-47. Installing Main Drive Gear–Typical

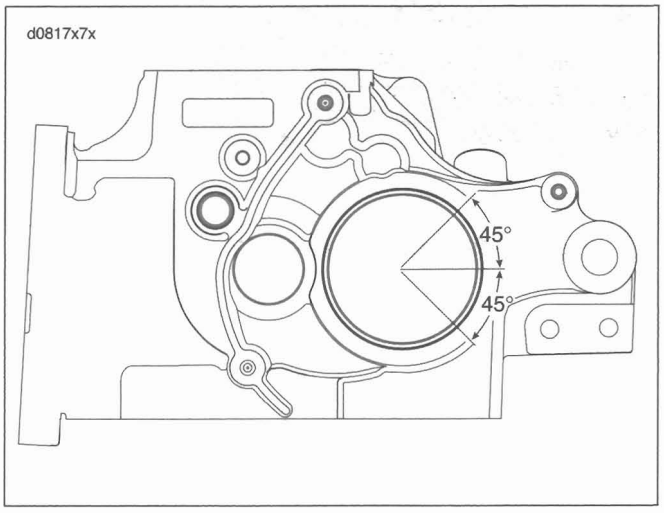


Figure 7-48. Retaining Ring Opening

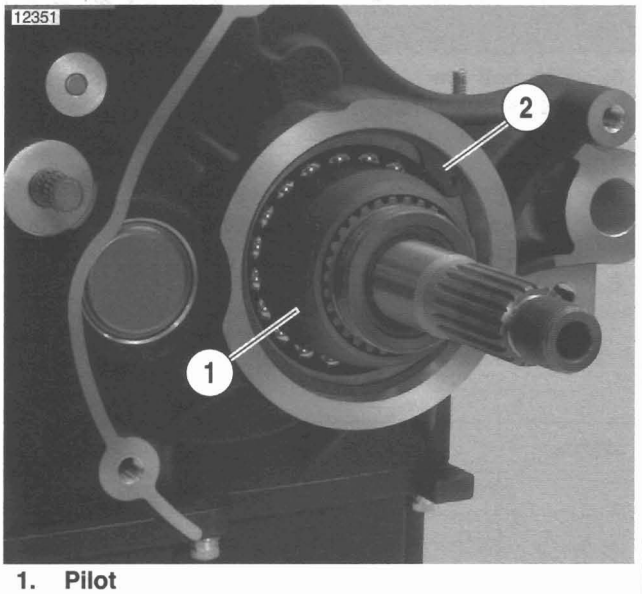
Installing Main Drive Gear Seal

1. See Figure 7-49. From outside of crankcase, install PILOT (Part No. HD-47856-2) over end of main drive gear bearing inner race.
2. Coat lips of **new** main drive gear seal with GENUINE HARLEY-DAVIDSON FORMULA+ TRANSMISSION AND PRIMARY CHAINCASE LUBRICANT.
3. See Figure 7-50. Place seal over pilot and position seal squarely in end of crankcase bore.

NOTE

Adapter (Part No. HD-47856-3) and main drive gear have right-hand threads.

4. See Figure 7-51. Thread ADAPTER (Part No. HD-47856-3) onto end of main drive gear until it bottoms on main drive gear.



1. **Pilot**
2. **Retaining Ring**

Figure 7-49. Install Pilot (Part No. HD-47856-2)

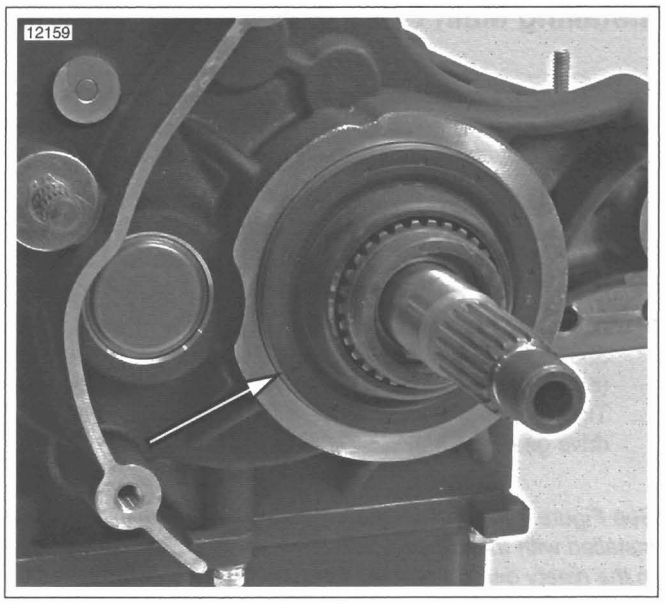


Figure 7-50. Place Main Drive Gear Seal Over Pilot

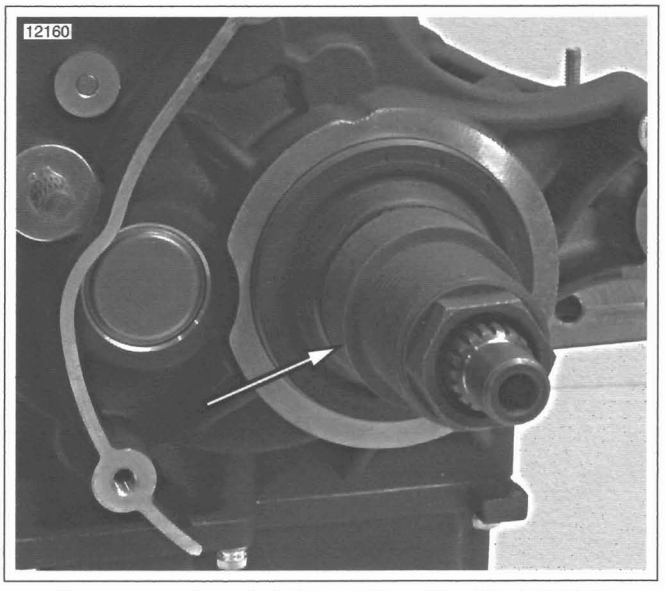


Figure 7-51. Install Adapter (Part No. HD-47856-3)

5. See Figure 7-52. Slide INSTALLER (Part No. HD-47856-1) over adapter until cupped end of installer is flat against seal.
6. See Figure 7-53. Thread nut (Part No. HD-47856-6) onto end of adapter, until it tightens against installer.
7. See Figure 7-54. Place crow's foot wrench (Part No. HD-47856-7) (1) with 1/2 inch drive breaker bar (2) on large nut. Place an adjustable wrench (3) on flats of hex head cast into end of adapter.
8. Holding adjustable wrench, tighten large nut with crow's foot wrench until outer face of seal is flush with outer edge of crankcase bore.

NOTE

It is acceptable to recess seal to about 0.030 in. (0.762 mm) below outer edge of bore. Seal depth will be controlled by tool.

9. Remove nut, installer, adapter and pilot.
10. Install main drive gear. See 6.5 TRANSMISSION SPROCKET.
11. Install the bearing inner race on the transmission mainshaft. See INSTALLATION under 7.5 TRANSMISSION ASSEMBLY.
12. Install the starter. See INSTALLATION under 5.4 STARTER.
13. Install the primary chaincase assembly. Install the clutch assembly, primary chain, chain tensioner assembly and compensating sprocket components. Install the primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.

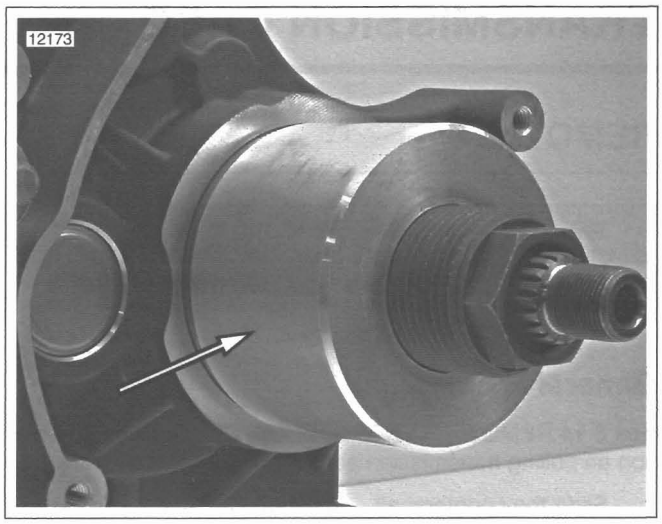


Figure 7-52. Place Installer (Part No. HD-47856-1) over Adapter

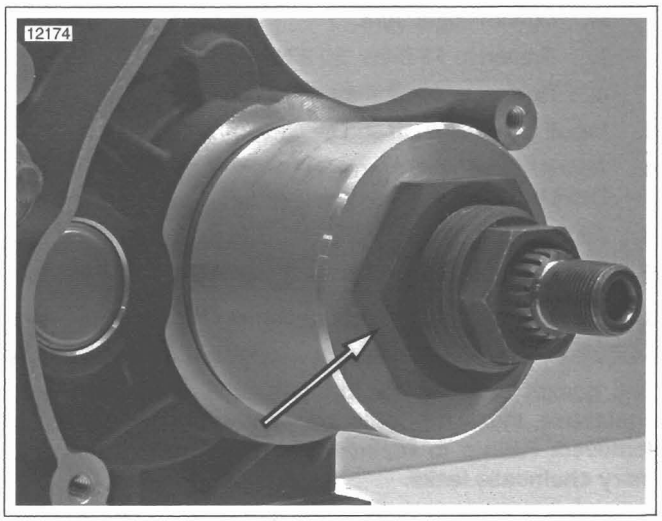
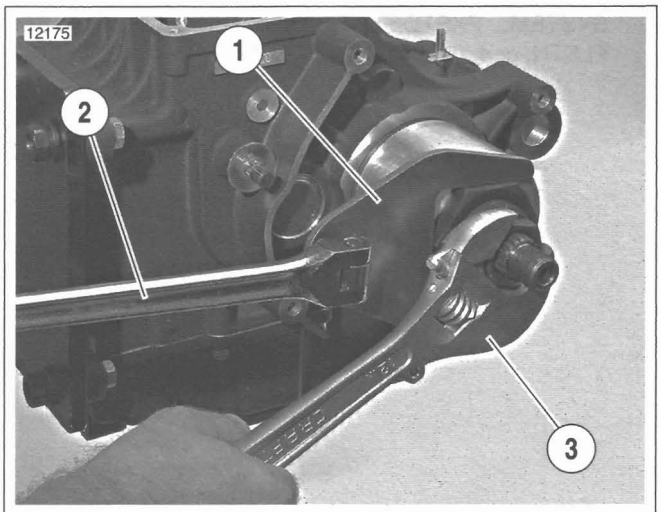


Figure 7-53. Install Nut (Part No. HD-47856-6)



1. **Crow's foot wrench (Part No. HD-47856-7)**
2. **1/2 inch breaker bar**
3. **Adjustable wrench**

Figure 7-54. Press Seal Into Crankcase

REMOVAL

PART NO.	SPECIALTY TOOL
HD-35316-C	Main drive gear remover and installer

General

See 3.14 REMOVING ENGINE FROM CHASSIS for information on pulling transmission case from frame.

1. Slide the countershaft, mainshaft and shift drum assemblies into the transmission case.
2. See Figure 7-56. 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).
3. Install the pivot shaft and side mounting plates.
4. Adjust drive belt tension. See 1.14 REAR BELT DEFLECTION.
5. Align vehicle. See 2.14 VEHICLE ALIGNMENT.
6. 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.

7. Install primary chaincase cover. See PRIMARY CHAINCASE COVER under 6.2 PRIMARY CHAINCASE.
8. Install the exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF,4.18 EXHAUST SYSTEM: FLSTN, or 4.19 EXHAUST SYSTEM: FLSTSC.

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.

9. 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.

CAUTION

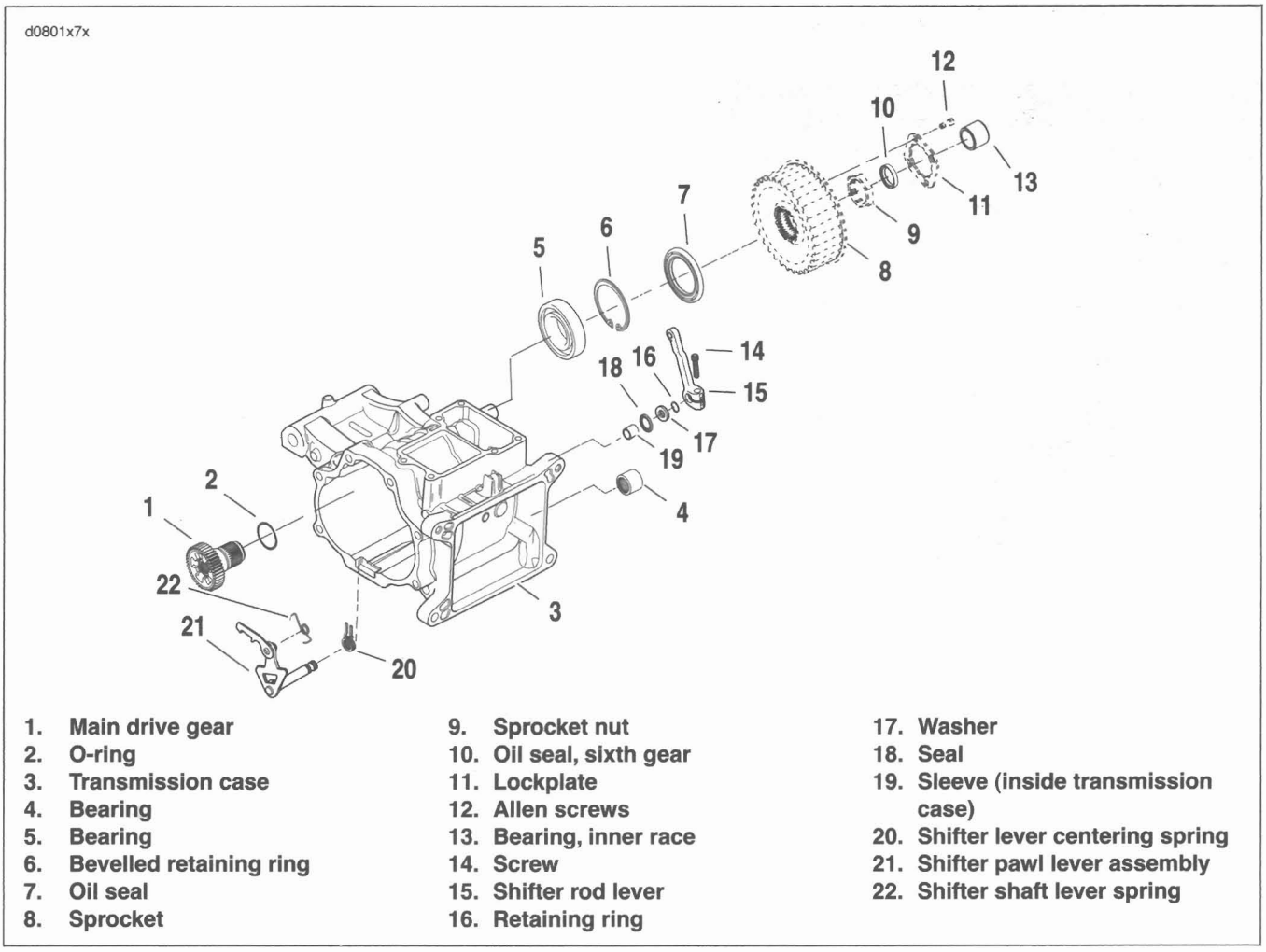
Do not overfill the primary chaincase with lubricant. Overfilling may cause rough clutch engagement, incomplete disengagement, clutch drag and/or difficulty in finding neutral at engine idle.

10. Fill primary chaincase. See 1.11 PRIMARY CHAINCASE LUBRICANT.

DISASSEMBLY

Shifter Arm Assembly

1. See Figure 7-57. After removing door assembly, remove screw (8) and shifter rod lever (9) from the shifter pawl lever assembly (1).
2. Remove retaining ring (7), washer (6) and seal (5). Discard retaining ring and seal. Pull shifter pawl lever assembly out of the transmission case.
3. Inspect sleeve (2) inside transmission case.



1. Main drive gear
2. O-ring
3. Transmission case
4. Bearing
5. Bearing
6. Bevelled retaining ring
7. Oil seal
8. Sprocket
9. Sprocket nut
10. Oil seal, sixth gear
11. Lockplate
12. Allen screws
13. Bearing, inner race
14. Screw
15. Shifter rod lever
16. Retaining ring
17. Washer
18. Seal
19. Sleeve (inside transmission case)
20. Shifter lever centering spring
21. Shifter pawl lever assembly
22. Shifter shaft lever spring

Figure 7-55. Transmission Case, Sprocket and Main Drive Gear

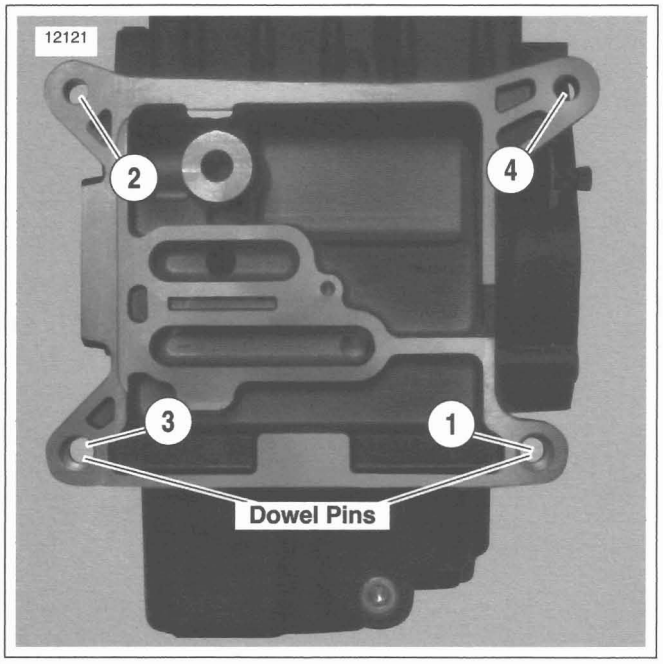


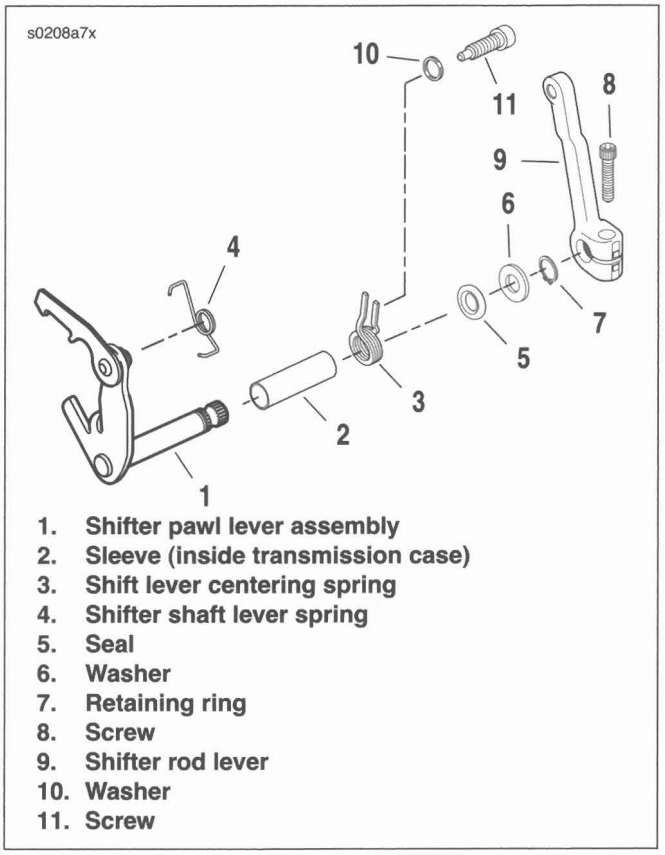
Figure 7-56. Transmission Mounting Bolts

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 in solvent except the case and main drive gear needle bearings. Blow parts dry with low pressure compressed air.
2. 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. See Figure 7-57. Inspect the shifter pawl lever assembly (1) for wear. If pawl ends are damaged, replace assembly.
4. Inspect the springs (3, 4). Replace if necessary.



1. **Shifter pawl lever assembly**
2. **Sleeve (inside transmission case)**
3. **Shift lever centering spring**
4. **Shifter shaft lever spring**
5. **Seal**
6. **Washer**
7. **Retaining ring**
8. **Screw**
9. **Shifter rod lever**
10. **Washer**
11. **Screw**

Figure 7-57. Shifter Arm Assembly

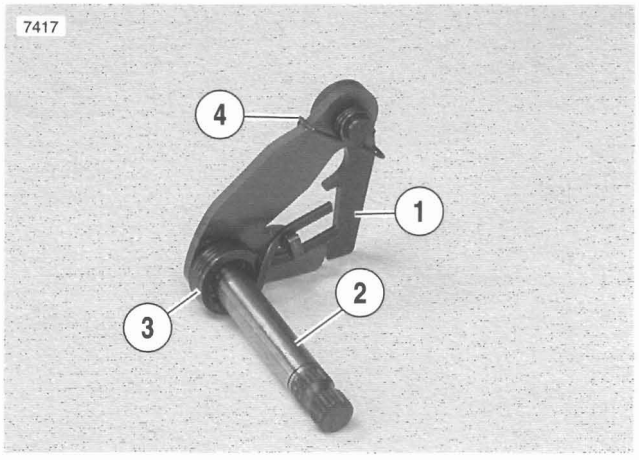
ASSEMBLY

Countershaft Needle Bearing Replacement

1. Find a suitable bearing driver 1.25 inch (31.75 mm) in diameter.
2. From the outside of the transmission case place the needle bearing open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven inward flush with the outside surface of the case or to a maximum depth of 0.030 in. (0.76 mm).
3. Lubricate the bearing with transmission lubricant.

Shifter Pawl Lever Assembly

1. See Figure 7-57. Verify that sleeve (2) is inside transmission case.
2. See Figure 7-58. Slide shifter lever centering spring (3) over shaft of shifter pawl lever assembly (2). Align opening on spring with tab on lever.
3. Place shifter shaft lever spring (4) on shifter pawl lever assembly.



1. **Pawl (part of shifter pawl lever assembly)**
2. **Shifter pawl lever assembly**
3. **Shifter lever centering spring**
4. **Shifter shaft lever spring**

Figure 7-58. Shifter Pawl Lever Assembly

NOTE

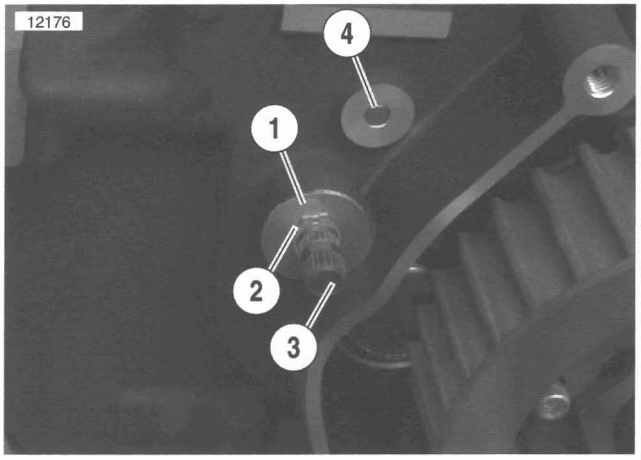
Do not bend shifter shaft lever spring more than necessary for assembly.

4. See Figure 7-59. Insert the assembly into the transmission case. See Figure 7-60. Verify that pin sits inside shifter shaft lever spring.
5. See Figure 7-59. Install a **new** seal. Install washer (1) and a **new** retaining ring (2).

NOTE

In next step shifter rod lever must be installed so angle of lever is towards front of vehicle, one spline from vertical.

6. See Figure 7-57. Install shifter rod lever (9) on the shifter pawl lever assembly shaft end using screw (8). Tighten to 18-22 ft-lbs (24.4-29.8 Nm).



1. **Washer (with seal behind)**
2. **Retaining ring**
3. **Shifter shaft lever**
4. **Pin**

Figure 7-59. Shifter Shaft Lever, Exterior View

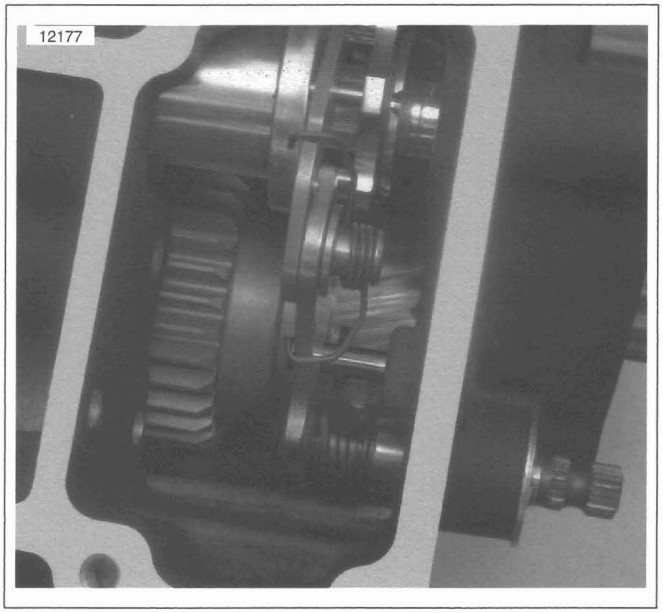


Figure 7-60. Shifter Shaft Lever Spring

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ELECTRICAL 8

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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

CIRCUIT BREAKER/FUSES	RATING (AMPERES)
Main fuse	40
Ignition fuse	15
Lights fuse	15
Accessory fuse	15
Instruments fuse	15
Battery fuse	15
Fuel pump fuse	15
ECM power fuse	15
Engine control fuse	15
Headlamp fuse	15

CHARGING SYSTEM	DATA
Battery	19 amp hour/270 CCA
Alternator AC voltage output	16-23 VAC per 1000 RPM
Alternator stator coil resistance	0.1-0.2 ohms
Regulator voltage output @ 3600 RPM	14.3-14.7 @ 75° F (24° C)
Regulator amperes @ 3600 RPM	35-50 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.

TORQUE VALUES

ITEM	TORQUE		NOTES
Active exhaust module fasteners	8-10 ft-lbs	10.8-13.6 Nm	page 8-67
Auxiliary lamp bracket hardware	72-120 **in-lbs**	10.8-13.6 Nm	FLSTC, page 8-40, page 8-42
Auxilliary lamp nut	15-18 ft-lbs	20.3-24.4 Nm	FLSTN, page 8-45
Battery terminal torque	60-96 **in-lbs**	6.8-10.9 Nm	page 8-28
Console mount, front screw	30-40 **in-lbs**	3.4-4.5 Nm	T27 TORX, tighten last during assembly, page 8-56
Console mount, rear screws	30-40 **in-lbs**	3.4-4.5 Nm	T25 TORX, tighten before front screw, page 8-56
Crank Position Sensor (CKP) sensor screw	90-120 **in-lbs**	10.2-13.6 Nm	page 8-9

ITEM	TORQUE		NOTES
Electrical panel mounting fasteners	60-108 **in-lbs**	6.8-12.2 Nm	page 8-5
Electronic control module (ECM) nuts	30-35 **in-lbs**	3.4-4.0 Nm	FXST/FXSTB/FXSTC/FXSTD/FLSTF, page 8-7
Electronic control module (ECM) screws	45-55 **in-lbs**	5.1-6.2 Nm	FLSTC/FLSTN/FLSTSC, page 8-7
Front turn signal lamp screws	30-60 **in-lbs**	4.1-6.8 Nm	FLSTC, page 8-45
Fuel tank console nut	14-18 **in-lbs**	19.0-24.4 Nm	all but FXSTD, page 8-16, page 8-57, page 8-60
Handlebar clamp screw	60-80 **in-lbs**	6.8-9.0 Nm	T27 TORX, page 8-75, page 8-80
Handlebar switch housing screws	35-45 **in-lbs**	4.0-5.1 Nm	T25 TORX, page 8-75, page 8-80
Horn bracket mounting nut	80-100 **in-lbs**	9.0-11.3 Nm	page 8-65
Horn mounting nut	80-100 **in-lbs**	9.0-11.3 Nm	page 8-65
Horn mounting screws	35-55 **in-lbs**	4.0-6.2 Nm	page 8-65
Ignition coil screws	120-180 **in-lbs**	13.6-20.3 Nm	page 8-12
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
Neutral switch	120-180 **in-lbs**	13.6-20.3 Nm	apply transmission oil to O-ring, page 8-62
Oil pressure switch	96-144 **in-lbs**	10.8-16.3 Nm	LOCTITE PIPE SEALANT WITH TEFLON, page 8-63
Rear stop light switch	12-15 ft-lbs	16.3-20.3 Nm	LOCTITE PIPE SEALANT WITH TEFLON, page 8-64
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 8-59
Sprocket nut	150-165 ft-lbs	203.4-223.7 Nm	LOCTITE THREADLOCKER 262 (red), page 8-17
Starter terminal nut	65-80 **in-lbs**	7.3-9.0 Nm	cover with protective boot, page 8-28
Stator screws	55-75 **in-lbs**	6.2-8.5 Nm	T27 TORX, use only once, page 8-17
Tail lamp connector cover fastener	60-90 **in-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 8-23
Voltage regulator mounting bolts	50-80 **in-lbs**	5.6-9.0 Nm	page 8-23

GENERAL

Refer to Table 8-1. This table gives the location and bulb requirements for all Harley-Davidson Softail motorcycles.

NOTES

- *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.*

Table 8-1. Softail Bulb Chart

LAMP DESCRIPTION (ALL LAMPS 12 VOLT)	NO. OF BULBS REQUIRED	CURRENT DRAW (AMPERAGE)	WATTAGE	
Headlamp				
High beam/low beam	1	4.7/4.3	60/55	60/55
Position lamp (HDI)				
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	0.37	5	
FXSTD	2			
Fender tip lamps				
FLSTC	2	0.10	1	
FLSTSC	1	0.35	4.2	

GENERAL

All Softail models use a panel under the rear fender to mount important electrical components. This electrical panel contains:

- Turn signal module (TSM), turn signal security module (TSSM) and connector or hands free security module HFSM [30].
- Security siren connector [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

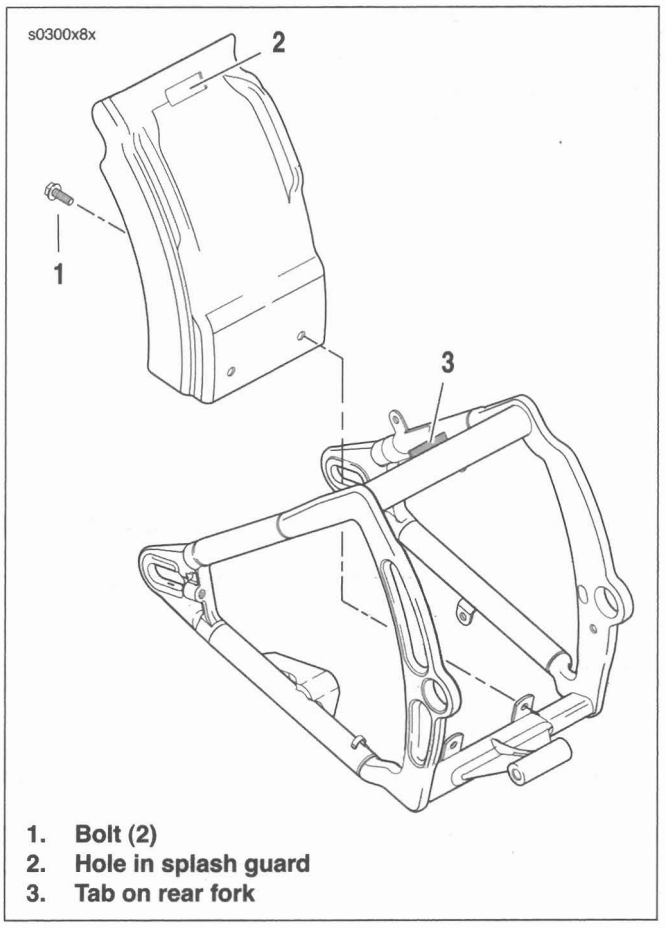
Rear wheel may have to be raised slightly to allow for splash guard removal.

4. See Figure 8-1. Remove two bolts (1) from splash guard. Bend upper right corner of fender towards rear tire and lift upward to clear hole in fender (2) from tab on rear fork (3).
5. Remove turn signal, turn signal security or hands free security module and vapor valve from tabs in electrical panel.

NOTE

If security siren is not installed, remove security siren connector [142] from receptacle in electrical panel.

6. If installed, remove security siren from tabs in electrical panel.
7. On California models, remove canister and tubing from electrical panel.
8. Remove electrical panel fasteners and remove electrical panel by disengaging tab at bottom of panel from slot in transmission case.



1. **Bolt (2)**
2. **Hole in splash guard**
3. **Tab on rear fork**

Figure 8-1. Splash Guard

INSTALLATION

1. See Figure 8-1. Place electrical panel into position by installing tab on panel into slot in bottom of transmission case.
2. 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.
4. Install turn signal, turn signal security or hands free security module.

NOTE

See Figure 8-2. If security siren is not installed, install security siren connector [142] into receptacle in electrical panel.

5. If vehicle is equipped with a security siren, install security siren.
6. See Figure 8-1. Install the rear splash guard using two bolts (1) at the bottom. Hole in fender (2) must fit over a tab on rear fork (3).
7. Install right side saddlebag if removed.
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.

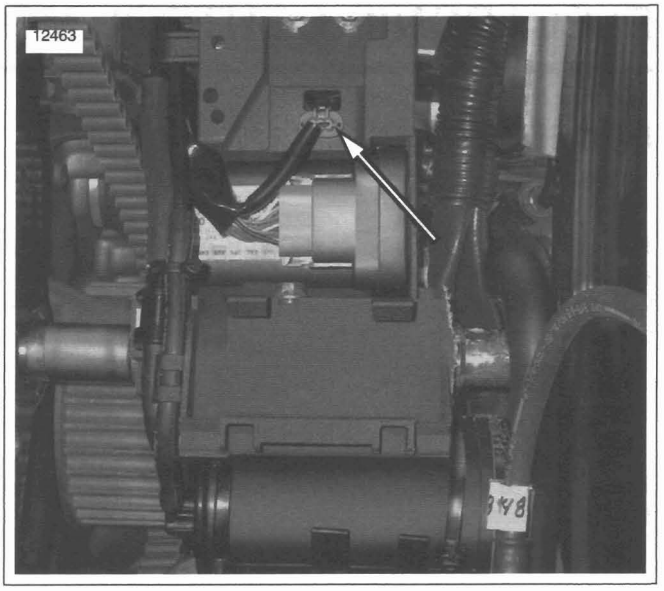


Figure 8-2. Siren Connector Receptacle

GENERAL

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

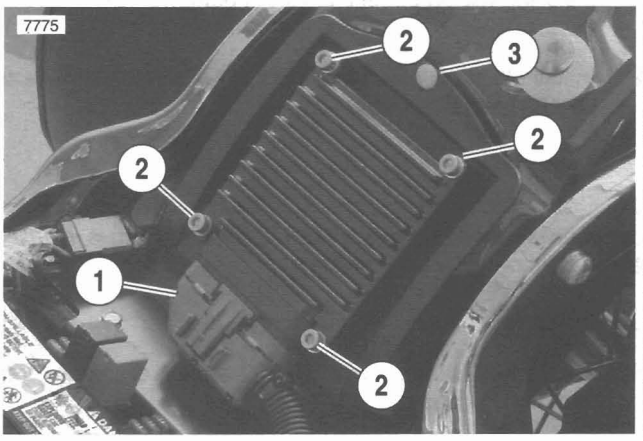
To prevent accidental vehicle start-up, which could cause death or serious injury, disconnect negative (-) battery cable before proceeding. (00048a)

2. Disconnect negative battery cable.

3. Remove electronic control module from mounting bracket.

   a. For FLSTC/FLSTN/FLSTSC, see Figure 8-3. Remove four screws (2) holding ECM to mounting bracket. Depress latch on connector [78] and disconnect from ECM.

   b. For FXST/FXSTB/FXSTC/FXSTD/FLSTF, see Figure 8-4. Remove four nuts and washers holding ECM to mounting bracket. Depress latch on connector [78] and disconnect from ECM.



1. **ECM connector [78]**
2. **Screw (4)**
3. **Nylon fastener**

Figure 8-3. ECM Mount: FLSTC/FLSTN/FLSTSC

INSTALLATION

1. Attach ECM connector [78] to ECM.
2. Install ECM on mounting bracket.
   a. For FLSTC/FLSTN/FLSTSC, see Figure 8-3. Install four screws (2) that secure ECM to mounting bracket. Tighten to 45-55 **in-lbs** (5.1-6.2 Nm).
   b. For FXST/FXSTB/FXSTC/FXSTD/FLSTF, see Figure 8-4. Install four nuts and washers that secure ECM to mounting bracket. Tighten to 30-35 **in-lbs** (3.4-4.0 Nm).
3. Connect negative battery cable.

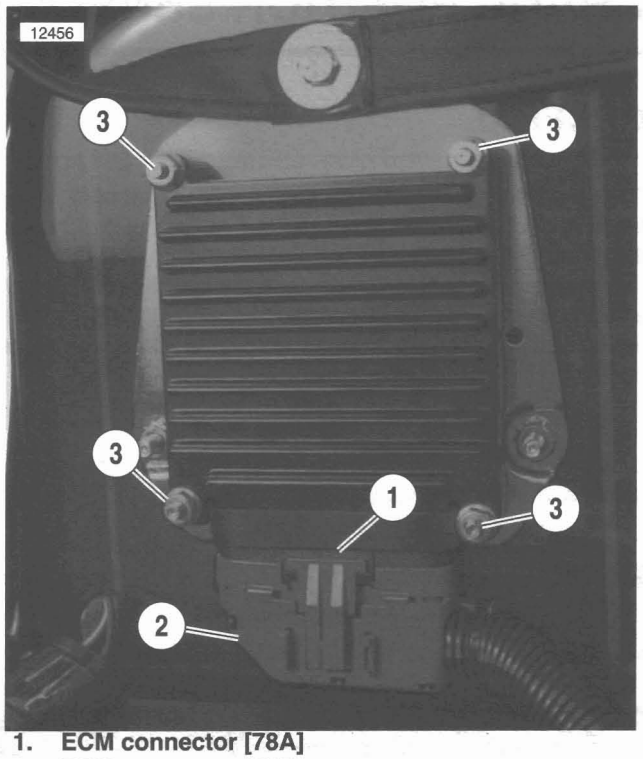
⚠WARNING

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.

NOTE

After installing ECM, the password learning procedure must be performed. See TSM/TSSM CONFIGURATION under 8.24 TSM/TSSM/HFSM.



1. **ECM connector [78A]**
2. **ECM connector [78B]**
3. **Nut (4)**

Figure 8-4. ECM Mount: FXST/FXSTB/FXSTC/FXSTD/FLSTF

GENERAL

See Figure 8-5. 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.

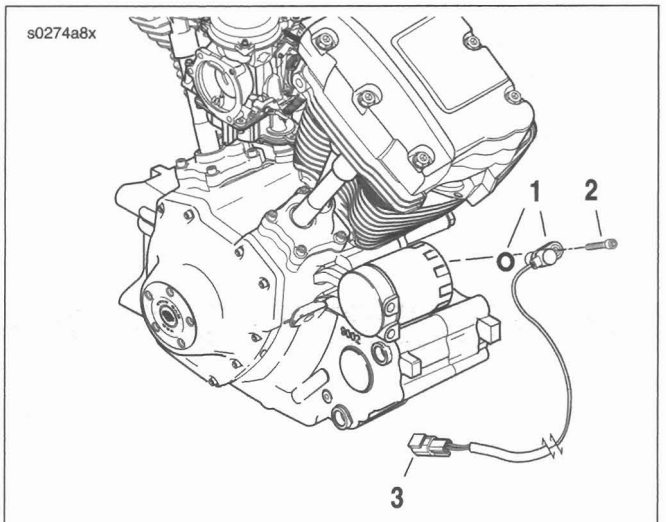
⚠WARNING

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. Detach wiring behind regulator bracket.
   a. Disengage small end of slot on attachment clip from T-stud on bracket. Lift connector off T-stud.
   b. See Figure 8-5. Disconnect the 2-place Mini-Deutsch CKP connector (3) [79].
4. 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.



1. **CKP sensor and O-ring**
2. **Screw and captive washer**
3. **CKP connector [79A]**

Figure 8-5. CKP Sensor Assembly

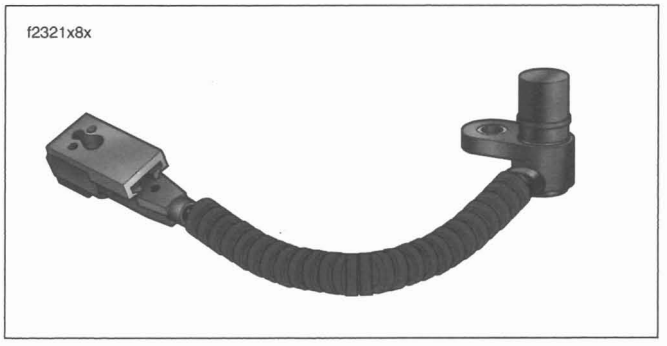


Figure 8-6. CKP Sensor

INSTALLATION

1. See Figure 8-5. Lubricate CKP sensor O-ring (1) with clean engine oil.
2. See Figure 8-7. 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].
   b. Place large end of slot on attachment clip over T-stud on bracket. Push connector to engage small end of slot.
5. Install 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.

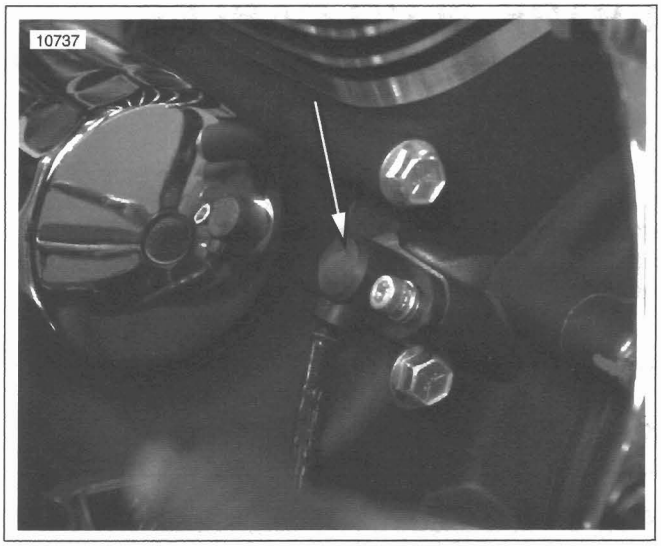


Figure 8-7. Installed CKP Sensor

GENERAL

Resistor-type high-tension spark plug cables have a carbon-impregnated 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

⚠WARNING

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.

1. Disconnect spark plug cables from ignition coil and spark plug terminals. Inspect all removed cables for damage.
2. See Figure 8-8. Remove cable straps on horn bracket for front spark plug cable.

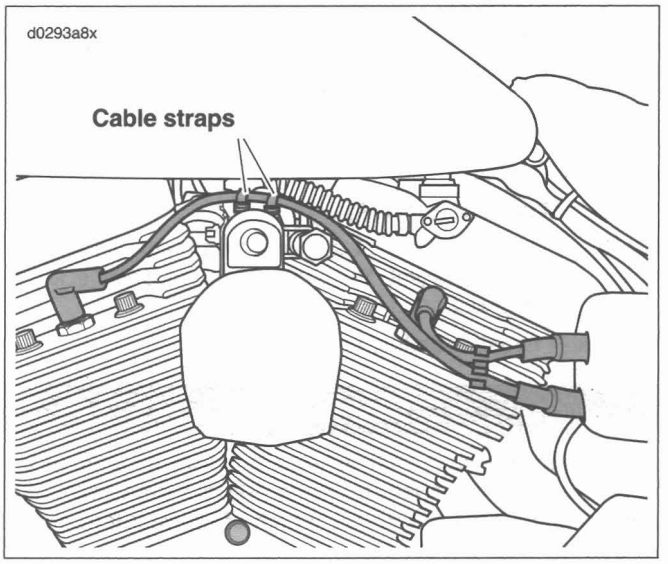


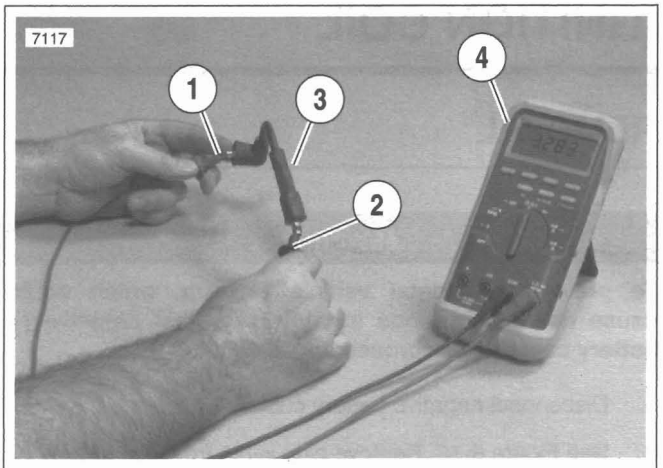
Figure 8-8. Spark Plug Cable Routing

INSPECTION

1. 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.
2. Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.
3. See Figure 8-9. 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.

INSTALLATION

1. See Figure 8-8. 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.
2. Secure front spark plug cable to horn bracket with **new** cable straps.



1. Ohmmeter positive lead
2. Ohmmeter negative lead
3. Spark plug cable (7.25 in./184 mm shown)
4. Ohmmeter

Figure 8-9. Testing Resistance

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.
2. See Figure 8-10. Remove plug wires from coil towers.

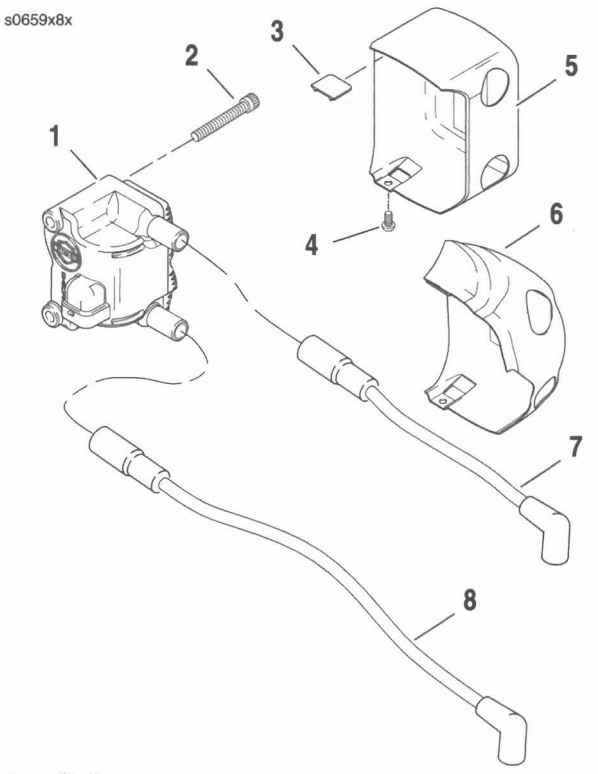
NOTE

Coil removal/installation on FLSTSC models requires swivel sockets and ball ended hex wrenches. Rear exhaust pipe removal is not necessary.

3. Remove screw (4) to detach cover (5, 6) from coil (1).
4. Remove two mounting screws (2) to detach coil from seat post.
5. Detach connector [83] from backside of coil.

INSTALLATION

1. See Figure 8-10. Attach connector [83] to backside of coil.
2. Position coil on seat post. Install two screws (2) and tighten to 120-180 **in-lbs** (13.6-20.3 Nm).
3. Fasten cover (5 or 6) to coil with screw (4).
4. Attach plug wires to coil towers. Rear cylinder plug wire attaches to upper coil tower.
5. Connect negative battery cable.



1. **Coil**
2. **Screw**
3. **Pad (2)**
4. **Screw with washer**
5. **Coil cover (All but FXSTD)**
6. **Coil cover (FXSTD)**
7. **Rear cylinder spark plug cable**
8. **Front cylinder spark plug cable**

Figure 8-10. Coil

GENERAL

See Figure 8-11. The fuse block is below the seat and behind the battery. The block 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 8-12. Pull cover away from fuse block.
4. See Figure 8-13. Replace suspect fuse.

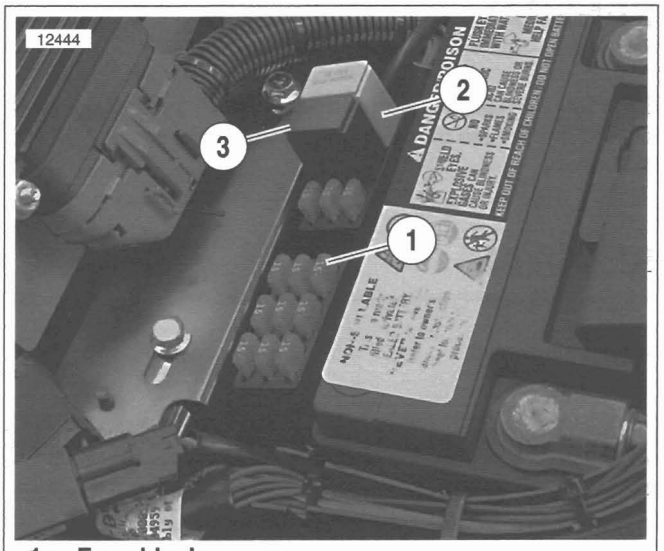
INSTALLATION

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.



1. Fuse block
2. Starter relay
3. System relay

Figure 8-11. Fuse Block

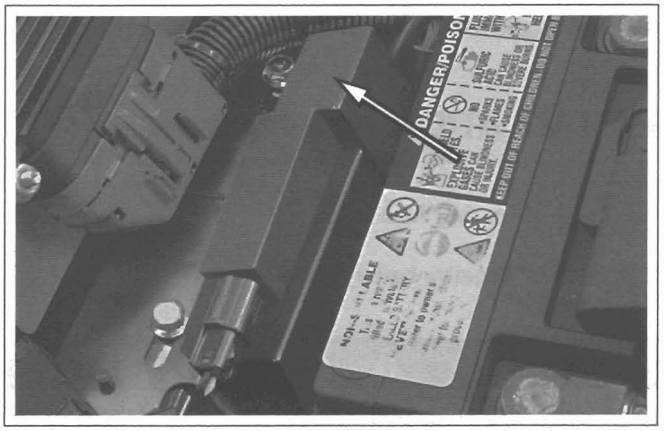
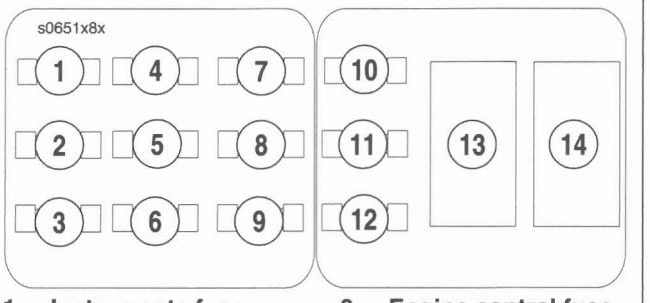


Figure 8-12. Fuse Block Cover



1. Instruments fuse
2. Ignition fuse
3. Lights fuse
4. P&A (2 Amp max)
5. Battery fuse
6. Accessories fuse
7. ECM fuse
8. Engine control fuse
9. Headlamp fuse
10. Spare 15 Amp
11. Spare 15 Amp
12. Fuel pump fuse
13. System Relay
14. Starter Relay

Figure 8-13. Fuse Block: Top View, All Fuses 15 Amp

GENERAL

See Figure 8-15. 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 8-14. Pull cover away from fuse block.
4. See Figure 8-15. Replace suspect relay (2) or (3).

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.

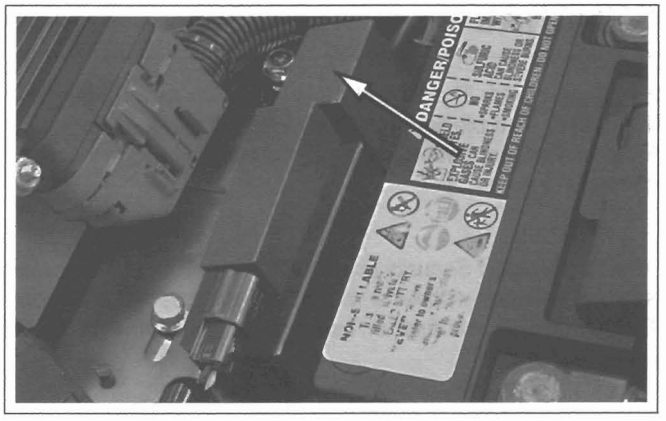


Figure 8-14. Fuse Block Cover

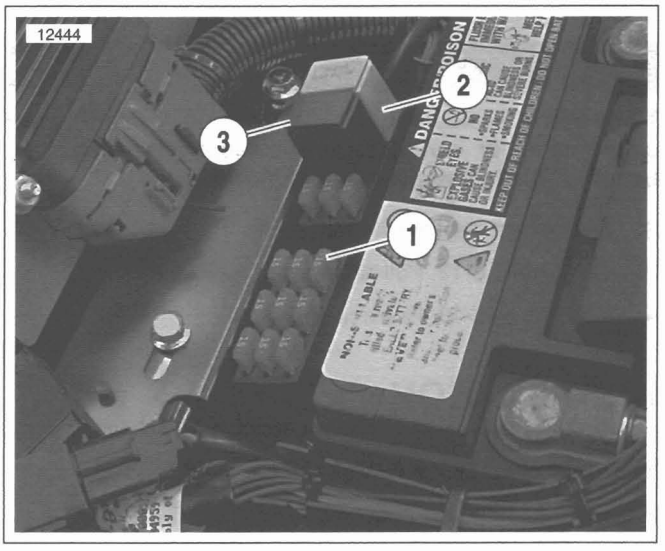


Figure 8-15. Relays

REMOVAL

1. Remove seat.
2. Pull main fuse holder (2) from location in front of battery.
3. Remove main fuse cover (1) from main fuse holder.
4. Pull main fuse from fuse holder.

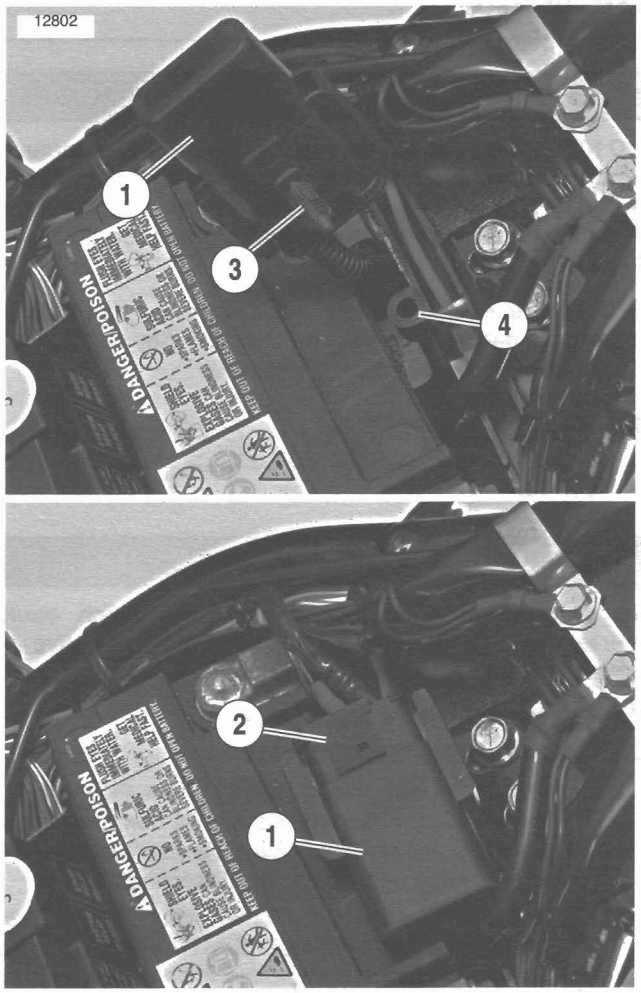
INSTALLATION

1. Push main fuse into fuse holder (2).
2. Install main fuse cover (1). on main fuse holder.
3. Push mounting stud (3) of fuse holder into mounting hole (4) in front of battery.

⚠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.



1. **Main fuse cover**
2. **Main fuse holder**
3. **Mounting stud**
4. **Mounting hole**

Figure 8-16. Main Fuse Location

GENERAL

⚠WARNING

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.

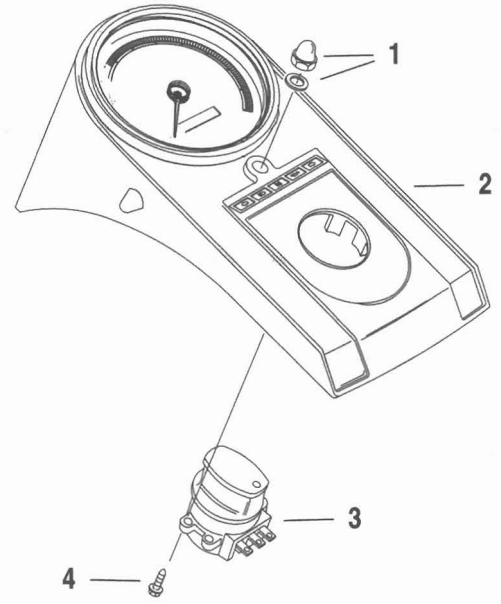
REPLACEMENT

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 8-17. Remove acorn nut and washer (1) from instrument panel (2) and remove panel. Note position and color of the switch wire connectors. Disconnect wires.
   b. For FXSTD, remove instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD. Remove wiring for ignition switch from wiring clip on back of console. Disconnect wires.
4. Remove mounting screws (4). Replace switch.
5. Reconnect switch wire connectors in their original positions.
6. Install instrument panel/console.
   a. For all models except FXSTD, See Figure 8-17. Install instrument panel (2) using acorn nut and washer (1). Tighten to 14-18 ft-lbs (19.0-24.4 Nm).
   b. For FXSTD, install instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD.
7. Connect negative battery cable.



1. **Nut and washer**
2. **Panel**
3. **Ignition switch**
4. **Mounting screws**

Figure 8-17. Ignition Switch

⚠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.
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.

Table 8-2. Key Switch Functions and Positions

MODEL AND LOCATION	DOMESTIC SWITCH	HDI SWITCH
Softail models Tank console. Switch is locked or unlocked by lifting switch cover, inserting key and turning key counterclockwise to lock, clockwise to unlock. Key may be removed in any position.	OFF - Ignition and lights are off. Key may be removed.	Same
	ACC. - Instrument lights are on. Brake light and horn can be activated.	Same; in addition, position lamp, tail lamp are ON.
	IGNITION - Hazard warning flasher can be turned on. Ignition, lights and accessories are on.	Same; in addition, position lamp is ON.

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.

2. Remove primary cover, primary drive and clutch. See 6.3 DRIVE COMPONENTS.
3. See Figure 8-18. 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.
6. On vehicles with footboards, remove footboard support assembly to reduce risk of damaging parts during removal process. Disconnect Deutsch connector [46].
7. 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.

8. 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.

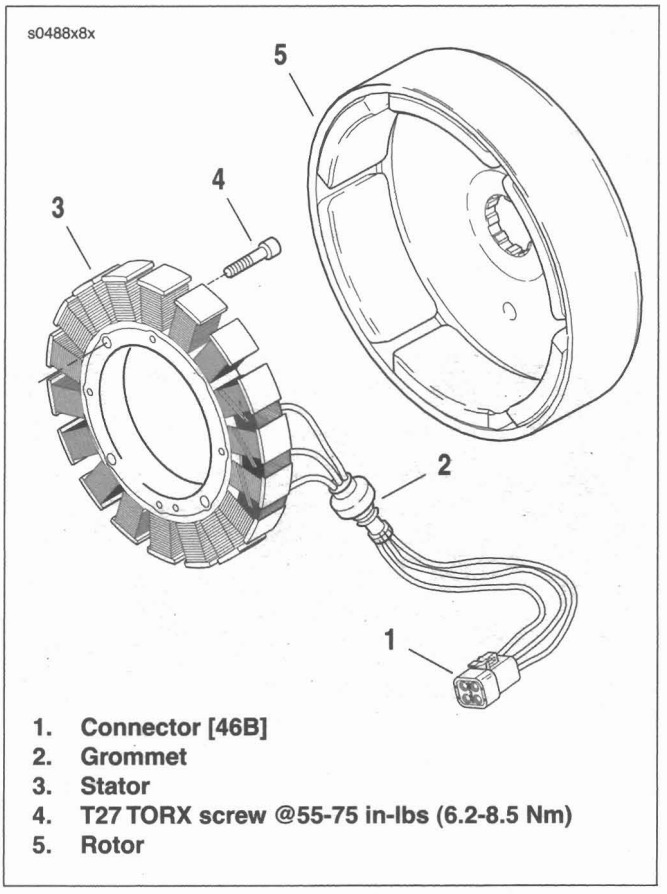
1. Remove all foreign particles from the rotor magnets.
2. Clean the rotor and stator in clean, soapy water.

ASSEMBLY/INSTALLATION

NOTE

*Stator Torx fasteners are not re-usable. They **must** be replaced.*

1. Insert wires through crankcase hole.



1. **Connector [46B]**
2. **Grommet**
3. **Stator**
4. **T27 TORX screw @55-75 in-lbs (6.2-8.5 Nm)**
5. **Rotor**

Figure 8-18. Rotor and Stator Mounting

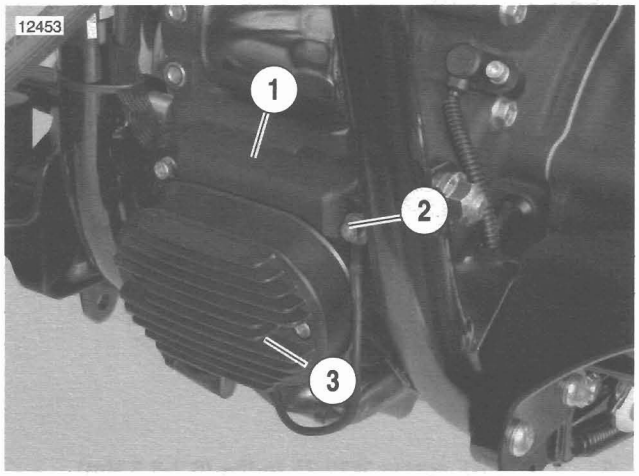
2. See Figure 8-18. Push rubber grommet (2) through crankcase hole. If necessary, apply the same lubricant used during removal.
3. Insert wires into connector [46B] (1).
4. Install secondary lock to connector.
5. Mate connector [46]. Position under regulator bracket before tightening regulator bracket screws.
6. 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.
8. Apply LOCTITE THREADLOCKER 262 (red) to sprocket nut threads. Tighten sprocket nut to 150-165 ft-lbs (203.4-223.7 Nm).
9. Install clutch, primary drive and primary cover. See 6.3 DRIVE COMPONENTS.
10. Connect negative battery cable.

GENERAL

NOTE

The voltage regulator cannot be repaired. Replace the unit if it fails. For diagnostic information see Softail Models Electrical Diagnostic Manual

See 8.14 FRONT ELECTRICAL CADDY for voltage regulator removal and installation procedures.



1. **Bracket**
2. **Ground wire connection**
3. **Bolt (2)**

Figure 8-19. Voltage Regulator Bracket

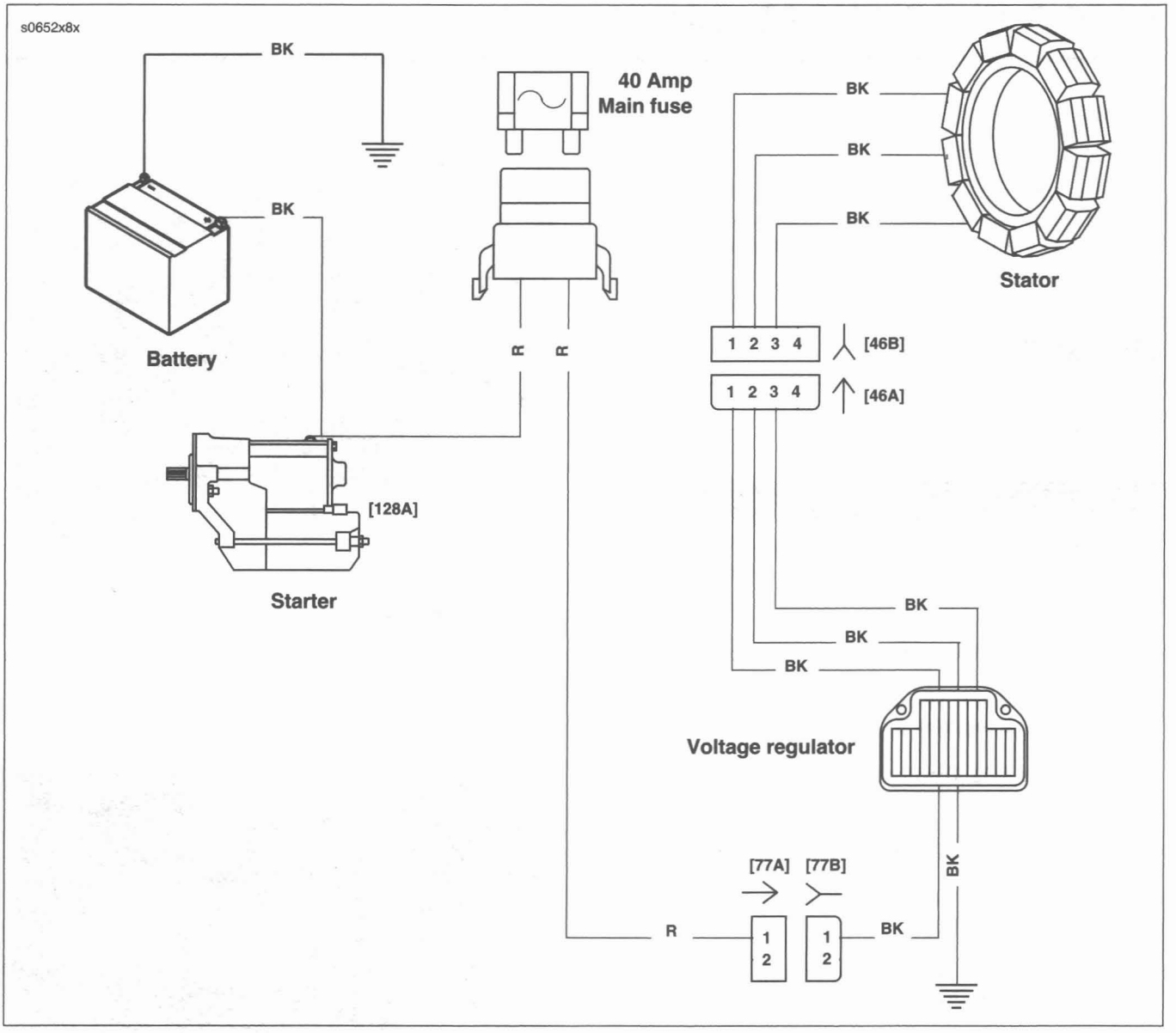


Figure 8-20. Charging System Circuit

GENERAL

The front electrical caddy is located in front of the engine. It contains the voltage regulator, crank position sensor connector, stator connector, voltage regulator connector and front oxygen sensor connector.

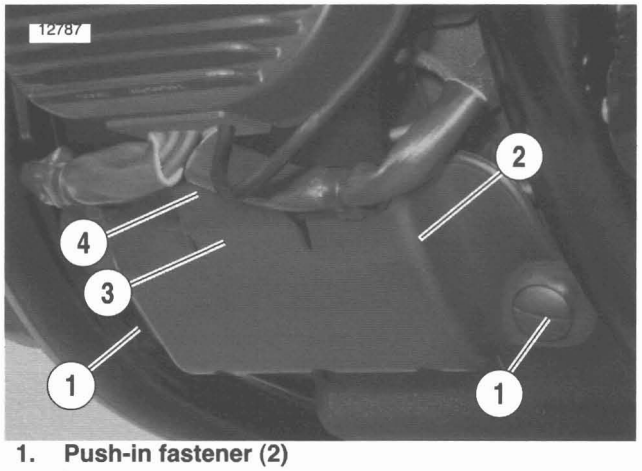
DISASSEMBLY

1. Remove seat.

⚠CAUTION

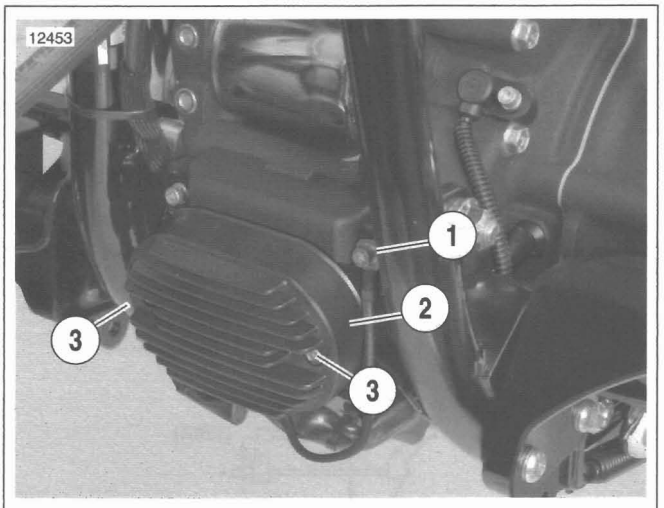
To prevent accidental vehicle start-up, which could cause death or serious injury, remove maxi-fuse before proceeding. (00251a)

2. Disconnect main fuse. See 8.10 MAIN FUSE.
3. See Figure 8-21. Remove push-in fasteners (1) from lower voltage regulator cover (2).
4. See Figure 8-22. Disconnect ground wire connection (1) from crankcase.
5. Remove fasteners (3) securing voltage regulator (2).
6. See Figure 8-23. Remove cable straps (5) from voltage regulator bracket (4).
7. Lift upper voltage regulator cover (2) off of tab (1) to free cover from front electrical caddy.
8. Remove fastener (1) securing voltage regulator bracket to crankcase.



