SERVICE MANUAL

SOFTAIL® MODELS

1997 1998

HARLEY-DAVIDSON MOTOR COMPANY

OFFICIAL FACTORY MANUAL PN99482-98

1997/1998 SOFTAIL

SERVICE MANUAL

The information in this manual applies to the 1997 and 1998 Softail models.

PART NO. 99482-98

CMI-3.5M-09/03

Printed in U.S.A.

FOREWORD

This service and repair manual has been prepared with two purposes in mind. First, it will acquaint the reader with the construction of the Harley-Davidson motorcycle and assist in performing 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 manual will make your association with Harley-Davidson products more pleasant and profitable.

HOW TO USE YOUR SERVICE MANUAL

Your Service Manual is arranged for quick, easy reference. This manual is divided into numbered sections. Sections are then divided into subjects. Use this manual as follows:

In order to find the desired subject, refer to the TABLE OF CONTENTS at the front of the manual, or check the INDEX at the back of the manual.

NOTE

All information for servicing a component should be read ***before*** *repair work is started to avoid needless disassembly.*

PREPARATION FOR SERVICE

Proper 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 reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts. Cleaning will occasionally uncover trouble sources. Tools, instruments and parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a needless delay. Special tools required for a job are listed at the end of Section 1.

⚠WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine and do not smoke or allow open flame or sparks when refueling or servicing the fuel system.

SERVICE BULLETINS

In addition to the information given in this Service Manual, Service Bulletins are issued to Harley-Davidson Dealers from time to time, which cover interim engineering changes and supplementary information. Service Bulletins should be consulted for complete information on the models covered by this manual.

USE GENUINE REPLACEMENT PARTS

⚠WARNING

- **When replacement parts are required, we recommend using only genuine Harley-Davidson parts. Other parts may appear to have equivalent characteristics including type, strength and material, but may be of inferior quality. Failure to use genuine Harley-Davidson parts may result in product malfunction and possible personal injury.**
- **The fasteners used in Harley-Davidson motorcycles have specific strength, finish and type requirements to perform properly in the assembly and its environment. Use only genuine Harley-Davidson replacement fasteners, tightened to the proper torque value. Substitution could cause fastener failure which may result in personal injury.**

To ensure a satisfactory and lasting repair job, follow the manual instructions carefully and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON® are more than 90 years of designing, research, manufacturing, testing and inspecting experience.

This is your insurance that the parts you are using will fit right, operate properly and last longer. When you use genuine Harley-Davidson parts, you use the best.

PRODUCT REFERENCES

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be used in place of the one mentioned.

All tools mentioned in this SERVICE MANUAL with HD or J preceding the part number must be ordered through:

Kent-Moore Tool Division

29784 Little Mack

Roseville, Michigan 48066-2239

Loctite® Products

The Loctite® products listed are designed to increase the reliability of fasteners and to aid in minor repairs.

If you have any further questions, please call Loctite Corp.

Loctite Corporation - Hartford
10 Columbus Blvd.
Hartford Square North
Hartford, CT 06106
Phone: 203-520-5000
Fax: 203-587-4919

International Operations Dept.
4450 Cranwood Parkway
Cleveland, OH. 44128
Phone: 216-475-3600
Fax: 216-587-4919

⚠WARNING

Follow the directions listed on all Loctite® products. Read all labels, warnings and cautions carefully before using.

CONTENTS

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

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

⚠WARNINGS AND ⚠CAUTIONS

Statements in this manual preceded by the words ⚠WARNING or ⚠CAUTION and printed in bold face are very important.

⚠WARNING

Means there is the possibility of personal injury to yourself or others.

⚠CAUTION

Means there is the possibility of damage to the vehicle.

We recommend you take special notice of these items.

⚠WARNING

Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this Service Manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended.

It is important to note that some warnings against the use of specific service methods which could damage the motorcycle or render it unsafe are stated in this Service Manual. However, please remember that these warnings are not all-inclusive. Since Harley-Davidson could not possibly know, evaluate and advise the service trade of all possible ways in which service might be done or of the possible hazardous consequences of each way, 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 by the service methods selected.

⚠WARNING

Wear eye protection while using any of these tools: hammers, arbor or hydraulic presses, gear pullers, spring compressors, and slide hammers. Be especially cautious when using pulling, pressing or compressing equipment. The forces involved can cause parts to "flyout" with considerable force and cause bodily injury.

Harley-Davidson products are manufactured under one or more of the following patents: U.S. Patents 2986162, 2987934, 2998809, 3116089, 3144631, 3144860,3226994, 3229792, 3434887, 3559773, 3673359, 3709317, Des. 225 626.

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SECTION 5 – ELECTRIC STARTER

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SERVICE INTERVALS

BREAK-IN MAINTENANCE

⚠WARNING

Always follow the listed service and maintenance recommendations, since they affect the safe operation of the motorcycle and the personal welfare of the rider. Failure to follow recommendations may cause personal injury.

The performance of new motorcycle initial service is required to keep new motorcycle warranty in force and to ensure proper emissions system operation.

After a new motorcycle has been driven the first 500 miles (800 km), initial service operations should be performed by an authorized Harley-Davidson dealer.

CHECK AT FIRST 500 MILES (800 km)

After 500 miles (800 km) a Harley-Davidson dealer should perform the 500 mile (800 km) maintenance listed in the Owner's Manual (see Scheduled Service Table).

SAFE OPERATING MAINTENANCE

Good maintenance means a safe machine. A careful check of certain equipment must be made after periods of storage and frequently between the regular service intervals to determine if additional maintenance is necessary.

Check the following items:

1. Tires for correct pressure, abrasions, cuts and wear.
2. Belt for proper tension.
3. Brakes, steering, and throttle for responsiveness.
4. Brake fluid level and condition. Hydraulic lines and fittings for leaks. Also, check brake pads and discs for wear.
5. Cables for fraying or crimping and free operation.
6. Engine oil, primary chaincase, and transmission fluid levels. Do not overfill oil tank.
7. Wheel spoke tightness, if applicable.
8. Headlight, taillight and turn signal operation.

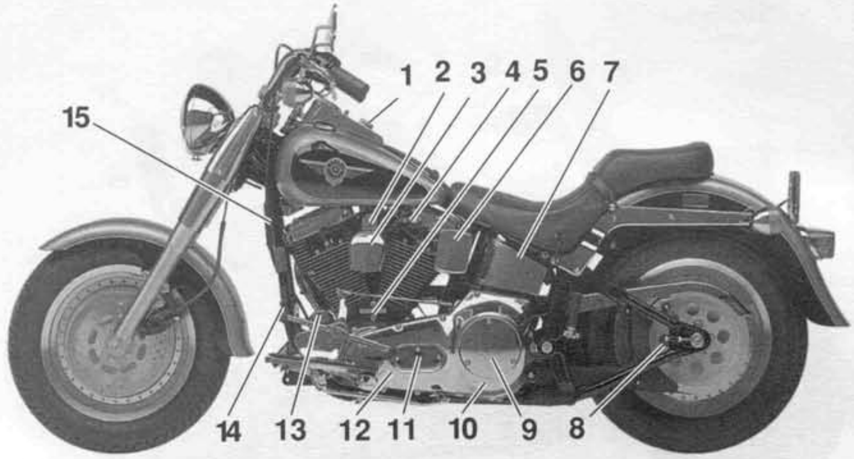
REGULAR SERVICE INTERVALS

Regular lubrication and maintenance is required to keep Harley-Davidson motorcycles operating at peak performance levels. In addition, regular maintenance will provide for longer motorcycle life and greater riding pleasure.

NOTE

Any alterations to the emission system components, such as carburetor and exhaust system, may be in violation of federal and state laws.

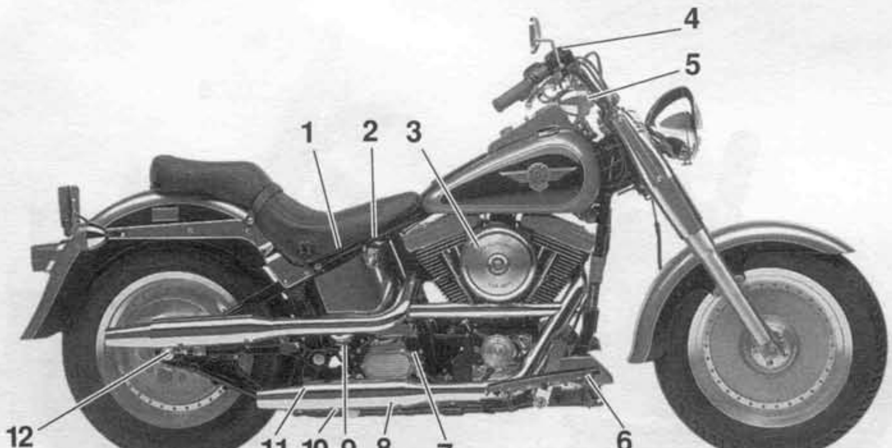
5787



1. Ignition/light switch
2. Carburetor enrichener knob
3. Horn
4. Fuel supply valve
5. Timing inspection hole plug
6. Ignition coil
7. Ignition module (under seat)
8. Rear axle adjuster
9. Clutch inspection cover
10. Primary drain plug
11. Primary chain inspection cover
12. Primary chain cover
13. Engine oil filter
14. Voltage regulator
15. Clutch cable adjuster

Fat Boy (FLSTF) – Left Side View (Typical - 1997 Model Shown)

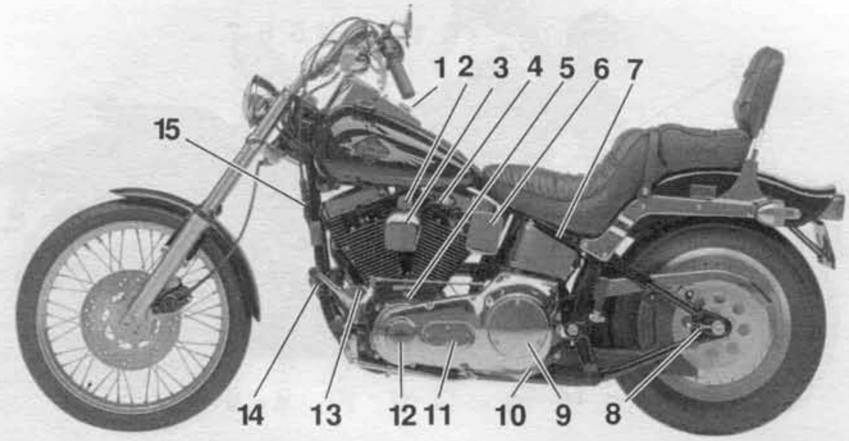
5786



1. Battery (under seat)
2. Engine oil fill plug/dipstick
3. Carburetor/air cleaner
4. Front brake master cylinder/reservoir
5. Front turn signal and running lamp
6. Rear brake master cylinder/reservoir
7. Transmission fill plug
8. Transmission drain plug
9. Electric starter motor
10. Shock absorbers
11. Engine oil tank drain
12. Rear axle adjuster

Fat Boy (FLSTF) – Right Side View (Typical - 1997 Model Shown)

5789



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Softail Custom (FXSTC) – Left Side View (Typical - 1997 Model Shown)

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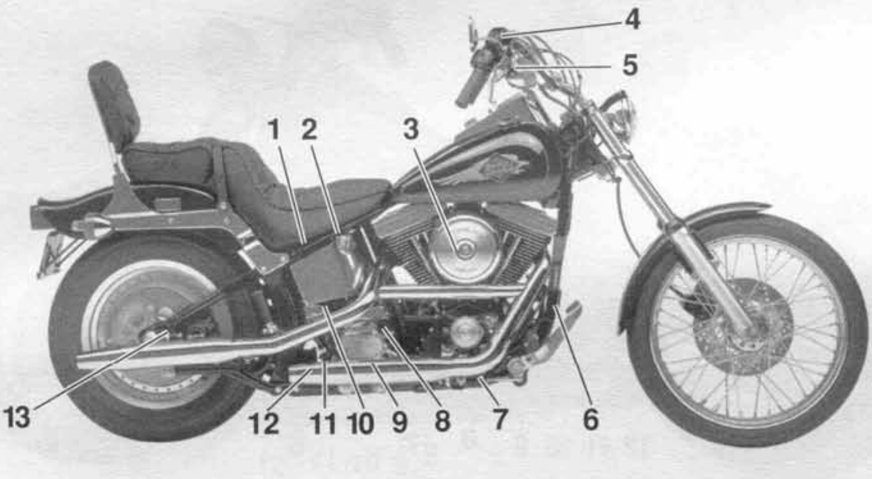

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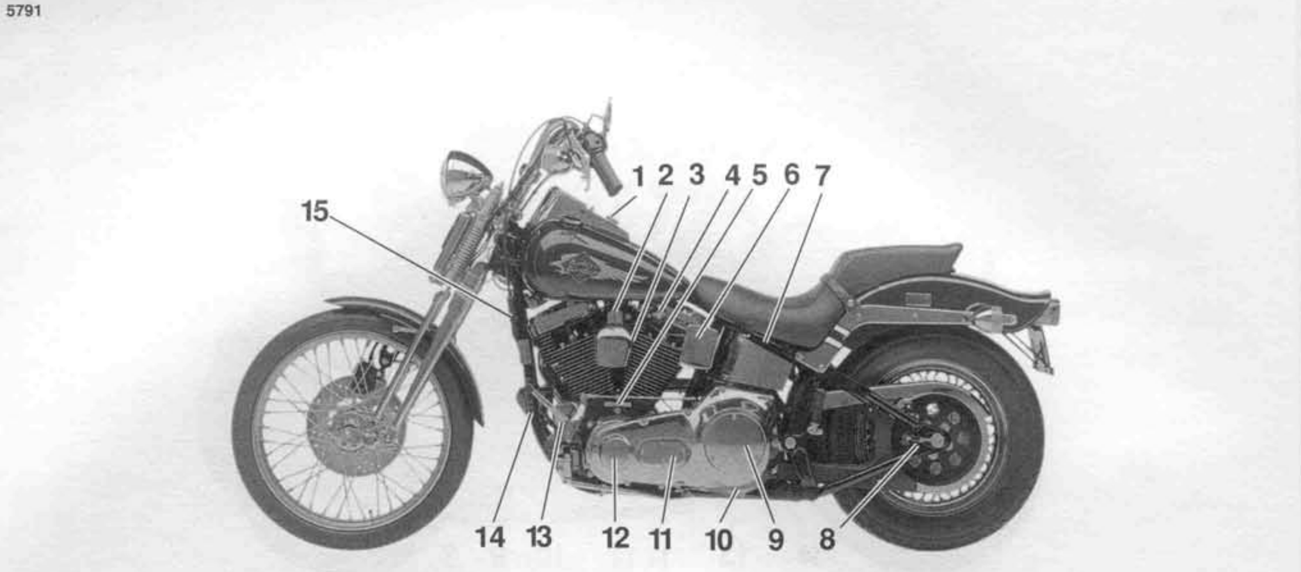
Softail Custom (FXSTC) – Right Side View (Typical - 1997 Model Shown)



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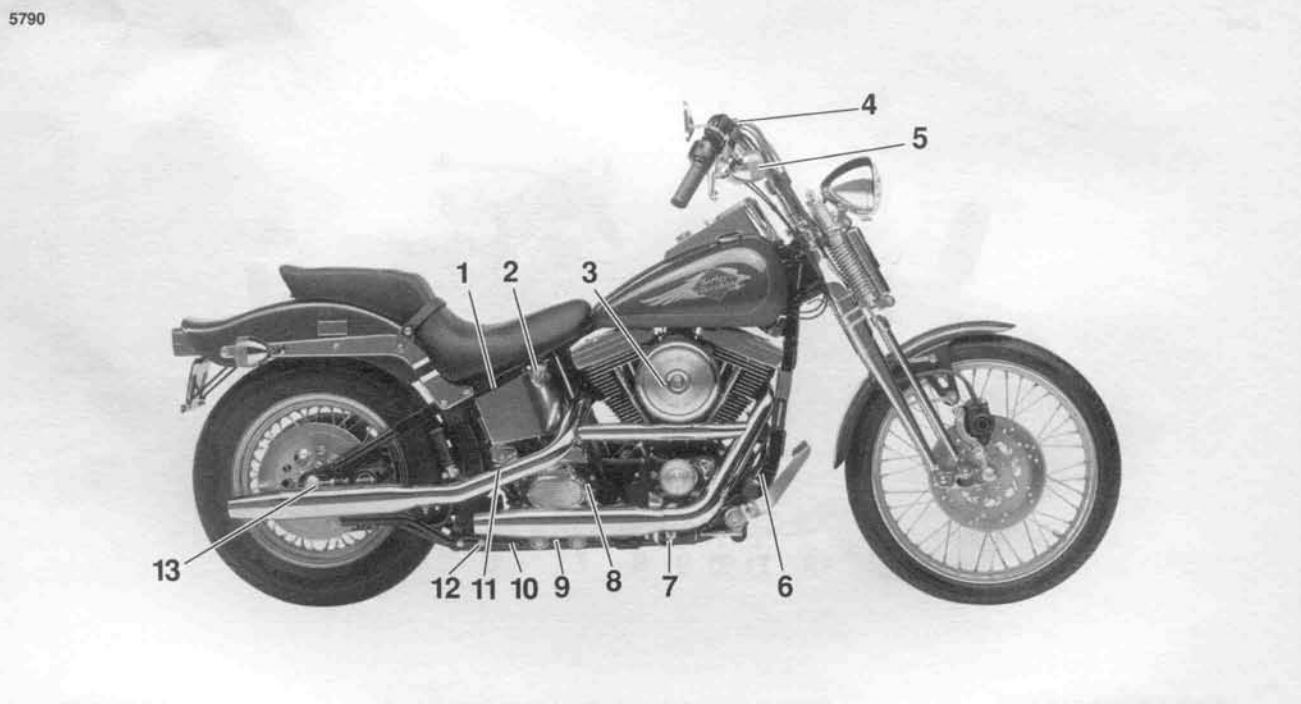
Springer Softail (FXSTS) – Left Side View (Typical - 1997 Model Shown)



1. Battery (under seat)
2. Engine oil fill plug/dipstick
3. Carburetor/air cleaner
4. Front brake master cylinder/reservoir
5. Front turn signal and running lamp
6. Rear brake fluid reservoir
7. Rear brake master cylinder
8. Transmission fill plug
9. Transmission drain plug
10. Engine oil tank drain
11. Electric starter motor
12. Shock absorbers
13. Rear axle adjuster

Springer Softail (FXSTS) – Right Side View (Typical - 1997 Model Shown)

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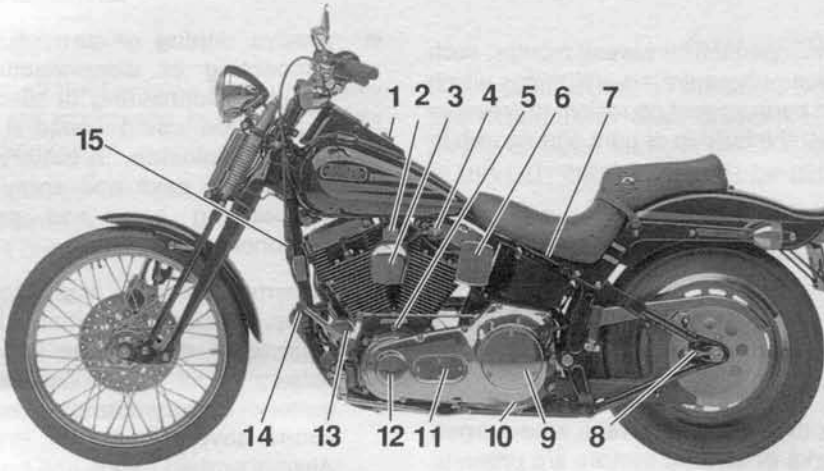

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Bad Boy Softail (FXSTSB) – Left Side View (Typical - 1997 Model Shown)

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1. Battery (under seat)
2. Engine oil fill plug/dipstick
3. Carburetor/air cleaner
4. Front brake master cylinder/reservoir
5. Front turn signal and running lamp
6. Rear brake fluid reservoir
7. Rear brake master cylinder
8. Transmission fill plug
9. Transmission drain plug
10. Engine oil tank drain
11. Electric starter motor
12. Shock absorbers
13. Rear axle adjuster

Bad Boy Softail (FXSTSB) – Right Side View (Typical - 1997 Model Shown)

STORAGE

GENERAL

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

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

⚠WARNING

Gasoline is flammable. Do not store a motorcycle having gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Inadequate safety precautions may cause an accident resulting in personal injury.

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.
2. Fill fuel tank and add a gasoline stabilizer. Use one of the commercially available gasoline stabilizers following the manufacturer's instructions. Turn fuel supply valve off. Drain all gasoline from carburetor by loosening fuel bowl drain screw one full turn; gasoline will drain through fuel overflow fitting. Retighten drain screw after all gasoline has been drained from carburetor.

   OR

   Drain all gasoline from the fuel tank. Spray the inside of the fuel tank with one of the commercially available rust preventatives. Follow the manufacturer's instructions.
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. Plug the line leading from the bottom of the oil tank to the 90° fitting on the oil pump cover. This will eliminate the possibility of oil seeping past the check ball into the oil pump and filling the engine flywheel compartment with oil.
5. Adjust primary chain.
6. Check tire inflation. If the motorcycle will be stored for an extended period of time, securely support the motorcycle under the frame so that all weight is off the tires.
7. Wash painted and chrome-plated surfaces. Apply a light film of oil to exposed unpainted surfaces.

⚠WARNING

Do not apply any oil to brake discs or brake pads. Oil on disc pads degrades braking efficiency and can result in an accident causing personal injury.

⚠WARNING

- **Always unplug or turn off battery charger before connecting or disconnecting charger clamps at battery. Connecting or disconnecting clamps with charger on could cause a spark and a possible battery explosion. A battery explosion may rupture the battery case and spray sulfuric acid onto the surrounding area and personnel, resulting in personal injury.**
- **Batteries produce explosive hydrogen gas at all times, especially when being charged. Keep cigarettes, open flame and sparks away from the battery at all times. Ventilate area when charging battery. Battery contains sulfuric acid which can cause severe burns to eyes, skin and clothing. Always protect hands and protect eyes with shield or goggles when working near a battery or acid. KEEP BATTERIES AND ACID OUT OF THE REACH OF CHILDREN!**

8. Remove battery from vehicle. Charge battery until the correct voltage is obtained (see Section 8 for more information). 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).
9. Grease wheel bearings and install new seals.
10. If the motorcycle is to be covered, use a material that will breathe, such as light canvas. Plastic materials that do not breathe promote the formation of condensation, which leads to corrosion.

REMOVAL FROM STORAGE

⚠WARNING

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

1. Charge and install 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. If oil feed line was pinched off or plugged, unplug it and reconnect.
6. Start the engine and run until it reaches normal operating temperature.
7. Check engine oil level. Check the transmission lubricant level. Fill to proper levels with correct fluids, if required.
8. Perform all of the checks in the PRE-RIDING CHECKLIST in the Owner's Manual.

FLUID REQUIREMENTS

GENERAL

United States System

Unless otherwise specified, **all fluid volume measurements in this Service Manual are expressed in United States (U.S.) units-of-measure.** See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.)
- 1 gallon (U.S.) = 4 quarts (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.)

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 (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.)

SILICONE BRAKE FLUID

⚠WARNING

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

Use only D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID, Harley-Davidson Part No. 99902-77.

FRONT FORK OIL

Use only HYDRAULIC FORK OIL TYPE "E", Harley-Davidson Part No. 99884-80.

FUEL

Use a good quality leaded or unleaded gasoline (87 pump octane or higher). Pump octane is the octane number usually shown on the gas pump. See Section 3 for more information on fuel.

⚠CAUTION

Using gasolines that have alcohol additives (such as methanol) may cause failure of rubber components in the fuel system and/or internal engine damage.

ENGINE OIL

Engine oil is a major factor in the performance and service life of the engine. Always use the proper grade of oil for the lowest temperature expected before next scheduled oil change.

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

Harley-Davidson Type	Viscosity	Harley-Davidson Rating	Lowest Ambient Temperature	Cold Weather Starts Below 50°F (10°C)
HD Multi-grade	SAE 10W40	HD 240	Below 40°F (4°C)	Excellent
HD Multi-grade	SAE 20W50	HD 240	Above 40°F (4°C)	Good
HD Regular Heavy	SAE 50	HD 240	Above 60°F (16°C)	Poor
HD Extra Heavy	SAE 60	HD 240	Above 80°F (27°C)	Poor

FASTENER TORQUE VALUES

Torque specifications for specific components are listed in each section at the point of use. When converting to Newton-meters, use the formulas given under the metric chart. For all other fasteners, use the values listed in one of the tables below. In the English table, torque figures are listed in ft-lbs, except those marked with an asterisk (*), which are listed in in-lbs. In the metric table, figures are listed in Newton-meters.

⚠WARNING

The quality fasteners used on Harley-Davidson motorcycles have specific strength, finish, and type requirements to perform properly in the assembly and the operating environment. Use only genuine Harley-Davidson replacement fasteners tightened to the proper torque. Substitution could cause fastener failure, which may result in vehicle damage and/or personal injury.

ENGLISH

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							in. (inches)									
				2	3	4	5	6	8	10	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
	SAE 2 STEEL	74,000 PSI	LOW CARBON								6	12	20	32	47	69	96	155	206	310
	SAE 5 STEEL	120,000 PSI	MEDIUM CARBON HEAT TREAT						14*	22*	10	19	33	54	78	114	154	257	382	587
	SAE 7 STEEL	133,000 PSI	MEDIUM CARBON ALLOY								13	25	44	71	110	154	215	360	570	840
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	29	47	78	119	169	230	380	600	900
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	29	47	78	119	169	230	380	600	900
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON QUENCHED TEMPERED					9*	16*	30*	70*	140*	18	29	43	63	100	146		
	STUDS																			

*These marked torque values are listed in **in-lbs.**

EQUIVALENTS FOR ENGLISH FASTENERS

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	BODY SIZE OR OUTSIDE DIAMETER																
				# (number)							mm (millimeters)									
				2	3	4	5	6	8	10	6.4	7.9	9.5	11.1	12.7	14.3	15.9	19.1	22.2	25.4
	SAE 2 STEEL	5,202 kg/cm^2	LOW CARBON								8.3	16.6	27.7	44.3	65.0	95.4	132.8	214.4	283.5	428.7
	SAE 5 STEEL	8,436 kg/cm^2	MEDIUM CARBON HEAT TREAT						1.6	2.5	13.8	26.3	45.6	74.7	107.9	157.7	213.0	355.4	528.3	811.8
	SAE 7 STEEL	9,350 kg/cm^2	MEDIUM CARBON ALLOY								18.0	34.6	60.8	98.2	152.1	213.0	297.3	497.9	788.3	1161.7
	SAE 8 STEEL	10,545 kg/cm^2	MEDIUM CARBON ALLOY								19.4	40.1	65.0	107.9	164.6	233.7	318.1	525.5	829.8	1220.0
	SAE 8 STEEL	10,545 kg/cm^2	MEDIUM CARBON ALLOY								19.4	40.1	65.0	107.9	164.6	233.7	318.1	525.5	829.8	1220.0
	SOCKET SET SCREW	14,904 kg/cm^2	HIGH CARBON QUENCHED TEMPERED					1.0	1.8	3.4	8.1	16.1	24.9	40.1	59.5	87.1	138.3	201.9		
	STUDS																			

foot-pounds **(ft-lbs) x 1.356 =** Newton-meters **(Nm)**

inch-pounds **(in-lbs) x 0.113 =** Newton-meters **(Nm)**

METRIC CONVERSION TABLE

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
0.1	0.0039	25	0.9842	58	2.283	91	3.582	0.001	0.025	0.6	15.240	1 15/16	49.21	3 5/16	84.14
0.2	0.0078	26	1.024	59	2.323	92	3.622	0.002	0.051	5/8	15.875	2	50.80	3 3/8	85.72
0.3	0.0118	27	1.063	60	2.362	93	3.661	0.003	0.076	11/16	17.462	2 1/16	52.39	3.4	86.36
0.4	0.0157	28	1.102	61	2.401	94	3.701	0.004	0.102	0.7	17.780	2.1	53.34	3 7/16	87.31
0.5	0.0197	29	1.142	62	2.441	95	3.740	0.005	0.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
0.6	0.0236	30	1.181	63	2.480	96	3.779	0.006	0.152	0.8	20.320	2 3/16	55.56	3 9/16	90.49
0.7	0.0275	31	1.220	64	2.519	97	3.819	0.007	0.178	13/16	20.638	2.2	55.88	3.6	91.44
0.8	0.0315	32	1.260	65	2.559	98	3.858	0.008	0.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
0.9	0.0354	33	1.299	66	2.598	99	3.897	0.009	0.229	0.9	22.860	2.3	58.42	3 11/16	93.66
1	0.0394	34	1.338	67	2.638	100	3.937	0.010	0.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	0.0787	35	1.378	68	2.677	101	3.976	1/64	0.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	0.1181	36	1.417	69	2.716	102	4.016	0.020	0.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	0.1575	37	1.456	70	2.756	103	4.055	0.030	0.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	0.1968	38	1.496	71	2.795	104	4.094	1/32	0.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	0.2362	39	1.535	72	2.834	105	4.134	0.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	0.2756	40	1.575	73	2.874	106	4.173	0.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	0.3149	41	1.614	74	2.913	107	4.212	0.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	0.3543	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	0.3937	43	1.693	76	2.992	109	4.291	0.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	0.4331	44	1.732	77	3.031	110	4.331	0.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	0.4724	45	1.772	78	3.071	111	4.370	0.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	0.5118	46	1.811	79	3.110	112	4.409	0.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	0.5512	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	0.5905	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	0.6299	49	1.929	82	3.228	115	4.527	0.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	0.6693	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	0.7086	51	2.008	84	3.307	117	4.606	0.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	0.7480	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	0.7874	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	0.8268	54	2.126	87	3.425	120	4.724	0.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	0.8661	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	0.9055	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	0.9449	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

TROUBLESHOOTING

GENERAL

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.

⚠CAUTION

The troubleshooting section of this manual is intended solely as a guide to diagnosing problems. Carefully read the appropriate sections of this manual before performing any work. Observe all cautions and warnings.

ENGINE

Starter Motor Does Not Operate or Does Not Turn Engine Over

1. Engine run switch in OFF position.
2. Ignition switch not on.
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.

Engine Turns Over But Does Not Start

1. Fuel tank empty or fuel supply valve turned off.
2. Vacuum hose to automatic fuel supply valve disconnected, leaking, or pinched.
3. Fuel valve or filter clogged.
4. Discharged battery, loose or broken battery terminal connections.
5. Fouled spark plugs.
6. Spark plug cables in bad condition and shorting or cable connections loose.
7. Ignition timing badly out of adjustment.
8. Loose wire connection at coil, battery, or plug between ignition sensor and module.
9. Faulty ignition coil, module, or sensor.
10. Sticking or damaged valve or wrong length push rod.
11. Engine flooded with gasoline as a result of over use of enrichener.
12. Engine lubricant too heavy (winter operation).

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 plug between ignition sensor and module.
5. Carburetor controls not adjusted correctly.
6. Faulty ignition coil.
7. Engine lubricant too heavy (winter operation).
8. Ignition not timed properly.
9. Fuel tank vent hose and vapor valve plugged, or carburetor fuel line closed off, restricting fuel flow.
10. Water or dirt in fuel system and carburetor.
11. Enrichener valve inoperative.
12. Air leak at intake manifold.
13. Valves sticking.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and leaking.
3. Spark plug gap too close or too wide.
4. Faulty ignition coil, module, or sensor.
5. Battery nearly discharged.
6. Damaged wire or loose connection at battery terminals, coil, or plug between ignition sensor and module.
7. Intermittent short circuit due to damaged wire insulation.
8. Water or dirt in fuel system, carburetor or filter.
9. Fuel tank vent system plugged or carburetor vent line closed off.
10. Carburetor controls misadjusted.
11. Damaged carburetor.
12. Weak or broken valve springs.
13. Air leak at intake manifold or air cleaner.
14. Damaged intake or exhaust valve.
15. Incorrect valve timing.
16. Faulty vacuum operated electric switch (V.O.E.S.).
17. Loose or dirty ignition module connector at crankcase.

A Spark Plug Fouls Repeatedly

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

Pre-Ignition or Detonation (Knocks or Pings)

1. Excessive carbon deposit on piston head or in combustion chamber.
2. Incorrect spark plug for the kind of service.
3. Faulty spark plugs.
4. Ignition timing advanced.
5. Fuel octane rating too low.
6. Faulty V.O.E.S.

Overheating

1. Insufficient oil supply or oil not circulating.
2. Leaking valve.
3. Heavy carbon deposit.
4. Ignition timing retarded.
5. Faulty V.O.E.S.
6. Insufficient air flow over engine.

Valve Train Noise

1. Low oil pressure caused by oil feed pump not functioning properly or oil screen obstructed.
2. Incorrect push rod length.
3. Faulty hydraulic tappets.
4. Bent push rod.
5. Cam or cam gears do not fit properly.
6. Rocker arm binding on shaft.
7. Valve sticking in guide.

Excessive Vibration

1. Upper engine mounting bracket loose.
2. Engine to transmission mounting bolts loose.
3. Broken frame.
4. Primary chain badly worn or links tight as a result of insufficient lubrication or misalignment.
5. Wheels and/or tires worn or damaged.
6. Internal engine problem.
7. Engine/transmission/rear wheel not aligned properly.
8. Ignition timing incorrect/poorly tuned engine.

LUBRICATION SYSTEM

Oil Does Not Return To Oil Tank

1. Oil tank empty.
2. Scavenger pump gear key sheared.
3. Oil feed pump not functioning.
4. Restricted oil lines or fittings.
5. Restricted oil filter.

Engine Uses Too Much Oil Or Smokes Excessively

1. Breather valve incorrectly timed.
2. Piston rings badly worn or broken.
3. Valve guides or seals worn.
4. Restricted oil return line to tank.
5. Restricted breather hose.
6. Oil tank overfilled.
7. Restricted oil filter.

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

1. Loose parts.
2. Imperfect seal at gaskets, push rod cover, washers, etc.
3. Restricted oil return line to tank.
4. Restricted breather hose to air cleaner.
5. Breather valve incorrectly timed.
6. Restricted oil filter.
7. Oil tank overfilled.

ELECTRICAL SYSTEM

Alternator Does Not Charge

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

Alternator Charge Rate Is Below Normal

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

CARBURETOR

Floods

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

TRANSMISSION

Shifts Hard

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

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

Clutch Chatters

1. Friction discs or steel discs worn or warped.

BRAKES

Brake Does Not Hold Normally

1. Master cylinder reservoir low on fluid.
2. Brake system contains air bubbles.
3. Master or wheel cylinder piston worn or parts damaged.
4. Brake pads contaminated with grease or oil.
5. Brake pads badly worn (1/16 in. minimum lining thickness).
6. Brake disc badly worn or warped.
7. Brake fades due to heat build up – brake pads dragging or excessive braking.
8. Brake drags – insufficient brake pedal free play.

HANDLING

Irregularities

1. Loose wheel axle nuts. Tighten to recommended torque specification.
2. Excessive wheel hub bearing play.
3. Rear wheel out of alignment with frame and front wheel.
4. Rims and tires out-of-true sideways.
5. Rims and tires out-of-round or eccentric with hub.
6. Irregular or peaked front tire tread wear.
7. Incorrect tire pressure. Check TIRE DATA section.
8. Tire and wheel unbalanced.
9. Steering head bearings improperly adjusted. Correct adjustment and replace pitted or worn bearings and races. See FORKS.
10. Shock absorber not functioning normally.
11. 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.
12. Damaged tire(s) or improper front-rear tire combination.

SHOP PRACTICES

REPAIR NOTES

General maintenance practices are given in this section. All special tools and torque values are noted at the point of use and 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. Don't just do the job – do the job safely.

Removing Parts

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

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

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

Cleaning

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

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

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

Disassembly and Assembly

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

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

REPAIR AND REPLACEMENT PROCEDURES

Hardware and Threaded Parts

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

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

Replace all damaged or missing lubrication fittings.

Use Teflon tape on pipe fitting threads.

Wiring, Hoses, and Lines

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

Instruments and Gauges

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

Bearings

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

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

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

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

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

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

Bushings

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

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

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

⚠CAUTION

Serious damage to the motorcycle can occur if any oil holes are blocked.

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.

If a gasket must be made, be sure to cut holes that match up with the mating part. Use gasket material that is the right type and thickness.

⚠CAUTION

Serious damage to the motorcycle can occur if any flange holes are blocked by gasket material.

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.

Remove burrs and rough spots with a honing stone or crocus cloth before installation. Lubricate mating surfaces before pressing gears on shafts.

Shafts

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

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

Clean all rust from the machined surfaces of new parts.

Part Replacement

Always replace worn or damaged parts with new parts.

CLEANING

Part Protection

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

Cleaning Process

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

Rust or Corrosion Removal

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

Bearings

Remove shields and seals from bearings before cleaning. Bearings with permanent shields should NOT be cleaned in solvent as they are already lubricated.

Clean open bearings by soaking them in a petroleum cleaning solution. Never use a solution that contains chlorine.

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

TOOL SAFETY

⚠ WARNING

Failure to follow the safety practices given in this section could lead to personal injury.

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.

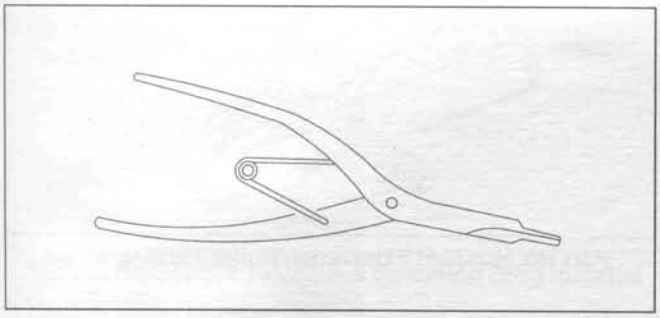
SOCKETS

- 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.

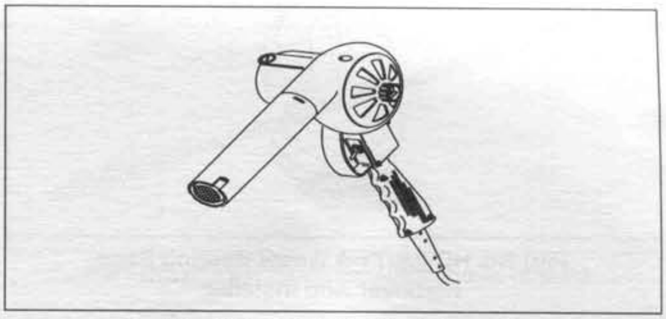
STORAGE UNITS

- 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.

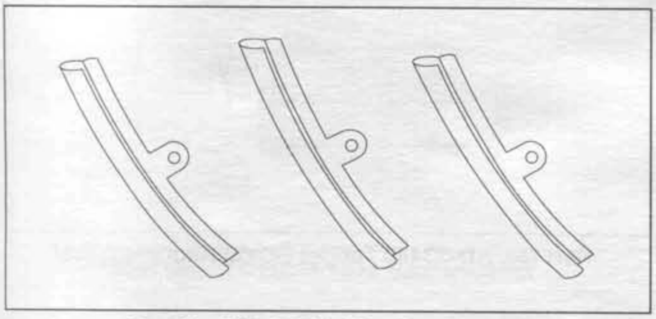
TOOLS



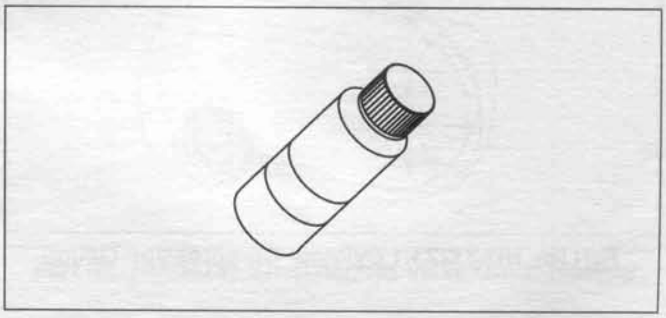
Part No. J-5586-A Transmission Shaft Retaining Ring Pliers



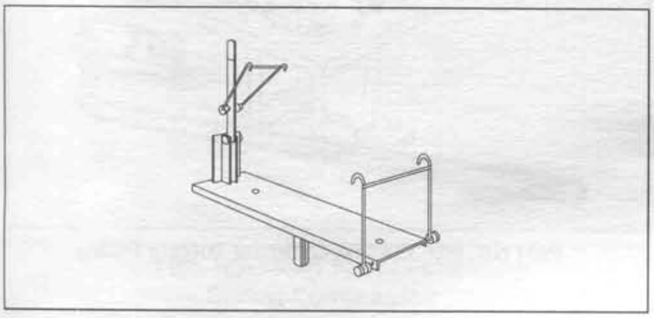
Part No. HD-25070 Robinair Heat Gun



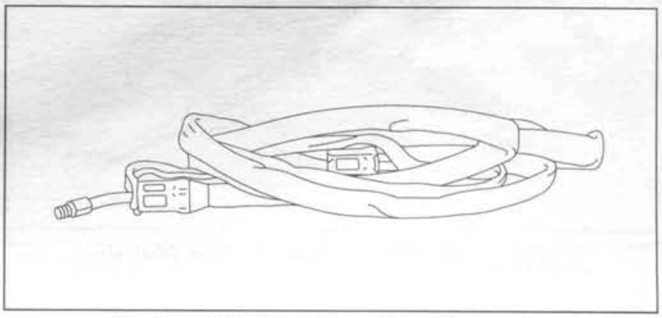
Part No. HD-01289 Rim Protectors



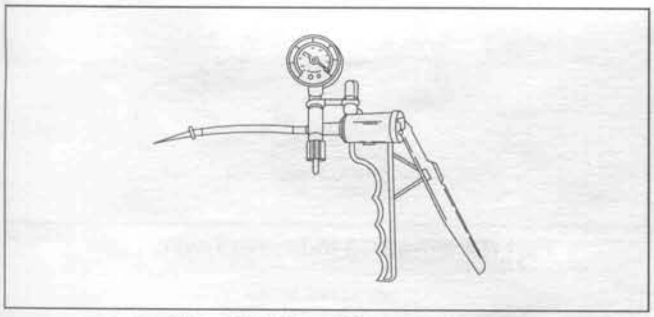
Part No. HD- 28431B Black Light Fluorescent Additive (24 Oz Bottle)



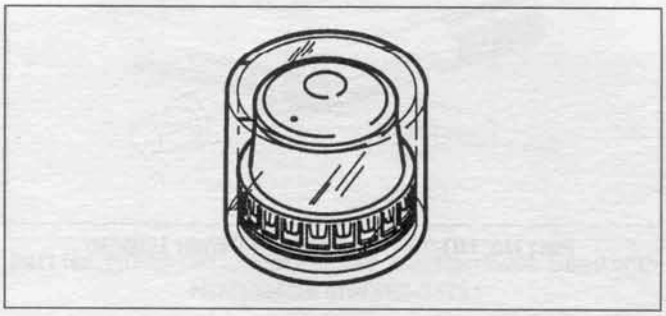
Part No. HD-21000 Tire Spreader



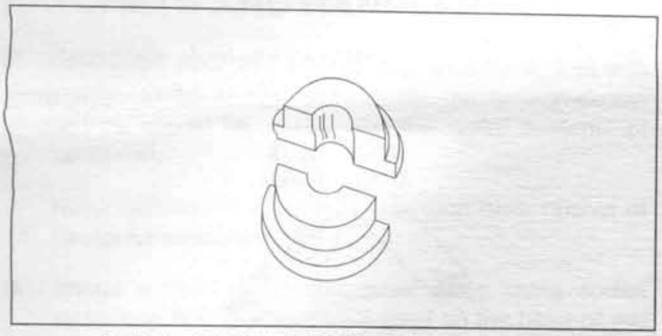
Part No. HD-28700 Tire Bead Expander



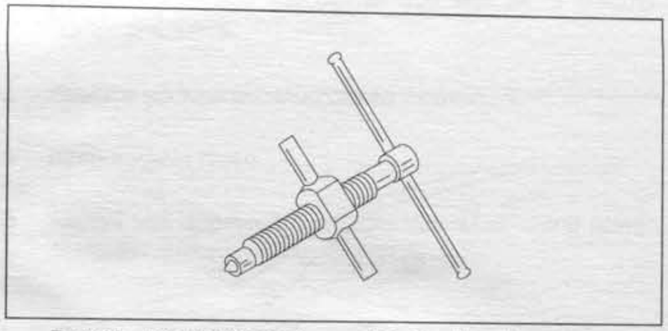
Part No. HD-23738 Vacuum Pump



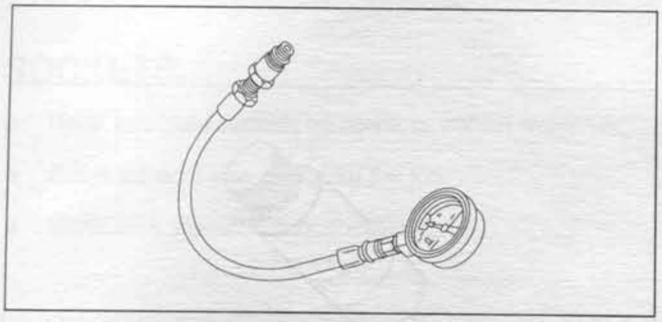
Part No. HD-33067 Wheel Bearing Packer



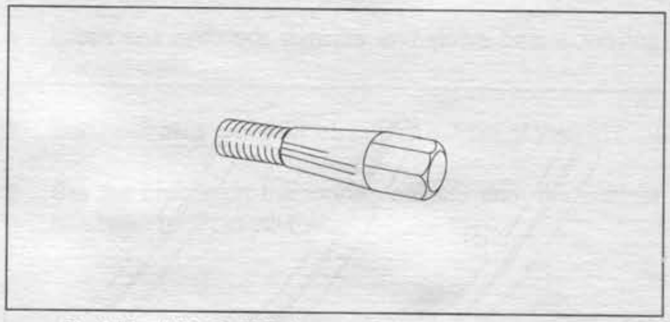
Part No. HD-33071-A Wheel Bearing Race Remover And Installer



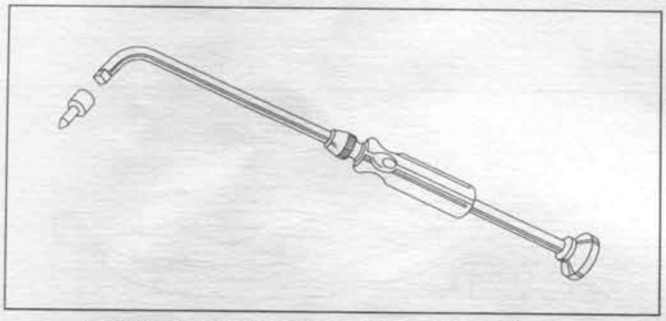
Part No. HD-33418 Universal Puller Forcing Screw



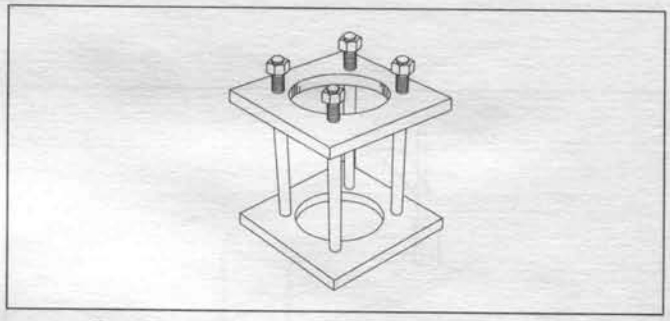
Part No. HD-33223-1 Cylinder Compression Gauge



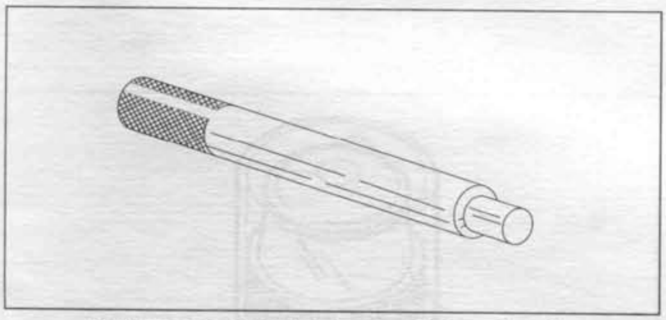
Part No. HD-33443 Tappet Guide Alignment Tool



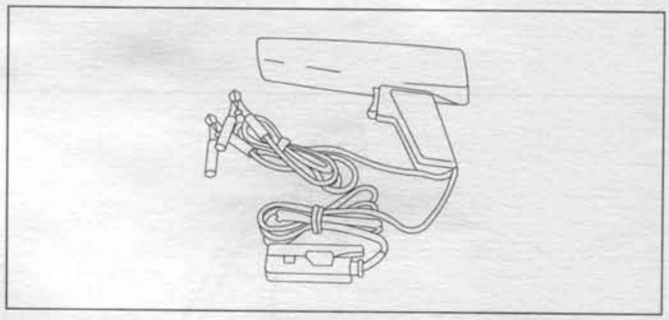
Part No. HD-33413 Carburetor Idle Adjuster



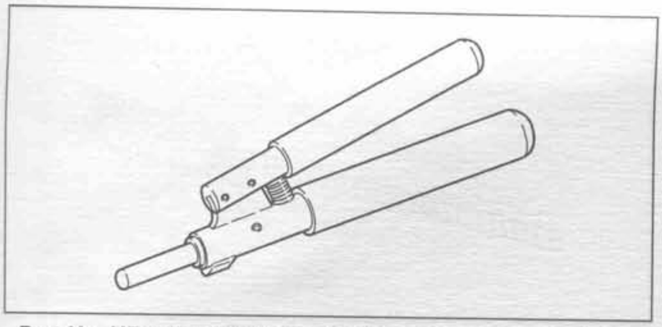
Part No. HD-33446A Cylinder Torque Plates



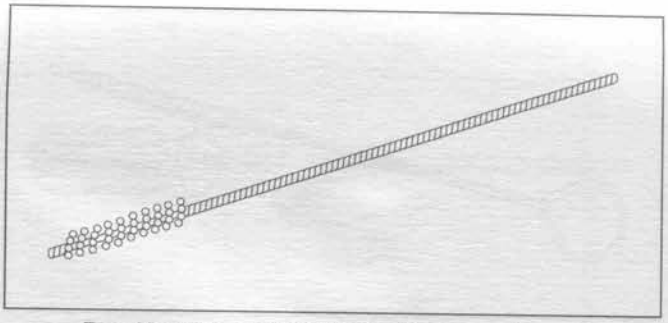
Part No. HD-33416 Universal Driver Handle



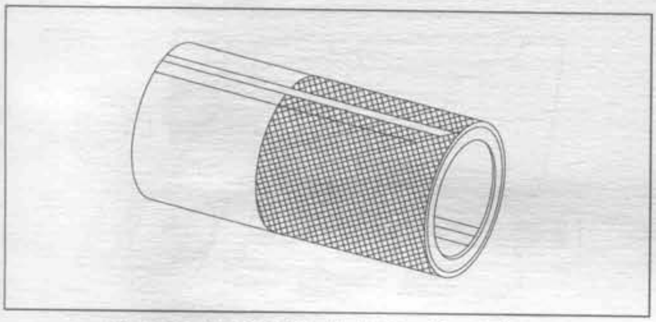
Part No. HD-33813 Inductive Timing Light



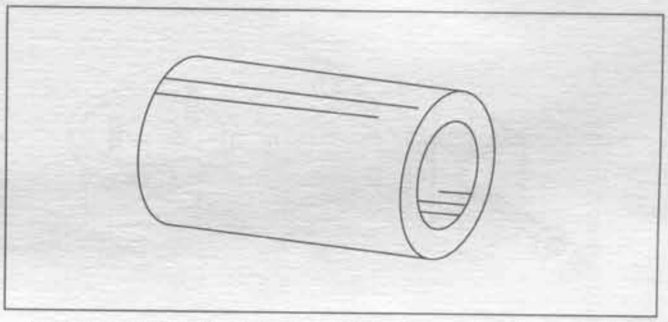
Part No. HD-34623B Piston Pin Retaining Ring Installer



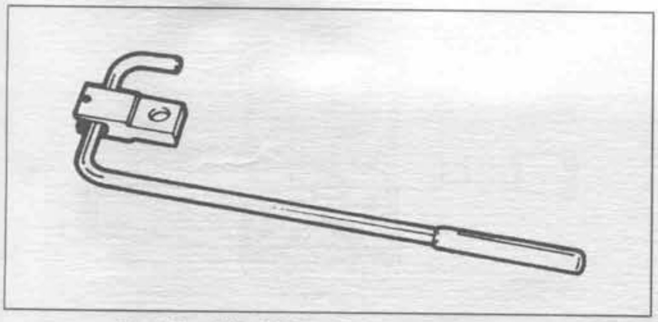
Part No. HD-34723 Valve Guide Hone (8 mm)



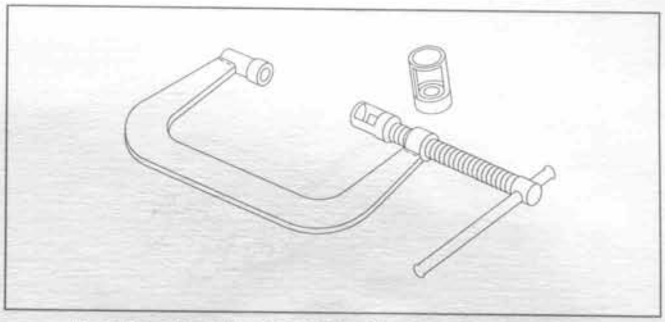
Part No. HD-34634 Fork Seal Installer



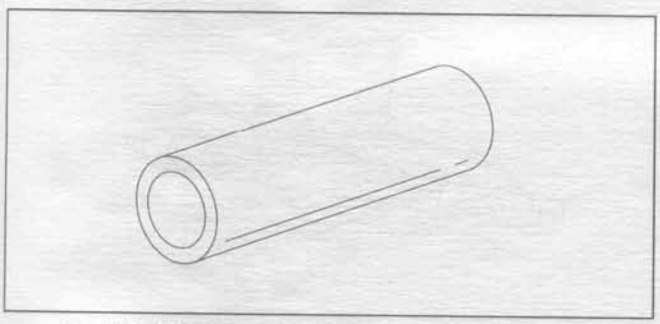
Part No. HD-34731 Shoulderless Valve Guide Installer



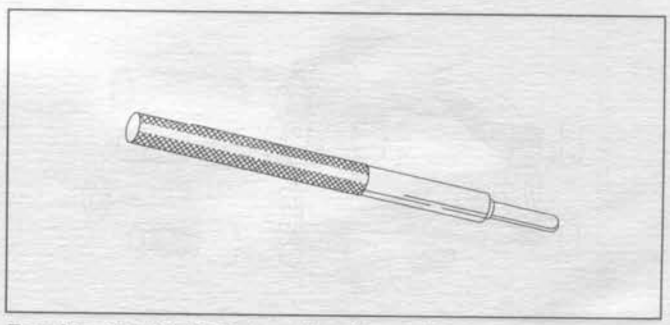
Part No. HD-34641 Rear Intake Valve Spring Compressor



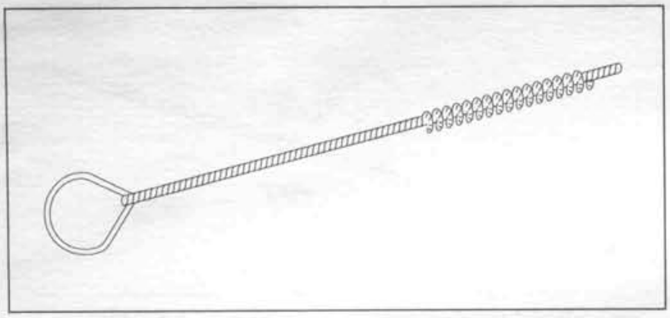
Part No. HD-34736B Valve Spring Compressor



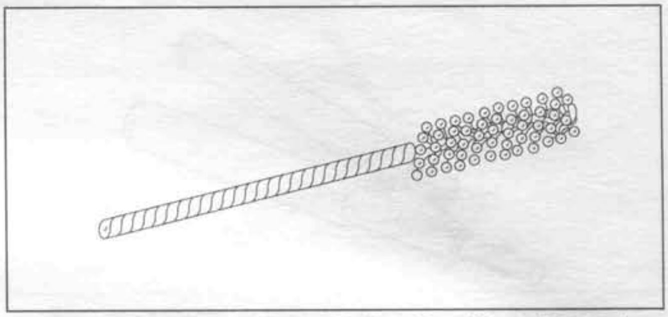
Part No. HD-34643A Shoulderless Valve Guide Seal Installer



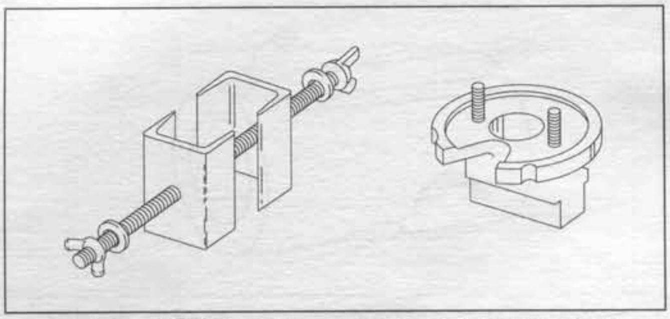
Part No. HD-34740 Driver Handle and Remover. Used with HD-34643A and HD-34731



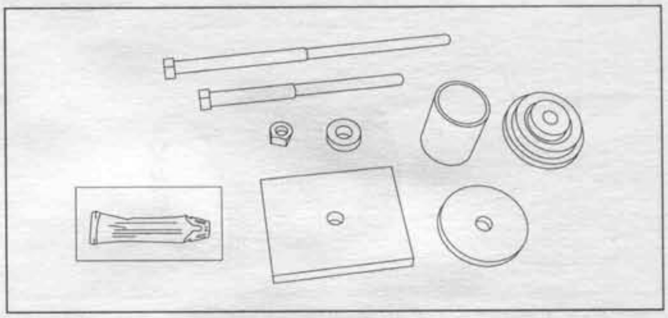
Part No. HD-34751 Nylon Valve Guide Cleaning Brush



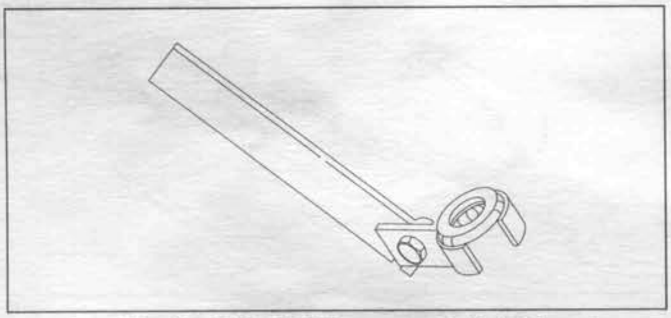
Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)



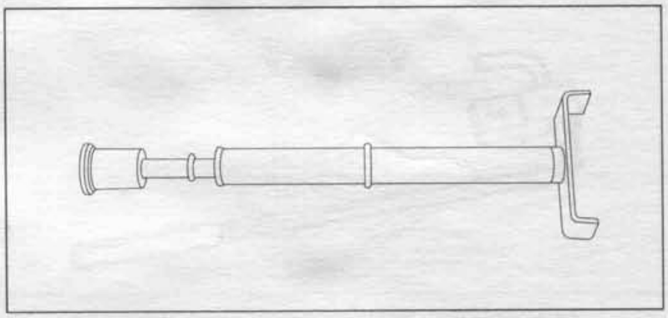
Part No. HD-34813 Rowe Flywheel Rebuilding Jig



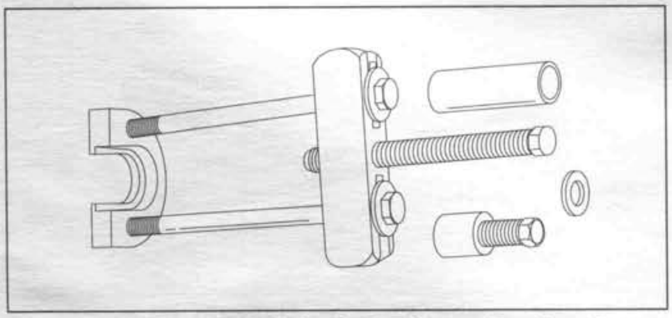
Part No. HD-35316A Main Drive Gear Remover/Installer and Main Drive Gear Bearing Installer



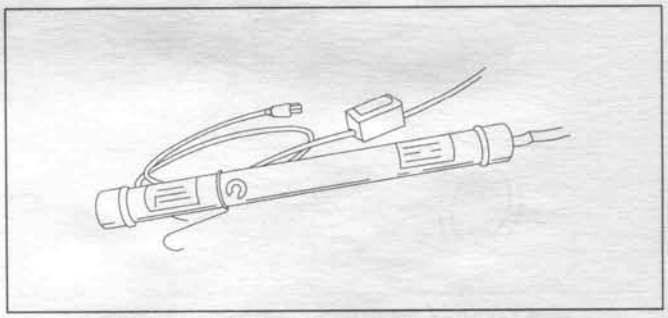
Part No. HD-34816 Oil Pressure Switch Wrench



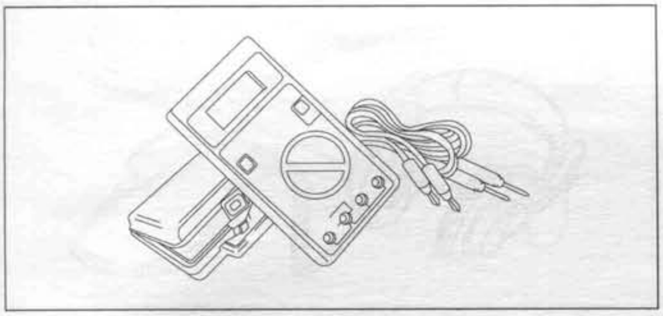
Part No. HD-35381 Belt Tension Gauge



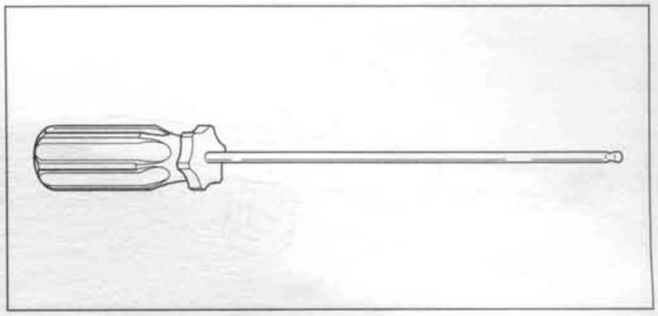
Part No. HD-34902A Mainshaft Primary Bearing Race Remover And Installer



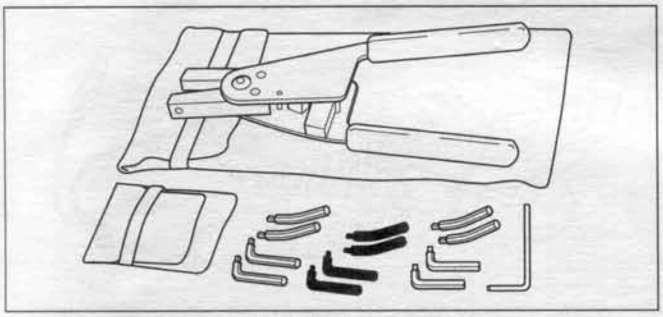
Part No. HD-35457 Black Light Leak Detector



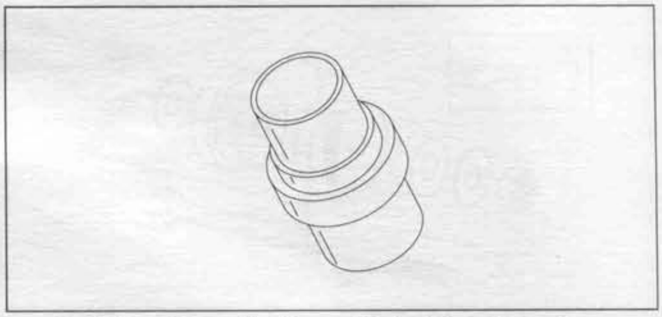
Part No. HD-35500B Digital Multimeter (Fluke 23)



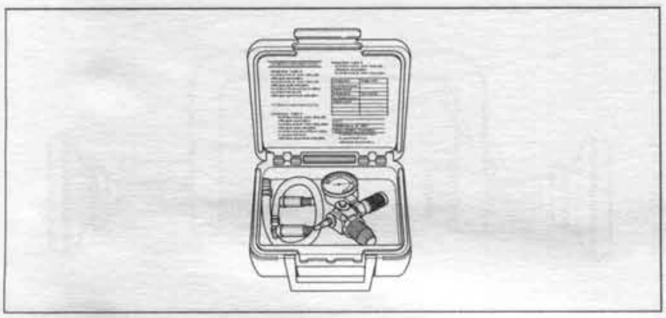
Part No. HD-35801 Intake Manifold Screw Wrench



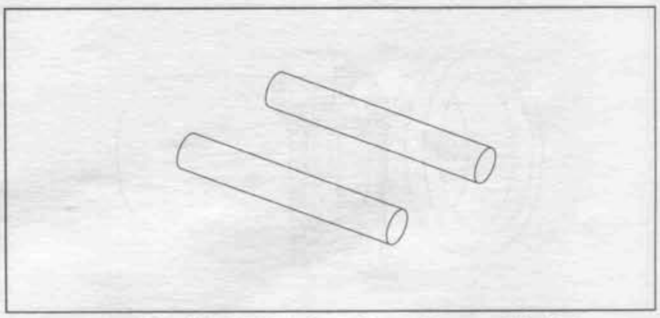
Part No. HD-35518 Internal/External Retaining Ring Pliers



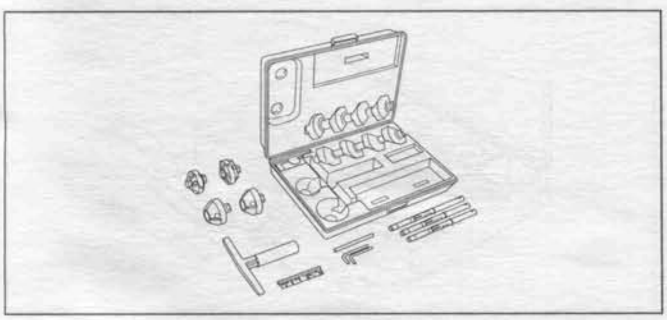
Part No. HD-37842A Inner/Outer Main Drive Gear Needle Bearing Installer



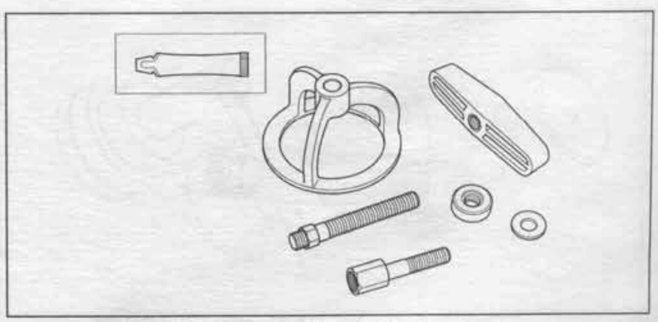
Part No. HD-35667A Cylinder Leakdown Tester



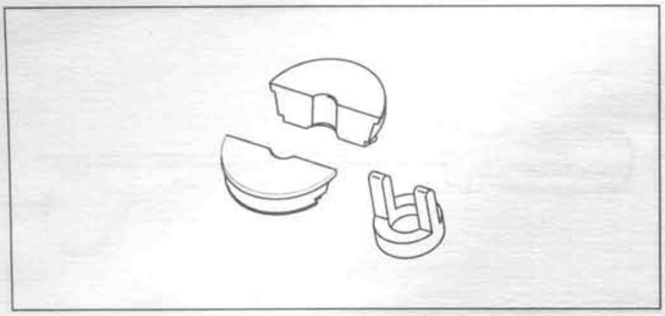
Part No. HD-38361 Cam Gear Gauge Pin Set (0.108 in. (2.74 mm) Diameter)



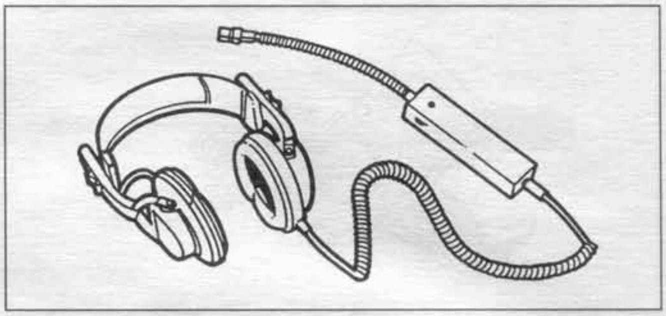
Part No. HD-35758 Neway Valve Seat Cutter Set



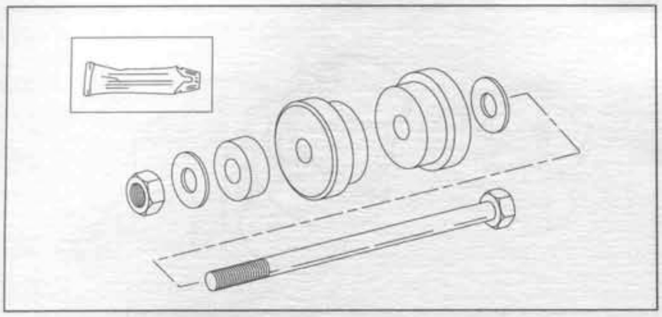
Part No. HD 38515A Clutch Spring Compressor



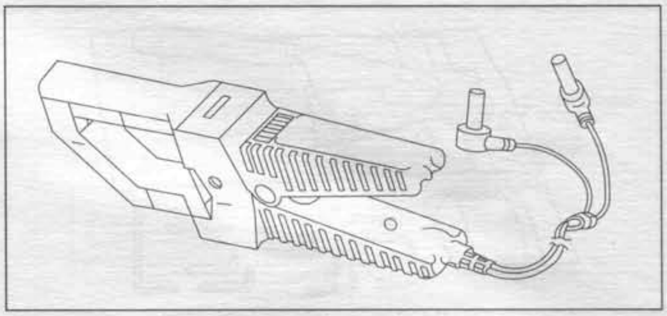
Part No. HD-39301A Steering Head Bearing Race Remover



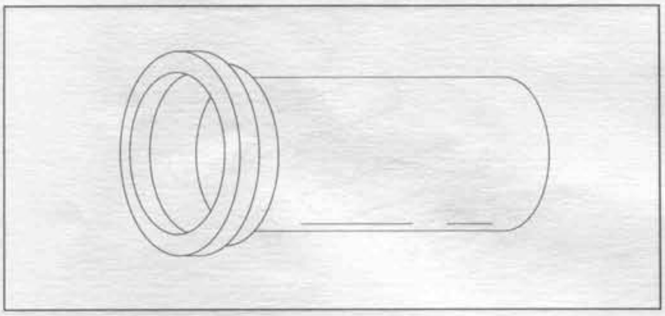
Part No. HD-39565 Engine Sound Probe



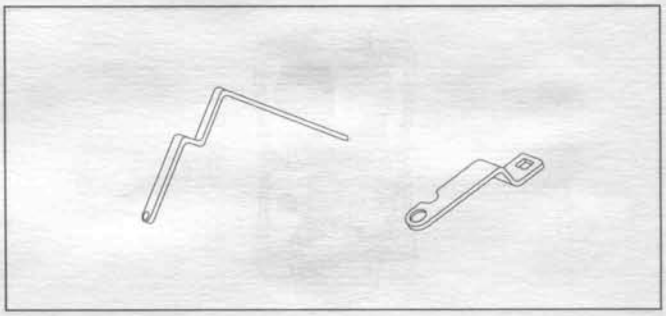
Part No. HD-39302 Steering Head Bearing Race Installer



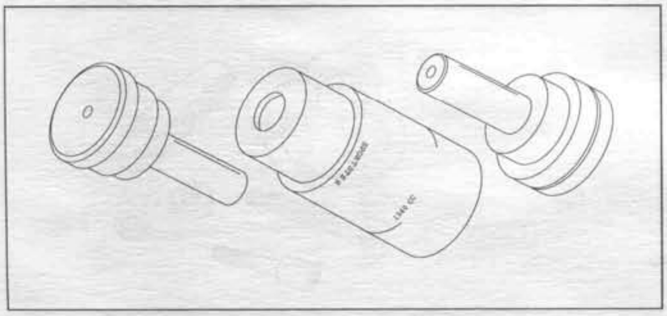
Part No. HD-39617 Inductive Amp Probe. Use with HD-35500A



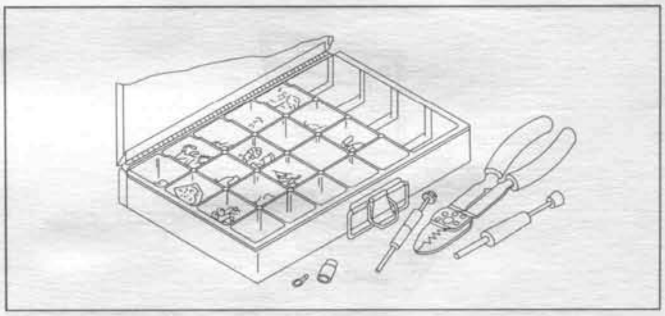
Part No. HD-39361A Sprocket Shaft Seal Installation Tool



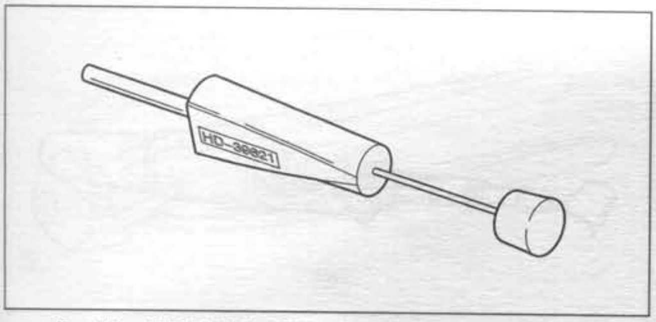
Part No. HD-39618 Transmission Pawl Adjuster - 1340 5-speed (Late 1992 & Later) except Heritage Springer (FLSTS)-See HD-42465



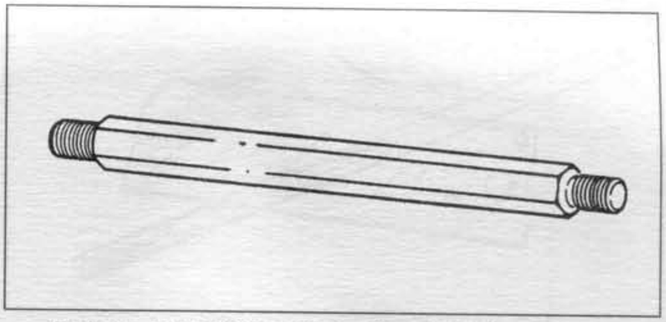
Part No. HD-39458 Sprocket Shaft Bearing Outer Race Installer



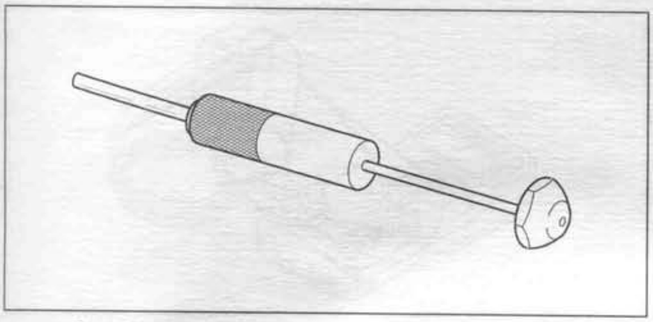
Part No. HD-39621 Electrical Terminal Repair Kit



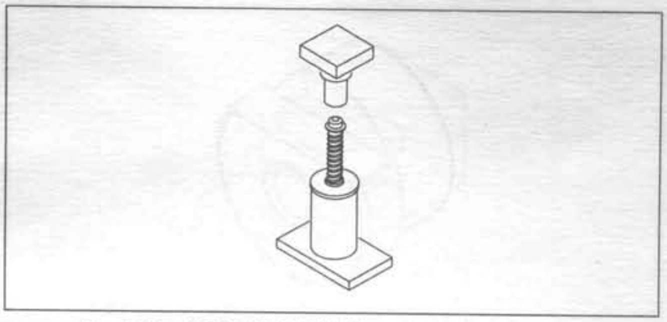
Part No. HD-39621-27 Socket Terminal Remover



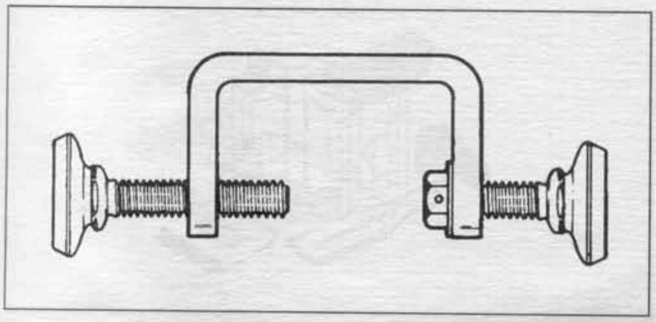
Part No. HD-39786 Cylinder Head Holding Fixture



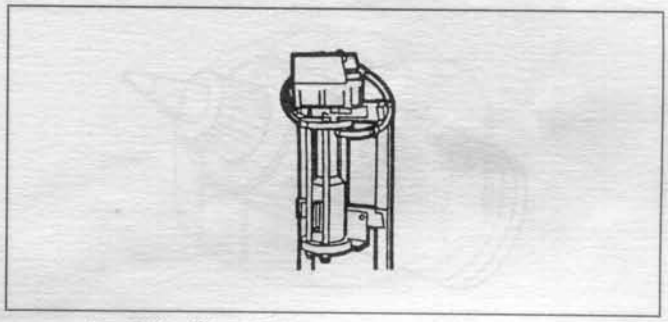
Part No. HD-39621-28 Pin Terminal Remover



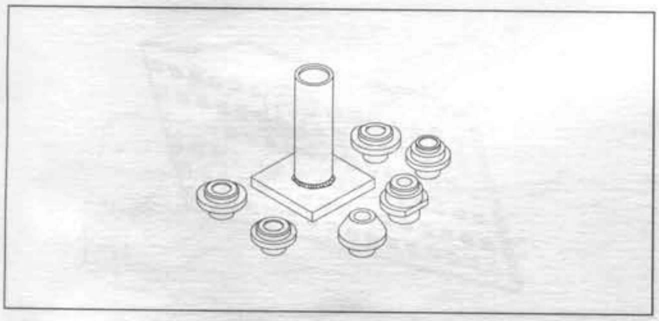
Part No. HD-39800 Oil Filter Crusher (Small)



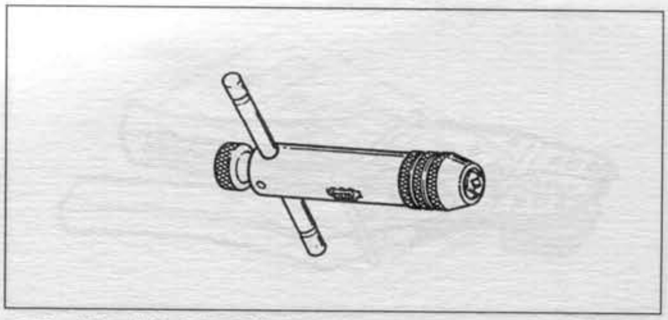
Part No. HD-39754 Springer Front Fender Link Tool



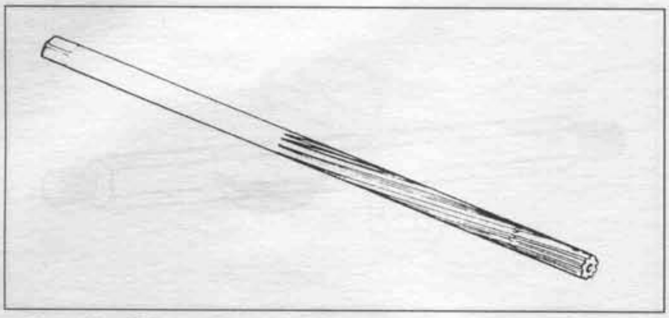
Part No. HD-39823 25 Ton Oil Filter Crusher



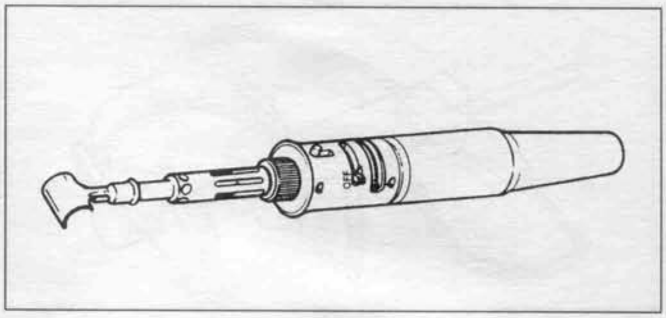
Part No. HD-39782 Cylinder Head Support



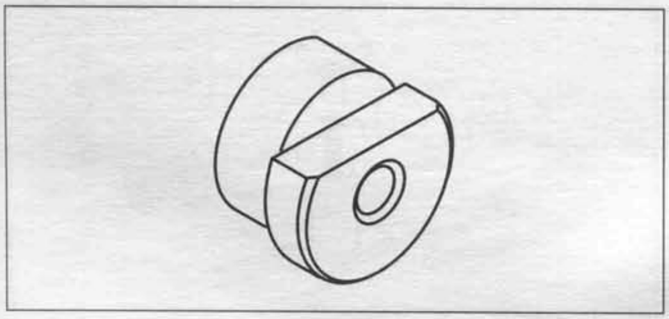
Part No. HD-39847 Universal Ratcheting Tap/Reamer Handle



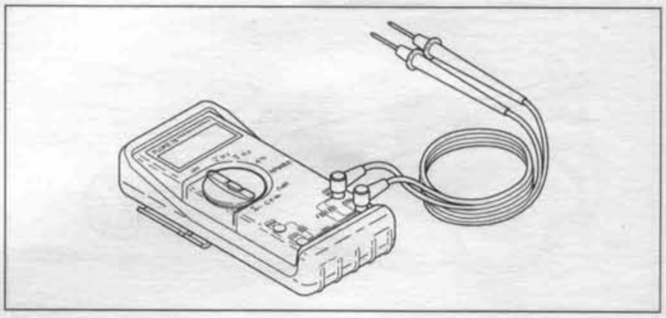
Part No. HD-39932 (Steel) or HD-39932-CAR (Carbide)
Intake and Exhaust Valve Guide Reamer



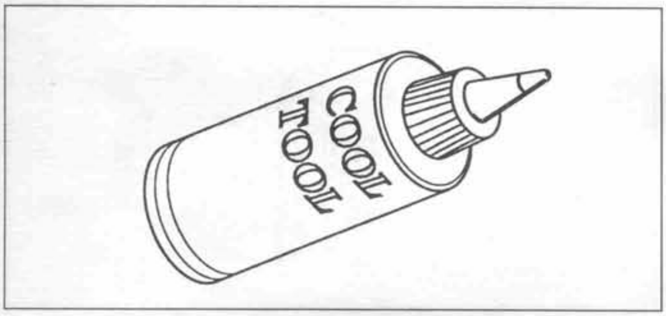
Part No. HD-39969 Ultra-Torch UT-100



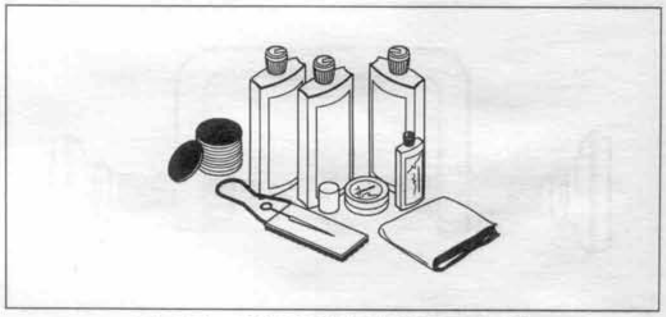
Part No. HD- 39958 Pinion Bearing Outer Race
Removal/Installation Tool



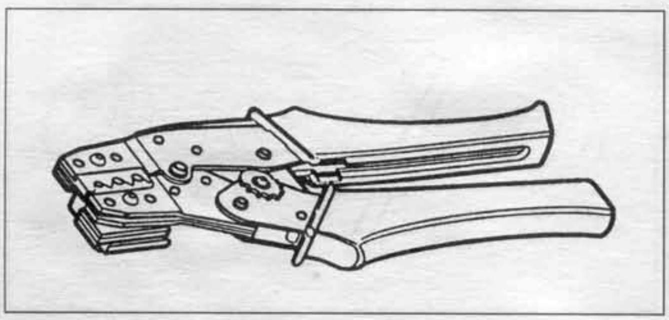
Part No. HD-39978 Multi-Meter (FLUKE 78)



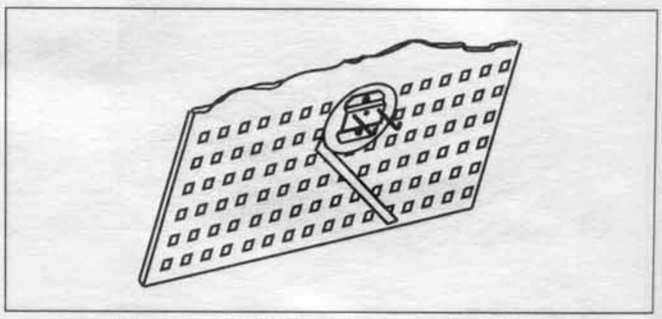
Part No. HD-39964 Reamer Lubricant (Cool Tool)



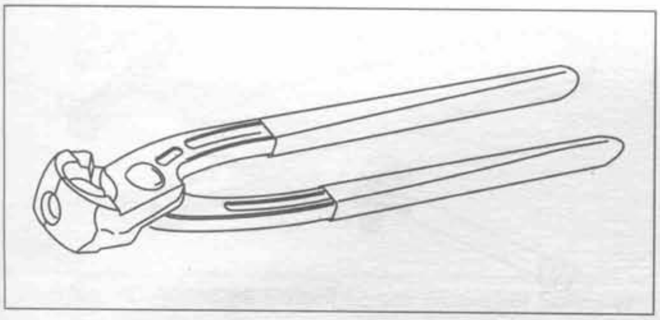
Part No. HD-39994 Paint Repair Kit



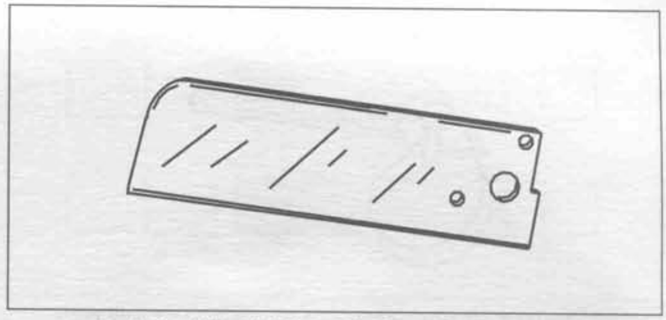
Part No. HD-39965 Deutsch Terminal Crimp Tool



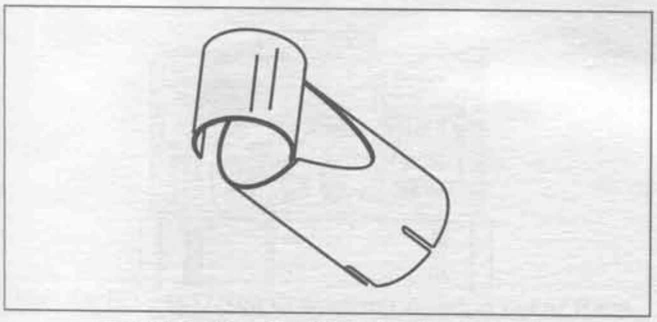
Part No. HD-41025 Tool Organizational System



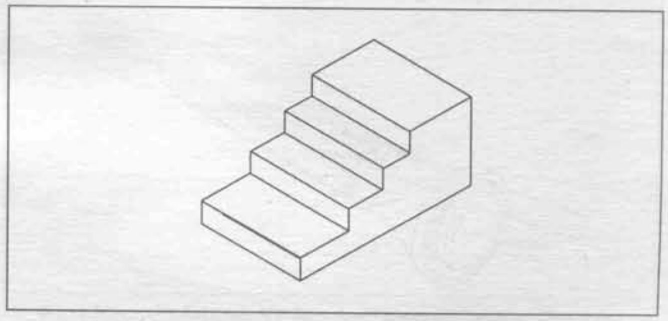
Part No. HD-41137 Hose Clamp Pliers



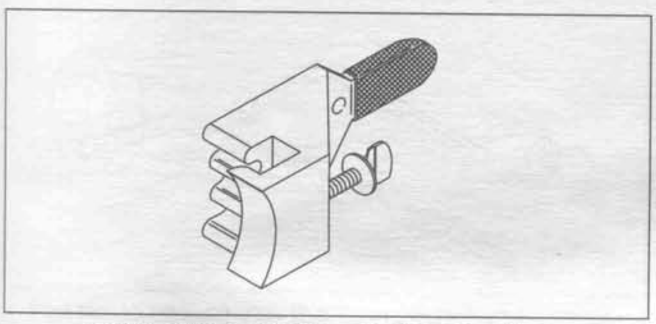
Part No. HD-41185-1 Oil Hose Cutter Blade



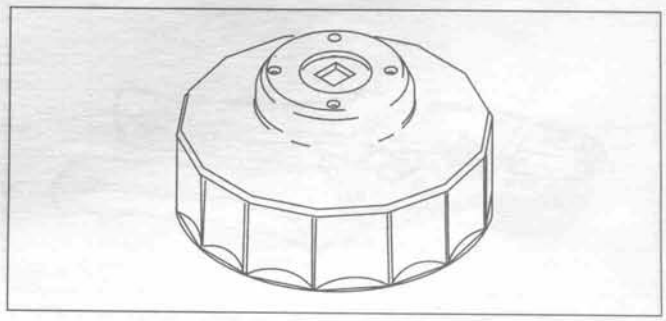
Part No. HD-41183 Shrink Attachment



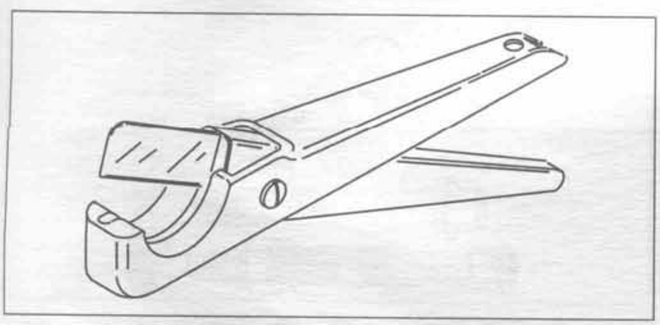
Part No. HD- 41214 Primary Drive
Locking Tool



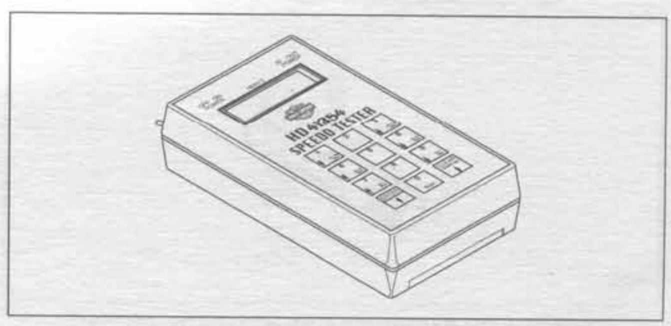
Part No. HD-41184 Sprocket Holding Tool



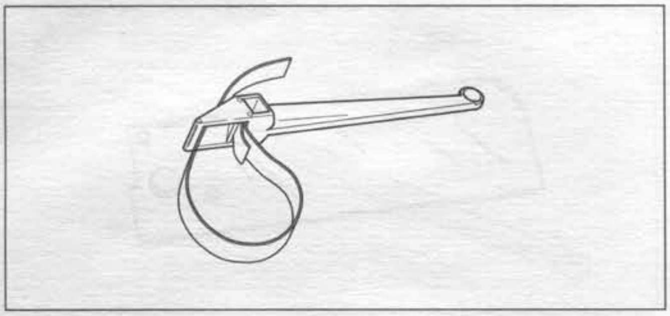
Part No. HD-41215 Oil Filter Wrench



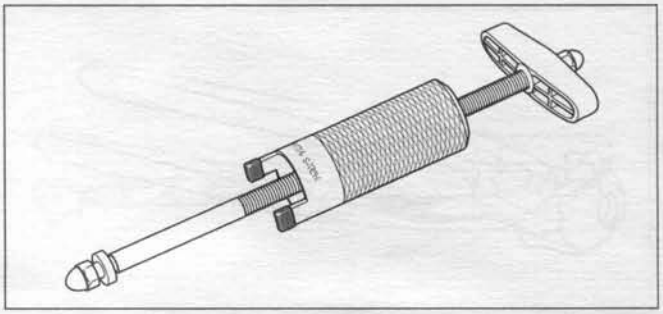
Part No. HD-41185 Hose Cutting Tool



Part No. HD-41354 Speedometer Tester



Part No. HD-41494 Hub Cap Removal/Installation Tool



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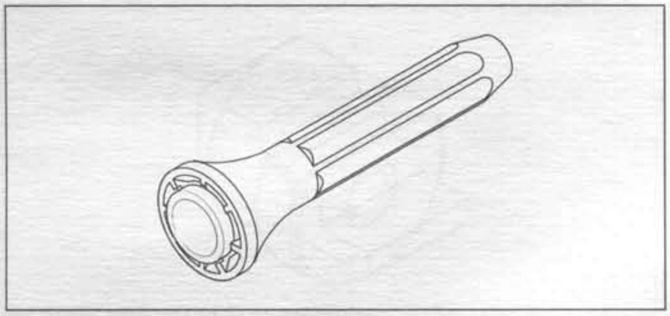
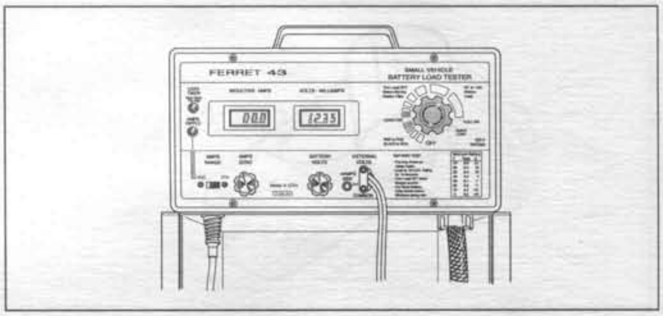
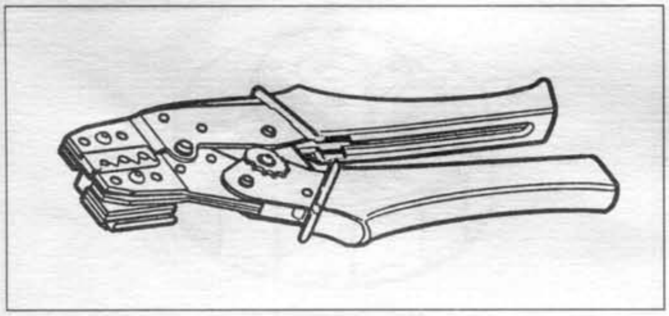


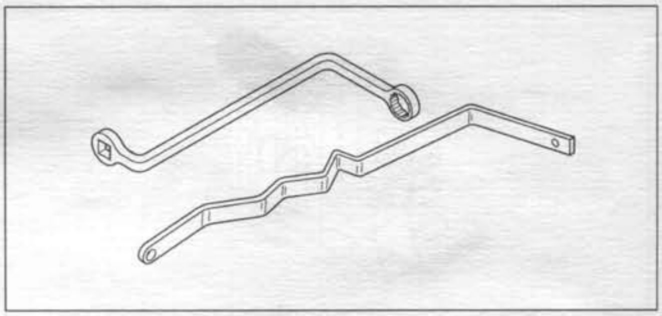
Part No. HD-41496 Main Drive Gear Seal Installer



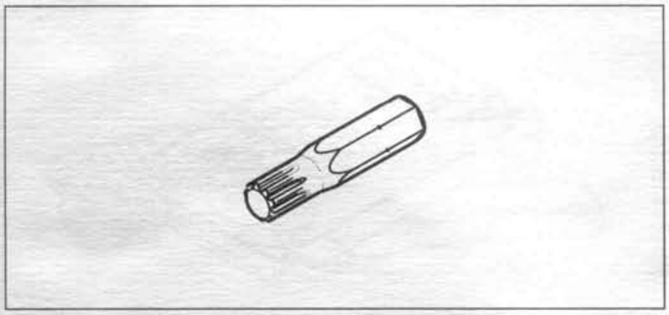
Part No. HD-42376 Battery/Charging System Load Tester



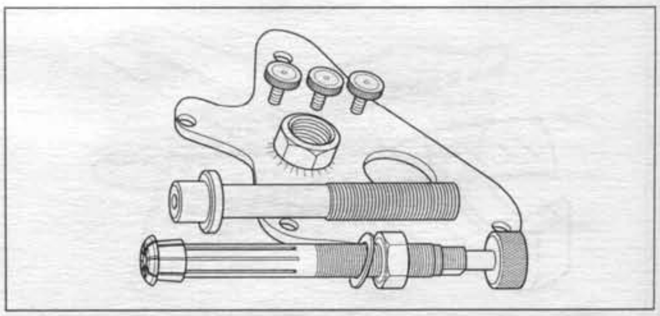
Part No. HD-41609 Amp Multilock Electrical Crimp Tool



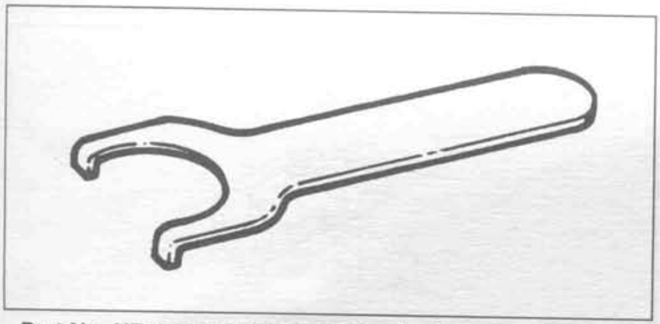
Part No. HD-42465 Transmission Pawl Adjuster - Heritage Springer Models (FLSTS)



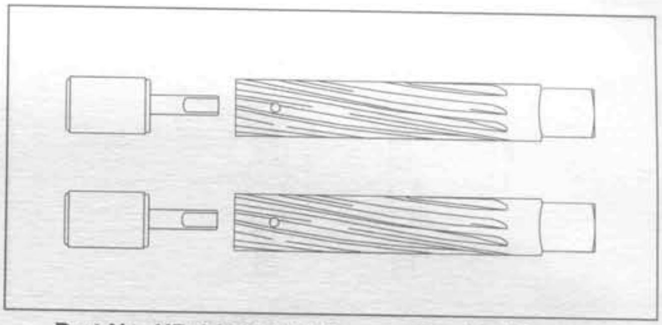
Part No. HD-42135 Spoke Nipple Driver



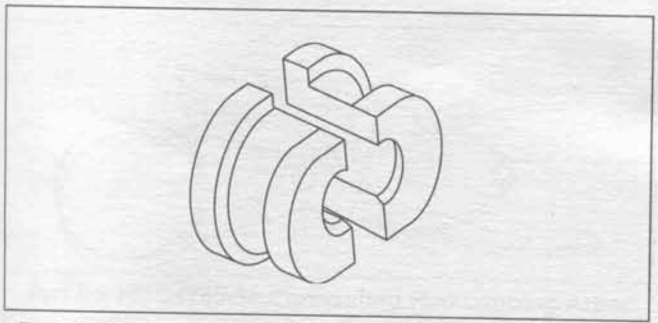
Part No. HD-42928 Cam Needle Bearing Remover/Installer



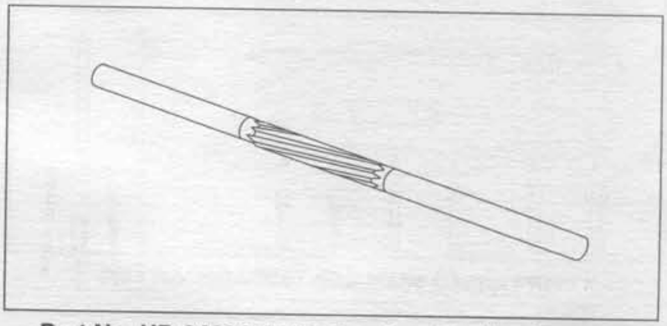
Part No. HD-94455-89 Softail Shock Absorber Spanner



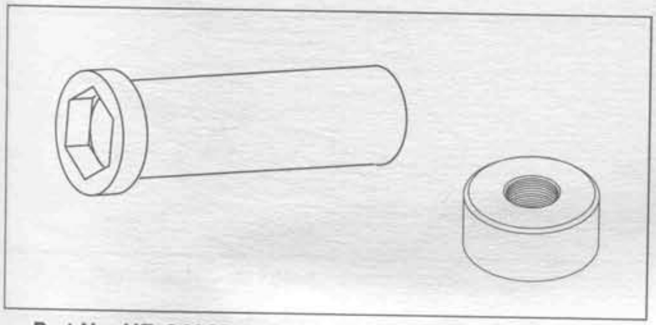
Part No. HD-94800-26A Connecting Rod Bushing Reamers and Pilots



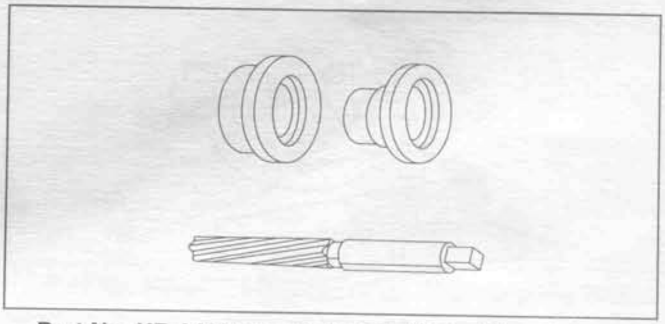
Part No. HD-94547-100 Crankshaft Bearing Outer Race Remover/Installer



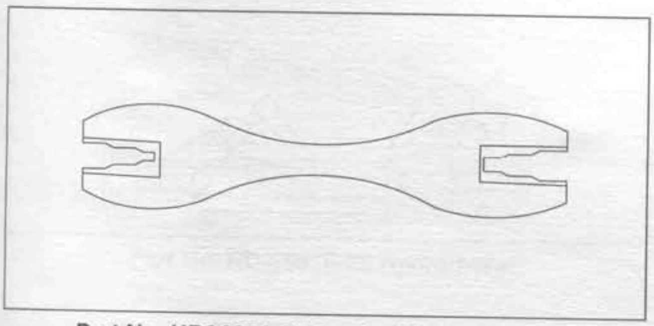
Part No. HD-94804-57 Rocker Arm Bushing Reamer



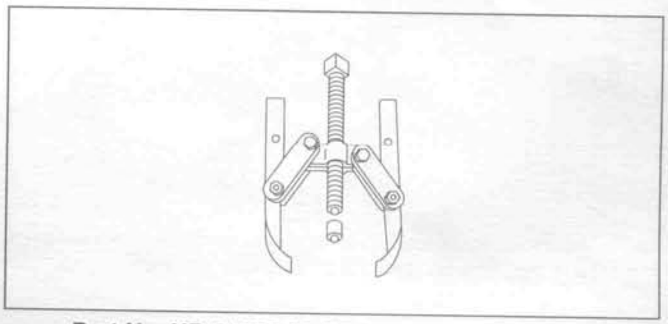
Part No. HD-94660-37B Big Twin Mainshaft Locknut Wrench



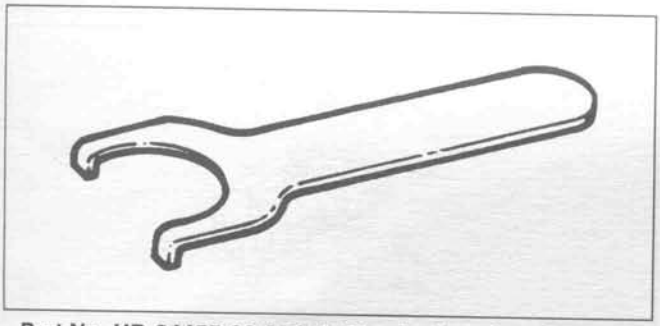
Part No. HD-94805-57 Pinion Shaft Bushing Reamer And Pilots



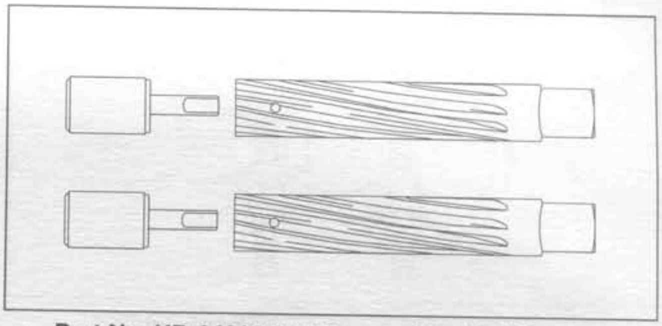
Part No. HD94681-80 Spoke Nipple Wrench



Part No. HD-95635-46 All-Purpose Claw Puller



Part No. HD-94455-89 Softail Shock Absorber Spanner



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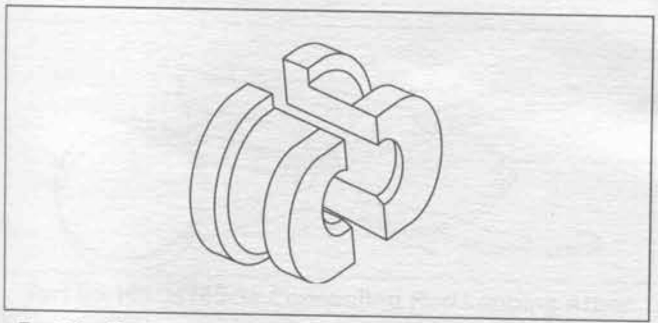
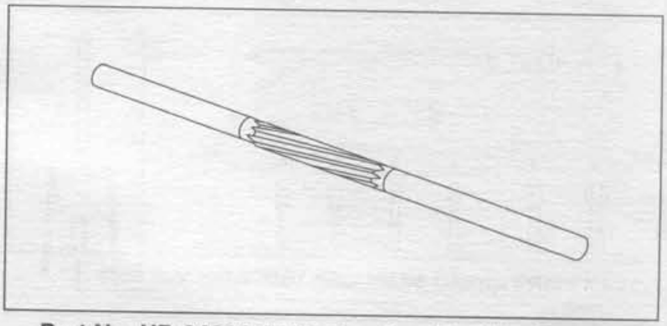
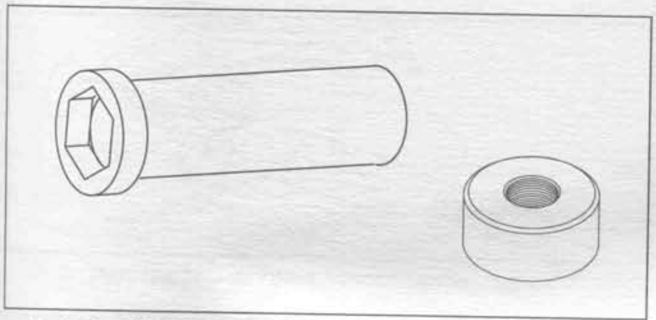


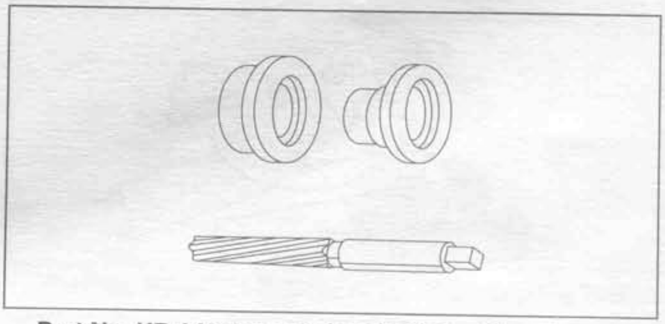
Part No. HD-94547-100 Crankshaft Bearing Outer Race Remover/Installer



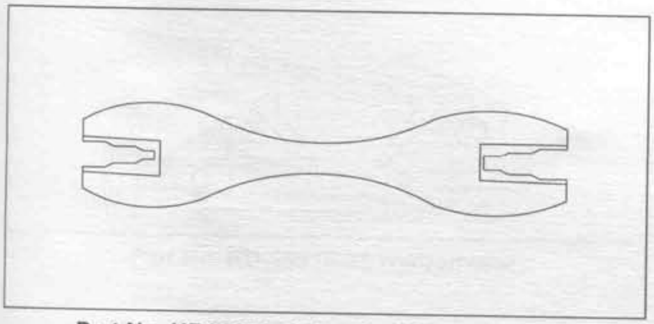
Part No. HD-94804-57 Rocker Arm Bushing Reamer



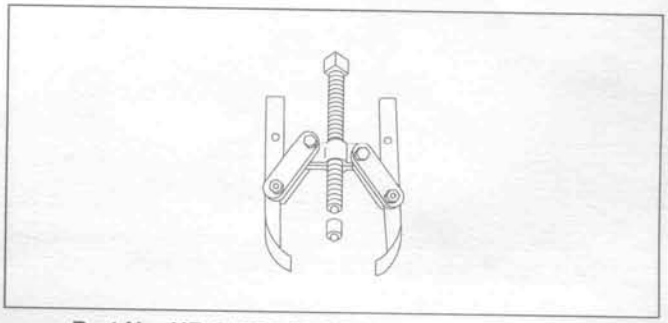
Part No. HD-94660-37B Big Twin Mainshaft Locknut Wrench



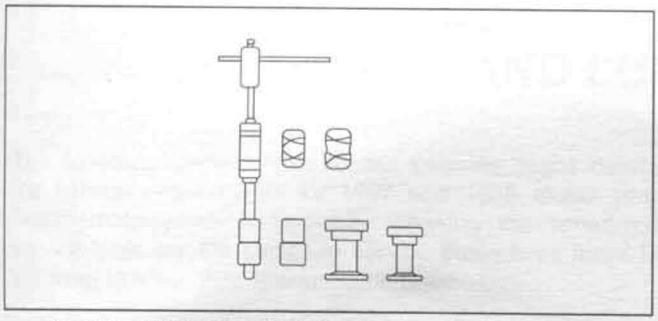
Part No. HD-94805-57 Pinion Shaft Bushing Reamer And Pilots



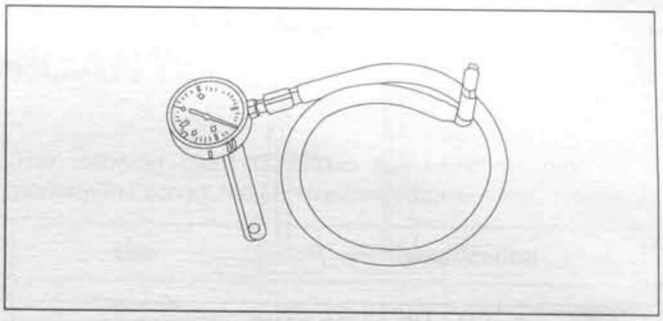
Part No. HD94681-80 Spoke Nipple Wrench



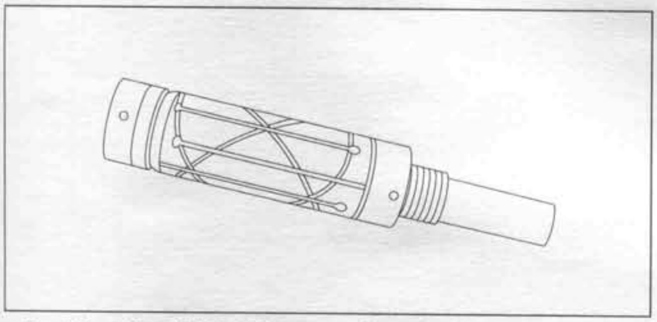
Part No. HD-95635-46 All-Purpose Claw Puller



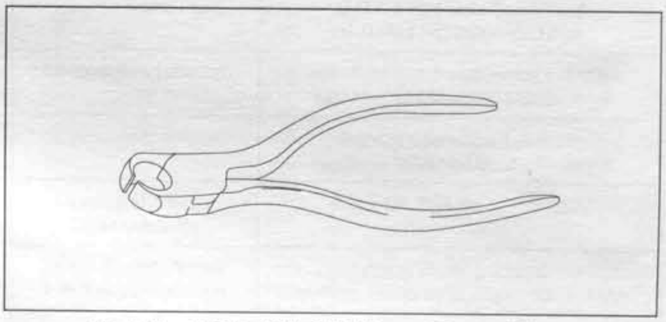
Part No. HD-96710-40B Crankcase Main Bearing Lapping Tool



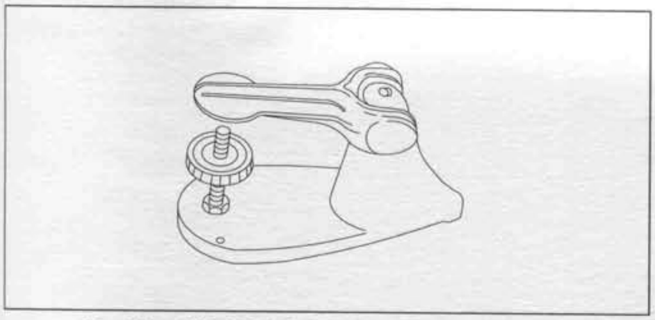
Part No. HD-96921-52A Oil Pressure Gauge



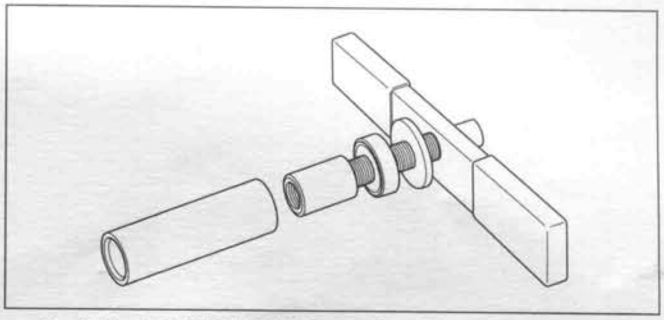
Part No. HD-96740-36 Connecting Rod Lapping Arbor



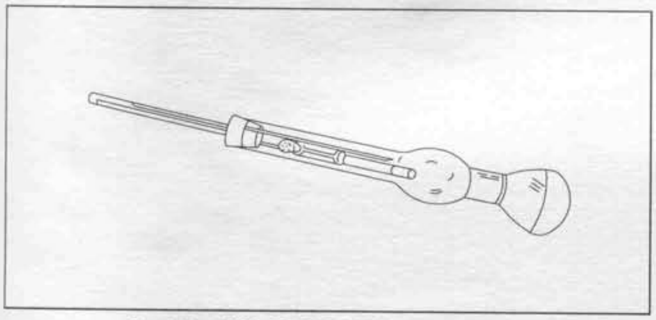
Part No. HD-97087-65B Hose Clamp Pliers



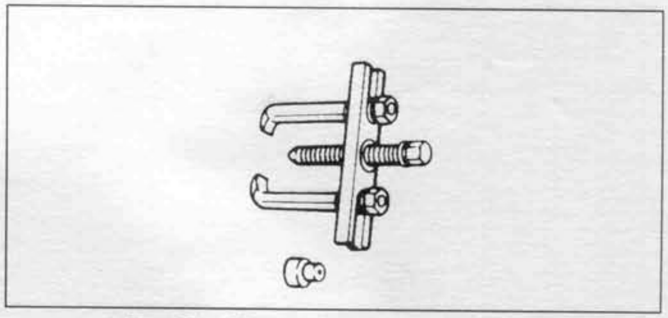
Part No. HD-96796-47 Valve Spring Tester



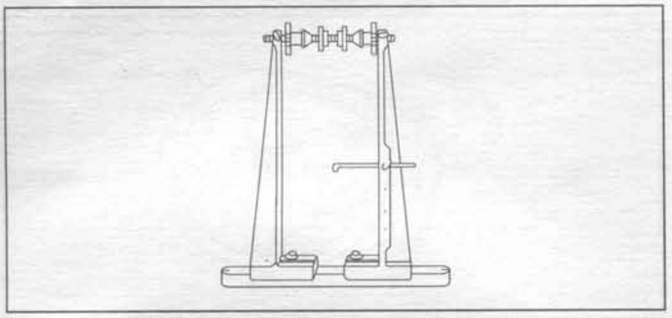
Part No. HD-97225-55B Sprocket Shaft Bearing Tool



Part No. HD-96910-35 Hydrometer



Part No. HD-97292-61 Two Jaw Puller



Part No. HD-99500-80 Wheel Truing and Balancing Stand

SCHEDULED SERVICE TABLE AND LUBRICANTS

The scheduled service table on the following pages details the service requirements for 1997 and 1998 model year Softail motorcycles. Immediately following the scheduled service table are the complete service procedures listed in the order in which they appear in the table.

The following chart describes the lubricants required to perform the scheduled service procedures:

Use	Specification
Engine Oil	See chart in service procedure on page 1-38.
Front Fork Oil	Hydraulic Fork Oil, Type "E", H-D Part No. 99884-80/16 oz.
Silicone Brake Fluid	D.O.T. 5 Hydraulic Brake Fluid, H-D Part No. 99902-77/12 oz.
Transmission Lubricant	Semi-Synthetic Transmission Lubricant, Part Nos. 98853-96/qt, 98852-96/gal
Chaincase Lubricant	Primary Chaincase Lubricant, Part Nos. 99887-84/qt, 99886-84/gal
Clutch and Throttle Cable Lubricant	Super Oil, Part No. 94968-85TV
Wheel Bearing, Swing Arm Bearing Lubricant	Wheel Bearing Grease, Part Nos. 99855-89/lb, 99856-92/cartridge
Steering Head Bearing Lubricant	Special Purpose Grease, Part No. 99857-97/cartridge
Electrical Contact Lubricant	Electrical Contact Grease, Part No. 99861-90

Service Operation	Preride	500 mi 800 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	32500 mi 52000 km	35000 mi 56000 km	37500 mi 60000 km	40000 mi 64000 km	42500 mi 68000 km	45000 mi 72000 km	47500 mi 76000 km	50000 mi 80000 km	Service Data	Page Numbers
Battery		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	See Section 8 for charging information.	1-38
Engine oil (*)	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	*Oil level* Full at bottom of fill plug with motorcycle level and engine warm. *Oil* 3 qt. (2.8 L) per chart in procedure.	1-38
Engine oil filter (*)		R		R		R		R		R		R		R		R		R		R		R	Hand tighten 1/2-3/4 turn after gasket contact.	1-38
Primary chain		I		I		I		I		I		I		I		I		I		I		I	*Deflection* cold: 5/8-7/8 in. (15.9-22.3 mm) hot: 3/8-5/8 in. (9.5-15.9 mm)	1-38
Primary chaincase lubricant		R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	*Lubricant level* **1997 Models:** Fill until level with bottom edge of clutch diaphragm spring. **1998 Models:** Fill until level with bottom edge of clutch diaphragm spring. *Lubricant* **1997 Models:** 32 oz. (946.4 ml) **1998 Models:** 26 oz. (768.9 ml) Part Nos. 99887-84 (qt), 99886-84 (gal)	1-39
Clutch Adjustment		X		X		X		X		X		X		X		X		X		X		X	*Free play at hand lever* 1/16-1/8 in. (1.6-3.2 mm)	1-40

R – Replace or change
I – Inspect, and if necessary, adjust, clean, or replace
L – Lubricate with specified lubricant
X – Perform
T – Tighten to proper torque
(*) – Also perform prior to storage or annually

Service Operation	Pre-ride	500 mi 800 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	32500 mi 52000 km	35000 mi 56000 km	37500 mi 60000 km	40000 mi 64000 km	42500 mi 68000 km	45000 mi 72000 km	47500 mi 76000 km	50000 mi 80000 km	Service Data	Page Numbers
Transmission lubricant (*)		R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	*Lubricant level* Dipstick at FULL with motorcycle level and dip-stick dipped, not screwed, into the fill hole. *Lubricant* 24 oz. (709.8 ml) Part Nos. 98853-96 (qt), 98852-96 (gal) Transmission drain plug 0.16-0.18 in. (4.1-4.6 mm) above surface of housing.	1-41
Hydraulic lifter oil screen				I		I		I		I		I		I		I		I		I		I	*Torque* 90-120 **in-lbs** (10.2-13.6 Nm)	1-41
Wheel bearings (*)						IL				IL				IL				IL				IL	*Lubricant* Part No. 99855-89 (lb), 99856-92 (cartridge)	1-41
Spoke tightness (if applicable)		I		I		I		I		I		I		I		I		I		I		I		1-42
Tire condition and pressure	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	See tire data chart in Section 2.	1-42
Steering head bearing fall-away		I		I		I		I		I		I		I		I		I		I		I	See Section 2	2-54/65/66
Springer steering head bearings (FLSTS, FXSTS, FXSTSB)		L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	Lubricate through neck fitting with *Special Purpose Grease,* Part No. 99857-97 (cartridge)	1-42
Steering head bearings (all other models: FLSTC, FLSTF, FXSTC)						L				L				L				L				L	Lubricate through neck fitting with *Special Purpose Grease,* Part No. 99857-97 (cartridge)	1-42
Steering head bearings (remove, inspect, and repack)										X								X					*Lubricant* Part No. 99857-97 (cartridge)	1-42
Rocker bearing adjustment (FXSTS, FXSTSB, FLSTS)		X				X				X				X				X				X	See Section 2.	1-42

R – Replace or change
X – Perform
I – Inspect, and if necessary, adjust, clean, or replace
T – Tighten to proper torque
L – Lubricate with specified lubricant
(*) – Also perform prior to storage or annually

Service Operation	Preride	500 mi 800 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	32500 mi 52000 km	35000 mi 56000 km	37500 mi 60000 km	40000 mi 64000 km	42500 mi 68000 km	45000 mi 72000 km	47500 mi 76000 km	50000 mi 80000 km	Service Data	Page Numbers
Front fork oil (*)						R				R				R				R				R	*Fork oil (Type E)* Part No. 99884-80 (16 oz.) *FXSTC capacity (WET):* 10.2 oz. (302 ml) *Other models, except Springers, capacity (WET)* 11.5 oz. (340 ml)	1-42
Brake fluid (*)		I		I		I		I		I		I		I		I		I		I		I	*Brake fluid (D.O.T. 5)* Part Nos. 99902-77 (12 oz.), 99901-77 (gal)	1-42
Brake pad linings and discs		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	*Minimum brake pad thickness* 0.0625 in. (1.6 mm)	1-43
Brake caliper mounting pin				IL		IL		IL		IL		IL		IL		IL		IL		IL		IL		1-43
Rear brake pedal height (FXSTC, FXSTS, FXSTSB)		I		I		I		I		I		I		I		I		I		I		I	*Pedal to footrest height* 1/4-1/2 in. (7-13 mm)	1-43
Drive belt	I	I		I		I		I		I		I		I		I		I		I		I	*Deflection* 3/8-1/2 in. (9.5-12.7 mm) in top strand with 10 lb (4.5 kg) upward force	1-43
Rear fork pivot bolts		I		I		I		I		I		I		I		I		I		I		I	*Pivot bolt torque* 120-150 ft-lbs (163-203 Nm)	1-44
Rear shock absorbers		I		I		I		I		I		I		I		I		I		I		I		1-44
Air cleaner		I		I		I		I		I		I		I		I		I		I		I	*Air cleaner cover screw torque:* 3-5 ft-lbs (4-7 Nm)	1-44
Fuel tank filter				I		I		I		I		I		I		I		I		I		I	*Filter hex fitting torque:* 15-20 ft-lbs (20-27 Nm)	1-44
Fuel system lines and fittings (leaks)		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		1-45

R – Replace or change **I** – Inspect, and if necessary, adjust, clean, or replace **L** – Lubricate with specified lubricant

Service Operation	Preride	500 mi 800 km	2500 mi 4000 km	5000 mi 8000 km	7500 mi 12000 km	10000 mi 16000 km	12500 mi 20000 km	15000 mi 24000 km	17500 mi 28000 km	20000 mi 32000 km	22500 mi 36000 km	25000 mi 40000 km	27500 mi 44000 km	30000 mi 48000 km	32500 mi 52000 km	35000 mi 56000 km	37500 mi 60000 km	40000 mi 64000 km	42500 mi 68000 km	45000 mi 72000 km	47500 mi 76000 km	50000 mi 80000 km	Service Data	Page Numbers
Enrichener control	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		1-45
Throttle cables		IL		IL		IL		IL		IL		IL		IL		IL		IL		IL		IL	*Handlebar housing screw torque* 12-16 **in-lbs** (1.4-1.8 Nm)	1-46
Engine mounts		I		I		I		I		I		I		I		I		I		I		I	*Engine-to-frame mounting bolt torque* 33-38 ft-lbs (45-52 Nm) *Upper engine bracket-to-cylinder head torque* 28-35 ft-lbs (38-48 Nm) *Upper engine bracket-to-frame bolt torque* 45-50 ft-lbs (61-68 Nm)	1-46
Spark plugs				I		R		I		R		I		R		I		R		I		R	*Plug type* 5R6A *Plug gap* 0.038-0.043 in. (0.97-1.09 mm) *Plug torque* 18-22 ft-lbs (24-30 Nm)	1-46
Electrical components	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		1-47
Engine idle speed		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	*Idle speed* 1000-1050 rpm	1-47
Ignition timing and V.O.E.S.				I		I		I		I		I		I		I		I		I		I	*Timing mark view plug* Part No. HD-96295-65D	1-48
Fasteners (except head bolts)		T		T		T		T		T		T		T		T		T		T		T		1-48
Road test		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		1-48

R – Replace or change
I – Inspect, and if necessary, adjust, clean, or replace
L – Lubricate with specified lubricant
X – Perform
T – Tighten to proper torque
(*) – Also perform prior to storage or annually

BATTERY

At every scheduled service interval, inspect the battery as follows:

1. Battery top must be clean and dry. Dirt on the top of battery may cause the battery to self-discharge at a faster than normal rate.
2. Inspect battery screws, clamps, and cables for breakage, loose connections and corrosion. Clean clamps. Coat terminals with grease.
3. Inspect battery for discoloration, raised top, or warped case which may indicate battery has been overheated or overcharged.
4. Inspect the battery case for cracks or leaks.

For information on charging, see Section 8.

ENGINE OIL/ENGINE OIL FILTER

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, change the engine oil and engine oil filter as follows:

NOTE

If the motorcycle is ridden hard, under dusty conditions, or in cold weather, the oil and filter should be changed more often.

1. Run engine until normal operating temperature is reached.
2. See Figure 1-1. Remove the oil tank drain plug from oil drain hose and allow oil to drain completely.

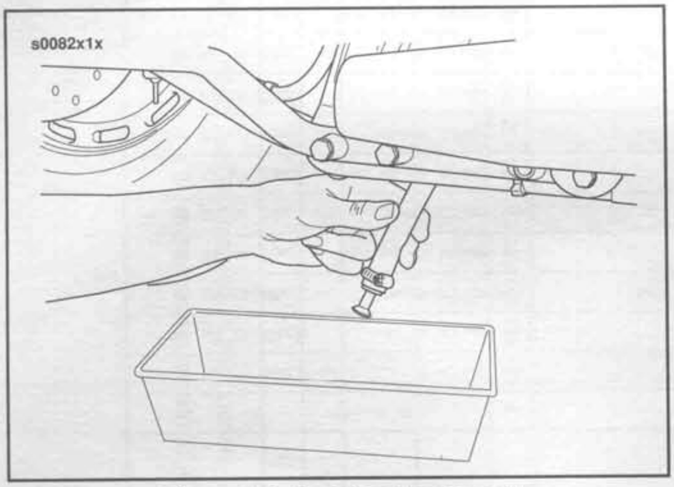


Figure 1-1. Draining Engine Oil

3. Remove the oil filter and clean the oil filter mount flange of any old gasket material.
4. Lube the gasket on new oil filter with engine oil and install new filter. Hand tighten oil filter 1/2-3/4 turn after gasket contacts filter mounting surface.
5. Install drain plug and clip plug in place.
6. Fill tank with three (3) quarts (2.8 liters) engine oil specified below. Use the proper grade of oil for the lowest temperature expected before next oil change.
7. Start engine and carefully check for oil leaks around drain plug and oil filter.
8. Check oil level in tank with vehicle upright and level at normal operating temperatures, and if necessary, add oil. Do not overfill tank. Tank needs some air space.

Harley-Davidson Type	Viscosity	Harley-Davidson Rating	Lowest Ambient Temperature	Cold Weather Starts Below 50°F (10°C)
HD Multi-grade	SAE 10W40	HD 240	Below 40°F (4°C)	Excellent
HD Multi-grade	SAE 20W50	HD 240	Above 40°F (4°C)	Good
HD Regular Heavy	SAE 50	HD 240	Above 60°F (16°C)	Poor
HD Extra Heavy	SAE 60	HD 240	Above 80°F (27°C)	Poor

PRIMARY CHAIN

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the primary chain and adjust the chain, if necessary, as follows:

⚠WARNING

To prevent accidental start-up of motorcycle, disconnect the battery cable (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

⚠CAUTION

The gasket between the primary chain adjustment inspection cover and the chaincase cover must be replaced each time the cover is removed.

1. See Figure 1-2. With vehicle upright and level, remove the primary chain inspection cover.

⚠CAUTION

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

2. Check the primary chain tension. Push on the upper strand of the chain to verify that it has free up and down movement midway between the engine compensating sprocket in the front and the clutch sprocket in the rear. The freeplay in the upper strand should be 5/8-7/8 in. (15.9-22.3 mm) with the engine cold and 3/8-5/8 in. (9.5-15.9 mm) with the engine hot.

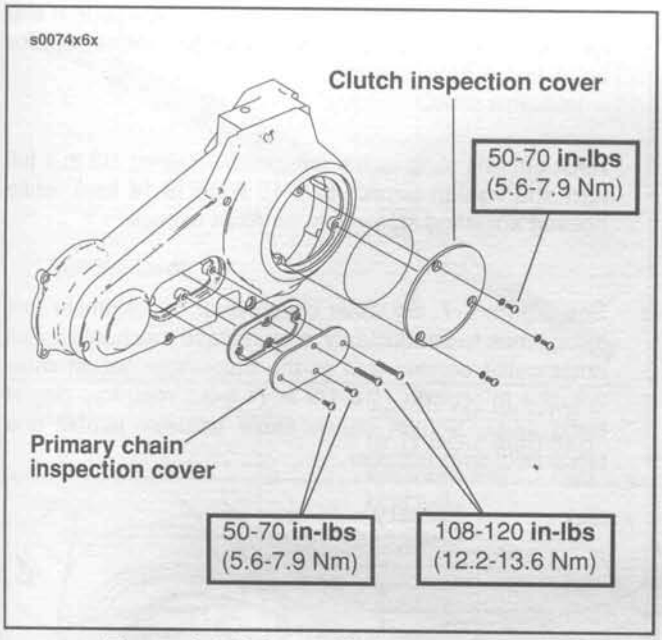


Figure 1-2. Primary Chaincase Covers

3. See Figure 1-3. If freeplay adjustment is required, loosen, but do not remove, the center bolt nut and move the shoe assembly up or down to obtain the specified free play. Tighten center bolt nut to 21-29 ft-lbs (28-39 Nm). Replace the primary chain if it is worn to the point where it cannot be properly adjusted.

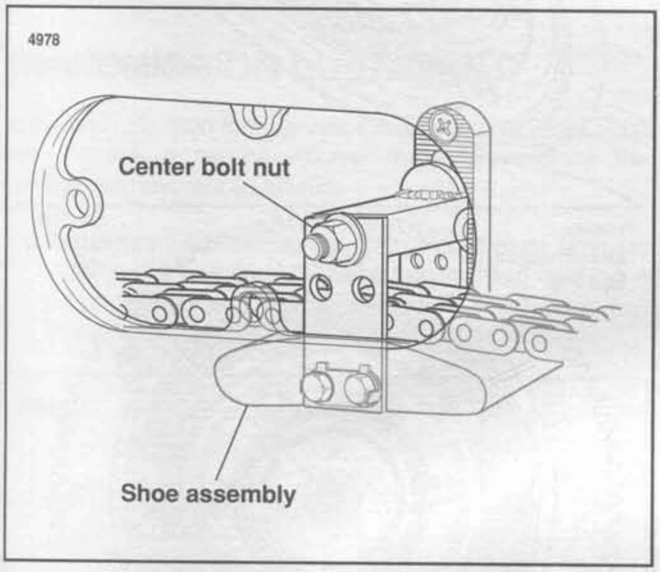


Figure 1-3. Primary Chain Adjustment

4. Install inspection cover with **new** gasket. Tighten primary chain inspection cover screws to values shown in Figure 1-2.

PRIMARY CHAINCASE LUBRICANT

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, change the primary chaincase lubricant as follows:

1. See Figure 1-4. Remove drain plug at bottom of primary chaincase. Drain lubricant into suitable container.

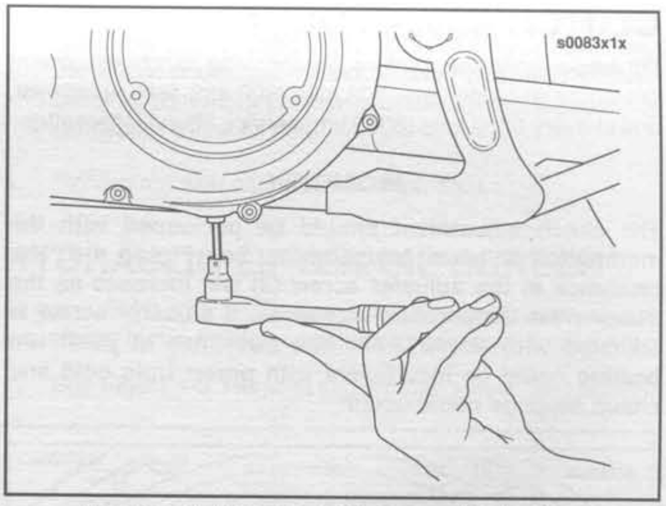


Figure 1-4. Removing Chaincase Drain Plug

2. Clean drain plug and install drain plug in chaincase. If a large amount of debris had accumulated on the chaincase plug, inspect the condition of chaincase components.

3. See Figure 1-2. Remove three socket screws with rubber sealing washers and clutch inspection cover. Discard sealing washers.

4. Pour the proper amount and type of primary chaincase lubricant in through the clutch inspection cover opening. With the vehicle standing upright, the level of the lubricant must be at the bottom edge of the diaphragm spring or 2-3/4 inches (69.8 mm) from the centerline of the clutch adjuster screw. Use only Harley-Davidson PRIMARY CHAINCASE LUBRICANT, Part No. 99887-84 (quart) or Part No. 99886-84 (gallon). The lubricant level is visually checked through clutch cover opening.
   1997 Models: See Figure 1-5. The primary chaincase lubricant should be level with bottom edge of the clutch diaphragm spring, approximately 32 oz. (946.4 ml).
   1998 Models: See Figure 1-6. The primary chaincase lubricant should be level with the bottom edge of the clutch diaphragm spring, approximately 26 oz. (768.9 ml).

NOTE

If new clutch discs are being installed, or if the lubricant has been wiped from serviceable discs, submerge the discs in PRIMARY CHAINCASE LUBRICANT for a minimum of five minutes before installation.

⚠CAUTION

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

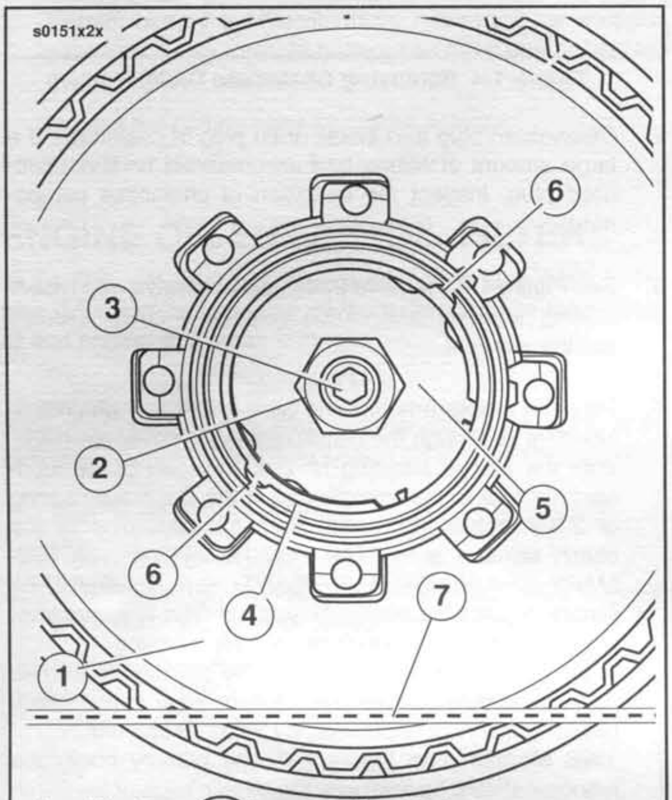
5. Install clutch inspection cover in primary chaincase cover with **new** O-ring. Install three socket head screws using **new** rubber sealing washers. Tighten screws to 50-70 **in-lbs** (5.6-7.9 Nm).