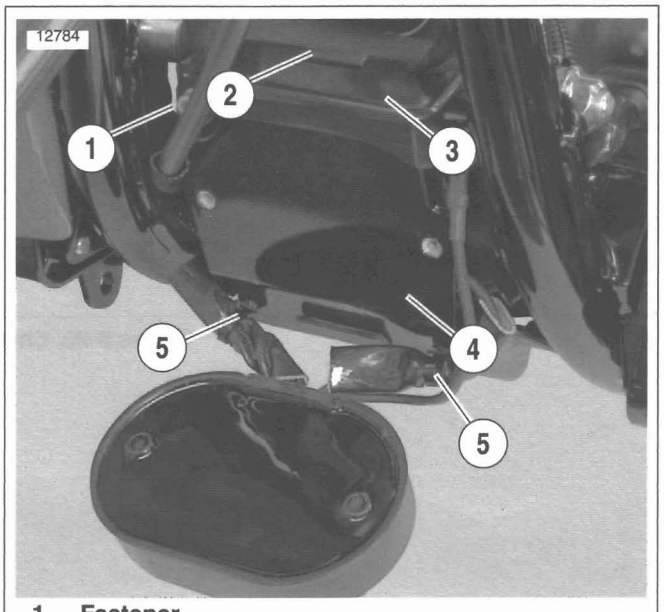
1. **Push-in fastener (2)**
2. **Lower voltage regulator cover**
3. **Tab**
4. **Voltage regulator bracket**

Figure 8-21. Lower Voltage Regulator Cover



1. **Ground wire connection**
2. **Voltage regulator**
3. **Fastener (2)**

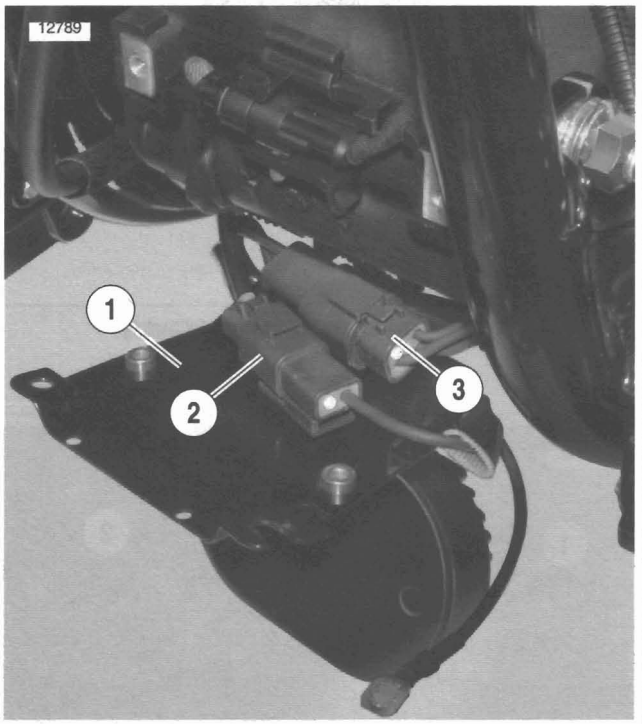
Figure 8-22. Voltage Regulator



1. **Fastener**
2. **Tab**
3. **Upper voltage regulator cover**
4. **Voltage regulator bracket**
5. **Cable strap (2)**

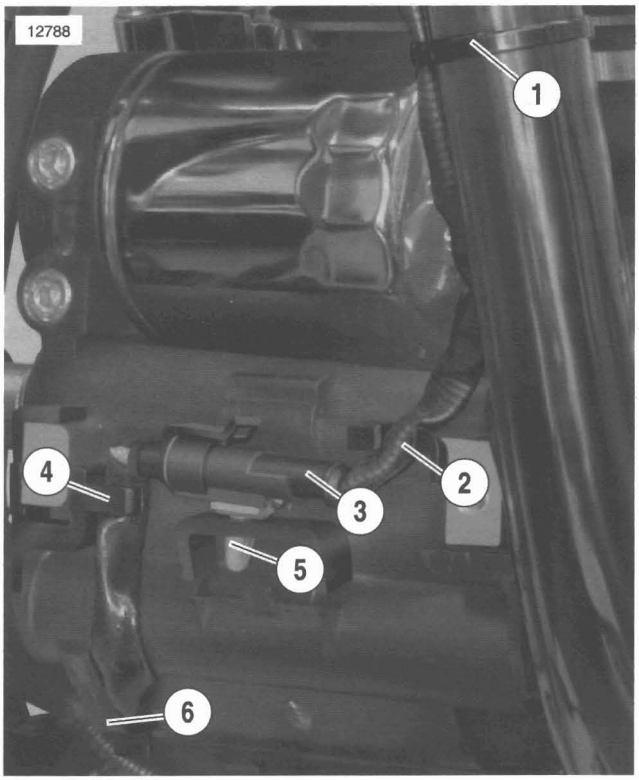
Figure 8-23. Upper Voltage Regulator Cover

9. See Figure 8-24. Disconnect voltage regulator connector (2) [77] and stator connector (3) [46] from voltage regulator bracket.
10. Separate voltage regulator and stator connector halves.
11. See Figure 8-25. Slide front oxygen sensor connector (3) [138] from anchor (5).
12. Remove wiring from clips (4, 6) and slot (2).
13. Disconnect crank position sensor [79]. See 8.5 CRANK POSITION SENSOR (CKP).
14. Remove electrical caddy from vehicle.



1. **Voltage regulator bracket**
2. **Voltage regulator connector**
3. **Stator connector**

Figure 8-24. Stator Connector

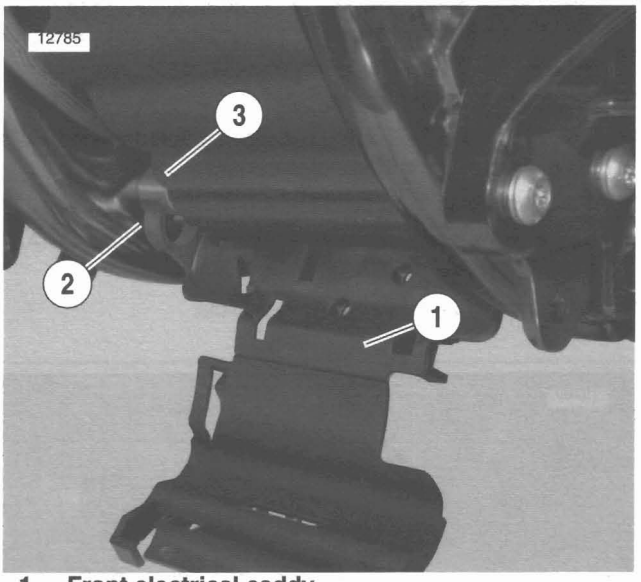


1. **Cable Strap**
2. **Slot**
3. **Front oxygen sensor connector**
4. **Clip**
5. **Anchor**
6. **Clip**

Figure 8-25. Front Oxygen Sensor Connector

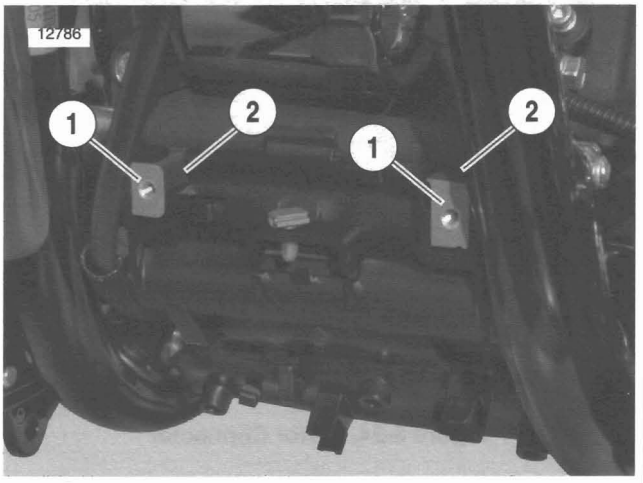
ASSEMBLY

1. See Figure 8-26. Install clips (2) on front electrical caddy (1) over washers (3).
2. Figure 8-27. Rotate front electrical caddy up and engage slots (2) on caddy with crankcase bosses (1).
3. Connect crank position sensor [79]. See 8.5 CRANK POSITION SENSOR (CKP).
4. See Figure 8-25. Connect front oxygen sensor connector (3) [138]. Install connector on clip (5). Route wiring as shown.
5. See Figure 8-24. Connect voltage regulator (2) [77] and stator (3) [46] connector halves.
6. Install voltage regulator and stator connectors on voltage regulator bracket (1).



1. **Front electrical caddy**
2. **Clip (2)**
3. **Washer (2)**

Figure 8-26. Front Electrical Caddy



1. **Crankcase boss**
2. **Slot**

Figure 8-27. Installing Caddy

7. See Figure 8-28. Install upper voltage regulator cover.

   a. Install projections on cover (1) into holes (2).

   b. Slide slot (5) over tab (4).

8. See Figure 8-23. Loosely install voltage regulator bracket (3) using fastener (1). do not tighten fastener at this time.

9. See Figure 8-22. Install voltage regulator. Tighten fasteners to 50-80 **in-lbs** (5.6-9.0 Nm).

10. Install ground wire. Tighten ground wire fastener and voltage regulator bracket fastener to 70-100 **in-lbs** (7.9-11.3 Nm).

11. See Figure 8-21. Install lower voltage regulator cover

    a. Place lower voltage regulator cover (2) into position with tab (3) of cover engaging voltage regulator bracket (4).

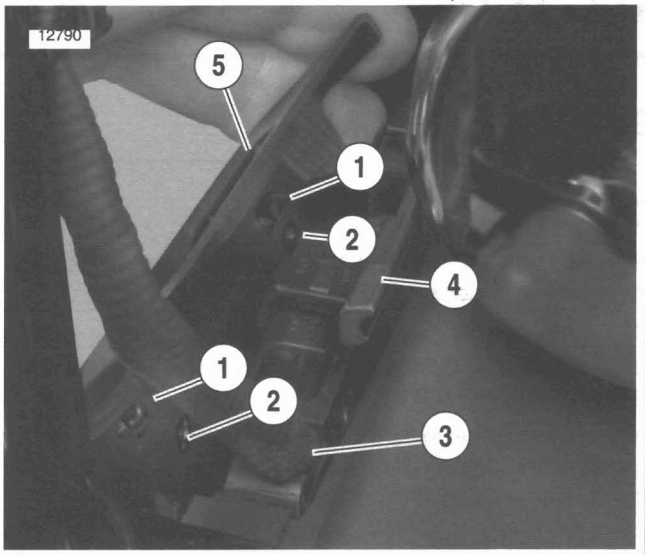
    b. Install push-in fasteners (1).

12. Connect main fuse. See 8.10 MAIN FUSE.

⚠CAUTION

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

13. Install seat.



1. **Projection (2)**
2. **Hole (2)**
3. **Front oxygen sensor wire**
4. **Tab**
5. **Slot**

Figure 8-28. Upper Voltage Regulator Cover

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 BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER. 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 8-29. 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.

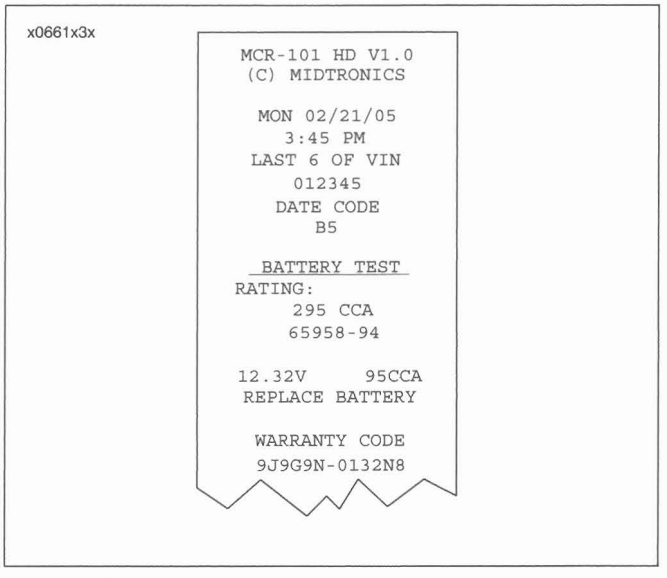


Figure 8-29. Battery Test Results–Printout

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.

2. 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.
3. 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)

4. See Figure 8-30. 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.

5. 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).

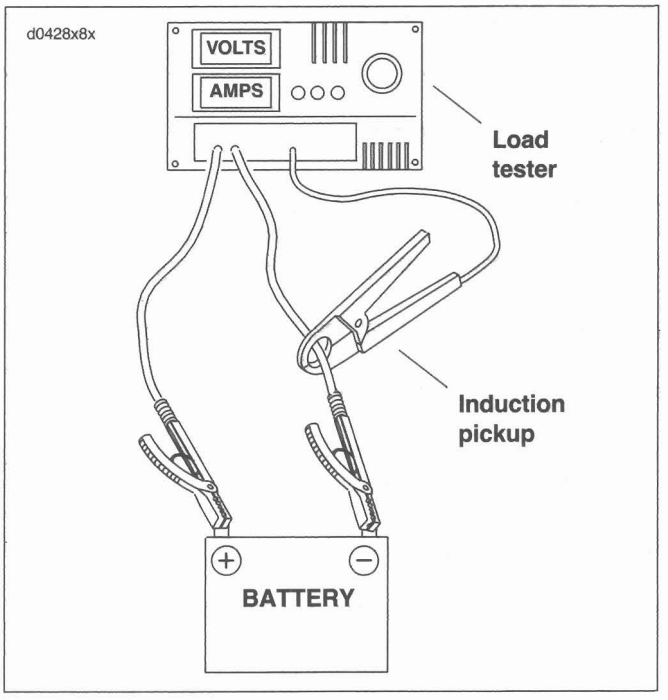


Figure 8-30. Load Test Battery

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.

Table 8-5. Battery Charging Rates/Times (Approximate)

BATTERY AMP HOUR	STATE OF CHARGE		3 AMP CHARGER	6 AMP CHARGER	10 AMP CHARGER	20 AMP CHARGER
	VOLTAGE	% OF CHARGE				
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

NOTE

*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)

2. Remove the battery from the motorcycle and place on a level surface.

⚠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)

CAUTION

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged.

3. Connect the red battery charger lead to the positive (+) terminal of the battery.
4. Connect the black battery charger lead to the negative (–) terminal of the battery.

NOTE

If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.

5. 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)

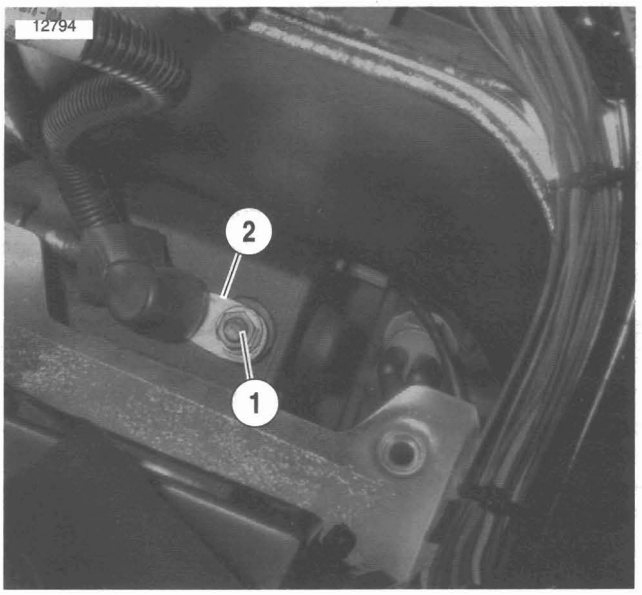
6. After the battery is fully charged, disconnect the black battery charger lead to the negative (–) terminal of the battery.
7. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
8. Mark the charging date on the battery.
9. Perform either a conductance test or load test to determine the condition of the battery. See Conductance Test or Load Test in this section.
10. If charging battery because voltmeter test reading was below 12.6 V, perform voltmeter test. See Voltmeter Test in this section.

ROUTING PROCEDURE

⚠WARNING

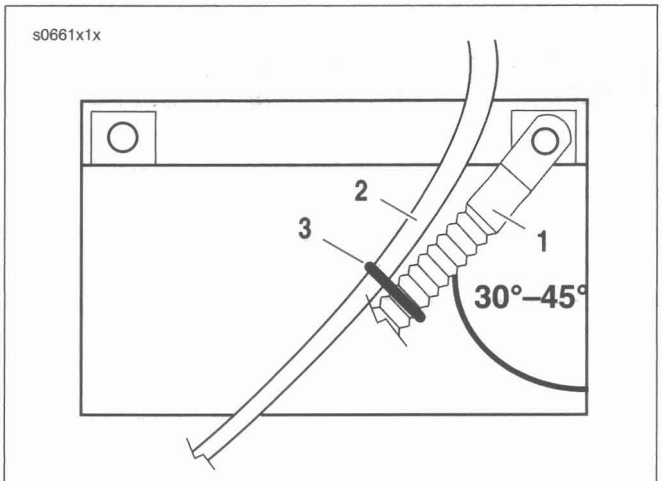
Make sure the starter solenoid terminal that is connected to the positive (+) battery cable is securely covered by the rubber boot. An uncovered terminal could short against other components resulting in sparks. These sparks could cause a fire or battery explosion which could result in death or serious injury.

1. See Figure 8-32. Install positive cable.
2. Install positive cable to starter post with nut. Orient terminal so cable faces away (towards left side of motorcycle).
   c. Tighten nut to 65-80 **in-lbs** (7.3-9.0 Nm).
   d. Cover nut with protective rubber boot.
3. Install battery. See 1.5 BATTERY MAINTENANCE.
4. See Figure 8-32. Route positive cable.
   a. Thread screw into battery positive terminal. Orient positive battery cable at an angle of between 30° and 45° to edge of battery case so that cable angles toward centerline of vehicle.
   b. Make certain that rear oxygen sensor harness is not pinched between positive battery cable and oil tank.
   c. Tighten battery positive terminal screw to 60-96 in-lbs (6.8-10.9 Nm).



1. **Nut with washer (metric)**
2. **Positive battery cable ring terminal**

Figure 8-31. Starter terminal



1. **Positive Battery cable**
2. **Rear oxygen sensor wire**
3. **Cable tie**

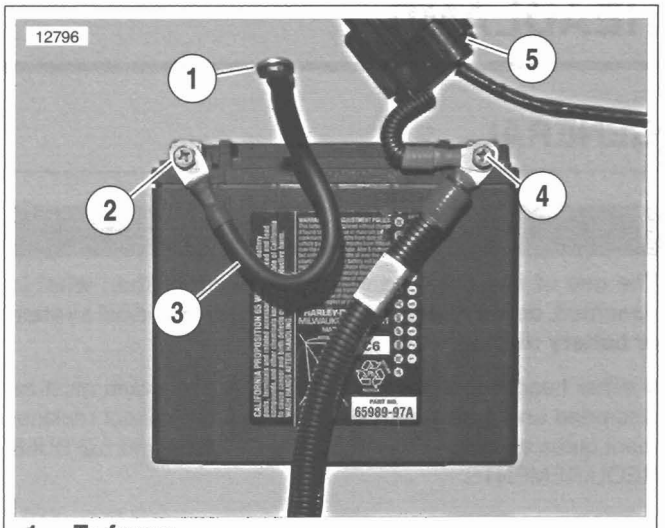
Figure 8-32. Positive Battery Cable Routing

5. See Figure 8-33. Install negative cable.
   a. Make a U-shaped loop in free end of negative battery cable (3), orienting cable so ring terminal points upward.
   b. Slide this loop down in front of battery. Insert second battery terminal screw through ring terminal on negative (-) battery cable.
   c. Route negative battery cable towards front of vehicle as shown.
   d. Install negative cable to frame (1) with bolt.

⚠WARNING

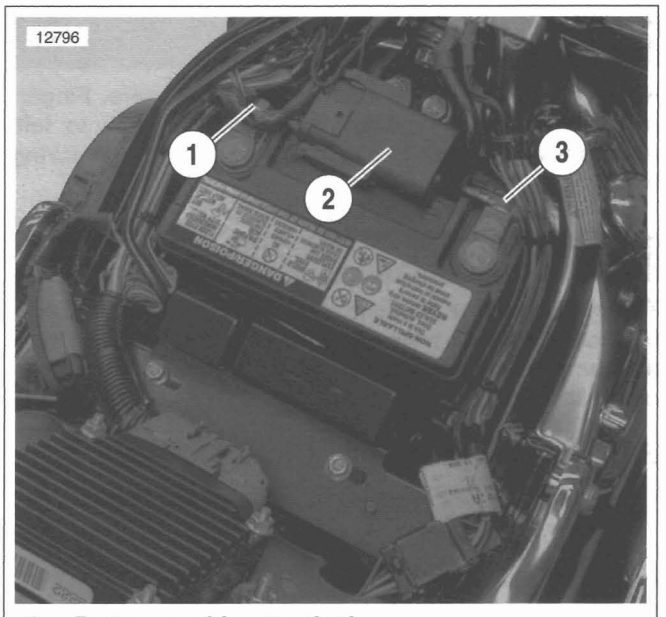
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.



1. To frame
2. Negative battery terminal
3. Negative battery cable
4. Positive battery terminal
5. Main fuse

Figure 8-33. Negative Battery Cable Routing



1. Battery positive terminal
2. Main fuse location
3. Battery negative terminal

Figure 8-34. Battery Terminals

GENERAL

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.

NOTES

- *When reassembling headlamp, make sure slots and tabs in headlamp, mounting ring, and trim ring are aligned.*
- *Mounting block on FXSTC models is installed in reverse direction from FXSTD and FLSTSC.*

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.

⚠WARNING

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, FXSTC 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.
3. 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.
5. Pivot wire retaining clip away from bulb. Replace old bulb with **new** bulb.
6. Assemble headlight components. See 1.26 HEADLAMP ALIGNMENT to adjust light beam.

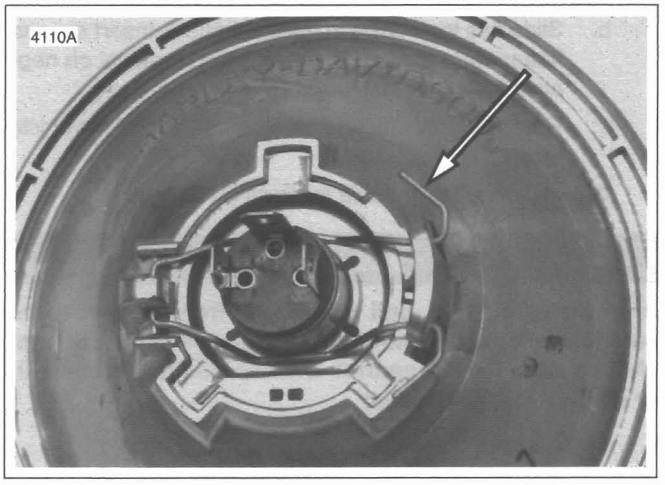


Figure 8-35. Wire Retaining Clip

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.
3. 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.
5. Pivot wire retaining clip away from bulb. Replace old bulb with **new** bulb.
6. Assemble headlight components. See 1.26 HEADLAMP ALIGNMENT to adjust light beam.

FLSTC, FLSTF and FLSTN Models

1. 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.
4. Remove rubber boot (2) from back of headlamp assembly (4).
5. See Figure 8-35. Squeeze wire retaining clip ends to unhook them from notches in headlamp assembly.
6. Pivot wire retaining clip away from bulb. Replace old bulb with **new** bulb.
7. Assemble headlight components. See 1.26 HEADLAMP ALIGNMENT to adjust light beam.

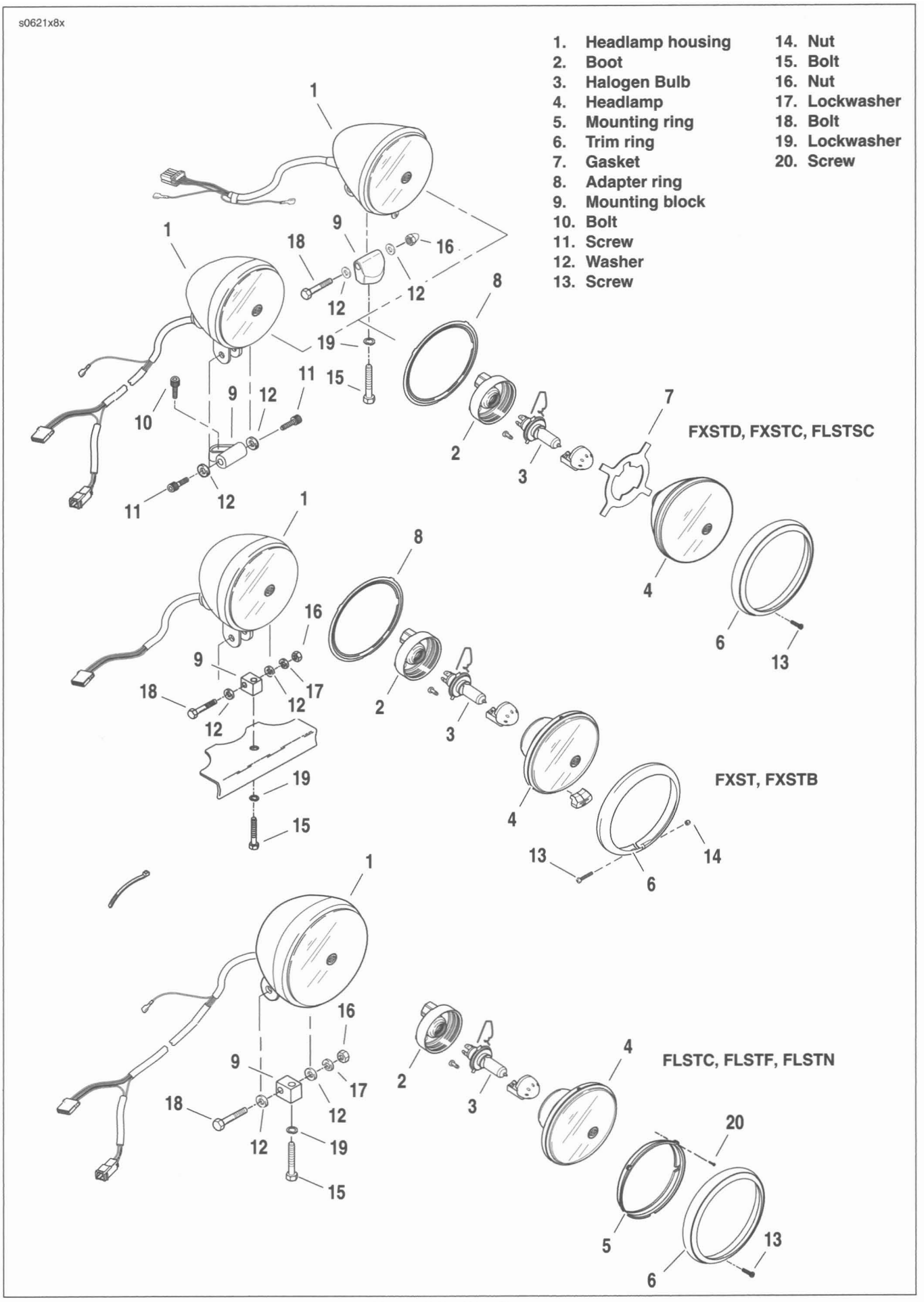


Figure 8-36. Headlamps

GENERAL

FLSTC and FLSTF Softail models are equipped with a tail lamp that uses a mini harness and circuit board to simplify replacement.

The FXSTC, 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.
2. Depress locking tab and remove 4-Pin multilock connector from circuit board.
3. Rotate bulb socket 1/4 turn in a counterclockwise direction and remove from tail lamp assembly. Gently pull bulb from socket.
4. 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
7. Install lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm).

⚠WARNING

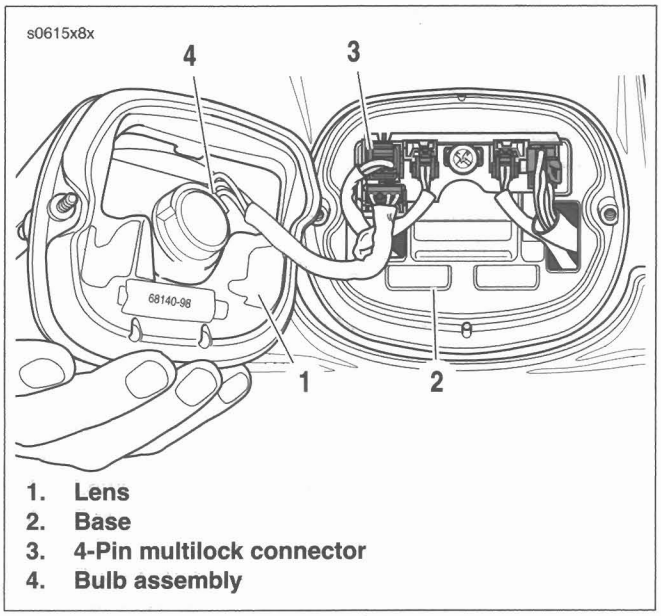
Be sure that all lights and switches operate properly before operating motorcycle. Low visibility of rider can result in death or serious injury. (00316a)

8. Turn ignition on and test for proper tail lamp operation.

BASE REPLACEMENT

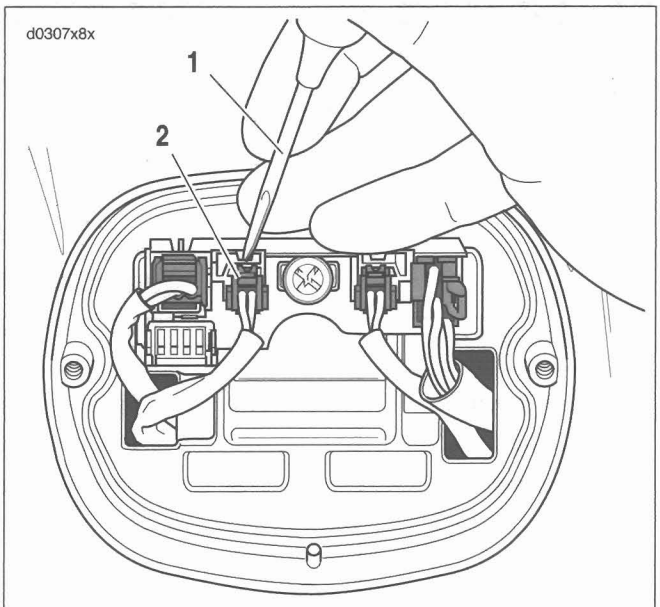
PART NO.	SPECIALTY TOOL
HD-41475-100	Terminal pick tool

1. Remove two screws and lens from base.
2. Depress locking tab and remove 4-Pin multilock connector from circuit board.
3. 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.
4. See Figure 8-39. Remove screw, pin housing and circuit board from base.
5. Remove base from rear fender.



1. **Lens**
2. **Base**
3. **4-Pin multilock connector**
4. **Bulb assembly**

Figure 8-37. Tail Lamp: FLSTC, FLSTF



1. **Terminal pick**
2. **2-Pin connector**

Figure 8-38. Removing 2-Pin Connectors

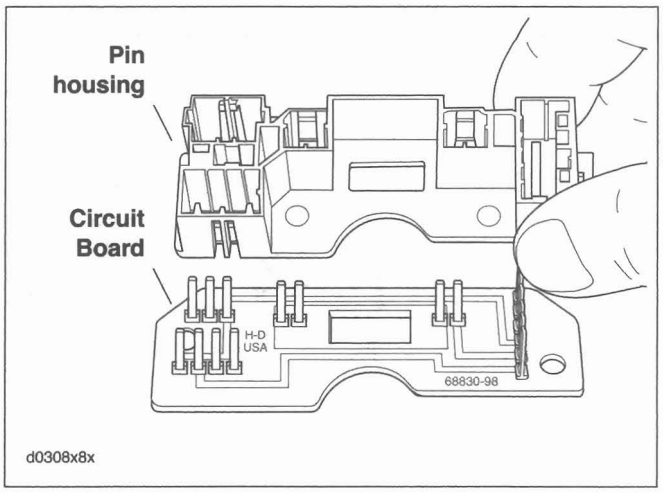


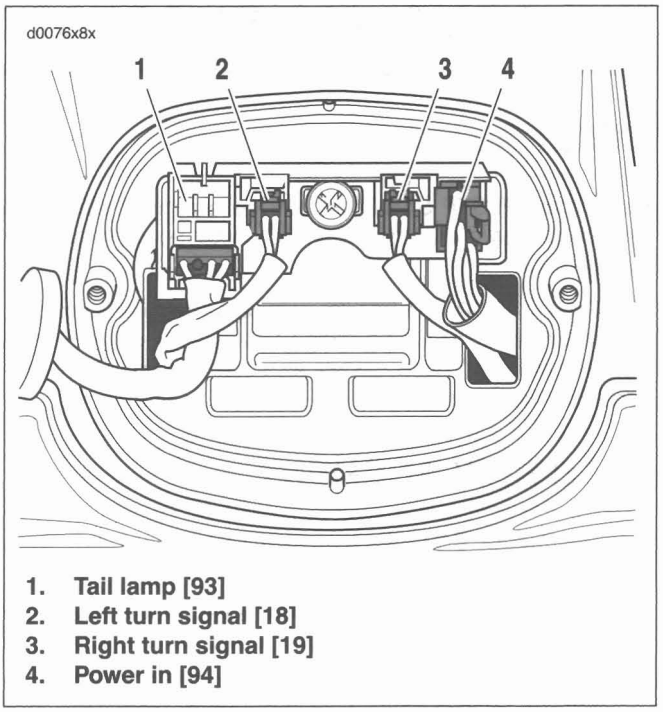
Figure 8-39. Pin Housing and Circuit Board

6. Install **new** base to rear fender. Install circuit board/pin housing to base with screw, nut and washer. Tighten screw to 40-48 **in-lbs** (4.5-5.4 Nm).
7. See Figure 8-40. Install connectors to circuit board.
8. Install lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm).

⚠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)

9. Turn ignition on and test for proper tail lamp and turn signal operation.



1. **Tail lamp [93]**
2. **Left turn signal [18]**
3. **Right turn signal [19]**
4. **Power in [94]**

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.

Table 8-6. Tail Lamp Wires

FUNCTION	NO.	TYPE	WIRE COLOR	CAVITY
Right turn signal	[19]	2-pin Multilock	V/BN	1
			BK	2
Left turn signal	[18]	2-pin Multilock	V/BN	1
			BK	2
Tail lamp	[93]	4-pin Multilock	BE	1
			HDI only-O/W or open on domestic models	2
			R/Y	3
			BK	4
Power in	[94]	6-pin Multilock	O/W	1
			BN (V on FXST/S/B)	2
			BE	3
			R/Y	4
			V (BN ON FXST/S/B)	5
			BK	6

REMOVAL

1. 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.

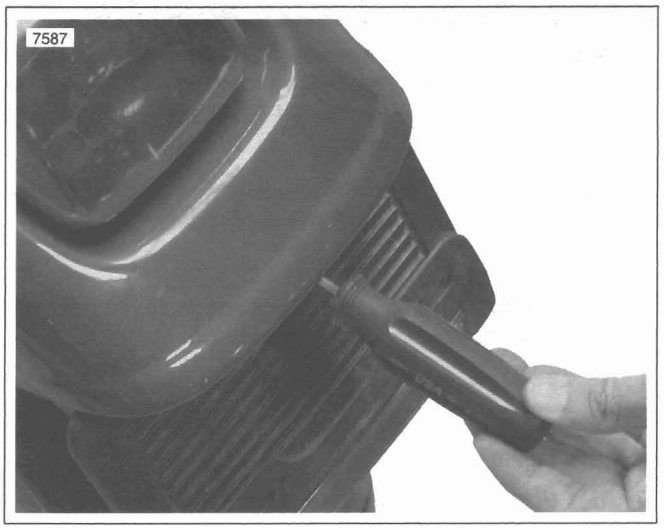
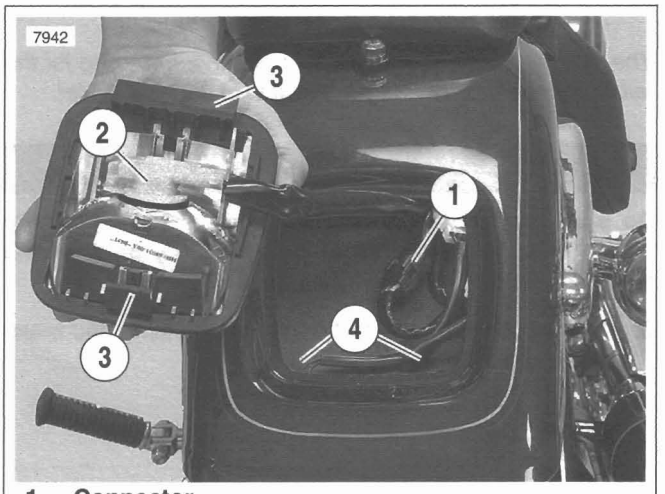


Figure 8-41. Removing Tail Lamp



1. **Connector**
2. **Tail lamp bulb housing**
3. **Clips**
4. **License plate bulbs (2)**

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.
   a. 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)

3. Turn ignition ON and test for proper tail lamp and brake lamp operation.

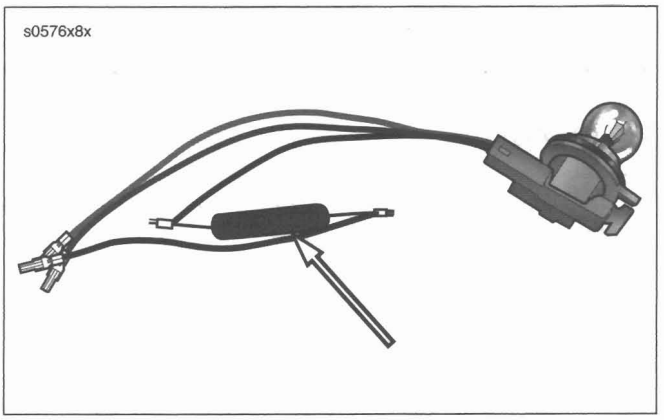


Figure 8-43. Tail Lamp Resistor

BULB REPLACEMENT

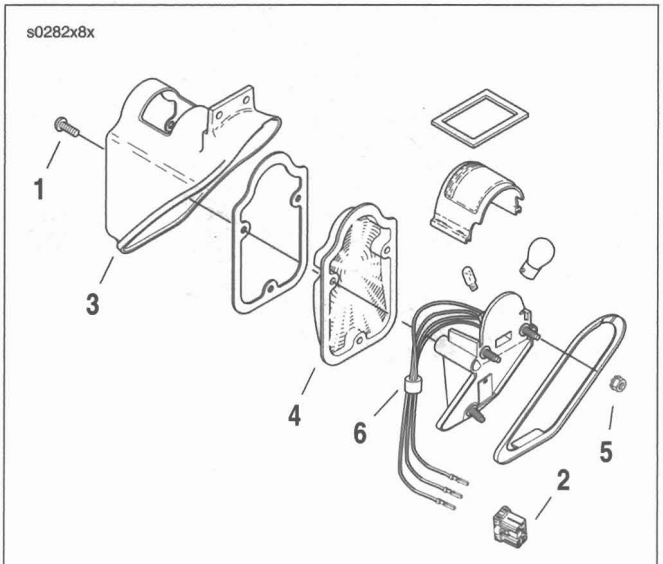
See Figure 8-44. To change a bulb, remove the lens, turn the bulb 1/4 turn while pressing the bulb into the housing, and remove the bulb. Replace the bulb and install the lens.

NOTE

If after replacing a bulb, the tail lamp will not light, check the wiring, the ground at the socket, and/or the switch.

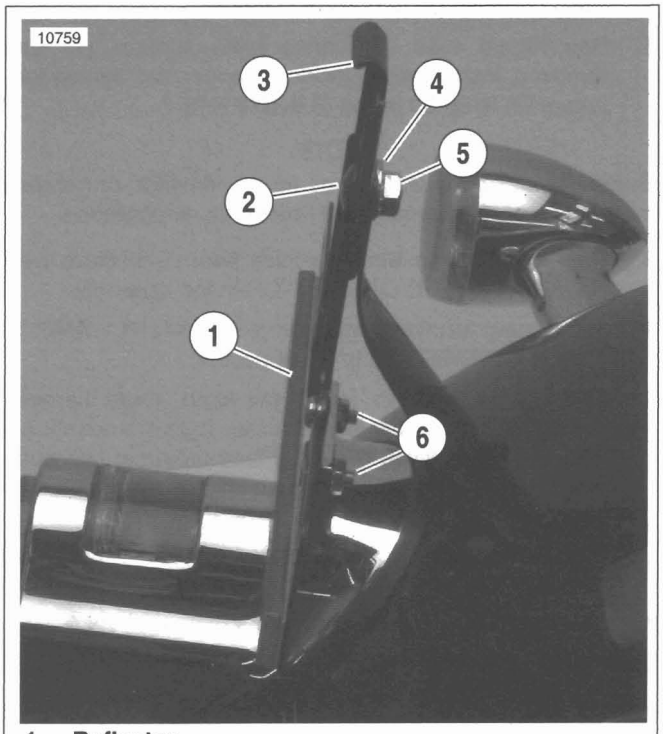
TAIL LAMP REPLACEMENT

1. Remove rear fender. See 2.36 REAR FENDER: FLSTSC or 2.37 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).



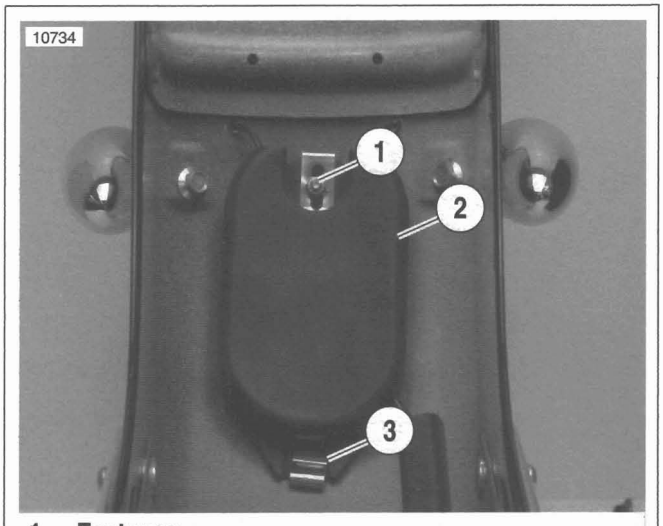
1. **Screws (3)**
2. **Tail lamp connector**
3. **Lamp housing**
4. **Lens**
5. **Nuts (3)**
6. **Rubber grommet**

Figure 8-44. Tail Lamp Assembly: FLSTSC



1. **Reflector**
2. **Bolt**
3. **Clamp**
4. **Washer**
5. **Nut**
6. **Fasteners (2)**

Figure 8-45. License Plate Bracket



1. **Fastener**
2. **Tail Lamp Connector Cover**
3. **Clip**

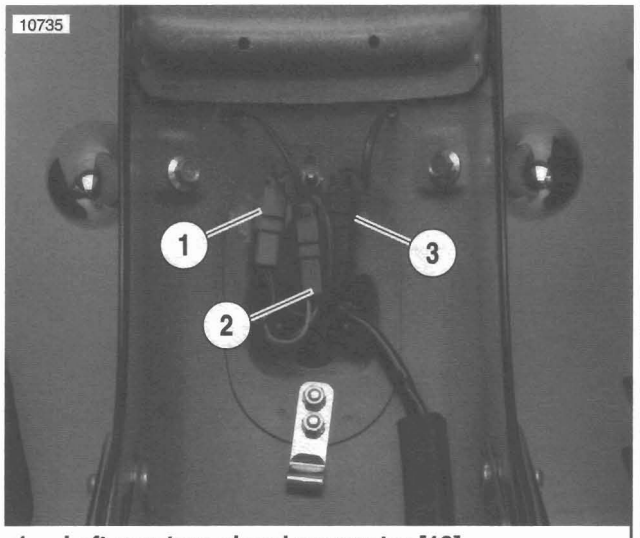
Figure 8-46. Tail Lamp Connector Cover

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.
8. 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

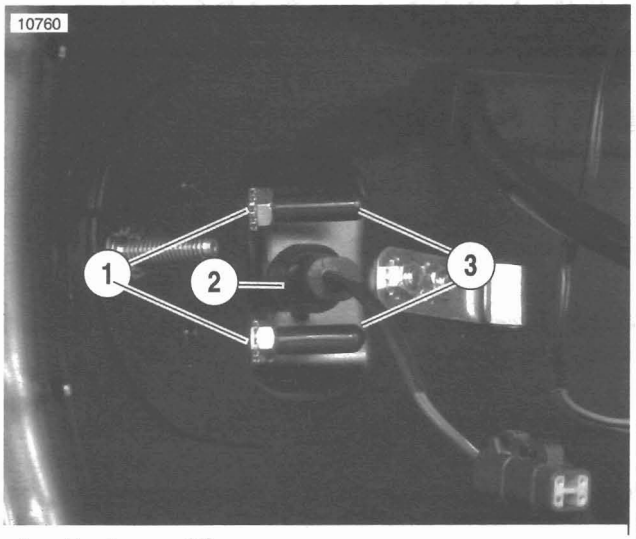
Before removing tail lamp wires from connector, or harness from fender clips, carefully note routing for reinstallation.

9. Remove tail lamp wire terminals from connectors. See B.1 AMP 1-PLACE CONNECTOR in the appendix.
10. Install **new** terminals into connector. See B.1 AMP 1-PLACE CONNECTOR 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.
12. 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).
14. 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).
15. 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).
16. Tighten license plate bracket fasteners to 30-50 **in-lbs** (3.4-5.6 Nm).



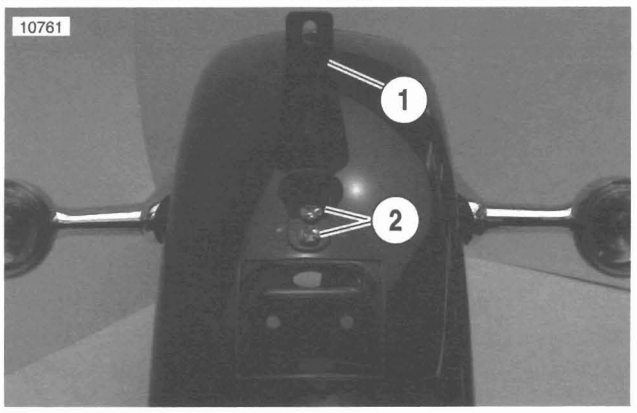
1. **Left rear turn signal connector [19]**
2. **Tail lamp connector [93]**
3. **Right rear turn signal connector [18]**

Figure 8-47. Tail Lamp Connector



1. **Fasteners (2)**
2. **Grommet**
3. **Plastic covers**

Figure 8-48. Tail Lamp



1. **License plate support**
2. **fasteners**

Figure 8-49. License Plate Support

AUXILIARY LAMP BULB

Removal

1. 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.

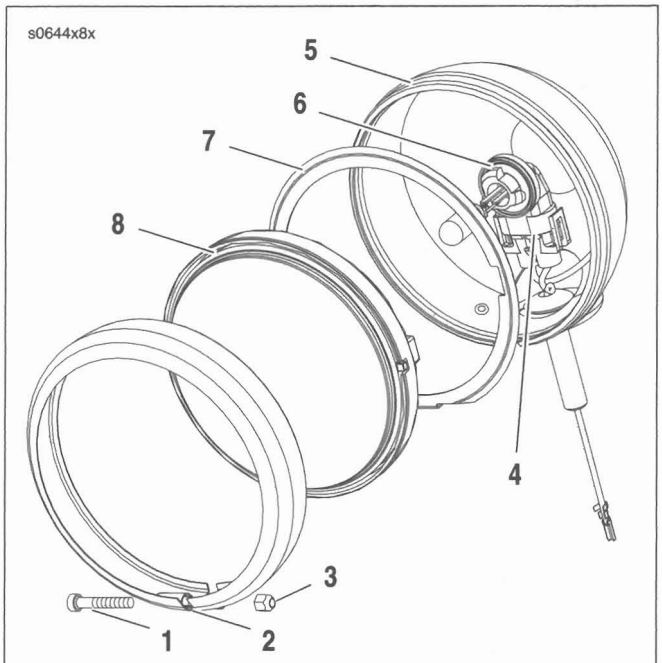
4. See Figure 8-51. Rotate bulb/pin housing 1/4 turn in a counterclockwise direction and remove from auxiliary lamp. Discard bulb/pin housing.

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.
2. 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).
4. 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.
6. 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.



1. **Trim ring fastener**
2. **Trim ring**
3. **Nut**
4. **Connector**
5. **Auxiliary lamp housing**
6. **Bulb**
7. **Nesting ring**
8. **Auxiliary lamp**

Figure 8-50. Auxiliary Lamp Bulb: Typical

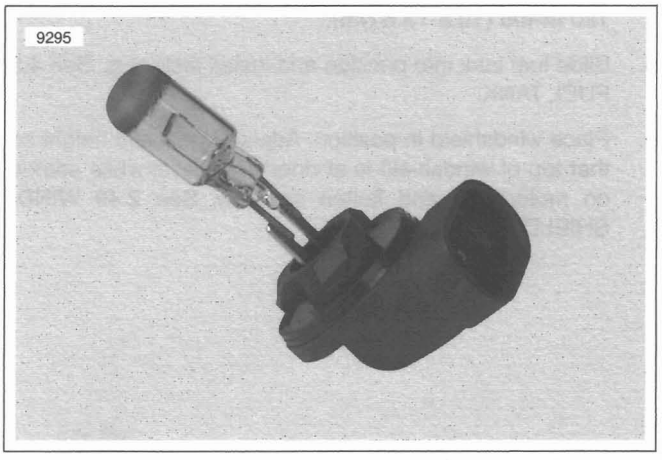


Figure 8-51. Auxiliary Lamp Bulb/Pin Housing

Auxiliary Lamp Bracket Removal

1. Detach quick release windshield. See 2.49 WINDSHIELD: FLSTC.
2. Detach wiring.
   a. Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.5 FUEL TANK.
   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.
3. 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

1. 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.
2. Attach auxiliary lamp housings (11) 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 (6, 7) to 72-120 **in-lbs** (10.8-13.6 Nm).
5. Slide fuel tank into position and install fasteners. See 4.5 FUEL TANK.
6. 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 2.49 WINDSHIELD: 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].
   a. Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.5 FUEL TANK.
   b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
   c. Remove auxiliary lamp terminals. See B.1 AMP 1-PLACE CONNECTOR in the appendix.
3. Remove appropriate terminal(s) from socket housing.
4. 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.
2. Push lamp wires back into the vinyl conduit. Insert wire terminals into connector. Route the harness back into position and mate connectors.
3. 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).

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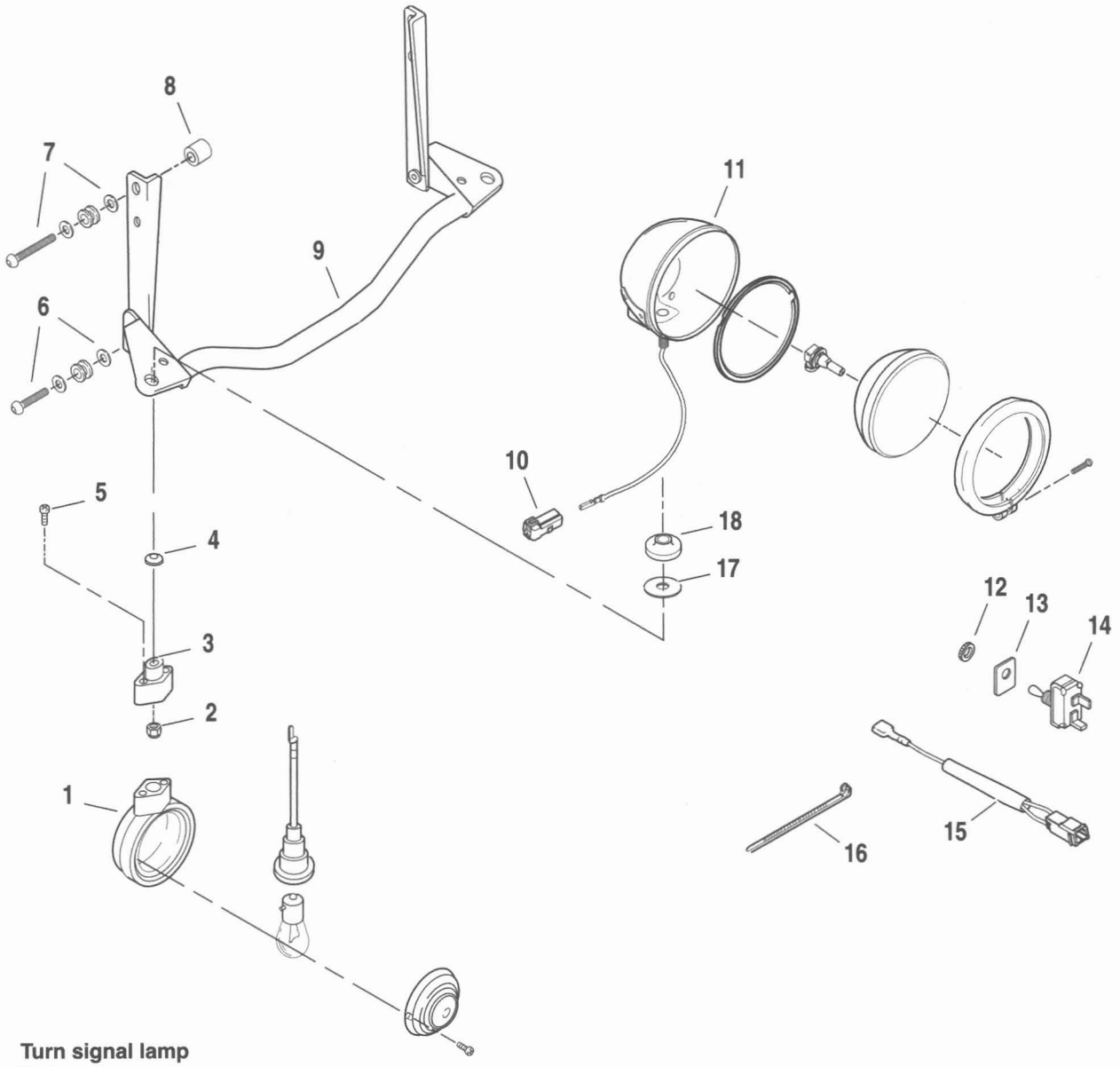


1. Turn signal lamp
2. Nut
3. Mounting bracket
4. Clamp block
5. Screw
6. Bracket hardware, upper
7. Bracket hardware, lower
8. Spacer
9. Lamp bracket
10. Auxiliary lamp connector
11. Auxiliary lamp housing
12. Toggle switch nut
13. Label
14. Toggle switch
15. Auxiliary lamp wiring harness
16. Cable strap
17. Belleville Washer
18. Swivel block

Figure 8-52. Auxiliary Lamp Bracket: FLSTC

Auxiliary Lamp Bracket Removal

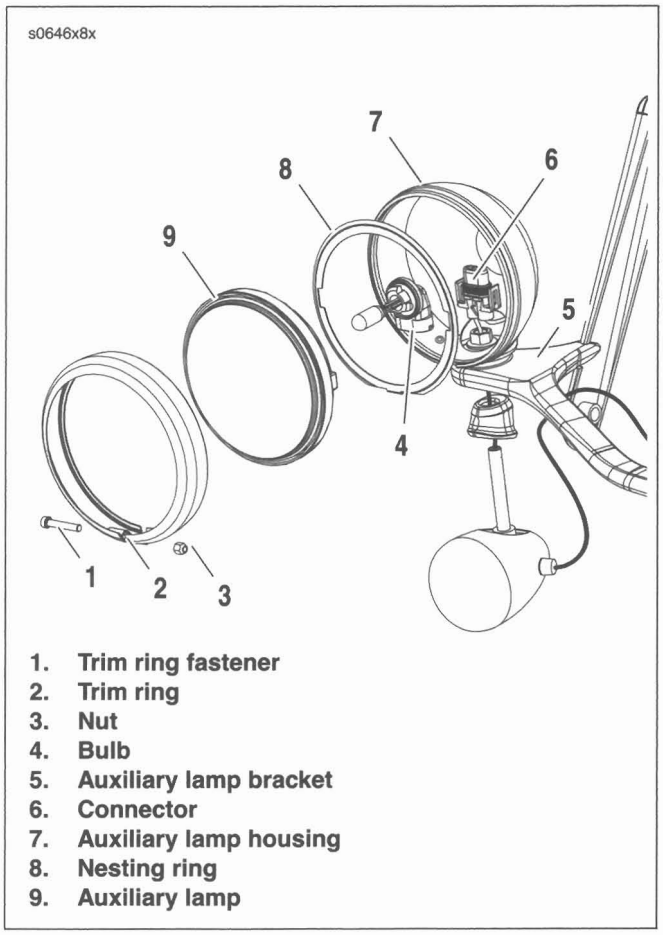
1. Detach wiring.
   a. Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.5 FUEL TANK
   b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
   c. Disconnect 6-place Multilock front turn signal connector [31] under fuel tank.
2. See Figure 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.

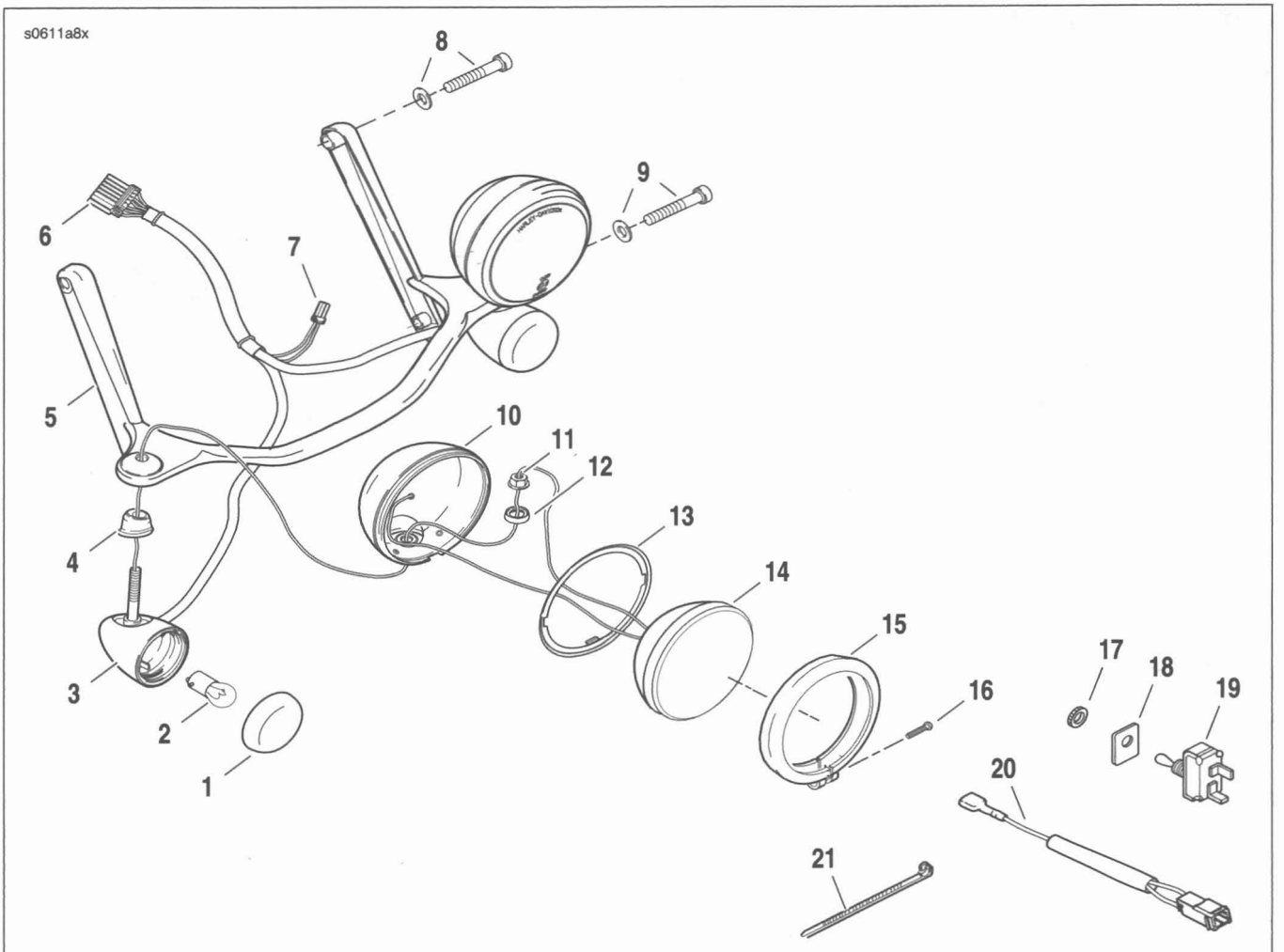
Auxiliary Lamp Bracket Installation

1. See Figure 8-54. Place auxiliary lamp bracket (5) in position. Loosely install upper and lower bracket hardware (8, 9).
2. 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 4.5 FUEL TANK.



1. **Trim ring fastener**
2. **Trim ring**
3. **Nut**
4. **Bulb**
5. **Auxiliary lamp bracket**
6. **Connector**
7. **Auxiliary lamp housing**
8. **Nesting ring**
9. **Auxiliary lamp**

Figure 8-53. Auxiliary Lamp Bulb: Typical



1. Turn signal lens
2. Turn signal bulb
3. Turn signal lamp
4. Adapter (2)
5. Auxiliary lamp bracket
6. Main harness connector [31]
7. Auxiliary lamp connector [73]
8. Bracket hardware, upper (2)
9. Bracket hardware, lower (2)
10. Auxiliary lamp housing
11. Nut (2)
12. Collar (2)
13. Nesting ring (2)
14. Auxiliary lamp
15. Trim ring
16. Trim ring fastener
17. Toggle switch nut
18. Label
19. Toggle switch
20. Auxiliary lamp wiring harness
21. Cable strap

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].
   a. Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.5 FUEL TANK.
   b. Disconnect 2-place Multilock auxiliary lamp connector [73] under fuel tank, left side.
   c. Remove auxiliary lamp terminals. See B.1 AMP 1-PLACE CONNECTOR in the appendix.
3. Remove appropriate terminal(s) from auxiliary lamp bulb socket housing.
4. 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.

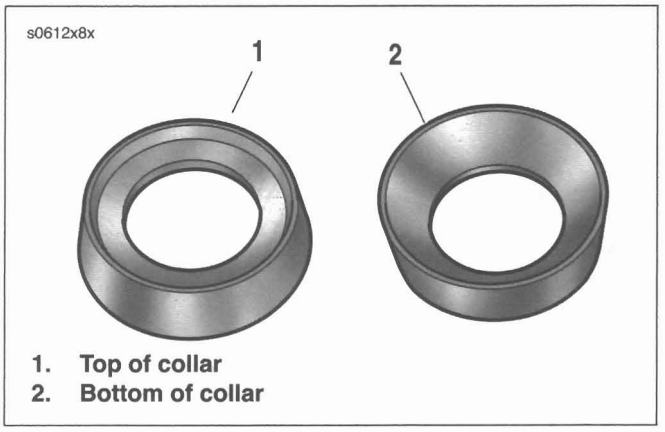
Auxiliary Lamp Housing Installation

1. 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.
6. 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.



1. Top of collar
2. Bottom of collar

Figure 8-55. Collar

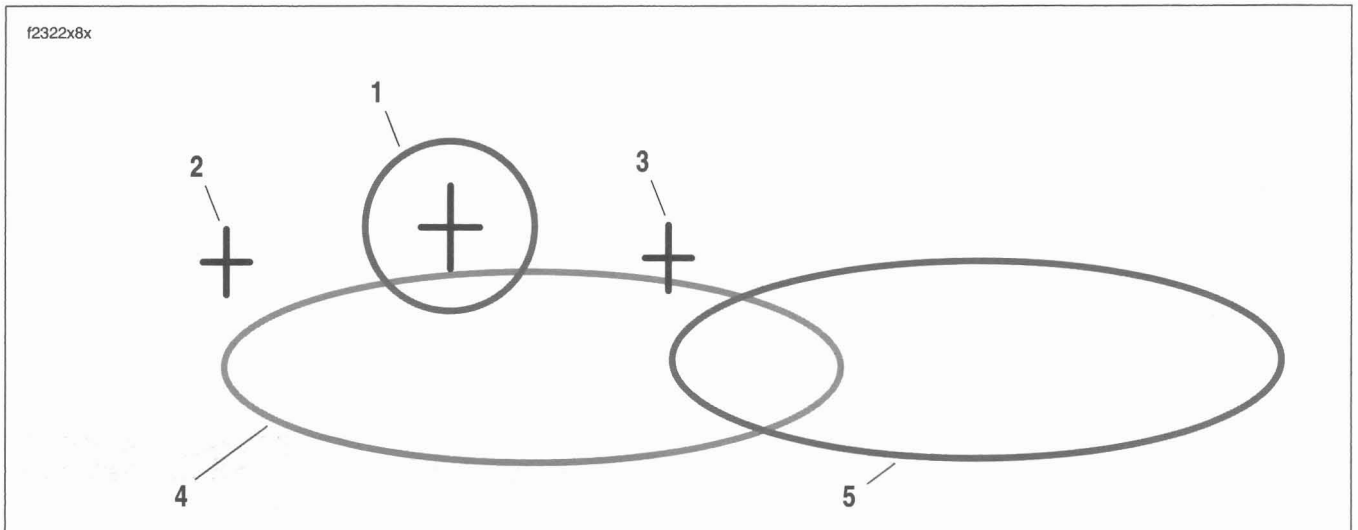
ADJUSTMENT: FLSTC/FLSTN MODELS

1. Check headlamp alignment. Adjust if necessary. See 1.26 HEADLAMP ALIGNMENT.
2. 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.
5. 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.
6. Repeat measurements performed in previous step on right side auxiliary lamp.
7. 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).
8. 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.
9. 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).
10. 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.
    a. See Figure 8-52. Loosen screws (5) to detach turn signal lamps (1) from mounting bracket (3).
    b. 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.
    a. See Figure 8-54. Loosen trim ring fastener (16) and remove trim ring (15) from auxiliary lamp housing (10).

NOTE

In next step, be sure to minimize auxiliary lamp movement while tightening. If excessive movement is permitted, auxiliary lamp aim will be incorrect.

    b. 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.



1. **Adjust headlamp high beam for proper height and lateral alignment.**
2. **Locate left side auxiliary lamp relative to high beam centerlines.**
3. **Locate right side auxiliary lamp relative to high beam centerlines.**
4. **Adjust high intensity beam below and right of left side auxiliary lamp centerlines.**
5. **Adjust high intensity beam below and right of right side auxiliary lamp centerlines.**

Figure 8-56. Auxiliary Lamp Aiming

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.
3. Remove fuel tank fasteners and slide tank back to reveal connectors. See 4.5 FUEL TANK.

NOTE

Before removing wires from connector, or harness from frame, carefully note routing for reinstallation.

4. Disconnect connector [32B] and remove socket terminals from connector. See B.1 AMP 1-PLACE CONNECTOR in the appendix.
5. Cut cable straps as necessary and pull harness free.
6. 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.
2. Place harness into metal clip inside of fender and carefully close clip to hold harness in place.
3. 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.

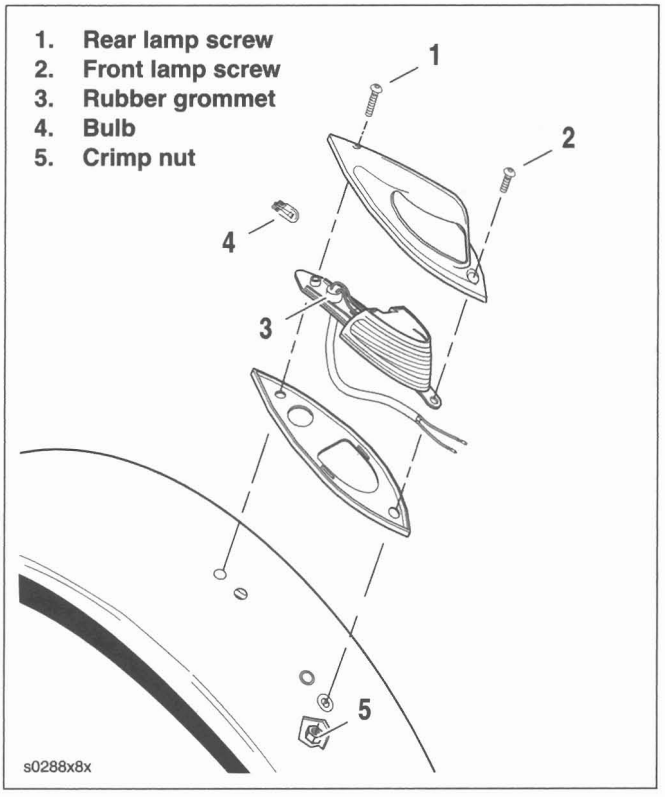


Figure 8-57. Fender Tip Lamp: FLSTSC

6. Tighten rear lamp screw (1) securely.
7. 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.
9. Insert terminals into connector and mate connector halves. See B.1 AMP 1-PLACE CONNECTOR in the appendix.
10. Slide fuel tank into position and install fasteners. See 4.5 FUEL TANK.
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 FLSTC

1. Locate notch on front or rear turn signal lens cap.
2. 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.
   c. Push **new** light bulb in and turn clockwise to lock in place.
4. Snap lens cap back into turn signal housing.

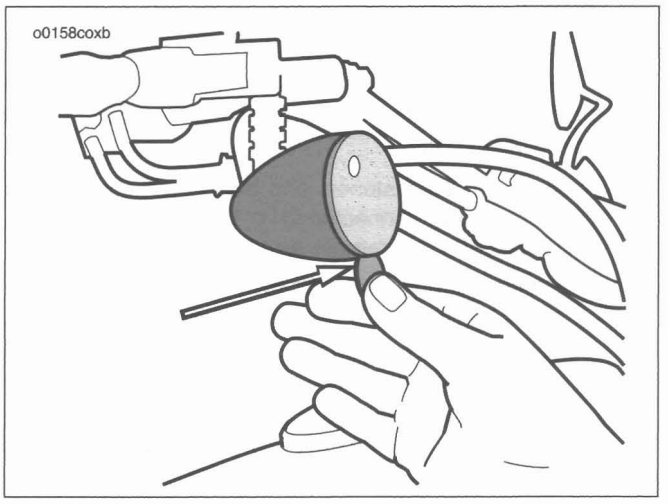


Figure 8-58. Lens Cap Removal

BULB REPLACEMENT: 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 8.21 AUXILIARY LAMPS: FLSTC/FLSTN for front turn signal replacement on FLSTC and FLSTN models. For all other models, follow the instructions below.

⚠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. Change turn signal following steps under Front Turn Signals: All But FLSTC, FLSTN, FLSTSC, FXSTC, Front Turn Signals: FLSTSC, FXSTC, Rear Turn Signals: All But FXSTD, FLSTSC, FLSTN or Rear Turn Signals: FXSTD.
3. Connect negative battery cable.