CLUTCH ADJUSTMENT

For proper operation, perform the following clutch adjustment procedure at predelivery, 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter.

⚠CAUTION

The clutch adjustment should be performed with the motorcycle at room temperature. See Figure 1-5. The clearance at the adjuster screw (3) will increase as the power train 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.



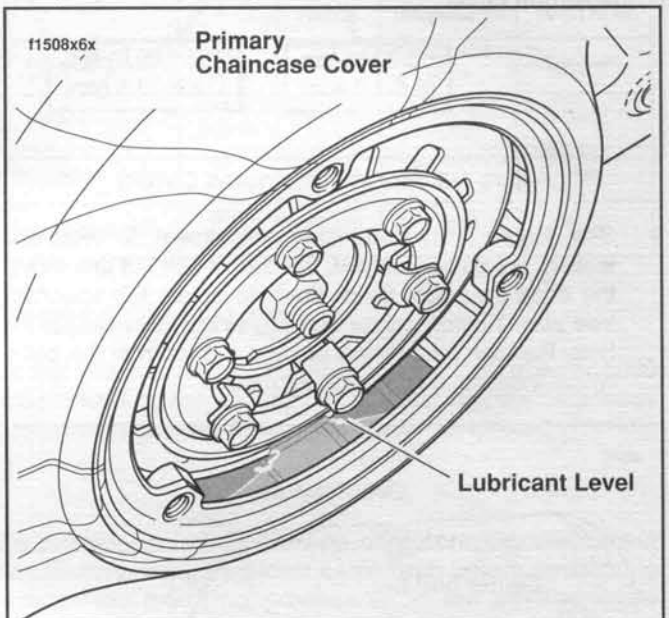
1. **Diaphragm spring**
2. **Jamnut**
3. **Adjuster screw**
4. **Retaining ring**
5. **Release plate**
6. **Slot**
7. **Lubricant level (motorcycle upright and level)**

Figure 1-5. 1997 Models Primary Chaincase Lubricant Level

NOTE

If clutch components are replaced during normal servicing, this adjustment must be performed. Adjust again after 500 miles (800 km) of use.

1. Stand vehicle upright and level.
2. See Figure 1-2. Remove three screws, rubber sealing washers and clutch inspection cover. Discard washers.
3. See Figure 1-7. The cable adjuster is located midway between the clutch cable ends. Push rubber boot upwards on the cable until the adjuster is exposed. Loosen nut and turn adjuster all the way in to provide slack in cable.
4. See Figure 1-7. Loosen clutch adjuster screw jamnut and turn push rod adjusting screw inward (clockwise) to take up all free play in pushrod.
5. Back out adjusting screw (counterclockwise) 1/2 to 1 full turn and tighten jamnut to 6-10 ft-lbs (8-14 Nm), while holding adjusting screw with an Allen wrench.
6. See Figure 1-7. Squeeze clutch lever to maximum limit three times to set ball and ramp release mechanism. Pull outer cable conduit and at the same time adjust cable adjuster to provide 1/16-1/8 in. (1.6-3.2 mm) free play at hand lever. Tighten clutch cable adjuster jamnut and place boot over adjuster.



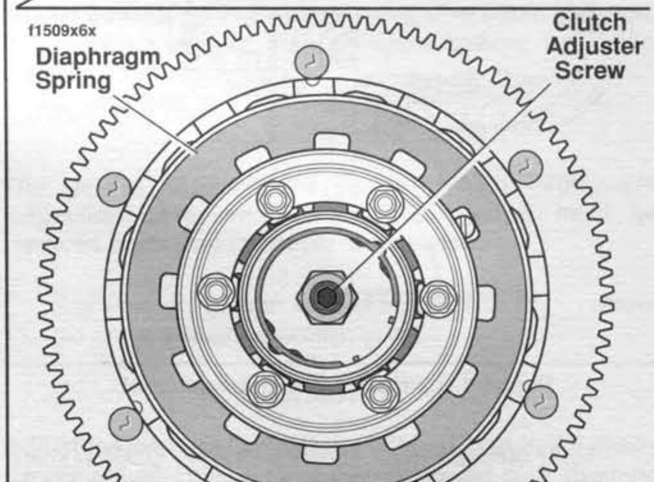


Figure 1-6. 1998 Models Primary Chaincase Lubricant Level

7. Install clutch cover in primary chaincase cover with **new** O-ring. Install three screws and **new** rubber sealing washers. Tighten screws to 50-70 **in-lbs** (5.6-7.9 Nm).

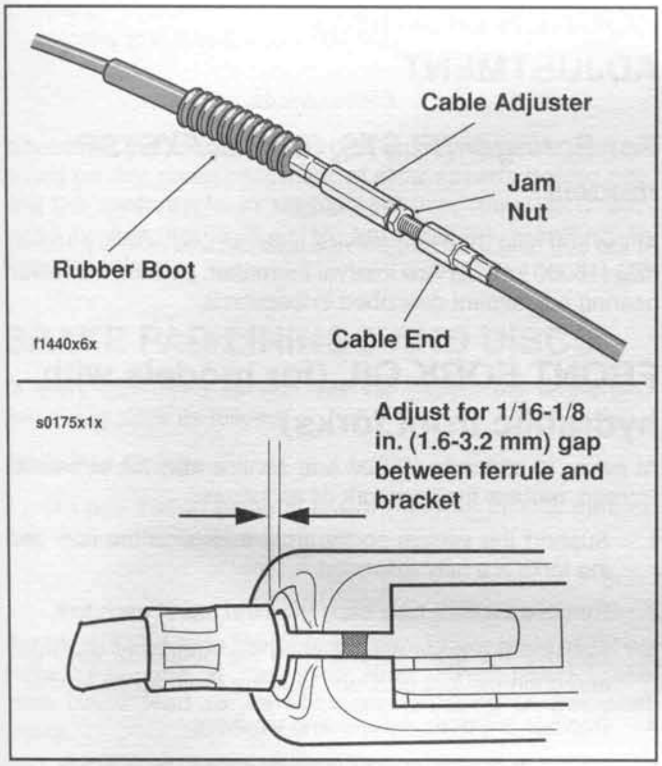


Figure 1-7. Clutch Cable Adjuster

8. Lubricate clutch cable with Super Oil, Part No. 94968-85TV.

TRANSMISSION LUBRICANT

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, replace the transmission lubricant as follows:

1. See Figure 1-8. Remove the drain and fill plugs from the transmission and drain the used transmission fluid into a suitable container. The drain plug on FLSTS models can be accessed using a T40 bit on a universal joint.

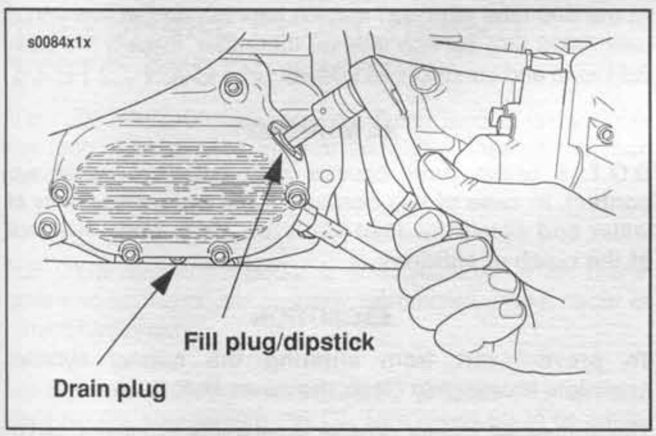


Figure 1-8. Transmission Fill and Drain

2. Install the drain plug so it projects 0.16-0.18 in. (4.1-4.6 mm) above surface of housing. Do not over-tighten. Over-tightening could cause transmission leakage.

3. Fill the transmission with 24 oz. (709.8 ml) of Harley-Davidson TRANSMISSION LUBRICANT, Part No. 99892-84, or until the dipstick shows FULL with motorcycle in level, upright position and the dipstick dipped, not screwed, into the fill hole.

4. Tighten the filler plug/dipstick finger tight.

HYDRAULIC LIFTER OIL SCREEN

At every 5000 mile (8000 km) service interval, remove and inspect the hydraulic lifter oil screen as follows:

1. See Figure 1-9. Remove cap, O-ring, spring, and screen.

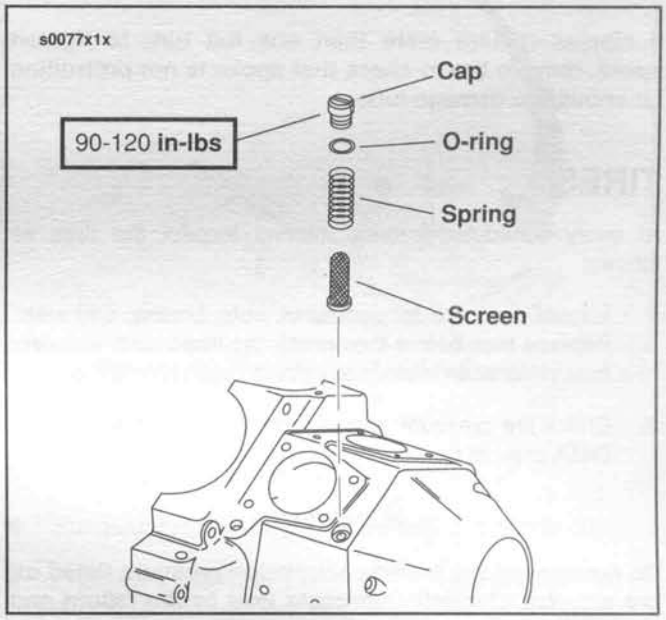


Figure 1-9. Hydraulic Lifter Oil Screen

2. Inspect screen to make sure mesh is open, and replace screen if plugged or damaged.

3. Install spring, screen and new O-ring, and tighten cap to 90-120 in-lbs (10.2-13.6 Nm).

WHEEL BEARINGS

At every 10,000 mile (16000 km) service interval, or prior to storage, remove, inspect, and repack the wheel bearings as follows:

1. Remove wheel assembly from motorcycle then remove spacers, seals, and wheel bearings. See Section 2.

⚠WARNING

Never "spin dry" bearings with compressed air. Spinning may cause a bearing to fly apart, causing personal injury.

2. Clean bearings in a non-flammable cleaning solution and inspect bearings for damage. Check bearing races, and if races are damaged, see Section 2 for replacement procedures. Always replace bearings and bearing races as a set.

3. Repack the bearings with wheel bearing grease and reassemble the wheel according to instructions in Section 2.

WHEEL SPOKES (if applicable)

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the wheel spokes as follows:

1. Raise motorcycle wheel off the ground.
2. Lightly tap each spoke with a spoke wrench. Loose spokes will sound dull and must be tightened. If more than a few spokes are loose, true the entire wheel following procedures in Section 2, TRUING LACED WHEEL.

⚠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.

TIRES

At every scheduled service interval inspect the tires as follows:

1. Inspect each tire for punctures, cuts, breaks, and wear. Replace tires before they reach the tread wear indicator bars (1/32 of an inch tread pattern depth remaining).
2. Check tire pressure against specification found in TIRE DATA chart in the specification part of Section 2.

⚠WARNING

Do not exceed the maximum inflation pressure listed on tire sidewall. Overinflation could lead to tire failure and personal injury.

STEERING HEAD BEARINGS

For Springer (FLSTS, FXSTS, FXSTSB models):

At every scheduled service interval grease the steering head bearings through the grease fitting on the steering neck with *Special Purpose Grease, Part No. 99857-97,* until grease begins to come out of the top and bottom of the steering head.

At every 20,000 mile (32000 km) service interval, remove, inspect, and repack the steering head bearings. See Section 2 for bearing removal.

For FXSTC, FLSTC, FLSTF models:

At every 10,000 mile (16000 km) service interval grease the steering head bearings through the grease fitting on the steering neck with *Special Purpose Grease, Part No. 99857-97,* until grease begins to come out of the top and bottom of the steering head.

At every 20,000 mile (32000 km) service interval, remove, inspect, and repack the steering head bearings. See Section 2 for bearing removal.

ROCKER BEARING ADJUSTMENT

For Springer (FLSTS, FXSTS, FXSTSB models):

At the 500 mile (800 km) service interval, and at every 10,000 mile (16000 km) service interval thereafter, perform the rocker bearing adjustment described in Section 2.

FRONT FORK OIL (for models with hydraulic front forks)

At every 10,000 mile (16000 km) service interval, or prior to storage, replace the front fork oil as follows:

1. Support the vehicle so the front end is off the floor and the forks are fully extended.
2. Remove the fork tube caps from the top of each fork.
3. Remove the drain screws from the bottom of each fork and drain the fork oil. Don't lose the drain screw washer.
4. Replace the drain screws and washers.
5. Fill the fork with Harley-Davidson's TYPE E FORK OIL with the specified amounts listed below:

FXSTC Models Wet	10.2 oz (302 mL)
FLSTC/F Models Wet	11.5 oz (340 mL)

6. Install fork tube caps and tighten caps to 40-60 ft-lbs (54-81 Nm).

BRAKE FLUID

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the brake fluid level and condition as follows:

⚠WARNING

D.O.T. 5 brake fluid causes eye irritation. Avoid eye contact. In case of eye contact, flush eyes with plenty of water and obtain medical attention. Keep brake fluid out of the reach of children.

⚠CAUTION

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

The front brake master cylinder reservoir is an integral part of the brake hand lever assembly. The rear brake master cylinder reservoir is located on the right side of the motorcycle near the brake pedal, or between the frame downtubes on FXSTC, FXSTS, FXSTSB models.

Use only D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID.

1. Check level in master cylinder reservoir. Level should be 1/ 8 in. (3.2 mm) below the gasket surface.

2. Install gaskets and covers and torque reservoir cover screws to 6-8 **in-lbs** (0.7-0.9 Nm).

⚠WARNING

Whenever the brake system is serviced, it should be tested on dry, clean pavement at slow speeds before putting the motorcycle in regular service. Improperly serviced brakes could lead to an accident resulting in personal injury.

BRAKE PAD LININGS AND DISCS

At every scheduled service interval inspect the brake pad linings and discs as follows:

Brake Pad Linings

If brake pad friction material is worn to 1/16 in. (1.6 mm) or less, replace the entire set of pads.

⚠WARNING

For correct and safe brake operation, brake pads must be replaced in sets at the same time. Mismatched brake pads could lead to an accident resulting in personal injury.

Brake Discs

The minimum brake disc thickness is stamped on the side of the disc.

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

BRAKE CALIPER MOUNTING PIN

At every 5000 mile (8000 km) service interval, inspect the lower brake caliper mounting pin.

1. Lubricate OD of lower mounting pin with Dow Corning MOLY 44 light grease.
2. Tighten lower pin to 25-30 ft-lbs (34-41 Nm).

REAR BRAKE PEDAL HEIGHT (FXSTC, FXSTS, FXSTSB)

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the rear brake pedal height as follows:

NOTE

FLSTC/F/S rear brake pedal is nonadjustable. When brake system components are properly assembled, brake pedal is correctly adjusted.

See Figure 1-10. Remove cotter pin (1) and remove brake rod clevis pin (2). Loosen jam nut (3). Turn clevis (4) in or out to obtain a pedal to footrest relationship of 1/4-1/2 in. (7-13 mm). Install brake rod clevis pin (2) and a new cotter pin (1).

DRIVE BELT

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the drive belt for damage and check belt adjustment as follows:

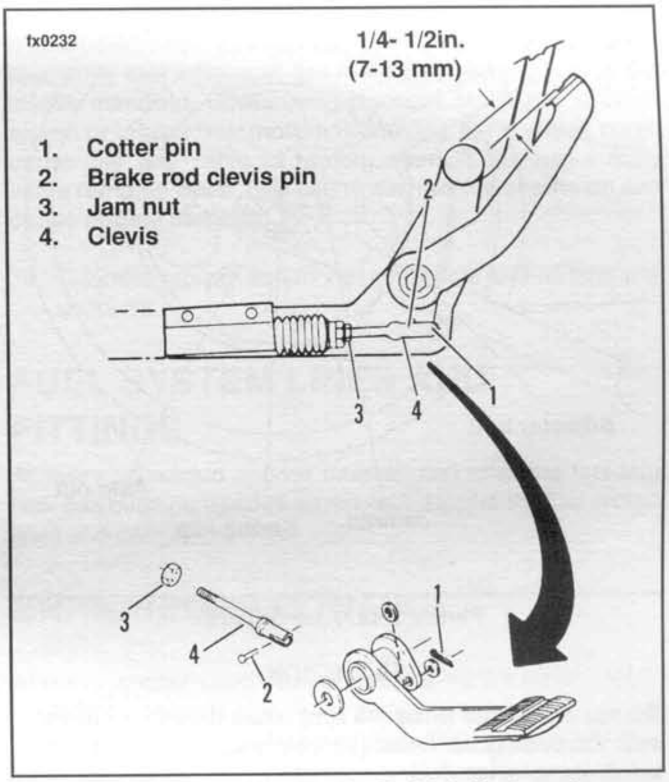


Figure 1-10. Rear Brake Pedal Adjustment

NOTE

- *Set belt tension at tightest point in belt.*
- *Procedure should be performed with motorcycle cold.*
- *Procedure should be performed with weight of owner on vehicle.*

1. See Figure 1-11. Using BELT TENSION GAUGE (HD-35381), check that the drive belt top strand deflects 3/8-1/2 in. (9.5-13 mm) while applying 10 lbs (4.5 kg) of force upward.

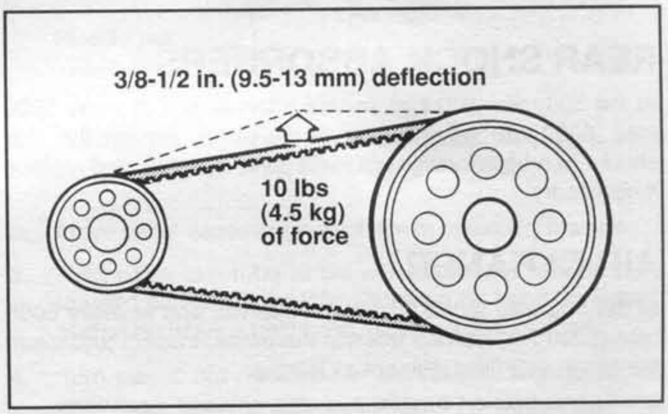


Figure 1-11. Belt Adjustment

2. If belt adjustment is necessary, see Figure 1-12. Remove spring clip and loosen axle nut and jamnut.
3. Remove belt guard. Adjust belt tension by turning each adjuster bolt an equal number of turns to keep the wheel aligned until the specification in step 1 is achieved.
4. Tighten jamnuts.

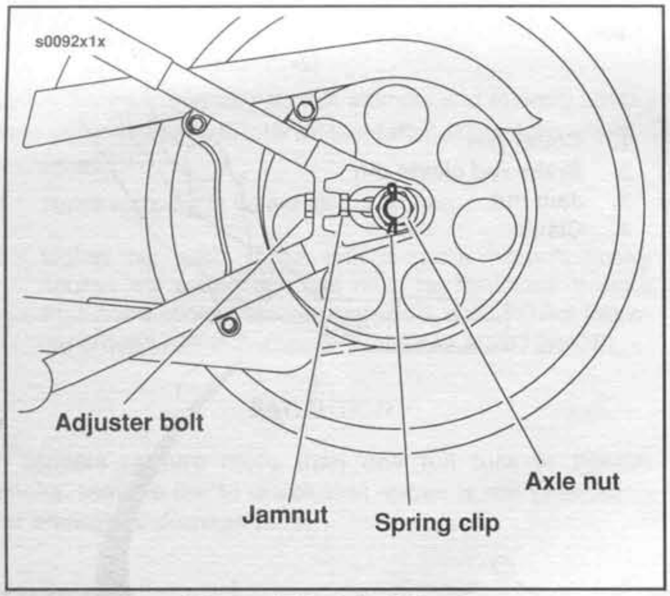


Figure 1-12. Axle Adjuster

CAUTION

Do not exceed 65 ft-lbs (88 Nm) when tightening the axle nut. Exceeding 65 ft-lbs (88 Nm) may cause the wheel bearings to seize during operation, resulting in personal injury.

5. Tighten axle nut to 60 ft-lbs (81 Nm) and check to see if the spring clip can be installed. If required, tighten nut just enough to align axle hole and nut slots, but do not exceed 65 ft-lbs (88 Nm).

REAR FORK PIVOT BOLTS

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the rear fork pivot bolts as follows:

1. Check that rear fork pivot bolts are torqued to 120-150 ft-lbs (163-203 Nm).

REAR SHOCK ABSORBERS

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the rear shock absorbers for signs of leakage or damage, and replace if necessary.

AIR CLEANER

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect and clean the air cleaner filter element as follows:

1. See Figure 1-13. Remove screw, washer, and air cleaner cover. Pull rubber breather connectors from the back of the filter element and remove element.

WARNING

Low pressure air can blow debris into your face and eyes causing injury. Always wear eye protection or a face shield when using pressurized air. Inadequate safety precautions may result in personal injury.

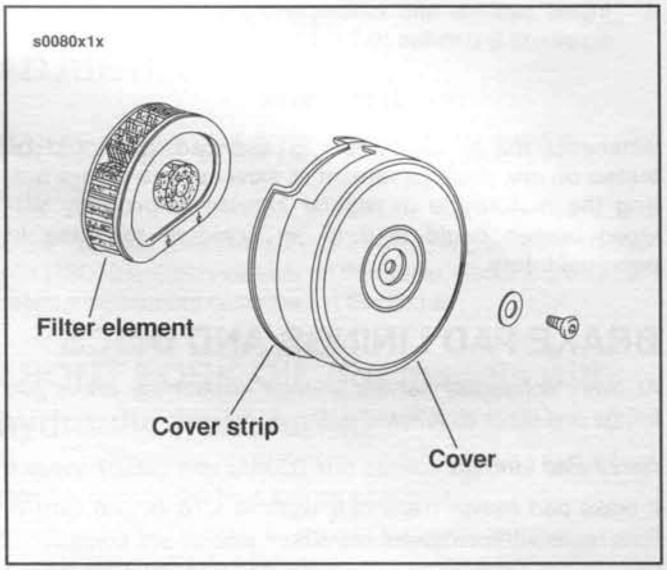


Figure 1-13. Air Cleaner

2. Wash the paper/wire mesh air filter element in lukewarm water with a mild detergent. Allow filter to either air dry or blow it dry, from the inside, with low pressure air. Do not use an air cleaner filter oil on the Harley-Davidson paper/wire mesh air filter element.
3. Reattach breather connectors to the back of the filter element and place the element back into position.
4. Place the cover and cover seal strip over filter and install screw and washer. Tighten the air cleaner cover screw to 3-5 ft-lbs (4-7 Nm).

FUEL TANK FILTER

At every 5000 mile (8000 km) service interval, remove and inspect the fuel tank filter as follows:

WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow open flame or sparks anywhere in the area when refueling or servicing the fuel system. Refuel only in a well ventilated area. Inadequate safety precautions may result in personal injury.

1. See Figure 1-14. Turn handle to OFF (horizontal) position. Remove the fuel hose from the outlet nipple and remove the vacuum hose from the vacuum nipple.
2. Attach a piece of fuel hose to fuel outlet nipple and route hose into a proper, clean gasoline container.
3. Turn valve handle to RESERVE (up).
4. Using the appropriate hose adapter, connect the PLASTIC MITY-VAC® HAND PUMP, Part No. HD 23738, to vacuum nipple on valve.
5. Gently apply a vacuum of 1-10 in. of Mercury (Hg) or just enough vacuum to get a good flow of gasoline through the valve.

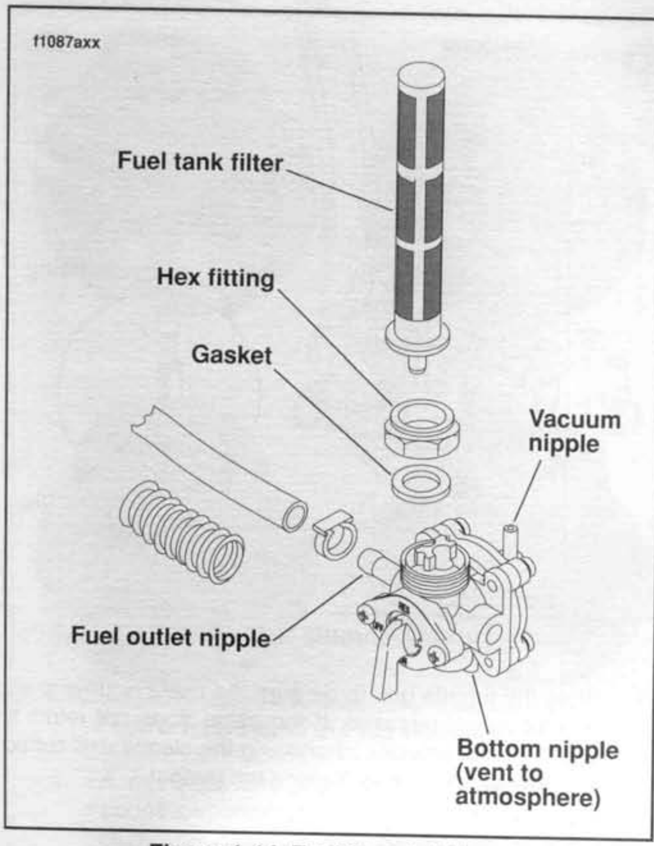


Figure 1-14. Fuel Supply Valve

CAUTION

Do not apply a vacuum greater than 10 in. of Hg to the valve at the vacuum nipple to avoid damaging the valve diaphragm.

6. After tank is drained, turn the hex fitting that attaches the valve to the fuel tank counterclockwise and remove the valve, gasket, and filter.
7. Clean or replace the fuel filter.
8. Coat the valve threads with Loctite PIPE SEALANT WITH TEFLON.
9. Install new gasket on valve and install fuel filter.
10. Thread fitting on right hand threads of fuel tank two turns. Hold fitting and thread valve into left hand threads of fitting for two turns.
11. Hold valve and tighten fitting (clockwise) to 15 - 20 ft-lbs (20 - 27 Nm).

WARNING

Do not thread fitting onto valve more than two turns to avoid "bottoming" fitting on valve. This could cause a gasoline leak, fire hazard, and possible personal injury.

12. Connect fuel hose to the valve using new clamp and HD-97087-66B Hose clamp pliers.
13. Connect the hose to the carburetor using new clamp and HD-97087-66B Hose clamp pliers.

CAUTION

Do not allow dirt or fluids to get into the vacuum hose assembly that connects the fuel valve and V.O.E.S. to the intake manifold. Contaminants could block the vacuum signal or inhibit free motion of moving parts which could cause the fuel valve to remain open. If the fuel supply valve remains open, fuel can drain into the engine oil and cause engine damage.

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

FUEL SYSTEM LINES AND FITTINGS

At every scheduled service interval, and after the fuel tank filter has been serviced (if scheduled), inspect the fuel system lines and fittings for leaks.

ENRICHENER CONTROL

At every scheduled service interval, inspect the enrichener controls as follows:

The fuel enrichener knob should open, remain open and then close without binding. The knurled plastic nut next to the enrichener knob controls the ease or difficulty with which the cable slides within the cable conduit.

If adjustment is needed:

1. Loosen hex nut at backside of mounting bracket.

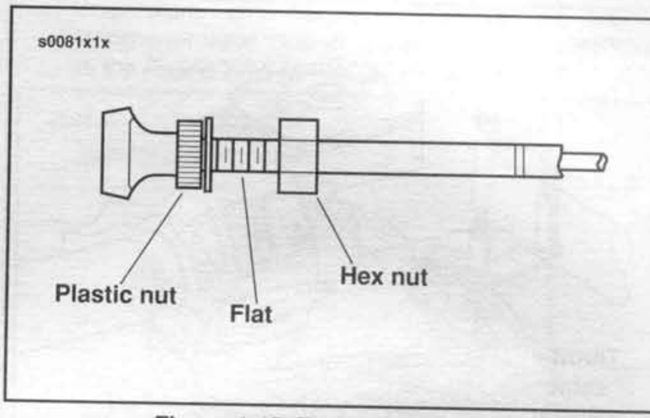


Figure 1-15. Enrichener Control

2. Move cable assembly free of slot in mounting bracket.
3. Hold cable assembly at flat with adjustable wrench. Turn knurled plastic nut counterclockwise by hand, to reduce sliding resistance until knob slides inward unaided.
4. Turn plastic nut clockwise to increase sliding resistance until knob remains fully out without holding and closes with relative ease.
5. Position cable assembly in slot in bracket. Tighten hex nut at backside of bracket.

CAUTION

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

THROTTLE CABLES

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the throttle and clutch cables as follows:

⚠WARNING

The throttle control must operate freely without binding. Irregular or sticking throttle response could cause a loss of control, leading to an accident resulting in personal injury.

Inspection and Lubrication

1. Remove the two screws that separate the upper handlebar housing from the lower housing.
2. Unhook each ferrule and cable from the throttle grip and remove the throttle sleeve.
3. Apply a light coat of graphite to the handlebar and replace throttle grip.
4. Put one or two drops of Super Oil, Part No. 94968-85TV into the housing of each cable.
5. When assembling the housing, torque the screws to 35 - 45 **in-lbs** (4 - 5 Nm).

Adjustment

1. See Figure 1-16. Turn the cable adjusters and jamnuts as short as they will go. Both cables should have zero adjustment at the start of this procedure.

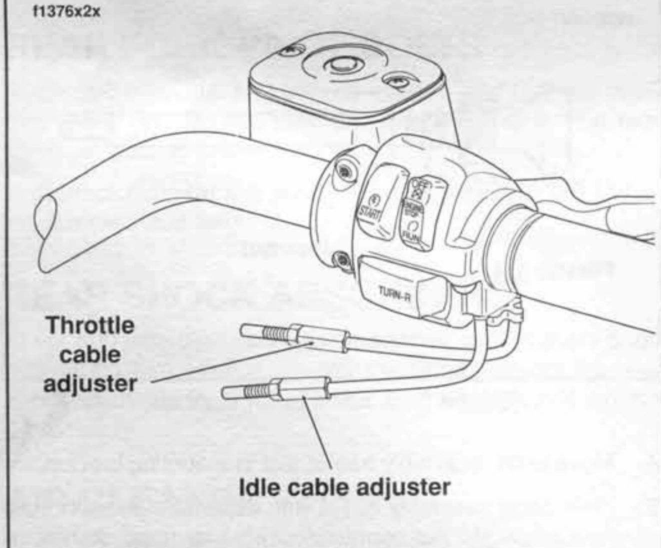


Figure 1-16. Throttle Cable Adjusters

2. Point the front wheel straight ahead. Turn the throttle grip wide open and hold it there. Now turn the throttle cable adjuster, lengthening the sleeve until the throttle cam just touches the cam stop. Tighten the adjuster jamnut and release the throttle.
3. Turn the front wheel full right.
4. See Figure 1-17. Turn the idle cable adjuster, lengthening the sleeve until the cable housing just touches the spring in the cable support sleeve.

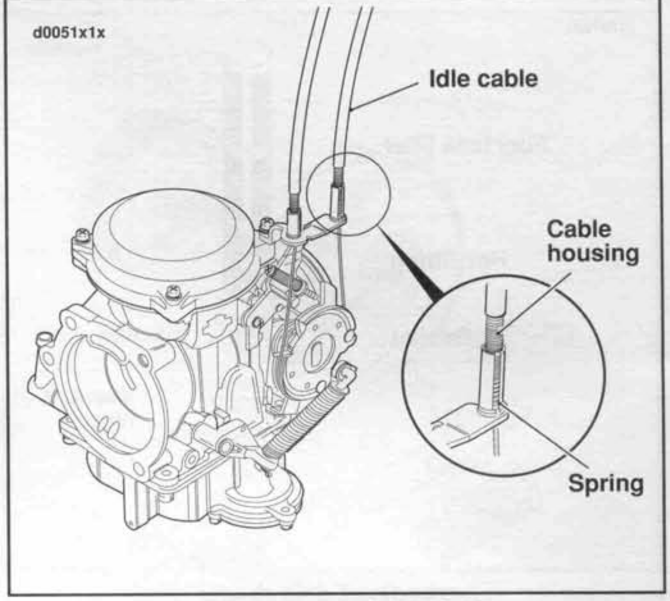


Figure 1-17. Throttle Cable Adjusters

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

ENGINE MOUNTS

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, inspect the engine mounting hardware as follows:

1. Torque the four engine-to-frame mounting bolts to 33-38 ft-lbs (45-52 Nm).
2. Torque the two upper engine mounting bracket-to-cylinder head bolts to 28-35 ft-lbs (38-48 Nm).
3. Torque the one upper engine mounting bracket-to-frame bolt to 45-50 ft-lbs (61-68 Nm).

Inspect all the engine mounting hardware for damage.

SPARK PLUGS

At every 5000 mile (8000 km) service interval inspect, and at every 10,000 mile (16000 km) service interval replace, the spark plugs as follows:

Size	14 mm
Gap	0.038-0.043 in. (0.97-1.09 mm)
Type	Harley-Davidson No. 5R6A (no substitute)

The 5R6A plug has a resistor element to reduce radio interference originating in the motorcycle ignition system. Only resistor type plugs should be used with the electronic ignition system.

1. Remove plugs and examine plugs immediately. The deposits on the plug base are an indication of the plug efficiency and are a guide to the general condition of rings, valves, carburetor and ignition system.

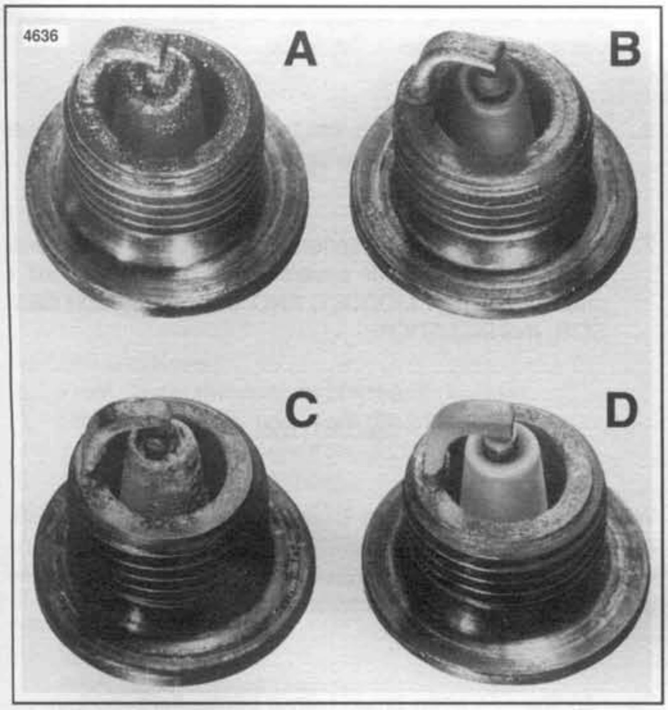


Figure 1-18. Types of Plug Base Deposits

A. A wet black and shiny deposit on plug base, electrodes and ceramic insulator tip indicate an oil fouled plug. The condition may be caused by worn rings and pistons, loose valves, weak battery or faulty ignition.

B. A dry fluffy or sooty black deposit indicates a too rich carburetor air/fuel mixture or long periods of engine idling.

C. An overheated plug can be identified by a light brown, glassy deposit. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes. This condition is caused by too lean an air/fuel mixture, 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 should be replaced.

D. A plug with a white, yellow or light tan to rusty brown powdery deposit indicates balanced combustion. The deposits may be cleaned off at regular intervals if desired.

2. Set the spark plug gap using a wire-type gauge. Bend the outside of the electrode so only a slight drag on the gauge is felt when passing it between electrodes. Never make adjustments by bending the center electrode. Set gap on all plugs at 0.038-0.043 in. (0.97-1.09 mm)

3. Before installing spark plugs, check condition of threads in cylinder head and on plug. If necessary soften deposits with penetrating oil and clean out with a thread chaser.

4. Apply engine oil to plug threads and install spark plug finger tight. Tighten to 18-22 ft-lbs (24-30 Nm).

ELECTRICAL COMPONENTS

At every scheduled service interval, inspect the operation of all electrical components and switches.

ENGINE IDLE SPEED

At every scheduled service interval inspect the engine idle speed as follows:

NOTE

- *The C.V. carburetor has an enrichener circuit that will cause the engine to idle at approximately 2000 rpm with the engine at normal operating temperature and the enrichener knob pulled fully out.*
- *The increase in idle speed is intended to alert the rider that the engine is warmed up to normal operating temperature and the enrichener knob should be pushed all the way in.*
- *Continuing to use the enrichener when the engine is at full operating temperature WILL CAUSE FOULED PLUGS.*
- *TECHNICIAN – Be sure the engine is warmed up to normal operating temperature and the enrichener knob is pushed all the way in BEFORE adjusting engine idle speed. Be aware that because there are variations in individual components, it is possible for a properly warmed up engine to idle at 2000 rpm with the enrichener knob pulled PARTIALLY OUT.*

1. See Figure 1-19. With the engine at normal operating temperature and the enrichener all the way in (enrichener valve closed) adjust the throttle stop screw so the engine idles at 1000-1050 rpm.

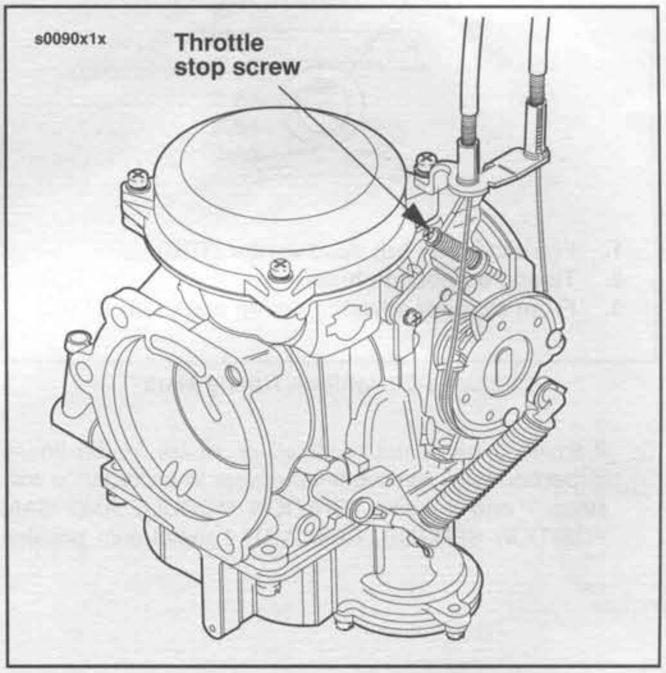


Figure 1-19. Carburetor

NOTE

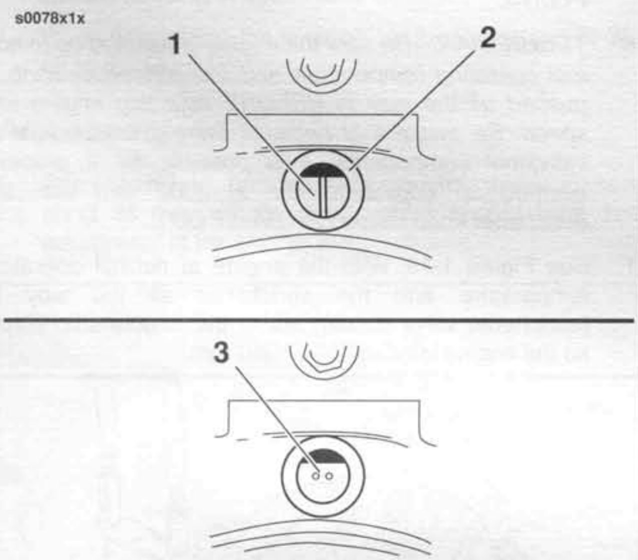
Use a test tachometer, connected to negative ignition coil terminal, to measure engine rpm on models without tachometers.

IGNITION TIMING AND V.O.E.S.

At every 5000 mile (8000 km) service interval, inspect the ignition timing and Vacuum Operated Electric Switch (V.O.E.S.) as follows:

Use an INDUCTIVE TIMING LIGHT, Part No. HD-33813 (timing gun) to view ignition timing mark on flywheel through TIMING MARK VIEW PLUG, Part No. HD-96295-65D, screwed into timing inspection hole. Be sure view plug does not touch flywheel.

1. Connect timing light leads to front spark plug cable, ground and battery positive terminal.
2. Be sure vacuum hose is properly installed at carburetor and at vacuum operated electric switch.
3. Start engine and check that engine speed is 1050-1500 rpm. Light will flash each time spark occurs.
4. See Figure 1-20. Aim timing light into timing inspection hole. Front cylinder advance timing mark should be centered in timing inspection hole.



1. **Front cylinder top dead center (TDC)**
2. **Timing inspection hole**
3. **Front cylinder advance timing mark (20˚ BTDC)**

Figure 1-20. Ignition Timing Mark

5. If timing mark is not centered or visible in the timing inspection hole, remove timer covers in accordance with steps 1 and 2 under IGNITION MODULE AND CAM POSITION SENSOR, REMOVAL. Loosen cam position sensor screws just enough so that plate can be rotated using a screwdriver in the notch.
6. With timing light aimed into inspection hole, rotate plate until timing mark is in the center of the inspection hole.
7. Tighten cam position sensor screws and install gasket inner and outer timer covers following steps 5 and 6 under IGNITION MODULE AND CAM POSITION SENSOR, INSTALLATION.

⚠CAUTION

When checking advance timing, always check V.O.E.S. operation. Failure to do so may result in running engine with too much spark advance, and may cause extreme engine knock and engine failure.

After engine has been timed with a strobe light, perform the following check:

8. With the engine idling, remove vacuum hose from carburetor and momentarily plug carburetor fitting. Timing will retard and engine speed should decrease. Reinstall vacuum hose to carburetor. Timing mark should reappear and engine speed should increase to preset speed.

If speed does not decrease and increase as described, check V.O.E.S. connection directly above switch. The V.O.E.S. must be replaced if it is malfunctioning.

FASTENERS

At the 500 mile (800 km) service interval, and at every 5000 mile (8000 km) service interval thereafter, torque all fasteners, except head bolts, to service manual specifications. Replace any damaged or missing hardware.

ROAD TEST

At every scheduled service interval perform a road test after all work is complete.

CHASSIS 2

SUBJECT PAGE NO.

SPECIFICATIONS

DIMENSIONS

	Wheel Base	Overall Length	Overall Height	Saddle Height
FXSTC	66.5 in. (168.9 cm)	94.92 in. (241.1 cm)	47.0 in. (119.4 cm)	26.7 in. (67.8 cm)
FXSTS	64.4 in. (163.6 cm)	92.5 in. (234.9 cm)	47.0 in. (119.4 cm)	26.1 in. (66.3 cm)
FXSTSB	64.4 in. (163.6 cm)	92.5 in. (234.9 cm)	47.0 in. (119.4 cm)	25.7 in. (65.3 cm)
FLSTC	63.9 in. (162.3 cm)	94.0 in. (238.8 cm)	59.4 in. (150.9 cm)	26.5 in. (67.3 cm)
FLSTF	63.9 in. (162.3 cm)	93.9 in. (238.5 cm)	48.0 in. (121.9 cm)	26.5 in. (67.3 cm)
FLSTS	63.1 in. (160.3 cm)	94.0 in. (238.8 cm)	44.0 in. (111.8 cm)	25.8 in. (65.6 cm)

WEIGHT

	Dry Weight	GVWR	GAWR-Front	GAWR-Rear
FXSTC	613 lbs (278 kg)	1084 lbs (492 kg)	390 lbs (177 kg)	694 lbs (315 kg)
FXSTS	625 lbs (283 kg)	1084 lbs (492 kg)	390 lbs (177 kg)	694 lbs (315 kg)
FXSTSB	620 lbs (281 kg)	1084 lbs (492 kg)	390 lbs (177 kg)	694 lbs (315 kg)
FLSTC	704 lbs (319 kg)	1118 lbs (507 kg)	402 lbs (182 kg)	716 lbs (325 kg)
FLSTF	631 lbs (286 kg)	1118 lbs (507 kg)	402 lbs (182 kg)	716 lbs (325 kg)
FLSTS	690 lbs (313 kg)	1135 lbs (515 kg)	405 lbs (184 kg)	730 lbs (331 kg)

NOTE

Gross Vehicle Weight Rating (GVWR) (maximum allowable loaded vehicle right-hand corresponding Gross Axle Weight Ratings (GAWR) are given on a label located on the right front downtube.

CAPACITIES

FXSTC	**Fuel Tank** 5.2 gal (19.7 L) total 0.6 gal (2.3 L) reserve **Front Fork, Each (wet)** 10.2 oz (302 ml)
FLSTC, FLSTF, FLSTS, FXSTS, FXSTSB	**Fuel Tank** 4.2 gal (15.9 L) total 0.4 gal (1.5 L) reserve **Front Fork, Each (wet), except Springers** 11.5 oz (340 ml)
ALL MODELS	**Oil Tank (w/filter)** 3.0 qt (2.8 L) **Transmission** 24 oz (709.8 ml) **Primary Chaincase** **1997 Models:** 32 oz. (946.4 ml) **1998 Models:** 26 oz. (768.9 ml)

TIRE DATA

⚠WARNING

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

- **In addition, using tires other than those specified may adversely affect motorcycle stability.**
- **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. Tube sizes are printed on the tube.**

DUNLOP TIRES ONLY	Tire Pressure (cold)			
	Front		Rear	
	psi	kPa	psi	kPa
FLSTC, FLSTF, FLSTS Solo Rider Rider & passenger	 36 36	 248 248	 36 40	 248 276
FXSTC, FXSTS, FXSTSB Solo Rider Rider & passenger	 30 30	 207 207	 36 40	 248 276

⚠WARNING

Maximum inflation pressure must not exceed specification on tire sidewall. If tires are overfilled, they could blow out while riding causing personal injury.

TORQUE VALUES

Slider cap nuts (FLSTC, FLSTF, FXSTC)	9-13 ft-lbs (12-18 Nm)
Front axle nut (FXSTC, FLSTC, FLSTF)	45-50 ft-lbs (61-68 Nm)
Front axle nut (FXSTS, FXSTSB, FLSTS)	60-65 ft-lbs (81-88 Nm)
Rear axle nut	60-65 ft-lbs (81-88 Nm)
Brake disc screws	Rear 30-45 ft-lbs (41-61 Nm) Front 16-24 ft-lbs (22-33 Nm)
Brake bleeder valve	80-100 **in-lbs** (9-11.3 Nm)
Brake pad retainer screw	40-50 **in-lbs** (4.5-5.6 Nm)
Rear wheel sprocket mounting bolts	55-65 ft-lbs (74.6-88.1 Nm)
Rear brake caliper (mounting) pin bolts	15-20 ft-lbs (20-27 Nm)
Rear fender supports	30-33 ft-lbs (41-45 Nm)
Rear shock absorber mounting bolts	115-130 ft-lbs (156-176 Nm)
Front brake bracket to fender bracket mounting bolt	FXSTS, FXSTSB, FLSTS 10-20 ft-lbs (14-27 Nm)
Front brake caliper mounting bolts	FXSTC, FLSTC, FLSTF (upper) 25-30 ft-lbs (34-41 Nm) FXSTS, FXSTSB, FLSTS (upper) **1997 Models (12 pt. bolt):** 42-46 ft-lbs (57-62 Nm) **1998 Models (Socket head bolt):** 28-30 ft-lbs (38-41 Nm) FXSTS, FXSTSB, FLSTS (lower) 25-30 ft-lbs (34-41 Nm)
Brake banjo bolts	17-22 ft-lbs (23-30 Nm)

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

The full 17 digit Vehicle Identification Number (V.I.N.) is stamped on the right downtube socket of the steering head and on a label located on the right front frame downtube. An abbreviated V.I.N. is stamped on the left side crankcase at the base of the rear cylinder.

1997 MODELS

BJ – FLSTC – Heritage Softail Classic
BM – FLSTF – Fat Boy
BR – FLSTS – Heritage Springer
BK – FXSTC – Softail Custom
BL – FXSTS – Springer Softail
BP – FXSTSB – Bad Boy

Model Designation

Engine Type

Varies – 1 thru 8

V for 1997 models

Sequential Number

1 HD 1 BJ L 4 * V Y 010000

*Varies – can be 0 thru 9 or X

Sample V.I.N. as it appears on the steering head –1HD1BJL41VY010000
Sample abbreviated V.I.N as it appears on the engine – **BJLV010000**

1998 MODELS

BJ – FLSTC – Heritage Softail Classic
BM – FLSTF – Fat Boy
BR – FLSTS – Heritage Springer
BK – FXSTC – Softail Custom
BL – FXSTS – Springer Softail

Model Designation

Engine Type

Varies – 1 thru 8

W for 1998 models

Sequential Number

1 HD 1 BJ L 4 * W Y 010000

*Varies – can be 0 thru 9 or X

Sample V.I.N. as it appears on the steering head –1HD1BJW41VY010000
Sample abbreviated V.I.N as it appears on the engine – **BJLW010000**

FRONT WHEEL (MODELS WITH HYDRAULIC FORKS)

REMOVAL

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. See Figure 2-1. Remove brake caliper(s) and let caliper(s) hang loose. Use care not to scratch the fender paint.

NOTE

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

3. Remove axle nut, lock washer, and washer.

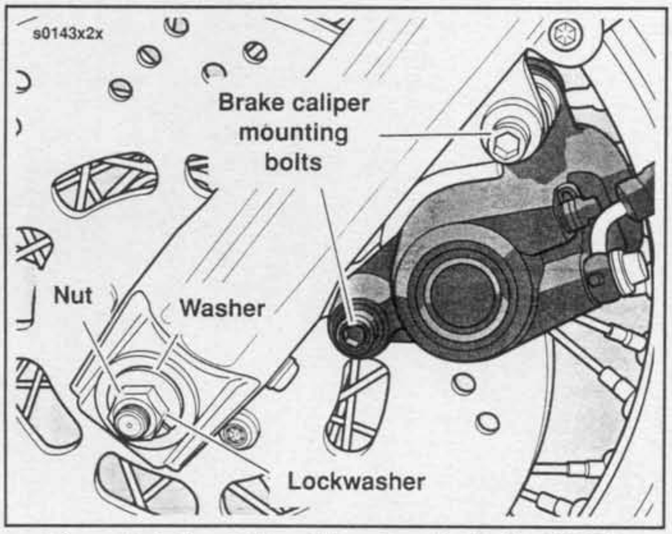


Figure 2-1. Front Wheel Mounting (left side FXSTC shown)

4. See Figure 2-2. Loosen the slider cap nuts and pull the axle free.

NOTE

On FLSTC, the hubcap will come off with the wheel.

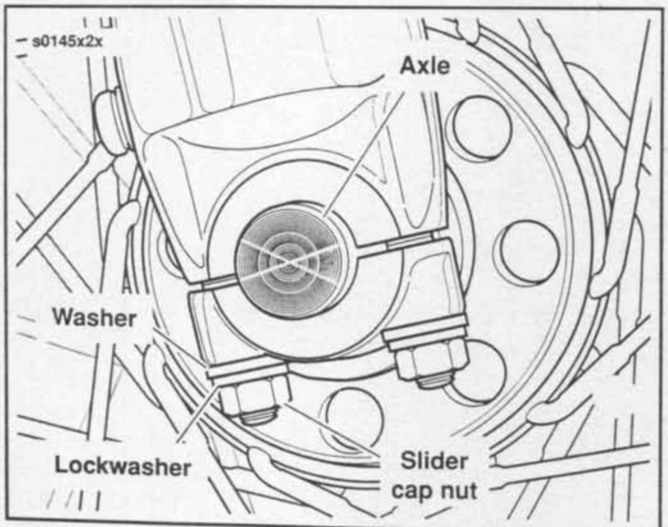


Figure 2-2. Front Wheel Mounting (FLSTC right side)

DISASSEMBLY

Disc Wheel

1. See Figure 2-3. Remove the spacer (5), oil seals (7), bearing cones (8), spacer washer (9), shim pack (10), and spacer sleeve (11). Discard oil seals.
2. If it is necessary to remove the bearing races from the wheel, use WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.
3. If it is necessary to remove the brake disc, remove the T-40 Torx screws (2) securing the disc. Mark the wheel and disc so they will be assembled in their original positions.

Laced Wheel

1. See Figure 2-4. Remove the spacer (4), oil seals (7), bearing cones (8), spacer washer (9), shim pack (10), and spacer sleeve (12). Discard the oil seals.
2. If it is necessary to remove the bearing races, use WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.
3. If it is necessary to remove the brake disc, remove the screws (5) securing the brake disc. Mark the wheel and disc so they will be assembled in their original positions.

CLEANING AND INSPECTION

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

⚠WARNING

Never use compressed air to "spin-dry" bearings. Spinning bearings with compressed air can cause a bearing to fly apart resulting in personal injury.

2. Replace the brake disc if warped, badly scored, or worn beyond the minimum thickness stamped on the disc.
3. Check the bearings and races for wear or corrosion and replace them if necessary. Replace bearings in sets only.
4. Inspect shims for tears, cuts, or kinks and replace as necessary.

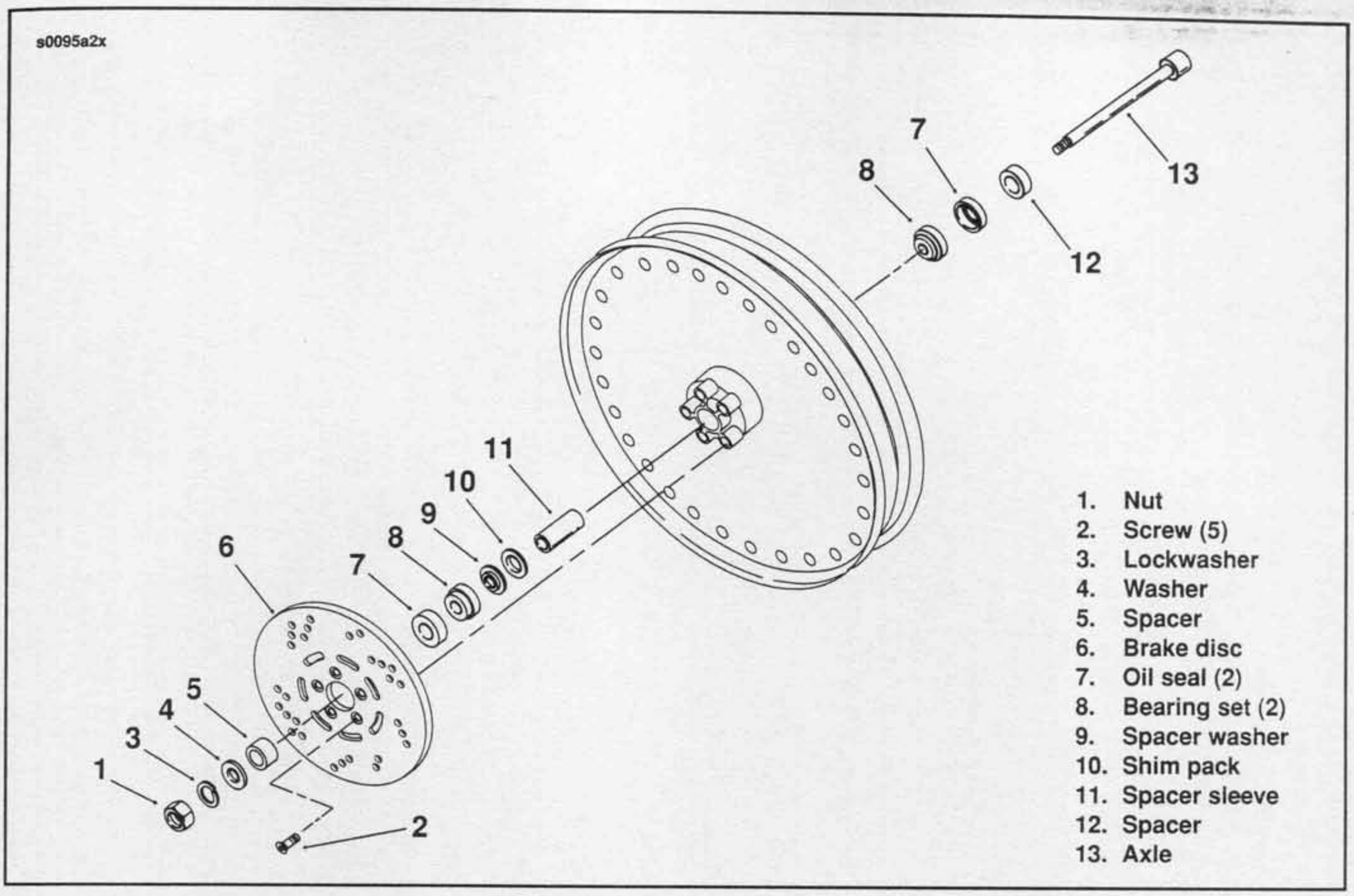


Figure 2-3. Disc Front Wheel

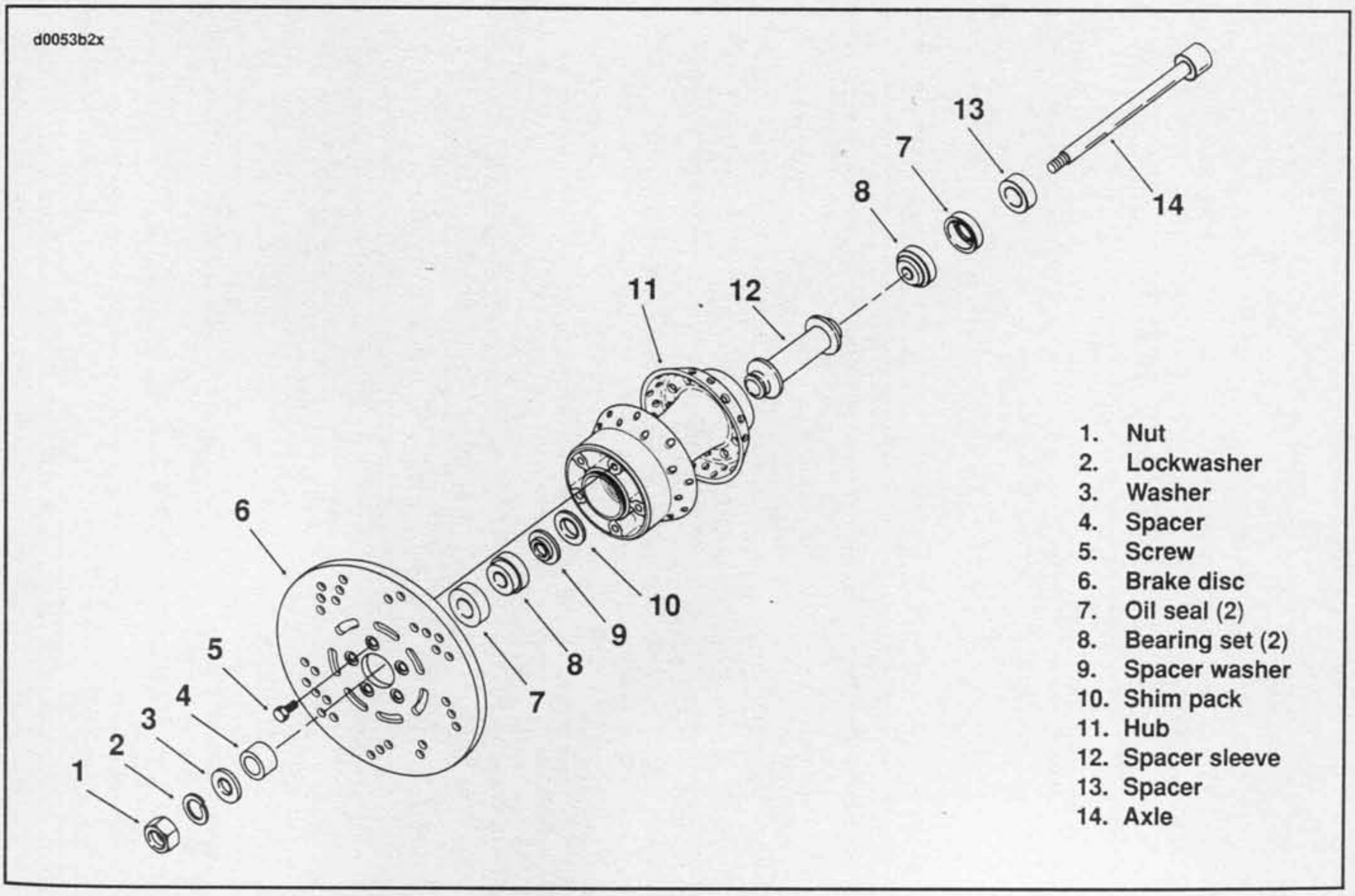


Figure 2-4. Laced Front Wheel

ASSEMBLY

Disc Wheel

1. See Figure 2-3. Be sure brake disc is clean. Install brake disc in the original position using new Torx screws (2). Tighten screws to 16-24 ft-lbs (22-33 Nm). If wheel cover was removed, install it now.
2. If bearing races were removed for replacement, lubricate the new races with oil and install races into hub using WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071, and an arbor press.
3. Place the spacer sleeve (11), shim pack (10), and spacer washer (9) into the wheel.

⚠CAUTION

Be sure smaller diameter on spacer washer (9) faces outward toward bearing. If spacer washer is reversed, the large diameter could contact the bearing rollers and cage and damage the bearing.

4. Pack the bearing cones with H-D WHEEL BEARING GREASE, Part No. 99855-89 and install one in each side of wheel hub. Pack the space between bearings and oil seals with grease.
5. Lightly coat the outside lip of each oil seal with engine oil. Press each seal into each side of the wheel until the seal is flush to 0.04 in. (1.0 mm) below outside edge of wheel hub.
6. Wheel and tire must be true. See CHECKING DISK RIM RUNOUT.

Laced Wheel

1. See Figure 2-4. If the hub and rim were disassembled, see assembly instructions under LACING WHEELS later in this section.
2. Be sure brake disc is clean. Install brake disc in the original position using new screws (5). Tighten screws to 16-24 ft-lbs (22-33 Nm).
3. If bearing races were removed for replacement, lubricate the new races with oil and install races into hub using WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, HD-33416.
4. Place the spacer sleeve (12), shim pack (10), and spacer washer (9) into the wheel.

⚠CAUTION

Be sure smaller diameter on spacer washer (9) faces outward toward bearing. If spacer washer is reversed, the large diameter could contact the bearing rollers and cage and damage the bearing.

5. Pack the bearing cones with H-D WHEEL BEARING GREASE, Part No. 99855-89 and install one in each side of wheel hub. Pack the space between bearings and oil seals with grease.
6. Lightly coat the outside lip of each oil seal with engine oil. Press each seal into each side of the wheel until the seal is flush to 0.02 in. (0.51 mm) below outside edge of wheel hub.
7. Install spacers (4, 13) with chamfered ends toward inside of wheel.

NOTE

On FLSTC, install the O-ring. Slide the hubcap into wheel hub and secure with snap ring.

8. Wheel and tire must be true. See TRUING LACED WHEEL.

INSTALLATION

1. Place wheel into front fork with valve stem hole on the right side.
2. Coat the axle with Loctite ANTI-SEIZE LUBRICANT. Insert axle into the wheel from the right side.
3. Install the washer, lockwasher, and axle nut. Tighten the slider cap nuts to prevent the axle from turning, then tighten the axle nut to 50 ft-lbs (68 Nm). After axle nut is tightened, loosen, then retighten, the slider cap nuts to 9-13 ft-lbs (7-15 Nm).

⚠WARNING

Wheel bearing end play on all models is set at 0.002 to 0.006 in. (0.05 to 0.15 mm) on all models except the FLSTS and at 0.001 to 0.010 in. (0.025 to 0.25 mm) on the FLSTS and must not be altered. Check end play after tightening axle nut. Excessive end play may cause a handling problem, and lack of adequate end play could result in a bearing seizure, both of which could cause an accident resulting in personal injury.

NOTE

The shim pack, Item (10) in Figures 2-3 and 2-4, controls the amount of wheel bearing end play.

4. See Figure 2-5. Mount a magnetic base dial indicator to the brake disc with the dial's contact point on the end of the axle

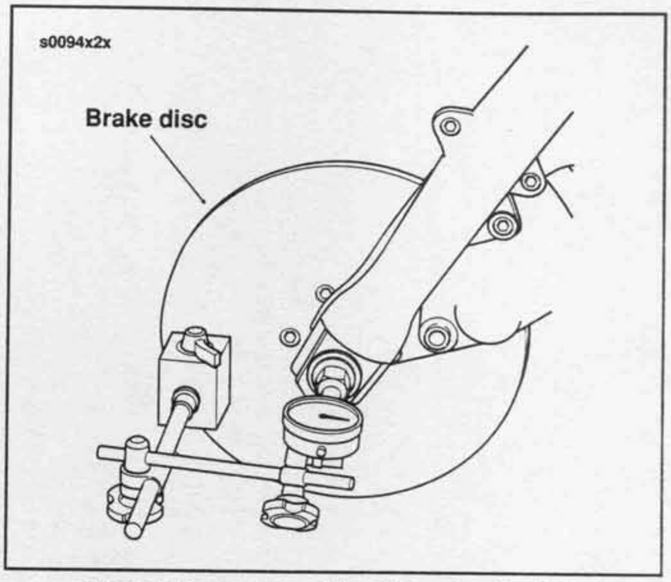
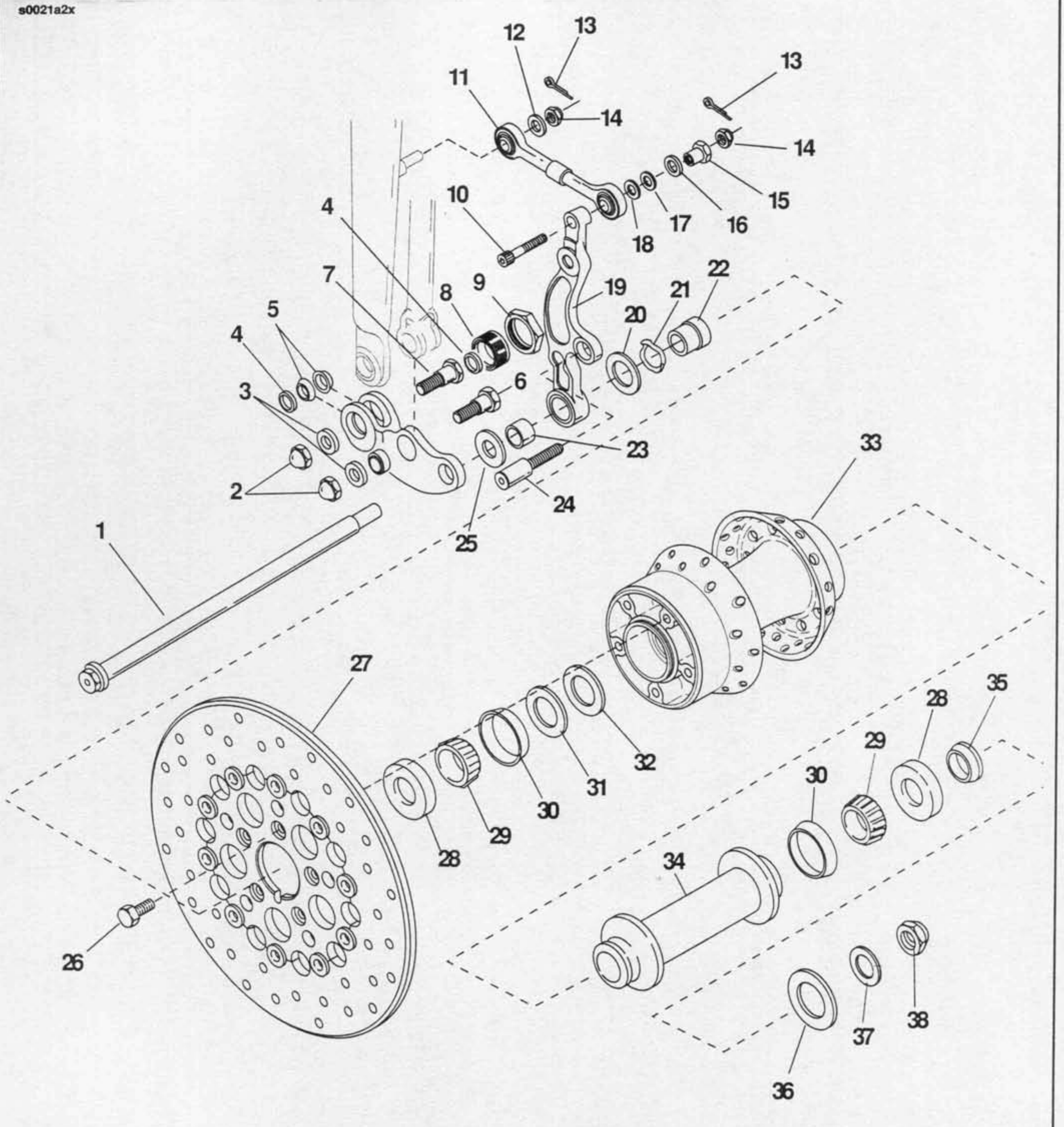


Figure 2-5. Checking Wheel Bearing End Play

5. Turn the wheel through several rotations, then move the wheel side to side to check for end play. If the end play is not 0.002 to 0.006 in. (0.05 to 0.15 mm), remove the wheel and substitute shims as required to obtain specification. Substitute thicker shim(s) if the end play must be increased, or thinner shim(s) if the end play must be reduced.

Shim Part No.	Thickness
43290-82	0.030-0.033 in. (0.76-0.84 mm)
43291-82	0.015-0.017 in. (0.38-0.43 mm)
43292-82	0.0075-0.0085 in. (0.190-0.216 mm)
43293-82	0.0035-0.0045 in. (0.089-0.114 mm)
43294-82	0.0015-0.0025 in. (0.038-0.064 mm)

6. Install the brake caliper to the fork sides. Tighten the caliper mounting bolts to 25-30 ft-lbs (34-41 Nm).



1. Axle
2. Acorn nuts
3. Washers
4. Bearing races
5. Spherical bearings
6. Pivot stud
7. Pivot stud
8. Bearing retainer
9. Jam nut
10. Socket head screw
11. Brake reaction link
12. Washer
13. Cotter pin
14. Lock nut
15. Shaft nut
16. Spacer
17. Washer
18. Washer
19. Bracket
20. Thrust washer
21. Wave washer
22. Spacer
23. Bushing
24. Lower mounting pin
25. Washer
26. Screw
27. Brake disk
28. Seals
29. Bearing cones
30. Bearing races
31. Washer
32. Shim pack
33. Hub
34. Spacer sleeve
35. Spacer
36. Washer
37. Washer
38. Axle locknut

Figure 2-6. Spring Fork–Hub and Axle Assembly (FXSTS, FXSTSB)

REMOVAL

Support vehicle so weight is off front wheel.

1. Remove the brake caliper mounting hardware and let brake line support caliper. See SPRINGER FORK FRONT BRAKE in this Section.

NOTE

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

2. See Figure 2-6. Remove axle locknut (39) and washer (38). Discard locknut.

3. Remove front fender. See FRONT FENDER in this Section.

4. Place a towel under hub to catch any loose parts that may fall from hub, then slide axle (1) out of hub (34).

5. Slide hub and wheel assembly out of rockers.

DISASSEMBLY

1. Remove brake bracket (19), spacer (22), thrust washers (20) and (25) and wave washer (21).

2. Remove the oil seals (28), bearings (29), spacer washer (31), shim pack (32), and spacer sleeve (35). Discard oil seals.

3. If it is necessary to remove the bearing races (30), use WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.

4. Mark the wheel and disc so they will be assembled in their original positions. Remove the Torx screws (26) securing the brake disc (27).

CLEANING AND INSPECTION

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

⚠WARNING

Never use compressed air to "spin-dry" bearings. Spinning bearings with compressed air can cause a bearing to fly apart resulting in personal injury.

2. Replace the brake disc if warped, badly scored, or worn beyond the minimum thickness stamped on the disc.

3. Check the bearings and bearing races for wear or corrosion and replace them if necessary. Replace them in sets only.

4. Inspect shims for tears, cuts, or kinks and replace as necessary.

ASSEMBLY

1. See Figure 2-6. Be sure brake disc (27) is clean. Install brake disc in original position using new screws. Tighten screws to 16-24 ft-lbs (22-33 Nm).

2. If bearing races (30) were removed for replacement, lubricate the new races with oil and install races into hub using WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.

3. Place the spacer sleeve (35), shim pack (32), and spacer washer (31) into the hub (34).

⚠CAUTION

Be sure smaller diameter on spacer washer (31) faces outward toward bearing cone. If spacer washer is reversed, the large diameter could contact the bearing rollers and cage and damage the bearing.

4. Pack the bearing cones (29) with Harley-Davidson WHEEL BEARING GREASE, Part No. 99855-89 and install one in each side of the wheel hub. Pack space between bearings and oil seals with WHEEL BEARING grease.

5. Lightly coat the outside lip of each oil seal (28) with engine oil. Press one seal into each side of the wheel so it is flush to 0.020 in. (0.51 mm) below outside edge of wheel hub.

NOTE

Wheel and tire must be true. See TRUING LACED WHEEL.

INSTALLATION

NOTE

You may want to use a dummy axle (Softail), installed from the left side, to make installing the parts easier.

1. Place wheel between rockers with brake disc on the right side.
2. Place axle (1) just barely through right rocker.

NOTE

The special thrust washers are not the same. One has a small I.D. (item 25) and one has a large I.D. (item 20). The small I.D. washer goes BETWEEN the brake bracket and the rocker.

CAUTION

Be sure the Gray, Teflon-coated side of the special thrust washers are against the brake bracket. If the washers are worn through the Teflon, to the brass, replace them.

3. Place large I.D. thrust washer (20) and wave washer (21) on spacer (22), to make an assembly. Place spacer assembly in brake bracket (19).
4. Place small I.D. thrust washer (25) and brake bracket assembly on axle, while carefully sliding axle into hub.
5. Install washer (38) and a **new** axle locknut (39). Tighten axle locknut to 60-65 ft-lbs (81-88 Nm).

WARNING

Wheel bearing end play has been set at 0.002 to 0.006 in. (0.05 to 0.15 mm) on FXSTS and FXSTSB models and must not be altered. Check end play after tightening axle nut. Excessive end play may adversely affect handling, and lack of adequate end play could result in a bearing seizure, both of which could cause an accident resulting in personal injury.

NOTE

The shim pack, Item 32 in Figure 2-6, controls the amount of wheel bearing end play.

6. Mount a magnetic base dial indicator to the brake disc with the dial's contact point on the end of the axle in the same fashion as shown in Figure 2-5.
7. Turn the wheel through several rotations, then move the wheel side to side to check for end play. If the end play is not 0.002 to 0.006 in. (0.05 to 0.15 mm), remove the wheel and substitute thicker shim(s), if the end play must be increased, or thinner shim(s), if end play must be reduced.

Shim Part No.	Thickness
43290-82	0.030-0.033 in. (0.76-0.84 mm)
43291-82	0.015-0.017 in. (0.38-0.43 mm)
43292-82	0.0075-0.0085 in. (0.190-0.216 mm)
43293-82	0.0035-0.0045 in. (0.089-0.114 mm)
43294-82	0.0015-0.0025 in. (0.038-0.064 mm)

8. Install the brake caliper. See SPRINGER FORK-FRONT BRAKE in this Section.
   1997 Models (12 pt. bolt): Tighten top bolt to 42-46 ft-lbs (57-62 Nm) and bottom bolt to 25-30 ft-lbs (34-41 Nm).
   1998 Models (Socket head bolt): Tighten top bolt to 28-30 ft-lbs (38-41Nm) and bottom bolt to 25-30 ft-lbs (34-41 Nm).

FRONT WHEEL - SPRINGER FORK (FLSTS)

REMOVAL

Support vehicle so weight is off front wheel.

1. Remove the brake caliper. See SPRINGER FORK (FLSTS)-FRONT BRAKE in this Section.

NOTE

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

2. See Figure 2-7. Remove left and right hub caps (15) from wheel with HUBCAP REMOVER AND INSTALLER, Part No. HD 41494.

3. Remove special pin (13) and axle castlenut (36) from axle (1).

4. Place a towel under hub to catch any loose parts that may fall from hub. Slide axle (1) out of hub (32).

5. Slide hub and wheel assembly out of rockers.

DISASSEMBLY

1. Remove left and right spacers (35 and 39).

2. Remove the spacers (40 and 41), oil seals (28), bearings (29), shim pack (30), and spacer sleeve (33). Discard oil seals (28).

3. If it is necessary to remove the bearing races (38), use WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.

4. Remove the screws (26) securing the brake disc (27). Mark the hub and disc so they will be assembled in their original positions.

CLEANING AND INSPECTION

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

⚠WARNING

Never use compressed air to "spin-dry" bearings. Spinning bearings with compressed air can cause a bearing to fly apart resulting in personal injury.

2. Replace the brake disc (27) if warped, badly scored, or worn beyond the minimum thickness stamped on the disc.

3. Check the bearings (29) and bearing races (38) for wear or corrosion and replace them if necessary. Replace them in sets only.

4. Inspect shims (30) for tears, cuts, or kinks and replace as necessary.

ASSEMBLY

1. See Figure 2-7. Be sure brake disc (27) is clean. Install brake disc in original position using new screws (26). Tighten screws to 16-24 ft-lbs (22-33 Nm).

2. If bearing races (38) were removed for replacement, lubricate the new races with oil and install races into hub using WHEEL BEARING RACE REMOVER & INSTALLER, Part No. HD-33071 and UNIVERSAL DRIVER HANDLE, Part No. HD-33416.

3. Place the spacer sleeve (33) and shim pack (30) into the hub.

4. Pack the bearings (29) with Harley-Davidson WHEEL BEARING GREASE, Part No. 99855-89 and install one in each side of the wheel hub (32). Pack space between bearings and oil seals with WHEEL BEARING grease.

5. Lightly coat the outside lip of each oil seal (28) with engine oil. Press one seal into each side of the hub so it is flush to 0.020 in. (0.51 mm) below outside edge of wheel hub.

NOTE

Wheel and tire must be true. See TRUING LACED WHEEL.

INSTALLATION

NOTE

The conical spacer (40) goes on the right side. The flat spacer (41) goes on the left (brake disc) side.

1. See Figure 2-7. Install spacers (40 and 41) to hub (32).
2. Place wheel between rockers (37) with brake disc (27) on the left side.

NOTE

The thick spacer goes on the left (brake disc) side. See Figure 2-95 on page 2-77 for proper orientation.

3. Install thin spacer (35) to axle and insert axle (1) through right rocker and hub.
4. Insert axle through left rocker and hub and install thick spacer (39) to axle.
5. Install axle castlenut (36). Tighten castlenut to 60-65 ft-lbs (81-88 Nm) and check to see if the special pin can be installed. If required, tighten nut just enough to align hole and nut slots.
6. Insert special pin (13) to axle.

⚠WARNING

DO NOT operate motorcycle without special pin (13) installed or handling may be adversely affected resulting in personal injury.

7. Install left and right hub caps (15) with HUBCAP REMOVER AND INSTALLER, Part No. HD 41494. Tighten until hubcap makes contact, then tighten 1/4 turn more.

⚠WARNING

Wheel bearing end play has been set at 0.001 to 0.010 in. (0.025 to 0.25 mm) on the FLSTS, and must not be altered. Check end play after tightening axle nut. Excessive end play may adversely affect handling, and lack of adequate end play could result in a bearing seizure, both of which could cause an accident resulting in personal injury.

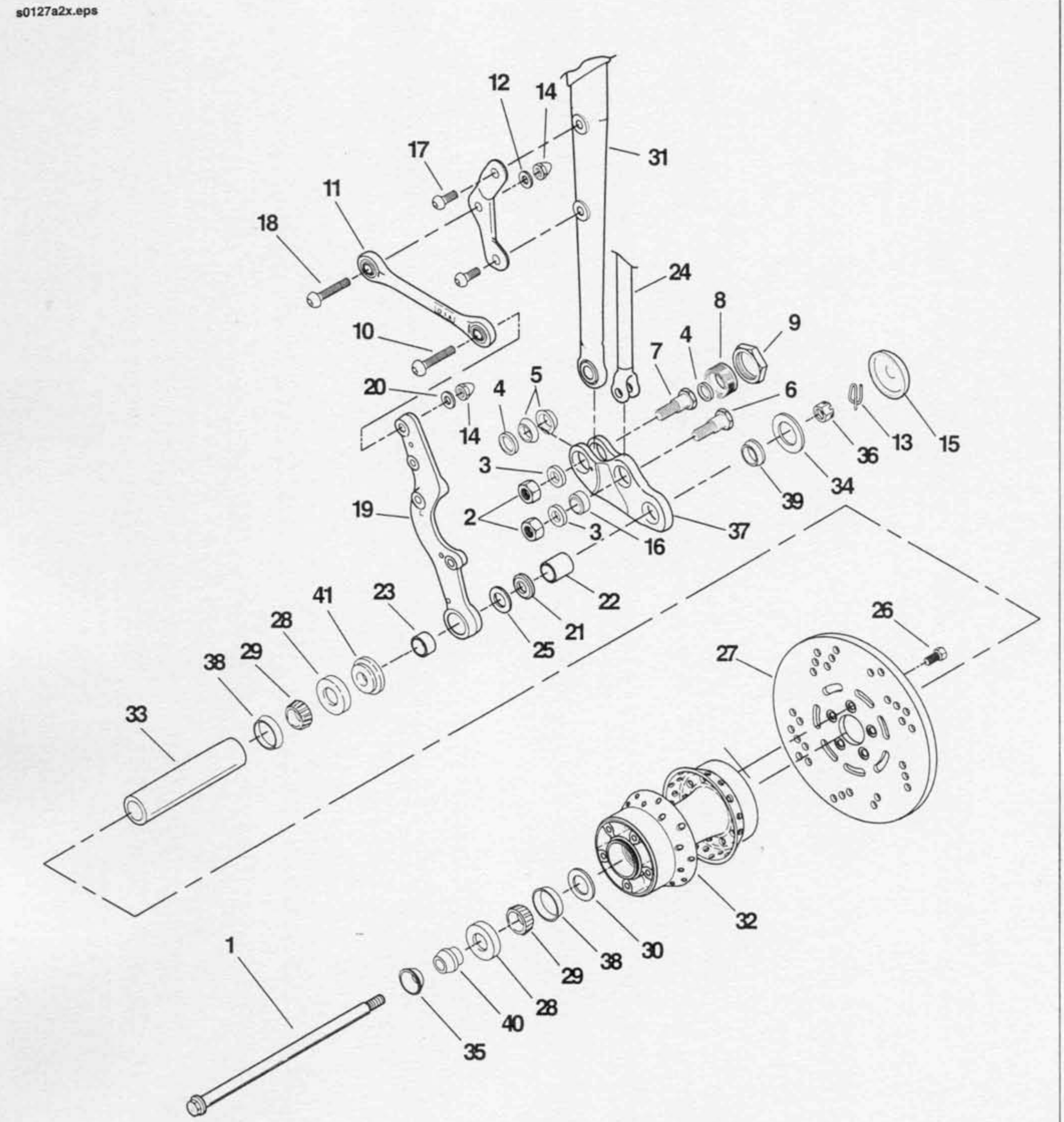
NOTE

The shim pack, Item 30 in Figure 2-7, controls the amount of wheel bearing end play.

8. Mount a magnetic base dial indicator to the brake disc with the dial's contact point on the end of the axle in the same fashion as shown in Figure 2-5.
9. Turn the wheel through several rotations, then move the wheel side to side to check for end play. If the end play is not 0.001 to 0.010 in. (0.025 to 0.25 mm), remove the wheel and substitute shims as required to obtain specification. Substitute thicker shim(s) if the end play must be increased, or thinner shim(s) if end play must be reduced.

Shim Part No.	Thickness
43290-82	0.030-0.033 in. (0.76-0.84 mm)
43291-82	0.015-0.017 in. (0.38-0.43 mm)
43292-82	0.0075-0.0085 in. (0.190-0.216 mm)
43293-82	0.0035-0.0045 in. (0.089-0.114 mm)
43294-82	0.0015-0.0025 in. (0.038-0.064 mm)

10. Install the brake caliper. See SPRINGER FORK-FRONT BRAKE in this Section.
1997 Models (12 pt. bolt): Tighten top bolt to 42-46 ft-lbs (57-62 Nm) and bottom bolt to 25-30 ft-lbs (34-41 Nm).
1998 Models (Socket head bolt): Tighten top bolt to 28-30 ft-lbs (38-41Nm) and bottom bolt to 25-30 ft-lbs (34-41 Nm).



1. Axle
2. Hex nuts
3. Washers
4. Bearing race
5. Spherical bearings
6. Pivot stud
7. Pivot stud
8. Bearing retainer
9. Jam nut
10. Socket head screw
11. Brake reaction link
12. Washer
13. Special pin
14. Acorn lock nut
15. Hub cap
16. Bearing
17. Screw
18. Sockethead screw
19. Bracket
20. Washer
21. Rubber spacer
22. Pivot sleeve
23. Bushing
24. Spring fork
25. Washer
26. Screw
27. Brake disc
28. Seals
29. Bearings
30. Shim pack
31. Rigid fork
32. Hub
33. Spacer sleeve
34. Spacer
35. Thin Spacer
36. Axle castlenut
37. Rocker
38. Bearing Races
39. Thick Spacer
40. Conical Spacer
41. Flat Spacer

Figure 2-7. Spring Fork–Hub and Axle Assembly (FLSTS)

NOTES

LACED OR DISC REAR WHEEL

REMOVAL

1. Support motorcycle so rear wheel is well off the floor. Remove rear muffler if necessary.

2. It may be necessary to remove the debris deflector from swing arm.

3. See Figure 2-8. Remove the spring clip, axle nut, and washer from left side of axle. Tap axle towards right side and remove. Belt adjuster collars will fall loose when axle is removed.

4. Move wheel forward and slip belt off sprocket.

5. Pull wheel and belt sprocket from swing arm.

6. If wheel or sprocket must be replaced, remove bolts and washers securing sprocket to wheel.

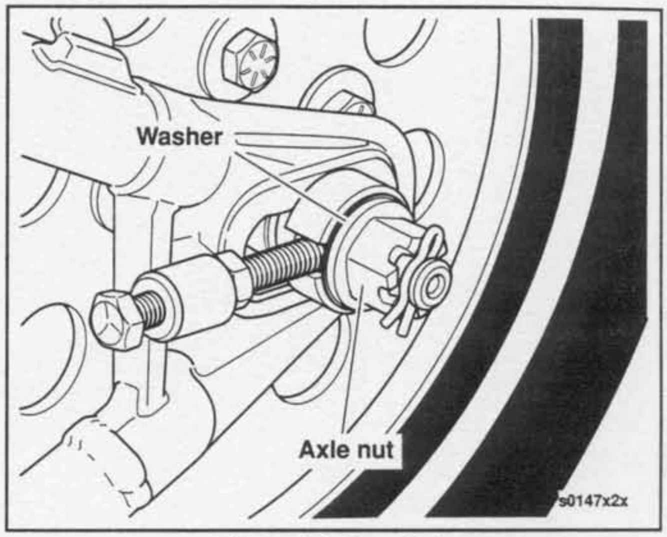


Figure 2-8. Rear Axle

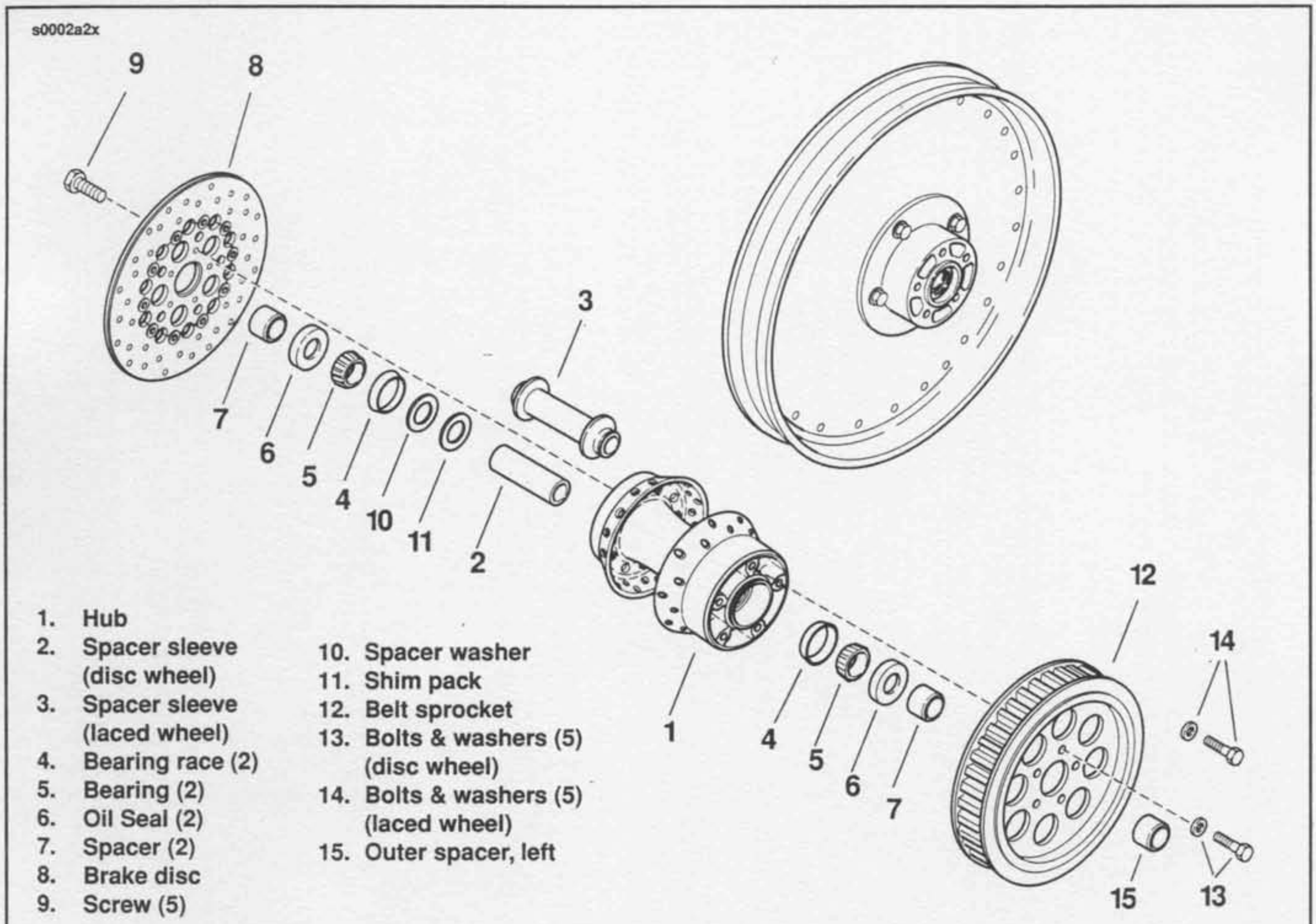


Figure 2-9. Rear Wheel/Hub

DISASSEMBLY

NOTE

Except for items 3 and 14 used on laced wheels only, wheel components are the same on laced and disc wheels.

1. See Figure 2-9. Remove the spacer (7), seal (6), bearing cone (5), spacer washer (10), shim pack (11) and spacer sleeve (2) or (3) from the right side of the wheel.
2. Remove the brake disc screws (9). Remove brake disc (8).
3. Remove spacer (7), seal (6), and bearing cone (5) from the left side of the wheel.
4. Remove the belt sprocket bolts and washers (13 or 14) to remove belt sprocket (12).
5. If it is necessary to remove the bearing races (4), use WHEEL BEARING RACE REMOVER AND INSTALLER, Part No. HD-33071.

CLEANING AND INSPECTION

1. Clean all parts, except oil seal, in solvent and inspect for damage or wear.
2. Replace the brake disc if it is warped, scored, or worn beyond the minimum thickness stamped on the disc.
3. Check the bearing races. If pitted or grooved, replace the races and the bearings, in sets only.
4. Check the rim trueness. See DISC RIM RUNOUT.
5. Check the belt sprocket for wear or damage. Replace if needed.

ASSEMBLY

1. See Figure 2-9. Clean the disc (8) with Loctite CLEANING SOLVENT and install disc on the wheel with new T-45 Torx screws (9) Tighten screws to 30-45 ft-lbs (41-61 Nm).
2. If bearing races were removed, lubricate races with oil and press one into each side of wheel.
3. Install spacer sleeve (2) or (3), shim pack (11) and spacer washer (10) in wheel.

⚠CAUTION

Be sure smaller diameter on spacer washer (10) faces outward toward bearing. If spacer washer is reversed, the large diameter could contact the bearing rollers and cage and damage the bearing.

4. Pack bearings with Harley-Davidson WHEEL BEARING GREASE, Part No. 99855-89 and install in each side of wheel.
5. Coat tip of oil seal with oil and fill area between lips of seal with wheel bearing grease listed above.
6. Press oil seals into both ends of hub with garter spring facing inward and seals 0.260-0.280 in. (6.60-7.11 mm) below outer surface of wheel hub on laced wheels. On cast wheels, press right side (brake disc side) seal flush with outer surface of wheel hub. The left (sprocket) side seal must be pressed into the hub to a depth of 0.31 in. (7.9 mm) from the outer surface of the hub.
7. Pack the space between bearings and seals with wheel bearing grease listed above.
8. Insert spacers (7), one into each side of the wheel hub.

NOTE

Spacers (7) must be installed with the large chamfered end facing the bearing.

9. If sprocket (12) was removed, install with bolts and washers (13 or 14). Apply two drops of Loctite 271 (red) to the threads on each bolt. Tighten bolts to 55-65 ft-lbs (75-88 Nm).
10. Wheel and tire must be true. See TRUING LACED WHEEL.

INSTALLATION

1. Place wheel forward in the swing arm and place belt on sprocket.
2. Move wheel back in swing arm and make sure brake disc is centered between brake pads.
3. See Figure 2-9. Coat axle with Loctite ANTI-SEIZE LUBRICANT and from right side carefully slide axle and belt adjuster collar through right rear fork, rear caliper bracket, spacer (7) and brake disc (8).
4. Continue sliding axle through wheel, spacer (7) on left side of wheel, and sprocket (12).
5. Place spacer (15) between sprocket (12) and inside of left side of rear fork.
6. Slide axle through spacer (15), belt adjuster collar and left side of rear fork.
7. Install washer and axle nut on axle.
8. Tighten axle nut to 60-65 ft-lbs (81-88 Nm) and check to see if the cotter pin or spring clip can be installed. If required, tighten nut just enough to align axle hole and nut slots.

⚠WARNING

Wheel bearing end play has been set at 0.002 to 0.006 in. (0.05 to 0.15 mm) and must not be altered. Check end play after tightening axle nut. Excessive end play may cause a handling problem, and lack of adequate end play could result in a bearing seizure, both of which could cause an accident resulting in personal injury.

NOTE

The shim pack, Item 11 in Figure 2-9, controls the amount of wheel bearing end play.

9. Mount a magnetic base dial indicator to the brake disc with the dial's contact point on the end of the axle in the same fashion as shown in Figure 2-5.
10. Turn the wheel through several rotations, then move the wheel side to side to check for end play. If the end play is not 0.002 to 0.006 in. (0.05 to 0.15 mm), remove the wheel and substitute thicker shim(s), if the end play must be increased, or thinner shim(s), if end play must be reduced.

Shim Part No.	Thickness
43290-82	0.030-0.033 in. (0.76-0.84 mm)
43291-82	0.015-0.017 in. (0.38-0.43 mm)
43292-82	0.0075-0.0085 in. (0.190-0.216 mm)
43293-82	0.0035-0.0045 in. (0.089-0.114 mm)
43294-82	0.0015-0.0025 in. (0.038-0.064 mm)

11. See Figure 2-8. Install new cotter pin or spring clip.
12. Install debris deflector on swing arm, if removed.
13. Install rear muffler, if removed.
14. Adjust belt. See Section 1, SCHEDULED MAINTENANCE PROCEDURES, Drive Belt.

NOTES

1997 MODEL YEAR CHANGES

New torx head spokes are shown below.

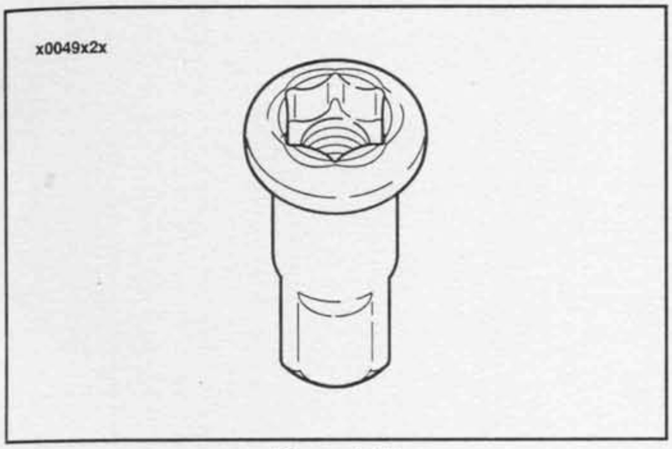


Figure 2-10

The new 16 inch laced wheel hub is shown below.

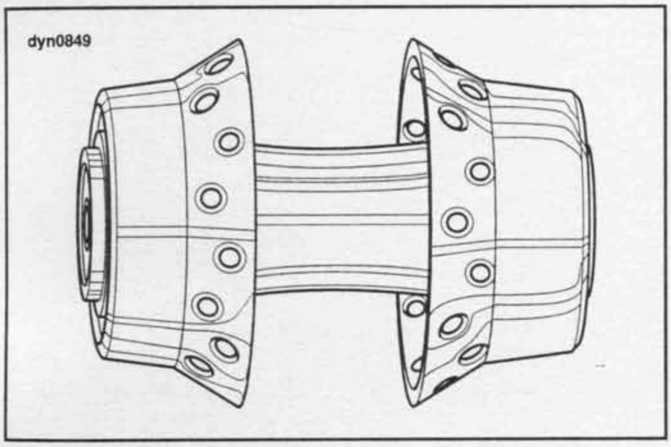


Figure 2-11

The new 16 inch laced wheel rim is shown below.

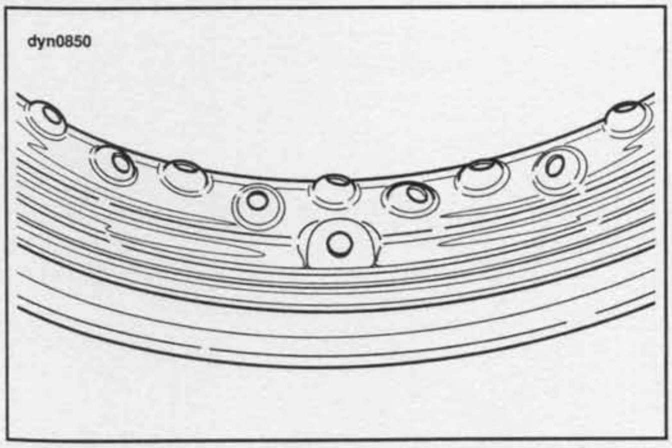


Figure 2-12

WHEEL LACING

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.

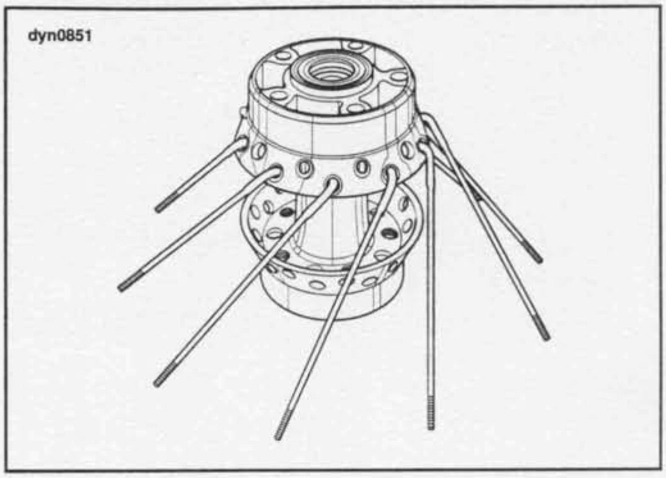


Figure 2-13

2. 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.

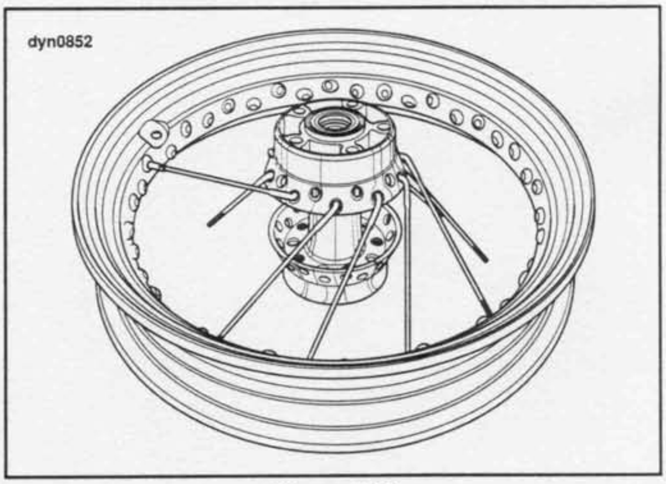


Figure 2-14

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

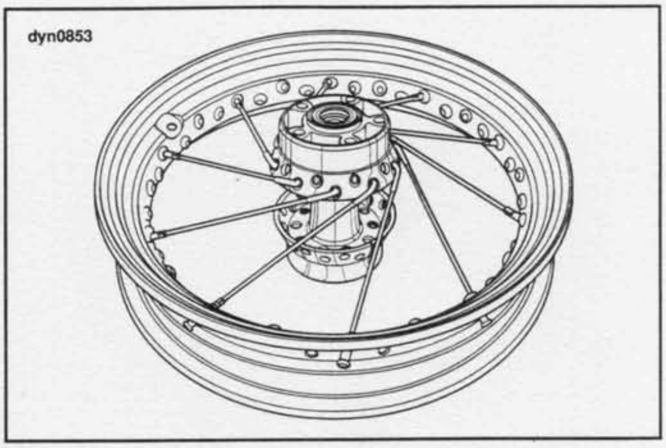


Figure 2-15

4. 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.

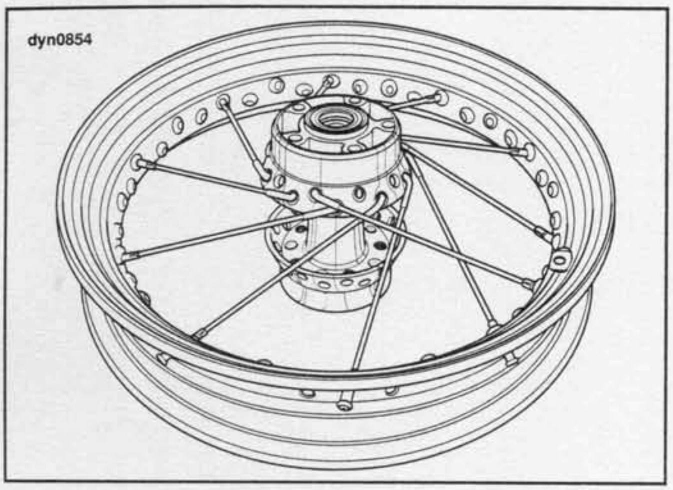


Figure 2-16

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

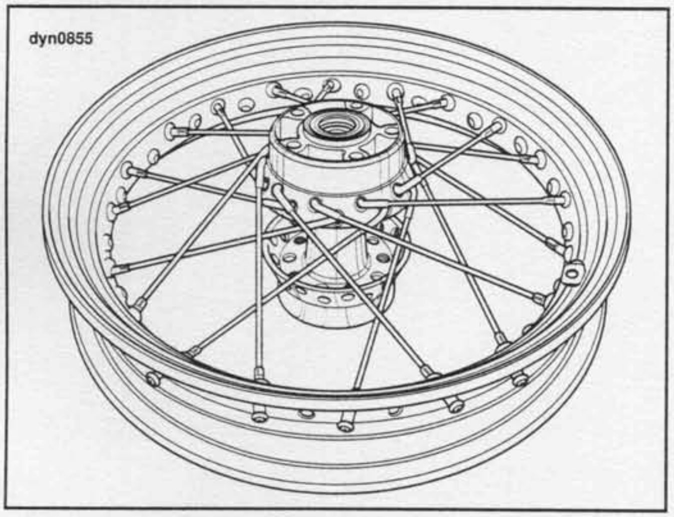


Figure 2-17

6. Place any lower row spoke into hub. Angle spoke clockwise and place into rim hole angled to accept it.

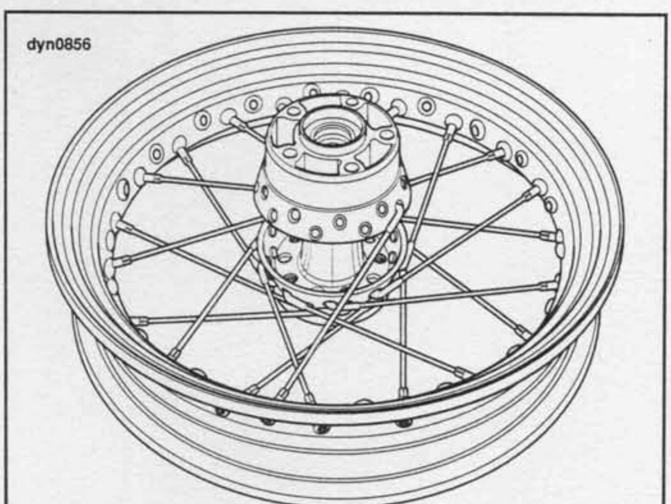


Figure 2-18

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

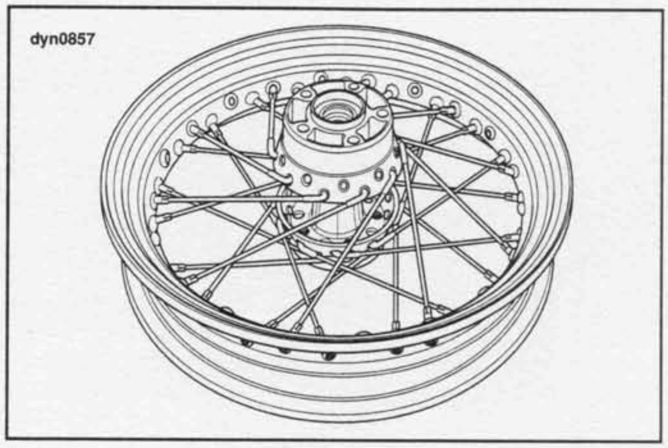


Figure 2-19

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

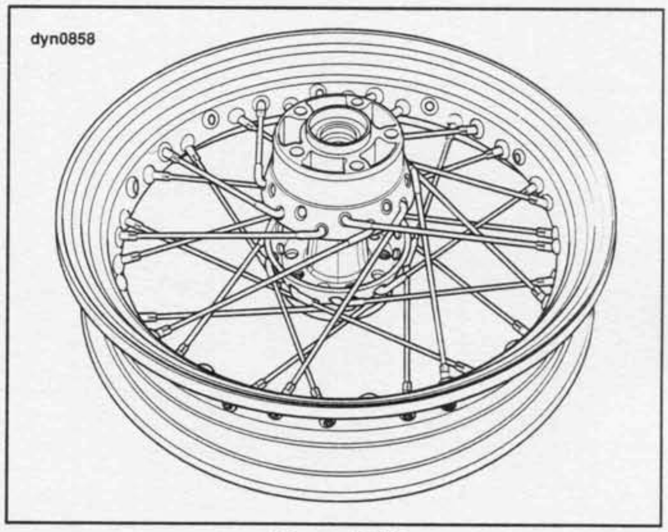


Figure 2-20

9. Install remaining nine upper row spokes.

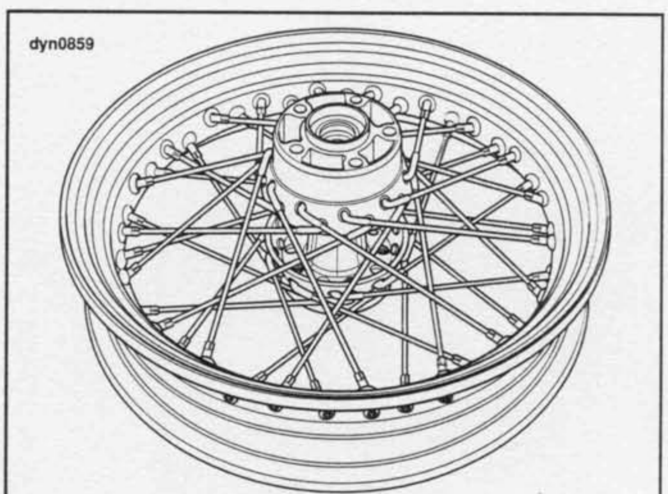


Figure 2-21

WHEEL LACING - 21 INCH RIM

WHEEL LACING

1. 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.

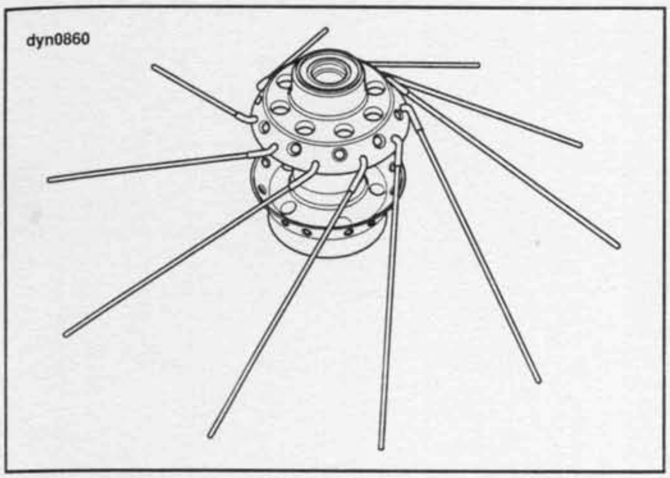


Figure 2-22

2. 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.

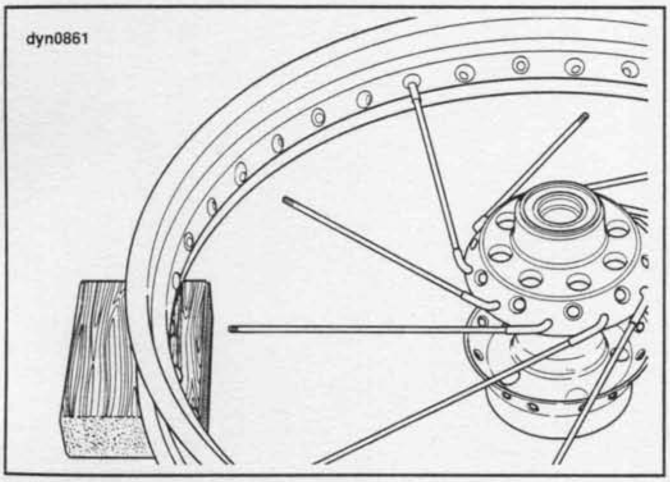


Figure 2-23

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

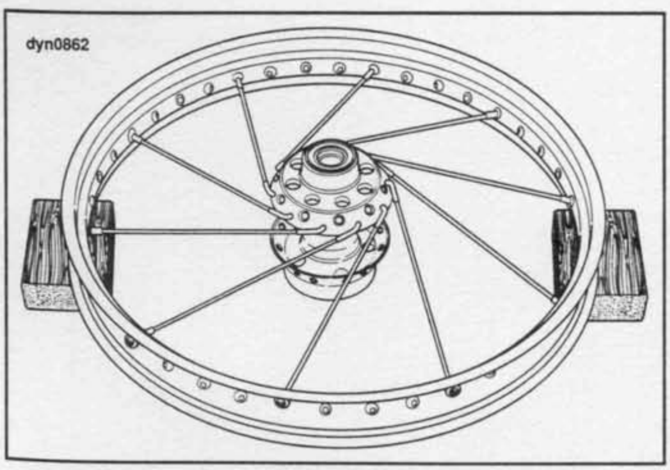


Figure 2-24

4. 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.

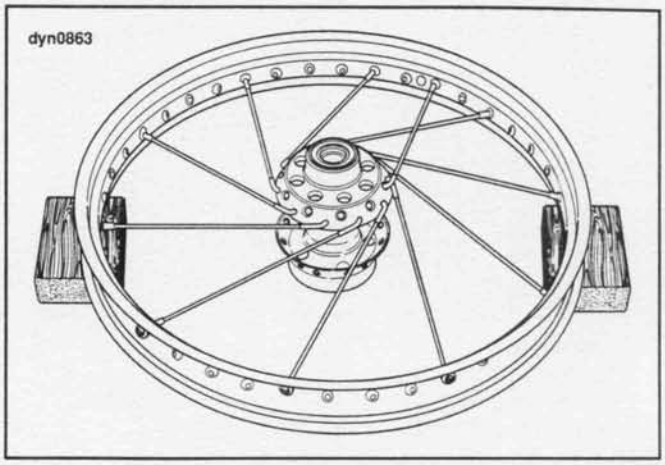


Figure 2-25

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

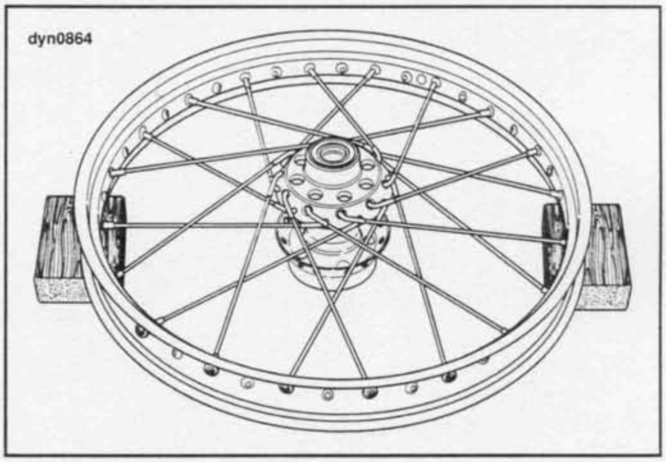


Figure 2-26

6. 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.

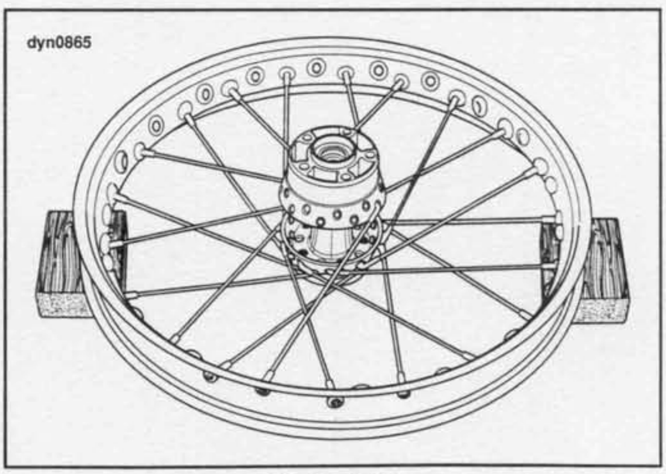


Figure 2-27

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

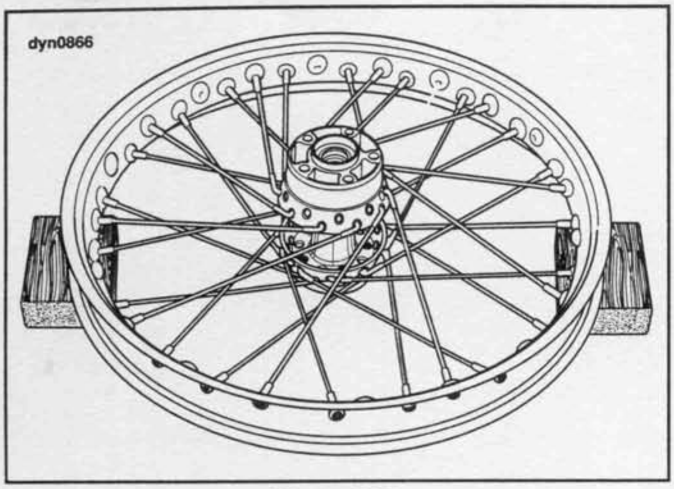


Figure 2-28

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

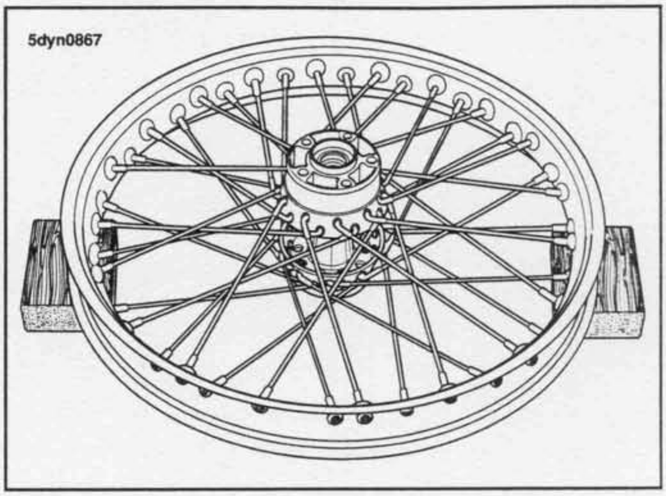


Figure 2-29

TRUING LACED WHEEL

1. Divide the wheel spokes into ten groups of four and mark the center of each group with a piece of tape. The groups should be directly across from one another and approximately 90° apart. Tighten the spokes in these four groups finger tight, leaving all others loose.

2. See Figure 2-31. Install truing arbor in wheel hub and place wheel in WHEEL TRUING STAND, Part No. HD-95500-80. Tighten arbor nuts so hub will turn on its bearings.

3. See Figure 2-30. Lay a straightedge across the hub brake disc flange and one of the marked spoke groups. Measure distance "A" from the straightedge to the location shown in Figure 2-30.

   This offset dimension (Distance A) must be:

   FRONT WHEEL

   FXSTC: 1.60-1.68 in. (40.6-42.7 mm).

   FXSTS, FXSTSB: 1.40-1.48 in. (35.6-37.6 mm)

   FLSTC, FLSTF, FLSTS: 1.22-1.34 in. (31.0-34.0 mm)

   REAR WHEEL

   All Models: 1.44-1.52 in. (36.6-38.6 mm).

   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 left side and tighten the two spokes attached to the hub right 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.

4. Repeat Step 3 for all four groups on the wheel.

5. See Figure 2-32. After rim has been trued sideways it must be checked and trued radially. Adjust truing stand gauge to the rim's tire bead seat as shown. The rim should be trued within 1/32 in. (0.79 mm).

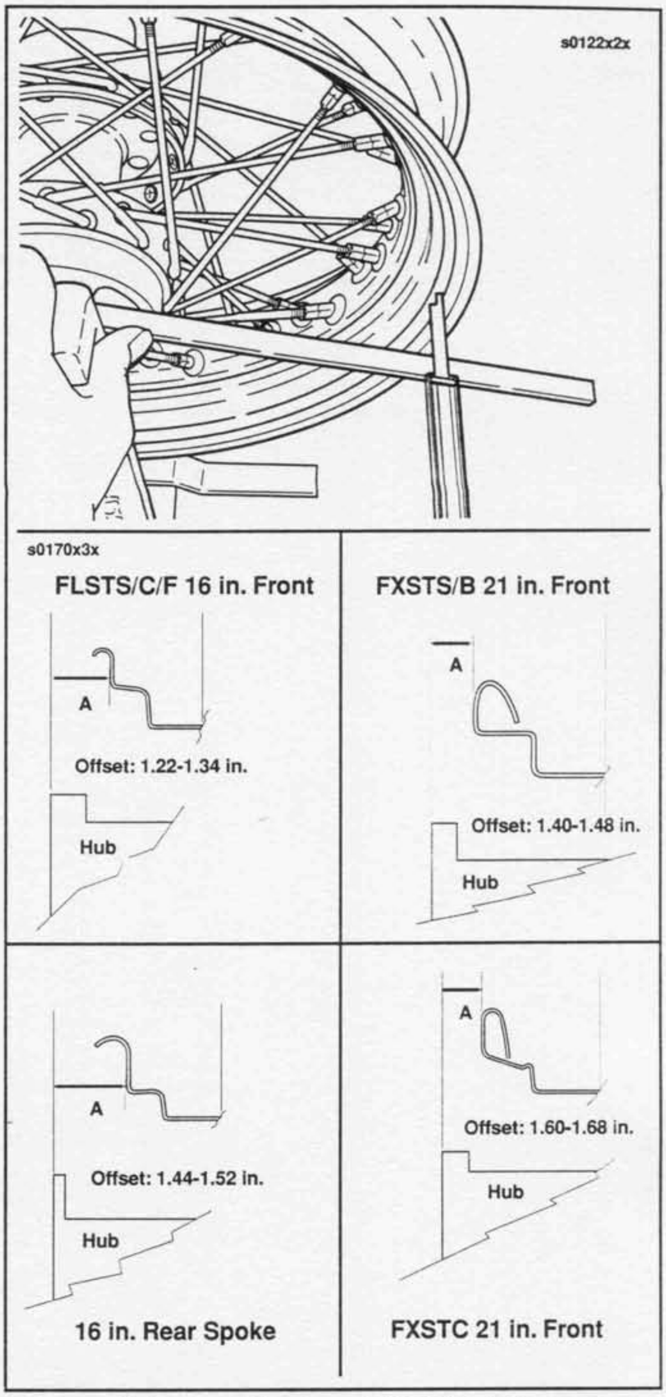


Figure 2-30. Checking Laced Hub Offset Dimension

6. 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.

7. 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.

8. 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.

9. 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.

10. 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.

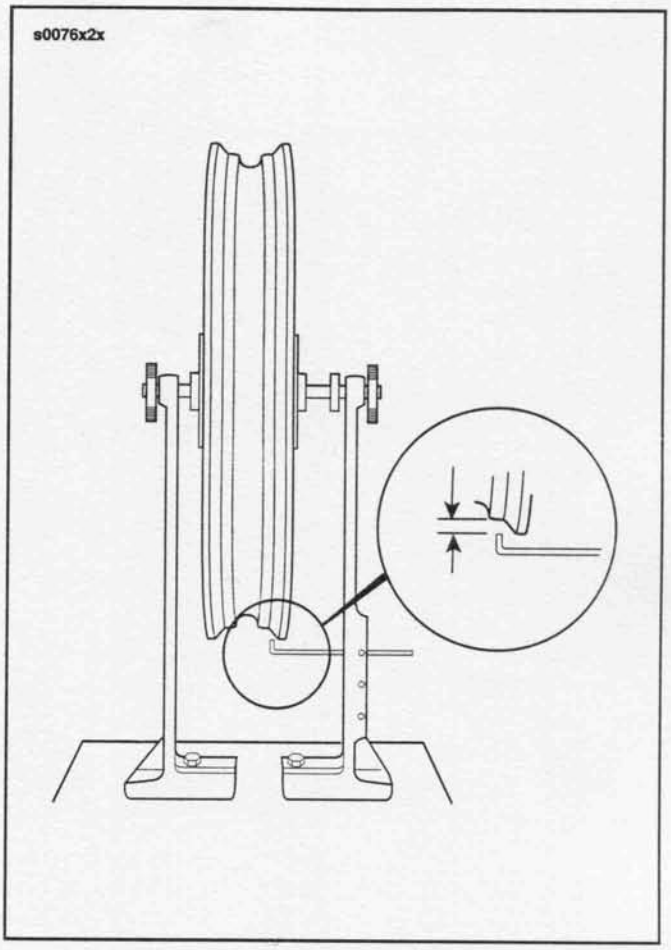


Figure 2-31. Truing Rim Radially

DISC RIM RUNOUT

The die-cast wheels should be checked for lateral and radial runout before installing a new tire or tube.

1. See Figure 2-32. 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.

See Figure 2-33. Check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).

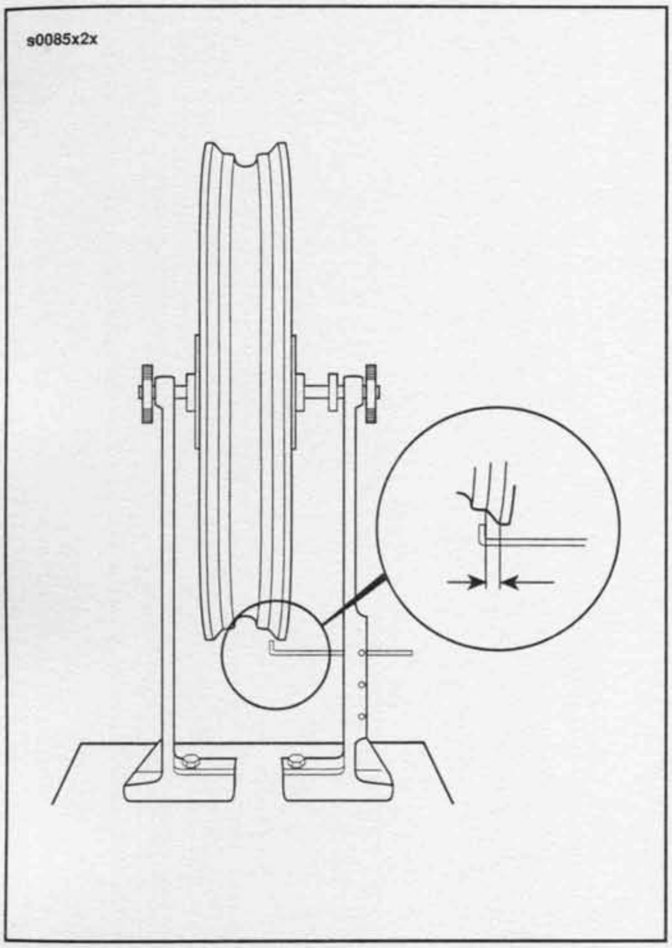


Figure 2-32. Checking Disc Rim Lateral Runout

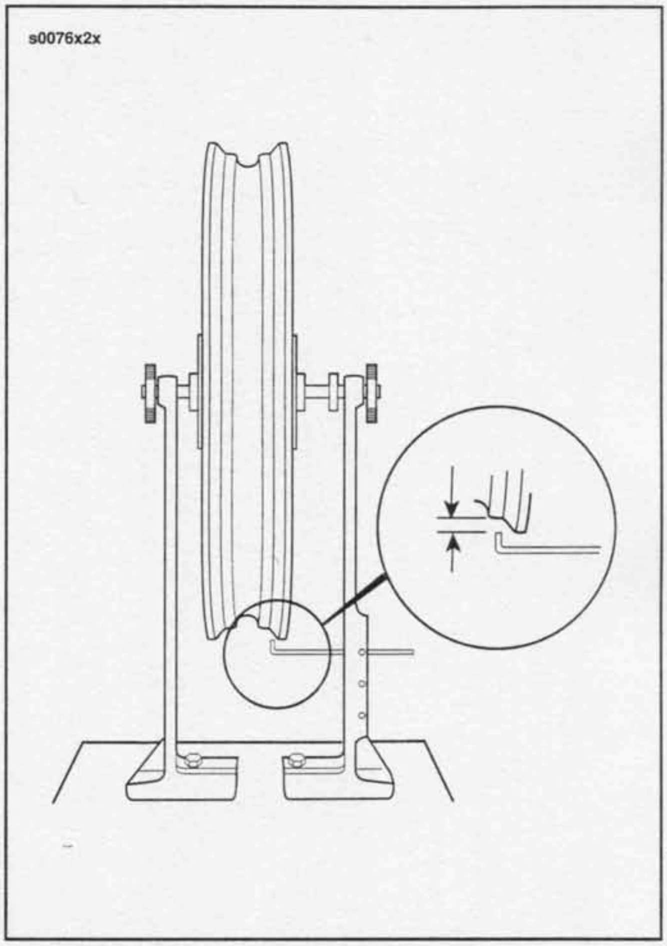


Figure 2-33. Checking Disc Rim Radial Runout

TIRES

GENERAL

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

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.

Inner tubes must be used on all Harley-Davidson wheels except cast wheels which are clearly marked "suitable for tubeless tires". Inner tubes are available from H-D Parts & Accessories.

Tires may be repaired in the tread area only, and only if the puncture is 1/4 in. (6.4 mm) or smaller. All repairs must be made from inside the tire. Acceptable repair methods include a patch and plug combination, chemical or hot vulcanizing patches or head-type plugs. When repairing tubeless tires, use TIRE SPREADER, Part No. HD-21000 to spread the tire sidewalls

⚠WARNING

Never repair a tire with less than 1/16 in. (1.6 mm) tread left. Inadequate tread depth can cause an accident resulting in personal injury.

⚠WARNING

To avoid personal injury follow these guidelines when servicing tires:

- **Always check both tire sidewalls for arrows indicating proper forward tire rotation. Some tires require different tire rotation depending on whether tire is used on front or rear wheel. Improperly installed tires will adversely affect handling, which could cause an accident resulting in personal injury.**
- **Rim strips must be used with all laced wheels.**
- **Do not mix tire brands on the same vehicle. Mismatching tire brands could cause handling difficulties, which could cause an accident resulting in personal injury.**
- **Do not use tubeless tires on rims designed for tube type tires unless an inner tube is also installed. Rims designed for tubeless tires are marked "tubeless".**

NOTE

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

REMOVAL

1. Remove wheel from motorcycle. See LACED or CAST WHEEL.
2. Let the air out of the tube or tire.
3. Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to break the bead.
4. See Figure 2-34. Using tire tools (not sharp instruments), and RIM PROTECTORS, Part No. HD-01289, start upper bead over edge of rim at valve. Do not use excessive force when starting bead over rim. Bead wires may be damaged, ruining the tire. Repeat all around rim until first bead is over rim. Remove tube valve stem locknuts. Keep the tube in its original position while removing the tube. This will help to locate tire damage. Discard tube.

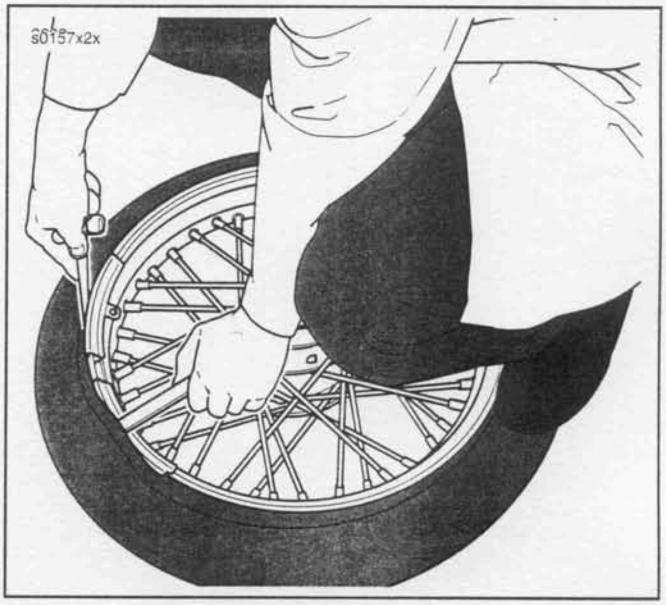


Figure 2-34. Starting Tire Off Rim

NOTE

Make sure beads are well lubricated before removing from rim.

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

⚠CAUTION

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

NOTE

It is not always necessary on tube type tires to completely remove tire from rim. Removing one side allows the tube to be replaced and allows for inspection of tire.

CLEANING AND INSPECTION

CAUTION

Once a tube has been removed from the tire, it cannot be used again. It will never go back to its original position and folds in the tube could cause failure.

CAUTION

Be sure you clean the rim properly. Heavily rusted rims can chafe a new tube, resulting in a flat tire.

1. Clean the inside of tire and rim.
2. If rim is dirty or rusty, clean with a stiff wire brush.
3. Thoroughly inspect the tire for wear or damage, visually and by touch.

INSTALLATION

WARNING

- **Use the correct inner tube and tire as specified. See TIRE DATA in SPECIFICATIONS. Use of non-standard parts could adversely affect handling.**
- **Install only original equipment (stock) tire valves and valve caps. A valve or valve and cap combination that is too long may interfere with (strike) adjacent components, damage the valve and cause rapid tire deflation. Rapid tire deflation could cause loss of control and personal injury or death.**
- **Aftermarket valve caps that are heavier than the stock cap may have clearance at slow speeds, but at high speed the valve/cap will be moved outward by centrifugal force. This outward movement could cause the valve/cap to strike the adjacent components, damage the valve and cause rapid tire deflation. Rapid tire deflation could cause loss of control and personal injury or death.**

NOTE

All cast disc wheels use the bolt-in style valve stems.

1. See Figure 2-35. On tubeless wheels, damaged or leaking valve stems must be replaced. Place rubber grommet on valve stem in recess of the valve stem head.
2. Insert valve stem into rim hole and install metal washer with raised center facing away from rim. Install first hex nut and tighten to 20-25 **in-lbs** (2.3-2.8 Nm).
3. Install second hex nut. While holding first nut with a wrench, tighten second nut to 40-60 **in-lbs** (4.5-6.8 Nm).
4. See Figure 2-36. On laced wheels, install a rim strip into the rim well. Be sure no spokes protrude through nipples and be sure to align the valve stem hole in rim strip with hole in rim.

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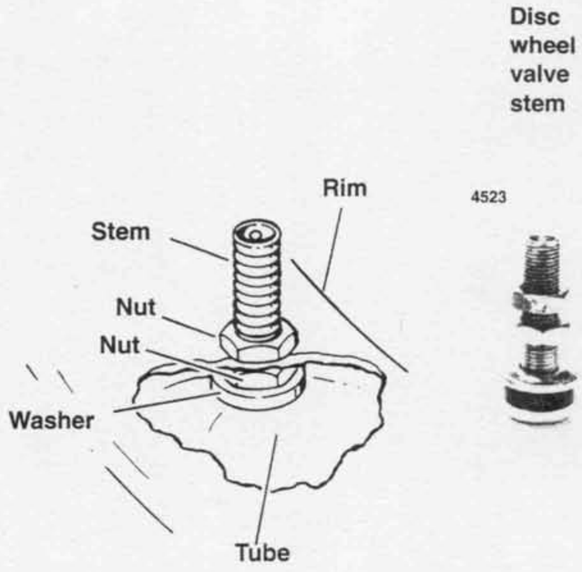

Figure 2-35. Tire Valve Stems

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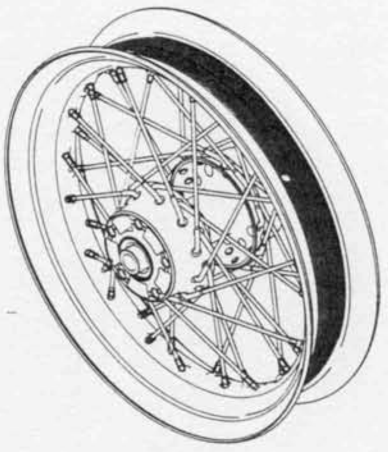

Figure 2-36. Wheel With Rim Strip Installed

5. Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant. Install RIM PROTECTORS, Part No. HD-01289 to prevent scarring rims.
6. See Figure 2-37. Starting at the valve stem, start the first bead into the rim well. Work the bead on as far as possible by hand. Use the tire tool to pry the remaining bead over the rim flange. If tire has colored dot on sidewall, it is a balance mark and should be located next to valve stem hole.

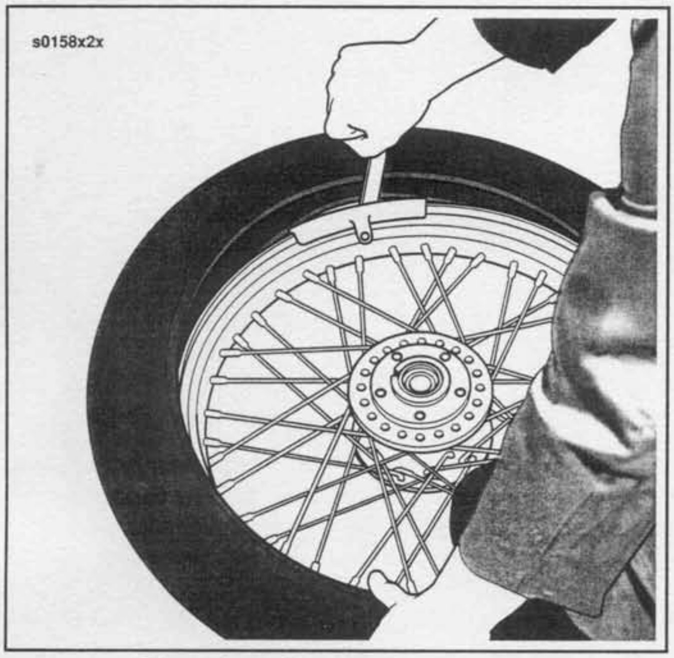

Figure 2-37. Starting Bead on Rim

7. Inflate a new tube just enough to round it out. Lubricate thoroughly 360° around the tube base.
8. See figure 2-38. Remove valve stem outer nut. Insert tube in tire with valve stem in hole. Install outer nut two or three turns.
9. See Figure 2-38. Starting 180° from valve stem, start the second bead onto the rim. Work the bead onto the rim with tire tools, working toward valve in both directions. Remove the valve core from the valve stem before prying the remaining bead over the rim flange.
   a. Be sure inner tube valve stem moves in and out freely, then tighten outer nut. Inflate the tire to recommended pressure to seat the bead. See SPECIFICATIONS. Then deflate tire to allow inner tube to smooth out.
   b. Install valve core. Inflate again to recommended pressure to seat the bead.
   c. Examine bead area on both sides to ensure that tire is completely seated.

NOTE

BEAD EXPANDER, Part No. HD-28700, should be used to seat beads on tubeless tires.

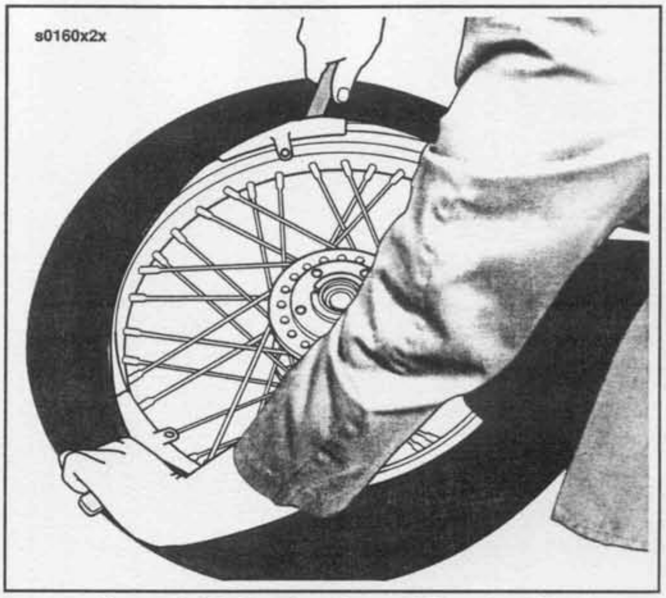

Figure 2-38. Starting Second Bead on Rim

⚠WARNING

- **Do not inflate more than manufacturer's recommended pressure to seat the beads. Inflating the tire more than manufacturer's recommended pressure to seat the beads can cause the tire rim assembly to burst with force sufficient to cause personal injury.**
- **If the beads fail to seat at manufacturer's recommended pressure, deflate and relubricate the bead and rim and inflate to seat the beads, but do not exceed manufacturer's recommended pressure.**

Checking Tire Lateral Runout

1. See Figure 2-39. Check lateral runout by turning wheel on axle, measuring amount of sideways displacement from a fixed point near the tire sidewall.

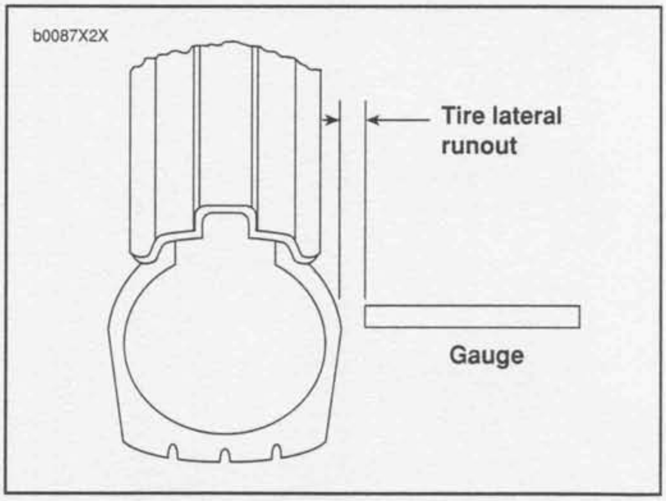

Figure 2-39. Checking Tire Lateral Runout

2. Lateral tire runout should be no more than 0.080 in. (2.03 mm). If lateral tire runout is more than 0.080 in. (2.03 mm), check lateral rim runout to see if rim is at fault.

3. If lateral rim runout is less than 0.030 in. (0.76 mm), the tire is at fault and should be replaced. If lateral rim runout is more than 0.030 in. (0.76 mm), correct by tightening selected spoke nipples on laced wheels or replacing the cast rim. If you turn nipples more than one full turn, remove the tire to check for protrusions. Install old tire and recheck lateral tire sidewall runout.

Checking Tire Radial Runout

1. See Figure 2-40. Check radial runout by turning wheel on axle, measuring tread runout.

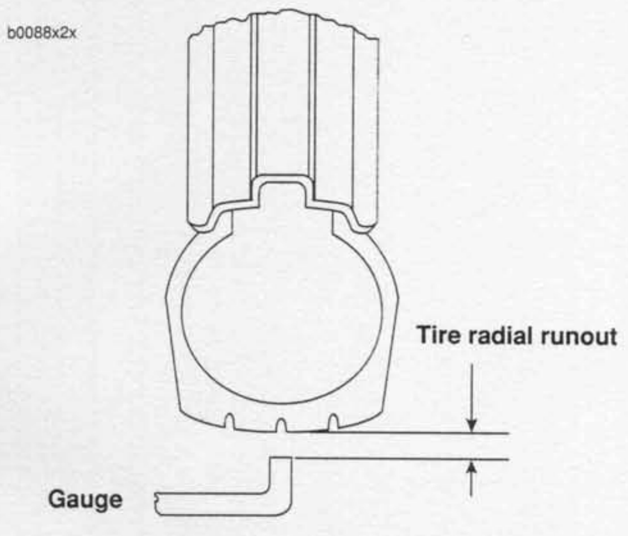

Figure 2-40. Checking Tire Radial Runout

2. Radial tire tread runout should be no more than 0.090 in. (2.29 mm). If radial tire tread runout is more than 0.090 in. (2.29 mm), check radial rim bead runout to see if rim is at fault.

3. If radial rim bead runout is less than 0.030 in. (0.76 mm), tire is at fault and should be replaced. If rim bead runout is more than 0.030 in.(0.76 mm), correct by tightening selected spoke nipples on laced wheels or replacing the cast rim. If you turn nipples more than one full turn, remove the tire to check for protrusions. Install tire and recheck tire tread runout.

Wheel Balancing

Wheels must be balanced to improve handling and reduce vibration, especially at high road speeds. In most cases, static balancing using WHEEL TRUING STAND, Part No. HD-95599-80 will produce satisfactory results.

Dynamic balancing, utilizing a wheel spinner, should be used to produce finer tolerances for best high speed handling characteristics.

Follow the instructions supplied with the balance machine you are using.

The maximum weight permissible to accomplish balance is 3-1/2 oz. (99 g) total weight applied on the rim. Wheels should be balanced to within 1/2 oz. (14 g) at 60 mph (97 km/h).

Harley-Davidson has made available the following spoke balance weights which press over the spoke nipple.

1 oz. (28 g) weight, Part No. 95582-47

3/4 oz. (21 g) weight, Part No. 95581-47

1/2 oz. (14g) weight, Part No. 95578-41

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

1/4 oz. (7 g) weight, Pkg. 12, Part No. 95594-84 (Black)

1/4 oz. (7 g) weight, Part No. 95595-84 (Silver)

NOTE

Self adhesive wheel weights should be applied to the flat surface of the rim in increments of 1/4 oz. (7 g).

To apply self adhesive wheel weights, make sure that area of application is completely clean, dry and free of oil and grease. Remove paper backing from weight and apply 3 drops of Loctite 420 (Superbonder) to the adhesive side of the weight. Place the weight on the rim, press firmly in place and hold for 10 seconds. Full adhesive cure takes 8 hours.

NOTE

If 1 oz. (28 g) or more weight must be added at one location, split the amount so that half is applied to each side of the rim. Wheel should not be used for 8 hours to allow adhesive to cure completely.

TYPES OF MISALIGNMENT

Check for the different types of misalignment in the following order.

A. Rear wheel misalignment

B. Horizontal/Wheel Offset misalignment

C. Vertical misalignment

NOTE

Rims and tires must be true before checking vehicle alignment.

NOTE

Visually check the relationship of the front wheel to the fork fender bosses. The front wheel should be approximately centered between the bosses.

A. Check for Rear Wheel Misalignment

ALL MODELS

1. See Figure 2-41. To get an accurate measurement, make a gauge from 1/8 in. aluminum welding rod, 25 in. long, as shown. Place a snug fitting grommet on the rod to act as a slide measurement indicator.
2. Using the gauge, measure from the center of the swing arm pivot shaft bolt to the center of the axle.
3. The measurements on both sides of the wheel should be the same. If they are different, use the axle adjusters to adjust the rear wheel as required.
4. Check belt adjustment as described in Section 6.

B. Check for Horizontal/ Wheel Offset Misalignment

FXSTC, FXSTS, FXSTSB MODELS

1. See Figure 2-42. Place a girder-type straightedge tightly against each side of the rear tire. Be sure they are parallel with each other.
2. Measure from the straightedge to the left side of the front wheel rim. Take the measurements in two places; at the front and rear of the wheel rim (A & B).
3. Measure from the straightedge to the right side of the front wheel rim. Take the measurements in two places; at the front and rear of the wheel rim (C & D).

NOTE

Be sure the measurements are equal. Turn the front wheel if necessary. Be sure and write down your measurements.

4. Subtract the right side measurement from the left side measurement.

NOTE

See table below. The difference between the two sides should match the offset factor given in the table below within 0.250 in. (6.35 mm).

WHEEL OFFSET TABLE

MODEL	OFFSET FACTOR in.	mm
FLSTC, FLSTF	0.359	9.12
FXSTC, FXSTS, FXSTSB	0.526	13.36
FLSTS	0.320	8.13

5. If wheel offset is not within specification, call the H-D Service Department.
6. Check belt adjustment as described in Section 6.

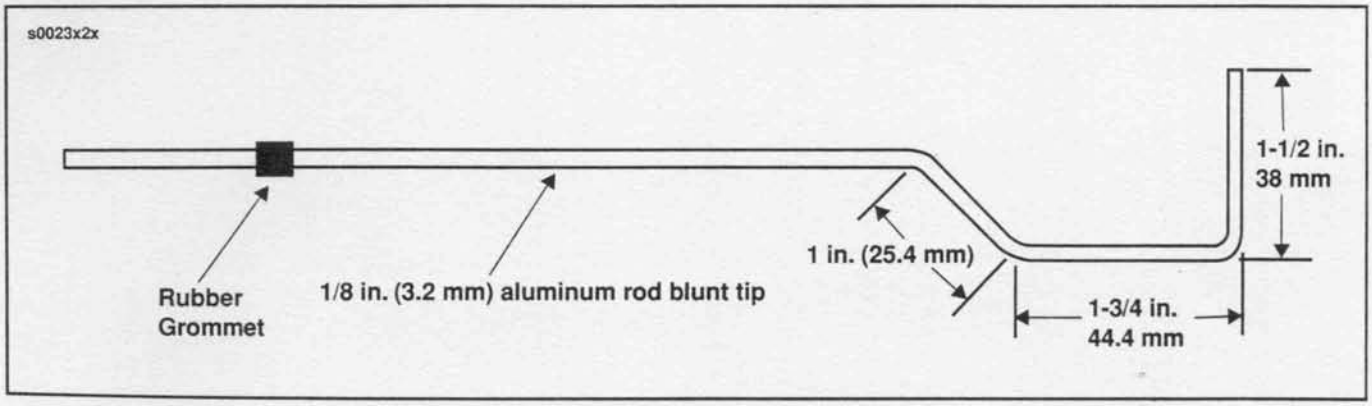

Figure 2-41. Alignment Gauge

FLSTC, FLSTF, and FLSTS MODELS

1. See Figure 2-42. Place a girder-type straightedge tightly against the left side of the rear tire.

2. Measure from the straightedge to the left side of the front wheel rim. Take the measurements in two places; at the front and rear of the wheel rim (A & B).

NOTE

Be sure the measurements are equal. Turn the front wheel if necessary. Be sure and write down your measurements.

3. Measure from the straightedge to the rear wheel rim. Take the measurements in two places; at the front and rear of the wheel rim (E).

4. Subtract the rear wheel measurement from the front wheel measurement.

NOTE

See WHEEL OFFSET TABLE on previous page. The difference between the two sides should match the offset factor given in the table within 0.125 in. (3.17 mm).

5. If wheel offset is not within specification, call the H-D Service Department.

6. Check belt adjustment as described in Section 6.

C. Check for Vertical Misalignment

1. Leave straightedge(s) in place and be sure the front wheel is parallel to the straightedge.

2. Place a clinometer on the front disc.

NOTE

Be sure the clinometer is vertical.

3. Write down the reading.

4. Place the clinometer on the rear disc and write down the reading.

5. If your readings are more than 1/2 degree apart, the frame, fork or swing arm may be bent. Inspect and replace damaged components as necessary.

NOTE

Clinometers are not perfectly accurate. Call your Harley-Davidson Service Department before replacing chassis components that don't appear damaged.

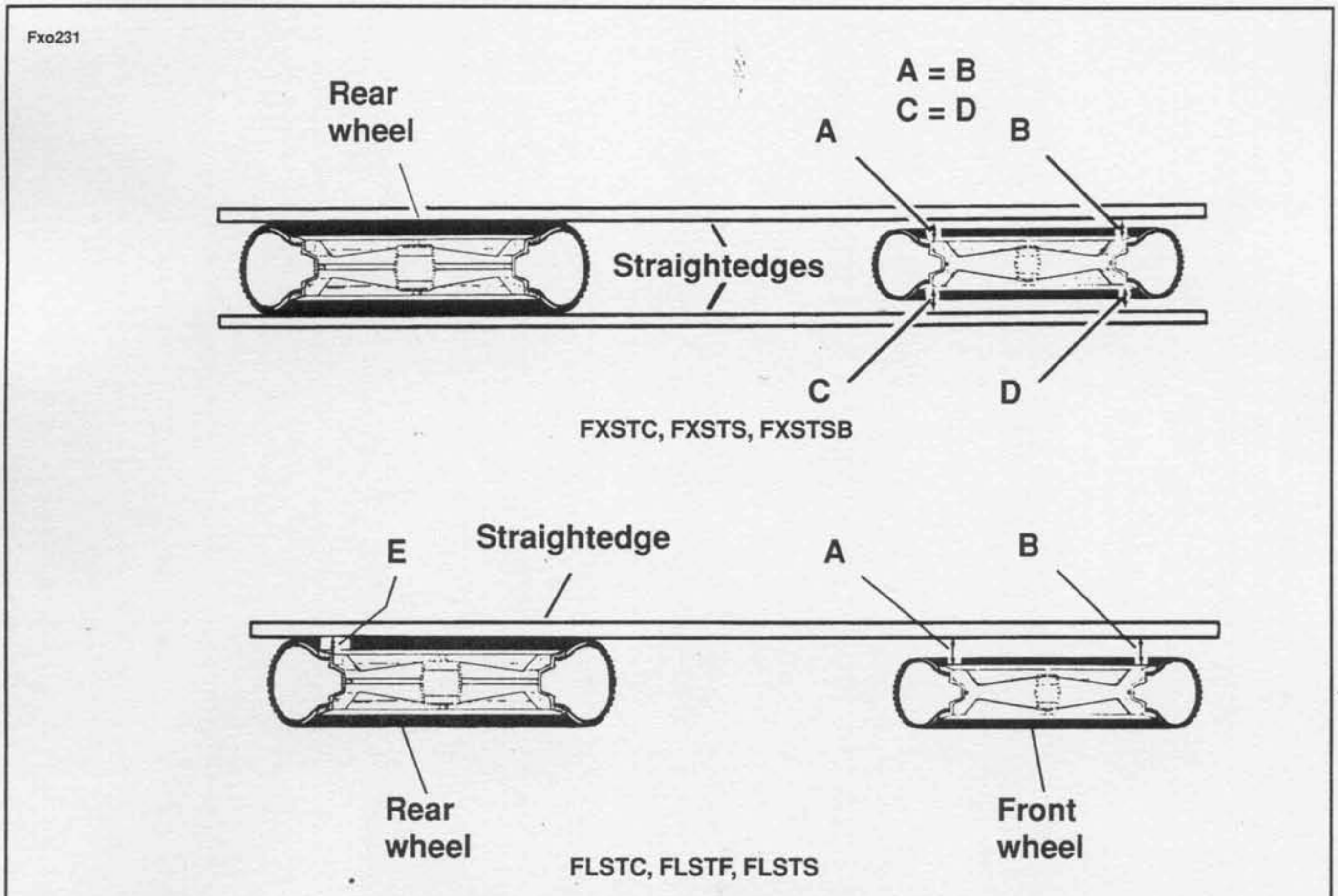

Figure 2-42. Horizontal/Wheel Offset Measurements

FRONT BRAKE MASTER CYLINDER

GENERAL

Master cylinders designed for dual disc (two caliper) operation have an 11/16 in. (17.5 mm) bore, while those that are designed for single disc (one caliper) operation have a 9/16 in. (14.3 mm) bore. The bore size is stamped on the master cylinder assembly inboard of the handlebar clamp bracket. See Figure 2-43.

⚠WARNING

Do not use an 11/16 in. bore master cylinder assembly on single disc (one caliper) models. These master cylinder assemblies are not interchangeable. Using the wrong assembly can adversely affect braking efficiency or result in brake failure resulting in personal injury.

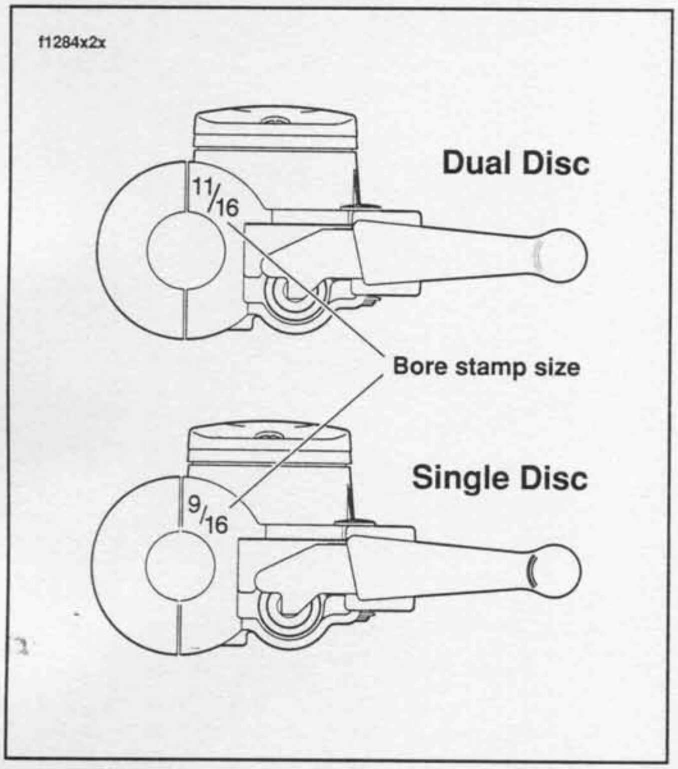

Figure 2-43. Verify Correct Size Before Use

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

⚠CAUTION

Do not remove the master cylinder assembly without first placing a 5/32 in. thick cardboard insert between the brake lever and lever bracket. Removal without the insert may result in damage to the rubber boot and plunger of the Front Stoplight Switch.

3. Place the cardboard insert between the brake lever and lever bracket. See Figure 2-44.

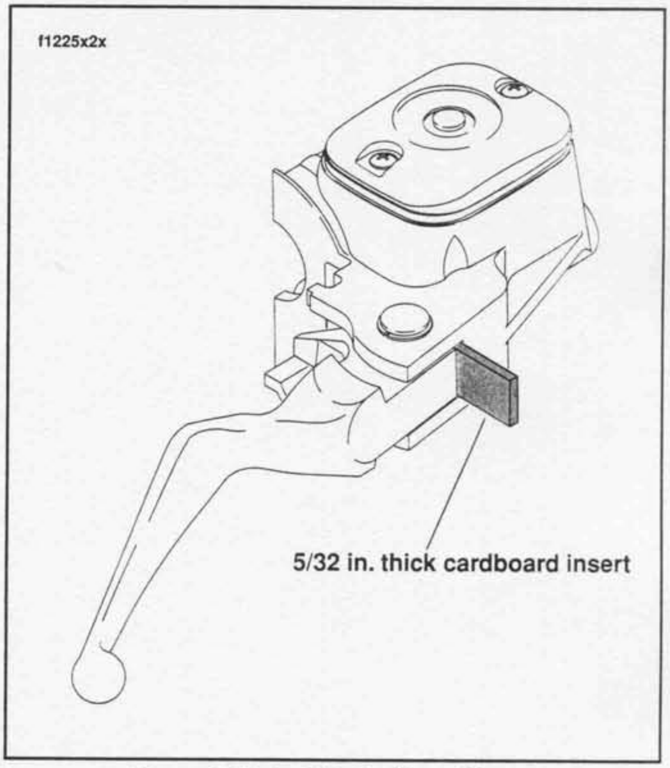

Figure 2-44. Install Cardboard Insert Before Removing Master Cylinder Assembly

4. See Figure 2-45. 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.

⚠WARNING

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

5. Remove retaining ring from pivot pin groove at bottom of master cylinder bracket.

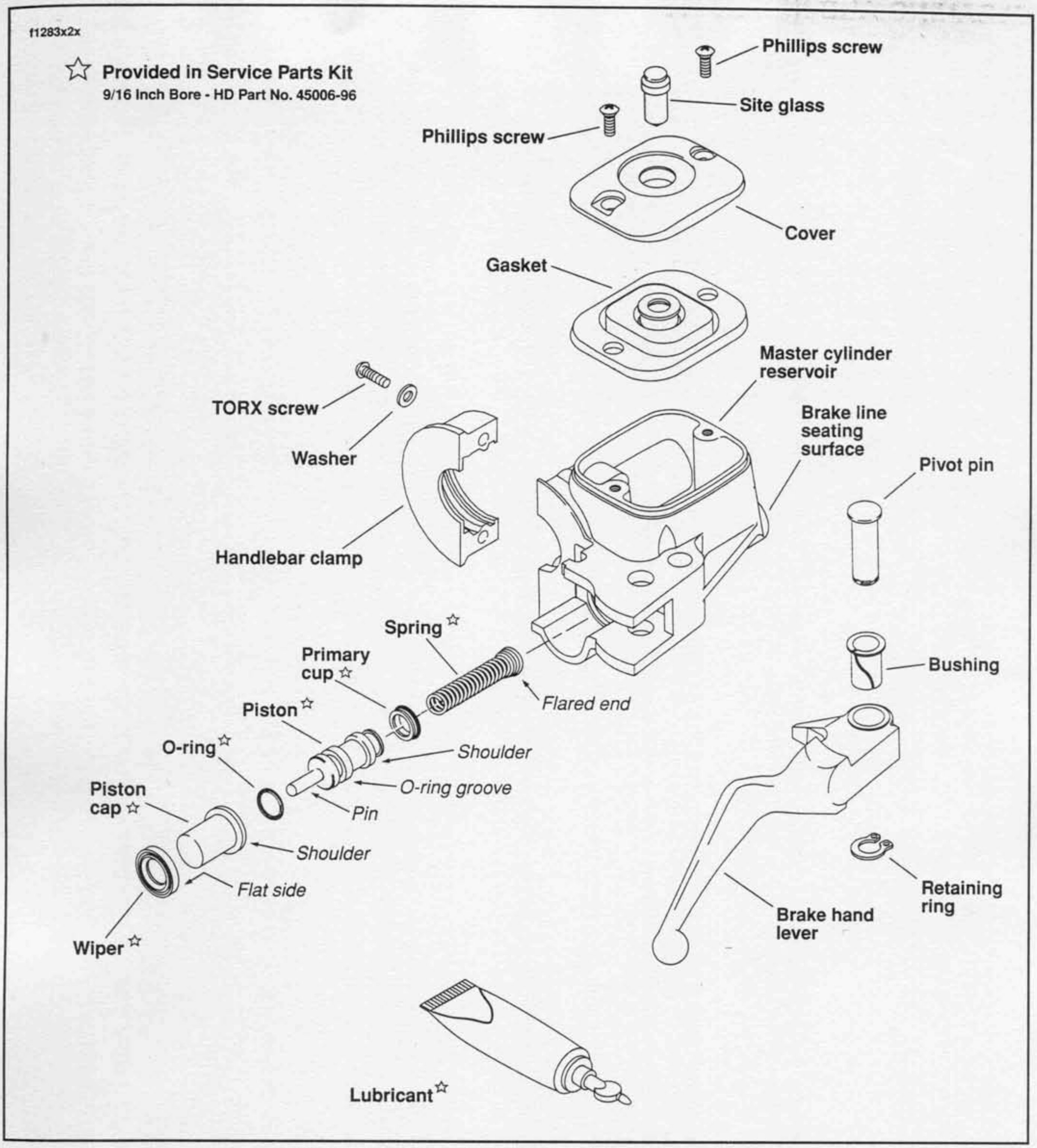

Figure 2-45. Front Brake Master Cylinder Assembly

6. Remove pivot pin and brake hand lever from master cylinder assembly.

7. Carefully remove wiper with pick or similar tool.

8. Remove piston cap.

9. Remove piston with O-ring and primary cup.

10. Remove spring.

⚠CAUTION

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

11. Remove the two Phillips screws, cover and cover gasket from the master cylinder reservoir.

CLEANING AND INSPECTION

⚠WARNING

Do not use replacement parts from dual caliper repair kits (11/16 inch bore) on single caliper models. Parts are not interchangeable. Using the wrong replacement parts can adversely affect braking efficiency or result in brake failure causing personal injury and property damage.

1. Always reassemble the master cylinder using **new** parts from the correct repair kit (9/16 in. bore- HD Part No. 45006-96; 11/16 in. bore- HD Part No. 45072-96).
2. Clean all parts with denatured alcohol or D.O.T. 5 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.

⚠WARNING

Always use denatured alcohol to clean brake system components. Do not use mineral base solvents (such as gasoline and paint thinner) or deterioration of rubber parts may occur after assembly. Deterioration of components may result in premature brake failure, possibly causing personal injury and/or property damage.

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.

ASSEMBLY/INSTALLATION

1. See Figure 2-45. Fit O-ring into groove at front of piston (pin side).
2. Fit primary cup over lip at back of piston so that closed side (smaller OD) contacts shoulder.
3. Coat piston bore of housing with special lubricant supplied in the service parts kit. Also apply the lubricant to OD of installed O-ring and primary cup.
4. Insert flared end of spring into master cylinder bore so that it seats against the counterbore (recess) at bottom.
5. Slide piston over spring.
6. Fit wiper over piston cap so that the flat side of wiper contacts cap shoulder.
7. Fit piston cap over piston pin.
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 (with gasket) on the master cylinder reservoir. Install two Phillips screws to fasten the cover to the reservoir, but do not tighten at this time.
10. Align hole in brake hand lever with hole in master cylinder bracket. From the top of the assembly, slide pivot pin through bracket and hand lever.

⚠WARNING

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

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

⚠CAUTION

See Figure 2-44. Do not install the master cylinder assembly without first placing the 5/32 inch thick cardboard insert (or cable strap eyelet) between the brake lever and lever bracket. Installation without the insert may result in damage to the rubber boot and plunger of the Front Stoplight Switch.

12. See Figure 2-46. Position the brake lever/master cylinder assembly inboard of the switch housing assembly engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

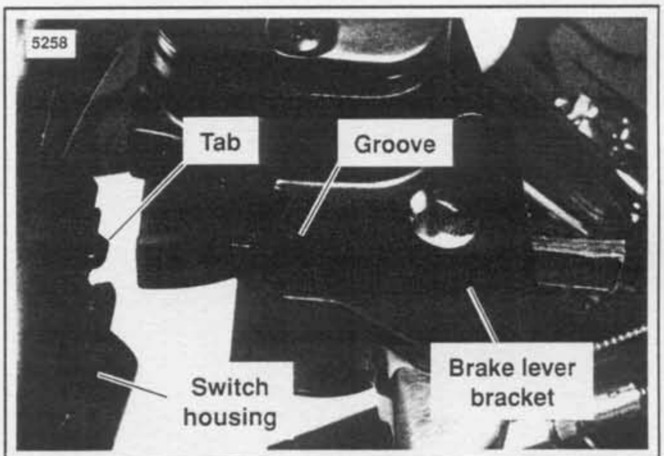

Figure 2-46. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

13. 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 the screws to 70-80 **in-lbs** (7.9-9.0 Nm) using a T27 TORX drive head.

⚠CAUTION

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

14. 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 (23-30 Nm).
15. Install length of clear plastic tubing over caliper bleeder valve, if removed. Place free end of tube in a clean container.
16. Remove the master cylinder cover. Stand the motorcycle upright so that the master cylinder is in a level position.

⚠WARNING

ALWAYS KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. Brake fluid can cause eye and skin irritation and can be harmful if swallowed. In case of eye or skin contact, flush with plenty of water. Seek medical attention for eyes. If fluid is swallowed, administer two tablespoons of salt in a glass of warm water to induce vomiting. Call a doctor immediately.

17. Add D.O.T. 5 SILICONE HYDRAULIC 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. 5 fluid from a sealed container.

⚠WARNING

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

18. Verify proper operation of the master cylinder relief port. Actuate the brake hand lever. A slight spurt of fluid will break the fluid surface in the reservoir compartment if all internal components are working properly.
19. Add brake fluid to the master cylinder reservoir until the fluid level is 1/8 inch (3.2 mm) from the top.
20. Depress and hold the brake hand lever to build up hydraulic pressure.
21. Open bleeder valve about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Close bleeder valve when brake hand lever has moved 1/2 to 3/4 of its full range of travel. Allow brake hand lever to return slowly to its released position.
22. Repeat Steps 19-21 until all air bubbles are purged.
23. Final tighten the bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm). Install the bleeder cap.
24. Add brake fluid to the master cylinder reservoir until the fluid level is about 1/8 inch (3.2 mm) from the top.
25. Note that the angular shape of the master cylinder cover makes one side thicker than the other. Install the cover (with gasket) on the master cylinder reservoir so that the thicker side is positioned above the brake line fitting. Install two Phillips screws to fasten the cover to the reservoir. Tighten the screws to 6-8 **in-lbs** (0.7-0.9 Nm).
26. With the Ignition/Light Key Switch turned to IGNITION, actuate the front brake hand lever to verify operation of the brake lamp.

⚠WARNING

Always test motorcycle brakes at low speed after completing repairs or bleeding the system. Improperly serviced brakes could lead to an accident resulting in personal injury

27. Test ride the motorcycle. If the brake feels spongy, repeat the bleeding procedure.

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.

FLSTC, FLSTF, FLSTS MASTER CYLINDER/RESERVOIR REMOVAL

1. Remove exhaust.
2. Remove master cylinder/reservoir mounting bolts and cover.
3. See Figure 2-47. Disconnect clevis (10) from brake pedal.
4. Remove banjo bolt (1), washers (2) and brake line (3). Discard washers.
5. Remove locknut (4).

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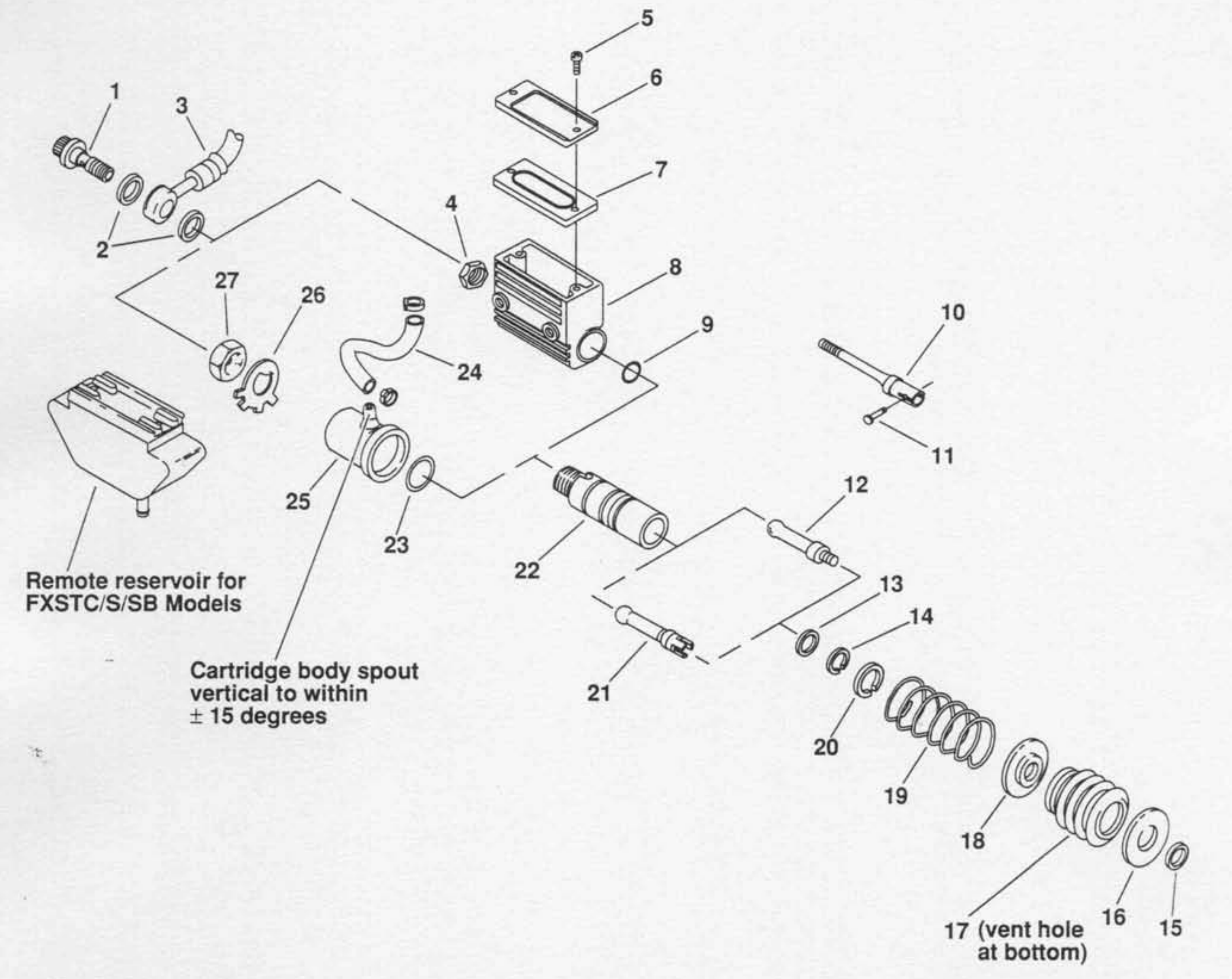

1. Banjo bolt
2. Washers (2)
3. Brake line
4. Locknut–FLSTC/F/S
5. Cover screws (2)–FLSTC/F/S
6. Cover–FLSTC/F/S
7. Gasket–FLSTC/F/S
8. Reservoir–FLSTC/F/S
9. O-rings (2)–FLSTC/F/S
10. Clevis
11. Spring pin–FLSTC/F/S
12. Push rod–FLSTC/F/S
13. Push rod washer
14. Washer retaining ring
15. Retaining ring, spring
16. Washer, boot retainer
17. Dust boot
18. Retainer, spring return
19. Spring, return
20. Retaining ring, spring
21. Push rod, FXSTC/S/SB
22. Cartridge
23. O-rings (2)–FXSTC/S/SB
24. Reservoir hose–FXSTC/S/SB
25. Cartridge body–FXSTC/S/SB
26. Lockplate–FXSTC/S/SB
27. Locknut–FXSTC//SBS

Figure 2-47. Rear Brake Master Cylinder/Reservoir Assembly

FLSTC/F/S MASTER CYLINDER/ RESERVOIR INSTALLATION

1. See Figure 2-47. Screw push rod (12) onto clevis (10) by rotating master cylinder/reservoir assembly. Screw clevis onto push rod until it is snug. Install spring pin (11).
2. Install locknut (4) on master cylinder/reservoir assembly. Do not tighten locknut at this time.
3. Install brake line (3) using banjo bolt (1) and NEW washers (2). Hold brake line in place and tighten banjo bolt to 17-22 ft-lbs (23-30 Nm). Tighten locknut (4) to 30-40 ft-lbs (41-54 Nm).
4. Install mounting bolts loosely.
5. Fill reservoir with D.O.T. 5 hydraulic brake fluid and bleed brakes as covered in BLEEDING THE HYDRAULIC BRAKE SYSTEM.
6. Connect clevis to brake pedal.

NOTE

Brake pedal height adjustment is complete when the brake pedal and master cylinder are assembled.

7. Install master cylinder/reservoir cover and tighten cover and mounting bolts.
8. Install exhaust.

FXSTC, FXSTS, FXSTSB MASTER CYLINDER REMOVAL

1. Remove exhaust.
2. See Figure 2-47. Disconnect clevis (10) from brake pedal.
3. Remove banjo bolt (1), washers (2) and brake line (3). Discard washers.
4. Remove reservoir hose (24). Be careful not to break cartridge body (25) nipple when removing reservoir hose.
5. Remove cylinder mounting nut (27) and lockplate (26).

FXSTC, FXSTS, FXSTSB MASTER CYLINDER INSTALLATION

1. See Figure 2-47. Screw push rod (21) onto clevis (10) by rotating master cylinder assembly. Do not tighten jam nut at this time.
2. Move brake pedal out of the way and guide the threaded end of the master cylinder through the mounting bracket.

⚠CAUTION

Be sure the square end of the master cylinder engages the mounting bracket square hole. The nipple should be pointing up. Be careful not to break nipple.

3. Place lockplate (26) on the threaded end of the master cylinder with the lip of the lockplate over the mounting bracket.
4. Install cylinder mounting nut (27). Tighten cylinder mounting nut to 30-40 ft-lbs (41-54 Nm). Bend lockplate (26) over flats on cylinder mounting nut.
5. Install brake line (3) using banjo bolt (1) and NEW washers (2). Position brake line fitting at 45-50° from horizontal. Hold brake line in place and tighten banjo bolt to 17-22 ft-lbs (23-30 Nm).
6. Install reservoir hose (24) and secure with hose clamp.
7. Connect clevis to brake pedal.
8. Adjust brake pedal height as covered under ADJUSTMENT.

NOTE

There is NO FREE PLAY ADJUSTMENT for the master cylinder assembly. Free play is built into the assembly.

9. Fill reservoir with D.O.T. 5 hydraulic brake fluid and bleed brakes as covered in BLEEDING THE HYDRAULIC BRAKE SYSTEM.
10. Install exhaust.

FLSTC/F/S MASTER CYLINDER/ RESERVOIR DISASSEMBLY

1. Clean exterior of master cylinder/reservoir with a clean, nonflammable solvent.

⚠CAUTION

Screw the banjo bolt into the cartridge. The banjo bolt will protect the sealing surface of the reservoir body during the disassembly procedure.

2. See Figure 2-47. Screw banjo bolt into the cartridge (22).
3. Remove dust boot (17) lip from groove in reservoir body (8).
4. Remove spring pin (11) from clevis (10) and push rod (12). Unscrew clevis from push rod.

⚠WARNING

Be sure to protect reservoir body from dirt or grease. Contaminants in brake fluid can adversely affect brake performance, which can lead to an accident resulting in personal injury.

5. Set master cylinder on work bench, resting on banjo bolt. Press down on large washer (16) to compress return spring (19) and remove retaining ring (15) from groove in push rod (12).
6. Carefully release spring (19). Remove washer (16), dust boot (17) and spring (19).
7. Remove spring return retainer (18) (inside dust boot).
8. Remove push rod (12) from cartridge (22) and discard cartridge.

NOTE

Do not try to repair the cartridge (22). The cartridge is nonrepairable. Replace the whole cartridge if damaged.

CLEANING AND INSPECTION

⚠WARNING

- **Always use a non-flammable solvent for cleaning metal parts. DO NOT use gasoline or other flammable substances which could ignite and cause personal injury.**
- **Always use denatured alcohol or D.O.T. 5 HYDRAULIC BRAKE FLUID to clean the brake system rubber components. DO NOT use mineral base solvents (such as gasoline or paint thinner) or deterioration of rubber parts may occur after assembly. Deterioration of components may result in brake failure and personal injury.**

1. See Figure 2-47. Clean all parts, except the cartridge (22), with a clean, nonflammable solvent and blow dry with compressed air. Clean all rubber parts using denatured alcohol or brake fluid.
2. Inspect reservoir body (8) bore for scratches. Replace if scratched or damaged.
3. Check dust boot (17) for tears or damage. Replace if torn or damaged.
4. Inspect threads on reservoir body (8), push rod (12) and banjo bolt (1). Replace any part with damaged threads.
5. Carefully remove large O-rings (9) from cartridge (22).
6. Lubricate all internal parts with lubricant provided in kit.

FLSTC/F/S MASTER CYLINDER ASSEMBLY

1. See Figure 2-47. Lubricate the O-rings (9) with D.O.T. 5 hydraulic brake fluid and install in the grooves on the cartridge (22).
2. Lubricate bore of body (8) with D.O.T. 5 hydraulic brake fluid.
3. Insert cartridge (22) into reservoir body (8) using hand pressure only. Be sure notch on cartridge engages lug inside reservoir body.
4. Screw banjo bolt (1) into cartridge and set master cylinder on work bench, resting on banjo bolt.
5. Place washer (13) on push rod (12). Install washer retaining ring (14) on push rod.
6. Insert ball-end of push rod (12) into cartridge and push into cartridge until washer (13) is properly seated in the cartridge bore.
7. Install washer retaining ring (14) in groove inside the cartridge bore. Be sure retaining ring is fully seated in the groove.
8. Release pressure on push rod (12) and be sure push rod rotates freely.
9. Place return spring (19), return spring retainer (18), dust boot (17) and washer (16) in position on the push rod (17).

NOTE

Drain hole in dust boot must face down to drain properly.

10. Press down on washer (16) and install retaining ring (15).
11. Seat sealing lip of dust boot (17) into groove on reservoir body (8).

FXSTC, FXSTS, FXSTSB MASTER CYLINDER DISASSEMBLY

1. Clean exterior of master cylinder with a clean, nonflammable solvent.

CAUTION

Screw the banjo bolt into the cartridge. The banjo bolt will protect the sealing surface of the cartridge body during the disassembly procedure.

2. See Figure 2-47. Screw banjo bolt (1) into the cartridge (22).
3. Remove dust boot (17) lip from groove in cartridge body (25).
4. Loosen clevis jam nut. Unscrew clevis from push rod.

WARNING

Be sure to protect cartridge body from dirt or grease. Contaminants in brake fluid can adversely affect brake performance, which can lead to an accident resulting in personal injury.

5. Set master cylinder on work bench, resting on banjo bolt. Press down on large washer (16) to compress return spring (19) and remove retaining ring (15) from groove in push rod (21).
6. Carefully release spring (19). Remove washer (16), boot (17) and spring.
7. Remove spring return retainer (18) (inside dust boot). Remove retaining ring (20) from the cartridge body (25).
8. Remove push rod (21) from cartridge (22) and discard cartridge.

NOTE

Do not try to repair the cartridge (22). The cartridge is non-repairable. Replace the whole cartridge if damaged.

CLEANING AND INSPECTION

WARNING

- **Always use a non-flammable solvent for cleaning metal parts. DO NOT use gasoline or other flammable substances which could ignite and cause personal injury.**
- **Always use denatured alcohol or D.O.T. 5 HYDRAULIC BRAKE FLUID to clean the brake system rubber components. DO NOT use mineral base solvents (such as gasoline or paint thinner) or deterioration of rubber parts may occur after assembly. Deterioration of components may result in brake failure and personal injury.**

1. Clean exterior of master cylinder/reservoir with a clean, nonflammable solvent. Lubricate all internal parts with lubricant provided in kit.
2. See Figure 2-47. Inspect body (25) bore for scratches. Replace if scratched.
3. Check dust boot (17) for tears or damage. Replace if torn or damaged.
4. Inspect threads on body (25), push rod (21) and banjo bolt (1). Replace any part with damaged threads.
5. Carefully remove large O-rings (23) from cartridge body (25).

FXSTC, FXSTS, FXSTSB MASTER CYLINDER ASSEMBLY

1. See Figure 2-47. Lubricate the O-rings (23) with D.O.T. 5 hydraulic brake fluid and install in the grooves in the cartridge body (17).
2. Lubricate bore of cartridge body with D.O.T. 5 hydraulic brake fluid. Align nipple on cartridge body with notch in threaded end of cartridge.
3. Insert cartridge into cartridge body using hand pressure only. Be sure notch on cartridge engages lug inside cartridge body.
4. Screw banjo bolt into cartridge and set master cylinder on work bench, resting on banjo bolt.
5. Place washer (13) on push rod (21). Install washer retaining ring (14) on push rod.
6. Insert ball-end of push rod into cartridge and push into cartridge until washer (13) is properly seated in the cartridge bore.
7. Install washer retaining ring (14) in groove inside the cartridge bore. Be sure retaining ring is fully seated in the groove.
8. Release pressure on push rod (21) and be sure push rod rotates freely.
9. Install retaining ring (20) in the groove on cartridge body. Place return spring (19), return spring retainer (18), dust boot (17) and washer (16) in position on the push rod (21).

NOTE

Drain hole in dust boot must face down to drain properly.

10. Press down on washer (16) and install retaining ring (15).
11. Seat sealing lip of dust boot (17) into groove on cartridge body (25).

FRONT BRAKE CALIPER

REMOVAL – Hydraulic Fork Models

1. See Figure 2-48. Disconnect the brakeline at the caliper fitting.

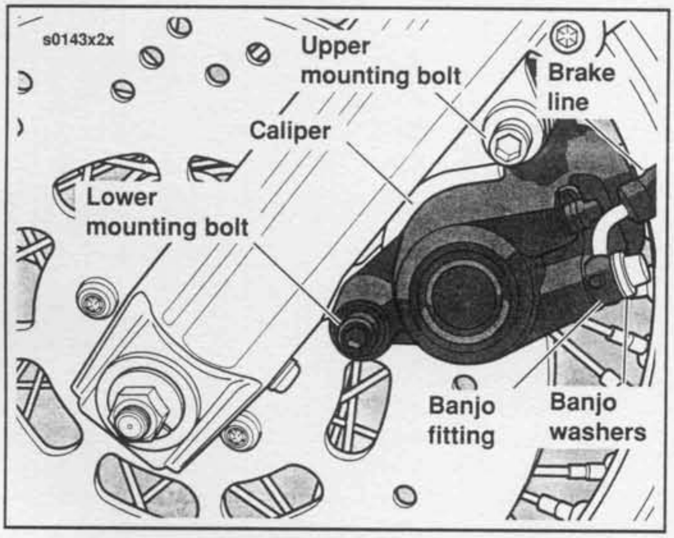

Figure 2-48. Front Brake Caliper Mounting

NOTE

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

2. Remove the upper and lower mounting bolts to release the caliper assembly from the vehicle.

3. Move the caliper assembly to a clean bench area.

INSTALLATION – Hydraulic Fork Models

⚠CAUTION

Whenever a caliper is installed, BEFORE moving motorcycle, you must pump brake fluid pressure back up until the pistons push the pads against the brake disc. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle and the motorcycle may be damaged.

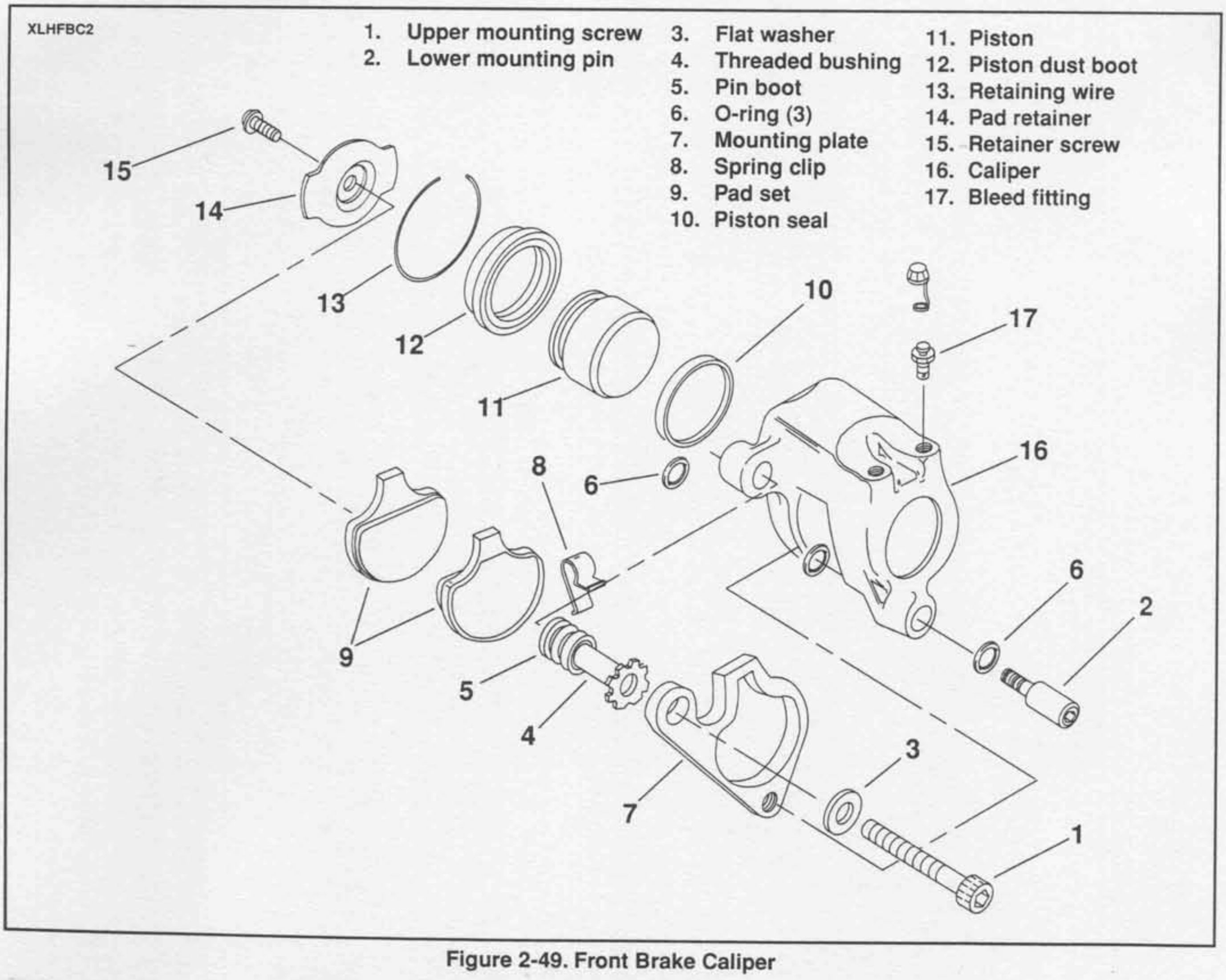

Figure 2-49. Front Brake Caliper

Mount the caliper on the vehicle as follows:

1. Coat the outside diameter of lower mounting pin (2) with Dow Corning MOLY 44 grease.

2. Position the caliper with the disc between the friction pads. Align the two mounting holes in the caliper with the mounting lugs on the fork.

WARNING

Check to be sure that the caliper bushings are in the mounting lugs on the fork. Installing caliper without bushings will result in improper caliper location and possible locked brake, which could lead to an accident resulting in personal injury.

CAUTION

See Figure 2-50. The threaded bushing's flange must go UNDER the rivet head during assembly. At the same time, one of the U-shaped notches on the outer edge of the bushing flange must engage the rivet body. If the bushing is not positioned properly the rivet will be damaged when the mounting bolts are tightened.

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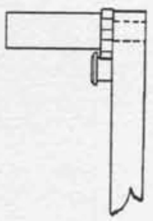

Figure 2-50. Threaded Bushing/Rivet Engagement

3. See Figure 2-50. Place a flat washer (3) on upper mounting bolt (1), then insert the bolt through the fork lug, and the mounting plate (7). Thread the bolt into the threaded bushing (4).

4. Insert the lower mounting pin (2) through the caliper and the fork lug. Thread it into the tapped hole at the lower end of mounting plate (7). Tighten lower mounting pin to 25-30 ft-lbs (34-41 Nm).

5. Tighten upper mounting bolt (1) to 25-30 ft-lbs (34-41 Nm).

6. If the bleeder valve was removed, install it and tighten to 80-100 **in-lbs** (9.0-11.3 Nm).

7. Use new banjo washers and connect the brake line to the caliper. Hold brake line in place and tighten banjo bolt to 17-22 ft-lbs (23-30 Nm).

8. Shift handlebars so master cylinder is level. Fill reservoir with D.O.T. 5 hydraulic brake fluid to 1/8 in. (3.2 mm) below top. Reservoir may be filled with bladder type pressurized equipment. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.

9. Install the master cylinder cover. Actuate the master cylinder and check for leaks. Bleed the brake system. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.

DISASSEMBLY – ALL MODELS

1. See Figure 2-50. Remove retainer screw (15), pad retainer (14) and inside pad (9).

2. Remove the outer pad (9), mounting plate (7 or 7A) and spring clip (8) as an assembly. Remove pad (9) from mounting plate (7) by pushing the pad free of the spring clip (8).

3. Pry out the retaining wire (13) by inserting a small screwdriver into the notched groove at the bottom of the piston bore.

WARNING

When removing the piston with air pressure, wear heavy gloves or hold piston with heavy towel to prevent personal injury. Be sure piston is not dropped on hard surface. Piston may develop considerable force from pressure build-up and you should take care to keep your hands out from under piston to prevent personal injury.

4. Remove the piston dust boot (12). Then remove the piston by applying air pressure to the hydraulic brake line inlet.

5. Pull threaded bushing (4) out of bushing bore, then remove pin boot (5) from groove in caliper.

6. Pry seal (10) and the three O-rings (6) out of their grooves.

CLEANING AND INSPECTION

⚠WARNING

For correct and safe brake operation, brake pads must be replaced in sets at the same time. Rear brake pads must also be replaced in sets. Mismatched brake pads could lead to an accident resulting in personal injury.

⚠CAUTION

Avoid hard stops for 300 miles. Proper burnishing will not occur if hard stops are made during the wear-in period.

1. 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.
2. Inspect all components carefully for excessive wear or damage.

⚠WARNING

Always clean brake system rubber parts by washing in denatured alcohol or brake fluid. DO NOT use mineral base cleaning solvents such as gasoline or paint thinner. Use of mineral base solvents will cause deterioration of the parts. Parts would continue to deteriorate after assembly which could result in component failure. This could lead to an accident resulting in personal injury.

3. Clean all metal parts with alcohol. Do not use gasoline. Clean all rubber parts in denatured alcohol or brake fluid.

ASSEMBLY – ALL MODELS

⚠CAUTION

Be sure washers, banjo bolt, hydraulic brake line and master cylinder bore are free of D.O.T. 5 hydraulic brake fluid, dirt and metal chips before assembly to avoid leakage.

After the parts have been inspected and any worn or damaged parts replaced, the caliper is assembled as follows:

1. See Figure 2-50. Apply a thin coating of GE Silicone Versilube grease (G322L) to the exterior surfaces of seal (10) and O-rings (6) in their respective grooves. Lightly coat the cavity of pin boot (5) with Dow Corning 44 grease. Insert the flanged end of pin boot (5) into the internal groove of the threaded bushing bore.
2. Push the piston dust boot (12), 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 (11) 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 wire (13) 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.
6. Push the threaded bushing (4) into the pin boot (5) and through the bushing bore in the mounting lug. Keep pushing until the free end of the pin boot seats in the grooved shoulder next to the hexagonal head of the threaded bushing.
7. Lay the mounting plate (7) down on a firm flat surface. The upper mounting bolt hole must be positioned at the upper right.
8. See Figure 2-51. Install the spring clip at the top of mounting plate as shown.

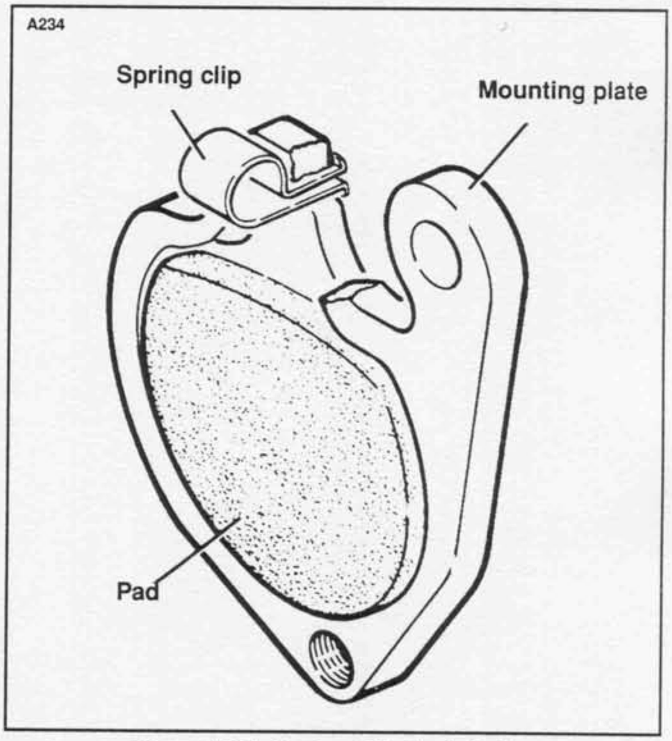

Figure 2-51. Spring Clip Installation

9. See Figure 2-50. Take the pad (9) 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.
10. Insert the outer pad (9), mounting plate (7) and spring clip (8) 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.

11. Place the inner pad (9) (without insulator backing) in the recessed seat machined into the caliper.

12. Position the pad retainer (14) within the counterbore at the inside end of the caliper. Insert self-tapping retainer screw (15) through the hole in the center of pad retainer (14) and thread into the hole in the pad. Tighten screw (15) to 40-50 **in-lbs** (4.5-5.6 Nm).

SPRINGER FORK (FXSTS, FXSTSB, FLSTS)–FRONT BRAKE

FRONT BRAKE AND BRAKE LINE REMOVAL (FXSTS, FXSTSB)

1. Disconnect brake line from caliper and drain brake fluid. Discard banjo bolt washers. Remove brake line assembly, if necessary. Remove brake line clamp bolts. 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 2 through 4.

2. See Figure 2-52. Remove cotter pins (1) from brake reaction link socket head screw (8) (brake bracket) and weld stud (on rigid fork).

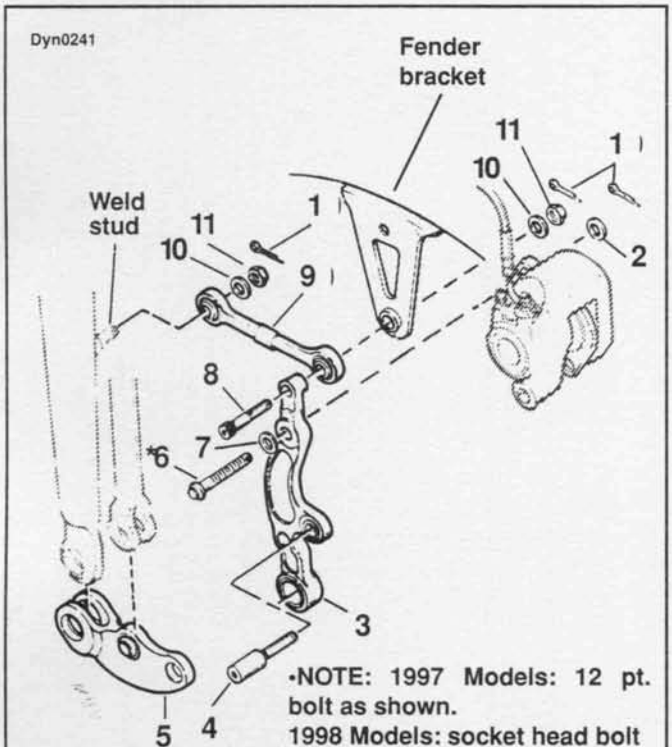

Figure 2-52. Brake Mounting (1997 Model Shown)

3. Remove nuts (11), washers (10) and brake bracket socket head bolt (8).

4. Remove brake reaction link (9). Remove cotter pin (1) and washer (2) from upper mounting bolt (6).

NOTE

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

5. Remove upper mounting bolt (6) and washer (7). Remove lower mounting pin (4) securing brake caliper to brake mounting bracket. Remove brake caliper.

6. If brake caliper needs repair, See FRONT BRAKE CALIPER DISASSEMBLY/ASSEMBLY – ALL MODELS.

⚠CAUTION

Be sure washers, banjo bolt, hydraulic brake line and master cylinder bore are free of D.O.T. 5 hydraulic brake fluid, dirt and metal chips before assembly to avoid leakage.

NOTE

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

FRONT BRAKE AND BRAKE LINE INSTALLATION (FXSTS, FXSTSB)

⚠CAUTION

Whenever a caliper is installed, BEFORE moving motorcycle, you must pump brake fluid pressure back up until the pistons push the pads against the brake disc. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle and the motorcycle may be damaged.

Mount the caliper on the vehicle as follows:

1. See Figure 2-52. Coat the outside diameter of lower mounting pin (4) with Dow Corning MOLY 44 light grease.

2. Position the caliper with the disc between the friction pads. Align the two mounting holes in the caliper with the mounting holes in the bracket.

3. See Figure 2-52. Place flat washer (7) on upper mounting bolt (6), then insert the bolt through the bracket holes, and the mounting plate. Screw the bolt into the threaded bushing.

NOTE

See Figure 2-53. The Springer brake bracket has a cast-in nub that engages a hole in the mounting plate.

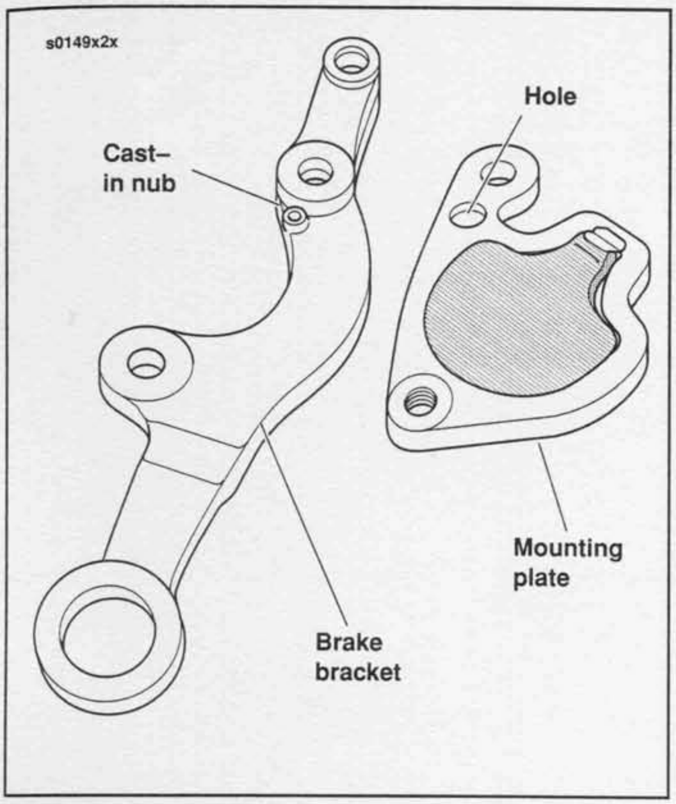

Figure 2-53. Springer Brake Bracket and Mounting Plate

4. Insert the lower mounting pin (4) through the caliper and the bracket hole. Thread it into the tapped hole at the lower end of mounting plate. Tighten lower mounting pin to 25-30 ft-lbs (34-41 Nm).
5. **1997 Models (12 pt. bolt):** Tighten upper mounting bolt (6) to 42-46 ft-lbs (57-62 Nm). Install washer (2) and **new** cotter pin (1).
   1998 Models (Socket head bolt): Tighten upper mounting bolt (6) to 28-30 ft-lbs (38-40.7 Nm). Install washer (2) and **new** cotter pin (1).
6. If the bleeder valve was removed, install it and tighten to 80-100 **in-lbs** (9-11.3 Nm).
7. Place brake reaction link (9) in position on rigid fork weld stud. Align brake reaction link with hole in brake bracket and install bolt (8).
8. Install washers (10) and nuts (11). Tighten weld stud nut to 14-18 ft-lbs (19-24 Nm) and bolt (8) nut to 10-20 ft-lbs (14-27 Nm) torque. Install **new** cotter pins (1).
9. Install brake line assembly, if necessary. Use **new** banjo washers and connect the brake line to the caliper. Hold brake line in place and tighten banjo bolt to 17-22 ft-lbs (23-30 Nm). Install brake line clamp and brake line clamp bolt.
10. Shift handlebars so master cylinder is level. Fill reservoir with D.O.T. 5 HYDRAULIC BRAKE FLUID to 1/8 in. (3.2 mm) below top. Reservoir may be filled with bladder type pressurized equipment. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.
11. Install the master cylinder cover. Actuate the master cylinder and check for leaks. Bleed the brake system. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.

BRAKE REACTION LINK REMOVAL (FLSTS)

1. Remove brake caliper. See FRONT BRAKE CALIPER in this Section.
2. Remove front wheel. See FRONT WHEEL in this Section.
3. Remove front fender. See FRONT FENDERS in this Section.
4. Remove fasteners connecting brake reaction link to caliper bracket.
5. Remove caliper bracket, thrust washer, rubber spacer and pivot sleeve from rocker.
6. Remove fastener connecting brake reaction link to fork leg bracket.
7. Remove button head fasteners connecting fork leg bracket to rigid fork.

BRAKE REACTION LINK INSTALLATION (FLSTS)

1. Install fork leg bracket on to rigid fork. Torque button head screws to 35-40 ft-lbs (47.5-54 Nm).
2. Install brake reaction link with screw, washer and **new** acorn nut to fork leg bracket. Torque acorn nut to 35-40 ft-lbs (47.5-54 Nm).
3. Insert **new** pivot sleeve of caliper bracket assembly into left rocker, if required.
4. Assemble rubber spacer and thrust washer, **with teflon-coated side towards caliper bracket**, onto pivot sleeve.
5. Assemble caliper bracket and **new** bushing if removed.
6. Install caliper bracket onto pivot sleeve.
7. Install special hex head screw, washer and **new** acorn nut into brake reaction link and caliper bracket. Torque acorn nut to 35-40 ft-lbs (47.5-54 Nm).
8. Install front fender. See FRONT FENDERS.
9. Install front wheel. See FRONT WHEEL.
10. Install front brake caliper. See FRONT BRAKE CALIPER.

FRONT BRAKE AND BRAKE LINE REMOVAL (FLSTS)

1. See Figure 2-54. Disconnect brake line (1) from caliper (2) and front master cylinder. Drain brake fluid.
2. Discard banjo bolt washers (3). Remove brake line assembly, if necessary.
3. Remove brake line clamp bolts. 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. See Figure 2-54. Remove spring pin (4) from upper caliper mounting bolt (5).

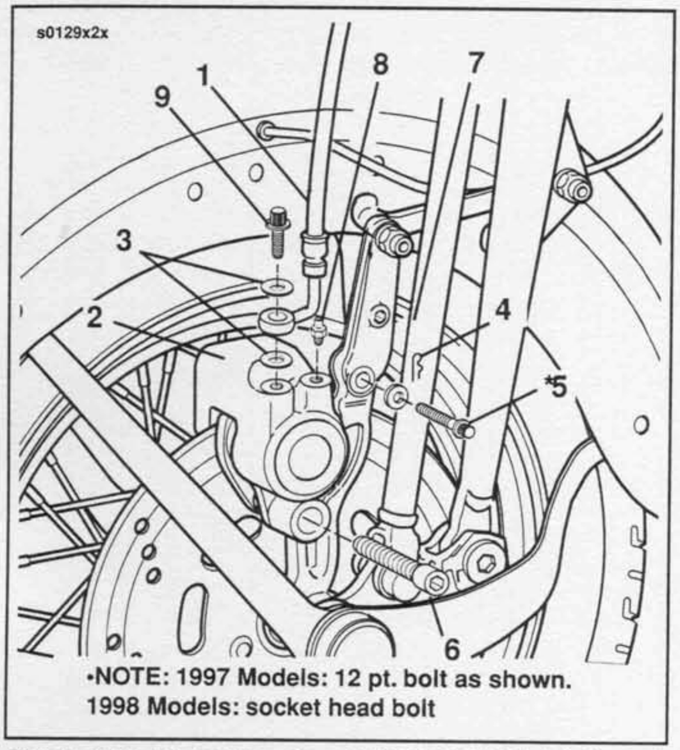

Figure 2-54. Brake Mounting -FLSTS (1997 Model Shown)

5. Remove upper (5) and lower (6) caliper mounting bolts.
6. Remove brake caliper (2).

NOTE

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

7. If brake caliper needs repair, See FRONT BRAKE CALIPER DISASSEMBLY/ASSEMBLY – ALL MODELS.

⚠CAUTION

Make sure washers, banjo bolt, hydraulic brake line and master cylinder bore are free of D.O.T. 5 hydraulic brake fluid, dirt and metal chips before assembly to avoid leakage.

NOTE

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

⚠CAUTION

Whenever a caliper is removed or installed, you must pump brake fluid pressure back up until the pistons push the pads against the brake disc, BEFORE moving motorcycle. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle and the motorcycle may be damaged.

FRONT BRAKE AND BRAKE LINE INSTALLATION (FLSTS)

⚠CAUTION

Whenever a caliper is installed, BEFORE moving motorcycle, you must pump brake fluid pressure back up until the pistons push the pads against the brake disc. If you don't pump fluid pressure up again, the brakes will not be available to stop the motorcycle and the motorcycle may be damaged.

Mount the caliper on the vehicle as follows:

1. See Figure 2-54. Coat the outside diameter of lower mounting bolt (6) with Dow Corning MOLY 44 light grease.
2. Place caliper mounting plate, with disc pad, on disc.
3. Install brake caliper (2) on brake disc.

NOTE

See Figure 2-53. The Springer brake bracket has a cast-in nub that engages a hole in the mounting plate.

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 2-54. Place flat washer (7) on upper mounting bolt (5), 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 (2) and the bracket hole. See Figure 2-53. Thread it into the tapped hole at the lower end of mounting plate. Tighten lower mounting pin to 25-30 ft-lbs (34-41 Nm).
7. **1997 Models (12 pt. bolt):** Tighten upper mounting bolt (5) to 42-46 ft-lbs (57-62 Nm). Install washer and **new** spring pin (4).
   1998 Models (Socket head bolt): Tighten upper mounting bolt (5) to 28-30 ft-lbs (38-40.7 Nm). Install washer and **new** spring pin (4).
8. Install bleeder valve (8) to the caliper (2), if removed, and tighten to 80-100 **in-lbs.** (9-11.3 Nm)
9. Install the brake line (1), if removed. The brake line is installed from the left side of the front fork. Use **new** banjo washers (3) and connect the brake line (1) to the caliper (2). Hold brake line in place and tighten banjo bolt (9) to 17-22 ft-lbs (23-30 Nm). Install brake line clamp and brake line clamp bolt.
10. Shift handlebars so master cylinder is level. Fill reservoir with D.O.T. 5 HYDRAULIC BRAKE FLUID to 1/8 in. (3.2 mm) below top. Reservoir may be filled with bladder type pressurized equipment. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.
11. Install the master cylinder cover. Actuate the master cylinder and check for leaks. Bleed the brake system. See BLEEDING THE HYDRAULIC BRAKE SYSTEM.

REAR BRAKE CALIPER

REMOVAL/DISASSEMBLY

If brake pads are worn to 1/16 in. (1.6 mm) or less of fiber material, replace entire set (4). After the brake pads are installed, avoid hard stops for 100 miles (160 km), to allow the pads to wear into the discs.

1. Remove rear muffler.

NOTE

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

2. See Figure 2-55. Remove pin bolts (11) and carefully lift caliper (10) off the brake disc and brake pads.
3. Remove retainer clip (13). Slide outside brake pad off mounting bracket. Slide inside caliper off mounting bracket, toward wheel.
4. Remove pad shims (3).

NOTE

Do not remove the pistons from the caliper unless there are signs of hydraulic fluid leakage or if the piston is not operating properly.

If the piston must be removed, proceed as follows:

5. Pump the brake lever until piston reaches its full travel. Disconnect the brake hose at the caliper. Remove the piston (6), dust boot (7) and seal (5). If the piston will not come loose, use the following method:

WARNING

Piston may develop considerable force from pressure build-up. Take care to keep hands from under piston to prevent personal injury.

Disconnect the brake hose at the caliper. Place the caliper on the workbench with the piston facing downward. Place a clean shop towel under the piston and apply low air pressure to the inlet hole until piston is forced out of the caliper. If piston is tight in bore, tap lightly around caliper while applying air pressure.

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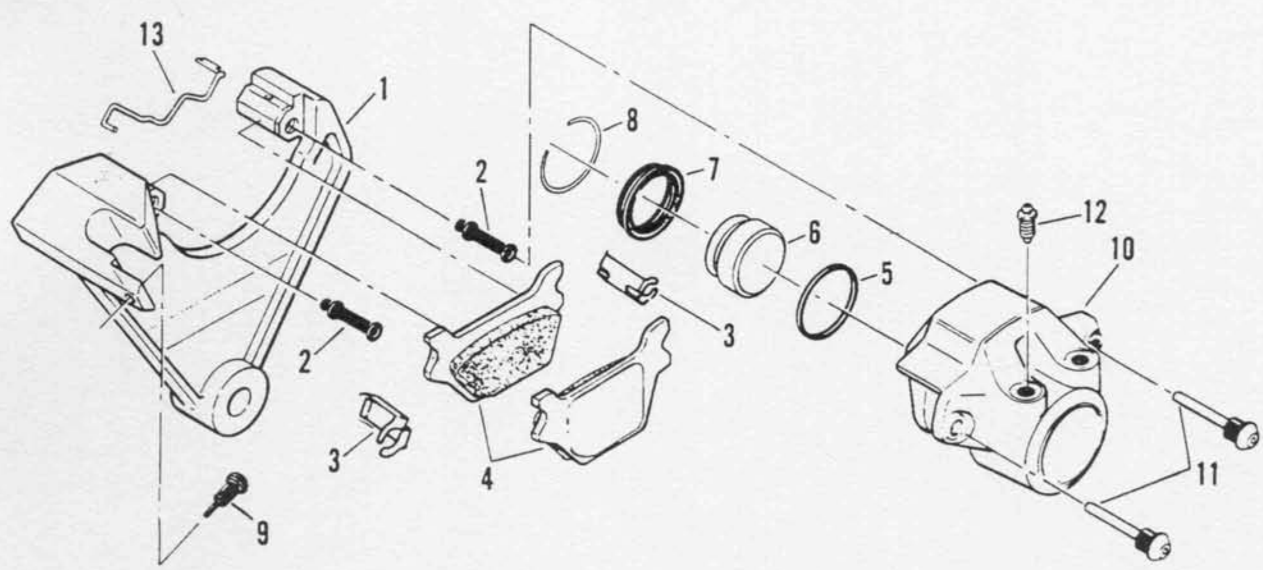


1. Mounting bracket
2. Rubber bushing (2)
3. Pad shim (2)
4. Brake pad (2)
5. Seal
6. Piston
7. Dust boot
8. Retaining ring
9. Bumper
10. Brake caliper
11. Pin bolt (2)
12. Bleeder valve
13. Retainer clip

Figure 2-55. Rear Caliper

CLEANING AND INSPECTION

⚠WARNING

For correct and safe brake operation, brake pads must be replaced in sets at the same time. Rear brake pads must also be replaced in sets. Mismatched brake pads could lead to an accident resulting in personal injury.

1. If the brake pads are worn to 1/16 in. (1.6 mm) thick or less of friction material, replace them as a set.

2. See Figure 2-55. Replace any parts that appear worn or damaged. Always replace seal (5) and dust boot (7) if removed from caliper bore. Replace rubber bushing (2) if damaged or worn. Do not hone or bore cylinder.

⚠WARNING

Always use a non-flammable solvent for cleaning metal parts. DO NOT use gasoline or other flammable substances which could ignite resulting in personal injury.

3. Clean all metal parts in a non-flammable cleaning solvent and blow dry with compressed air.

⚠WARNING

Always clean brake system rubber parts by washing in denatured alcohol. DO NOT use mineral base cleaning solvents which would deteriorate rubber parts. This could lead to an accident resulting in personal injury.

4. Clean all rubber parts in denatured alcohol or brake fluid.

⚠CAUTION

Be sure washers, banjo bolt, hydraulic brake line and master cylinder bore are free of D.O.T. 5 hydraulic brake fluid, dirt and metal chips before assembly to avoid leakage.

ASSEMBLY/INSTALLATION

1. See Figure 2-55. Place pad shims (3) on mounting bracket with the tabs seated in mounting holes.

⚠CAUTION

Be sure pads are on the pad shim. Motorcycle operation with the pad off the shim will result in rear brake pad drag, uneven pad wear and damage to the mounting bracket.

2. Slide brake pad over pad shims (3) from saddlebag carrier side. From wheel side of brake disc, slide the other brake pad (4) over pad shims (3). Insert retainer clip (13) in holes in mounting bracket (1) and bring clip over the top of outer pad (4) as shown in Figure 2-56.

NOTE

Use care when installing caliper to be sure brake pads (4) are not knocked off pad shims (3).

⚠CAUTION

Whenever a caliper is removed/installed, you must pump brake fluid pressure back up, until the pistons push the pads against the brake disc, BEFORE moving motorcycle. If you don't pump fluid pressure up again, the brakes will not be available to stop the vehicle and the vehicle may be damaged.

NOTE

If piston (6) was removed, refer to the ASSEMBLY procedure for the FRONT BRAKE CALIPER for instructions needed to assemble seal (5), piston (6), boot (7) and retaining ring (8). Use care when installing caliper to be sure brake pads (4) are not knocked off pad shims (3).

3. Lower caliper (10) so that caliper straddles brake pads. Align holes in caliper with holes in mounting bracket (1) and install pin bolts (11). Tighten bolts (11) to 15-20 ft-lbs (20-27 Nm).

4. If brake line was disconnected, hold brake line in place and tighten banjo bolt to 17-22 ft-lbs (23-30 Nm).

5. Bleed the rear brake system following the procedure BLEEDING THE HYDRAULIC SYSTEM contained in this section.

6. Install rear muffler.

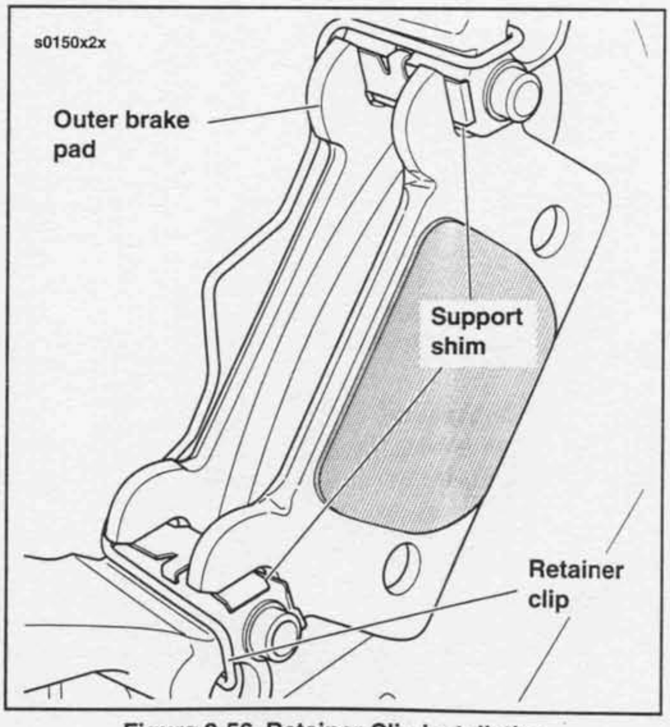


Figure 2-56. Retainer Clip Installation

BLEEDING THE HYDRAULIC BRAKE SYSTEM

NOTE

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

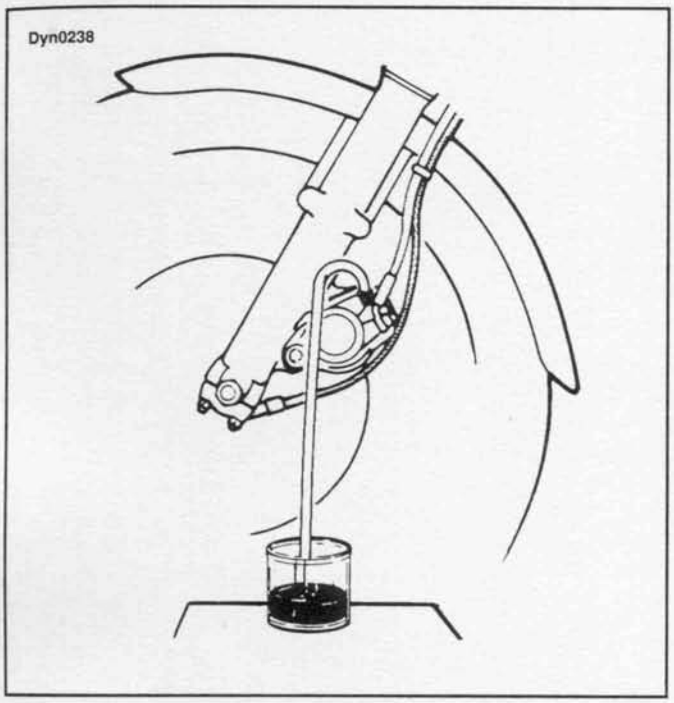


Figure 2-57. Bleeding Brakes

1. See Figure 2-57. Slip a length of appropriate size clear plastic tubing over wheel cylinder bleeder valve with other end in a clean container. Turn handlebars so that bleeder valve is nearly vertical.
2. Depress brake pedal or lever once to build up pressure. Open bleeder valve by rotating counterclockwise about one-half turn.
3. Keep master cylinder full of fluid at all times. Slowly depress brake pedal or lever once until fluid stops flowing from tubing. Close the bleeder valve. Allow pedal or lever to return slowly to release position.
4. Repeat operation until brake system is free of air bubbles. Add fluid to master cylinder to bring to original level. Do not reuse fluid. Tighten brake bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm).

⚠WARNING

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

⚠WARNING

Whenever a hydraulic brake line or fitting is opened the fitting should be flushed with brake fluid and the brake system must be bled. Do this to eliminate any air or contaminants from the brake system. Air in the fluid will cause the brake pedal to have a spongy feel. If a contaminant becomes lodged in the seat of a fitting, leakage of fluid could occur, and/or air could be drawn into the system resulting in decreased brake performance and possible personal injury.

NOTES

HYDRAULIC FRONT FORKS (FXSTC, FLSTC, FLSTF)

REMOVAL

1. Remove the front wheel and brake caliper as described previously in this section.
2. Remove the front fender.
3. See Figures 2-58 or 2-59. 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 1 through 4 for the other fork side.

DISASSEMBLY

⚠WARNING

The FLSTC and FLSTF models have a preloaded fork spring. Disassemble the fork tube(s) carefully. The spring can force parts from the tube unexpectedly, possibly causing personal injury.

⚠WARNING

See Figures 2-58 or 2-59. Fork tube plug (5) is under spring pressure. Remove carefully to prevent personal injury.

1. Support the vehicle so the front end is off floor and the forks are fully extended.
2. See Figures 2-58 or 2-59. 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. Remove dust seal (23) (FXSTC only). Compress retaining ring (11) and remove the clip from the internal groove at the top of slider (12).

NOTE

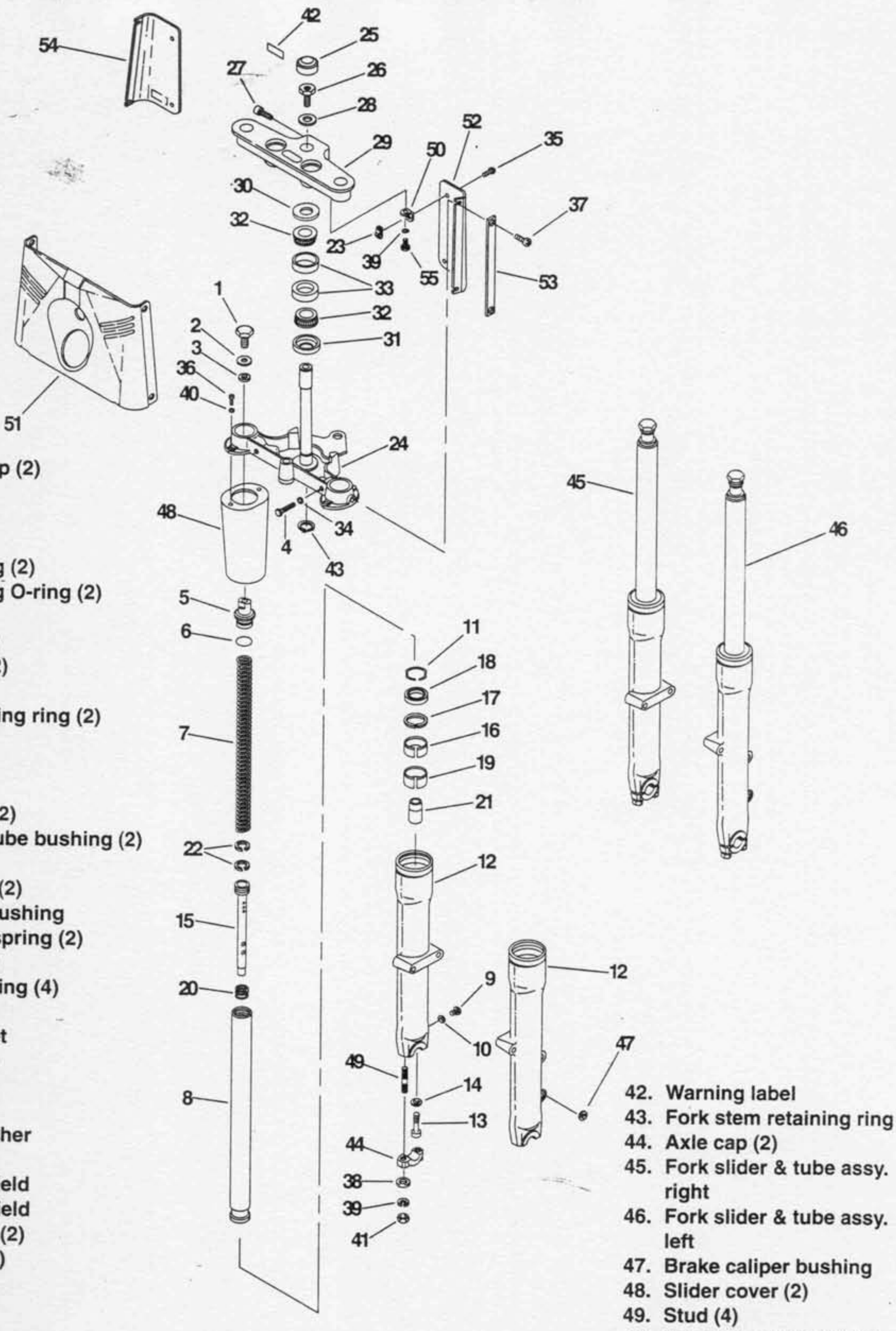
Since there is little resistance to rotation when removing socket screw (13), the job is done more easily with an air impact wrench.

4. 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 (12).
5. The upper bushing (16) is a slight interference fit in slider (12). The upper bushing (16) 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 (12) in a quick continuous stroke. Continue this slide hammer action until the components are freed.
6. Push the damper tube (15) and damper tube spring (20) free of fork tube (8) by inserting a small diameter rod through the opening in the bottom of tube.
7. Remove lower stop (21) from the lower end of damper tube (15).
8. Damper tube rings (22) can now be removed from the grooves at the top end of damper tube (15). Lower bushing (19) should not be removed unless it is to be replaced. When replacing lower bushing (19), expand the new split bushing diameter only enough to fit over slider tube (8) and slide bushing into the bushing groove.

CLEANING AND INSPECTION

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

1. See Figures 2-58 or 2-59. Inspect friction rings (22) on damper tube (15) and replace if worn excessively or damaged.
2. Check FXSTC dust seal (23) where it rubs on fork tube (8). The tube should show a bright, shining surface, free of scoring or abrasions, and the dust seal 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 fork 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. Check both washers (10 and 14) to see that they provide a good seal when used with their respective screws (9 and 13) to prevent oil leakage.
7. Replace bent or damaged fork 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 (4)
23. Clip nut
24. Stem & bracket
25. Fork stem cap
26. Bolt (2)
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 (4)
39. Lockwasher (2)
40. Lockwasher(4)
41. Nut (4)
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. Brake caliper bushing
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 2-58. Front Fork – FLSTC, FLSTF

s0066x2x

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 (4)
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 (4)
37. Lockwasher (4)
38. Nut (4)
39. Pad (2)
40. Axle cap (4)
41. Stud (4)
42. Fork slider & tube assy. left
43. Fork slider & tube assy. right
44. Brake caliper bushing
45. Headlamp mounting plate
46. Fork stem retaining ring

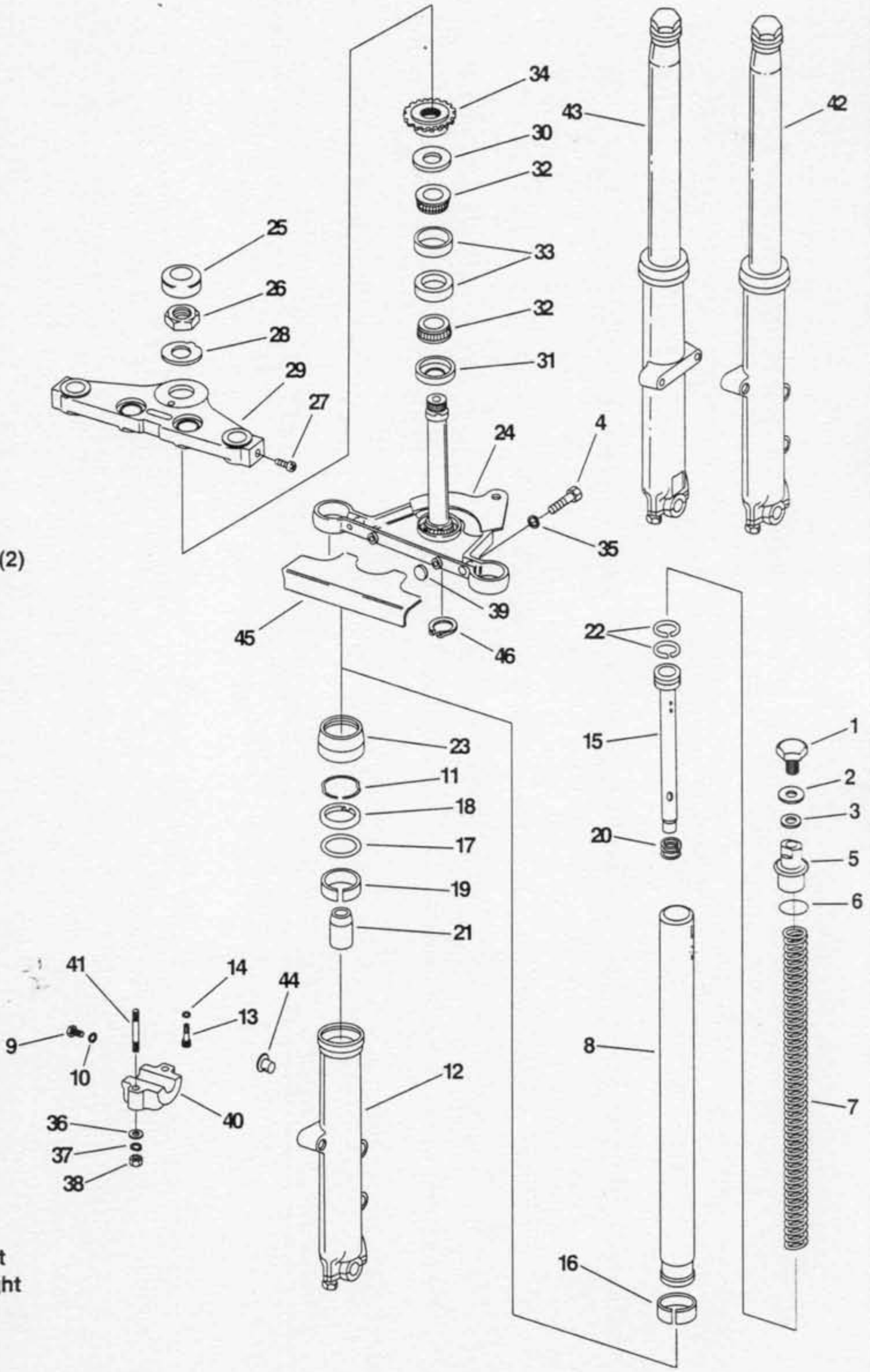


Figure 2-59. Fork Stem and Bracket – FXSTC

ASSEMBLY

1. See Figures 2-58 or 2-59. Install damper tube rings (22). Place damper tube spring (20) on damper tube (15). Insert damper tube into fork tube (8).
2. Insert spring (7) into fork 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 fork 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. Place installation tool 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. Install retaining ring (11). On FXSTC only, install dust cover (23).
5. Fill fork sides with Harley-Davidson TYPE E FORK OIL in the amount specified under GENERAL.

INSTALLATION

1. See Figures 2-58 or 2-59. Insert both fork side assemblies up through the fork stem and bracket (24) and upper bracket (29).
2. Install a new oil seal (3), spacer (2) and fork tube plug (5). 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).
4. Tighten the fork stem bracket pinch bolt(s) (4) to 23-28 ft-lbs (31-38 Nm).

FORK ADJUSTMENT

Steering Head Bearing Adjustment - "1 - 2 Inch (25 - 50 mm) Fall-Away" Method

1. Support motorcycle in an upright position so the front end is completely suspended.
2. Remove all accessory weight, such as 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 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 must be straight ahead.
5. Loosen lower triple clamp pinch bolts.
6. Tap the fender on one side until the front end begins to "fall-away" by itself. mark this point on the marking material. Repeat in the other direction.

NOTE

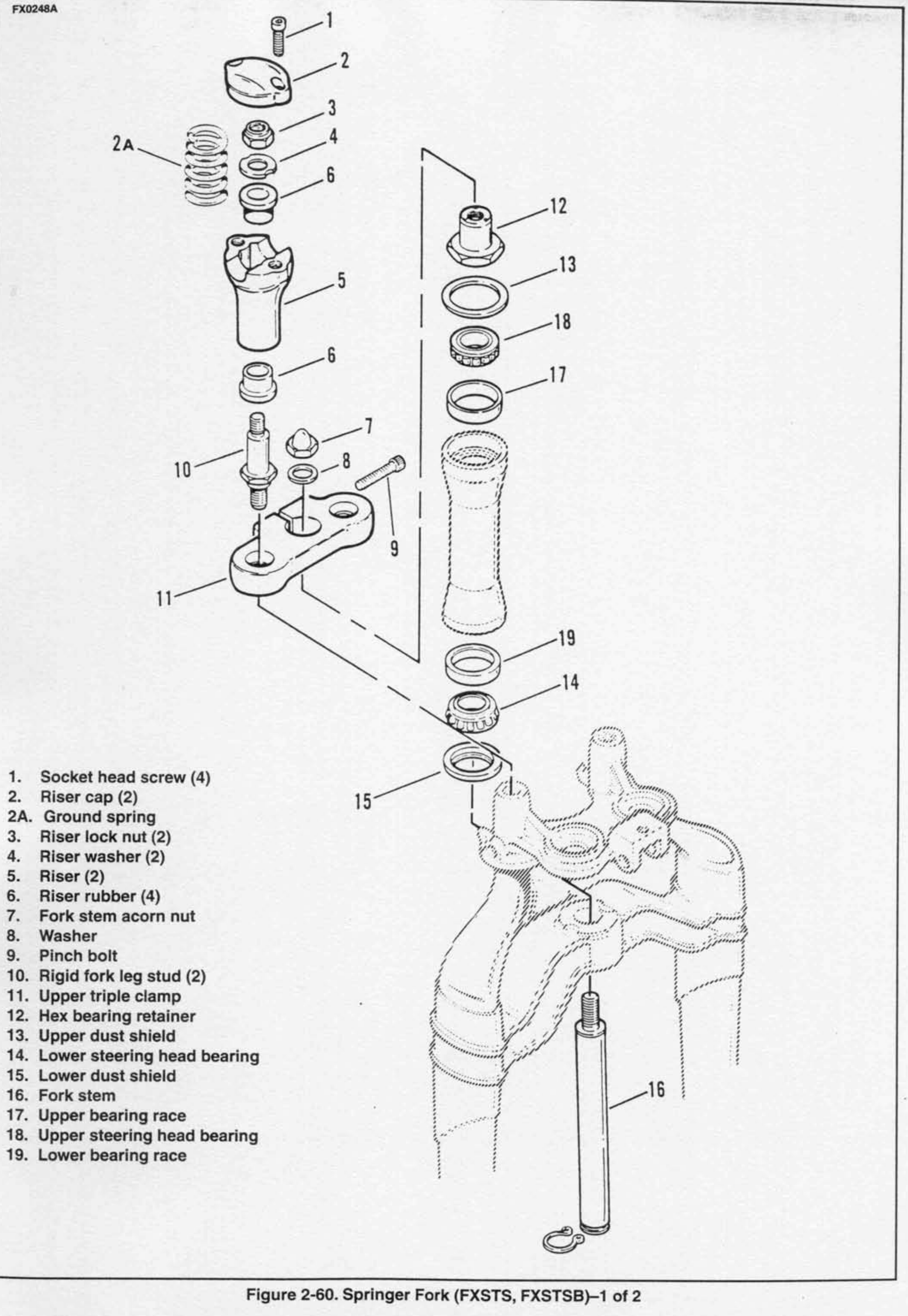
The distance between the "fall-away" marks must be 1-2 inches (25-50 mm).

7. Tighten or loosen the fork adjuster nut/bolt until the "fall-away" point is within 1 to 2 inches (25 to 50 mm).

NOTE

If the "fall-away" point is more than 2 inches (50 mm), loosen the adjuster nut. If it is less than 1 inch (25 mm), tighten the adjuster nut.

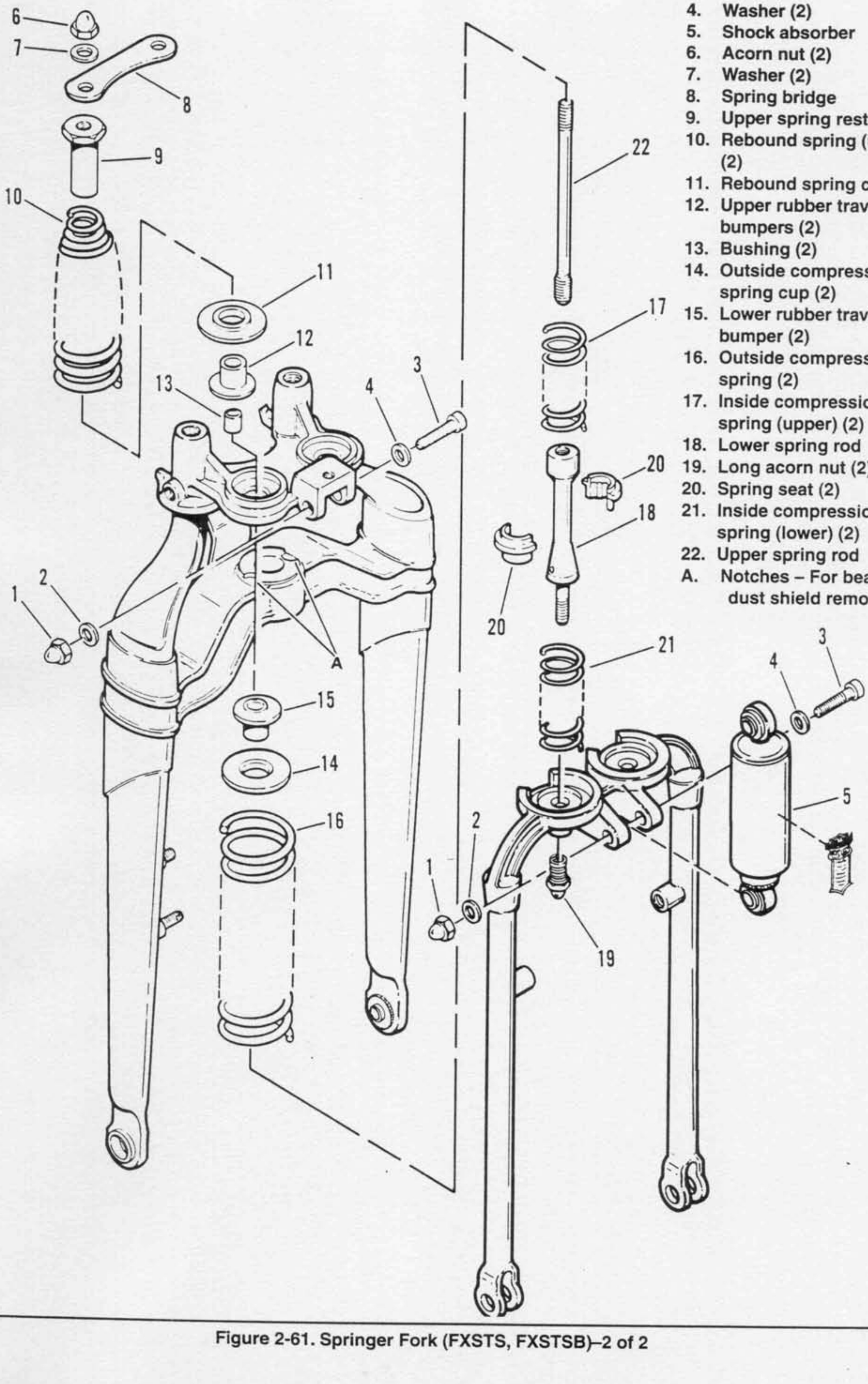
8. Tighten lower triple clamp pinch bolts to a torque of 30 to 35 ft-lbs (41 to 47 Nm).
9. Repeat the "fall-away" procedure to be sure the adjustment is correct.



1. Socket head screw (4)
2. Riser cap (2)
2A. Ground spring
3. Riser lock nut (2)
4. Riser washer (2)
5. Riser (2)
6. Riser rubber (4)
7. Fork stem acorn nut
8. Washer
9. Pinch bolt
10. Rigid fork leg stud (2)
11. Upper triple clamp
12. Hex bearing retainer
13. Upper dust shield
14. Lower steering head bearing
15. Lower dust shield
16. Fork stem
17. Upper bearing race
18. Upper steering head bearing
19. Lower bearing race

Figure 2-60. Springer Fork (FXSTS, FXSTSB)–1 of 2

FX0248B



1. Acorn nut (2)
2. Washer (2)
3. Bolt (2)
4. Washer (2)
5. Shock absorber
6. Acorn nut (2)
7. Washer (2)
8. Spring bridge
9. Upper spring restraint (2)
10. Rebound spring (upper) (2)
11. Rebound spring cups (2)
12. Upper rubber travel bumpers (2)
13. Bushing (2)
14. Outside compression spring cup (2)
15. Lower rubber travel bumper (2)
16. Outside compression spring (2)
17. Inside compression spring (upper) (2)
18. Lower spring rod
19. Long acorn nut (2)
20. Spring seat (2)
21. Inside compression spring (lower) (2)
22. Upper spring rod

A. Notches – For bearing & dust shield removal

Figure 2-61. Springer Fork (FXSTS, FXSTSB)–2 of 2

HANDLEBAR AND RISER REMOVAL

NOTE

For illustrations of complete springer fork assembly, see Figures 2-60 and 2-61 on the preceding two pages.

1. See Figure 2-62. Remove handlebar risers socket head screws (1) and riser caps (2). Remove handlebars. One of the risers contains a ground spring, to provide an electrical ground for the front turn signals. Remove ground spring (3).
2. Remove risers lock nuts (4) and washers (5). Discard lock nuts. Remove the risers (7). If necessary, remove the riser rubbers (6).

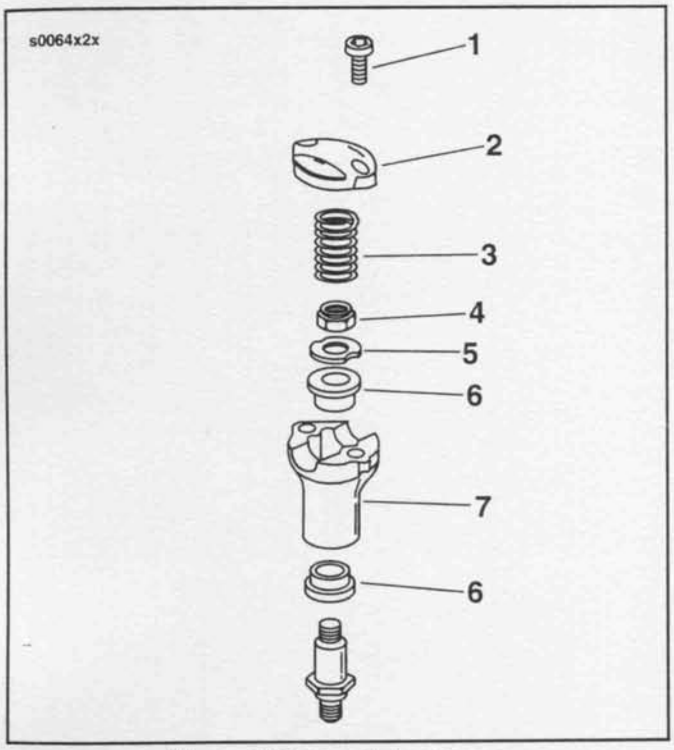


Figure 2-62. Handlebar Risers

HANDLEBAR AND RISER INSTALLATION

1. See Figure 2-62. If you removed the riser rubbers (6), lubricate the outside of the riser rubbers 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.

NOTE

Place the washer cutouts on the bosses inside the risers so that when the locknuts are tightened, the bosses are centered in the washer cutouts.

3. Install the washers (5) and NEW locknuts (4). Tighten locknuts to 25-35 ft-lbs (34-47 Nm). Place ground spring (3) in one of the risers.
4. Place handlebars on risers and put riser caps (2) in position. Install socket head screws (1). Make the gap between caps and risers even, front and rear. Adjust handle bars and tighten socket head screws to 12-15 ft-lbs (16-20 Nm).

FRONT SHOCK ABSORBER REMOVAL

NOTE

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

1. See Figure 2-63. Remove acorn nuts (1) and washers (2) on retaining bolts (3).
2. Remove bolts (3) and washers (4). Remove shock absorber (5).

FX0250

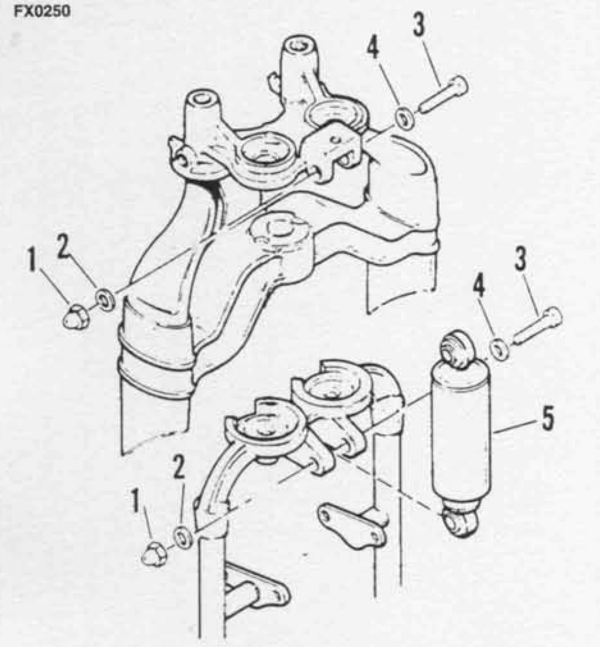


Figure 2-63. Shock Absorber

FRONT SHOCK ABSORBER INSTALLATION

⚠CAUTION

The Springer front suspension was designed as a system and the shock absorber: FLSTS Part No. 54482-97; FXSTS and FXSTSB Part No. 54483-88A has specific characteristics that make it an integral part of the suspension system. Replacing this shock absorber with anything other than the specified Harley-Davidson replacement part or altering the suspension system, may affect handling, resulting in personal injury.

1. See Figure 2-63. Place shock absorber (5) in position in bracket holes and install bolts (3), washers (2 and 4) and acorn nuts (1). Use Loctite 242 (blue) on threads and tighten acorn nut to 45-50 ft-lbs (61-68 Nm).

⚠CAUTION

Be sure there is no freeplay between shock absorber eyes and shock absorber brackets. Freeplay between shock absorber eyes and shock absorber brackets indicates incorrect shock absorber usage.

FORK REMOVAL

NOTE

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

1. Remove headlamp and mounting block. See HEADLAMP, Section 8. Move headlamp out of the way and let wire support it.
2. On FLSTS only, remove the passing lamp assembly. See PASSING LAMP, Section 8.
3. Remove handlebars and risers. See SPRINGER FORK (FXSTS, FXSTSB, FLSTS), Disassembly in this Section.
4. Remove front brake caliper and brake line. See FRONT BRAKE in this Section.
5. Remove wheel. See FRONT WHEEL - Springer Fork.
6. Remove front fender. See FRONT FENDERS.
7. See Figure 2-64. Remove fork stem acorn nut (7) and rubber washer (8). Loosen the upper triple clamp pinch bolt (9).
8. Remove the rigid fork leg studs (10).
9. Remove upper triple clamp (11).
10. Remove hex bearing retainer (12) and dust shield (13).
11. Remove fork stem and fork from steering head.

FX0251

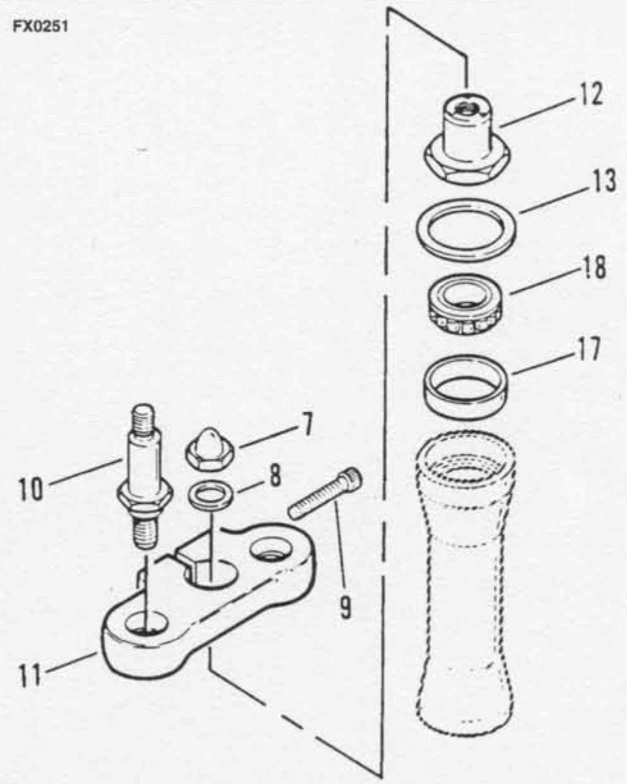


Figure 2-64. Steering Head

FORK INSTALLATION

1. Place fork stem in steering head.
2. See Figure 2-65. Install upper dust shield (13) and hex bearing retainer (12).

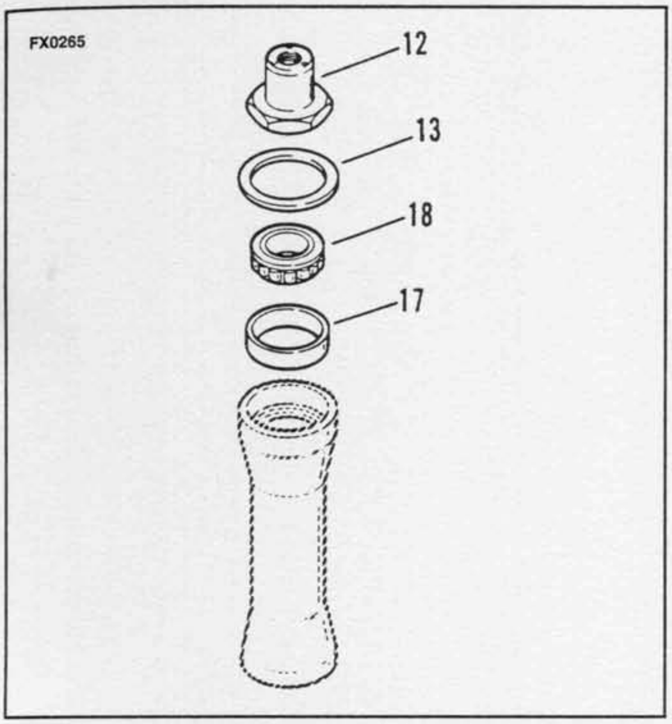


Figure 2-65. Dust Shield and Hex Bearing Retainer

NOTE

Retainer is installed with hex DOWN.

3. Seat steering head bearing by torquing bearing retainer (12) to 40 ft-lbs. (54 Nm). Loosen and then re-torque bearing retainer (12) to 6 ft-lbs (8 Nm).
4. See Figure 2-66. Place upper triple clamp (11) in position on stem and rigid fork legs.

NOTE

Install rigid fork leg studs (10) in three steps (Steps 5-7).

5. Start threads of both studs in fork leg.
6. Tighten both studs.
7. Torque both studs to 60-65 ft-lbs (81-88 Nm).
8. Install upper triple clamp pinch bolt (9) and tighten to 25-30 ft-lbs (23-30 Nm).
9. Install fork stem rubber washer (8) and acorn nut (7). Tighten fork stem acorn nut to 30-35 **in-lbs** (3.4-4.0 Nm).
10. Adjust fall-away. See SPRINGER FORK ADJUSTMENT, Springer Steering Head Bearing Adjustment.

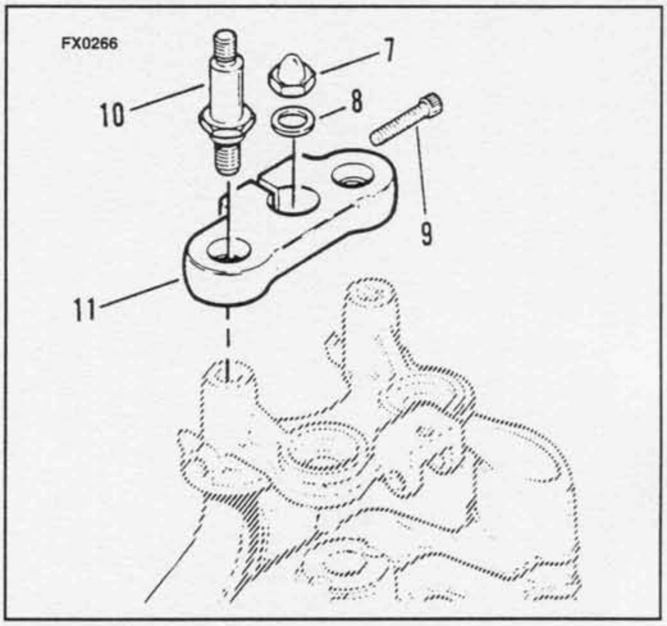


Figure 2-66. Upper Triple Clamp and Fork Leg Studs

SPRING FORK DISASSEMBLY

⚠WARNING

The springs are compressed. If they are released suddenly, they could cause personal injury.

1. Remove front shock absorber. See SHOCK ABSORBER.

See Figure 2-67. Make a spring fork compression tool as shown.

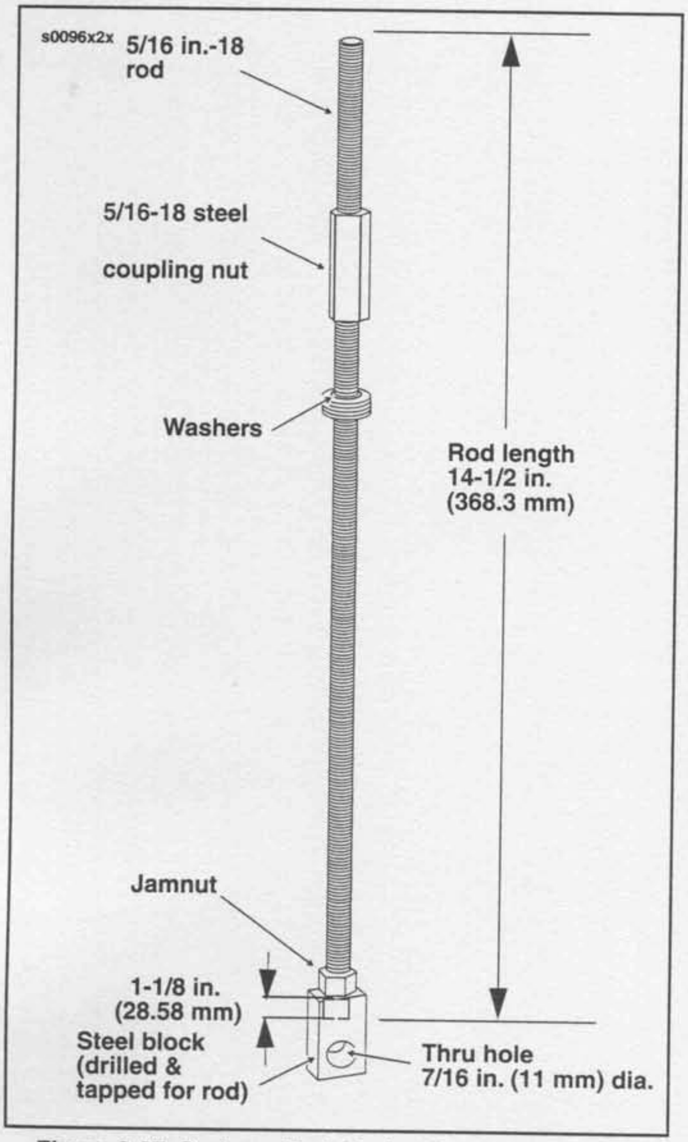


Figure 2-67. Springer Fork Spring Compression Tool

⚠WARNING

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 cause personal injury. See Figure 2-68. Use nylon cable ties around the rigid and spring fork legs to hold them in place.

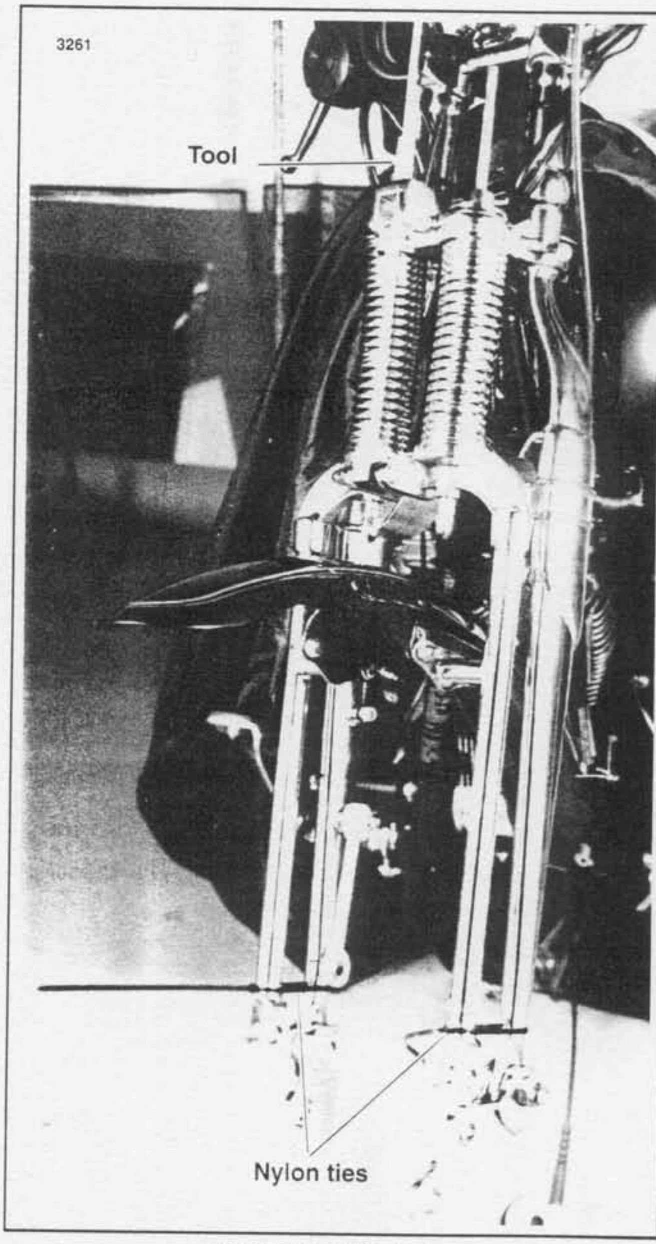


Figure 2-68. Tool Use

Tool use:

1. See Figure 2-68. Slide the rod, without the long hex nut and washers, into the hole above the upper shock eye mount.
2. Install the block in the bottom shock absorber eye using the shock absorber mounting bolt and washers.
3. Install the washers and long hex nut on the rod.
4. See Figure 2-68. Use cable ties to tie wrap the fork legs in place as shown.
5. See Figure 2-68. 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.

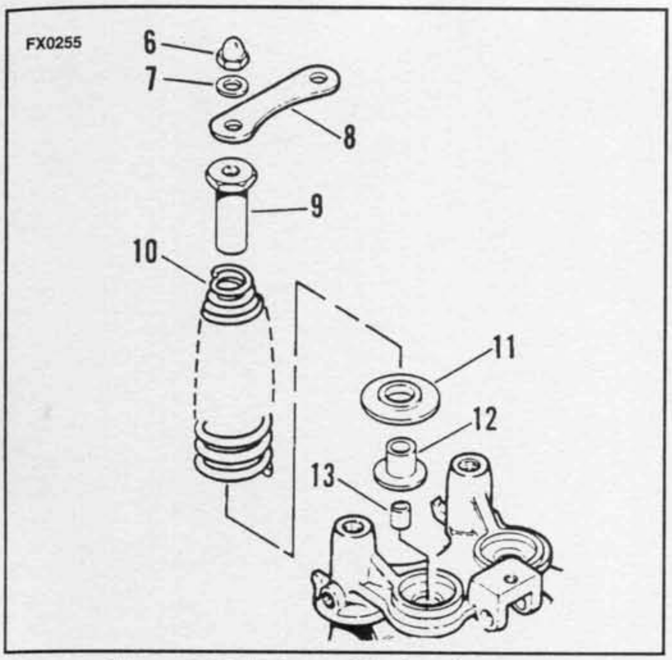


Figure 2-69. Rebound Spring Assembly

NOTE

The FLSTS uses hex nuts. The FXSTS and FXSTSB use acorn nuts.

6. See Figure 2-69. Remove acorn nuts (6), washers (7) and spring bridge (8).
7. Remove upper spring restraints (9).
8. Remove upper (rebound) springs (10).
9. Remove rebound spring cups (11).
10. Remove upper rubber travel bumpers (12).
11. Remove bushings (13).
12. See Figure 2-71. Remove thick rocker head pivot studs (1), thick washers (2) and acorn nuts (3) (FLSTS hex nuts) from rockers (4).
13. Unscrew the tool, gradually releasing the tension on the lower (compression) springs.
14. Remove spring fork assembly from rigid fork assembly and rockers. Slide legs out of nylon tie wraps
15. See Figure 2-70. Remove compression spring cups (14) and lower rubber travel bumpers (15). Remove outer compression springs (16).
16. Remove upper, inner compression springs (17).
17. Insert a # 2 Phillips head screwdriver in the cross-hole at the bottom of the lower spring rod (18) and loosen long acorn nuts (19). Remove Phillips head screwdriver. Remove the long acorn nuts (19) and spring rod assemblies.

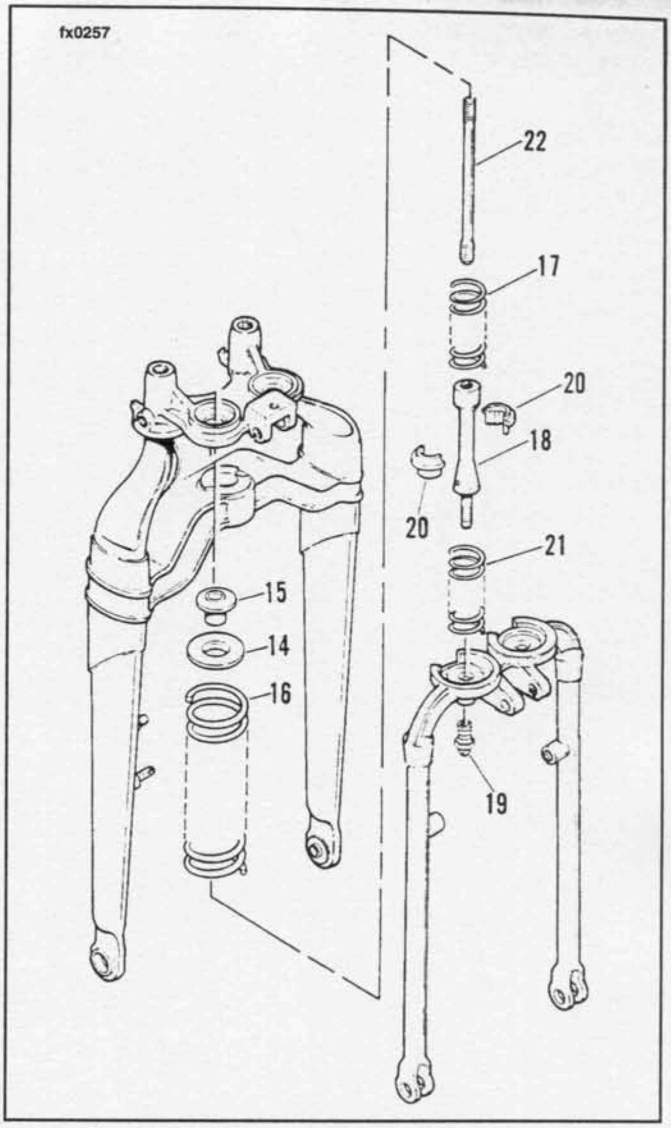


Figure 2-70. Compression Spring Assembly

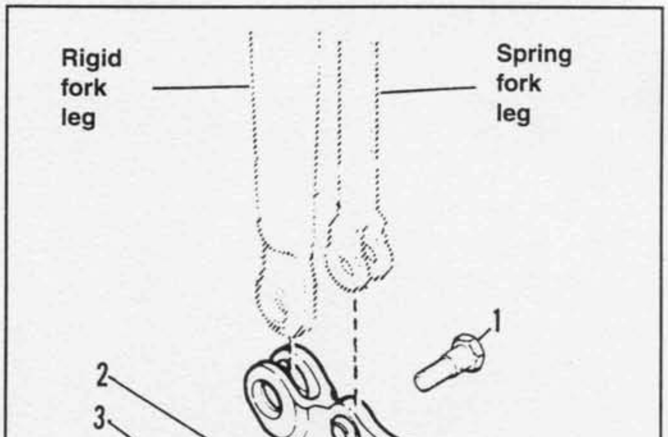


Figure 2-71. Rocker Assembly

NOTE

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

18. Remove spring seats (20) and inside lower compression springs (21) from lower spring rod (18).

⚠CAUTION

DO NOT remove the upper spring rods (22) from the lower spring rods (18). If either the upper spring rod(s) (22) or the lower spring rod(s) (18) are damaged, replace as an assembly.

SPRING FORK ASSEMBLY

1. See Figure 2-70. Place spring seats (20) on lower spring rod (18).
2. Place lower inside compression spring (21) over lower spring rod and spring seats.
3. Position spring rods assembly in spring fork bracket (B).
4. Install long acorn nut (19).
5. Use a #2 Phillips head screwdriver in the cross-hole at the bottom of the lower spring rod (18) and tighten long acorn nut to 20-25 ft-lbs (27-34 Nm).
6. Place upper inside compression spring (17) on spring seats.
7. Place outside compression spring (16) over the inside compression springs.
8. Install compression spring cup (14) and lower rubber travel bumpers (15).
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 2-71. Place spring fork lower end in position in rocker (4).
13. Install thick head pivot stud (1) with thick washer (2) and acorn nut (3) (FLSTS hex nut on <u>inboard</u> side). Tighten nut to 45-50 ft-lbs (61-68 Nm).
14. Repeat steps 12 and 13 for other side.
15. See Figure 2-72. Oil bushing (13) and place on spring rod. Slide bushing down until it bottoms in lower rubber travel bumpers (15).
16. Install upper rubber travel bumpers (12) over spring rod and bushing.
17. Install rebound spring cup (11).
18. Install rebound spring (10).

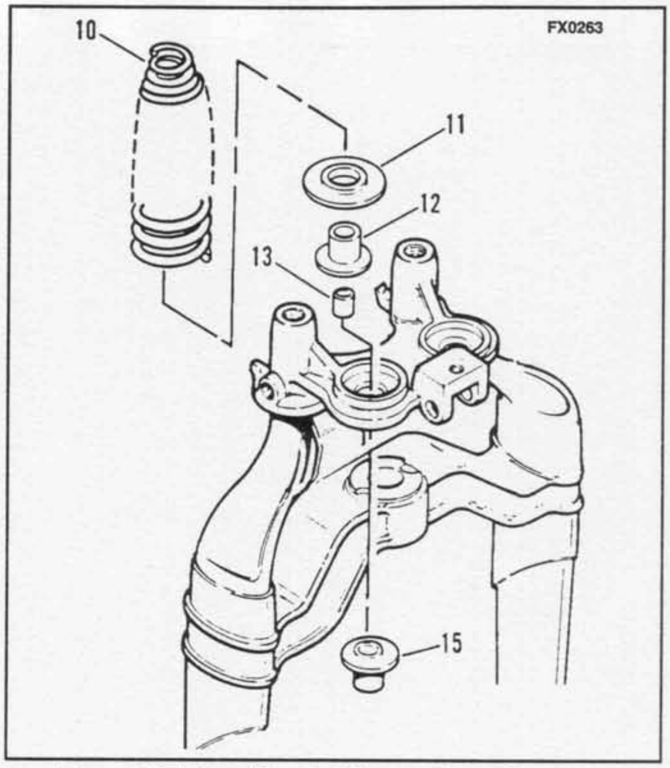


Figure 2-72. Bushing and Lower Travel Bumpers

19. Repeat steps 15 through 18 for other side.
20. Apply anti-seize to top 1/2 in. (13 mm) of upper spring rods.
21. See Figure 2-73. Place upper spring restraints (9) in position. Tighten spring restraints until the spring rods protrude 5/8-3/4 in. (16-19 mm) from the tops of the spring restraints.

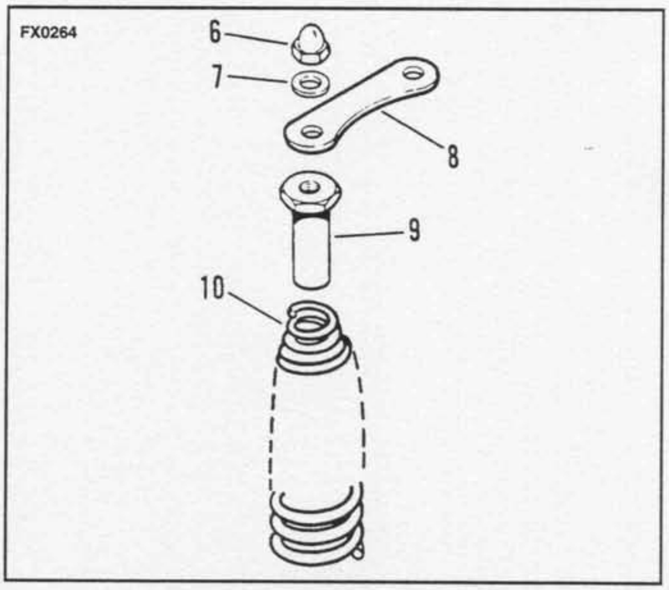


Figure 2-73. Spring Restraints

NOTE

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

22. Place spring bridge (8) in position. Install washers (7) and acorn nuts (6). Tighten acorn nuts to 30-35 ft-lbs (41-47 Nm).

23. On FLSTS only, install passing lamp assembly. See PASSING LAMP, Section 8.

24. Install front shock absorber. See SHOCK ABSORBER INSTALLATION in this Section.

25. Install front brake caliper and brake line. See FRONT BRAKE in this Section.

26. Install front wheel. See FRONT WHEEL - Springer Fork.

27. Install front fender. See FRONT FENDERS.

28. Install handlebars and risers. See SPRINGER FORK (FXSTS, FXSTSB, FLSTS), Assembly in this Section.

29. Install headlamp and mounting block. See HEADLAMP, Section 8.

ROCKER REMOVAL

1. Remove front brake caliper. See SPRINGER FORK-Front Brake.

2. Remove front wheel. See FRONT WHEEL - SPRINGER FORK.

3. On FLSTS only, remove front fender. See FRONT FENDERS (FLSTS).

4. Use cable ties to tie wrap the fork legs in place as shown in Figure 2-68.

WARNING

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 cause personal injury. See Figure 2-68. Use nylon cable ties around the rigid and spring fork legs to hold them in place.

5. Remove spring fork rocker pivot stud, washer and acorn nut (FLSTS hex nut) from rocker.

6. See Figure 2-74. Remove bearing retainer jam nuts (6).

7. Remove bearing retainers (7).

8. Remove acorn nuts (4) (FLSTS hex nut) from rigid fork pivot studs. Remove rigid fork thin head pivot studs (8) from rockers and rigid fork legs. Remove bearings (9) from thin head pivot studs (8).

9. Remove rockers (5).

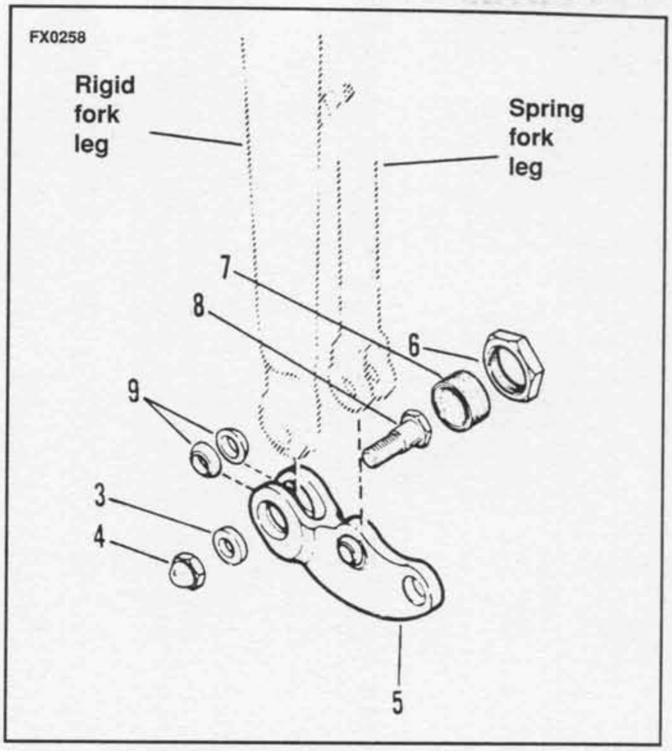


Figure 2-74. Rocker Assembly

ROCKER INSTALLATION

NOTE

*Be sure you install the left rocker in the left rigid fork leg and the right rocker in the right rigid fork leg. **On FXSTS and FXSTSB** the **threaded side** of the rocker goes **inboard**. On **FLSTS** the **threaded side** goes **outboard**.*

1. If bearing races were removed, press races into rockers.
2. See Figure 2-74. Grease rocker bearing race with a finger full of grease. Place one bearing half (9) in rocker race, spherical surface against the race.
3. Place other half of bearing on pivot stud (8), 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 (3) and acorn nut (4) (FLSTS hex nut). Use Loctite 242 (blue) on acorn nut (FLSTS hex nut) and tighten nut to 45-50 ft-lbs (61-68 Nm).
7. Apply anti-seize to threads of bearing retainer (7). Apply a finger full of grease on the bearing race. Install bearing retainer. Tighten retainer to 25-35 in-lbs. (2.8-4.0 Nm).
8. Secure bearing retainer by installing jam nut (6). Tighten jam nut to 95-105 ft-lbs (129-142 Nm).

NOTE

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

9. To adjust rocker see ROCKER BEARING ADJUSTMENT.

FORK STEM BEARING REMOVAL

NOTE

See Figure 2-75. Springer rigid fork stem bracket has notches (A) 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.

⚠CAUTION

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

1. See Figure 2-75. Remove bearing (14) and dust shield (15) from fork stem (16).

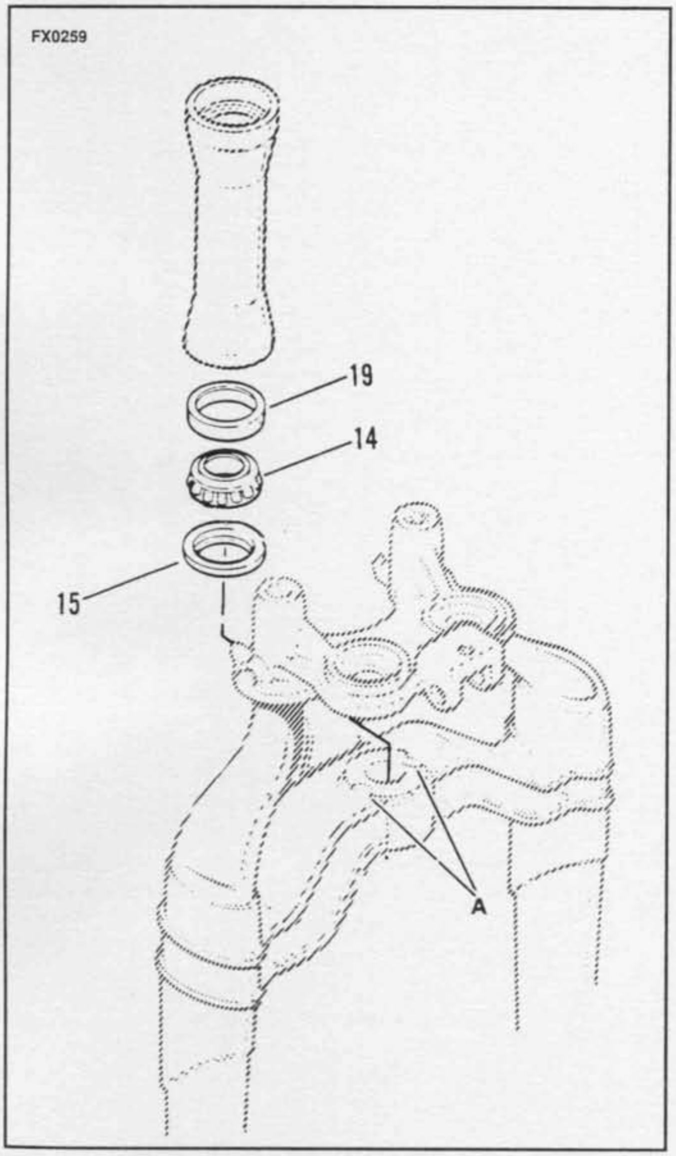


Figure 2-75. Fork Stem Assembly

FORK STEM BEARING INSTALLATION

1. See Figure 2-75. Press dust shield (15) and bearing (14) onto fork stem.

SPRINGER FORK ADJUSTMENT

General

⚠WARNING

The springer fork was NOT designed for sidecar use. DO NOT use either the FXSTS, FXSTSB or FLSTS motorcycle, or any springer fork-equipped vehicle for this purpose. Use of any springer fork-equipped vehicle for this purpose could cause personal injury.