⚠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)

4. Turn ignition on and test for proper turn signal operation.

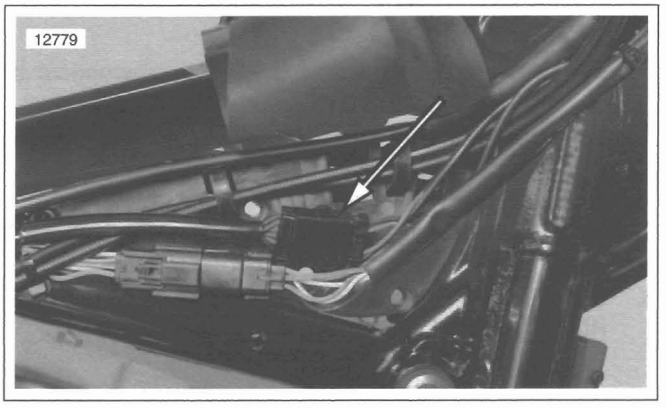


Figure 8-59. Front Turn Signal Connector [31]

Front Turn Signals: All But FLSTC, FLSTN, FLSTSC, FXSTC

1. Follow preliminary steps listed under LAMP REPLACEMENT, 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. Remove fuel tank fasteners and slide tank back to reveal front turn signal connector [31]. See 4.5 FUEL TANK. Disconnect [31] and remove terminals.
3. Detach front turn signals from mounting point.
   a. 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.
   c. For all models, remove wire terminals from turn signal connectors.
4. Install **new** front turn signal.
   a. 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 4.5 FUEL TANK.
6. Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

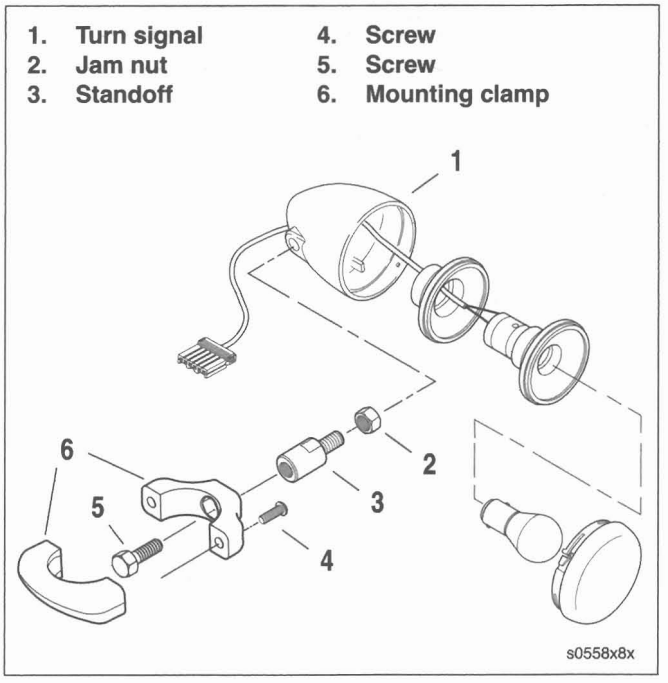


Figure 8-60. Front Turn Signals: FXSTB

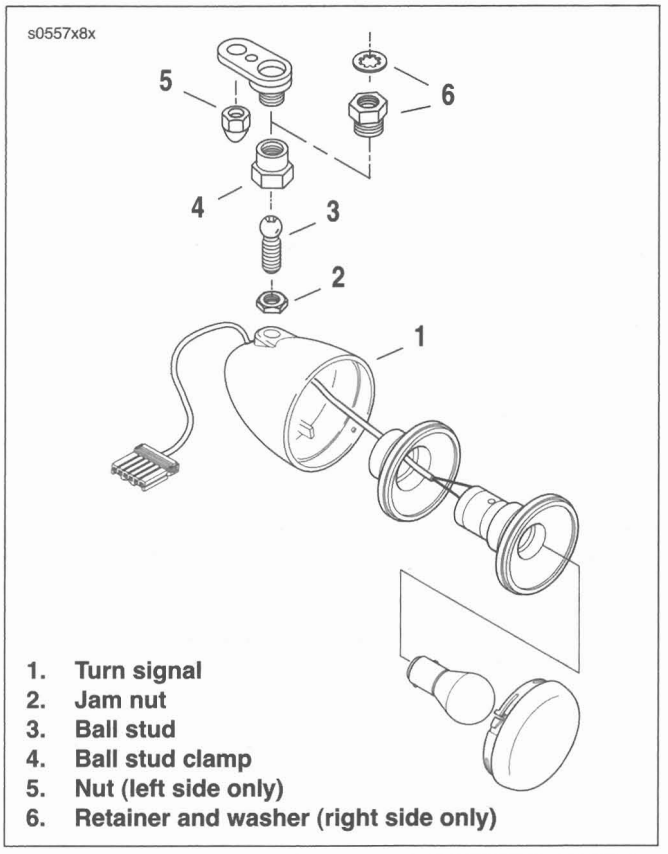


Figure 8-61. Front Turn Signals: FXST, FXSTD, FLSTF

Front Turn Signals: FLSTSC, FXSTC

1. Follow preliminary steps listed under LAMP REPLACEMENT, 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. Remove fuel tank fasteners and slide tank back to reveal front turn signal connector [31]. See 4.5 FUEL TANK. 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.
   a. 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.
   f. 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.
5. Slide fuel tank into position and install fasteners. See 4.5 FUEL TANK.
6. Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

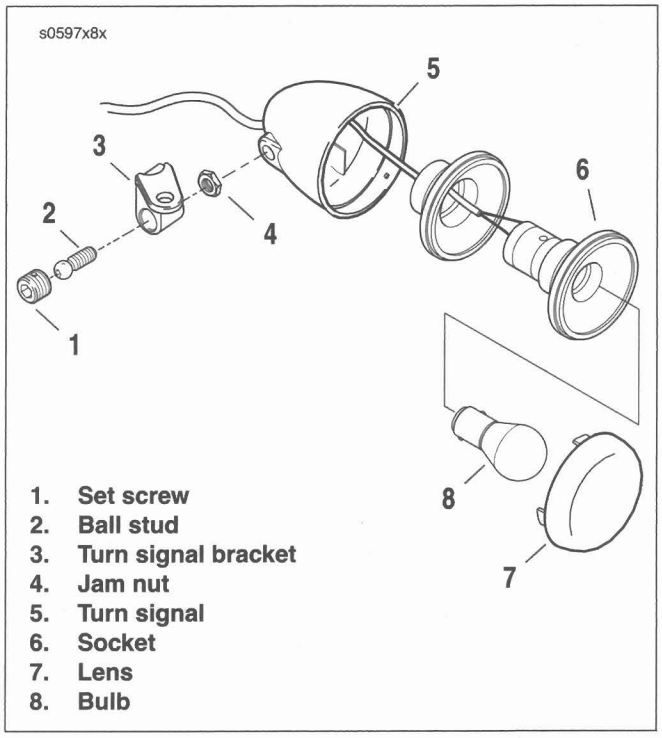


Figure 8-62. Front Turn Signals: FLSTS, FXSTC

Rear Turn Signals: All But FXSTD, FLSTSC, FLSTN

1. Follow preliminary steps listed under LAMP REPLACEMENT, 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.
   a. Disconnect right turn signal [18] and left turn signal [19] connectors from within tail lamp. See 8.18 TAIL LAMP: ALL BUT FXSTD/FLSTSC/FLSTN.
   b. Remove wire terminals from turn signal connectors.
3. Detach turn signal from mount.
   a. For FLSTC models, see Figure 8-63. Remove the screw (1) to detach turn signal from mount (2).
   b. For all other models, see Figure 8-64. Detach fender support hardware. See 2.34 REAR FENDER: FXST/FXSTB/FXSTC. Remove screw and washer (1) from inside fender support to detach turn signal from mount (2).
4. Install **new** rear turn signal.
   a. 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.
5. Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

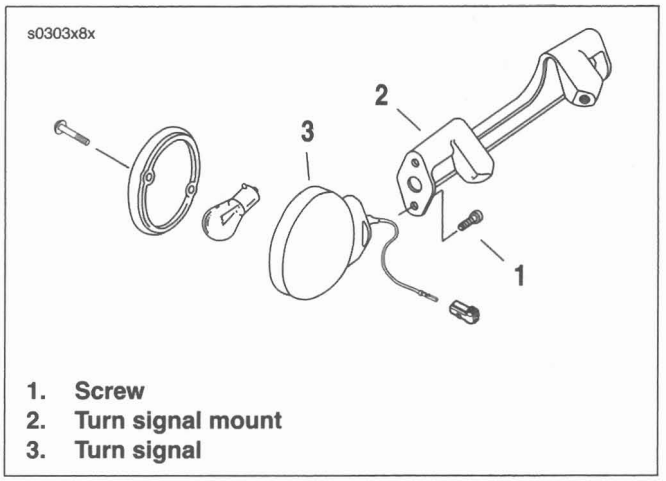
Rear Turn Signals: FXSTD

1. Follow preliminary steps listed under LAMP REPLACEMENT, GENERAL.

NOTE

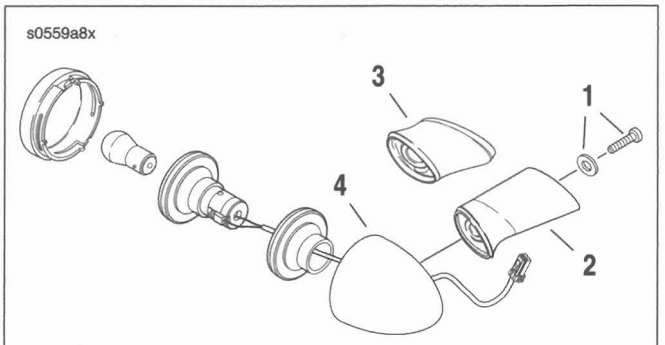
Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

2. Disconnect turn signal wiring.
   a. Remove tail lamp and disconnect the right and left 2-place turn signal connectors. See 8.19 TAIL LAMP: FXSTD.
   b. Remove wire terminals from turn signal connectors.
3. Remove fender support. See 2.35 REAR FENDER: FXSTD.



1. **Screw**
2. **Turn signal mount**
3. **Turn signal**

Figure 8-63. Rear Turn Signals: FLSTC



1. **Screw and washer**
2. **Turn signal mount: all but FLSTC, FXSTD**
3. **Turn signal mount: FXSTD**
4. **Turn signal**

Figure 8-64. Rear Turn Signals: All But FLSTC

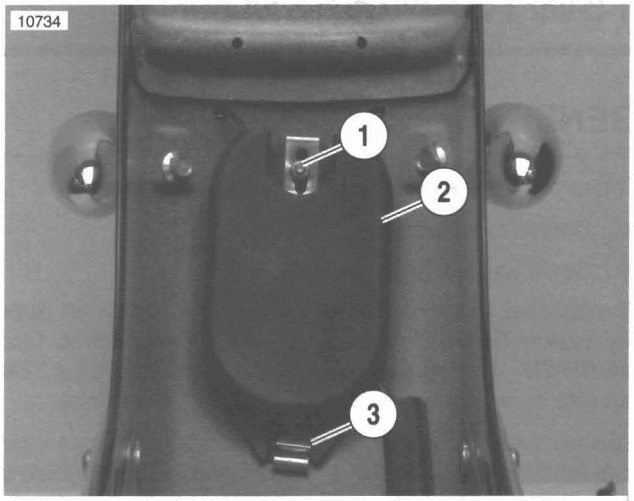
4. See Figure 8-64. Detach turn signal from mount (2) by removing screw and washer (1) from inside of fender support.
5. Install **new** rear turn signal.
   a. Attach signal to fender support using screw and washer (1). Tighten screw to 96-120 **in-lbs** (10.8-13.6 Nm).
   b. Install fender support. See 2.35 REAR FENDER: FXSTD.
   c. Route wiring to connector location and install terminals in connector. Attach connectors.
   d. Verify that turn signal points straight behind.
6. Continue with remaining instructions under LAMP REPLACEMENT, GENERAL.

Rear Turn Signals: FLSTSC

See 2.36 REAR FENDER: FLSTSC

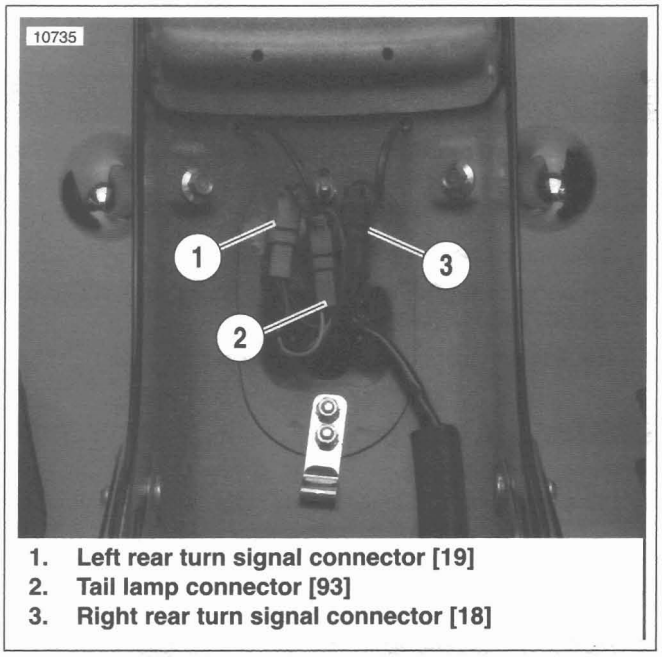
Rear Turn Signals: FLSTN

1. Remove rear fender. See 2.37 REAR FENDER: FLSTN.
2. See Figure 8-65. Remove fastener (1). Disengage tail 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.5 DEUTSCH 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.5 DEUTSCH 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-lbs** (6.8-10.2 Nm).



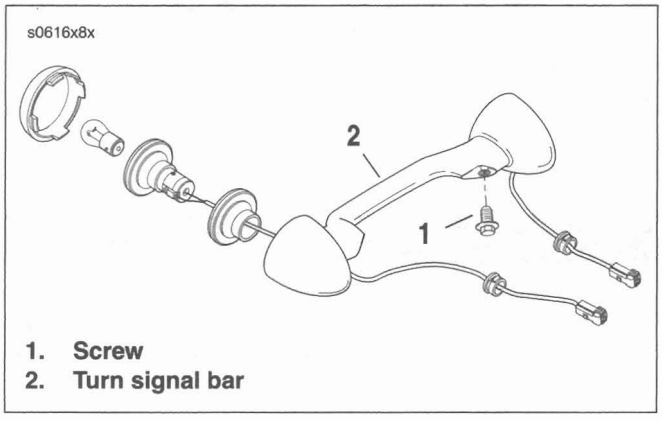
1. **Fastener**
2. **Tail Lamp Connector Cover**
3. **Clip**

Figure 8-65. Tail Lamp Connector Cover



1. **Left rear turn signal connector [19]**
2. **Tail lamp connector [93]**
3. **Right rear turn signal connector [18]**

Figure 8-66. Turn Signal Connectors



1. **Screw**
2. **Turn signal bar**

Figure 8-67. Rear Turn Signals: FLSTN

GENERAL

The turn signal module (TSM) has two major functions:

- Control turn signals.
- Serve as bank angle sensor.

The optional, factory-installed, Harley-Davidson Smart Security System (**H-DSSS**) includes a Hands-Free Security Module (**HFSM**) which provides the same functions as the TSM, but also includes security and immobilization functions.

Security systems sold in Japan and Korea meet those country's regulatory requirements. These systems are identified as Turn Signal Security Modules (**TSSM**) which provides the same functions as the TSM, but also includes security and immobilization functions.

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 8.3 ELECTRICAL PANEL.
4. Unplug turn signal module connector [30].

INSTALLATION

1. See Figure 8-68. Connect turn signal module connector [30]. Follow installation instructions under 8.3 ELECTRICAL PANEL.
2. Connect negative battery cable.

⚠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)

3. Test for correct operation.
4. 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.

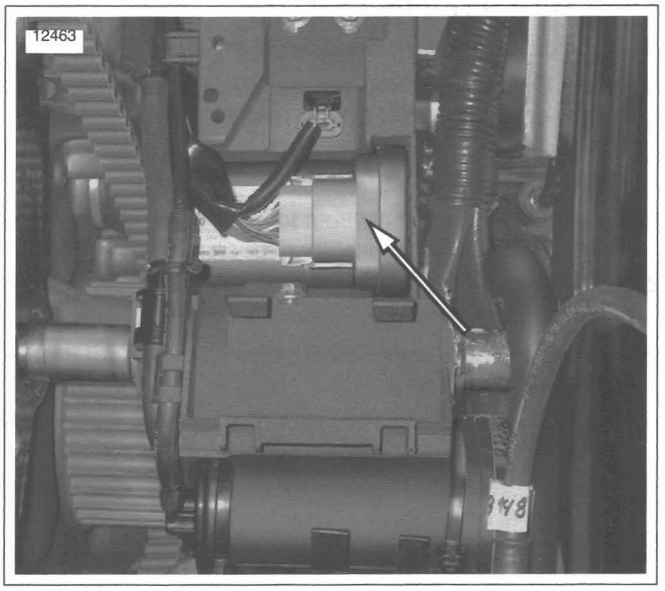


Figure 8-68. Turn Signal/Security Module Location

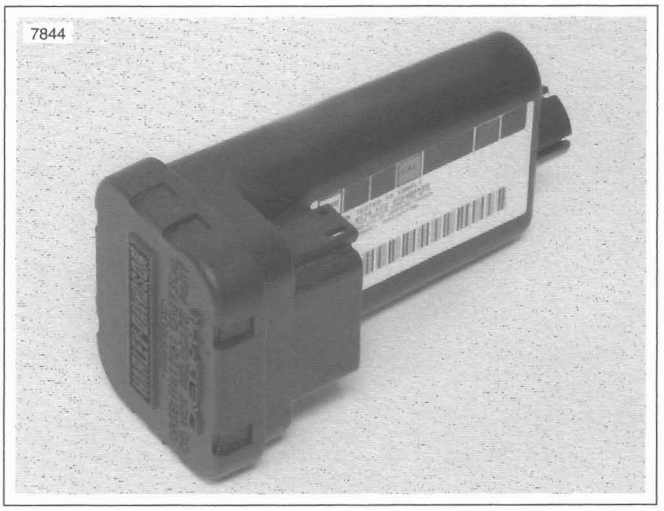


Figure 8-69. TSM/TSSM

TSM/TSSM CONFIGURATION

- After replacing TSSM, check if a password learning process is necessary. For more information, refer to Table 8-7. For information on the password learning procedure, see Softail Models Electrical Diagnostic Manual.
- After replacement of TSM/TSSM/HFSM, always perform key fob assignment and personal code entry. See Softail Models Electrical Diagnostic Manual.

Table 8-7. Password Learning Needed?

DEVICE REPLACED	IS PASSWORD LEARN NECESSARY?
ECM	Yes
TSM	No *
TSM/HFSM	Yes
* If a TSM has been replaced by a HFSM, or a HFSM has been replaced by a TSM, password learn **is** necessary.	

GENERAL

- The fuel gauge is mounted in a simulated left fuel tank cap. Remove by gently pulling upward. Do not twist.
- See Figure 8-70. 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

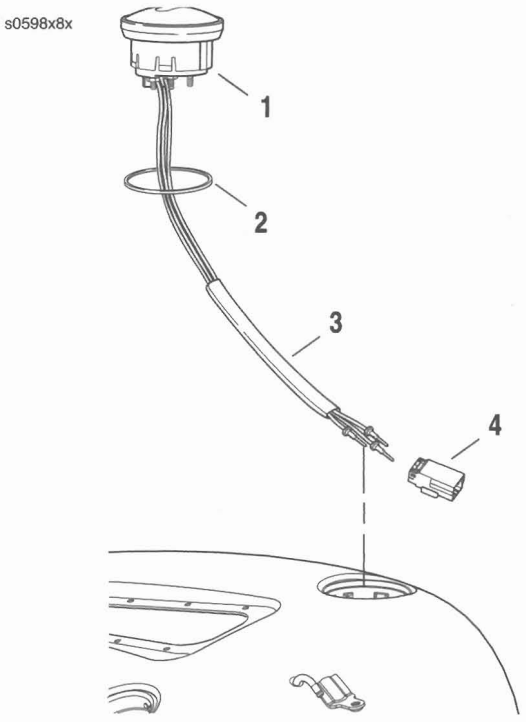
Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

3. Remove fuel tank fasteners and slide tank back to reveal fuel gauge connector [117]. See 4.5 FUEL TANK. Disconnect connector [117] and remove terminals.
4. See Figure 8-71. Disconnect wiring harness from connector [117]. See APPENDIX B–WIRING.
5. Remove fuel gauge wiring from clamp at bottom of fuel tank.

NOTE

Do not twist gauge and wiring during removal.

6. See Figure 8-70. Pull up on gauge (1). Remove gauge, gasket (2) and wiring from fuel tank. Discard gasket.



1. **Gauge**
2. **Gasket**
3. **Wiring harness**
4. **Connector [117]**

Figure 8-70. Fuel Gauge

INSTALLATION

1. See Figure 8-70. Install wiring harness (3) through **new** gasket (2).
2. Push wiring harness through tube in fuel tank.
3. 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 8-71. Install wiring into connector (4) [117]. Mate connector halves.
5. Slide fuel tank into position and install fasteners. See 4.5 FUEL TANK.
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 8-71. Fuel Gauge Connector [117] Location

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 8-72. Remove T27 TORX screw from front console mount.
4. See Figure 8-73. Remove two T25 TORX screws and washers (2) from rear mount (1).
5. See Figure 8-74. 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.

1. See Figure 8-74. 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.
   a. See Figure 8-73. Loosely install two T25 TORX screws and washers (2) in rear mount (1).
   b. See Figure 8-72. Loosely install T27 TORX screw in front console mount.
   c. Tighten both rear screws before tightening front screw. Torque to 30-40 **in-lbs** (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.

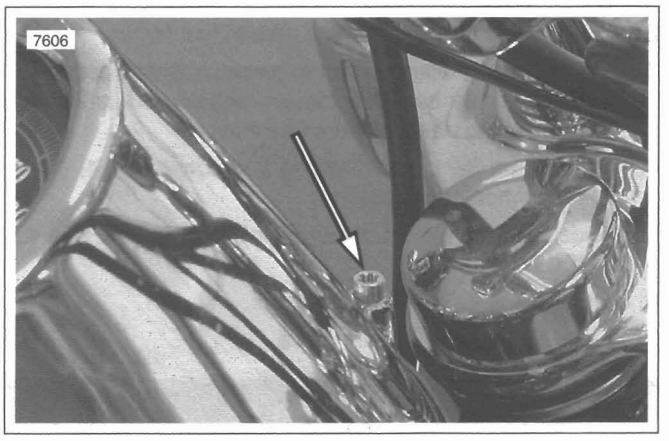
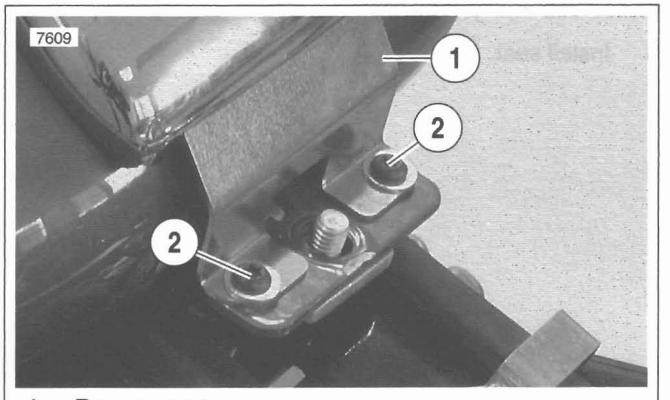
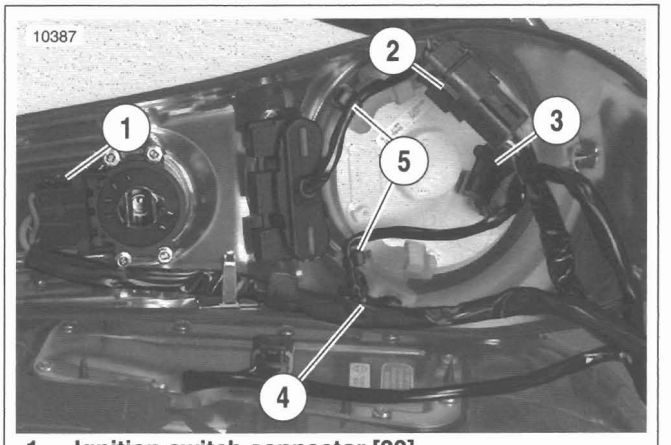


Figure 8-72. Front Console Screw



1. **Rear mount**
2. **T25 TORX screw and washer (2)**

Figure 8-73. 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 8-74. Console Wiring

REMOVAL

1. See Figure 8-75. 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.
4. 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 8-76. 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 8-75. Remove speedometer from console.
8. Remove gasket (3) from speedometer.

INSTALLATION

1. See Figure 8-75. Install gasket (3) to speedometer.
2. Position speedometer in console (5).
3. See Figure 8-76. Press on back clamp (3) until three tabs engage on back of speedometer.
4. See Figure 8-75. Insert odometer reset switch (6) through hole in console and install rubber boot.
5. Connect 12-place connector (2) [39] to speedometer under console.
6. 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.

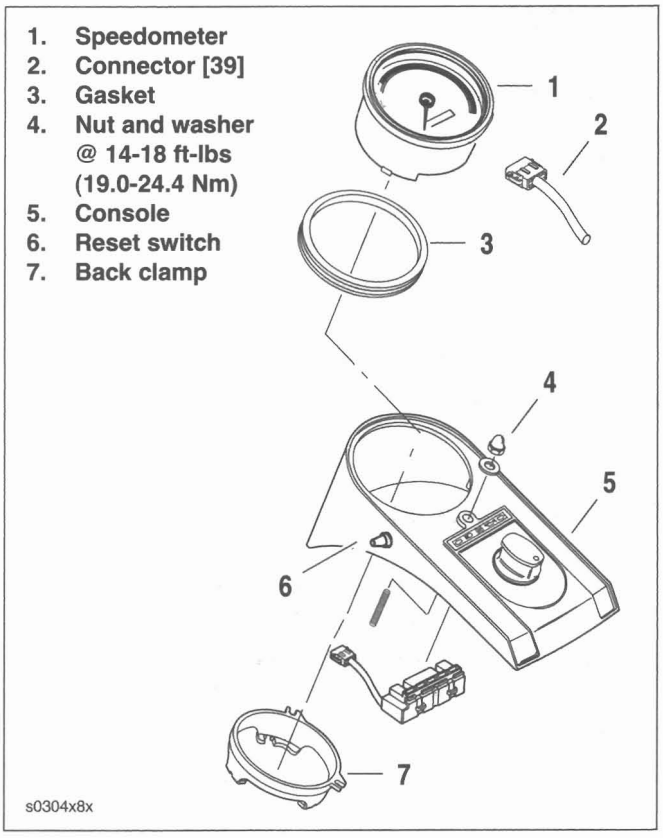
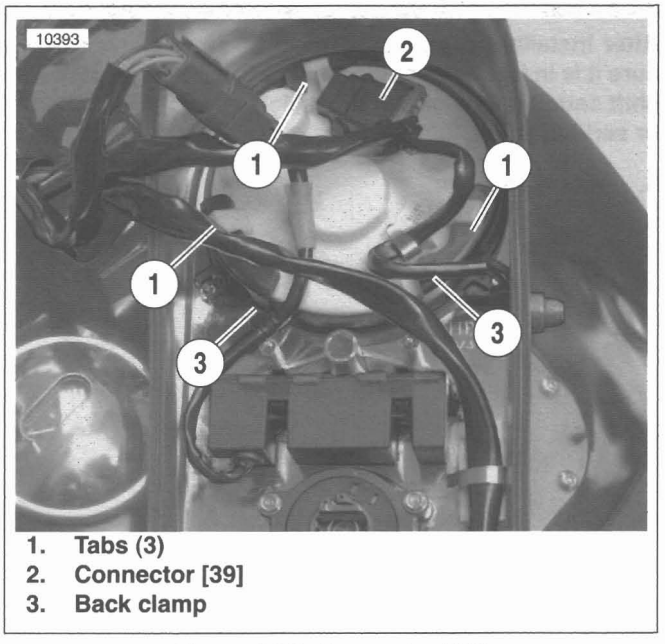


Figure 8-75. Speedometer: All But FXSTD



1. Tabs (3)
2. Connector [39]
3. Back clamp

Figure 8-76. Connector [39]

REMOVAL

1. Remove seat.
2. Remove instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD.
3. See Figure 8-77. Remove wiring for indicator lamps from cable straps (2) on back of speedometer.
4. Detach speedometer connector (3) [39].
5. Disengage retention clips (1) holding speedometer back clamp to instrument console.
6. See Figure 8-78. Disengage clips (1) to free speedometer from back clamp (2). Remove seal (3).

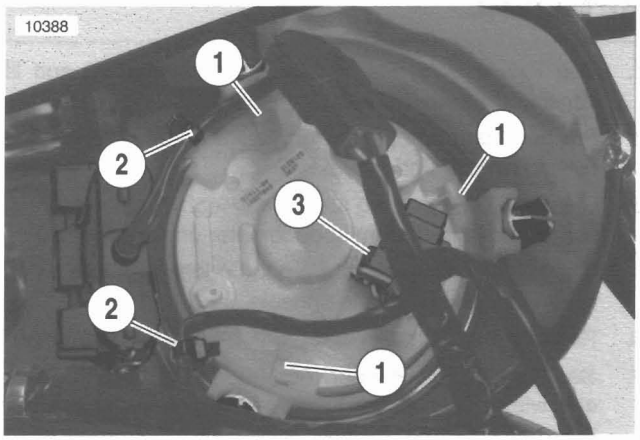
INSTALLATION

1. See Figure 8-78. Secure the speedometer inside back clamp (2) using clips (1). Install seal (3).
2. See Figure 8-77. 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].
5. Install instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD.

⚠WARNING

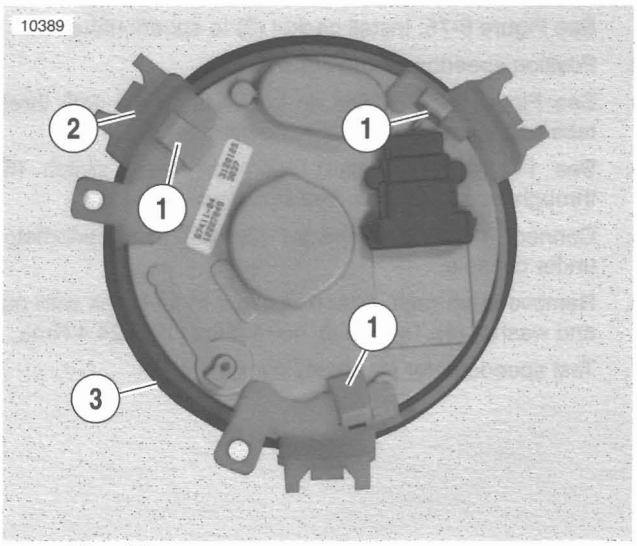
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

6. Install seat.



1. **Retention clip (3) on console**
2. **Cable strap (2)**
3. **Speedometer connector [39]**

Figure 8-77. Speedometer Mount: FXSTD



1. **Clips (3)**
2. **Back clamp**
3. **Seal**

Figure 8-78. Speedometer Clips

GENERAL

The vehicle speed sensor is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the TSM/TSSM/HFSM and speedometer through serial data.

The vehicle 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.
3. See Figure 8-79. Disconnect 3-place vehicle speed sensor connector [65].
4. See Figure 8-79. Remove sensor mounting bolt and lift sensor from transmission case.

INSTALLATION

1. See Figure 8-79. Install sensor into transmission case using mounting bolt. Tighten bolt to 84-108 **in-lbs** (9.5-12.2 Nm).
2. See Figure 8-79. Mate 3-place vehicle speed sensor connector [65].
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.

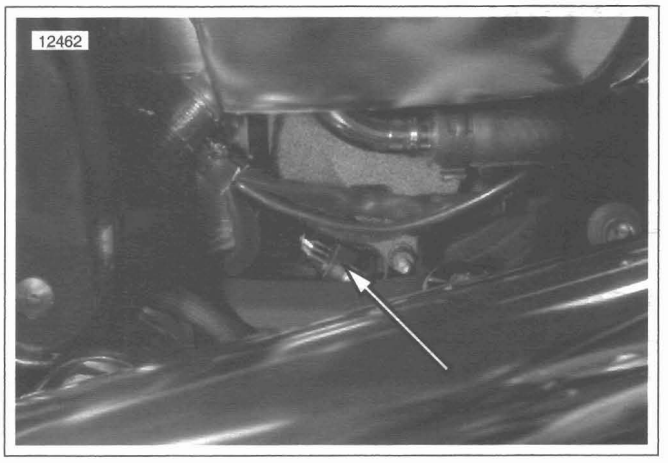


Figure 8-79. Vehicle Speed Sensor

GENERAL

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 8-80. 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 8-81. Squeeze clips together (2) and gently pry indicator lamp assembly (1) out of console from the side with a screwdriver.
3. Disconnect 8-place connector (3) [21] from indicator lamp assembly.

INSTALLATION

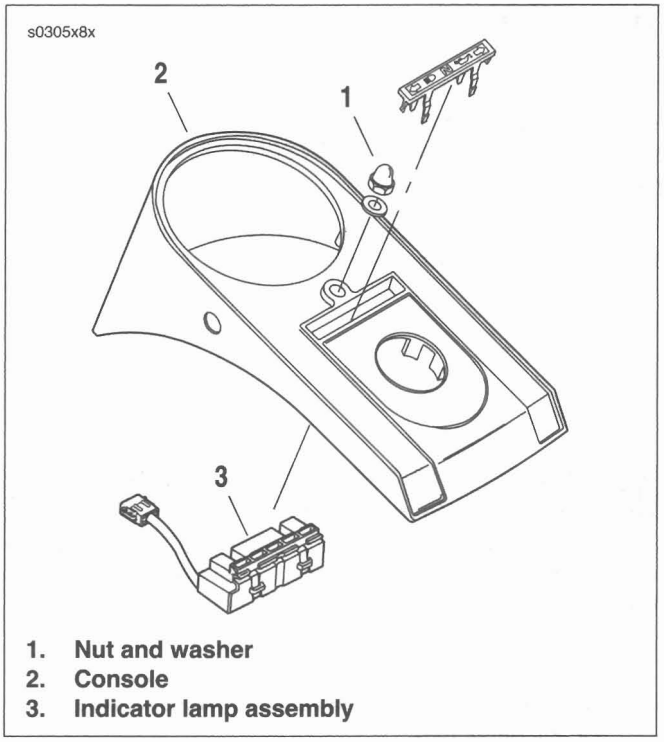
1. See Figure 8-81. Install indicator lamp assembly (1) into console. Make sure clips (2) engage to secure assembly in place.
2. Connect connector (3) [21] to main wiring harness.
3. See Figure 8-80. Place console (2) in position. Install nut and washer (1). Tighten to 14-18 ft-lbs (19.0-24.4 Nm).

Table 8-8. 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

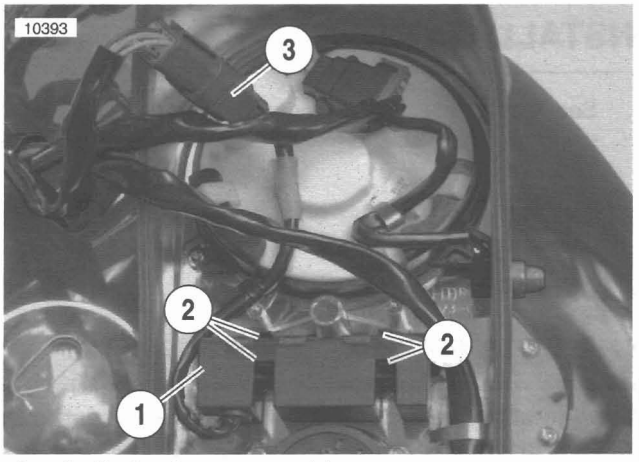
Table 8-9. Indicator Lamp Assembly Wiring

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



1. **Nut and washer**
2. **Console**
3. **Indicator lamp assembly**

Figure 8-80. Indicator Lamp Assembly: All But FXSTD



1. **Indicator lamp assembly**
2. **Clips (2 pair)**
3. **Connector [21]**

Figure 8-81. Connector [21]

GENERAL

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.
2. Remove instrument console. See 8.26 INSTRUMENT CONSOLE: FXSTD.
3. See Figure 8-82. 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.

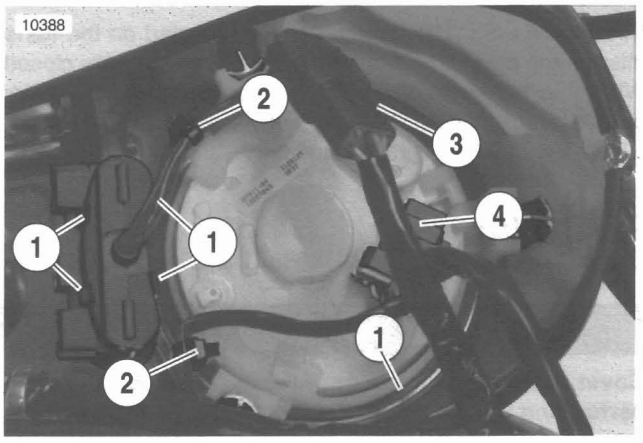
INSTALLATION

1. Push light bezel into console from front side.
2. See Figure 8-82. Secure the indicator lamps inside.
3. Fasten wiring for indicator lamps with cable strap (2).
4. Attach indicator lamp connector (3) [21].
5. Install instrument console. See 8.26 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 clips (4) on lamp bezel**
2. **Cable strap**
3. **Indicator lamp connector [21]**
4. **Indicator lamps**

Figure 8-82. Indicator Lamp Mounting: FXSTD

GENERAL

See Figure 8-83. The neutral switch is located on the transmission top cover. The two terminal switch is normally closed. 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.

1. For all models except FLSTSC, remove rear exhaust pipe. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF or 4.18 EXHAUST SYSTEM: FLSTN as appropriate.
2. Make sure transmission shifter is in NEUTRAL.
3. See Figure 8-84. 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.19 SEALED SPLICE 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 8-84. 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.

4. Using fingers and a flat tip screwdriver, install connectors to switch studs.

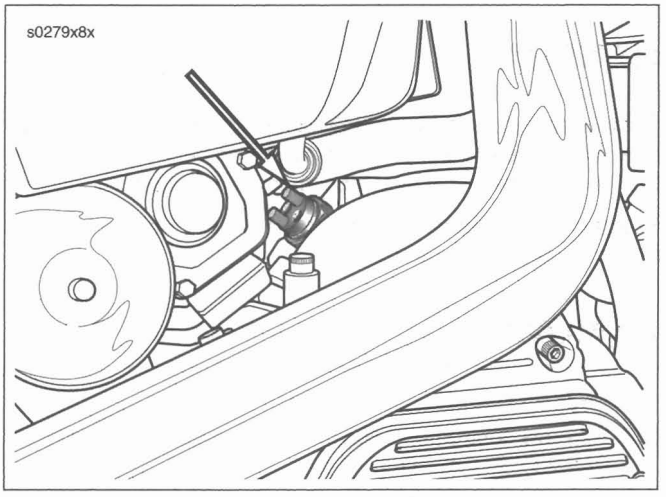


Figure 8-83. Neutral Switch Location

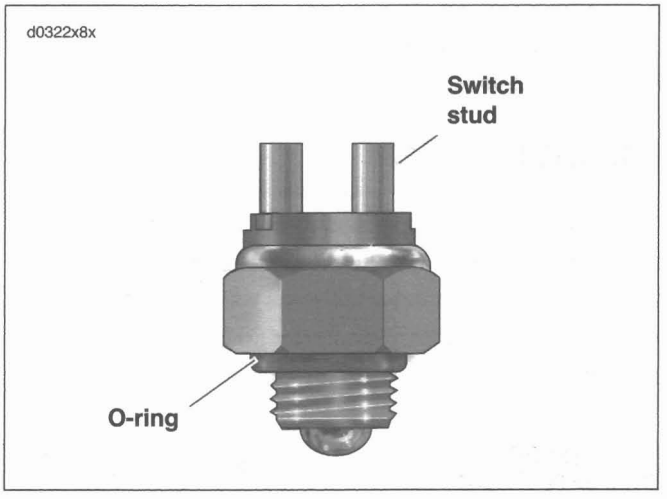


Figure 8-84. Neutral Switch

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.
6. For all models except FLSTSC, install rear exhaust pipe. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF or 4.18 EXHAUST SYSTEM: FLSTN as appropriate.

GENERAL

See Figure 8-85. 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

1. See Figure 8-85. Remove connector jumper (2) from oil pressure switch (1).
2. Using a 15/16 in. open end wrench, remove switch (1) from crankcase.

INSTALLATION

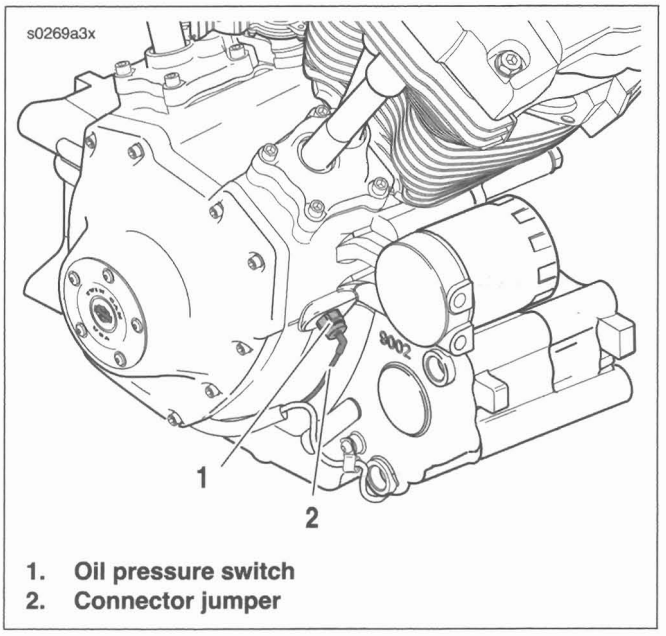
NOTE

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 8-85. Install oil pressure switch (1) to crankcase.
3. Tighten switch to 96-144 **in-lbs** (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.19 SEALED SPLICE in the appendix.



1. Oil pressure switch
2. Connector jumper

Figure 8-85. Oil Pressure Switch

GENERAL

See Figure 8-86. 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 8-86. Remove terminal boot (1) from rear stop light switch (4).
2. 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 8-86. 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.

1. Coat threads of stop light switch with LOCTITE PIPE SEALANT WITH TEFLON (PST).
2. See Figure 8-86. Install rear stop light switch (4) to rear brake line (5). Tighten switch to 12-15 ft-lbs (16.3-20.3 Nm).
3. 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.

⚠WARNING

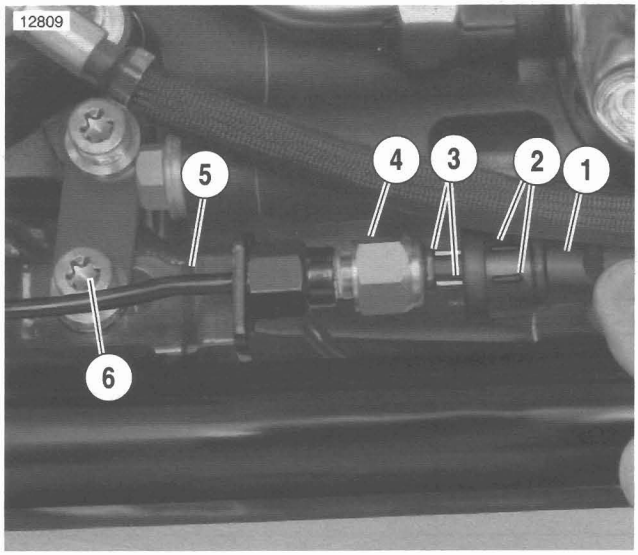
After repairing the brake system, test brakes at low speed. If brakes are not operating properly, testing at high speeds can cause loss of control, which could result in death or serious injury. (00289a).

5. Bleed brake system. See 1.7 BLEEDING BRAKES.

⚠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)

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 8-86. 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.

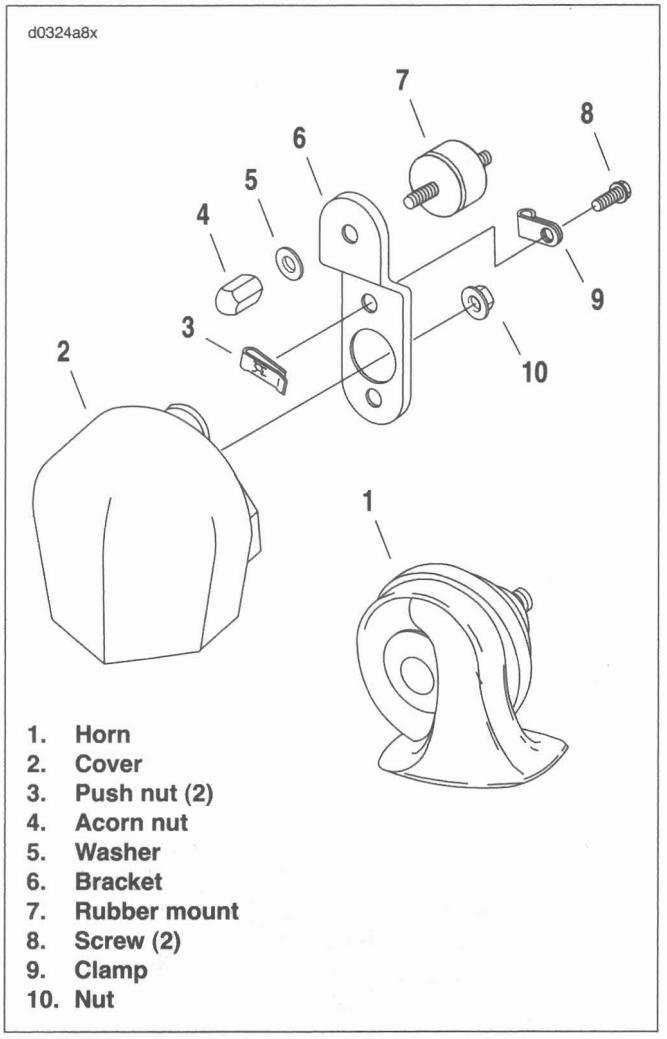
The horn it is permanently sealed and non-repairable. Only the mounting hardware is replaceable.

NOTE

No tonal adjustments may be made to this horn.

REPLACEMENT

1. See Figure 8-87. Remove nut (4) and washer (5) to detach horn bracket (6) from vehicle.
2. Disconnect wires from posts on back side of horn.
3. 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.
6. 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.



1. **Horn**
2. **Cover**
3. **Push nut (2)**
4. **Acorn nut**
5. **Washer**
6. **Bracket**
7. **Rubber mount**
8. **Screw (2)**
9. **Clamp**
10. **Nut**

Figure 8-87. Horn

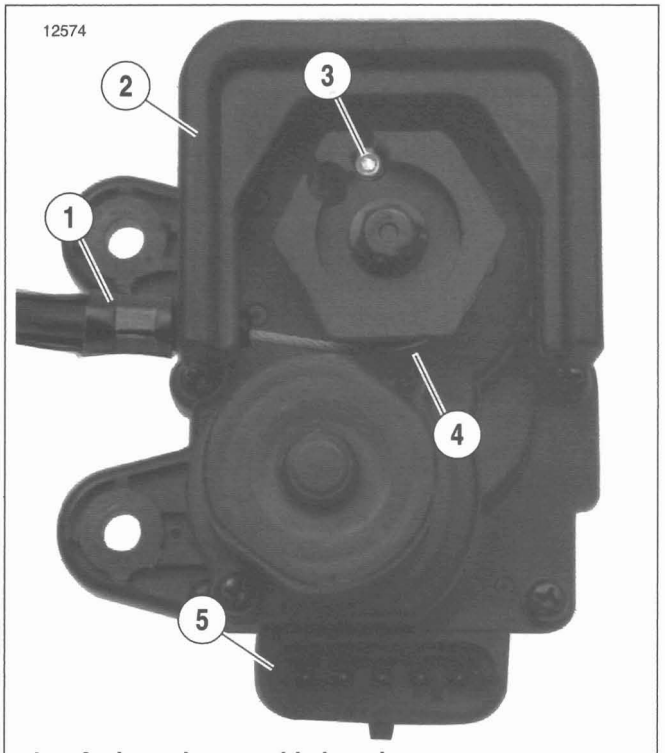
GENERAL

The active exhaust system utilizes an actuator valve located in the rear exhaust pipe which is connected to a servo motor via a cable. The valve position automatically adjusts to enhance engine performance.

The active exhaust module is located on the exhaust bracket. The attached cable is routed to a bellcrank located on the rear exhaust pipe.

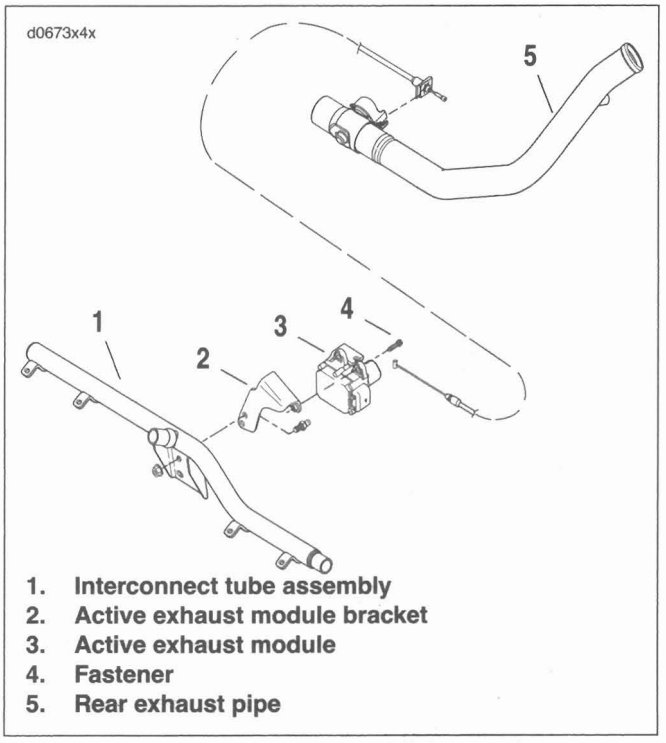
REMOVAL

1. Remove exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF,4.18 EXHAUST SYSTEM: FLSTN, or 4.19 EXHAUST SYSTEM: FLSTSC.
2. Disconnect active exhaust module connector (5) [179].
3. See Figure 8-88. Remove active exhaust cable housing (1) from notch in shroud (2). Remove ferrule (3) from active exhaust module to free cable (4).
4. See Figure 8-89. Remove module fasteners (4) from active exhaust module bracket (2).



1. **Active exhaust cable housing**
2. **Shroud**
3. **Ferrule**
4. **Active exhaust cable**
5. **Active exhaust module connector [179]**

Figure 8-88. Active Exhaust Module



1. **Interconnect tube assembly**
2. **Active exhaust module bracket**
3. **Active exhaust module**
4. **Fastener**
5. **Rear exhaust pipe**

Figure 8-89. Active Exhaust Module Mounting

REPAIR

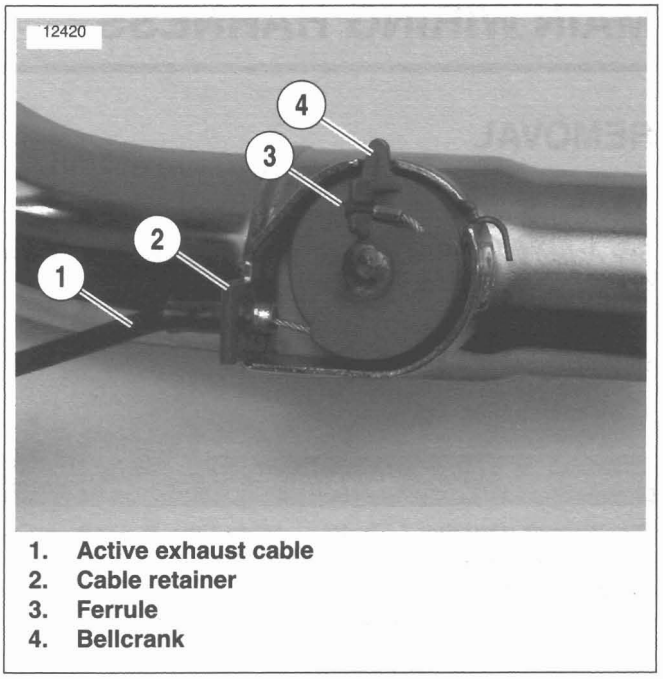
NOTE

See Figure 8-88. Active exhaust module shroud (2) can be replaced. Replace shroud if active exhaust cable housing (1) is a loose fit in shroud.

1. Remove fasteners securing shroud.
2. Replace shroud. Replace fasteners and tighten securely.

INSTALLATION

1. See Figure 8-89. install active exhaust module (3) to bracket (2) using fasteners (4). Tighten fasteners to 8-10 ft-lbs (10.8-13.6 Nm).
2. See Figure 8-88. Install ferrule (3) into slot shown. Wrap cable counterclockwise around active exhaust module shroud as shown.
3. Clip cable housing into active exhaust module housing. (2).
4. Connect active exhaust module connector (5) [179].
5. Install exhaust system. See 4.16 EXHAUST SYSTEM: FXST/FLSTC/FXSTB/FXSTC, 4.17 EXHAUST SYSTEM: FXSTD/FLSTF,4.18 EXHAUST SYSTEM: FLSTN, or 4.19 EXHAUST SYSTEM: FLSTSC.



1. **Active exhaust cable**
2. **Cable retainer**
3. **Ferrule**
4. **Bellcrank**

Figure 8-90. Bellcrank

REMOVAL

NOTE

See Appendix B for the main wiring harness schematic and a description of all connector locations.

NOTE

Disarm TSSM/HFSM 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)

2. Disconnect battery cables, negative cable first. Remove battery. See 8.16 BATTERY CABLES.
3. Disconnect harness grounds.
4. Remove rear splash guard to access electrical panel. See 8.3 ELECTRICAL PANEL.
5. Remove instrument console. See 8.27 SPEEDOMETER: ALL BUT FXSTD or 8.28 SPEEDOMETER: FXSTD. This includes detaching speedometer connector [39], indicator LED connector [21] and ignition key switch [33].
6. Remove voltage regulator and connectors located in front electrical caddy. See 8.14 FRONT ELECTRICAL CADDY.
   a. Voltage regulator [77].
   b. Stator [46].
   c. Front oxygen sensor connector [138].
   d. crank position sensor [79].
7. Remove fuel tank. See 4.5 FUEL TANK. This includes detaching fuel gauge connector [117] and fuel pump and sender [86].
8. On vehicles with active exhaust, remove active exhaust connector [179] from active exhaust module
9. On vehicles with active intake, remove air cleaner and disconnect active intake solenoid connector [178]. See 4.4 AIR CLEANER.

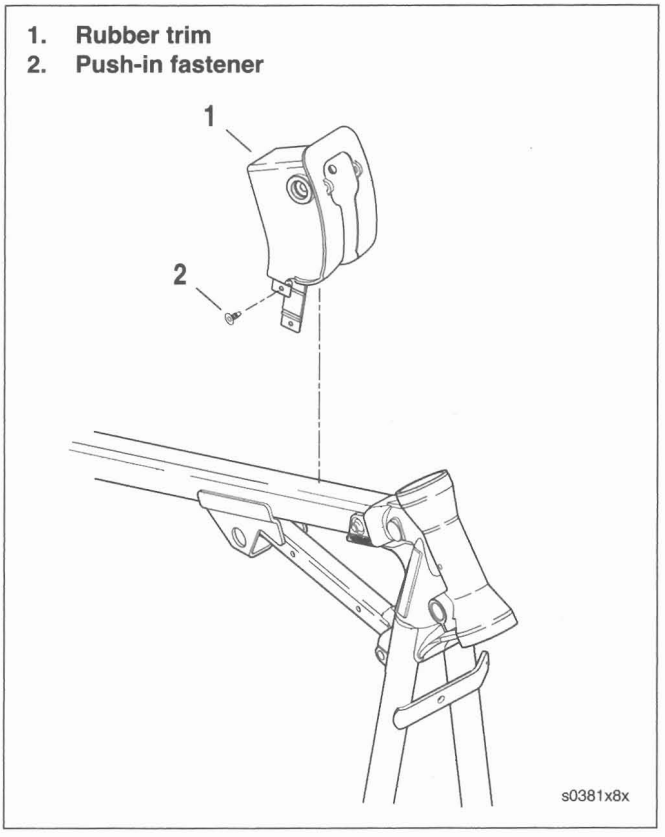
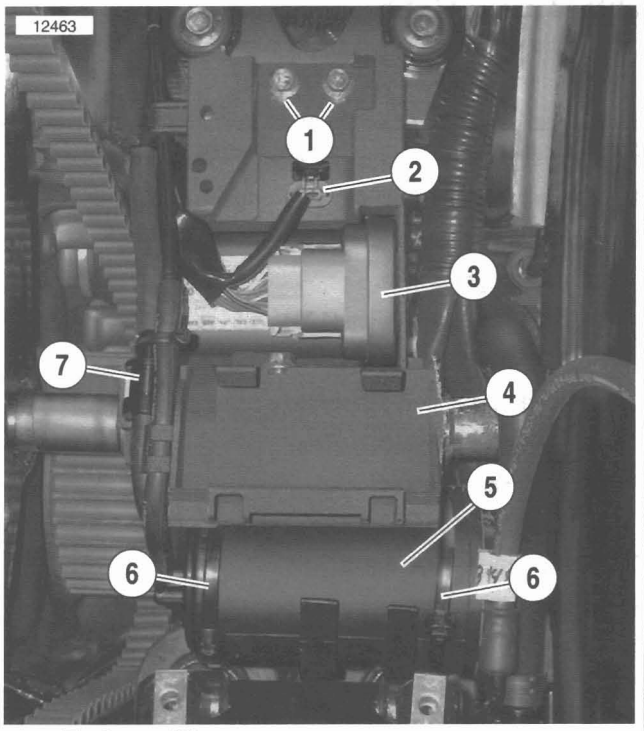


Figure 8-91. Rubber Trim

10. See Figure 8-91. 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 [89].
    j. ET sensor connector [90].
    k. IAC connector [87].
    l. TP sensor connector [88].
    m. Front [84] and rear [85] fuel injector connectors.
11. Rear oxygen sensor connector [137] located under oil tank on right side of vehicle.

12. Remove starter. See 5.4 STARTER.
13. Remove vehicle speed sensor connector [65] located on transmission case.
14. Open clamps around harness along frame tubes. Cut cable strap from harness as necessary.
15. Disconnect connectors:
    a. Electronic control module [78].
    b. Stoplight switch.
    c. Oil pressure switch [120].
    d. Starter solenoid.
    e. Tail lamp [7].
    f. TSM/HFSM/TSSM connector. [30].
    g. Neutral switch wiring.
16. Detach data link connector [91A] from fuse block bracket.
17. Detach fuse block wiring.
    a. Remove fuse block bracket from frame.
    b. Depress tab located on fuse block bracket and slide the fuse block out of the mounting slots. Repeat for other block.
18. Disconnect coil connector [83].
19. Remove harness clips and any remaining cable straps. Disconnect all ground wires.
20. Slowly remove harness from frame taking note of wire routings.



1. **Fastener (2)**
2. **Security siren connector [142]**
3. **TSM/TSSM/HFSM**
4. **Security siren location**
5. **Canister**
6. **Cable strap (2)**
7. **Vapor valve**

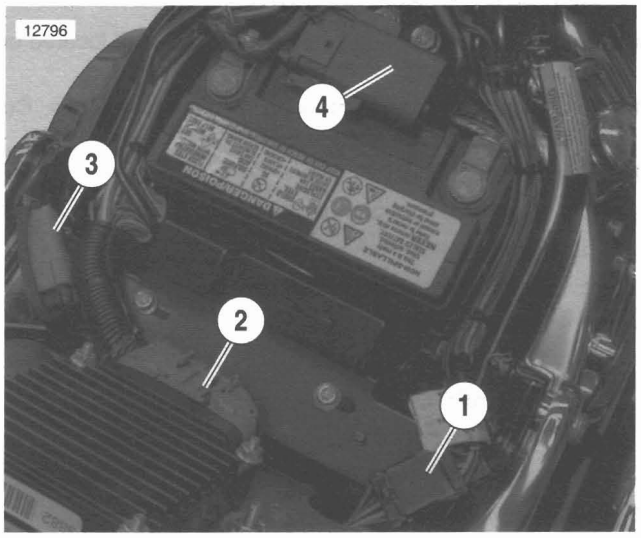
Figure 8-92. Electrical Panel

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. Stoplight switch.
   b. Oil pressure switch [120].
   c. Turn signal/turn signal security module [30].
   d. Vehicle speed sensor connector [65].
   e. Neutral indicator switch.
   f. Starter solenoid.
   g. Ignition coil [83].
3. Install starter. See 5.4 STARTER.
4. Install fuse and relay blocks on bracket.
5. See Figure 8-93. Attach connectors under seat.
   a. Tail lamp [7].
   b. Electronic control module [78].
   c. Secure data link connector [91A] to frame.
6. 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 [89].
   j. ET sensor connector [90].
   k. IAC connector [87].
   l. TP sensor connector [88].
   m. Front [84] and rear [85] fuel injector connectors.



1. **Tail lamp connector [7]**
2. **Ignition control module [10]**
3. **Data link connector [91A]**
4. **Main Fuse [5]**

Figure 8-93. Connectors Under Seat

7. See Figure 8-94. Attach ground wires to frame in front of battery. Negative battery cable attaches to right side post (2). See 8.16 BATTERY CABLES.
8. See Figure 8-91. On all but FXSTD, insert push-in fastener (2) into rubber trim (1) on frame.
9. Install splash guard over electrical panel. See 8.3 ELECTRICAL PANEL.
10. Install fuel tank. See 4.5 FUEL TANK.
11. Install instrument console. See 8.27 SPEEDOMETER: ALL BUT FXSTD. or 8.28 SPEEDOMETER: FXSTD.
12. Install voltage regulator and connectors located in front electrical caddy. See 8.14 FRONT ELECTRICAL CADDY.
    a. Voltage regulator [77].
    b. Stator [46].
    c. Front oxygen sensor connector [138].
    d. crank position sensor [79].
13. On vehicles with active exhaust, connect active exhaust connector [179] to active exhaust module
14. On vehicles with active intake, connect active intake solenoid connector [178] and install air cleaner. See 4.4 AIR CLEANER.

⚠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)

15. Install battery and connect battery cables, positive cable first.

⚠WARNING

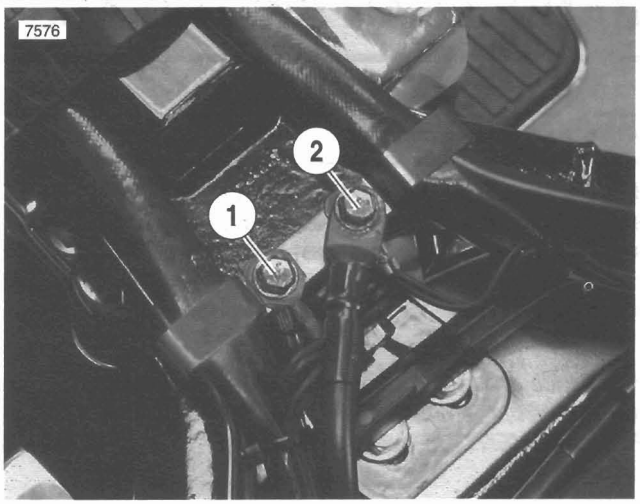
After installing seat, pull upward on front of seat to be sure it is in locked position. While riding, a loose seat can shift causing loss of control, which could result in death or serious injury. (00070a)

16. 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)

17. 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.



1. **Ground wires (2)**
2. **Ground wire and negative battery cable**

Figure 8-94. Ground Wires and Negative Battery Cable

GENERAL

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 8.39 RIGHT HANDLEBAR SWITCH and 8.40 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.
2. 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.
4. 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.

REMOVAL

NOTES

- *The removal and installation steps listed apply when replacing the entire switch assembly, switch housing or handlebars.*

On FXDWG and FXDB models, the turn signal wiring is routed through the lower switch housings. On FXDWG models, the turn signal wires are then routed through the handlebars. See 2.28 HANDLEBARS FLSTF for more information.

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.

1. See Figure 8-95. Place the cardboard insert between the brake lever and lever bracket.
2. 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.
3. Using a T25 TORX drive head, remove the upper and lower switch housing screws.
4. 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.

5. 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 throttle control grip from the end of the handlebar.
7. 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

1. 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.

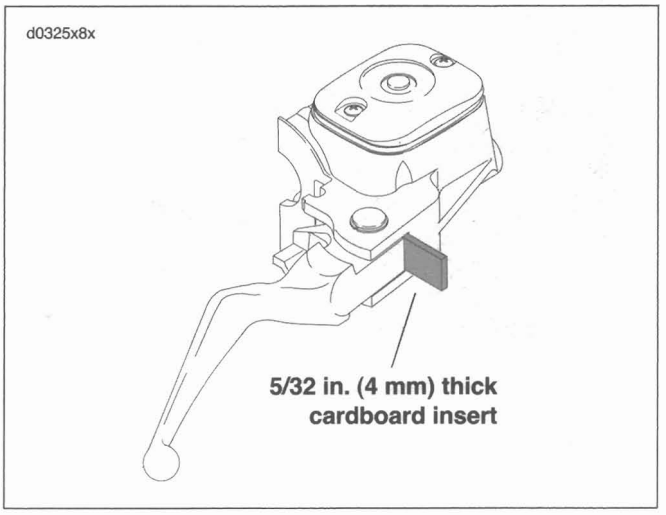
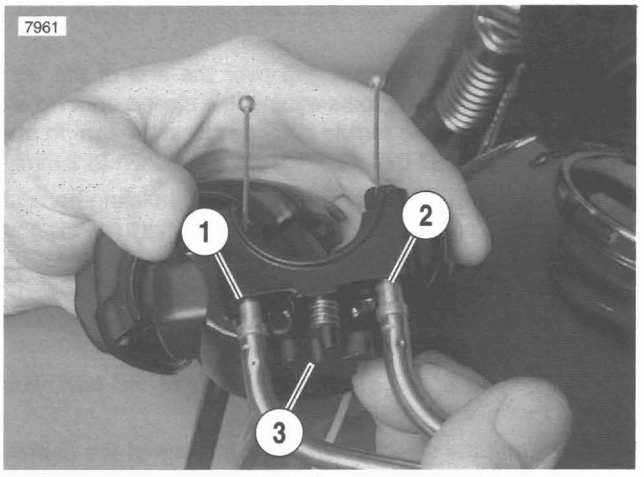


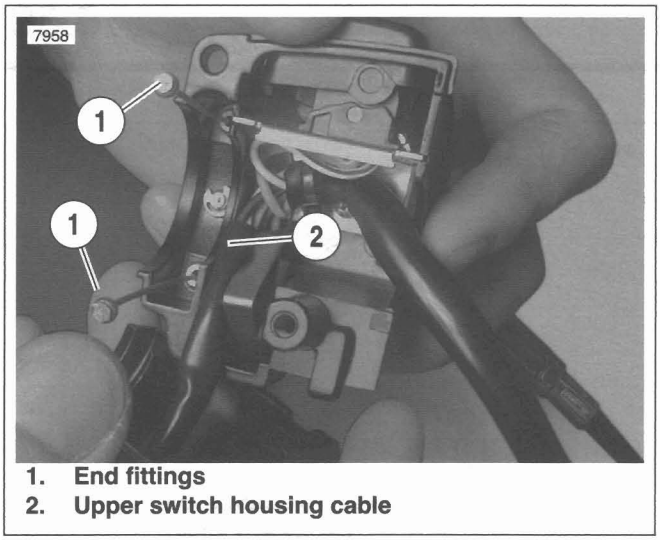
Figure 8-95. Install Cardboard Insert



1. **Idle cable insert (gold insert, rear hole)**
2. **Throttle cable insert (silver insert, front hole)**
3. **Tension adjuster screw**

Figure 8-96. Right Lower Switch Housing

2. See Figure 8-96. 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.
   a. 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).



1. End fittings
2. Upper switch housing cable

Figure 8-97. Route Cable to Upper Switch Housing

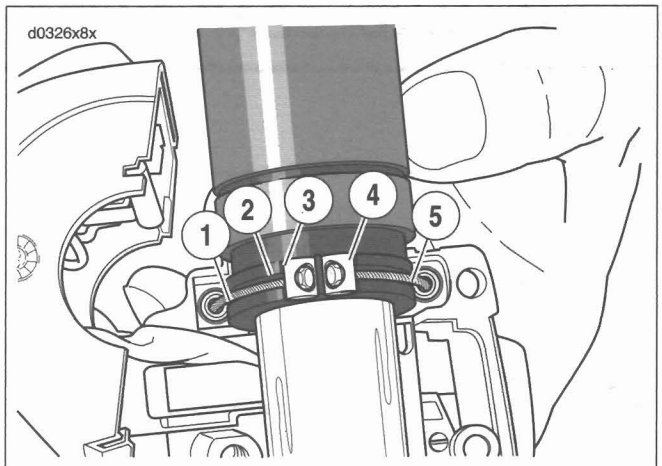
NOTE

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 8-97. 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 8-98. 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.
7. 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 8-99. 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.



1. Throttle cable (silver insert, front hole)
2. Groove in throttle grip
3. Notch
4. Brass ferrule
5. Idle cable (gold insert, rear hole)

Figure 8-98. Throttle Cable Installation

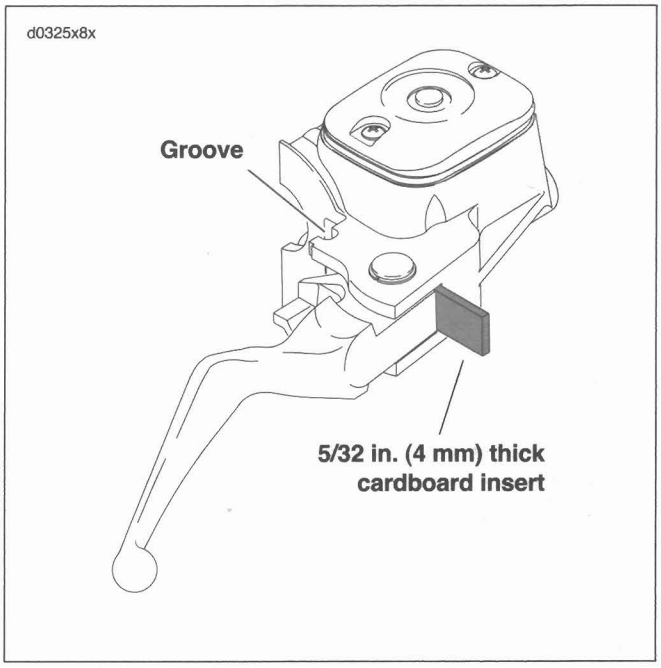


Figure 8-99. Leave Cardboard Insert in Place

9. See Figure 8-100. 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.

11. 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.