⚠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 resulting in personal injury.

DO NOT:

- **Alter the fender brackets to lower the fender. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.**
- **Replace the O.E.M. tire with a higher-aspect ratio tire. Doing this could allow the front wheel to bind on the fender during hard stops or big bumps.**
- **Replace the O.E.M. tire on FXSTS and FXSTSB models with a traditional-looking 16 in. front wheel, tire and front fender. In addition to above, this could adversely affect the handling characteristics of this motorcycle.**
- **Replace the O.E.M. tire on FLSTS 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 does not assume responsibility for mishaps resulting from these changes.

Special Tool Fabrication:

See Figure 2-76. Use a spare hex bearing retainer, P.N. 48306-88, to make a special tool. Place a drop of green loctite in each of the three holes in the hex bearing retaining nut. Insert a roll pin, Part No. 614 in each of the three holes. Cut the pins so that about 1/2 inch (12.7 mm) of the pin protrudes from the retaining nut. Use this as a tool to adjust the steering head bearings.

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. DO NOT USE THIS TOOL TO SEAT THE UPPER BEARING RETAINER NUT. HIGH TORQUE WILL BEND THE PINS IN THE TOOL.

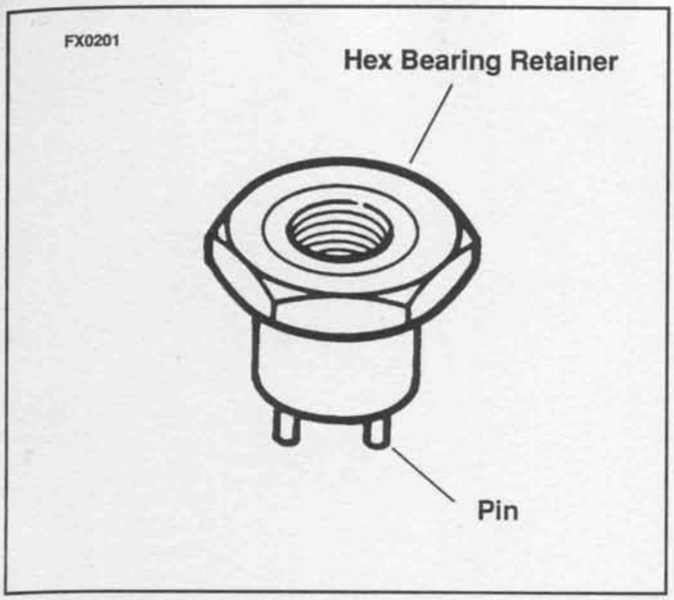


Figure 2-76. Special Tool

Springer Steering Head Bearing Adjustment (FXSTS, FXSTSB)

NOTE

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

1. Raise the motorcycle so wheels are off the floor and equal amount.
2. See Figure 2-77. Remove the acorn nut and rubber washer. Loosen but do not remove the upper triple clamp pinch bolt.
3. Turn the fork to full left lock.
4. See Figure 2-78. Hang a plum bob from the hole in the rear of the fender. Lay a rule on the floor directly under the plumb bob, with the point of the plumb bob at zero.
5. Insert the hex bearing retainer tool into the upper triple clamp and hex bearing retainer holes.
6. Move the front wheel to the balance point and tap it until it begins to "fall-away" **to the right**.
7. Adjust the hex bearing retainer with the tool until the total measurement, from zero to "fall-away" (**from full left lock to "fall-away" to the right**) is 4-6 inches (101.6 - 152.4 mm).
8. See Figure 2-77. Tighten the pinch bolt to 25-30 ft-lbs (34-41 Nm).
9. Install the rubber washer and acorn nut. Tighten acorn nut to 30-35 **in-lbs** (3.4-4.0 Nm).

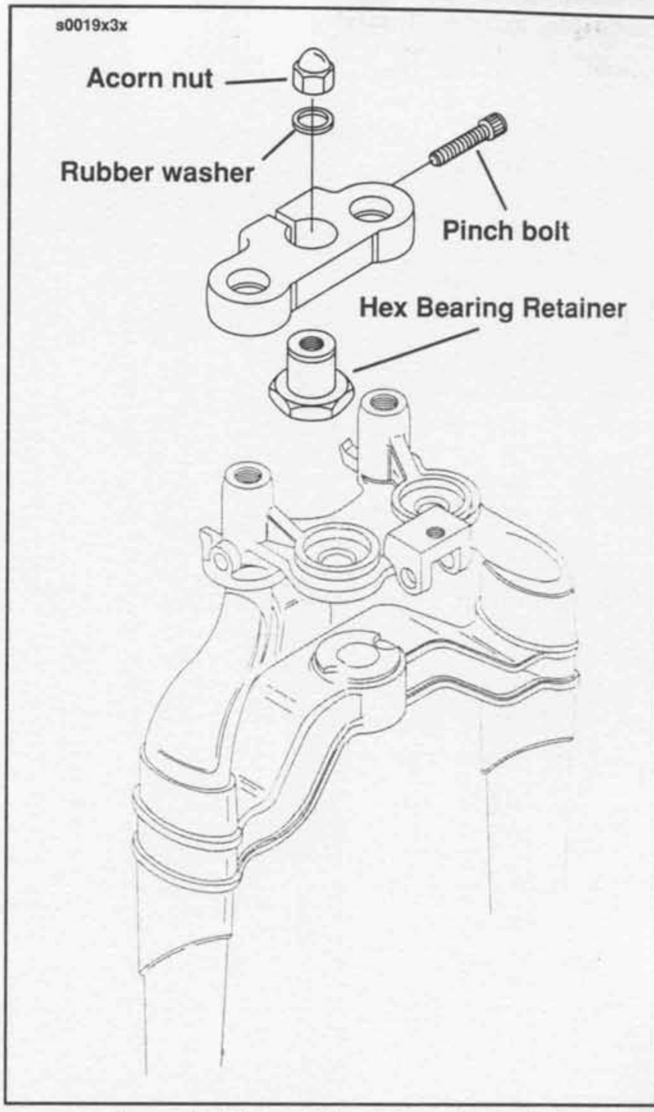


Figure 2-77. Handlebar Risers Assembly

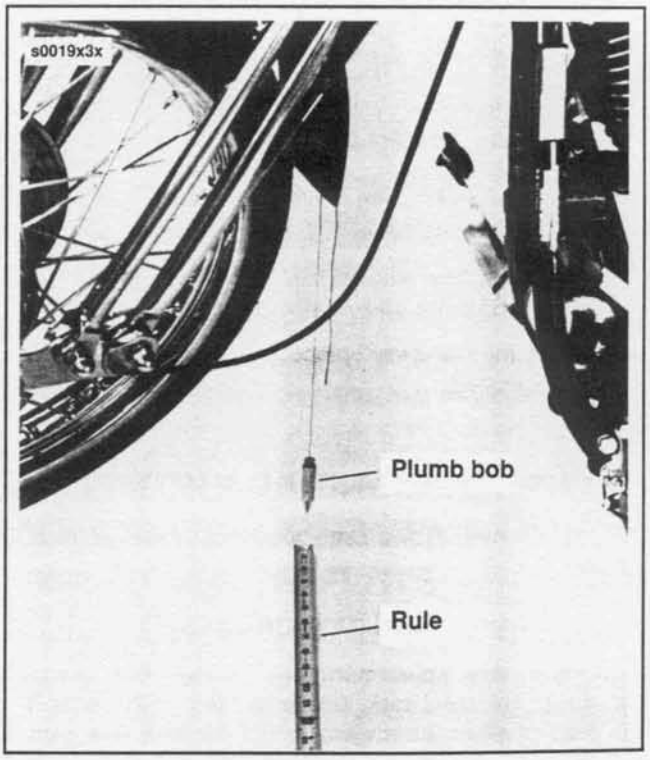


Figure 2-78. Adjusting "Fall-away"

Springer Steering Head Bearing Adjustment (FLSTS)

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 2-77. Remove the acorn nut and washer. Loosen but do not remove the upper triple clamp pinch bolt.
5. Remove all accessory weight, such as 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. Tap the fender on one side until the front end begins to "fall-away" by itself. Mark this point on the marking material.
10. Repeat step 10 in the other direction.

NOTE

The correct distance between the "fall-away" marks must be 1 to 2 inches (25 to 50 mm).

11. Tighten or loosen the hex bearing retaining nut until the "fall-away" point is 1 to 2 inches (25 to 50 mm).

NOTE

If the "fall-away" point is <u>more than 2 inches (50 mm)</u>, the adjuster nut is too tight; loosen the adjuster nut. If the "fall-away" point is <u>less than 1 inch (25 mm)</u>, the adjuster nut is too loose; tighten the adjuster nut.

12. Tighten the triple clamp pinch bolts to a torque of 25 to 30 ft-lbs (34 to 41 Nm).
13. Install the rubber washer and acorn nut. Torque acorn nut to 30-35 **in-lbs** (3.4-4.0 Nm).
14. Repeat the "fall-away" procedure to verify that adjustment is correct.

ROCKER BEARING ADJUSTMENT

Every 10,000 miles (16,000 km) check the rocker bearings for tightness.

⚠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 2-68. The spring fork can be disconnected from the rockers without removing the front end from the motorcycle.

1. Remove the front brake caliper and brake line. See SPRINGER FORK-Front Brake.
2. Remove the front wheel. See FRONT WHEEL - Springer Fork.
3. On FLSTS only, remove front fender. See FRONT FENDERS (FLSTS).

⚠WARNING

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 cause personal injury. See Figure 2-68. Use nylon cable ties around the rigid and spring fork legs to hold them in place.

4. See Figure 2-68. Use cable ties to tie wrap the spring fork legs to the rigid fork legs.
5. Loosen, but do not remove the bearing retainer jam nuts and bearing retainers on the rockers.
6. Loosen spring fork pivot studs (thick head) and remove the nut and washer from each stud. Do not remove the pivot stud from the rocker at this time.
7. Tighten the bearing retainers to 25-35 **in-lbs.** (2.8-4.0 Nm).
8. Hold the bearing retainer in place with a hex driver while tightening the jam nut to 95-105 ft lbs. (129-142 Nm).
9. Remove the pivot studs from the spring fork.
10. Use the torque wrench to rotate the rocker through its arc. The torque reading should be 25-35 **in-lbs.** (2.8-4.0 Nm).
11. If the torque reading from step 10 is out of specification, readjust the bearing retainer to obtain 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. Attach the spring fork legs to the rockers by installing the pivot studs, from the outboard side, with washers and acorn nuts. Tighten the acorn nuts (FLSTS hex nuts) to 45-50 ft-lbs. (61-68 Nm).
13. On FLSTS only, install fender. See FRONT FENDERS (FLSTS).
14. Install front wheel. See FRONT WHEEL - Springer Fork.
15. Install front brake caliper and brake line. See SPRINGER FORK - Front Brake.

NOTE

Inspect all spherical rocker bearings at 50,000 miles. Replace the bearing race if the Teflon lining is worn through to metal anywhere.

STEERING HEAD

REMOVAL/DISASSEMBLY– FLSTC, FLSTF

1. Remove fork shrouds.
2. Remove the fork sides. See HYDRAULIC FRONT FORKS.
3. Remove the headlamp and headlamp bracket. See the ELECTRICAL section.
4. See Figure 2-79. Remove the brake hose bracket from the bottom of the fork stem and bracket (9).

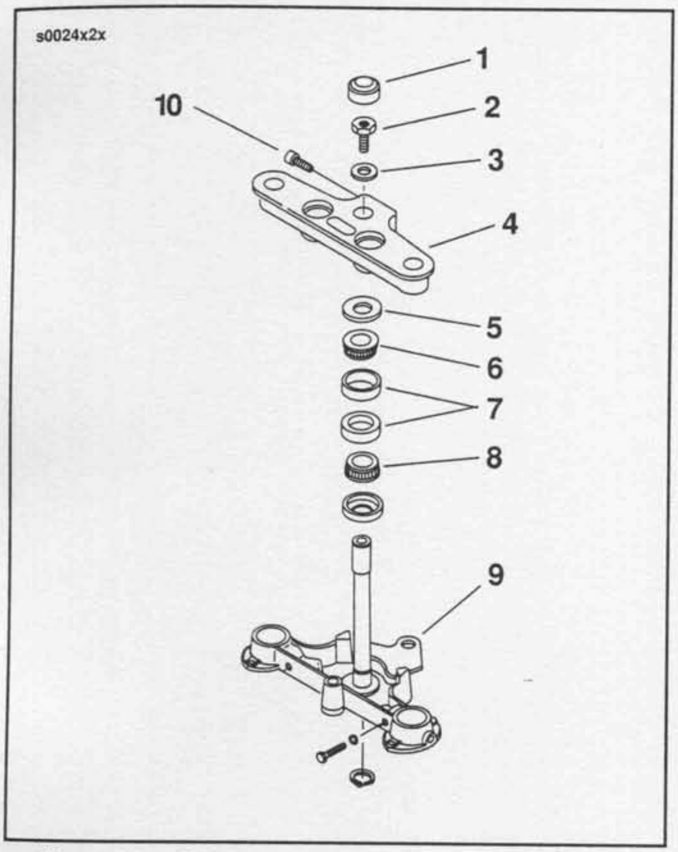


Figure 2-79. FLSTC, FLSTF Steering Head Assembly

5. Remove the fork stem cap (1). Loosen pinch bolt (10) and remove fork stem bolt (2). Remove washer (3) with the handlebar and upper bracket (4).
6. Remove the fork stem and bracket (9) from the steering head. Remove the upper dust shield (5).
7. Remove bearings (7) using STEERING HEAD BEARING RACE REMOVER Part No. HD-39301A and UNIVERSAL DRIVER HANDLE Part No. HD-33416, if necessary.

NOTE

If bearing races are removed, the bearings cannot be reused–they must be replaced. See REMOVING LOWER BEARINGS FROM FORK STEM.

REMOVAL/DISASSEMBLY– FXSTC

1. Remove the fork sides. See HYDRAULIC FRONT FORKS.
2. Remove the headlamp and headlamp bracket.
3. See Figure 2-80. Remove the brake hose bracket from the bottom of the fork stem and bracket (11).

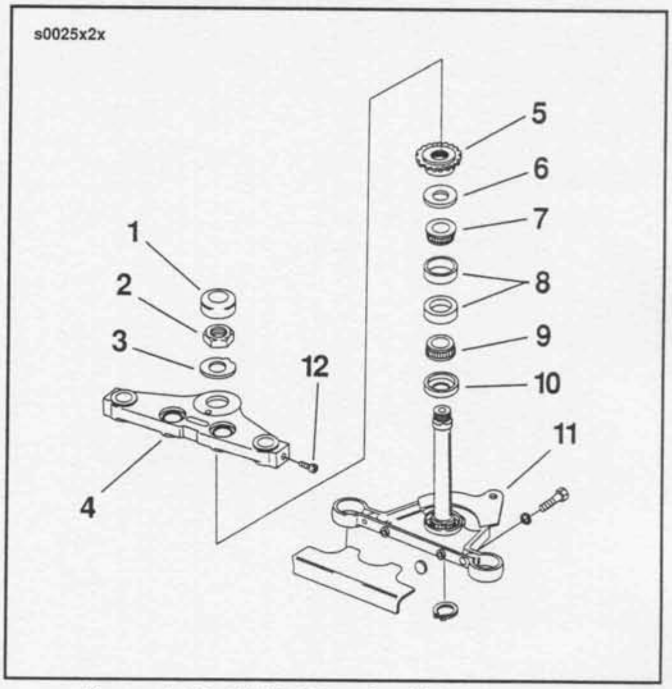


Figure 2-80. FXSTC Steering Head Assembly

4. Remove the fork stem cap (1). Bend the lockwasher (3) tab away from the fork stem nut (2) and remove the fork stem nut with the handlebar and upper bracket (4).
5. Remove the adjusting nut (5) and pull the fork stem and bracket (11) out of the steering head. Remove the upper dust shield (6).
6. Remove bearings (7) using STEERING HEAD BEARING RACE REMOVER Part No. HD-39301A and UNIVERSAL DRIVER HANDLE Part No. HD-33416, if necessary.

NOTE

If bearing races are removed, the bearings cannot be reused–they must be replaced. See REMOVING LOWER BEARINGS FROM FORK STEM.

REMOVAL/DISASSEMBLY– FXSTS, FXSTSB, FLSTS

1. Remove fork from steering head as described under FORK REMOVAL.
2. See Figure 2-81. Remove upper bearing dust shield (13) and bearing (18).

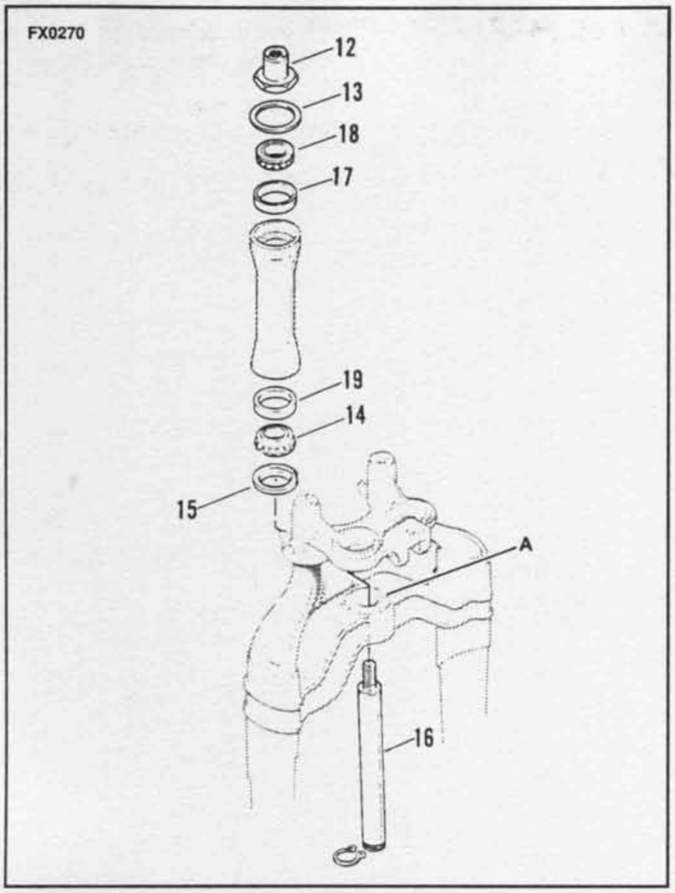


Figure 2-81. FXSTS, FXSTSB, FLSTS Steering Head Assembly

3. Remove bearings (14 and 18) and lower dust shield (15), if necessary.

NOTE

If bearing races are removed, the bearings cannot be reused–they must be replaced. See REMOVING LOWER BEARINGS FROM FORK STEM.

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.

⚠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

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

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.

⚠CAUTION

Protect the rigid fork legs when prying the neck bearing off the steering stem. Failure to comply may result in damage to fork legs.

Steering Head Bearing Race Removal

NOTE

To remove the bearing race from the frame neck, use STEERING HEAD BEARING RACE REMOVER Part No. HD39301A and UNIVERSAL DRIVER Part No. HD33416. See Figure 2-82.

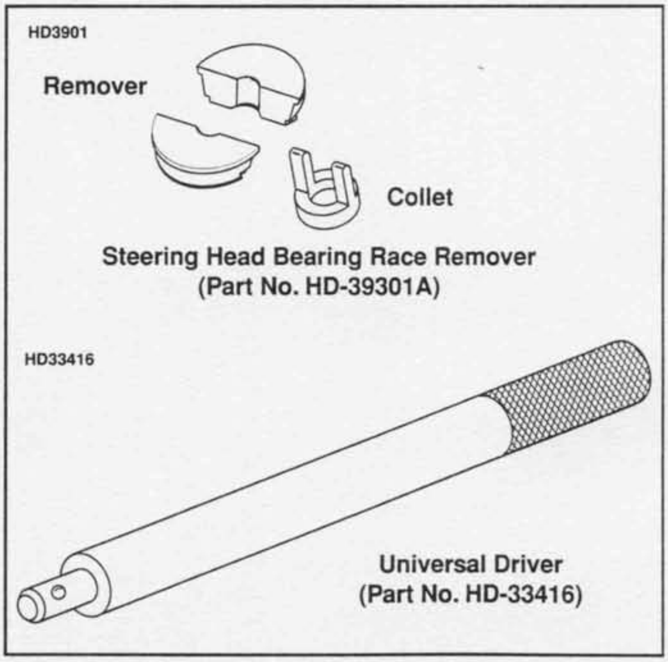


Figure 2-82. Steering Head Bearing Race Removal Tools

1. See Figure 2-83. 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.

Figure 2-83. Remove Upper and Lower Steering Head Bearing Races

ASSEMBLY–ALL MODELS

1. Lubricate the 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 resulting in personal injury.

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

⚠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.

5. Install fork in steering head. See either HYDRAULIC FRONT FORKS or SPRINGER FORK in this Section.
6. Fill neck with Harley-Davidson Special Purpose Grease through grease zerk located in the steering head.
7. Adjust fall-away. See Head Bearing Adjustment in HYDRAULIC FORKS Section or Springer Head Bearing Adjustment in SPRINGER FORK Section.

INSTALLATION–FLSTC, FLSTF

1. See Figure 2-79. Insert the fork stem and bracket assembly (9) into the frame steering head and install the upper bearing and dust shield (5).
2. Install the upper bracket (4), 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. Tighten pinch bolt (10) to 21-27 ft-lbs (28-37 Nm).

⚠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 11 ft-lbs (15 Nm).
4. Install the headlamp assembly. See the ELECTRICAL section.
5. Install the fork sides as described previously.

⚠WARNING

An improperly adjusted fork stem bolt may adversely affect handling, which could lead to an accident resulting in personal injury.

6. Adjust bearing tightness using fork stem bolt (2). See ADJUSTMENT.
7. Install the fork stem cap (1).

INSTALLATION–FXSTC

1. See Figure 2-80. Insert the fork stem bracket assembly (11) into the frame steering head and install the upper bearing and dust shield (6). Secure with the adjusting nut (5). 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 (11), a new lockwasher (3) and fork stem nut (2). Be sure pin on lockwasher registers in upper bracket hole. Tighten the nut securely. Tighten pinch bolt (12) to 21-27 ft-lbs (28-37 Nm).
3. Fasten the brake hose bracket to bottom bracket using original hardware. Tighten bolt to 11 ft-lbs (15 Nm).
4. Install the headlamp assembly.
5. Install the fork sides as described previously.

⚠WARNING

An improperly adjusted fork stem nut may adversely affect handling, which could lead to an accident resulting in personal injury.

6. Adjust bearing tightness using adjusting nut (5). See ADJUSTMENT.
7. Tighten fork stem nut (2) to 35-40 ft-lbs (47-54 Nm). Bend the lockwasher (3) tab against the nut flat.
8. Install the fork stem cap (1).

REAR FORK

REMOVAL

1. Remove the rear wheel as described under REAR WHEEL earlier in this section.
2. Remove the belt guard. Remove rear brake caliper and mounting bracket as described under REAR BRAKE CALIPER earlier in this section.
3. See Figure 2-84. Remove the rear shock absorber bolts (8) only. See the instructions under REAR SHOCK ABSORBER later in this section.
4. Remove the hardware that holds the canister (California models) to swing axis tube (11). Note location of flat on swing axis tube for assembly.
5. Remove the pivot bolts (4) that are threaded into each end of the swing axis tube (11). Removing the bolts will free the lockwasher (5), spacer (3), and swing axis tube (11). The rear fork (2) can now be pulled free of frame (1).

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 swing arm must be replaced.

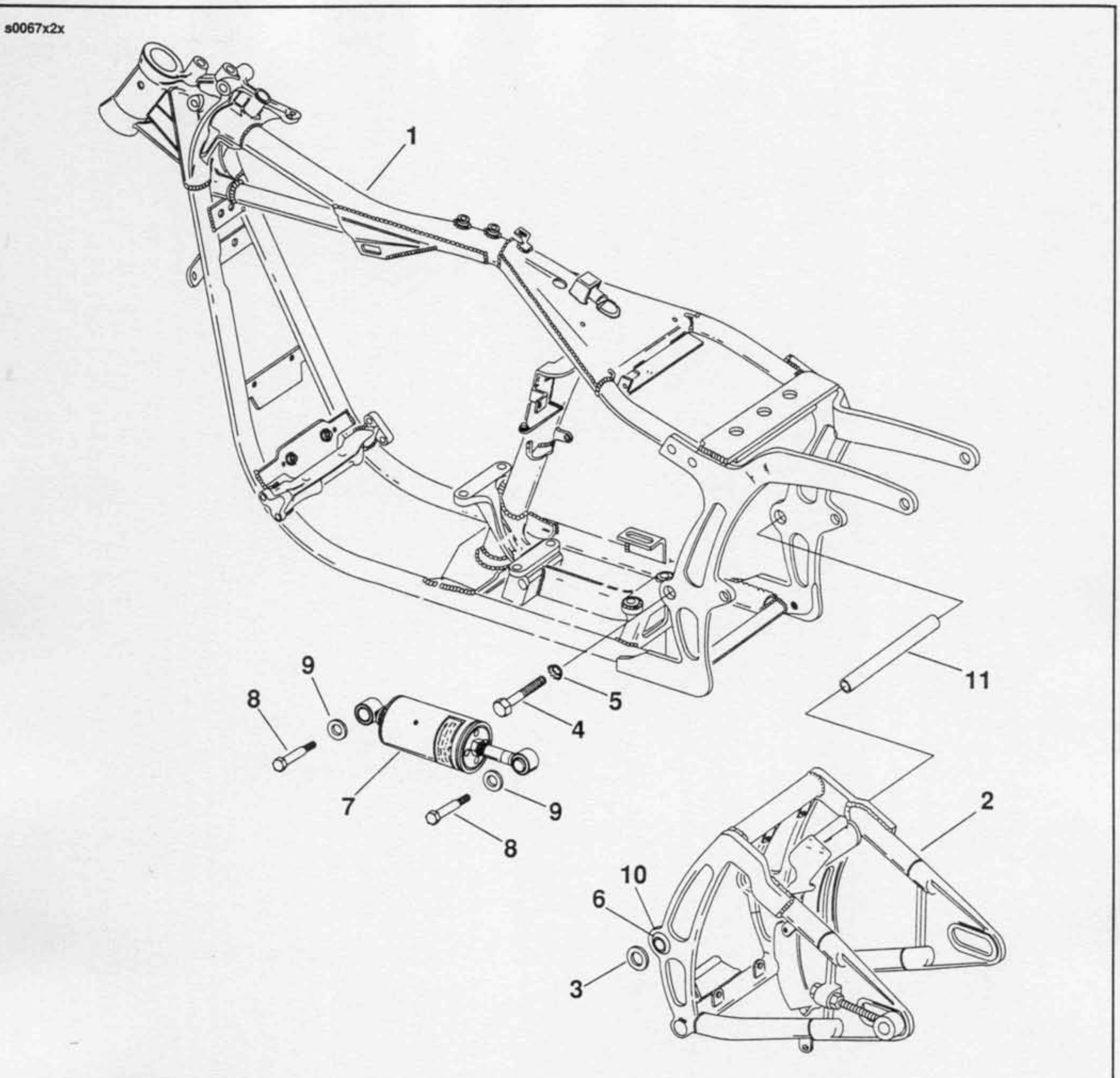
INSTALLATION

1. See Figure 2-84. Place rear fork (2) in the frame so that the bores in the frame align with the bores in the fork, and spacers (3) are positioned between the fork and the frame.
2. Hold the swing axis tube (11) in position between the rear fork bores. Place lockwashers (5) onto bolts (4). Insert bolts (4) through the frame bore, through spacer (3), through spherical bearings (6), and thread into each end of swing axis tube (11). Hold the swing axis tube with a wrench at the two flats provided and tighten pivot bolts (4) evenly to 120-150 ft-lbs (163-203 Nm).

NOTE

Proper pivot bolt 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 bolts were tightened.
4. Install the canister (California models), brake caliper, and rear wheel.
5. Install rear shock absorber and shock absorber bolts (8), see SHOCK ABSORBER INSTALLATION.



1. Frame
2. Fork
3. Spacer
4. Pivot bolt
5. Lockwasher
6. Spherical bearing
7. Shock absorber, left side shown
8. Bolt
9. Washer
10. Snap ring
11. Swing axis tube

Figure 2-84. Rear Fork and Shock Assembly–Softail Models

REAR SHOCK ABSORBERS

ADJUSTMENT

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

1. Loosen the locknuts.
2. 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.

   Turning the adjuster plates OUT (toward the locknut) increases the spring preload to carry a heavier load. 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.

REMOVAL

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

1. See Figure 2-84. Remove bolts (8), with washers (9), from each end of shock absorber (7). Remove the second shock absorber in the same manner if necessary.

NOTE

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

INSTALLATION

1. See Figure 2-84. Place washer (9) on bolt (8) and coat threads of bolt with Loctite 242 (blue). Coat shoulder of bolt with Anti-seize.
2. Insert bolt (8) through shock end. Pivot shock absorber to align bolt with tapped hole in frame bracket (front bolt) or swing arm (rear bolt).
3. Tighten bolt only enough to support shock absorber and still allow shock to pivot when installing the second bolt.
4. Install the second bolt following the procedure given above.

⚠CAUTION

Softail shock absorber bolt torquing procedure requires the use of a SNAP-ON-ADAPTER, Part No. SRES 24. Since the adapter lengthens the torque wrench, torque must be computed with a TORQUE COMPUTER, Snap-On Part No. SS-306G.

5. Tighten both bolts (8) to 115-130 ft-lbs (156-176 Nm).
6. Adjust shock absorbers equally. See ADJUSTMENT.

THROTTLE CONTROL

DISASSEMBLY

1. See Figure 2-85. Loosen cable adjuster jam nuts. Screw throttle cable adjuster until it is as short as possible. Remove the two screws that hold the handlebar housing together and separate the upper housing from the lower housing.

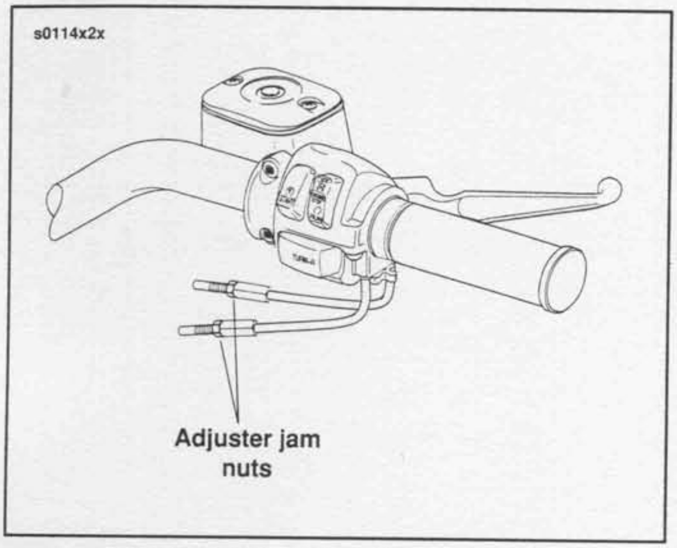


Figure 2-85. Handlebar Throttle Control

2. See Figure 2-86. Unhook the ferrules and cables from the throttle grip and lower housing. Remove the air cleaner assembly–see Section 4. Disconnect the other end of the cables from the carburetor.

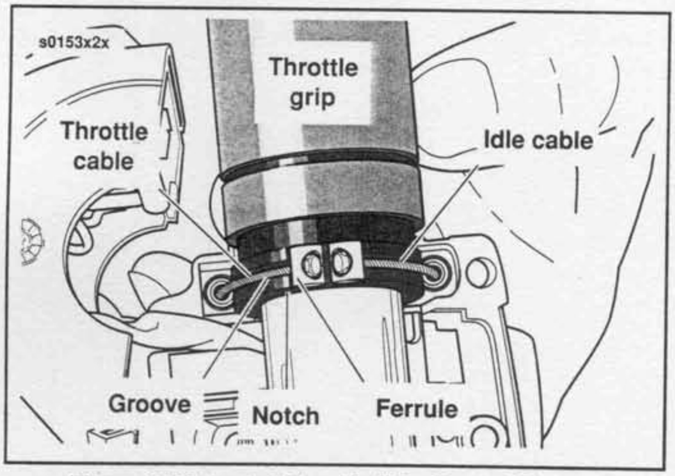


Figure 2-86. Install Throttle/Idle Control Cables on Throttle Control Grip

3. Pull the throttle 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

1. Clean all parts in a non-flammable cleaning solvent and blow dry with compressed air.

2. Replace the cables if frayed, kinked, or bent.

ASSEMBLY

1. Apply a light coating of graphite to the handlebar and inside surface of the housings.

2. Attach the cable assemblies to the lower housing. The throttle cable has a 5/16-18 threaded retainer and should be assembled to the right side of the throttle grip. The idle cable has a 1/4-20 threaded retainer and should be assembled to the left side of the throttle grip. Install adjusting screw, spring, and friction pad in the lower clamp if they were removed.

3. Position the throttle grip on the handlebar. Place the lower housing on the throttle. Position the ferrules over the cable balls and seat them in the throttle notches.

⚠WARNING

Do not overtighten the adjusting screw. If the adjusting screw is overtightened, the engine will not return to idle speed automatically in an emergency, possibly leading to an accident resulting in personal injury.

4. Fasten the upper housing to the lower housing and tighten the housing screws to 18-24 **in-lbs** (2.0-2.7 Nm).

NOTE

On all models except Springers, the throttle cables are routed between the brake line and the handlebars. They pass under the top frame tube, between the harness connectors and the harness bracket, and then to the carburetor.

On the Springer, (FXSTS, FXSTSB), the throttle cables are routed through a vinyl-covered clamp on the right side of the rigid fork, under the bottom frame bracket (held in place by a cable tie), and then to the carburetor.

On the Heritage Springer, (FLSTS), the throttle cables are routed through a wireform on the right side of the rigid fork, under the bottom frame bracket (held in place by a cable tie), and then to the carburetor.

5. Install the idle cable and spring into the longer of the two support sleeves on the carburetor. The idle cable has a 1/4-20 threaded adjuster.

6. Install the throttle cable into the other support sleeve on the carburetor. The throttle cable has a 5/16-18 threaded adjuster.

CLUTCH HAND CONTROL

REMOVAL

1. Loosen cable adjuster so all tension is out of the clutch cable. See Section 6.
2. Remove transmission clutch release cover. See Section 7.

⚠CAUTION

Inner ramp and coupling must be removed from side cover before disconnecting cable end or cable will be damaged.

3. Disconnect cable end from ball and ramp coupling. Unscrew cable fitting from side cover.
4. See Figure 2-87. Remove hand lever pivot pin.
5. Remove the clutch cable and anchor pin from the hand lever.

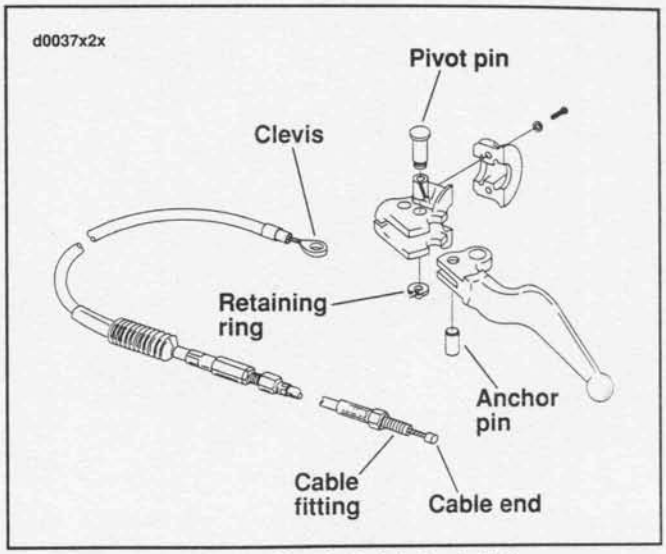


Figure 2-87. Clutch Cable Installation

INSTALLATION

1. See Figure 2-87. Install the clutch cable and anchor pin in the clutch hand lever. The flat in the pin must face in towards the hand lever.
2. Put cable clevis in position in hand lever and slide anchor pin into place.
3. Install hand lever assembly and pivot pin.
4. See Figure 2-88. Route clutch cable as follows:
   A. Route clutch cable across the front of handlebars for the following models: FLSTS, FXSTS, FXSTSB, FXSTC. Route clutch cable behind handlebars for the following models: FLSTF, FLSTC.
   B. Route cable down to clamp on left frame downtube.
   C. Route cable under gear cover and through bracket.
   D. Route cable to transmission cover.
5. Insert cable end into side cover and connect it to the ball and ramp coupling.
6. Screw the cable fitting into the side cover. Tighten fitting to 3-5 ft-lbs (4-7 Nm).
7. Adjust cable adjuster so there is enough slack to install side cover. See Section 7.
8. Adjust clutch cable. See Section 1.

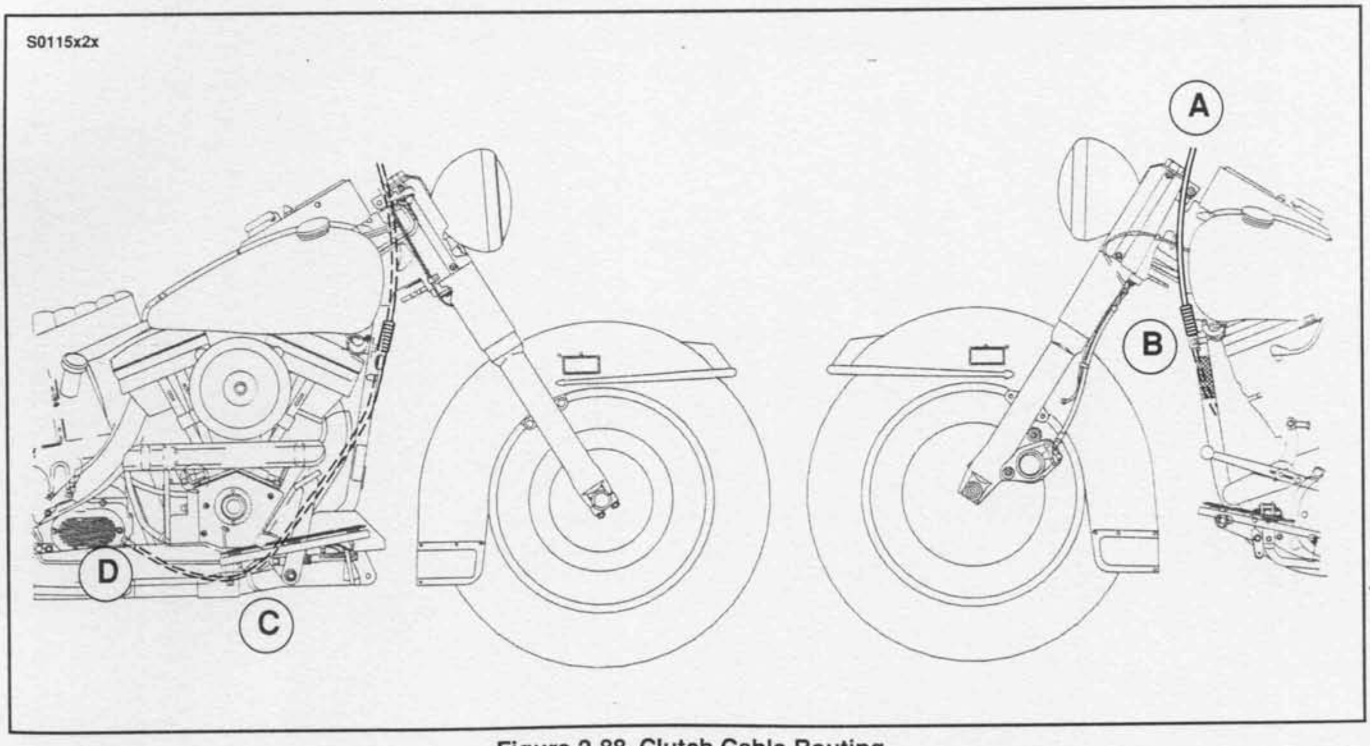


Figure 2-88. Clutch Cable Routing

NOTES

⚠CAUTION

Remove fenders carefully to prevent damage to painted surfaces.

REMOVAL (FXSTC)

See Figure 2-89. Remove the acorn nuts, washers, and screws that hold the fender in place and remove fender.

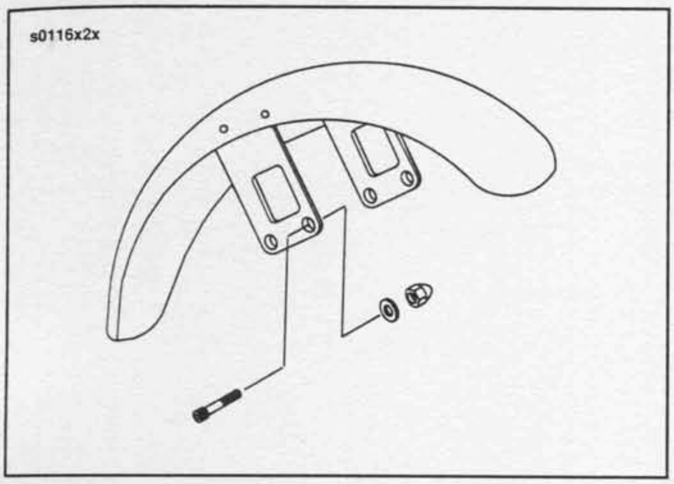


Figure 2-89. Front Fender – FXSTC

INSTALLATION (FXSTC)

Position fender into position and secure with screws, washers, and acorn nuts. Tighten acorn nuts to 15-21 ft-lbs (20-28 Nm).

REMOVAL (FLSTC)

1. Remove front wheel. See FRONT WHEEL (MODELS WITH HYDRAULIC FORKS) in this Section.
2. See Figure 2-90. Remove screws and flange nuts that hold fender in place. Disconnect fender tip lamp and remove fender.

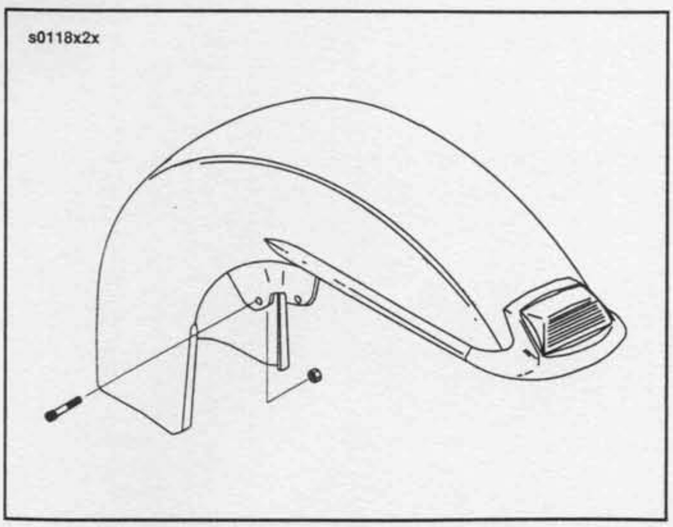


Figure 2-90. Front Fender – FLSTC

INSTALLATION (FLSTC)

1. Put fender in position and install screws and flange nuts. Tighten nuts to 15-21 ft-lbs (20-28 Nm). Connect fender tip lamp on FLSTC.
2. Install front wheel. See Section 2

REMOVAL (FLSTF)

1. Remove front wheel. See Section 2.
2. See Figure 2-91. Remove screws and flange nuts that hold fender in place and remove fender.

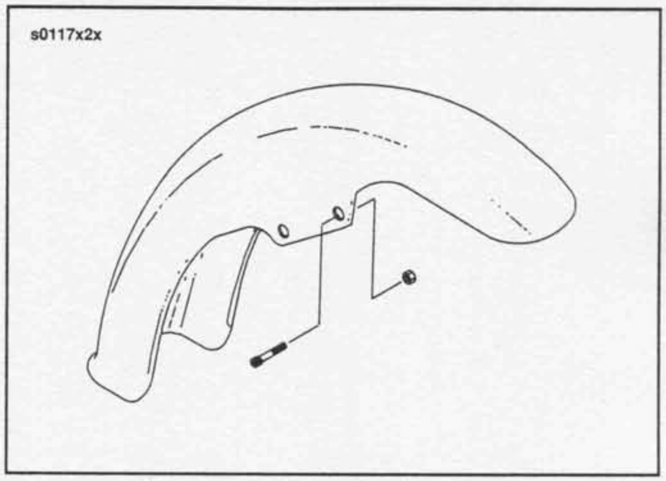


Figure 2-91. Front Fender – FLSTF

INSTALLATION (FLSTF)

1. Put fender in position and install screws and flange nuts. Tighten nuts to 15-21 ft-lbs.
2. Install front wheel. See FRONT WHEEL (MODELS WITH HYDRAULIC FORKS) in this Section.

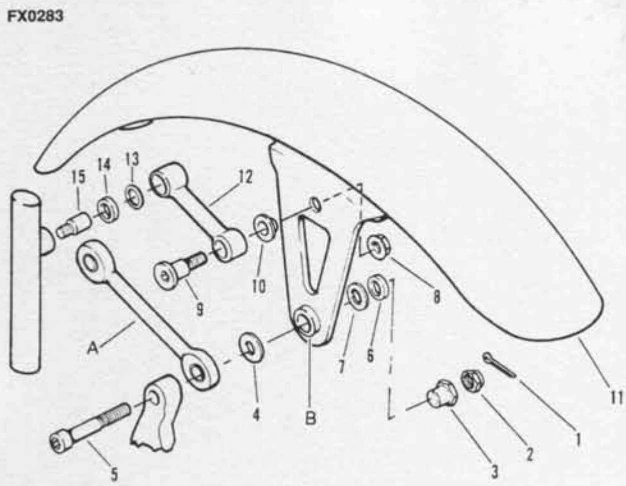
REMOVAL (FXSTS, FXSTSB)

1. See Figure 2-92. Remove cotter pin (1), jam nut (2), shaft nut (3), washer (4) and socket head capscrew (5) from brake reaction link (A). Rubber spacer (6) and nylon washer (7) may come off with the shaft nut (3) or may stay in the fender bracket bushing (B).
2. Lift fender up, away from tire. Place HD-39754 Fender link tool between the fender links (12) and tighten snugly. Remove flange nuts (8) and shoulder screw (9). Fender insert (10) is loose in fender. Do not lose.

⚠CAUTION

Be careful lifting fender out of fork and fender links or you may scratch the paint. If necessary, cover fender with a clean shop rag.

3. Very carefully lift fender (11) out of forks and fender links (12). Remove fender link assembly tool.
4. If necessary, the nylon washers (13), rubber spacers (14) and pivot screws (15) can be removed.



1. Cotter pin
2. Jam nut
3. Shaft nut
4. Washer
5. Capscrew
6. Rubber spacer
7. Nylon washer
8. Flange nut (2)
9. Shoulder screw (2)
10. Fender insert
11. Fender
12. Fender link (2)
13. Nylon washer
14. Rubber spacer
15. Pivot screw (2)

A. Brake reaction link
B. Fender Bushing

Figure 2-92. Front Fender – FXSTS, FXSTSB

INSTALLATION (FXSTS, FXSTSB)

⚠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 the motorcycle and lead to an accident resulting in personal injury.

DO NOT alter the fender brackets to lower the fender or 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 with a traditional-looking 16 in. front wheel, tire, and front fender. This could adversely affect the handling of the motorcycle and lead to an accident resulting in personal injury.

1. If you removed pivot screws (15), install them using Loctite 262 (red) and tighten to 10-20 ft-lbs (14-27 Nm).
2. Be sure rubber spacer (14) and nylon washer (13) are in place. Install fender links (12) on pivot screws.
3. Place HD-39754 Fender link tool between the fender links (12) and tighten snugly. The tool will properly spread and hold the links in position while you install the fender.
4. Very carefully position fender (11) between forks and fender links (12).
5. Be sure fender insert (10) is in fender. Install shoulder screws (9) and flange nuts (8). Remove fender link assembly tool. Tighten shoulder screws to 10-20 ft-lbs (14-27 Nm).
6. Be sure rubber spacer (6) and nylon washer (7) are in place. Place washer (4) between fender bushing (B) and brake reaction link (A). Install socket head capscrew (5) and shaft nut (3). Tighten socket head capscrew to 20-25 ft-lbs (27-34 Nm).
7. Install jam nut (2) and tighten to 10-20 ft-lbs (14-27 Nm).
8. Install cotter pin (1).

REMOVAL (FLSTS)

1. Remove front wheel and brake caliper. See FRONT WHEEL - SPRINGER FORK (FLSTS) in this Section.
2. Remove instrument console. See IGNITION LIGHT/SWITCH, Section 8, Steps 2 and 3.
3. Loosen two front gas tank mounting screws and move left gas tank to gain access to wiring harness.
4. See Figure 2-93. Disconnect the fender lamp wire connector from the main wiring harness.

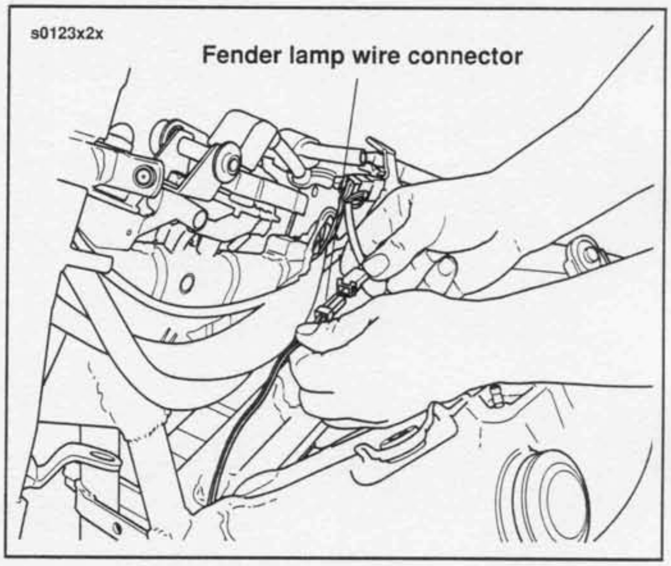


Figure 2-93. Wire Connector– FLSTS

5. See Figure 2-94. Remove spring pin and nut from socket head screw that mounts fender to bracket.

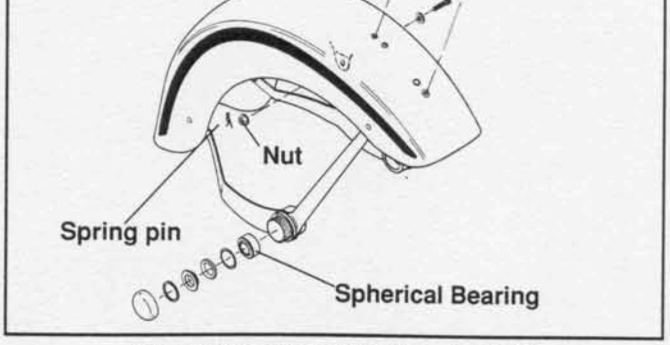


Figure 2-94. Front Fender – FLSTS

6. Insert axle into fender to support assembly.

7. Remove socket head screw while supporting fender.

8. Remove axle while supporting rear portion of fender.

⚠CAUTION

Removal of the front fender on FLSTS 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.

9. Front fender removal is accomplished in two steps:
   a. See Figure 2-95. Slide fender down until mounting bracket is just in front of the rigid fork leg.
   b. See Figure 2-96. Rotate fender putting fork between fender bracket and fender and remove fender.

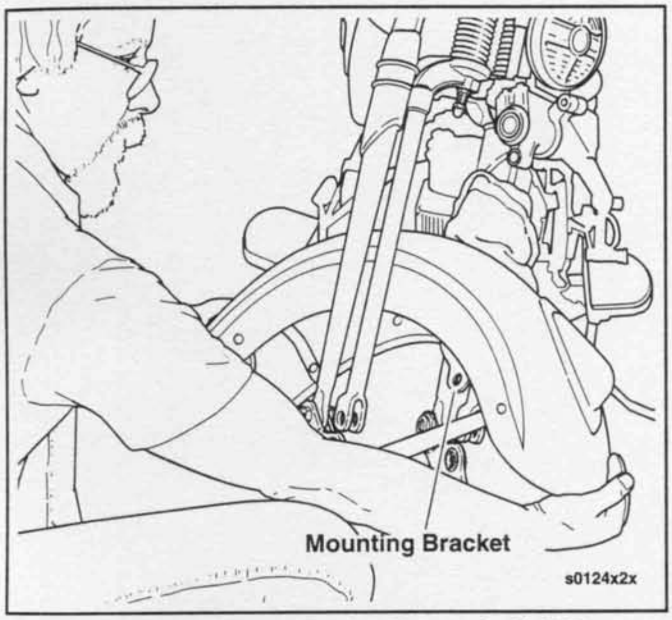


Figure 2-95. Front Fender Removal– FLSTS

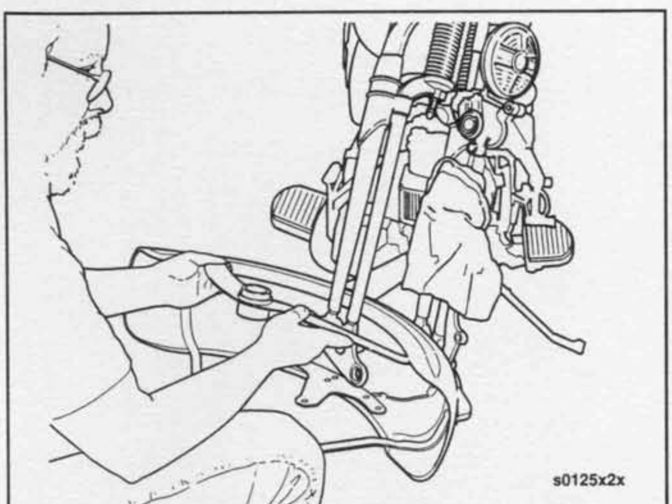


Figure 2-96. Front Fender Removal– FLSTS

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 2-94. Using an arbor press and suitable tool that makes contact with outer race of bearing but is smaller than the fender bore, press spherical bearing out of fender bore, outboard to inboard.

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 steps 1 through 4 for other spherical bearing.

INSTALLATION (FLSTS)

1. Front fender installation is accomplished in two steps:
   a. See Figure 2-96. Install fender by keeping right fork leg between fender and struts and rotating fender towards the left leg position.
   b. See Figure 2-95. Raise fender until fender holes are aligned with fork holes for axle.

2. While holding fender, slide axle through the fender and front end to support assembly.

3. Install socket head screw, washer and **new** nut. Torque to 18-22 ft-lbs (24-30 Nm).

4. Install spring clip to socket head screw.

5. Remove front axle.

NOTE

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

6. See Figure 2-97. Install spacer to axle with step towards the front wheel.

7. Install front wheel and brake caliper. See FRONT WHEEL - SPRINGER FORK (FLSTS) in this Section.

8. See Figure 2-93. Connect fender lamp wire connector to main wiring harness.

9. Tighten gas tank mounting screws.

10. Install instrument console. See IGNITION LIGHT/ SWITCH, Section 8.

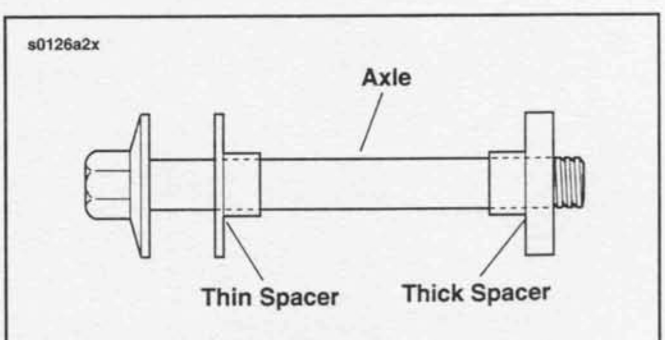


Figure 2-97. Spacer Orientation– FLSTS

REMOVAL

WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables (negative cable first), before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

1. Remove the seat and disconnect battery cables, negative cable first.
2. Remove saddlebags. if equipped.
3. Disconnect the wiring harness at the connector under the seat.
4. Remove turn signal lamps, see Section 8.
5. Remove ignition module, see Section 8. Then remove the fuse box cover along with the starter relay and circuit breakers that are attached to the inside of the cover.

NOTE

Note location of hardware for correct installation.

6. See Figure 2-98. Remove the hardware securing the rear fender and carefully remove the fender.

NOTE

Information on removing and installing wires from harness connector are given in AMP MULTILOCK ELECTRICAL CONNECTORS, in Section 8.

INSTALLATION

1. Carefully place the fender into position and tighten hardware to torque specifications shown in Figure 2-98.
2. Reinstall turn signal lamps and connect the wiring harness at the connector.
3. Install ignition module.
4. Reconnect the battery cables, positive cable first.
5. Install the seat.

WARNING

Check the operation of the turn signals and tail light before operating the vehicle. Improper turn signal or tail light operation could lead to an accident resulting in personal injury.

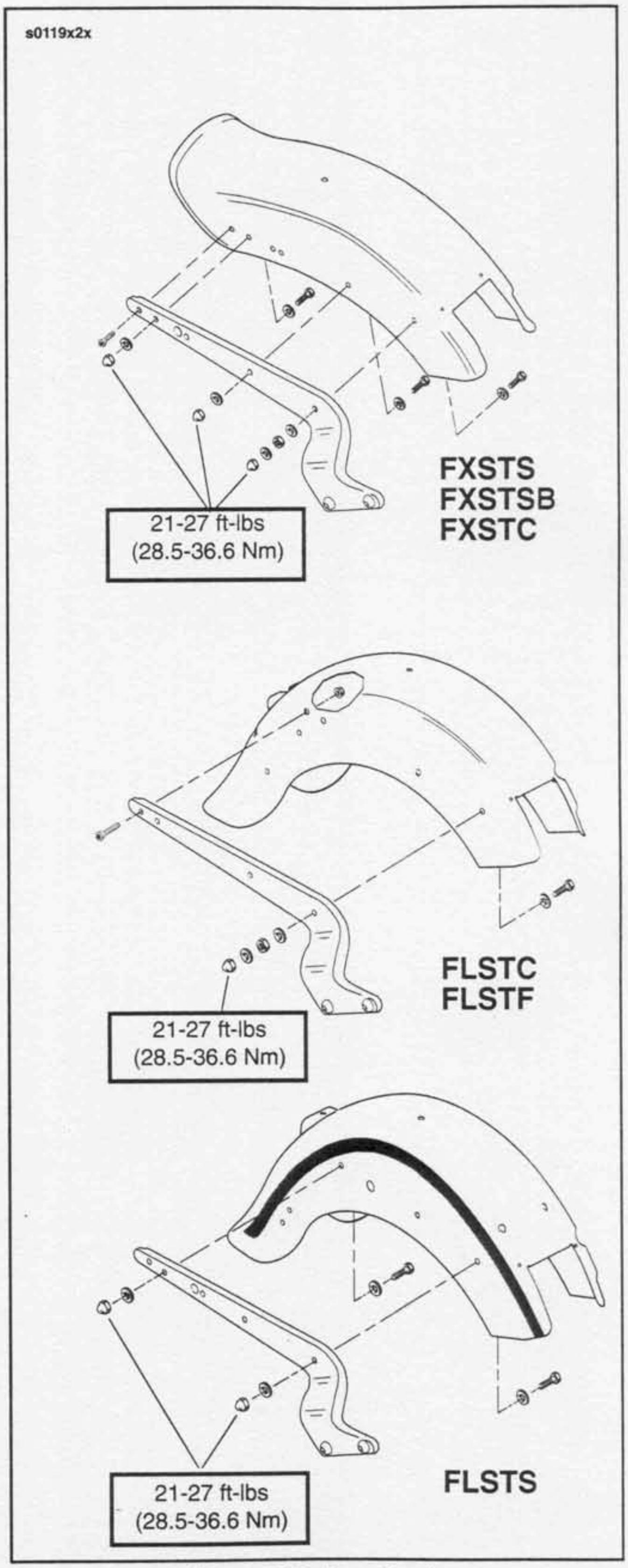


Figure 2-98. Rear Fender

WIRE ROUTING

When replacing rear fender wires, follow Figure 2-99 for correct wire routing and fender clip use.

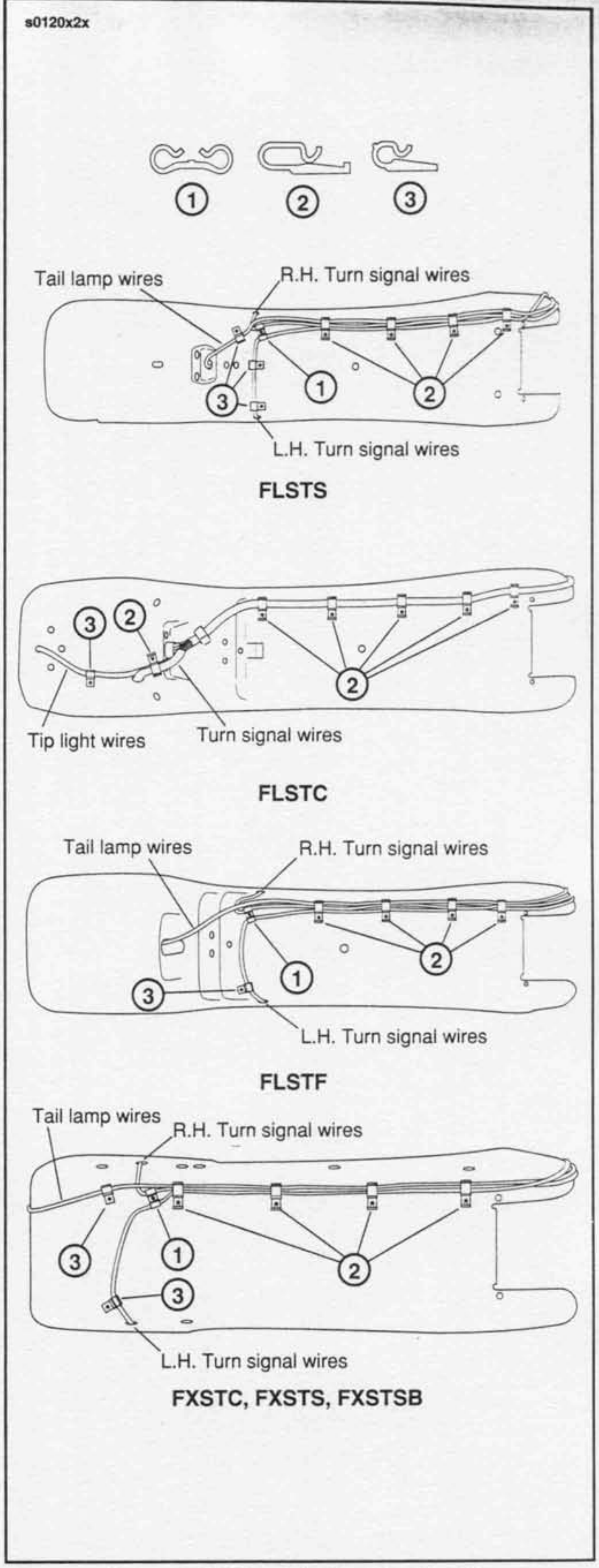


Figure 2-99. Rear Fender WIre Routing and Fender Clip Locations

Clean and lubricate the jiffy stand at 500 miles (800 km) and every 2500 miles (4000 km) thereafter. If operation is on muddy or dusty roads, clean and lubricate at shorter intervals.

LUBRICATION

Clean and lubricate as follows:

1. Raise motorcycle so front wheel is 1-2 in. (25-50 mm) above floor and support with blocks under frame.

2. See Figure 2-100. Inspect leg stop (1). If covered with dirt, wipe dirt off with a shop towel and spray stop and mating surface with Loctite aerosol anti-seize.

3. Move jiffy stand (2) leg up and down to "work" anti-seize into mating parts.

REMOVAL/INSTALLATION

1. If leg stop (1) is too covered with mud/grime to spray, remove spring (3), bolt (4), lockwasher (5), washer (6) and leg stop (1).

2. Clean leg stop and pivot bracket (7) mating surface.

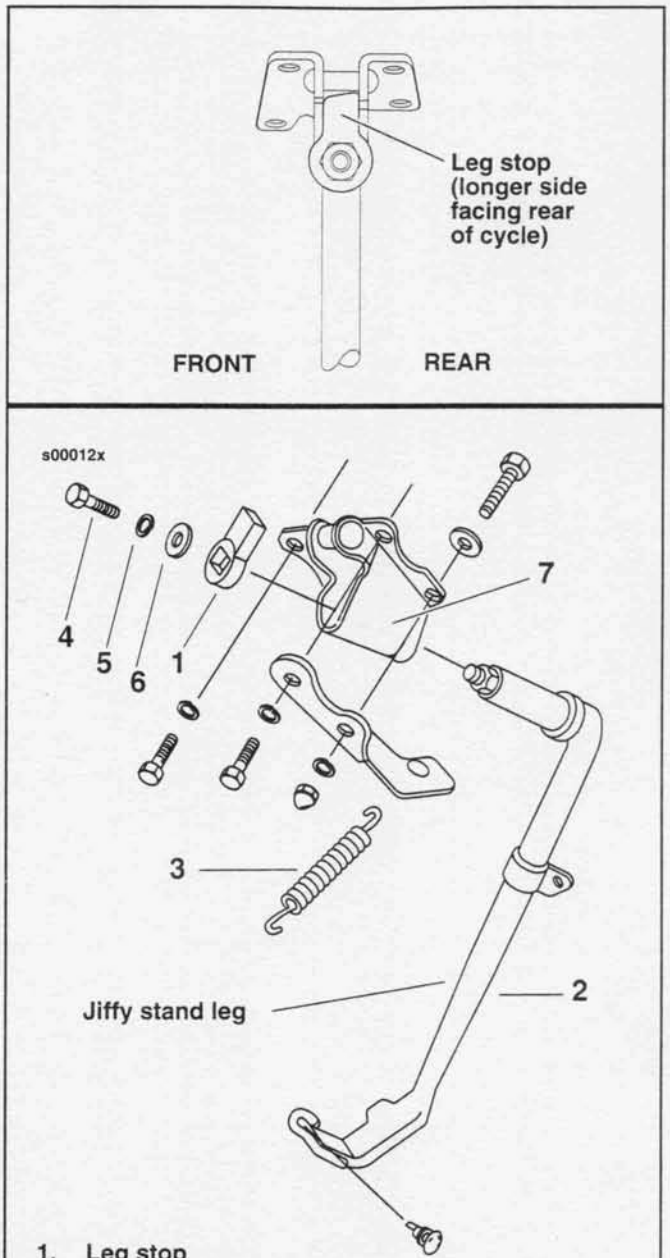
3. Spray Loctite anti-seize on jiffy stand leg to lubricate the mating surface between leg and pivot bracket and leg stop (1).

4. Assemble the leg stop (1) so it engages the flats on the shaft of the jiffy stand leg (2) and secure with washer (5), lockwasher (4) and bolt (3). Make sure the longer side of the leg stop faces the rear of the motorcycle.

5. Install spring (3).

6. Tighten bolt (4) to 19 ft-lbs (26 Nm).

7. Extend and retract jiffy stand several time to verify proper operation. The Jiffy stand should swing freely to the fully extended and fully retracted positions.



1. Leg stop
2. Jiffy stand
3. Spring
4. Bolt
5. Lockwasher
6. Washer
7. Pivot bracket

Figure 2-100. Jiffy Stand

REMOVAL/INSTALLATION

See Figure 2-101. **On FXSTS, FXSTSB and FXSTC models**, the seat is held in place with a single fender mounting screw. **On FLSTC, FLSTF models**, two additional side screws must be removed to remove seat. **On FLSTS models**, the pillion is held in place with a fender mounting screw, and the seat is secured to the fender with two mounting studs.

⚠WARNING

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

NOTE

If the seat retention nut is damaged or lost, see SEAT RETENTION NUT REPLACEMENT on following page for instructions.

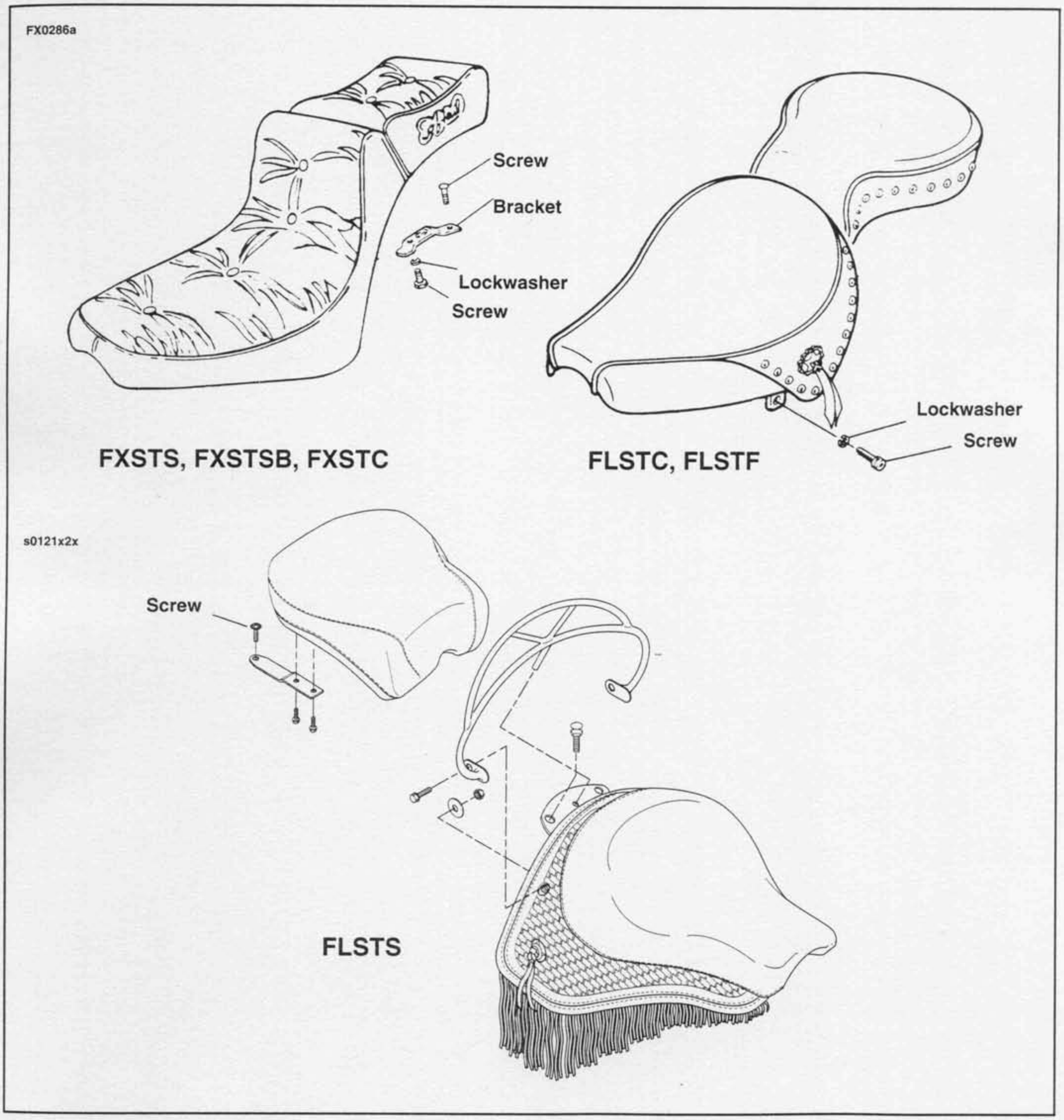


Figure 2-101. Softail Seats

SEAT RETENTION NUT REPLACEMENT

NOTE

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

1. Slide retention nut over tapered end of cable strap so that larger OD of nut rests on cable strap eyelet. From bottom of rear fender, feed cable strap up through fender hole.
2. See Figure 2-102. With tab on retention nut seated in notch of fender hole, pull up on cable strap to hold nut snug against underside of rear fender. From the side opposite the tab, slide on the retention washer to lock the position of the retention nut.

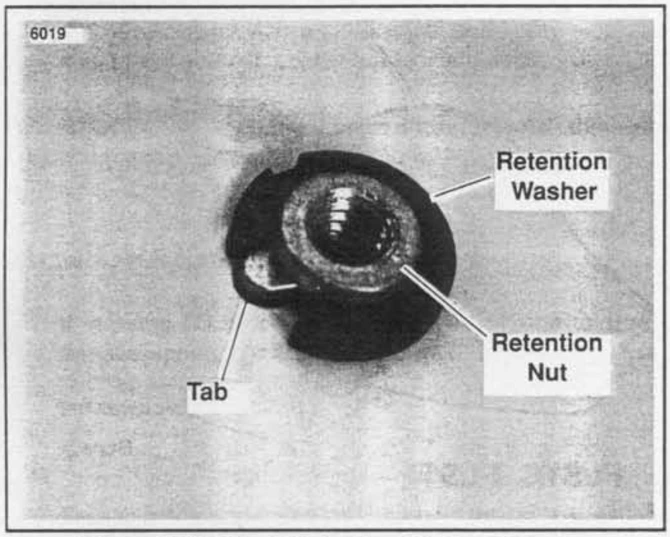


Figure 2-102. Seat Retention Nut and Washer

NOTE

See Figure 2-103. The ***FLSTS*** *has a plug for inserting in the seat retention nut if the passenger seat is not used. The plug is stored in the underside of the passenger seat.*

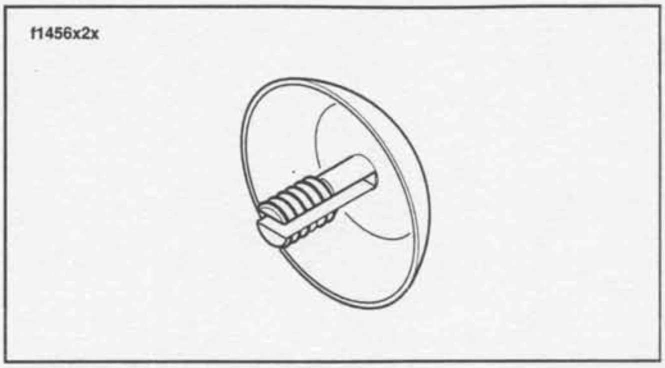


Figure 2-103. Passenger Seat Retention Nut Plug (FLSTS)

REMOVAL

SADDLEBAGS

1. See Figure 2-104. Remove screws (1) and flat washers (2).
2. Remove saddlebags (3).

SADDLEBAG BRACKETS

1. Remove bolts (4) and flat washers (5).
2. Remove acorn nut (6) and washer (7).
3. Remove saddlebag brackets (8).

INSTALLATION

SADDLEBAG BRACKETS

1. See Figure 2-104. Place saddlebag bracket (8) in position.
2. Install flat washers (5) and bolts (4).
3. Install acorn nut(6) and washer (7).

SADDLEBAGS

1. Place saddlebag (3) in position on bracket (6).
2. Install flat washers (2) and screws (1).

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1. **Screws (3)**
2. **Flat washers (3)**
3. **Saddlebags (2)**
4. **Bolts (3)**
5. **Flat washers (3)**
6. **Acorn nut (2)**
7. **Washer (2)**
8. **Saddlebag brackets (2)**

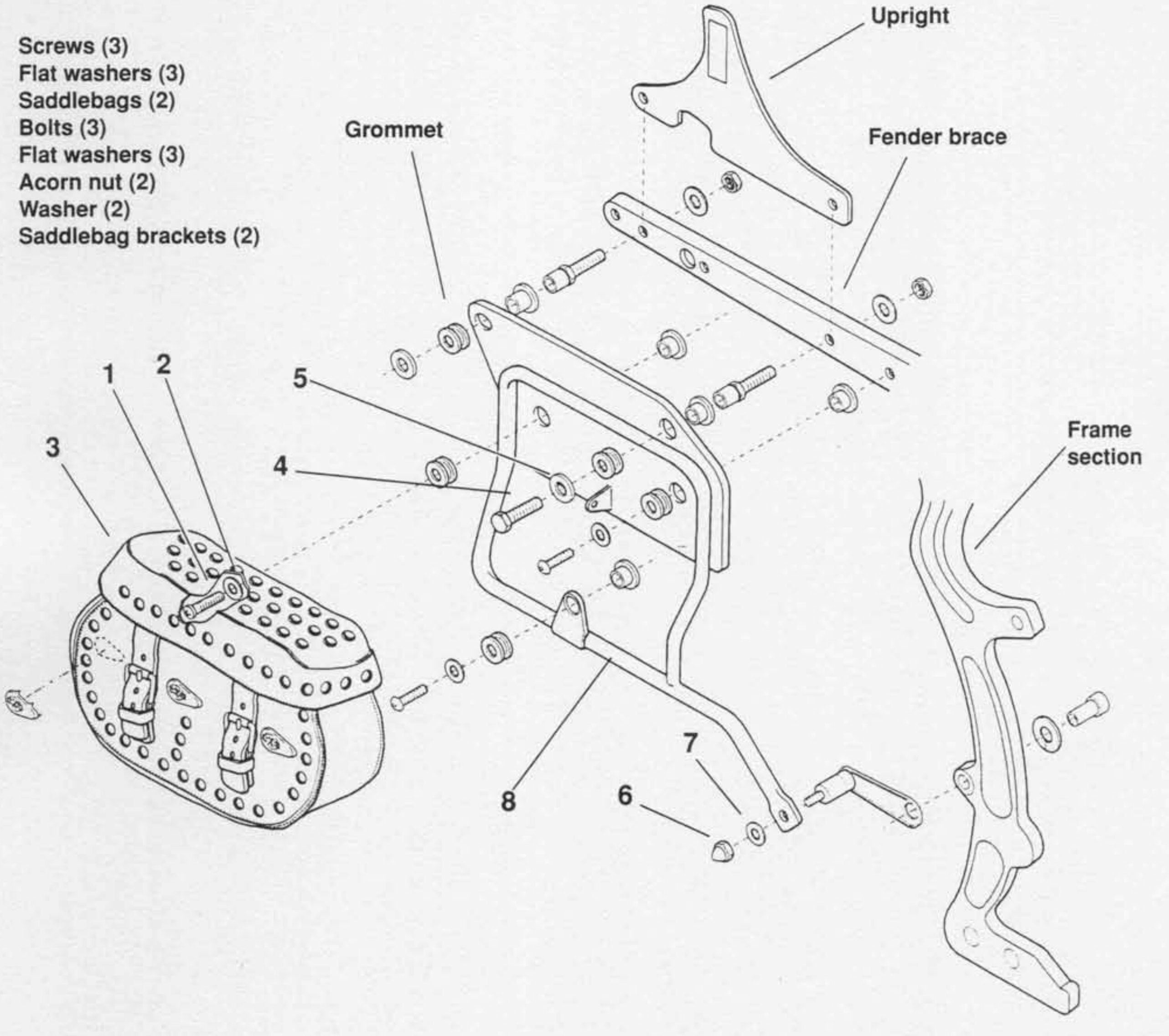

Figure 2-104. Saddlebags and Saddlebag Brackets

SADDLEBAGS (FLSTS)

REMOVAL

1. See Figure 2-105. Remove two flange locknuts (6).
2. Remove acorn nut (11) and washer (10).
3. Remove saddlebag (1).

INSTALLATION

1. See Figure 2-105. Place saddlebag (1) in position.
2. Install two flange locknuts (6).
3. Install washer (10) and locking acorn nut (11).

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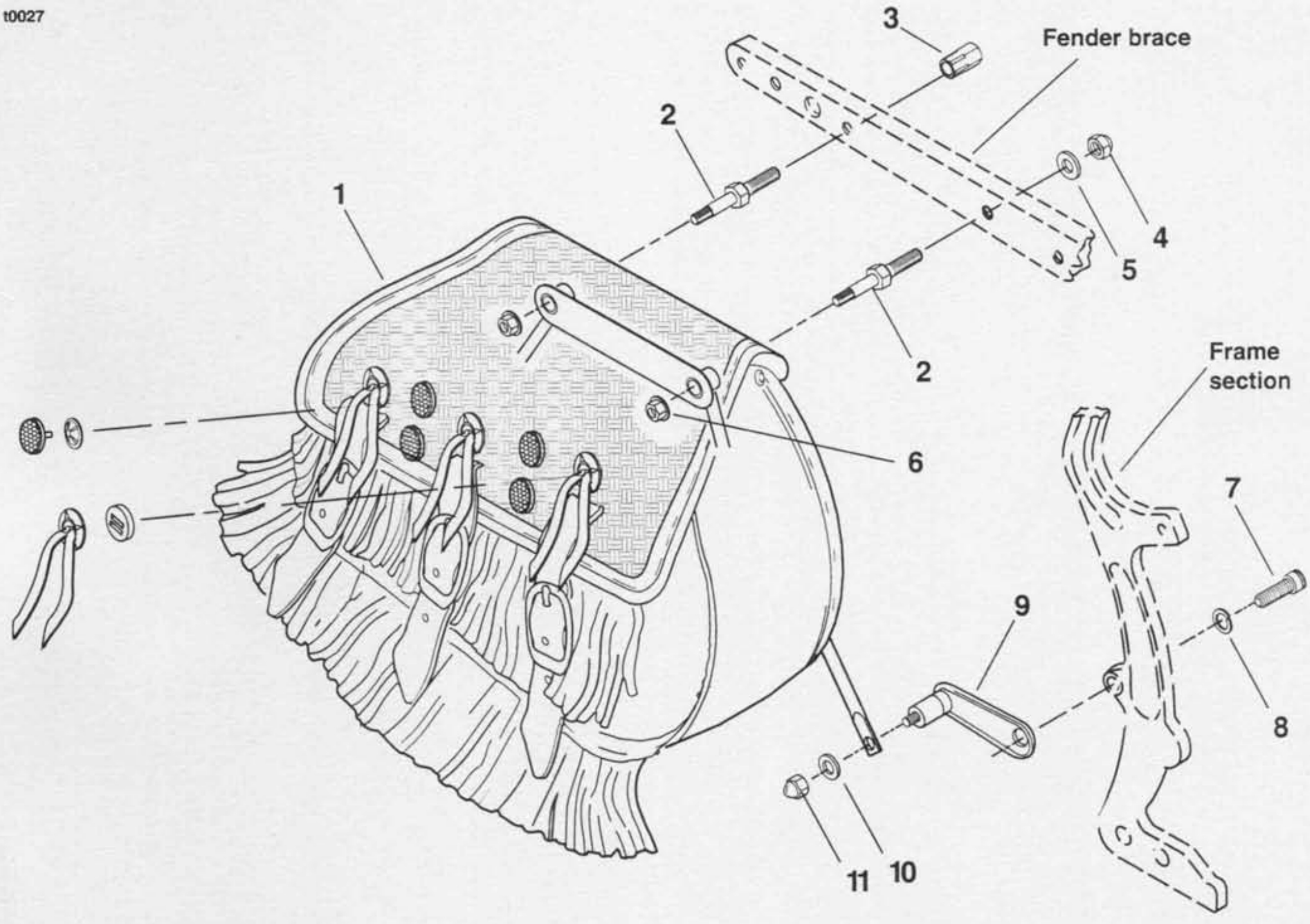


1. Saddlebag
2. Bag hanger studs (2)
3. Bracket mounting nut
4. Flange locknut
5. Washer
6. Flange locknut
7. Capscrew
8. Lockwasher
9. Front support assembly
10. Washer
11. Locking acorn nut

Figure 2-105. Saddlebags and Saddlebag Brackets - FLSTS

ENGINE 3

SUBJECT | PAGE NO.

1997/1998 SOFTAIL SPECIFICATIONS

GENERAL

Number of Cylinders	2
Type	4-cycle, 45°V, air-cooled
Horsepower	69 hp @ 5000 rpm
Torque	82 ft-lbs (111 Nm) @ 3600 rpm
Bore	3.498 in. (88.8 mm)
Stroke	4.250 in. (107.95 mm)
Piston displacement (approx.)	80 cu. in. (1340 cc)
Compression Ratio	8.5-1

VALVES

Fit in guide: Exhaust Intake	 0.0015-0.0033 in. (0.038-0.084 mm) 0.0008-0.0026 in. (0.020-0.066 mm)
Seat width	0.040-0.062 in. (1.02-1.57 mm)
Stem protrusion from cylinder head boss	1.990-2.024 in. (50.55-51.41 mm)
Outer spring: 1.751-1.848 in. **(closed)** (44.48-46.94 mm) 1.282-1.378 in. **(open)** (32.56-35.00 mm) Free length	 72-92 lbs (33-42 kg) 183-207 lbs (83-94 kg) 2.105-2.177 in. (53.47-55.30 mm)
Inner spring: 1.577-1.683 in. **(closed)** (40.06-42.75 mm) 1.107-1.213 in. **(open)** (28.12-30.81 mm) Free length	 38-49 lbs (17-22 kg) 98-112 lbs (44-51 kg) 1.926-1.996 in. (48.92-50.70 mm)

ROCKER ARM

Shaft fit in bushing (loose)	0.0005-0.002 in. (0.013-0.05 mm)
End clearance	0.003-0.013 in. (0.08-0.33 mm)
Bushing fit in rocker arm (tight)	0.004-0.002 in. (0.10-0.05 mm)

ROCKER ARM SHAFT

Shaft fit in rocker cover (loose)	0.0007-0.002 in. (0.018-0.056 mm)

OIL PUMP PRESSURE

At normal operating temperature and engine speed of 2000 rpm, oil pressure should be 12-35 psi (83-241 kN/m^2).

PISTON

Fit in cylinder	0.00075-0.00175 in. (0.0190-.0444 mm)
Compression ring gap	0.007-0.020 in. (0.18-0.51 mm)
Oil control ring rail gap (stock ring)	0.009-0.052 in. (0.23-1.32 mm)
Compression ring side clearance: Top 2nd	 0.002-0.0045 in. (0.05-0.114 mm) 0.0016-0.0076 in. (0.041-0.104 mm)
Oil control ring side clearance	0.0016-0.0076 in. (0.041-0.193 mm)
Piston pin fit (loose)	0.0001-0.0004 in. (0.0025-0.010 mm)

CYLINDER HEAD

Valve guide in head (tight)	0.0033-0.002 in. (0.084-0.05 mm)
Valve seat in head (tight)	0.0045-0.0020 in. (0.114-0.051 mm)
Head gasket surface (flatness)	0.006 in. total (0.015 mm)

CONNECTING ROD

Piston pin fit (loose)	0.0003-0.0007 in. (0.008-0.018 mm)
Side play between flywheels	0.005-0.025 in. (0.13-0.64 mm)
Connecting rod to crankpin (loose)	0.0004-0.0017 in. (0.010-0.043 mm)

HYDRAULIC LIFTERS

Guide fit in crankcase (loose)	0.000-0.004 in. (0.00-0.10 mm)
Fit in guide (loose)	0.0008-0.002 in. (0.020-0.05 mm)

GEARCASE

Breather gear end play (loose)	0.001-0.011 in. (0.025-0.28 mm)
Cam gear shaft (loose)	0.00075-0.00175 in. (0.019-0.0445 mm)
Cam gear shaft in bearing (loose)	0.0005-0.0025 in. (0.013-0.064 mm)
Cam gear end play (loose)	0.001-0.050 in. (0.025-1.27 mm)
Oil pump drive shaft (crankcase bushing)	0.0004-0.0025 in. (0.010-0.064 mm)

FLYWHEELS

Runout (flywheels at rim)	0.000-0.010 in. (0.00-0.25 mm)
Runout (shaft at flywheel)	0.000-0.002 in. (0.00-0.05 mm)
End play	0.001-0.005 in. (0.025-0.13 mm)

SPROCKET SHAFT BEARING

Cup fit in crankcase (tight)	0.005-0.003 in. (0.13-0.08 mm)
Cone fit on shaft (tight)	0.0015-0.0005 in. (0.038-0.013 mm)

PINION SHAFT & BEARING

Roller bearing fit (loose)	0.0002-0.0009 in. (0.005-0.023 mm)
Cover bushing fit (loose)	0.001-0.0025 in. (0.025-0.064 mm)
Pinion shaft runout	0.000-0.0045 in. (0.000-0.114 mm)
Bushing fit in crankcase	0.005-0.003 in. (0.127-0.76 mm)

IGNITION TIMING

Timer air gap	not adjustable
Ignition timing: fully retarded 1050-1500 rpm	 TDC 20° BTDC
Spark plug gap	0.038-0.043 in. (0.96-1.09 mm)

TORQUE VALUES

Crank pin nut	180-210 ft-lbs (244-285 Nm)
Pinion gear nut	35-45 ft-lbs (47-61 Nm)
Oil pump cover bolts	90-120 **in-lbs** (10.2-13.6 Nm)
Hydraulic lifter guide bolts	9-12 ft-lbs (12-16 Nm)
Hydraulic lifter screen plug	90-120 **in-lbs** (10.2-13.6 Nm)
Rocker cover screws: Part No. 4718A	90-120 **in-lbs** (10-13 Nm)
Part Nos. 3997/882	10-14 ft-lbs (14-19 Nm)
Part Nos. 3501/3500	15-19 ft-lbs (20-26 Nm)
Cylinder head bolts	See Cylinder Head Torque Sequence
Upper engine mounting bracket: To cylinder heads To frame	 28-35 ft-lbs (38-48 Nm) 28-32 ft-lbs (38-43 Nm)
Crankcase stud nut	See Crankcase Torque Sequence
Crankcase bolt	See Crankcase Torque Sequence
Gearcase cover screws	90-120 **in-lbs** (10.2-13.6 Nm)
Timer screws (inner cover and sensor plate)	15-30 **in-lbs** (1.7-3.4 Nm)
Spark plug	18-22 ft-lbs (24-30 Nm)

SERVICE WEAR LIMITS

NOTE

Wear limits are given here as a guideline for measuring used engine components. Components must be replaced when they exceed the wear limits given below:

ROCKER ARM

	Replace if wear exceeds:
Shaft fit in bushing (loose)	0.0035 in. (0.089 mm)
End clearance	0.025 in. (0.64 mm)

GEARCASE

	Replace if wear exceeds:
Breather gear end play	0.016 in. (0.41 mm)
Cam gear shaft in bushing	0.003 in. (0.08 mm)
Cam gear shaft in bearing	0.005 in. (0.13 mm)
Cam gear shaft end play	0.050 in. (1.27 mm)
Oil pump drive shaft (crankcase bushing)	0.0035 in. (0.089 mm)

VALVES

	Replace if wear exceeds:
Fit in guide–with seal:	
Exhaust	0.0040 in. (0.102 mm)
Intake	0.0035 in. (0.089 mm)
Stem taper	0.0015 in. (0.038 mm)
Stem-face eccentricity	0.002 in. (0.05 mm)
Head margin	0.031 in. (0.79 mm)
Seat width	0.090 in. (2.29 mm)
Stem protrusion from cylinder head boss	2.034 in. (51.66 mm)

ROCKER ARM SHAFT

	Replace if wear exceeds:
Shaft fit in rocker cover (loose)	0.0035 in. (0.089 mm)

PISTON

	Replace if wear exceeds:
Fit in cylinder (loose)	0.0053 in. (0.135 mm)
Compression ring gap	0.030 in. (0.76 mm)
Oil control ring gap	0.065 in. (1.65 mm)
Compression ring side clearance:	
Top ring	0.006 in. (0.15 mm)
2nd ring	0.006 in. (0.15 mm)
Oil control ring side clearance	0.008 in. (0.20 mm)
Piston pin fit (loose)	0.001 in. (0.025 mm)

CYLINDER HEAD

	Replace if:
Valve guide in head (tight)	Less than 0.0020 in. (0.051 mm)
Valve seat in head (tight)	Less than 0.0020 in. (0.051 mm)
	Replace if wear exceeds:
Head warpage	0.006 in. (0.15 mm)

CYLINDER

	Replace if wear exceeds:
Taper	0.002 in. (0.05 mm)
Out of round	0.003 in. (0.08 mm)
Warpage (gasket surfaces):	
Top	0.006 in. (0.15 mm)
Base	0.008 in. (0.20 mm)
Bore:	
Standard	3.501 in. (88.93 mm)
0.005 Oversize (O.S.)	3.506 in. (89.05 mm)
0.010 O.S. Bore	3.511 in. (89.18 mm)
0.020 O.S. Bore	3.521 in. (89.43 mm)
0.030 O.S. Bore	3.531 in. (89.69 mm)

CONNECTING ROD

	Replace if wear exceeds:
Piston pin fit (loose)	0.001 in. (0.025 mm)
Side play between flywheels	0.030 in. (0.76 mm)
Fit on crankpin (loose)	0.002 in. (0.05 mm)

HYDRAULIC LIFTERS

	Replace if wear exceeds:
Fit in guide	0.003 in. (0.08 mm)
Roller fit	0.0015 in. (0.038 mm)
Roller end clearance	0.015 in. (0.038 mm)

FLYWHEELS

	Replace if wear exceeds:
Runout (flywheels at rim)	0.015 in. (0.38 mm)
Runout (shaft at flywheel)	0.003 in. (0.08 mm)
[illegible]	(0.15 mm)

PINION SHAFT BEARINGS

	Replace if wear exceeds:
Cover bushing fit (loose)	0.0035 in. (0.089 mm)

GENERAL INFORMATION

DESCRIPTION

The $V^2{}_{TM}$ Evolution engine is a two cylinder, four-cycle, air cooled, overhead-valve V-type engine. It has three major component assemblies: **cylinders**, **crankcase** and **gearcase**.

Cylinder assemblies include cylinder head, valves, rocker arm cover, rocker arms and piston. Cylinders mount on the crankcase in a 45° "V" with both connecting rods running on a single crank pin.

The up and down motion of the pistons in the cylinders is converted to circular motion in the **crankcase**. The crankshaft consists of an off-center crankpin positioned between two counterweighted flywheels which rotate on two end shafts (pinion shaft right side and sprocket shaft left side). These shafts are integral parts of the flywheels. They are supported by roller bearings. The crankpin (big) end of the rear cylinder connecting rod is forked to fit around the single crankpin end of the front connecting rod, allowing a single connecting rod crankpin connection to the flywheels.

Flywheel rotation is clockwise when viewed from the right side of the engine. Using the front cylinder firing position as a starting point, the rear cylinder fires at 315 degrees rotation (360 degrees minus the 45 degrees between cylinders). The front cylinder fires in an additional 405 degrees rotation (360 degrees plus the 45 degrees between cylinders), completing the 720 degrees of flywheel rotation necessary for the four piston strokes.

The **gearcase** is located in the right side crankcase half and houses gears which operate and time the valves and crankcase breather. The rotating crankcase breather relieves crankcase pressure produced by the downstroke of the pistons. Air exhausted from the crankcase by the breather is fed into the air cleaner assembly.

A single four-lobe gear driven camshaft operates both the intake and exhaust valves through the hydraulic lifters, push rods, and rocker arms. Hydraulic lifters automatically compensate for heat expansion to maintain the no-lash fit of valve train components.

Ignition spark is produced by the operation of a computerized microprocessor, electronic ignition module, ignition coil, and spark plugs. Spark timing is determined by a trigger rotor, magnetic sensing unit, and Vacuum Operated Electric Switch (V.O.E.S.). Both spark plugs fire during each crankshaft revolution. However, the spark in one cylinder occurs ineffectively during a non-compression stroke.

FUEL

Use a good quality leaded or unleaded gasoline (at least 87 pump octane). Octane rating is usually found on the pump.

⚠CAUTION

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

Gasoline Blends

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 driveablility 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.

LUBRICATION

General

The engine is lubricated by a pressure system circulating oil from the tank through the moving parts and back to tank. For adequate lubrication, the tank must contain an ample supply of clean oil at all times.

Oil consumption depends on the nature of service, fast or moderate riding, and how well the engine is kept tuned.

Remove tank cap and check oil supply as part of every preriding inspection. If level is down near REFILL mark on dipstick, add oil. The engine will run cooler and oil usage will be less with a full oil tank.

The oil tank capacity with filter is 3 quarts (2.8 liters) for all models. The dipstick does not have an upper or full mark. The tank is full when the hot oil level is at the bottom of the rubber seal on fill plug with motorcycle upright. Do not fill above this level because the tank needs some air space. Insert the cap securely to prevent leakage.

Winter Lubrication

Combustion in an engine produces a certain amount of water vapor. During starting and warm-up in cold weather, especially freezing weather, this vapor condenses to water before the crankcase is hot enough to exhaust the vapor through the breather. If the engine is run long enough to thoroughly heat up the crankcase, the water is again vaporized and blown out through the breather. A moderately run engine used for only short trips, and seldom allowed to thoroughly warm up, will accumulate increasing amounts of water in the oil tank. Water mixed with oil for a period of time will form a sludge that is harmful to the engine (causing rapid wear of moving parts). In freezing weather this water will become slush or ice, and if allowed to accumulate, could block oil lines and damage the engine. In winter, the oil should be changed more often than in milder weather. Any engine used for short runs must have the oil changed frequently, and the oil tank flushed thoroughly, to remove ice and sludge before refilling with new oil. The further below freezing the temperature drops, the more frequently the oil should be changed.

Oil Hose Routing

See Figure 3-1 for correct oil hose location.

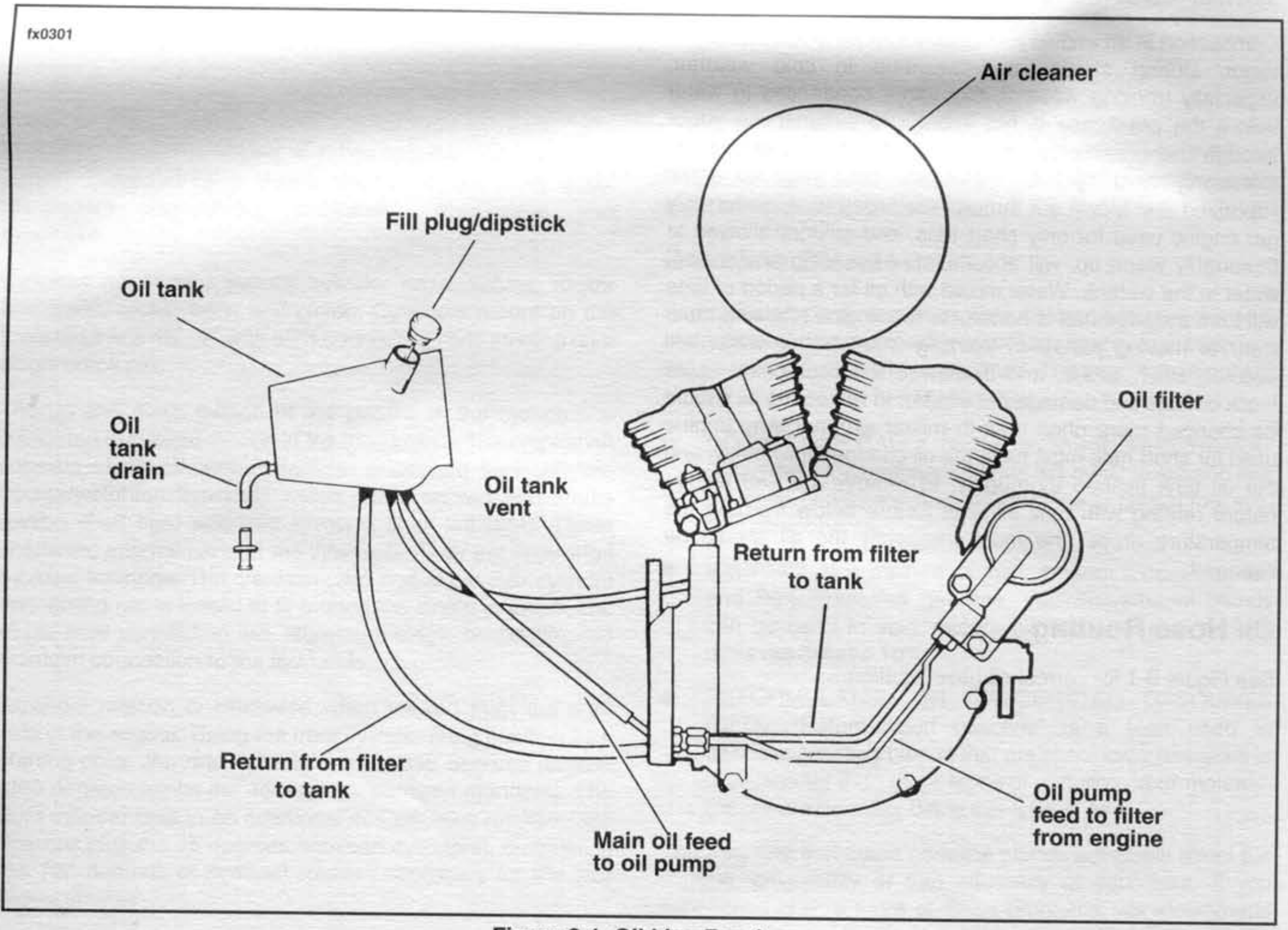


Figure 3-1. Oil Line Routing

Oil Pressure Signal Light

If the oil signal light fails to go off at speeds above idling, it is usually because of low or diluted oil supply, or plugged lifter screen. In freezing weather, the oil feed pipe may clog with ice and sludge, preventing circulation of oil. A grounded oil signal switch wire, faulty signal switch, or trouble with oil pump will also cause the light to stay on. If the oil signal light fails to go off, always check the oil supply first. Then, if oil supply is normal, look inside the oil tank to determine if oil returns to the tank from the oil return pipe outlet located at front of oil tank near filler hole when the engine is running. If it is returning to the tank, there is some circulation and the engine may be run a short distance if necessary. If no oil returns, shut off engine until trouble is located and corrected.

Operating oil pressure is checked as follows:

1. Fill oil tank to proper level.
2. Attach OIL PRESSURE GAUGE, Part No. HD-96921-52A to oil pressure gauge ADAPTER, Part No. HD-96921-107 and install at the hydraulic lifter screen plug.

NOTE

Engine oil should be at normal operating temperature for accurate gauging.

3. Oil pressure should be 12-35 psi (83-241 kN/m^2) at 2000 rpm.

Crankcase Breathing System

1. See Figure 3-2 and foldout. On the piston downstroke, crankcase air is vented up the push rod tubes to individual umbrella valves in each middle rocker box section.
2. Oil mist carried by the crankcase air is separated and returns to the valve pocket through a small drain hole.
3. Crankcase air is routed through a passage in each cylinder head. The crankcase air then travels through the air cleaner backing plate mounting bolts into the air box

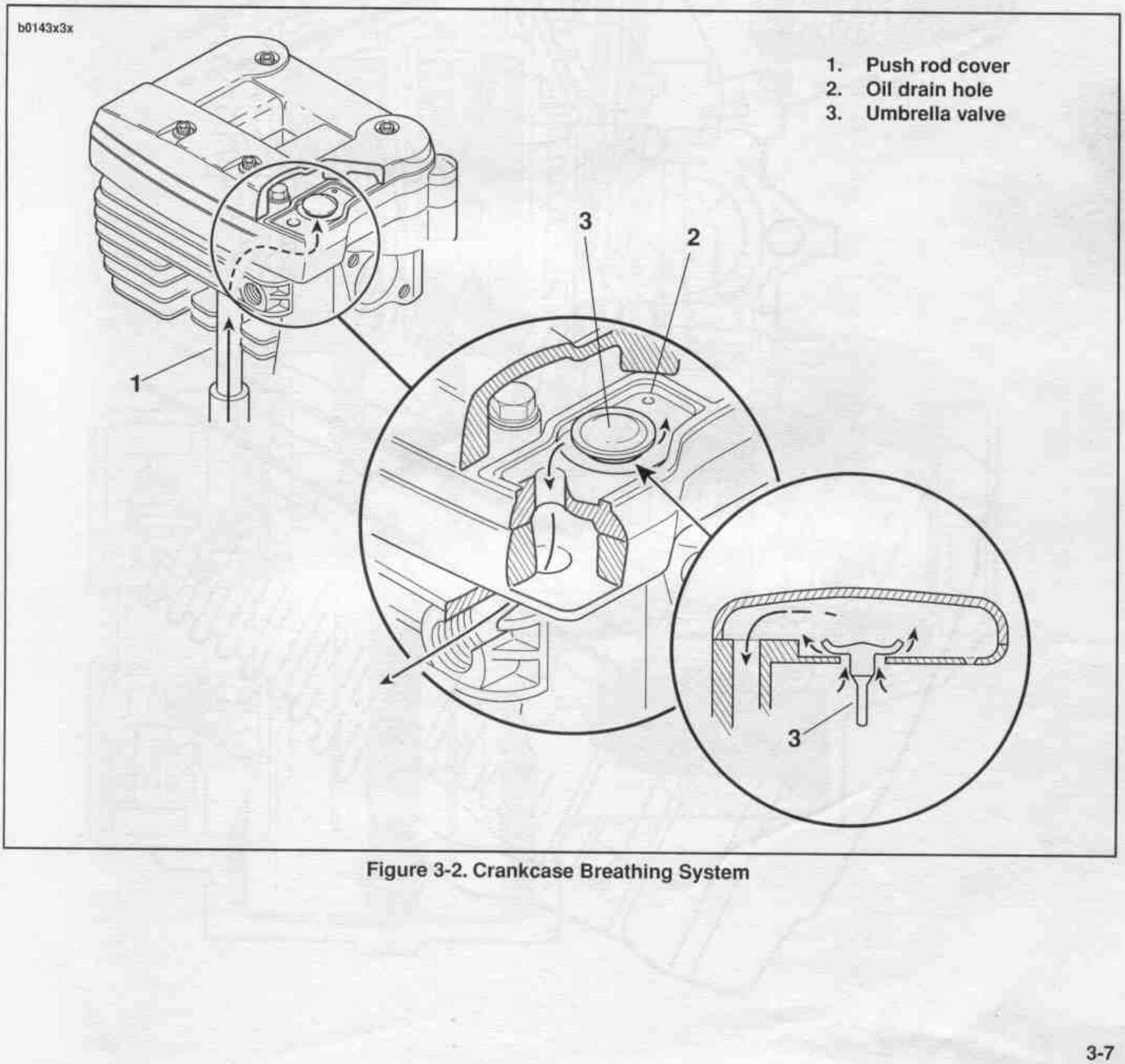
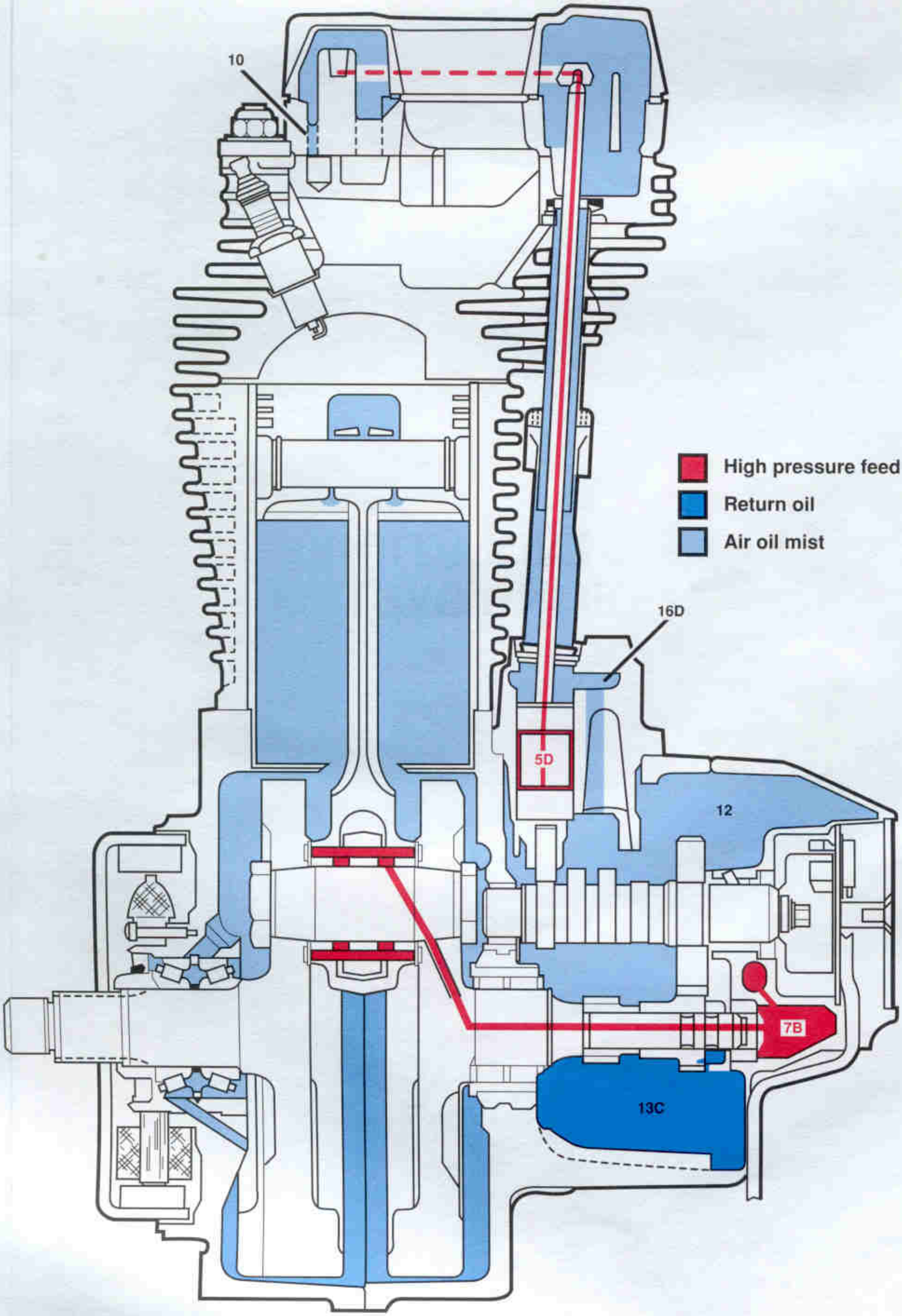


Figure 3-2. Crankcase Breathing System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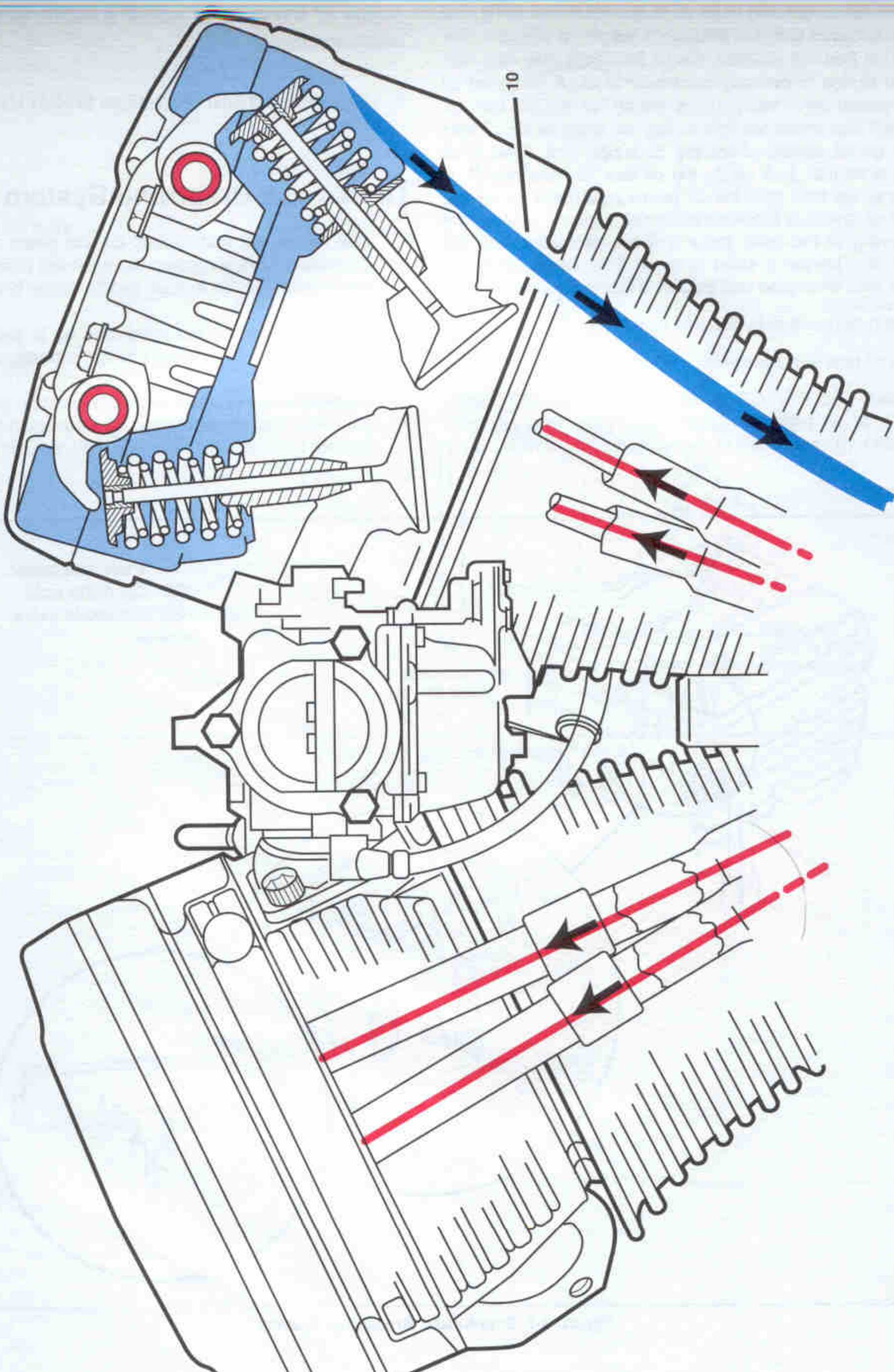
High pressure feed
Return oil
Air oil mist
16D
5D
12
7B
13C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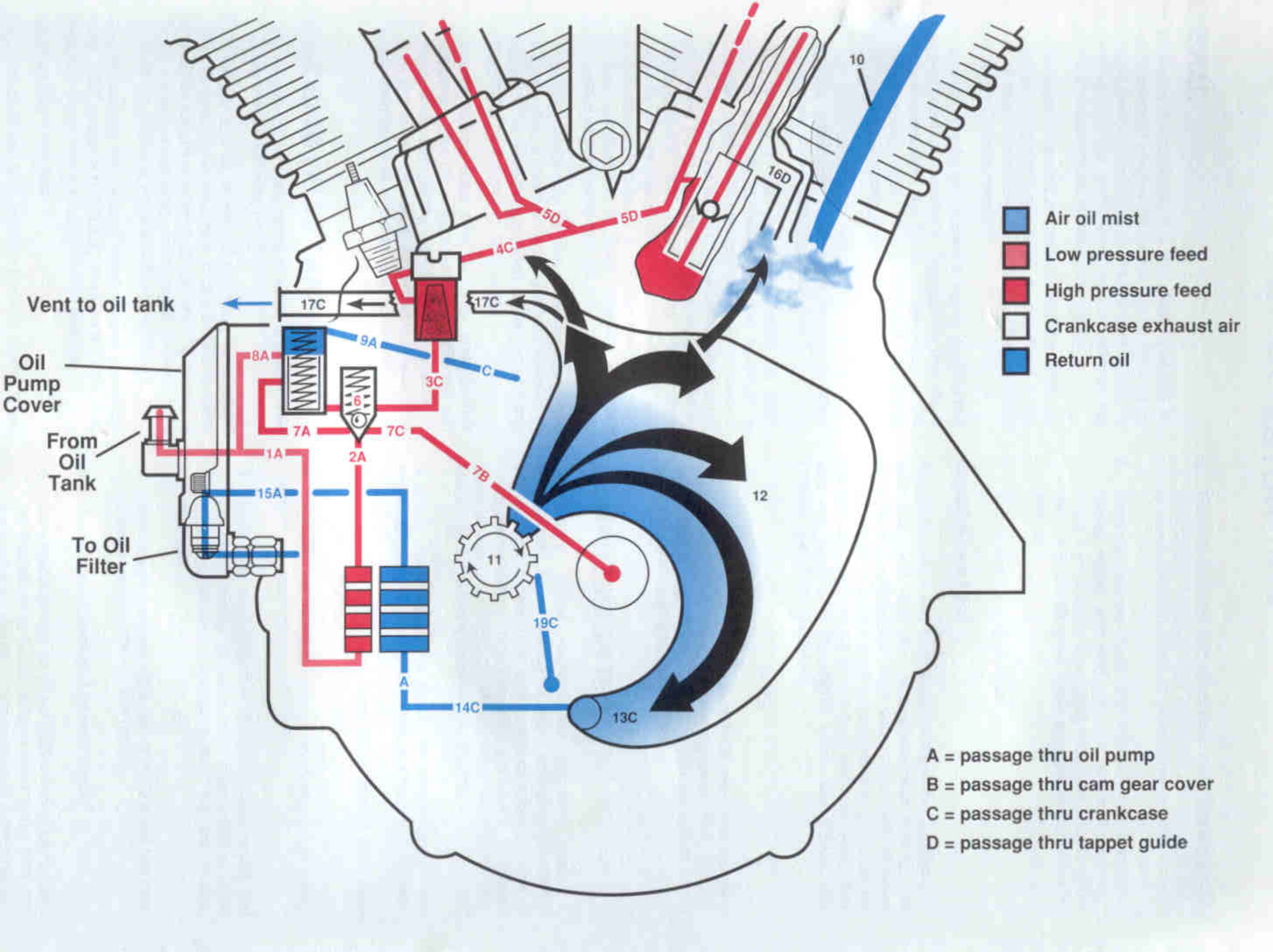


Vent to oil tank
Oil Pump Cover
From Oil Tank
To Oil Filter
17C
9A
8A
3C
4C
5D
5D
16D
10
6
7A
7C
1A
2A
7B
15A
C
11
12
19C
A
14C
13C
Air oil mist
Low pressure feed
High pressure feed
Crankcase exhaust air
Return oil
A = passage thru oil pump
B = passage thru cam gear cover
C = passage thru crankcase
D = passage thru tappet guide

OIL FEED SYSTEM

Oil gravity feeds from oil tank to oil pump feed gears (IA).

Check valve (2A) prevents oil drainage from oil tank into the engine with engine stopped. When feed gears create a pressure of 3 psi, the check valve in the oil pump rises.

Oil is fed thru crankcase passage (3C) into the tappet oil screen. An additional crankcase passage leads to the oil pressure switch which activates above 5 psi.

Oil is fed thru crankcase passage (4C) to the tappet guide.

Oil passage in tappet guide (5D) provides oil to the bottom of hydraulic lifters. Oil fills and pumps up lifters and continues up thru the oil passage in the valve push rods. This oil lubricates rocker arm bushings, shafts, valve stems and push rod sockets.

The pressure created in the top end oil system causes oil pressure regulating valve (6) to open. Oil is then allowed to travel thru oil pump passage (7A) into a crankcase passage (7C) and thru cam gear cover passage (7B) lubricating pinion shaft bushing and lower connecting rod bearings.

When there is sufficient pressure to feed the upper and lower oil system, the oil pressure regulating valve lifts further allowing excessive pressure to return to the feed side of the oil pump cover (8A).

A passage (9A) from the top of the regulating valve tower leading thru the crankcase into the cam gear compartment prevents oil from being trapped and not allowing the regulating valve to lift.

OIL RETURN & CRANKCASE BREATHING SYSTEM

Feed oil to the rocker area is returned to the crankcase thru a passage (10) in the cylinder and head. This oil is then distributed to the piston, cylinder walls and flywheel components.

The rotary breather valve (11) is timed to open on the downstroke of the pistons, allowing crankcase exhaust air pressure to expel scavenged oil from the flywheel compartment through the breather valve into the cam gear compartment.

The oil and air mixture exhausted through the breather valve is separated in the cam gear compartment (12). The oil falls to the bottom of the case (1 3C), flows to the passage in the crankcase (1 4C), is picked up by the scavenge gears in the oil pump and returned (15A) to the oil filter and tank.

The air continues through the cam gear compartment (12) up the push rod tubes (16D) to the umbrella valve in each middle rocker box section.

A vent passage (17C) vents to the oil tank.

GENERAL

When an engine needs repair, it is not always possible to determine beforehand whether the engine can be repaired on the motorcycle by disassembling only the cylinders, heads, or gearcase; or whether the engine must be removed from the motorcycle and disassembled for crankcase repair.

If upper end repair is needed, it is recommended to first strip the motorcycle for cylinder head repair as described in the first series of steps under Engine Removal, *Disassembling Engine as Far as Cylinder Heads*.

After disassembling as far as the cylinder heads you may find that lower end repair is necessary. This requires removal of the engine crankcase from the frame as described in the second series of step under Engine Removal, *Removing Engine Crankcase or Complete Engine*.

When it has been determined beforehand that the lower portion of engine (crankcase) needs repair, remove complete engine from chassis before starting disassembly.

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults (see TROUBLESHOOTING, Section 1). But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

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

Most frequently, valves, rings, pins, bushings, and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate that any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

DIAGNOSING VALVE TRAIN NOISE

To diagnose and correct noisy hydraulic lifters and valve train components, use the following procedures:

1. With engine and oil at normal operating temperature, check oil pressure at 2000 rpm. If oil pressure is above 50 psi (345 kN/m^2) or below 5 psi (34 kN/m^2), inspect oil pump, crankcase passages, and oil hoses for restrictions or blockage. Repair or replace parts as necessary.
2. If oil is reaching the hydraulic lifters, inspect per procedure listed under HYDRAULIC VALVE LIFTERS AND GUIDES. Clean lifter bore of all foreign material.

   Replace lifter if required.
3. Examine push rod, lifter and lifter block for proper fit and any signs of unusual wear. Replace parts as necessary.
4. Visually inspect camshaft lobes for abnormal wear.
5. Remove camshaft and pinion gear, clean and inspect for wear and fit. Measure pitch diameters and check for out-of-round condition. Replace parts as necessary.
6. Remove cylinder head and rocker box assemblies. Check rocker arm end play and check for binding. Inspect valve stems for scuffing and check stem to guide clearance. Check valve seats for signs of looseness or shifting.
7. Grind valves and valve seats.

Checking Gear Mesh

Assemble pinion and cam gears to respective positions in gearcase. Omit cam gear end spacer and seal for the purpose of checking gear mesh. Attach cover with all cover screws. Mesh is correct when no play between gears can be felt and cam gear can be moved back and forth along shaft axis with slight drag. See NOTE below. See GEARCASE COVER AND TIMING GEARS.

NOTE

Gear mesh must be checked twice (with gear cover installed) over two complete gear revolutions (revolution 1: at TDC, BDC, revolution 2: at TDC, BDC) as two revolutions of the gear occur with each engine revolution.

COMPRESSION TEST

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE, Part No. HD-33223-1 that has a screw-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature. Proceed as follows:

1. Disconnect spark plug wires, clean around plug base and remove plugs.
2. Connect compression tester to front cylinder per manufacturer's instructions.
3. Make sure transmission is in neutral. With choke and carburetor throttle plates in wide open position, crank engine continuously through 5 to 7 full compression strokes.
4. Note gauge readings at the end of the first and last compression strokes. Record test results.
5. Repeat steps 2 through 4 on rear cylinder.
6. If the final readings are 90 psi (620 kN/m^2)or more, and if the final readings do not indicate more than a 10% variance between cylinders, compression is considered normal. If compression does not meet specifications, see diagnostic chart below.

7. Inject approximately 1/2 oz. (15 ml) engine oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

NOTE

After installing spark plugs, be sure that throttle plate is in the closed position before starting the engine.

Diagnosis	Test Results
Ring Trouble	Compression low on first stroke, tends to build up on the following strokes, but does not reach normal. Improves considerably when oil is added to cylinder.
Valve Trouble	Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Check for correct pushrod length.
Head Gasket Leak	Same reaction as valve trouble.

CYLINDER LEAKAGE TEST

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

Use CYLINDER LEAKDOWN TESTER, Part No. HD-35667 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 carburetor choke and throttle in the wide open position.
4. Remove the timing inspection plug from the crankcase.
5. The piston in the cylinder being tested must be at top dead center of compression stroke (both valves closed) during the test.
6. 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 all around test fittings, connect the cylinder leakdown tester to the compressed air source and look for any bubbles that would indicate leakage from the tester.

7. 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.
8. Listen for air leaks at carburetor intake, exhaust pipe, head gasket, and timing inspection hole. Air escaping through the carburetor indicates a leaking intake valve. Air escaping through the exhaust pipe indicates a leaking exhaust valve. Air escaping through the timing inspection hole indicates leaking, worn, or broken piston rings, a worn piston and/or cylinder, or a leaking head gasket.

NOTE

If air is escaping through valves, check for correct pushrod length.

9. Repeat procedure on rear cylinder.

NOTE

After installing spark plugs, be sure throttle plate is in the closed position before starting engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

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

- Overfill. } Check prior to head removal.
- Oil carryover. }
- Oil return passages for clogging.
- Valve guide seals.
- Valve guide to valve stem clearance.
- Gasket surface of both head and cylinder.
- Cylinder head casting's porosity allowing oil to drain into combustion chamber.

STRIPPING MOTORCYCLE FOR ENGINE REPAIR

ENGINE REMOVAL

Special Tools	Torque Values
HD-34641 Intake valve spring compressor	None

Disassembling Engine as Far as Cylinder Heads

1. Remove seat. See SEAT, Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. Disconnect battery cables, negative cable first.
3. Remove instrument cover. See ELECTRONIC SPEEDOMETER, Section 8.

⚠WARNING

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

4. Drain fuel tank. Disconnect fuel line and remove fuel tank. See Section 4.

NOTE

An access hole has been provided through the frame to remove the left rear rocker box bolt. A rolled up paper tube should be inserted through the hole in the frame and around the bolt head during removal, to prevent accidentally dropping the bolt into the frame opening.

5. Remove upper cylinder head engine bracket. Note washer(s) between bracket and frame lug, use same washer(s) when bracket is assembled.
6. Remove spark plugs to avoid damaging them.
7. Remove air cleaner cover, filter element, air cleaner back plate, and air cleaner back plate support bracket from carburetor body. See AIR CLEANER, Section 4.
8. Remove fuel and V.O.E.S. hoses from carburetor. See CARBURETOR, Section 4.
9. Disconnect throttle and choke controls from carburetor. See THROTTLE CONTROL, Section 2.
10. Remove carburetor and intake manifold as an assembly. See CARBURETOR, Section 4.
11. Remove exhaust system. See EXHAUST SYSTEM, Section 4.

At this stage, the lower rocker boxes, the cylinder heads and cylinders may be removed.

NOTE

It may be necessary to compress rear intake valve spring to provide clearance for lower rocker cover removal. Use Harley-Davidson INTAKE VALVE SPRING COMPRESSOR, Part No. HD-34641 to compress the spring.

Removing Engine Crankcase or Complete Engine

To remove engine crankcase or complete engine, continue stripping motorcycle as follows:

1. On models that do not have forward foot controls, remove right footrest, brake pedal, and master cylinder assembly. See REAR BRAKE MASTER CYLINDER/ RESERVOIR, Section 2.
2. Drain engine oil from tank. Drain lubricant from primary chaincase.
3. Remove primary cover. Remove compensating sprocket shaft nut so that compensating sprocket can be removed from sprocket shaft during engine removal. See CLUTCH, Section 6.
4. Remove bolts attaching inner primary housing to engine. See PRIMARY CHAINCASE, Section 6.
5. Disconnect sensor from ignition module. Disconnect alternator plug from crankcase. Unplug spark plug wires.
6. Remove clutch cable bracket from engine.
7. Disconnect wire from oil pressure switch.
8. Remove oil lines from oil pump.
9. Remove front and rear engine mounting bolts.
10. Remove engine from right side of motorcycle using hoist.

ENGINE INSTALLATION

Special Tools	Torque Values
HD-97087-65A Hose clamp tool	See Engine Mount Torque Procedure below

1. Place the engine, with new engine-to-primary O-ring, in position on the frame motor mounting pads. Slide compensating sprocket onto shaft while replacing engine. See PRIMARY CHAINCASE, Section 6.

2. Install and hand tighten front and rear engine mounting bolts and washers.

3. Insert the inner primary-to-engine mounting bolts. Leave the primary mounting bolts loose at this time. See PRIMARY CHAINCASE, Section 6.

4. Tighten the engine mounting bolts in the following torque sequence:

    a. Tighten the rear mounting bolts to 33-38 ft-lbs (45-52 Nm).

    b. Inspect the relationship of the front frame pad and engine mounting boss for proper alignment.

    c. Tighten the front mounting bolts to 33-38 ft-lbs (45-52 Nm).

5. Tighten the inner primary-to-engine mounting bolts to 25-29 ft-lbs (34-39 Nm) and bend up lock tabs. See PRIMARY CHAINCASE, Section 6.

6. Install the upper engine mounting bracket and tighten fasteners to following torque values: Shim as needed.

    To cylinder heads .... 28-35 ft-lbs (38-48 Nm)

    To frame .... 28-35 ft-lbs (38-48 Nm)

7. Install compensating sprocket nut and adjust primary chain. See Section 6.

8. Install primary cover and new gasket. See Section 6.

9. Install spark plugs. Install rectifier/regulator. Plug in charging system and spark plug wires. Attach sensor to ignition module.

10. Install oil lines to oil pump and crankcase. Use new hose clamps. See OIL PUMP, Section 3.

11. Install oil pressure switch wire.

12. Attach clutch cable bracket to engine.

13. Install carburetor and manifold assembly. Tighten screws. See CARBURETOR, Section 4.

14. Attach throttle and enrichener cables to carburetor. See THROTTLE CONTROL, Section 2.

15. Install air cleaner. See AIR CLEANER, Section 4.

16. Install exhaust system. See EXHAUST SYSTEM, Section 4.

17. On models without forward foot controls, install right footrest, brake pedal and master cylinder assembly. See REAR BRAKE MASTER CYLINDER/RESERVOIR, Section 2.

18. Install fuel tank and connect fuel lines. Use new hose clamps. See CARBURETOR, Section 4.

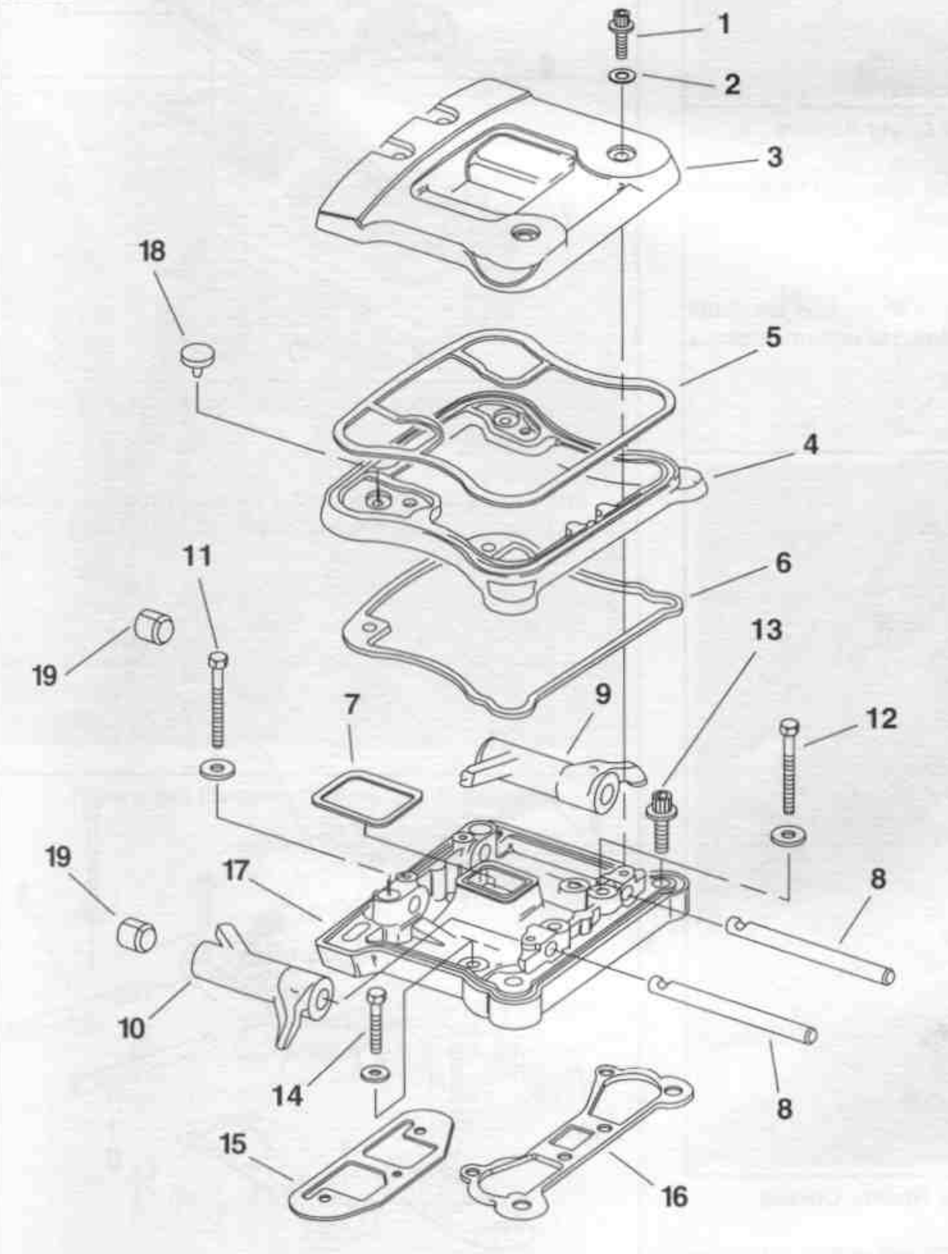
19. Install seat. See SEAT, Section 2.

20. Install new oil filter, engine oil and primary chaincase lubricant.

21. Connect battery cables, positive cable first. See BATTERY, Section 8.

CYLINDER HEAD REMOVAL

Before removing cylinder head assembly, strip motorcycle as described in STRIPPING MOTORCYCLE FOR ENGINE REPAIR.



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

Figure 3-3. Rocker Arm Cover Assembly

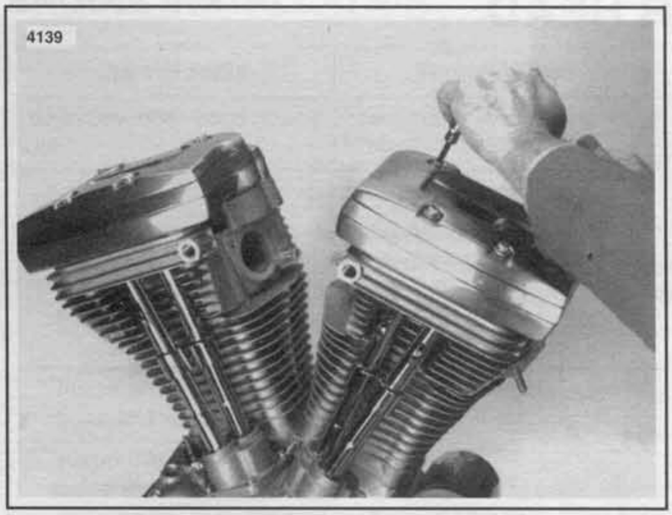


Figure 3-4. Remove Rocker Cover Screws

1. See Figures 3-4 and 3-6. Remove screws (1) and seals (2).

NOTE

All washers and fasteners used in the V^2 engine are hardened, so they must not be mixed or replaced with unhardened parts.

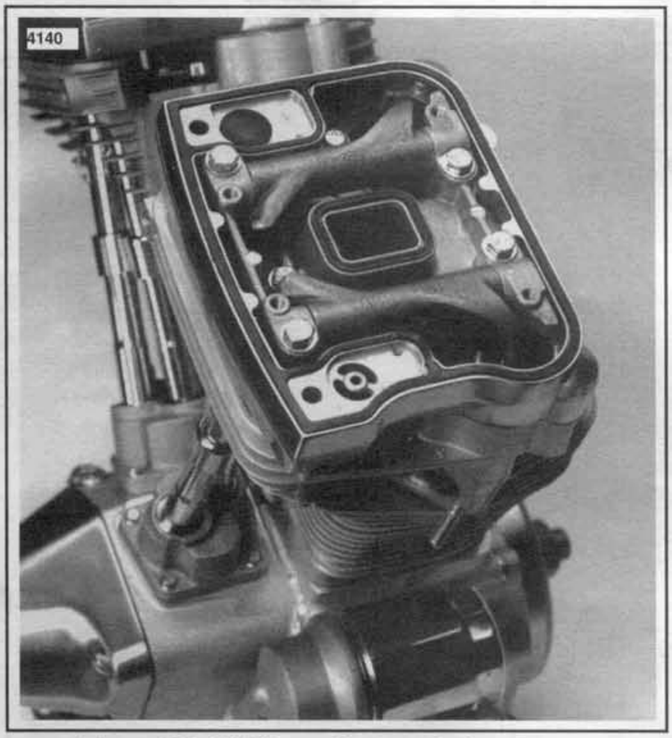


Figure 3-5. Middle and Lower Rocker Covers

2. See Figure 3-6. Remove upper (3) and middle (4) rocker arm covers. Remove gaskets (5, 6 and 7) and discard.
3. Rotate the engine so both valves are closed on the head being replaced.