⚠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)

13. Test the switches for proper operation.

14. 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

CAUTION

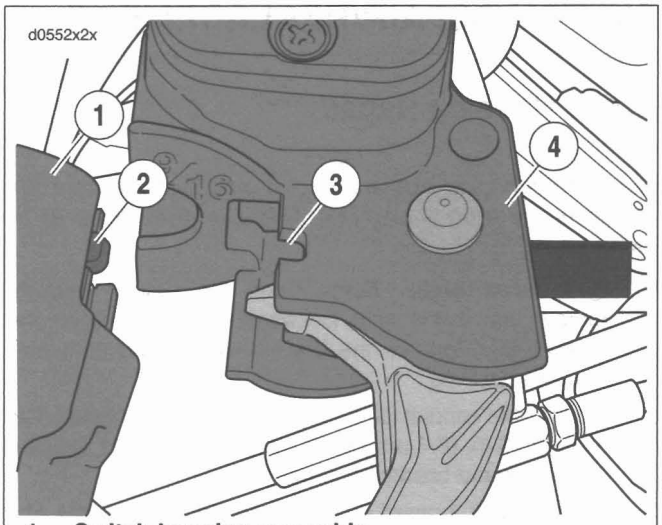
See Figure 8-99. Do not remove the switch housing assembly without first placing a 5/32 in. (4 mm) cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the front stoplight switch.

1. 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.

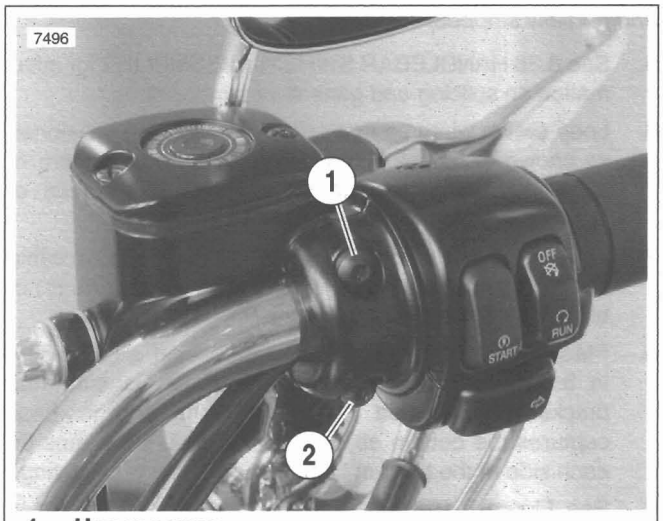
3. If replacing lower housing switches, perform steps 4 through 7 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.

4. See Figure 8-101. 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).



1. **Switch housing assembly**
2. **Tab**
3. **Groove**
4. **Brake lever bracket**

Figure 8-100. Switch Housing Alignment



1. **Upper screw**
2. **Lower screw and flat washer**

Figure 8-101. Handlebar Clamp Screws

5. 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.

7. Remove the throttle control grip from the end of the handlebar.

SWITCH REPAIR/REPLACEMENT

Upper Housing Repair

NOTE

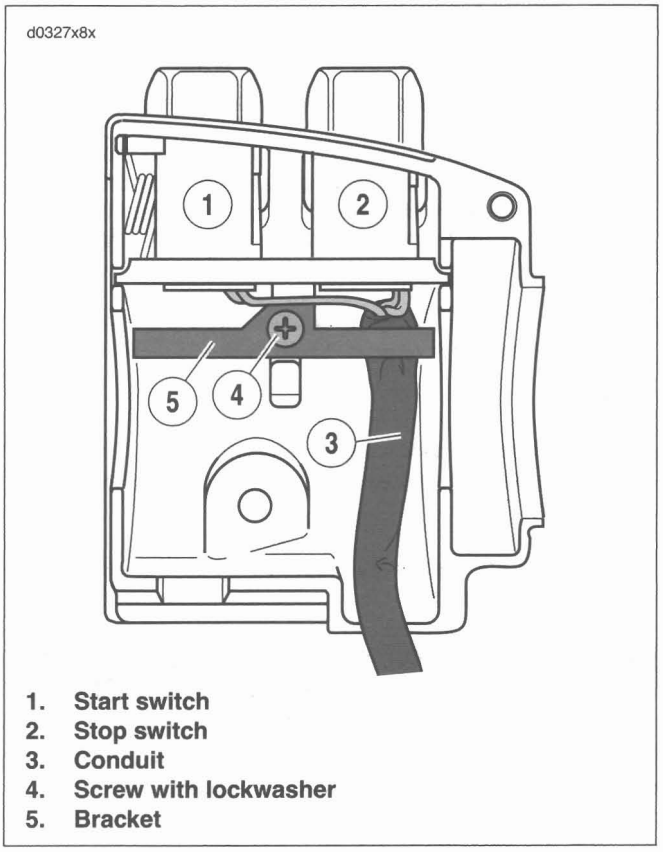
Replace the engine stop and engine start switches as a single assembly even if only one switch is determined to be faulty.

1. See Figure 8-102. 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.
2. 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 **new** engine stop switch (2) and engine start switch (1) wires into two bundles.

NOTE

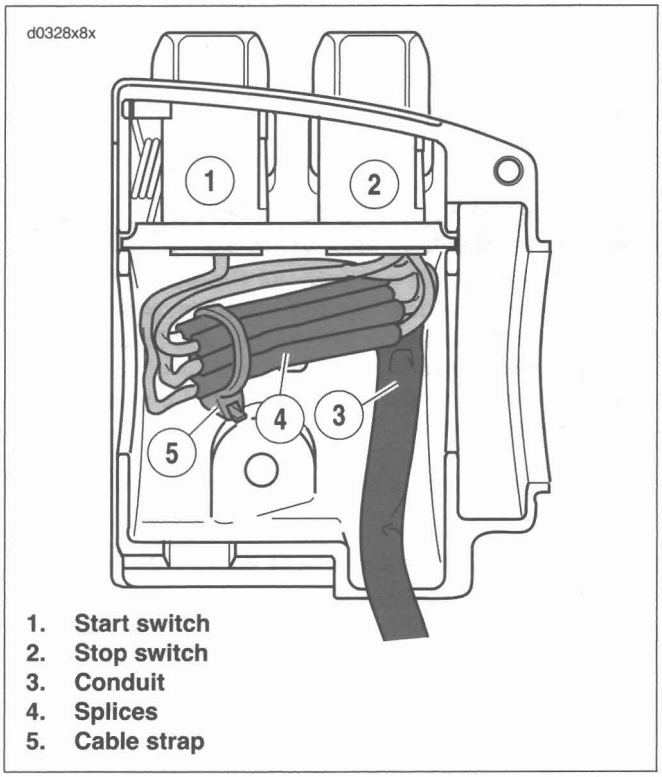
Replacement stop switch and start switch wires are cut to length (2.5 in./63.5 mm and 2.0 in./50.8 mm, respectively) and partially stripped.

5. See 8.38 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-103. Route wires downstream of splices beneath wing on engine stop switch side of bracket as seen in Figure 8-102.
7. See Figure 8-103. 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.
9. See Figure 8-102. 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.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. Continue with ASSEMBLY on page 8-78.



1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

Figure 8-102. Upper Housing Without Splices



1. **Start switch**
2. **Stop switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 8-103. Upper Housing With Splices

Lower Housing Repair

NOTE

On FXDWG and FXDB models, be sure grommet in lower switch housing used to route turn signal wiring is in good condition. Replace if necessary.

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. 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

1. 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.

2. See 8.38 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with ASSEMBLY on page 8-78.

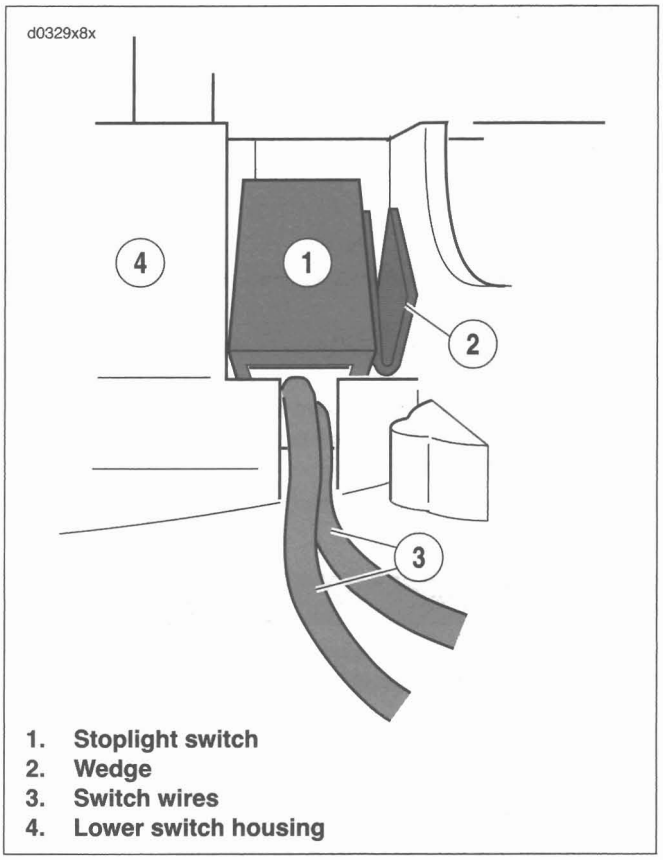
FRONT STOPLIGHT SWITCH

1. 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.
2. 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 8.38 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.
5. 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.



1. **Stoplight switch**
2. **Wedge**
3. **Switch wires**
4. **Lower switch housing**

Figure 8-104. Install Stoplight Switch

6. See Figure 8-104. 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.
7. 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 8-78.

ASSEMBLY

1. See Figure 8-105. 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

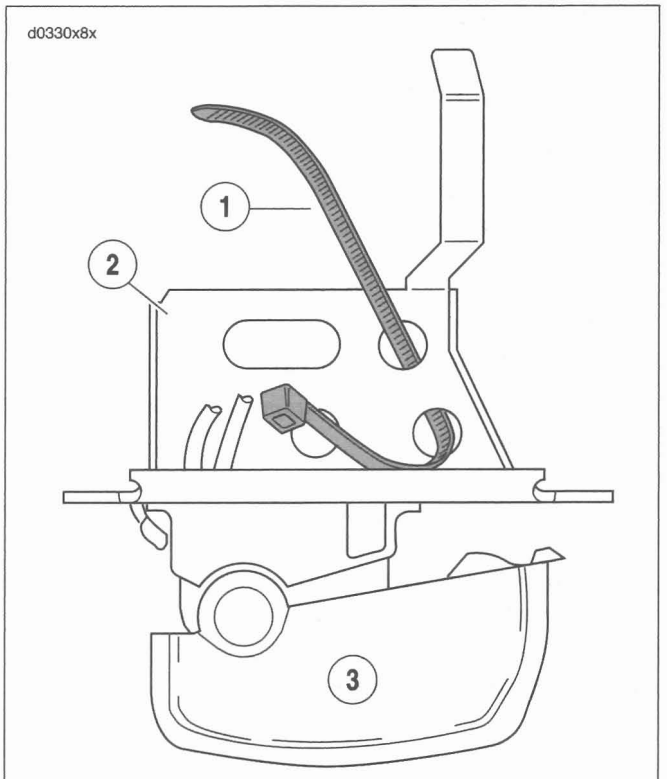
Be sure that all splices are positioned above the turn signal switch bracket.

2. 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.
3. 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.
5. 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. 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.
8. 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 8-73.
   a. If lower housing switches were replaced, perform the whole procedure.
   b. If upper housing switches were replaced, begin with step 11.



1. **Cable strap**
2. **Bracket**
3. **Right turn signal switch**

Figure 8-105. Insert Cable Strap in Switch Bracket

REMOVAL

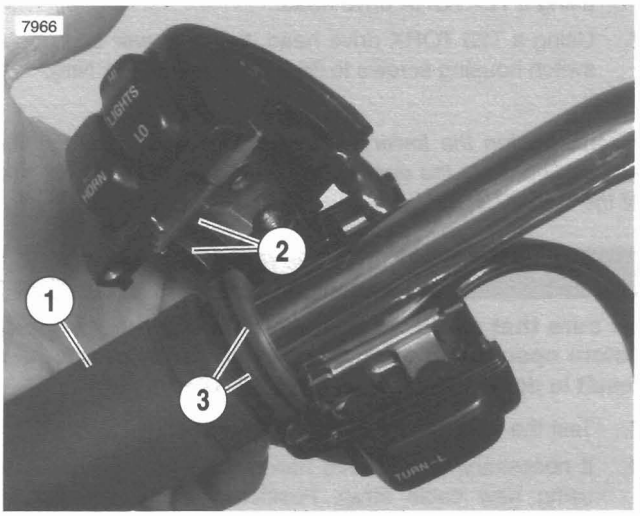
NOTE

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.

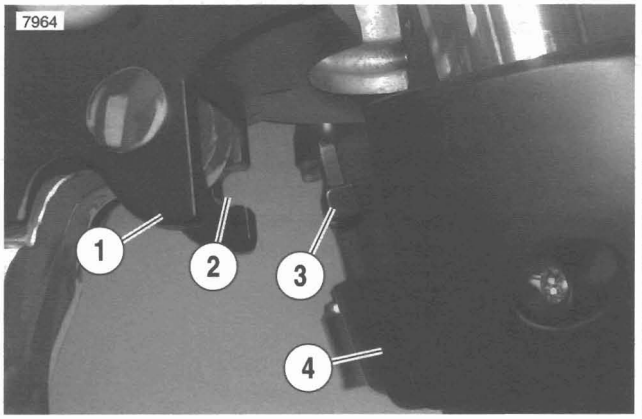
INSTALLATION

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 8-106. 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 8-107. 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.



1. **Grip sleeve**
2. **Ribs**
3. **Grooves**

Figure 8-106. Left Handlebar Switch Housings



1. **Clutch lever bracket**
2. **Groove**
3. **Tab**
4. **Switch housing assembly**

Figure 8-107. 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.

⚠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. Test the switches for proper operation.
9. If necessary, secure wire harness conduit to handlebar 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.
2. If replacing lower housing switches, perform step 3 before continuing to repair section. If replacing upper housing switches, proceed directly to repair section.
3. 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.

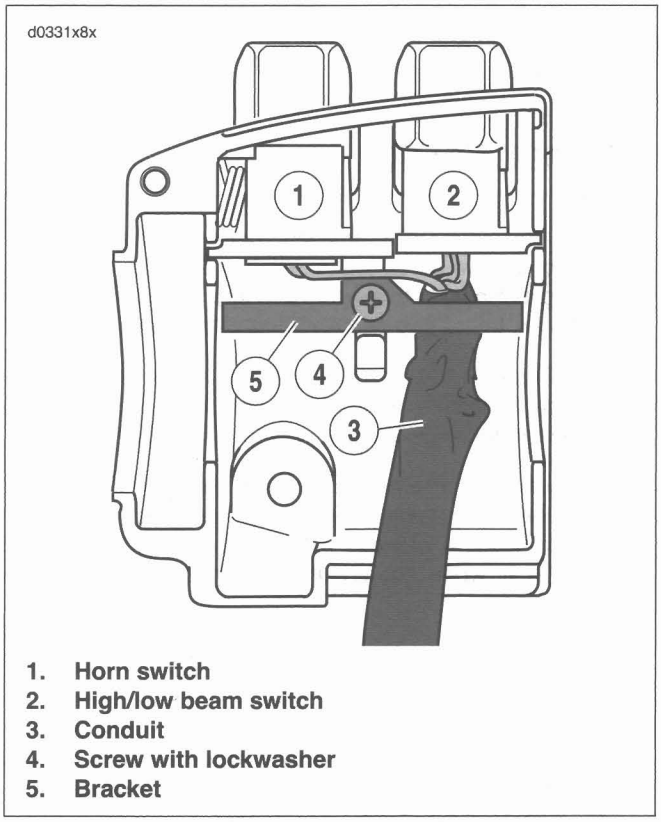
SWITCH REPAIR/REPLACEMENT

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 8-108. From inside the switch housing, remove the screw with lockwasher (4) to release the bracket (5). Remove bracket and switch assembly from the housing.
2. 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.



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Screw with lockwasher**
5. **Bracket**

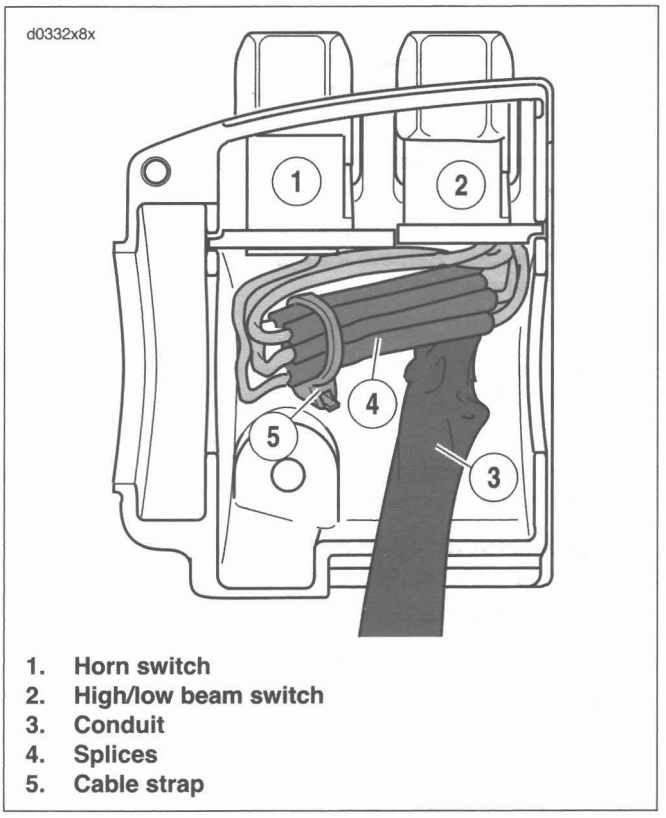
Figure 8-108. Upper Housing Without Splices

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 8.38 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-109. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as seen in Figure 8-108.
7. See Figure 8-109. 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).
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.
9. See Figure 8-108. 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 8-83.



1. **Horn switch**
2. **High/low beam switch**
3. **Conduit**
4. **Splices**
5. **Cable strap**

Figure 8-109. Upper Housing With Splices

Lower Housing Repair

NOTE

On FLSTF models, be sure grommet in lower switch housing used to route turn signal wiring is in good condition. Replace if necessary.

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.

TURN-LEFT SIGNAL SWITCH

1. Cut wires 1.5 in. (38.1 mm) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length (1.5 in./38.1 mm) and partially stripped.

2. See 8.38 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with ASSEMBLY which follows.

CLUTCH INTERLOCK SWITCH

1. Cut wires 1/4 inch (6 mm) from old switch. Discard switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length and partially stripped.

2. See 8.38 HANDLEBAR SWITCH ASSEMBLIES for information on splicing and general repair practices.
3. Continue with ASSEMBLY which follows.

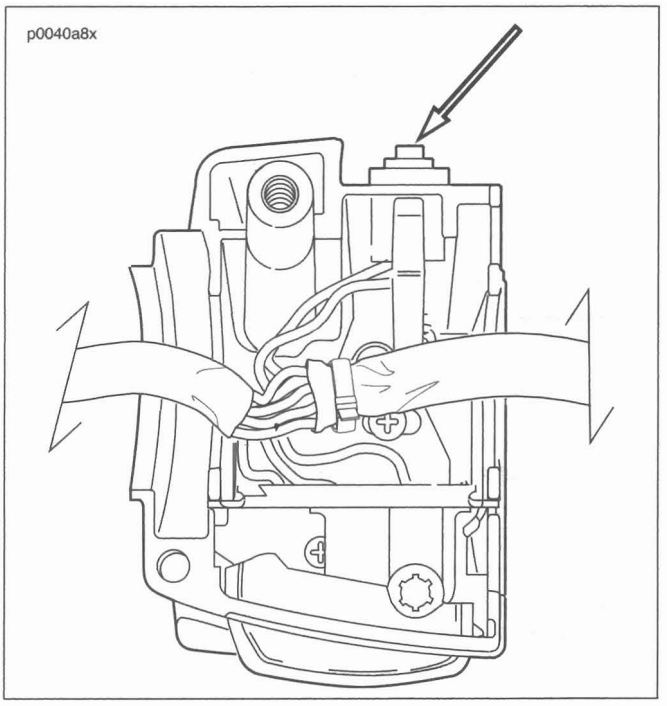


Figure 8-110. Clutch interlock Switch

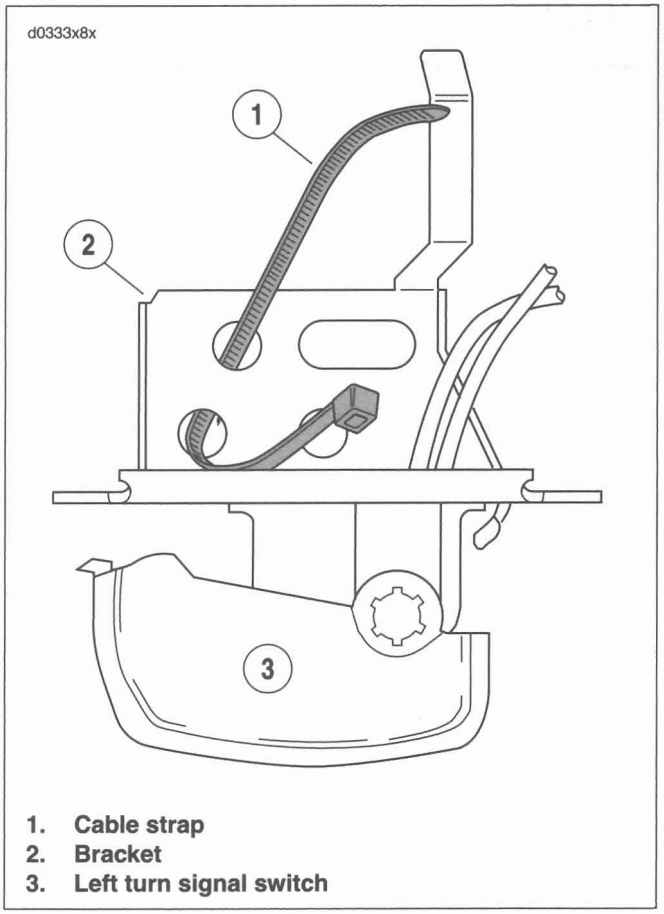
ASSEMBLY

1. See Figure 8-111. 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.

2. 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.
3. Start screw with lockwasher to secure bracket inside housing.
4. Loop switch wires so that spliced lengths are positioned across bracket.
5. 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.
7. 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 8-79.
   a. If lower housing switches were replaced, perform the whole procedure.
   b. If upper housing switches were replaced, begin with step 7.



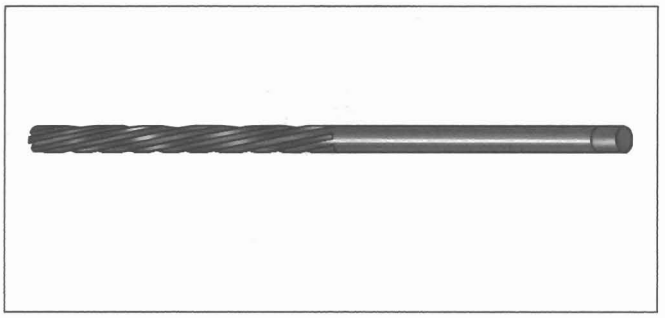
1. **Cable strap**
2. **Bracket**
3. **Left turn signal switch**

Figure 8-111. Insert Cable Strap in Switch Bracket

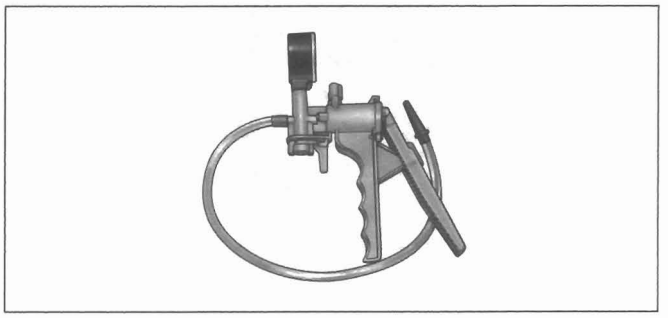
NOTES

SUBJECT	PAGE NO.
Appendix A-Tools	A-1
Appendix B-Wiring	B-1
Appendix C-Metric Conversions	C-1
Appendix D-Glossary	D-1

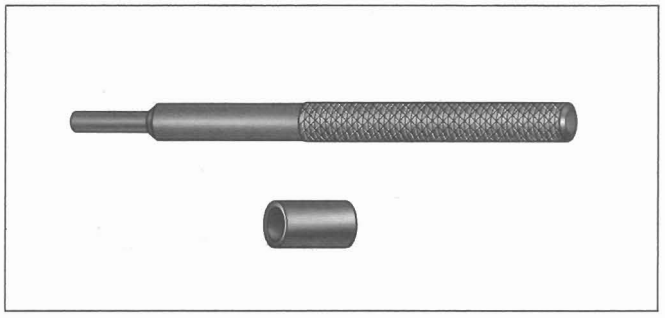
APPENDIX



Part No. B-45523 Valve Guide Reamer (7mm)

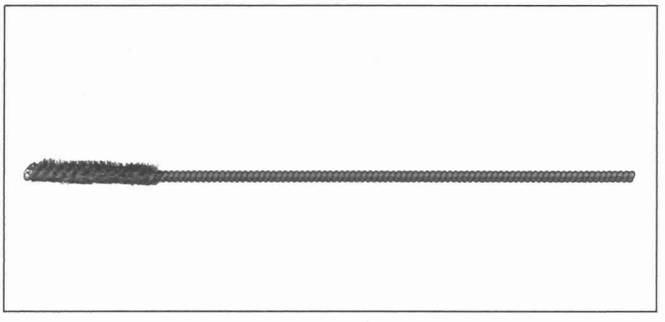


Part No. HD-23738-A Vacuum Pump

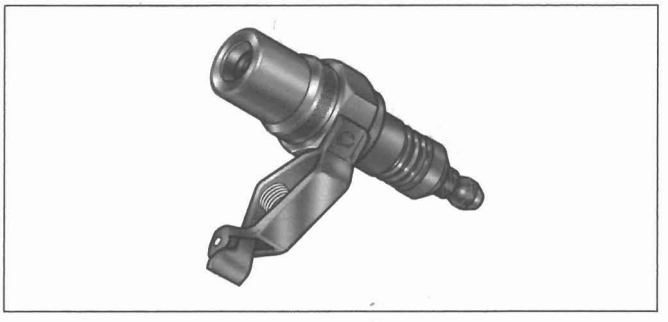


Part No. B-45524-A Valve Guide Driver and sleeve (7mm)

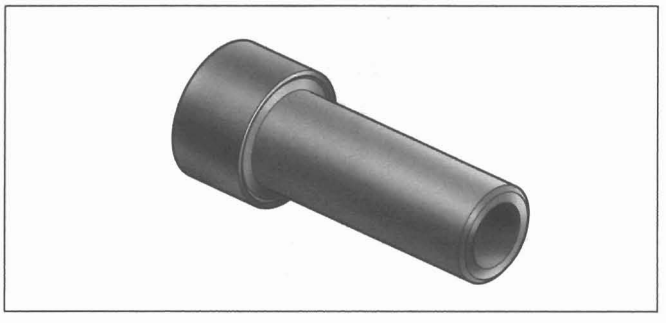
Part No. HD-25070 Robinair Heat Gun



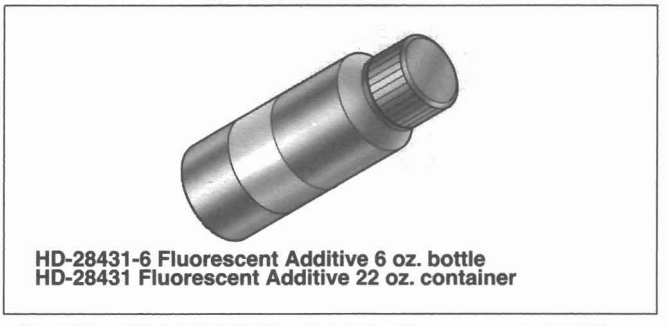
Part No. B-45525 Valve Guide Hone (7mm)



Part No. HD-26792 Spark Tester

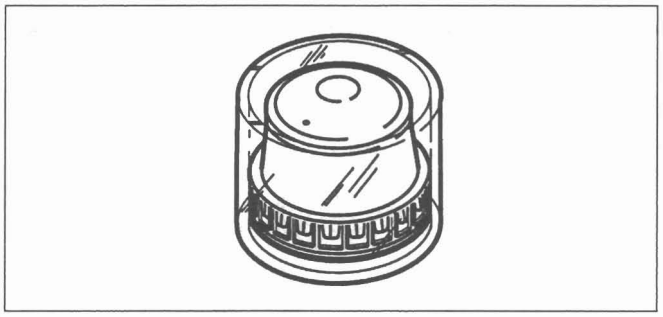


Part No. B-45655 Left Crankcase Bearing Remover/
Installer Pilot/Driver
(Use with HD-42720-5)

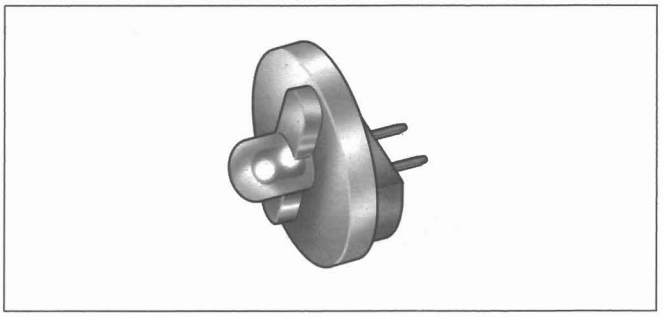


HD-28431-6 Fluorescent Additive 6 oz. bottle
HD-28431 Fluorescent Additive 22 oz. container

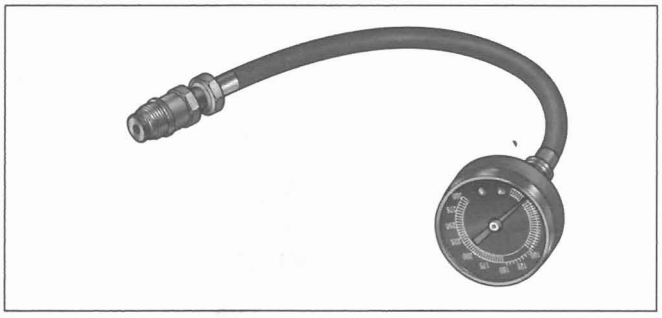
Part No. HD-28431-B Black Light Fluorescent Additive.
(Use with HD-35457, HD-47183 or HD-47184)



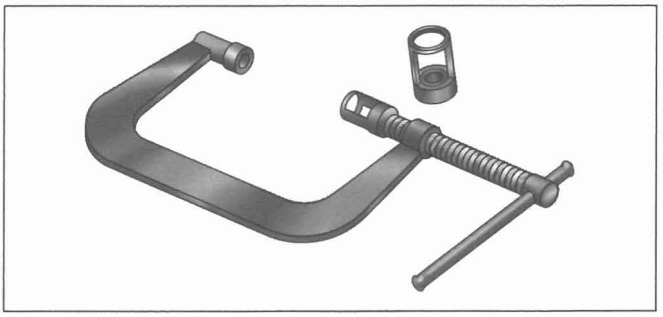
Part No. HD-33067 Bearing Packer



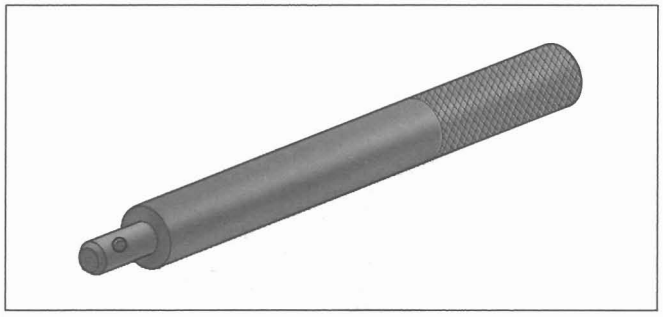
Part No. HD-34730-2C Fuel Injector Test Lamp



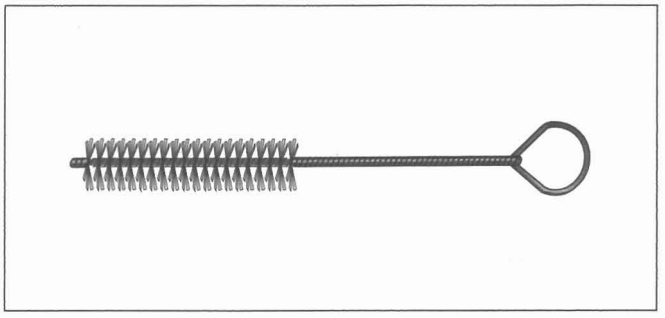
Part No. HD-33223-1 Cylinder Compression Gauge



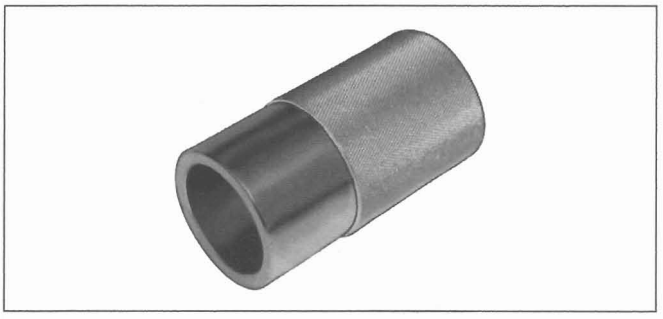
Part No. HD-34736-B Valve Spring Compressor



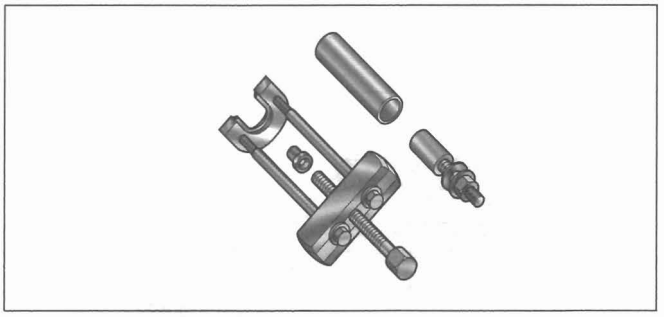
Universal Driver Handle
4 in. length (Part No. HD-45907), 7 IN. length (Part No. HD-44567, 12 in. length (Part No. HD-33416)



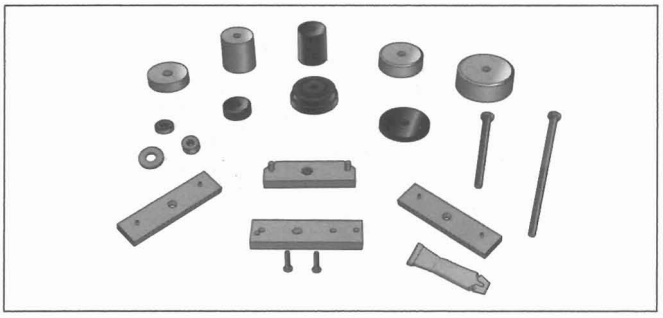
Part No. HD-34751 Nylon Valve Guide Cleaning Brush



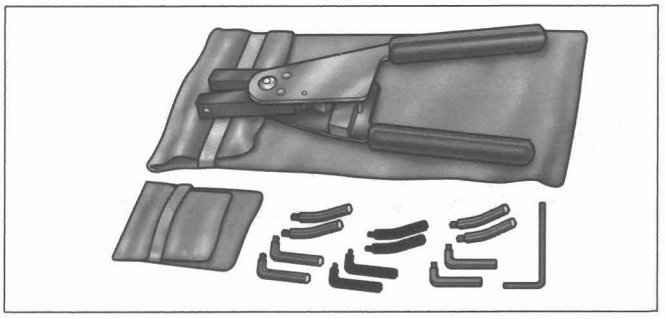
Part No. HD-34634 Fork Bushing and Seal Installer



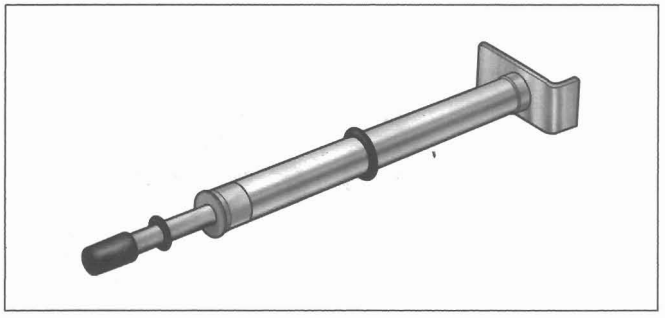
Part No. HD-34902-B Mainshaft Primary Bearing Race Remover And Installer



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

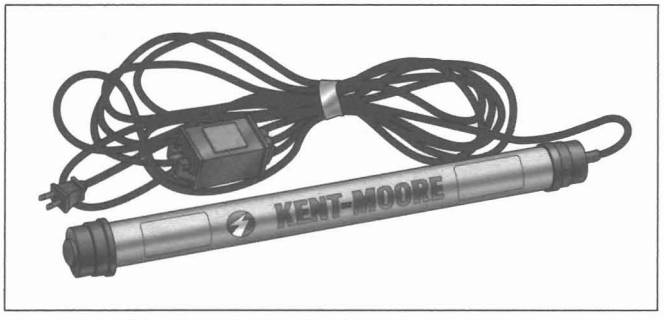


Part No. HD-35518 Internal/External Retaining Ring Pliers



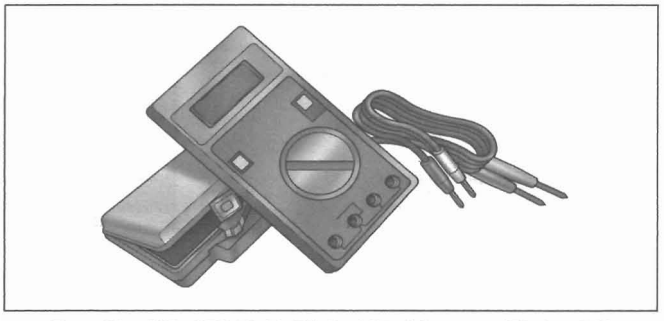
Part No. HD-35381-A Belt Tension Gauge

Part No. HD-35667-A Cylinder Leakdown Tester

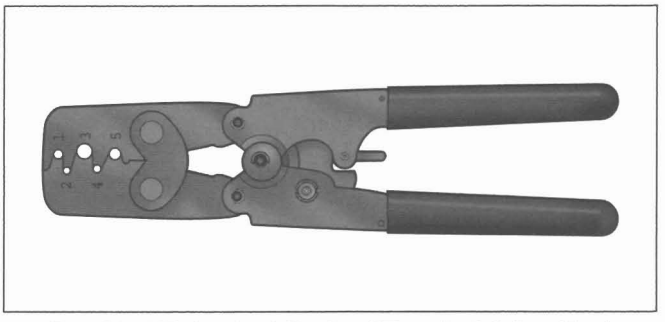


Part No. HD-35457 Black Light Leak Detector (Use with HD-28431-B)

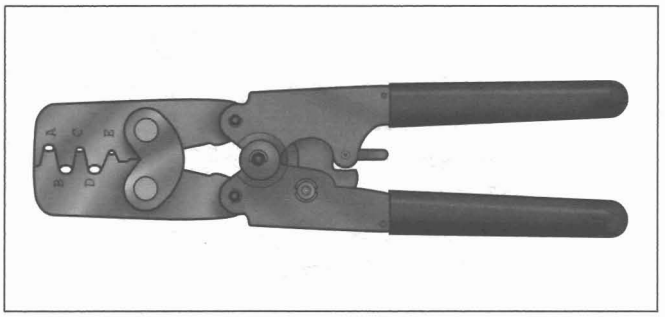
Part No. HD-35758-B Neway Valve Seat Cutter Set



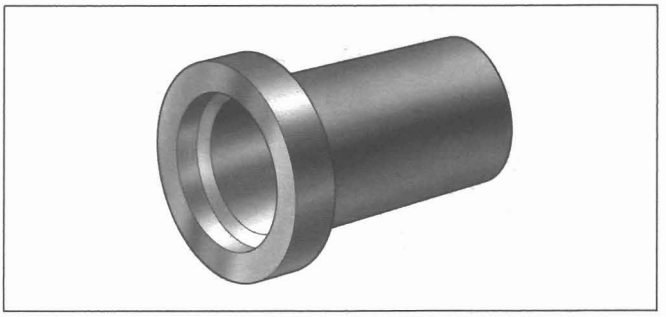
Part No. HD-35500-B Digital Multimeter (Fluke 23)



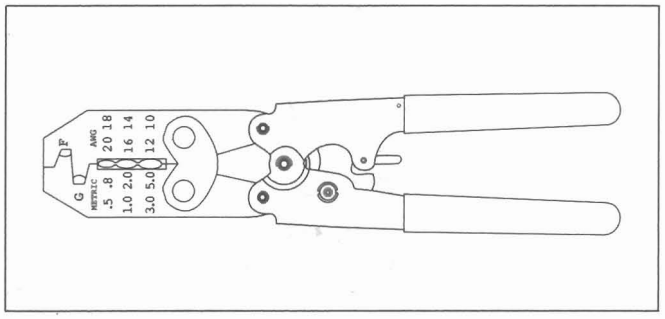
Part No. HD-38125-6 Packard Terminal Crimp Tool



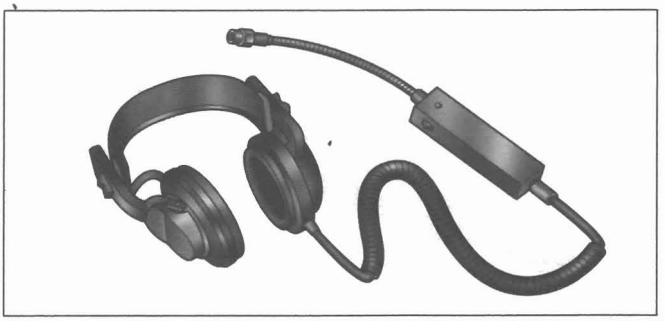
Part No. HD-38125-7 Packard Terminal Crimp Tool



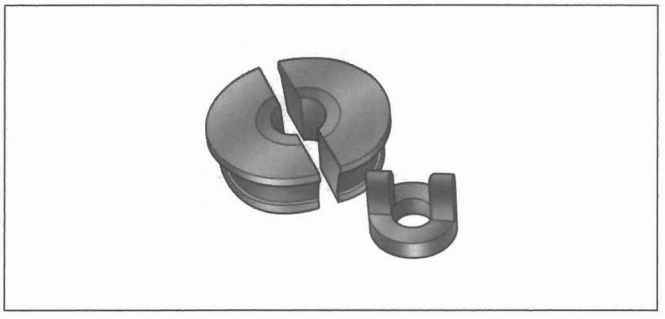
Part No. HD-39361-B Sprocket Shaft Seal Installation Tool
(Use with HD-97225-55C)



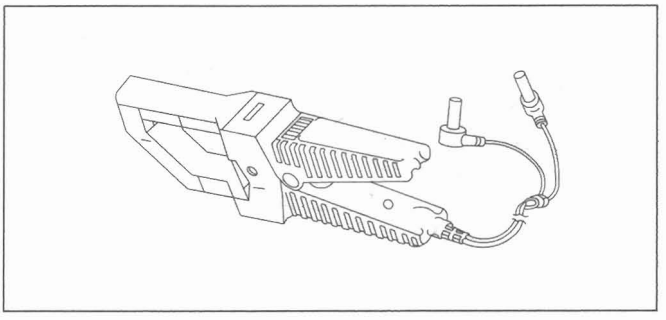
Part No. HD-38125-8 Packard Terminal Crimp Tool



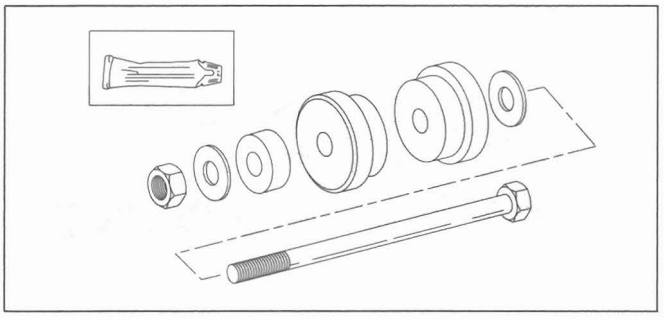
Part No. HD-39565 Engine Sound Probe



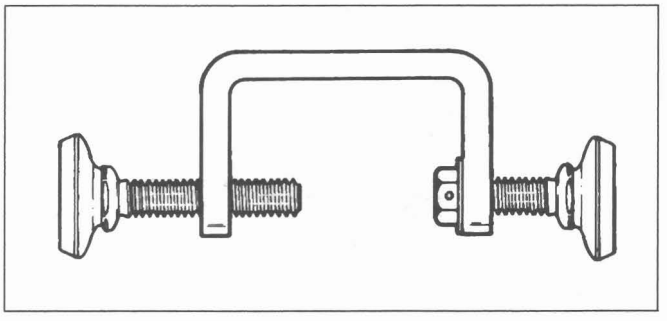
Part No. HD-39301-A Steering Head Bearing Race Remove. (Used with HD-33416)



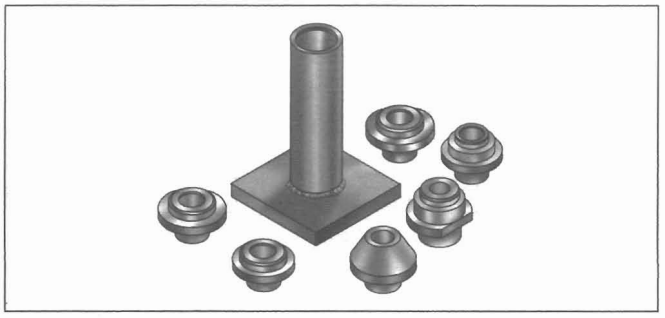
Part No. HD-39617 Inductive Amp Probe.
(Used with HD-35500-B, HD-39978 and HD-39200)



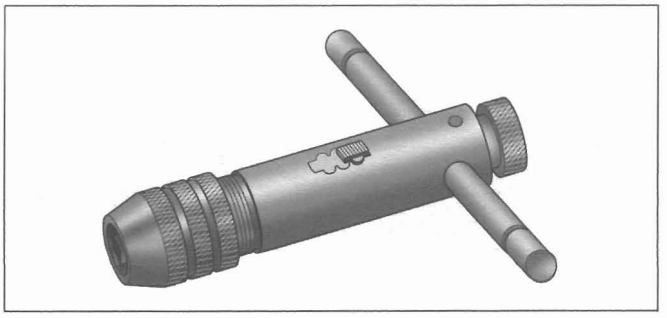
Part No. HD-39302 Steering Head Bearing Race Installer



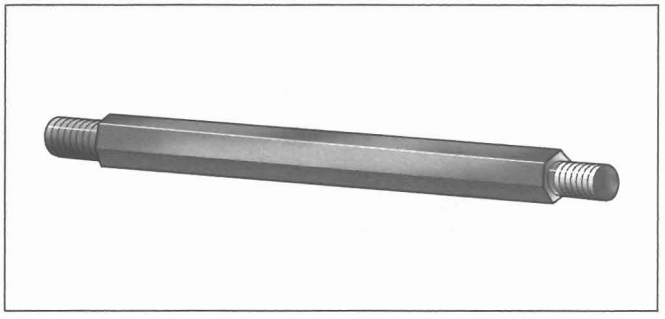
Part No. HD-39754 Fender link Tool



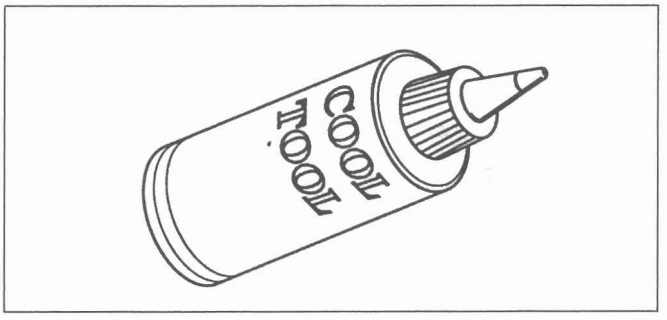
Part No. HD-39782-A Cylinder Head Support



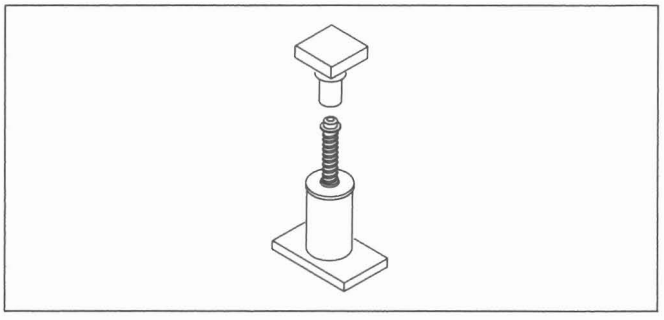
Part No. HD-39847 Universal Ratcheting Tap/Reamer Handle



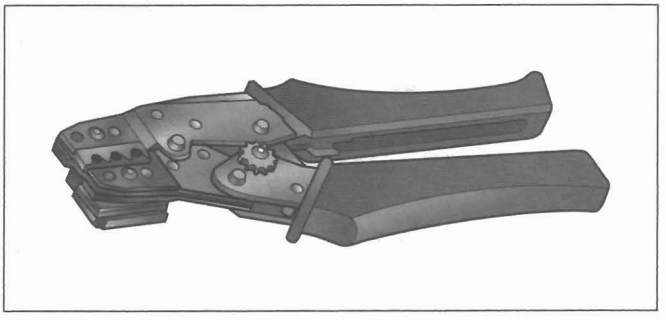
Part No. HD-39786-A Cylinder Head Holding Fixture



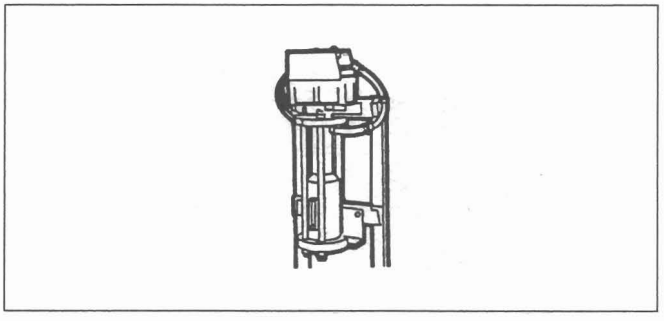
Part No. HD-39964 Reamer Lubricant (Cool Tool)



Part No. HD-39800 Oil Filter Crusher (Small)

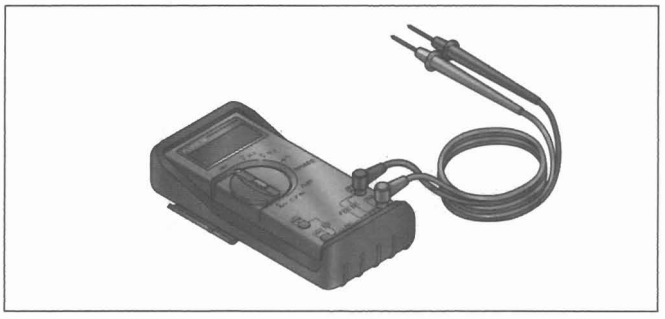


Part No. HD-39965 Deutsch Terminal Crimp Tool

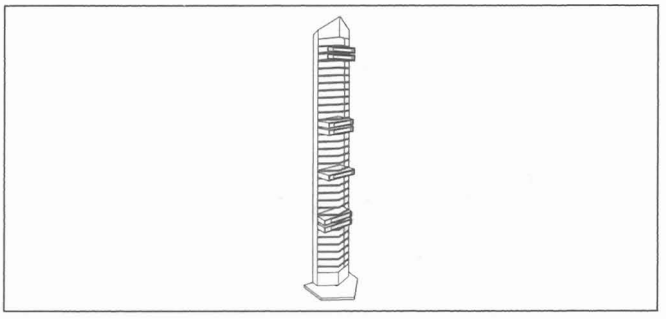


Part No. HD-39823 25 Ton Oil Filter Crusher

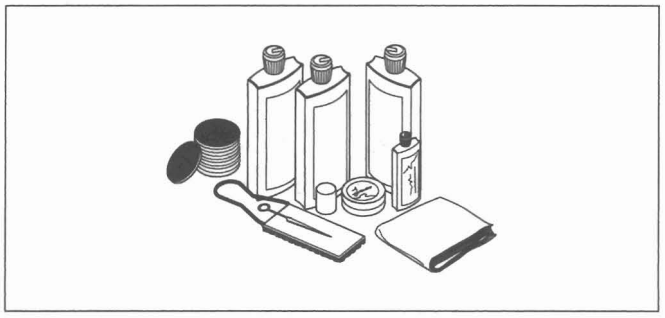
Part No. HD-39969 Ultra-Torch UT-100



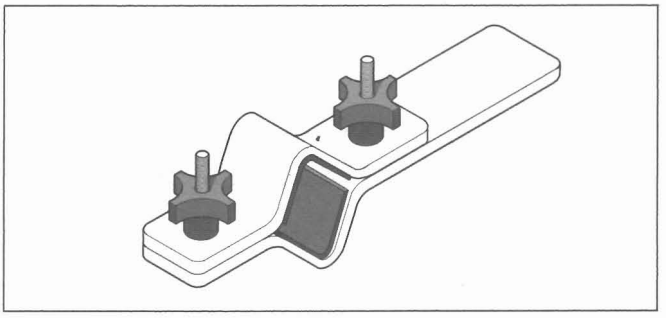
Part No. HD-39978 Multi-Meter (FLUKE 78)
(Used with HD-39617)



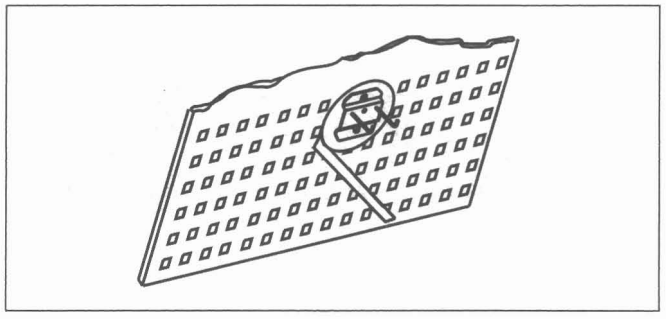
Part No. HD-41155 VHS Tape Storage Tower



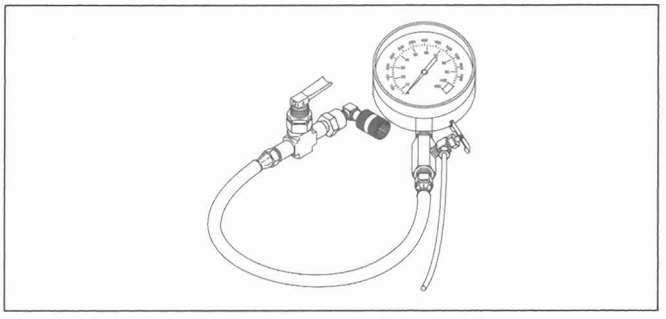
Part No. HD-39994-A Paint Repair Kit



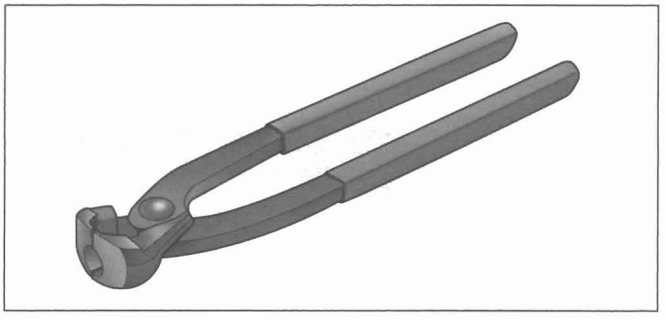
Part No. HD-41177 Fork Tube Holder



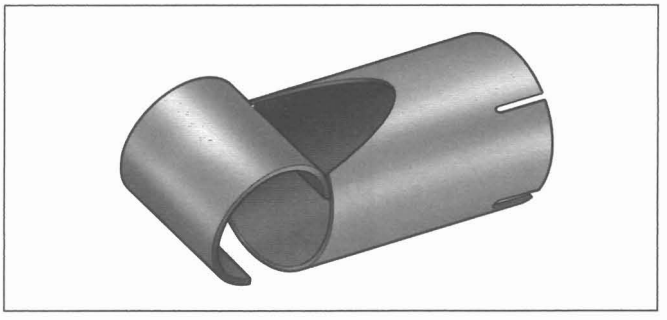
Part No. HD-41025-A Tool Organizational System



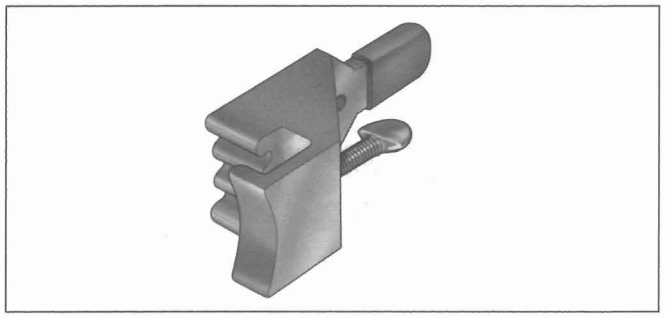
Part No. HD-41182 Fuel Pressure Gauge



Part No. HD-41137 Hose Clamp Pliers

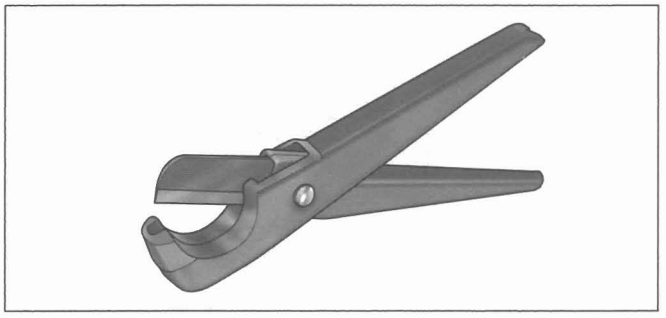


Part No. HD-41183 Robinair Heat Gun Shrink Tool
Attachment. Used with HD-25070.

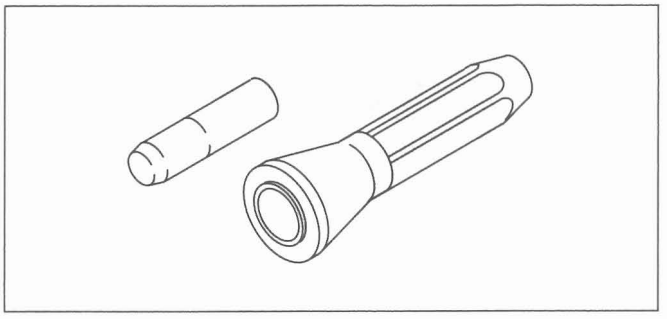


Part No. HD-41184 Sprocket Holding Tool

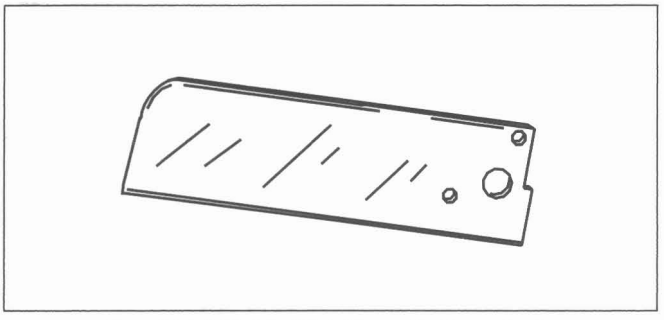
Part No. HD-41404
Harness Connector Test Kit



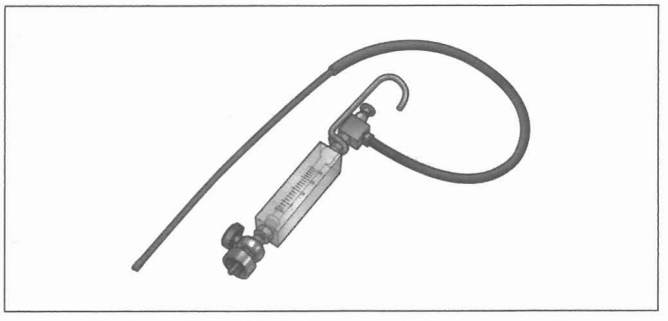
Part No. HD-41185 Hose Cutting Tool



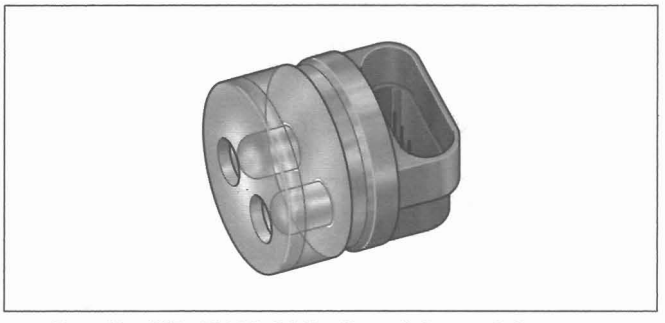
Part No. HD-41405 Main Drive Gear Seal Installer



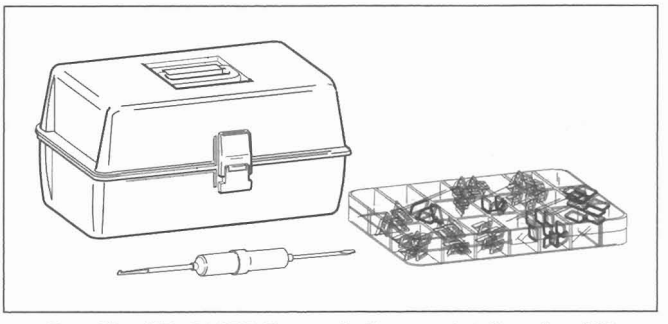
Part No. HD-41185-1 Hose Cutter Blade



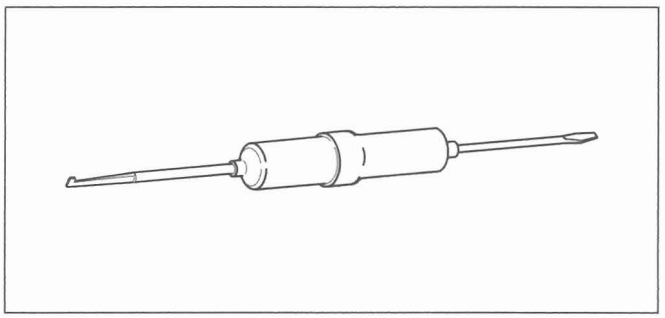
Part No. HD-41417 Propane Enrichment Kit



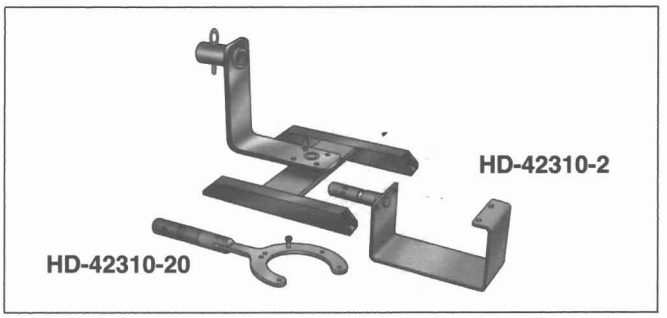
Part No. HD-41199-3 Idle Speed Control Actuator
Test Lamp



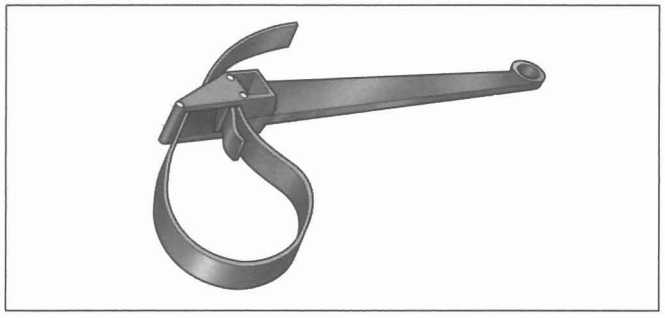
Part No. HD-41475 Deutsch Connector Service Kit
Includes HD-41475-100



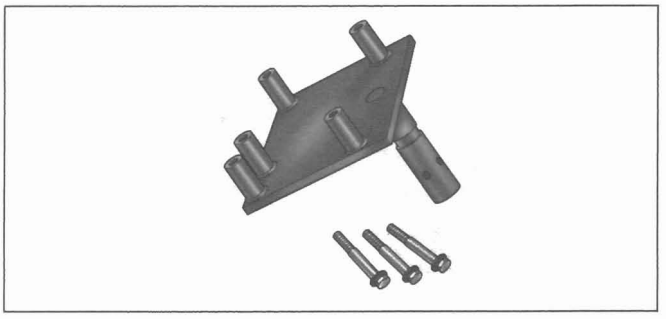
Part No. HD-41475-100 Deutsch Connector Pick Tool



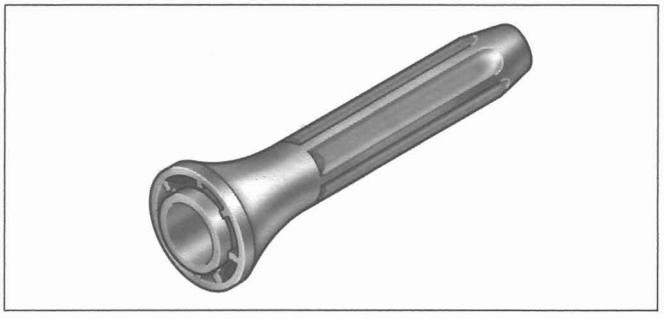
Part No. HD-42310 Engine/Transmission Stand.
(Used With Engine Cradle HD-42310-25)



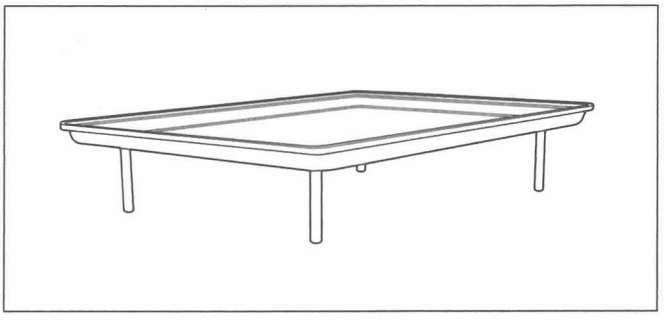
Part No. HD-41494 Hubcap Remover and Installer



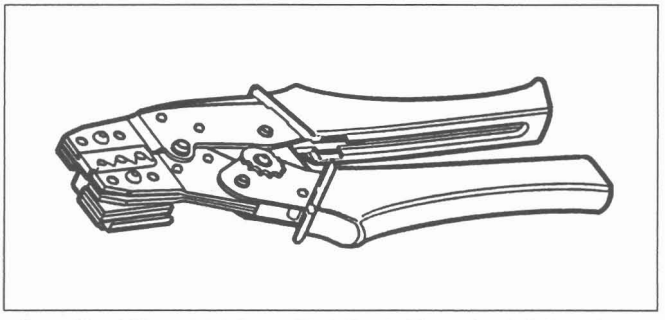
Part No. HD-42310-50 Transmission Cradle
(Use with HD-42310 or HD-43646-A)



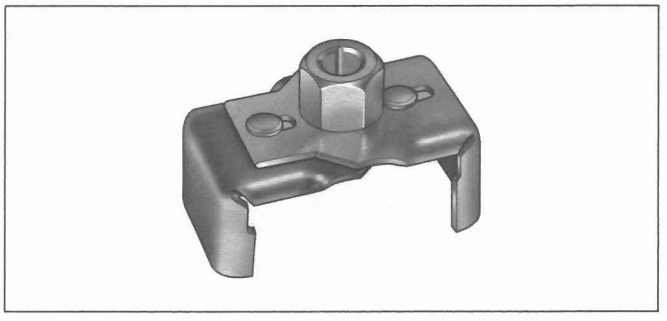
Part No. HD-41496 Main Drive Gear Large Seal Installer



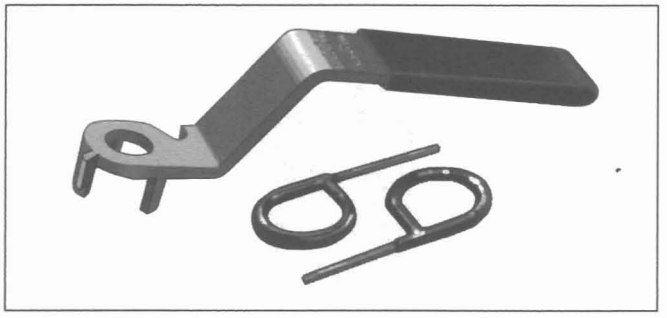
Part No. HD-42310-150 Drip Tray.
Used with HD-42310.



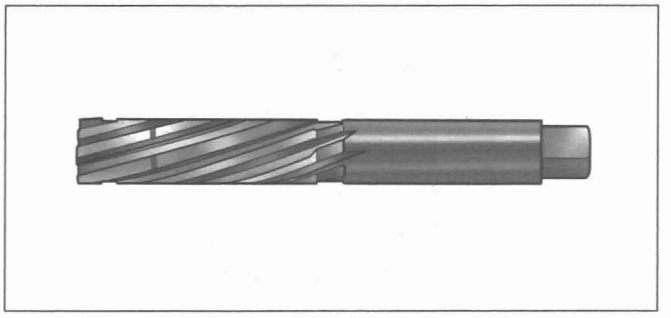
Part No. HD-41609 Amp Multilock Electrical Crimp Tool



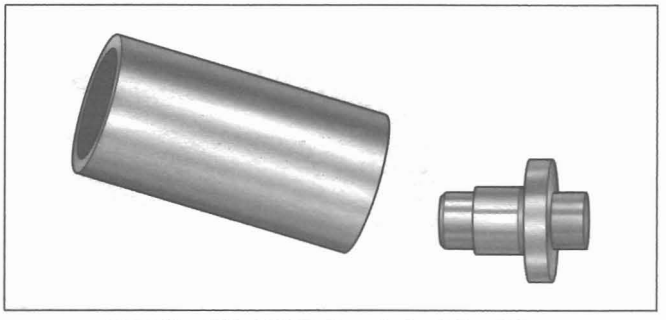
Part No. HD-42311 Oil Filter Wrench



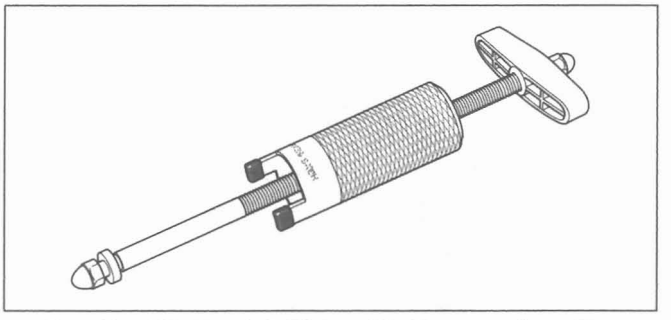
Part No. HD-42313 Cam Chain Tensioner Unloader With Retention Pins



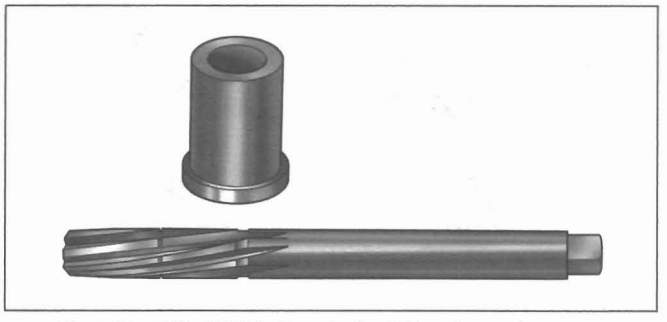
Part No. HD-42318 Connecting Rod Bushing Reamer



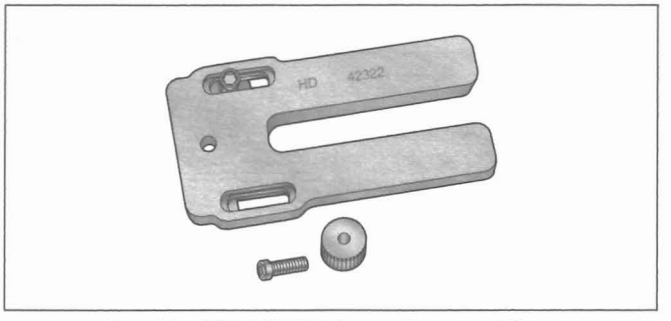
Part No. HD-42315 Crankshaft Bushing Remover/Installer



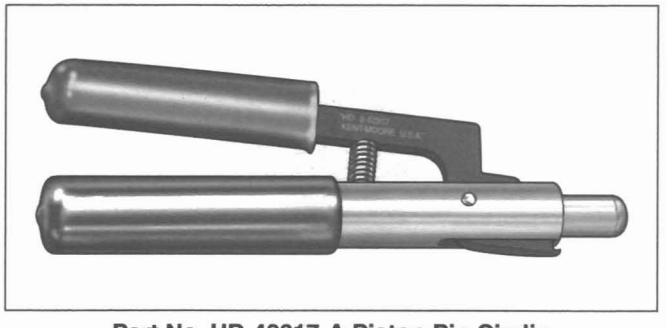
Part No. HD-42320-A Piston Pin Remover/Installer



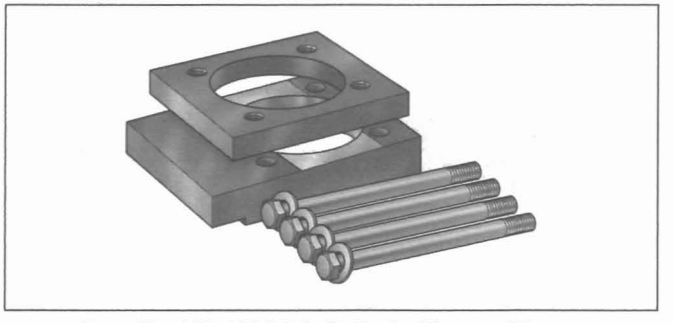
Part No. HD-42316 Crankshaft Bushing Reamer. Used with HD-43645.



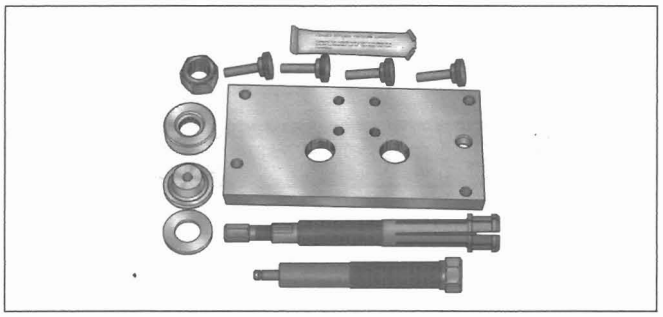
Part No. HD-42322 Piston Support Plate



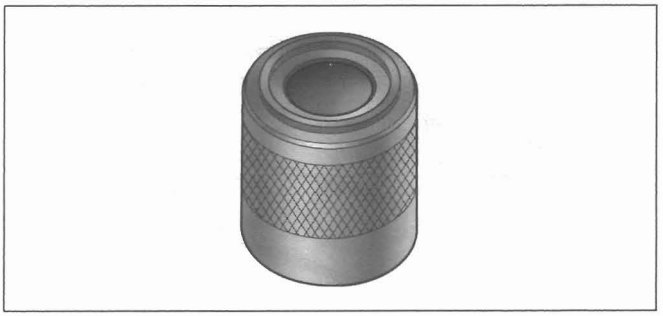
Part No. HD-42317-A Piston Pin Circlip Remover/Installer



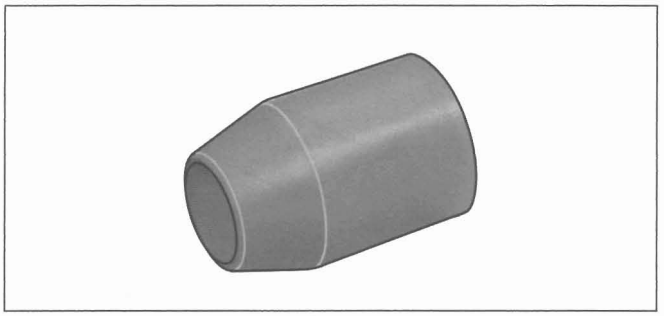
Part No. HD-42324-A Cylinder Torque Plates



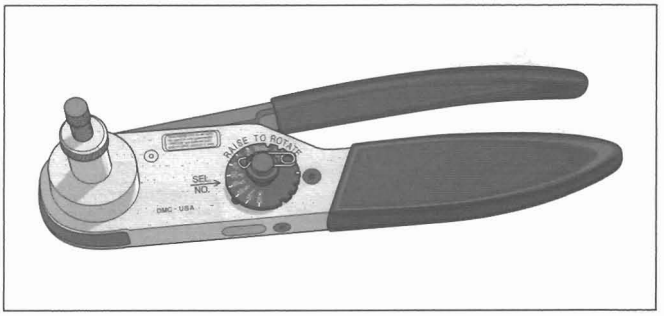
Part No. HD-42325-A Camshaft Needle Bearing Remover/Installer



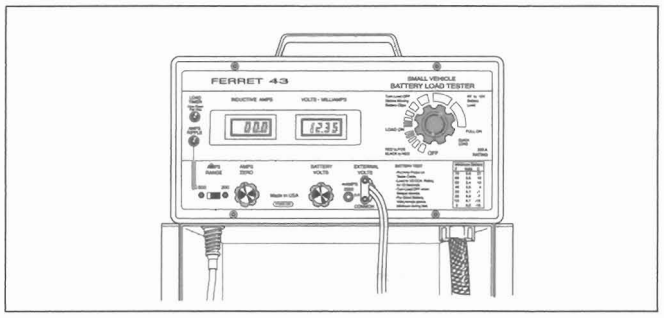
Part No. HD-42720-5 Left Crankcase Bearing Remover/Installer



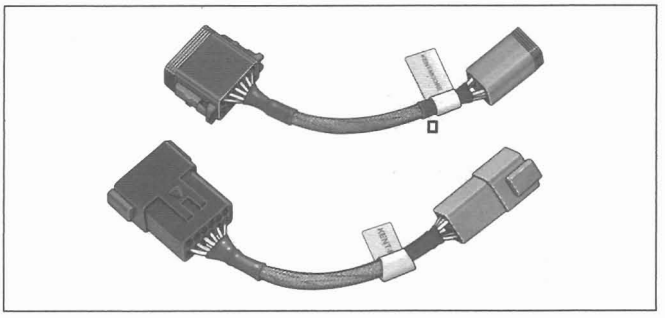
Part No. HD-42326-A Crankshaft Guide



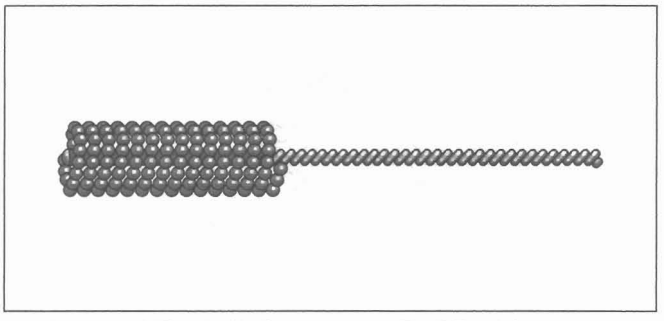
Part No. HD-42879 Deutsch Solid Barrel Contact Crimp Tool



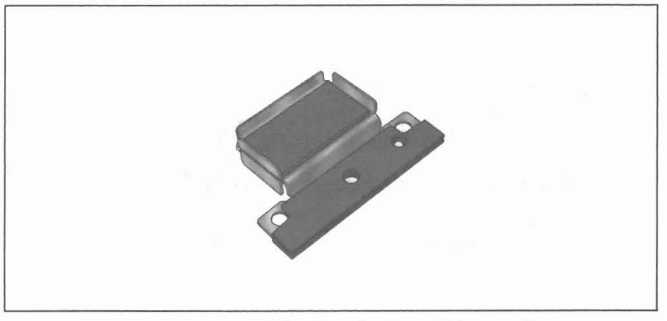
Part No. HD-42376 Battery /Charging System Load Tester



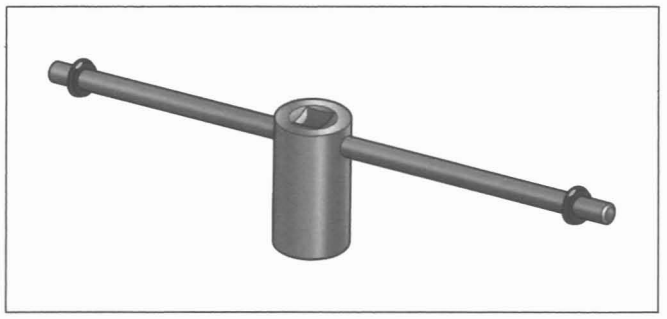
Part No. HD-42962 Breakout Box Adapters



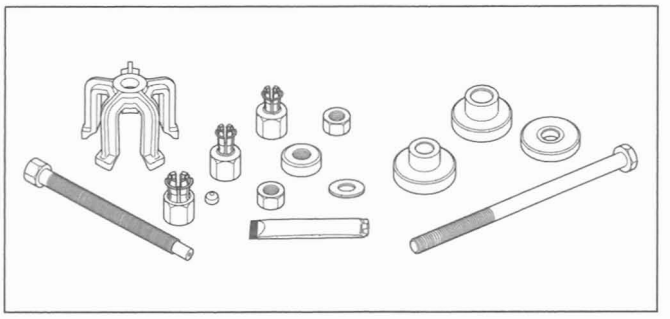
Part No. HD-42569 Connecting Rod Bushing Hone



Part No. HD-43293-A Brake Caliper Piston Remover

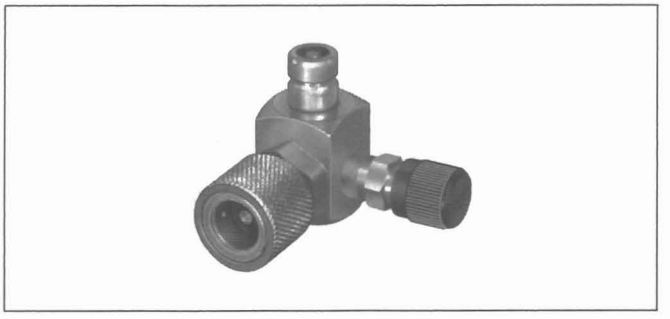


Part No. HD-43645 Reamer Handle/Drive Socket



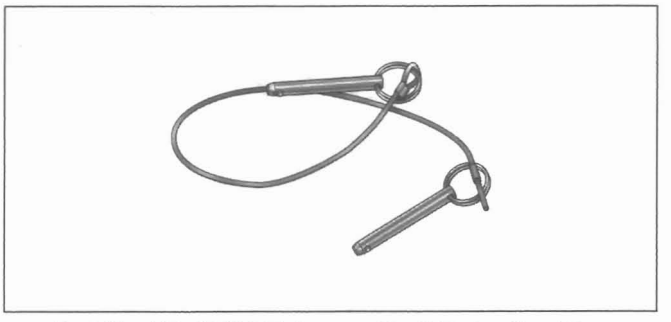
Part No. HD-44060 Wheel Bearing Remover

Part No. HD-43646-A Rolling Engine Stand

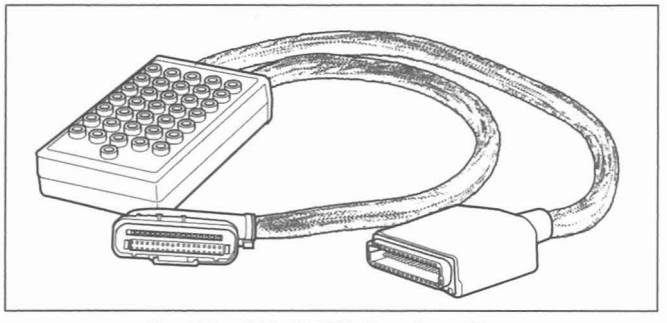


Part No. HD-44061 Fuel Pressure Gauge Adapter

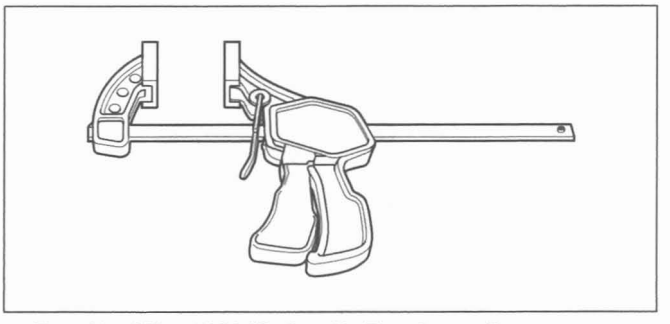
Part No. HD-43646-10 Drip Pan. (Use with H-D 43646)



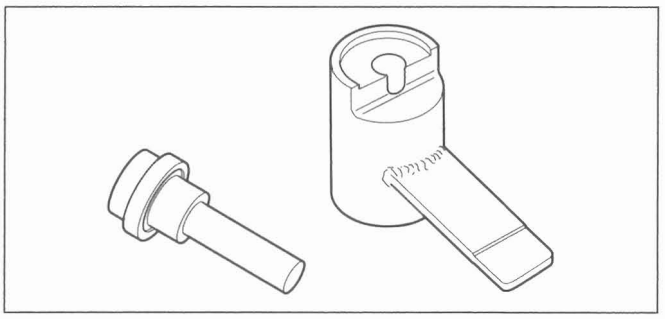
Part No. HD-44062 Balancer Shaft Retention Pins



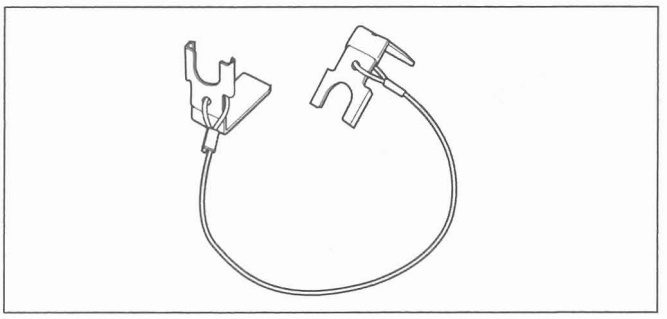
Part No. HD-43876 Breakout Box



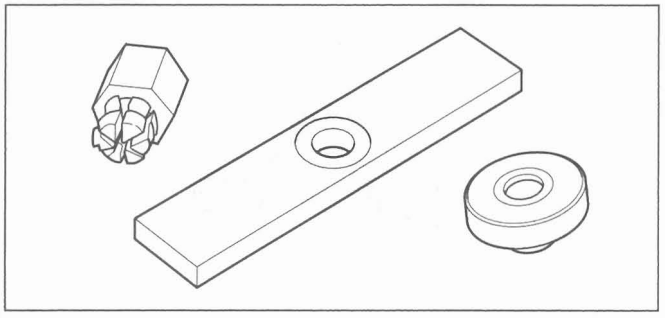
Part No. HD-44063 Hydraulic Tensioner Compressor



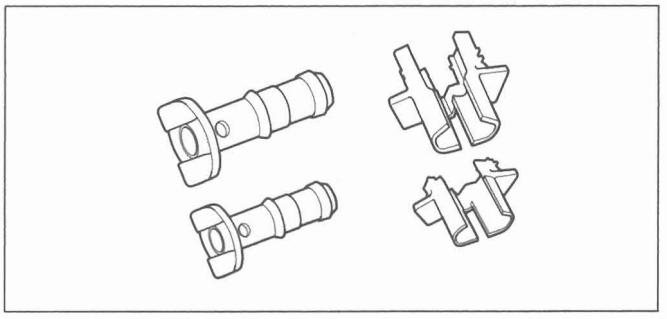
Part No. HD-44065 Right Cranckcase Bearing Remover and Installer



Part No. HD-44408 Hydraulic Tensioner Retainers

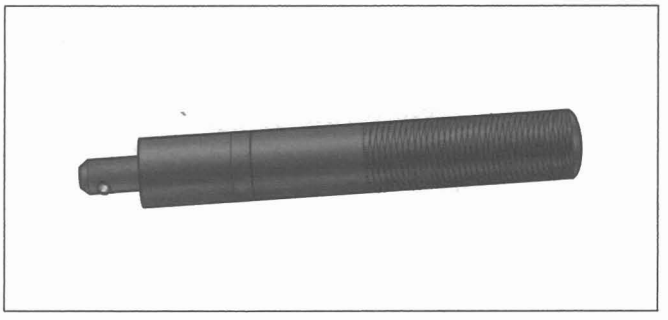


Part No. HD-44066 Balancer Shaft Inner/outer Bearing Remover/Installer. (Used with HD-44060)

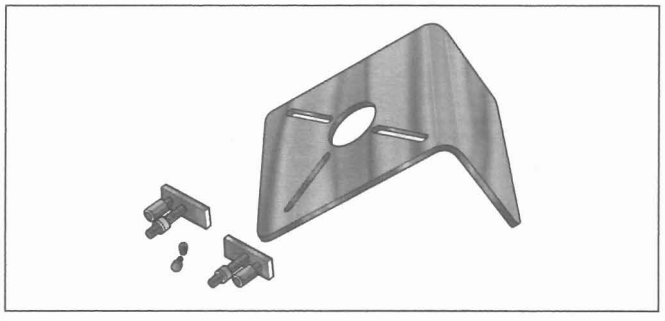


Part No. HD-44455 Oil Line Remover and Replacement Tool

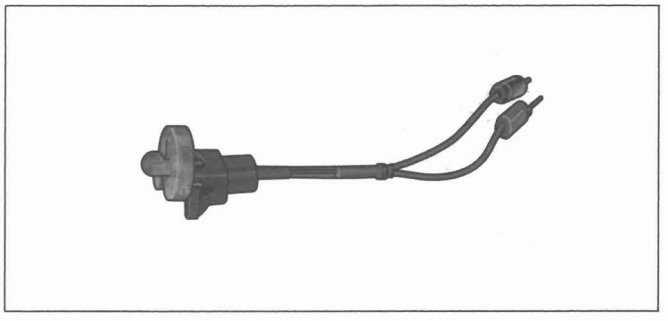
Part No. HD-44067A Oil Filter Remover



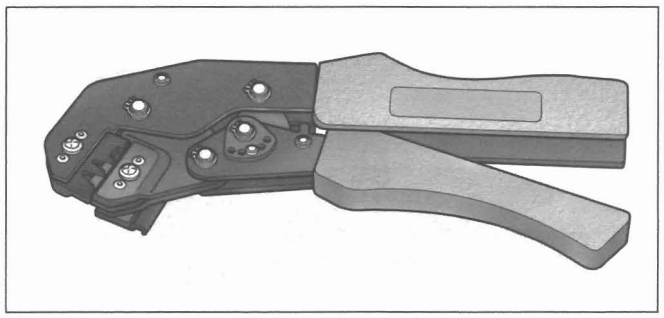
Part No. HD-44567 Universal Driver Handle (7 Inch Length)



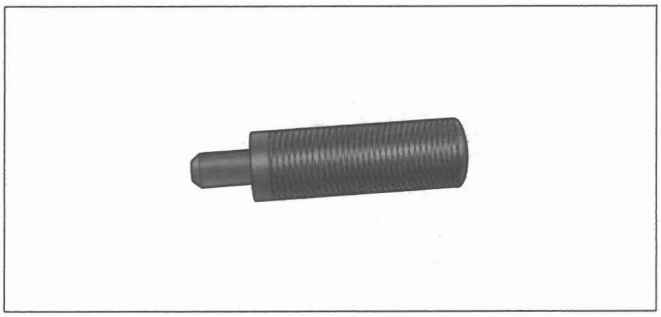
Part No. HD-44358 Flywheel Fixture



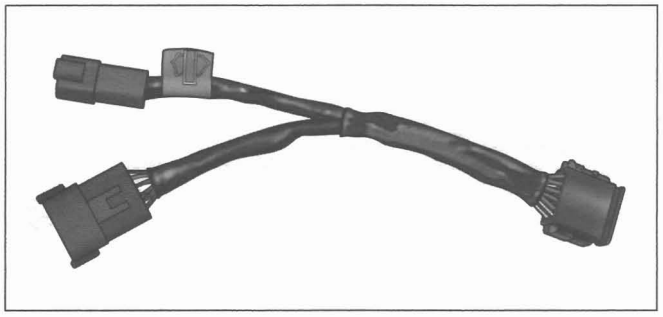
Part No. HD-44687 Ignition Coil Circuit Test Adapter



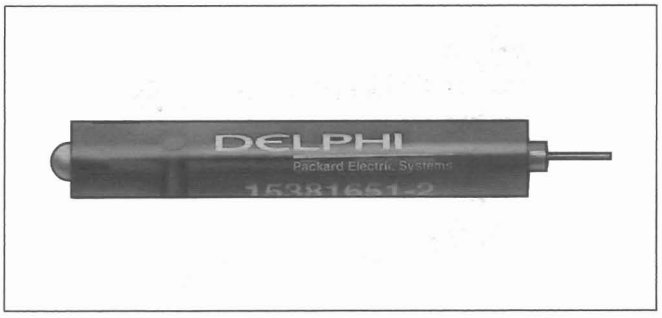
Part No. HD-44695 Mini Amp Multilock
Electrical Terminal Crimp Tool



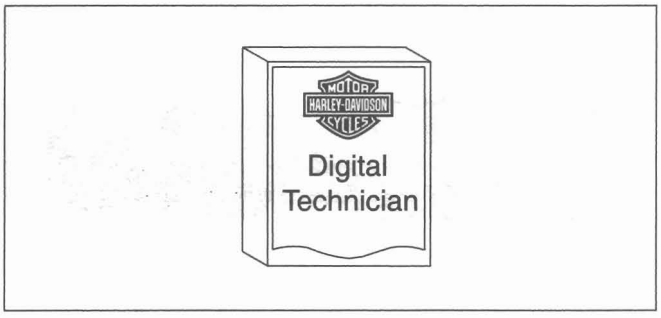
Part No. HD-45907 Universal Driver Handle
(4 Inch Length)



Part No. HD-44720 TSSM Diagnostic Interface Harness



Part No. HD-45928 Packard Micro 64 Terminal Remover



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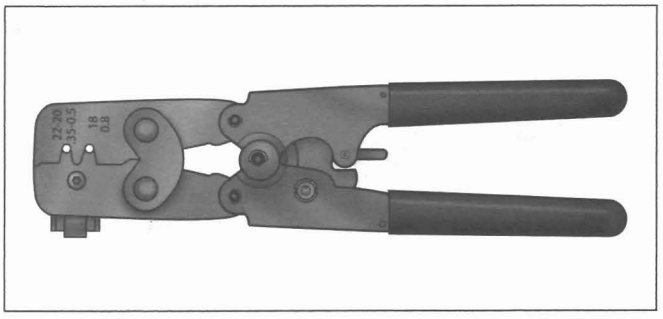
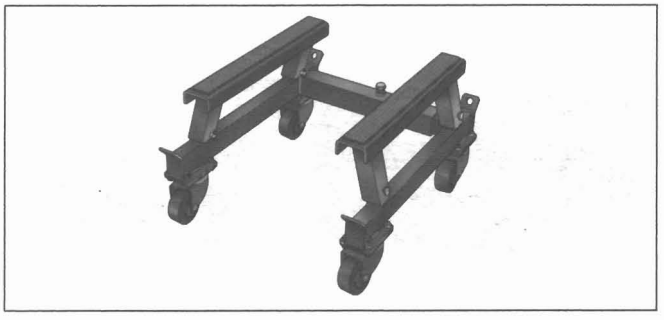


Part No. HD-45929 Packard Micro 64 Terminal Crimper

Part No. HD-44830 Tech-Link



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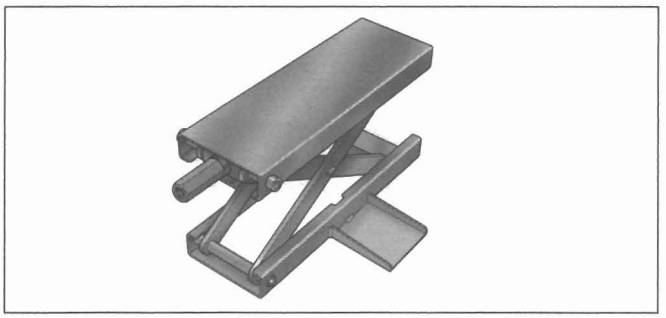
(Use with HD-45968)



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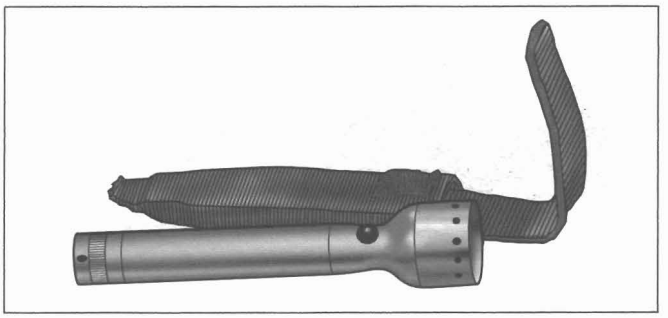

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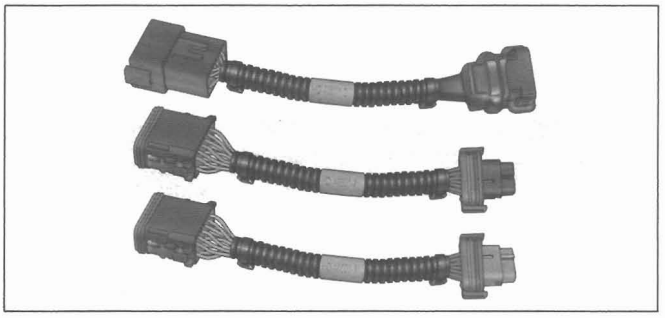

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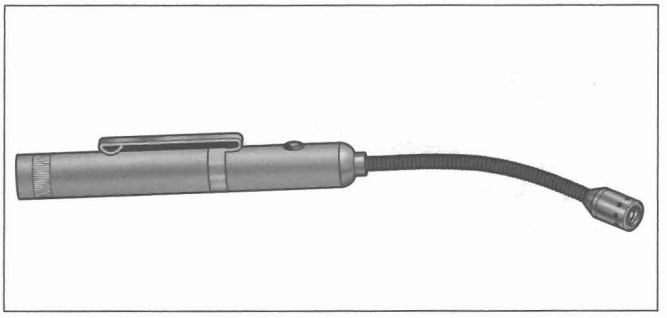
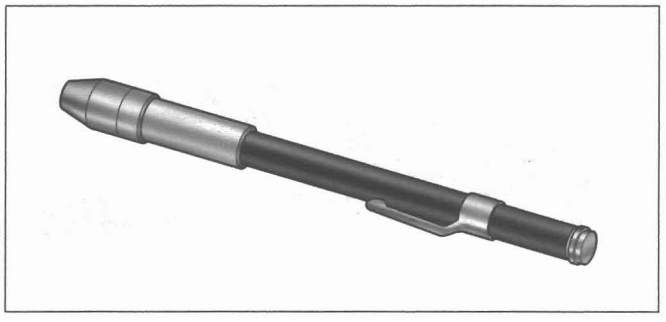
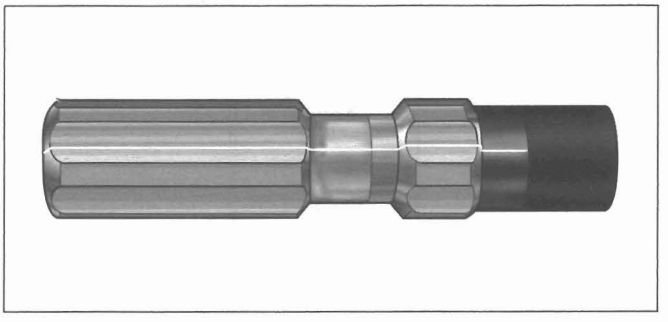


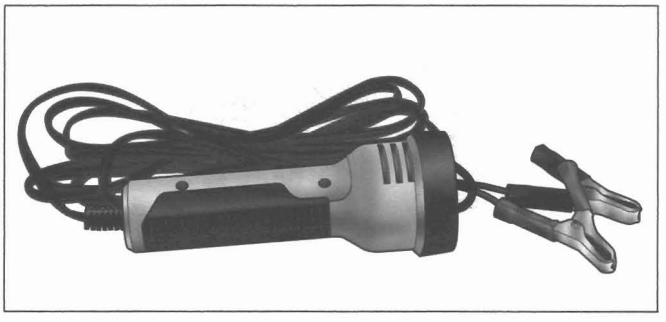
Part No. HD-47188 Technician's Flex Light



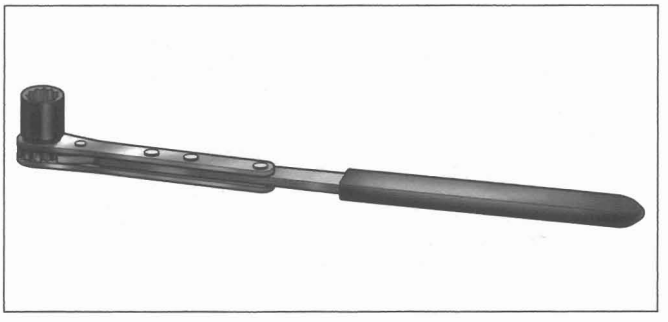
Part No. HD-47183 Black Light Leak Detector Penlight



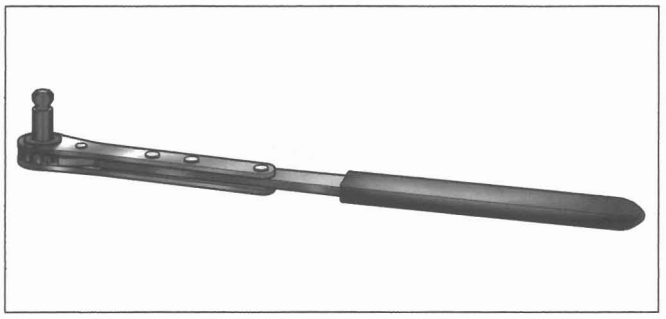
Part No. HD-47190 Seat Mounting Screw Tool



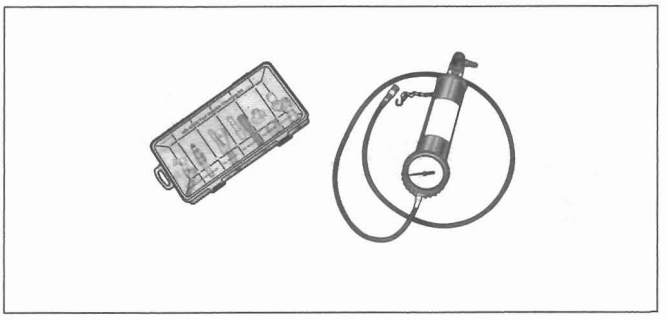
Part No. HD-47184 Black Light Leak Detector Flashlight



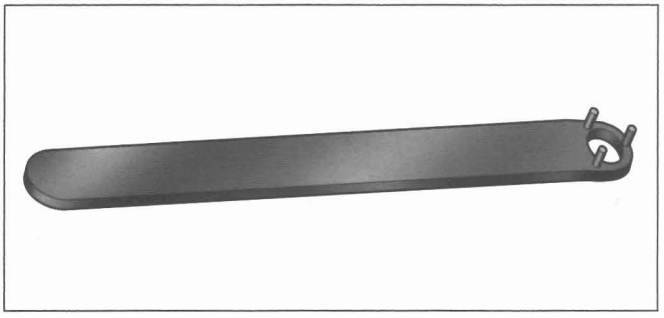
Part No. HD-47248 Rocker Housing Wrench



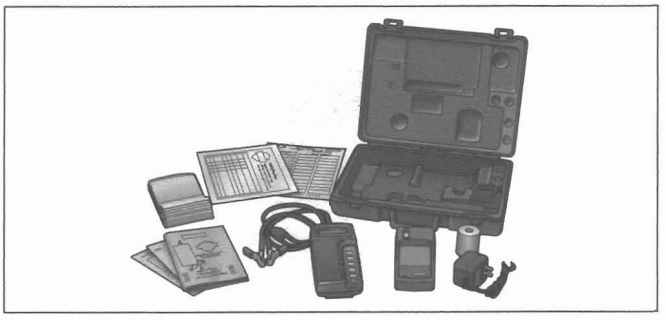
Part No. HD-47250 Intake Manifold Wrench



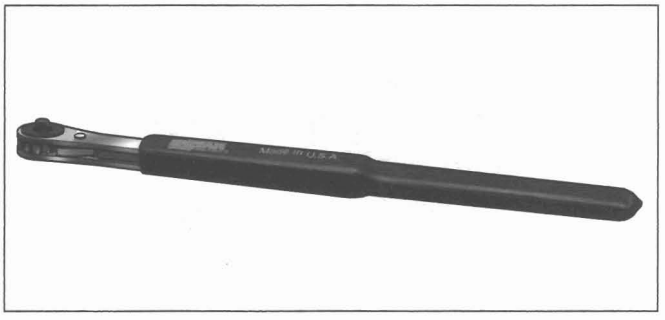
Part No. HD-48030 Fuel Injector Cleaner



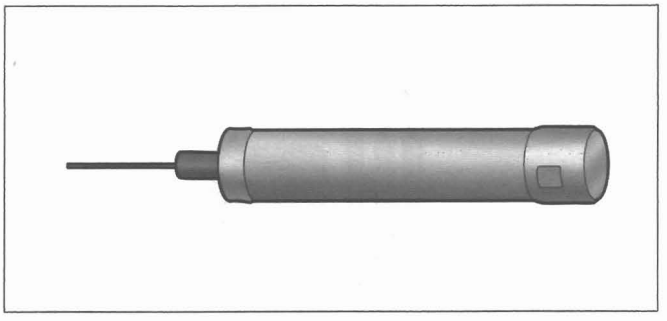
Part No. HD-47255 Springer Steering Stem Bearing Tool



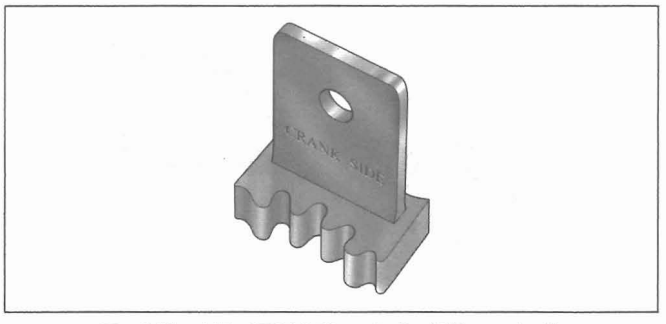
Part No. HD-48053 Battery and
Electrical System Analyzer



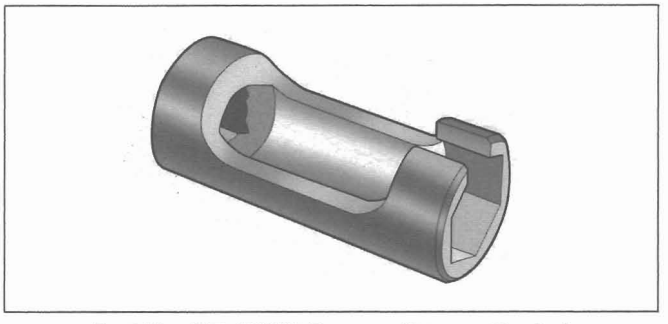
Part No. HD-47258 Rocker Cover Wrench



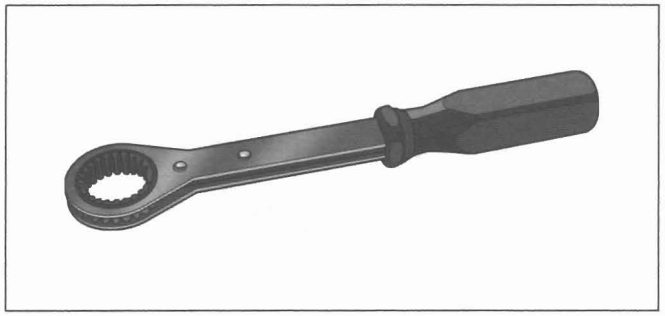
Part No. HD-48114 Molex Connector
Terminal Remover



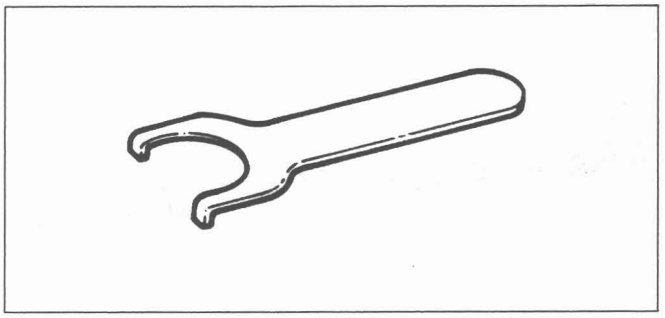
Part No. HD-47941 Crankshaft/Camshaft
Sprocket Locking Tool



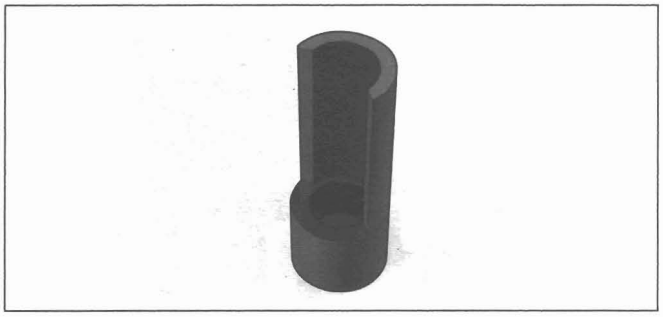
Part No. HD-48262 Oxygen Sensor Socket



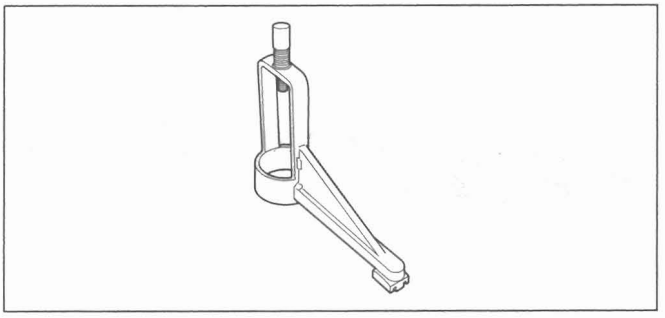
Part No. HD-48283 Crankshaft Rotating Wrench



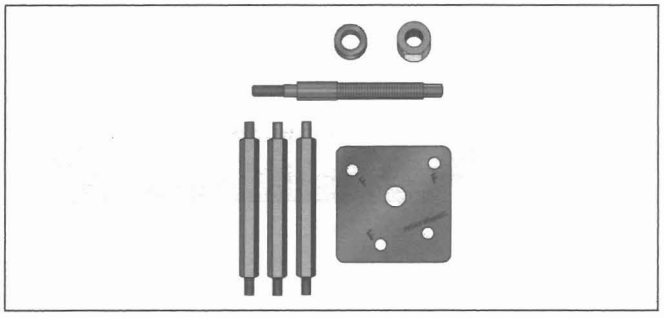
Part No. HD-94455-89 Shock Spanner Wrench



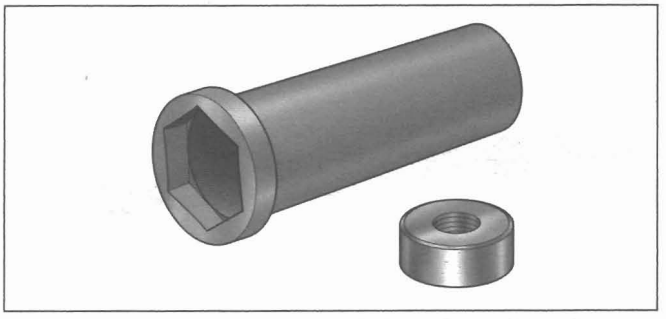
Part No. HD-48309 Balancer Bearing Installer



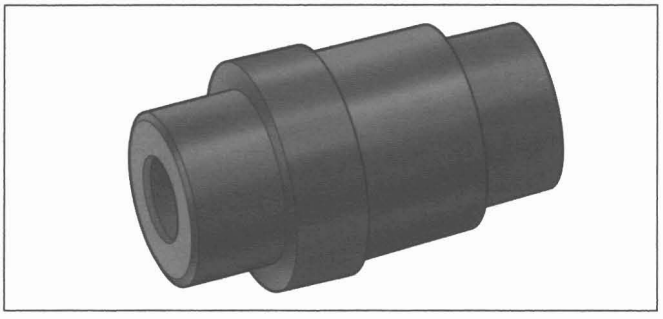
Part No. HD-48615 Balancer Shaft Sprocket Alignment Tool



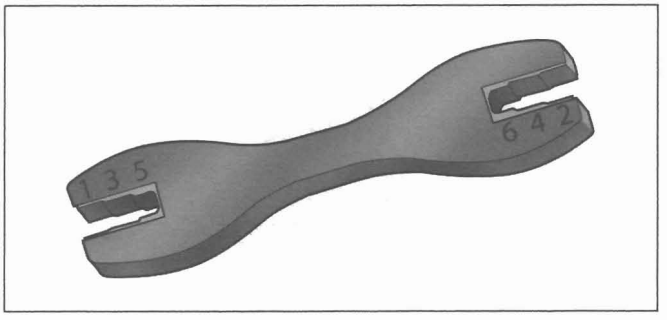
Part No. HD-48457 Balancer/Bearing Remover



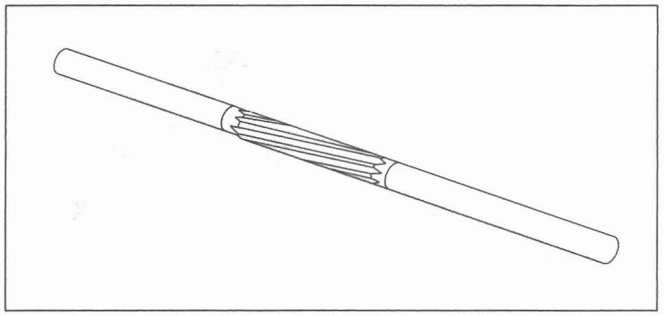
Part No. HD-94660-37B Big Twin Mainshaft Locknut Wrench



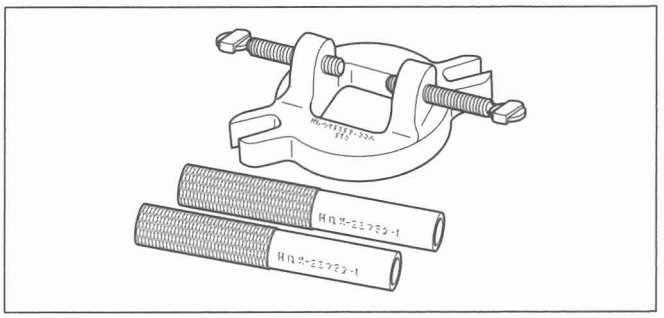
Part No. HD-48474 Outer Bearing Remover/Installer



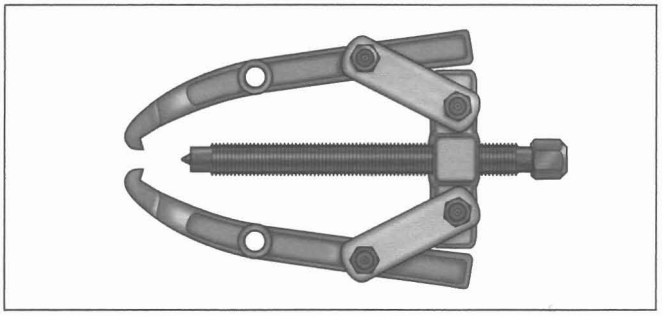
Part No. HD-94681-80 Spoke Nipple Wrench



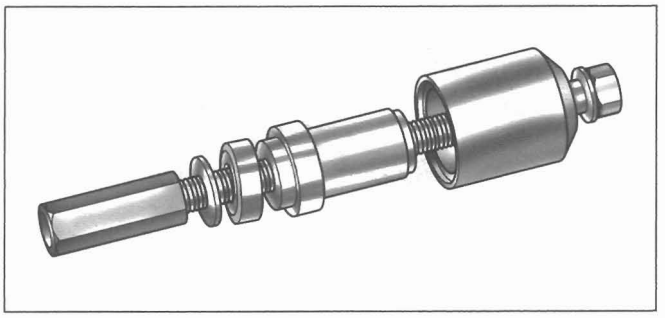
Part No. HD-94804-57 Rocker Arm Bushing Reamer



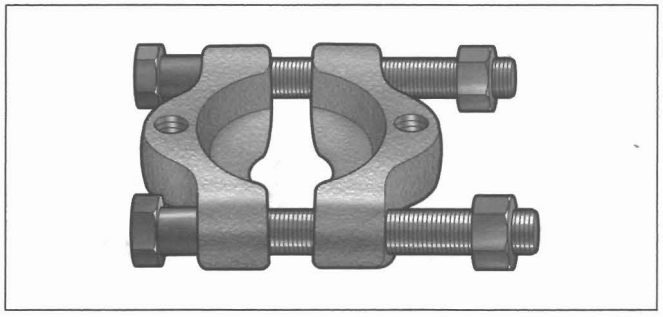
Part No. HD-95952-33C Connecting Rod Clamping Tool



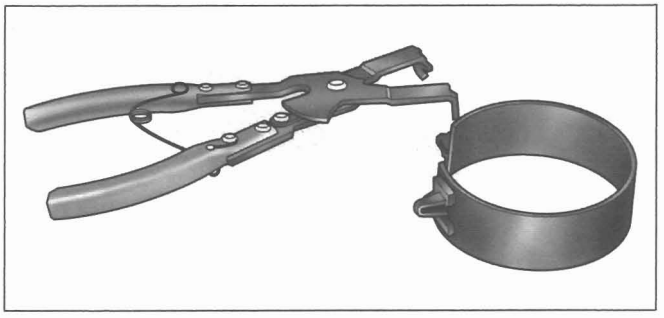
Part No. HD-95635-46 All-Purpose Claw Puller



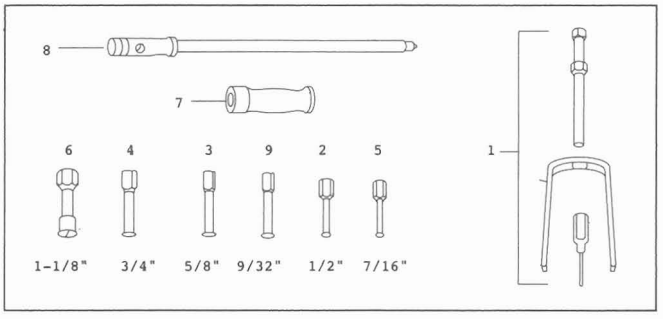
Part No. HD-95970-32D Piston Pin Bushing Tool. (Used with Body HD-95984-99 and Remover/Installer HD-95986-99)



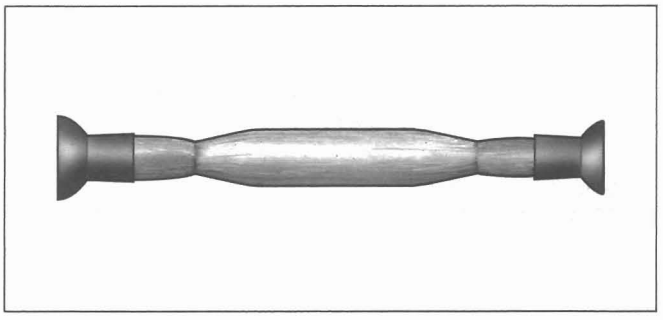
Part No. HD-95637-46B Wedge Attachment for Claw Puller. Used with HD-95635-46.



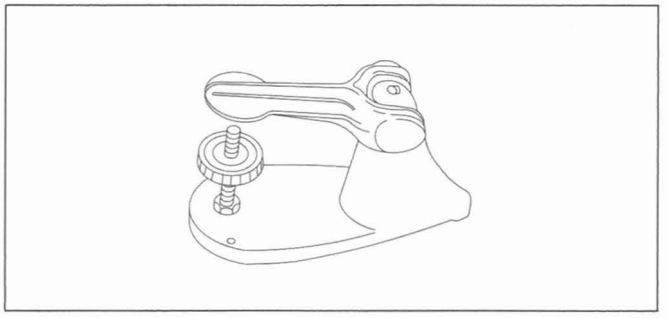
Part No. HD-96333-51D Piston Ring Compressor (Used with Band HD-96333-103)



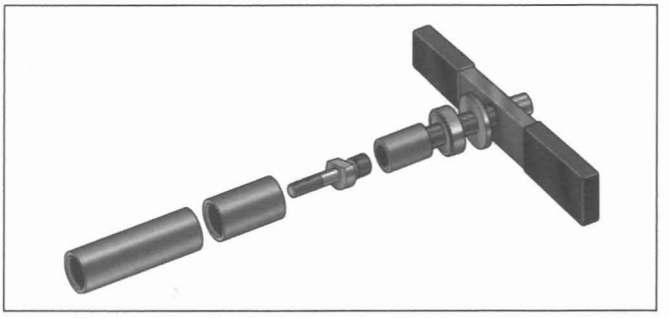
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-7. Items 8 (HD-95769-69), 9 (HD-95770-69) and 10 (HD-95771-69) are optional.



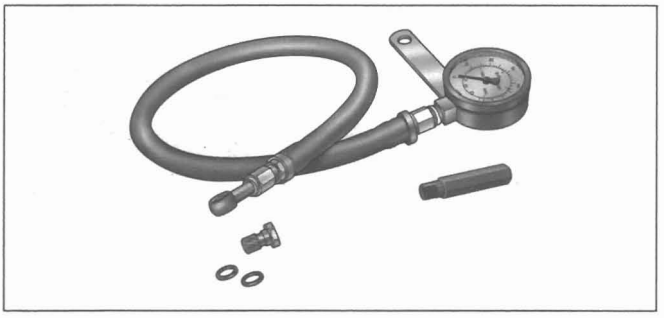
Part No. HD-96550-36B Valve Lapping Tool



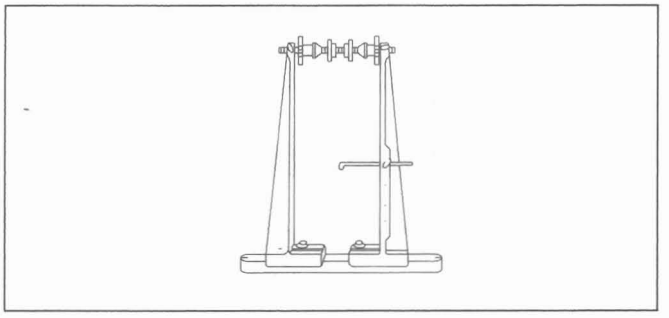
Part No. HD-96796-47 Valve Spring Tester



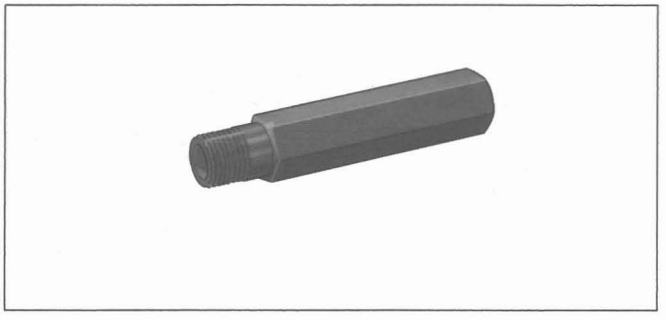
Part No. HD-97225-55C Sprocket Shaft Bearing Tool



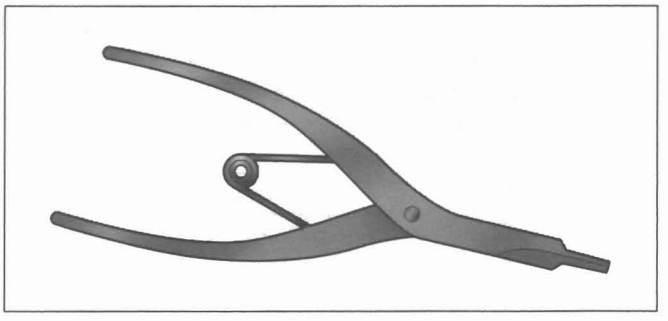
Part No. HD-96921-52B Oil Pressure Gauge.
Used with HD-96921-120.



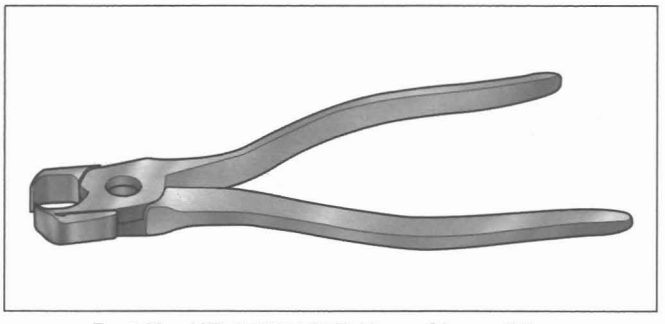
Part No. HD-99500-80 Wheel Truing
and Balancing Stand



Part No. HD-96921-120 Oil Pressure Gauge Adapter



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



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

APPENDIX B–WIRING
AMP 1-PLACE CONNECTOR B.1

GENERAL

PART NO.	SPECIALTY TOOL
HD-41609	AMP Multi-lock crimper
HD-44695	Terminal crimper
HD-39621-27	Socket terminal tool
HD-39621-28	Pin terminal tool

NOTE

A TERMINAL REPAIR KIT (HD-39621-A) contains a variety of replacement AMP terminals and the pin and socket tools. For terminal crimping use the PACKARD TERMINAL CRIMPER (HD-38125-7).

PIN AND SOCKET HOUSINGS

To Separate Housings

Bend back the ears on the pin housing slightly and separate the pin and socket halves of the connector.

To Mate Housings

Push the pin and socket halves of the connector together until the latches click.

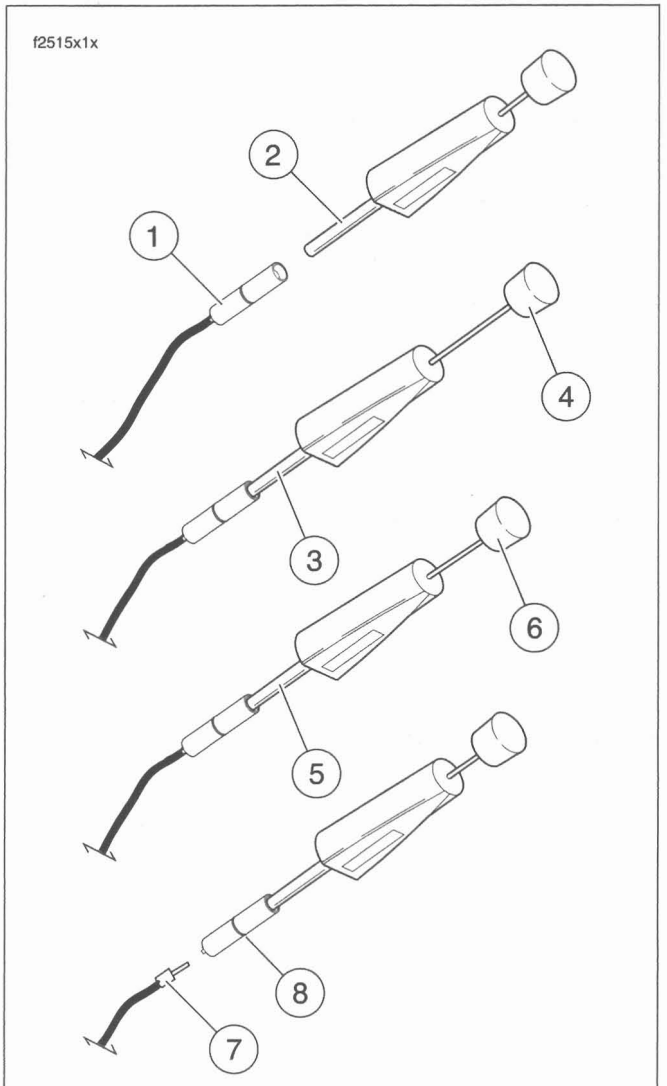
WIRE TERMINALS

Remove Socket Terminal

1. See Figure B-1. Grasp the lead on the wire end of the socket housing (1) and push the terminal forward toward the mating end of the connector until it stops. This will disengage the locking tang from the groove in the connector.
2. Fit the barrel (2) of the SOCKET TERMINAL TOOL (Part No. HD-39621-27) over the socket.
3. While rotating the tool slightly, push until it bottoms (3) in the socket housing.
4. Allow the plunger (4) to retract from the handle.
5. Holding the socket housing while keeping the tool firmly bottomed (5), depress the plunger (6). The terminal (7) pops out the wire end of the connector.

NOTE

If the terminal is not released from the socket housing, then the terminal was not pushed forward far enough before placement of the tool or the tool was not bottomed in the connector housing.



1. **Socket housing**
2. **Barrel**
3. **Barrel bottomed in connector**
4. **Plunger retracted**
5. **Hold barrel bottomed**
6. **Plunger pressed**
7. **Socket terminal**
8. **Connector lip**

Figure B-1. Socket Terminal Tool (HD-39621-27)

Install Socket Terminal

1. Note the lip at the middle of the socket housing. One side of the lip is flat while the other side is tapered. Insert the wire terminal into the socket housing on the flat lip) side.
2. Push the lead into the socket housing until it stops. A click is heard when the terminal is properly seated.
3. Gently tug on the lead to verify that the terminal is locked in place.

Remove Pin Terminal

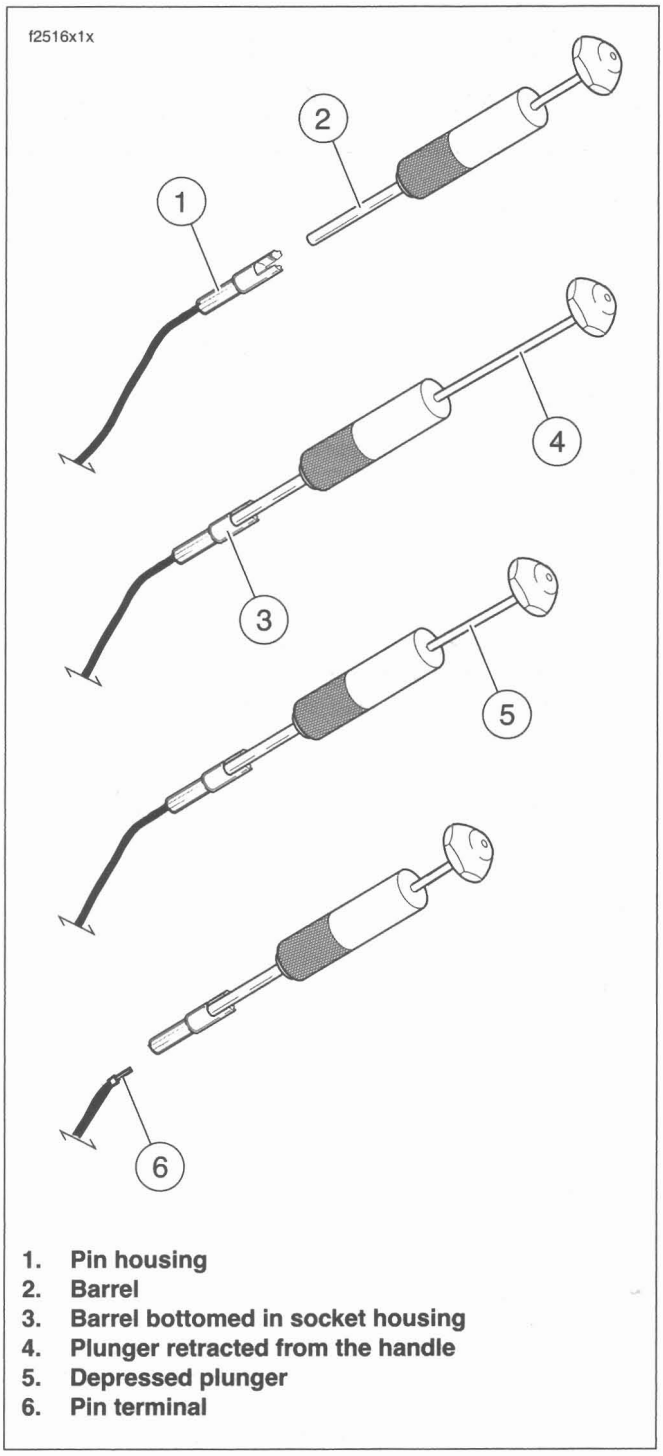
1. Grasp the lead on the wire end of the pin housing and push the terminal forward toward the mating end of the connector until it stops. This will disengage the locking tang from the groove in the connector.
2. See Figure B-2.
   a. Fit the barrel of the Amp Pin Terminal Remover (HD-39621-28) over the pin, and while rotating the tool slightly, push until it bottoms in the housing. Allow the plunger to retract from the handle.
   b. Holding the pin housing while keeping the tool firmly bottomed, depress the plunger. The terminal pops out the wire end of the connector.

NOTE

If the terminal is not released from the pin housing, then the terminal was not pushed forward far enough before placement of the tool or the tool was not bottomed in the connector housing.

Install Pin Terminal

1. Push the lead into the pin housing until it stops. A click is heard when the terminal is properly seated.
2. Gently tug on the lead to verify that the terminal is locked in place.



1. **Pin housing**
2. **Barrel**
3. **Barrel bottomed in socket housing**
4. **Plunger retracted from the handle**
5. **Depressed plunger**
6. **Pin terminal**

Figure B-2. Amp Pin Terminal Remover (HD-39621-27)

GENERAL

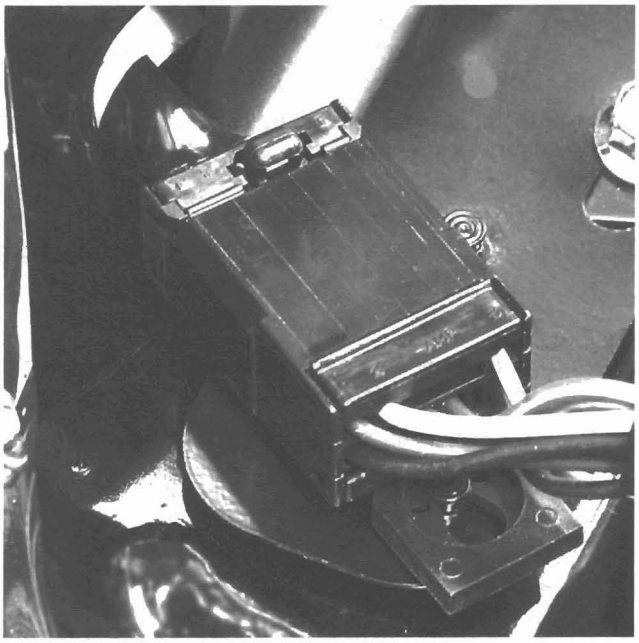
PART NO.	SPECIALTY TOOL
HD-39621-A	Terminal repair kits
HD-41609	Amp Multi-lock crimper
HD-39621-28	Pin terminal tool
HD-39621-27	Socket terminal tool

Amp Multilock connectors are found in 3-place, 6-place and 10-place versions though not all terminal cavities may be used. Amp Multilock connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See Figure B-3. Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

NOTE

A TERMINAL REPAIR KIT (HD-39621-A) contains a variety of replacement Amp terminals and the pin and socket tools. For terminal crimping use the PACKARD TERMINAL CRIMPER (HD-38125-7).



1. **Attachment clip**
2. **Release button**
3. **Socket housing**
4. **Pin housing**

Figure B-3. Amp Multilock Connector

PIN AND SOCKET HOUSINGS

Separate Housings

1. If necessary, slide connector with attachment clip rearward to release it from the T-stud.
2. See Figure B-3. Depress the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

Mate Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it snaps in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector forward to engage T-stud to small end of opening.

WIRE TERMINALS

Remove Terminals from Housing

1. See Figure B-4. Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
4. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
2. Insert the terminal tool into the cavity until it stops.
   a. **Socket:** SOCKET TERMINAL TOOL (HD-39621-27)
   b. **Pin:** PIN TERMINAL TOOL (HD-39621-28)

NOTE

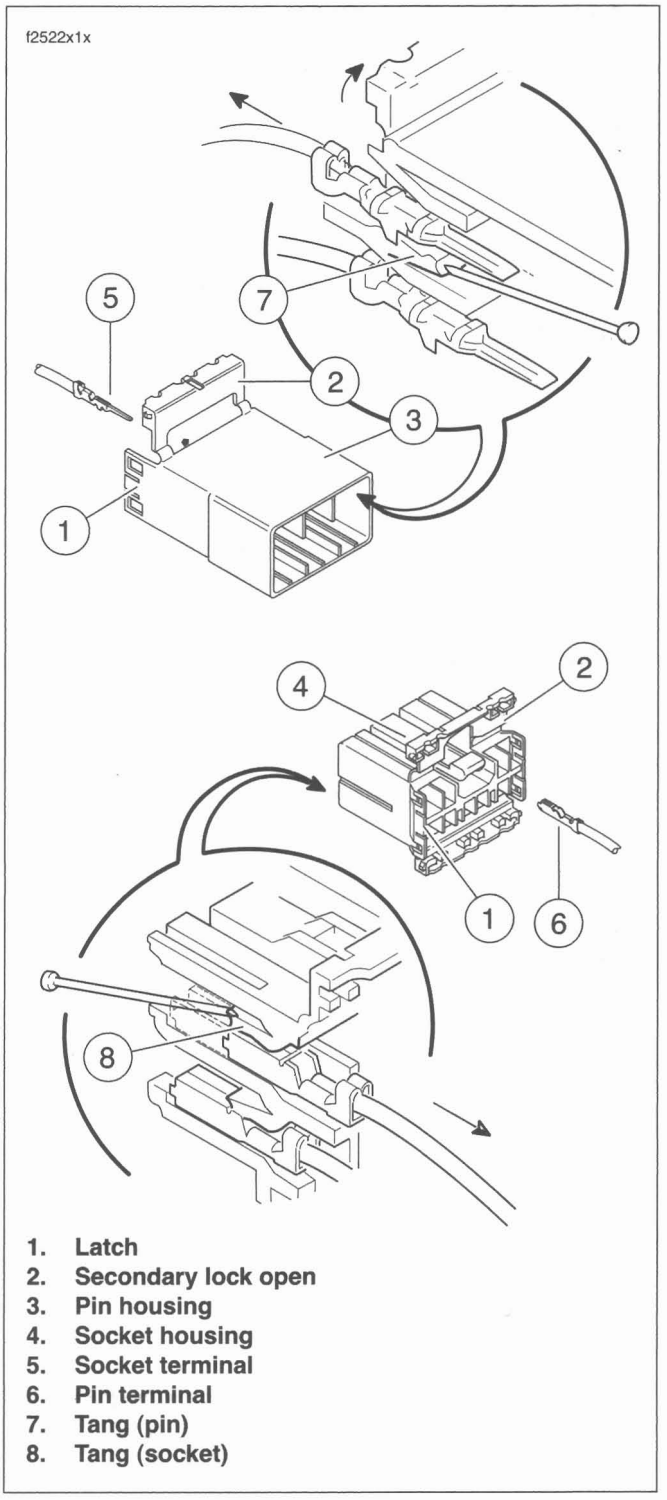
If socket/pin terminal tool is not available, a push pin/safety pin or a Snap-On (Part No. TT600-3) pick may be used.

3. Press the tang in the housing to release the terminal.
   a. **Socket:** Lift the socket tang (8) up.
   b. **Pin:** Press the pin tang (7) down.

NOTE

A "click" is heard if the tang is released.