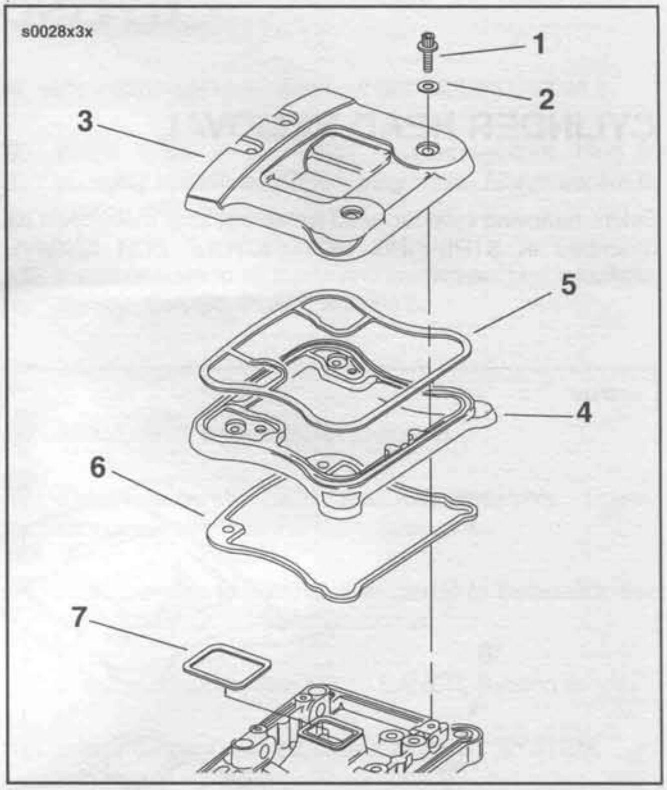


Figure 3-6. Upper and Middle Rocker Arm Covers

4. See Figure 3-7. Remove the rocker arm retaining bolts (11) and washers nearest the rocker arm shafts at the push rod end.

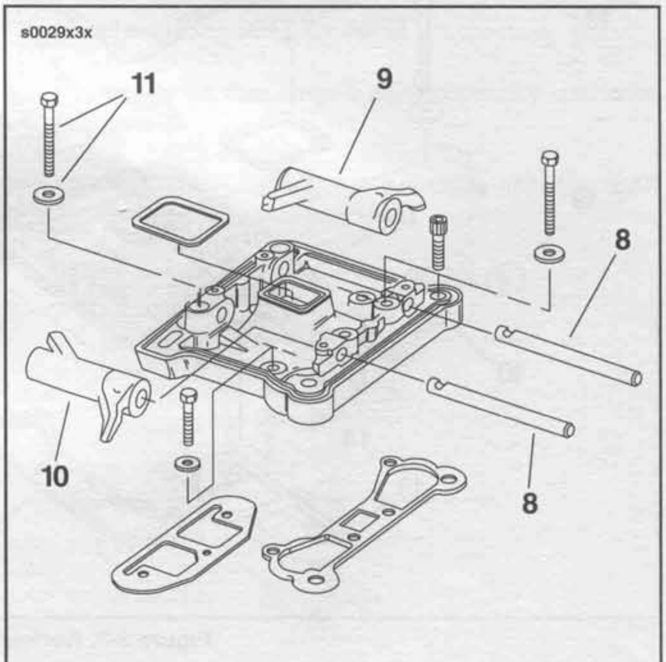


Figure 3-7. Rocker Arm Retaining Bolts

5. See Figure 3-7. Mark rocker arm shafts (8) so they will be assembled in their original locations, then remove them by tapping them out with a hammer and soft metal punch.

6. Mark rocker arms (9 and 10) so they will be assembled in their original locations, then remove them.

7. See Figure 3-9. Remove the push rods (1) and mark their location and orientation, top and bottom.

8. See Figures 3-8 and 3-9. Remove spring cap retainers (2) on push rod covers and remove push rod covers and associated parts (3 through 11).

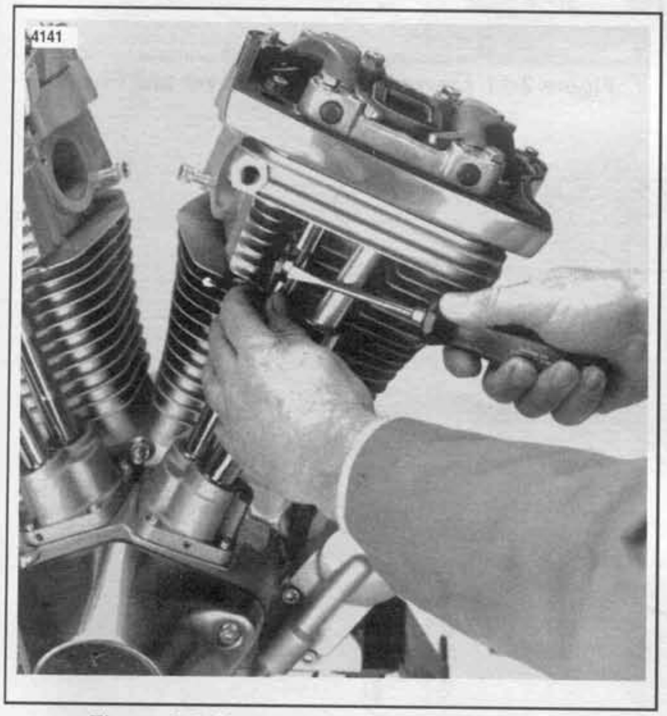
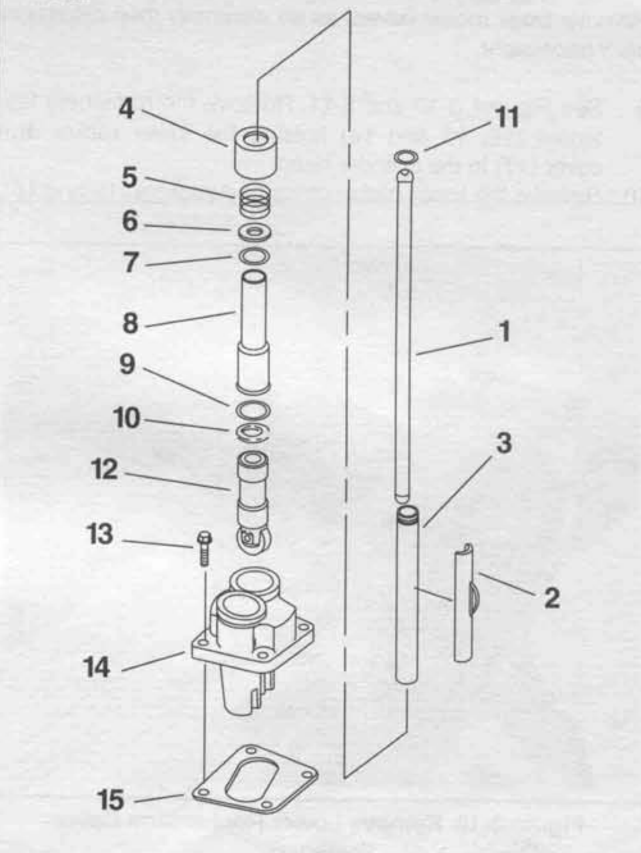


Figure 3-8. Remove Spring Cap Retainers



1. **Push rod (2)**
2. **Spring cap retainer (2)**
3. **Upper push rod cover (2)**
4. **Spring Cap (2)**
5. **Spring (2)**
6. **Spacer (2)**
7. **O-ring (2)**
8. **Lower push rod cover (2)**
9. **O-ring (2)**
10. **Spacer (2)**
11. **O-ring (2)**
12. **Hydraulic lifter(2)**
13. **Bolt (4)**
14. **Lifter guide**
15. **Gasket**

Figure 3-9. Rocker Arm Push Rod and Cover

Forstcylinder

O Indsugning 2
O udst 1 lang stødstind

Bagerst cylinder

O O Inds 4

uds 3

NOTE

Remove lower rocker covers as an assembly then disassemble if necessary.

9. See Figures 3-10 and 3-11. Remove the remaining fasteners (12, 13 and 14) holding the lower rocker arm cover (17) to the cylinder head.
10. Remove the lower rocker cover and gaskets (15 and 16).

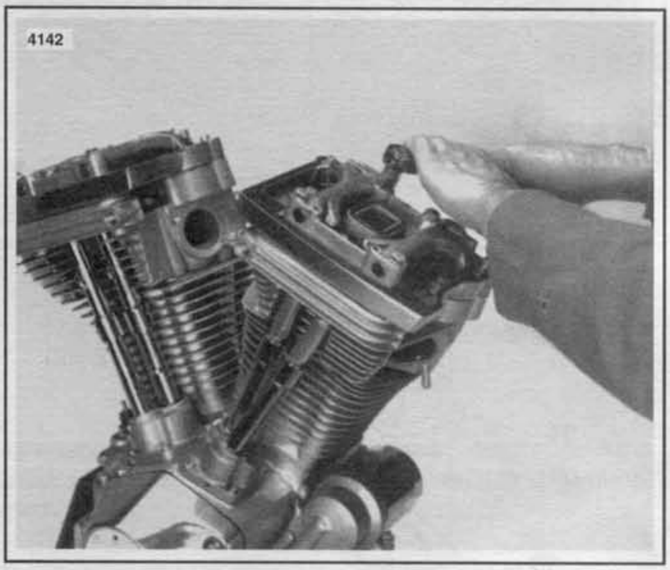


Figure 3-10. Remove Lower Rocker Arm Cover Fasteners

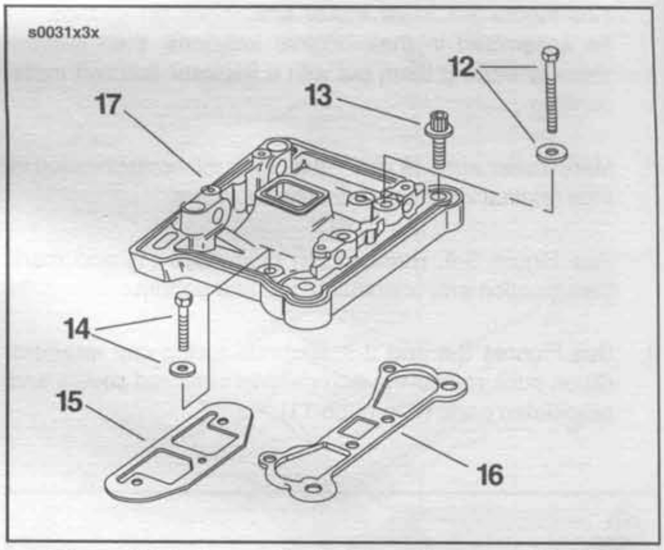
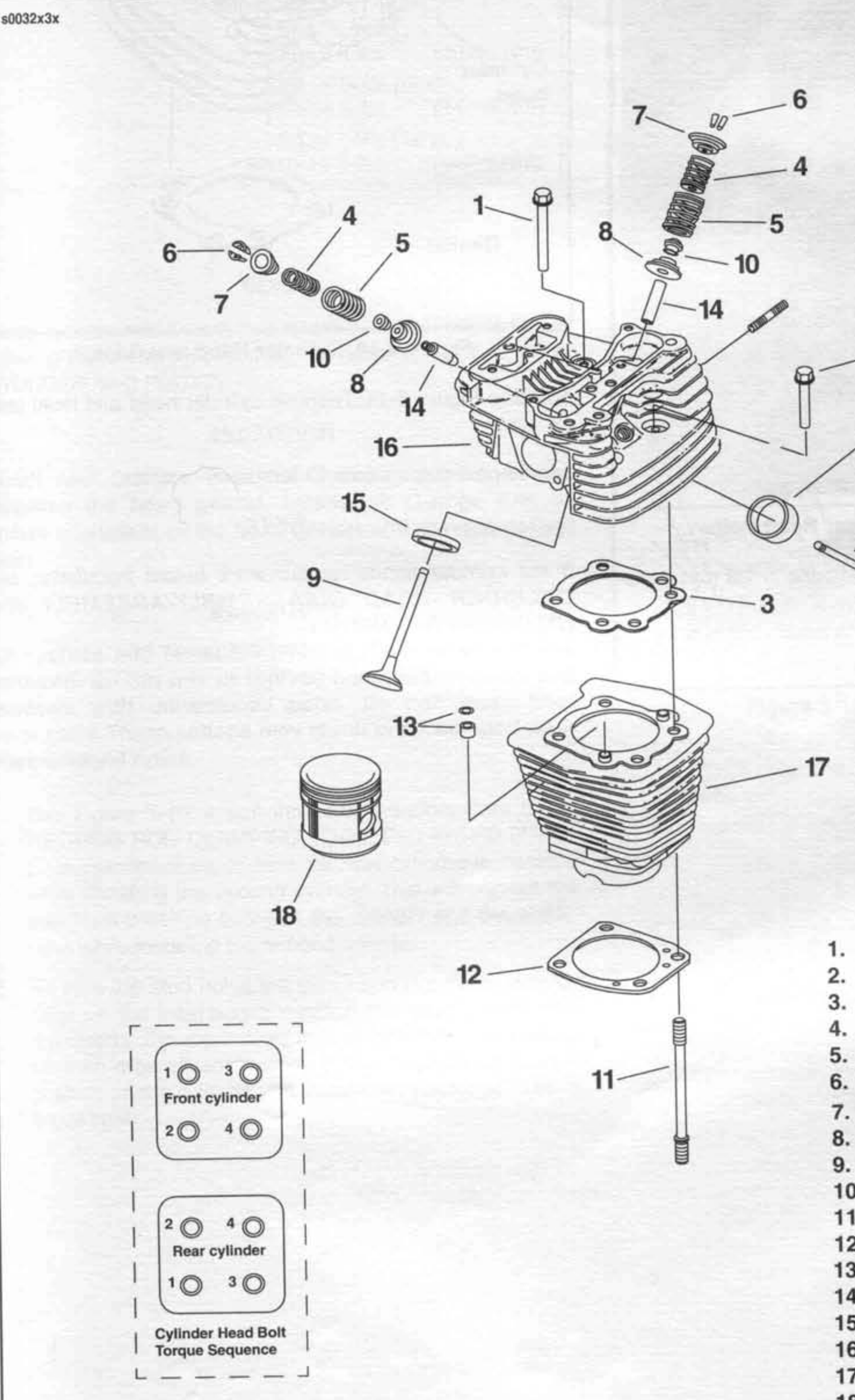


Figure 3-11. Lower Rocker Arm Cover and Gasket

⚠CAUTION

Loosen head bolts gradually, in a cross pattern, to prevent distorting the head, cylinder and crankcase studs.

11. See Figures 3-12 and 3-13. Loosen each head bolt (1, 2) 1/8 turn following the cross pattern sequence shown.



1. **Head bolt, long (2)**
2. **Head bolt, short (2)**
3. **Cylinder head gasket**
4. **Inner valve spring (2)**
5. **Outer valve spring (2)**
6. **Valve keeper (4)**
7. **Upper collar (2)**
8. **Lower collar (2)**
9. **Valve (1) intake, (1) exhaust**
10. **Valve stem seal (2)**
11. **Cylinder stud (4)**
12. **Cylinder base gasket**
13. **O-ring and insert (2)**
14. **Valve guide (2)**
15. **Valve seat (2)**
16. **Cylinder head (2)**
17. **Cylinder (2)**
18. **Piston**

Figure 3-12. Cylinder Head and Cylinder

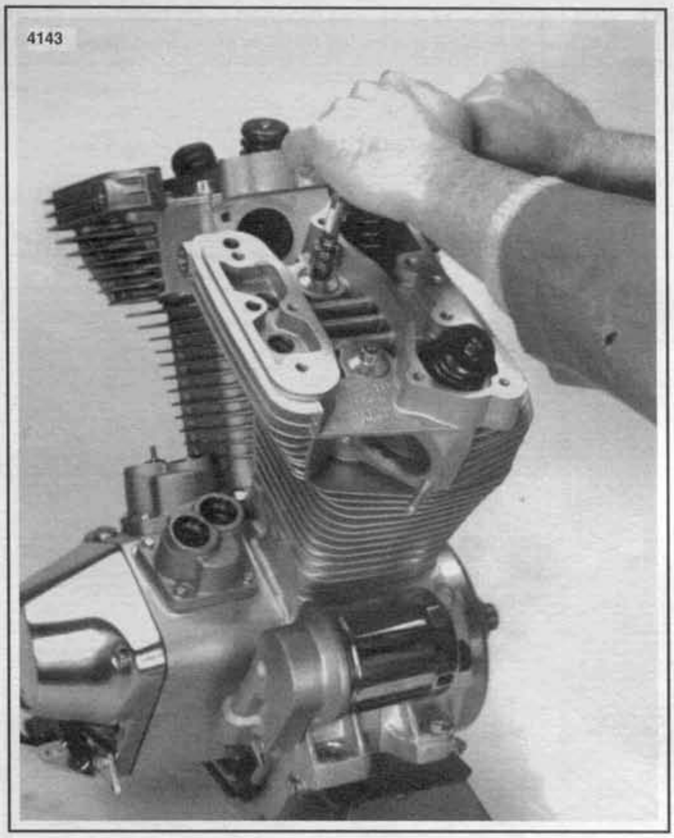


Figure 3-13. Loosen Cylinder Head Bolts

12. Continue loosening cylinder head bolts in 1/8 turn increments until bolts are loose, then remove bolts.

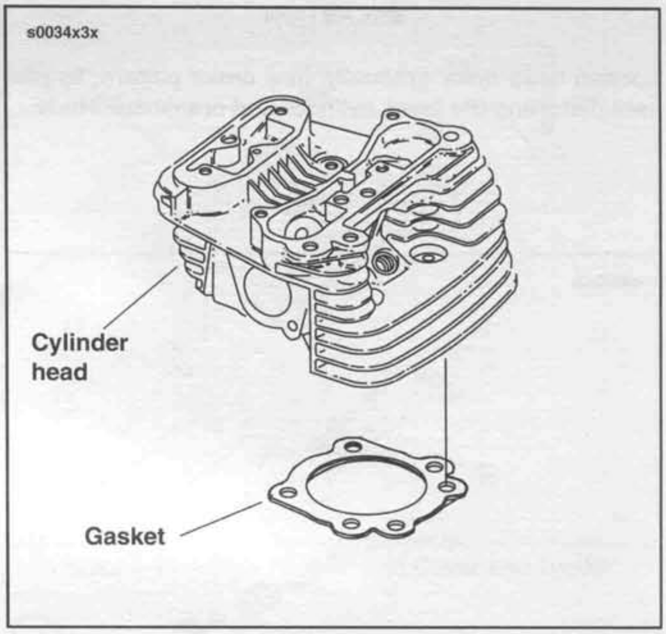


Figure 3-14. Cylinder Head and Gasket

13. See Figure 3-14. Remove cylinder head and head gasket.

14. Repeat steps 1 thru 13 for the other head.

NOTE

If the cylinder heads require work before installation, see CYLINDER HEAD DISASSEMBLY/ASSEMBLY and CYLINDER HEAD REPAIR.

CYLINDER AND CYLINDER HEAD INSTALLATION

Special Tools	Torque Values
HD-95952-2 Connecting Rod Clamping Tool-Threaded Cylinders	See cylinder head bolt **TORQUE SEQUENCE**. Lower rocker box bolts 5/16 in. bolts 15-19 ft-lbs (20-26 Nm) 1/4 in. bolts (hex) 10-14 ft-lbs (14-19 Nm) 1/4 in. bolts (12 pt.) 10-14 ft-lbs (14-19 Nm)

NOTE

If only cylinder head work was needed, install cylinder head following these instructions. If further repair is required, go to CYLINDER AND PISTON.

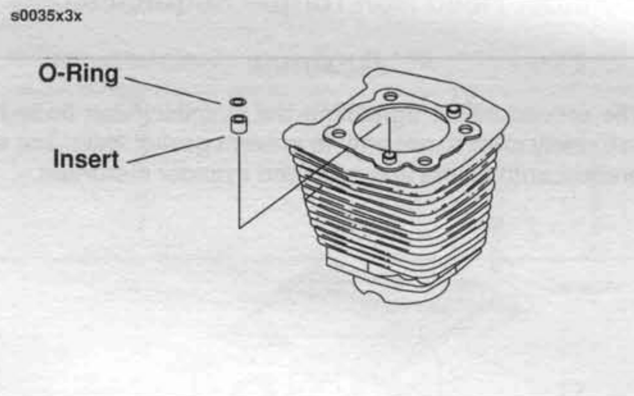
⚠CAUTION

Install new O-rings over the cylinder dowels before installing the head gasket. Install the O-rings first to ensure alignment of the head gasket and prevent gasket leaks.

⚠CAUTION

All washers and fasteners used in the V^2™ engine are hardened. Do not mix or replace hardened washers and fasteners with unhardened parts. Do not reuse fiber cover seals. These actions may result in accelerated wear and increased noise.

1. See Figure 3-15. Install threaded cylinders from CONNECTING ROD CLAMPING TOOL, Part No. HD-95952-2, to cylinder studs to hold the first cylinder in position while installing the second cylinder. This will prevent the seal from breaking between the cylinder and the crankcase while installing the second cylinder.
2. Be sure the stud holes are clean and dry. Place new O-rings on the inserts and position the head gasket over the inserts. Dip the bottom face of cylinder head bolts in oil; then wipe off any excess. Place the cylinder head in position on the cylinder and install the cylinder head bolts finger tight.



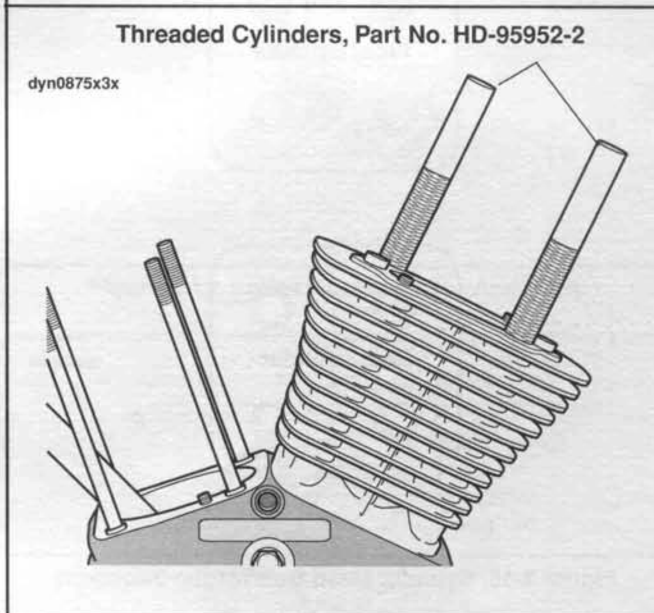


Figure 3-15. Cylinder Installation

Cylinder Head Bolt Torque Sequence

CAUTION

The procedure for tightening the cylinder head bolts is extremely critical; not only to prevent gasket leaks, but to prevent stud failure and head and cylinder distortion.

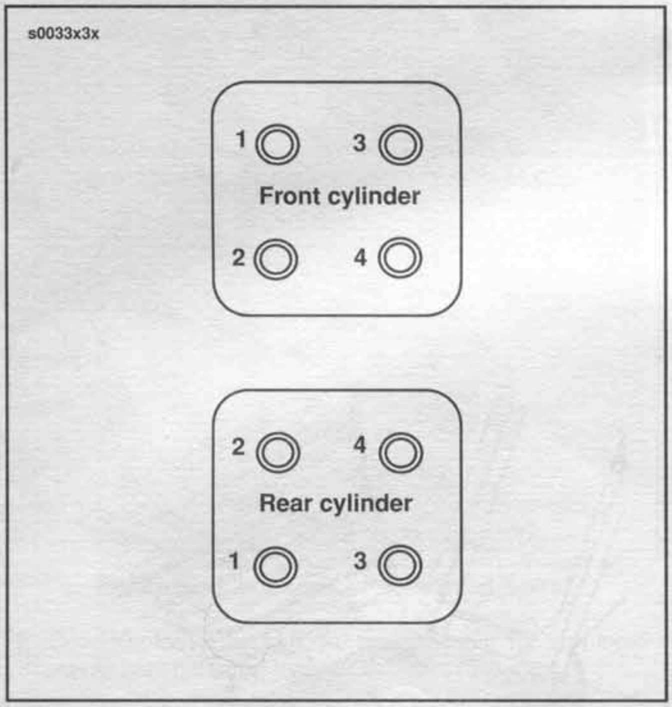


Figure 3-16. Cylinder Head Bolt Torque Sequence

CAUTION

Be sure you thoroughly clean and lubricate the cylinder head bolts before tightening to the correct torque. Friction because of dirt or grime will cause the torque wrench readings to be incorrect. Clean and lubricate the threads with engine oil and screw the bolts onto the cylinder studs to be sure there is no friction.

1. See Figure 3-16. With a torque wrench, start at the cylinder head bolt numbered "1" and tighten to 7-9 ft-lbs (9-12 Nm). Then tighten "2", "3" and "4", in order, to 7-9 ft-lbs (9-12 Nm).
2. Again, on the other cylinder, starting at the cylinder head bolt numbered "1" and ending with "4" sequentially, tighten each bolt to 12-14 ft-lbs (16-19 Nm).
3. See Figure 3-17. Mark a line on the cylinder head and a corresponding line on the head of the cylinder head bolt as shown in View A. Following the same sequence 1, 2, 3, then 4, turn each bolt, one at a time one quarter turn (90°) using the marks as a guide. When marks are all positioned, as in View B, the procedure is completed.

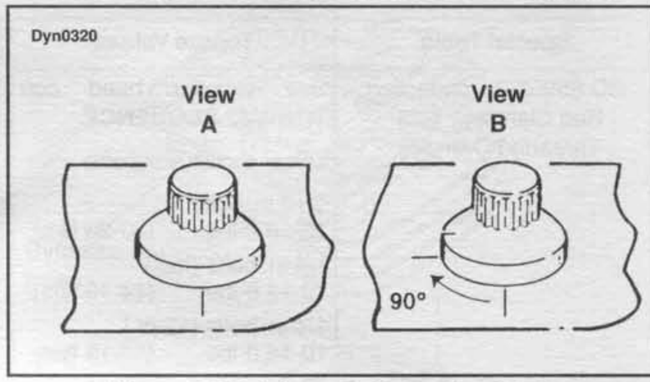


Figure 3-17. Tighten Cylinder Head Bolts

PUSH ROD AND ROCKER COVERS INSTALLATION

NOTE

There is one length push rod for each of four locations. See table below. Be sure to color match each push rod to its correct valve and cam lobe; purple to rear exhaust, blue to rear intake, yellow to front intake and green to front exhaust.

Push rod Position	Color Code
Rear Exhaust	Purple
Rear Intake	Blue
Front Intake	Yellow
Front Exhaust	Green

1. Rotate camshaft so lifter is at its lowest point (on base circle of camshaft).
2. Remove the rocker arms and shafts and lower rocker arm cover, if not already removed.
3. Rotate the engine so that both lifters of the cylinder being serviced are on the base circle (lowest position) of the cam.
4. See Figure 3-18. Install rocker arms and rocker shafts if removed. The rocker arm shafts are notched to accept the rocker arm retaining bolts. Align the notches with the bolt holes before installing the bolts.

5. Check end play of rocker arms with a feeler gauge and replace rocker arms or lower cover if end play exceeds 0.025 in. (0.64 mm).

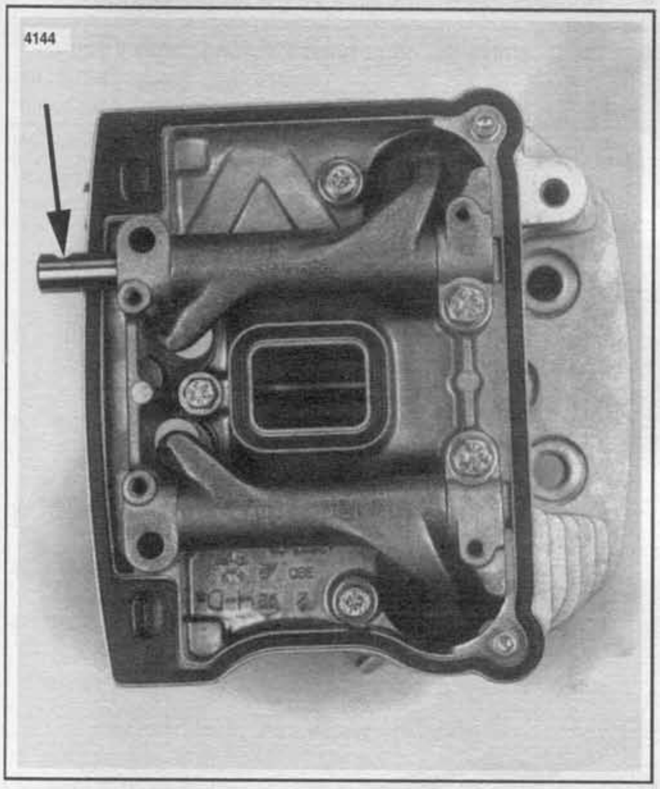


Figure 3-18. Rocker Arm Shaft Bolt Notches

6. See Figure 3-19. Install push rods. Install gaskets (15, 16). Place lower rocker cover assembly (17) (with rocker arms and shafts) in position on cylinder head.
7. Install screws and washers (11, 12, 13, and 14). Slowly snug lower rocker box fasteners in small increments (one at a time) in a cross pattern. This will bleed the lifters. Tighten the 5/16 in. screws (11, 12) to 15-19 ft-lbs (20-26 Nm). Tighten the 1/4 in. screws (13) to 90-120 in-lbs (10-13 Nm), and tighten the 1/4 in. screws (14) to 10-14 ft-lbs (14-19 Nm).

CAUTION

Do not turn engine over until push rods spin freely. Damage could occur to valves.

NOTE

If the original push rods are being installed, be sure you do not turn them end for end from their original position because they have worn into their mating components.

8. See Figure 3-20. Install the middle (5) and upper (3) rocker arm covers, using new gaskets (4, 6, and 7) and new fiber seals (2). Be sure the middle cover section is spaced evenly on all sides before tightening the cover screws. Tighten the screws (1) to 10-14 ft-lbs (14-19 Nm) following a crisscross pattern.

9. Install the carburetor, V.O.E.S. and ignition components.

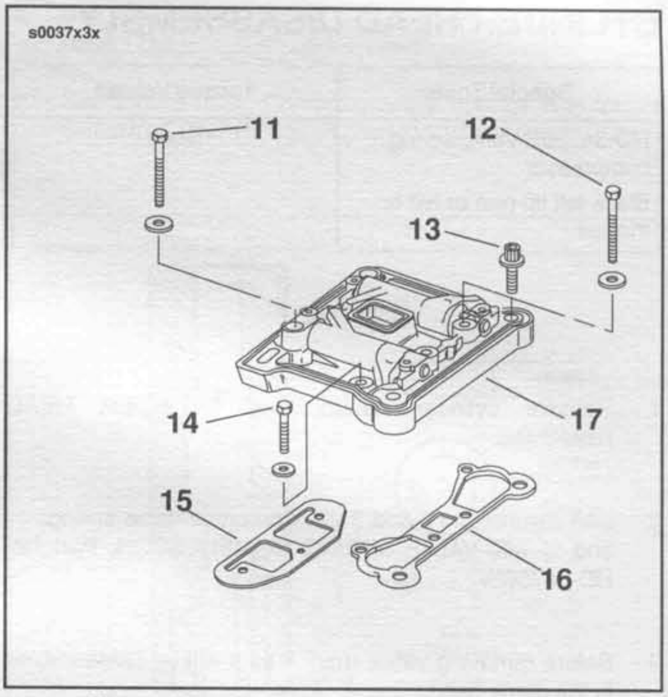


Figure 3-19. Lower Rocker Cover Assembly

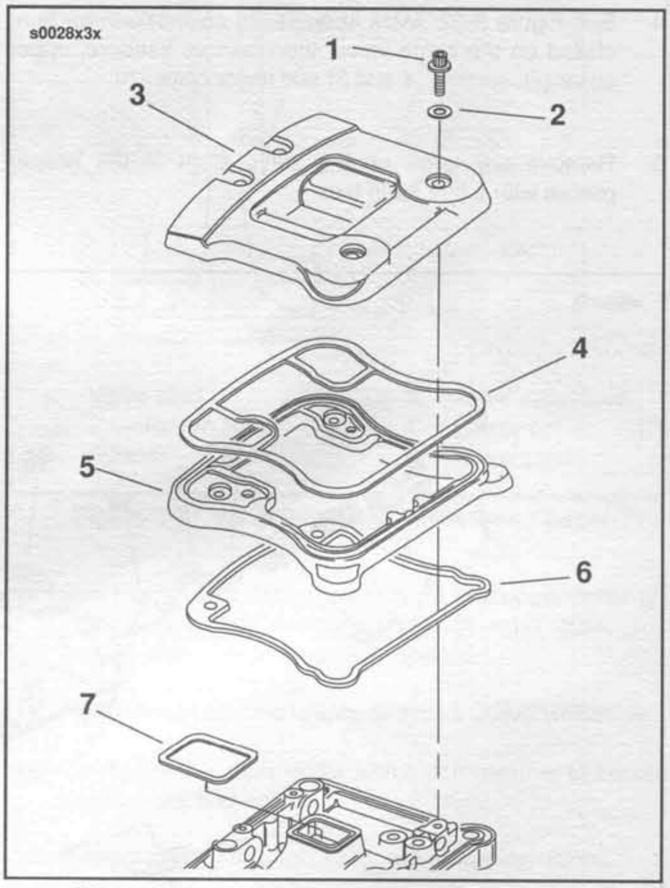


Figure 3-20. Middle and Upper Rocker Covers

CYLINDER HEAD DISASSEMBLY

Special Tools	Torque Values
HD-34736B Valve spring compressor Black felt tip pen or felt tip marker	None

1. Remove cylinder heads. See CYLINDER HEAD REMOVAL.
2. See Figures 3-21 and 3-22. Compress valve springs (4 and 5) with VALVE SPRING COMPRESSOR, Part No. HD-34736B.
3. Before removing valve, mark it so it will be reassembled in the same head.
4. See Figure 3-22. Mark keepers (6) so they will be reinstalled on the same valve, then remove keepers, upper collar (7), springs (4 and 5) and lower collar (8).
5. Remove any burrs on the valve stem at the keeper groove with a fine tooth file.
6. See Figure 3-22. Remove valve (9) and valve stem seal (10).
7. Repeat steps 1 through 5 for the other valve.
8. Disassemble the other head following steps 1 thru 7.

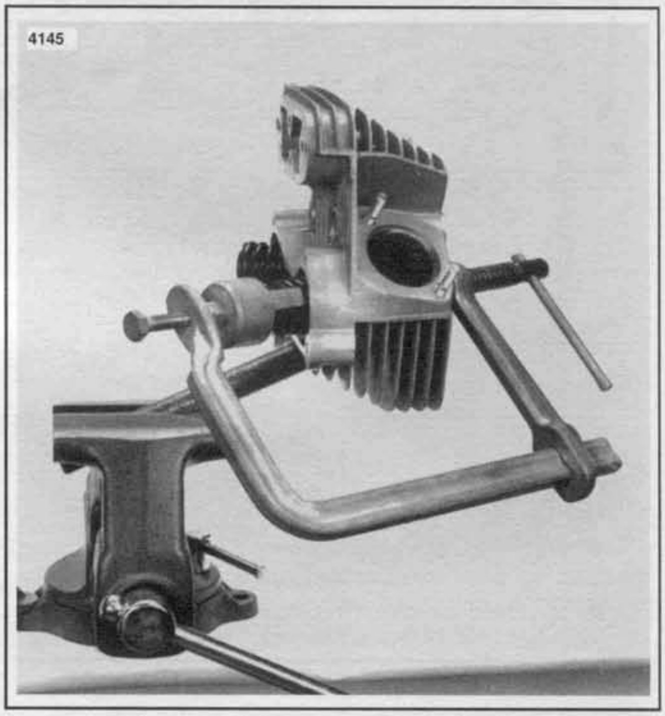


Figure 3-21. Compress Valve Springs

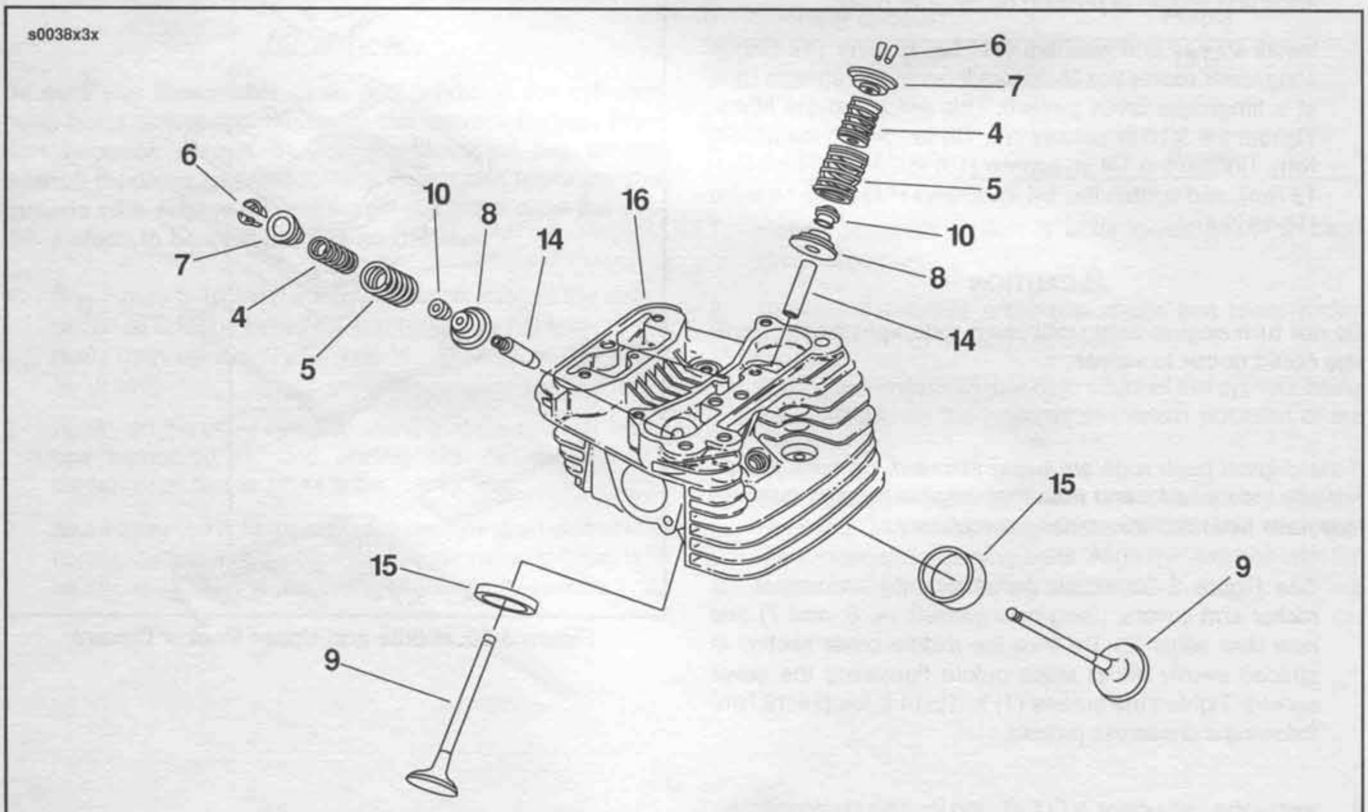


Figure 3-22. Cylinder Head Assembly

CYLINDER HEAD ASSEMBLY

Special Tools	Torque Values
HD-34571 Valve guide brush HD-34643 Valve seal installation tool HD-34740 Driver handle HD-34736B Valve spring compressor	None

1. Wash cylinder head and valves in warm soapy water to remove all lapping compound if valve seats were lapped.
2. Scrub valve guide bores with VALVE GUIDE BRUSH, Part No. HD-34751 and hot soapy water.
3. Blow dry with compressed air.
4. Apply a liberal amount of engine oil to the valve stem.
5. See Figure 3-23. Insert valve into guide (5) and install lower collar (4).

⚠CAUTION

Do not apply Loctite to inner portion of seal or top of guide. Excess Loctite may result in valve damage.

6. Apply a small amount of RC 620 Loctite (green) retaining compound to outside diameter of guide near the top of guide. Place a protective sleeve over the valve stem keeper grooves. Coat the sleeve with oil and place a new seal over the valve stem.

⚠CAUTION

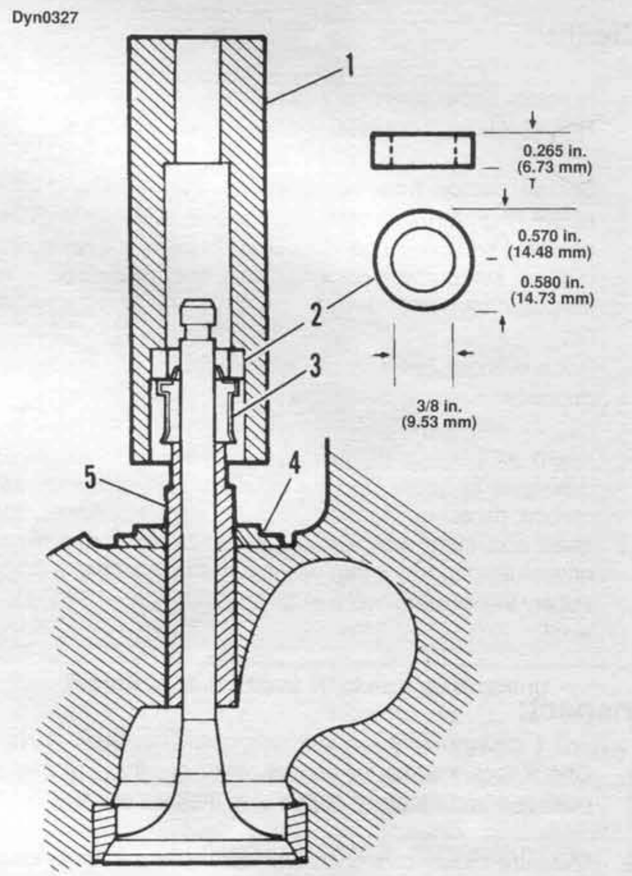
If the seal is installed without using the protective sleeve, the seal will be damaged.

7. See Figure 3-23. Tap the seal (3) onto the guide (5) using the VALVE SEAL INSTALLATION TOOL (1) and spacer (2), Part No. HD-34643 and DRIVER HANDLE, Part No. HD-34740. The seal is completely installed when the tool (1) touches the lower collar (4).

⚠CAUTION

Do not remove valve after seal is installed. Sharp edges on keeper groove will cut and ruin seal.

8. See Figure 3-22. Install valve springs (4 and 5), upper collar (7).
9. See Figure 3-21. Compress valve springs with VALVE SPRING COMPRESSOR, Part No. HD-34736B.



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

Figure 3-23. Valve Seal Installation With Spacer

10. See Figure 3-22. Insert keepers (6) into upper collar (7) making sure they engage groove in valve stem. The keeper gaps should be equally spaced.
11. Release and remove VALVE SPRING COMPRESSOR.
12. Gently tap the upper collar with a soft hammer to ensure keepers are fully seated.
13. Repeat steps 4 through 12 for the remaining valves.

CLEANING AND INSPECTION

Special Tools	Torque Values
HD-34723 Valve guide hone HD-34571 Valve guide brush	None

Clean:

1. Remove and disassemble heads. See CYLINDER HEAD REMOVAL and CYLINDER HEAD DISASSEMBLY.

2. Scrape carbon from head, top of cylinder, top of bore above ring path, and inlet and exhaust valve ports. When scraping carbon, be careful to avoid scratching or nicking cylinder head and cylinder joint faces or bore. Blow off loosened carbon or dirt with compressed air.

3. Soak cylinder head in HYDRO-SEAL to loosen carbon deposits.

4. Wash all parts in non-flammable solvent. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem with a wire wheel. Never use a file or other hardened tool that will scratch or nick valve stem. Polish valve stem with very fine emery cloth or steel wool.

Inspect:

1. Check rocker arms for uneven wear or pitting at pad or push rod end. Replace rocker arm if either exists.

2. Measure rocker arm shaft diameter where it fits in lower rocker arm cover and where rocker bushings ride. Record the measurements.

3. Measure rocker arm shaft bores in the lower rocker cover and the rocker arm bushing diameter. Record the measurements.

4. Compare fit against SERVICE WEAR LIMITS and repair or replace parts exceeding the wear limits.

5. Valve heads should have a seating surface 0.040-0.062 in. (1.02-1.57 mm) wide and should be free of pit marks and burn spots. Exhaust valves should contain carbon that is black or dark brown. White or light buff carbon indicates excessive heat and burning.

6. Valve seats are also subject to wear, pitting and burning. They should be resurfaced whenever valves are refinished.

7. Clean valve guides by lightly honing with VALVE GUIDE HONE, Part No. HD-34723.

8. Scrub guides with VALVE GUIDE BRUSH, Part No. HD-34571 and hot soapy water. Measure valve stem and guide bore and check measurements against SERVICE WEAR LIMITS.

9. Inspect spark plug port threads for damage. If threads in head are damaged, a special plug type insert can be installed using a standard spark plug port repair kit.

10. Inspect valve springs for broken or discolored coils. Check free length or check tension of each spring. If a spring is shorter than specification, or tension shows spring to be below specification, replace it with a new spring. Check valve spring compression against tolerances shown in engine SPECIFICATIONS.

11. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored or broken.

12. Check head gasket surface on head for flatness.

CYLINDER HEAD REPAIR

Special Tools	Torque Values
9/16-18 Tap	None
HD-94804-57 Rocker arm bushing reamer	
HD-34740 Driver handle and remover	
HD-34731 Valve guide installation tool	
HD-39932 Valve guide reamer	
HD-39847 Reamer T-handle	
HD-34723 Valve guide hone	
HD-34751 Valve guide brush	
082454 Neway valve seat cutter	
HD-96550 36A Valve lapping tool	
HD-39847 Ratcheting reamer handle	
HD-39786 Cylinder head holding fixture	

Rocker Arms and Bushings

1. Remove and disassemble heads. See CYLINDER HEAD REMOVAL and CYLINDER HEAD DISASSEMBLY. Clean heads. See CLEANING AND INSPECTION.

2. See Figure 3-24. To replace worn bushings, press them from the rocker arm one at a time. If bushing is difficult to remove, turn a 9/16-18 tap into bushing. From opposite side of rocker arm, press out bushing and tap.

3. Press replacement bushing into rocker arm, flush with arm end, with split portion of bushing towards top of arm.

4. Use the old bushing in the opposite end as a pilot and line ream the new bushing with Harley-Davidson ROCKER ARM BUSHING REAMER, Part No. HD-94804-57.

NOTE

Drive end of reamer is pilot. Be sure pilot end is in old bushing.

5. Repeat for other end of rocker arm, using new, reamed bushing as a guide.

Valve Guides

If replacing valve guides is necessary, it must be done before valve seat is ground because the valve stem hole in valve guide is the basis from which all seat grinding is done. Valve stem-to-valve guide clearances are listed in chart below. If valve stems and/or guides are worn beyond SERVICE WEAR LIMITS, new parts must be installed.

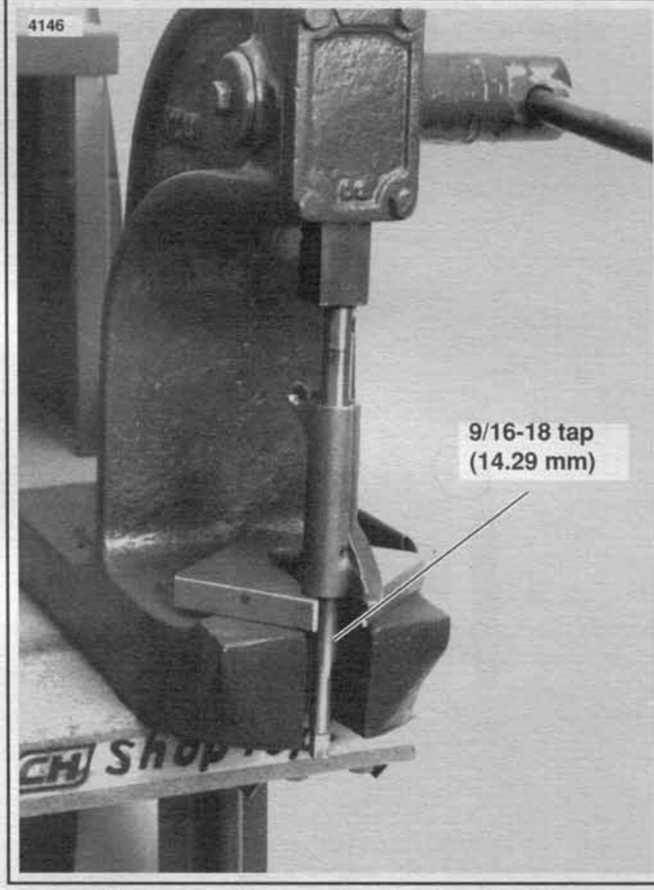


Figure 3-24. Remove Rocker Arm Bushing

Valve Stem Clearances and Service Limits

Valve	Valve Stem Clearance
Exhaust	0.0015 - 0.0040 in. (0.038-0.102 mm)
Intake	0.0008 - 0.0035 in. (0.020-0.089 mm)

Shoulderless guides are pressed toward combustion chamber using DRIVER HANDLE AND REMOVER, Part No. HD-34740.

1. Clean and measure valve guide bore in head.
2. The guide diameter should be 0.0020-0.0033 in. (0.051-0.084 mm) larger than bore in head. If it is not, select one of the following oversizes: intake and exhaust – 0.001, 0.002, and 0.003 in. (0.025, 0.05, and 0.08 mm).

3. See Figure 3-25. Install shoulderless guides using CYLINDER HEAD SUPPORT, Part No. HD-39782, VALVE GUIDE INSTALLATION TOOL, Part No. HD-34731 and DRIVER HANDLE, Part No. HD-34740. Lubricate and press guide until the tool touches the machined surface surrounding the guide. At this point, you have reached the correct guide height.

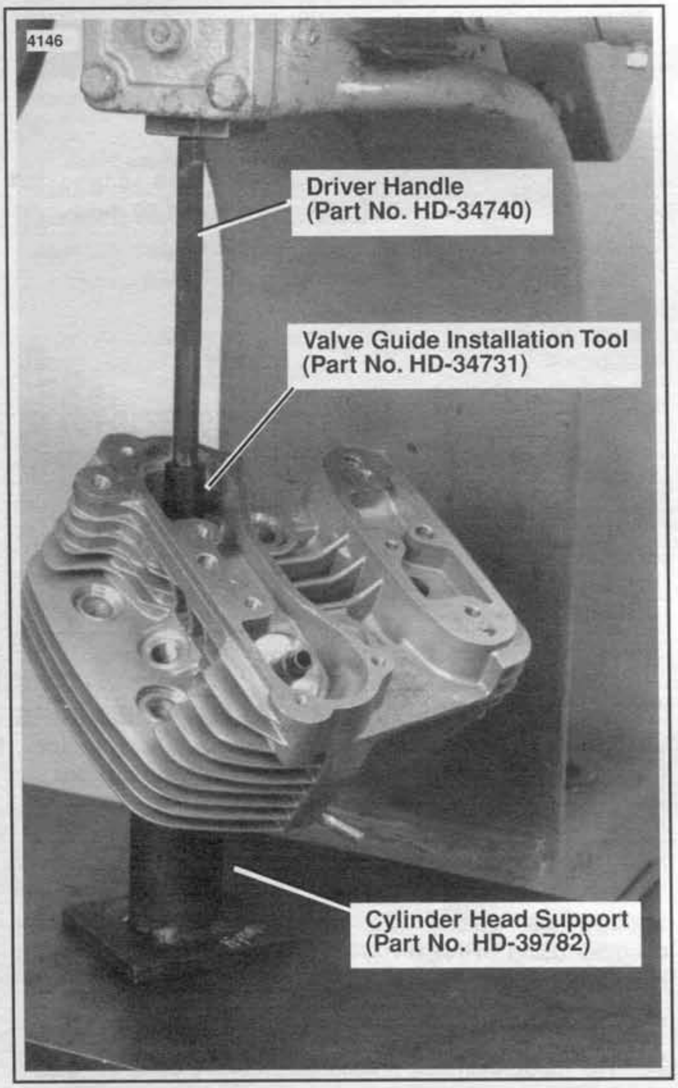


Figure 3-25. Installing Shoulderless Valve Guide

4. See Figure 3-26. The guides must be reamed to within 0.0005-0.0001 in. (0.013-0.0025 mm) of finished size with VALVE GUIDE REAMER, Part No. HD-39932 and HD-39847 REAMER T-HANDLE. Use liberal amounts of cutting oil to prevent reamer chatter. Use CYLINDER HEAD HOLDING FIXTURE, Part No. HD-39786 to hold the cylinder head in a vise at a proper working angle.

5. See Figure 3-27. Finish the guide bore with the VALVE GUIDE HONE, Part No. HD-34723. Drive hone with an electric drill and work for a crosshatch pattern of approximately 60°. Lubricate hone with honing oil.

6. Clean guide bores with VALVE GUIDE BRUSH, Part No. HD-34751 and hot soapy water after honing.

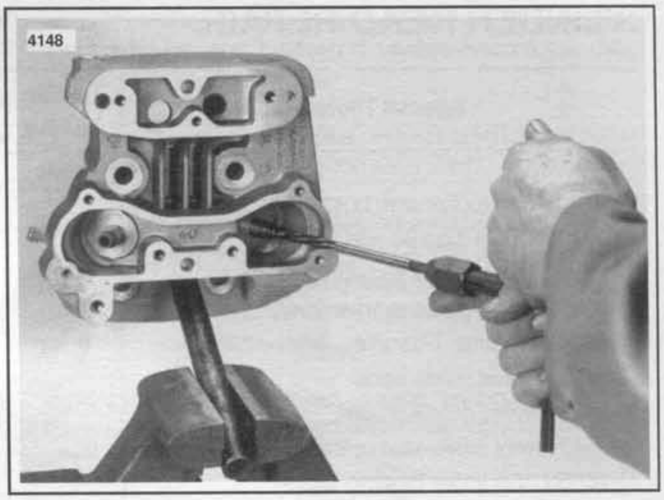


Figure 3-26. Ream Valve Guide

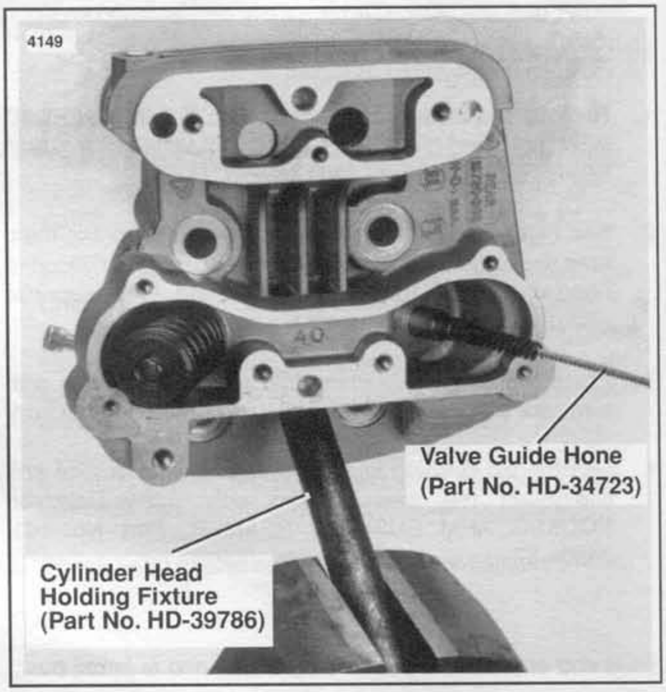


Figure 3-27. Honing Valve Guides

Valve Faces and Seats

After installing valve guides, valve seats must be refaced to true them with guides.

Valve face angle is 45° for both intake and exhaust valves, and if a valve refacing grinder is used, it must be adjusted exactly to this angle. It is important to not remove any more metal than is necessary to clean up and true valve face.

If grinding leaves the edge of valve (the margin) less than 0.031 in. (0.79 mm), install a new valve. A valve in this condition does not seat normally, will burn easily and may cause pre-ignition. There is also danger of cracking.

Valves that do not clean up quickly are probably warped or too deeply pitted to be used. If end of valve stem shows uneven wear, replace the valve.

After valves have been ground, they must be handled with care to prevent damage to the ground faces.

See Figure 3-28. The valve seats may be refinished with cutters or grinders. Cut seat to 46°, grind seats to 45°. Valve seat tools and fixtures are available commercially. Seat each valve in same port from which it was disassembled.

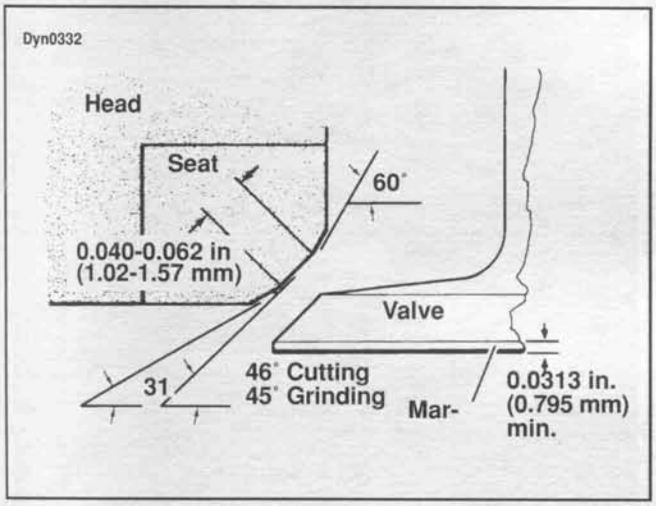


Figure 3-28. Valve Seat Angles

Use a NEWAY VALVE SEAT CUTTER, Part No. 082454, to cut the seats. Always grind valves before cutting the seats.

1. Cut 46° valve seat angle first. Cut only enough to clean up the seat.

2. Use bluing or magic marker and check the contact pattern on the valve face. It should be 0.040-0.062 in. (1.02-1.57 mm) wide and 2/3 the way towards the outside edge of the face.

3. If valve seat pattern is too wide and too close to stem side of valve face, cut 60° angle to narrow and move contact area away from stem side of valve. If pattern is too wide and too close to the edge of the valve face, cut 31° angle to narrow and move contact area away from margin.

4. If contact area is too narrow, use 46° valve cutter to increase width.

5. Check valve seat to be sure contact area is 0.040-0.062 in. (1.02-1.57 mm) and concentric.

6. See Figure 3-29. Measure the valve stem protrusion from the cylinder head to the top of the stem. If valve stem protrudes more than 2.034 in. (51.66 mm), the valve or seat must be replaced.

NOTE

Service replacement valves are available which are 0.030 in. (0.76 mm) shorter than the standard valve. If the valve stem protrudes beyond 2.034 in. (51.66 mm), but no more than 2.064 in. (52.43 mm), use the service replacement valve.

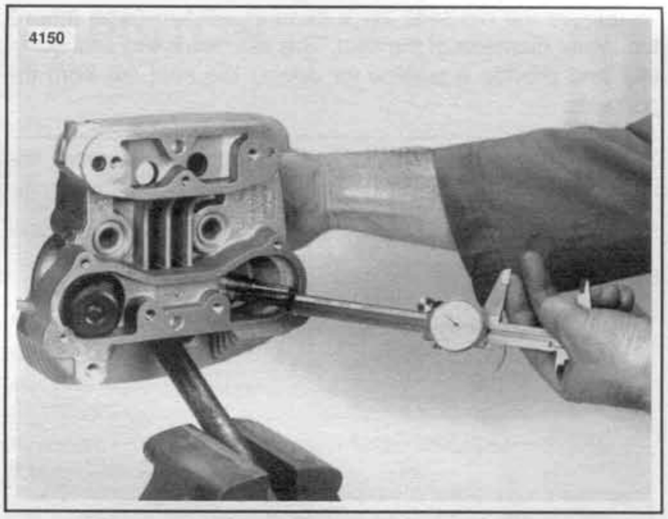


Figure 3-29. Measure Valve Stem Protrusion

⚠CAUTION

See Figure 3-30. Do not attempt to shorten valve by grinding on the end. The hardened case will be gone and the end will be mild steel. This will cause the end to wear rapidly. The shorter replacement valves are shortened in the stem body.

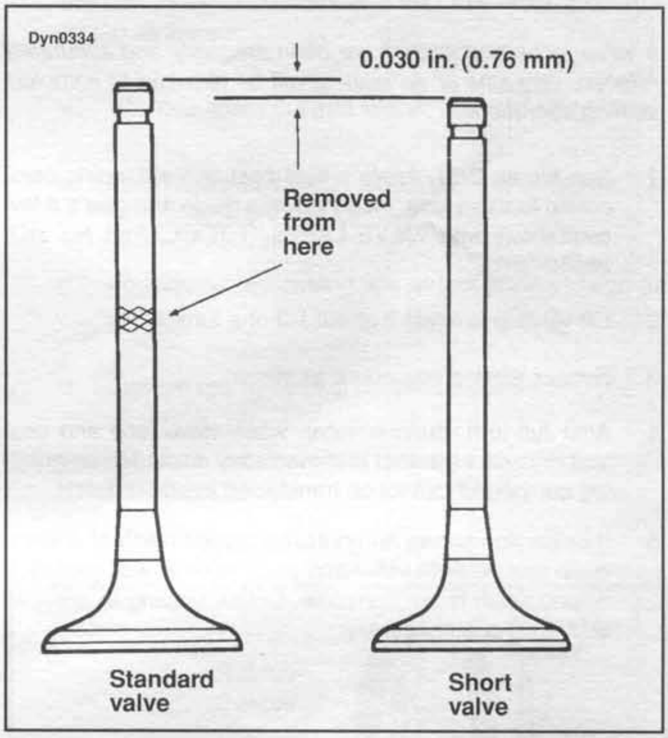


Figure 3-30. Shorter Replacement Valves

NOTE

Replacing a valve seat is a complex operation requiring special equipment. If the seat is loose or not sealed fully into the head, the seat will move and not transfer heat away from the valve properly. The seat surface must be flush with or below the head surface. See SPECIFICATIONS for valve seat to cylinder head fit.

To remove the old seat, lay a bead of weld material around the inside diameter of the seat. This will shrink the seat diameter and provide a surface for driving the seat out from the port side.

7. See Figure 3-29. If valve stem protrusion is within the proper range, the valves and seats are ready for inspection.

8. Inspect for proper valve seat as follows:

   a. Insert valve in guide and press with fingers to seat. Hold cylinder head valve port to light source. If light is visible around edges of seat and valve re-cut seat or re-face valve as required until no light is visible when cylinder head valve port is held to light. When no light is visible around edges of seat, proceed to b.

   b. Hold valve to seat with fingers and pour solvent into port from top until full. Check for solvent leakage into combustion chamber for 10 seconds. If no solvent leaks or seeps past valve and seat, the valve is properly seated and no lapping is required. If solvent leaks or seeps into combustion chamber, either re-cut seat, reface valve, or lap valve faces and seat.

Lapping Valve Faces and Seats

NOTE

If valve faces and seats have been smoothly and accurately refaced, very little or no lapping will be required to complete seating operation.

1. See Figure 3-31. Apply a light coat of fine lapping compound to valve face, insert valve in guide and give it a few oscillations with VALVE LAPPING TOOL, Part No. HD-96550-36A.

2. Lift valve and rotate it about 1/3 of a turn.

3. Repeat lapping procedure as shown.

4. After full turn, remove valve, wash valve face and seat and dry with cloth that is immediately discarded so grinding compound cannot be transferred to engine parts.

5. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated. If lapped finish is not complete, further lapping or grinding and lapping is necessary.

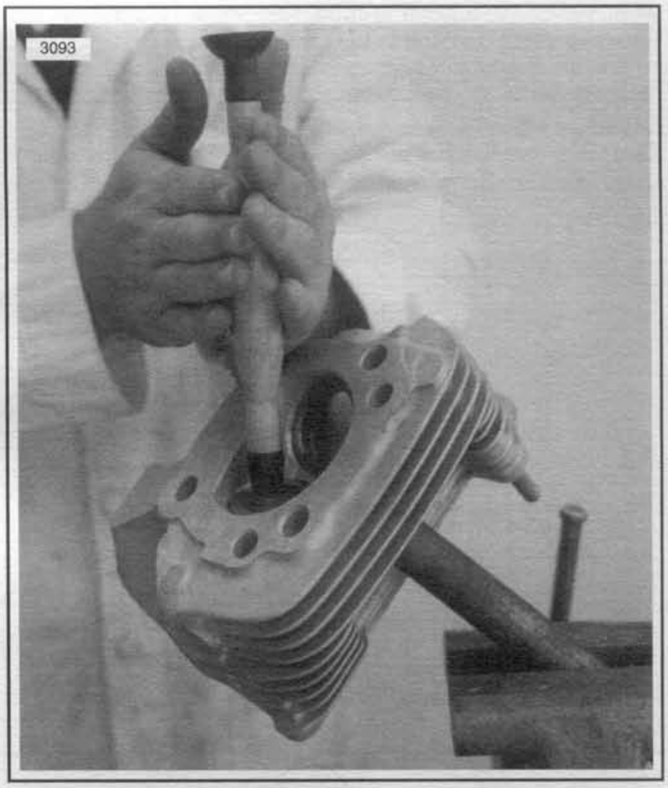


Figure 3-31. Lapping Valves

CYLINDER AND PISTON

REMOVAL

Special Tools	Torque Values
HD-34623B Piston Pin Retaining Ring Installer	None
HD-42320 Piston Pin Remover/Installer	None

1. Strip motorcycle. See STRIPPING MOTORCYCLE FOR ENGINE REPAIR.
2. Remove cylinder head. See CYLINDER HEAD, REMOVAL.
3. Raise the cylinder enough to place some clean towels under the piston. This will prevent any debris, such as broken ring pieces, from falling into the crankcase.
4. Mark cylinder "front" or "rear". Remove the cylinder taking extreme care not to scratch or bend the studs or to scratch the pistons in any way. When lifting the cylinder, make sure the piston does not drop sideways striking the studs.

CAUTION

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

5. Install a 6 in. (152 mm) length of 0.500 in. (12.7 mm) inside diameter plastic or rubber hose over each stud. This not only protects the studs, but the pistons too.

WARNING

Retaining rings are highly compressed in the ring groove and may "fly-out" with considerable force when removed. Safety glasses or goggles must be worn while removing or installing retaining rings.

6. See Figure 3-32. Insert the PISTON PIN RETAINING RING INSTALLER (Part No. HD-34623B) into the piston pin bore. Make sure claw on tool is under retaining ring (in slot in piston). Squeeze the handles together and pull the tool out of the bore to remove the retaining ring. To prevent the ring from flying out, hold a shop rag over the bore when removing the retaining ring.

CAUTION

The piston pin retaining ring must not be reused. Removal may weaken retaining rings and they may break or dislodge. Either occurrence may damage engine.

NOTE

- *The piston pins have tapered ends to help seat the round retaining rings. Piston pins from earlier engines must not be used in the V² engine.*
- *Piston pin retaining ring grooves may become burred from the retaining rings. Use care when removing the piston pins.*

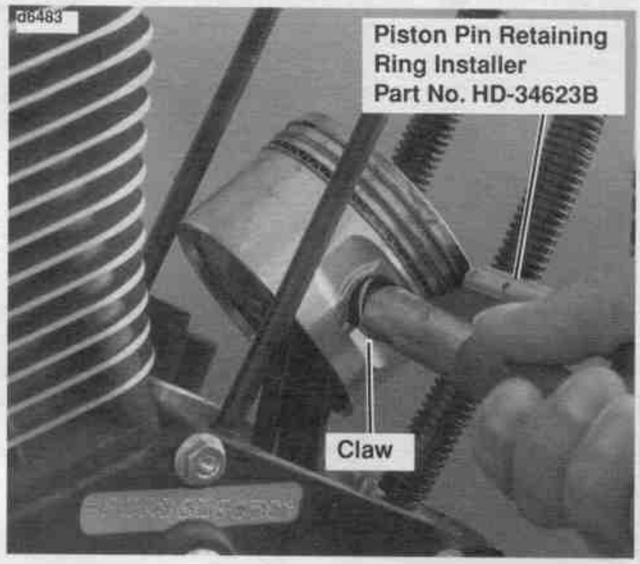


Figure 3-32. Remove /Install Piston Pin Retaining Ring

7. See Figure 3-33. If piston pin is difficult to remove, use PISTON PIN REMOVER/INSTALLER, Part No. HD-42320 as follows:

   a. Remove acorn nut and spacer from rod end of tool.

   b. Insert rod end through piston pin. Install spacer and acorn nut to rod end.

   c. Position rubber-coated tips of tool in depression on piston.

   d. Tighten tool by turning handle clockwise.

   e. Continue to turn handle clockwise to pull piston pin from bore.

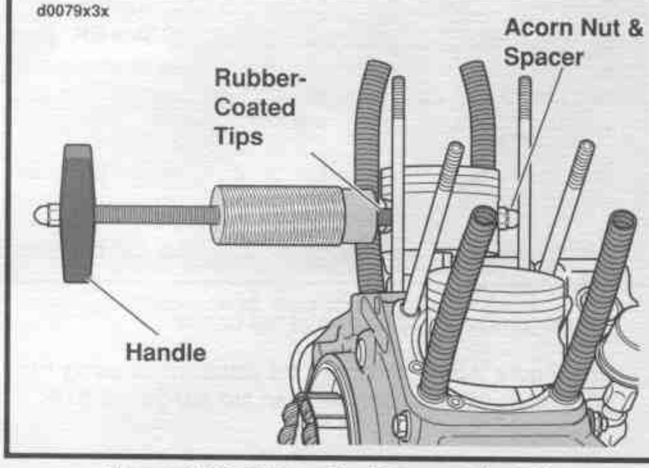


Figure 3-33. Piston Pin Remover/Installer Part No. HD-42320

8. See Figure 3-34. Mark the piston by marking an "F" or "R" for front or rear cylinder, on the piston pin boss as shown.

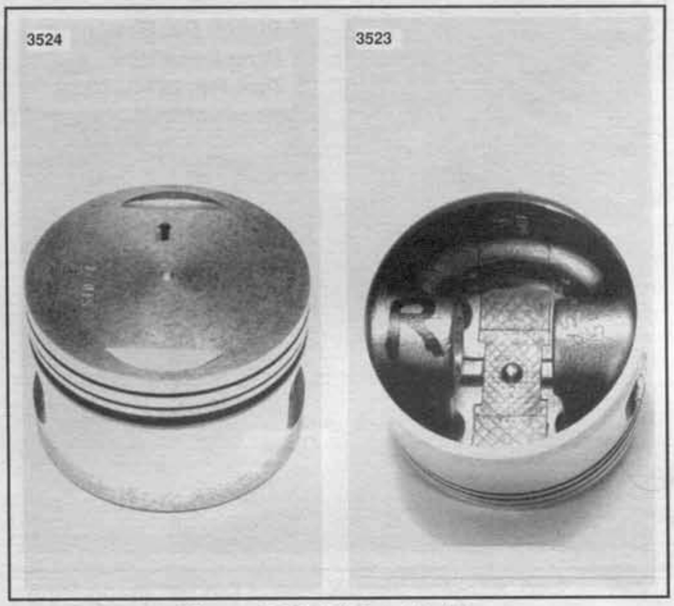


Figure 3-34. Piston Marking

⚠CAUTION

Handle the piston with extreme care because the alloy used in these pistons is very hard. Any scratches, gouges or other marks on the piston could score the cylinder during engine operation.

INSTALLATION

Special Tools	Torque Values
HD-34623B Piston pin retaining ring installer HD-96333-51B Piston ring compressor	None

1. Install the pistons. Be sure they are properly oriented front to back. The piston has a cast-in arrow on top of the piston that points to the front of the engine.
2. See Figure 3-33. Install the piston pin retaining rings with the PISTON PIN RETAINING RING INSTALLER, Part No. HD-34623B. Be sure the ring groove is clean and that the ring is fully seated in the groove with the gap away from the slot at the bottom.
3. See Figure 3-38. Be sure the piston ring end gaps are properly positioned.
4. Lubricate cylinder walls, pistons, pins and rod bushings with engine oil.
5. Turn engine until crankpin is at top center.
6. See Figure 3-35. Compress the piston rings using PISTON RING COMPRESSOR, Part No. HD-96333-51B.

Figure 3-35. Slip Cylinder Over Piston

7. Remove cylinder stud sleeves and install a new cylinder base gasket. Use a small amount of grease to hold the gasket in place. Be sure the pistons do not bump the studs or crankcase.
8. Support the piston with one hand while sliding the cylinder on with the other.
9. Remove piston ring compressor.
10. Assemble cylinder heads. See CYLINDER HEADS, ASSEMBLY.

CLEANING AND INSPECTION

1. Where carbon deposit is thick and hard, it is advisable to scrape carbon off. Use a carbon scraper. Be careful not to scrape piston.
2. Place the cylinders and piston in GUNK HYDRO-SEAL or other carbon and gum dissolving agent until deposits are soft.
3. Scrub piston dome and cylinder to remove deposits.
4. Wash all parts in solvent and blow dry with compressed air. Force air through return oil passage in cylinder.
5. If necessary, clean piston ring grooves with a piece of compression ring ground to a chisel shape.
6. Examine piston pin to see that it is not pitted or scored.

7. Check the piston pin bushing to see that it is not loose in connecting rod, grooved, pitted or scored. A piston pin, properly fitted, is a loose (0.0001-0.0004 in.) (0.0025-0.010 mm) fit in piston and has 0.0003-0.0007 in. (0.008-0.018 mm) clearance in connecting rod upper bushing. If piston pin-to-bushing fit exceeds 0.001 in. (0.025 mm), replace worn parts. See REPAIR – Rod Bushings.

8. Make sure the piston pin retaining ring grooves are clean.

9. Examine piston and cylinder for cracks, burned spots, grooves and gouges. The cylinder will have four faint polish marks running the length of the bore near the stud holes. These marks are usually 0.375 in. (9.52 mm) wide and appear as the engine accumulates running time. They are normal and require no attention.

10. Check rods for excessive lower bearings clearance. If you detect excessive lower bearings clearance, you should disassemble flywheels for further inspection. See FLYWHEEL DISASSEMBLY/ASSEMBLY.

REPAIR

Special Tools	Torque Values
HD-33446A Cylinder torque plate	None
HD-95970-32B Piston pin bushing tool	
HD-95952-33B Connecting rod clamping tool	
280 Grit rigid hone	
240 Grit flexible ball hone	
HD-94800-1 Reamer	
HD-94800-3 Reamer pilot	
HD-35102 Wrist pin bushing hone	

Cylinder

1. Check the gasket surfaces for flatness. The top of head gasket surface must be flat within 0.006 in. (0.15 mm) and the base gasket surface must be flat within 0.008 in. (0.20 mm). Check the above surfaces by installing cylinder on crankcase and checking with a feeler gauge.

2. If one or both of the surfaces do not meet the flatness requirements, the cylinder and piston must be replaced.

3. Before measuring the cylinder, be sure the gasket surfaces are free of burrs and install a head and base gasket and the CYLINDER TORQUE PLATE, Part No. HD-33446A. Tighten the bolts using correct torque procedure. See CYLINDER HEAD BOLT TORQUE SEQUENCE. This will simulate engine operating conditions. Your measurements will vary as much as 0.001 in. (0.025 mm) if you don't use the torque plates.

4. See Figure 3-36. Take cylinder bore measurement in the ring path, starting about 0.500 in. (12.70 mm) from the top of the cylinder measuring from front to rear and then side to side. Record readings.

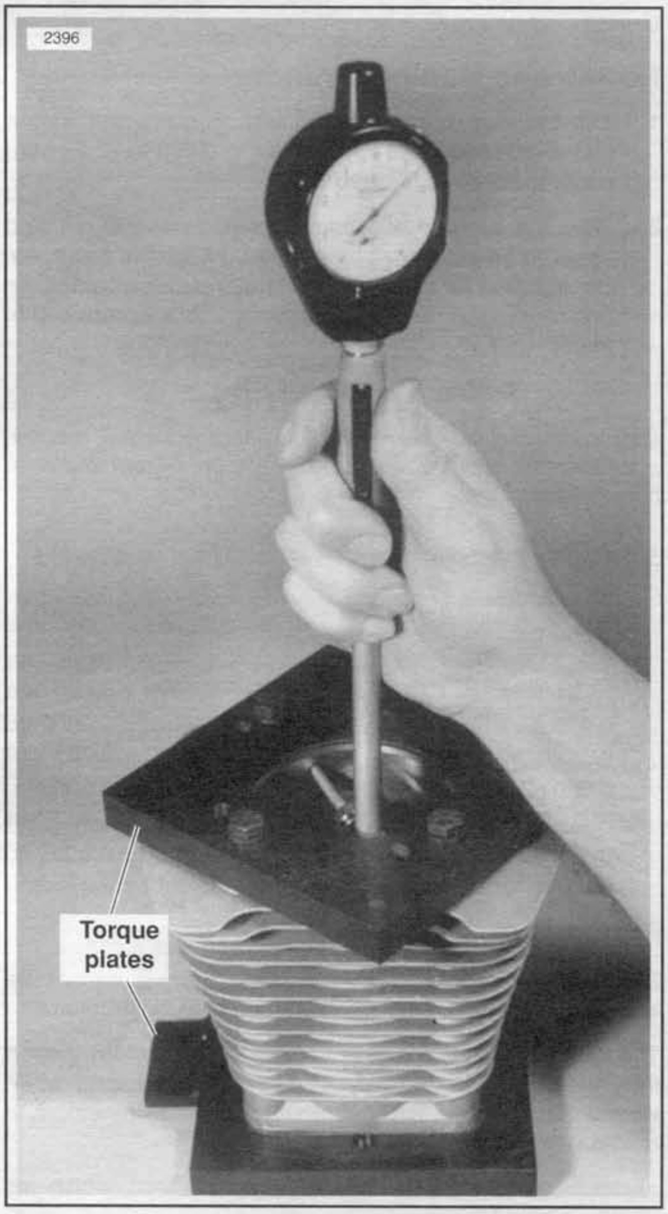


Figure 3-36. Measure Cylinder Bore

5. Repeat measurement at center and bottom ring path. Record readings. This process will determine if cylinder is out-of-round or "egged" and will also show any cylinder taper or bulge.

6. If cylinders are not scuffed or scored and are not worn beyond service limits, it is not necessary to rebore oversize.

7. If cylinders show wear beyond service limits, they should be rebored and/or honed to next standard oversize and refitted with corresponding pistons and rings.

NOTE

- *A standard piston may be fitted to a standard bore if only minor honing is required and bore is within SERVICE WEAR LIMITS.*
- *All models require pistons with valve pockets.*

Boring and Honing Cylinder

1. The cylinder must be bored with gaskets and torque plates attached. Bore the cylinder to 0.003 in. (0.08 mm) under the desired finished size.

2. Hone the cylinder to its finished size using 280 grit rigid hone. To break a glaze, use 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.

NOTE

Improper crosshatch pattern or too fine a hone will result in insufficient oil retention and possible piston seizure and/or oil consumption.

3. Final cylinder bore sizes, after honing are as follows:

Standard bore	3.4980 in ± 0.0002 in. 88.849 ± 0.005 mm
0.005 Oversize (O.S.) bore (0.13 mm)	3.5030 in ± 0.0002 in. 88.976 ± 0.005 mm
0.010 (O.S.) bore (0.25 mm)	3.5080 in ± 0.0002 in. 89.103 ± 0.005 mm
0.020 (O.S.) bore (0.51 mm)	3.5180 in ± 0.0002 in. 89.357 ± 0.005 mm
0.030 (O.S.) bore (0.76 mm)	3.5280 ± 0.0002 in. 89.611 ± 0.005 mm

Piston

Because of their complex shape, the pistons cannot be accurately measured with standard measuring instruments.

The pistons have the typical elliptical shape when viewed from the top. However, they also are barrel shaped when viewed from the side. This barrel shape is not symmetrical. In addition, the piston pin bore is offset.

Any damage to the piston will change its shape, which will cause problems.

Fitting Cylinder to Piston

Since pistons cannot be accurately measured with standard measuring instruments, the bore sizes given in step 3 under Boring and Honing Cylinder must be observed. Example: a 0.005 in. (0.13 mm) oversize piston will have the proper clearance with a bore size of 3.5030 in. ± 0.0002 in. (88.976 ± 0.005 mm).

Fitting Piston Rings

Piston rings are two types: compression and oil control ring. The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward because it is a reverse-twist ring and aids in oil control. Ring sets are available to fit standard and oversize pistons.

1. See Figure 3-37. Check the end gap of both oil rings and the compression rings. Use the top of the piston to square the ring in the bore.

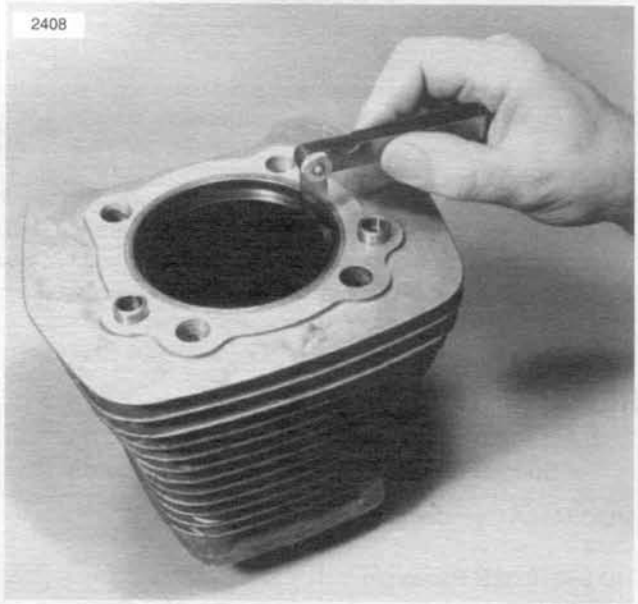


Figure 3-37. Check Ring Gap

2. See SERVICE WEAR LIMITS for end gap dimensions for standard bore. Gap dimensions do not apply to oversize rings. Do not file rings to obtain proper gap. Replace rings if ring gap is incorrect.

3. See Figure 3-38. Apply engine oil to the piston grooves. Install the new rings on the piston making sure the dot on the second compression ring is facing up. Stagger the ring gaps.

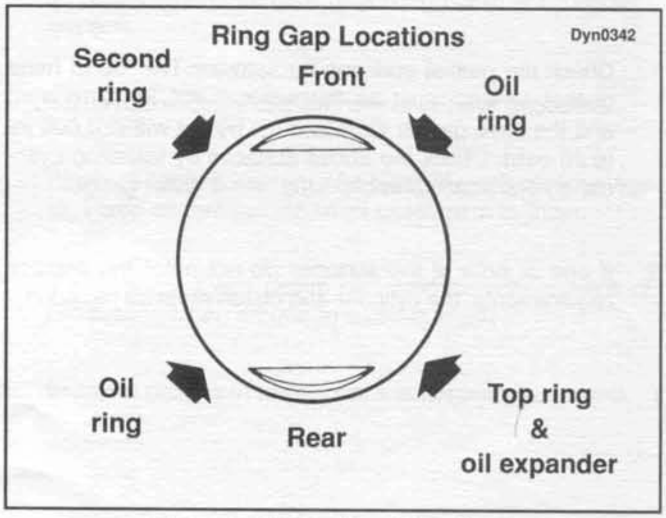


Figure 3-38. Position Ring Gaps

4. See Figure 3-39. Check the ring side play in the piston grooves. If the ring grooves are clean and the side play is still not correct, replace the rings, the piston, or both.

Figure 3-39. Measure Ring Side Clearance

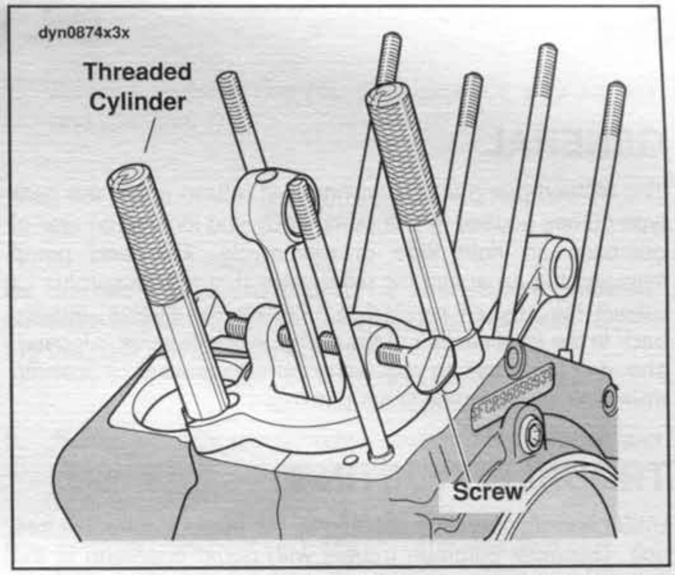


Figure 3-40. Connecting Rod Clamping Tool HD-95952-33B

Rod Bushings

If the piston pin to rod bushing clearance is greater than 0.001 in. (0.025 mm), replace the rod bushing.

NOTE

To replace bushing, use Harley-Davidson PISTON PIN BUSHING TOOL, Part No. HD-95970-32C and CONNECTING ROD CLAMPING TOOL, Part No. HD-95952-33B.

⚠CAUTION

Place rag over crankcase opening to keep chips and shavings out of crankcase.

1. See Figure 3-40. To use CONNECTING ROD CLAMPING TOOL, Part No. HD-95952-33B, place the tool (Part No. 95952-1) over the studs taking care not to scratch or bend them. Install the threaded cylinders (Part No. 95952-2) to the studs to secure the tool in place. Tighten the two screws against the connecting rod.
2. See Figure 3-41. Using PISTON PIN BUSHING TOOL, Part No. 95970-32C, press out the old bushing and install **new** bushing. Drill the bushing oil hole, using the rod oil hole as a guide. Remove sharp edges and thoroughly clean hole.
3. Ream new bushing to 0.0005 in. (0.013 mm) undersize using REAMER, Part No. HD-94800-1 and REAMER PILOT, Part No. HD-94800-3. Finish clearance using WRIST PIN BUSHING HONE, Part No. HD-35102. Drive hone with an electric drill and work for a crosshatch pattern of approximately 60°. Lubricate hone with honing oil.
4. Clean bushing bore with cleaning solvent.

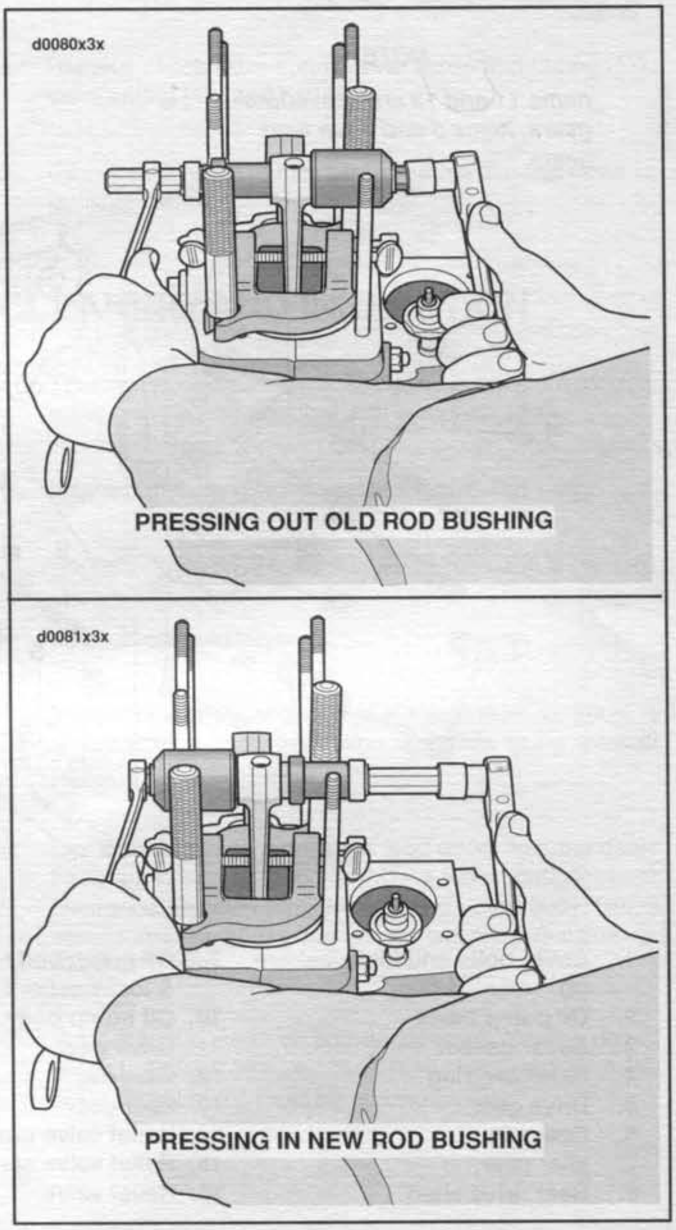


Figure 3-41. Removing and Installing Rod Bushings

Connecting Rods

⚠CAUTION

DO NOT ATTEMPT TO STRAIGHTEN CONNECTING RODS. If there is evidence of bent rods, they must be replaced. Straightening rods by bending will damage the bearing on the crankpin and the piston pin bushing.

OIL PUMP

GENERAL

The oil feed pump and scavenger (oil return) pump are gear type pumps housed in one pump body and located on rear of gearcase on right side of motorcycle. The feed pump incorporates an automatic relief valve that routes surplus oil (above the amount needed to lubricate the engine) directly back to the feed section of the pump. A check valve is located ahead of the pressure regulating valve to prevent oil draining from tank when engine is not running.

TROUBLESHOOTING

Under normal operating conditions, the pump is a trouble free unit. The most common trouble with pump operation is the introduction of a metal or hard carbon chip into the pump. If either gets between the gear teeth, it is possible to shear a key, fracture a gear or break off a gear tooth.

If oil fails to return to the tank, check the scavenger pump gear drive shaft key. When the engine receives no lubrication (oil remains in tank), the drive shaft key on the feed pump drive gear may be sheared. Both conditions together could be caused by a sheared oil pump (gearcase) drive gear key. In cold weather, slush ice formed from moisture condensation in oil may block oil passages and cause any of above troubles.

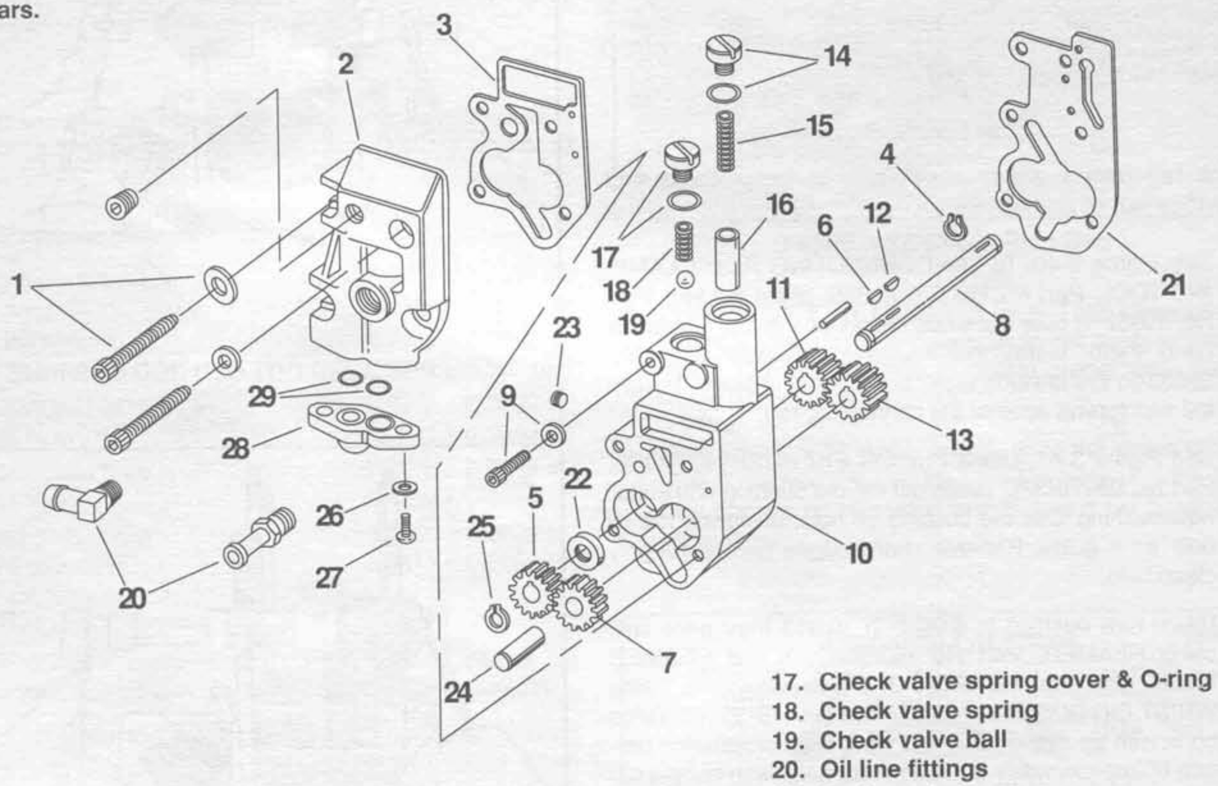
DISASSEMBLY

See Figure 3-42. The oil pump can be disassembled, piece-by-piece without removing gearcase cover, with engine in chassis as follows:

s0039x3x

NOTE

Items 11 and 13 are scavenger gears. Items 5 and 7 are feed **gears.**



1. **Cover bolts and lockwashers (4)**
2. **Oil pump cover**
3. **Cover gasket**
4. **Retaining ring**
5. **Drive gear**
6. **Gear key**
7. **Idler gear**
8. **Gear drive shaft**
9. **Oil pump body mounting bolts & lockwashers**
10. **Oil pump body**
11. **Drive gear**
12. **Gear key**
13. **Idler gear**
14. **Relief valve plug & O-ring**
15. **Relief valve spring**
16. **Relief valve**
17. **Check valve spring cover & O-ring**
18. **Check valve spring**
19. **Check valve ball**
20. **Oil line fittings**
21. **Body gasket**
22. **Seal**
23. **Plug & gasket**
24. **Idler shaft**
25. **Retaining ring**
26. **Washer (2)**
27. **Button head screw (2)**
28. **Manifold**
29. **O-ring (2)**

Figure 3-42. Engine Oil Pump

NOTE

Gears and keys must be replaced in the same position as removed.

1. See Figure 3-43. Disconnect oil lines from pump. See OIL FILTER MOUNT.

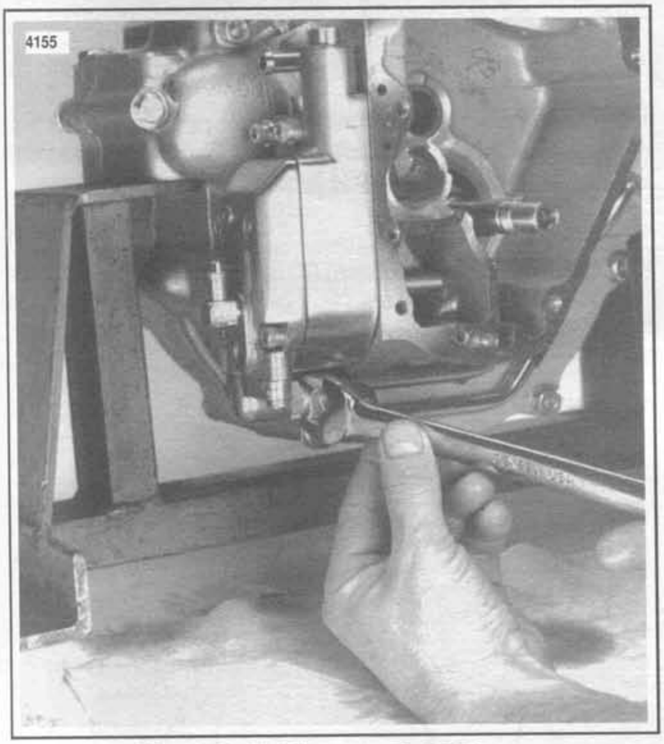


Figure 3-43. Disconnect Oil Lines

2. See Figures 3-42 and 3-44. Remove bolts and lockwashers (1) that hold oil pump cover in place. The upper inside pump cover bolt(s) must be removed with the pump body.

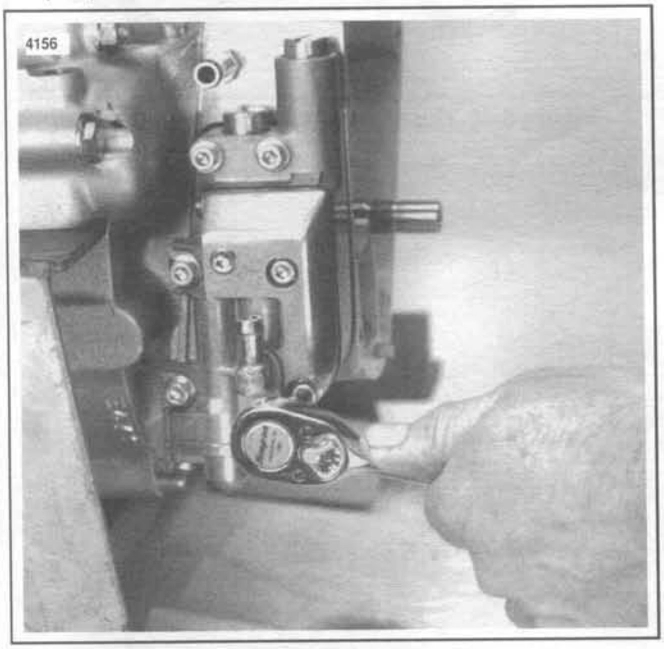


Figure 3-44. Remove Oil Pump Fasteners

3. Remove oil pump cover (2) and gasket (3).

4. Remove retaining ring (4), drive gear (5), gear key (6) and idler gear (7).

⚠CAUTION

Do not allow drive shaft (8) to be pushed into gearcase because key could fall out of shaft into gearcase requiring the gear cover to be removed.

5. Remove the oil pump body mounting hardware (9) and slip pump body (10) off drive gear shaft (8).

6. Remove drive gear (11), key (12) and idler gear (13).

7. Remove relief valve plug and O-ring (14) from pump body and remove relief valve spring (15), and valve (16).

8. Remove check valve spring cover screw and O-ring (17), valve spring (18) and ball (19).

9. Oil pump fittings (20) may be turned out of pump cover to facilitate cleaning.

CLEANING AND INSPECTION

1. Thoroughly clean all parts in cleaning solvent and blow pump body passages clear with compressed air.

2. Inspect valves and valve seats for pitting and wear.

3. Replace pump having worn or damaged valve seat.

4. Inspect keys and keyways.

5. Inspect scavenger and feed pump gear teeth for gouging or cracking caused by foreign materials going through pump.

6. Lay a straightedge across the feed gears with the gears installed in the pump body. With a feeler gauge, check clearance between straightedge and pump body. Gears should extend above the pump body 0.003-0.004 in. (0.08-0.10 mm).

7. Repeat above check on scavenger gears. If gears do not extend 0.003-0.004 in. (0.08-0.10 mm) above pump body, the oil pump must be replaced.

ASSEMBLY

Special Tools	Torque Values
HD-97087-65A Hose clamp tool	Relief valve plug 80-110 **in-lbs**(9.0-12.4 Nm) Oil pump body bolts 60-85 **in-lbs** (6.8-9.6 Nm) Cover bolts 90-120 **in-lbs** (10.2-13.6 Nm)

NOTE

Do not mix gears and keys. Replace in original location. Oil pump gaskets must not be reused. Use only original Harley-Davidson gaskets (gasket thickness is important for proper pump operation). Lock rings are often damaged when removed. Use new lock rings and be sure they are seated securely in the groove.

1. See Figure 3-42. Install oil pump fittings (20).
2. Install check valve ball (19), valve spring (18), cover screw, and O-ring (17).
3. Install relief valve (16), spring (15), plug, and O-ring (14). Tighten plug to 80-110 **in-lbs** (9.0-12.4 Nm).
4. Install key (12) and drive gear (11) on drive shaft (8).
5. Install idler gear (13) on idler gear shaft from back side of oil pump body (10).
6. Place **new** gasket (21) on gearcase and install pump body (10) with top inside pump cover bolt and tighten mounting hardware (9) to 60-85 **in-lbs** (6.8-9.6 Nm).
7. Install a **new** drive shaft seal (22) in the pump body with the lip facing toward the feed gears. Install key (6) and drive gear (5). Secure drive gear (5) with **new** lock ring (4).
8. Install idler gear (7).

⚠CAUTION

Do not overtighten mounting bolts and nuts. Overtightening will eliminate pump gear side clearance which may cause the pump to seize up, damaging pump and engine parts.

NOTE

A correctly installed pump will allow pump drive gear to rotate without binding when pump is installed and torqued down.

9. Install a **new** cover gasket (3) and oil pump cover (2) with bolts and lockwashers (1). Tighten cover bolts evenly to 90-120 **in-lbs** (10.2-13.6 Nm).
10. Install oil lines. See OIL FILTER MOUNT.

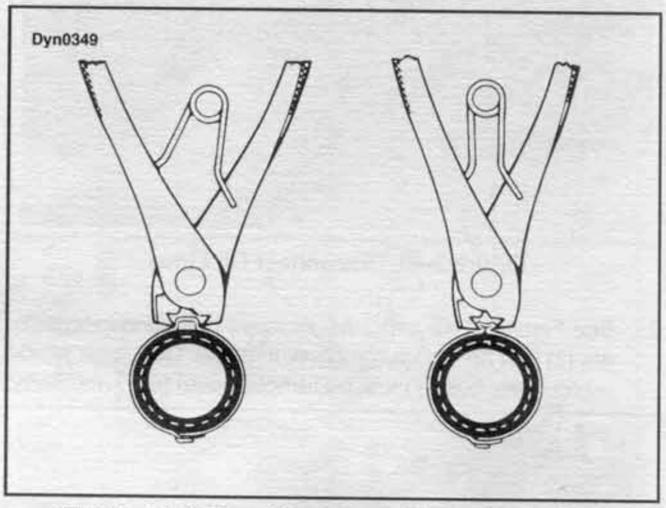


Figure 3-45. Hose Clamps and Hose Clamp Tool

OIL FILTER MOUNT

REMOVAL

1. See Figure 3-46. Loosen oil line compression nut (1) at oil pump cover manifold (2) until it rests on the oil line (3).
2. Remove manifold screws (4) and washers (5).
3. Remove oil pump cover manifold (2) and O-rings (6) from oil pump cover (7).
4. Loosen or if necessary, remove oil line clamp (8) by removing nut (9), washer (10), clamp (8) and spacer (11).
5. Loosen or remove oil line compression fittings (12) at oil filter mount (13). Remove oil lines from oil filter mount.
6. Remove oil filter mount screws (14) and washers (15). Remove oil filter mount. Remove seals (16).

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1. **Compression nut**
2. **Oil pump cover manifold**
3. **Oil lines (2)**
4. **Manifold screws (2)**
5. **Washers (2)**
6. **O-rings (2)**
7. **Oil pump cover**
8. **Oil line clamp**
9. **Nut**
10. **Washer**
11. **Spacer**
12. **Oil line compression fittings (2)**
13. **Oil filter mount**
14. **Oil filter mount screws (2)**
15. **Washers (2)**
16. **Seals (2)**
17. **Compression nut fitting**
18. **Oil filter adapter**
19. **Rubber sleeves (2)**
20. **Seal**
21. **Nipple**

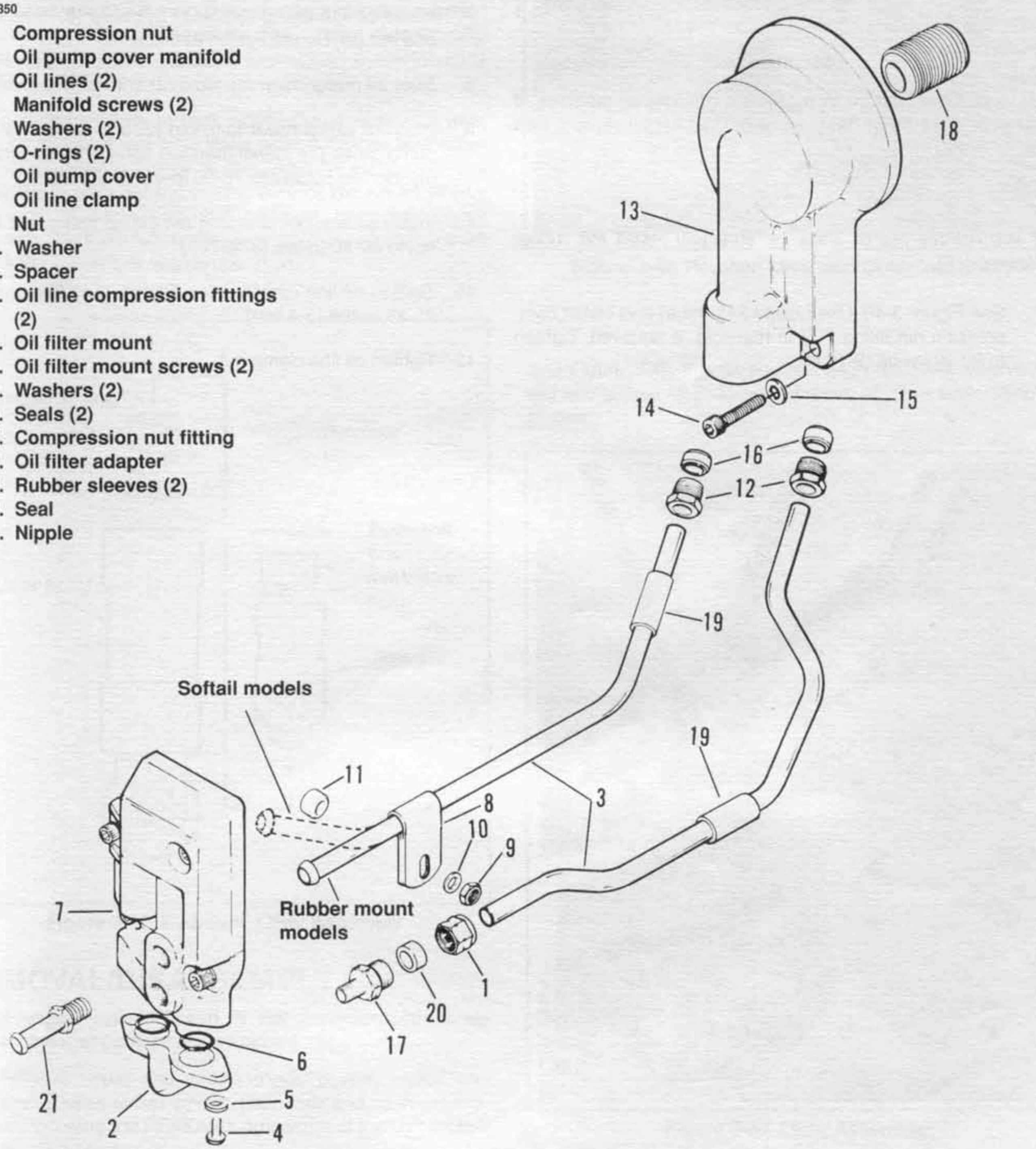


Figure 3-46. Oil Filter Mount and Oil Pump Cover

7. Remove compression nut fitting (17) from manifold and seal (20) from compression nut, if necessary.
8. Remove fittings (12) from oil filter mount, if necessary.
9. Remove oil filter adapter (18), if necessary.

INSTALLATION

Special Tools	Torque Values
None	Pump cover manifold screws 70-80 **in-lbs** (7.9-9.0 Nm) Oil filter mount screws 13-16 ft-lbs (18-22 Nm)

CAUTION

Be sure lines bottom in oil filter mount when inserted. If they are not fully in the bottom of the holes, they will leak oil.

NOTE

If you replace the oil lines, be sure you install the rubber sleeves (19).

1. See Figure 3-46. Use Loctite 242 (blue) and install compression nut fitting (17) in manifold, if removed. Tighten to 80-90 **in-lbs** (9-10 Nm).
2. Place oil filter mount (13) in position and install oil filter mount screws (14) and washers (15). Tighten oil filter mount screws to 13-16 ft-lbs (18-22 Nm).
3. Place oil line compression nut (1) on oil line.
4. Install compression fitting oil seals (16) in filter mount holes (13).
5. Install fittings (12) in oil filter mount (13). Do not tighten at this time. Install adapter (19).
6. Install oil lines in oil filter mount fittings (12). Be sure the lines bottom in the holes.
7. Install oil line clamp spacer (11), clamp (8), washer (10) and nut (9). Do not tighten at this time.
8. Slide oil pump cover manifold (2) onto oil line.
9. Place oil pump cover manifold (2) and O-rings (6) on oil pump cover (7). Install manifold screws (4) and washers (5). Tighten screws to 70-80 **in-lbs** (7.9-9.0 Nm).
10. Install oil line compression nut (1) on fitting and tighten nut to 80-90 **in-lbs** (9-10 Nm).
11. Tighten oil line compression fittings at oil filter mount to 25-35 **in-lbs** (3-4 Nm).
12. Tighten oil line clamp nut.

HYDRAULIC VALVE LIFTERS AND GUIDES

GENERAL

See Figure 3-47. The hydraulic lifter assembly consists of lifter and roller. The lifter and roller, under compression force from the valve springs, follow the surface of the revolving cam. The up-and-down motion produced is transmitted to the valve by the push rod and rocker arm. The lifter contains a piston or plunger and cylinder, plus a check valve, which allows the unit to pump itself full of engine oil to take up play in the valve train.

When lifters are functioning properly, the assembly operates with minimal lifter clearance. The units automatically compensate for heat expansion to maintain a no-clearance condition.

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

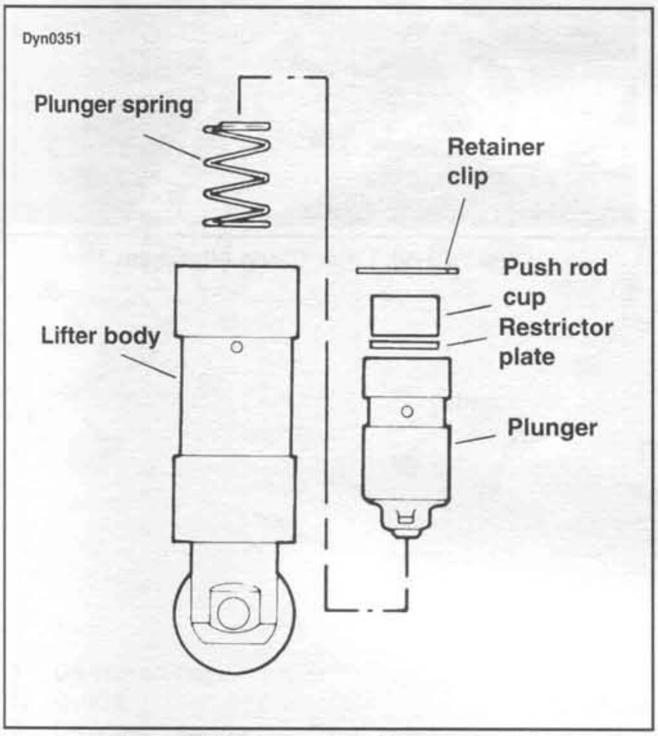


Figure 3-47. Hydraulic Lifter Assembly

REMOVAL/DISASSEMBLY

1. If engine cylinder head is not disassembled, rotate engine until both valves are closed.
2. Remove upper and middle rocker covers, rocker arm shafts, lower rocker covers, push rods and push rod covers following the REMOVAL procedure of the CYLINDER HEAD subject.
3. Remove the bolts holding the lifter guide to the crankcase.
4. See Figure 3-48. To remove the lifters and guides together, fashion a U-shaped wire from a large paper clip. Insert the ends into the lifters and tilt the guide and lifters out together.

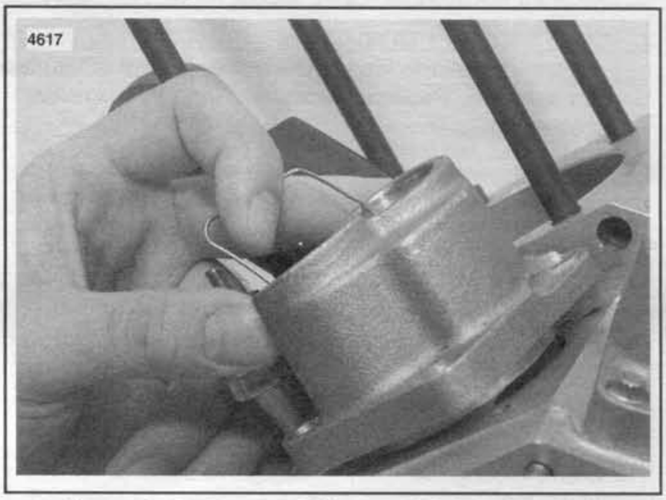


Figure 3-48. Remove Lifter and Guide Assembly

NOTE

See Figure 3-49. If gearcase has been removed, remove lifters and guides by pushing at bottom of lifters while lifting at guides.

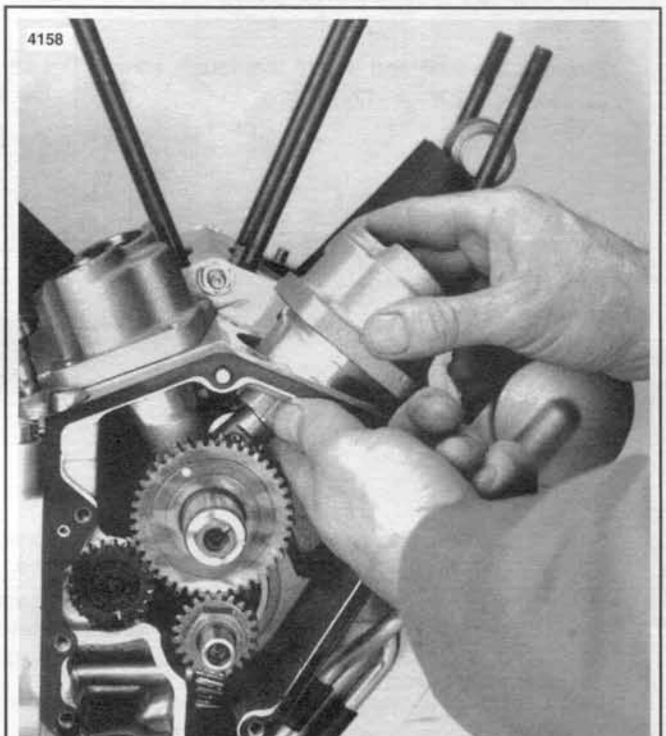


Figure 3-49. Lifter Assembly

5. Mark lifters and guides so they will be assembled in their original locations.

1. Wash all parts, except lifter and roller assembly and gaskets, in grease solvent.
2. Inspect the lifters, rollers and guide bores for damage. Measure the guide bores and lifter diameters and check the clearance with the SERVICE WEAR LIMITS. Replace the lifter, the guide, or both if clearance is excessive.
3. Clean the roller with an oil free aerosol cleaning solvent or contact cleaner. Measure the roller radial clearance and side play. Replace the lifters if the rollers are damaged or if clearances are excessive.
4. If you suspect there might be dirt in the lifter or internal parts are malfunctioning, replace the lifter.
5. Lifters should be soaked in clean engine oil and kept covered until assembly.

ASSEMBLY/INSTALLATION

Special Tools	Torque Values
HD-33443 Lifter guide alignment tool	Lifter guide bolts 9-12 ft-lbs (12-16 Nm)

1. Install the lifters and guides using the wire clip to hold the lifters in the guide. The orientation of the oil hole in the side of the lifter does not affect lifter performance.
2. See Figure 3-50. Insert the lifter GUIDE ALIGNMENT TOOL, Part No. HD-33443, in the screw hole nearest the lifter oil feed hole and install and tighten the other three screws.
3. Remove the tool and install the fourth screw. Tighten screws to 9-12 ft-lbs (12-16 Nm).
4. Repeat the above procedure for the other lifter guide. Install lifter GUIDE ALIGNMENT TOOL in the hole closest to oil feed hole.
5. After lifters and guides are installed, check push rod length following the procedure given in the CYLINDER HEAD subject.
6. Install push rods following the procedure given in INSTALLATION, PUSH RODS.

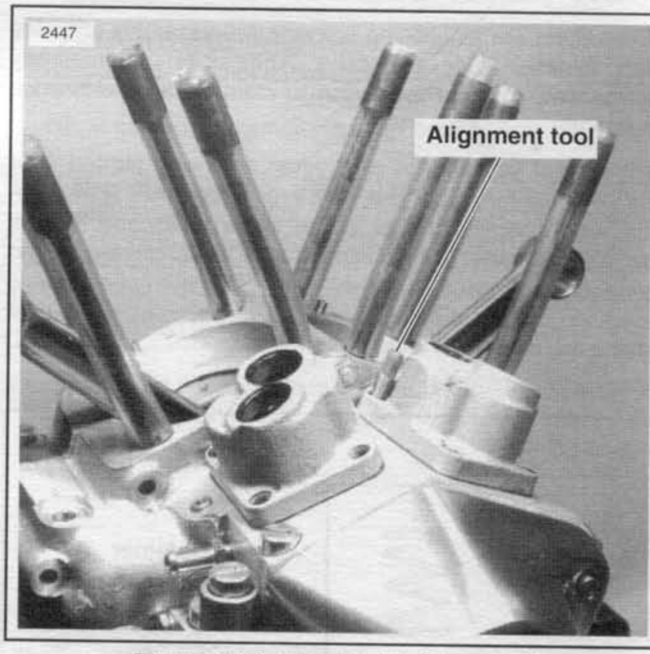


Figure 3-50. Lifter Guide Alignment

GEARCASE COVER AND TIMING GEARS

GENERAL

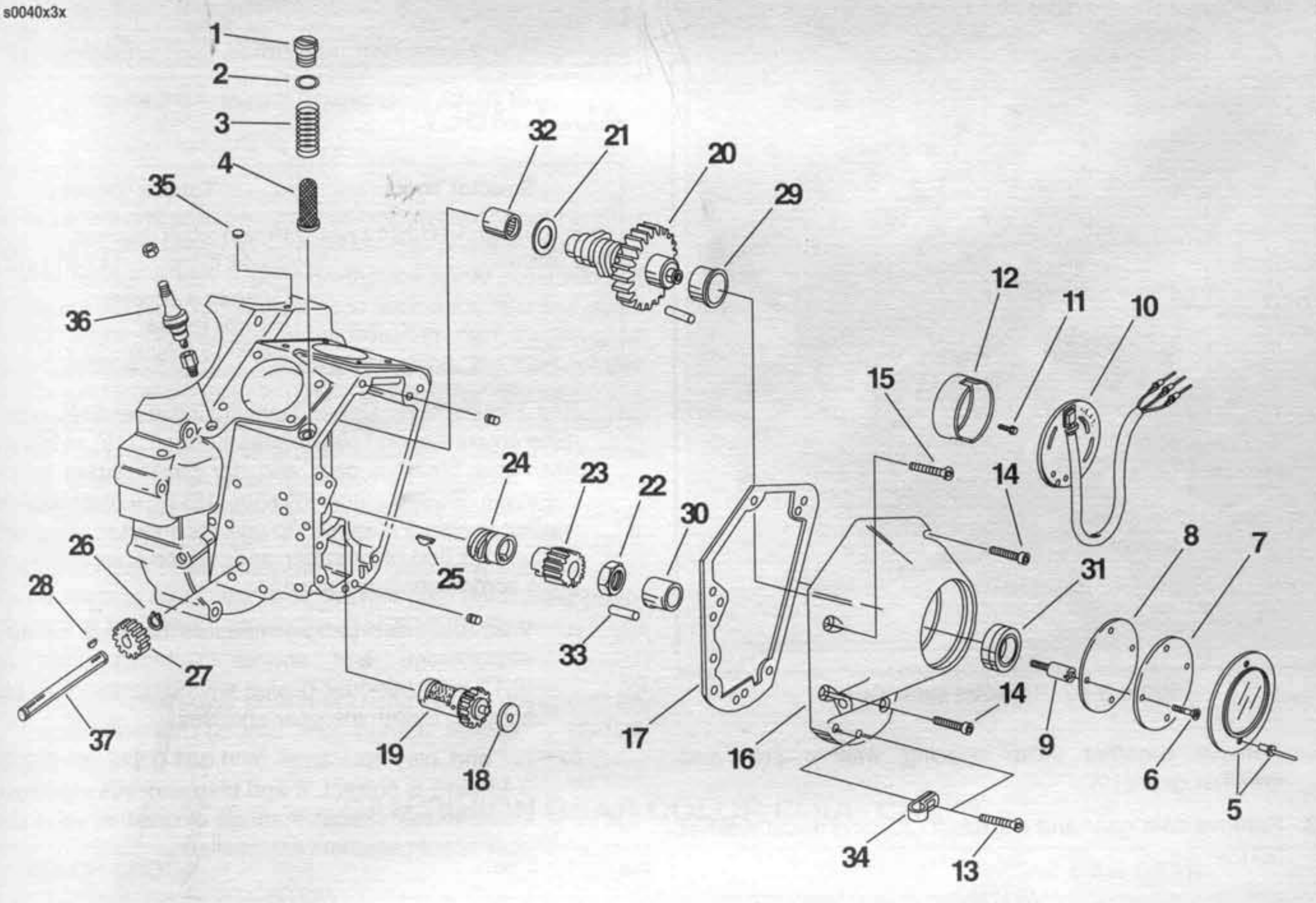
The gearcase, located on the right side of the engine crankcase, contains a series of gears which transmit engine power to the cam shaft and ignition timer, crankcase breather and oil pump.

The gearcase is lubricated with engine oil through the breather valve from the engine crankcase.

Shafts run in bushings except the crankcase side of the cam shaft which operates in a needle roller bearing.

DISASSEMBLY

Special Tools	Torque Values
Snap-On Part No. PR129A Lock ring pliers HD-33418 Universal puller forcing screw	None



1. Oil screen cap
2. O-ring
3. Oil screen spring
4. Oil screen
5. Outer cover and rivets (2)
6. Inner cover screw (2)
7. Inner cover
8. Gasket
9. Cam position plate screw/lockwasher (2)
10. Cam position plate
11. Rotor screw
12. Rotor
13. Gear cover screw (2)
14. Gear cover screw (3)
15. Gear cover screw (1)
16. Gear cover
17. Gear cover gasket
18. Breather gear washer
19. Breather gear
20. Cam gear
21. Cam gear thrust washer
22. Gear shaft nut
23. Pinion gear
24. Oil pump pinion shaft gear
25. Oil pump/pinion gear key
26. Oil pump drive gear lock ring
27. Oil pump drive gear
28. Oil pump drive gear key
29. Gear cover camshaft bushing
30. Gear cover pinion bushing
31. Camshaft oil seal
32. Camshaft needle bearing
33. Cover dowel pin
34. Wire clip
35. Crankcase plug
36. Oil pressure switch
37. Oil pump shaft

Figure 3-51. Gearcase

1. See Figure 3-51. Remove rocker box assemblies. See CYLINDER HEADS.
2. Remove lifter oil screen cap (1), O-ring (2) screen spring (3) and screen (4). If necessary, drill out two cover rivets and remove outer cover (5).
3. Remove two ignition sensor cover screws (6), cover (7) and gasket (8).
4. Remove sensor plate screws and lockwashers (9).
5. Disconnect sensor plate wires at connection so that sensor plate may be moved out of the way.
6. Remove screw (11) and rotor (12).
7. Remove gearcase cover screws (13, 14 and 15).
8. See Figures 3-51 and 3-52. Remove gearcase cover (16) by using Universal puller, HD-33418 and an early-style timing cover with timing cover screws. Remove gearcase cover gasket (17).

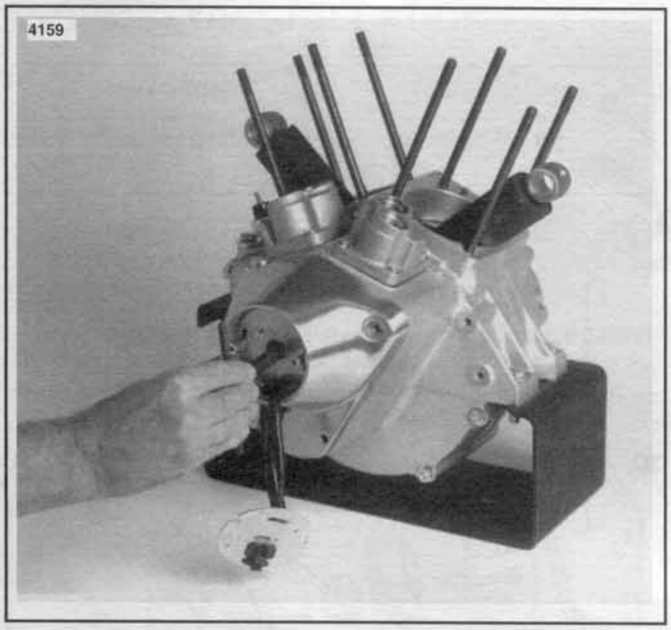


Figure 3-52. Remove Gear Cover

9. Remove breather valve spacing washer (18) and breather gear (19).
10. Remove cam gear and camshaft (20) and thrust washer (21).

NOTE

Pinion shaft gear HEX NUT has RIGHT-HAND threads.

11. See Figures 3-51 and 3-53. Remove pinion gear shaft nut (22). Remove pinion gear (23).
12. Remove oil pump pinion shaft gear (24) and key (25).
13. Use a LOCK RING PLIERS such as Snap-On No. PR129A and, if necessary, remove oil pump drive gear shaft lock ring (26), drive gear (27) and drive gear key (28).
14. If necessary, remove oil pump bolts and washers and remove oil pump from gearcase. See OIL PUMP, DISASSEMBLY.
15. Inspect components. See CLEANING AND INSPECTION.

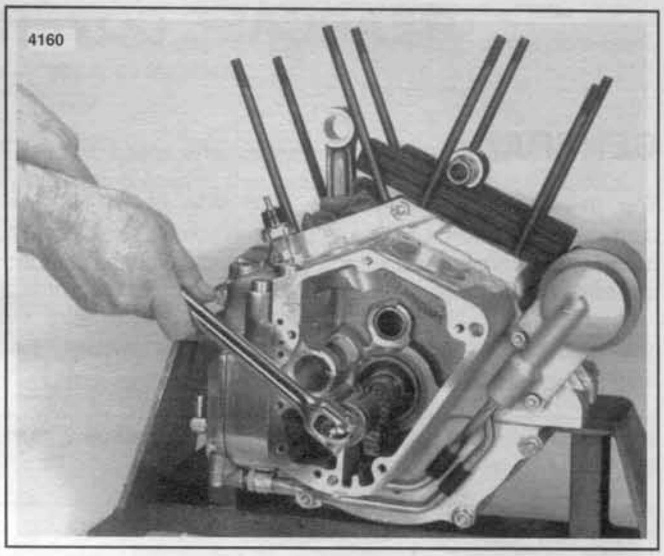


Figure 3-53. Remove Pinion Gear Shaft Nut

ASSEMBLY

Special Tools	Torque Values
Snap-On No. PR129A Lock ring pliers	Pinion shaft gear nut 35-45 ft-lbs (47-61 Nm) Gearcase screws 90-120 **in-lbs** (10.2-13.6 Nm)

1. See Figure 3-51. Before assembling gear train, determine amount of end play in breather gear (19) as follows: Assemble breather gear and dry cover gasket (17) to gearcase. Select spacer washer (18) (use disassembled washer unless it is known to give incorrect spacing) and position on end of breather gear. Place a steel straightedge across gearcase at spacer.
   a. With thickness gauge, measure distance between straightedge and spacer. Subtract 0.006 in. (0.15 mm) (amount gasket will compress) from this figure to determine gear end play.
   b. An end play tolerance of 0.001-0.016 in. (0.025-0.41 mm) is correct. If end play exceeds maximum, insert thicker spacer. A range of breather valve and gear spacer washers are available.

NOTE

PINION SHAFT GEAR hex nut has RIGHT-HAND THREADS.

2. See Figures 3-51 and 3-54. Place 2 drops of Loctite 262 (red) on threads and tighten pinion shaft gear nut (22) to 35-45 ft-lbs (47-61 Nm).
3. See Figure 3-55. Breather, cam and pinion gears have timing marks which must be aligned or matched. Rotate gear train and note if it revolves freely. Binding indicates gears are meshing too tightly.

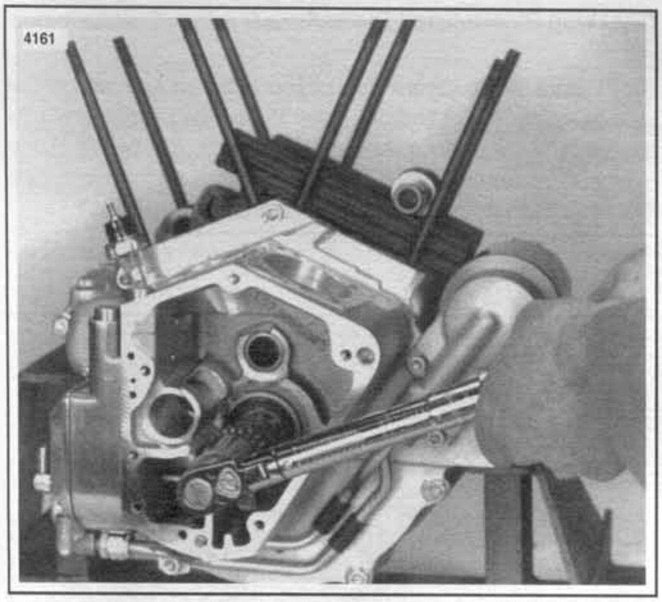


Figure 3-54. Install Pinion Gear Shaft Nut

NOTE

Pinion gears and cam gears are color coded according to their pitch diameters. When replacing only one of these gears, you should replace it with a gear having the same color code. If gears are not matched according to their color, lifter-like noise or gear whine may result. See the following chart. If a matched set of gears produces a severe gear whine, the next smaller pinion gear may be used to obtain proper gear clearance. If a lifter type noise is present, the next larger pinion gear may be used. The proper gear clearance will give a very slight gear whine when engine is at operating temperature. With gear cover installed and torqued to specification, proper gear clearance is evidenced by slight drag when cam gear is moved back and forth along shaft axis (with zero gear lash between gear teeth) checked twice over two complete gear revolutions (revolution 1: at TDC, BDC, revolution 2: at TDC, BDC).

4. Position new cover gasket (17) and secure cover with all cover screws (13 thru 15). Tighten screws to 90-120 **in-lbs** (10.2-13.6 Nm).
5. After securing cover, pour about 1/4 pint (57 ml) of engine oil through lifter guide hole over gears to provide initial lubrication.
6. Assemble remainder of gearcase and ignition timer. See IGNITION SYSTEM, section 8.
7. Install rocker box assemblies. See CYLINDER HEADS.

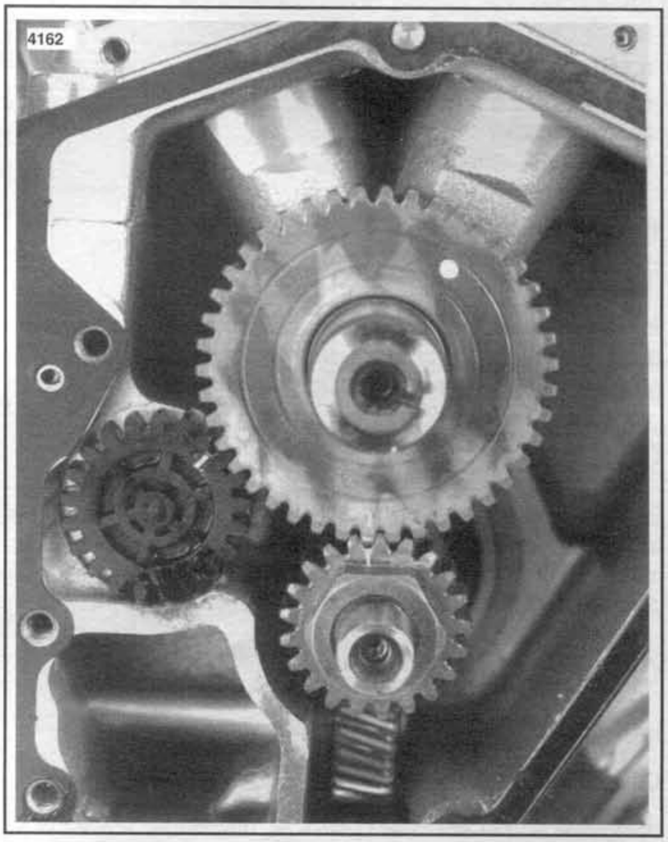


Figure 3-55. Timing Gears with Marks Aligned

CAM/PINION GEAR COLOR CODE CHART

COLOR CODE	PINION GEAR				CAM GEAR	
NOTE ●*Use 0.108 in. (2.74 mm) pins to measure.* ●*Cam gears have two grooves on face.*	(matched sets)					
	Part no.	Size (in.)	Size (mm)		Size (in.)	Size (mm)
ORANGE	24040-93	1.4853/1.4850	37.727/37.719	*NOTE*	2.7472/2.7476	69.779/69.789
WHITE	24041-93	1.4849/1.4846	37.716/37.709	*Check parts catalog for cam and pinion sets part numbers*	2.7477/2.7481	69.792/69.802
YELLOW	24042-93	1.4845/1.4842	37.706/37.699		2.7482/2.7486	69.804/69.814
RED	24043-93	1.4841/4.4838	37.696/37.689		2.7487/2.7491	69.817/69.827
BLUE	24044-93	1.4837/1.4834	37.686/37.678		2.7492/2.7496	69.830/69.840
GREEN	24045-93	1.4833/1.4830	37.676/37.668		2.7497/2.7501	69.842/69.853
BLACK	24046-93	1.4829/1.4826	37.666/37.658		2.7502/2.7506	69.855/69.865

CLEANING AND INSPECTION

Special Tools	Torque Values
HD-95760-69 Puller tool & Collet, 0.500 in.	None
HD-42928 Cam needle bearing remover/installer	
Arbor press	
No. 31 Drill	
0.156 in. (3.96 mm) Drill	
HD-94805-57 0.563 in. Pinion shaft cover bushing reamer	
1 in. (25.4 mm) Expansion reamer	

Wash and air dry all parts and inside of case.

NOTE

If crankcase is to be disassembled, wash parts after complete disassembly. If it is not to be disassembled, be careful not to get grease or solvent into crankcase when washing gearcase.

Oil Screen

See Figure 3-51. Remove and inspect oil screen (4) carefully to be sure mesh is open. Fill screen with oil and watch for complete and even flow of oil through screen. Replace plugged or partially plugged screen.

Cam and Pinion Gears

Inspect gears for wear. Replace worn or damaged gears.

Checking Gear Mesh

Assemble pinion and cam gears to respective positions in gearcase. Omit cam gear end spacer for the purpose of checking gear mesh. Attach cover with at least three cover screws. Mesh is correct when no play between gears can be felt and cam gear can be moved back and forth along shaft axis with slight drag.

NOTE

Gear mesh must be checked twice (with gear cover installed) over two complete gear revolutions (revolution 1: at TDC, BDC, revolution 2: at TDC, BDC) as two revolutions of the gear occur with each engine revolution.

Pinion Shaft and Bearing

1. Clean the pinion shaft bearing with contact cleaner and check the bearing clearance by attempting to move shaft up and down. If there is noticeable movement, disassemble and check bearing.
2. Pinion shaft main roller bearing may be replaced only when crankcase is disassembled, see CRANKCASE, DISASSEMBLY.

Checking Pinion Shaft Runout

See Figure 3-56. Check the pinion shaft runout with a dial indicator. Mount the indicator with the probe perpendicular to the shaft. If the runout exceeds 0.0045 in. (0.1143 mm), the flywheel assembly must be checked for trueness. See TRUING FLYWHEELS under FLYWHEEL ASSEMBLY.

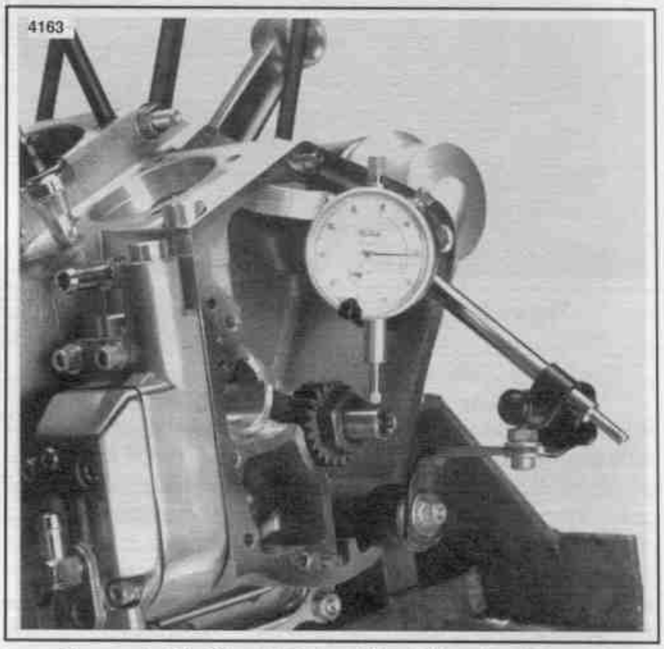


Figure 3-56. Check Pinion Shaft Bearing Runout

Cam Shaft and Needle Bearing

1. See Figure 3-51. Measure the small end of the cam shaft at the bearing surface and again near the cam lobes. If the shaft is worn more than 0.003 in. (0.08 mm) or is damaged in any way, replace both the cam and the needle bearing (32).
2. Replace the cam if any of the lobes are damaged or worn more than 0.006 in. (0.15 mm). Measure the lobes on a new cam for comparison. Be sure you use an Evolution engine cam. Because the lift and profile on the cam lobes differs from earlier engines, cams must not be interchanged.
3. Replace cam shaft oil seal (31).
4. Inspect needle bearing (32) for wear and broken or gouged bearings. If end of cam shaft shows any appreciable wear (0.003 in. (0.08 mm) or more), replace needle bearing and cam shaft.