4. Gently tug on wire to pull wire and terminal from cavity.



1. **Latch**
2. **Secondary lock open**
3. **Pin housing**
4. **Socket housing**
5. **Socket terminal**
6. **Pin terminal**
7. **Tang (pin)**
8. **Tang (socket)**

Figure B-4. Socket and Pin Housings

Insert Terminals into Housings

NOTE

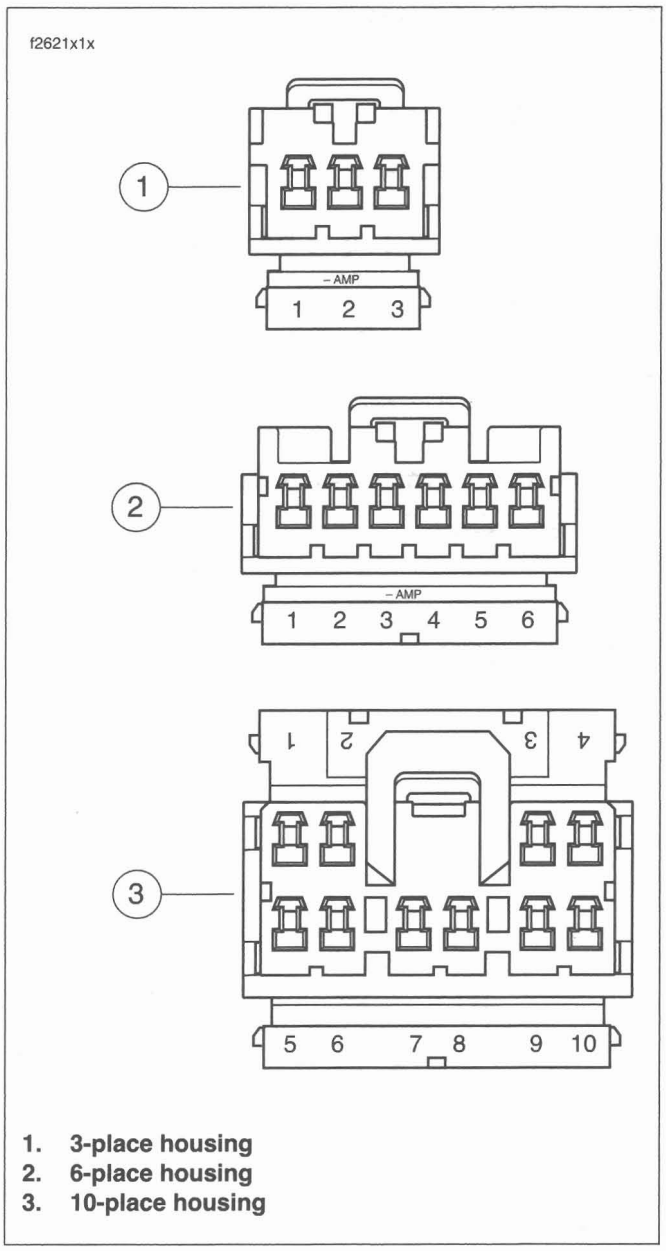
See Figure B-5. Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

NOTES

- *Up and down can be determined by the position of the release button, the button is the top of the connector.*
- *On the pin side of the connector, tangs are positioned at the bottom of each cavity, 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 cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.*

2. Gently tug on wire end to verify that the terminal is locked in place.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.



1. **3-place housing**
2. **6-place housing**
3. **10-place housing**

Figure B-5. Cavity Numbers on Secondary Locks (socket housings shown)

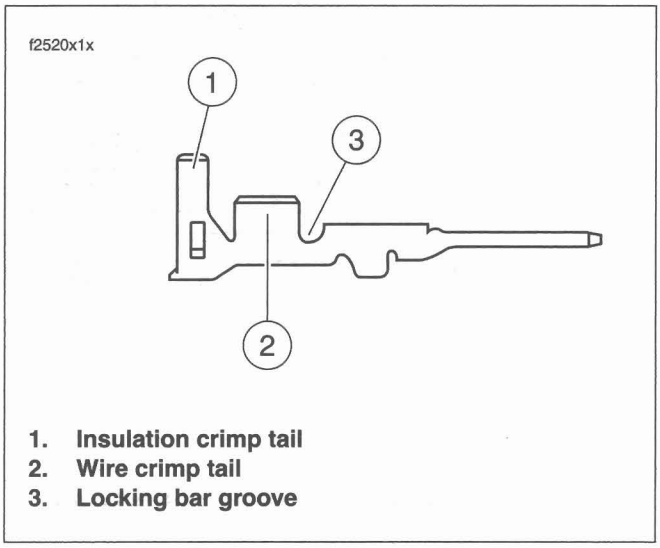
TERMINAL CRIMPS

Prepare Wire Leads

1. Strip wire lead removing 0.16 in. (4.0 mm) of insulation from the wire lead.
2. See Figure B-6. and Figure B-7. Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3)
3. Identify the wire lead gauge and the corresponding crimper tool and nesting die.

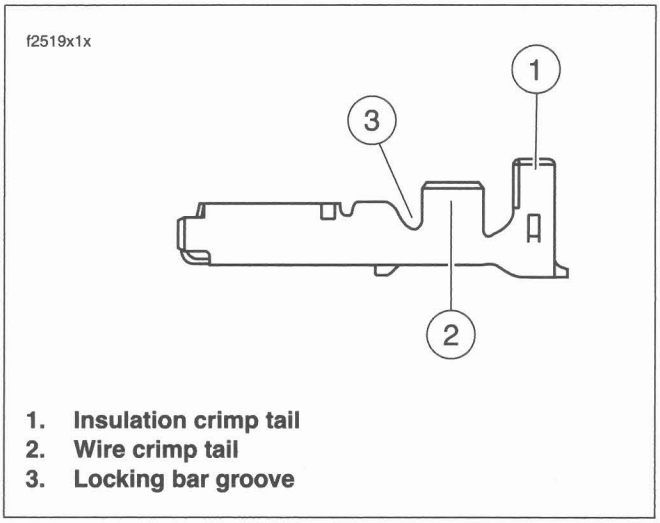
Table B-1. Crimp Tool Wire Gauge/Nest

Wire Gauge	Nest
20	Front
16	Middle
18	Rear



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure B-6. Pin Terminal



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure B-7. Socket Terminal

Crimp Terminals to Leads

NOTE

Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.

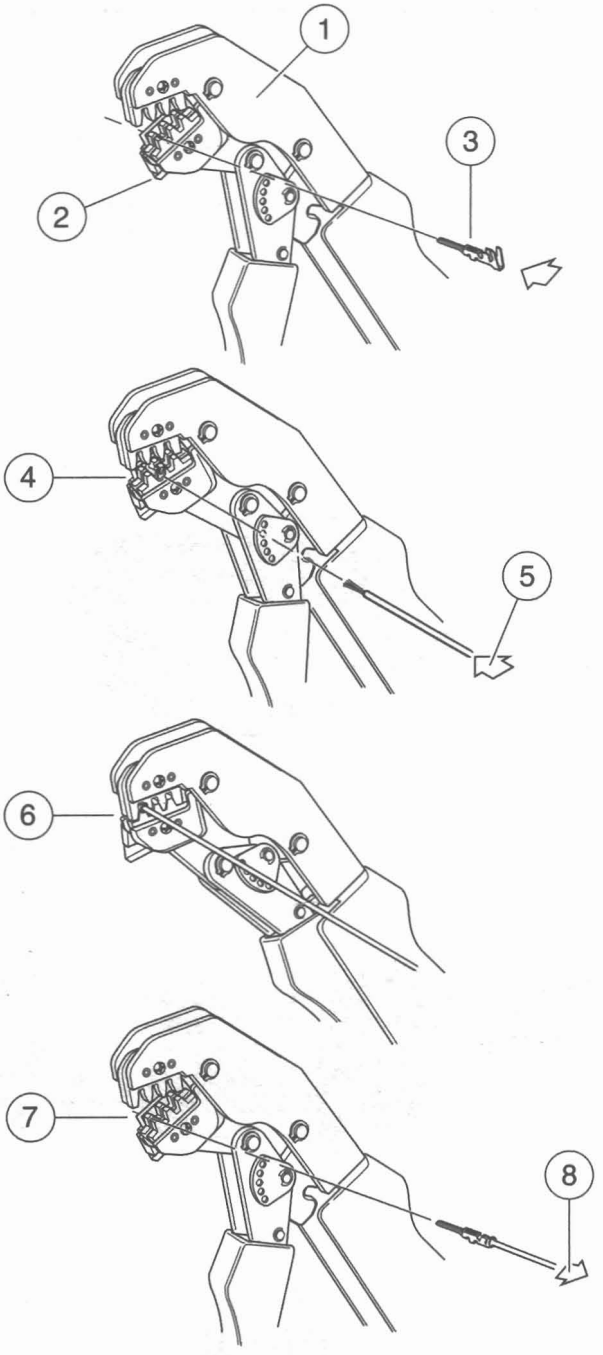
1. See Figure B-8. Squeeze the handles to cycle the AMP MULTI-LOCK CRIMPER (HD-41609) to the fully open position (1).
2. Raise locking bar by pushing up on bottom flange (2).

NOTE

See Figure B-6. and Figure B-7. Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and crimp the wire crimp tail (2) around the bare wire of the stripped lead and the insulation crimp tail around the insulation.

3. See Figure B-8. With the installation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool. Refer to Table B-1.
4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
5. Insert stripped end of lead (5) until ends make contact with locking bar.
6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Raise up locking bar (8) and remove crimped terminal.

f2518x1x



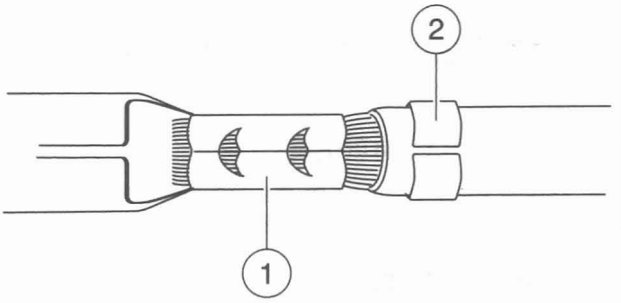
1. Open position
2. Locking bar flange
3. Insert contact
4. Release locking bar
5. Insert lead
6. Squeeze
7. Raise locking bar
8. Remove crimped terminal

Figure B-8. Multilock Crimping Procedure

INSPECT CRIMP

See Figure B-9. Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.

f2517x1x



1. Insulation crimp
2. Wire core crimp

Figure B-9. Terminal Crimp

GENERAL

Delphi connectors are embossed with the brand name, Delphi, on the housing latch.

PIN AND SOCKET HOUSINGS

To Separate Housings

See Figure B-10. Bend back the external latch(es) slightly and separate pin and socket halves of connector.

To Mate Housings

Push pin and socket halves of connector together until external latch(es) engage.

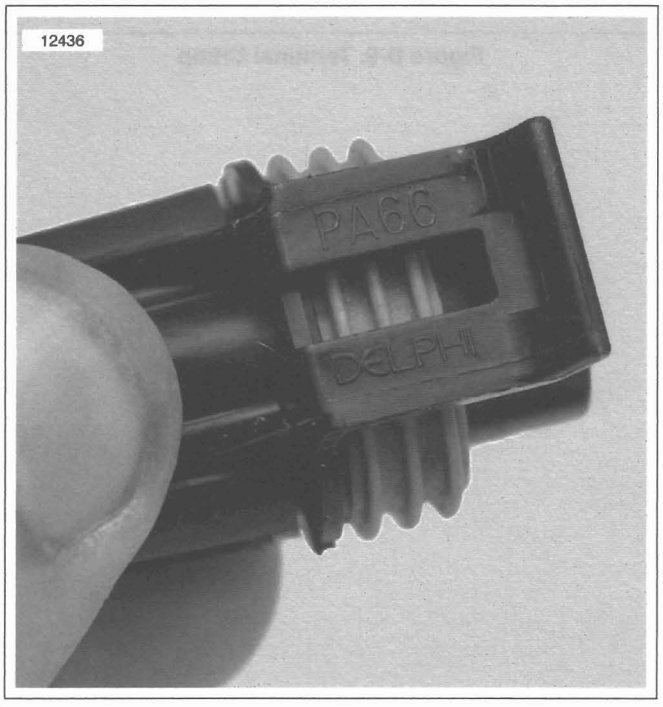


Figure B-10. Delphi Socket Housing Latch

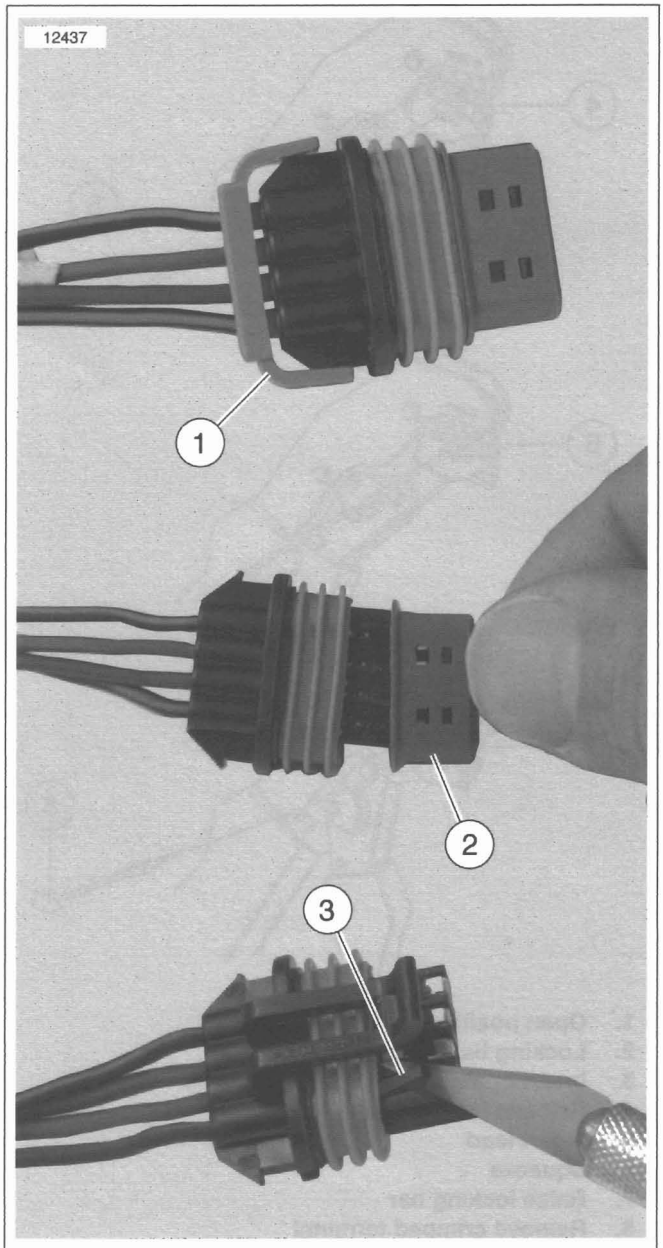
WIRE TERMINALS

Remove 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-to-seat connectors. Therefore, see B.10 150 METRI-PACK to remove/install terminals in this connector.

1. See Figure B-11. If present, free one side of wire lock (1) 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.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Using a thin flat blade, like the *unsharpened* edge on an X-Acto knife, gently pry tang (3) 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.



1. **Remove wire lock**
2. **Remove terminal lock**
3. **Pry tang outward**

Figure B-11. Remove Socket Terminals

Install Socket Terminals

NOTE

For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

1. 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.
2. 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.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

HOUSING

To Separate Housings

Depress external latch and separate the pin and socket housings of the Deutsch one place connector found on voltage regulators.

To Mate Housings

Orient the housings so the latch faces the catch and push the housings together until it clicks.

WIRE TERMINALS

Remove Terminal

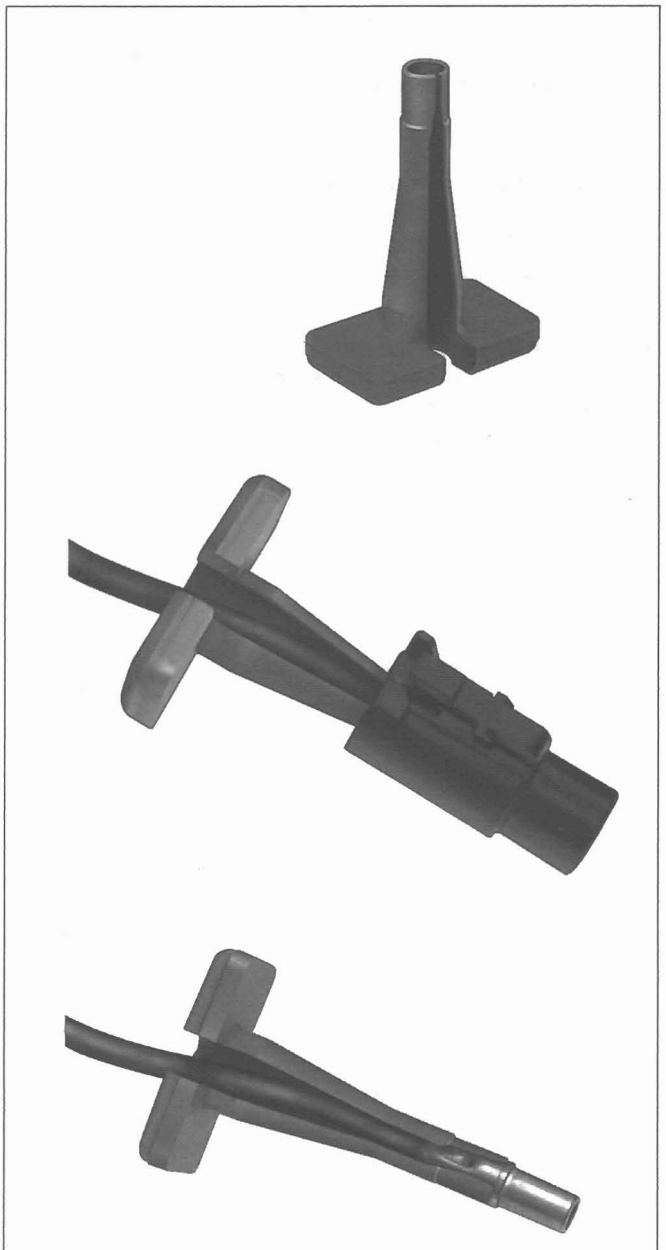
CAUTION

Rough handling or careless storage can result in tool damage. Exercise care to avoid cracking or breaking the thin plastic construction.

1. Pull rear wire seal from back of housing and slide down voltage regulator cable to move out of the way.
2. See Figure B-12. Using terminal pick tool (Deutsch® 114008) (1), install tool onto voltage regulator cable so that the tapered end is in the wire end of the housing (2).
3. Push tool into wire end of housing until it bottoms. Gently tug on housing to pull from terminal (3).
4. Remove tool from voltage regulator cable.

Installation

1. Insert terminal into wire end of housing until it "clicks" in place. Verify that terminal will not back out of housing. A slight tug on the voltage regulator cable will confirm that it is properly locked in place.
2. Fit rear wire seal into back of housing.



1. **Deutsch terminal pick tool (114008)**
2. **Tool installed in housing**
3. **Terminal removed from housing**

Figure B-12. Remove Socket/Pin Housing

GENERAL

Deutsch connectors are colored 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.

PART NO.	SPECIALTY TOOL
HD-42879	Electrical crimp tool
HD-41475	Deutsch terminal repair kit
HD-38125-7	Packard terminal crimper

NOTE

A Deutsch Connector Service Kit (HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and pick tool (HD-41475-100) used for the removal of all types of locking wedges.

1. **External latch**
2. **Socket housing**
3. **Pin housing**

Figure B-13. Deutsch Electrical Connector

PIN AND SOCKET HOUSINGS

Separate Housings

See Figure B-13. To separate the connector halves, depress the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

NOTES

- *Generally, the socket housing is found on the accessory side, while the pin housing is plumbed to the wiring harness.*
- *Two-, three-, four- and six-place Deutsch connectors have one latch on the connector.*
- *Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.*

Mate Housings

1. Align the connectors to match the wire lead colors.
   a. **For One External Latch:** Two-, three-, four- and six-place 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.
   b. **For Two External Latches:** (8-place and 12-place) Align the tabs on the socket housing with the grooves on the pin housing.

NOTE

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.

2. Insert socket housing into pin housing until it snaps or clicks into place.
3. If necessary, fit the attachment clip to the pin housing.
4. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.

WIRE TERMINALS

Remove Socket Terminals

1. See Figure B-14. Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal. See Figure B-17.

NOTE

If wire leads require new terminals, go to TERMINAL CRIMPS.

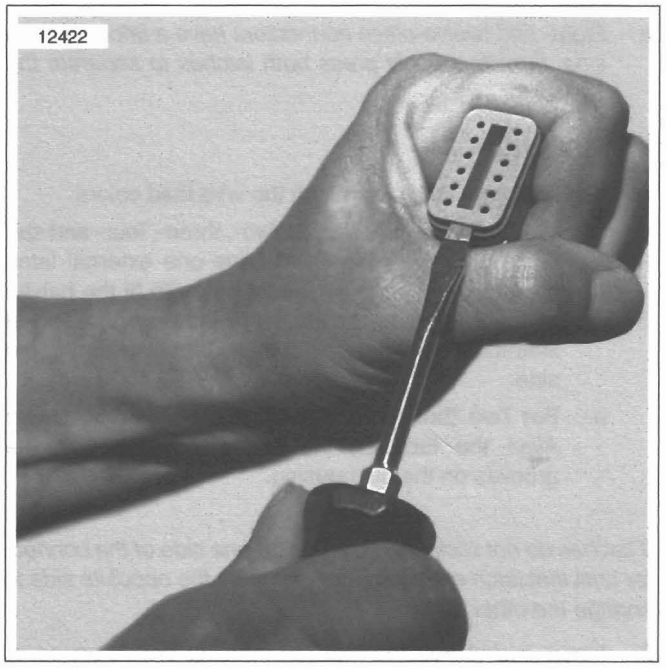


Figure B-14. Remove Secondary Locking Wedge

Install Socket Terminals

1. Match wire lead color to connector cavity.
2. See Figure B-16. Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead approximately 1 in. (25.4 mm) behind the socket terminal (3). Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
4. A tug on the wire will confirm that it is properly locked in place.

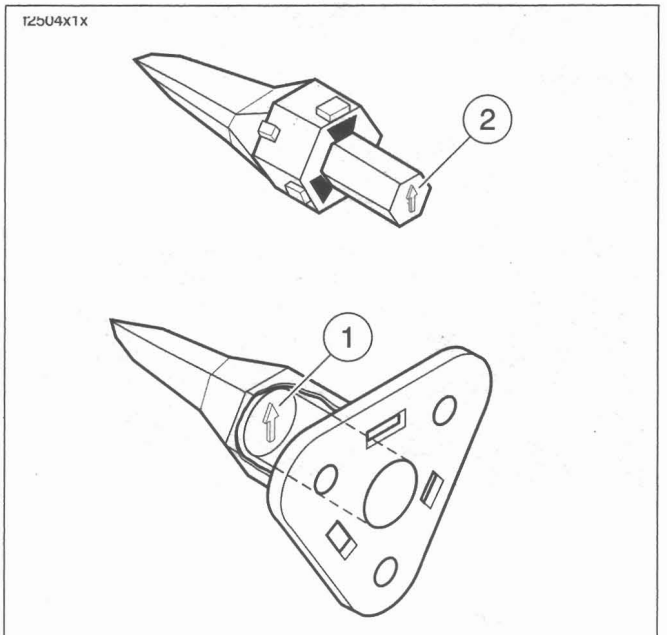
NOTE

Seal plugs (6) are installed through the wire seals of unused chambers. If removed, seal plugs must be replaced to seal the connector.

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) 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.

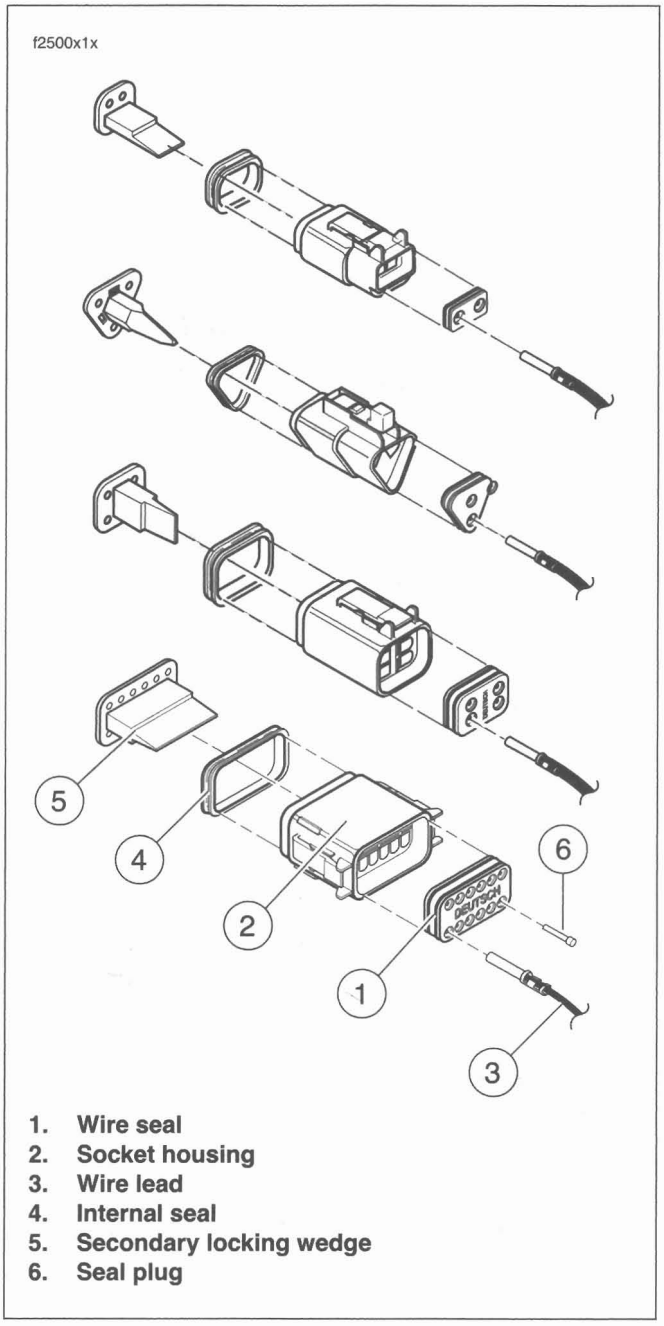
NOTES

- *See Figure B-15. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.*
- *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.*



1. **Arrow on socket locking wedge**
2. **Arrow on pin locking wedge**

Figure B-15. 3-Place Locking Wedges



1. **Wire seal**
2. **Socket housing**
3. **Wire lead**
4. **Internal seal**
5. **Secondary locking wedge**
6. **Seal plug**

Figure B-16. Two, Three, Four and Six Place Socket Housings

Remove Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or a suitable pick tool (HD-41475-100) to remove the secondary locking wedge.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

- *If wire leads require new terminals, go to TERMINAL CRIMPS.*
- *If it should become necessary to replace a pin or socket housing, please note that the 8-place and 12-place 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.*
- *When replacing both socket and pin housings, then the black may be substituted for the gray, and vice versa. The socket and pin housings of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.*

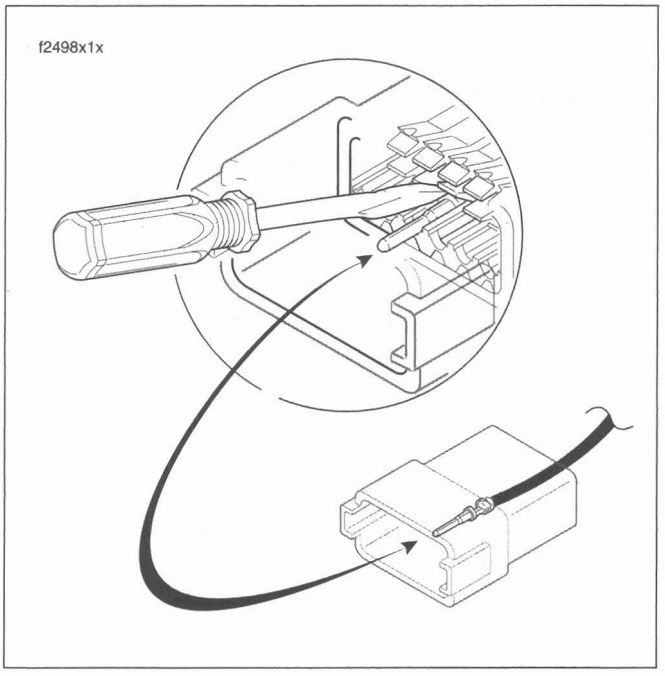


Figure B-17. Depress Terminal Latch & Back Out Pin

Install Pin Terminals

1. See Figure B-18. Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 1 in. (25.4 mm) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

NOTE

A tug on the wire lead will confirm that a pin is locked in place.

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

NOTES

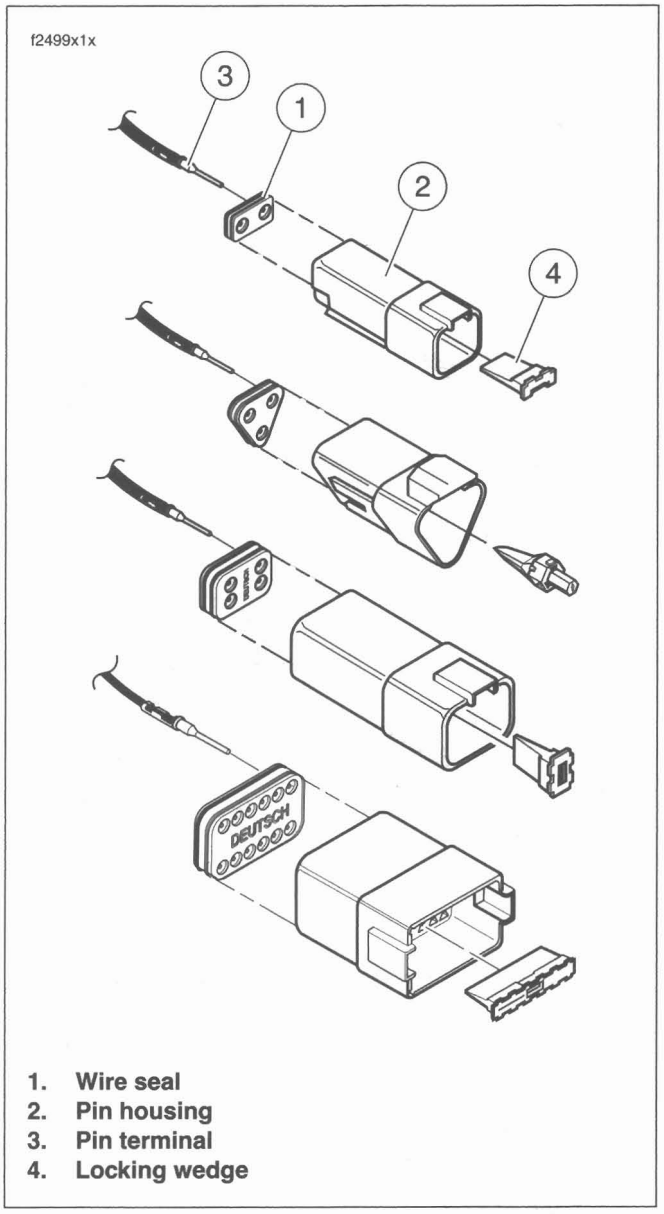
- The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.
- *See Figure B-15. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.*
- *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.*

TERMINAL CRIMPS

Refer to Table B-2. Identify which of the types of Deutsch terminals are used with the connector and follow the corresponding crimping instructions.

Table B-2. Deutsch Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
Standard (with crimp tails)	B.6 DEUTSCH STANDARD TERMINAL CRIMPS
Mini-Deutsch (with crimp tails)	N/A
Solid barrel (without crimp tails)	N/A



1. **Wire seal**
2. **Pin housing**
3. **Pin terminal**
4. **Locking wedge**

Figure B-18. 2, 3, 4 and 12 Place Pin Housings

TERMINAL CRIMPS

Prepare Wire Lead

1. Use a shop gauge to determine gauge of wire lead.
2. Strip lead removing 5/32 inch (4.0 mm) of insulation.

Crimp Terminal to Lead

1. See Figure B-19. Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (HD-39965) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the die (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to Table B-3.

Table B-3. Wire Gauge to Die

Wire Gauge (AWG)	Crimp Tool Die
20	Front
16-18	Middle

3. Release locking bar to lock terminal in die.

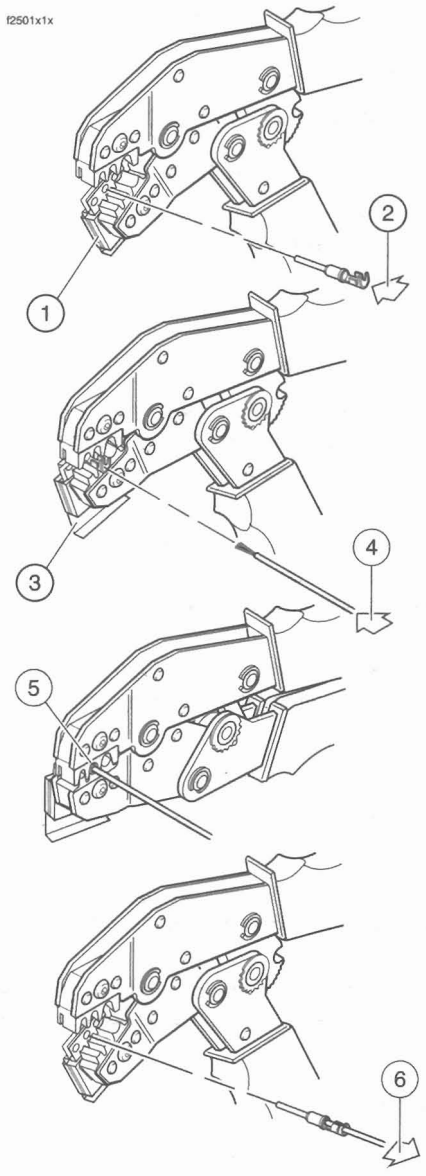
NOTE

If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.

4. Insert stripped wire core 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 the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

Inspect Crimp

Inspect the wire core and insulation crimps. Distortion should be minimal.



1. **Open jaws and raise locking bar**
2. **Insert terminal in locking bar**
3. **Release locking bar to lock terminal in die**
4. **Insert stripped lead**
5. **Squeeze crimper**
6. **Raise locking bar and remove terminal**

Figure B-19. Crimping a Deutsch Standard Terminal

TERMINAL CRIMPS

Prepare Wire Lead

Strip wire lead removing 5/32 inch (4.0 mm) of insulation.

Crimp a Mini Terminal to a Wire Lead

1. See Figure B-20. Compress the handles of PACKARD TERMINAL CRIMPER (HD-38125-7) until the ratchet (2) automatically opens.

NOTE

Always perform core crimp before insulation crimp.

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

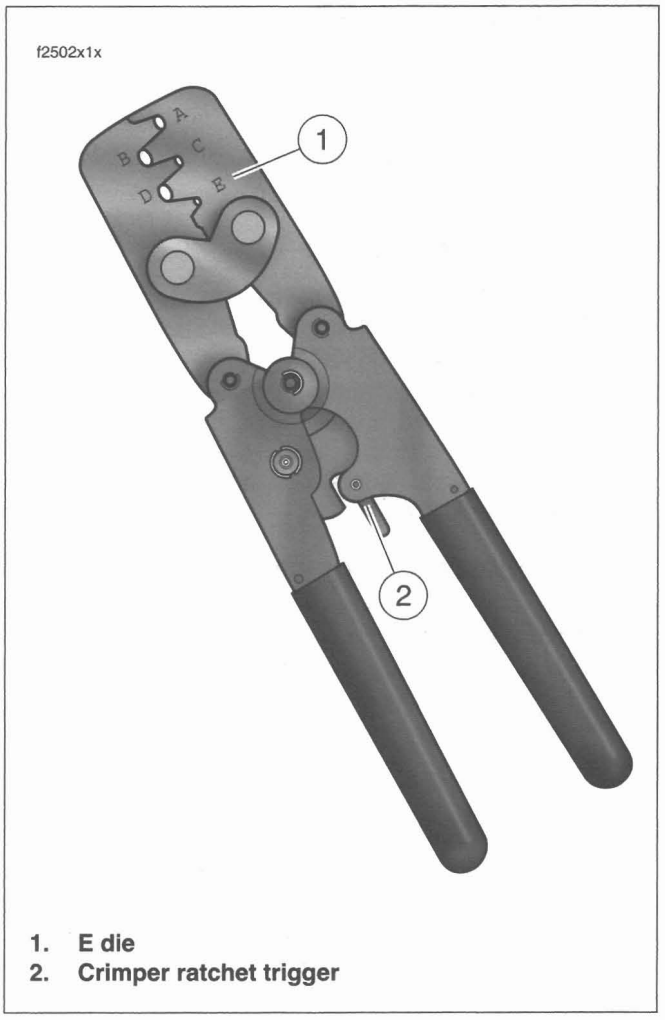
NOTE

If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspect Crimp

Inspect the core and insulation crimps. Distortion should be minimal.



1. E die
2. Crimper ratchet trigger

Figure B-20. Packard Terminal Crimper (HD-38125-7)

WIRE TERMINALS

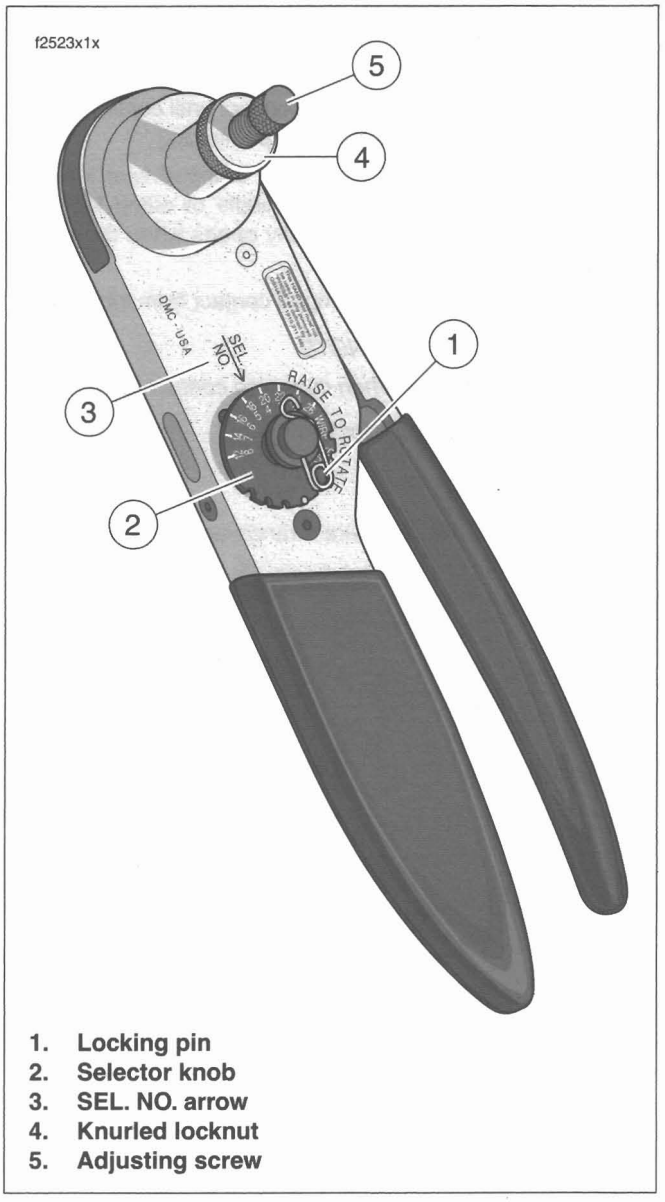
Prepare Wire Lead

For Size 20, 16 and 12 Contacts
Wire Range 26-12 AWG

Strip wire lead removing 1/4 inch (6.4 mm) of insulation.

Adjust Crimper Tool

1. See Figure B-21. Squeeze the ELECTRICAL CRIMPER TOOL (HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.



1. **Locking pin**
2. **Selector knob**
3. **SEL. NO. arrow**
4. **Knurled locknut**
5. **Adjusting screw**

Figure B-21. Electrical Crimper Tool (Part No. HD-42879)

Crimp Barrel Contact to Wire Lead

1. See Figure B-22. Turn tool over and drop contact barrel (1) into indentor cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indentor points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indentor.

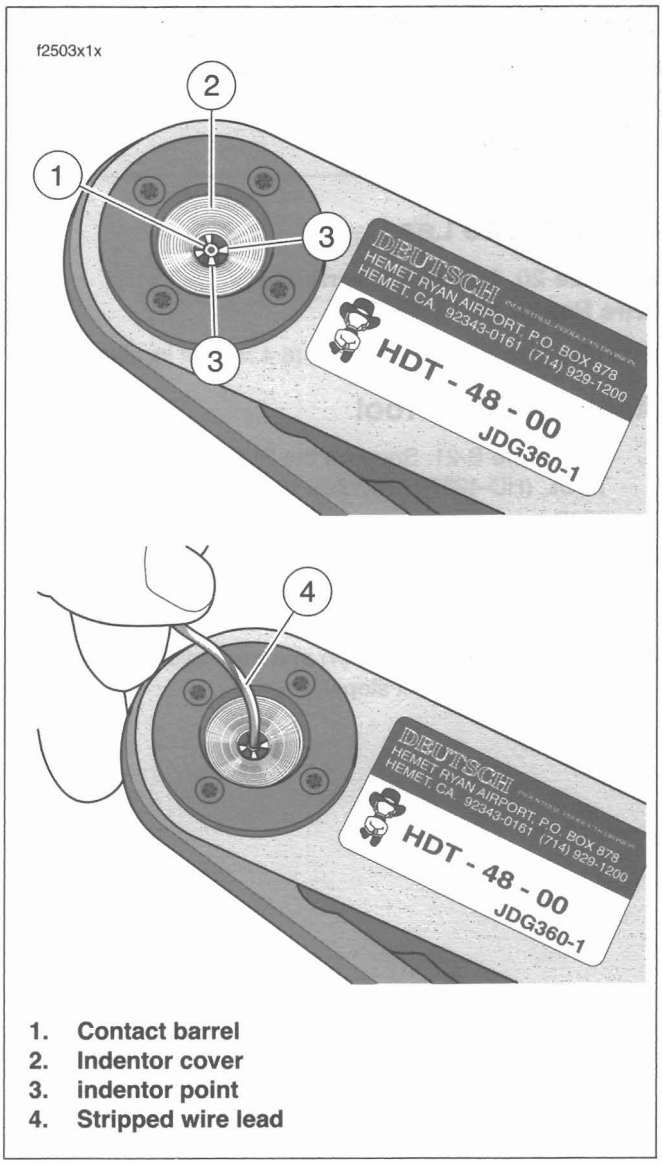
NOTE

Tool must be readjusted when changing contact size/type.

6. Install pin to lock selector knob.

Inspect Crimp

Inspect the crimp. All core wire strands are to be crimped in the barrel.



1. **Contact barrel**
2. **Indentor cover**
3. **indentor point**
4. **Stripped wire lead**

Figure B-22. Deutsch Solid Barrel

FUSE WIRE TERMINALS

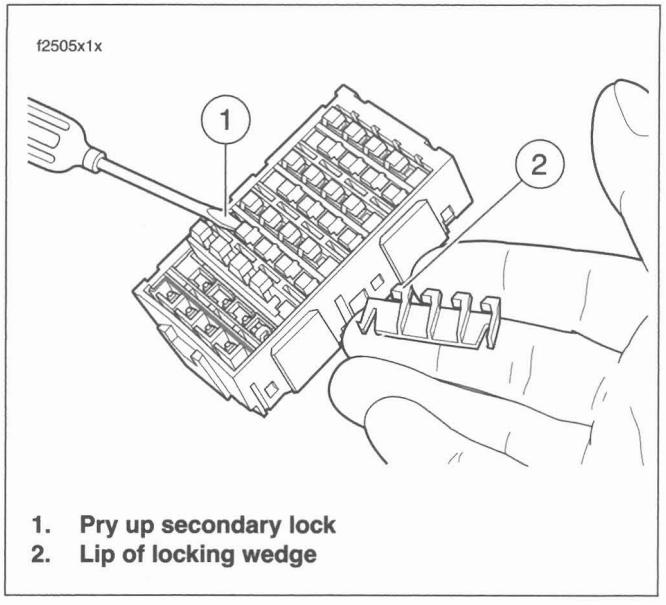
Remove Socket Terminals

1. See Figure B-23. To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

NOTE

For best results, start with locking wedge on outboard side of secondary lock.

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Using a thin flat blade, like that on an X-Acto knife, gently push tang away from terminal, and then tug on wire to back terminal out.



1. **Pry up secondary lock**
2. **Lip of locking wedge**

Figure B-23. Remove Secondary Locks From Fuse Block

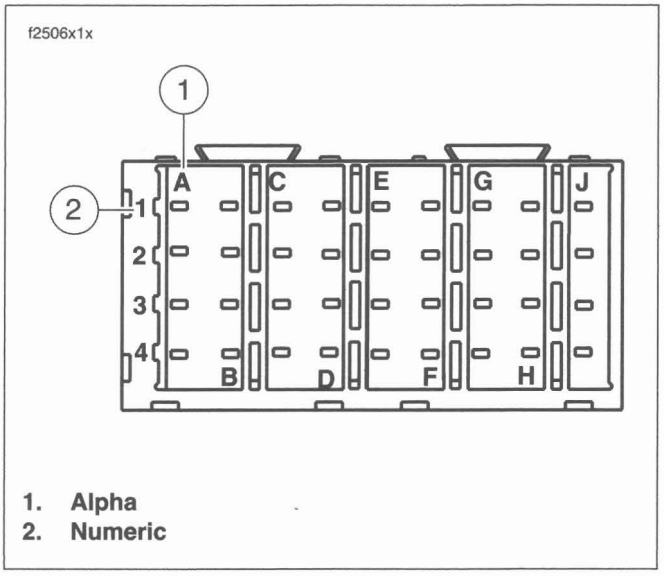
Install Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

NOTES

- *Refer to the main harness wiring diagram and Table B-7. for wire lead color codes.*
- *See Figure B-24. The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.*

2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.



1. **Alpha**
2. **Numeric**

Figure B-24. Fuse Block Coordinates

TERMINAL CRIMPS

Terminals are crimped twice once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers. Refer to Table B-4.

NOTE

The wiring diagram indicates when one socket terminal is be crimped to two wire leads.

Table B-4. Fuse Terminal Crimping Table

Terminal Part No.	Wire Gauge
72279-04	14-16
72286-04	12-14
72309-04	16-18

A = HD-38125-6 Packard terminal crimp tool
B = HD-38125-7 Packard terminal crimper
C = HD-38125-8 Packard crimping tool

GENERAL

Metri-Pack connectors are embossed with the initials (P.E.D.).

NOTE

There are two types of connectors in this series:

- *pull-to-seat.*
- *push-to-seat.*

PIN AND SOCKET HOUSINGS

To Separate Housings: Bend back the external latch slightly and separate the pin and socket halves of the connector.

To Mate Housings: Align the wire colors and push the pin and socket halves of the connector together.

WIRE TERMINALS

Remove Terminals

1. See Figure B-25. for pull-to-seat or Figure B-26. push to seat. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

For best results, free one side of wire lock first and then release the other side.

2. Find the locking tang in the mating end of the connector.

NOTE

The tangs are always positioned in the middle of the chamber and are on the same side as the external latch.

3. Gently insert a safety pin into the chamber about 1/8 inch (3.2 mm).
   a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
   b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

NOTE

The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

NOTE

On those terminals that have been extracted on multiple occasions, the click may not be heard, but pivot the pin as if the click was hear at least 3 times.

6. Remove the pin.
   a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
   b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

Insert Terminals

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. See Figure B-25. for pull-to-seat or Figure B-26. push to seat. Using a thin flat blade, like that on an X-Acto knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.

NOTE

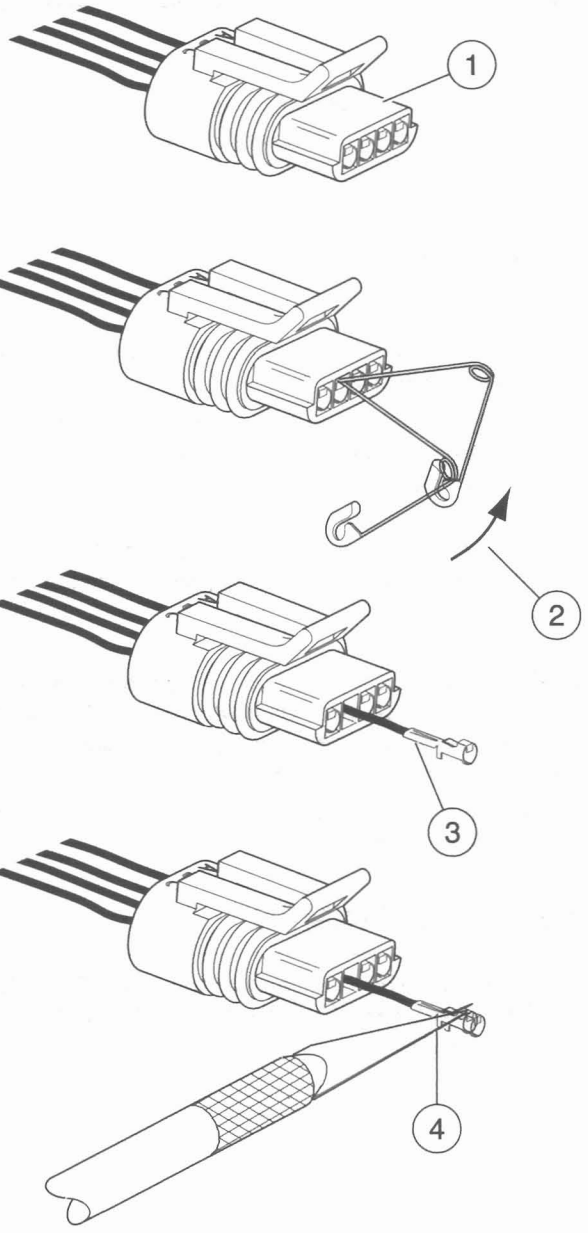
***For push-to-seat:** See Figure B-26. Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.*

3. Gently pull or push on the lead to verify that the terminal is locked in place.

TERMINAL CRIMPS

If necessary, crimp new terminals on wires. See B.15 METRI-PACK TERMINAL CRIMPS following the Metri-Pack (P.E.D.) connector instructions.

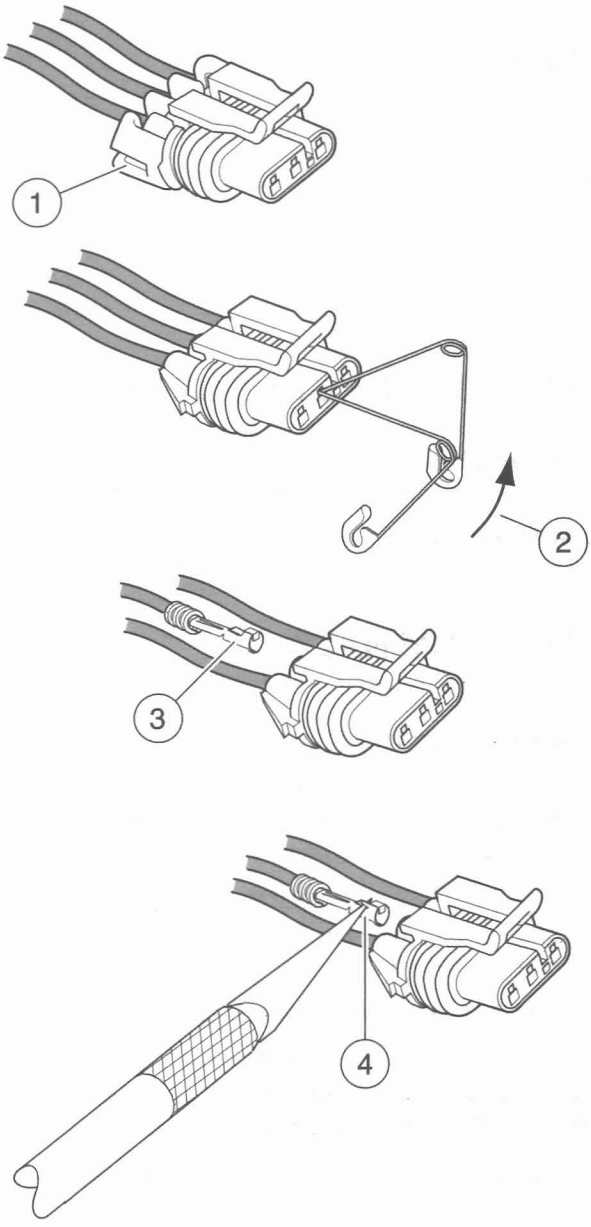
f2533x1x



1. Locate tang in chamber
2. Pivot pin to depress tang
3. Push to remove
4. Raise tang to install

Figure B-25. Pull-to-Seat Connector

f2531x1x



1. Remove wire lock
2. Pivot pin to depress tang
3. Pull to remove
4. Raise tang to install

Figure B-26. Push-to-Seat Connector

GENERAL

Called Packard connectors, Metri-Pack series connectors are embossed with the initials (P.E.D.)

PIN AND SOCKET HOUSINGS

To Separate Housings

Depress the wireform and use a rocking motion to detach the socket connector half.

To Mate Housings

Align the groove in the socket housing with the tab in the pin housing. Push the pin and socket halves of the connector together until the latch clicks.

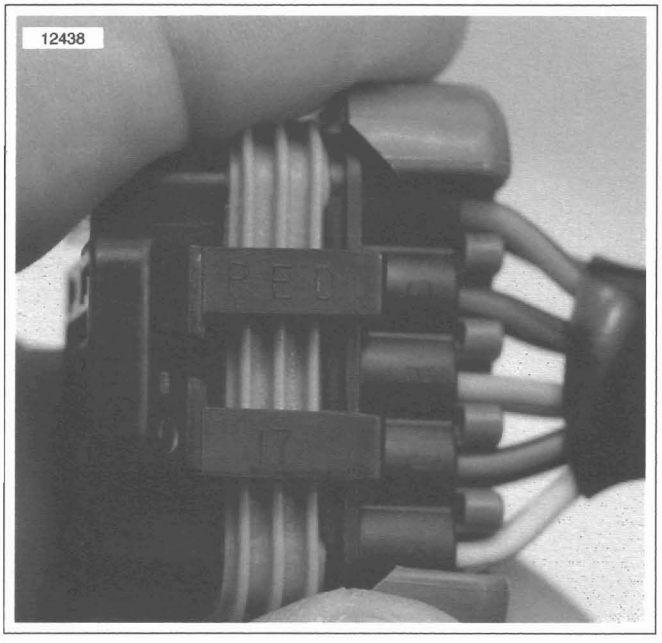


Figure B-27. Metri-Pack (P.E.D.) 280

WIRE TERMINALS

Remove Socket Terminal

1. See Figure B-28. Pry rubber seal from wire end of connector and move seal down wires (1) toward conduit. Hold the connector so that the wireform is facing down.
2. Looking into the wire end of the connector, insert the point of a safety pin (2) between the top of the terminal and the inside chamber wall.
3. Push safety pin completely into chamber while watching terminal on mating end of connector. When terminal is observed moving forward slightly, tang is depressed. Remove safety pin.

NOTE

Repeat as necessary until the terminal can be pushed out of the connector.

4. Push on wire end of the lead to extract the terminal from the mating end of the connector.
5. If necessary, crimp new terminals on wires. See B.15 METRI-PACK TERMINAL CRIMPS.

Install Socket Terminal

NOTE

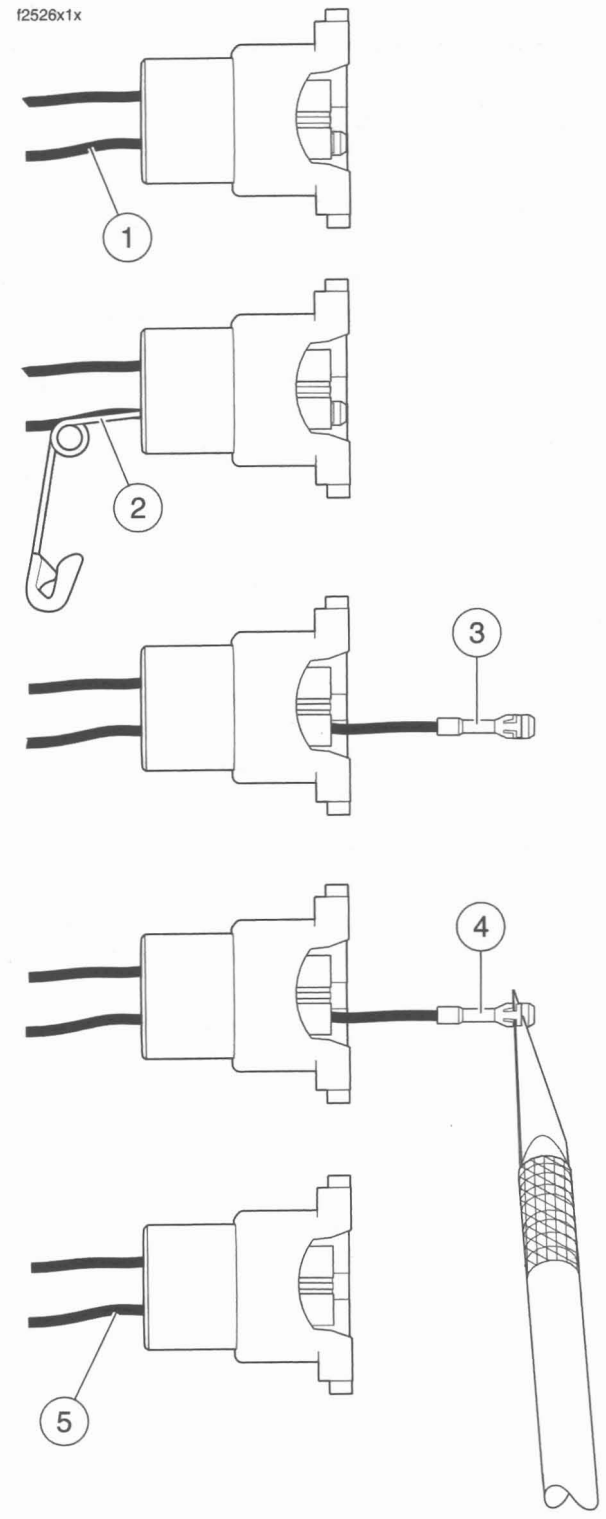
Terminal cavities are lettered on the socket housing. To match the wire lead colors to the terminal cavity, refer to the wiring diagram.

1. See Figure B-28. Using a thin flat blade, like an X-Acto knife (4), carefully bend the tang outward away from the terminal body.
2. Gently pull on the wire lead (5) to draw the terminal back into the chamber. The tang faces opposite the wireform as it enters the chamber.

NOTE

A "click" is heard when the terminal is properly seated.

3. Push on lead to verify that terminal is locked in place.
4. Fit rubber wire seal back into wire end of connector.



1. **Pry rubber seal from connector**
2. **Insert safety pin to depress tang.**
3. **Push on lead to remove terminal.**
4. **Raise tang with X-Acto knife.**
5. **Pull on lead to draw terminal into chamber.**

Figure B-28. Remove/Install Socket Terminal

TERMINAL CRIMPS

If necessary, crimp new terminals on the wire leads. Refer to B.15 METRI-PACK TERMINAL CRIMPS.

GENERAL

A 480 Metri-Pack (P.E.D.) connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

Referred to as Packard connectors, Metri-Pack connectors are embossed with the initials P.E.D.

PIN AND SOCKET HOUSINGS

NOTE

Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.

To Separate Housings

See Figure B-29. Using small flat blade screwdriver, depress button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

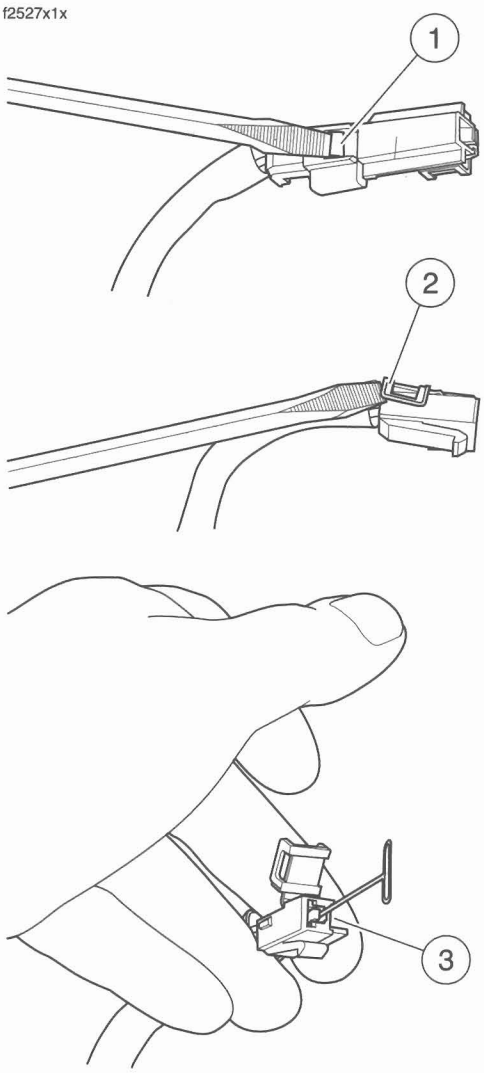
To Mate Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

WIRE TERMINAL

Remove Socket Terminal

1. See Figure B-29. Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. 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 (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to depress the tang.
4. Remove the pin and then pull terminal out wire end of connector housing.
5. If necessary, crimp new terminals on wires. See B.15 METRI-PACK TERMINAL CRIMPS.



1. **Button on pin housing**
2. **Secondary lock latch**
3. **Opening between tang and chamber wall**

Figure B-29. Remove Socket Terminal

Install Socket Terminal

1. Carefully bend the tang outward away from the terminal body.
2. 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.
3. 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.

NOTE

*If removed, install **new** anchored cable strap in O.E. location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 1.0 inch (25.4 mm) from housings.*

GENERAL

A Metri-Pack (P.E.D.) 630 series connector is frequently used for a main to interconnect harness connection. Referred to as Packard connectors, Metri-Pack 630 series connectors are embossed with the initials P.E.D.

PIN AND SOCKET HOUSINGS

Separate Housings

NOTE

If necessary, remove connector from barbed anchor or other retaining device.

Bend back the external latch slightly and separate pin and socket halves of the connector.

Mate Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

WIRE TERMINALS

Remove Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and engages a rib in the chamber wall to lock the terminal in place.
3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert pick (Snap-on® TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp new terminals on wires. Refer to B.15 METRI-PACK TERMINAL CRIMPS.

Install Socket Terminals

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Using a thin flat blade, like that on an X-Acto knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

GENERAL

A Metri-Pack 800 series connector completes the circuit through the main fuse (maxi-fuse).

FUSE AND SOCKET HOUSING

Remove Maxi-Fuse

1. See Figure B-30. Depress latches on maxi-fuse cover (1) and then slide cover off of connector (2).

NOTE

If necessary, disengage tongue of maxi-fuse cover from groove in fuse block cover.

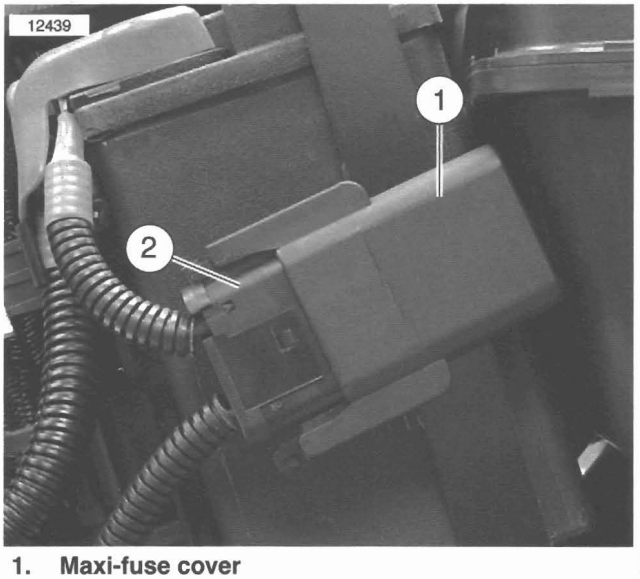
2. Holding the connector (fuse holder), pull the maxi-fuse straight out of the connector.

Install Maxi-Fuse

1. Insert the blade terminals of the maxi-fuse into the sockets of the connector and press the maxi-fuse into the connector.
2. Slide the cover over the fuse until the cover clicks into place.

NOTE

If removed from an OE attachment such as a grooved fuse block cover, engage cover and slide into place.



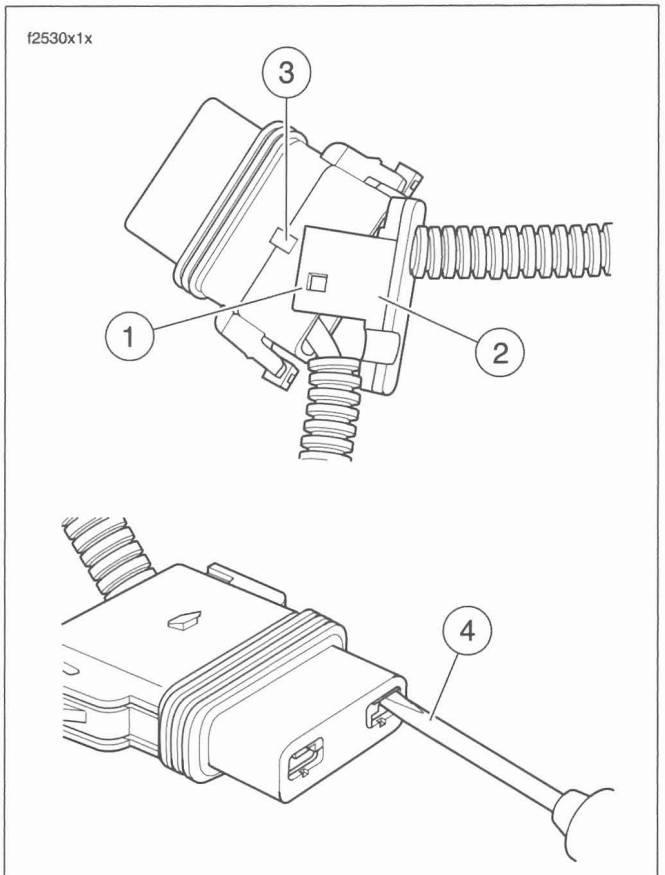
1. **Maxi-fuse cover**
2. **Metri-Pack (P.E.D.) 800 series connector**

Figure B-30. Maxi-Fuse

WIRE TERMINALS

Remove Socket Terminals

1. See Figure B-31. Gently pull socket housing to disengage slots (1) on secondary lock (2) from tabs (3) on socket housing. Free secondary lock from cables and set aside.
2. Take note of the opening on one side of the socket terminal. Gently insert flat blade of pick (Snap-On TT600-5) or small screwdriver into opening (4) until it stops. Pivot the pick toward the terminal body and hold in position.
3. Tug on cable to pull socket from wire end of socket housing. A firm tug is necessary to overcome the resistance of the rubber seal.
4. Repeat to remove remaining socket terminal.



1. **Secondary lock slot**
2. **Secondary lock**
3. **Tab**
4. **Insert flat blade into opening**

Figure B-31. Remove Socket Terminals

Install Socket Terminals

1. See Figure B-32. Carefully bend tang outward away from the terminal body.
2. Feed socket into wire end of socket housing until it clicks in place. Verify that socket will not back out of chamber. A slight tug on the cable will confirm that it is locked.
3. Push rubber seal into wire end of socket housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto cables and then push onto wire end of socket housing until slots engage tabs on sides of socket housing.

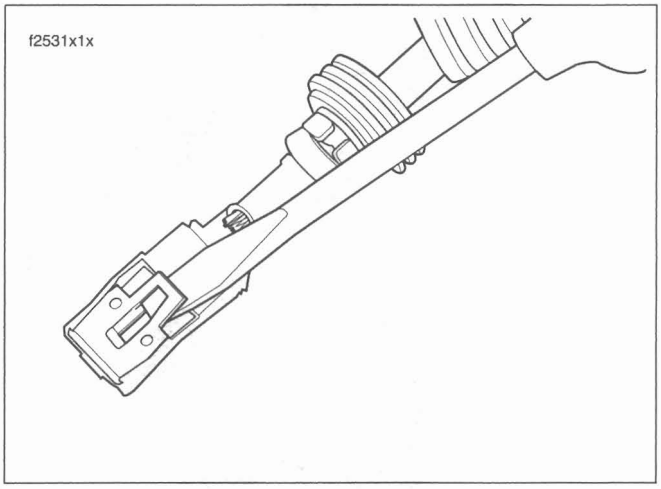


Figure B-32. Bend Tang

TERMINAL CRIMPS

If necessary, crimp new terminals on wire leads. See B.15 METRI-PACK TERMINAL CRIMPS.

MATCH TERMINAL TO CRIMPER

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

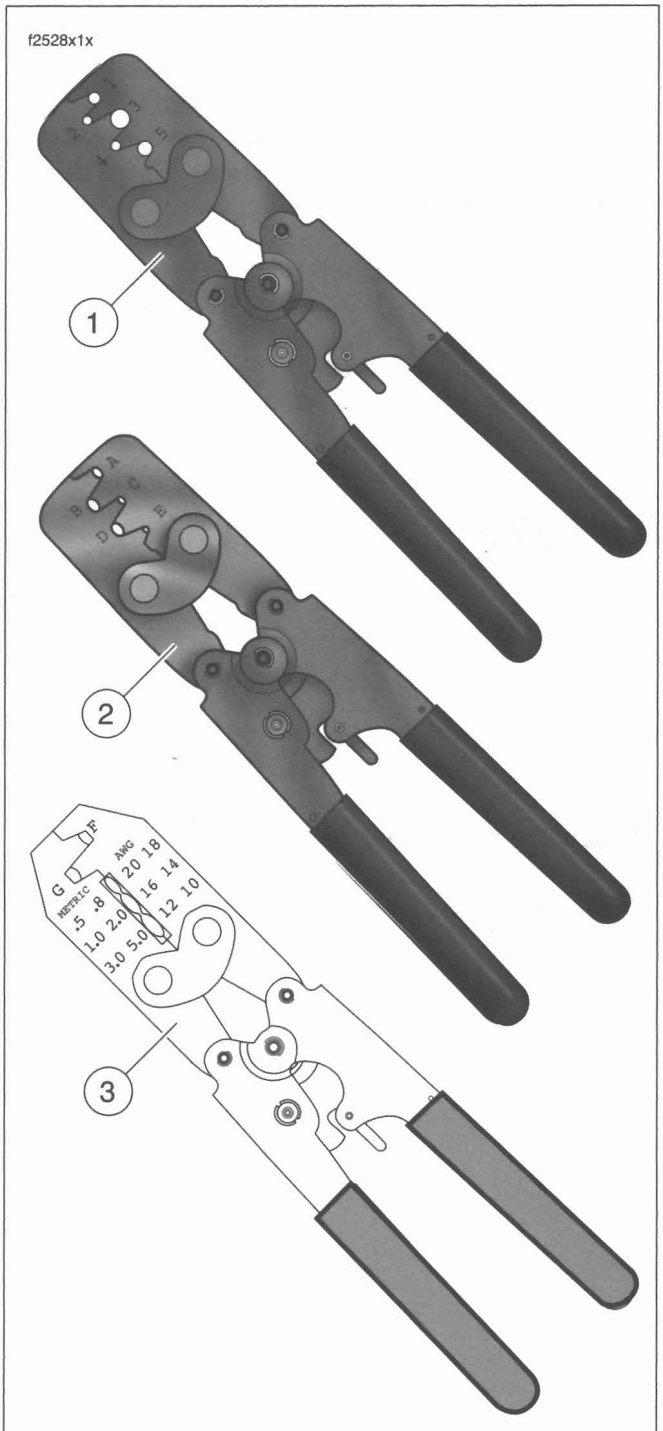
PART NO.	SPECIALTY TOOL
HD-38125-6	Packard terminal crimp tool (Packard 270)
HD-38125-7	Packard terminal crimper (Packard 271)
HD-38125-8	Packard crimping tool (Packard 115)

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

A completed crimp may require two different crimping dies found on separate crimper tools. The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

The HD-38125-8 (Packard 115) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.



1. **HD-38125-6 sealed terminals**
2. **HD-38125-7 non-sealed terminals**
3. **HD-38125-8 non-sealed terminals**

Figure B-33. Terminal Crimp Tools

TERMINAL CRIMPS

Prepare Wire Lead

Use a wire striper to strip off the insulation and expose 5/32 in. (4.0 mm) of wire core.

Crimp Wire Core

NOTE

*Metri-Pack terminal crimps require two steps. Always perform **Crimp Wire Core** before **Crimp Insulation/Seal Crimp**.*

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.

Crimp Insulation/Seal

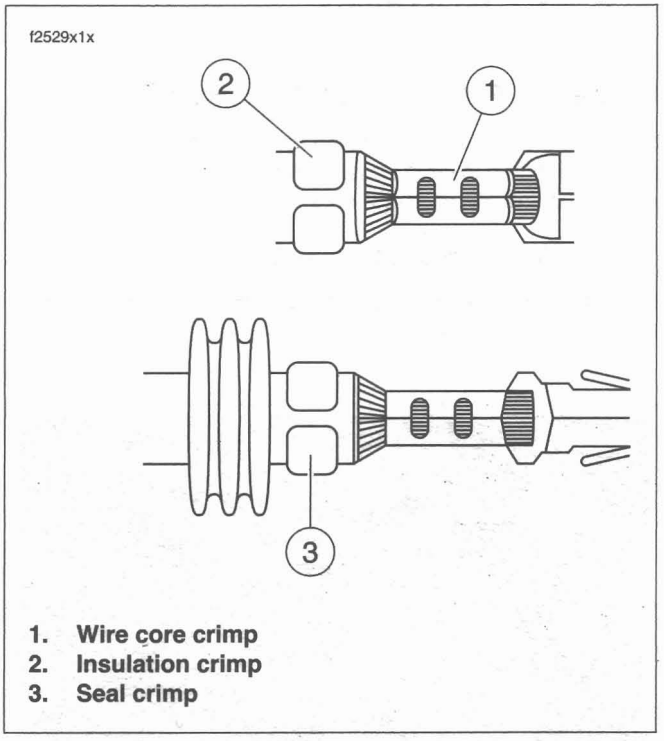
NOTE

*Always perform **Crimp Wire Core** before **Crimp Insulation/Seal Crimp**.*

1. See Figure B-34. Identify the correct die for the insulation/seal crimp (2).
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

INSPECT CRIMP

1. See Figure B-34. Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) / seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.



1. **Wire core crimp**
2. **Insulation crimp**
3. **Seal crimp**

Figure B-34. Inspect Core and Insulation/Seal Crimps

GENERAL

A Packard 100W connector connects the The Electronic Control Module (ECM) to the main harness.

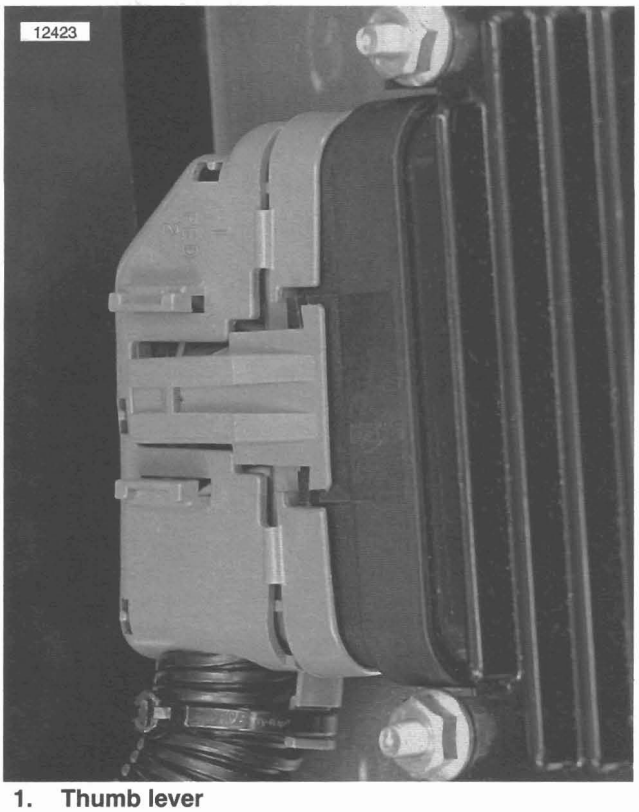
SOCKET HOUSING

Separate Socket Housing from ECM

See Figure B-35. While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

Mate Socket Housing to ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.



1. **Thumb lever**
2. **Latch**
3. **Catch (ECM)**

Figure B-35. Packard 100W to ECM (typical)

WIRE TERMINALS

Remove Socket Terminals

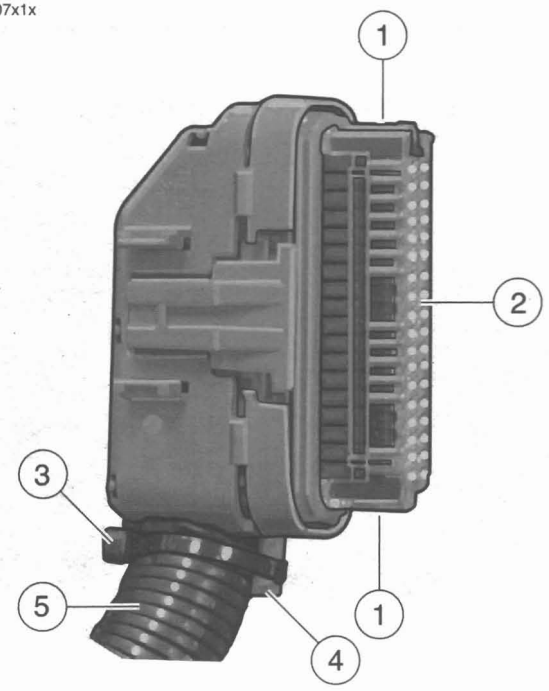
1. See Figure B-36. Gently depress latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See Figure B-37. Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

Install Socket Terminals

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

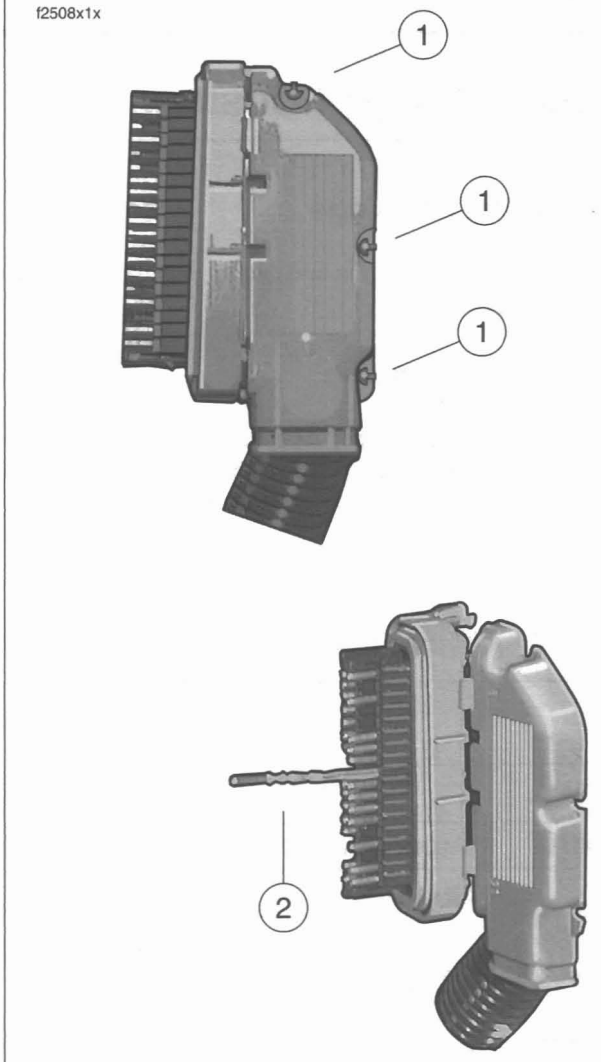
TERMINAL CRIMPS

If necessary, crimp new terminals on wire leads. See B.15 METRI-PACK TERMINAL CRIMPS.



1. Latch
2. Secondary lock
3. Cable strap
4. Strain relief collar
5. Conduit

Figure B-36. Packard 100W Connector



1. Pins
2. Socket terminal

Figure B-37. Separate Halves of Socket Housing

PIN AND SOCKET HOUSINGS

Separate the Housings

See Figure B-38. Depress the latch while pulling the pin and socket housings apart.

Mate the Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

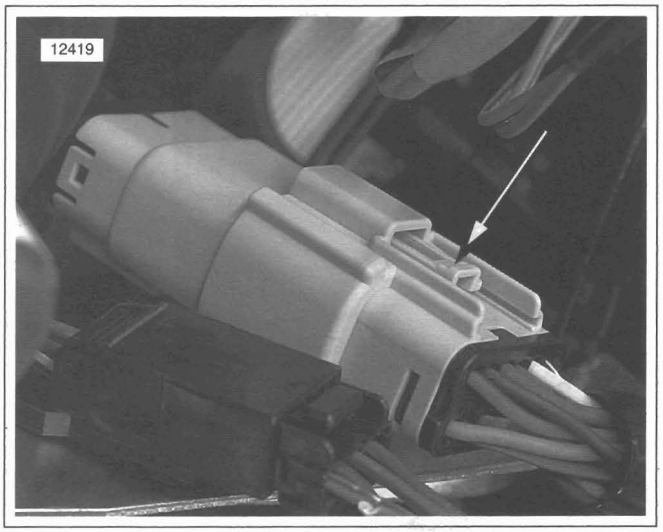


Figure B-38. Molex Connector Latch

WIRE TERMINALS

PART NO.	SPECIALTY TOOL
HD-48114	Molex electrical connector terminal remover
	Molex crimper

Remove Terminal

1. Pull the secondary lock up, approximately 3/16 in. (4.8 mm), until it stops.
   a. **Socket Housing:** See Figure B-39. Use a small screwdriver in the pry slot.
   b. **Pin Housing:** See Figure B-40. Use a hooked pick or needle nose pliers to engage the D-holes in the center.

NOTE

Do not remove the secondary lock from the connector housing.

2. See Figure B-41. Insert MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (HD-48114) into the pin hole next to the terminal until the tool bottoms.
   a. **Socket Housing:** The pin holes are inside the terminal openings.
   b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the Terminal Remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

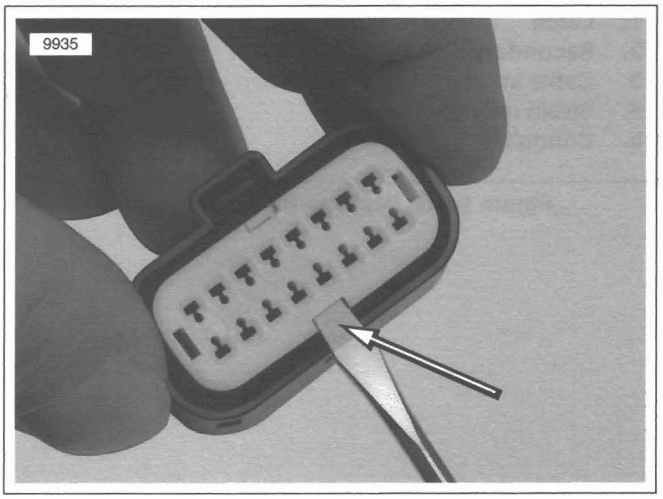


Figure B-39. Secondary Lock Pry Slot (socket housing)

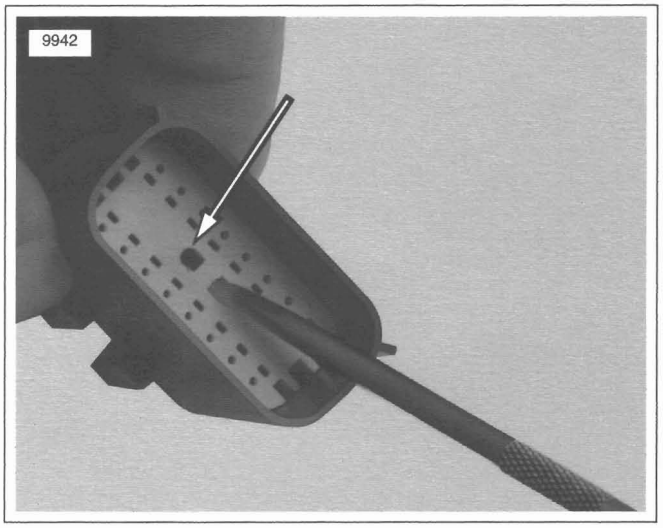


Figure B-40. Secondary Lock D-Holes (pin housing)

Install Terminal

1. See Figure B-42. From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE

Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.
5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

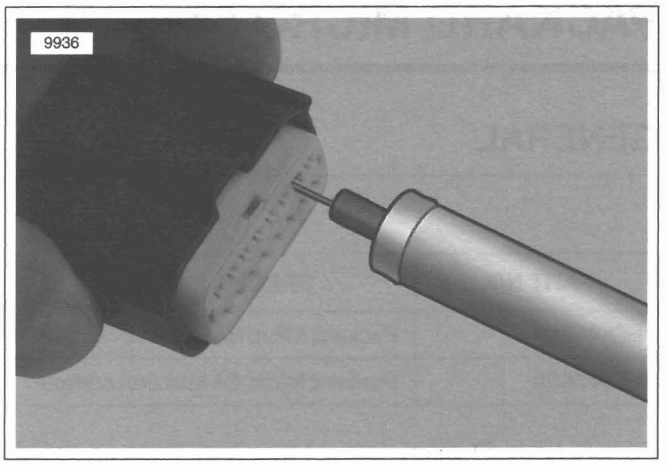
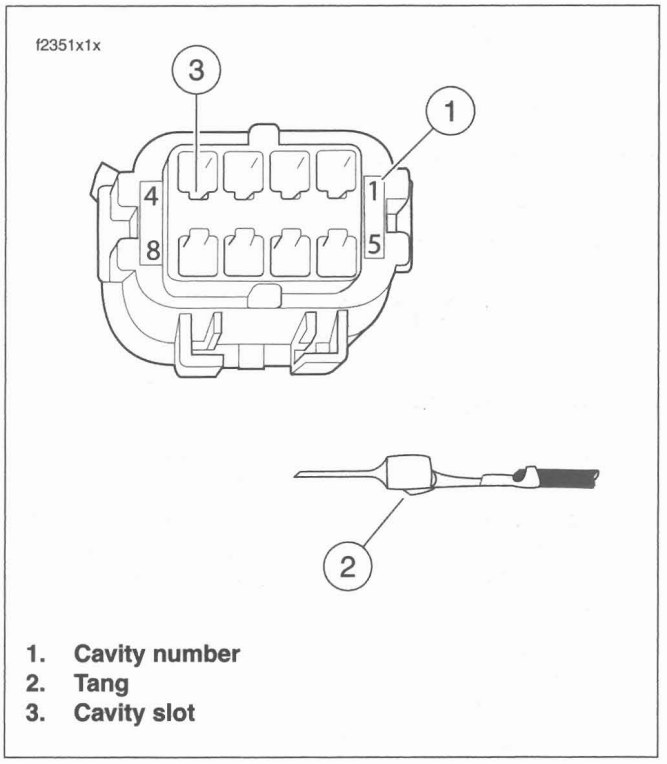


Figure B-41. Molex Connector Terminal Remover (Part No. HD-48114)



1. **Cavity number**
2. **Tang**
3. **Cavity slot**

Figure B-42. Molex PIN Cavities and Wire Terminal

GENERAL

PART NO.	SPECIALTY TOOL
HD-45928	Packard Micro 64 terminal remover
HD-45929	Packard Micro 64 terminal crimper

Packard Micro 64 connectors are frequently found on speedometers and tachometers.

PIN AND SOCKET HOUSINGS

Separate the Housings

Bend back the external latches slightly and separate the pin and socket housings.

Mate the Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

WIRE TERMINALS

Remove Terminals

1. See Figure B-45. Locate the head of the secondary lock (1) on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole (2) between terminals on mating end of connector.
4. See Figure B-44. Obtain the PACKARD MICRO 64 TERMINAL REMOVER (HD-45928).
5. See Figure B-46. Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.

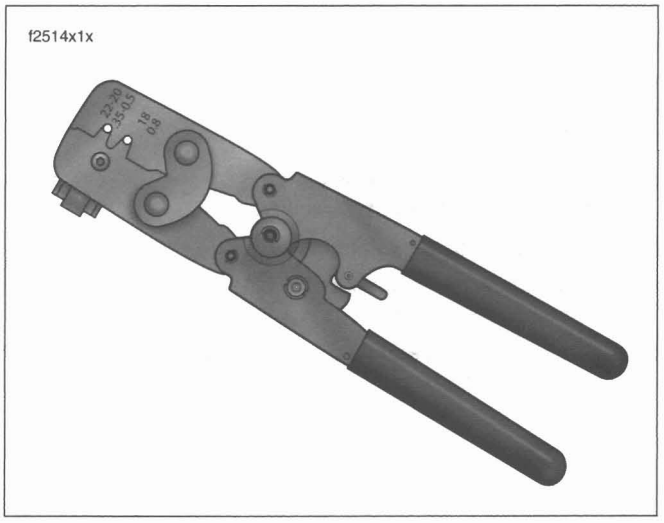
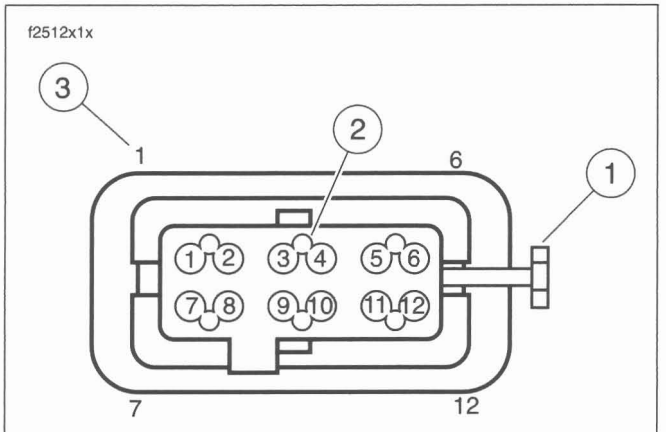


Figure B-43. Packard Micro 64 Terminal Crimper (Part No. HD-45929)

Figure B-44. Packard Micro 64 Terminal Remover (Part No. HD-45928).



1. **Secondary lock**
2. **Pin hole**
3. **Stamped number**

Figure B-45. Housing

Install Terminals

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

See Figure B-45. For wire location purposes, the corners of the socket housing are stamped (3) with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.

2. Bottom the terminal in the chamber and then gently tug on the wire to verify that it is locked in place.

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.

3. 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.
4. With the center ear on the head of the secondary lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

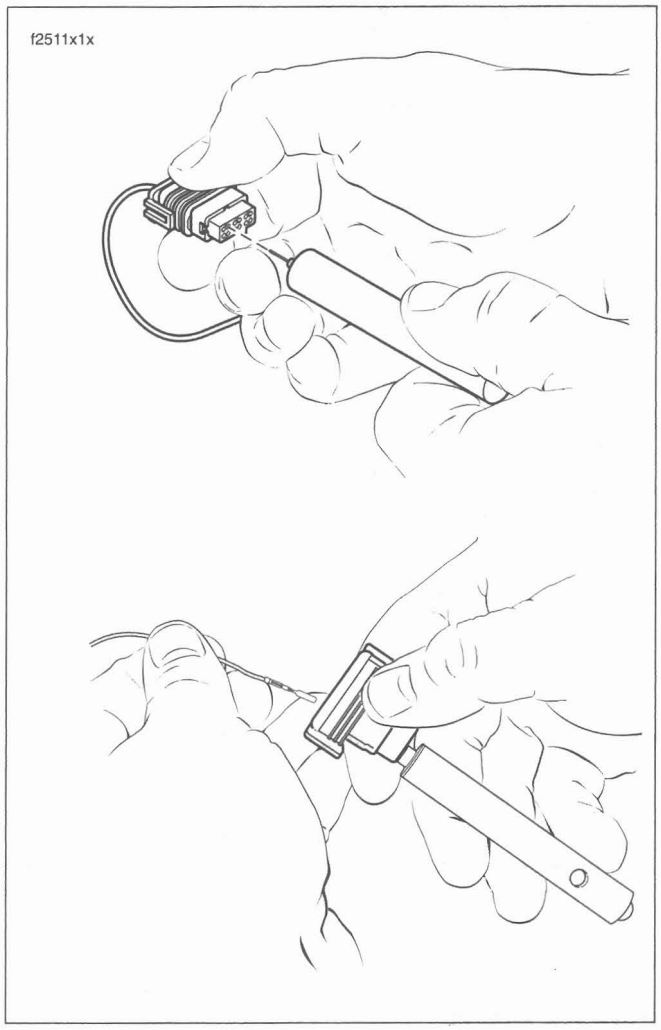


Figure B-46. Insert Tool and Remove Terminal

TERMINAL CRIMPS

Prepare Wire Lead

Strip lead removing 1/8 inch (3.0 mm) of insulation.

Crimp Terminal

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.
2. See Figure B-47. Squeeze the handles of the PACKARD MICRO 64 TERMINAL CRIMPER (HD-45929) to cycle the tool to the fully open position (1).
3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).
4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).
5. 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.
6. 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.
7. Squeeze handle of crimp tool until tightly closed (4. Tool automatically opens when the crimping sequence is complete.
8. Raise locking bar and barrel holder to remove contact.

Inspect Crimp

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

1. **Open position**
2. **Raising locking bar**
3. **Insert terminal**
4. **Crimp terminal**

Figure B-47. Terminal in Crimper

GENERAL

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

PREPARE THE WIRE LEADS

PART NO.	SPECIALTY TOOL
HD-38125-8	Packard crimping tool
HD-39969	Ultra-torch
HD-25070	Heat gun
HD-41183	Heat shield attachment

NOTE

If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.

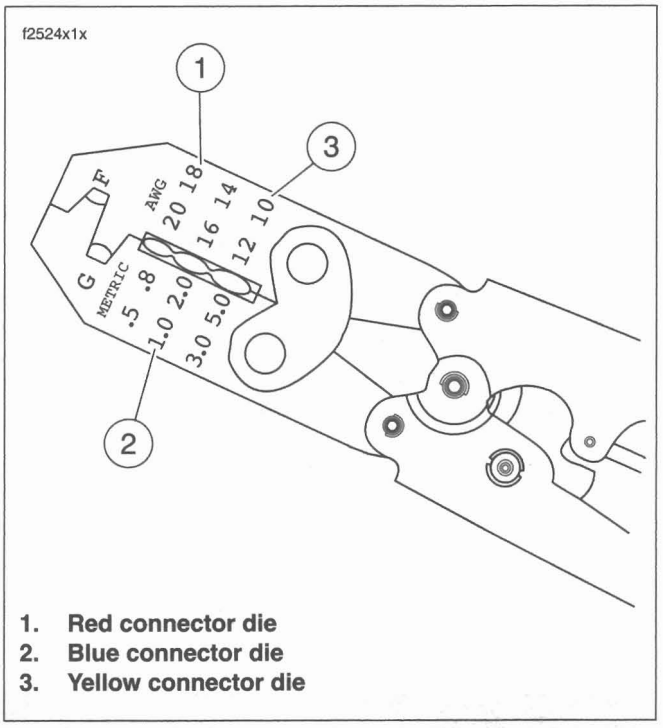
1. Identify (use a shop gauge) the gauge of the wire.
2. Match the wire gauge to a sealed splice connector by color and part number. Refer to Table B-5.
3. Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to Table B-5. for the strip length.

Table B-5. Sealed Splice Connectors

Wire Gauge	Connector Color	Connector Part No.	Strip Length
18-20 (0.5-0.8 mm	Red	70585-93	3/8 in. (9.5 mm)
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8 in. (9.5 mm)
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8 in.? (9.5 mm)

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.



1. **Red connector die**
2. **Blue connector die**
3. **Yellow connector die**

Figure B-48. Packard Crimping Tool (HD-38125-8)

SPLICING WIRE LEADS

NOTE

See Figure B-49. The connector is crimped twice - one side and then the other.

1. See Figure B-48. Open the Packard Crimping Tool (HD-38125-8) ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See Figure B-49. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).
5. Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
6. Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

⚠WARNING

Be sure to follow manufacturer's instructions when using the Ultra-Torch 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)

- **Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.**
- **Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.**
- **Always keep hands away from tool tip area and heat shrink attachment.**

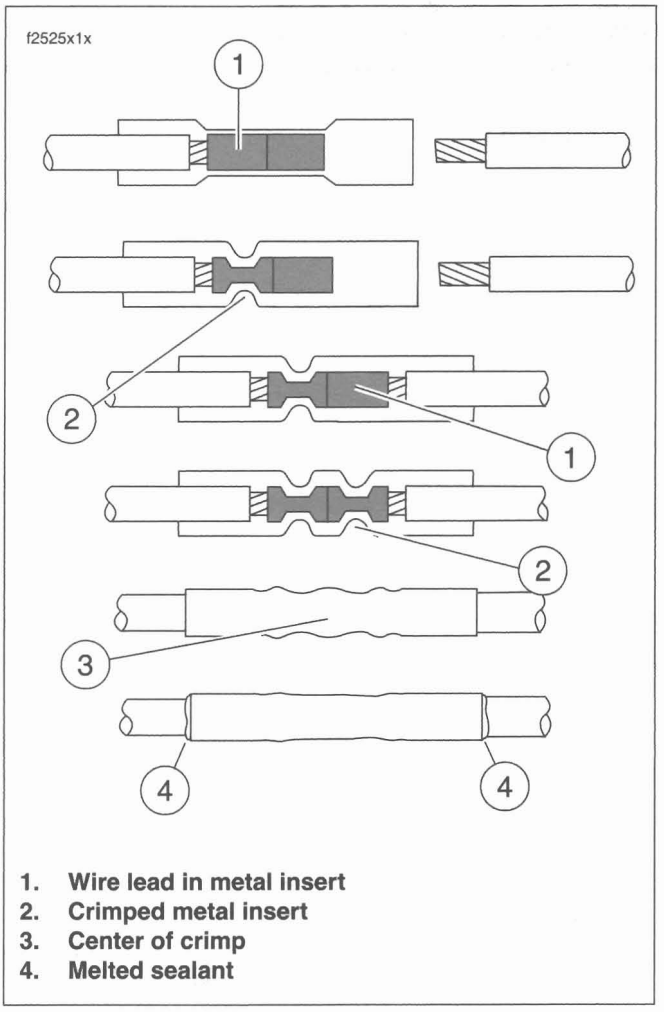
7. Use an Ultra-Torch (HD-39969), or a Heat Gun (HD-25070) with a Heat Shield Attachment (HD-41183), to heat the connector from the center of the crimp (3) out to each end.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

INSPECT SEAL

See Figure B-49. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.



1. **Wire lead in metal insert**
2. **Crimped metal insert**
3. **Center of crimp**
4. **Melted sealant**

Figure B-49. Sealed Splice Connector

Table B-6. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[5]	main fuse	spade terminals	under seat
[7]	tail lamp harness to main harness	8-place Multilock	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 Molex	under fuel tank, right side
[24]	left hand controls and horn	8-place Molex	under fuel tank, left side
[30]	TSM/TSSM/HFSM	12-place Deutsch	electrical panel behind fender extension
[31 L]	front turn signals (left)	3-place Multilock	Inside top frame tube
[31 R]	front turn signals (right)	3-place Multilock	Inside top frame tube
[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 Delphi	top of transmission case
[73]	passing lamp	2-place Multilock	under fuel tank, left side
[77]	voltage regulator	2-place Deutsch	inside front electrical caddie
[78]	electronic control module (ECM)	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	4-place Delphi	back of coil
[84]	front injector	2-place Delphi	beneath fuel tank
[85]	rear injector	2-place Delphi	beneath fuel tank
[86]	fuel pump and sender	4-place Packard	top of fuel tank
[87]	idle air control (IAC)	4-place Delphi	beneath fuel tank
[88]	throttle position sensor (TP)	3-place Delphi	behind air cleaner backing plate
[89]	intake air temperature sensor (IAT)	2-place Delphi	behind air cleaner backing plate
[90]	engine temperature sensor (ET)	2-place Delphi	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
[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

Table B-6. Connector Locations

CONNECTOR NO.	DESCRIPTION	TYPE	LOCATION
[128]	starter solenoid	spade terminal	top of starter
[137]	rear oxygen sensor	2-place Amp	under oil tank
[138]	front oxygen sensor	2-place Amp	behind voltage regulator
[142]	security siren (optional)	3-place Delphi	electrical panel behind fender extension
[160]	B+ connector	1-place Packard	under seat
[178]	active intake solenoid	2-place Amp	air cleaner backing plate
[179]	active exhaust	5-place Amp	exhaust bracket
[208]	hands free security module antenna harness	4-place Deutsch	electrical panel behind fender extension
[209]	hands free security module antenna	2-place Molex	under seat
-	fuse block	spade terminals	under seat
-	harness grounds (2)	ring terminals	under seat
-	neutral switch	post terminals	top of transmission
-	oil pressure switch	post terminal	front right crankcase
-	rear stoplight switch	spade terminals	behind transmission
-	starter solenoid	spade terminal	top of starter

WIRE COLOR CODES

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table B-7.

For Solid Color Wires: See Figure B-50. The alpha code identifies wire color (3).

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code (4). For example, a trace labeled GN / Y is a green wire with a yellow stripe.

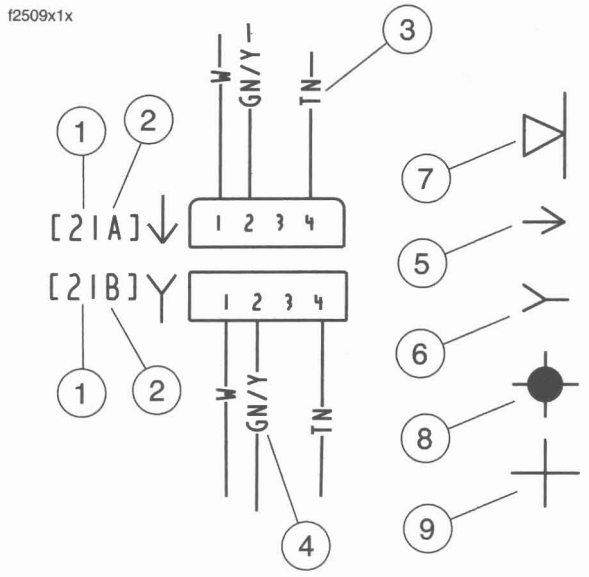
WIRING DIAGRAM SYMBOLS

See Figure B-50. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets (1). The letter (2) inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A after a connector number and the pin symbol (5) identifies a pin housing.

B=Socket: The letter B after a connector number and the socket symbol (6) identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode (7), a symbol for a wire-to-wire connection (8) and a symbol that verifies that no connection (9) between two wire traces exists.



1. **Connector number**
2. **Terminal code (A=pin, B=socket)**
3. **Solid wire color**
4. **Striped wire color**
5. **Pin symbol**
6. **Socket symbol**
7. **Diode**
8. **Connection**
9. **No connection**

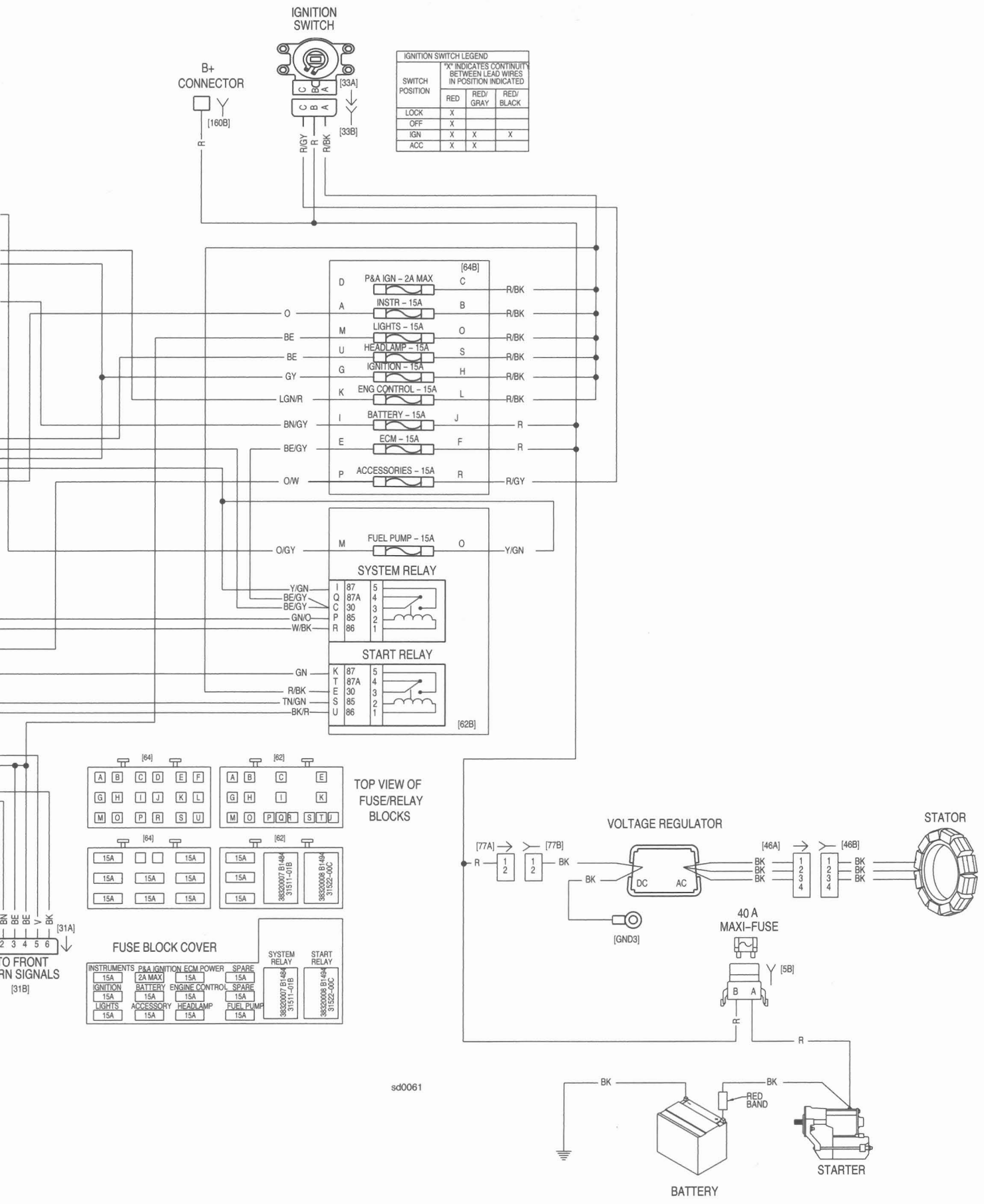
Figure B-50. Connector/Wiring Diagram Symbols (typical)

Table B-7. Wire Color Codes

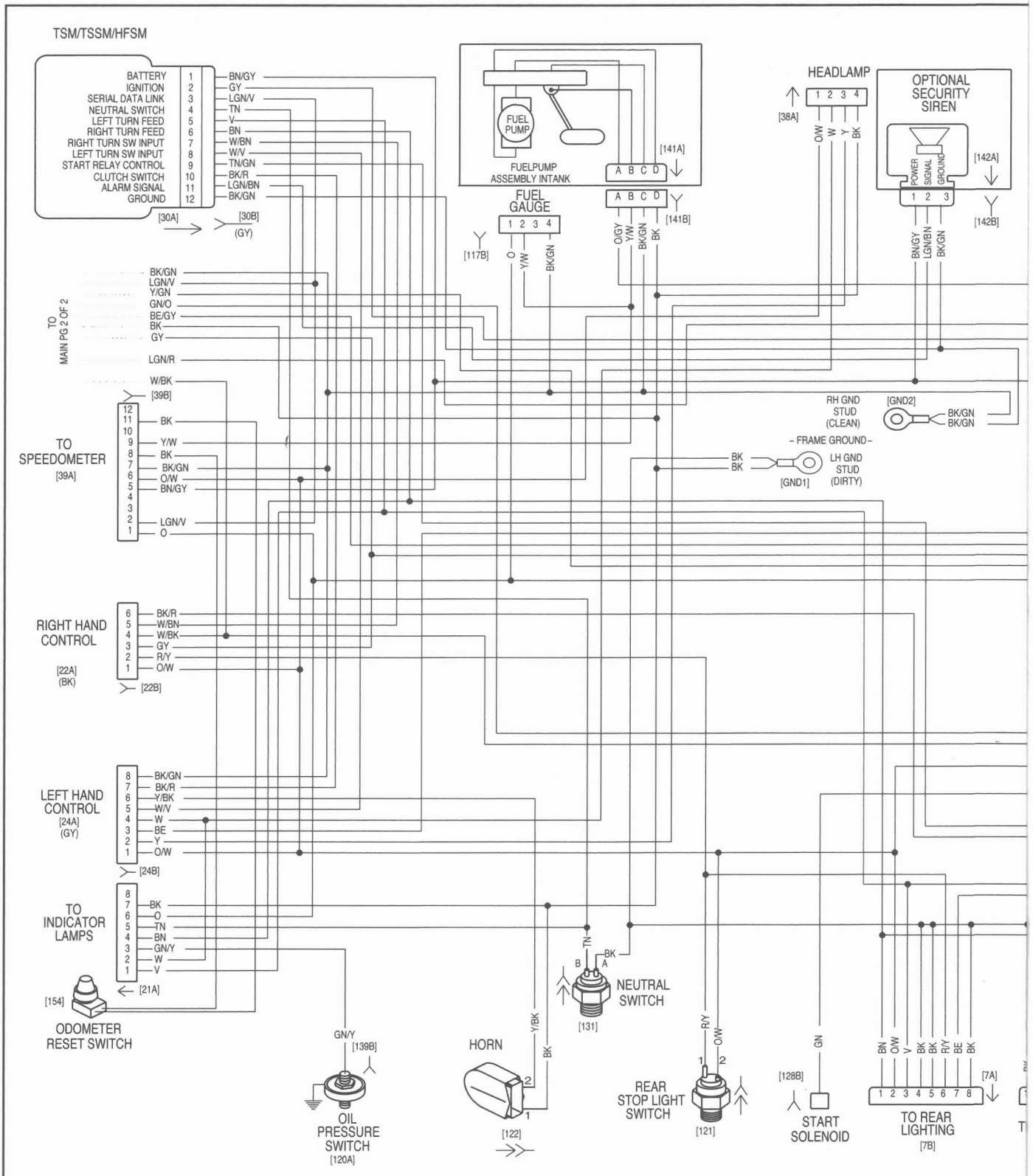
Alpha Code	Wire Color
BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Grey
LGN	Light Green
O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

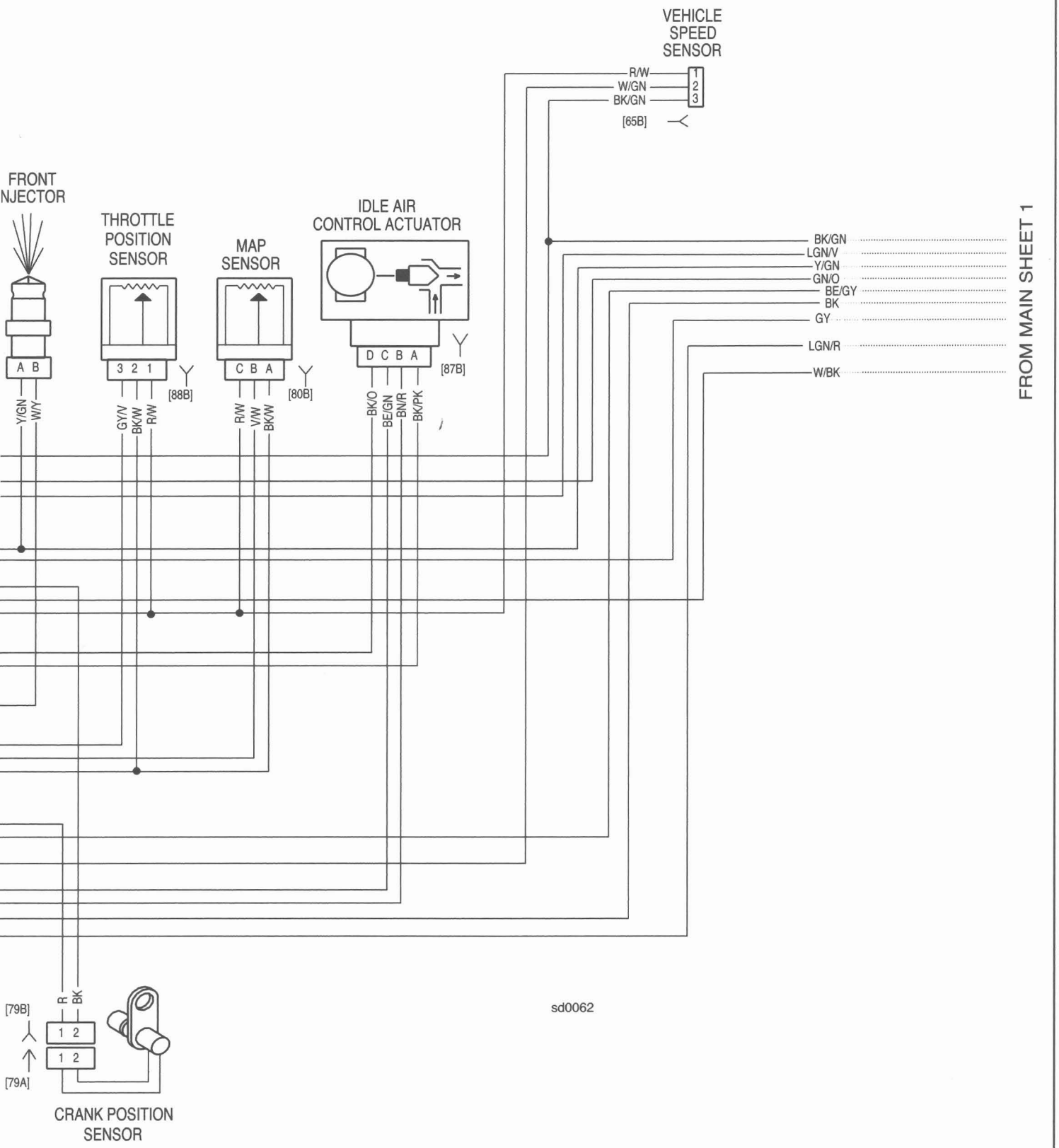
Table B-8. Wiring Diagrams

DIAGRAM	PAGE
2007 ALL SOFTAIL DOM. and INT. MODELS, MAIN HARNESS: SHEET 1 OF 3	B-45
2007 ALL SOFTAIL DOM. and INT. MODELS, MAIN HARNESS: SHEET 2 OF 3	B-47
2007 ALL SOFTAIL DOM. and INT. MODELS, MAIN HARNESS: SHEET 3 OF 3	B-49
2007 ALL SOFTAIL DOM. and INT. MODELS, IGNITION CIRCUIT	B-51
2007 ALL SOFTAIL DOM. and INT. MODELS, LIGHTING CIRCUIT: PAGE 1 of 2	B-53
2007 ALL SOFTAIL DOM. and INT. MODELS, LIGHTING CIRCUIT: PAGE 2 of 2	B-55
2007 ALL SOFTAIL DOM. and INT. MODELS, HORN & INSTRUMENTS	B-57
2007 ALL SOFTAIL DOM. and INT. MODELS, STARTING CIRCUIT	B-59
2007 ALL SOFTAIL DOM. and INT. MODELS, CHARGING CIRCUIT	B-61
2007 ALL SOFTAIL DOM. and INT. MODELS, SECURITY CIRCUIT: SHEET 1 OF 2	B-63
2007 ALL SOFTAIL DOM. and INT. MODELS, SECURITY CIRCUIT: SHEET 2 OF 2	B-65

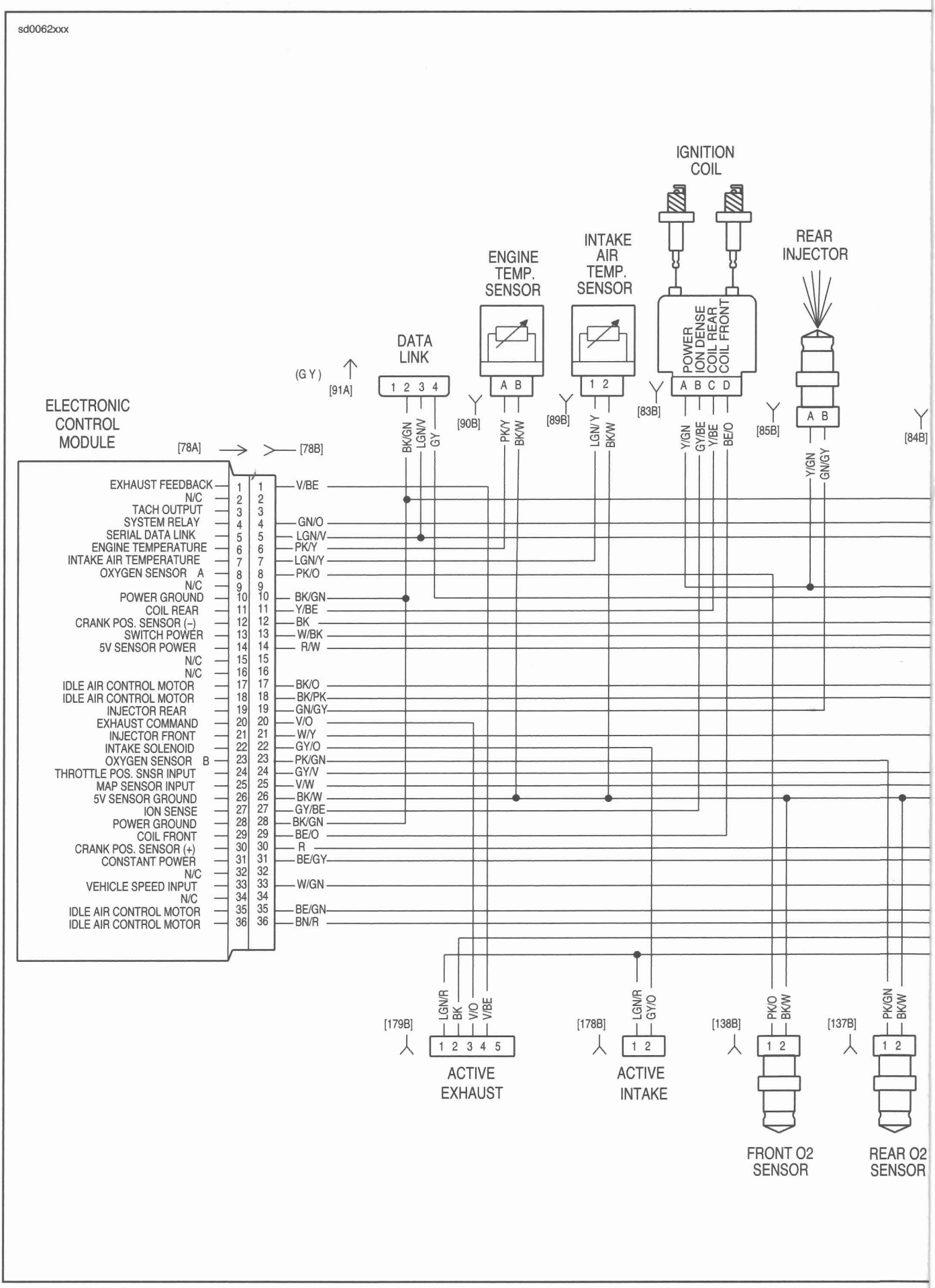


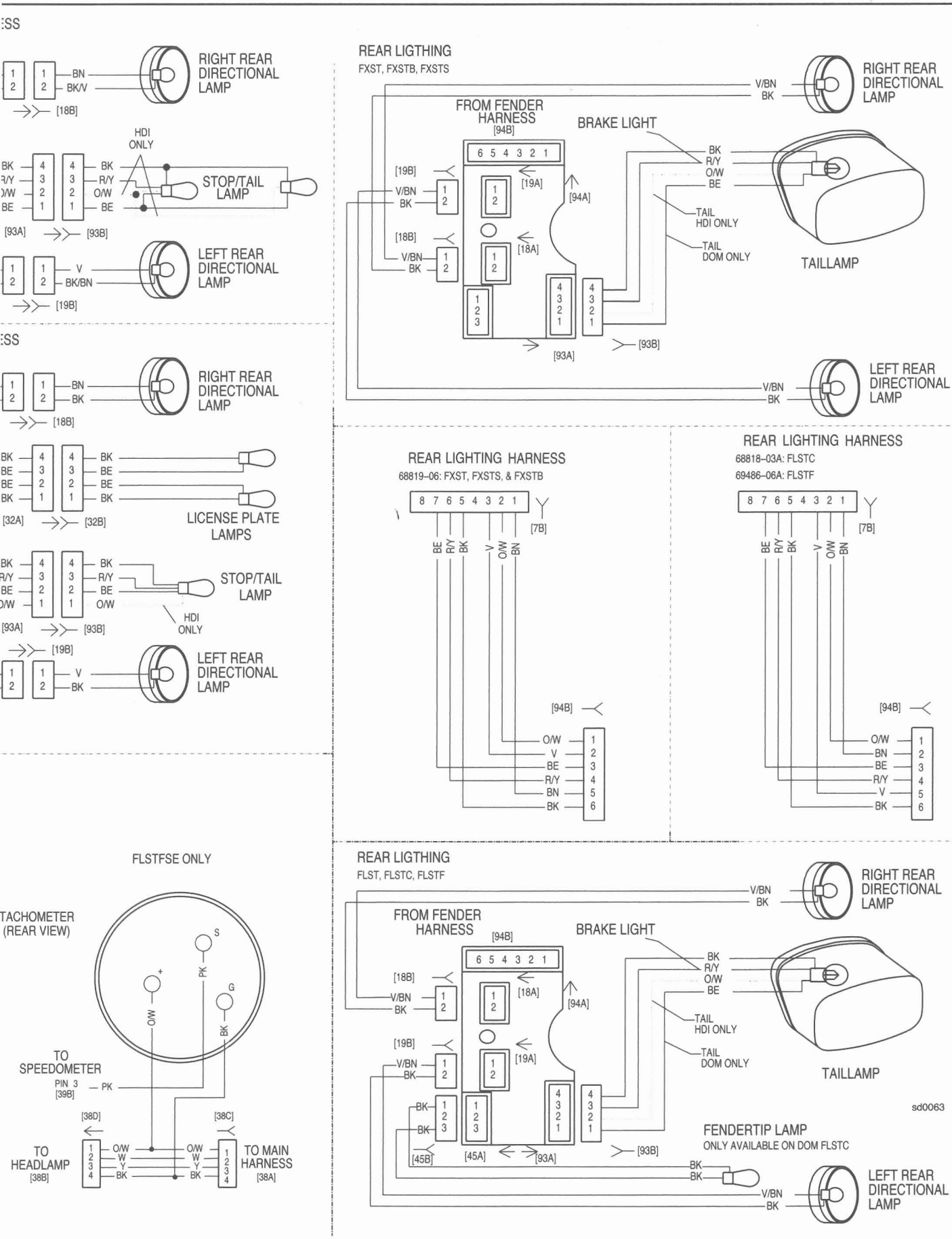
ODELS, MAIN HARNESS: SHEET 1 OF 3


TSM/TSSM/HFSM
BATTERY 1 BN/GY
IGNITION 2 GY
SERIAL DATA LINK 3 LGN/V
NEUTRAL SWITCH 4 TN
LEFT TURN FEED 5 V
RIGHT TURN FEED 6 BN
RIGHT TURN SW INPUT 7 W/BN
LEFT TURN SW INPUT 8 W/V
START RELAY CONTROL 9 TN/GN
CLUTCH SWITCH 10 BK/R
ALARM SIGNAL 11 LGN/BN
GROUND 12 BK/GN
[30A]
[30B] (GY)
FUEL PUMP
FUELPUMP ASSEMBLY INTANK
[141A]
A B C D
FUEL GAUGE
1 2 3 4
[117B]
O
Y/W
BK/GN
[141B]
O/GY
Y/W
BK/GN
BK
HEADLAMP
[38A]
1 2 3 4
O/W
W
Y
BK
OPTIONAL SECURITY SIREN
POWER
SIGNAL
GROUND
[142A]
1 2 3
[142B]
BN/GY
LGN/BN
BK/GN
TO MAIN PG 2 OF 2
BK/GN
LGN/V
Y/GN
GN/O
BE/GY
BK
GY
LGN/R
W/BK
[39B]
TO SPEEDOMETER
[39A]
12 BK
11
10 Y/W
9 BK
8 BK/GN
7 O/W
6 BN/GY
5
4
3
2 LGN/V
1 O
RH GND STUD (CLEAN)
[GND2]
BK/GN
BK/GN
– FRAME GROUND –
BK
BK
[GND1]
LH GND STUD (DIRTY)
RIGHT HAND CONTROL
[22A]
(BK)
6 BK/R
5 W/BN
4 W/BK
3 GY
2 R/Y
1 O/W
[22B]
LEFT HAND CONTROL
[24A]
(GY)
8 BK/GN
7 BK/R
6 Y/BK
5 W/V
4 W
3 BE
2 Y
1 O/W
[24B]
TO INDICATOR LAMPS
8
7 BK
6 O
5 TN
4 BN
3 GN/Y
2 W
1 V
[21A]
[154]
ODOMETER RESET SWITCH
GN/Y
[139B]
OIL PRESSURE SWITCH
[120A]
HORN
Y/BK
BK
2
1
[122]
TN
BK
B
A
NEUTRAL SWITCH
[131]
R/Y
O/W
1
2
REAR STOP LIGHT SWITCH
[121]
[128B]
GN
START SOLENOID
BN
O/W
V
BK
BK
R/Y
BE
BK
[7A]
1 2 3 4 5 6 7 8
TO REAR LIGHTING
[7B]

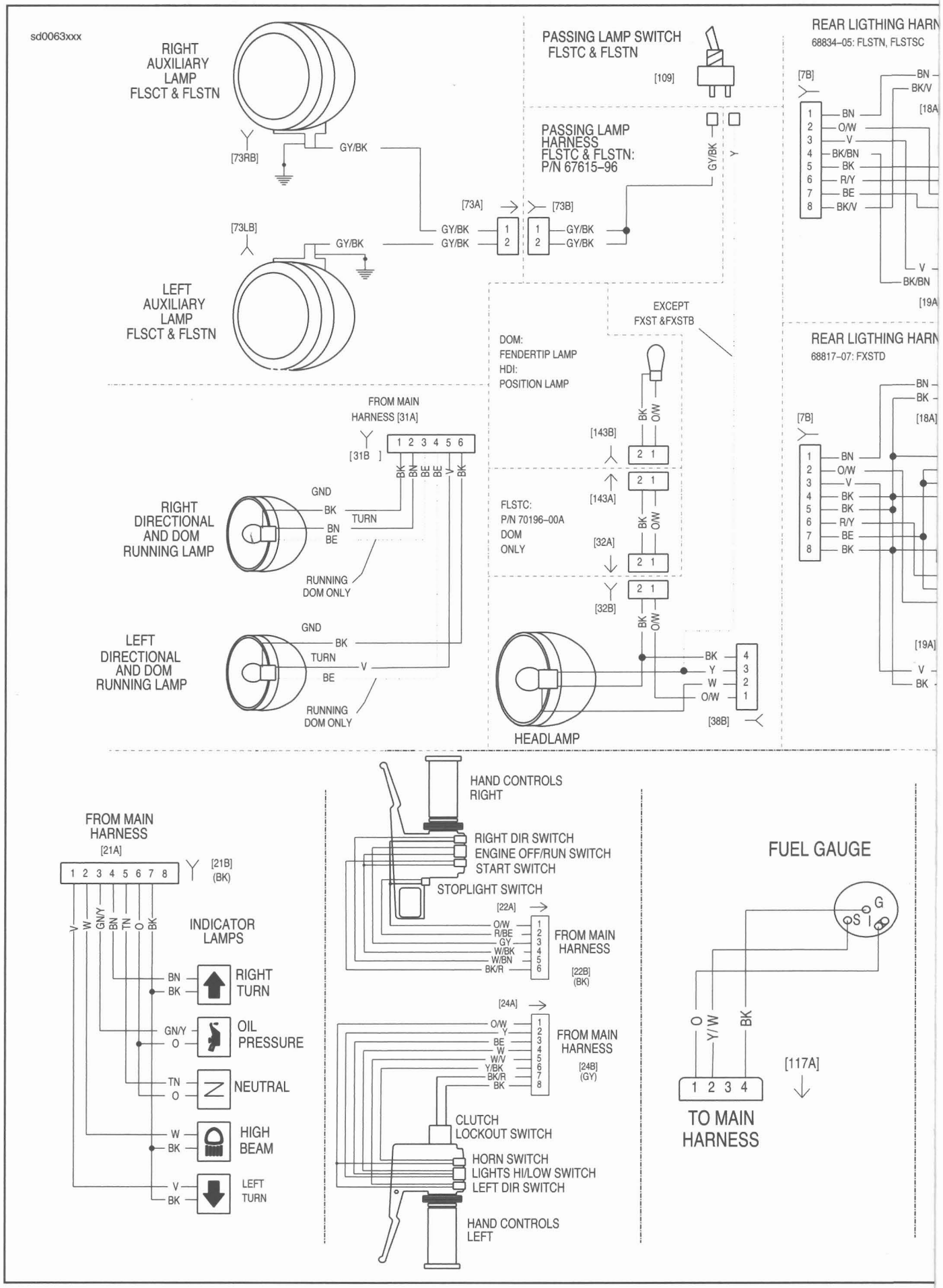


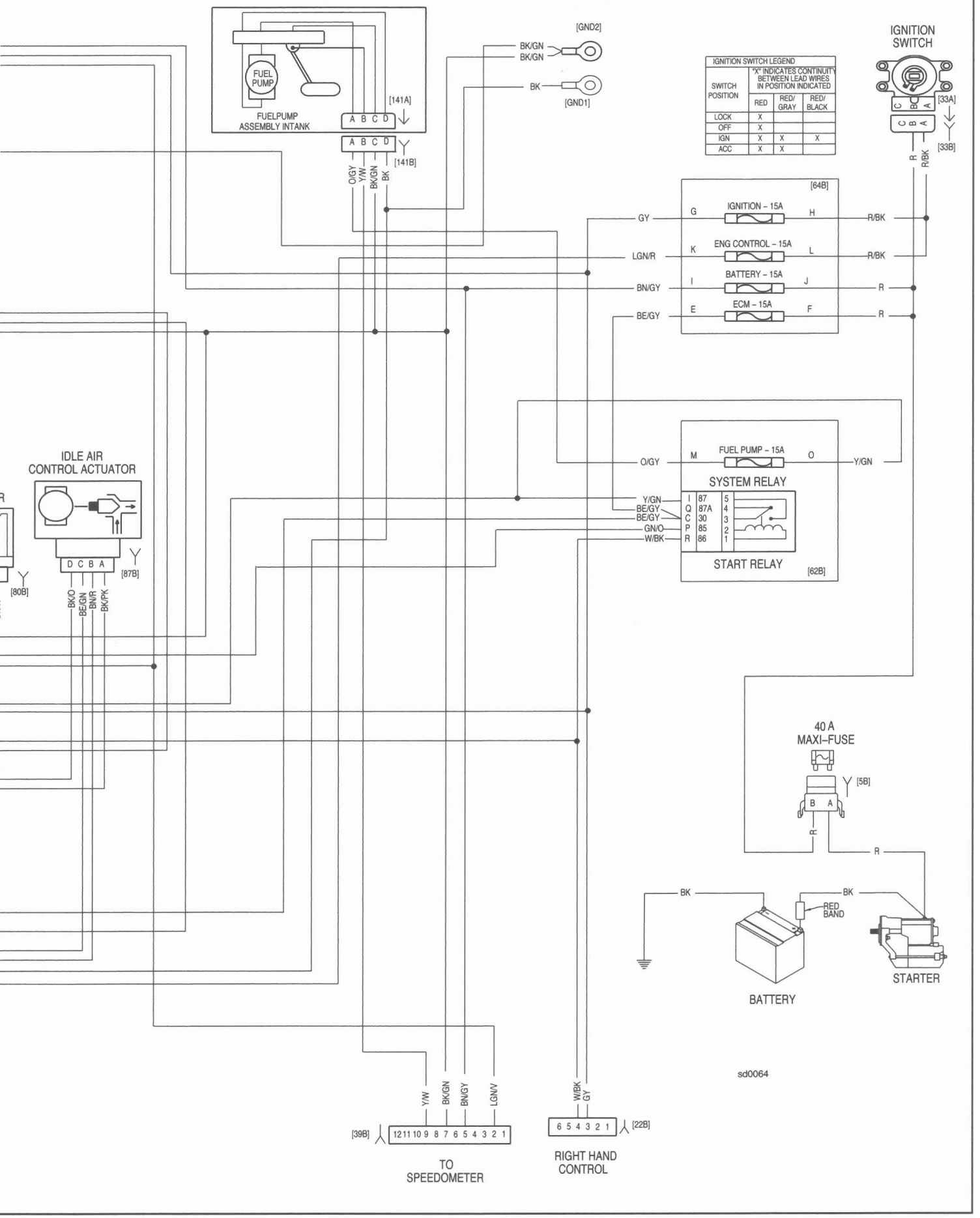
ODELS, MAIN HARNESS: SHEET 2 OF 3


sd0062xxx
ELECTRONIC CONTROL MODULE
[78A]
[78B]
EXHAUST FEEDBACK
N/C
TACH OUTPUT
SYSTEM RELAY
SERIAL DATA LINK
ENGINE TEMPERATURE
INTAKE AIR TEMPERATURE
OXYGEN SENSOR A
N/C
POWER GROUND
COIL REAR
CRANK POS. SENSOR (–)
SWITCH POWER
5V SENSOR POWER
N/C
N/C
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
EXHAUST COMMAND
INJECTOR FRONT
INTAKE SOLENOID
OXYGEN SENSOR B
THROTTLE POS. SNSR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANK POS. SENSOR (+)
CONSTANT POWER
N/C
VEHICLE SPEED INPUT
N/C
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
V/BE
GN/O
LGN/V
PK/Y
LGN/Y
PK/O
BK/GN
Y/BE
BK
W/BK
R/W
BK/O
BK/PK
GN/GY
V/O
W/Y
GY/O
PK/GN
GY/V
V/W
BK/W
GY/BE
BK/GN
BE/O
R
BE/GY
W/GN
BE/GN
BN/R
(G Y)
[91A]
DATA LINK
1 2 3 4
BK/GN
LGN/V
GY
ENGINE TEMP. SENSOR
[90B]
A B
PK/Y
BK/W
INTAKE AIR TEMP. SENSOR
[89B]
1 2
LGN/ Y
BK/W
IGNITION COIL
POWER ION DENSE COIL REAR COIL FRONT
[83B]
A B C D
Y/GN
GY/BE
Y/BE
BE/O
REAR INJECTOR
[85B]
A B
Y/GN
GN/GY
[84B]
[179B]
LGN/R
BK
V/O
V/BE
1 2 3 4 5
ACTIVE EXHAUST
[178B]
LGN/R
GY/O
1 2
ACTIVE INTAKE
[138B]
PK/O
BK/W
1 2
FRONT O2 SENSOR
[137B]
PK/GN
BK/W
1 2
REAR O2 SENSOR

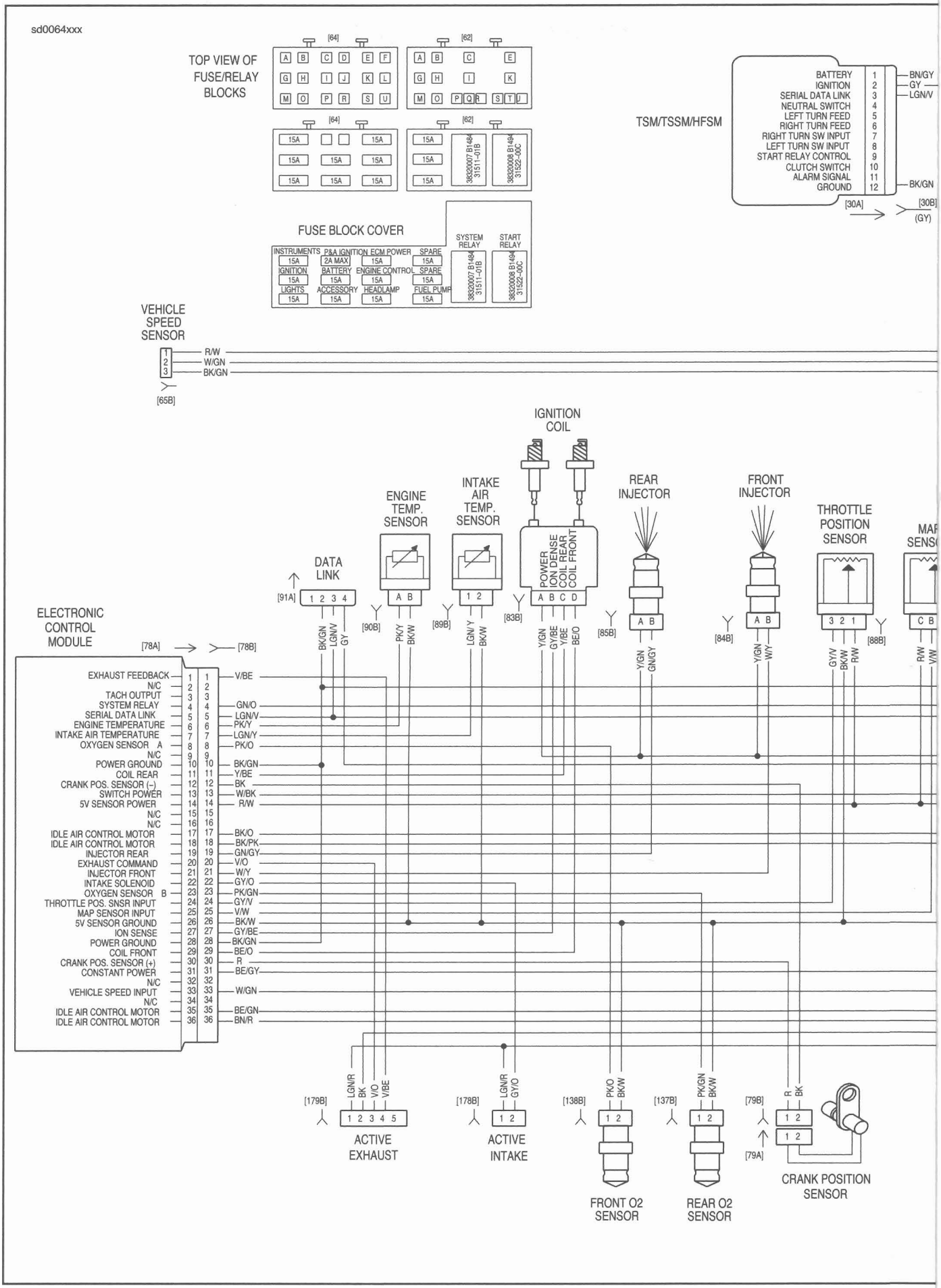


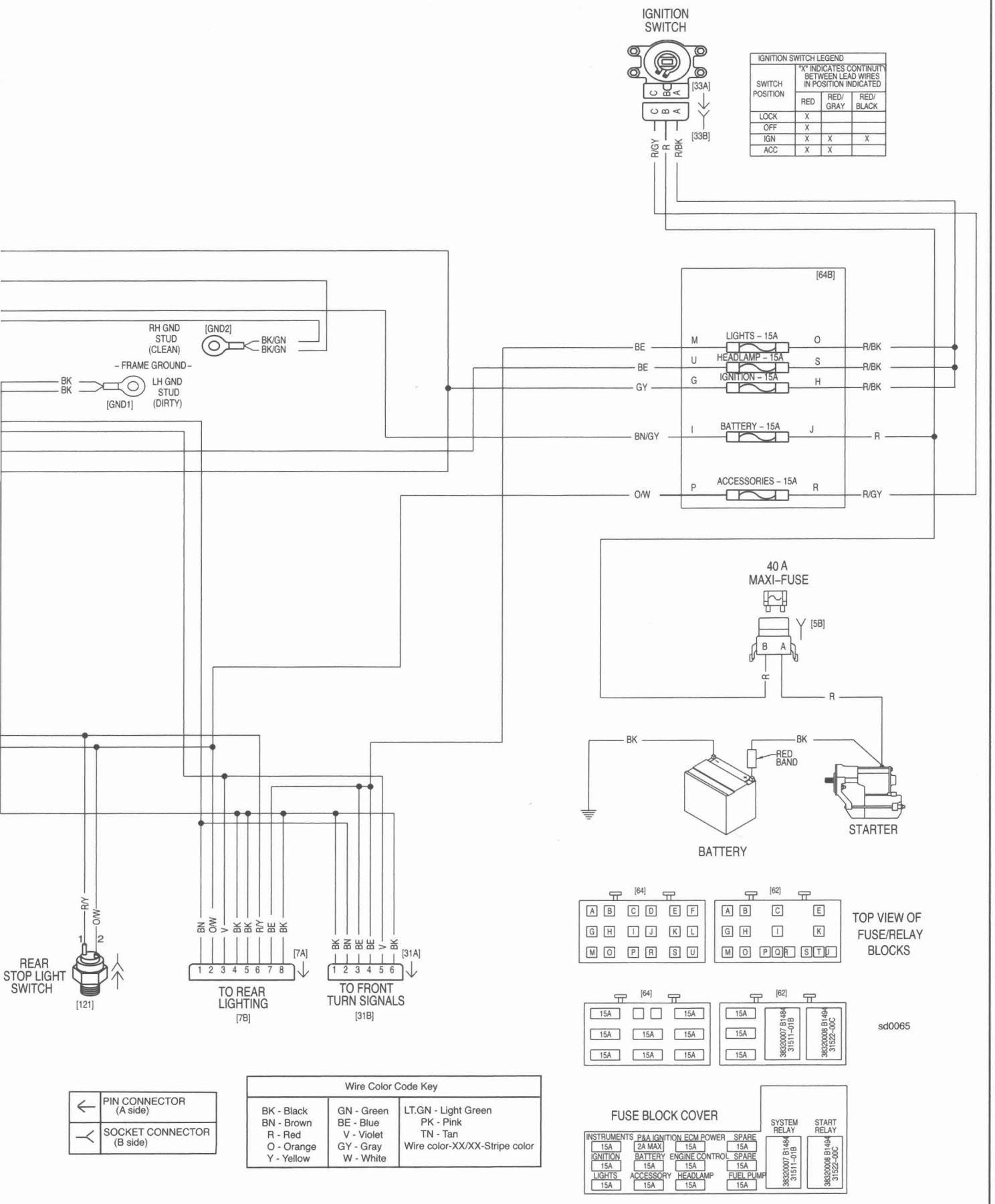
IODELS, MAIN HARNESS: SHEET 3 OF 3


sd0063xxx
RIGHT AUXILIARY LAMP FLSCT & FLSTN
[73RB]
GY/BK
LEFT AUXILIARY LAMP FLSCT & FLSTN
[73LB]
GY/BK
[73A]
GY/BK
GY/BK
[73B]
GY/BK
GY/BK
PASSING LAMP SWITCH FLSTC & FLSTN
[109]
PASSING LAMP HARNESS FLSTC & FLSTN: P/N 67615-96
GY/BK
Y
REAR LIGTHING HARN
68834-05: FLSTN, FLSTSC
[7B]
1 BN
2 O/W
3 V
4 BK/BN
5 BK
6 R/Y
7 BE
8 BK/V
BN
BK/V
[18A
V
BK/BN
[19A
EXCEPT FXST &FXSTB
DOM:
FENDERTIP LAMP
HDI:
POSITION LAMP
[143B]
BK
O/W
FLSTC:
P/N 70196-00A
DOM
ONLY
[143A]
[32A]
[32B]
REAR LIGTHING HARN
68817-07: FXSTD
[7B]
1 BN
2 O/W
3 V
4 BK
5 BK
6 R/Y
7 BE
8 BK
BN
BK
[18A]
[19A]
V
BK
FROM MAIN HARNESS [31A]
[31B]
1 2 3 4 5 6
BK BN BE BE V BK
RIGHT DIRECTIONAL AND DOM RUNNING LAMP
GND
BK
TURN
BN
BE
RUNNING DOM ONLY
LEFT DIRECTIONAL AND DOM RUNNING LAMP
GND
BK
TURN
V
BE
RUNNING DOM ONLY
BK
Y
W
O/W
4
3
2
1
[38B]
HEADLAMP
HAND CONTROLS RIGHT
RIGHT DIR SWITCH
ENGINE OFF/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH
[22A]
O/W
R/BE
GY
W/BK
W/BN
BK/R
FROM MAIN HARNESS
[22B] (BK)
[24A]
O/W
Y
BE
W
W/V
Y/BK
BK/R
BK
FROM MAIN HARNESS
[24B] (GY)
CLUTCH LOCKOUT SWITCH
HORN SWITCH
LIGHTS HI/LOW SWITCH
LEFT DIR SWITCH
HAND CONTROLS LEFT
FROM MAIN HARNESS
[21A]
1 2 3 4 5 6 7 8
[21B] (BK)
V W GN/Y BN TN O BK
INDICATOR LAMPS
BN
BK
RIGHT TURN
GN/Y
O
OIL PRESSURE
TN
O
NEUTRAL
W
BK
HIGH BEAM
V
BK
LEFT TURN
FUEL GAUGE
G
S
I
O
Y/W
BK
[117A]
1 2 3 4
TO MAIN HARNESS