Cam Needle Bearing Removal/Installation

NOTE

The following procedure describes cam needle bearing removal and installation using the CAM NEEDLE BEARING REMOVER/INSTALLER, Part No. HD-42928.

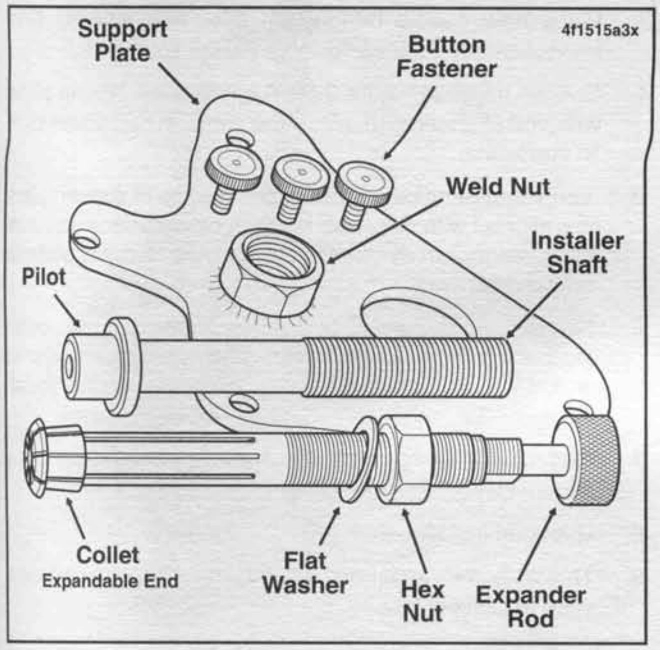


Figure 3-57. Cam Needle Bearing Remover/Installer (Part No. HD-42928)

Removal

1. Move connecting rod to verify that crank pin nut is **not** visible through cam needle bearing bore (not at top dead center).
2. See Figure 3-57. Remove three button fasteners from threaded holes in the support plate.
3. Slide collet through support plate so that threaded end exits weld nut on outboard side.
4. Aligning large hole in plate with end of crankshaft, place the plate on two dowel pins in crankcase.
5. See top frame of Figure 3-58. Verify that remaining three holes at edge of support plate are aligned with threaded holes in crankcase. Install button fasteners in these holes to secure support plate to crankcase.
6. Center expandable end of collet in bearing bore and slide flat washer on threaded end. Start hex nut on threaded end.
7. Push expandable end of collet through bearing bore into crankcase. Feel for inside edge of bearing using end of collet and then back off slightly.
8. Finger tighten hex nut (with flat washer) against weld nut on support plate.
9. See center frame of Figure 3-58. Insert expander rod into threaded end of collet. Expandable end of collet makes contact with needle bearing ID.

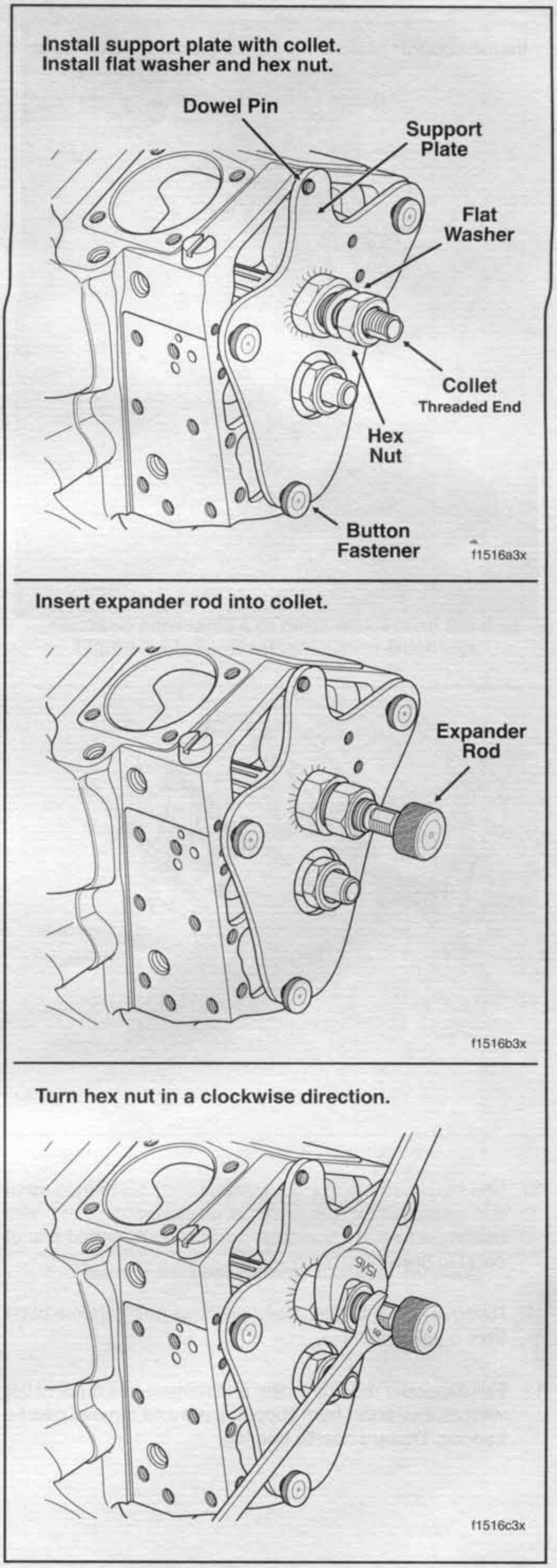


Figure 3-58. Remove Cam Gear Needle Bearing

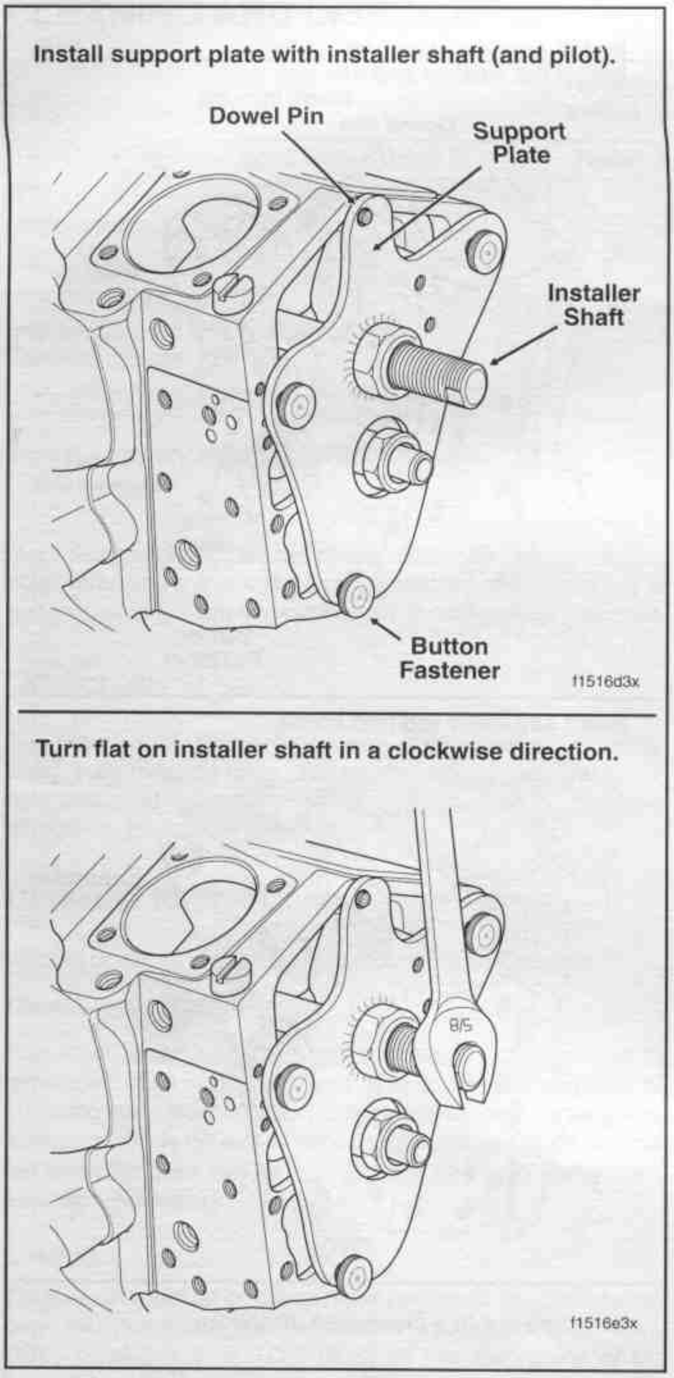


Figure 3-59. Install Cam Gear Needle Bearing

10. See bottom frame of Figure 3-58. Using 15/16 inch open end wrench, turn hex nut in a clockwise direction until bearing is free. If necessary, hold flat on threaded end of collet to prevent rotation.
11. Remove three button fasteners and pull support plate from crankcase.
12. Pull expander rod from collet and remove hex nut and flat washer. Pull collet from support plate and remove needle bearing. Discard needle bearing.

Installation

1. See Figure 3-57. Install pilot at end of installer shaft.
2. Thread installer shaft into support plate until threaded end exits weld nut on outboard side. Continue turning shaft until about 2 inches (50.8 mm) extends beyond weld nut.
3. Place **new** needle bearing on pilot with lettered side (manufacturer's name) facing shoulder (outward).
4. See top frame of Figure 3-59. Aligning large hole in plate with end of crankshaft, place the plate on two dowel pins in crankcase.
5. Verify that remaining three holes at edge of support plate are aligned with threaded holes in crankcase. Install button fasteners in these holes to secure support plate to crankcase.
6. See bottom frame of Figure 3-59. Center pilot over bearing bore. Using 5/8 inch open end wrench, turn flat at end of installer shaft in a clockwise direction until shoulder on pilot makes full contact with crankcase face.
7. Remove three bottom fasteners and pull support plate and installer shaft (with pilot) from crankcase.
8. Unthread installer shaft from support plate.
9. Thread button fasteners into threaded holes in support plate to prevent loss.

Cam and Pinion Gear Bushings

See Figure 3-51. Inspect cam gear and pinion gear bushings (29 and 30) in gearcase cover for pitting, scuffing and grooving. Determine amount of pinion and cam shaft wear in cover bushing. If it exceeds SERVICE WEAR LIMIT shown in ENGINE, SPECIFICATIONS, install new bushings.

NOTE

The original bushings are not pinned, but the replacement bushings must be pinned to prevent possible rotation in the cover.

Pinion Gear Shaft Bushing Replacement

1. See Figure 3-60. To remove old bushing, use PULLER TOOL, Part No. HD-95760-69 with a 0.500 in. collet.
2. Use an arbor press and press in the new bushing until the top of the bushing is flush with the boss in the cover.
3. See Figure 3-61. Locate and center punch dowel pin location 0.125 in. (3.17 mm) or more from oil hole in cover. Drill No. 31 hole 0.188 in. (4.77 mm) deep. Press in bushing until it bottoms on shoulder in cover boss hole. Continue drilling dowel pin hole to depth of 0.281 in. (7.14 mm) from top of bushing. Drive in new dowel pin no more than 0.020 in. (0.51 mm) below the bushing face and carefully peen edges of hole to lock in place.
4. Ream bushing. See *Reaming Gearcase Cover Bushings.*

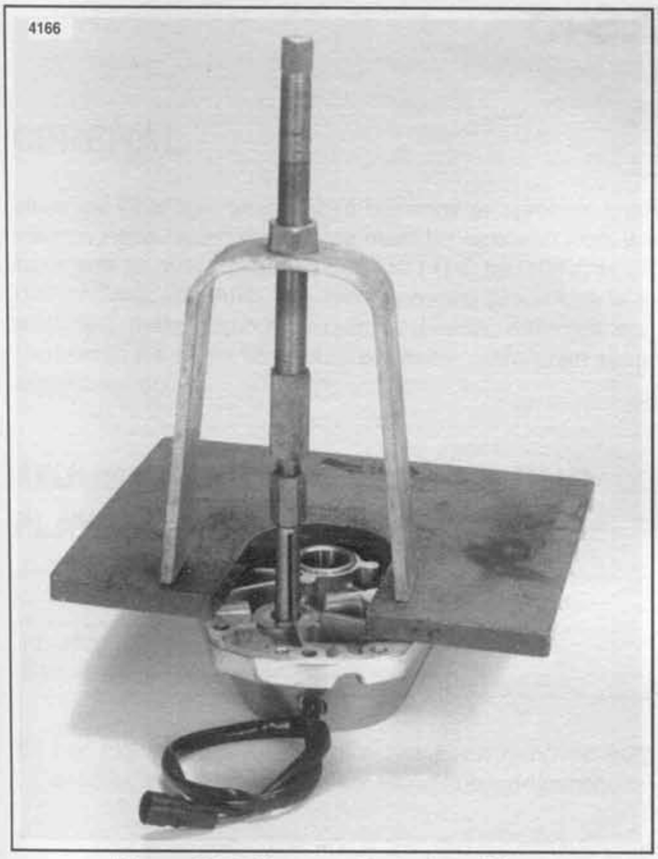


Figure 3-60. Remove Cover Bushing

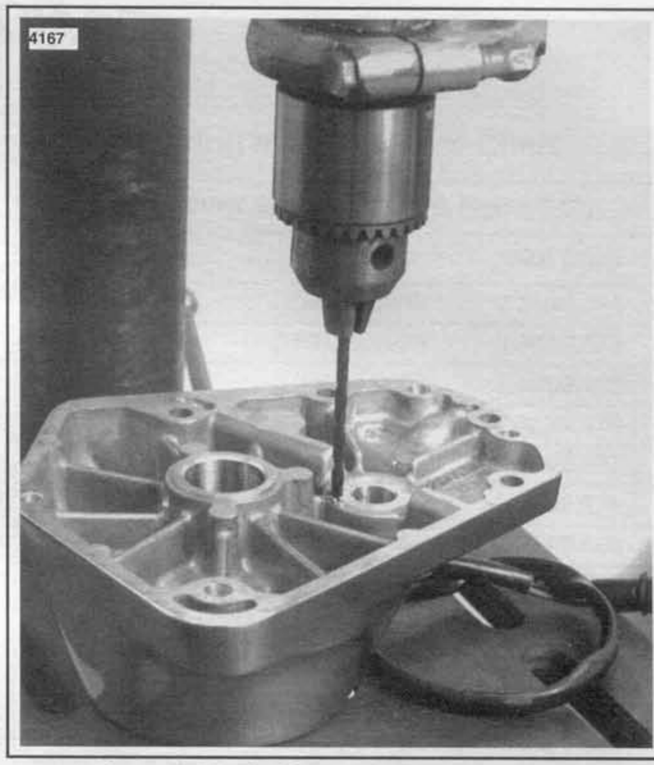


Figure 3-61. Pin Gearcase Cover Bushings

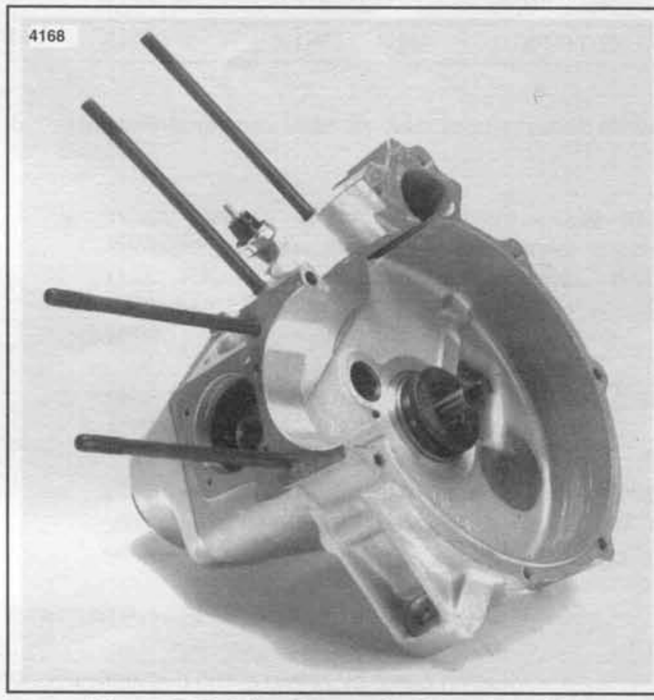


Figure 3-62. Line Reamer in Cover Bushing

Cam Shaft Bushing Replacement

1. Turn cam shaft housing onto flange and press out old bushing, using a suitable driver.
2. Press in the new bushing until the shoulder is tight against the boss in the cover.
3. See Figure 3-61. Center punch and drill No. 31 hole exactly 0.281 in. (7.14 mm) deep. Drive in new dowel pin and peen bushing edges over dowel to secure it. Pin must be no more than 0.020 in. (0.51 mm) below the bushing surface.
4. Drill lubrication oil hole through wall of bushing with 0.156 in. (3.96 mm) drill using oil hole in bushing boss as a drill guide.

Reaming Gearcase Cover Bushings

NOTE

Pinion shaft and camshaft bushings must be line reamed to remove burrs and irregularities from hole and to ensure perfect alignment. If crankcase is not disassembled, use another right crankcase side. Fasten cover in place with at least three screws.

1. See Figure 3-62. To ream pinion shaft bushing, insert reamer pilot in right crankcase roller race. Insert 0.563 in. PINION SHAFT COVER BUSHING REAMER, Part No. HD-94805-57, through pilot and push into cover bushing until it bottoms, then give reamer one complete turn to size bushing. Rotate reamer the same direction (clockwise) during extraction.
2. To ream cam gear cover bushing, use a 1 in. (25.4 mm) expansion reamer and ream to 1.003-1.002 in. (25.48-25.45 mm) diameter.

CRANKCASE

GENERAL

When rod bearings, pinion shaft bearings or sprocket shaft bearings need repair, the engine must be removed from the motorcycle as described in STRIPPING THE MOTORCYCLE FOR ENGINE REPAIR. The recommended procedure is to check and make repairs to cylinder heads, cylinders and gearcase at the same time, in other words, perform an entire engine overhaul.

ADJUSTMENT – FLYWHEEL END PLAY

Special Tools	Torque Values
HD-97225-55B Sprocket Shaft Bearing Tool	None

1. See Figure 3-63. After engine has been removed from chassis, securely fasten it to a stand and workbench.

2. Remove gearcase cover and fasten dial indicator to gear side crankcase with indicator stem on end of gearshaft.

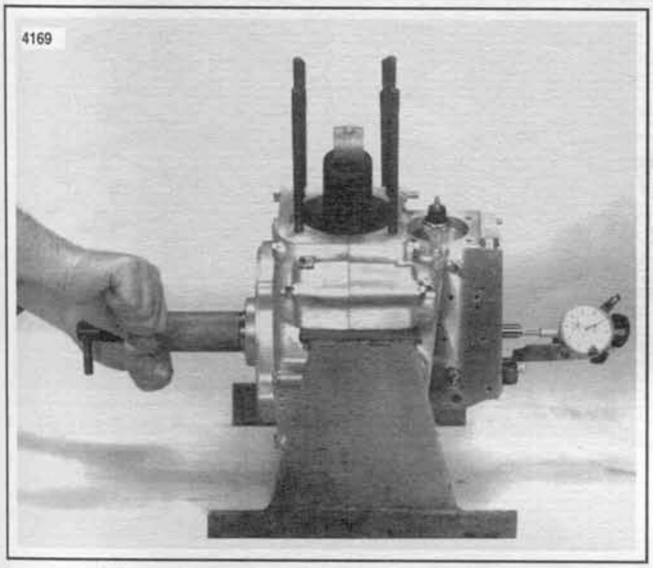


Figure 3-63. Check Flywheel End Play

3. Install SPROCKET SHAFT BEARING TOOL, Part No. HD-97225-55B, on sprocket shaft to preload the bearing races.

4. Check amount of main bearing end play by rotating and pushing on the sprocket shaft while reading the dial indicator. Rotate and pull on the sprocket shaft and note the difference on the indicator readings. If difference (end play) is not 0.001-0.005 in. (0.025-0.13 mm), the bearing inner spacer (10, Figure 3-63) must be replaced. Choose spacer from the chart. A thinner spacer will result in less end play.

Bearing Inner Spacers Chart

Bearing Inner Spacers (Item 10, Figure 3-63)		
PART NO.	**SIZE (in.)**	**SIZE (mm)**
9120	0.0925/0.0915	2.349/2.324
9121	0.0945/0.0935	2.400/2.375
9122	0.0965/0.0955	2.451/2.426
9123	0.0985/0.0975	2.502/2.476
9124	0.1005/0.0995	2.553/2.527
9125	0.1005/0.1015	2.603/2.578
9126	0.1045/0.1035	2.654/2.629
9127	0.1065/0.1055	2.705/2.680
9128	0.1085/0.1075	2.756/2.730
9129	0.1105/0.1095	2.807/2.781
9130	0.1125/0.1115	2.857/2.832
9131	0.1145/0.1135	2.908/2.883
9132	0.1165/0.1155	2.959/2.934
9133	0.1185/0.1175	3.010/2.984
9134	0.1205/0.1195	3.061/3.035

5. If the crankcase has been disassembled, proceed as follows:

   a. When assembling the left crankcase half and flywheels, use the thickest available inner spacer (10), P.N. 9134. (Step 4, FLYWHEEL AND CRANKCASE ASSEMBLY). Measure the spacer before installation. Record the measurement.

   b. Next, follow steps 5 through 10 under FLYWHEEL AND CRANKCASE ASSEMBLY.

   c. Check end play. Record the measurement. Subtract your measurement from the spacer measurement to determine the correct spacer.

Example: (Use Spacer Chart)

Specification is 0.001-0.005 in. (0.025-0.05 mm)
Measured end play is 0.007 in. (0.18 mm)
Spacer #9134 measured 0.120 in. (3.05)
Subtract 0.007 from 0.120: (0.18 from 3.05)

	(3.05)	0.120
	(-0.18)	-0.007
	(2.87)	0.113
PLUS DESIRED END PLAY	(+0.08)	+0.003
	(2.95)	0.116

Use spacer # 9132. Repeat steps 5 through 9 and check end play again.

DISASSEMBLY

1. Remove cylinder heads as described in CYLINDER HEAD, REMOVAL.

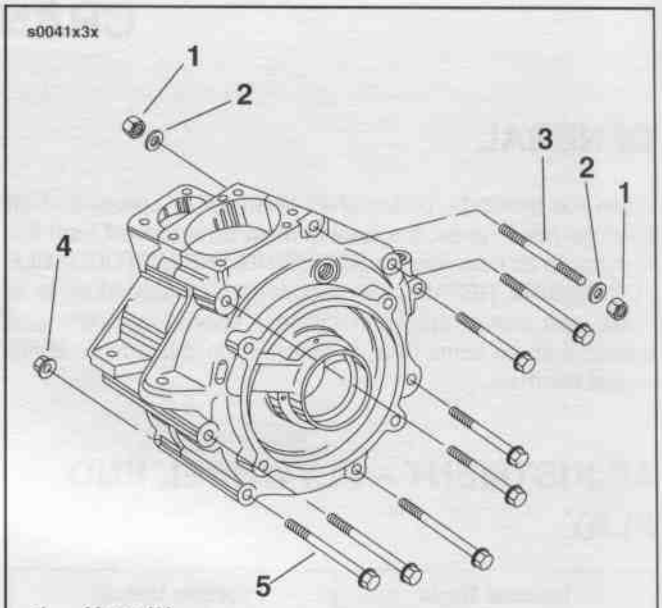
2. Remove cylinders as described in CYLINDER AND PISTON, REMOVAL.

⚠CAUTION

After removing cylinders, install 0.500 in. (12.7 mm) inside diameter plastic or rubber hose over the cylinder studs. Never lift or move the crankcase by grasping the cylinder studs.

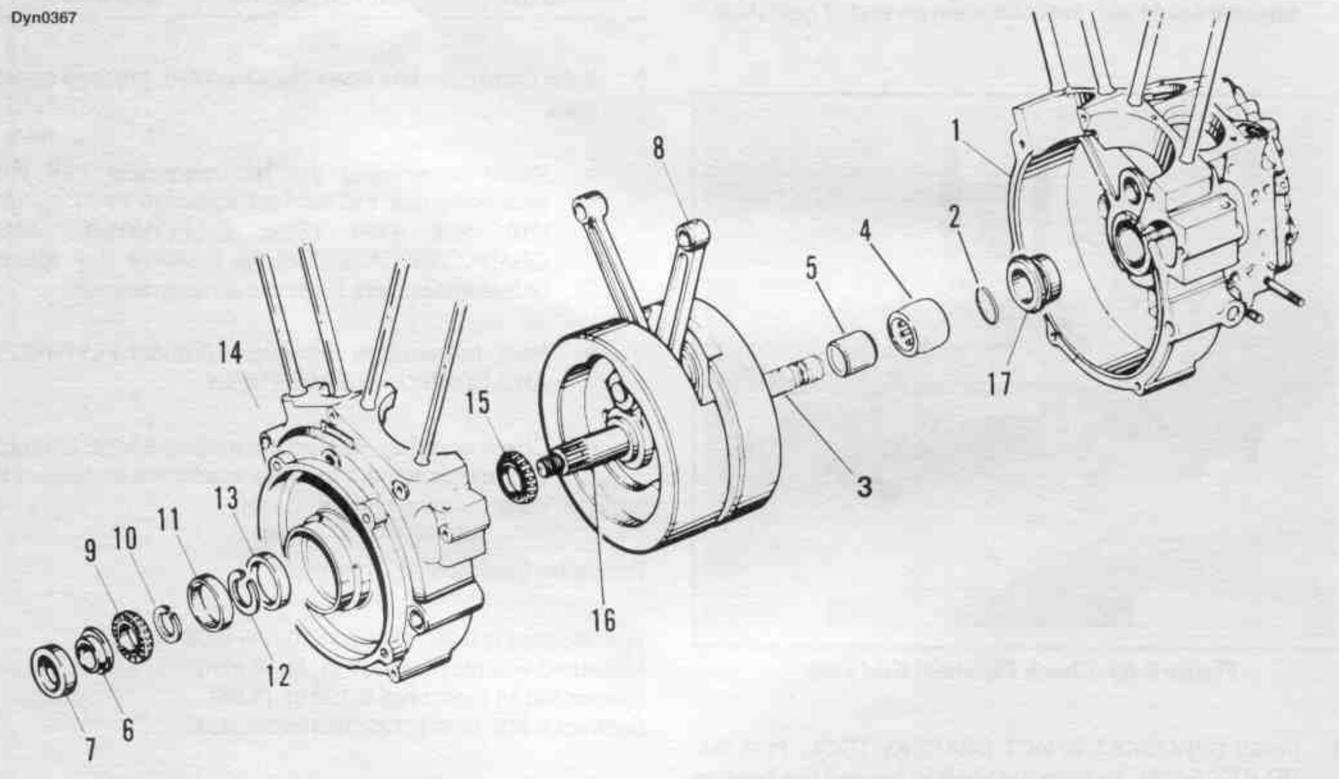
3. Remove gearcase parts as described in GEARCASE, DISASSEMBLY. Check flywheel end play as described previously.

4. See Figure 3-64. Remove crankcase bolts (5) and stud (3). It is necessary to remove only one stud nut (1) and slip stud and other nut out opposite side of crankcase.



1. **Nuts (2)**
2. **Washers (2)**
3. **Stud**
4. **Flange nuts (3)**
5. **Bolts (7)**

Figure 3-64. Crankcase Studs



1. **Right crankcase half**
2. **Circlip**
3. **Pinion shaft**
4. **Bearing and retainer**
5. **Inner race**
6. **Sprocket shaft spacer**
7. **Sprocket shaft bearing seal**
8. **Flywheel and rod assembly**
9. **Sprocket bearing half**
10. **Bearing inner spacer**
11. **Bearing outer race**
12. **Outer race lock ring**
13. **Bearing outer race**
14. **Left crankcase half**
15. **Sprocket bearing half**
16. **Sprocket shaft**
17. **Crankcase bearing**

Note: Keep parts 9, 11, 12, 13 and 15 as a set. Do not interchange parts.

Figure 3-65. Crankcase

NOTE

The top center crankcase stud and left and right bottom bolts are fitted to the crankcase holes for proper crankcase alignment. Mark these studs and bolts so they can be installed in their original location.

5. See Figure 3-65. Position crankcase with gearcase (right) side up. Tap crankcase with soft face mallet to loosen right half. Lift right crankcase half (1) off pinion shaft main bearings (4). Remove circlip (2) from pinion shaft. Remove bearings (4) from pinion shaft.
6. See Figures 3-65 and 3-66. Mount flywheel and left case assembly on press table supporting case on parallel bars. Press on end of sprocket shaft with arbor press until flywheel assembly (8) drops out. Remove seal (7), freeing sprocket side bearing half (9), spacer (6) and spacer (10).

NOTE

Do not remove lock ring (Item 10, Figure 3-65).

7. See Figure 3-67. If left main bearing is to be replaced, press out bearing races (11 and 13, Figure 3-65) from opposite sides of crankcase hole, using CRANKSHAFT BEARING REMOVAL & INSTALLATION TOOL, Part No. HD-94547-80. Do not remove the lock ring (12).

NOTE

If oil pump shaft bushing needs to be replaced, call H-D Service Department.

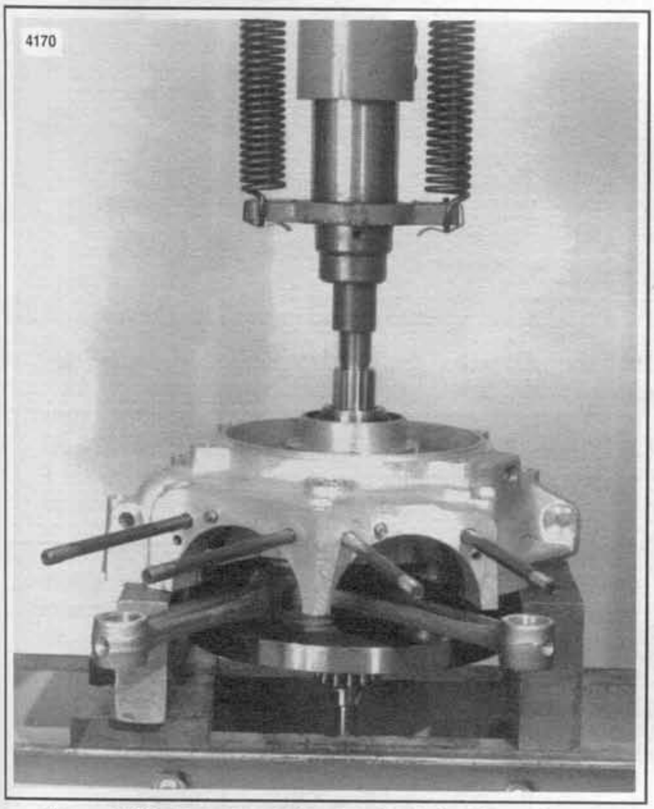


Figure 3-66. Pressing Flywheels Out of Crankcase

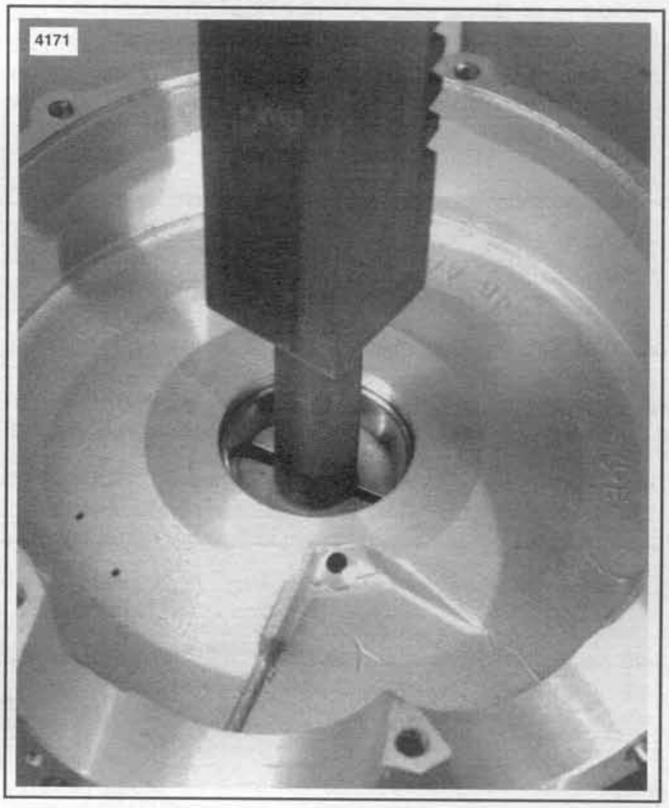


Figure 3-67. Removing Left Crankcase Bearing Races

FLYWHEEL DISASSEMBLY

Special Tools	Torque Values
HD-34813 Flywheel rebuilding jig HD-95635-46 General purpose claw puller HD-95637-46 Wedge attachment	None

1. See Figure 3-68. If flywheels are to be disassembled, place a FLYWHEEL REBUILDING JIG, Part No. HD-34813 in a vise. Insert pinion shaft into fixture and install WEDGE ATTACHMENT, Part No. HD-95637-46 and GENERAL PURPOSE CLAW PULLER, Part No. HD-95635-46 over sprocket shaft bearing. Turn forcing screw to remove bearing. Keep bearings in a set with proper bearing outer races.

NOTE

On the one-piece flywheel and sprocket shaft, the inner bearing will be destroyed during removal and must be replaced.

2. See Figure 3-69. Remove crankpin nut (1).

3. See Figure 3-70. Remove left flywheel assembly. To loosen flywheel, strike left flywheel cheek with soft metal mallet at 90 degrees to crankpin.

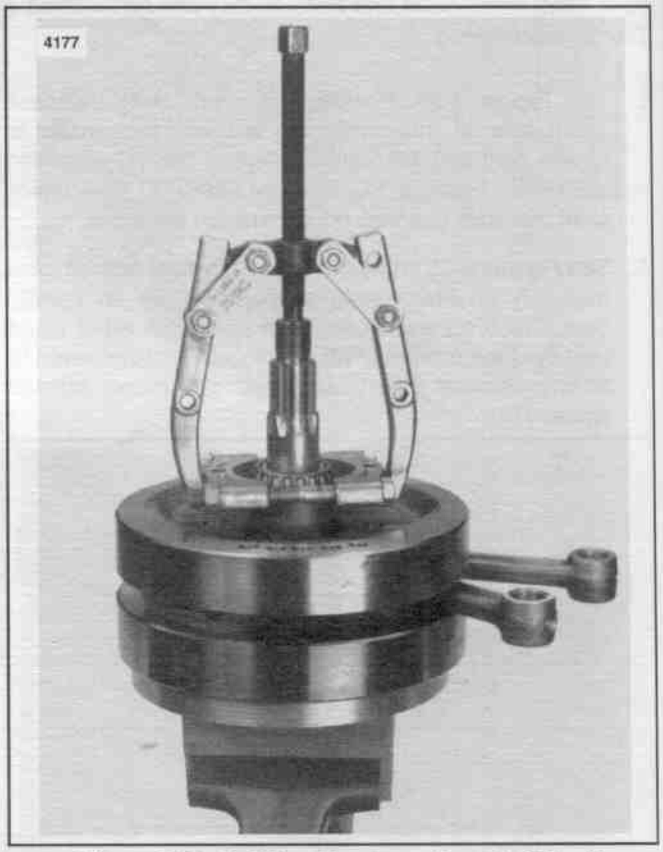
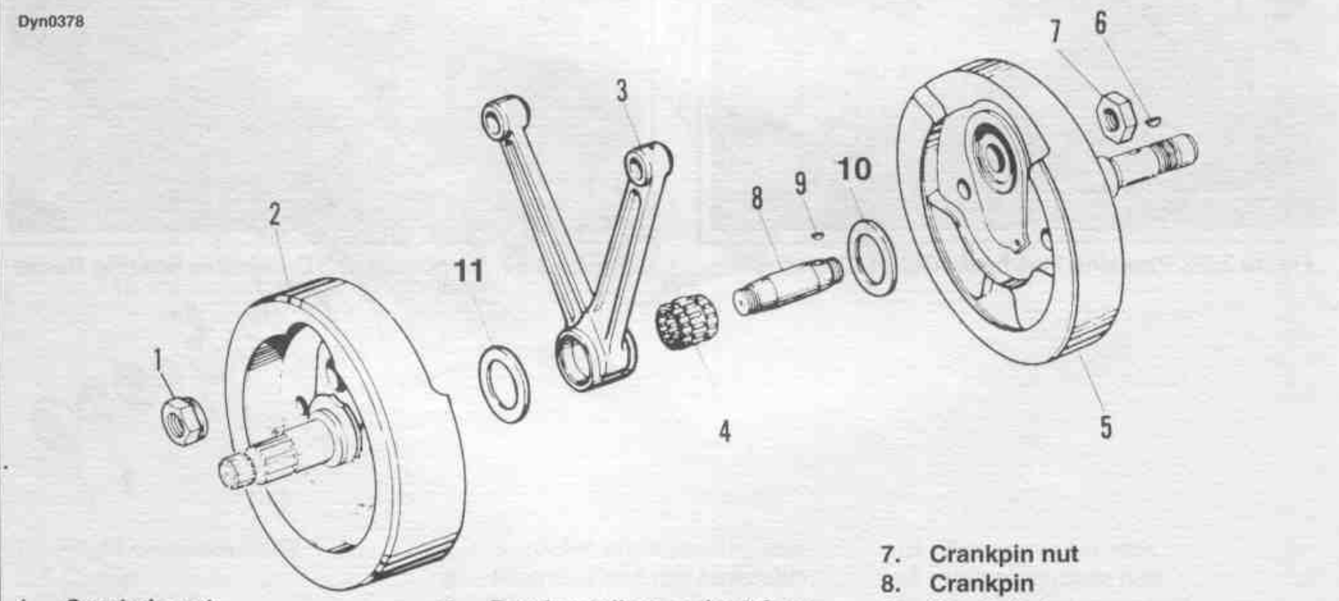


Figure 3-68. Pull Bearing from Sprocket Shaft



1. **Crankpin nut**
2. **Left flywheel**
3. **Connecting rods**
4. **Bearing rollers and retainer**
5. **Right flywheel**
6. **Pinion shaft key**
7. **Crankpin nut**
8. **Crankpin**
9. **Crankpin key**
10. **Flywheel washer**
11. **Flywheel washer**

Figure 3-69. Flywheel Assembly

4. See Figure 3-69. Hold down bearing assembly with a short length of pipe so connecting rods (3) may be slipped off bearings. Remove bearings (4). Hold together in set until bearings are washed and refitted to crankpin
5. Turn flywheel over in fixture and remove crankpin nut (7). Press crankpin out of flywheel. Remove crankpin key (9).

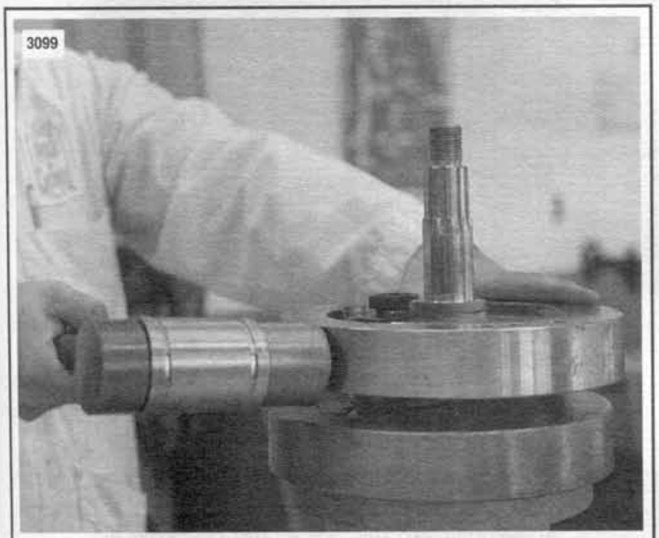


Figure 3-70. Loosening Flywheels

CLEANING AND INSPECTION

1. See Figure 3-69. Wash all parts in grease solvent and blow dry with compressed air. Examine crankpin for wear, grooving and pitting. If the surface is at all worn, replace with new pin. Examine flywheel washers (10,11). If either washer is worn and grooved, it should be replaced.
2. Examine connecting rod lower races. If they appear slightly grooved or shouldered where edge of bearing rollers ride, they may be lapped out and oversize crankpin installed. If they appear badly worn, grooved or pitted, new rods should be installed, preferably as an assembly with new bearings and crankpin.
3. See Figure 3-65. Examine pinion shaft inner race and right crankcase bearing race (17) for pitting, grooving and gouging at point where right main roller bearings ride. A pinion shaft inner race that is worn must be replaced. See REMOVING/INSTALLING PINION SHAFT INNER RACE. If crankcase bearing race is worn beyond repair, replace as described in Truing and Sizing Pinion Shaft Main Bearing.
4. Examine sprocket shaft outer races for wear, grooving and pitting. Examine bearing rollers for wear, pitting, grooving and heat discoloration. The sprocket shaft Timken tapered roller bearings are manufactured in selectively fitted sets. The same serial number appears on all parts. If any part is damaged, the complete set must be replaced. When a new bearing set is installed, check flywheel end play as described earlier in this section.

CAUTION

All bearings that were removed must be replaced. Once a bearing has been removed, it is destroyed.

5. If flywheel and connecting rod assembly need repair, see REPAIR for detailed instructions.

FLYWHEEL ASSEMBLY

Special Tools	Torque Values
HD-34813 Flywheel assembly jig HD-96650-80 Flywheel truing stand C-clamp Wedge	Crankpin nut 180-210 ft-lbs(244-285 Nm)

See FLYWHEEL REPAIR. After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

1. Before assembly, all flywheel components must be perfectly clean and dry. Use a non-petroleum based solvent such as Loctite CLEANING SOLVENT or electrical contact cleaner.

CAUTION

Do not apply Perma-Loc to the crankpin shaft tapers. Foreign material on tapers can result in a cocked or incorrect fit creating an out of true condition resulting in vibration and possible engine damage.

2. See Figure 3-69. Assemble the crankpin to the right flywheel. Place two drops of Perma-Loc HM 161 Retaining Compound on the threads and face of the nut. Tighten the crankpin nut to 180-210 ft-lbs (244-285 Nm).
3. Check to be sure oil passages through pinion shaft, right flywheel and crankpin are clear by blowing compressed air into hole in end of pinion shaft.
4. Position right flywheel assembly in flywheel fixture, crankpin up.
5. See Figure 3-71. Install the rods and bearings on the crankpin using a thin film of petroleum jelly to retain the rollers. Never use a stiff, high temperature grease on the roller bearings.

   The forked rod is for the rear cylinder and the offset reinforcement on the front rod faces forward. If the front rod is turned 180° it will interfere with the rear rod.
6. Install the left flywheel and shaft on the crankpin. Apply Perma-Loc HM 161 Retaining Compound to the threads and face of the nut.
7. See Figure 3-72. Place flywheel assembly in FLYWHEEL ASSEMBLY JIG, Part No. 34813. Apply Perma-Loc HM 161 Retaining Compound to the threads and face of the nut. Tighten the crankpin nut to 180-210 ft-lbs (244-285 Nm).

NOTE

The set time for Perma-Loc HM 161 Retaining Compound is 30 minutes. Flywheel truing must be completed within this time.

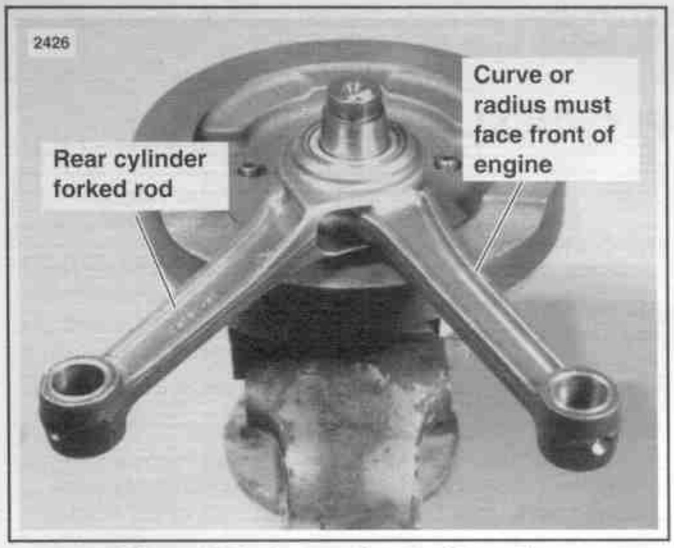


Figure 3-71. Connecting Rod Location

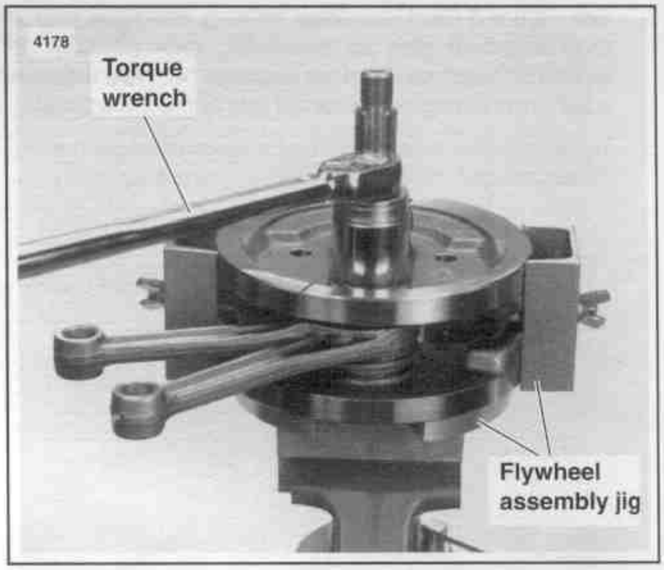


Figure 3-72. Tightening Crankpin Nut

Truing Flywheels

1. See Figure 3-73. Install flywheel assembly in FLYWHEEL TRUING STAND, Part No. HD-96650-80. Tighten, then back off, adjusting so centers are snug but wheels rotate under weight of rods.

Wheels must turn freely but shafts may not be loose in centers. If flywheel assembly is either loose or squeezed, indicators will not read accurately.

Adjust indicators to take reading as near to flywheels as possible, so pointers read at about the middle of the scales.

2. Turn flywheels slowly and observe the movement of indicator pointers. Movement toward flywheels indicates high points of shafts. Find highest point of each shaft and chalk-mark flywheel rims at those points. Chalk marks must be parallel to pointers. Remove flywheel from truing stand and make corrections as stated in step 5.

3. See Figure 3-74. Flywheel may be out of true three ways, A, B, or C, or a combination of two of the three ways.
   a. When wheels are both out of true as described in "A", tighten C-clamp on rims or wheels at high spot and lightly tap the rim at the crankpin with a lead mallet.
   b. When wheels are both out of true as indicated in "B", install a screw-type wedge between the wheels at high spot and lightly tap the rims near the crankpins with a mallet.
   c. When wheels are out of true as indicated in "C", strike the rim of the wheel a firm blow at about 90 degrees from crankpin on high side.
   d. When wheels are out of true in a combination of any of conditions shown, correct "C" first, tapping rim of right pinion shaft only, and then correct condition "A" or "B".

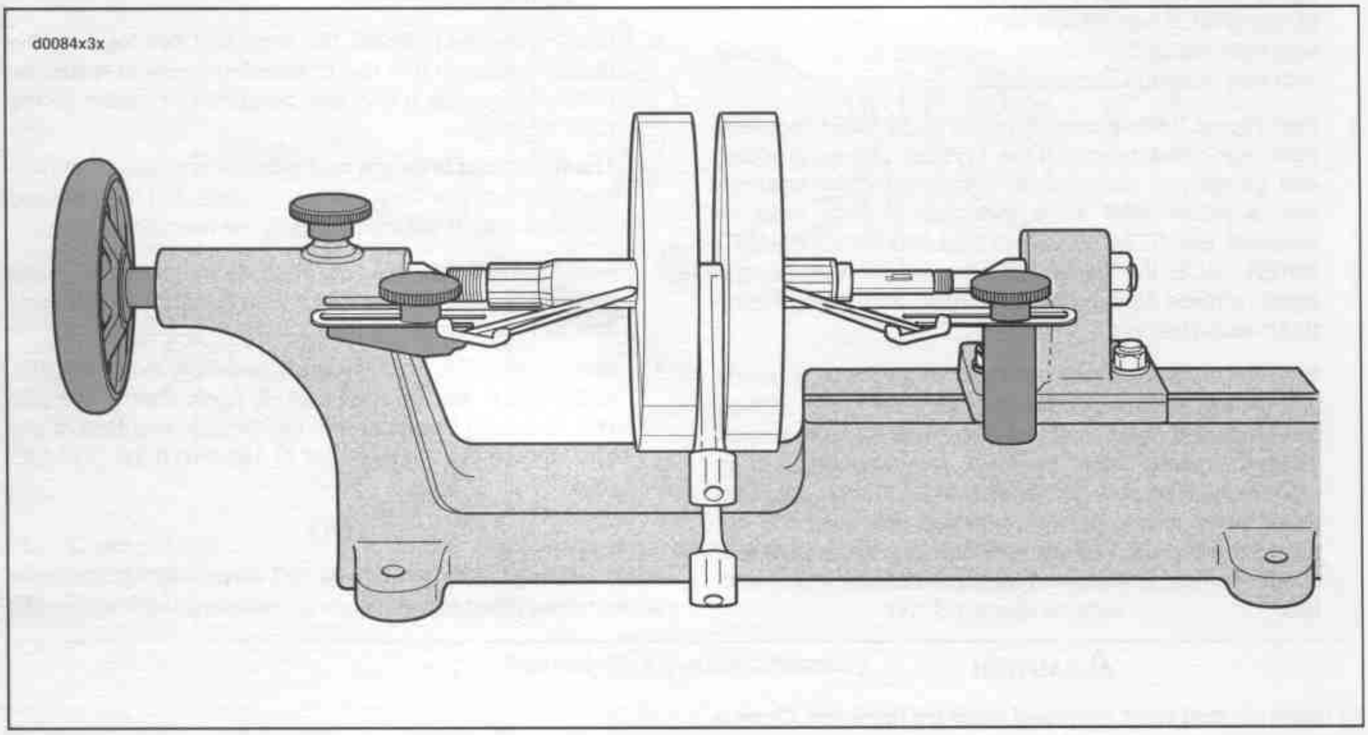


Figure 3-73. Flywheels on Truing Stand

NOTE

- *The number of blows required and how hard they should be struck depends on how far shafts are out of true and how tight nuts are drawn.*
- *Always remove the flywheels from the stand and strike the flywheel rim only at 90° to the crankpin. Use only a soft metal mallet. Never strike wheels a hard blow near crankpin. This could result in a broken crankpin.*

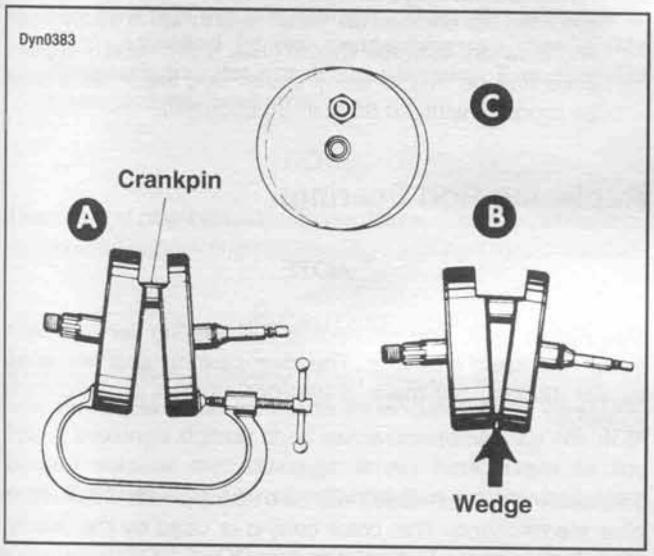


Figure 3-74. Types of Flywheels Misalignment

4. Readjust centers, revolve wheels and take reading from indicator. Repeat truing operation until indicated runout does not exceed 0.002 in. (0.1 mm) (each graduation on indicator is 0.002 in.(0.1 mm)).
5. See Figure 3-75. Check connecting rod side play with thickness gauge. If it is greater than tolerance shown in engine SPECIFICATIONS, tighten crank pin nuts until within, but not exceeding torque limits. Insufficient play between rods and flywheel face is caused by one of the following conditions:
   a. Flywheel and crank pin assembled with oil on tapers and nuts over-tightened. Disassemble, clean, reassemble.
   b. New flywheel washers installed and not fully seated. Disassemble, inspect, replace deepest seating flywheel or exchange crankpin. As last resort, grind down width of forked rod.
   c. Tapered hole(s) enlarged as a result of having been taken apart several times. Replace flywheel(s).

After rod side play is checked and adjusted and crank pin nut tightened to specified torque, again recheck wheel trueness on truing stand. Correct any runout as above.

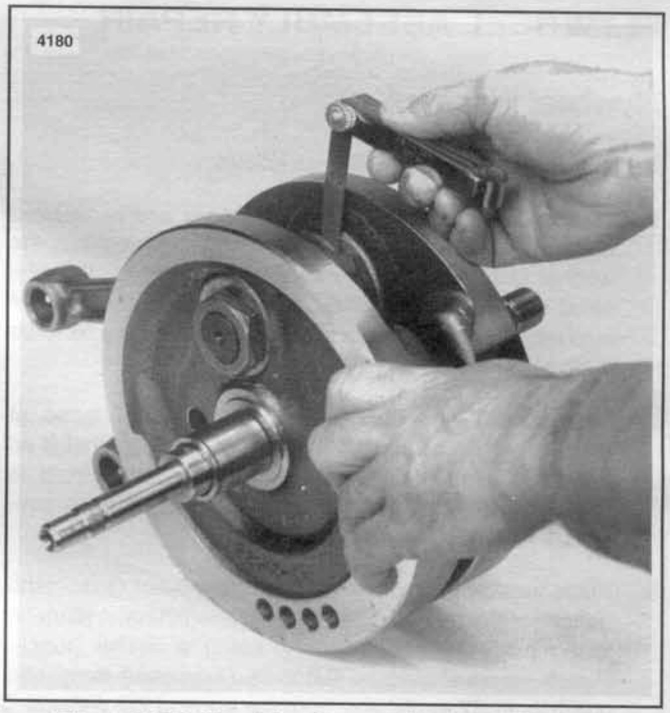


Figure 3-75. Checking Connecting Rod Side Play

6. See Figure 3-72. When wheels are true, place flywheel in FLYWHEEL ASSEMBLY JIG, Part No. HD-34813 and using a torque wrench, tighten crank pin nuts to 180-210 ft-lbs (244-285 Nm) final torque. Recheck for truing and runout, and if either is not within specification, repeat truing procedure.

FLYWHEEL ASSEMBLY REPAIR

Flywheel Washers

Replace worn flywheel washers as follows:

1. Washer is a close fit in flywheel recess and is secured originally by punching flywheel metal tight against the washer at several points. It is usually necessary to drill a small hole (0.125 in. (3.18 mm) or smaller) through the washer. Turn a self-tapping screw into the hole to force the washer out.

2. Before installing new washer, scrape outer edge of washer recess where metal was punched against it so new washer may seat fully against recess bottom. If washer does not seat fully, forked rod will not have necessary clearance for side play.

3. Place washer in position with the chamfered O.D. in the bottom of the recess. Stake the new washers in place in four equally spaced locations using a center punch. Punch marks should be 0.045 in. (1.14 mm) deep and 0.050 in. (1.27 mm) away from the edge of the washer.

Lapping Connecting Rod Races

Special Tools	Torque Values
HD-96740-36 Connecting rod lapping arbor	None

1. See Figure 3-76. Connecting rod lower races that are likely to clean up within the range of an oversize crankpin and are otherwise in serviceable condition, should be trued and sized up with CONNECTING ROD LAPPING ARBOR, Part No. HD-96740-36.

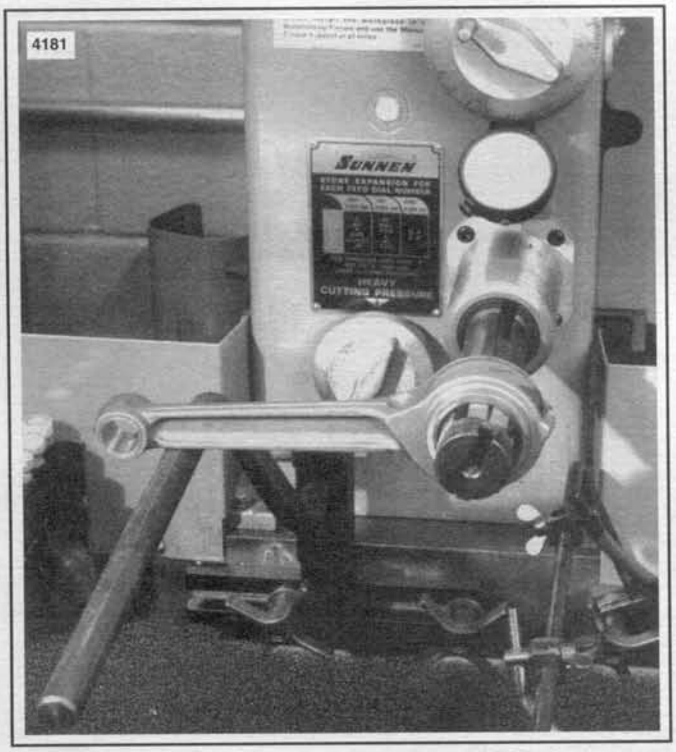


Figure 3-76. Lapping Connecting Rod

2. Turn lap in lathe at 150 to 200 rpm. Adjust lap by means of adjusting nut to a dragging but free fit in rod race. Clean lap before using, then apply fine lapping compound (No. 220 grit grinding compound mixed with oil) to lap. A loose lap will "bell mouth" bearing race so it must be kept adjusted at all times. To avoid grooving or tapering lapped surfaces in rods, work rod back and forth the full length of the lap holding rod as near race end as possible. Lap rods individually.

3. When rods are lapped true and all traces of pit marks or grooving are cleaned up, wash rods in warm soapy water and blow dry. Surface should have a soft velvety appearance and be free of shiny spots. Rod lower races must be round to within 0.0002 in. (0.005 mm).

Replacing Rod Bearings

NOTE

See Figure 3-77. The connecting rod bearing set consists of three packaged bearings. The new bearing sets will retrofit earlier models, but there is another method of using these bearings.

The bearing set packages are color coded with either red or blue identification. This color coding is used by the bearing manufacturer only. The color coding DOES NOT indicate size selection for connecting rod bearing replacement.

CAUTION

Either a red or a blue coded bearing set may be used. DO NOT intermix bearings from a red and a blue bearing set because this will cause excessive loading on one bearing resulting in premature bearing failure.

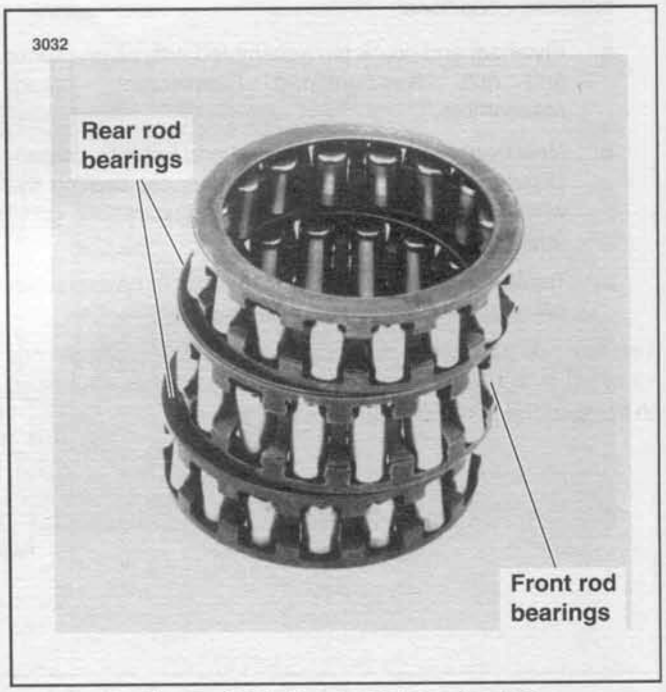


Figure 3-77. Crank Pin Bearing Set

⚠CAUTION

- **The bearings consist of rollers retained in steel cages. The wide bearing (male/front rod) retains the rollers both internally and externally. The two narrow bearings (female/rear rod) only retain the rollers in one direction so care must be taken that the rollers do not drop out of the cage when the bearing set is removed from the plastic sleeve.**
- **Only one size replacement bearing set is sold. Oversize bearings are not available. Bearing clearance or fit is controlled by the connecting rod race inside diameters and the crank pin diameter. Two oversize crank pins are available.**

NOTE

Measure end play between connecting rod and thrust washer, not between connecting rod bearing cage and thrust washer.

⚠CAUTION

Because of the extremely small tolerances involved, all measurements must be made as accurately as possible. Fitting bearings tighter than recommended may result in bearing seizure and damage when heat expands the parts. Excessive clearance will result in a noisy bearing.

All fitting and checking must be made with bearings, rods and crank pin clean and free of oil.

Establishing Proper Bearing Clearance

Oversized crank pins are used in the rod bearing to establish connecting rod clearance on crank pin.

See Figure 3-78. Oversize (OS) crank pins are available in two oversizes: 0.0010 and 0.0020 in. (0.025 and 0.051 mm) OS crank pins will have a blue or a red dot painted on their ends. A blue dot indicates 0.0010 in. (0.025 mm) OS, a red dot indicates 0.0020 in. (0.051 mm) OS. Standard size crank pins will not be marked.

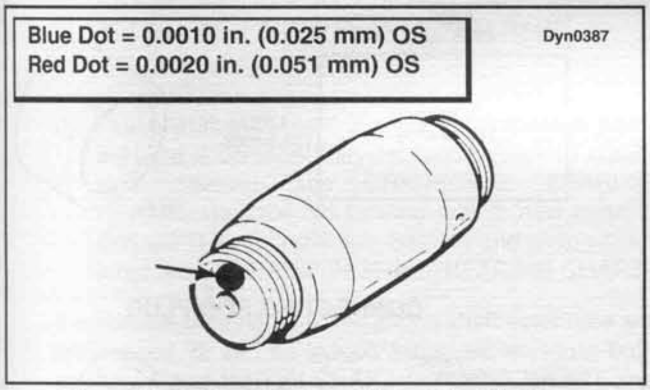


Figure 3-78. Oversize Crank Pin Identification

1. See Figure 3-79. To properly fit the rod bearings, measure inside diameter (ID) of lapped connecting rod races with a dial bore gauge that has 0.0001 in. (0.0025 mm) graduations. Measure the ID at four places as shown. Record the four measurements.

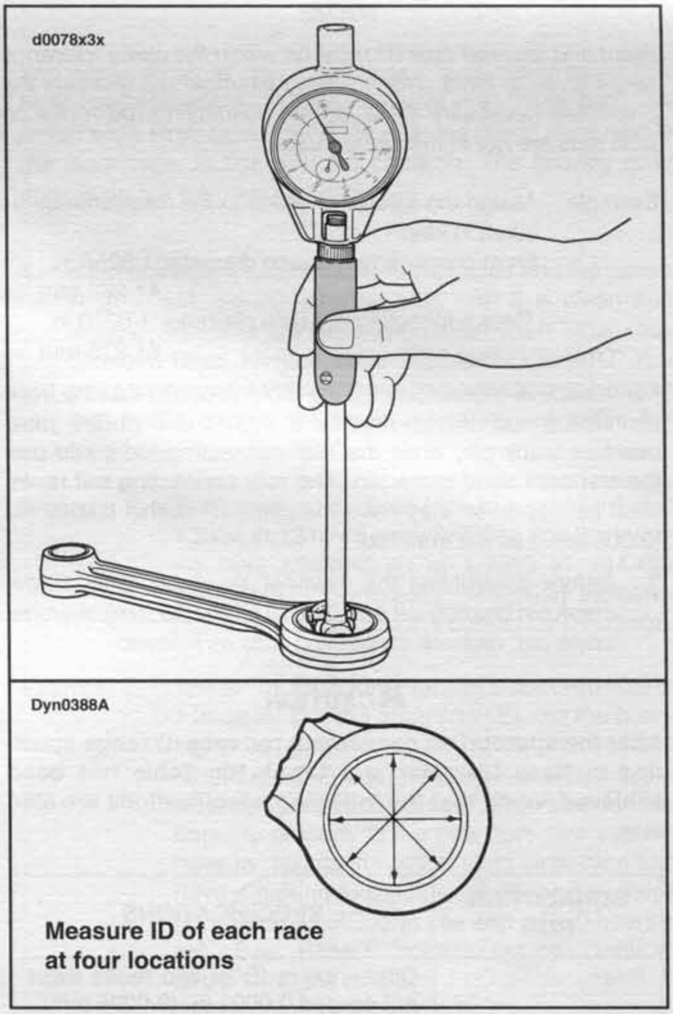


Figure 3-79. Measuring Connecting Rod Race Inside Diameters

See Replacing Rod Bearing Outer Races. If any race ID exceeds Service Wear Limit of 1.6270 in. (41.326 mm), replace races or connecting rod set. If race ID measurements are less than 1.6270 in. (41.326 mm), continue procedure as follows:

2. Compare the measurement recorded in step 1 with the ranges given in Race Diameter and Crank Pin Size Table below. If the four measurements taken in each race differ, use the smallest measurement.

Race Diameter and Crankpin Size Table

CONNECTING ROD RACE ID REQUIRED	CRANK PIN REQUIRED
1.6245-1.6250 in. (41.262-41.275 mm)	Standard
1.6255-1.6260 in. (41.288-41.300 mm)	0.0010 in. (0.025 mm) oversize
1.6265-1.6270 in. (41.313-41.326 mm)	0.0020 in. (0.051 mm) oversize
Greater than 1.6270 in. (41.326 mm)	Service wear limit exceeded. Replace races or rods.

NOTE

Front and rear rod race ID must be within the same tolerance range given in table. The following example will illustrate the procedure necessary if the lapped connecting rod races on both rods are not in the same range.

Example: Assign the following values to the measurements taken in step 1.
Front connecting rod race diameter:1.6255 in.
41.288 mm
Rear connecting rod race diameter:1.6250 in.
41.275 mm

For the above measurements the table specifies that the front connecting rod would require a 0.0010 in. (0.025 mm) oversize crank pin, while the rear connecting rod could use the standard sized crank pin. The rear connecting rod races must be lapped so they have the same ID (within 0.0002 in. (0.005 mm)) as the front rod.

3. Before assembling the flywheel assembly, with a new crank pin bearing set and 0.0010 in. (0.025 mm) oversize crank pin, recheck connecting rods as follows:

⚠CAUTION

After the appropriate connecting rod race ID range specified in Race Diameter and Crank Pin Table has been achieved, verify that the following specifications are also met.

CONNECTING ROD	SPECIFICATIONS
Rear	Difference in ID of two races must not exceed 0.0001 in. (0.0025 mm).
Front	Difference in ID of race in front connecting rod must not exceed 0.0001 in. (0.0025 mm).
Front and rear	Races must be round within 0.00025 in. (0.0064 mm). (Difference between largest and smallest ID measurement in any race must not exceed 0.00025 in. (0.0064 mm))

NOTE

Always use new bearings and crank pin after resizing (lapping) connecting rods to ensure proper running clearance.

Replacing Rod Bearing Outer Races

Special Tools	Torque Values
HD-33416 Universal driver handle Fabricated tools – See below	None

FRONT ROD

1. See Figure 3-80. Make a plug and sleeve to the dimensions shown.

⚠CAUTION

Be sure the sleeve fully supports the outside of the connecting rod or the rod will be damaged beyond repair.

2. Use plug and sleeve with the UNIVERSAL DRIVER HANDLE, Part No. HD-33416 and your shop press. Press the outer race out of the connecting rod, into the sleeve.

REAR ROD

NOTE

*To remove the rear rod races, position the plug **between** the two races and press out.*

1. Press out first one race, then turn the rod over and press out the opposite race.
2. Press new races into the rods until they bottom on the table. Make sure the chamfer in the race faces in the direction the race is being pressed.

NOTE

The race outside edge should be flush with the outside surface of the rod.

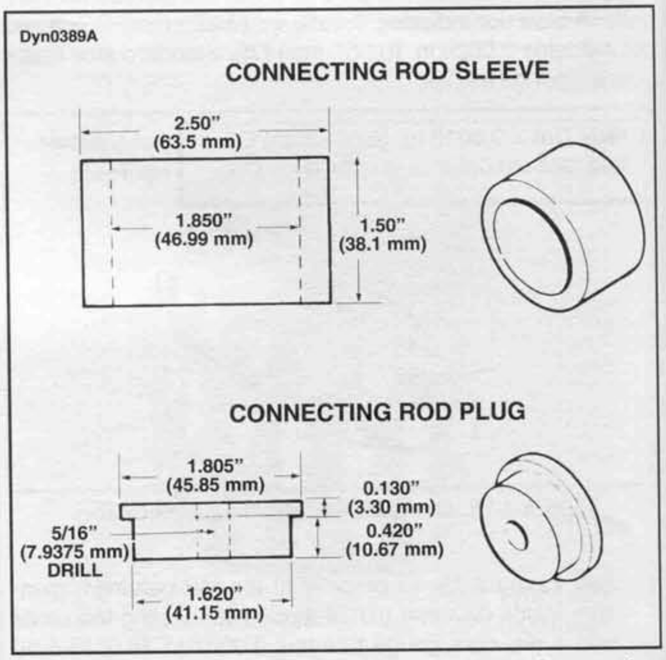


Figure 3-80. Manufactured Tools for Pressing Connecting Rod Bearing And Pinion Outer Races

Replacing Pinion Shaft Bearings

⚠CAUTION

Because of the extremely small tolerances involved, all measurements must be made as accurately as possible. Fitting bearings tighter than recommended may result in bearing seizure and damage when heat expands the parts. Excessive clearance will result in a noisy bearing.

NOTE

Shafts/flywheels have a replaceable crankcase bushing. Instead of shafts with oversized journals, one-piece flywheels use a pressed-on inner race that can be replaced and ground to the outside diameter (O.D.) needed for proper crankcase bushing fit.

All fitting and checking must be made with bearings, crankcase and pinion shaft clean and free of oil.

1. See Figure 3-65. Inspect pinion shaft inner race (5) and crankcase bearing (17) for wear or damage. If inner race and bearing bore are clean and undamaged, go to step 3.
2. If crankcase bearing or pinion shaft inner race, or both, are scored, worn or damaged, you must:
   A. Lap the crankcase bearing bore and pinion shaft inner race until they are smoothly finished and replace the old bearings with new, oversize bearings. See PINION SHAFT BEARING CHART.

OR:

   B. Lap the crankcase bearing bore and replace the old pinion shaft inner race and bearings with a new pinion shaft inner race and bearings. See REMOVING/INSTALLING PINION SHAFT INNER RACE.

OR:

   C. Both crankcase bearing bore and pinion shaft inner race are too badly damaged to be reused. Replace crankcase bearing and pinion shaft inner race. See CRANKCASE BEARING REPAIR and REMOVING/INSTALLING PINION SHAFT INNER RACE.

OR:

   D. Pinion shaft inner race is good and crankcase bearing bore is damaged beyond reuse. Replace crankcase bearing, see CRANKCASE BEARING REPAIR. Replace old bearing with a new bearing that will fit both crankcase bearing and pinion shaft inner race. See PINION SHAFT BEARING CHART.

3. If crankcase bearing bore and pinion shaft inner race are undamaged, or can be lapped for reuse, measure both carefully. Read PINION SHAFT BEARING CHART and select the bearing set that will fit both dimensions correctly.

Example: If the crankcase bearing bore measures 1.7509 in. (44.473 mm) and the pinion shaft inner race measures 1.2500 in. (31.750 mm), use a BLUE bearing set. This will fit a class two (2) crankcase and the pinion shaft inner race (GREEN).

NOTE

The class code on new crankcases is stamped below the base gasket surface, INSIDE the right crankcase half. The pinion shaft inner race color code is on the pinion shaft next to the inner race, in line with the crankpin. The bearing color code is on the wrapper and carton.

4. If the crankcase bearing bore is damaged and the pinion shaft is not, lap the bearing bore until it is clean and smooth. Measure the bore and pinion shaft inner race carefully. Read PINION SHAFT BEARING CHART. You must determine if the new bore size will allow you to use the existing pinion shaft with a bearing set within the range shown on the chart.

Example 1: The pinion shaft inner race is a standard size 1.2498 in. (31.745 mm)(GREEN) and the bushing bore cleaned up at 1.7513 in. (44.483 mm)(class 3 crankcase). The chart indicates that a RED bearing set is correct for this range.

Example 2: The pinion shaft inner race is a standard size of 1.2502 in. (31.755 mm)(WHITE), but the bushing bore cleaned up at 1.7531 in. (44.529 mm)(class 3, O.S.). The chart indicates that the existing inner race is now undersize for the bore. To properly fit the new bore size you will have to replace the pinion shaft inner race and have it ground to 0.002 in. (0.05 mm) oversize (O.S.)(class 1 RED), to use with a RED bearing set. See REMOVING/INSTALLING PINION SHAFT INNER RACE.

5. If you successfully lap the bore, but the shaft inner race is damaged beyond reuse, see example 2 above. Replace the inner race and bearing set with parts suitable for the bore size. See REMOVING/INSTALLING PINION SHAFT INNER RACE.
6. If you successfully lap the bore, but the shaft is damaged beyond reuse, replace the flywheel set and bearing set with parts suitable for the crankcase bore size.

Pinion Shaft Bearing Chart

Crankcase bushing bore size (in.)	(mm)	Bearing Sets (Color Coded to Shaft and Bore)	
1.7511-1.7513	44.478-44.483	Red (3)	Blue (3)
1.7509-1.7511	44.473-44.478	Blue (2)	White (2)
1.7507-1.7509	44.468-44.473	White (1)	Green (1)
Color Code Shaft (in.)		Green 1.2498-1.2500 STD.	White 1.2500-1.2502
Color Code Shaft (mm.)		Green 31.745-31.750 STD.	White 31.750-31.755

7. If the crankcase bearing must be replaced, you will have to match the other components to the bearing bore.

NOTE

If the crankcase is not damaged and the bore is outside the O.S. limits shown on the chart, replace the bearing as explained in CRANKCASE BEARING REPAIR earlier in this section. Replace other components as explained.

8. If all components, pinion shaft bearing race, shaft and bearings are damaged beyond repair, replace them all using standard size components.

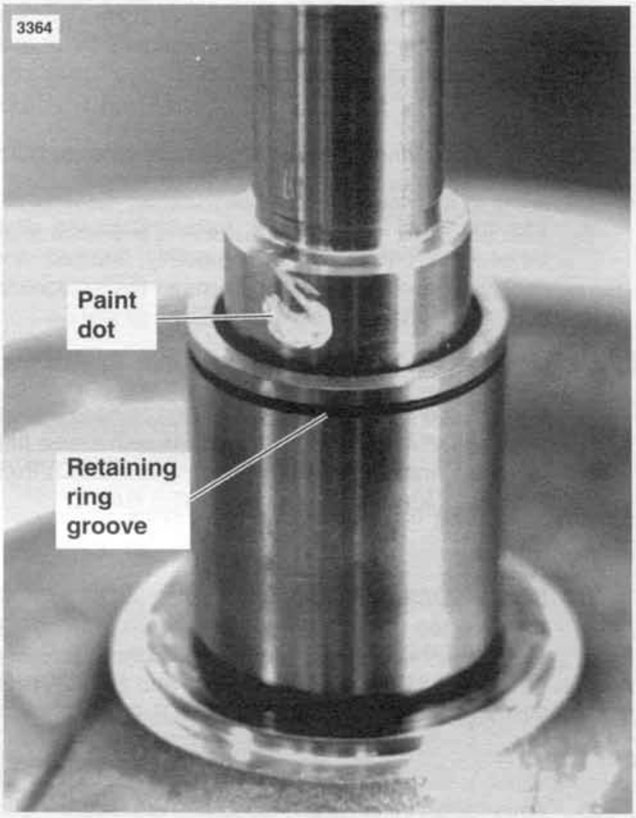
Removing/Installing Pinion Shaft Inner Race

Special Tools	Torque Values
HD-97292-61 Puller HD-95652-43A Shaft protector CJ950 (Snap-on®) Bearing separator	None

NOTE

Harley-Davidson has initiated a program to replace the pinion shaft inner race. Information is available from your H-D Service Department.

9. See Figure 3-81. A paint dot, located next to the inner race and in-line with the crankpin identifies the Class or O.D. of the inner race. See chart in Figure 3-81.



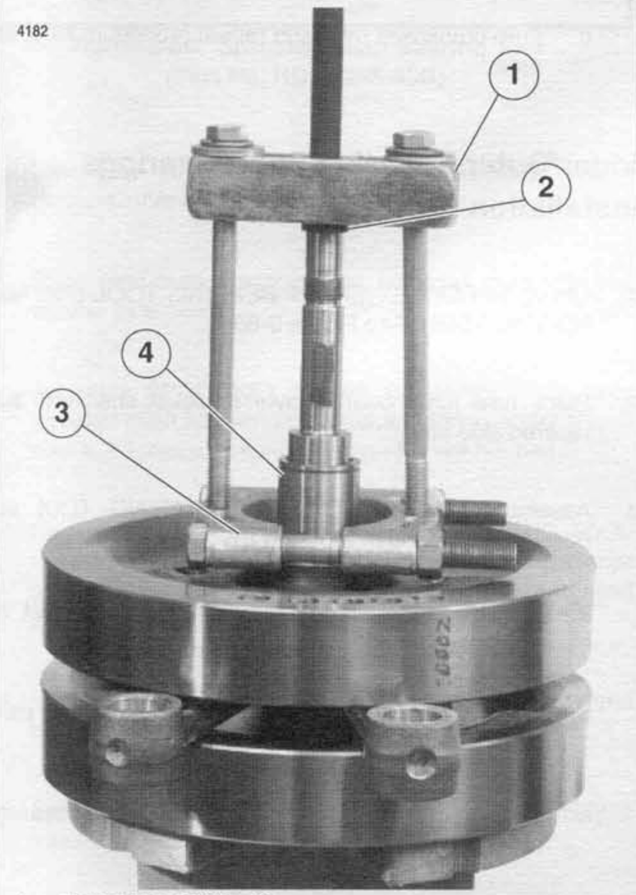
RACE O.D.	CLASS	IDENTIFICATION
1.2502-1.2500 in. (31.755-31.750 mm)	A	White
1.2500-1.2498 in. (31.750-31.745 mm)	B	Green

Figure 3-81. Factory Inner Race Sizes

⚠CAUTION

- **To prevent damage to the pinion shaft center (and bearing journal) always use a shaft protector between the puller forcing screw and shaft when pulling pinion gear or bearing inner race.**
- **Be careful with shaft protectors that have centering projections which could damage the shaft center or flare the end of the shaft. If a shaft protector is not available, breather gear washers H-D Part No. 25320-79 through 25328-79 may be used as shaft protectors.**

1. See Figure 3-82. Remove inner race (4) with tools shown. Apply heat to race to aid removal.
2. See Figure 3-83. Press new race (1) on pinion shaft to the dimension shown. Make sure retaining ring groove end of inner race is away from flywheel. Figure 3-84 shows a fabricated installation tool that will locate the inner race properly when tool is "bottomed" on flywheel.



1. **Puller HD-97292-61**
2. **Shaft protector HD-95652-43A or Washer 25324-79**
3. **Bearing separator, Snap-on® Tools stock no. CJ950 or equivalent**
4. **Inner race**

Figure 3-82. Pulling Pinion Shaft Inner Race

GRIND RACE

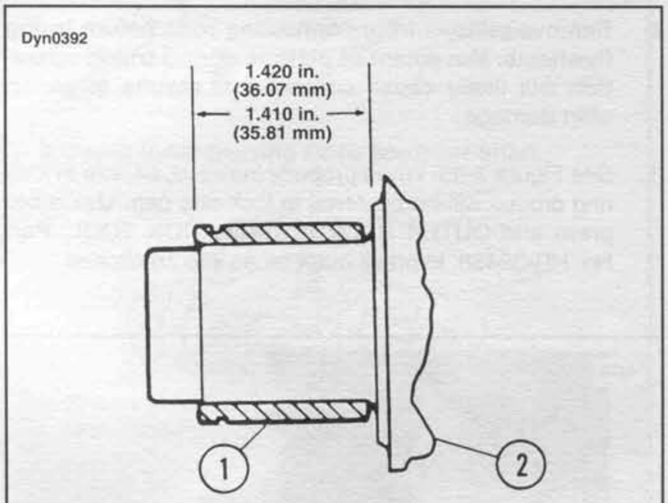
1. See **Pinion Shaft Bearing Chart** and LAPPING ENGINE MAIN BEARING RACES.
2. Find the BORE SIZE that was measured in the pinion outer race.
3. The new inner race must be ground by a competent machinist, to O.D. dimension range given in bottom row of PINION SHAFT BEARING CHART for the finished lapped I.D. of the outer race. The finished inner race must meet these specifications:

   Roundness: .... within 0.0002 in. (0.005 mm)
   Taper: .... within 0.0002 in. (0.005 mm)
   Surface finish: .... 16 RMS

NOTE

Have machinist grind inner race to center or middle of required O.D. range. This will prevent grinding inner race undersize and gives a more easily achieved tolerance range. For example, if BORE SIZE is 1.7518 in., grind inner race to 1.2510.

When flywheels have been properly repaired, install into crankcase. See FLYWHEEL AND CRANKCASE ASSEMBLY.



1. **Pinion shaft inner race** 2. **Flywheel (gear side)**

Figure 3-83. Inner Race Location

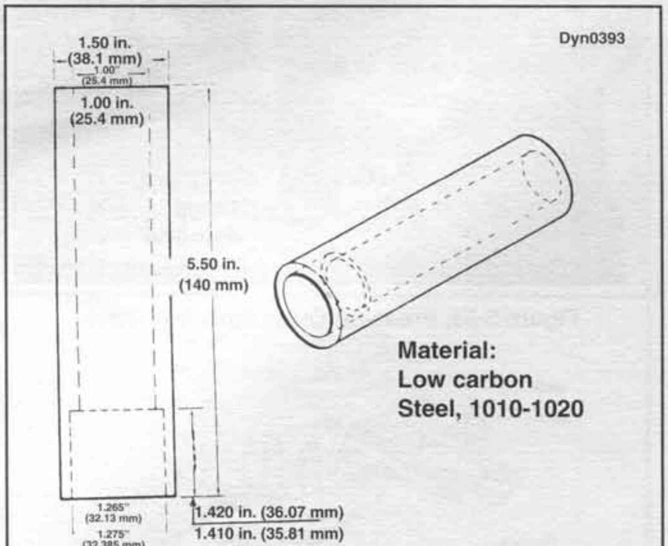


Figure 3-84. Inner Race Installation Tool

FLYWHEEL AND CRANKCASE ASSEMBLY

Special Tools	Torque Values
HD-39458 Outer Race Installation Tool HD-97225-55B Sprocket Shaft Bearing Tool HD-24036-70 Sprocket Shaft Spacer HD-39361A Sprocket Shaft Seal Installation Tool	Crankcase studs, bolts, nuts – See CRANKCASE TORQUE SEQUENCE

⚠CAUTION

- **If you have only replaced crankcase halves, be sure flywheels are true before installing. See TRUING FLYWHEELS. Failure to true flywheels can result in engine damage.**
- **Remove pistons from connecting rods before truing flywheels. Movement of pistons during truing operation will likely cause contact that results in piston skirt damage.**

1. See Figure 3-85. When properly installed, oil hole in lock ring groove will be centered in lock ring gap. Use arbor press and OUTER RACE INSTALLATION TOOL, Part No. HD-39458, to press outer races into crankcase.

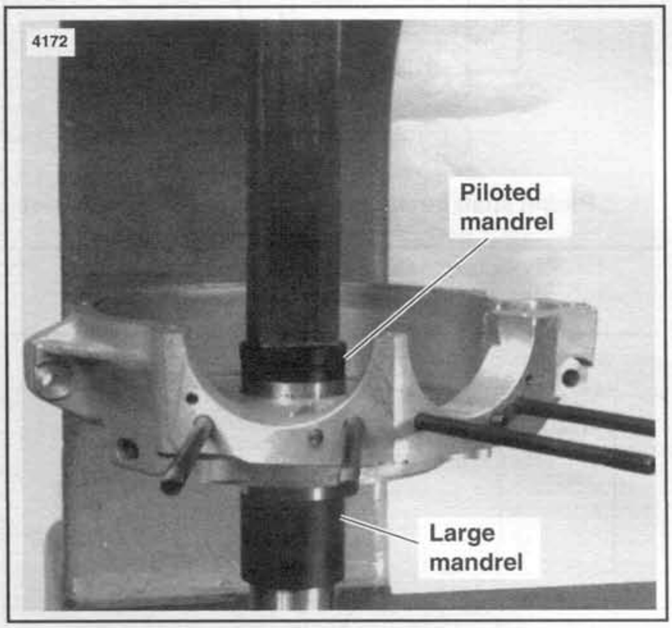


Figure 3-85. Pressing Outer Race Into Case

2. Press the races into the case, one from each side, with the largest diameter outward to match taper of bearings. Be sure each race bottoms on the lock ring (Item 12, Figure 3-65).

NOTE

Be sure Sportster piloted mandrel is not in large mandrel. If Sportster piloted mandrel is in large mandrel, the Big Twin piloted mandrel will stop against the Sportster piloted mandrel and the inner race will not be fully inserted in the crankcase.

   a. Place crankcase on large mandrel so it rests on circlip (Item 2, Figure 3-65).

   b. Place inner race on piloted mandrel and place in position on crankcase.

   c. Turn crankcase over and repeat procedure for other race.

Inner/Outer Sprocket Shaft Bearings Installation

1. Obtain SPROCKET SHAFT BEARING TOOL (Part No. HD-97225-55B). See Figure 3-86.

2. Place **new** inner bearing over sprocket shaft with the tapered side up.

3. Assemble SPROCKET SHAFT BEARING TOOL as described below. See Figure 3-87.

   a. Thread pilot onto sprocket shaft until contact is made with shoulder.

   b. Sparingly apply graphite lubricant to threads of pilot shaft to ensure smooth operation.

   c. Slide sleeve over pilot until it contacts inner bearing race.

   d. Slide Nice bearing and large flat washer over pilot until contact is made with sleeve.

   e. Thread handle onto pilot shaft.

4. Rotate handle of SPROCKET SHAFT BEARING TOOL in a clockwise direction until inner bearing firmly contacts shoulder of flywheel.

5. Remove handle, flat washer, Nice bearing, sleeve and pilot from sprocket shaft.

6. Carefully place crankcase half over sprocket shaft so that it rests flat on inner bearing.

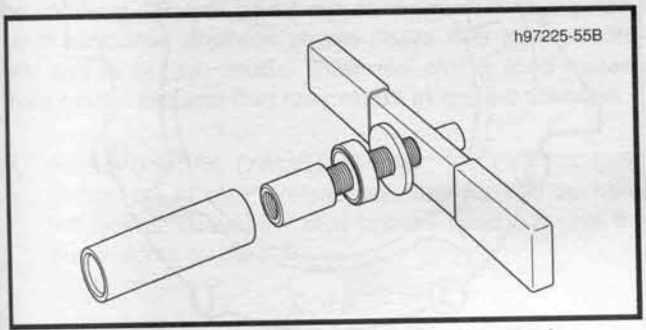


Figure 3-86. Sprocket Shaft Bearing Tool (Part No. HD-97225-55B)

7. Slide **new** inner spacer over sprocket shaft until it contacts inner bearing race.

8. Place **new** outer bearing over sprocket shaft with the tapered side down.

9. Assemble SPROCKET SHAFT BEARING TOOL onto sprocket shaft following procedure outlined under step 3 above. Additional graphite lubricant is not needed.

10. Rotate handle of SPROCKET SHAFT BEARING TOOL in a clockwise direction until bearing firmly contacts inner spacer. Inner and outer bearings must be tight against inner spacer for correct bearing clearance.

11. Remove handle, flat washer, Nice bearing, sleeve and pilot from sprocket shaft.

12. Spin crankcase half to verify that flywheel assembly is free.

13. See Figure 3-65. Remove assembly from fixture and install bearings (4) and bearing washer on pinion shaft (3). Install new circlip (2) on groove in pinion shaft. Slip right case half over bearing and against left case half after applying coat of non-hardening gasket sealer, CRANKCASE SEALANT, Part No. HD-99650-81 or 3M #800 to mating surfaces.

14. See Figure 3-64. Align case halves and tap crankcase studs into holes. These three studs properly align the case halves and must be installed before remaining studs. Start nuts and tighten until snug. Assemble remaining studs, bolts and nuts. Tighten fasteners to torque sequence given below.

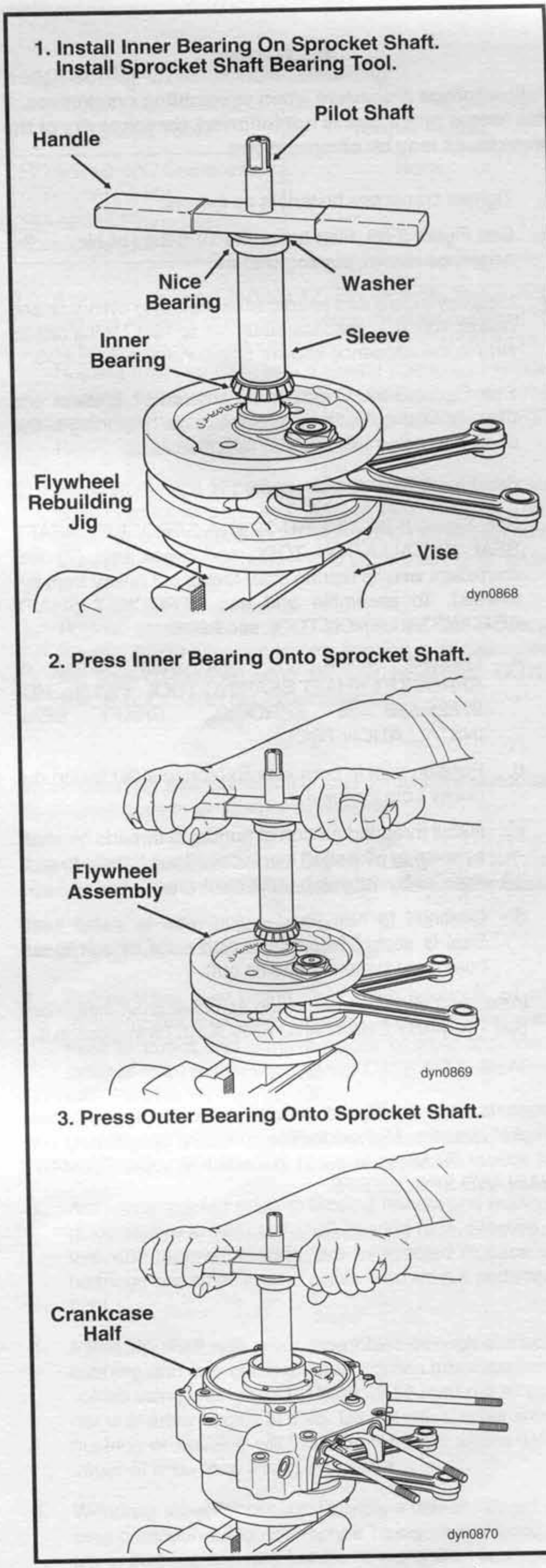


Figure 3-87. Press Inner and Outer Bearings onto Sprocket Shaft

Crankcase Torque Sequence

⚠CAUTION

Follow torque procedure when assembling crankcases. If this torque procedure is not followed, the longevity of the crankcases may be compromised.

1. Tighten crankcase fasteners as follows:

- See Figure 3-88. First tighten to 10 ft-lbs (14 Nm) in the sequence shown, starting with #1.
- Install cylinders and heads. After installing cylinders and heads, tighten crankcase fasteners to 15-17 ft-lbs (20-35 Nm) in the sequence shown. See CYLINDER HEADS.

2. See Figure 3-63. Check exact amount of flywheel end play with dial indicator as directed at the beginning of this section to determine if within specified limits.
3. See Figure 3-65. Install spacer (6).
4. See Figure 3-89. Use HD-39361A SPROCKET SHAFT SEAL INSTALLATION TOOL and press seal (7) into crankcase with lip (spring side) facing out (away from flywheels). To assemble and use SPROCKET SHAFT SEAL INSTALLATION TOOL see below:
   a. Connect handle and pilot shaft portion of SPROCKET SHAFT BEARING TOOL, Part No. HD-97225-55B to SPROCKET SHAFT SEAL INSTALLATION TOOL.
   b. Position seal in bore with lip (spring side) facing out (away from flywheels).
   c. Install threaded portion of handle to threads on shaft by rotating pilot shaft clockwise. Snug handle to seal installer by rotating handle clockwise.
   d. Continue to turn handle clockwise to install seal. Seal is seated when flush with edge of crankcase bore (seal installer bottoms out).
5. Install and align compensating sprocket shaft extension. See PRIMARY CHAIN AND SPROCKETS in Section 6.

NOTE

Sprockets must be aligned through use of correct thickness sprocket spacers. Method for checking and determining correct spacer thickness is given in section 6 under PRIMARY CHAIN AND SPROCKETS.

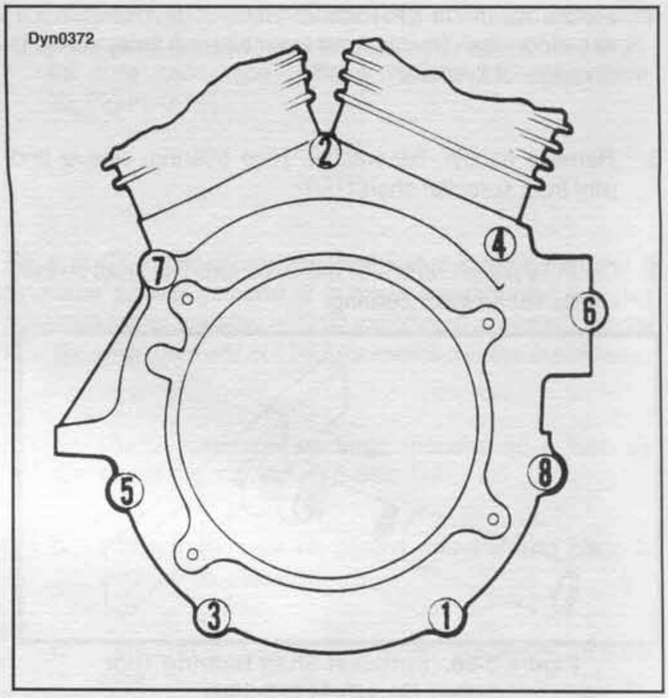


Figure 3-88. Crankcase Torque Sequence

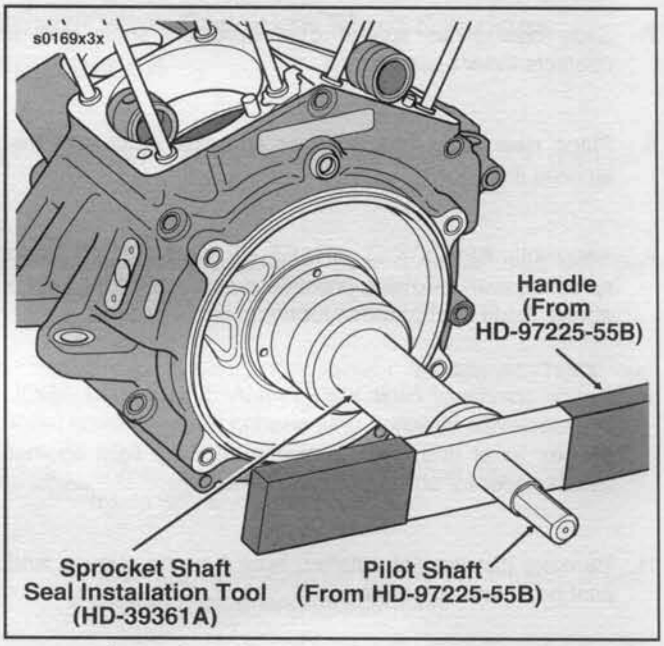


Figure 3-89. Pressing Seal into Crankcase

CYLINDER STUDS

Special Tools	Torque Values
None	Cylinder studs 10 ft-lbs (13.6 Nm)

⚠CAUTION

Cylinder studs that are bent, scratched or broken must be replaced. Broken and bent studs distort clamp load while scratches produce stress risers that may eventually lead to broken studs. Distorted clamp load causes head gasket leakage that may result in engine damage.

1. Place a 0.313 in. DIAMETER BALL, HD Part No. 8860 (or from the XL clutch release mechanism) into the head bolt recess. Thread the stud into the head bolt until the stud bottoms on the ball.

NOTE

Pack clean shop towels into the crankcase openings to prevent the ball from falling into the flywheel compartment when removing the head bolt.

2. Clean the threads in the crankcase.
3. See Figure 3-90. Install the studs in the crankcase with the shoulder side down. Studs have a Loctite patch on the crankcase end threads.

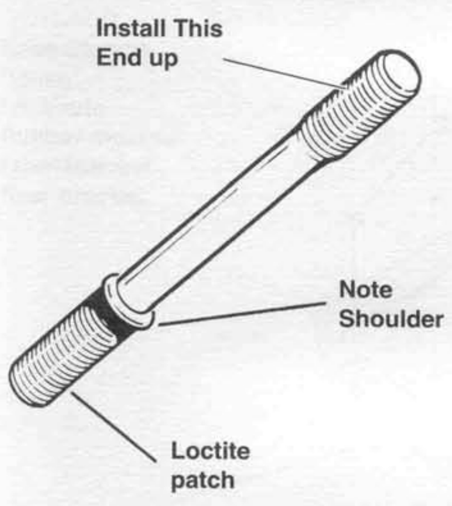


Figure 3-90. Cylinder Stud

⚠CAUTION

Do not use a ratchet or breaker bar to install cylinder studs because they will bend the studs.

4. Use a T-handle to install the studs. Tighten to 10 ft-lbs (13.6 Nm).

NOTE

Refer to FLYWHEEL ASSEMBLY INTO CRANKCASE following FLYWHEELS for additional crankcase installation procedures.

CRANKCASE BEARING REPAIR

Replacing Crankcase Bearing

Special Tools	Torque Values
HD-96710-40C Crankcase main bearing lap HD-39958 Pinion bearing outer race tool	None

1. A crankcase bearing (Item 17, Figure 3-65) that is worn beyond limits of oversize bearings must be replaced. To remove bearing, heat case to 275°-300°F (135°-149°C). Heating expands case and makes it possible to remove bearing using less force. After case is heated, press worn bearing out using PINION BEARING OUTER RACE TOOL, Part No. HD-39958.
2. Allow crankcase to cool to room temperature, then measure crankcase bore and O.D. of new bearing. There must be 0.005-0.003 in. (0.127-0.076 mm) interference between crankcase bore and O.D. of bearing for proper fit.
3. Reheat crankcase to 275°-300°F (135°-149°C), apply Sunner B-200 lubricant to new bearing, and press bearing into crankcase using PINION BEARING OUTER RACE TOOL, Part No. HD-39958.

NOTE

When installing bearing, turn tool and component periodically so bearing goes in as straight as possible.

New bearing must be lapped slightly to align with left case bearing and to be a size compatible with roller sizes available.

Lapping Crankcase Bearing

1. Before fitting new pinion shaft main bearings, or after replacing old crankcase bearing, lap bearing in crankcase to true it and remove traces of wear shoulder at sides of roller paths. Use CRANKCASE MAIN BEARING LAP, Part No. HD-96710-40C.
2. See Figure 3-91. Assemble crankcase halves and top end. Torque all fasteners to specification.
3. Assemble lapping arbor to lapping handle and assemble guide sleeve to sprocket shaft bearing race. Sleeves, for use with tapered bearing, are assembled to case with bearings and small spacer collar. Turn sleeve parts finger tight.
4. Insert lap shaft with arbor assembled through crankcase bushing and into guide sleeve. Tighten arbor expansion collars using a length of 0.156 in. (3.96 mm) rod as spanner until arbor begins to drag. Do not adjust arbor snug in bushing or bushing will "bell," a condition where hole is larger at ends than it is in the center.
5. Withdraw arbor far enough to apply a dab of 220 grit lapping compound. Do not apply a heavy coat. Reposition lap in bushing and turn handle at moderate hand speed. Work lap back and forth in bushing as it is revolved to avoid grooving and tapering.

6. At frequent intervals, remove lap from crankcase; wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance. If necessary, apply a few drops of oil to prevent lapping compound from drying up.

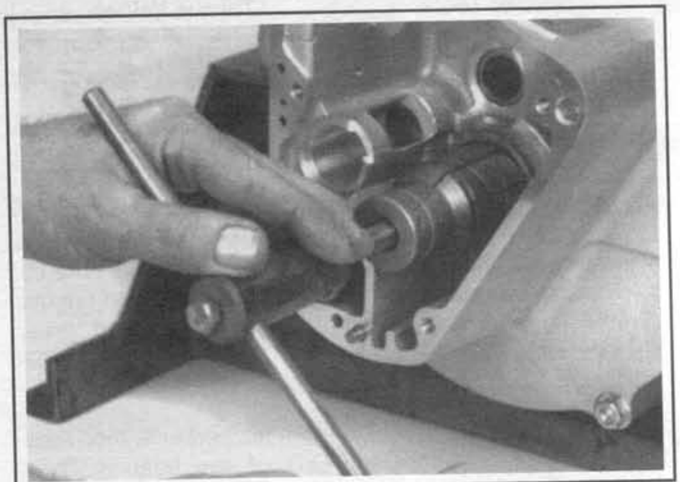


Figure 3-91. Lapping Crankcase Bushing

Cleaning Crankcase

⚠CAUTION

Crankcase half must have all lapping compound cleaned out of it or severe engine damage could result.

Use solvent in parts cleaner.

1. Pump solvent through all oil holes to thoroughly clean all lapping compound out of crankcase half.
   - Tilt case, hold finger over different holes and force solvent through oil passages.
   - After cleaning with solvent, blow out all oil passages with low pressure air.
2. Use pipe cleaners and clean all oil holes.
3. Wash with hot, soapy water and dry thoroughly, before assembly.

OIL TANK

REMOVAL

Special Tools	Torque Values
HD-97087-65B Hose clamp pliers	Rubber mount locknuts 15-19 ft-lbs (20-26 Nm)

1. Drain oil into a suitable container.
2. Remove seat. See Section 2, SEAT.
3. Disconnect electrical harness connector. See Section 2, REAR FENDER.

NOTE

If motorcycle is equipped with shotgun mufflers or accessories such as tool box or saddlebag guards, you may have to remove them.

4. See Figure 3-92. Remove hose clamps (1). Slide hoses (2) off oil tank nipples.
5. Remove locknuts (3) from rubber mounts (4).

NOTE

Do not remove rubber mounts (4) and brackets (5 and 6) unless necessary.

6. Carefully maneuver oil tank away from the rubber mounts and out of motorcycle frame.

INSTALLATION

1. See Figure 3-92. Carefully place oil tank in position on rubber mounts (4).
2. Install locknuts (3). Tighten locknuts (3) to 15-19 ft-lbs (20-26 Nm)

⚠CAUTION

Be sure you put the hoses on the correct nipples. If you mix up the hoses, you will mix up the engine oil flow, causing severe engine damage.

3. Place new hose clamps (1) over hoses (2) and slide hoses onto nipples. Be sure you put the hoses on the correct nipples.
4. Install hose clamps using hose clamp pliers, HD-97087-65B. Fill tank with 3 quarts (2.8 liters) Harley-Davidson oil.
5. Connect electrical harness connector. See Section 2, REAR FENDER.
6. Install exhaust system, accessories.
7. Install seat. See Section 2, SEAT

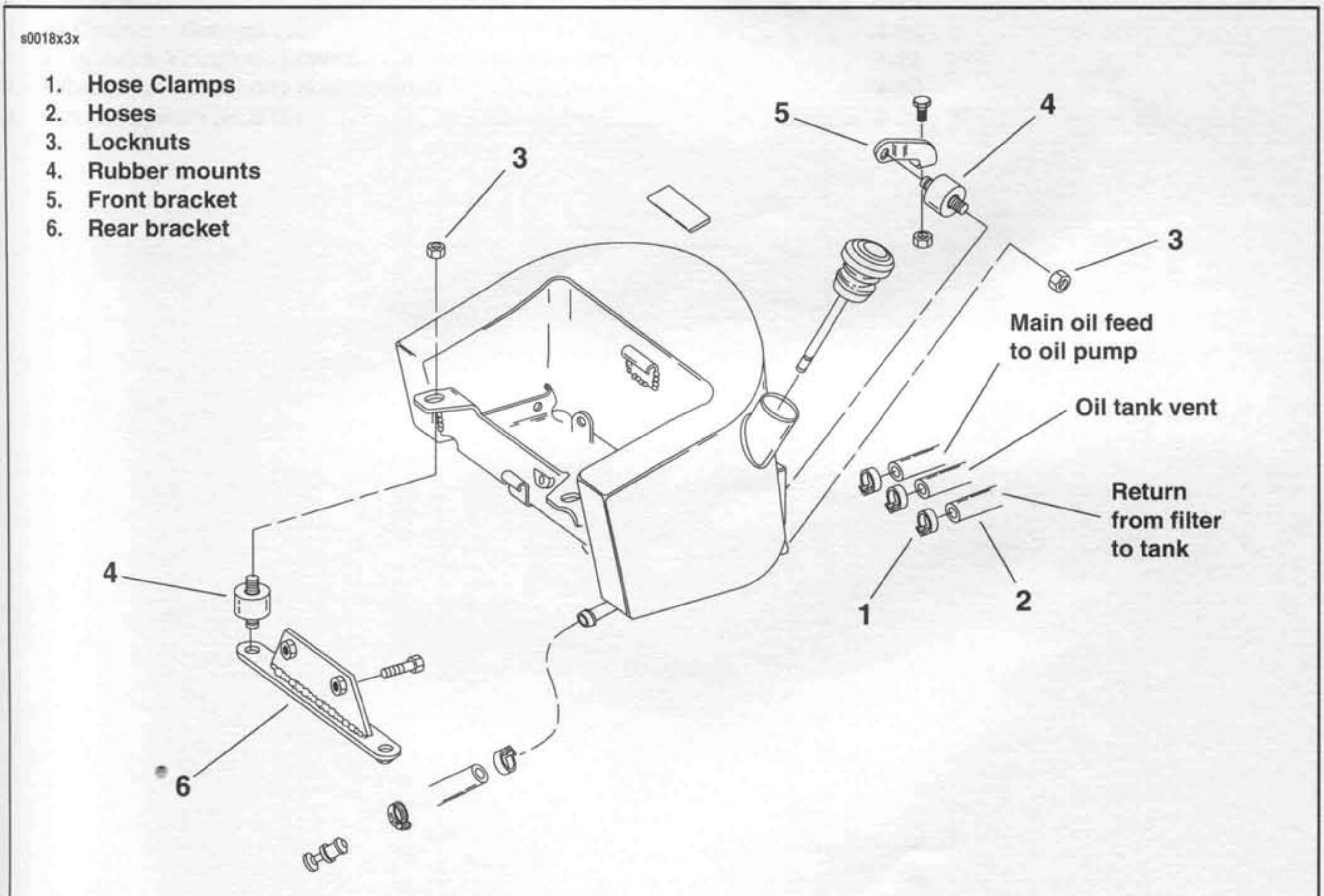


Figure 3-92. Softail Oil Tank

FUEL SYSTEM 4

SUBJECT **PAGE NO.**

SPECIFICATIONS

CARBURETOR JET SIZES

49 State Models Main jet Slow jet	 170 42
California Models Main jet Slow jet	 175 42
HDI Models Main jet Slow jet	 180 42

FUEL TANK CAPACITY

FXSTC	5.2 gal (19.7 L)–total .6 gal–reserve
All other models	4.2 gal (15.9 L)–total .4 gal–reserve

TORQUE VALUES

Manifold mounting capscrews	15-17 ft-lbs (20-23 Nm)
Backplate-to-cylinder head screws	10-12 ft-lbs (14-16 Nm)
Backplate-to-carburetor screws	3-5 ft-lbs (4-7 Nm)
Air cleaner cover screw	3-5 ft-lbs (4-7 Nm)

CARBURETOR

GENERAL

The carburetor is a constant velocity, gravity fed type with a float operated inlet valve, a variable venturi, a throttle stop screw for idle speed adjustment and a fuel enrichment system for starting.

Idle and transfer ports provide a balanced fuel mixture during the transition period from stop to mid-range. A vacuum piston controls venturi opening.

The carburetor is specifically designed to control exhaust emissions. All jets are fixed. The idle mixture has been preset at the factory.

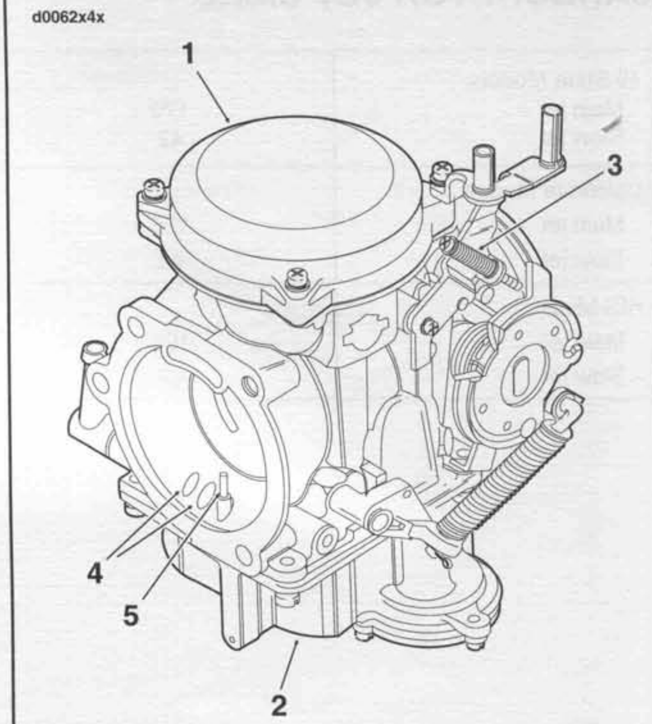
The idle mixture screw is recessed in the carburetor casting. The opening is sealed with a plug because it is intended that the idle mixture be non-adjustable.

NOTE

Adjusting mixture setting by procedures other than specified in this section may be in violation of Federal or State regulations.

The carburetor has a drain for emptying the float chamber during seasonal or extended storage periods. To drain, loosen float bowl drain screw. Fuel will drain from bowl through overflow hose.

The carburetor is equipped with an accelerator pump. The accelerator pump system uses sudden throttle openings (rapid accelerations) to quickly inject fuel into carburetor venturi to provide extra fuel for smooth acceleration.



1. **Vacuum piston chamber**
2. **Float chamber**
3. **Screw, idle speed**
4. **Air jets**
5. **Accelerator pump nozzle**

Figure 4-1. CVH Carburetor

TROUBLESHOOTING

OVERFLOW

Check for:	Remedy:
1. Damaged or non-venting (pinched) continuous venting system.	1. Unclog system.
2. Loose float bowl screws.	2. Tighten screws.
3. Damaged float bowl O-ring.	3. Replace O-ring.
4. Damaged or leaking float assembly.	4. Replace float assembly.
5. Particle contamination in inlet fitting cavity.	5. Clean and clear cavity and fuel supply tract.
6. Worn or dirty inlet valve or seat.	6. Clean or replace valve and clean seat.
7. Improper fuel level in float bowl.	7. Adjust float tab for correct fuel level.
8. Misaligned float halves.	8. Align and adjust float level.

POOR IDLING

Check for:	Remedy:
1. Idle speed improperly adjusted.	1. Adjust idle speed.
2. Inlet system air leak.	2. Correct as required.
3. Loose low speed jet.	3. Tighten jet.
4. Plugged low speed jet.	4. Clean contaminants and clear passages.
5. Contaminated or plugged low speed system.	5. Clean contaminants and clear passages.
6. Enrichener valve not seated or leaking.	6. Adjust, clean or replace.
7. Leaking accelerator pump.	7. Repair.

POOR FUEL ECONOMY

Check for:	Remedy:
1. Excessive enrichener use.	1. Instruct rider.
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Dirty air cleaner element.	3. Clean or replace as required.
4. High speed riding style.	4. Modify riding habits.
5. Idle speed improperly adjusted.	5. Adjust operating idle speed.
6. Loose jets.	6. Tighten jets.
7. Fuel level too high.	7. Adjust float level.
8. Plugged or restricted bowl vent.	8. Clean and clear passages.
9. Worn or damaged needle or needle jet.	9. Replace needle or needle jet.
10. Vacuum piston assembly malfunction.	10. See Vacuum Piston Troubleshooting
11. Plugged air jets or passages.	11. Clean and clear passages.
12. Excessive accelerator pump output.	12. Replace accelerator pump nozzle.

POOR ACCELERATION

Check for:	Remedy:
1. Throttle cables misaligned.	1. Adjust throttle cables.
2. Inlet system air leak.	2. Correct as required.
3. Damaged or non-venting (pinched) continuous venting system.	3. Unclog system.
4. Restricted fuel supply passages.	4. Correct and clear restriction
5. Plugged bowl vent or overflow.	5. Clean and clear passages.
6. Enrichener valve not seated or leaking.	6. Adjust, clean or replace.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston malfunction.	8. See Vacuum Piston Troubleshooting.
9. Plugged jets or passages.	9. Clean and clear as required.
10. Fuel level (float chamber) too low.	10. Adjust float level.
11. Accelerator pump leaking or no output.	11. Repair as necessary.

HARD STARTING

Check for:	Remedy:
1. Enrichener system plugged, not properly functioning or improperly operated.	1. Clean, adjust, replace or read Owner's Manual.
2. Inlet system air leak.	2. Correct as required.
3. Restricted fuel supply.	3. Correct fuel supply or passages.
4. Fuel overflow.	4. See Overflow Troubleshooting.
5. Plugged slow jet or passages.	5. Clean and clear jet or passages.

POOR PERFORMANCE ON ROAD

Check for:	Remedy:
1. Idle speed improperly adjusted.	1. Adjust idle speed.
2. Inlet system air leak.	2. Correct as required.
3. Damaged or non-venting (pinched) continuous venting system.	3. Unclog system.
4. Dirty or damaged air cleaner element.	4. Clean or replace.
5. Enrichener valve not seated or leaking.	5. Adjust, clean or replace.
6. Restricted fuel supply tract.	6. Correct and clear restriction.
7. Plugged bowl vent or overflow.	7. Clean and clear passages.
8. Loose or plugged fuel and air jets or passages.	8. Clean, clear and correct as required.
9. Worn or damaged needle or needle jet.	9. Replace assembly.
10. Vacuum piston assembly malfunction.	10. See Vacuum Piston Troubleshooting.
11. Accelerator pump inoperative.	11. Repair as required.

POOR HIGH SPEED PERFORMANCE

Check for:	Remedy:
1. Inlet system air leak.	1. Clean or replace
2. Enrichener valve not seated or leaking.	2. Adjust, clean or replace.
3. Damaged or non-venting (pinched) continuous venting system.	3. Unclog system.
4. Restricted fuel supply tract.	4. Correct and clear restriction.
5. Dirty or damaged air cleaner element.	5. Clean or replace.
6. Plugged bowl vent or overflow.	6. Clean and clear passages.
7. Worn or damaged needle or needle jet.	7. Replace assembly.
8. Vacuum piston assembly malfunction.	8. See Vacuum Piston Troubleshooting.
9. Loose or plugged main jets or passages.	9. Tighten, clean, clear as required.
10. Improper fuel level.	10. Adjust float level.
11. Accelerator pump inoperative.	11. Repair as required.

VACUUM PISTON ASSEMBLY TROUBLESHOOTING

PISTON DOES NOT RAISE PROPERLY	
Check for:	**Remedy:**
1. Enrichener valve open, not seated or leaking.	1. Adjust, clean or replace.
2. Piston atmosphere vent blocked.	2. Clear vent.
3. Diaphragm cap loose, damaged or leaking.	3. Tighten or replace cap.
4. Spring binding.	4. Correct or replace spring.
5. Diaphragm pinched at lip groove.	5. Reposition diaphragm lip.
6. Torn diaphragm.	6. Replace piston diaphragm assembly.
7. Piston binding.	7. Clean piston slides and body or replace piston.
8. Piston vacuum passage plugged.	8. Clean and clear passage.
PISTON DOES NOT CLOSE PROPERLY	
Check for:	**Remedy:**
1. Spring damaged.	1. Replace spring.
2. Piston binding.	2. Clean piston slides and body or replace piston.
3. Piston diaphragm ring dirty or damaged.	3. Clean or replace piston.

OPERATION

Enrichener

The enrichener knob, labeled CHOKE, and located under the left side fuel tank, controls the opening and closing of the enrichener circuit in the carburetor. The enrichener knob can be adjusted to any position, from full-in to full-out.

⚠CAUTION

You must pay close attention to warm-up time. Either excessive or insufficient use of the enrichener may cause poor performance, erratic idle, poor fuel economy and spark plug fouling.

NOTE

The following starting and operating instructions for all Harley-Davidson motorcycles are recommendations. They may be modified for individual vehicles.

COOL ENGINE

Outside Temperature Less than 60˚F (15.6˚C).

BE SURE THROTTLE IS CLOSED. Pull enrichener knob to full out position. Turn the ignition switch ON and press starter switch to operate the electric starter.

1. See Figure 4-2. After initial 15-30 second warm-up, ride for 3 minutes or 2 miles (3.2 km) with enrichener knob in full out position.
2. After 3 minutes or 2 miles (3.2 km), push the enrichener knob in to the 1/2 way position. Ride 2 minutes or 2 miles (3.2 km).
3. After 2 minutes or 2 miles (3.2 km), push the enrichener knob fully in.

NOTE

If outside temperature is cooler than 20°F (-6.7°C) it may be necessary to pump the throttle 2 or 3 times.

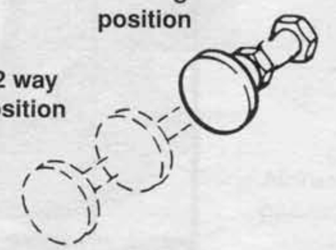


Figure 4-2. Setting the enrichener

Outside Temperature Warmer than 60˚F (15.6˚C).

BE SURE THROTTLE IS CLOSED. Pull enrichener knob to full out position. Turn the ignition switch ON and press starter switch to operate the electric starter.

1. See Figure 4-2. After initial 15-30 second warm-up, ride for 1 minute or 1/2 mile (0.8 km) with enrichener knob in full out position.
2. After 1 minute or 1/2 mile (0.8 km), push the enrichener knob in to the 1/2 way position. Ride 1 minute or 1/2 mile (0.8 km).
3. After 1 minute or 1/2 mile (0.8 km), push the enrichener knob fully in.

WARM CLIMATE OR HOT ENGINE

Open throttle 1/8-1/4. Turn on ignition switch and operate electric starter. DO NOT USE ENRICHENER.

NOTE

If the engine does not start after a few turns or if one cylinder fires weakly but engine does not start, it is usually because of an over-rich (flooded) condition. This is especially true of a hot engine. If the engine is flooded, push enrichener knob in all the way, turn ignition on and operate starter with throttle wide open. DO NOT "pump" the throttle while turning the engine over.

Fuel Supply System

See Figure 4-3. Fuel from the fuel tank passes through the inlet valve into the float chamber. The fuel entering the chamber causes the float to rise until it shuts off the fuel valve, stopping flow at a level pre-determined by float level setting.

The float chamber is vented to atmosphere through an air passage opening in the air cleaner mounting flange.

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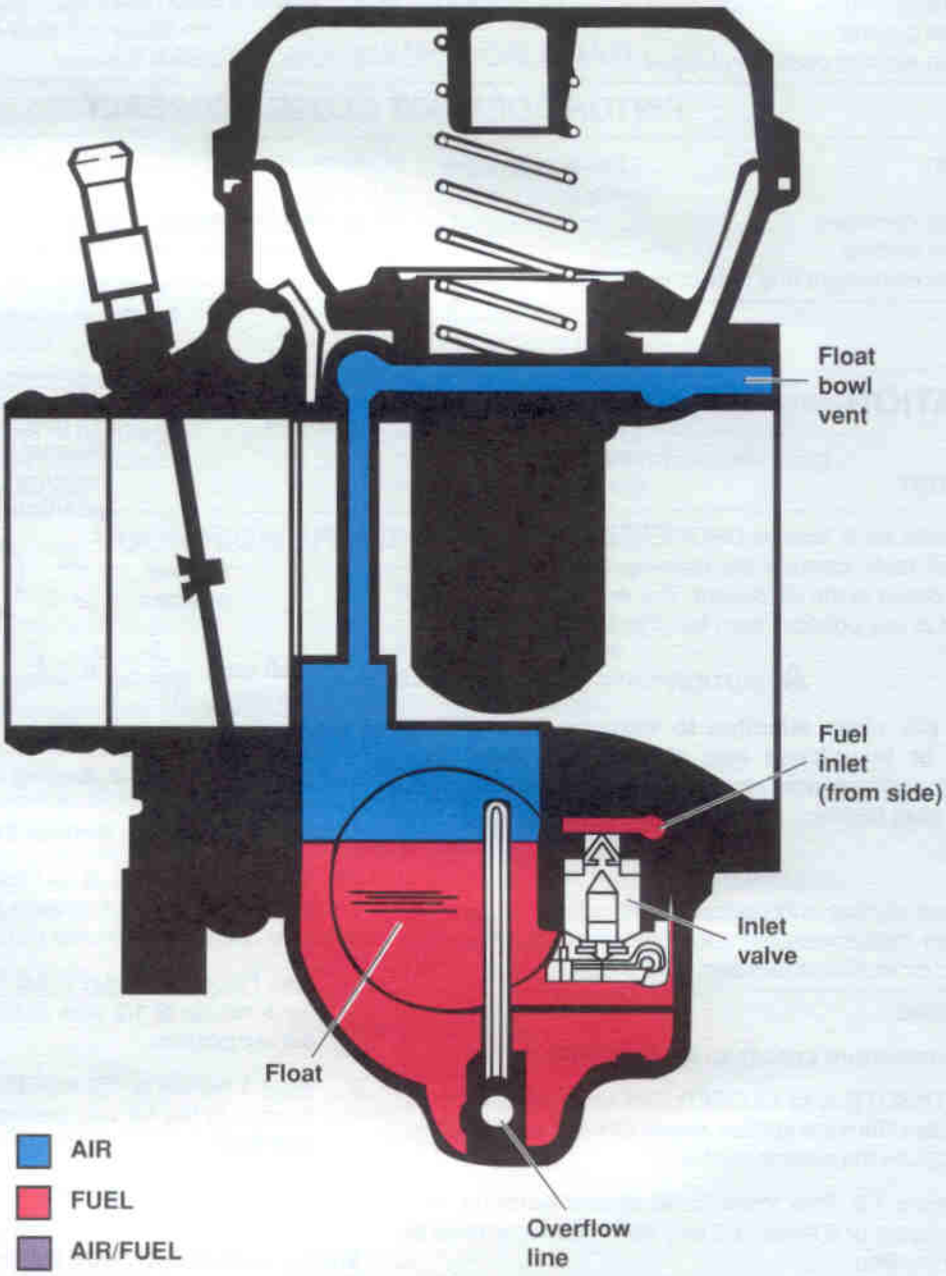


Figure 4-3. Fuel Supply System

Starter System (Enrichener)

See Figure 4-4. The starting circuit consists of a cable actuated enrichener valve and converging fuel and air passages in the carburetor body.

Fuel metered through the enrichener jet is directed upward through a passage to the valve chamber. The enrichener valve opens the fuel passage to the carburetor venturi (vacuum side) when the enrichener knob is pulled outward. Air from an opening in the carburetor inlet is directed to the valve chamber, where it mixes with incoming fuel.

Low pressure, (vacuum) created by the downward stroke of the engine pistons, causes the higher pressure in the float chamber to force the fuel/air mixture through the fuel/air outlet passage in the carburetor venturi.

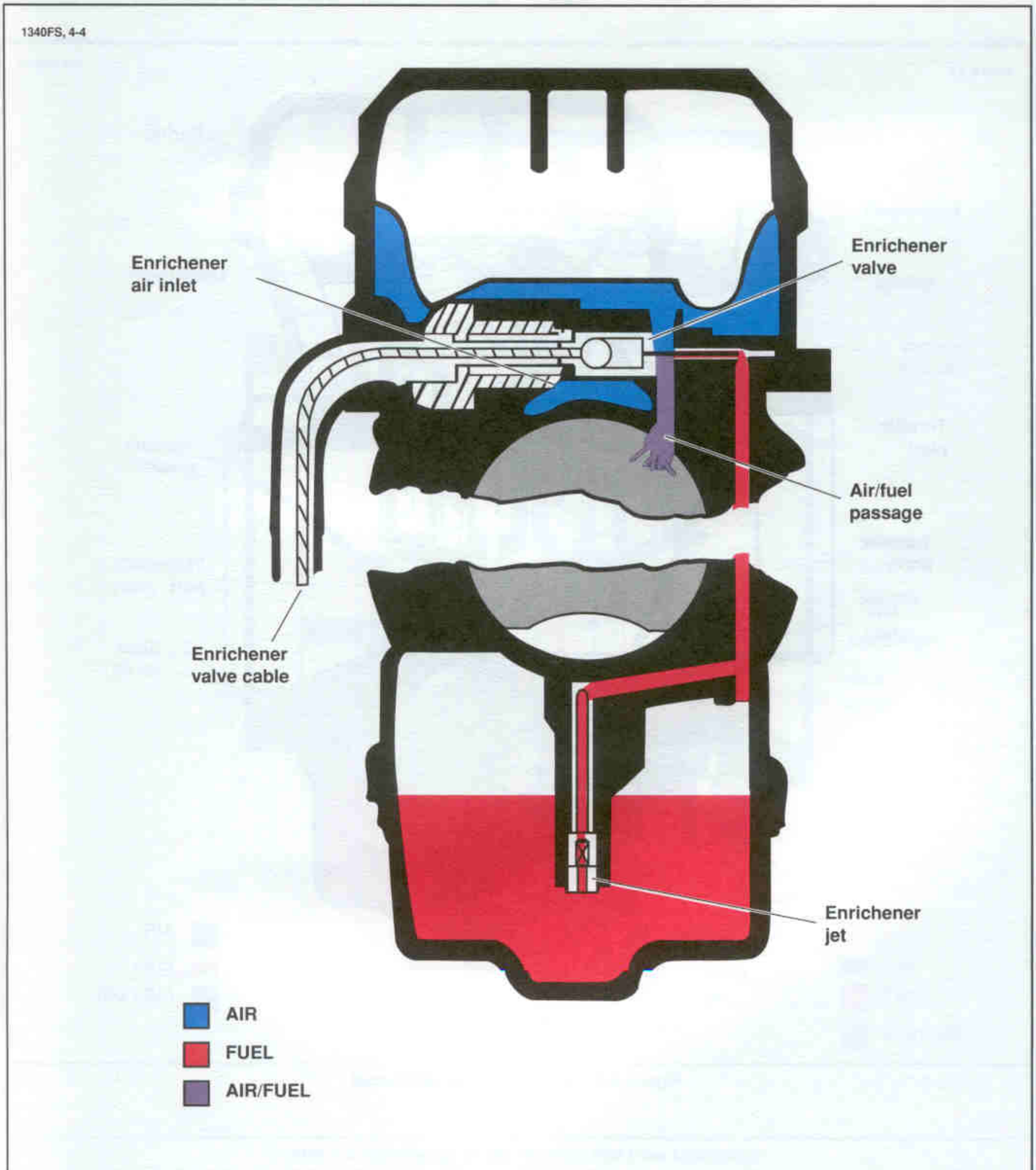


Figure 4-4. Starter System

Idle and Low Speed Circuit

See Figure 4-5. At idle, with the throttle plate closed and the air stream cut off, idle speed is maintained by fuel metered through the slow jet. Air from the slow air jet mixes with the fuel and is delivered to the idle port at the vacuum side of the throttle plate. At low speed as the throttle plate is cracked open the transfer ports are exposed to the vacuum side of the throttle plate and additional fuel is directed to the barrel of the carburetor. With the throttle plate cracked open, a quantity of fuel also enters the air stream from the needle jet. The idle and transfer ports supply additional fuel to the carburetor barrel to assist during the transition period from idle to mid range.

The venturi opening is reduced by the low position of the vacuum piston. This enables initial air stream velocities to be higher than normally attainable with fixed venturi carburetors. The higher air stream velocities provide greater quantities of fuel necessary for good acceleration.

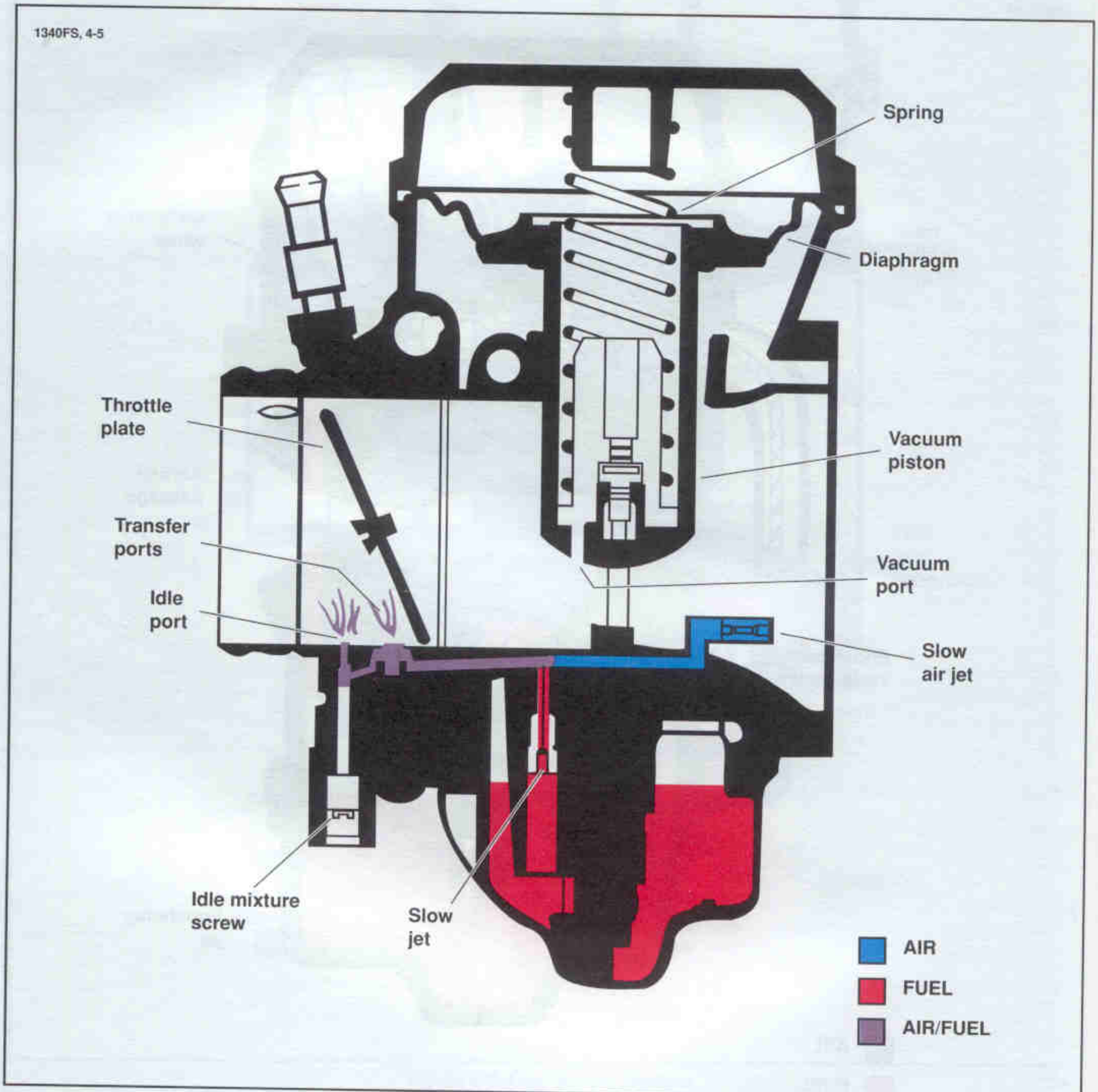


Figure 4-5. Idle and Low Speed Circuit

Mid Range Slide Position and Fuel Discharge

See Figure 4-6. As the throttle plate is opened, air flow increases through the carburetor and the pressure drop in the venturi near the needle jet increases.

The low pressure in the venturi travels through the vacuum port in the vacuum piston to the chamber above the diaphragm. The chamber beneath the diaphragm is vented to atmospheric pressure by a passage from the chamber to the carburetor inlet. The higher pressure at the underside of the diaphragm overcomes spring pressure and moves the vacuum piston upward in proportion to the pressure difference between chambers.

The tapered needle moves upward with the vacuum piston, opening the needle jet. The higher pressure in the float chamber forces fuel into the needle jet passage. Air at atmospheric pressure from the main air jet is forced through the main bleed tube openings and mixes with the fuel. The air/fuel mixture is then delivered through the needle jet into the air stream.

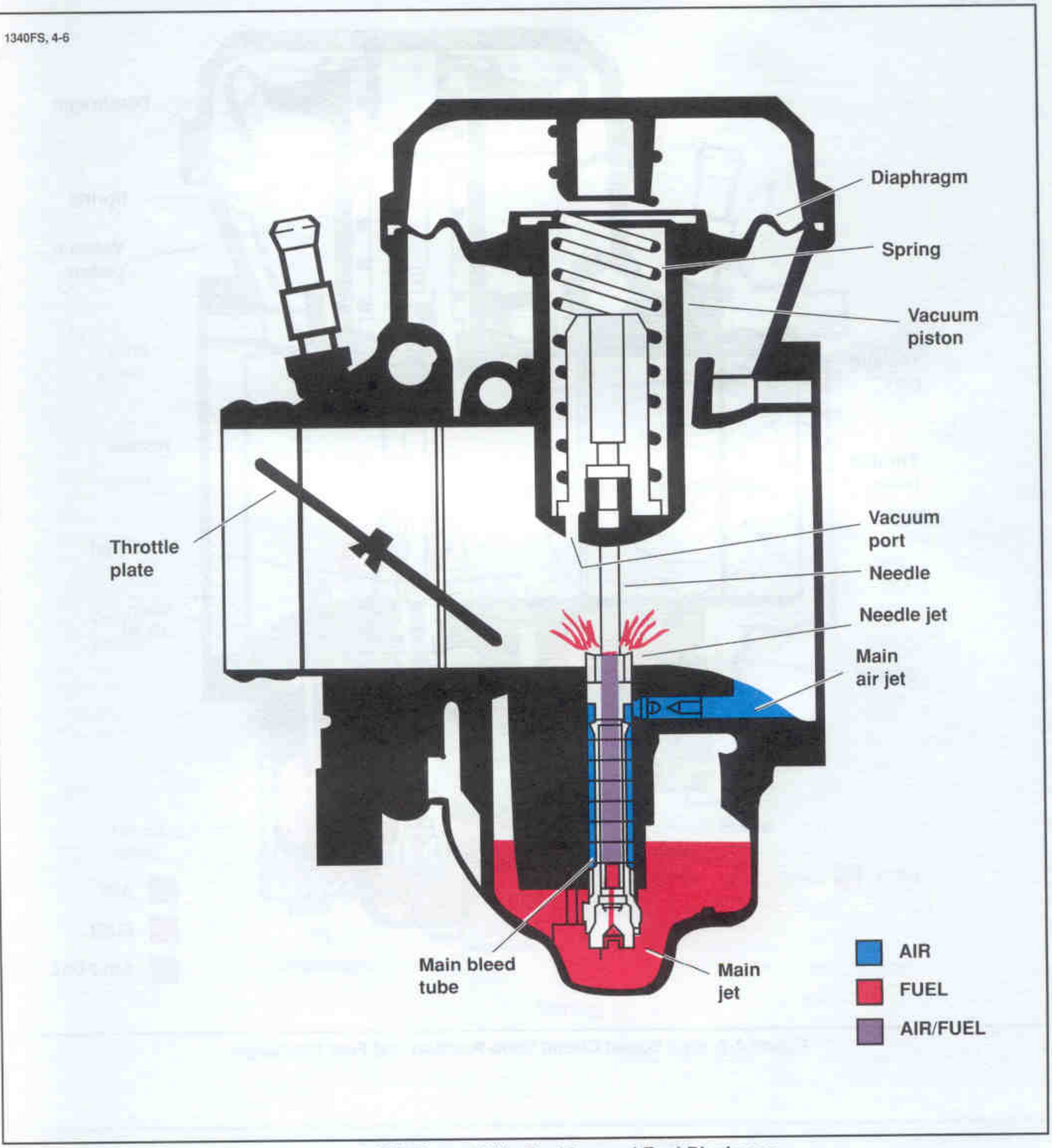


Figure 4-6. Mid Range Slide Position and Fuel Discharge

High Speed Circuit Slide Position and Fuel Discharge

See Figure 4-7. As the throttle plate is opened, the pressure difference between the chambers above and below the diaphragm increases and the vacuum piston moves further upward.