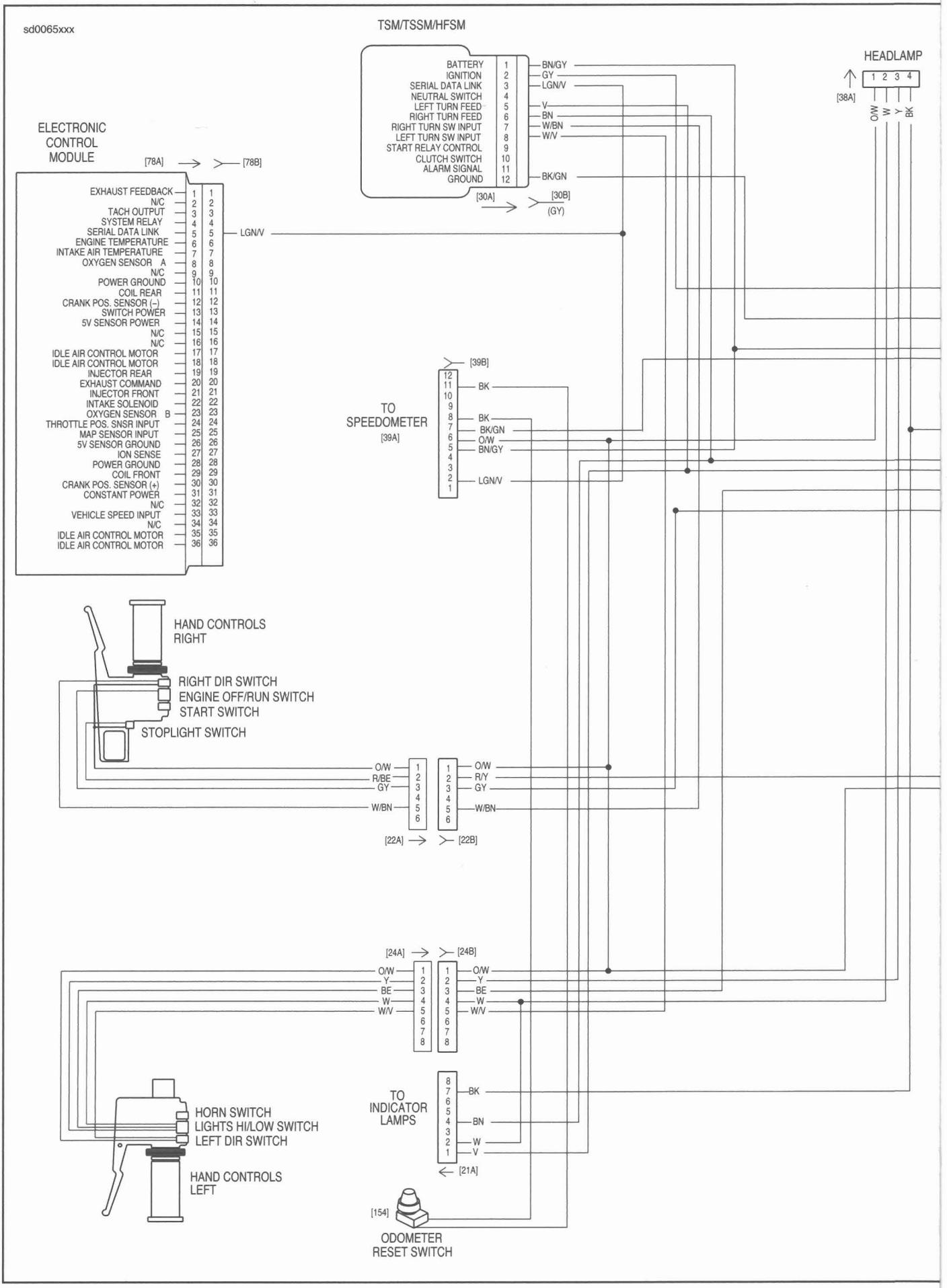


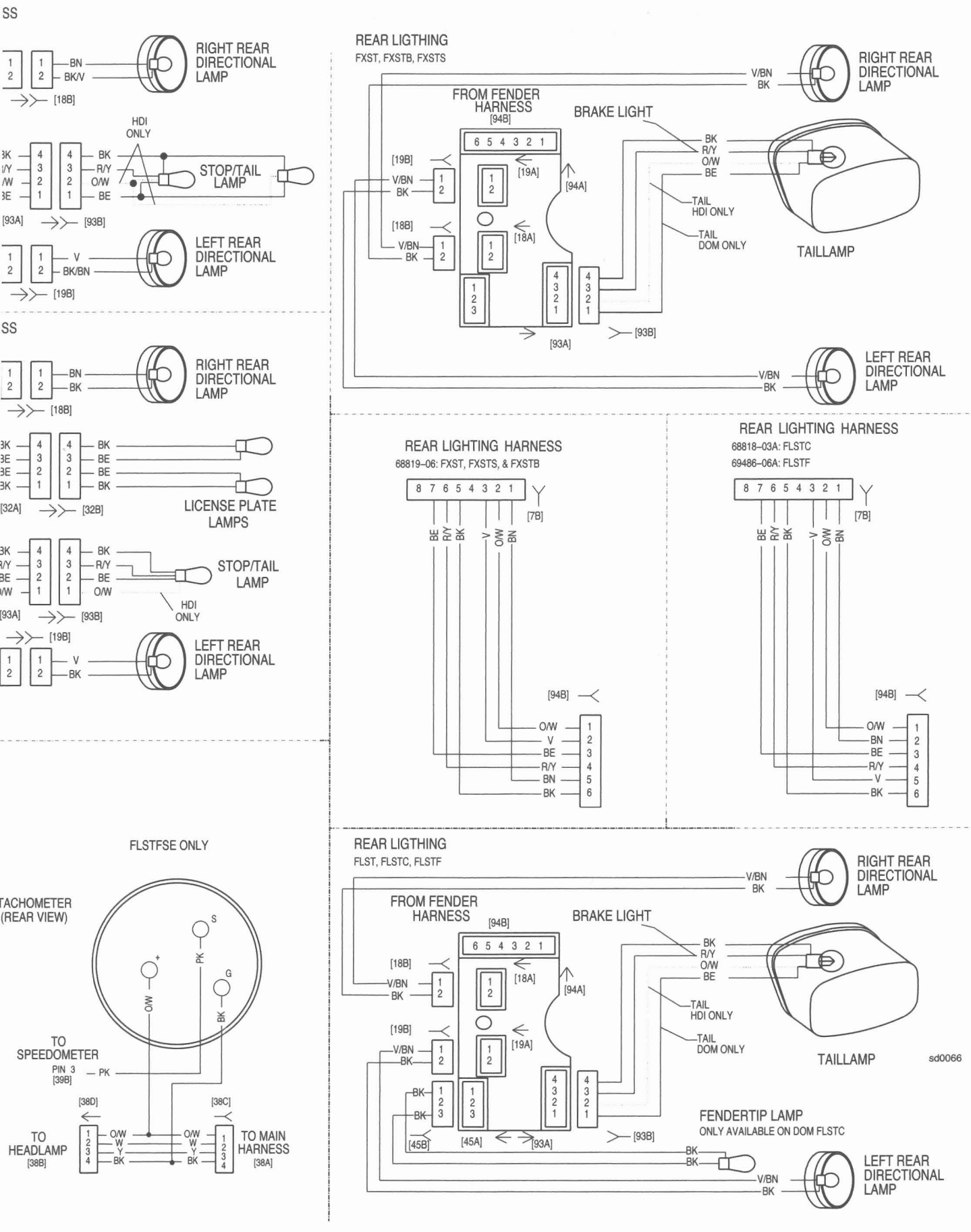
INT. MODELS, IGNITION CIRCUIT


sd0064xxx
TOP VIEW OF FUSE/RELAY BLOCKS
FUSE BLOCK COVER
INSTRUMENTS
P&A IGNITION
ECM POWER
SPARE
IGNITION
BATTERY
ENGINE CONTROL
LIGHTS
ACCESSORY
HEADLAMP
FUEL PUMP
SYSTEM RELAY
START RELAY
TSM/TSSM/HFSM
BATTERY
IGNITION
SERIAL DATA LINK
NEUTRAL SWITCH
LEFT TURN FEED
RIGHT TURN FEED
RIGHT TURN SW INPUT
LEFT TURN SW INPUT
START RELAY CONTROL
CLUTCH SWITCH
ALARM SIGNAL
GROUND
VEHICLE SPEED SENSOR
R/W
W/GN
BK/GN
IGNITION COIL
POWER
ION DENSE
COIL REAR
COIL FRONT
ENGINE TEMP. SENSOR
INTAKE AIR TEMP. SENSOR
REAR INJECTOR
FRONT INJECTOR
THROTTLE POSITION SENSOR
DATA LINK
ELECTRONIC CONTROL MODULE
EXHAUST FEEDBACK
TACH OUTPUT
SYSTEM RELAY
SERIAL DATA LINK
ENGINE TEMPERATURE
INTAKE AIR TEMPERATURE
OXYGEN SENSOR A
POWER GROUND
COIL REAR
CRANK POS. SENSOR (–)
SWITCH POWER
5V SENSOR POWER
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
EXHAUST COMMAND
INJECTOR FRONT
INTAKE SOLENOID
OXYGEN SENSOR B
THROTTLE POS. SNSR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANK POS. SENSOR (+)
CONSTANT POWER
VEHICLE SPEED INPUT
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
ACTIVE EXHAUST
ACTIVE INTAKE
FRONT O2 SENSOR
REAR O2 SENSOR
CRANK POSITION SENSOR

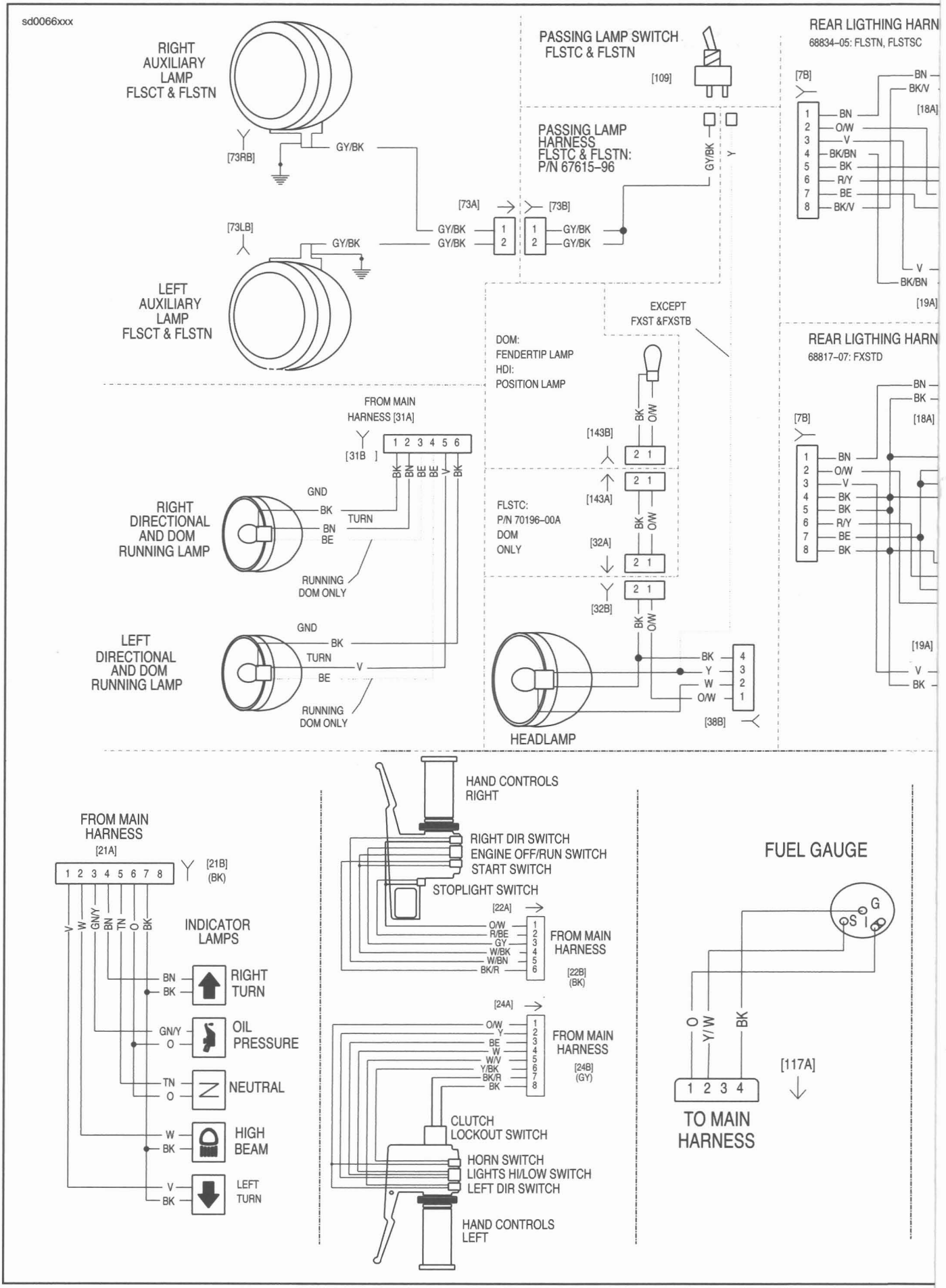


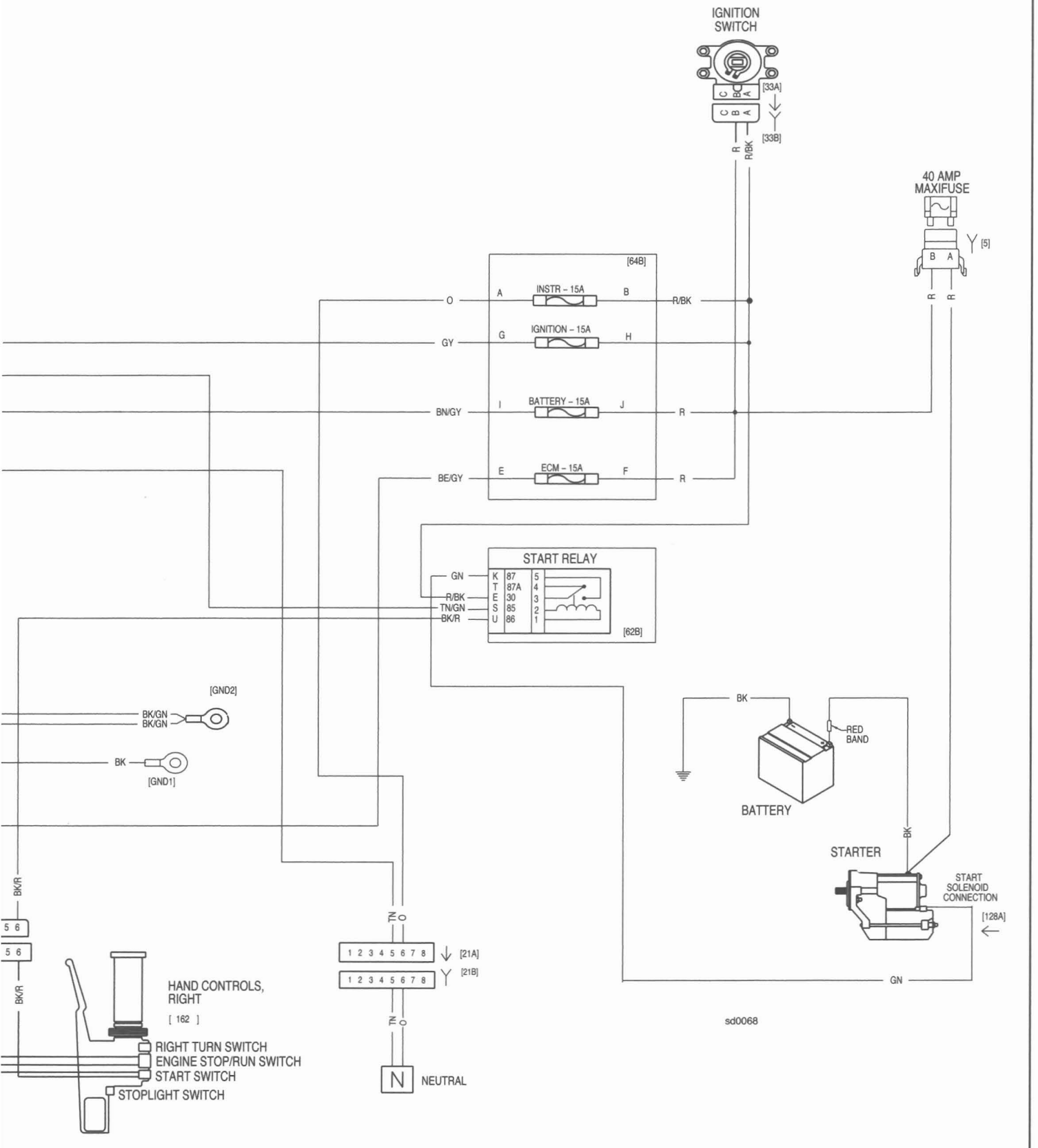
ODELS, LIGHTING CIRCUIT: PAGE 1 of 2


sd0065xxx
TSM/TSSM/HFSM
BATTERY 1
IGNITION 2
SERIAL DATA LINK 3
NEUTRAL SWITCH 4
LEFT TURN FEED 5
RIGHT TURN FEED 6
RIGHT TURN SW INPUT 7
LEFT TURN SW INPUT 8
START RELAY CONTROL 9
CLUTCH SWITCH 10
ALARM SIGNAL 11
GROUND 12
BN/GY
GY
LGN/V
V
BN
W/BN
W/V
BK/GN
[30A]
[30B]
(GY)
HEADLAMP
[38A]
1 2 3 4
O/W
W
Y
BK
ELECTRONIC CONTROL MODULE
[78A]
[78B]
EXHAUST FEEDBACK 1
N/C 2
TACH OUTPUT 3
SYSTEM RELAY 4
SERIAL DATA LINK 5
ENGINE TEMPERATURE 6
INTAKE AIR TEMPERATURE 7
OXYGEN SENSOR A 8
N/C 9
POWER GROUND 10
COIL REAR 11
CRANK POS. SENSOR (–) 12
SWITCH POWER 13
5V SENSOR POWER 14
N/C 15
N/C 16
IDLE AIR CONTROL MOTOR 17
IDLE AIR CONTROL MOTOR 18
INJECTOR REAR 19
EXHAUST COMMAND 20
INJECTOR FRONT 21
INTAKE SOLENOID 22
OXYGEN SENSOR B 23
THROTTLE POS. SNSR INPUT 24
MAP SENSOR INPUT 25
5V SENSOR GROUND 26
ION SENSE 27
POWER GROUND 28
COIL FRONT 29
CRANK POS. SENSOR (+) 30
CONSTANT POWER 31
N/C 32
VEHICLE SPEED INPUT 33
N/C 34
IDLE AIR CONTROL MOTOR 35
IDLE AIR CONTROL MOTOR 36
LGN/V
[39B]
TO SPEEDOMETER
[39A]
BK
BK
BK/GN
O/W
BN/GY
LGN/V
HAND CONTROLS RIGHT
RIGHT DIR SWITCH
ENGINE OFF/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH
O/W
R/BE
GY
W/BN
[22A]
[22B]
O/W
R/Y
GY
W/BN
[24A]
[24B]
O/W
Y
BE
W
W/V
HORN SWITCH
LIGHTS HI/LOW SWITCH
LEFT DIR SWITCH
HAND CONTROLS LEFT
TO INDICATOR LAMPS
BK
BN
W
V
[21A]
[154]
ODOMETER RESET SWITCH

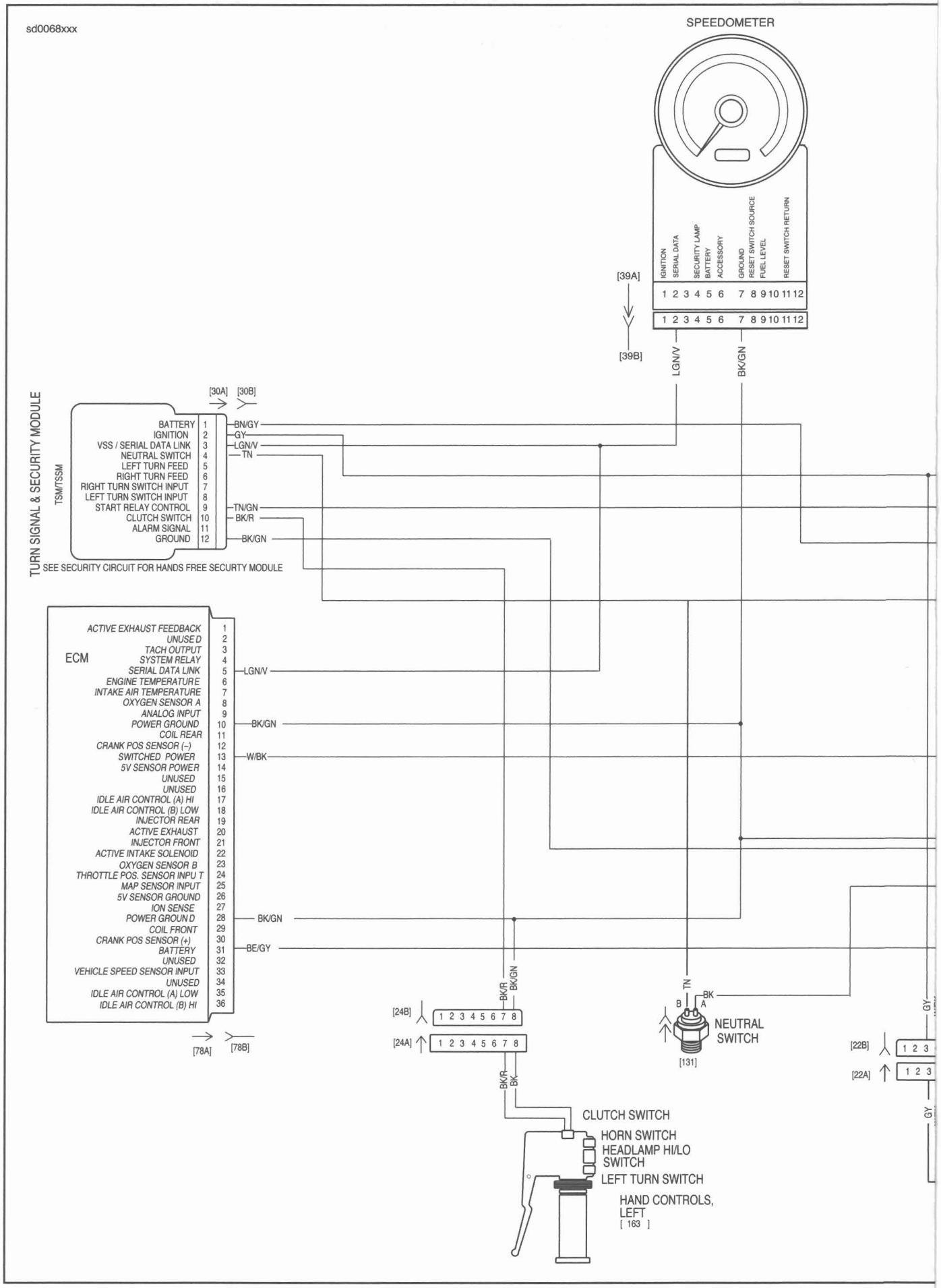


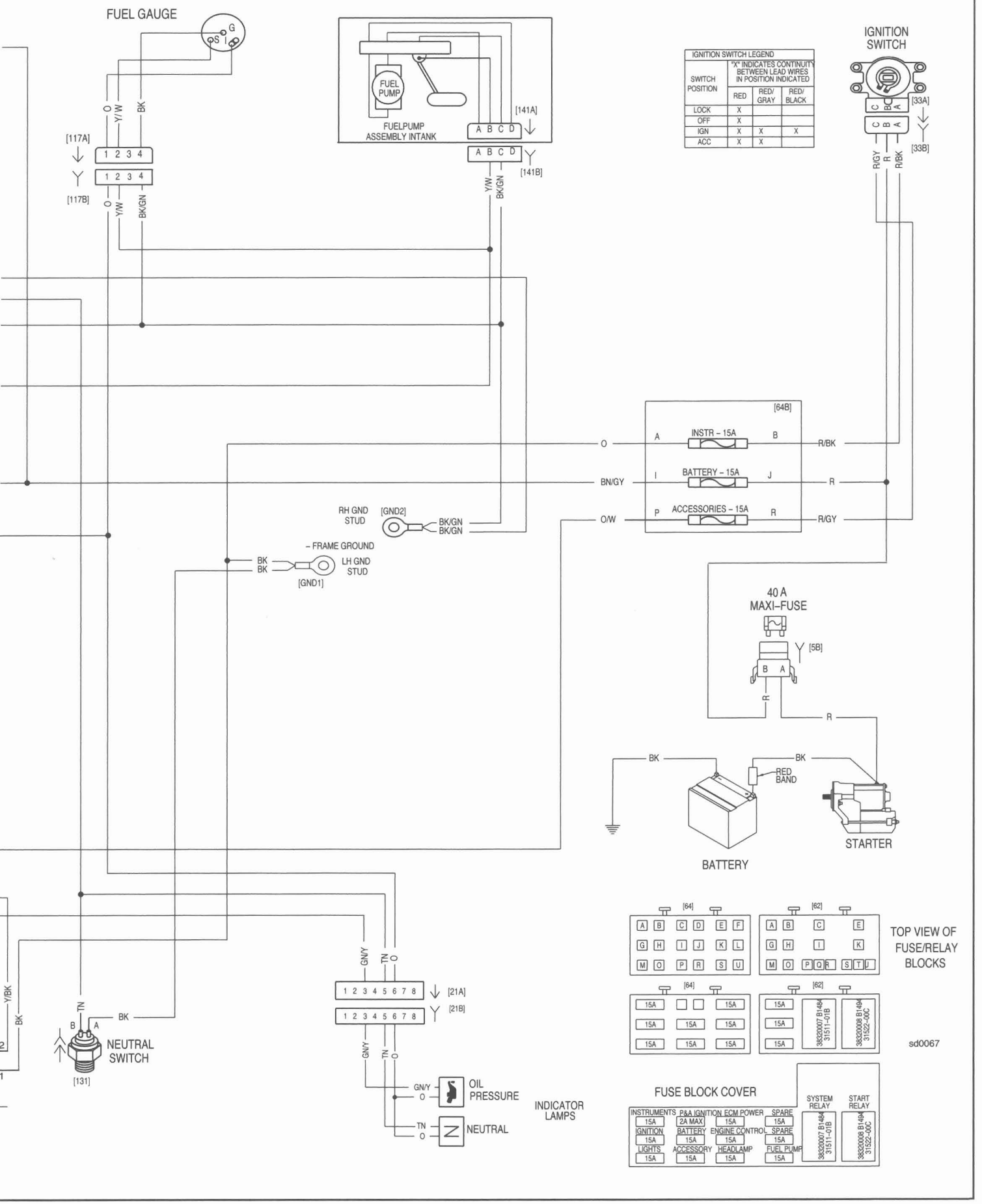
ODELS, LIGHTING CIRCUIT: PAGE 2 of 2

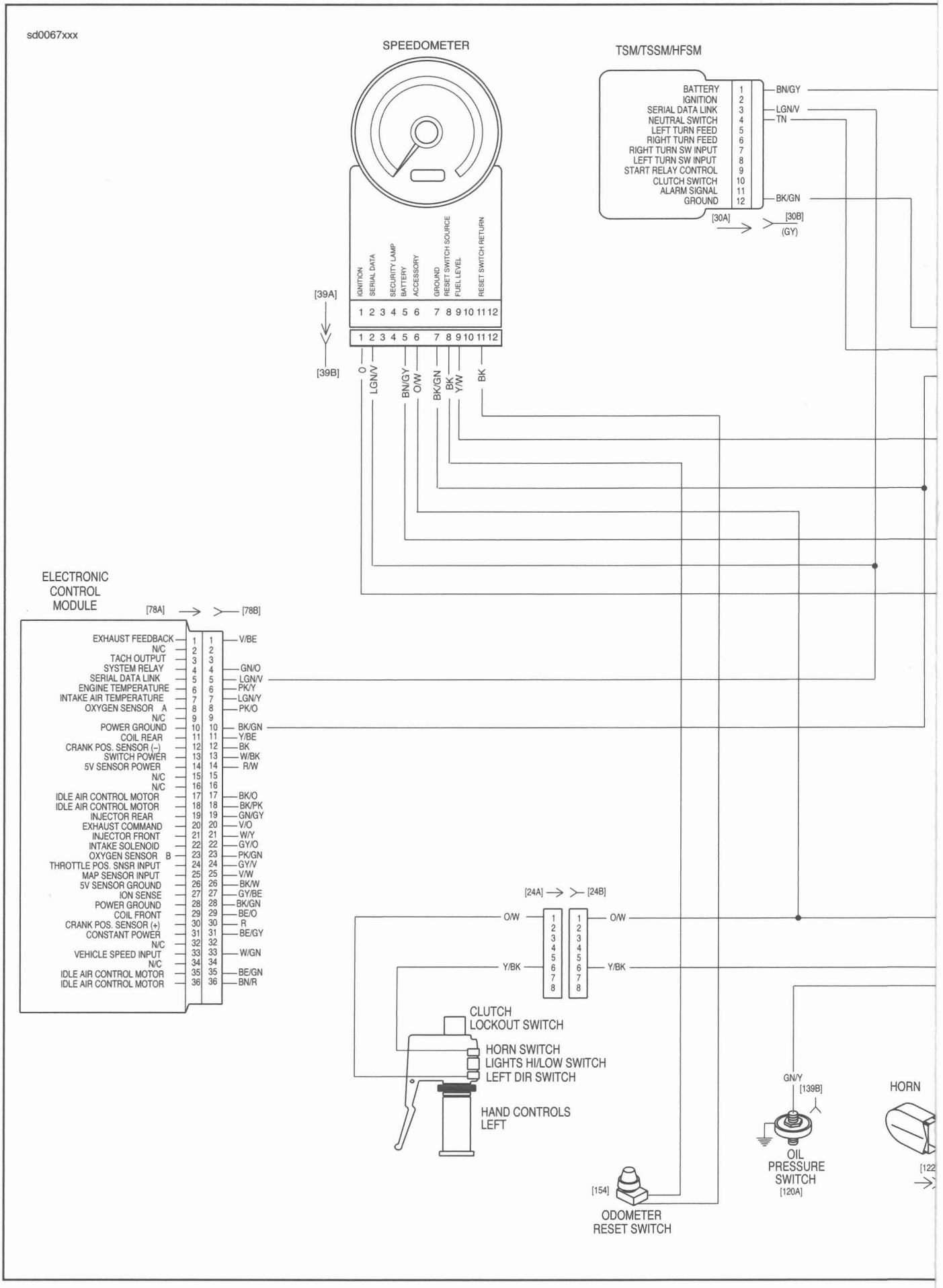

sd0066xxx
RIGHT AUXILIARY LAMP FLSCT & FLSTN
[73RB]
GY/BK
LEFT AUXILIARY LAMP FLSCT & FLSTN
[73LB]
GY/BK
PASSING LAMP SWITCH FLSTC & FLSTN
[109]
PASSING LAMP HARNESS FLSTC & FLSTN: P/N 67615-96
[73A]
[73B]
GY/BK
GY/BK
GY/BK
GY/BK
Y
REAR LIGTHING HARN
68834-05: FLSTN, FLSTSC
[7B]
[18A]
BN
BK/V
O/W
V
BK/BN
BK
R/Y
BE
BK/V
[19A]
EXCEPT FXST &FXSTB
DOM:
FENDERTIP LAMP
HDI:
POSITION LAMP
[143B]
[143A]
FLSTC:
P/N 70196-00A
DOM
ONLY
[32A]
[32B]
BK
O/W
REAR LIGTHING HARN
68817-07: FXSTD
FROM MAIN HARNESS [31A]
[31B]
1 2 3 4 5 6
BK
BN
BE
V
BK
RIGHT DIRECTIONAL AND DOM RUNNING LAMP
GND
BK
TURN
BN
BE
RUNNING DOM ONLY
LEFT DIRECTIONAL AND DOM RUNNING LAMP
GND
BK
TURN
V
BE
RUNNING DOM ONLY
HEADLAMP
BK
Y
W
O/W
[38B]
FROM MAIN HARNESS
[21A]
1 2 3 4 5 6 7 8
[21B] (BK)
V
W
GN/Y
BN
TN
O
BK
INDICATOR LAMPS
BN
BK
RIGHT TURN
GN/Y
O
OIL PRESSURE
TN
O
NEUTRAL
W
BK
HIGH BEAM
V
BK
LEFT TURN
HAND CONTROLS RIGHT
RIGHT DIR SWITCH
ENGINE OFF/RUN SWITCH
START SWITCH
STOPLIGHT SWITCH
[22A]
O/W
R/BE
GY
W/BK
W/BN
BK/R
FROM MAIN HARNESS
[22B] (BK)
[24A]
O/W
Y
BE
W
W/V
Y/BK
BK/R
BK
FROM MAIN HARNESS
[24B] (GY)
CLUTCH LOCKOUT SWITCH
HORN SWITCH
LIGHTS HI/LOW SWITCH
LEFT DIR SWITCH
HAND CONTROLS LEFT
FUEL GAUGE
S
I
G
O
Y/W
BK
[117A]
1 2 3 4
TO MAIN HARNESS

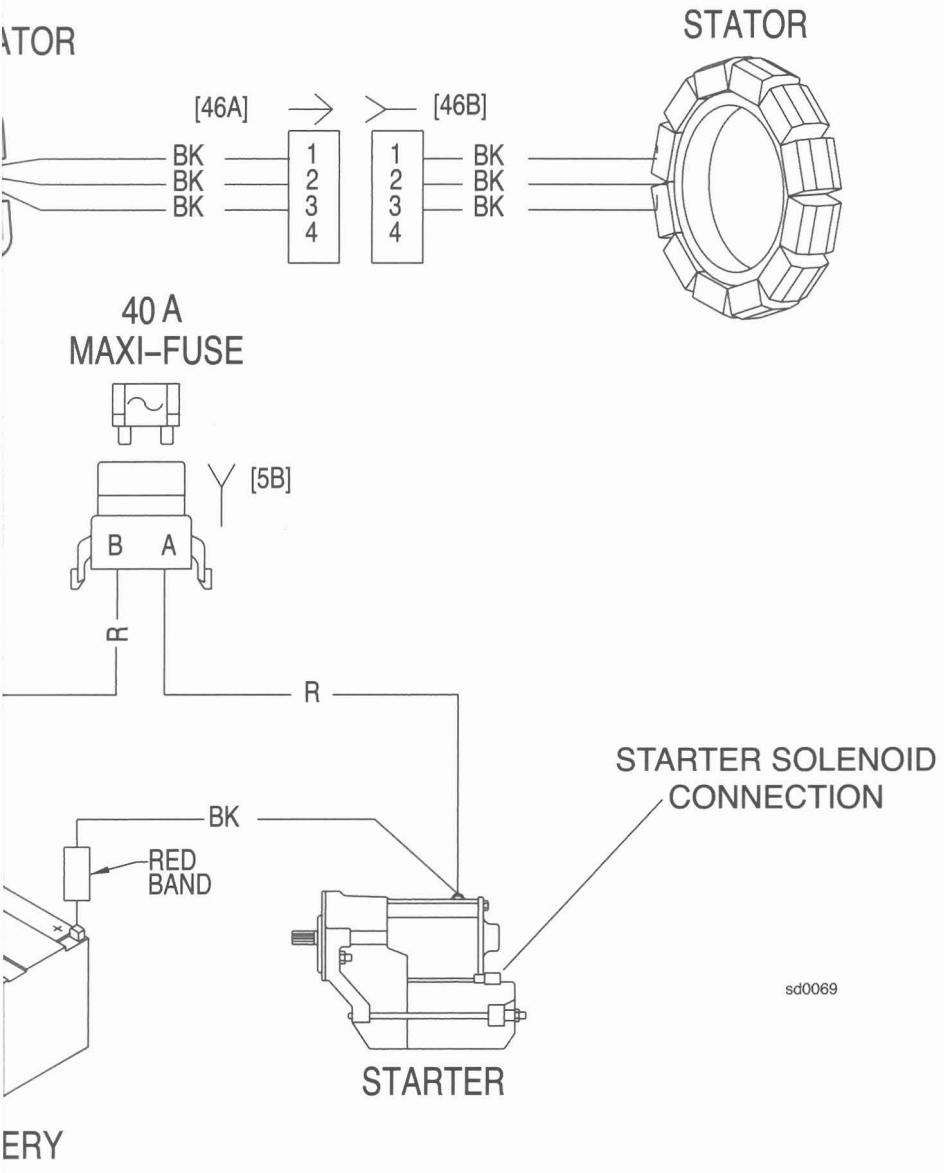


INT. MODELS, STARTING CIRCUIT

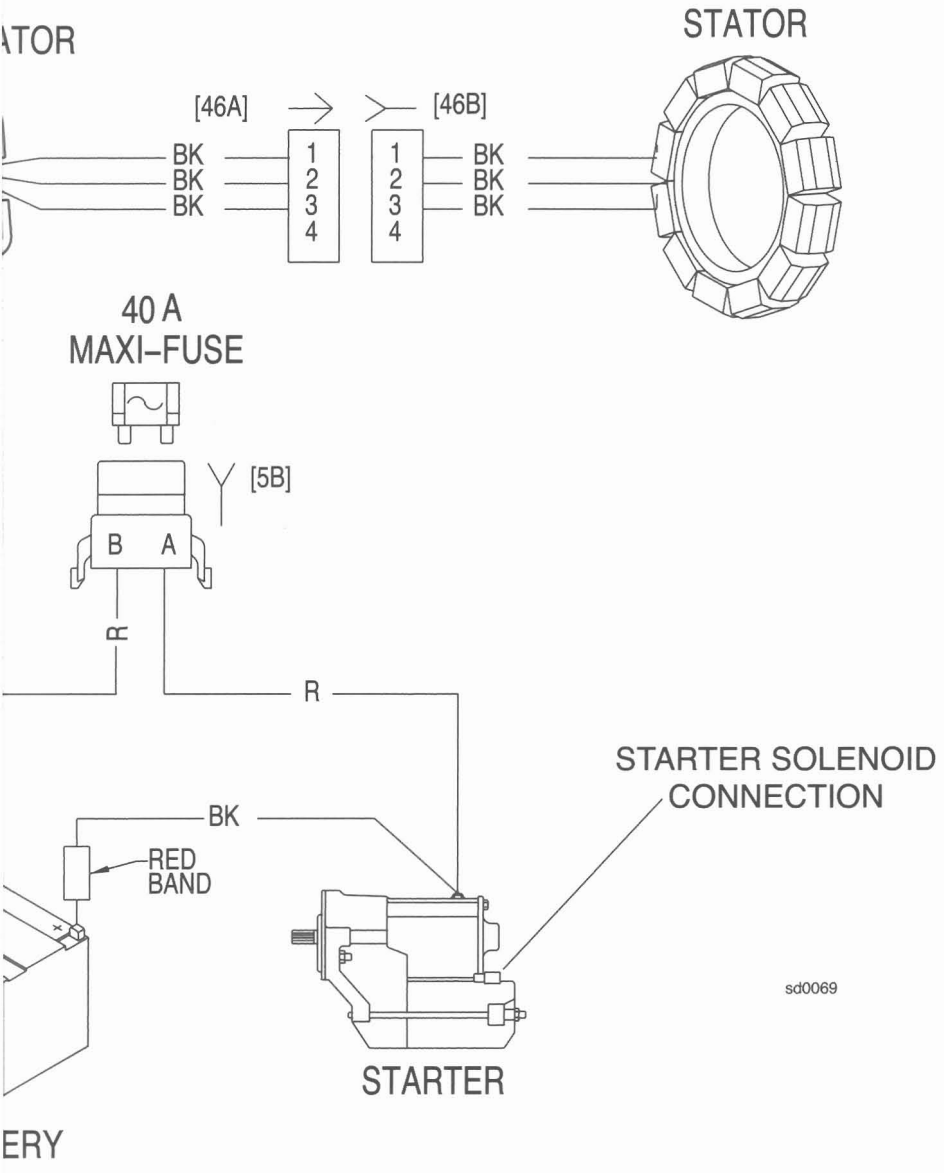

sd0068xxx
SPEEDOMETER
IGNITION
SERIAL DATA
SECURITY LAMP
BATTERY
ACCESSORY
GROUND
RESET SWITCH SOURCE
FUEL LEVEL
RESET SWITCH RETURN
1 2 3 4 5 6 7 8 9 10 11 12
[39A]
[39B]
LGN/V
BK/GN
TURN SIGNAL & SECURITY MODULE
TSM/TSSM
[30A] [30B]
BATTERY 1
IGNITION 2
VSS / SERIAL DATA LINK 3
NEUTRAL SWITCH 4
LEFT TURN FEED 5
RIGHT TURN FEED 6
RIGHT TURN SWITCH INPUT 7
LEFT TURN SWITCH INPUT 8
START RELAY CONTROL 9
CLUTCH SWITCH 10
ALARM SIGNAL 11
GROUND 12
BN/GY
GY
LGN/V
TN
TN/GN
BK/R
BK/GN
SEE SECURITY CIRCUIT FOR HANDS FREE SECURTY MODULE
ECM
ACTIVE EXHAUST FEEDBACK 1
UNUSED 2
TACH OUTPUT 3
SYSTEM RELAY 4
SERIAL DATA LINK 5
ENGINE TEMPERATURE 6
INTAKE AIR TEMPERATURE 7
OXYGEN SENSOR A 8
ANALOG INPUT 9
POWER GROUND 10
COIL REAR 11
CRANK POS SENSOR (-) 12
SWITCHED POWER 13
5V SENSOR POWER 14
UNUSED 15
UNUSED 16
IDLE AIR CONTROL (A) HI 17
IDLE AIR CONTROL (B) LOW 18
INJECTOR REAR 19
ACTIVE EXHAUST 20
INJECTOR FRONT 21
ACTIVE INTAKE SOLENOID 22
OXYGEN SENSOR B 23
THROTTLE POS. SENSOR INPU T 24
MAP SENSOR INPUT 25
5V SENSOR GROUND 26
ION SENSE 27
POWER GROUN D 28
COIL FRONT 29
CRANK POS SENSOR (+) 30
BATTERY 31
UNUSED 32
VEHICLE SPEED SENSOR INPUT 33
UNUSED 34
IDLE AIR CONTROL (A) LOW 35
IDLE AIR CONTROL (B) HI 36
LGN/V
BK/GN
W/BK
BK/GN
BE/GY
[78A] [78B]
[24B] [24A]
1 2 3 4 5 6 7 8
BK/R
BK/GN
BK/R
BK
TN
B
BK
A
NEUTRAL SWITCH
[131]
[22B] [22A]
1 2 3
GY
GY
CLUTCH SWITCH
HORN SWITCH
HEADLAMP HI/LO SWITCH
LEFT TURN SWITCH
HAND CONTROLS, LEFT
[163]


FUEL GAUGE
G
S
I
O
Y/W
BK
[117A]
1 2 3 4
[117B]
FUEL PUMP
FUELPUMP ASSEMBLY INTANK
A B C D
[141A]
[141B]
Y/W
BK/GN
IGNITION SWITCH LEGEND
SWITCH POSITION
"X" INDICATES CONTINUITY BETWEEN LEAD WIRES IN POSITION INDICATED
RED
RED/ GRAY
RED/ BLACK
LOCK X
OFF X
IGN X X X
ACC X X
IGNITION SWITCH
C B A
[33A]
[33B]
R/GY
R
R/BK
[64B]
INSTR – 15A
BATTERY – 15A
ACCESSORIES – 15A
O
BN/GY
O/W
R/BK
R
R/GY
RH GND STUD
[GND2]
BK/GN
BK/GN
– FRAME GROUND
BK
BK
LH GND STUD
[GND1]
40 A MAXI-FUSE
[5B]
BK
BK
RED BAND
BATTERY
STARTER
[64]
[62]
TOP VIEW OF FUSE/RELAY BLOCKS
sd0067
GN/Y
TN
O
[21A]
[21B]
TN
BK
NEUTRAL SWITCH
[131]
OIL PRESSURE
NEUTRAL
INDICATOR LAMPS
FUSE BLOCK COVER
SYSTEM RELAY
START RELAY
INSTRUMENTS 15A
P&A IGNITION 2A MAX
ECM POWER 15A
SPARE 15A
IGNITION 15A
BATTERY 15A
ENGINE CONTROL 15A
SPARE 15A
LIGHTS 15A
ACCESSORY 15A
HEADLAMP 15A
FUEL PUMP 15A


sd0067xxx
SPEEDOMETER
IGNITION
SERIAL DATA
SECURITY LAMP
BATTERY
ACCESSORY
GROUND
RESET SWITCH SOURCE
FUEL LEVEL
RESET SWITCH RETURN
1 2 3 4 5 6 7 8 9 10 11 12
[39A]
[39B]
O
LGN/V
BN/GY
O/W
BK/GN
BK
Y/W
BK
TSM/TSSM/HFSM
BATTERY
IGNITION
SERIAL DATA LINK
NEUTRAL SWITCH
LEFT TURN FEED
RIGHT TURN FEED
RIGHT TURN SW INPUT
LEFT TURN SW INPUT
START RELAY CONTROL
CLUTCH SWITCH
ALARM SIGNAL
GROUND
BN/GY
LGN/V
TN
BK/GN
[30A]
[30B]
(GY)
ELECTRONIC CONTROL MODULE
[78A]
[78B]
EXHAUST FEEDBACK
N/C
TACH OUTPUT
SYSTEM RELAY
SERIAL DATA LINK
ENGINE TEMPERATURE
INTAKE AIR TEMPERATURE
OXYGEN SENSOR A
N/C
POWER GROUND
COIL REAR
CRANK POS. SENSOR (–)
SWITCH POWER
5V SENSOR POWER
N/C
N/C
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
INJECTOR REAR
EXHAUST COMMAND
INJECTOR FRONT
INTAKE SOLENOID
OXYGEN SENSOR B
THROTTLE POS. SNSR INPUT
MAP SENSOR INPUT
5V SENSOR GROUND
ION SENSE
POWER GROUND
COIL FRONT
CRANK POS. SENSOR (+)
CONSTANT POWER
N/C
VEHICLE SPEED INPUT
N/C
IDLE AIR CONTROL MOTOR
IDLE AIR CONTROL MOTOR
V/BE
GN/O
LGN/V
PK/Y
LGN/Y
PK/O
BK/GN
Y/BE
BK
W/BK
R/W
BK/O
BK/PK
GN/GY
V/O
W/Y
GY/O
PK/GN
GY/V
V/W
BK/W
GY/BE
BK/GN
BE/O
R
BE/GY
W/GN
BE/GN
BN/R
[24A]
[24B]
O/W
Y/BK
CLUTCH LOCKOUT SWITCH
HORN SWITCH
LIGHTS HI/LOW SWITCH
LEFT DIR SWITCH
HAND CONTROLS LEFT
[154]
ODOMETER RESET SWITCH
GN/Y
[139B]
OIL PRESSURE SWITCH
[120A]
HORN

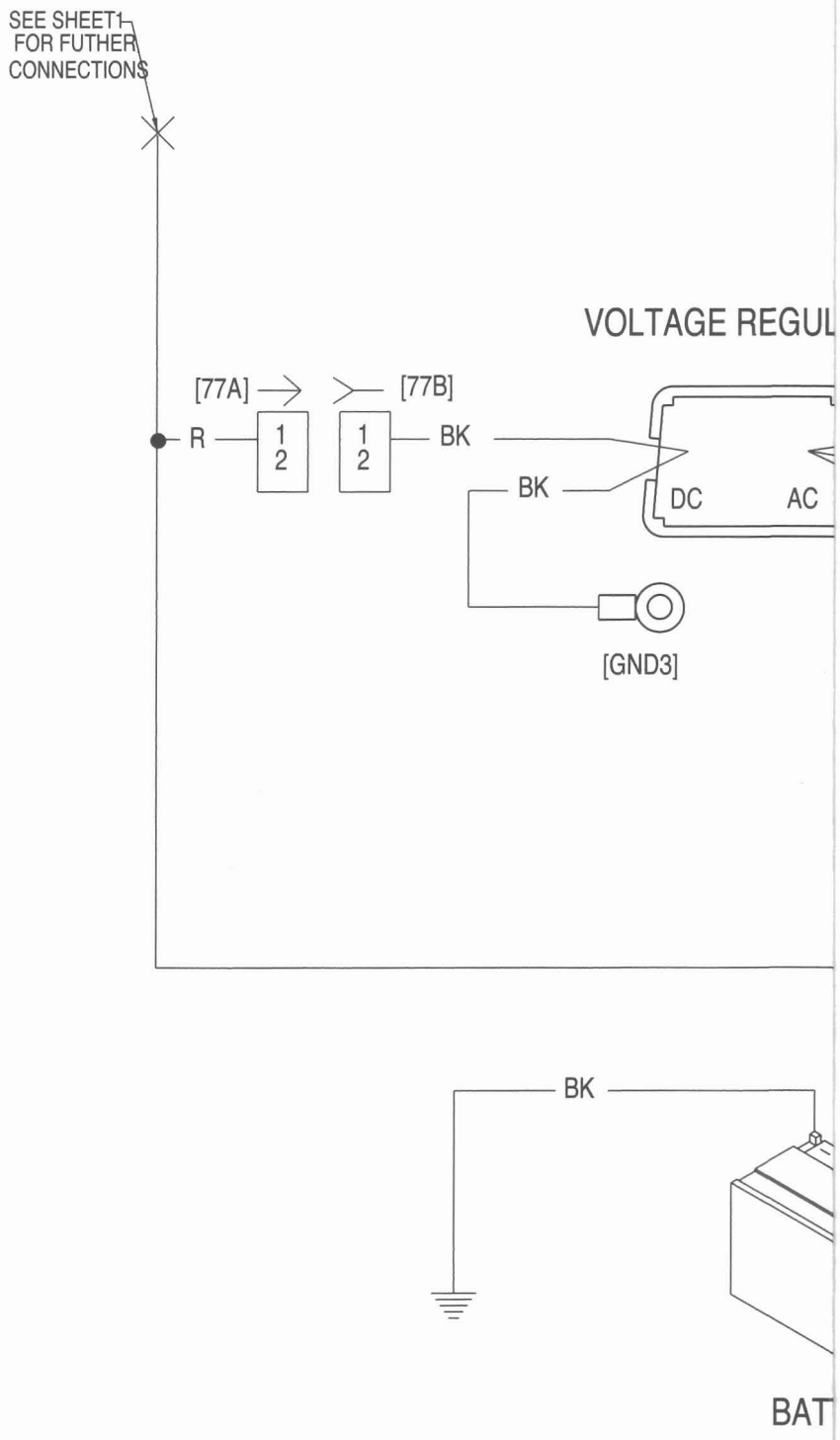


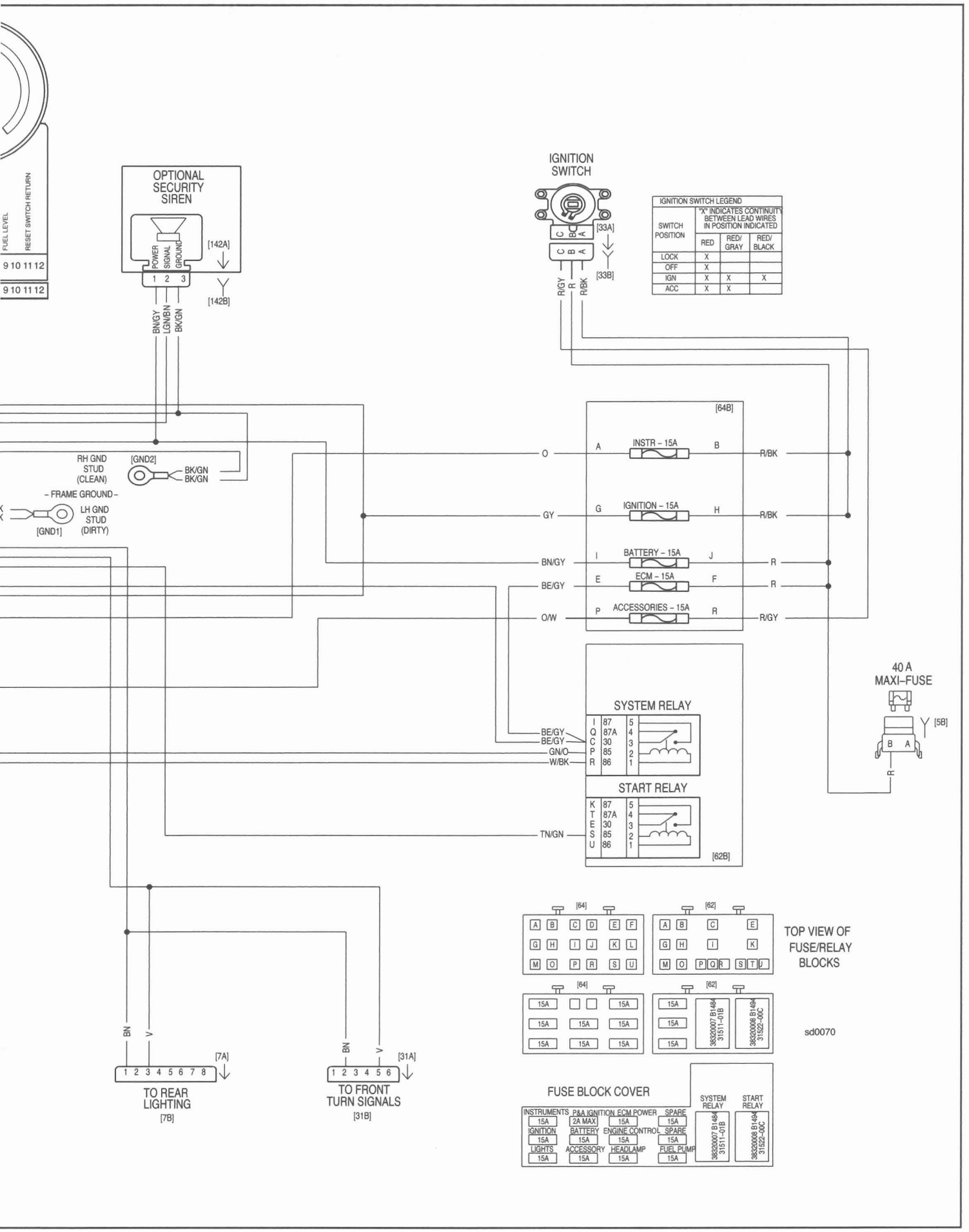
NT. MODELS, CHARGING CIRCUIT



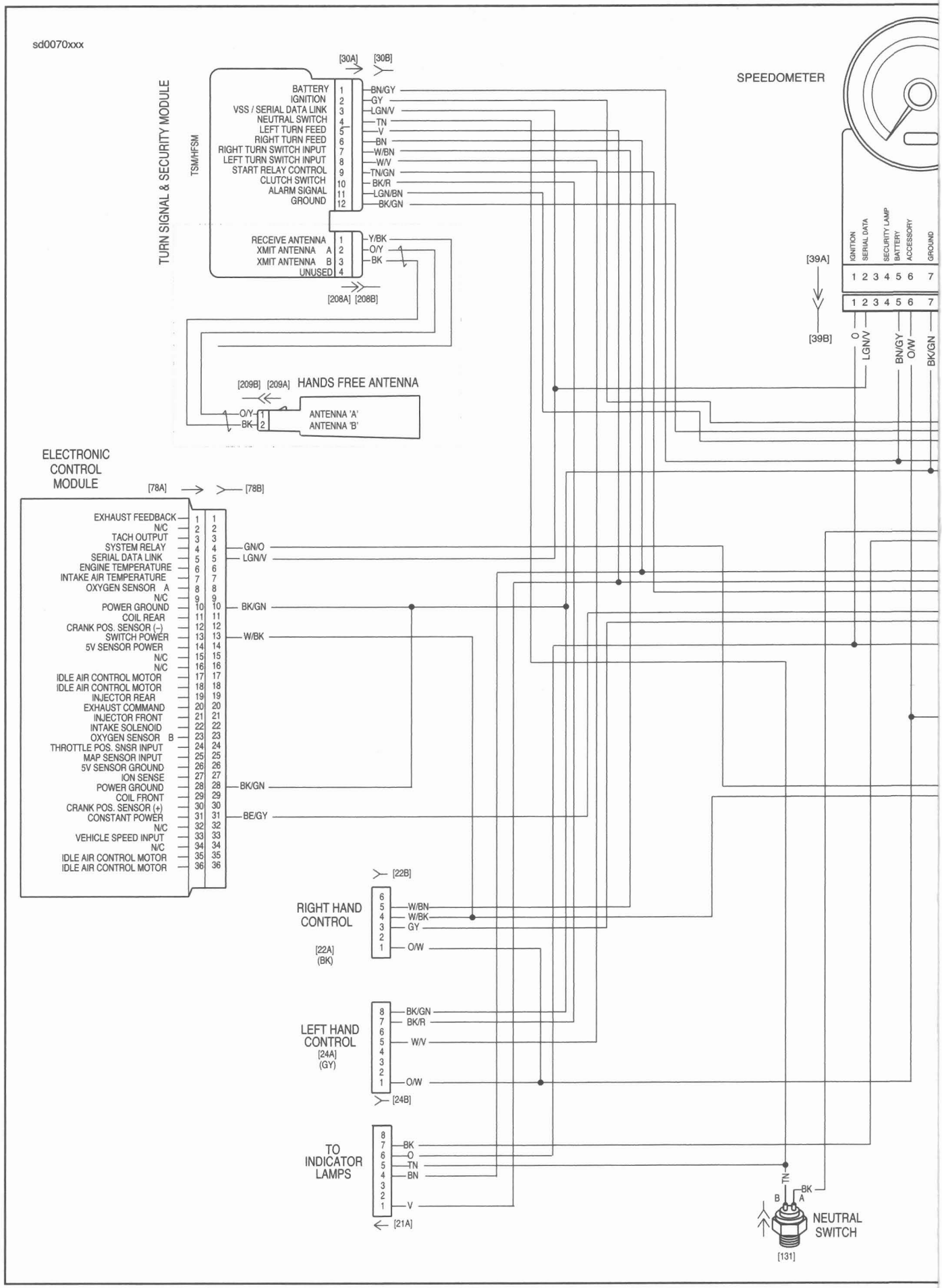
NT. MODELS, CHARGING CIRCUIT

sd0069xxx

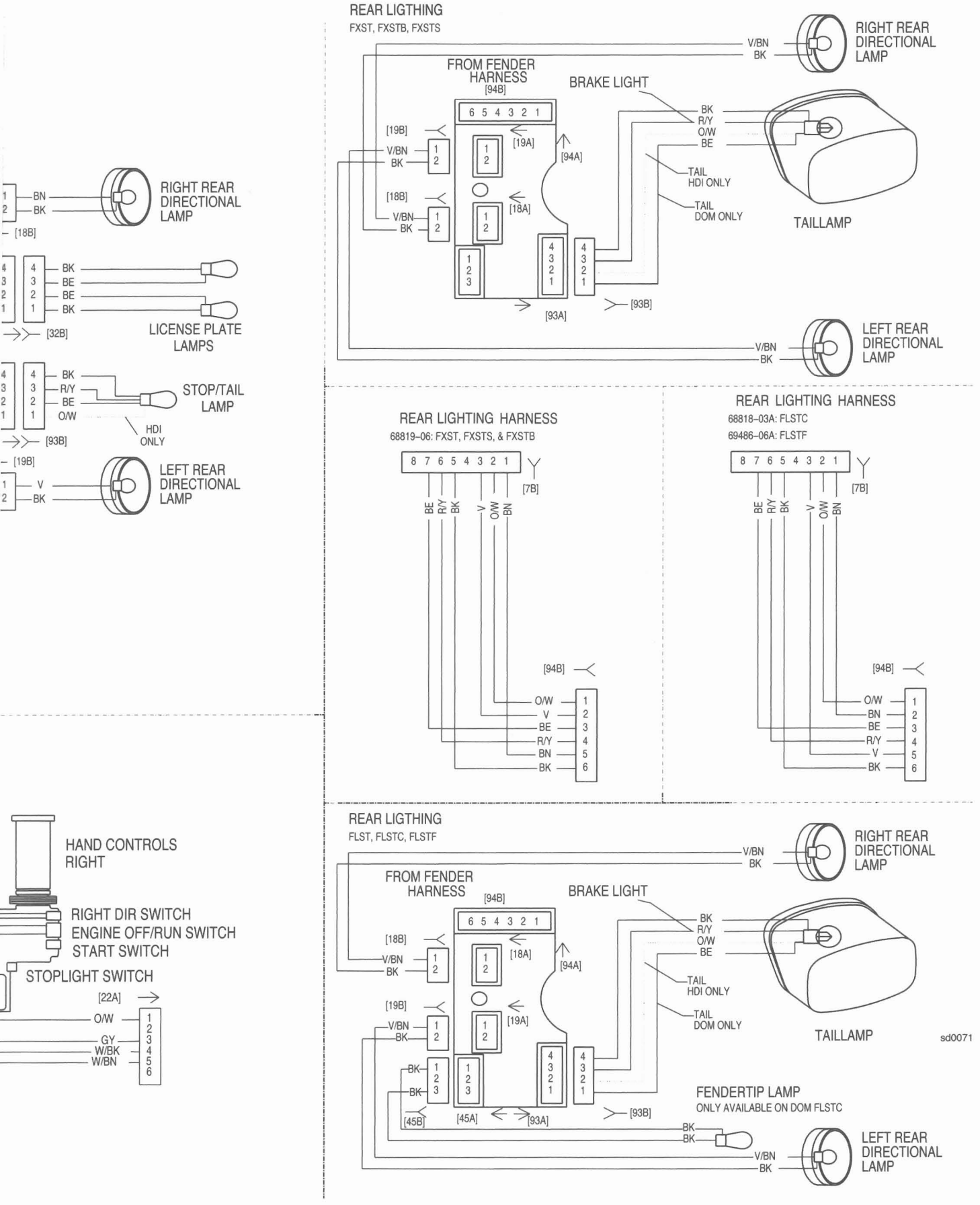

SEE SHEET1
FOR FUTHER
CONNECTIONS
VOLTAGE REGUL
[77A]
[77B]
R
1
2
1
2
BK
BK
DC
AC
[GND3]
BK
BAT



DELS, SECURITY CIRCUIT: SHEET 1 OF 2



2007 ALL SOFTAIL DOM. and INT. MC

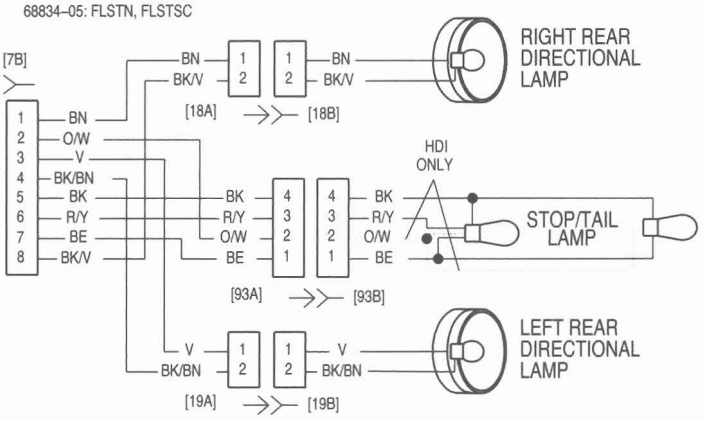


DELS, SECURITY CIRCUIT: SHEET 2 OF 2

sd0071xxx

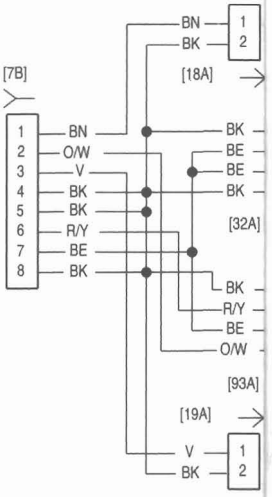
REAR LIGTHING HARNESS

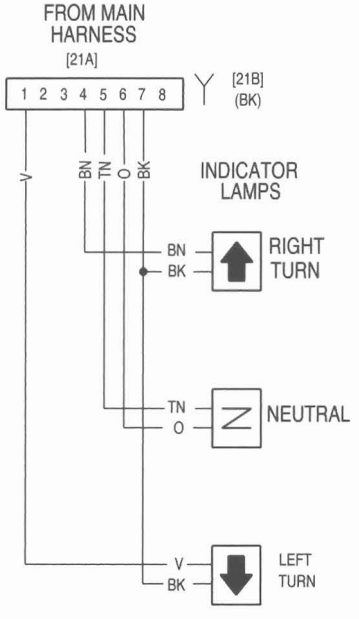
68834-05: FLSTN, FLSTSC

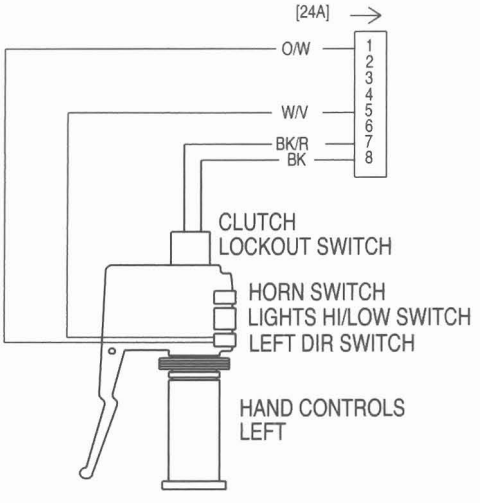


REAR LIGTHING HARNESS

68817-07: FXSTD







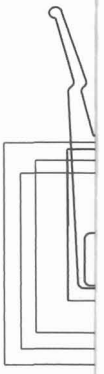


Table C-1. Metric Conversions

MILLIMETERS to INCHES (mm x 0.03937 = inches)								INCHES to MILLIMETERS (inches x 25.40 = mm)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

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.)

Acronyms and Abbreviations

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
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWR	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson Smart Security System
HFSM	Hands Free Security Module
Hg	Mercury
IAC	Idle Air Control
IAT	Intake Air Temperature
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
O2	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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