The venturi opening increases and the needle is lifted further out of the needle jet. The quantity of fuel and the volume of air are simultaneously increased and metered to the proportions of engine demand by the variable venturi and needle lift. With the vacuum piston fully upward, the venturi opening is fully enlarged and the needle jet opening exposure to the air stream is at its maximum. Air and fuel supplies are now available in quantities sufficient to meet maximum engine demand.

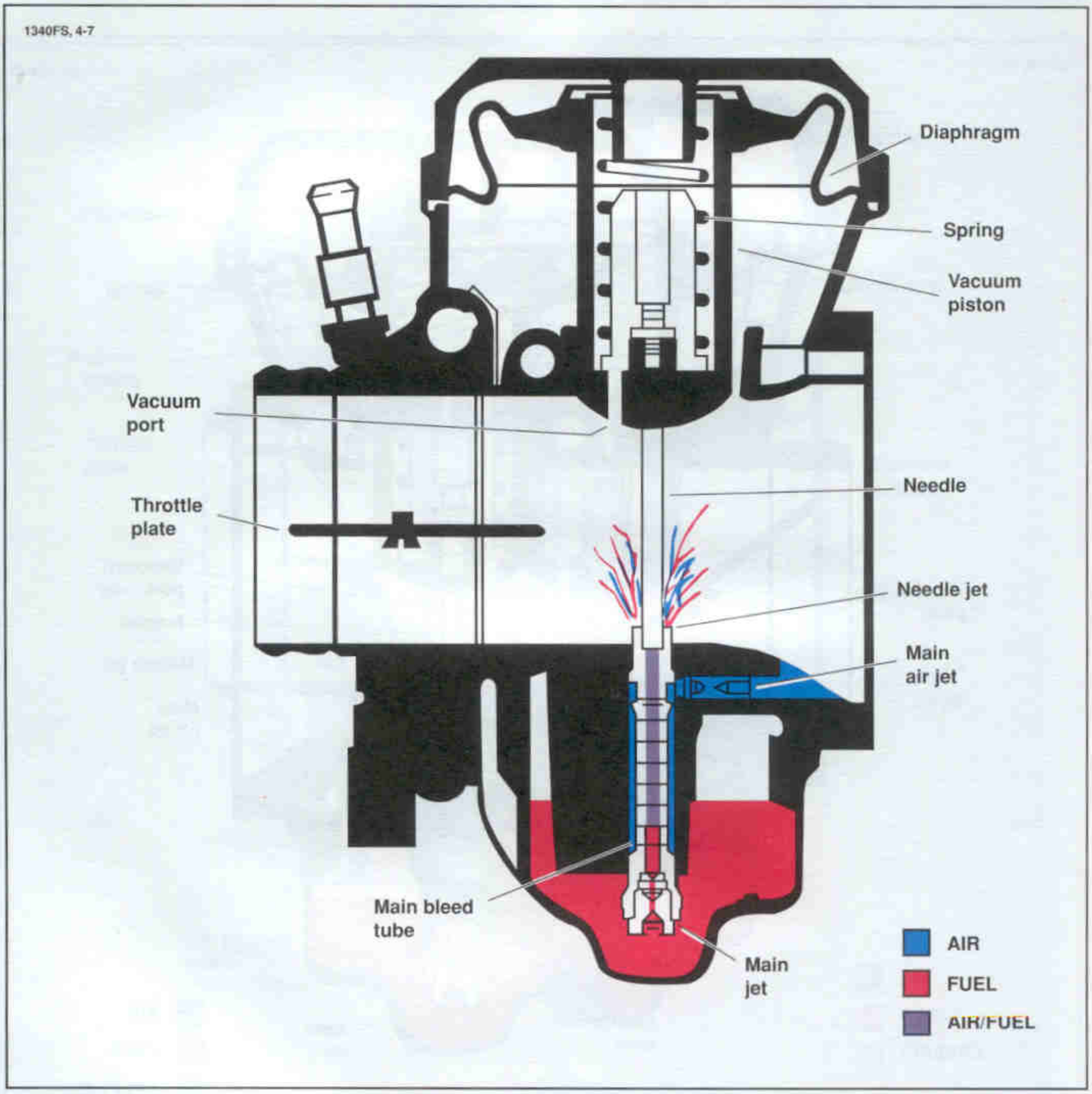


Figure 4-7. High Speed Circuit Slide Position and Fuel Discharge

Accelerator Pump System

See Figure 4-8. The accelerator pump system uses sudden throttle openings (rapid accelerations) to quickly inject fuel into the carburetor venturi to provide extra fuel for smooth acceleration.

Rapid throttle action during the first third of throttle travel, pushes the pump rod down, flexing a diaphragm. This flexing action forces fuel past a check valve into the venturi. The check valve prevents backflow during this stroke. A spring then returns diaphragm to its original position and a new supply of fuel flows in under the diaphragm from the float chamber for the next acceleration.

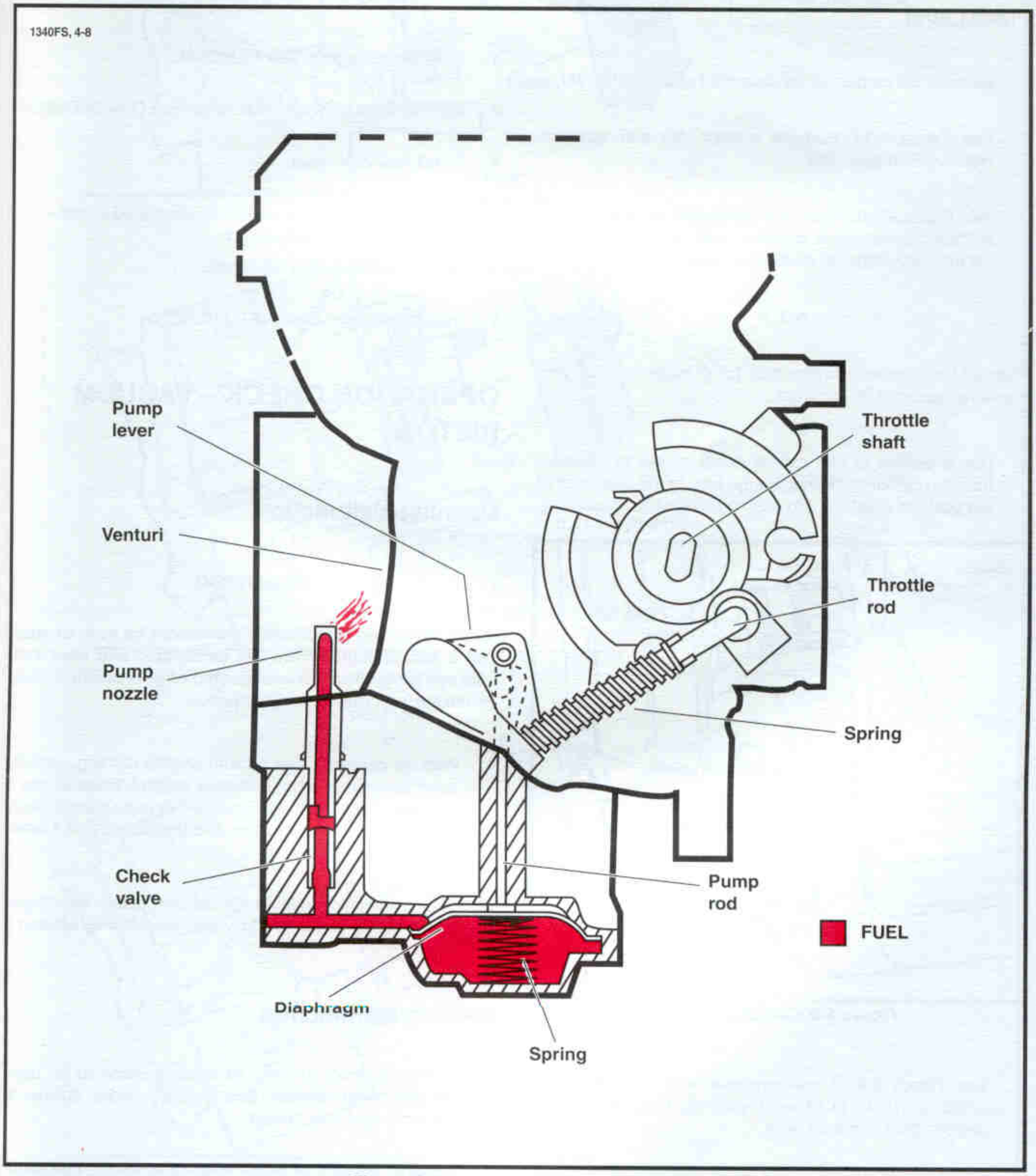


Figure 4-8. Accelerator Pump System

ADJUSTMENTS

NOTE

*For **Engine Idle Speed** and **Enrichener** adjustments, see SCHEDULED MAINTENANCE PROCEDURES in Section 1.*

Float Level

1. Remove the carburetor as described under REMOVAL.
2. See Figure 4-12. Remove screws (48) and washers. Remove float bowl (38).
3. See Figure 4-10. Place the carburetor on a flat, clean surface on the engine manifold side. This is the "base". Tilt the carburetor 15° to 20° from base.

NOTE

If you tilt the carburetor to less than 15° or more than 20°, your measurements will be incorrect.

4. Use a vernier or dial caliper depth gauge to measure from the carburetor O-ring flange face to the perimeter of the float. Be careful not to push on float while measuring.

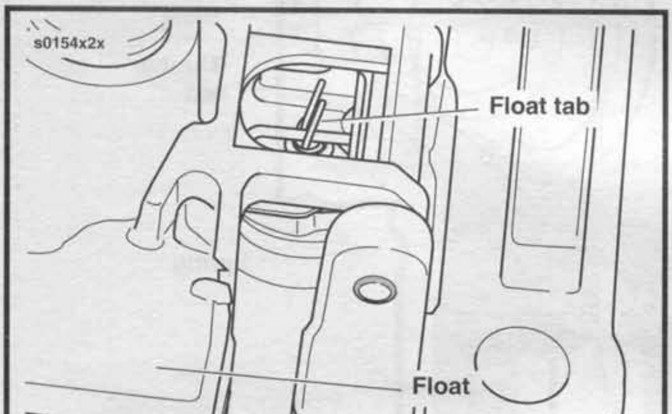


Figure 4-9. Carburetor Float

5. See Figure 4-9. If measurement is not within 0.413-0.453 in. (10.49-11.51 mm), carefully bend float tab to position float at proper level.
6. Install float bowl. See ASSEMBLY.
7. Install carburetor. See INSTALLATION.

FLOAT BOWL INLET (NEEDLE) VALVE REPLACEMENT

NOTE

Four sided inlet valves may be used in any Keihin carburetor. Three sided inlet valves should not be used in C.V. carburetors because they may cause carburetor overflow.

1. Remove carburetor. See REMOVAL.
2. Remove float bowl and inlet valve. See DISASSEMBLY.
3. Install new inlet valve.
4. Perform float level adjustment as described above.
5. Install float bowl. See ASSEMBLY.
6. Install carburetor. See INSTALLATION.

OPERATION CHECK – VACUUM PISTON

Opening Malfunction

⚠WARNING

While observing piston slide movement be sure to maintain a safe distance from the carburetor and wear suitable eye protection. An unexpected engine backfire could cause serious burns or eye injury.

1. With air cleaner cover off and engine running, partially open and close throttle control several times to see if vacuum piston (Item 6, Figure 4-12) has upward movement. If piston does not rise, see Vacuum Piston Assembly Troubleshooting.
2. [illegible] Feel whether piston lifts fully and smoothly or whether it binds.

Closing Malfunction

1. With engine not running, lift vacuum piston to full open position, then release. See if piston slides downward smoothly and fully to stop.
2. Observe position of piston slide at its lowest downward point. Lower edge of slide should rest at horizontal groove at lower end of slide track. See Vacuum Piston Assembly Troubleshooting if any problems are observed.

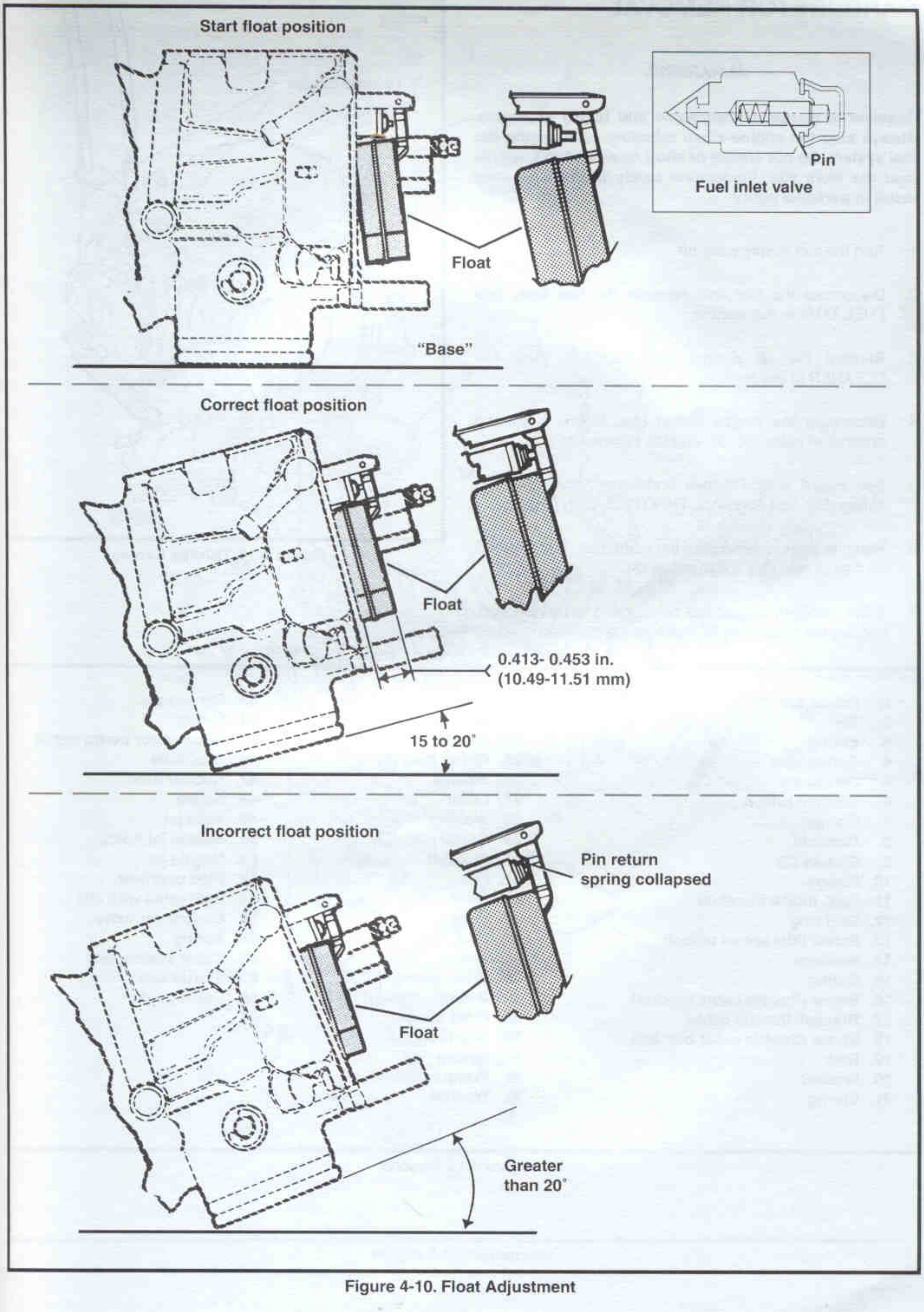


Figure 4-10. Float Adjustment

CARBURETOR REMOVAL

⚠WARNING

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

1. Turn the fuel supply valve off.
2. Disconnect the fuel line. Remove the fuel tank. See FUEL TANK in this section.
3. Remove the air cleaner and backplate. See AIR CLEANER in this section.
4. Disconnect the throttle cables (see Figure 4-11) and enrichener cable (56, 57, and 58, Figure 4-12).
5. See Figure 4-12. Remove enrichener valve (54) and spring (55). See Section 2, THROTTLE CONTROL.
6. Remove vacuum hose from the carburetor. Pull carburetor free of seal ring and manifold (8).
7. If the manifold, or manifold seals, need to be removed, remove the capscrews (9) that hold the manifold in place.

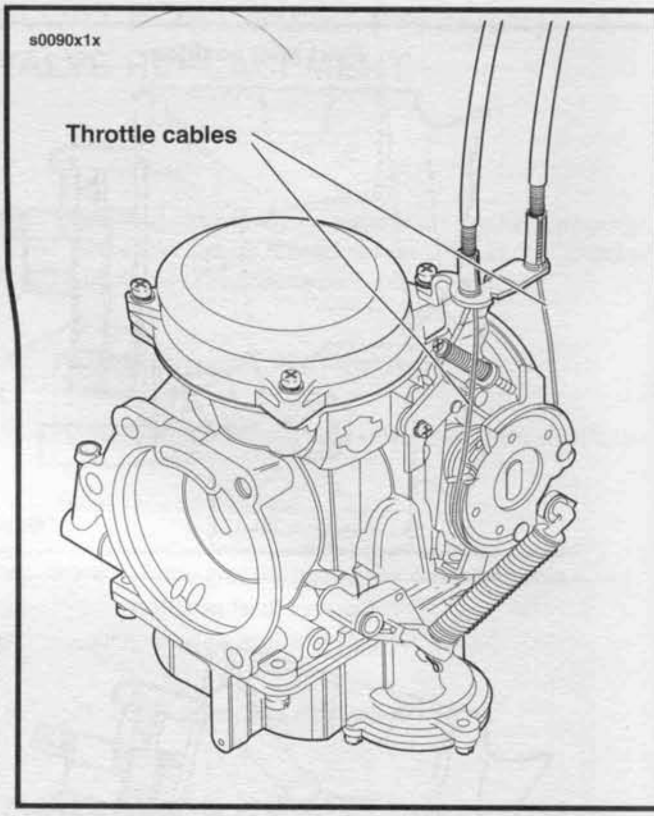


Figure 4-11. Throttle Cables

1. Screw, top (3)
2. Top
3. Spring
4. Spring seat
5. Jet needle
6. Vacuum piston
7. Flange
8. Manifold
9. Screws (2)
10. Flange
11. Seal, intake manifold
12. Seal ring
13. Screw (idle speed adjust)
14. Washers
15. Spring
16. Screw (throttle cable bracket)
17. Bracket, throttle cable
18. Screw (throttle cable bracket)
19. Rod
20. Washer
21. Spring
22. Collar
23. E-clip
24. Washer
25. Cotter pins (2)
26. Washer
27. Lever
28. Washer
29. Cotter pins (2)
30. Slow jet
31. Pin
32. Float
33. Boot
34. Rod
35. O-ring
36. Drain screw
37. O-ring
38. Float bowl
39. Diaphragm
40. Spring
41. Pump housing
42. Washer
43. Screws (3)
44. O-ring
45. Accelerator pump nozzle
46. Clip, tube
47. Rubber tube
48. Screw
49. Main jet
50. Needle jet holder
51. Needle jet
52. Pipe overflow
53. Fuel valve with clip
54. Enrichener valve
55. Spring
56. Cable sealing cap
57. Starter cap
58. Cable guide

Figure 4-12. Legend

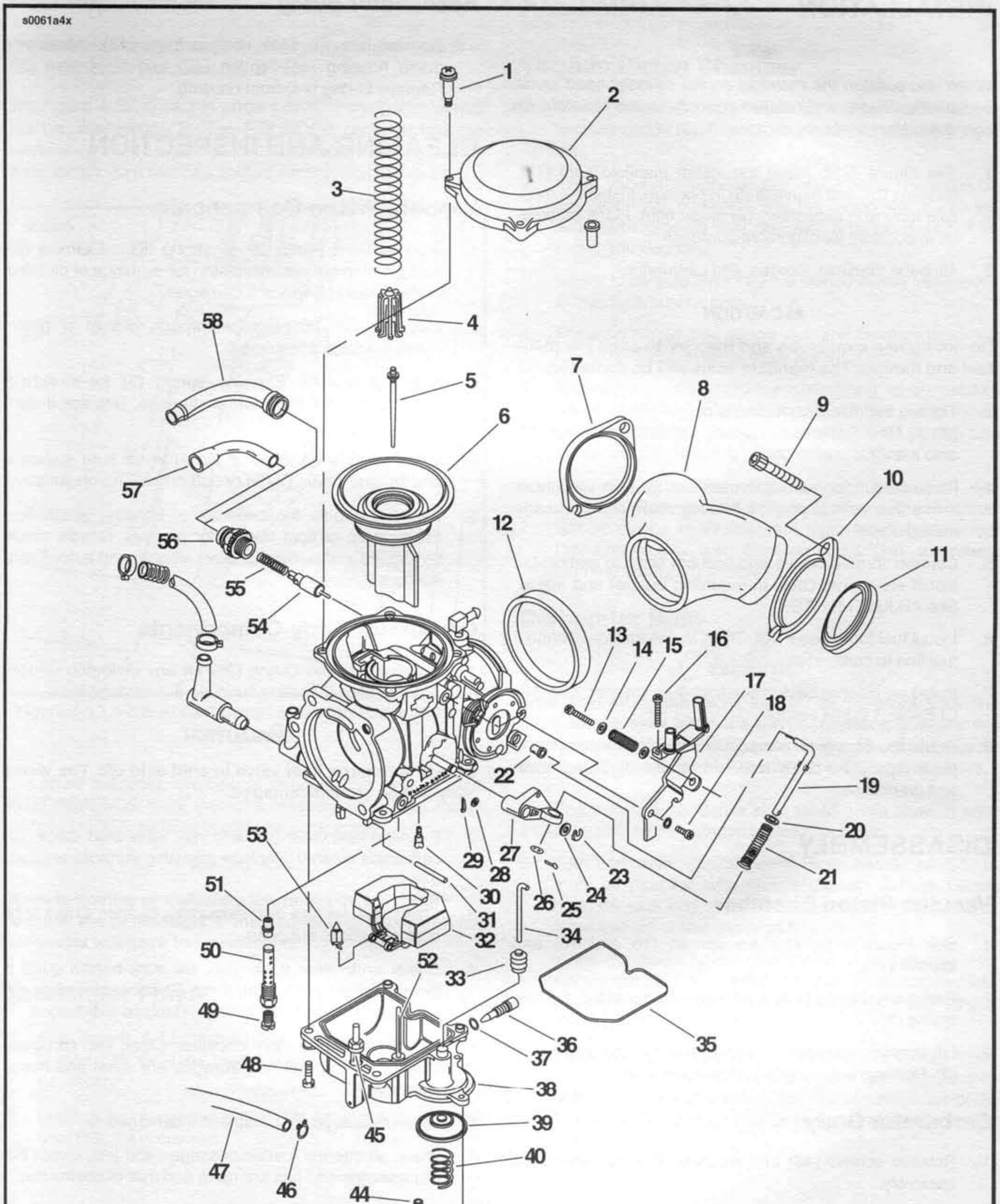


Figure 4-12. Carburetor

INSTALLATION

NOTE

When you position the manifold on the cylinder head studs, be sure the flanges are installed correctly on the manifold. Be sure the rubber seals are in place.

1. See Figure 4-12. Place the intake manifold seal (11), flanges (10), and manifold (8) in position. Install the manifold mounting capscrews (9) finger tight. Place carburetor in position, for alignment purposes.
2. Align the manifold, flanges, and carburetor.

⚠CAUTION

Do not tighten capscrews and then try to align the manifold and flanges. The manifold seals will be damaged.

3. Tighten the manifold mounting capscrews to 15-17 ft-lbs (20-23 Nm). Remove carburetor and place seal ring (12) onto manifold inlet.
4. Place carburetor outlet into manifold. Be sure carburetor is in a true vertical position. Misalignment could damage manifold seal ring.
5. Connect throttle cables and vacuum hose to carburetor. Install enrichener cable in mounting bracket and adjust. See ADJUSTMENTS.
6. Install fuel tank. See FUEL TANK in this section. Connect fuel line to carburetor.
7. Install air cleaner back plate. Install air cleaner. See AIR CLEANER in this section.
8. Route the float bowl overflow line between rear cylinder push rods, then down between engine oil pump cover and crankcase.

DISASSEMBLY

Vacuum Piston Chamber

1. See Figure 4-12. Remove screws (16 and 18) and bracket (17).
2. Remove screws (1) and washers. Remove top (2) and spring (3).
3. Lift out vacuum piston (6) with needle (5) and spring seat (4). Remove loose parts from vacuum piston.

Carburetor Body

1. Remove screws (48) and washers. Remove float bowl assembly.
2. Remove pin (31), float (32) and valve (53).
3. Unscrew main jet (49) and needle jet holder (50). Needle jet (51) is now free to be removed from bottom end of passage.
4. Insert thin bladed screw driver into slow jet passage and turn out slow jet (30).

Accelerator pump

Remove screws (43), lockwashers (42), accelerator pump housing (41), spring (40) and diaphragm (39). Remove O-ring (44) from housing.

CLEANING AND INSPECTION

Vacuum Piston Components

1. Hold vacuum piston up to strong light. Examine diaphragm at top of vacuum piston for evidence of pinching, holes or tears. Replace if damaged.
2. Examine vacuum passage through bottom of piston. Clean passage if restricted.
3. See Figure 4-12. Examine spring (3) for stretching, crimping or any distortion or damage. Replace if damaged.
4. Examine slide on sides of piston to be sure surface is smooth and clean. Clean or buff out any rough surfaces.
5. Examine needle for evidence of bending or damage. Examine tip of float needle for grooves. Needle shculd be straight and surface of taper smooth and even. Examine float for holes.

Carburetor Body Components

1. Check float bowl O-ring (35) for any distortion or damage. Replace if seating surfaces are damaged.

⚠CAUTION

Do not submerge inlet valve in cold acid dip. The valve's alloy will be etched/damaged.

2. Examine inlet valve (53) and inlet valve seat. Clean with carburetor cleaner. Replace if seating surfaces are damaged.
3. Clean slow jet (30) with carburetor cleaner. Check to be sure all orifices are open.
4. Check enrichener valve (54). Be sure needle guide is clean, straight and undamaged. Check seat surface and spring (55) for wear or damage. Replace if damaged.
5. Check enrichener valve chamber. Clean with carburetor cleaner. Check that all passages are open and free of obstruction.
6. Clean needle jet (51). Replace if damaged.
7. Clean all internal fuel/air passages and jets. Check that all passages and jets are open and free of obstruction.
8. Check needle jet holder (50). Clean bleed tube orifices. Replace holder if damaged.
9. Check float (32) for cracks or other leaks. Replace if damaged. See FLOAT REPLACEMENT.
10. Clean main jet with carburetor cleaner and inspect for damage. Replace if damaged.

Float Replacement

One of the carburetor float pedestals has an interference fit to hold the float pin more securely in place.

See Figure 4-13. A cast-in arrow points at the pedestal that has the interference fit. The ROUNDED pedestal has the interference fit. The pin is a uniform width throughout its entire length, so it can be installed starting from either end.

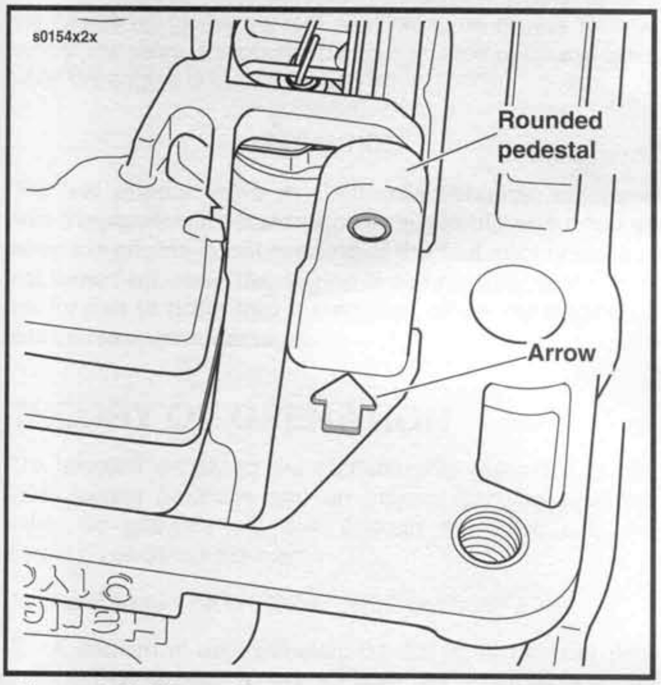


Figure 4-13. View of Carburetor Float Pin Pedestal With Cast-in Arrow

The arrow indicates direction of removal. Tap pin out from INTERFERENCE SIDE pedestal (direction of arrow): install pin from LOOSE SIDE pedestal (opposite arrow).

⚠CAUTION

When removing or installing the float pin, be careful not to break the pedestal(s). If the pedestal(s) is broken, the carburetor will have to be replaced.

Accelerator Pump

1. See Figure 4-12. Inspect the accelerator pump diaphragm (39) for holes, cracks or deformation. Replace as necessary.
2. Replace the pump rod (34) if it is bent and replace the boot (33) if it is cracked.

ASSEMBLY

Vacuum Piston Chamber

1. See Figure 4-12. Place needle (5) through center hole in vacuum piston (6). Place spring seat (4) over top of needle.
2. Insert vacuum piston into carburetor body. The slides on the piston are off-center and the piston will fit into the slide track grooves only one way. If piston does not fit, rotate 180 degrees.
3. Check to be sure diaphragm is seated evenly into groove at top of carburetor body.
4. Place spring (3) over spring seat and carefully lower top (2). Keep spring straight while lowering top.
5. After top is seated, hold top while lifting up on vacuum piston. Piston should rise to top smoothly. If piston movement is restricted, spring is cocked. Lift up on top and lower carefully, keeping spring coils straight.
6. Once top is installed correctly, install screws (1) and washers. Place bracket (17) in position with idle screw resting on top of throttle cam stop. Install body screw (18) and washer first, then top screw (16), to prevent bending bracket or throttle cam.

Carburetor Body

⚠CAUTION

Slow fuel jets from fixed venturi carburetors look the same as the slow jet of the CVH carburetor, however the air bleed hole sizes are different on fixed venturi carburetors and they must not be installed on CVH carburetors.

1. See Figure 4-12. Screw slow jet (30) into slow jet passage with narrow bladed screwdriver.
2. Turn carburetor upside down. Place needle jet (51) in main jet passage with needle passing through center hole. Be sure end of jet with larger opening and chamfered surface enters passage first.
3. Insert needle jet holder (50) into main jet passage with needle inserted into center of holder. Thread holder into passage and tighten. Thread main jet (49) into tapped hole in holder and tighten.
4. Place float assembly (32) into position with fuel valve (53) inserted into valve seat and pivot arm aligned with holes in mounting posts at bottom of carburetor body. Insert pin (31) through float pivot arm and float mounting posts.

5. Place float bowl over float and onto carburetor body flange. Bowl will only fit in one position. Install screws (48) and washers and tighten.

6. Install enrichener valve (54) and spring (55). Install enrichener cable (56, 57, and 58) on carburetor.

Accelerator Pump

Install diaphragm (39), spring (40), O-ring (44) and housing (41). Secure with three screws (43) and lockwashers (42).

FUEL SUPPLY VALVE

GENERAL

The fuel supply valve is located under the left side of the fuel tank. The gasoline supply to the carburetor is turned off when the handle is in the horizontal position. Turning the handle down to the vertical position turns on the main supply. Turning the handle up to the vertical position turns on the reserve supply. The valve is vacuum operated and will open and close when the engine is turned on and off.

⚠CAUTION

The fuel supply valve in California vehicles, equipped with Evaporative Emission Controls, should be turned off when the engine is not running. If the fuel supply valve is not turned off when the engine is not running, it is possible for fuel to drain into the engine, dilute the engine oil and cause engine damage.

THEORY OF OPERATION

The gasoline supply to the carburetor is controlled by the valve handle positions and an internal vacuum operated valve. No gasoline will flow through the valve until the following conditions are met:

1. Handle must be in "ON" or "RES" position.
2. A vacuum of approximately 0.5-1.0 in. of Mercury (Hg) must be applied to the vacuum nipple. In service, the vacuum nipple is connected to the intake manifold. When the engine is running, there will be a vacuum at the nipple.

The partial vacuum applied at the vacuum nipple creates a pressure difference between the front side of the diaphragm, vented through the bottom nipple to the atmosphere, and the rear of the diaphragm connected to the vacuum nipple. This pressure difference causes the diaphragm to move against an internal spring and open the internal valve. When the vacuum at the vacuum nipple is removed, (when the engine stops running), the internal spring causes the internal valve to close.

REMOVAL

⚠WARNING

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

1. Turn handle to OFF (horizontal) position.

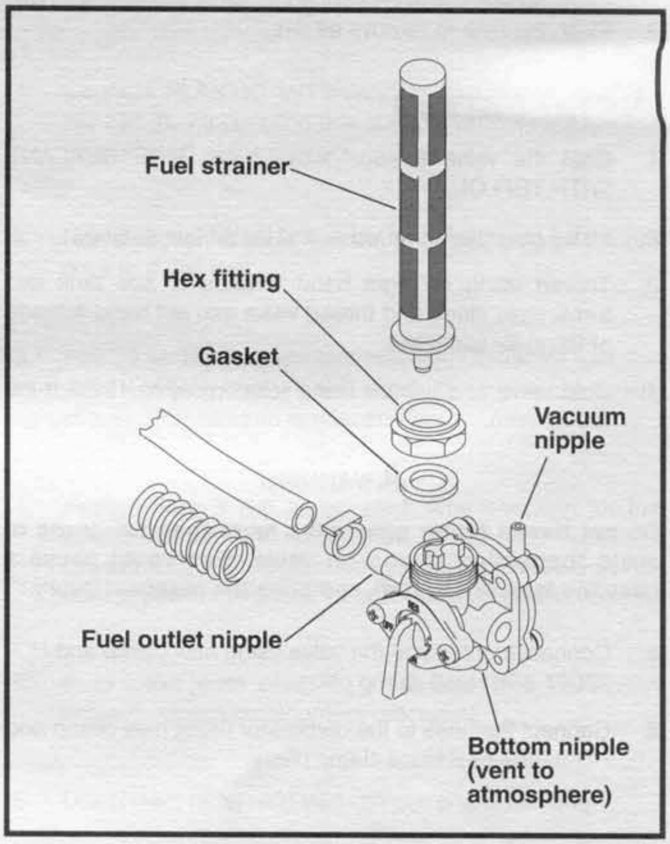


Figure 4-14. Fuel Supply Valve

2. See Figure 4-14. Remove the fuel hose from fuel outlet nipple and remove vacuum hose from vacuum nipple.
3. Attach a piece of fuel hose to fuel outlet nipple and route hose into a proper, clean gasoline container.
4. Turn valve handle to RESERVE (up).
5. Using the appropriate hose adapter, connect the PLASTIC MITY-VAC® HAND PUMP, Part No. HD 23738, to vacuum nipple on valve.
6. Gently apply a vacuum of 1-10 in. of Mercury (Hg) or just enough vacuum to get a good flow of gasoline through the valve.

⚠CAUTION

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

7. After tank is drained, turn the hex fitting that attaches the valve to the fuel tank counterclockwise and remove the valve, gasket, and filter assembly.

CLEANING AND INSPECTION

1. Clean or replace the fuel strainer located on top of the valve, inside fuel tank.
2. Flush the tank to remove all dirt.

INSTALLATION

1. Coat the valve threads with Loctite PIPE SEALANT WITH TEFLON.
2. Install new gasket on valve and install fuel strainer.
3. Thread fitting on right hand threads of fuel tank two turns. Hold fitting and thread valve into left hand threads of fitting for two turns.
4. Hold valve and tighten fitting (clockwise) to 15-20 ft-lbs (20-27 Nm).

⚠WARNING

Do not thread fitting onto valve more than two turns to avoid "bottoming" fitting on valve. This could cause a gasoline leak, fire hazard, and possible personal injury.

5. Connect fuel hose to the valve using new clamp and HD-97087-66B Hose clamp pliers.
6. Connect the hose to the carburetor using new clamp and HD-97087-66B Hose clamp pliers.

⚠CAUTION

Do not allow dirt or fluids to get into the vacuum hose assembly that connects the fuel valve and VOES to the intake manifold. Contaminants could block the vacuum signal or inhibit free motion of moving parts which could cause the fuel valve to remain open. An open fuel valve may allow fuel to drain into the engine, dilute the engine oil and cause engine damage.

7. Connect vacuum line to vacuum nipple. Fill tank with gasoline and check for leaks.

NOTE

If vacuum line is connected to bottom nipple the valve will not open.

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

TROUBLESHOOTING

If valve is not functioning properly refer to the following chart.

TROUBLESHOOTING VACUUM OPERATED FUEL VALVE

Problem	Cause	Solution
1. Vacuum valve not opening.	1.1 Vacuum hose not connected to vacuum nipple.	1.1.1 Connect hose to vacuum nipple.
	1.2 Leaking diaphragm.	1.2.1 Replace diaphragm.
	1.3 Vacuum hose assembly pinched or cracked	1.3.1 Replace vacuum hose assembly. (Vacuum hose assembly also connects intake manifold vacuum to VOES.)
2. Vacuum valve does not close.	2.1 Damaged sealing surface on valve side of diaphragm.	2.1.1 Replace diaphragm.
	2.2 Broken or missing internal spring.	2.2.1 Replace entire valve assembly.
3. Valve leaks gasoline at bottom nipple.	3.1 Leaking diaphragm.	3.1.1 Replace diaphragm.
	3.2 Loose diaphragm housing screws.	3.2.1 Tighten screws.

DIAPHRAGM REPLACEMENT

NOTE

There may be some fuel leakage during this procedure. Place a shop rag under the valve to catch any fuel.

1. Turn fuel valve lever to the OFF position and remove vacuum hose from valve nipple.
2. Disconnect fuel hose from outlet fitting on valve body.
3. Loosen fuel valve hex fitting just enough (approximately 1/8 turn) to allow valve body to be rotated.
4. Turn valve body to the right until back of valve is accessible, then tighten hex fitting to prevent fuel from leaking.
5. Remove the four black screws with captured lockwashers that hold the diaphragm cover in place.
6. Remove the diaphragm cover and coil spring. Note the orientation of the original diaphragm as it sits in the diaphragm frame. The replacement diaphragm will fit in the frame the same way.
7. See Figure 4-15. Remove diaphragm frame from valve body, then remove the diaphragm assembly from the frame by pressing the small diaphragm end through the frame.

NOTE

Diaphragm will install easily if small diaphragm is pinched in half when inserted into frame.

8. Install the **new** diaphragm into the frame. Make sure that the diaphragm edges are seated in the grooves in the frame.
9. Install the two alignment pins, provided in the service kit, into the top left and bottom right holes of the fuel valve body and tighten a few turns by hand.
10. Slide the diaphragm frame over the alignment pins and up to the valve body, small end of the diaphragm first. Make sure the atmospheric port points downward.

NOTE

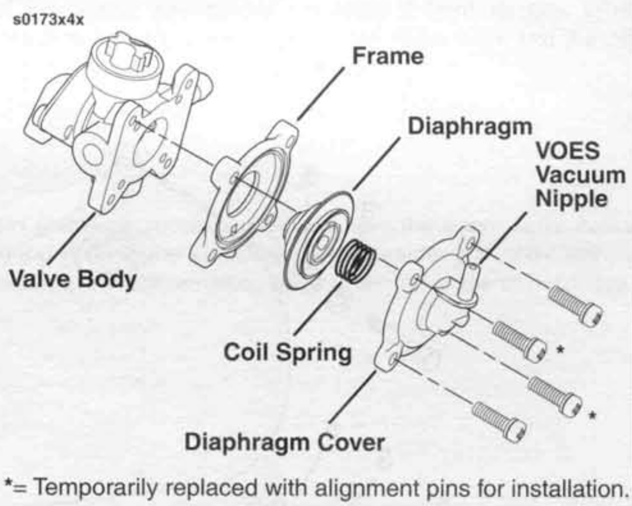
Do not attempt to assemble diaphragm frame with spring and cover without inserting onto pins. Install frame on pins first, then position spring and cover.

11. While holding diaphragm frame firmly against valve body, place coil spring and cover over the alignment pins and slide them into position. Do not disturb the position of the diaphragm, it must remain seated in the groove.
12. Install two cover screws in the two open holes in cover. Tighten screws to 18.5 in-lbs (2.1 Nm).
13. Remove alignment pins and install remaining two cover screws to cover. Tighten screws to 18.5 in-lbs (2.1 Nm).
14. Perform a vacuum test on the valve.

Vacuum Test

Vacuum test the valve using the procedure below:

1. Connect PLASTIC MITY-VAC® HAND PUMP, Part No. HD 23738, vacuum line and suitable vacuum fitting to the vacuum port of the petcock.
2. Run a section of clear fuel line from the fitting on the petcock to a gas can.
3. Pull 25 in. Hg vacuum and release. Check for fuel flow while applying vacuum and check that fuel stops flowing shortly after vacuum is released.
4. Repeat Step 3 five times, each time checking for fuel flow at vacuum and no fuel flow shortly after vacuum is released. On fifth application of vacuum, pause with vacuum applied, and check for slow leaks. Release vacuum.
5. If no leaks were present, go to Step 6. If leaks were present, repeat replacement procedure.
6. Disconnect hand held vacuum pump and fuel line.
7. Loosen fuel valve hex fitting 1/8 turn and rotate valve to the left. Tighten hex fitting.
8. Position **new** hose clamp to fuel hose and install fuel hose to outlet fitting on valve body.
9. Install vacuum hose to valve nipple.



*= Temporarily replaced with alignment pins for installation.

Figure 4-15. Fuel Valve Components

FUEL TANK

GENERAL

The fuel tank is treated to resist rusting. However, when the motorcycle is not operated for a long period of time, tanks should be drained and treated with an oil/fuel mixture of equal proportion. This will protect the inside of the tank during storage.

REMOVAL

⚠WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow open flame or sparks anywhere in the area when refueling or servicing the fuel system. Refuel only in a well ventilated area.

1. Remove instrument panel and center trim panel. See Section 2.
2. Check to be sure fuel supply valve is in "OFF" position. Remove fuel line from the fuel supply valve.
3. Drain fuel into adequately sized, approved gasoline container following procedure outlined under FUEL SUPPLY VALVE-REMOVAL.
4. See Figure 4-16. Disconnect crossover line (1).
5. Remove the upper and lower front mounting bolts (2) and washers (3 and 4). Remove grommets (5) if necessary.
6. Remove the two rear mounting bolts (6), spacers (7), and washers (3).
7. Disconnect vent line and remove tank halves from motorcycle.

CLEANING AND INSPECTION

⚠WARNING

Use only non-ferrous (non-sparking) metal balls, such as lead pellets, to loosen deposits. Metal balls, such as steel ball bearings, could produce a spark igniting the fumes in the tank. The resulting flames or explosion could cause personal injury.

1. Crossover line
2. Front mounting bolts (4)
3. Washers, 0.328 in. (6)
4. Washers, 0.531 in. (2)
5. Grommets (6)
6. Rear mounting bolts (2)
7. Spacer (2)
8. Bracket, lower
9. Continuous venting system vent line
10. Vapor valve
11. Bracket, upper

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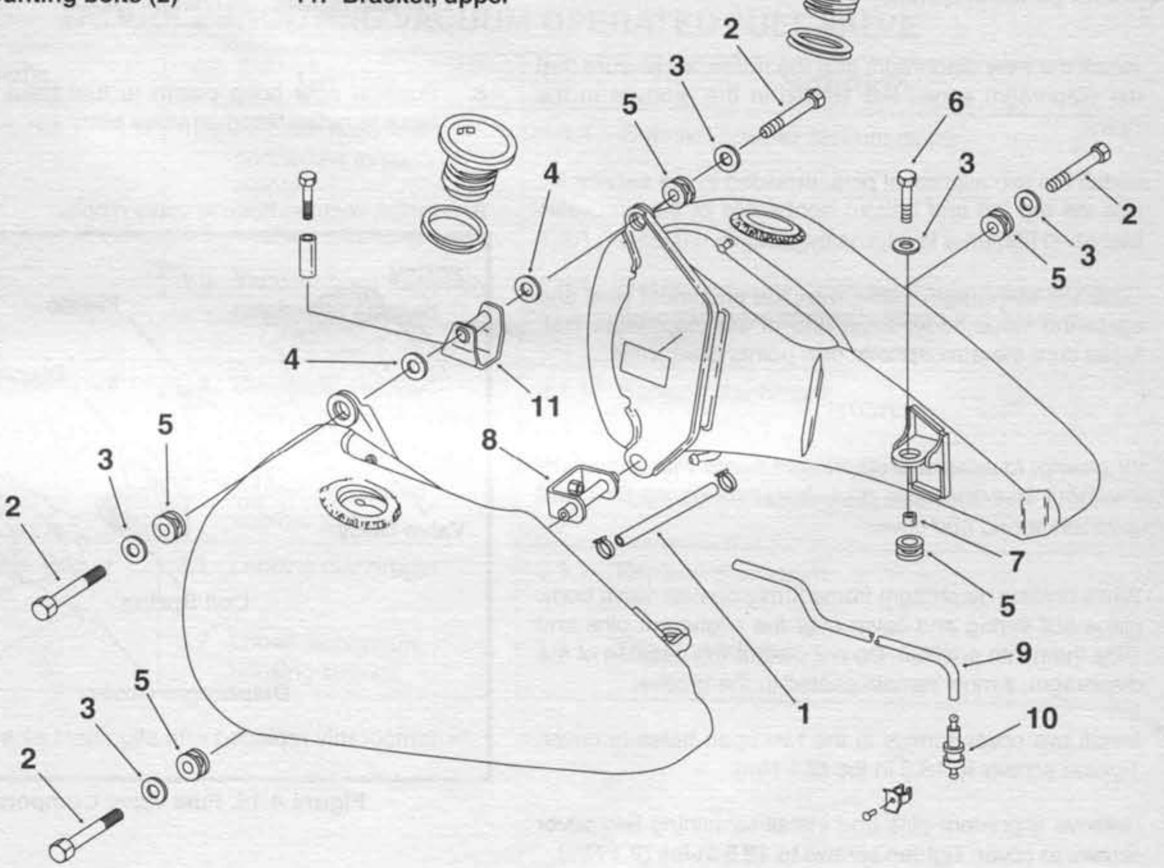

Figure 4-16. Fuel Tank

1. Clean the tank interior with commercial cleaning solvent or a soap and water solution. Shake the tank to agitate the cleaning agent. If necessary, non-ferrous metallic balls or pellets may be added to the tank to assist in loosening deposits.

NOTE

Be sure to count the number of pellets going into the tank and the number that come out. An extra pellet in the tank could cause fuel delivery problems.

2. Flush the tank thoroughly after cleaning and allow it to air dry.

⚠WARNING

If all traces of fuel are not purged, an open flame repair may result in a tank explosion resulting in personal injury. Extreme caution should be taken when repairing tanks.

3. Inspect the interconnect lines, continuous venting system vent line (if applicable) and fuel line for cuts, cracks or holes. Replace lines as needed.
4. Inspect the rubber mounts and bumpers for wear and deterioration. Replace as needed.
5. Inspect the tank for leaks and other damage. If a damaged tank cannot be successfully repaired, replace it.

INSTALLATION

1. Install continuous venting system vent line (10) and vapor valve (11). The vapor valve is clipped onto the swing axis frame member.

⚠CAUTION

The vapor valve must be mounted in a vertical position, with the long fitting at the top, otherwise, excessive fuel vapor pressure may build up in the fuel tank.

2. Connect two hoses to vapor valve. Connect the hose which has its one end connected to the fuel tank vent nipple to the long fitting end of vapor valve.
3. Place a large I.D. washer (4) over each end of the spacer tube at the upper bracket (12).
4. Position the fuel tank halves with the rubber grommets (5) over the spacer tubes at each side of the upper and lower brackets (12) and (9). Position the center bracket at the rear of each tank over the large I.D. washer that has been placed over the tapped anchor insert.
5. Place a small I.D. washer (3) over each bolt (2), insert the bolts through the front tank mounting lugs and thread into the bracket (12) tapped spacer tubes. Place washer (3) over rear mounting bolt (6). Insert the bolt through the tank mounting lug, spacer (7) and thread into the tapped anchor insert.
6. Tighten the front bolts (2) and the rear bolt (6) to 15-19 ft-lbs (20-26 Nm).
7. Connect the lower crossover line (1). Route line over the lower bracket (8).
8. Remove the drain hose and reconnect the fuel feed line. Install new hose clamp using HD-97087-66B Hose clamp pliers.
9. Inspect fuel line for cuts, cracks or holes and replace if necessary.
10. Install instrument panel cover and center trim panel. See INSTRUMENTS in Section 2.
11. Check for leaks.

VAPOR VALVE

⚠WARNING

Verify that the fuel tank vapor valve hoses do not contact hot exhaust or hot engine parts. The hoses contain flammable vapors that can be ignited if damaged, resulting in personal injury.

The vapor valve is clipped to the swing axis frame member. Mark the two hoses connected to the upper and lower fittings of the vapor vale before removing it from its clip. When installing the vapor valve, place the valve back into the clip with the long necked end at the top.

NOTE

On California models, the hose from the vapor valve bottom fitting goes to the charcoal EVAP canister. On non-California models, the bottom fitting hose is vented to the atmosphere.

AIR CLEANER – GENERAL

REMOVAL

1. See Figure 4-17. Remove screw (1) and washer (2).
2. Remove cover (3) and filter element (4).

NOTE

If filter is being removed for cleaning, proceed to Step 1, CLEANING, INSPECTION AND REPAIR.

3. Remove breather connectors (5) from screws (6) and element. Remove screws (6).
4. Back out screws (8), in sequence, a couple of turns at a time while pulling the backplate away from the carburetor.

⚠CAUTION

Do not let the captive bolt thread catch the backplate threads when removing the backplate or backplate will become damaged.

Continue this procedure until screws are clear, then remove backplate (7), baffle (9) (if necessary) and gasket (10).

CLEANING AND INSPECTION

⚠WARNING

Low pressure air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air.

Wash the paper/wire mesh air filter element in lukewarm water with a mild detergent. Allow filter to either air dry or blow it dry, from the inside, with low pressure air. Do not use an air cleaner filter oil on the Harley-Davidson paper/wire mesh air filter element.

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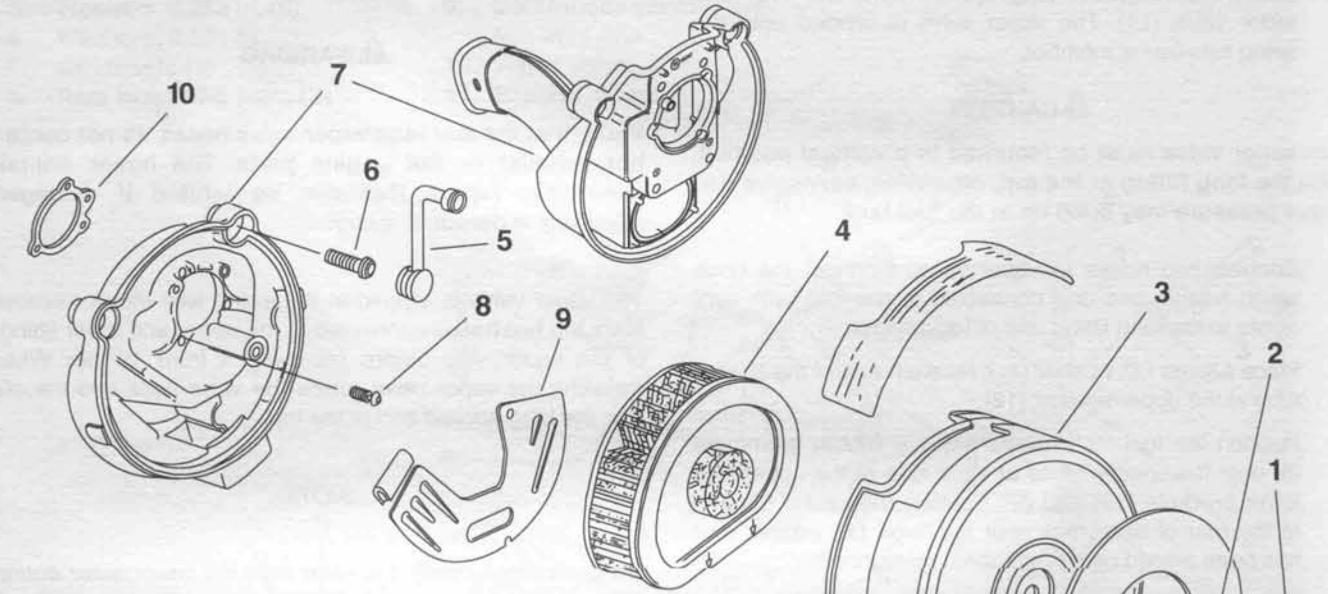

1. **Air cleaner cover screw**
2. **Washer**
3. **Air cleaner cover**
4. **Filter element**
5. **Breather connector (2)**
6. **Backplate-to-cylinder head breather Screw (2)**
7. **Backplate**
8. **Backplate-to-carburetor Screw**
9. **Baffle**
10. **Gasket**
11. **Seal Strip**

Figure 4-17. Air Cleaner – General

INSTALLATION

1. See Figure 4-17. Check each backplate-to-carburetor screw (8) to be sure they are not threaded into backplate threaded insert. Place baffle (9) (if removed) in backplate (7).
2. Position backplate and gasket (10) on carburetor. Start each backplate-to-carburetor screw (9) into threaded holes in carburetor flange.
3. By hand, turn each backplate-to-carburetor screw a couple of turns in sequence, until the backplate is drawn to a loose fit next to the carburetor flange.
4. Apply Loctite pipe sealant to threads and insert one screw (6) into each upper backplate mounting hole and thread loosely into the threaded hole in each cylinder head.
5. Tighten backplate-to-carburetor screws (8) to 3-5 ft-lbs (4-7 Nm).
6. Tighten backplate-to-cylinder head screws (6) to 10-12 ft-lbs (14-16 Nm).
7. Install breather connectors (5) over screws (6) at two upper mounting holes and in filter element.
8. Place filter element (4) in position. Place cover (3) and seal strip (11) over filter and install screw (1) and washer (2). Tighten air cleaner cover screw to 3-5 ft-lbs (4-7 Nm).

AIR CLEANER BACKPLATE ASSEMBLY – CALIFORNIA MODELS

The Removal/Installation procedure for the California models air cleaner assembly is the same as AIR CLEANER – GENERAL, except for the following differences:

1. See Figure 4-18. After performing steps 1 through 5 under REMOVAL, disconnect the solenoid wiring harness connector (1). Remove overflow hose from hose fitting (2).
2. Remove screws (3) and washers (4) securing the baffle (5) and solenoid bracket (6) to the backplate (7). Remove solenoid plunger screw (8). Remove solenoid (9).
3. If necessary, the rivets (10) securing the butterfly valve assembly (11) to the backplate and the screws (12) securing the butterfly valve (13) to the shaft (14) can be replaced.

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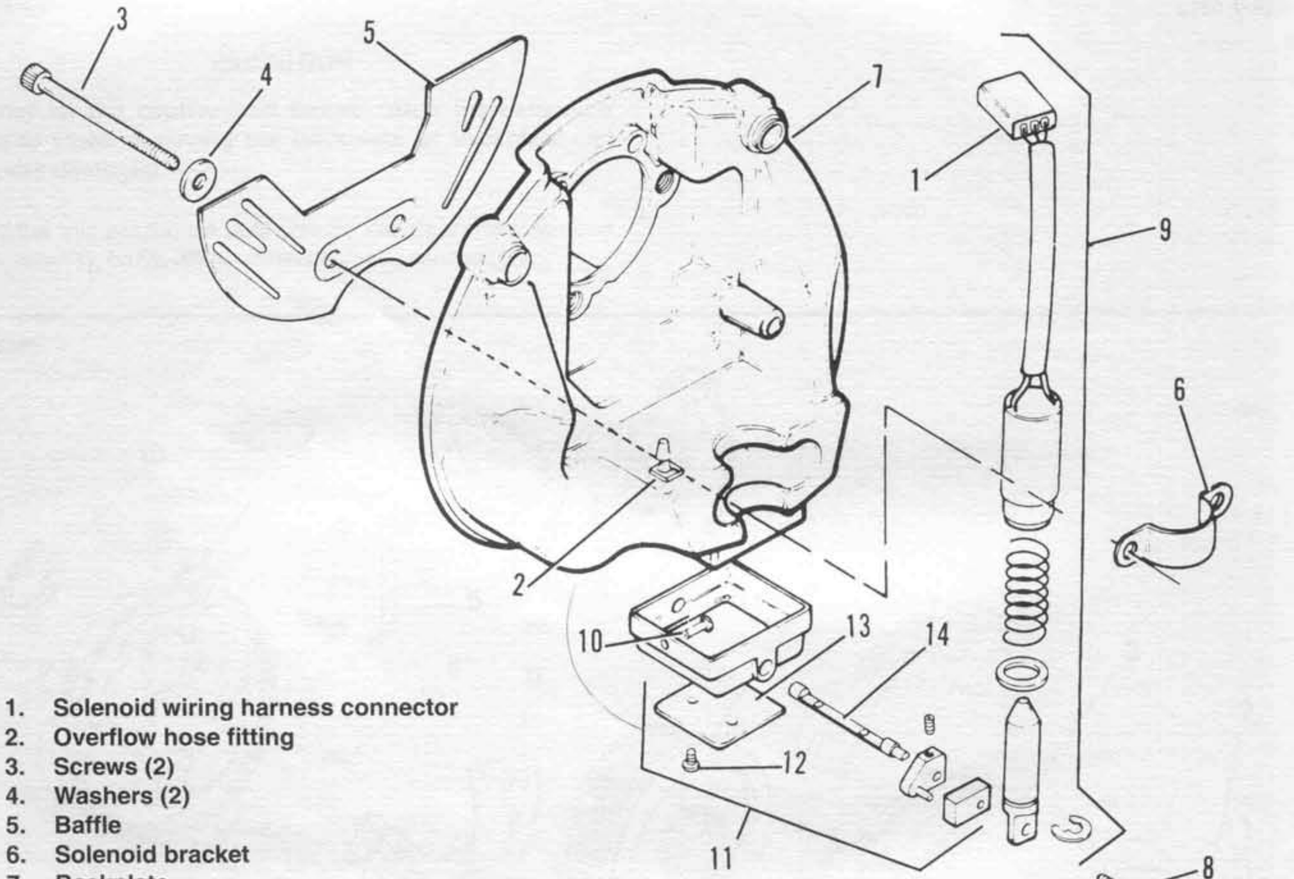


1. Solenoid wiring harness connector
2. Overflow hose fitting
3. Screws (2)
4. Washers (2)
5. Baffle
6. Solenoid bracket
7. Backplate
8. Screw
9. Solenoid assembly
10. Rivets (2)
11. Butterfly valve assembly
12. Screws (2)
13. Butterfly valve
14. Shaft

Figure 4-18. Air Cleaner Backplate Assembly

EVAPORATIVE EMISSIONS CONTROL CALIFORNIA MODELS ONLY

GENERAL

Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations in effect at the time of manufacture.

The EVAP functions in the following manner:

- Hydrocarbon vapors in the fuel tank are directed through the vapor valve and stored in the charcoal canister. If the vehicle is tipped at an abnormal angle, the vapor valve closes to prevent liquid gasoline from leaking out of the fuel tank through the vent hose.
- When the engine is not running and the Ignition Switch is OFF or in the LOCK position, the air cleaner's solenoid-operated butterfly valve is closed to seal the inlet port of the air cleaner backplate. This prevents hydrocarbon vapors emanating from the carburetor throat and from the float bowl overflow (vent) hose from escaping into the atmosphere.
- When the Ignition Switch is ON, the hold-in winding of the air cleaner butterfly valve solenoid is energized with 12 volts DC current. The solenoid will open the butterfly valve when the pull-in winding is energized with 12 volts DC from the Start Switch. The hold-in winding keeps the butterfly valve open until the Ignition Switch is turned OFF.
- When the engine is running, carburetor venturi negative pressure (vacuum) slowly draws off the hydrocarbon vapors from the carbon canister through the canister-to-carburetor purge hose. These vapors pass through the carburetor and are burned as part of normal combustion in the engine. The long, nylon canister-to-air cleaner hose (canister clean air inlet hose) supplies the canister with fresh air from the air cleaner.

⚠WARNING

Verify that the evaporative emissions vent hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged resulting in personal injury.

See SOLENOID ELECTRICAL TESTS, in Section 8, for air cleaner butterfly valve solenoid troubleshooting.

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.

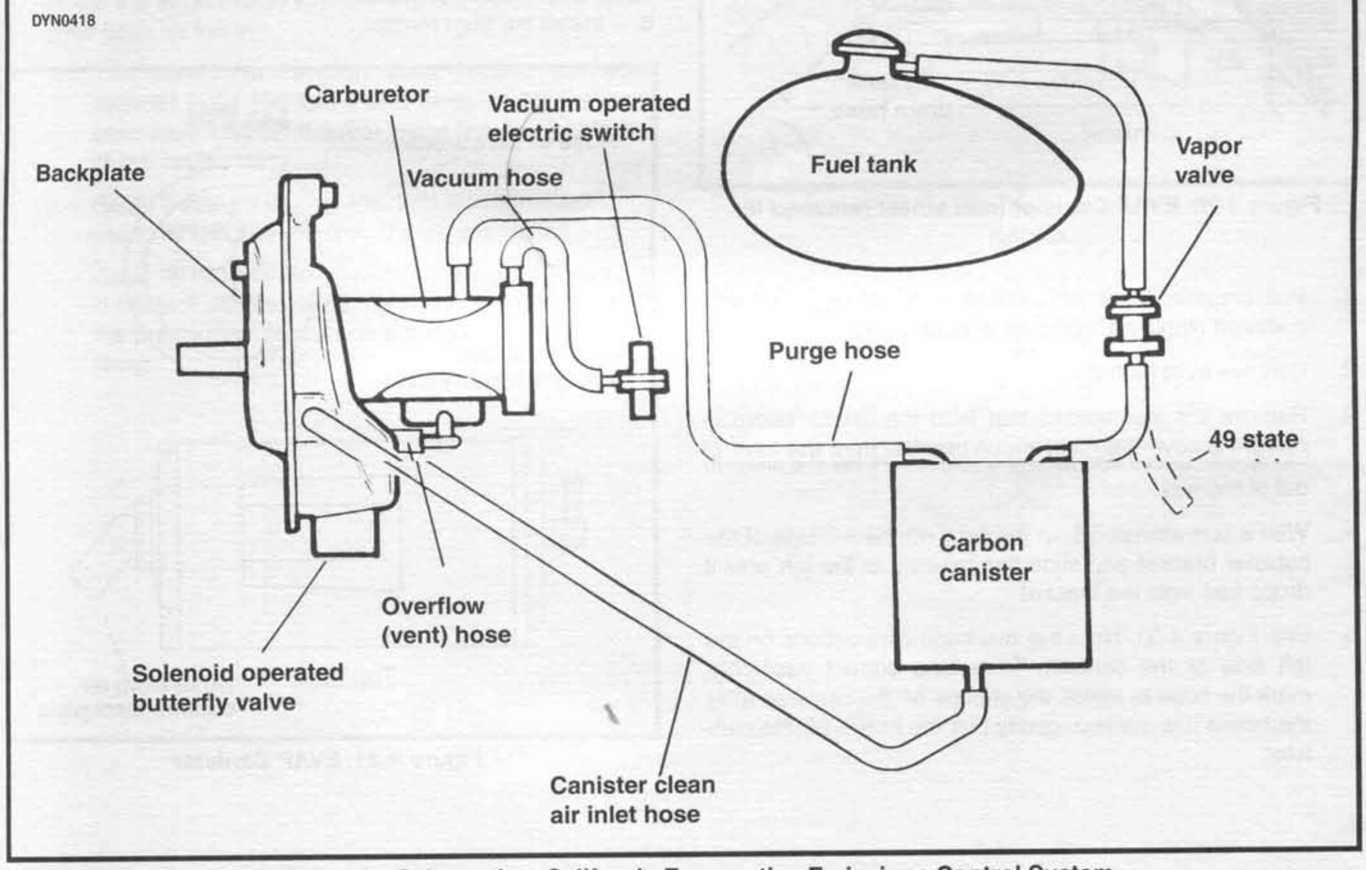


Figure 4-19. Schematic – California Evaporative Emissions Control System

CHARCOAL CANISTER

Removal

⚠WARNING

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

See Figure 4-20. The EVAP charcoal canister is mounted just below the electric starter motor on a bracket attached to the swing axis frame member.

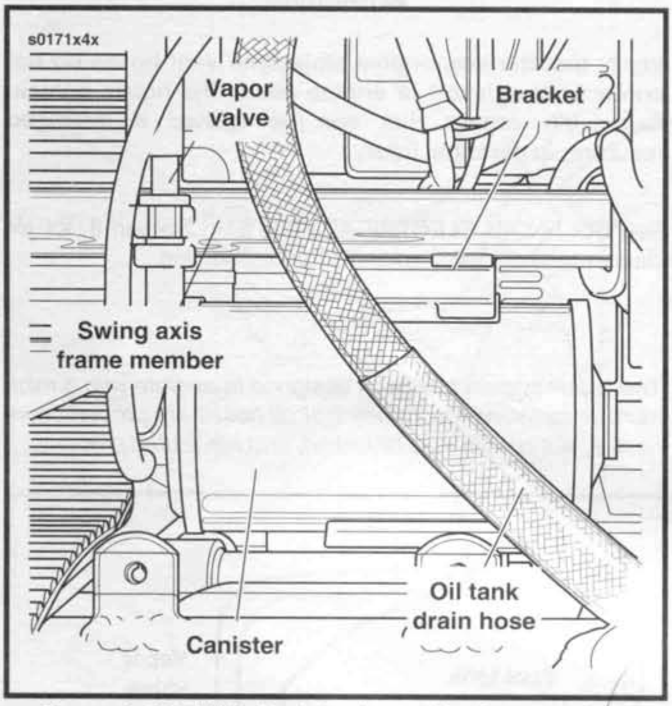


Figure 4-20. EVAP Canister (rear wheel removed for clarity)

1. Pull breather hose (connection from air cleaner backplate) off nipple on right side of charcoal canister.
2. Remove front muffler.
3. Remove the four screws that hold the splash guard in place. Remove the main circuit breaker from the front of the splash guard and slide the guard up over the tire and out of the way.
4. With a screwdriver, lift up the tang on the left side of the canister bracket and slide the canister to the left until it drops free from the bracket.
5. See Figure 4-21. 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 the hoses are marked, gently pull the hoses off the canister.
6. Support motorcycle so rear wheel is off the floor. Remove the cotter pin or spring clip from the rear wheel axle, loosen the axle nut, and turn the axle adjusting bolts all the way forward.
7. 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.
8. Remove canister.

Installation

1. Slide canister into mounting bracket until canister clicks in place.
2. Attach hoses to canister nipples.
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. Perform belt adjustment. See SCHEDULED MAINTENANCE PROCEDURES in Section 1.
5. Place main circuit breaker back in place on the splash guard and install the splash guard.
6. Install the front muffler.

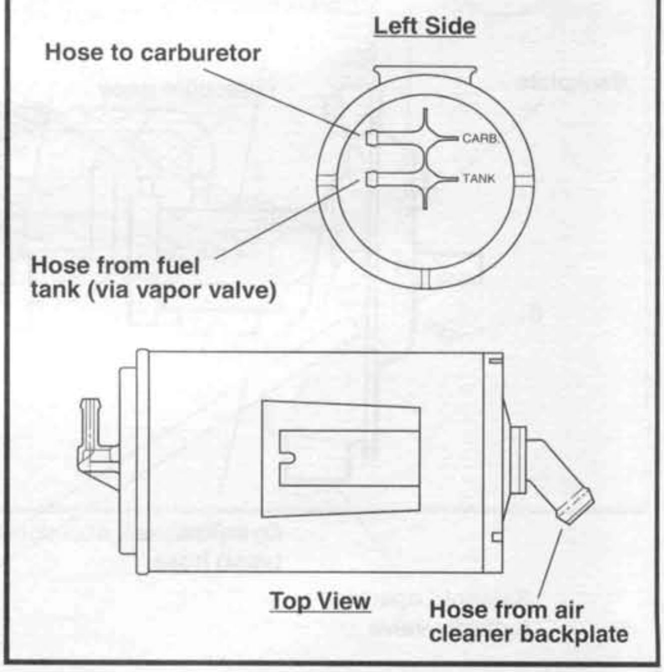


Figure 4-21. EVAP Canister

HOSE ROUTING/REPLACEMENT

⚠WARNING

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

1. Remove right side fuel tank. See FUEL TANK in this section.
2. Attach the shorter hose to the carburetor purge fitting. The longer white striped hose goes on right side fuel tank vent nipple.
3. The dots on the hoses should be at the front of the vinyl-coated bracket. Route hoses over the tank brackets, through the vinyl-coated bracket on frame backbone, between battery and inside of oil tank and out the bottom, back of oil tank.
4. Attach the carburetor purge fitting hose to the canister fitting marked "carb". Attach the fuel tank hose to the top (long) fitting on the vapor valve.
5. At the fuel tank area, push loose end of the fuel tank vent/vapor valve hose inside throttle cables, under wiring harness. Cable tie loosely, using hole in wiring harness bracket. Install fuel tank and place fuel tank hose on fuel tank vent nipple.

Canister to Air Cleaner Hose

1. Route the large (0.500 ID), pre-formed, carburetor backplate hose as follows:
   a. The pre-formed section goes behind the front cylinder push rod tubes and loops under the cam gear case, outside the rear brake line, but inside the clutch cable.
   b. Route it straight back to the right side canister fitting. Cut to length and slip onto the canister fitting.
   c. Cable tie hose to the frame tube to prevent it coming in contact with the exhaust system. Install the end of the pre-formed section on the carburetor backplate fitting.
2. See Figure 4-17. Position gasket (10) and backplate (7) next to carburetor and install the crankcase breather tube. Start each backplate-to-carburetor screw (8) into threaded holes in carburetor flange.
3. By hand, turn each backplate-to-carburetor screw a couple of turns in sequence until the backplate is drawn to a loose fit next to the carburetor flange
4. Insert one backplate-to-cylinder head breather screw (6) into each upper backplate mounting hole and thread loosely into the threaded hole in each cylinder head.
5. Tighten backplate-to-carburetor screws to 3-5 ft-lbs (4-7 Nm).
6. Tighten backplate-to-cylinder head breather screws to 10-12 ft-lbs (14-16 Nm).
7. Install rubber plugs over backplate-to-cylinder head breather screws at two upper mounting holes.
8. Install baffle plate (9) in bottom of backplate and place element (4) in backplate.
9. Position cover (3) on backplate and secure with washer (2) and air cleaner cover screw (1).
10. Tighten air cleaner cover screw to 3-5 ft-lbs (4-7 Nm).
11. Install new EVAP system label on front frame down tube.

EXHAUST SYSTEM (Shorty dual exhaust)

REMOVAL

1. Loosen or remove heat shields by opening worm drive clamps.

2. See Figure 4-22. Remove nuts (11) from front and rear cylinder head exhaust studs.

CAUTION

Be sure to protect gearcase cover and transmission side cover from scratches when removing the exhaust system.

3. Remove muffler support tubes/bracket bolts (27 and 30), washers (29 and 31), and lockwashers (26 and 28). If necessary, remove bolts (25) and lockwashers (26) attaching exhaust support tubes to frame.

4. Remove exhaust system as an assembly.

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

DISASSEMBLY

1. Loosen nuts on muffler clamps (10) clamping front muffler (8) and rear muffler (9) to exhaust pipes (5 and 7). Remove mufflers.

2. Free front exhaust pipe from rear exhaust pipe by twisting and separating at crossover pipe.

3. Examine retaining rings (13) and gaskets (14) in cylinder head exhaust ports. Replace if necessary.

4. Remove gasket (15) and washer (16) from crossover pipe bell on rear exhaust pipe.

ASSEMBLY

1. Insert washer (16) and new gasket (15) (if necessary) into crossover pipe bell on rear exhaust pipe. Connect rear exhaust pipe to front exhaust pipe at crossover pipe.

2. Install front and rear mufflers on front and rear exhaust pipes. Install muffler clamps using nuts and washers. Do not tighten nuts until exhaust system is installed.

INSTALLATION

1. If removed, position exhaust support tubes/bracket on frame. Install bolts (25) and lockwashers (26). Tighten bolts to 19 ft-lbs (26 Nm).

NOTE

See inset in Figure 4-22. Replacement cylinder head exhaust gaskets are tapered internally. Be sure the thin end goes over the exhaust pipe.

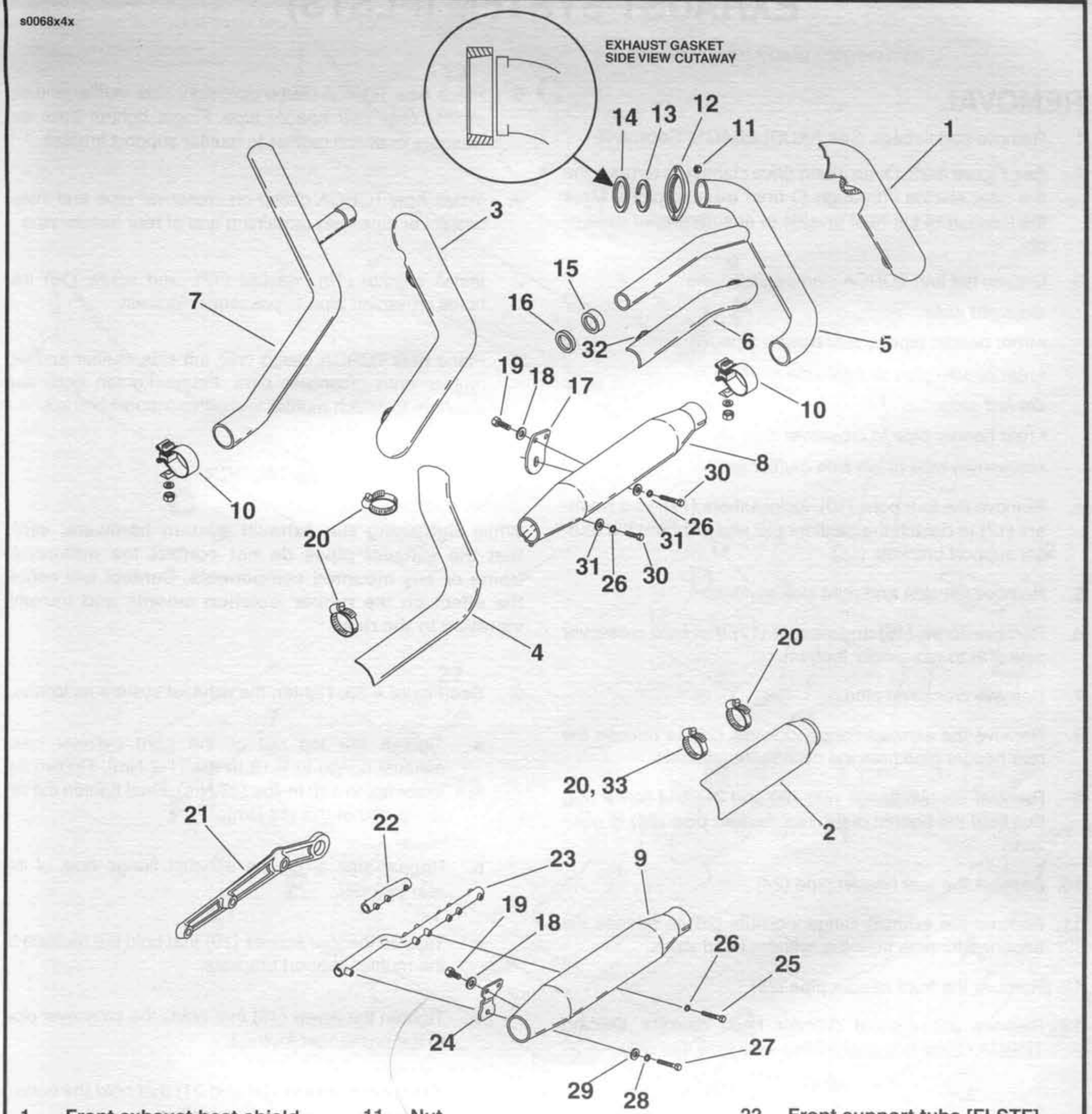
2. Position ends of exhaust pipes into front and rear cylinder head exhaust ports with holes in exhaust flange (12) over cylinder head exhaust studs. Loosely thread on nuts (11).

3. Install muffler support tubes/bracket bolts (27 and 30), washers (29 and 31), and lockwashers (26 and 28).

4. Align exhaust system and tighten all nuts and bolts beginning at cylinder head exhaust ports and working backwards.

5. Secure nuts (11), at cylinder studs, by tightening to 60-80 **in-lbs** (6.8-9.0 Nm). Tighten nuts at muffler clamps (10) to 45-60 ft-lbs (61-81 Nm). Tighten bolts (27 and 30) at muffler support tube/bracket to 19 ft-lbs (26 Nm).

6. Open the worm drive clamps and install heat shields.



1. Front exhaust heat shield
2. Muffler heat shield
3. Rear exhaust heat shield [FLSTC/FXSTC/S/SB]
4. Rear exhaust heat shield [FLSTF]
5. Front exhaust pipe
6. Crossover heat shield
7. Rear exhaust pipe
8. Front muffler
9. Rear muffler
10. TORCA clamp
11. Nut
12. Exhaust flange
13. Exhaust gasket retaining ring
14. Exhaust port gasket
15. Gasket
16. Washer
17. Front muffler bracket
18. Washer (Lockplate on late 1997/ 1998 Model FLSTF)
19. Screw
20. Clamp
21. Rear muffler support [FLSTF]
22. Front support tube [FLSTF]
23. Support tube [FLSTC/FXSTC/S/SB]
24. Rear muffler bracket
25. Bolt
26. Lockwasher
27. Bolt
28. Lockwasher
29. Washer
30. Screw
31. Washer
32. Clamp
33. Clamp Shield

Figure 4-22. Shorty Dual Exhaust System

EXHAUST SYSTEM (FLSTS)

REMOVAL

1. Remove saddlebags. See SADDLEBAGS, Section 2.
2. See Figure 4-23. Open worm drive clamps to remove the five heat shields (1through 5) from exhaust pipes. Mark the location of the heat shields to ensure proper assembly.
3. Loosen the four TORCA clamps as follows:

   On right side

   - front header pipe to rear header pipe (6)
   - rear header pipe to right side muffler (7)

   On left side

   - rear header pipe to crossover pipe (8)
   - crossover pipe to left side muffler (9)
4. Remove the four bolts (10), lockwashers (11), and washers (12) to detach the mufflers (13 and 14) from the muffler support brackets (15).
5. Remove left side and right side mufflers.
6. Remove screw (16) and washer (17) that hold crossover pipe (19) to passenger footrest.
7. Remove crossover pipe.
8. Remove the exhaust flange locknuts (26) to release the rear header pipe from the cylinder head studs.
9. Remove the two flange nuts (20 and 21) and screw (23) that hold the bottom of the rear header pipe (24) in position.
10. Remove the rear header pipe (24).
11. Remove the exhaust flange locknuts (26) to release the front header pipe from the cylinder head studs.
12. Remove the front header pipe (25).
13. Remove and discard cylinder head gaskets. Discard TORCA clamp bolt assemblies–one time use only.

NOTE

TORCA muffler clamps have eliminated the need for silicone or graphite tape during assembly. To ensure sealing integrity of muffler clamps, and prevent the possibility of leakage, Harley-Davidson recommends that muffler clamp assemblies be discarded and replaced each time they are removed.

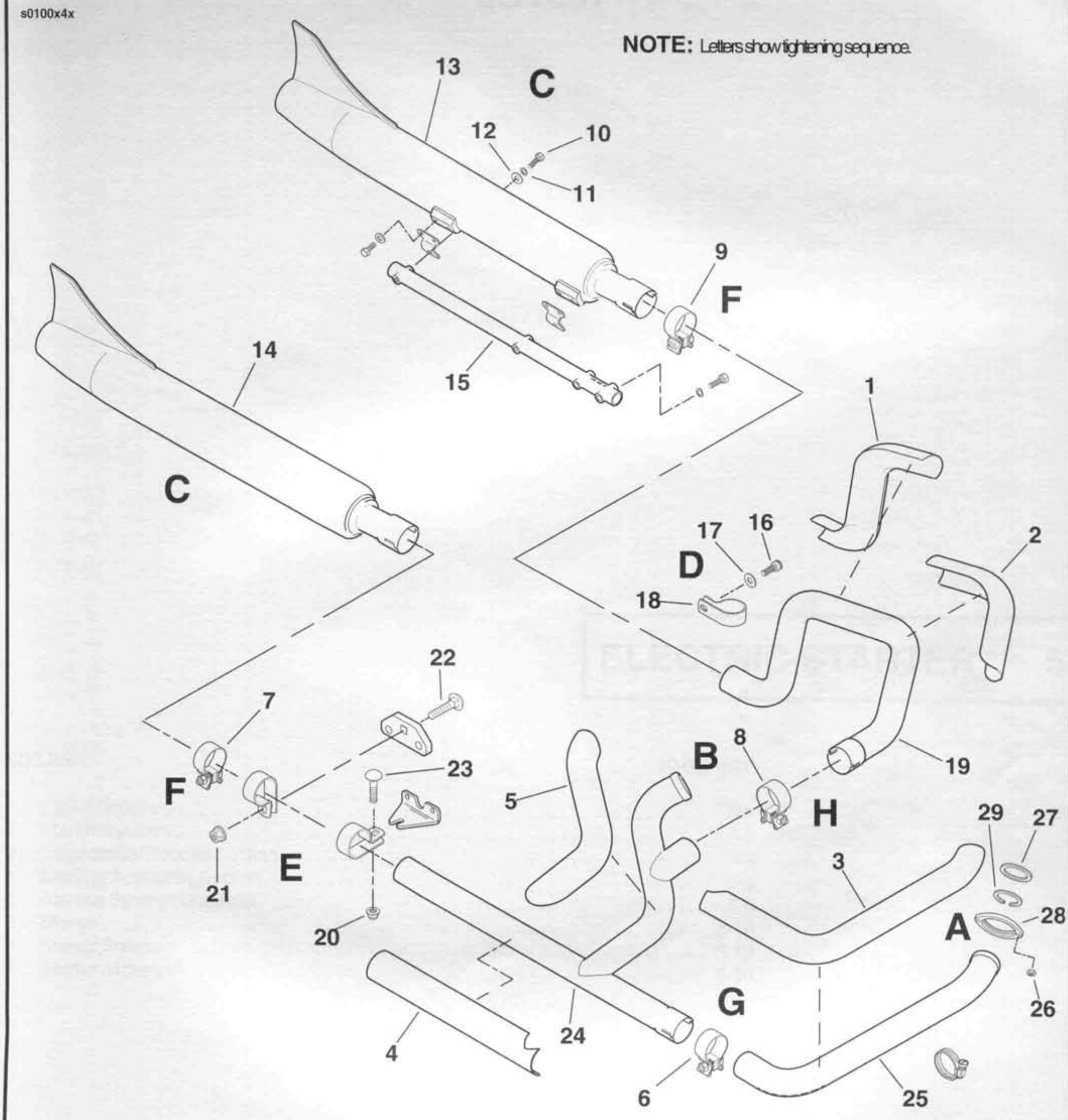
INSTALLATION

1. Assemble front and rear header pipes with **new** TORCA clamp, but leave clamp loose.
2. Install **new** gaskets (27) in both the front and rear cylinder heads with the tapered side out.
3. Install header pipes by placing exhaust flanges (28) 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** TORCA clamp on crossover pipe and install crossover pipe onto remaining end of rear header pipe.
7. Install bracket (18), washer (17), and screw (16) 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.

⚠CAUTION

While tightening the exhaust system hardware, verify that the exhaust pipes do not contact the motorcycle frame or any mounted components. Contact will cancel the effect on the rubber isolation mounts and transmit vibration to the rider.

9. See Figure 4-23. Tighten the exhaust system as follows:
   a. Tighten the top nut of the front cylinder head exhaust flange to 9-18 **in-lbs** (1-2 Nm). Tighten the lower nut to 120 **in-lbs** (14 Nm). Final tighten the top nut to 120 **in-lbs** (14 Nm).
   b. Repeat step a. on the exhaust flange nuts of the rear cylinder.
   c. Tighten the four screws (10) that hold the mufflers to the muffler support brackets.
   d. Tighten the screw (16) that holds the crossover pipe to the passenger footrest.
   e. Tighten the screws (20 and 21) that hold the bottom of the rear header pipe in position.
   f. Tighten the TORCA clamps (7 and 9) that hold the mufflers on to 45-60 ft-lbs (61-81 Nm).
   g. Tighten the TORCA clamp (6) that connects the header pipes together to 45-60 ft-lbs (61-81 Nm).
   h. Tighten the TORCA clamp (8) that connects the crossover pipe to the rear header pipe to 45-60 ft-lbs (61-81 Nm).
10. Open worm drive clamps and install the five heat shields. Position clamps so the screws are on the outboard side in the most accessible position.
11. Install saddlebags. See SADDLEBAGS, Section 2.



1. Heat shield
2. Heat shield
3. Heat shield
4. Heat shield
5. Heat shield
6. TORCA clamp
7. TORCA clamp
8. TORCA clamp
9. TORCA clamp
10. Screw
11. Lockwasher
12. Washer
13. Left muffler
14. Right muffler
15. Muffler support bracket
16. Screw
17. Washer
18. Clamp
19. Crossover pipe
20. Flange nut
21. Flange nut
22. Screw
23. Screw
24. Rear header pipe
25. Front header pipe
26. Nut
27. Exhaust port gasket
28. Exhaust flange
29. Exhaust gasket retaining ring

Figure 4-23. FLSTS Exhaust System

ELECTRIC STARTER 5

SPECIFICATIONS

STARTER MOTOR

Free speed	3000 rpm (min) @ 11.5 V
Free current	90 arnp (max) @ 11.5 V
Cranking current	200 amp (max) @ 68˚

SERVICE WEAR LIMITS

Brush length (min)	0.433 in. (11 mm)
Commutator diameter (min)	1.141 in. (28.98 mm)

TORQUE VALUES

Thru-bolts	39-65 **in-lbs** (4.4-7.3 Nm)
End cover mounting bracket	50-60 **in-lbs** (5.6-6.8 Nm)
End cover center screw	90-110 **in-lbs** (10.2-12.4 Nm)
Cable terminal nuts	65-80 **in-lbs** (7.3-9.0 Nm)
Starter mounting bolts	13-20 ft-lbs (18-27 Nm)
Jackshaft bolt	7-9 ft-lbs (9-12 Nm)

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 and 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.

The starter relay is a non-repairable part and must be replaced if it malfunctions.

Operation

See Figure 5-1. When the starter switch is pushed, the starter relay is activated and battery current flows into the pull-in winding and the hold-in winding, to ground.

The magnetic forces of the pull-in and hold-in windings in the solenoid, pull the plunger and cause it to shift to the left, so that the pinion gear is engaged with the clutch ring gear. At the same time, the main solenoid contacts are closed and battery current flows directly through the field windings to the armature and to ground. Simultaneously, the pull-in winding is opened.

The current continues flowing through the hold-in winding, keeping the main solenoid contacts closed. At this point the starter begins to crank the engine.

After the engine has started, the pinion gear turns freely on the pinion shaft through the action of the overrunning clutch which prevents the armature overrunning by the rotation of the clutch ring gear.

When the starter switch is released, the current of the hold-in winding is fed through the main solenoid contacts and the direction of the current in the pull-in winding is reversed. The solenoid plunger is returned to its original position by the return spring, disengaging the pinion gear from the clutch ring gear.

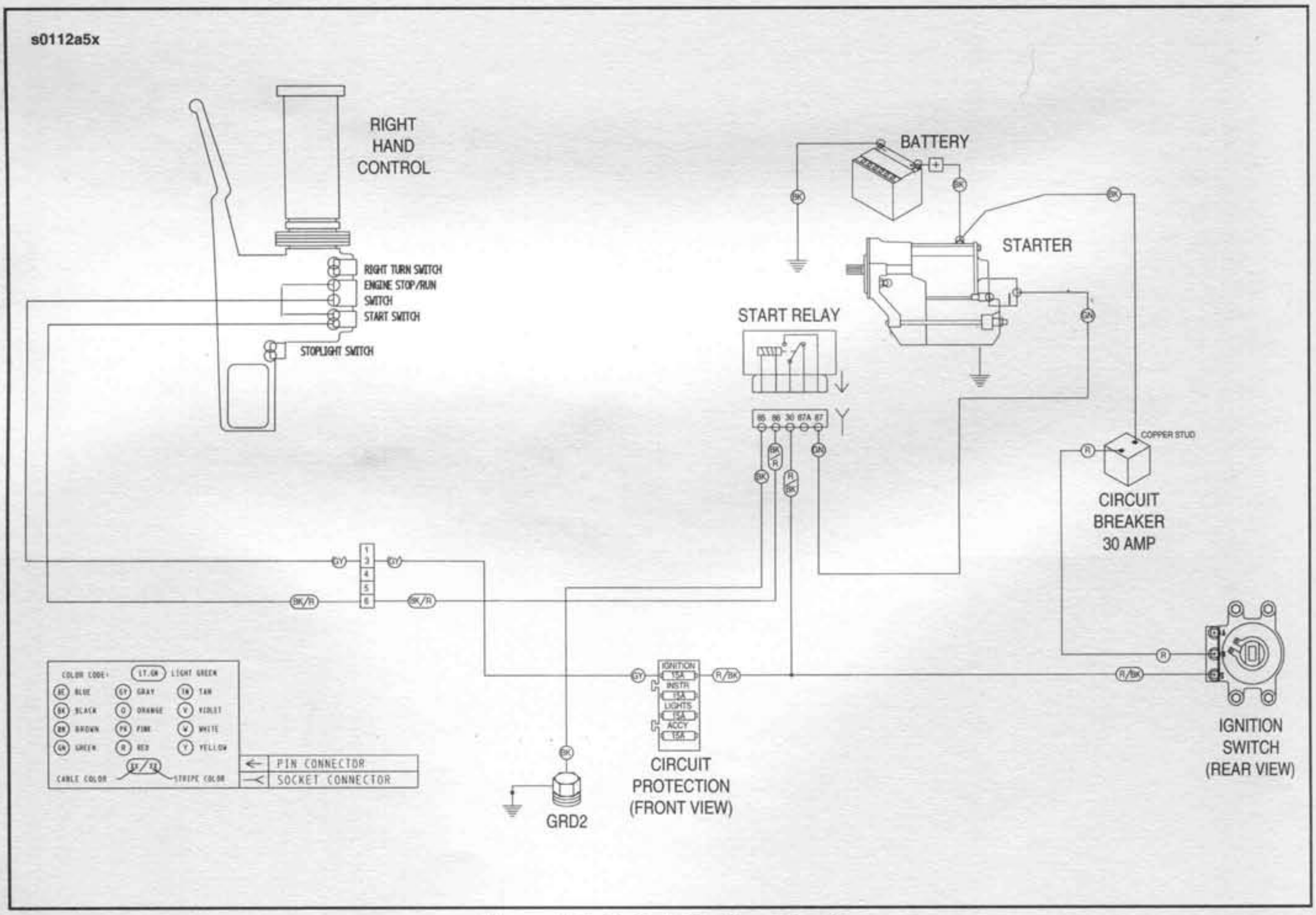


Figure 5-1. Softail Starting Circuit

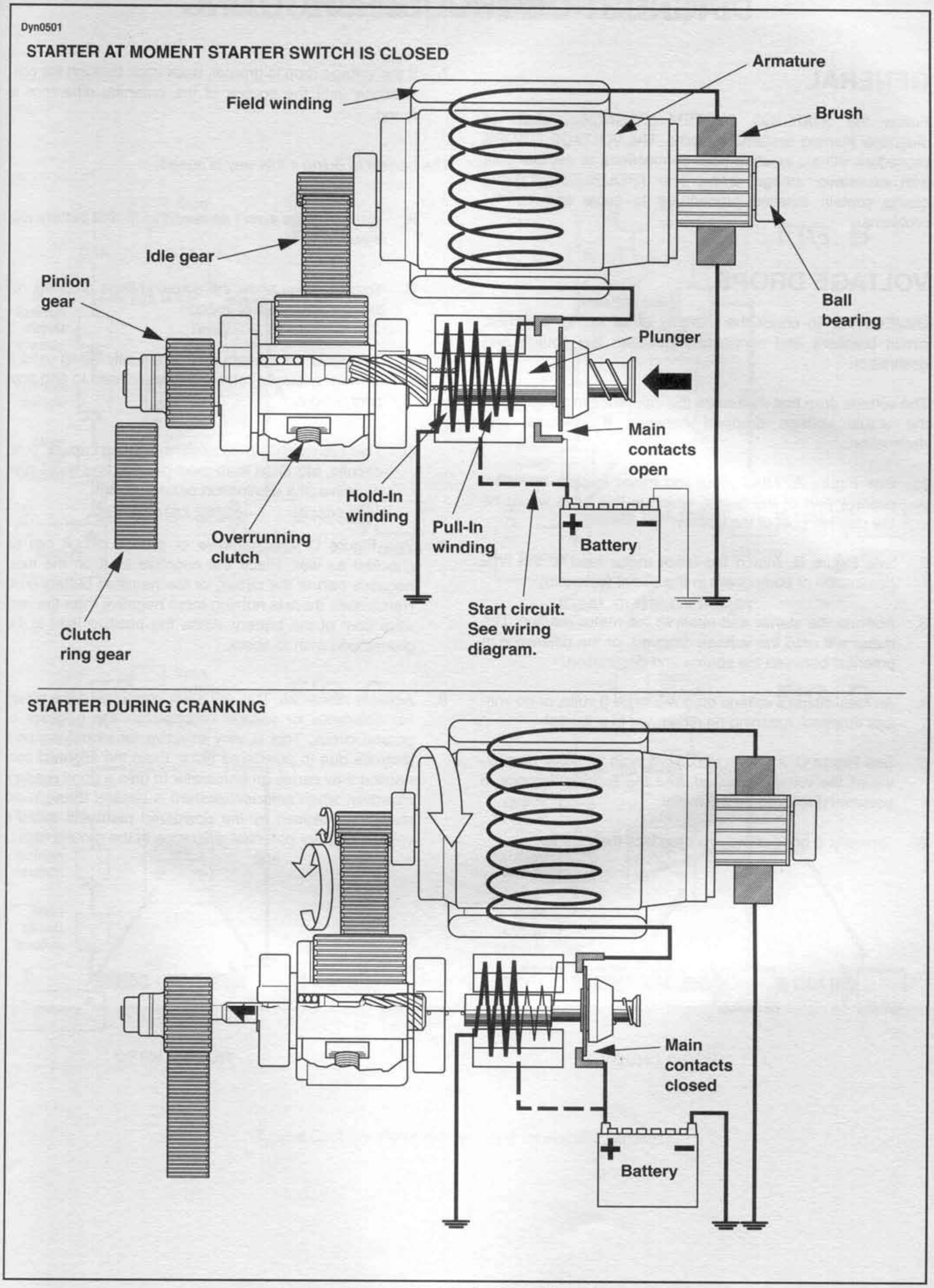


Figure 5-2. Starter Operation

DIAGNOSTICS/TROUBLESHOOTING

GENERAL

Follow the STARTING SYSTEM DIAGNOSIS chart to diagnose starting system problems. The VOLTAGE DROPS procedure will aid locating poor connections or components with excessive voltage drops. The TROUBLESHOOTING charts contain detailed procedures to solve and correct problems.

VOLTAGE DROPS

OBJECTIVE: To check the integrity of all wiring, switches, circuit breakers and connectors between the source and destination.

The voltage drop test measures the difference in potential, or the actual voltage dropped between the source and destination.

1. See Figure A. Attach your red meter lead to the most positive part of the circuit, which in this case would be the positive post of the battery.
2. See Figure B. Attach the black meter lead to the final destination or component in the circuit (solenoid).
3. Activate the starter and observe the meter reading. The meter will read the voltage dropped, or the difference in potential between the source and destination.
4. An ideal circuit's voltage drop would be 0 volts, or no voltage dropped, meaning no difference in potential.
5. See Figure C. An open circuit will read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.
6. Typically, a good circuit will drop less than 1 volt.
7. If the voltage drop is greater, back track through the connections until the source of the potential difference is found.

The benefit of doing it this way is speed.

A. Your readings aren't as sensitive to real battery voltage.

B. Your readings show the actual voltage dropped, not just the presence of voltage.

C. This tests the system as it is actually being used. It is more accurate, and will display hard to find poor connections.

D. This approach can be used on lighting circuits, radio circuits, etc. Start from most positive and go to most negative (the destination or component).

8. See Figure D. The negative or ground circuit can be checked as well. Place the negative lead on the most negative part of the circuit, or the negative battery post. Remember, there is nothing more negative than the negative post of the battery. Place the positive lead to the ground you wish to check.
9. Activate the circuit. This will allow you to read the potential difference or voltage dropped on the negative or ground circuit. This is very effective for identifying poor grounds due to powdered paint. Even the slightest connection may cause an ohmmeter to give a good reading. However, when sufficient current is passed through, the resistance caused by the powdered paint will cause a voltage drop, or potential difference in the ground circuit.

STARTING ACTIVATION CIRCUITS

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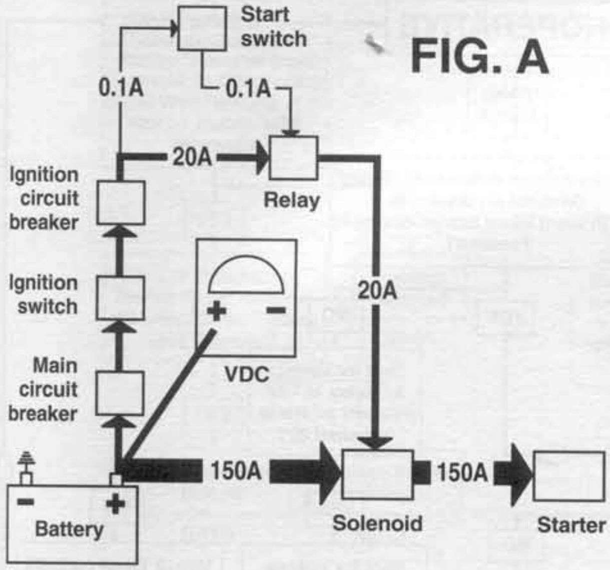
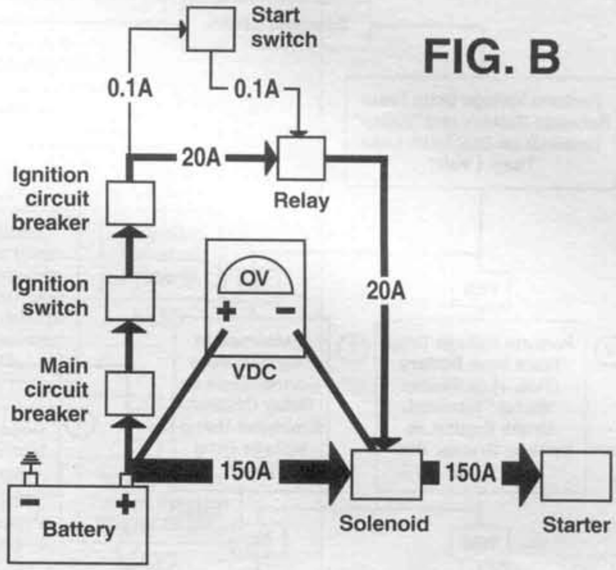
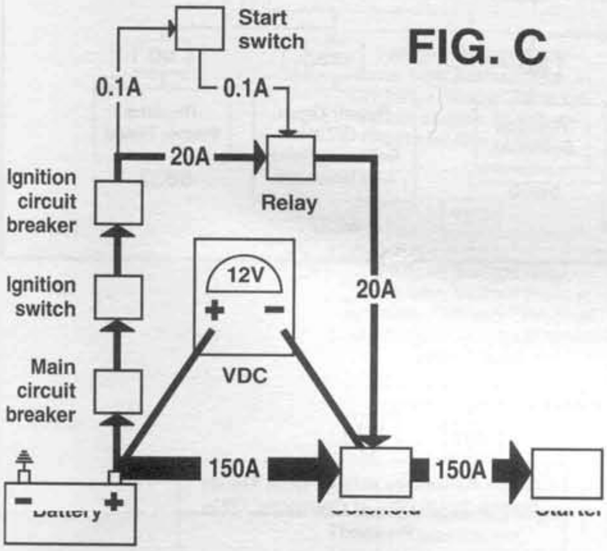
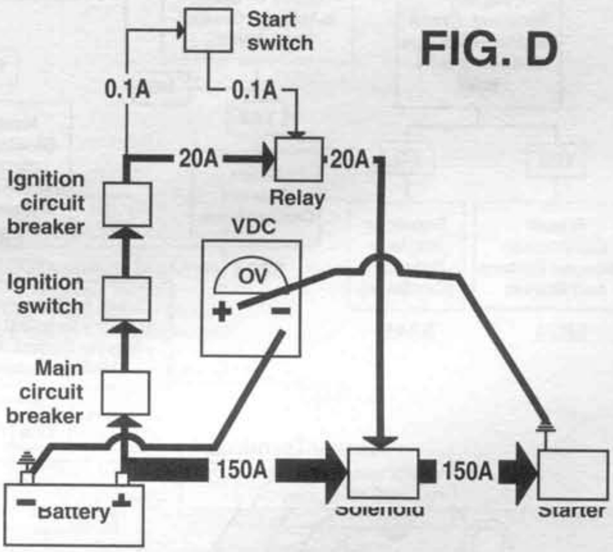




IDEAL CLOSED CIRCUIT



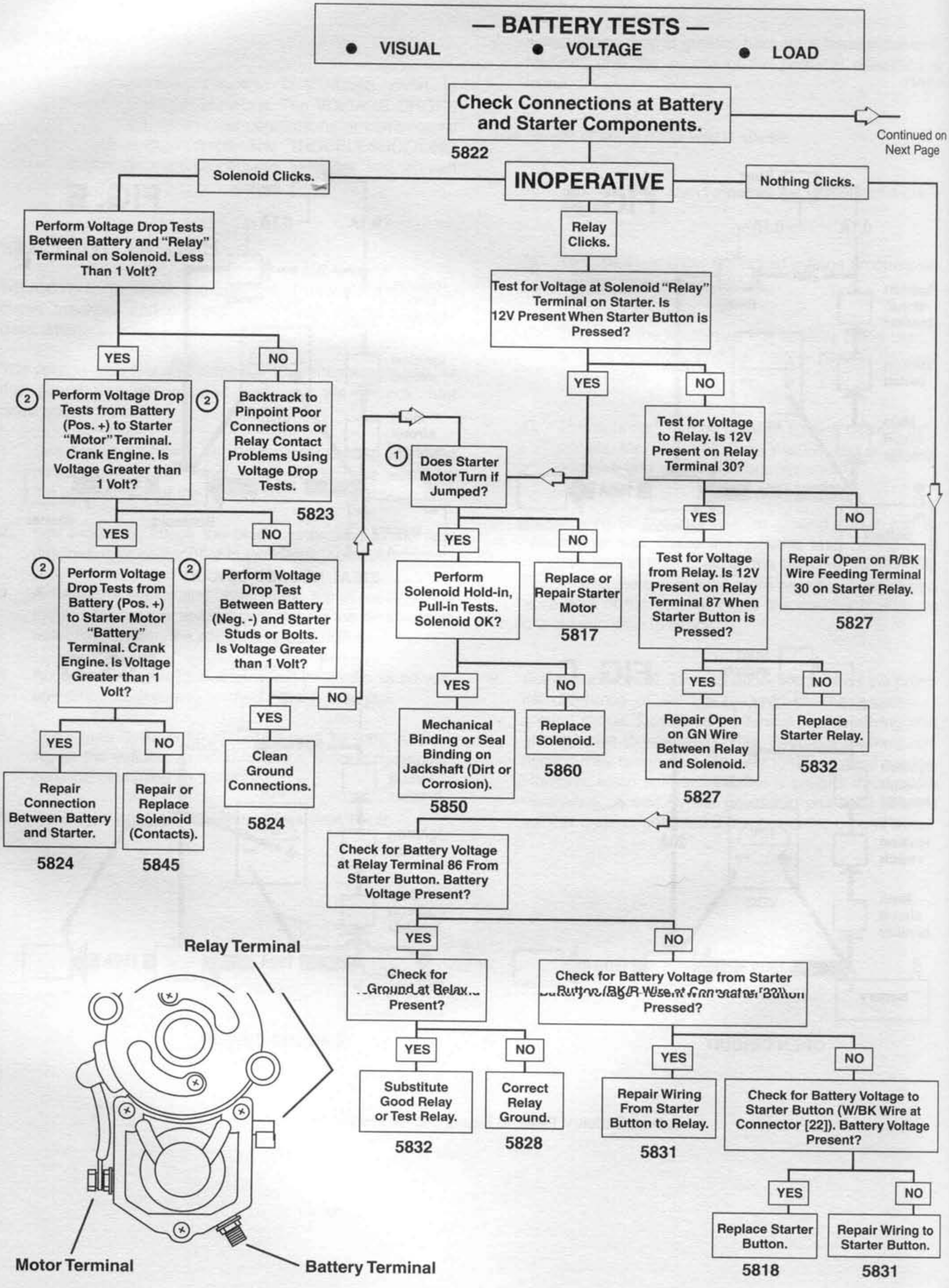
OPEN CIRCUIT



GROUND CIRCUIT

Typical Circuitry. Refer to Figure 5-2 for specific vehicles.

STARTING SYSTEM DIAGNOSIS



STARTING SYSTEM DIAGNOSIS-continued

Continued from Previous Page

RUN-ON

Disconnect Solenoid "Relay" Terminal from Solenoid. Is 12V Present at GN Wire Terminal with Starter Button NOT Pressed?

- YES: Is 12V Present on Starter Relay Terminal 86 with Starter Button NOT Pressed?
  - YES: Replace Starter Button. **5818**
  - NO: Replace Starter Relay. **5832**
- NO: Replace Solenoid. **5845**

STARTER SPINS, BUT DOES NOT ENGAGE

Remove and Disassemble Starter Jackshaft Assembly. Is Jackshaft Properly Assembled?

- YES: Remove Starter. Disassemble Drive Housing Assembly. Inspect for Damage to Armature Gear or Idler Gear. Damage Present?
  - YES: Replace Damaged Idler Gear & Armature. **5825**
  - NO: Starter Clutch Failure. Replace Starter Clutch. **5837**
- NO: Assemble Jackshaft Properly. **5850**

STARTER STALLS OR SPINS TOO SLOWLY

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

- YES: (2) Perform Voltage Drop Tests from Battery (Pos. +) to Starter "Battery" Terminal. Crank Engine. Is Voltage Greater than 1 Volt?
  - YES: Between Battery and Starter. **5824**
  - NO: Replace Solenoid (Contacts). **5845**
- NO: Perform Voltage Drop Test Between Battery (Neg. -) and Starter Studs or Bolts. Is Voltage Greater than 1 Volt?
  - YES: Clean Ground Connections. **5835**
  - NO: (3) Perform Starter Motor Current Draw Test (on
    - (4) Perform Starter Motor Free Draw Bench Test. Are Test Results in Range?
      - YES: Remove spark plugs while in 5th gear. Rotate rear wheel. Check for engine, primary and/or crankshaft bind. **Use Appropriate Code**
      - NO: Replace or Repair Starter Motor. **5817**

NOTES

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

Numbers refer to the proper Warranty Code.

TROUBLESHOOTING

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
1. Starter does not run, or runs at very low speeds.	1.1 Battery.	1.1.1 Voltage drop due to discharge battery.	1.1.1 Charge battery.
		1.1.2 Worn or defective battery.	1.1.2 Replace battery.
		1.1.3 Corroded battery terminal(s).	1.1.3 Clean and retighten.
	1.2 Wiring.	1.2.1 Poor or no connection at either battery positive or negative cable, at either end.	1.2.1 Repair or replace cable(s).
		1.2.2 Cracked or corroded battery cable ends.	1.2.2 Clean, tighten or replace cable(s) as needed.
		1.2.3 Open wire(s) or poor connection at handlebar switch or starter relay, especially relay ground wire.	1.2.3 Tighten connections or repair or replace wire(s).
	1.3 Handlebar start switch.	1.3.1 Poor switch contacts or open switch.	1.3.1 Replace switch.
	1.4 Starter relay.	1.4.1 Open coil winding.	1.4.1 Replace relay.
		1.4.2 Poor or no continuity at relay points.	1.4.2 Replace relay.
	1.5 Solenoid.	1.5.1 Poor contact condition caused by burnt contact.	1.5.1 Rebuild solenoid assembly. See NOTE below.
		1.5.2 Pull-in winding open or short-circuited.	1.5.2 Repair or replace solenoid assembly.
		1.5.3 Hold-in winding open or short circuited.	1.5.3 Repair or replace solenoid assembly.
	1.6 Starting motor.	1.6.1 Brushes worn below specification.	1.6.1 Replace brushes.
		1.6.2 Poor contact condition of brushes.	1.6.2 Check brush spring tension.
		1.6.3 Commutator burned.	1.6.3 Correct on lathe or replace armature.
		1.6.4 Commutator mica is too high.	1.6.4 Correct by undercutting.
		1.6.5 Field winding grounded.	1.6.5 Replace field winding.
		1.6.6 Armature winding grounded or short circuited.	1.6.6 Replace armature winding.
		1.6.7 Reduction gears damaged.	1.6.7 Replace reduction gears.
		1.6.8 Insufficient brush spring tension.	1.6.8 Replace brush spring
		1.6.9 Lead wire disconnected between solenoid and field windings.	1.6.9 Repair or replace lead wire.
		1.6.10 Ball bearing sticks.	1.6.10 Replace bearing.
	1.7 Starter jackshaft assembly.	1.7.1 Jackshaft binding or sticking.	1.7.1 Replace jackshaft bushing.
		1.7.2 Jackshaft binding at primary case seal because of corrosion.	1.7.2 Repair or replace jackshaft assembly.

NOTE:

A solenoid repair kit is available from your Harley-Davidson dealer. Follow the repair procedure given in the Instruction Sheet included with the repair kit.

TROUBLESHOOTING-continued

PROBLEM	SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
2. Pinion does not engage with ring gear while starter is running/engine cannot be cranked.	2.1 Battery.	2.1.1 Voltage drop because of discharged battery.	2.1.1 Charge battery.
		2.1.2 Worn or defective battery.	2.1.2 Replace battery.
		2.1.3 Corroded battery terminal(s).	2.1.3 Clean and retighten.
	2.2 Overrunning clutch.	2.2.1 Overrunning clutch malfunction (rollers or compression spring).	2.2.1 Replace overrunning clutch.
		2.2.2 Pinion teeth worn out.	2.2.2 Replace pinion.
		2.2.3 Pinion does not run in overrunning direction.	2.2.3 Replace overrunning clutch.
		2.2.4 Spline teeth do not slide properly.	2.2.4 Remove foreign materials, dirt, or replace overrunning clutch or pinion shaft.
		2.2.5 Reduction gears damaged.	2.2.5 Replace overrunning clutch and idler gear.
	2.3 Jackshaft assembly.	2.3.1 Improper jackshaft parts assembly.	2.3.1 Disassemble and assemble parts properly.
	2.3 Gear teeth on clutch shell.	2.3.2 Excessively worn teeth.	2.3.2 Replace clutch shell.
3. Starter does not stop running.	3.1 Starting switch or starter relay.	3.1.1 Unopened contacts.	3.1.1 Replace starting switch or starter relay.
		3.1.2 Poor return caused by sticky switch or relay contacts.	3.1.2 Replace starting switch or starter relay.
	3.2 Gear teeth on clutch shell.	3.2.1 Excessively worn teeth.	3.1.2 Replace clutch shell.
	3.3 Solenoid.	3.3.1 Return spring worn.	3.2.1 Replace spring.
		3.3.2 Coil layer shorted.	3.2.2 Replace solenoid.
		3.3.3 Contact plate melted and stuck.	3.2.3 Repair solenoid.

ON MOTORCYCLE TESTING

Special Tools	Torque Values
HD-35500-A Digital Multimeter HD-39617AC/DC Current Probe	None

Before removing starter perform the following tests:

STARTER RELAY

1. See Figure 5-3. Unplug the relay connector and substitute a new relay or perform the following test.

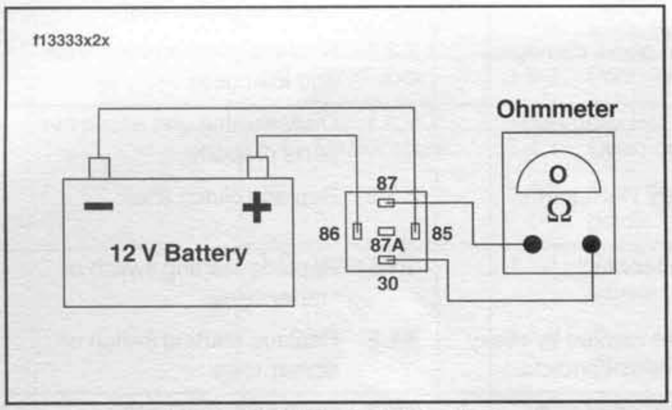


Figure 5-3. Starter Relay Test

2. The starter relay can be tested with the motorcycle's 12 Volt battery and a multimeter. Unplug the wires from the relay and connect the battery leads to the 86 and 85 terminals to energize the relay (see wiring schematic for wire colors). Check for continuity between the 30 and 87 terminals. A good relay will show continuity. There will be continuity if the tester lamp is "on" or there is a zero ohm reading on the ohmmeter setting of the multimeter. A malfunctioning relay will not have continuity and must be replaced.

STARTER CURRENT DRAW TEST

See Figure 5-4. Starter current draw should be checked with an induction ammeter before disconnecting the battery, under the following conditions:

- Engine temperature should be stable and at room temperature.
- Battery should be fully charged.

1. Make sure the transmission is in neutral. Disconnect the spark plug wires from spark plug terminals.
2. Clamp DC Current Probe over the positive battery cable.
3. With the ignition ON, turn engine over by pressing starter switch while taking a reading on the ammeter setting of the multimeter. Disregard initial high current reading which is normal during time the engine is first turned over.
   - Typical starter current draw will range between 160 and 180 amperes.
4. If starter current draw exceeds 200 amperes, the problem may be in the starter or starter drive and the starter must be removed and tested further. See REMOVAL and FREE RUNNING CURRENT DRAW TEST.

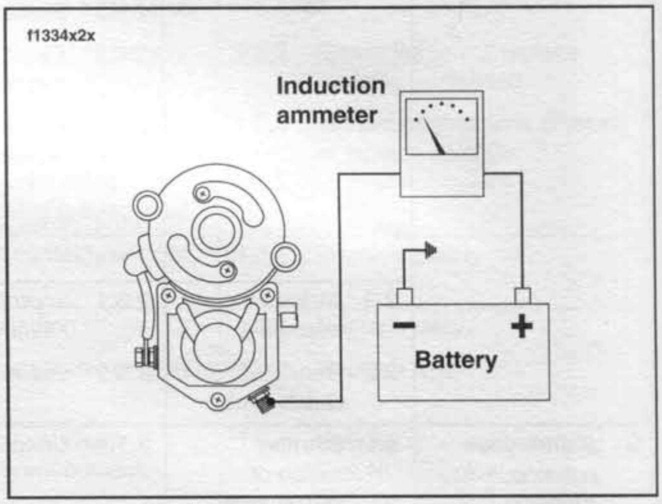


Figure 5-4. Starter Draw Test

REMOVAL

WARNING

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

1. Disconnect battery cables, negative cable first.
2. Remove primary chaincase cover. See PRIMARY CHAINCASE, in Section 6.
3. See Figure 5-28. Bend tab on lockplate (2) away from head of jackshaft bolt.
4. Hold pinion gear (4) in place and remove jackshaft bolt (1) and lockplate (2).

NOTE

Because of variations in components, it may be necessary to loosen the oil tank mounts on some Softail motorcycles to provided clearance for starter removal. See Section 3, OIL TANK REMOVAL/INSTALLATION.

5. Remove rear exhaust pipe. See Section 4.
6. Remove Allen screw and end cover.

7. See Figure 5-5. Remove the starter mounting Allen head bolts and washers.

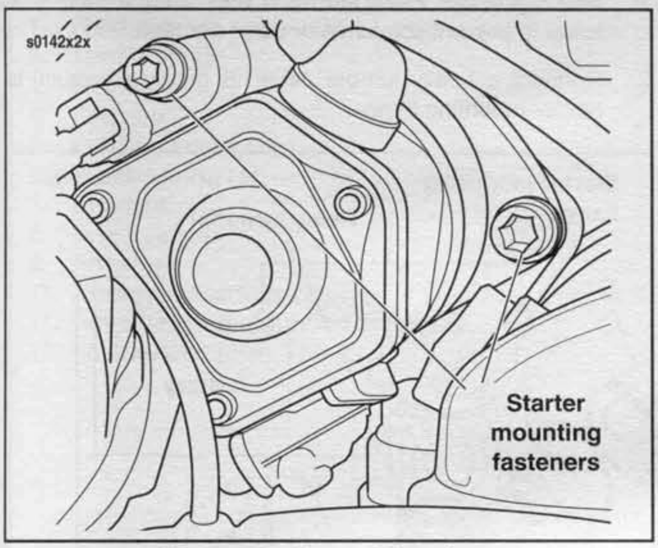


Figure 5-5. Starter Mounting

8. Disconnect positive battery lead and solenoid wire from starter.

9. Remove starter from right side of motorcycle.

NOTE

Jackshaft-to-starter shaft coupling will stay on the starter shaft.

Before disassembling the starter, perform tests on the assembled starter. See TESTING ASSEMBLED STARTER.

INSTALLATION

Special tools	Torque Values
None	Starter mounting bolts 13-20 ft-lbs (18-27 Nm) Jackshaft bolt 7-9 ft-lbs (9-12 Nm)

1. Install starter from right side of motorcycle.

NOTE

Be sure jackshaft coupling engages starter shaft.

2. Install positive battery cable and solenoid wire to solenoid.

3. See Figure 5-5. Install the two starter mounting bolts and washers. Tighten mounting bolts to 13-20 ft-lbs (18-27 Nm).

NOTE

Be sure the lockplate protrusion is sticking into the keyway.

4. Install jackshaft lockplate and bolt. Hold pinion gear in place and tighten bolt to 7-9 ft-lbs (9-12 Nm). Bend tab on lockplate against flat of bolt head to secure.

5. Install primary chaincase cover. See Section 6.

6. Fill primary chaincase with lubricant as described in section 1, SCHEDULED MAINTENANCE PROCEDURES.

7. Install starter end cover and Allen screw.

NOTE

If you loosened the oil tank mounts, tighten them now.

8. Install rear exhaust pipe.

9. Connect battery cables, positive cable first.

TESTING ASSEMBLED STARTER

Starter Solenoid

⚠WARNING

Wear eye protection during this series of tests. These tests may produce flying sparks which could cause eye injury.

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from "Motor" terminal, shown in Figure 5-6.

⚠CAUTION

Each test should be performed for only 3 to 5 seconds to prevent damage to solenoid.

NOTE

Perform the following tests one after the other without interruption.

Solenoid Pull-In

See Figure 5-6. Connect test leads from 12 Volt battery as shown. Connect the test lead to the "Relay" terminal last. The starter shaft should extend strongly if the solenoid is working properly. If shaft does not extend, solenoid should be replaced.

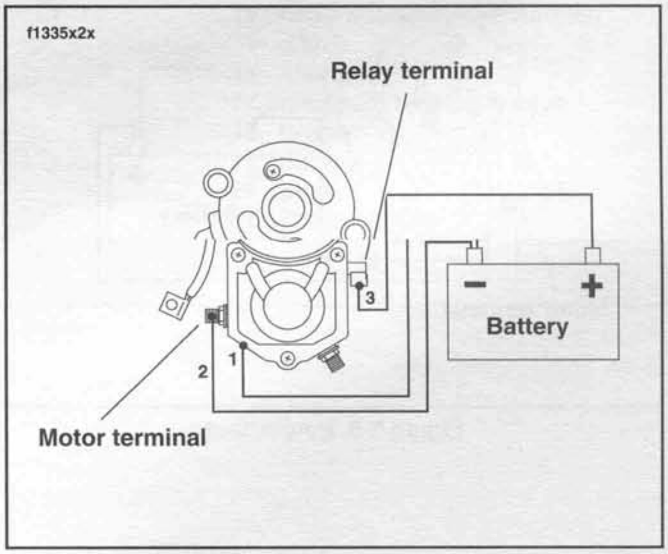


Figure 5-6. Pull-In Test

Solenoid Hold-In

See Figure 5-7. Keep test leads connected as in Pull-In Test. Begin with the starter shaft still extended. Disconnect "Motor" terminal test lead from the battery negative terminal and connect it to the battery positive terminal. If shaft does not remain in the extended position, replace solenoid.

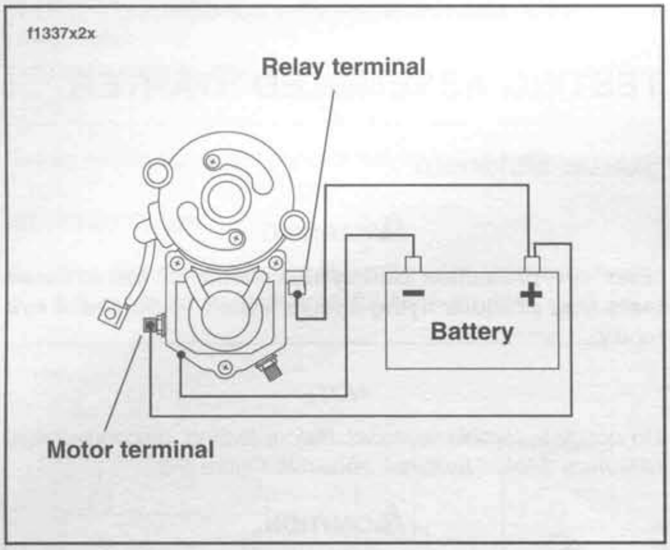


Figure 5-7. Hold-in Test

Solenoid Return

See Figure 5-8. Keep test leads connected as they were at the completion of the Hold-In Test. Disconnect the "Relay" terminal test lead. If shaft retracts, the solenoid is working properly. If the shaft does not retract, the solenoid should be replaced.

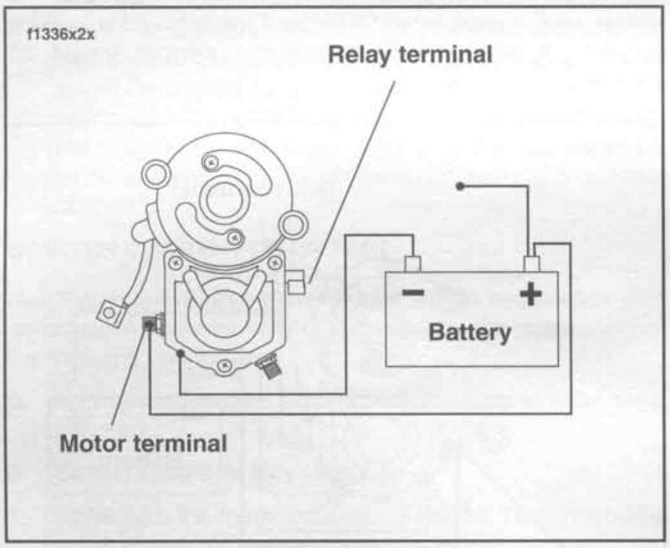


Figure 5-8. Return Test

Free Running Current Draw Test

1. See Figure 5-9. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. Connect a heavy jumper cable (6 gauge minimum) to starter mounting flange.

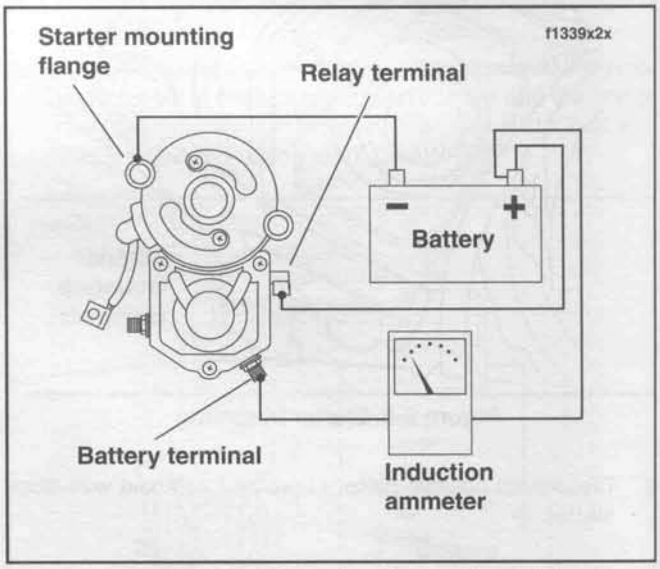


Figure 5-9. Free Running Current Draw Test

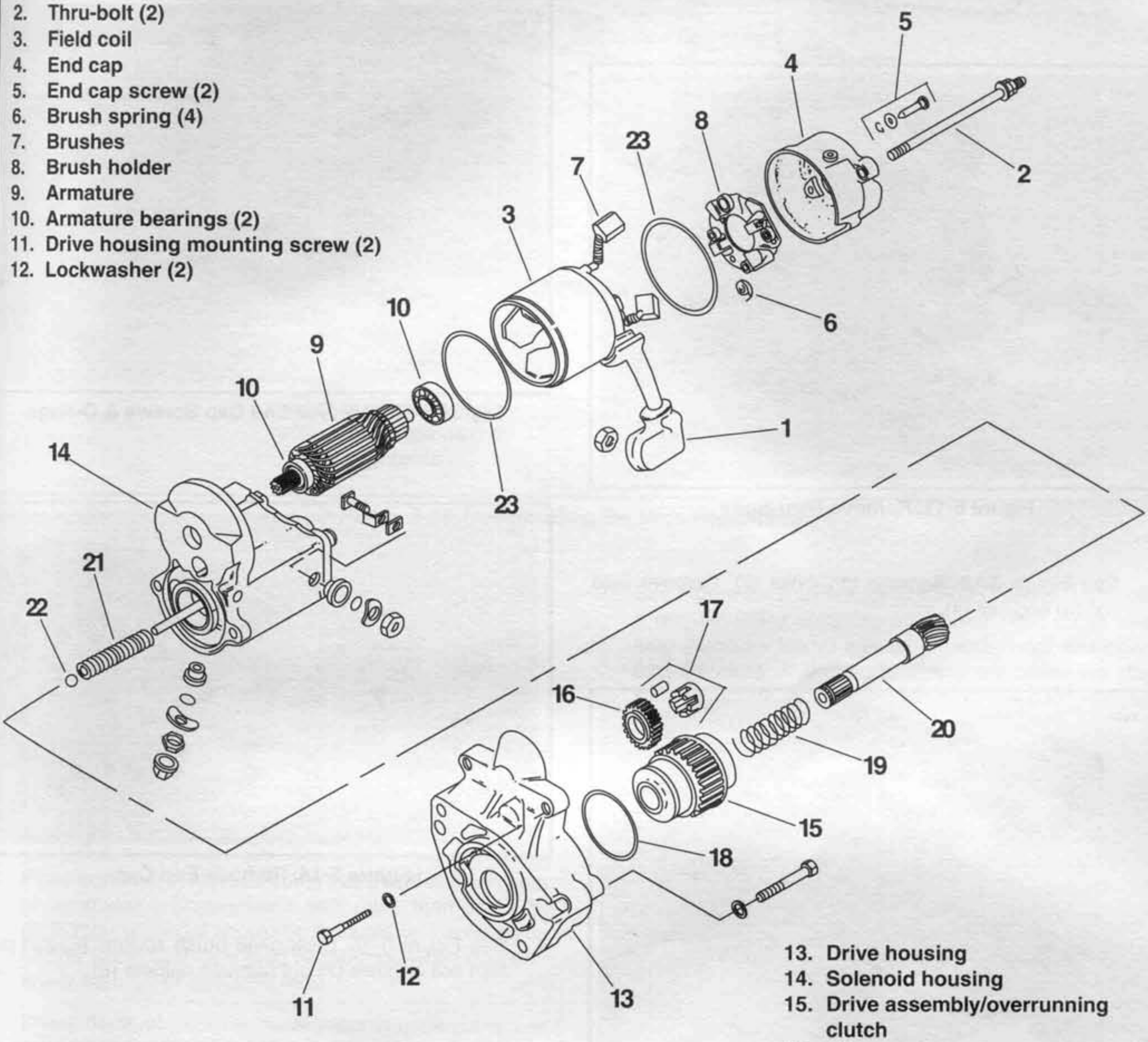
3. Connect other end to the negative (-) terminal of a fully charged battery.
4. Connect a heavy jumper cable (6 gauge minimum) to the positive (+) terminal of the battery.
5. Attach an inductive ammeter to positive cable and connect the other end of the positive cable to the "Battery" terminal of the starter solenoid.
6. Use a smaller jumper cable (14 gauge) and connect to the positive (+) terminal of the battery.
7. Connect other end of small jumper cable to the solenoid "Relay" terminal.
8. Check ammeter reading. Ammeter should show 90 amps maximum. If reading is higher, disassemble starter for inspection.

NOTE

If starter current draw on vehicle was over 200 amps and the starter FREE RUNNING CURRENT DRAW TEST was within specification, there may be a problem with engine, primary drive or starter jackshaft.

s0042x5x

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)

Figure 5-10. Starter

DISASSEMBLY AND TESTING

1. See Figure 5-11. Disconnect field wire (1).

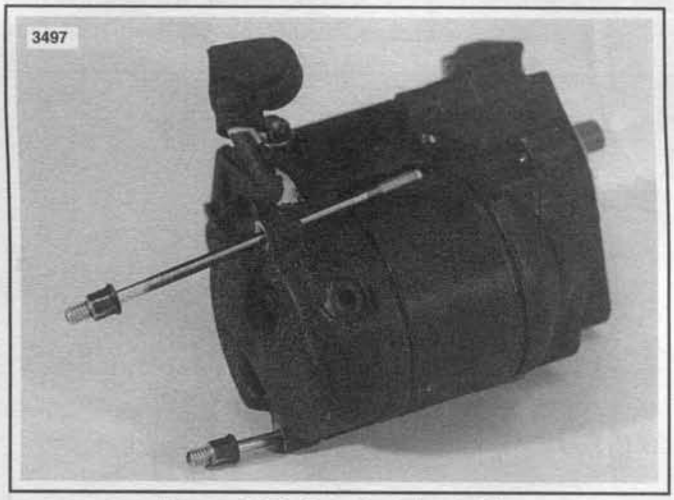


Figure 5-11. Remove Thru-Bolts

2. See Figure 5-12. Remove thru-bolts (2). Remove field coil (3) and cap (4).

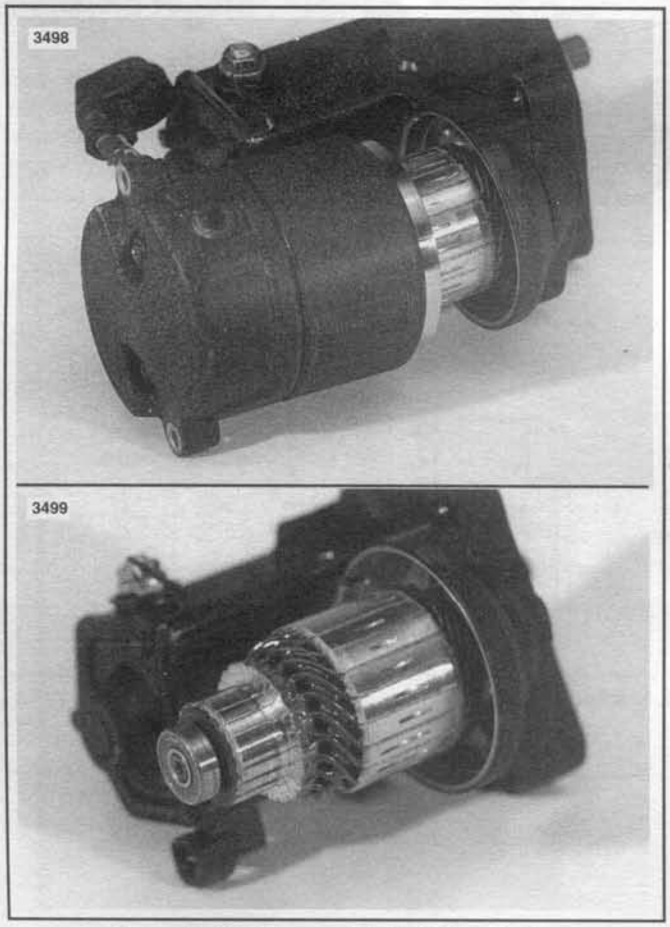


Figure 5-12. Remove Field Coil and Cap

3. See Figures 5-13 and 5-14. Remove the end cap screws (5) and cap.

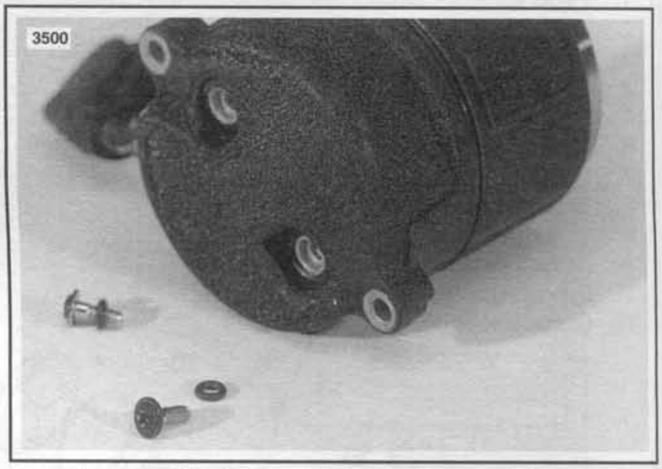


Figure 5-13. Remove End Cap Screws & O-rings

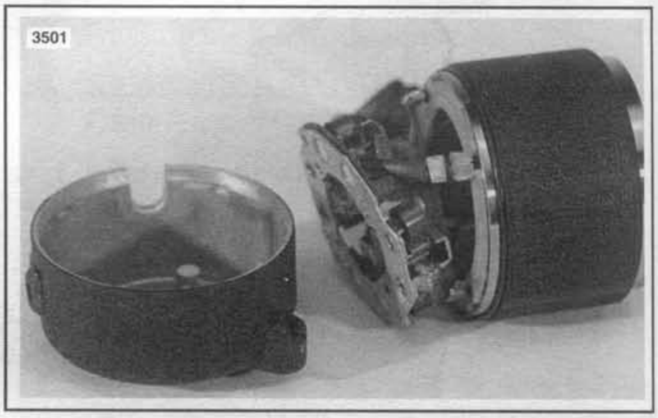


Figure 5-14. Remove End Cap

4. See Figure 5-15. Disengage brush springs (6) and pull field coil brushes (7) out of brush holders (8).

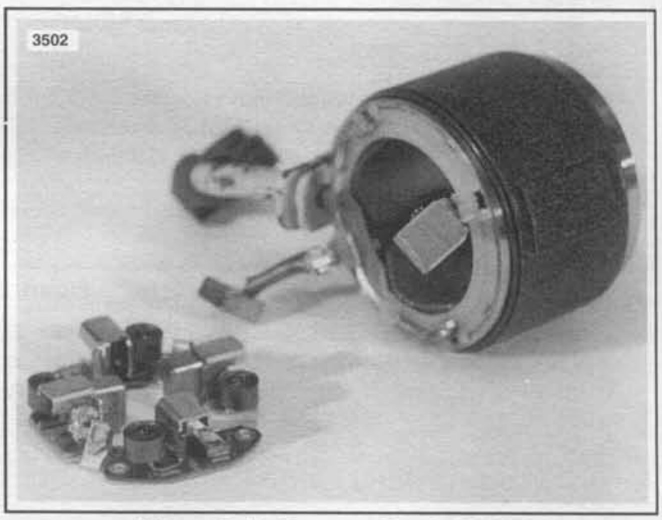


Figure 5-15. Remove Brush Holder

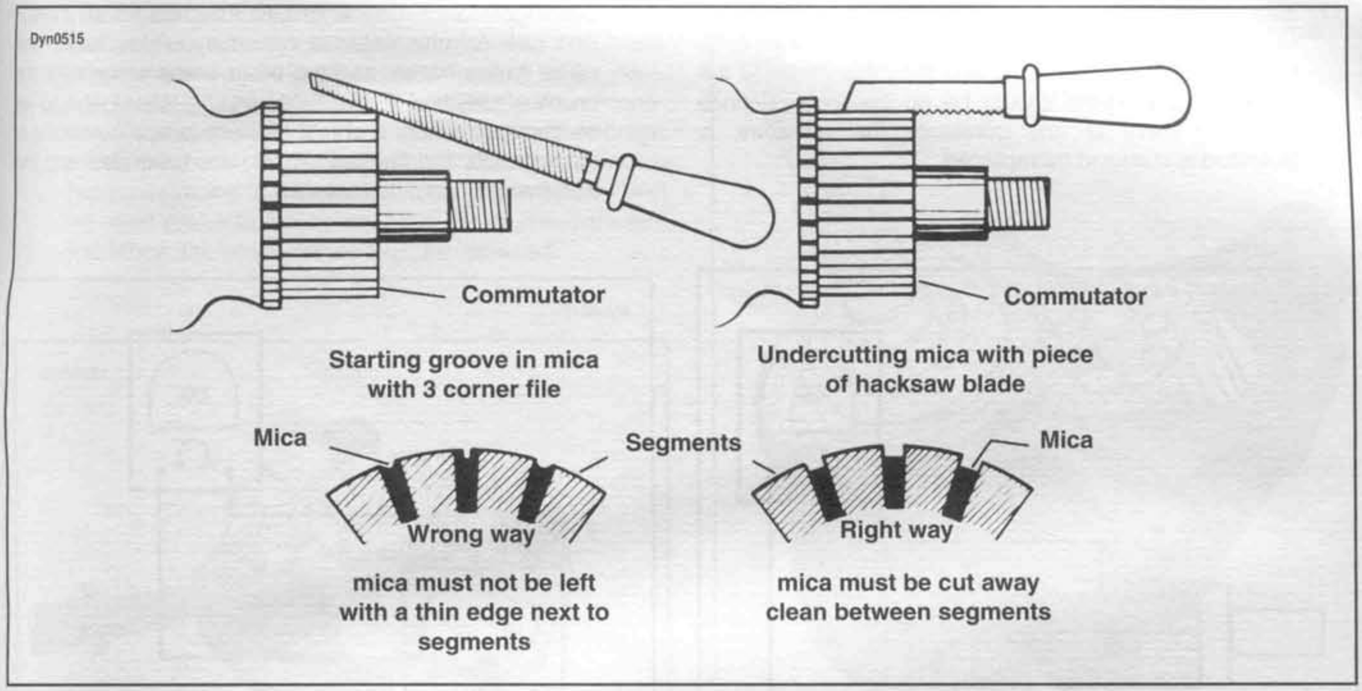


Figure 5-16. Undercutting the Mica Separators

5. Check brush length. Brushes less than 0.433 in. (11 mm) long should be replaced.

NOTE

- *Replace brushes in sets of four only.*
- *Field coil and brush holder brushes are attached to field coil and brush holder. To replace brushes, replace field coil and brush holder.*

6. See Figure 5-10. Remove armature (9).
7. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.015 in. (0.38 mm) of runout should be replaced or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (29.98 mm).
8. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.20 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.79 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.
9. See Figure 5-16. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the armature with crocus cloth to remove any burrs.
10. See Figure 5-17. Check for SHORTED ARMATURE with a growler. Place armature on growler. Hold a thin steel strip (hacksaw blade) against armature core and slowly turn armature. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Shorted armatures should be replaced.

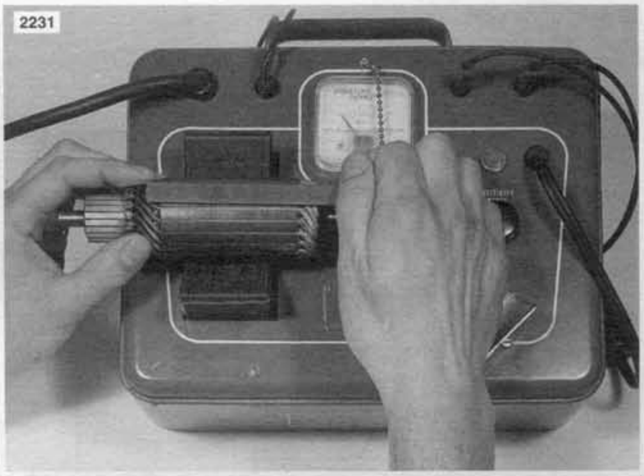


Figure 5-17. Shorted Armature Test Using Growler

15. See Figure 5-22. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester. Touch one probe to holder plate and the other probe to each of the positive (insulated) brush holders. There should be no continuity (infinite ohms). If there is continuity at either brush holder, the brush holder assembly should be replaced. Touch one probe to the non-insulated brush holders and the other probe to the holder plate. If you measure any resistance, the brush holder must be replaced.

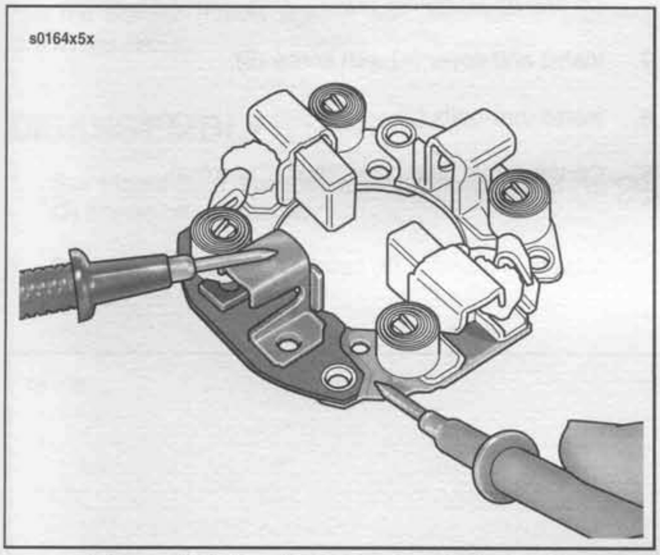


Figure 5-22. Brush Holder Insulation Test

16. See Figure 5-10. Check armature bearings (10) and replace if necessary.

NOTE

See Figure 5-10. Spring (21) and ball (22) are loose in shaft gear end.

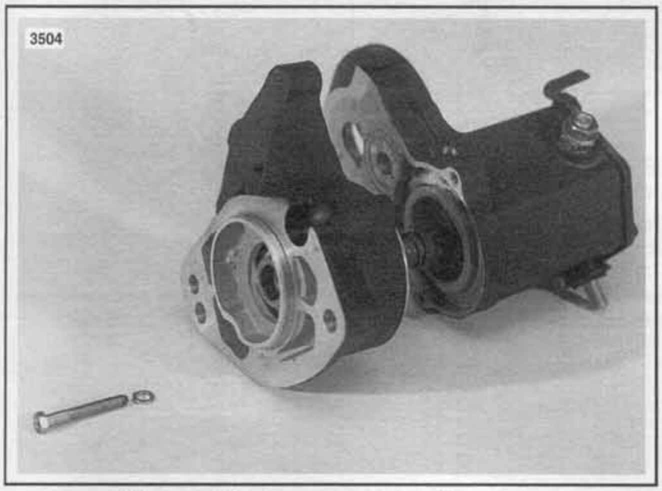


Figure 5-23. Remove Drive Housing

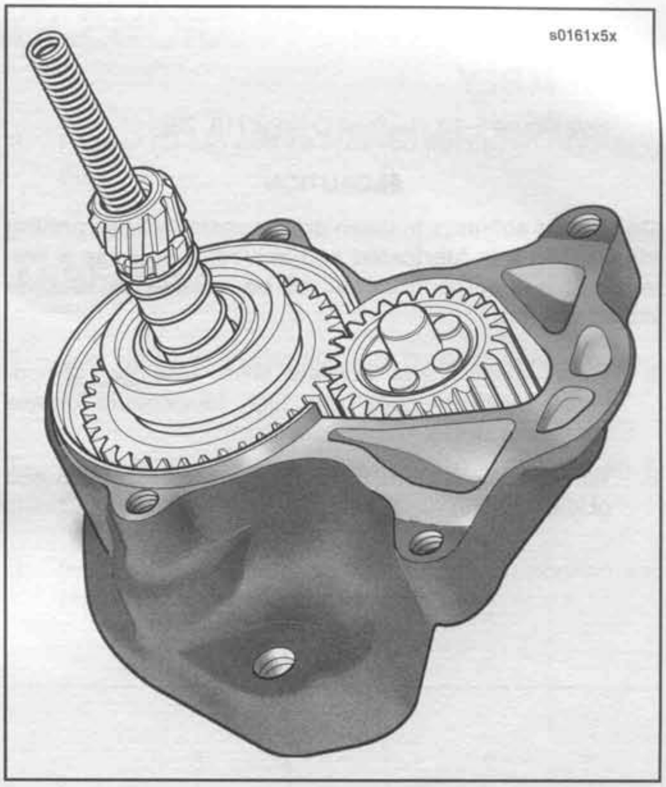


Figure 5-24. Drive Housing Assembly

17. See Figures 5-23 and 5-24. Remove the two drive housing mounting screws (11) and washers (12). Remove drive housing (13) from solenoid housing (14).

18. See Figure 5-25. Remove drive (15), idler gear (16) and idler gear bearing (17) from drive housing (13). O-ring (18) is in groove in drive housing.

19. Remove spring (19) and shaft (20).

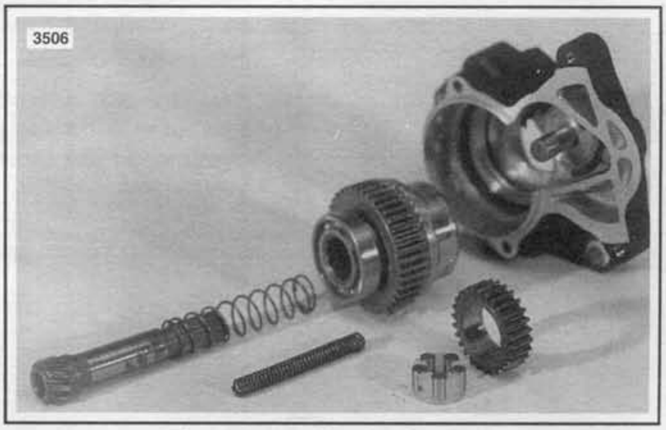


Figure 5-25. Clutch Assembly

ASSEMBLY

1. See Figure 5-10. Replace O-rings (18, 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 cover (4) with screw (5).
8. Install thru-bolts (2).
9. Connect field wire (1) to "motor" terminal.

STARTER SOLENOID

GENERAL

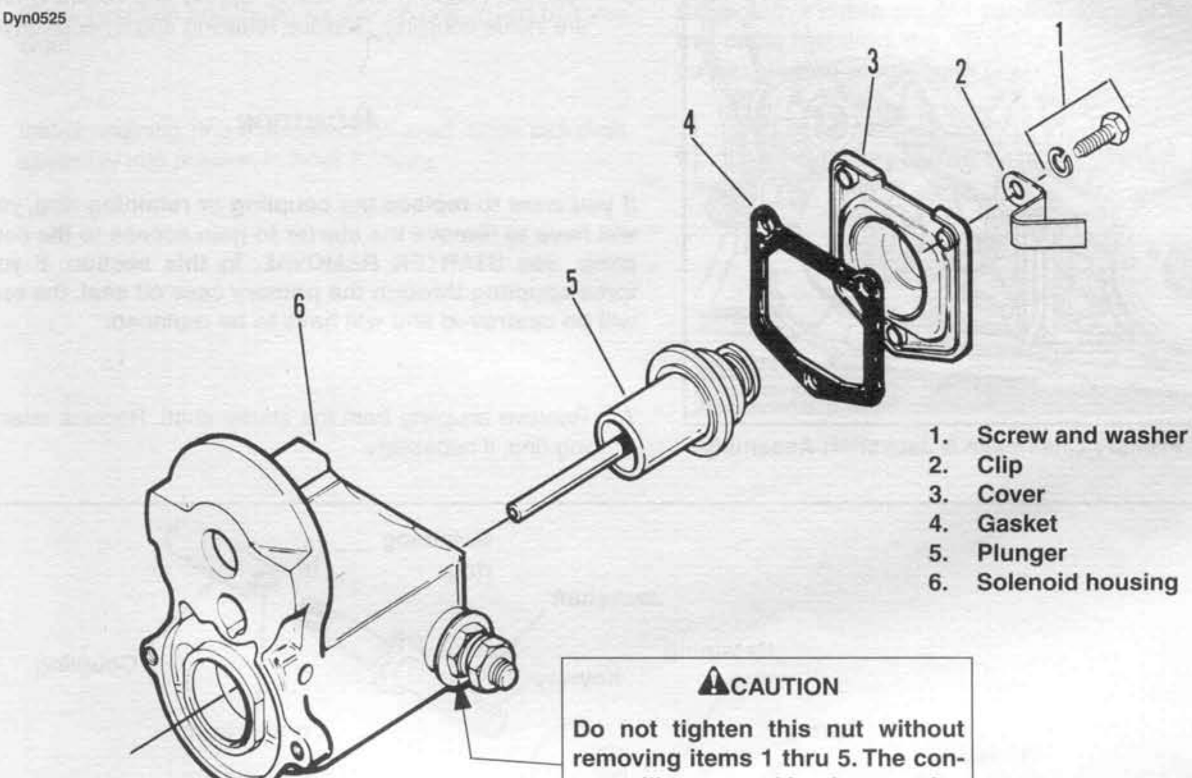
The starter solenoid is a switch, designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger. When the winding is energized by the battery, the magnetism produced pulls the plunger into the coil. The plunger moves against two main switch contacts, closing the circuit.

DISASSEMBLY

1. See Figure 5-26. Remove screws and washers (1). Clip (2) comes off with screw.
2. Remove cover (3) and gasket (4). Discard gasket.
3. Plunger (5) can now be removed from solenoid housing (6).

ASSEMBLY

1. See Figure 5-26. 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). Place cover (3) in position and install screws, washers (1) and clip (2).



1. **Screw and washer (3)**
2. **Clip**
3. **Cover**
4. **Gasket**
5. **Plunger**
6. **Solenoid housing**

⚠CAUTION

Do not tighten this nut without removing items 1 thru 5. The contact will move and be destroyed.

Figure 5-26. Starter Solenoid

STARTER SOLENOID

GENERAL

The starter solenoid is a switch, 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. When the winding is energized by the battery, the magnetism produced pulls the plunger into the coil. The plunger moves against two main switch contacts, closing the circuit.

DISASSEMBLY

1. See Figure 5-26. Remove screws and washers (1). Clip (2) comes off with screw.
2. Remove cover (3) and gasket (4). Discard gasket.
3. Plunger (5) can now be removed from solenoid housing (6).

ASSEMBLY

1. See Figure 5-26. 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). Place cover (3) in position and install screws, washers (1) and clip (2).

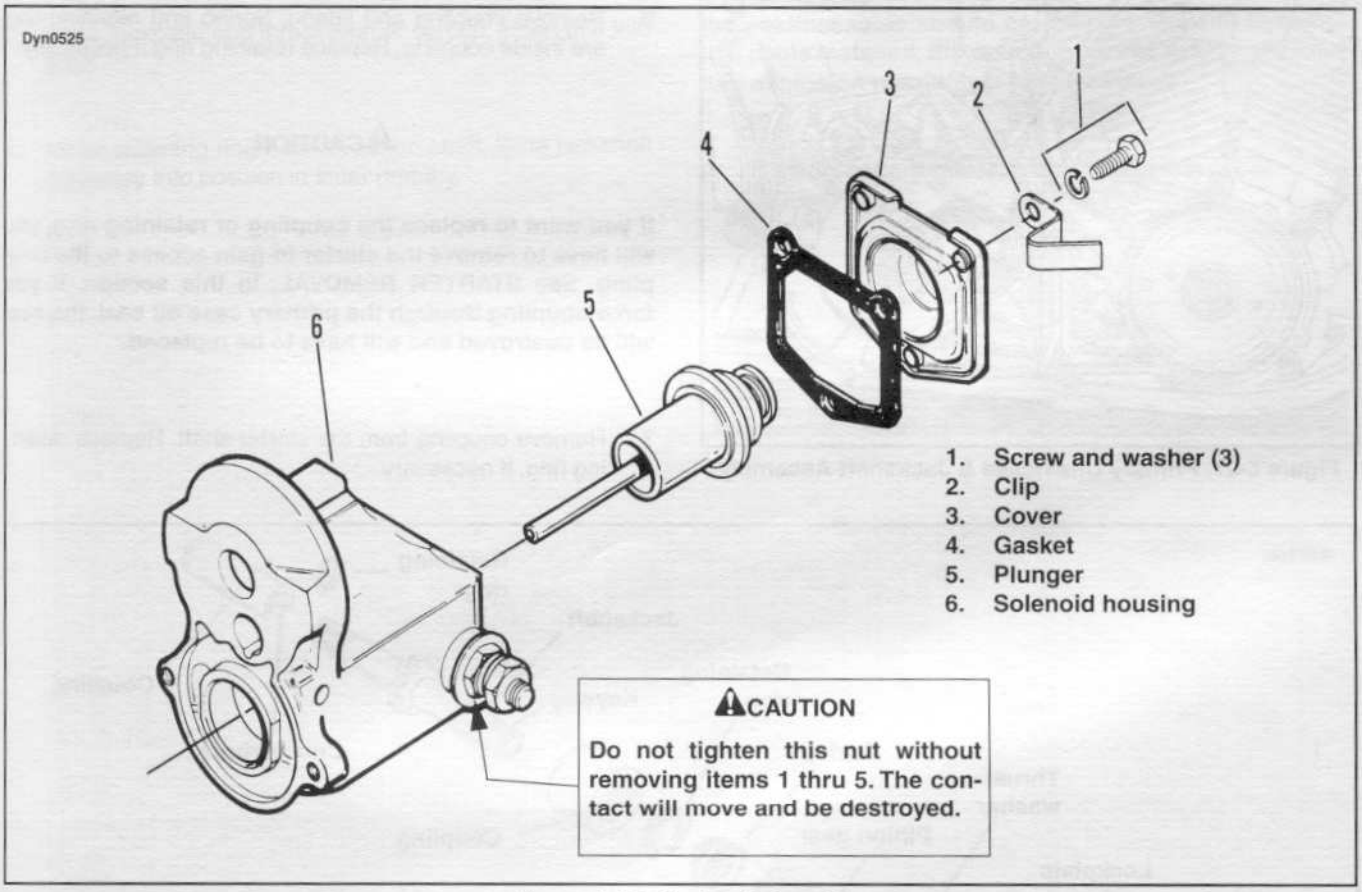


Figure 5-26. Starter Solenoid

REMOVAL/DISASSEMBLY

⚠WARNING

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

1. Disconnect battery cables, negative cable first.

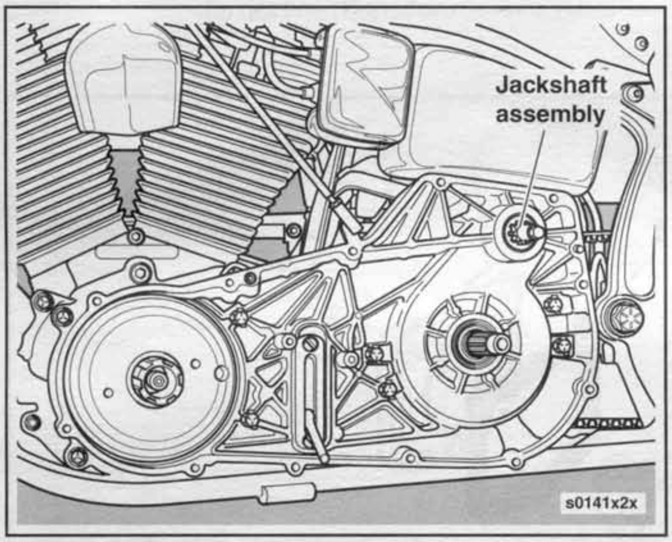


Figure 5-27. Primary Chaincase & Jackshaft Assembly

NOTE

If you are only going to service the items from the jackshaft bolt through the spring, it is not necessary to remove clutch.

2. Remove primary cover and clutch. See Section 6.

3. See Figures 5-27 and 5-28. Hold pinion gear in place and remove jackshaft bolt, lockplate and thrust washer.

4. Remove jackshaft from inner primary as an assembly.

5. Remove pinion gear from jackshaft.

6. Remove coupling and spring. Spring and retaining ring are inside coupling. Replace retaining ring if necessary.

⚠CAUTION

If you want to replace the coupling or retaining ring, you will have to remove the starter to gain access to the coupling. See STARTER REMOVAL, in this section. If you force coupling through the primary case oil seal, the seal will be destroyed and will have to be replaced.

7. Remove coupling from the starter shaft. Replace retaining ring, if necessary.

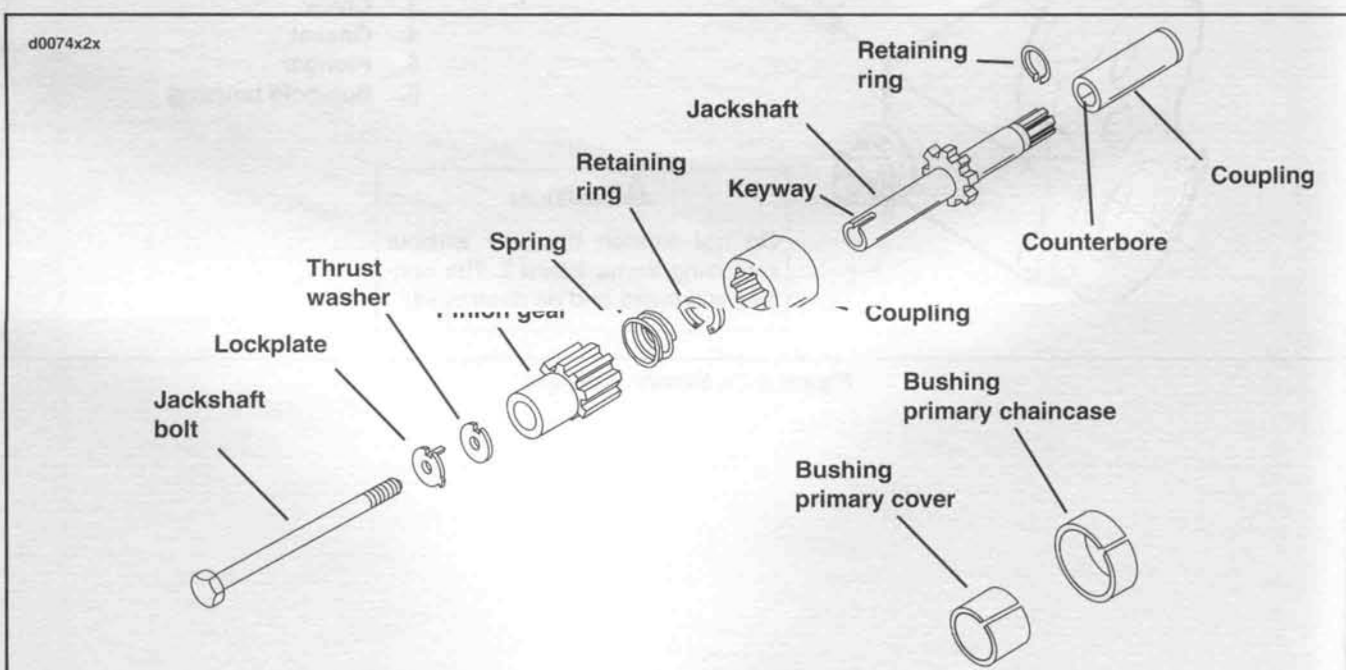


Figure 5-28. Starter Jackshaft

ASSEMBLY/INSTALLATION

Special Tools	Torque Values
None	Jackshaft bolt 7-9 ft-lbs (9-12 Nm)

NOTE

When you install the coupling (9), be sure the end with the COUNTERBORE goes toward the jackshaft.

1. Insert retaining ring in coupling. Install coupling on starter output shaft with counter bore facing jackshaft. Shallow side of coupling faces jackshaft splines. Place spring inside coupling.

2. Install pinion gear on shaft.

3. Place lockplate and thrust washer on bolt. Insert bolt into shaft.

4. Install retaining ring if removed, on shaft. Slide jackshaft assembly into position in inner primary.

CAUTION

Be sure the lockplate tab is in the keyway. This will hold lockplate and thrust washer in place.

5. Align lockplate tab and thrust washer slot with jackshaft keyway. Screw the jackshaft bolt into the starter shaft.

6. Hold the pinion gear in position and tighten the bolt to 7-9 ft-lbs (9-12 Nm).

7. Bend locking tab against bolt head.

8. Install clutch and primary cover. See Section 6.

WARNING

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

9. Connect battery cables, positive cable first.

DRIVE 6

SUBJECT **PAGE NO.**

SPECIFICATIONS

CLUTCH (1997/1998 MODELS)

Type	Wet-multiple disc
Clutch lever free play	1/16-1/8 in. (1.6-3.2 mm)

SPROCKETS

Sprocket:	Number of teeth
Compensating	25
Clutch	36
Transmission	32
Rear wheel-Domestic	65

OVERALL GEAR RATIOS

Gear	Overall Gear Ratio
1	10.11
2	6.96
3	4.95
4	3.86
5	3.15

TORQUE VALUES

Primary cover screws	108-120 **in-lbs** (12-13.5 Nm)
Primary chain inspection cover screws	50-70 **in-lbs** (5.6-7.9 Nm)
Clutch inspection cover screws	50-70 **in-lbs** (5.6-7.9 Nm)
Compensating sprocket nut	150-165 ft-lbs (203-224 Nm)
Transmission sprocket nut	50 ft-lbs (67.8 Nm) initial torque, then turn another 30°-45°
Transmission sprocket locking screw	7-9 ft-lbs (9-12 Nm)
Clutch hub nut (left hand threads)	70-80 ft-lbs (95-108 Nm)
Clutch adjusting screw jamnut	6-10 ft-lbs (8-14 Nm)

GENERAL

The primary chaincase is a sealed housing containing the primary chain, clutch, engine compensating sprocket, chain adjuster, alternator, and starter drive mechanism.

For information on primary chain adjustment and lubrication, see SCHEDULED MAINTENANCE PROCEDURES in Section 1.

PRIMARY CHAINCASE COVER

⚠CAUTION

See Figure 6-1. The inspection cover is fastened to the inner primary chaincase at the top and rear screws (items 13 and 14). Before removing the primary cover, be sure you remove the inspection cover's top and rear screws or the cover, primary cover and inner primary will be damaged.

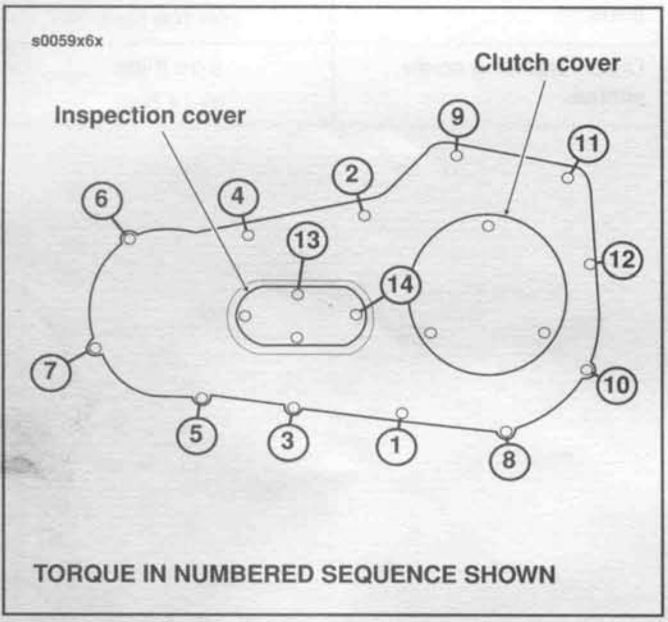


Figure 6-1. Primary Chaincase Cover

Removal

1. Drain the primary [illegible] SCHEDULED MAINTENANCE PROCEDURES in Section 1.

⚠WARNING

To prevent accidental start-up of vehicle and possible personal injury disconnect the battery cable (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. When lubricant has drained, remove the primary chaincase cover by first removing the top and rear inspection cover screws (items 13 and 14 in Figure 6-1), then remove the rest of the chaincase cover screws.

Installation

1. To install the chaincase cover, replace the cover gasket, and the two small round gaskets on the two inner primary case towers (under items 13 and 14 in Figure 6-1).

2. Tighten screws to 108-120 **in-lbs** (12-13.5 Nm) in sequence shown in Figure 6-1. Then replace chaincase lubricant, see SCHEDULED SERVICE PROCEDURES in Section 1.

PRIMARY CHAINCASE HOUSING

Removal

1. Remove primary chaincase cover.

2. Remove primary chain, clutch, engine compensating sprocket, and chain adjuster as an assembly. See DRIVE COMPONENTS, COMPONENT REMOVAL.

3. Remove the starter jackshaft and starter as described in Section 5.

4. See Figure 6-2. Bend the lockplate tabs back and remove primary-to-engine mounting bolts (1) and primary-to-transmission mounting bolts (2).

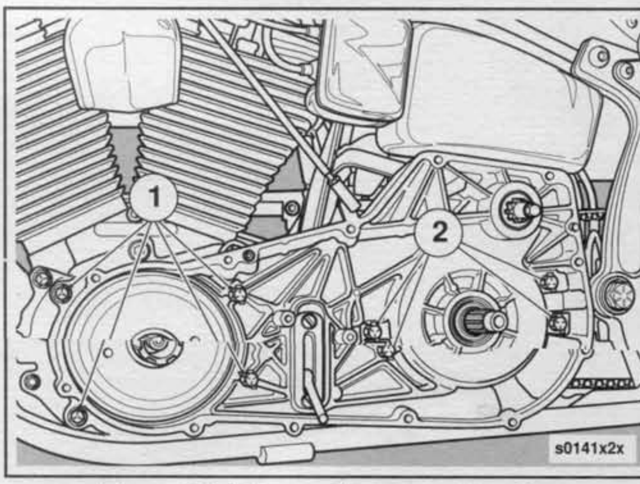


Figure 6-2. Primary Chaincase Mounting

5. Remove primary chaincase and discard the crankcase lip O-ring.

Inspection

1. Inspect primary chaincase for cracks or damaged gasket surfaces.
2. Check primary chaincase and primary cover jackshaft bushings and replace if they are rough or stick.

NOTE

The edge of jackshaft bushings in the primary chaincase and the primary cover must be flush with the edge of their holes.

3. Check primary chaincase jackshaft oil seal. Replace if necessary. Drive in oil seal from inside.

NOTE

See Figure 6-3. The primary chaincase has a shoulder for the oil seal. When replacing the oil seal, Be sure the oil seal seats against the shoulder.

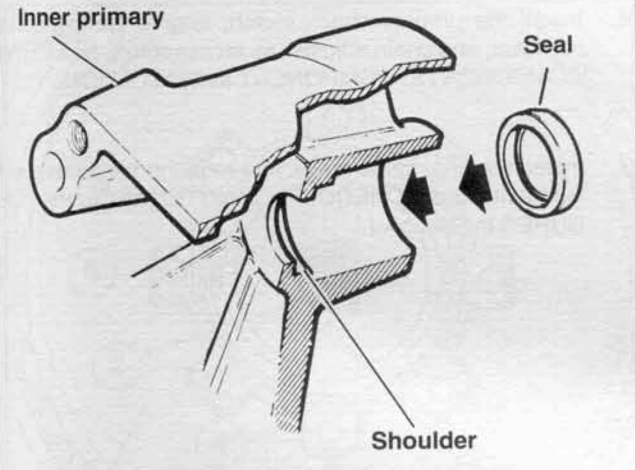


Figure 6-3. Primary Chaincase Jackshaft Oil Seal

4. Check primary chaincase mainshaft oil seal. Replace if worn, scored or damaged. Install seal flush with chaincase surface.

Installation

Special Tools	Torque Values
None	Inner primary-to-engine bolts 25-29 ft-lbs (34-39 Nm) Inner primary-to-transmission bolts 17-21 ft-lbs (23-28 Nm) Engine-to-frame mount fasteners 33-38 ft-lbs (45-52 Nm) Transmission-to-frame mount fasteners 33-38 ft-lbs (45-52 Nm)

If a *new* chaincase is being installed, the engine, chaincase, and transmission will need to be aligned as described below. If the original chaincase is undamaged and is simply being reinstalled, the mount fasteners can be left alone.

To install *new* chaincase:

1. Loosen the engine and transmission mount fasteners.

⚠CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

2. Be sure the O-ring is in position on the crankcase around the alternator surface.
3. Oil both seal lips and install primary case. Be careful not to damage mainshaft seal when installing chaincase over the primary bearing inner race on the mainshaft. Place the primary chaincase in position on the motorcycle.

⚠CAUTION

The following steps should be followed closely and in order. This procedure aligns the transmission and is critical to the proper operation of the motorcycle. Failure to follow these steps correctly could result in premature chain and transmission failure.

NOTE

Clean oil from two bottom bolt holes of the inner primary case and put a bead of silicone sealant around the holes before installing the bolts.

4. See Figure 6-2. Attach inner primary to the transmission using the original hardware. Lay a bead of silicone sealant around the two bottom bolt holes before installing bolts. Do not tighten hardware yet. Replace locktabs if necessary.
5. Attach inner primary to the engine using the original bolts and washers. Tighten bolts (1) to 25-29 ft-lbs (34-39 Nm). Bend up locktabs of the inner primary-to-engine bolts.
6. Tighten bolts (2) to 17-21 ft-lbs (23-28 Nm) and bend locktabs into place.
7. Tighten engine and transmission mount fasteners to 33-38 ft-lbs (45-52 Nm).
8. Install the starter. See STARTER INSTALLATION in Section 5.
9. Install jackshaft as described under STARTER JACKSHAFT ASSEMBLY/INSTALLATION in Section 5.

⚠CAUTION

The Print-O-Seal gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed.

10. Install the primary chain, clutch, engine compensating sprocket, and chain adjuster as an assembly. See DRIVE COMPONENTS, COMPONENT INSTALLATION.
11. Install the chaincase cover and refill the chaincase with lubricant. See SCHEDULED MAINTENANCE PROCEDURES in Section 1.

To reinstall *original* chaincase:

⚠CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

1. Be sure the O-ring is in position on the crankcase around the alternator surface.
2. Oil both seal lips and install primary case. Be careful not to damage mainshaft seal when installing chaincase over the primary bearing inner race on the mainshaft. Place the primary chaincase in position on the motorcycle.

NOTE

Clean oil from two bottom bolt holes of the inner primary case and put a bead of silicone sealant around the holes before installing the bolts.

3. See Figure 6-2. Attach the inner primary to the transmission using the original hardware. Lay a bead of silicone sealant around the two bottom bolt holes before installing the bolts. Replace locktabs if necessary.
4. Attach the inner primary to the engine using the original bolts and washers. Tighten bolts (1) to 25-29 ft-lbs (34-39 Nm).

   Bend up the locktabs of the inner primary-to-engine bolts.
5. Tighten bolts (2) to 17-21 ft-lbs (23-28 Nm) and bend locktabs into place.
6. Install the starter. See STARTER INSTALLATION in Section 5.
7. Install jackshaft as described under STARTER JACKSHAFT ASSEMBLY/INSTALLATION in Section 5.

⚠CAUTION

The Print-O-Seal gasket between the primary chaincase cover and chaincase must be replaced each time the cover is removed.

8. Install the primary chain, clutch, engine compensating sprocket, and chain adjuster as an assembly. See DRIVE COMPONENTS, COMPONENT INSTALLATION.
9. Install the chaincase cover and refill the chaincase with lubricant. See SCHEDULED MAINTENANCE PROCEDURES in Section 1.

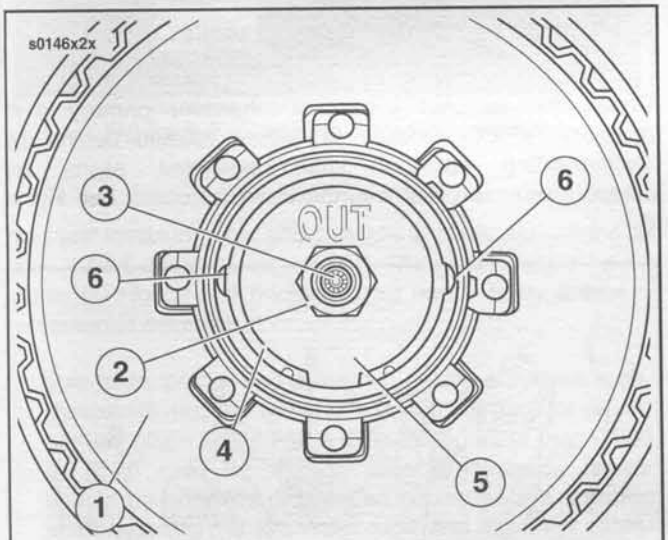
PRIMARY CHAIN

The chain must be replaced when it is worn to the point that it cannot be properly adjusted.

Removal

To remove the primary chain, remove compensating sprocket, clutch assembly, primary chain, and chain tensioner as an assembly.

1. Remove primary chaincase cover as described under PRIMARY CHAINCASE COVER.
2. Remove top center nut from chain tensioner.
3. See Figure 6-4. Loosen jamnut (2) and remove adjuster screw (3) and jamnut.



1. **Diaphragm spring**
2. **Jamnut**
3. **Adjuster screw**
4. **Retaining ring**
5. **Release plate**
6. **Slot**

Figure 6-4. Clutch (1997 Model Shown)

⚠WARNING

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

4. Remove retaining ring (4) and release plate (5).
5. See Figure 6-5. Using an air impact wrench, remove clutch hub mainshaft nut. The mainshaft nut has left handed threads, so turn clockwise to remove.
6. Using a breaker bar, remove compensating sprocket nut.

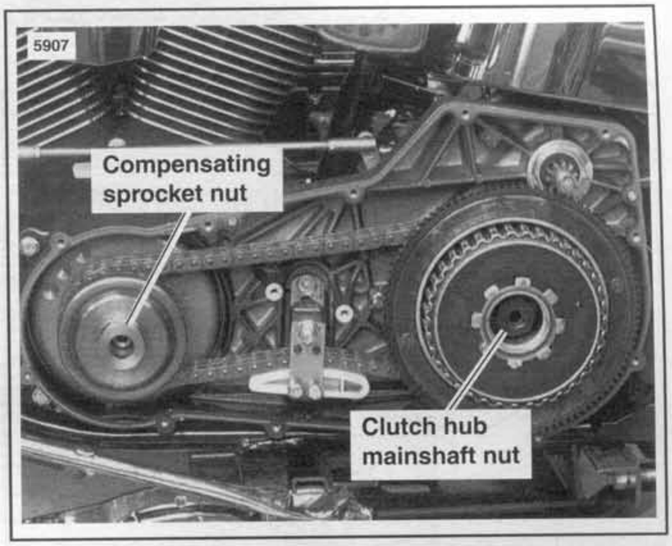


Figure 6-5. Compensating Sprocket and Clutch Hub

7. Remove sprocket cover and sliding cam.
8. Remove clutch assembly, primary chain tensioner, and compensating sprocket as a single assembly.

Installation

Special Tools	Torque Values
HD-41214 Primary drive locking tool	Mainshaft nut 70-80 ft-lbs (95-108 Nm) Compensating sprocket nut 150-165 ft-lbs(203-224 Nm)

The primary chain, compensating sprocket, clutch assembly, and chain tensioner must be installed as an assembly.

1. Place drive components (primary chain, compensating sprocket, clutch assembly, and chain tensioner) into position. The clutch hub and compensating sprocket are splined, so a slight rotation of the chain drive will aid in lining up the splines.
2. Install top center nut of the chain tensioner.
3. Place sliding cam over shaft extension and slide sprocket cover over cam.
4. Apply two drops of Loctite 262 (red) to the threads of the engine compensating sprocket and loosely install.
5. Apply two drops of Loctite 262 (red) to the threads of the clutch hub mainshaft nut and start nut onto mainshaft.

NOTE

Mainshaft nut has left handed threads, so turn counterclockwise to install.

6. See Figure 6-6. Place the PRIMARY DRIVE LOCKING TOOL (HD-41214) on the primary chain just to the rear of the engine compensating sprocket. Tighten sprocket nut to 150-165 ft-lbs (203-224 Nm). As the nut is tightened, the stepped area of the tool is drawn into the sprocket, thereby preventing further rotation.

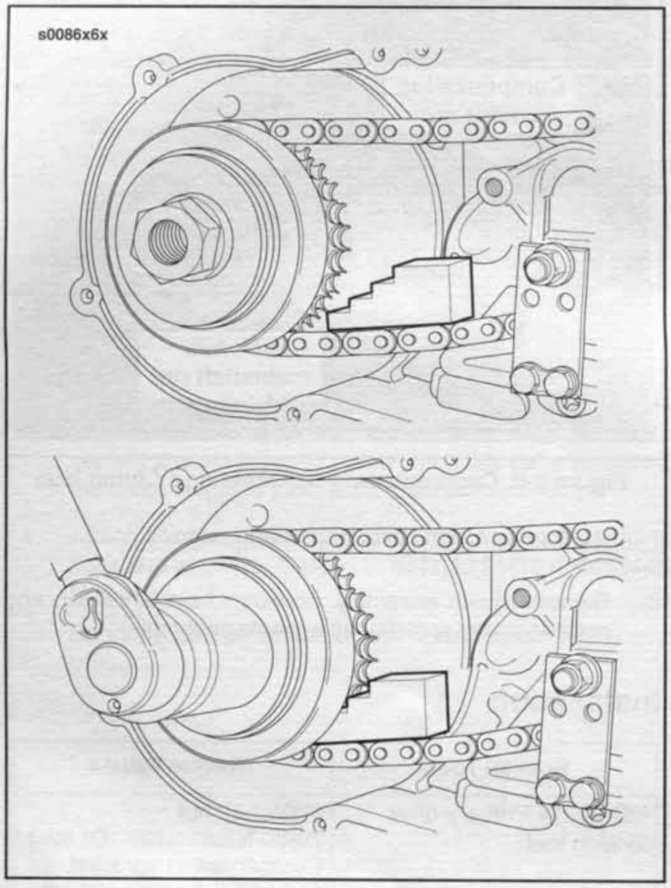


Figure 6-6. Locking Tool Use

7. In a similar fashion, tighten clutch hub nut by placing the stepped area of the locking tool in front of the clutch sprocket. Tighten clutch hub nut to 70-80 ft-lbs (95-108 Nm). Remove primary drive locking tool.

8. Install release plate (with locknut and adjuster screw) into clutch hub bore. The word "OUT" stamped on the release plate should face outward.

⚠WARNING

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

9. Install retaining ring in clutch hub bore to lock release plate in position. Verify that the retaining ring is completely seated in the groove.

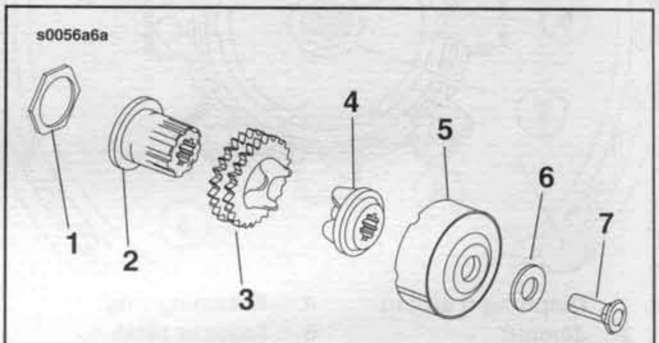
10. Adjust clutch and primary chain tension. See SCHEDULED SERVICE PROCEDURES in Section 1.

11. Check SPROCKET ALIGNMENT below.

12. Install primary chaincase cover.

Sprocket Alignment

Check the sprocket alignment whenever primary drive components are removed. A spacer located behind the compensating sprocket shaft extension aligns the compensation sprocket with the clutch sprocket. See Figure 6-7.



1. Hex spacer (0.070 in. thick)	**4. Sliding cam**
2. Shaft extension	**5. Cover assembly**
3. Compensating sprocket	**6. Spacer**
	7. Nut

Figure 6-7. Compensating Sprocket

1. To align the sprockets, push primary chain inward as far as it will go at both the engine compensating sprocket and clutch sprocket.

2. See Figure 6-8. Place a straightedge across the primary chain tensioner. With a dial caliper, measure the distance from the straightedge to the chain link sideplates. Measure as close to the engine compensating sprocket as possible. Record this measurement then repeat the measurement at the clutch sprocket.

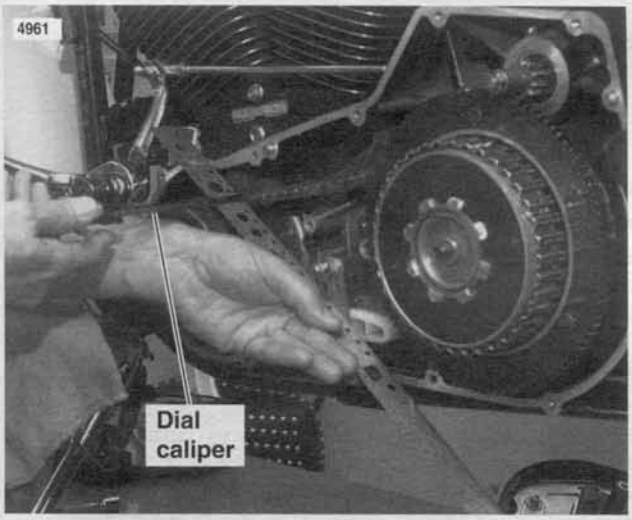


Figure 6-8. Checking Chain Alignment

NOTE

You must measure from straightedge to chain side plates as close to both sprockets as possible. The difference will be the spacer (1, Figure 6-7) thickness that needs to be added or subtracted (if necessary).

3. See table, below. The difference between the two measurements must be within 0.030 in. (0.76 mm) for proper primary chain alignment. A difference greater than 0.030 in. (0.76 mm) indicates a variable thickness spacer should be removed or installed on the engine sprocket shaft between the alternator rotor and the shaft extension.

SPACER THICKNESS	
0.010 in. (0.25 mm)	0.030 in. (0.76 mm)
0.020 in (0.51 mm)	0.060 in. (1.52 mm)

COMPENSATING SPROCKET

To remove the compensating sprocket, follow the instructions given above for primary chain removal.

CHAIN TENSIONER SHOE

If the chain tensioner shoe is worn to the point where proper adjustment cannot be obtained, replace the shoe as follows:

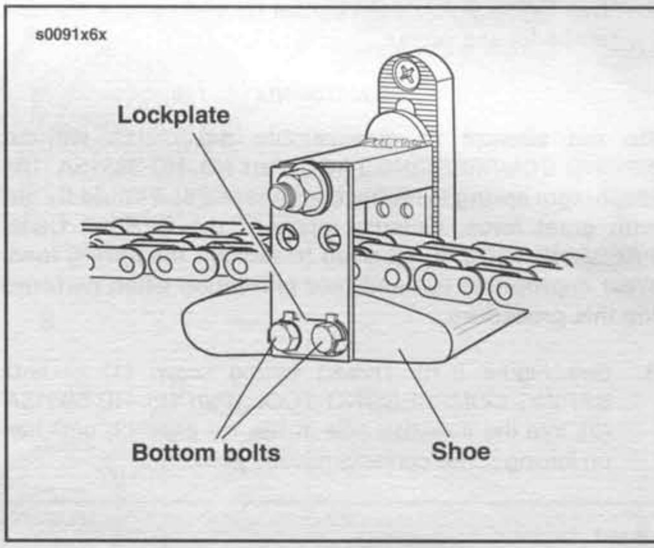


Figure 6-9. Adjusting Shoe

1. Remove the primary chaincase cover as described under PRIMARY CHAINCASE COVER.

2. See Figure 6-9. Remove the two bottom bolts, lockplate, and washers. Remove the shoe. When installing adjusting shoe, bend one lockplate tab over each screw head after tightening. The lockplate is installed outside of the two washers.

CLUTCH (1997 MODELS)

DISASSEMBLY ON MOTORCYCLE

If only friction plates and discs need attention, the clutch can be disassembled on the motorcycle as described below:

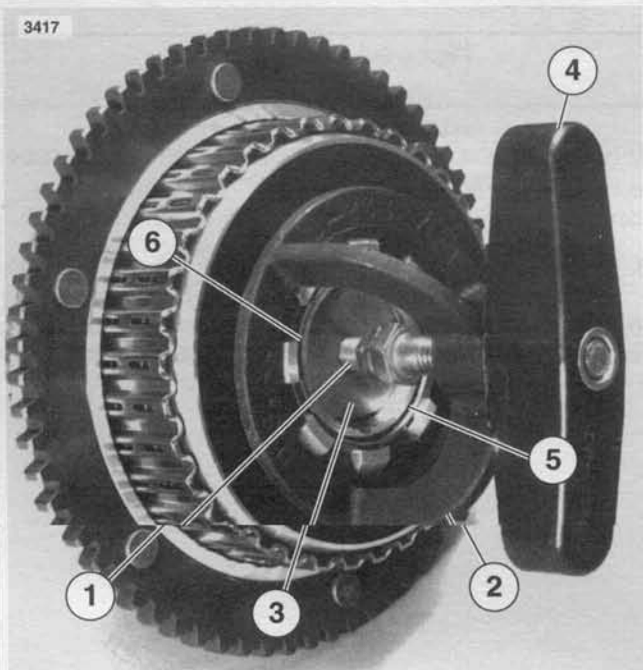
Special Tools	Torque Values
HD-38515A Clutch spring compressing tool	None

1. Remove primary chaincase cover as described under PRIMARY CHAINCASE COVER.
2. See Figure 6-4. Loosen jamnut (2) and remove adjuster screw (3) and jamnut.

⚠WARNING

Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL, Part No. HD-38515A. The diaphragm spring is highly compressed and could fly out with great force, causing injury, if the SPRING COMPRESSING TOOL is not used to remove the spring load. Wear appropriate eye and face protection when performing this procedure.

3. See Figure 6-10. Thread forcing screw (1) of H-D SPRING COMPRESSING TOOL, Part No. HD-38515A (2), into the threaded hole in release plate (3) until hex on forcing screw contacts release plate.



1. **Forcing screw**
2. **Spring compressing tool**
3. **Release plate**
4. **Handle**
5. **Clutch spring seat**
6. **Retaining ring**

Figure 6-10. Compressing Clutch Diaphragm Spring

4. Turn handle (4) clockwise to compress the diaphragm spring and move the clutch spring seat (5) inward enough to allow removing retaining ring (6). Remove retaining ring (6) with a retaining ring pliers or gently pry ring from its groove with a screwdriver.
5. Remove spring compressing tool with diaphragm spring and pressure plate attached

⚠CAUTION

Do not loosen SPRING COMPRESSION TOOL unless inspection or replacement of pressure plate and diaphragm spring is required. Loosening tool will allow diaphragm spring to change its position on the pressure plate. If the diaphragm spring is not centered in the "spring-pocket" of the pressure plate it may cause difficulty finding neutral.

See Figure 6-12. The friction plates (9) and the steel discs (10, 11) can now be changed or inspected. See CLEANING AND INSPECTION below for instructions on checking the plates.

COMPLETE CLUTCH DISASSEMBLY

To completely disassemble clutch, remove clutch as described in PRIMARY CHAIN, REMOVAL and perform steps 3 through 5 above. After removing friction plates and steel discs, continue disassembly as follows:

⚠CAUTION

Because of possible damage to the bearing, the clutch shell and hub assembly should not be disassembled unless the bearing, hub or shell require replacement. If pressed apart, the bearing must be replaced.

1. See Figure 6-11. Remove and discard external retaining ring (1).

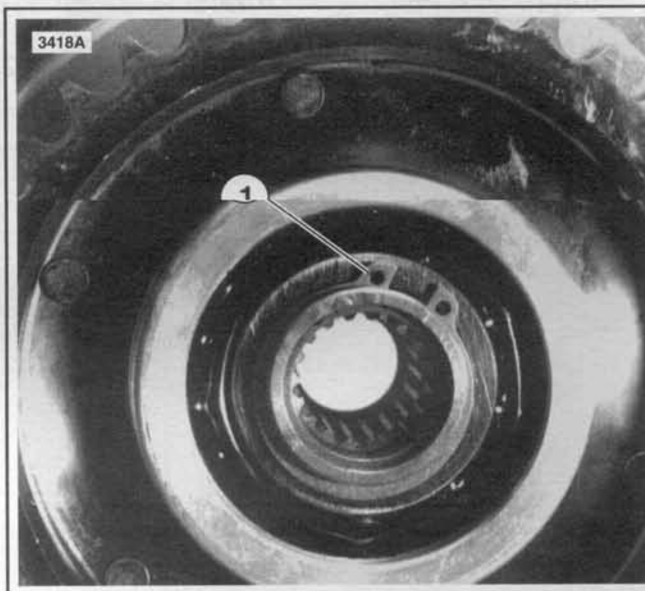


Figure 6-11. Clutch Hub Retaining Ring

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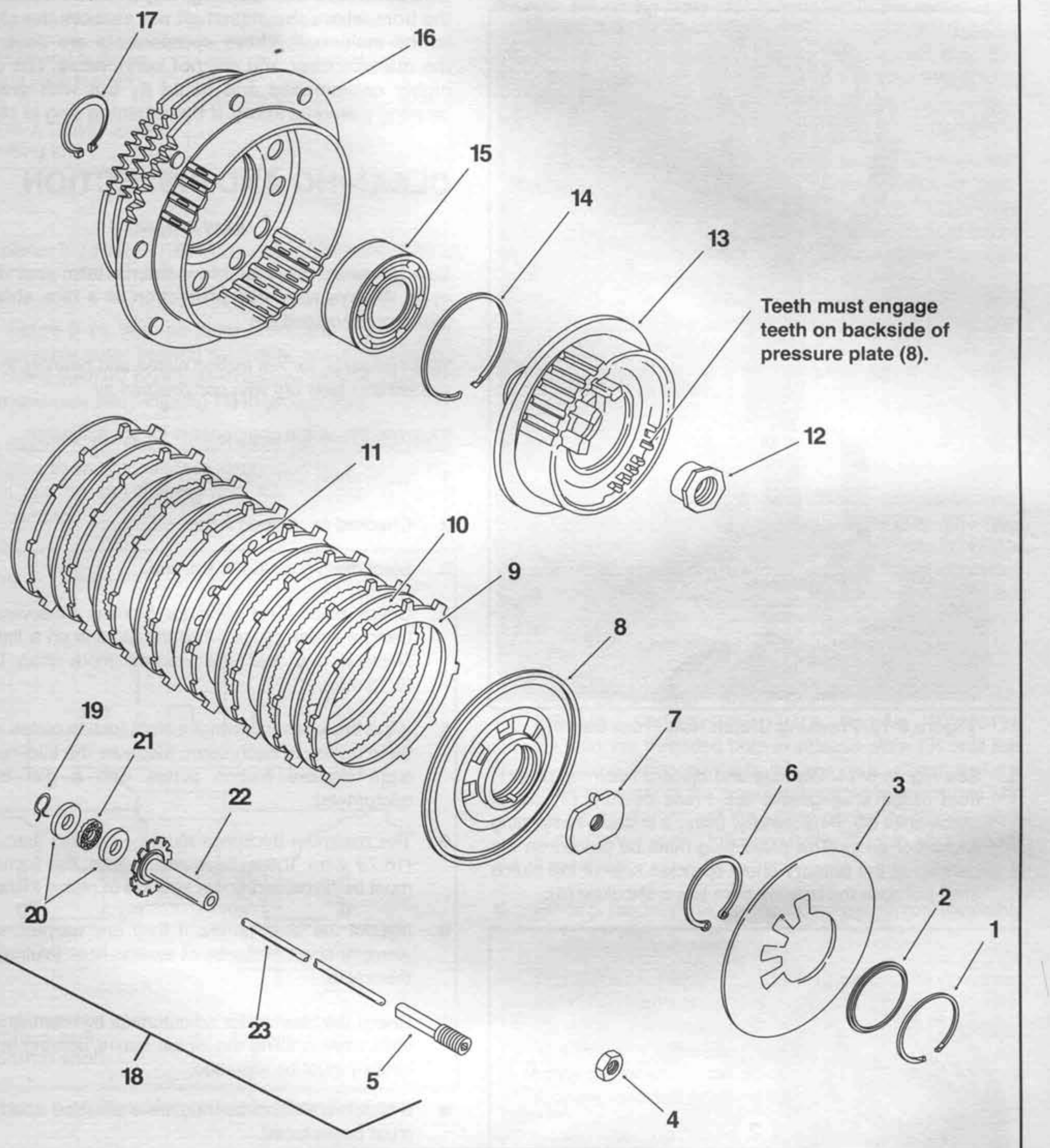


1. Internal retaining ring
2. Clutch spring seat
3. Diaphragm spring
4. Locknut
5. Adjusting screw
6. Internal retaining ring
7. Release plate
8. Pressure plate
9. Friction plate (8)
10. Steel plate (6)
11. Spring plate
12. Nut (main shaft, left hand threads)
13. Clutch hub
14. Internal retaining ring
15. Double-row ball bearing
16. Clutch shell
17. External retaining ring
18. Push rod components
19. Retaining ring
20. Thrust washer (2)
21. Push rod bearing
22. Push rod end
23. Push rod, clutch release

Figure 6-12. Clutch Assembly

2. See Figure 6-13. Press clutch hub from inner bearing race with arbor press.

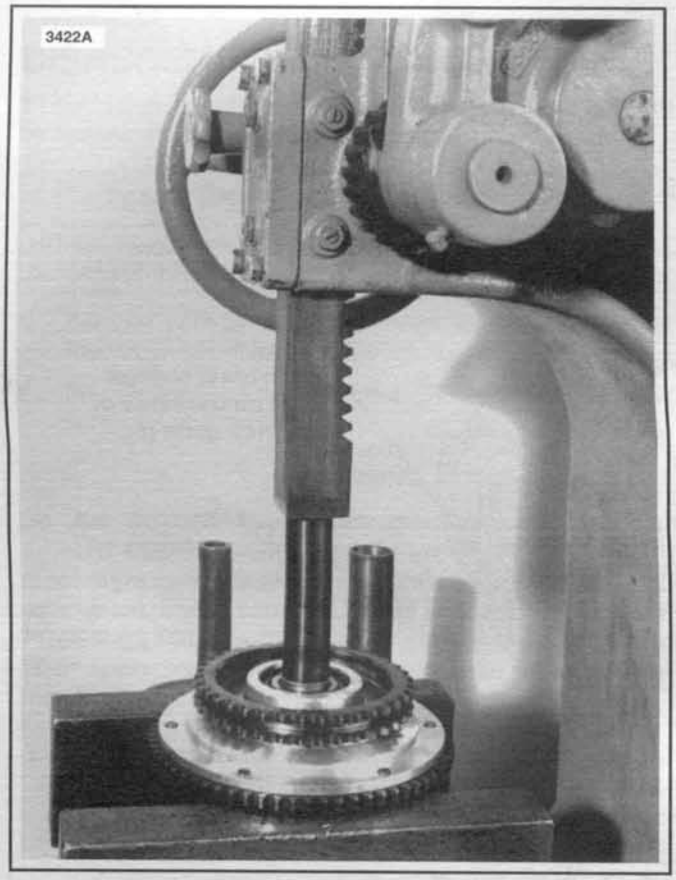
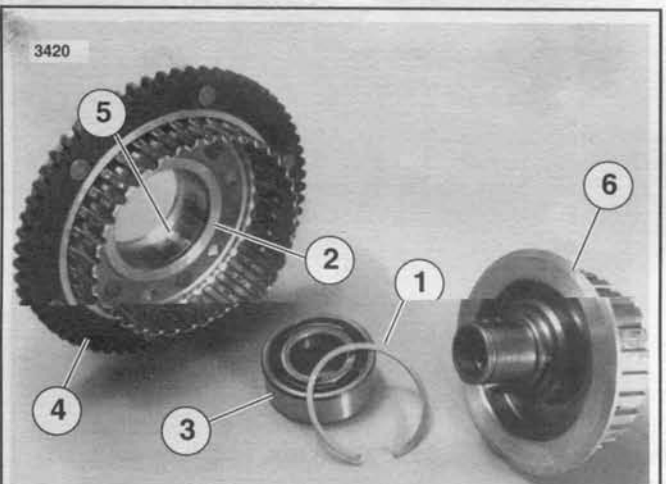


Figure 6-13. Pressing Clutch Hub From Bearing

3. See Figure 6-14. Remove and discard retaining ring (1) from clutch shell groove (2). Press bearing (3) out of clutch shell (4), if necessary, using a suitable press plug and arbor press. The press plug must be placed on the bearing at the primary chain sprocket side of the clutch shell because the bearing bore has a shoulder (5).



1. Retaining ring	**4. Clutch shell**
2. Clutch shell groove	**5. Shoulder**
3. Bearing	**6. Clutch hub**

Figure 6-14. Clutch Components

⚠WARNING

Do not remove the retaining ring located at the bottom of the bore where the mainshaft nut secures the clutch hub to the mainshaft. These components are assembled at the manufacturer and are not serviceable. The parts are highly compressed and could fly out with great force, causing personal injury, if the retaining ring is removed.

CLEANING AND INSPECTION

⚠WARNING

Low pressure air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air.

Wash all parts, except friction plates and bearing, in cleaning solvent and blow dry with compressed air.

Examine the clutch components for the following:

1. Worn lining surface.
2. Checked or chipped lining.
3. Steel discs grooved or warped.
4. Check each steel plate for flatness in several places using a feeler gauge while the plate is on a flat surface. Replace any that are warped more than 0.006 in. (0.15 mm).
5. Wipe the lubricant from the eight friction plates and stack them on top of each other. Measure the thickness of the eight stacked friction plates with a dial caliper or micrometer.
   - The minimum thickness must be no less than 0.661 in. (16.79 mm). If the thickness is less, the friction plates must be discarded and a new set of plates installed.
   - Inspect the steel plates. If they are warped, scored or worn, or show evidence of excess heat (bluing), replace them also.
6. Check the bearing for smoothness by rotating the clutch shell while holding the clutch hub. If bearing is rough or binds it must be replaced.
   - If clutch shell and bearing were pressed apart, bearing must be replaced.
7. Check the primary chain sprocket and the starter ring gear on the clutch shell (16). If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
8. Check the slots that mate with the clutch plates on both clutch shell and hub. If slots are worn or damaged, replace shell and/or hub.
9. Check the diaphragm spring (3) for cracks or bent tabs. Install a new spring if either condition exists.
10. Measure thickness of spring plate (11) in 4 places around the circumference. If you find 0.020 in. (0.51 mm) difference in any of the measurements, replace plate.

ASSEMBLY

Special Tools	Torque Values
Arbor press and suitable press plug (clutch shell bearing) HD-38515-A Clutch spring compressing tool	Clutch adjusting screw jamnut 6-10 ft-lbs (8-14 Nm)

NOTE

Soak all plates in PRIMARY CHAINCASE LUBRICANT for at least 5 minutes before installing.

1. See Figure 6-14. With an arbor press and a press plug that contacts outer bearing race only, press bearing (3) into clutch shell (4) bore until it bottoms against shoulder (5). Install new retaining ring (1) in groove (2).

2. See Figure 6-15. Place clutch shell (3) on arbor press with pilot bearing inner race supported by a sleeve (5). Press hub (2) into bearing until hub shoulder contacts pilot bearing.

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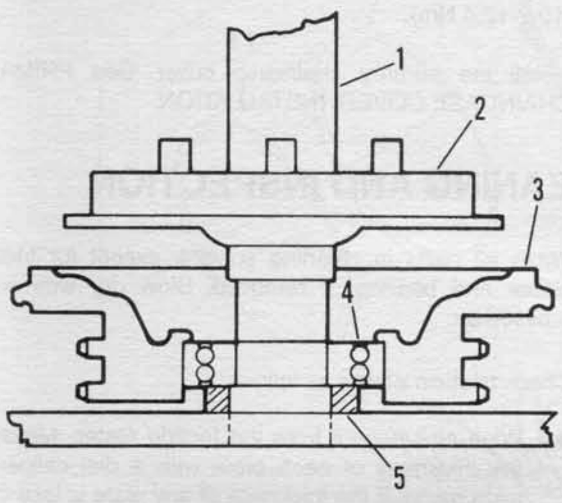


1. **Arbor press**
2. **Clutch hub**
3. **Clutch shell**
4. **Pilot bearing**
5. **Sleeve**

Figure 6-15. Pressing Hub into Pilot Bearing

3. See Figure 6-11. With lock ring pliers, expand new external retaining ring (1) and install into groove next to bearing.

4. See Figure 6-12. Place a friction plate (9) over clutch hub (13) and into clutch shell (16). Next place a steel plate (10) over hub (13) and into clutch shell. Continue installing plates alternately, starting and ending with a friction plate.

NOTE

Be sure the spring plate (11) is installed in the center of the stack as shown in Figure 6-12. If the SPRING COMPRESSING TOOL, Part No. HD-38515A, has not been removed, perform steps 8 through 12. If the SPRING COMPRESSING TOOL was removed continue at step 5.

5. Install diaphragm spring (3) on pressure plate (8) with domed or convex side of spring facing away from pressure plate. Center the diaphragm spring on the pressure plate; that is, the outer diameter of the diaphragm spring must be equidistant from the inside diameter of the pressure plate "spring pocket".

6. Place clutch spring seat (2) on diaphragm spring (3) with lip of seat facing outward. Install release plate (7) and retaining ring (6) in pressure plate (8), if they were removed.

⚠WARNING

Do not attempt to assemble the clutch without SPRING COMPRESSING TOOL, Part No. HD-38515A. The diaphragm spring is highly compressed and could fly out with great force, causing injury, if the SPRING COMPRESSING TOOL is not used to control the spring load. Wear appropriate eye and face protection when performing this procedure.

7. See Figure 6-10. Thread forcing screw (1) of H-D SPRING COMPRESSING TOOL, Part No. HD-38515A (2), into the threaded hole in release plate (3) until hex on forcing screw contacts release plate. Check that the outer diameter of the diaphragm spring is concentric with the inside diameter of the spring-pocket on the pressure plate. Center spring following instructions in step 7 above if required.

8. Place pressure plate, spring, compressing tool assembly on clutch hub.

9. See Figure 6-10. Turn handle (4) clockwise to compress the diaphragm spring and move the clutch spring seat (5) inward enough to allow retaining ring (6) installation. The ends of retaining ring (6) must not overhang the posts or bosses on the clutch hub. See Figure 6-10 for a properly installed retaining ring.

10. Release compressing force on diaphragm spring by turning handle (4) counterclockwise while checking that clutch spring seat (5) lip is seated inside retaining ring (6).

11. Remove SPRING COMPRESSING TOOL, Part No. HD-38515A.

12. See Figure 6-12. Install adjusting screw (5) and locknut (4) in release plate (7).

CLUTCH (1998 MODELS)

GENERAL

The 1998 Model Softails are equipped with a new 9-Plate clutch. This clutch allows for increased durability and reliability and reduced clutch lever effort. The increased displacement of the clutch results in a change in primary chaincase lubricant capacity to 26 oz. (768.9 ml).

REMOVAL/INSTALLATION

To remove the clutch without disassembly, see PRIMARY CHAINCASE HOUSING, REMOVAL, steps 1-2.

For installation instructions, see PRIMARY CHAINCASE HOUSING, INSTALLATION, steps 8-10.

NOTE

If only the clutch pack is to be disassembled, see PARTIAL DISASSEMBLY below, a procedure that can be performed on the motorcycle without removing the clutch shell or hub.

For complete disassembly of the clutch, which includes clutch pack disassembly and bearing replacement, see COMPLETE DISASSEMBLY, page 6-14.

PARTIAL DISASSEMBLY

Clutch Pack Only

1. Remove the primary chaincase cover. See PRIMARY CHAINCASE COVER, REMOVAL.
2. See Figure 6-16. Remove six bolts to release diaphragm spring retainer from clutch hub.
3. Remove diaphragm spring retainer, diaphragm spring and pressure plate from clutch hub.
4. Remove friction plates, steel plates, damper spring and damper spring seat from clutch hub. See CLEANING AND INSPECTION.

ASSEMBLY

Clutch Pack Only

1. See Figure 6-16. Install the narrow friction plate on the clutch hub engaging tabs on plate with slots in clutch shell.
2. [illegible] inboard of narrow friction plate.
3. Install damper spring on clutch hub with the concave side up (facing opposite damper spring seat).
4. 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.
5. Install pressure plate on clutch hub aligning holes in plate with threaded bosses on hub.
6. Seat diaphragm spring in recess of pressure plate with the concave side down.
7. Align holes in diaphragm spring retainer with threaded bosses on clutch hub. Tabs on spring retainer contact flats on inboard side of bosses.

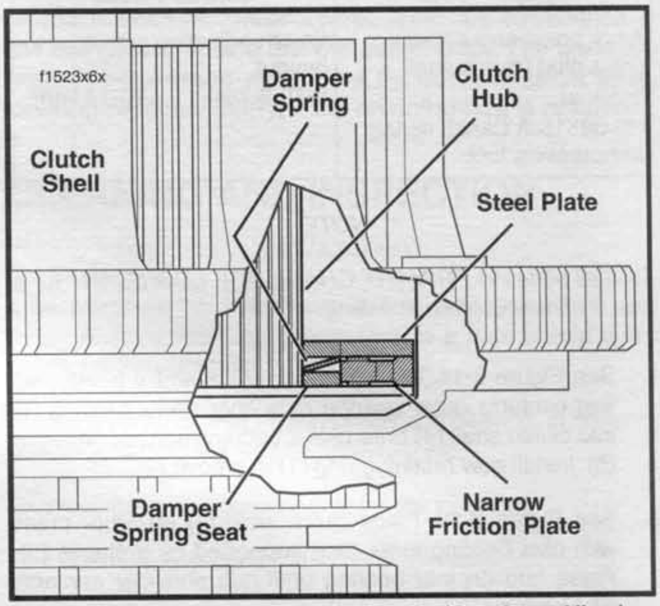


Figure 6-16. Clutch Pack Stack-Up (Cut-Away View)

8. Install six bolts to secure diaphragm spring retainer to clutch hub. Alternately tighten bolts to 90-110 **in-lbs** (10.2-12.4 Nm).
9. Install the primary chaincase cover. See PRIMARY CHAINCASE COVER, INSTALLATION.

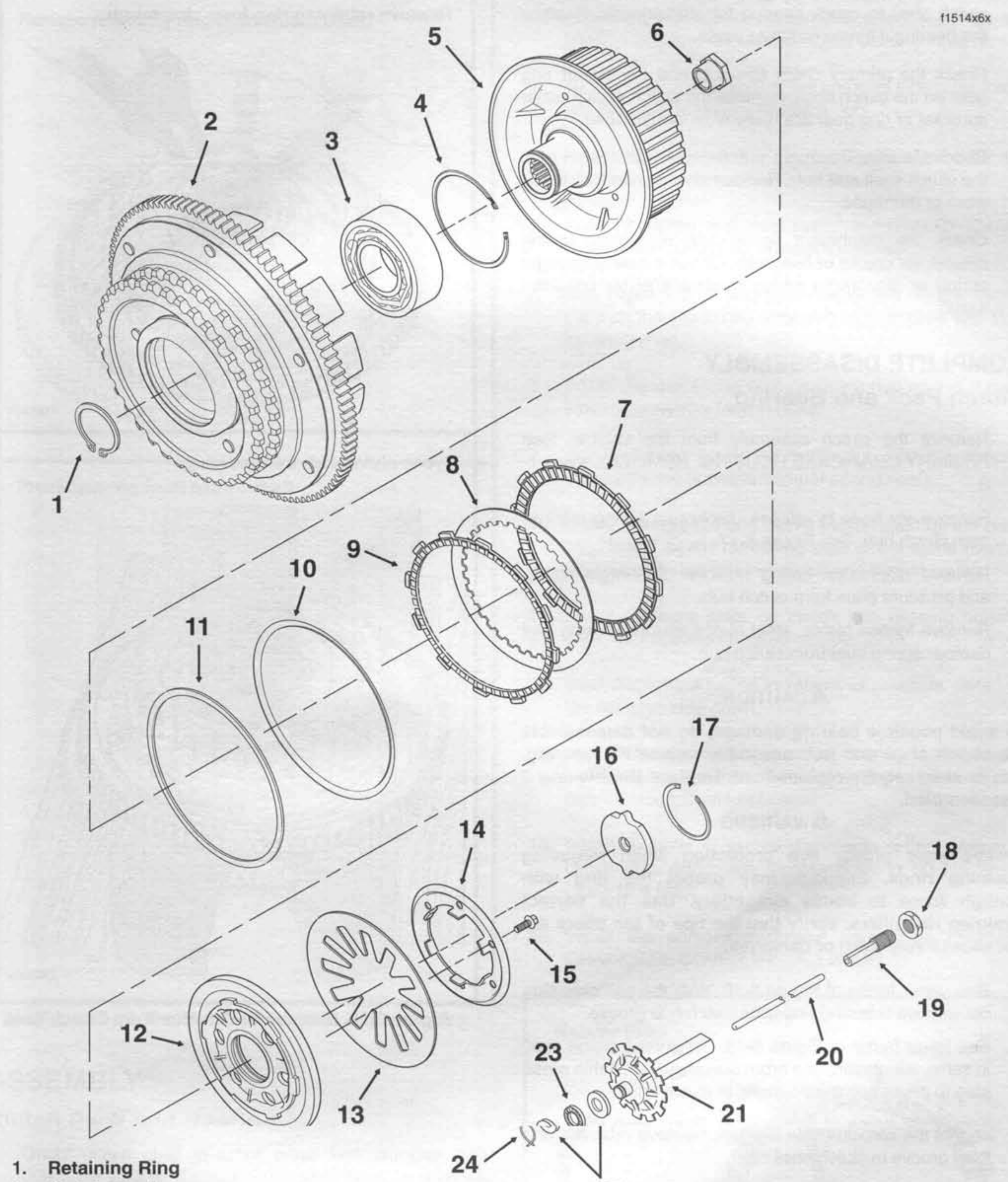
CLEANING AND INSPECTION

1. Wash all parts in cleaning solvent, except for friction plates and bearing, if removed. Blow dry with compressed air.
2. Check **friction plates** as follows:
   - Wipe all lubricant from the friction plates. Measure the thickness of each plate with a dial caliper or micrometer. If the thickness of any plate is less than 0.143 inch (3.62 mm), discard all friction plates and replace with an entirely new set.
   - Look for worn or damaged fiber surface material (both sides).

NOTE

Replace all nine friction plates with an entirely new set if any individual plate shows evidence of wear or damage.

3. Check the **steel plates** as follows:
   - Discard any plate that is grooved or bluish in color. Blue plates are likey warped or distorted.
   - 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 inch (0.15 mm).



1. Retaining Ring
2. Clutch Shell
3. Bearing
4. Retaining Ring
5. Clutch Hub
6. Mainshaft Nut
7. Friction Plate (9)
8. Steel Plate (8)
9. Narrow Friction Plate
10. Damper Spring
11. Damper Spring Seat
12. Pressure Plate
13. Diaphragm Spring
14. Diaphragm Spring Retainer
15. Bolt (6)
16. Release Plate
17. Retaining Ring
18. Locknut
19. Adjuster Screw
20. Push Rod
21. Oil Slinger
22. Thrust Washer (2)
23. Throw Out Bearing
24. Retaining Ring

Figure 6-17. Clutch Assembly

4. See Figure 6-16. Holding the clutch hub, rotate the clutch shell to check bearing for smoothness. Replace the bearing if it runs rough or binds.
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.

COMPLETE DISASSEMBLY

Clutch Pack and Bearing

1. Remove the clutch assembly from the vehicle. See PRIMARY CHAINCASE HOUSING, REMOVAL, steps 1-2.
2. Remove six bolts to release diaphragm spring retainer from clutch hub. See Figure 6-17.
3. Remove diaphragm spring retainer, diaphragm spring and pressure plate from clutch hub.
4. Remove friction plates, steel plates, damper spring and damper spring seat from clutch hub.

⚠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

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

5. See upper frame of Figure 6-18. With the sprocket side up, remove retaining ring from clutch hub groove.
6. See lower frame of Figure 6-18. Supporting clutch shell in same orientation, use arbor press and a suitable press plug to press hub from bearing in clutch shell.
7. See upper frame of Figure 6-19. Turn clutch shell over so that the sprocket side is down. Remove retaining ring from groove in clutch shell bore.
8. See lower frame of Figure 6-19. Turn clutch shell over so that sprocket side is up. Using arbor press and a suitable press plug, press on inner race to remove bearing from clutch shell bore.
9. See CLEANING AND INSPECTION on page 6-12.

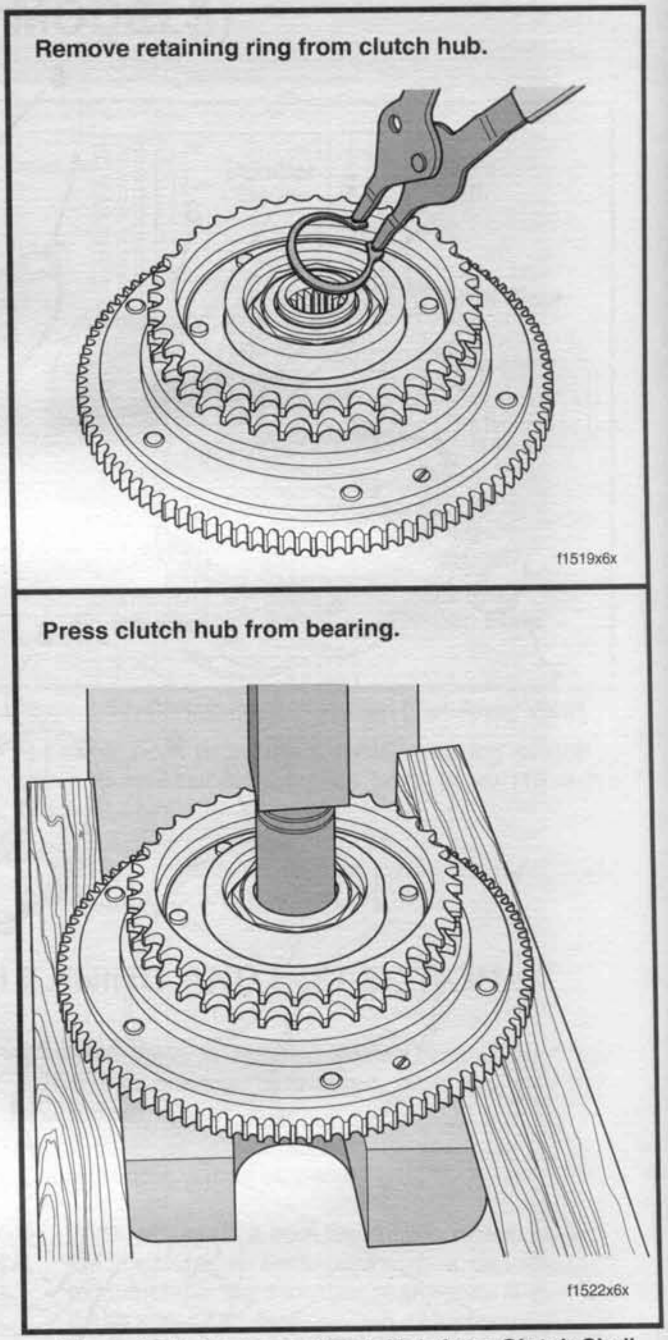


Figure 6-18. Remove Clutch Hub from Clutch Shell

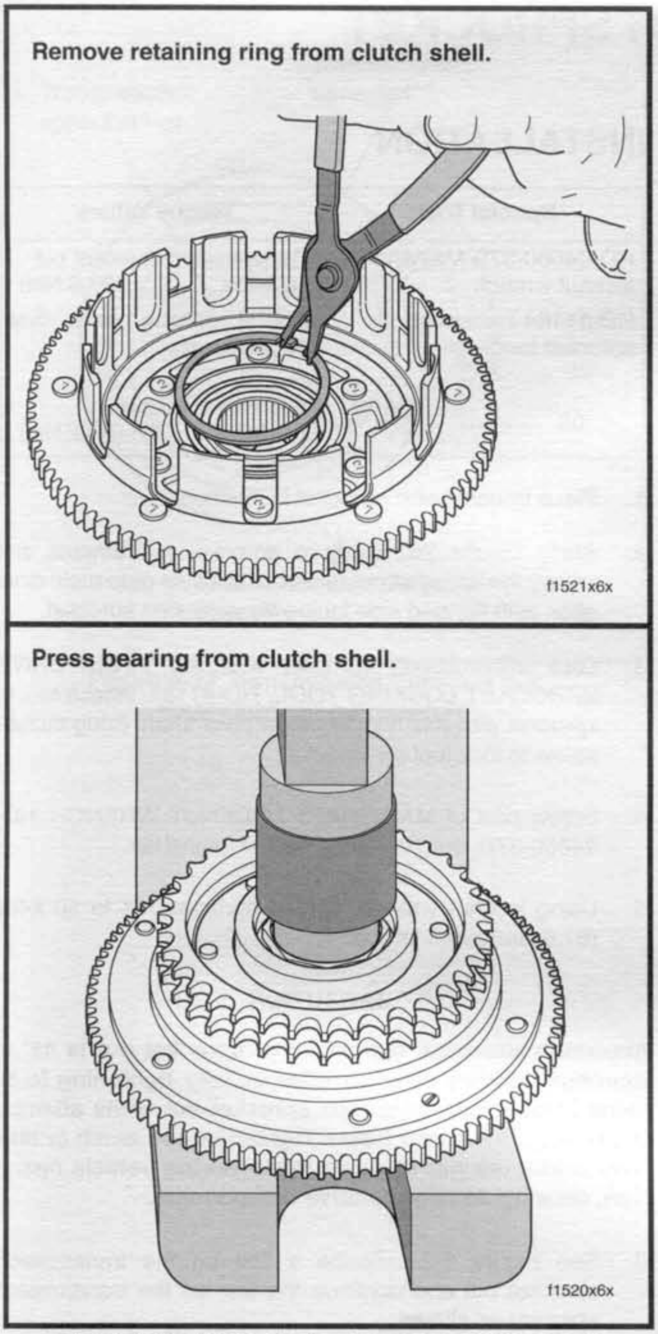


Figure 6-19. Remove Bearing from Clutch Shell

ASSEMBLY

Clutch Pack and Bearing

1. Orient clutch shell in arbor press with sprocket side down. Be sure to support clutch shell bore on sprocket side. Using a suitable press plug, press against outer race until bearing contacts shoulder in clutch shell bore.

⚠WARNING

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

2. Install retaining ring in groove of clutch shell bore.
3. Center hub in bearing. Be sure that bearing inner race is supported with sleeve on sprocket side. Press hub into bearing until hub shoulder contacts bearing inner race.
4. Turn assembly over so that the sprocket side is up. Install retaining ring in groove of clutch hub.
5. Place clutch assembly on bench oriented with the sprocket side down.
6. Soak all friction and steel plates in PRIMARY CHAINCASE LUBRICANT for at least 5 minutes.
7. See Figures 6-17 and 6-20. 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. Seat diaphragm spring 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 to secure diaphragm spring retainer to clutch hub. Alternately tighten bolts to 90-110 **in-lbs** (10.2-12.4 Nm).
15. Install the primary chaincase cover. See PRIMARY CHAINCASE COVER, INSTALLATION.

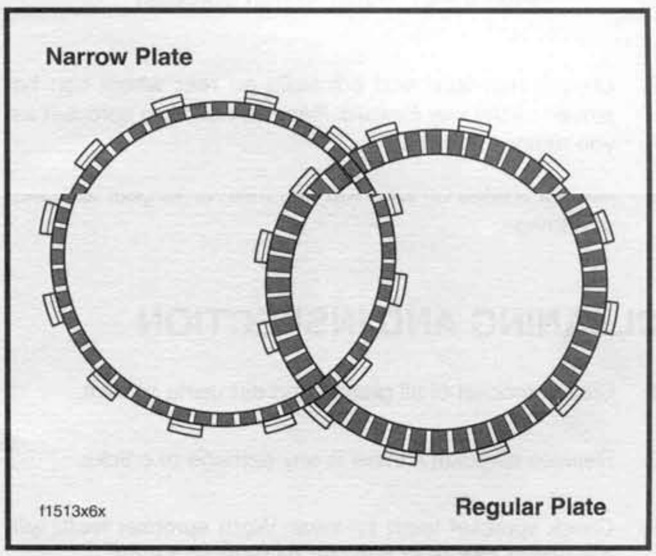


Figure 6-20. Friction Plates

TRANSMISSION SPROCKET

REMOVAL

Special Tools	Torque Values
HD-94660-37B Mainshaft locknut wrench HD-41184 Transmission sprocket tool	None

1. Remove primary chaincase cover as described under PRIMARY CHAINCASE COVER.

2. See Figure 6-21. Remove Allen screws and lockplate. Use TRANSMISSION SPROCKET TOOL, HD-41184, and remove the sprocket nut using MAINSHAFT LOCKNUT WRENCH, Part No. HD-94660-37B.

NOTE

Sprocket nut has a left hand thread.

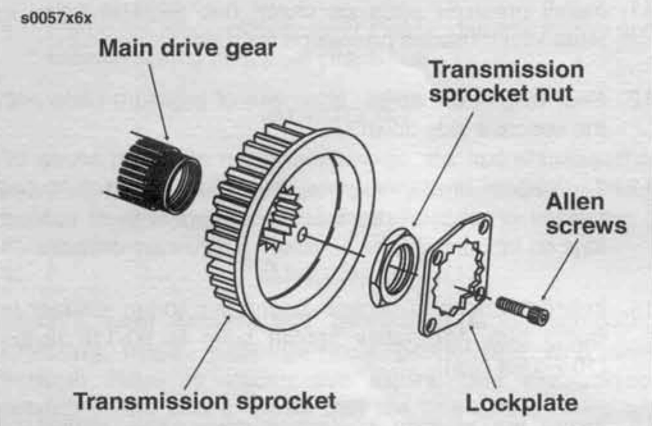


Figure 6-21. Transmission Sprocket

3. Loosen rear axle and adjusters so rear wheel can be moved all the way forward. Remove belt from sprocket as you remove sprocket.

4. Inspect splines on sprocket and main drive gear for wear or damage.

CLEANING AND INSPECTION

1. Clean sprocket of all grease and dirt using solvent.

2. Replace sprocket if there is any damage or cracks.

3. Check sprocket teeth for wear. Worn sprocket teeth will accelerate belt wear and can damage belt teeth.

INSTALLATION

Special Tools	Torque Values
HD-94660-37B Mainshaft locknut wrench HD-41184 Transmission sprocket tool	Transmission sprocket nut 50 ft-lbs (67.8 Nm) **(Initial torque only. See Procedure)** Allen head screw 7-9 ft-lbs (9-12 Nm)

1. Place transmission sprocket in position.

2. Apply Loctite 262 (red) to sprocket nut threads and thread the sprocket nut counterclockwise onto main drive gear, with flanged side facing transmission sprocket.

3. Lock transmission sprocket with the FINAL DRIVE SPROCKET LOCKING TOOL, HD-41184. Attach tool to sprocket with tool handle below pivot shaft. Snug thumbscrew to lock tool on sprocket.

4. Screw pilot of MAINSHAFT LOCKNUT WRENCH, HD-94660-37B, onto threaded end of mainshaft.

5. Using locknut wrench, tighten sprocket nut to 50 ft-lbs (67.8 Nm) initial torque.

CAUTION

Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs torque. Do not loosen sprocket nut while attempting to align the screw holes. Tightening too much or little may cause the nut to come loose during vehicle operation, causing damage to drive components.

6. See Figure 6-22. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.

7. Tighten the transmission sprocket nut an additional 30° to 40° (45° MAXIMUM).

8. Install lockplate over transmission sprocket nut so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's two tapped holes.

9. Install Allen head screws through two of the four holes in lockplate, then into two corresponding tapped holes in sprocket.

NOTE

The lockplate has 4 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.

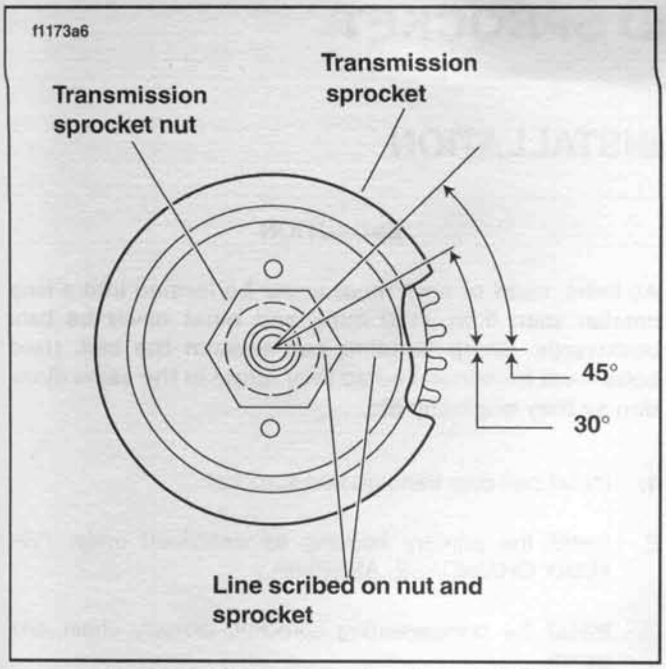


Figure 6-22. Transmission Sprocket Nut Final Tightening Procedure

⚠CAUTION

To ensure the lockplate's security, you must use BOTH screws when you install the lockplate.

10. Tighten Allen head screws to 7-9 ft-lbs (9-12 Nm).

NOTE

The Allen head screws have Loctite patches and can be re-used 3 - 5 times.

11. Install primary chain and chaincase as described under PRIMARY CHAINCASE, ASSEMBLY later in this section.
12. Align vehicle and adjust belt tension. See Section 2, VEHICLE ALIGNMENT and Section 1, SCHEDULED MAINTENANCE PROCEDURES, Drive Belt.

DRIVE BELT AND SPROCKET

GENERAL

For information on drive belt adjustment, see SCHEDULED MAINTENANCE PROCEDURES in Section 1.

REMOVAL

1. Remove the rear wheel, see REAR WHEEL in Section 2.
2. Remove the compensating sprocket, primary chain, and clutch as an assembly as described under PRIMARY CHAIN.
3. Remove the primary housing as described under PRIMARY CHAINCASE, DISASSEMBLY.
4. Remove the drive belt from the transmission sprocket.

INSTALLATION

⚠CAUTION

All belts, used or new, must never be formed into a loop smaller than 5 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.

1. Install belt over transmission sprocket.
2. Install the primary housing as described under PRIMARY CHAINCASE, ASSEMBLY.
3. Install the compensating sprocket, primary chain, and clutch.
4. Install rear wheel and adjust belt tension as described in Section 2.

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TRANSMISSION 7

COUNTERSHAFT TOLERANCE

Countershaft runout	0.000-0.003 in. (0.00-0.08 mm)
Countershaft end play	None
1st gear end play	0.0050-0.0039 in. (0.127-0.099 mm)
1st gear clearance	0.003-0.0019 in. (0.008-0.048 mm)
2nd gear end play	0.0050-0.0440 in. (0.127-1.118 mm)
2nd gear clearance	0.0003-0.0019 in. (0.008-0.048 mm)
3rd gear clearance	0.0000-0.0080 in. (0.000-0.203 mm)
4th gear end play	0.0050-0.0390 in. (0.127-0.991 mm)
4th gear clearance	0.0000-0.0080 in. (0.000-0.203 mm)
5th gear end play	0.0050-0.0040 in. (0.127-0.102 mm)
5th gear clearance	0.0000-0.0080 in. (0.000-0.203 mm)

SHIFTER CAM ASSEMBLY

Shifter cam end play	0.0001-0.004 in. (0.0025-0.10 mm)
Right edge of middle cam groove to right support block	1.992-2.002 in. (50.60-50.85 mm)

SHIFTER FORKS

Shifter fork to cam groove end play	0.0017-0.0019 in. (0.043-0.048 mm)
Shifter fork to gear groove end play	0.0010-0.0110 in. (0.025-0.279 mm)

TORQUE VALUES

Neutral switch (**1997** Models)	3-5 ft-lbs (4-7 Nm)
Neutral switch (**1998** Models)	10-15 ft-lbs (13.6-20.3 Nm)
Transmission mounting bolts	33-38 ft-lbs (45-52 Nm)
Transmission housing-to-mounting plate bolts	15-20 ft-lbs (20-27 Nm)
Mounting plate-to-frame bolts	30-33 ft-lbs (41-45 Nm)
Side door mounting screws: (5/16 in.) (1/4 in.)	 13-16 ft-lbs (18-22 Nm) 7-9 ft-lbs (9-12 Nm)
Support block bolts	7-9 ft-lbs (9-12 Nm)
Clutch cable bracket screws	6-8 ft-lbs (8-11 Nm)
Clutch cable fitting	3-5 ft-lbs (4-7 Nm)
Shifter lever screw	18-22 ft-lbs (24-30 Nm)
Shifter arm adjusting screw locknut	20-24 ft-lbs (27-33 Nm)
Transmission sprocket nut	50 ft-lbs (67.8 Nm) initial torque, then turn another 30°-40°.
Transmission sprocket lock-plate screws	7-9 ft-lbs (9-12 Nm)
Top cover mounting bolts	7-9 ft-lbs (9-12 Nm)
Clutch release cover mounting bolts	7-9 ft-lbs (9-12 Nm)
Transmission drain plug (above surface of housing)	0.16-0.18 in. (4.1-4.6 mm)
Transmission filler cap	finger tight
All 1/4 in. fasteners	7-9 ft-lbs (9-12 Nm)
Mainshaft and counter-shaft nuts	45-55 ft-lbs (61-75 Nm)

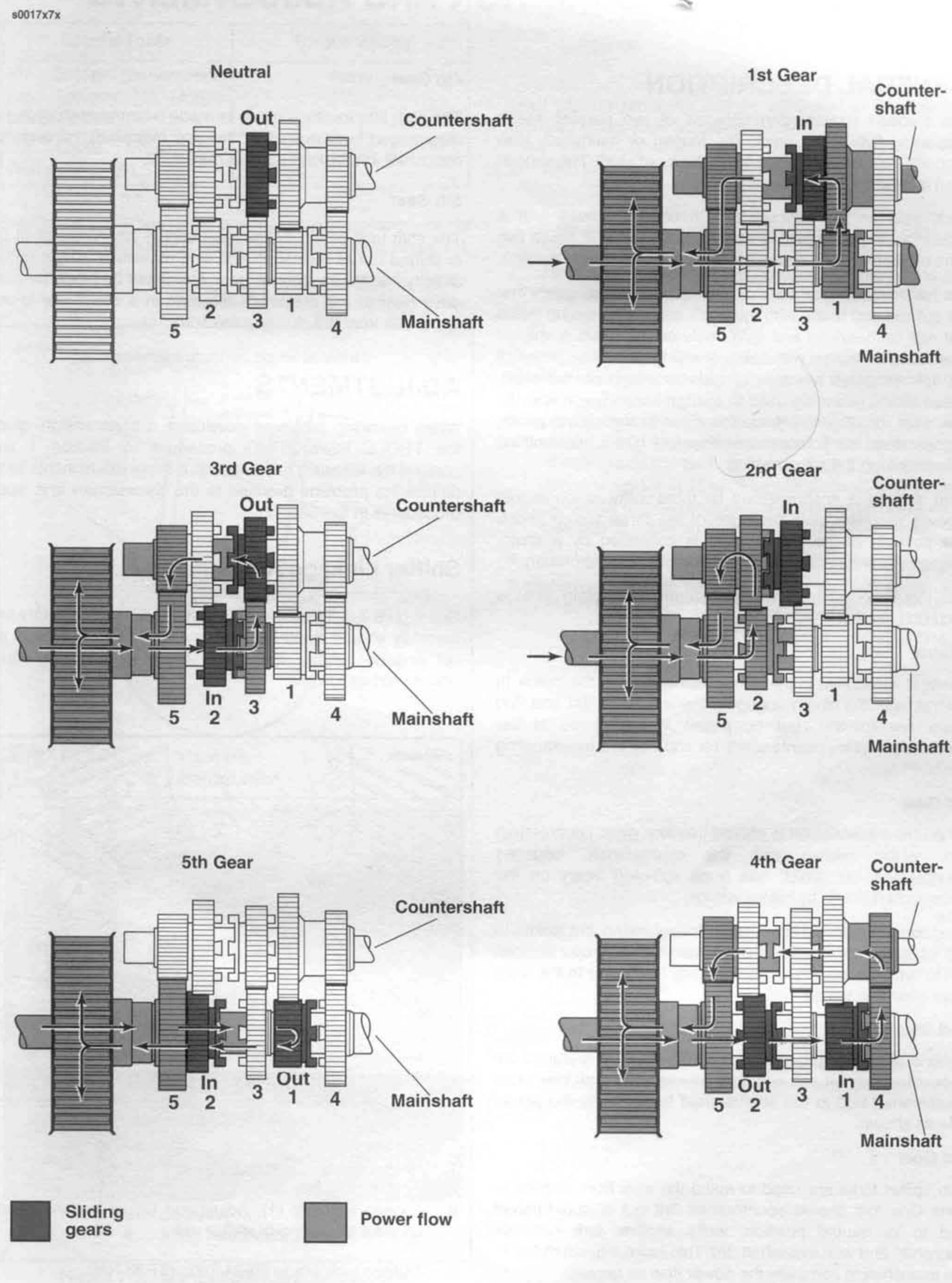


Figure 7-1. Transmission Power Flow

GENERAL DESCRIPTION AND ADJUSTMENTS

GENERAL DESCRIPTION

The 5-speed transmission consists of two parallel shafts supporting five gears each. The longer, or mainshaft, also supports the clutch and serves as the input shaft. The shorter shaft is called the countershaft.

Each gear on the mainshaft is in constant mesh with a corresponding gear on the countershaft. Each of these five pairs of gears makes up a different speed in the transmission.

The transmission gears are divided into two types, gears that are splined and rotate with the shaft, and freewheeling gears that ride on bearings and spin freely on the shaft. A splined gear always meshes with a freewheeling gear. Also, three of the splined gears are able to slide sideways on the shaft. These sliding gears are used to change transmission speeds. The dogs, or projections, on the sides of the sliding gears, engage dogs on adjacent freewheeling gears, transmitting power through the transmission.

Gear shifting is accomplished by three forks which fit into grooves machined into the hubs of the three sliding gears. The position of the shifter forks is controlled by a drum-shaped shifter cam located on the top of the transmission.

See Figure 7-1. The following descriptions explain what is occurring in each shift position.

Neutral

Power is introduced to the transmission through the clutch. In neutral, with the clutch engaged, the mainshaft 1st and 2nd gears are rotating, but no power is transferred to the countershaft since countershaft 1st and 2nd are freewheeling gears.

1st Gear

When the transmission is shifted into first gear, countershaft 3rd, which rotates with the countershaft, engages countershaft 1st, which has been spinning freely on the countershaft driven by mainshaft 1st.

Now countershaft 3rd is no longer freewheeling, but locked to the countershaft causing the countershaft and countershaft 5th to turn. Countershaft 5th transmits the power to the main drive gear and the sprocket.

2nd Gear

Second gear is engaged when countershaft 3rd is shifted out of countershaft 1st and engages countershaft 2nd. This locks countershaft 2nd to the countershaft to complete the power flow as shown.

3rd Gear

Two shifter forks are used to make the shift from second to third. One fork moves countershaft 3rd out of countershaft 2nd to its neutral position, while another fork engages mainshaft 2nd with mainshaft 3rd. This locks mainshaft 3rd to the mainshaft to complete the power flow as shown.

4th Gear

The shift into fourth is made is made when mainshaft 2nd is disengaged from mainshaft 3rd and mainshaft 1st engages mainshaft 4th, locking it to the mainshaft.

5th Gear

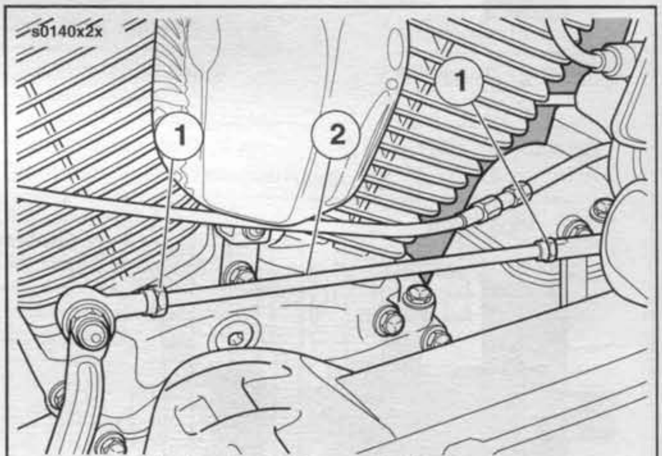
The shift from fourth to fifth gear occurs when mainshaft 1st is shifted out of mainshaft 4th, and mainshaft 2nd is shifted directly into the main drive gear. Mainshaft 2nd lock the main drive gear to the mainshaft resulting in a direct one-to-one drive ratio from the clutch to the sprocket.

ADJUSTMENTS

When operating problems develop in a transmission, check the TROUBLESHOOTING procedure in Section 1 and perform the following adjustments. If these adjustments fail to correct the problem, proceed to the disassembly and repair procedures in this section.

Shifter Linkage Adjustment

See Figure 7-2. 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. Locknut (2) 2. Rod

Figure 7-2. Softail Shifter Rod

1. 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 20-24 ft-lbs (27-33 Nm).

Gear Engagement Adjustment

Special Tools	Torque Values
HD 39618 Transmission Pawl Adjuster (all Models except FLSTS)	None
HD 42465 Transmission Pawl Adjuster (FLSTS)	None

See Figure 7-3. When gears are not engaging properly or not at all, make the following checks before performing Steps 1-4, following:

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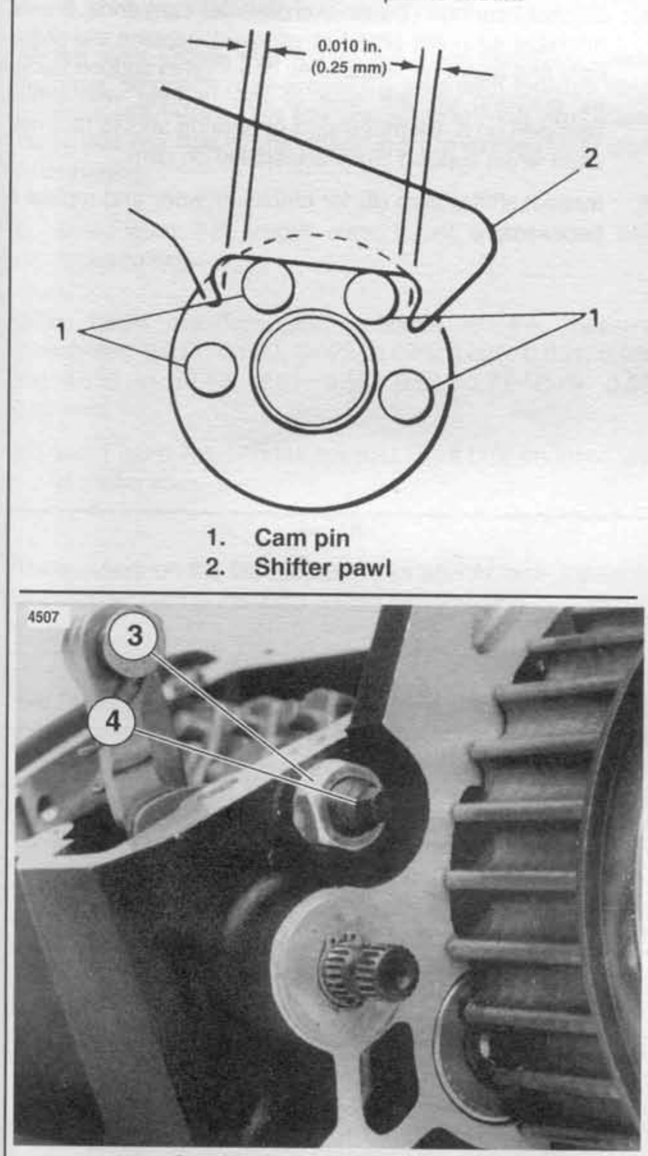

1. **Cam pin**
2. **Shifter pawl**

3. **Locknut**
4. **Allen head screw**

Figure 7-3. Gear Engagement Adjustment

A. Check for proper clutch operation.

B. Check the shift linkage for wear, adjustment or interference.

NOTE

Most shifting problems can be attributed to an improperly adjusted shifter pawl adjusting screw.

1. Shift transmission into 3rd gear.

NOTE

Be sure transmission is fully engaged in 3rd gear.

2. Move shifter lever and feel for free play and spring pressure in both directions.

NOTE

See Figure 7-3. The spring pressure you feel defines the limits of travel of the shifter pawl (2) against the cam pins (1).

3. Use Transmission Pawl Adjuster, H-D 39618 (all models except FLSTS), or Transmission Pawl Adjuster, H-D 42465 (FLSTS), and loosen locknut (3). Adjust Allen screw (4) in 1/4 in. (6 mm) turn increments or less (either clockwise or counterclockwise) until spring pressure and free play is equal on both sides of shift lever travel.
4. Recheck adjustment after tightening locknut (3).

If preceding steps do not work, check for bent shifter forks. See SHIFTER FORKS, CLEANING AND INSPECTION.

SHIFTER CAM ASSEMBLY

DISASSEMBLY

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

1. Remove battery and oil tank. Remove starter. See STARTER, Section 5. Disconnect wire on neutral indicator switch. Remove hose from fitting in cover.
2. Remove the five socket head screws and washers from the top cover. Remove the top cover and discard the cover gasket.
3. See Figure 7-4. Remove the four hex head screws and washers to free the right (3) and left (10) support blocks. The left support block (10) is a slip fit on the cam and will slide off.

⚠WARNING

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

4. Remove retaining ring (1), outer thrust washer (2) and right support block (3). Mark thrust washer (2) so it can be installed in the original position. Discard retaining ring.

CLEANING AND INSPECTION

1. See Figure 7-4. Clean all parts except bearings (7 and 9) with solvent. Blow dry with compressed air.
2. Inspect neutral indicator switch in top cover. Depress plunger. It should spring back without binding. The switch is a non-repairable item and must be replaced if damaged.
3. Inspect bearings (7 and 9) and shifter cam ends. If ends of shifter cam are pitted or grooved, replace the shifter cam and bearings. Install new bearings in support blocks by pressing on the side of the bearing with letters stamped on it. Stamped side of bearing should face outward when support block is installed on cam.
4. Inspect shifter cam (8) for cracks or wear and replace if necessary.

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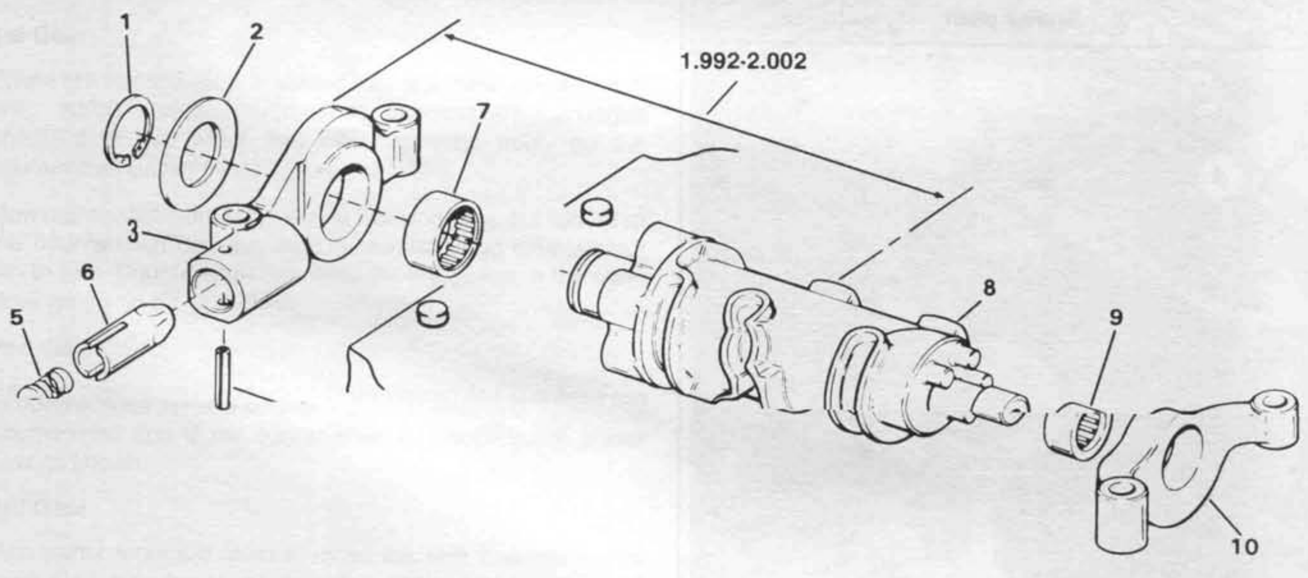


1. **Retaining ring**
2. **Outer thrust washer (variable thickness)**
3. **Right support block**
4. **Roll pin**
5. **Spring**
6. **Cam follower**
7. **Bearing**
8. **Shifter cam**
9. **Bearing**
10. **Left support block**

Figure 7-4. Shifter Cam Assembly

ASSEMBLY

Special Tools	Torque Values
None	Support block bolts 7-9 ft-lbs (9-12 Nm) Top cover bolts 7-9 ft-lbs (9-12 Nm) **1997** Neutral switch 3-5 ft-lbs (4-7 Nm) **1998** Neutral switch 10-15ft-lbs (13.6-20.3 Nm)

NOTE

The shifter cam uses an OUTER SPACER to set shifter cam end play.

⚠WARNING

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

1. See Figure 7-5. Install outer thrust washer and new retaining ring.

Outer thrust washers are available in the following thicknesses: 0.017, 0.020, 0.022, 0.025, 0.028, 0.031, 0.035 and 0.039 in. (0.43, 0.51, 0.56, 0.64, 0.71, 0.79, 0.89, 0.99 mm).

2. See Figure 7-4. Slip left support block (10) on small end of shifter cam.

NOTE

The numbers on the left support block should face downward when shifter cam is installed on the transmission.

NOTE

See Figure 7-5. Retaining ring must seat firmly in groove. The thrust washers must spin after assembly. They must not be so tight they will not move.

3. See Figures 7-4, 7-6. Use a feeler gauge and check end play of shifter cam (8). If end play is not 0.001-0.004 in. (0.025-0.10 mm), remove OUTER thrust washer (2) and replace it with a thinner or thicker one. With proper end play, thrust washer (2) should turn freely.

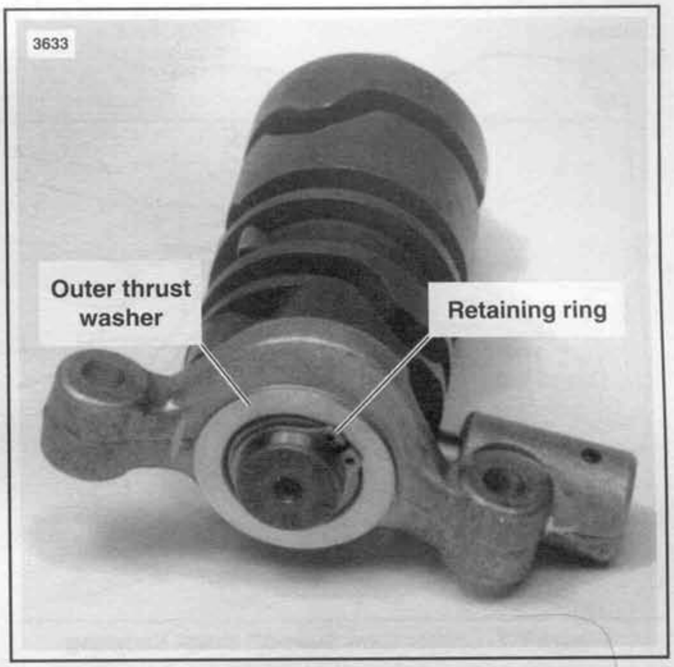


Figure 7-5. Right Support Block Retaining Ring

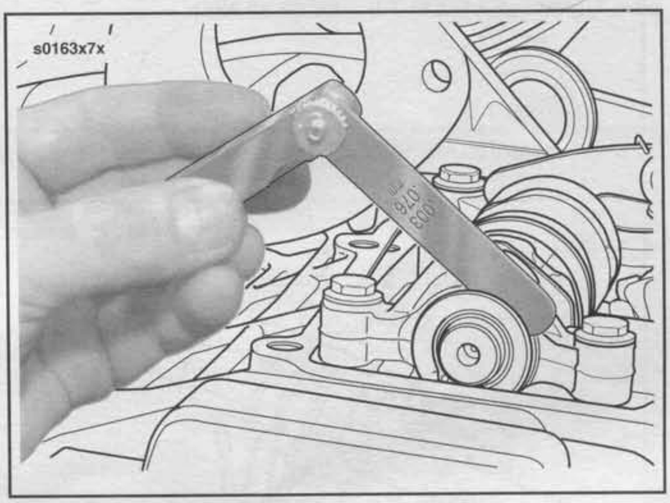


Figure 7-6. Checking End Play

4. See Figure 7-7. Place shifter cam assembly on transmission case with shifter forks positioned in the slots.

The transmission case has dowel pins which fit into the mounting holes of BOTH support blocks. Align the cam assembly by positioning the support blocks on the dowel

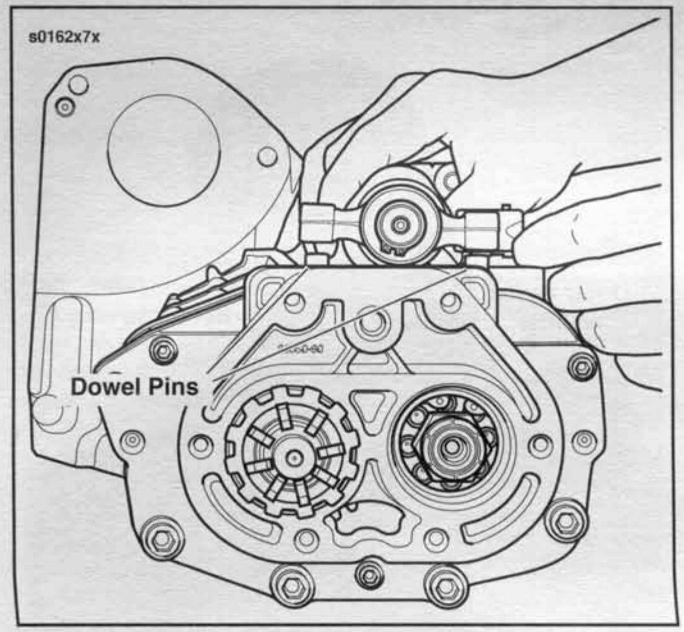


Figure 7-7. Shifter Cam Support Block Locating Dowel Pins

pins. Tighten all bolts to 7-9 ft-lbs (9-12 Nm).

NOTE

Check the gear engagement and clearance in every gear to be sure assembly and alignment is correct.

5. Perform the GEAR ENGAGEMENT ADJUSTMENT as listed under ADJUSTMENTS. Install top cover with a new gasket. Tighten bolts to 7-9 ft-lbs (9-12 Nm).
6. If neutral switch was removed, it must be installed in the top cover with the transmission in NEUTRAL position to properly engage slot. See NEUTRAL SWITCH, Section 8.
7. Install oil tank and battery.

SHIFTER FORKS

REMOVAL

1. Remove the transmission top cover and shifter cam assembly as described in the SHIFTER CAM DISASSEMBLY section.

2. Remove the transmission clutch release cover. See TRANSMISSION CLUTCH RELEASE COVER.

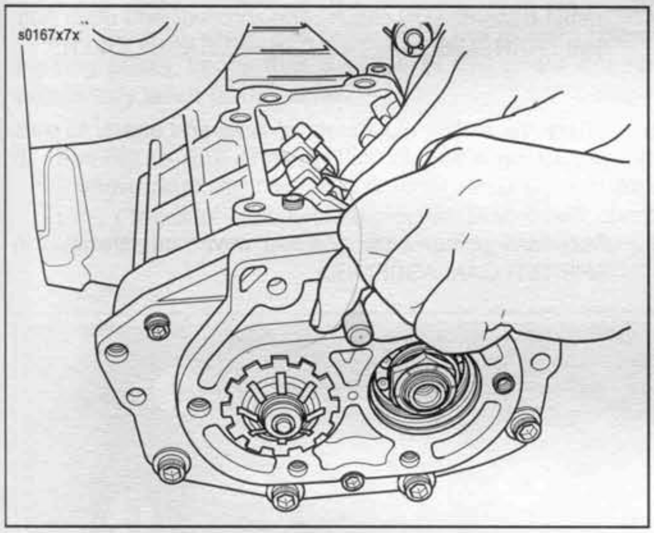


Figure 7-8. Fork & Fork Shaft Removal

3. See Figure 7-8. Slide fork shaft out through the hole and remove the shifter forks.

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent and blow dry with compressed air.

2. Check the shifter fork shaft and replace it if bent or damaged.

3. See Figure 7-9. 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. If they are worn thinner than 0.165 in. (4.19 mm) at mating surfaces, replace them.

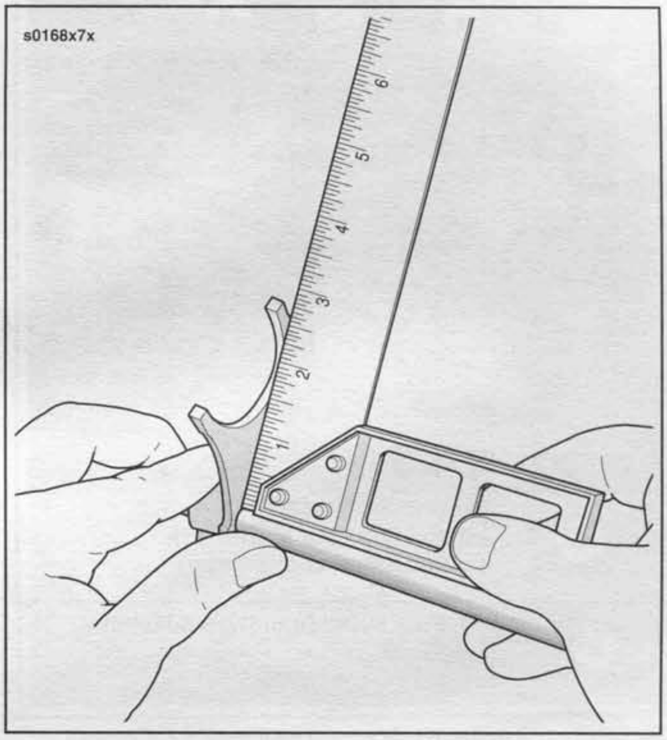
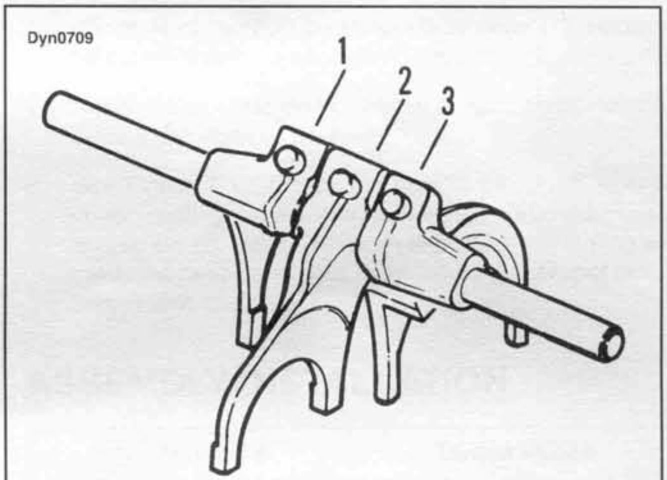
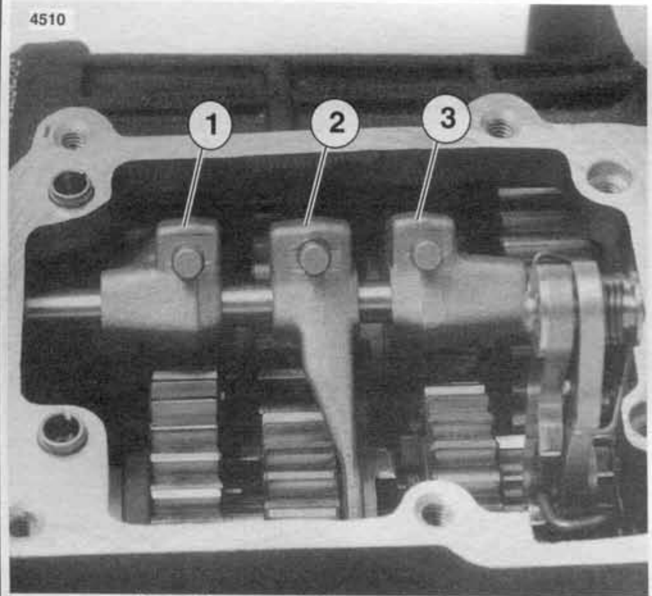


Figure 7-9. Checking Fork for Squareness



1. 4th gear shifter fork
2. 1st and 2nd gear shifter fork
3. 3rd and 5th gear shifter fork

Figure 7-10. Shifter Fork Identification



1. 4th gear shifter fork
2. 1st and 2nd gear shifter fork
3. 3rd and 5th gear shifter fork

Figure 7-11. Fork Position in Transmission

INSTALLATION

1. See Figure 7-10. The forks are different from each other and are identified as shown.
2. See Figure 7-11. Insert shifter fork (1) into the slot of the mainshaft 1st gear. Insert shifter fork (2) into the slot of the countershaft 3rd gear and insert shifter fork (3) into the slot of the mainshaft 2nd gear.
3. Slide fork shaft through the transmission case hole, through the forks and into the hole in the opposite side of the case.
4. Install transmission clutch release cover and drain plug. See TRANSMISSION CLUTCH RELEASE COVER.
5. Check the sliding movement of forks and gears. All parts should move freely.
6. Assemble shifter cam and top cover as described in SHIFTER CAM ASSEMBLY.

TRANSMISSION CLUTCH RELEASE COVER

REMOVAL/DISASSEMBLY

1. Drain transmission and remove fill plug/dipstick. Loosen cable adjuster so clutch cable is slack. See SCHEDULED MAINTENANCE PROCEDURES in Section 1.
2. Remove clutch release cover. If necessary, loosen exhaust system. See Section 4.

⚠WARNING

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

3. See Figure 7-12. Note position of retaining ring opening. Remove retaining ring (1). Lift inner ramp (2) and coupling (3) out of clutch release cover. Disconnect clutch cable end (4) from the ball and ramp coupling (3).

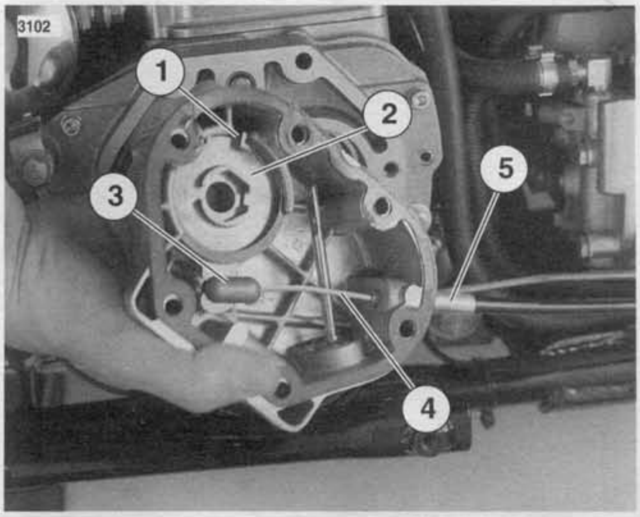


Figure 7-12. Clutch Cable Connection

4. Unscrew cable fitting (5) from clutch release cover.
5. See Figure 7-13. Remove balls (6) and outer ramp (7).

CLEANING AND INSPECTION

1. Wash the ball and ramp mechanism components in cleaning solvent.
2. Inspect the three release mechanism balls (6) and ball socket surfaces on ramps (2 and 7) for wear, pitting, surface breakdown and other damage. Replace damaged parts.

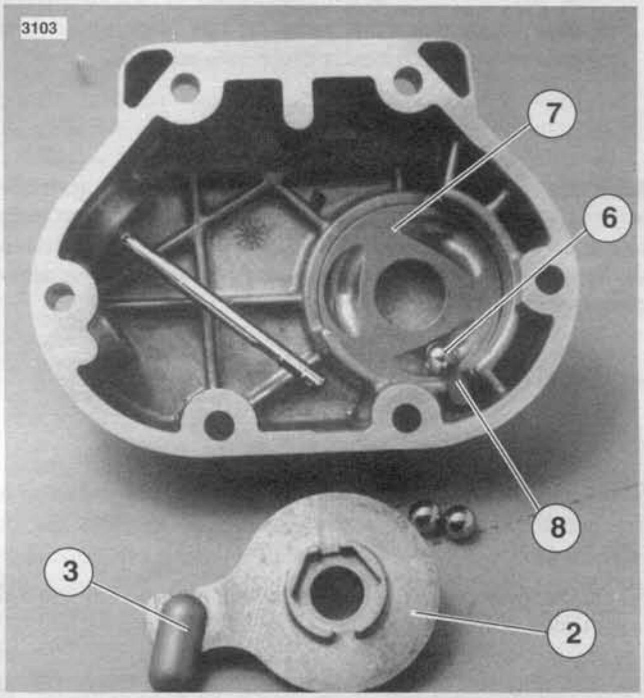


Figure 7-13. Ball and Ramp Mechanism With Inner Ramp and Coupling Removed

3. Check fit of the hub on ramp (2) in ramp (7). 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. See Figure 7-12. Check the bore in the clutch release cover casting where the ramps are retained. There should be no wear; lips worn into the bore that would catch the ramps and cock them, causing improper clutch adjustment.

ASSEMBLY/INSTALLATION

Special Tools	Torque Values
None	1/4 in. Clutch release cover mounting bolts 7-9 ft-lbs (9-12 Nm) Clutch cable fitting 3-5 ft-lbs (4-7 Nm)

1. See Figure 7-12. Screw clutch cable fitting (5) into clutch release cover. Do not tighten at this time.

NOTE

Replace cable fitting O-ring if damaged or deformed.

2. See Figure 7-14. Place outer ramp in clutch release cover and place balls in slots. Be sure tang is in side cover slot.

3. See Figure 7-12. Connect cable end (4) to coupling (3). Install coupling on inner ramp (2) and place inner ramp and coupling in position in clutch release cover.

⚠WARNING

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

4. Install retaining ring (1).

Note

See Figure 7-13. Retaining ring opening must be installed to the right of the outer ramp tang (8) slot.

5. Install **new** gasket and clutch release cover. Tighten 1/4 in. side cover bolts to 7-9 ft-lbs (9-12 Nm).

6. See Figure 7-12. Tighten clutch cable fitting (5) to 3-5 ft-lbs (4-7 Nm).

7. Fill transmission to proper level with fresh transmission lubricant and install fill plug/dipstick. Tighten exhaust system if loosened.

8. Adjust clutch cable. See SCHEDULED MAINTENANCE PROCEDURES in Section 1.

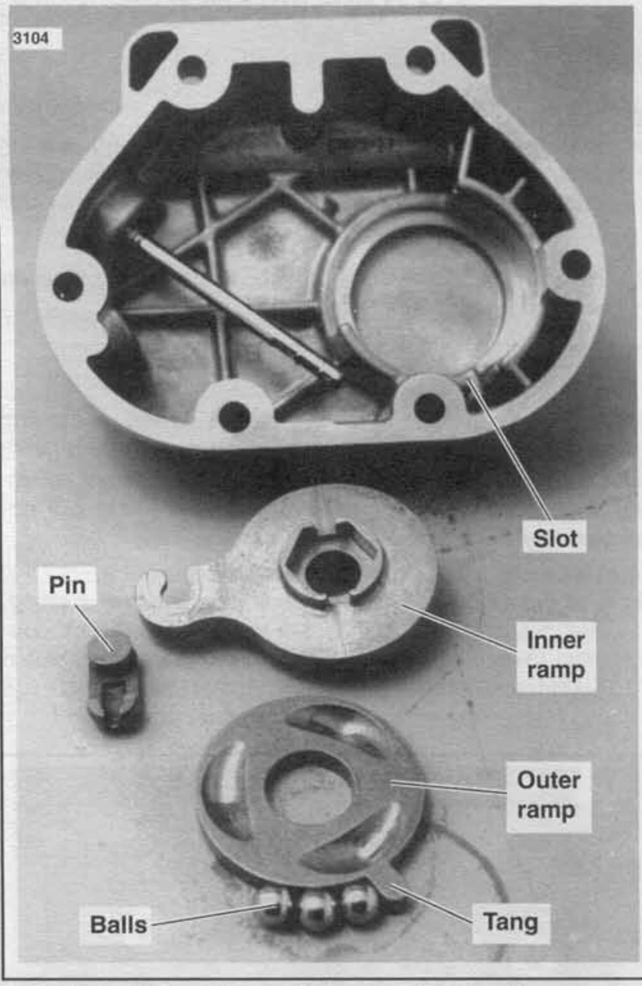


Figure 7-14. Ball and Ramp Mechanism Removed From Clutch Release Cover

MAINSHAFT AND COUNTERSHAFT

REMOVAL

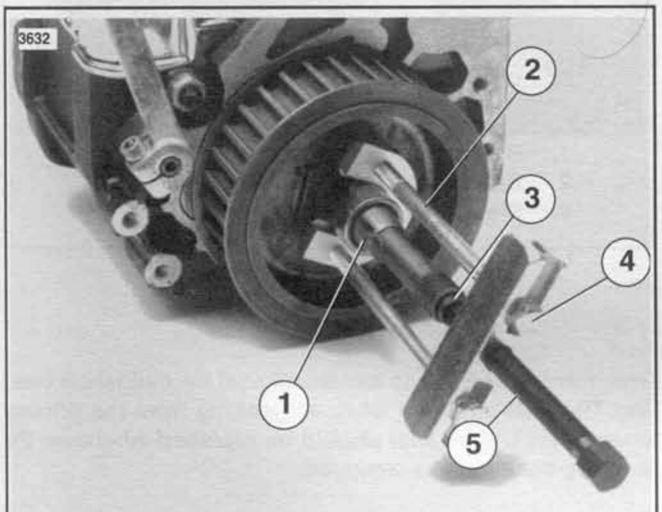
Special Tools	Torque Values
HD-34902A Bearing race puller & installation tool HD-94660-37B Mainshaft locknut wrench	None

1. Remove exhaust system. See Section 4.
2. Remove the clutch and primary chaincase. See Section 6.
3. Remove transmission top cover, shifter cam assembly and shifter forks as described earlier in this section.

CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the inner primary cover oil seal.

4. See Figure 7-15. Remove the bearing inner race from the transmission mainshaft using BEARING RACE PULLER & INSTALLATION TOOL, Part No. HD-34902A.



1. **Bearing inner race**
2. **Leg**
3. **Center disc**
4. **Nut**
5. **Puller screw**

Figure 7-15. Pull Mainshaft Inner Bearing Race

5. Remove the magnetic drain plug from the side of the transmission and drain the lubricant.
6. Remove the clutch release cover from the transmission side door. See TRANSMISSION CLUTCH RELEASE COVER.
7. Lock the transmission by meshing the gears into two speeds at the same time.
8. See Figure 7-18. Remove the locknuts (8) and spacers (7) from the shafts.
9. If main drive gear (9, Figure 7-26) is to be removed, lock transmission as above and remove transmission sprocket nut as described in Section 6.

NOTE

The main drive gear bearing must be replaced if the main drive gear is removed. The bearing will be damaged during the removal procedure.

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.

10. See Figure 7-16. Remove the transmission side door mounting hardware. Pry the side door loose and remove side door, mainshaft and countershaft from transmission case as an assembly.

Figure 7-16. Remove Transmission Side Door

INSTALLATION

Special Tools	Torque Values
HD-34902A Bearing race puller & installation tool HD-94660-37B Mainshaft locknut wrench	5/16 in. Side door mounting screws 13-16 ft-lbs (18-22 Nm) 1/4 in. Side door screws 7-9 ft-lbs (9-12 Nm) 1/4 in. Clutch release cover screws 7-9 ft-lbs (9-12 Nm) Lockplate allen bolts 7-9 ft-lbs (9-12 Nm)

1. Assemble transmission. See MAINSHAFT AND COUNTERSHAFT DISASSEMBLY/ASSEMBLY.

⚠CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear oil seal.

2. See Figure 7-18. Install the assembly in the transmission case using a **new** gasket (2). Tighten 5/16 in. mounting hardware to 13-16 ft-lbs (18-22 Nm) and 1/4 in. screws to 7-9 ft-lbs (9-12 Nm).
3. Lock the transmission by engaging two gears. Tighten mainshaft and countershaft nuts to 45-55 ft-lbs (61-74.6 Nm).
4. See Figure 7-17. 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-34902A.
   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).

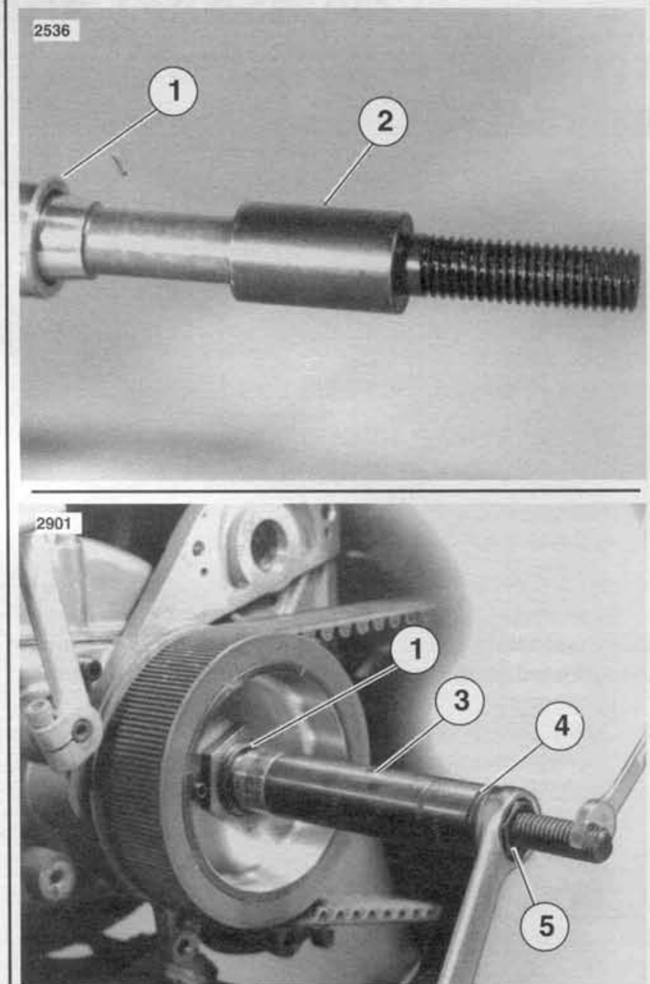
NOTE

Measure the length of the bearing inner race (1). The race must be 0.9950-1.000 in. (25.27-25.40 mm) long. Record the length. It will determine the race's position in step e.

⚠CAUTION

Press race onto shaft so inside edge is 0.100 in. (2.54 mm) from main drive gear.

   e. Tighten nut (5) while holding sleeve pilot (2) stationary with wrench on flats at end of screw threads. Press race (1) onto shaft.



1. **Bearing inner race**
2. **Sleeve pilot**
3. **Sleeve**
4. **Washer**
5. **Nut**

Figure 7-17. Install Bearing Race

⚠CAUTION

The primary chaincase has an oil seal for mainshaft bearing. The seal prevents lubricant leaking from the primary chaincase. The oil seal should be replaced whenever the primary chaincase is removed.

5. See Figure 7-18. Install 2-piece push rod (21 and 22) in mainshaft hole.

   Install the shifter forks, shifter cam and top cover as described earlier in this section.

7. If main drive gear (9, Figure 7-26) was removed/installed, lock transmission as described earlier and install transmission sprocket nut as described in Section 6.
8. Install primary chaincase and clutch. See Section 6.

⚠CAUTION

Do not over-tighten drain plug and filler cap. Over-tightening could cause transmission leakage.

9. Install the drain plug so it projects 0.16-0.18 in. (4.1-4.6 mm) above surface of housing.

10. Fill the transmission with 24 oz. (709.8 ml) of Harley-Davidson TRANSMISSION LUBRICANT, Part No. 98853-96, or until the dipstick on the clutch release cover filler cap shows FULL with motorcycle in level, upright position and the dipstick dipped, not screwed, into the fill hole.

11. Install filler cap. Tighten finger tight.

12. Install exhaust system, See Section 4.

DISASSEMBLY

Special Tools	Torque Values
J-5586 Retaining ring pliers	None

1. See Figure 7-18. Remove the 2-piece push rod (21 and 22) from the hole in the mainshaft. Use RETAINING RING PLIERS, Part No. J-5586, to remove all retaining rings (12).
2. With access door on end (shafts pointing upward), remove the retaining ring (12) from the countershaft (6). Remove the countershaft 5th gear (19) and countershaft 2nd gear (18).
3. Remove the bearings (9), retaining ring (12) and countershaft 3rd gear (16).
4. Remove mainshaft 2nd gear (20) and leave 4th and 1st gear respectively on each shaft.

NOTE

To remove the mainshaft 3rd gear (17), move the retaining ring on the access door side of 3rd gear out of the slot and slide it on the shaft away from 3rd gear. The gear will move down the shaft for easy access to the upper retaining ring.

5. Remove the upper retaining ring, thrust washer (11), mainshaft 3rd gear (17), bearings and retaining ring.

⚠CAUTION

Supporting the gears in the following step is necessary to provide support for the inner bearing races. Failure to support the gears will damage the bearings.

6. Support countershaft 1st gear and press out countershaft.
7. Support mainshaft 4th gear and press out mainshaft.
8. Remove the remaining spacers, and retaining rings.

s0060x7x

1. **Side door**
2. **Gasket**
3. **Mainshaft spacer**
4. **Countershaft spacer**
5. **Mainshaft**
6. **Countershaft**
7. **Spacer (2)**
8. **Locknut (2)**
9. **Bearings (4)**
10. **Mainshaft 4th gear**
11. **Thrust washer (5)**
12. **Retaining ring (6)**
13. **Mainshaft 1st gear**
14. **Countershaft 4th gear**
15. **Countershaft 1st gear**
16. **Countershaft 3rd gear**
17. **Mainshaft 3rd gear**
18. **Countershaft 2nd gear**
19. **Countershaft 5th gear**
20. **Mainshaft 2nd gear**
21. **Push rod**
22. **Push rod – left side**

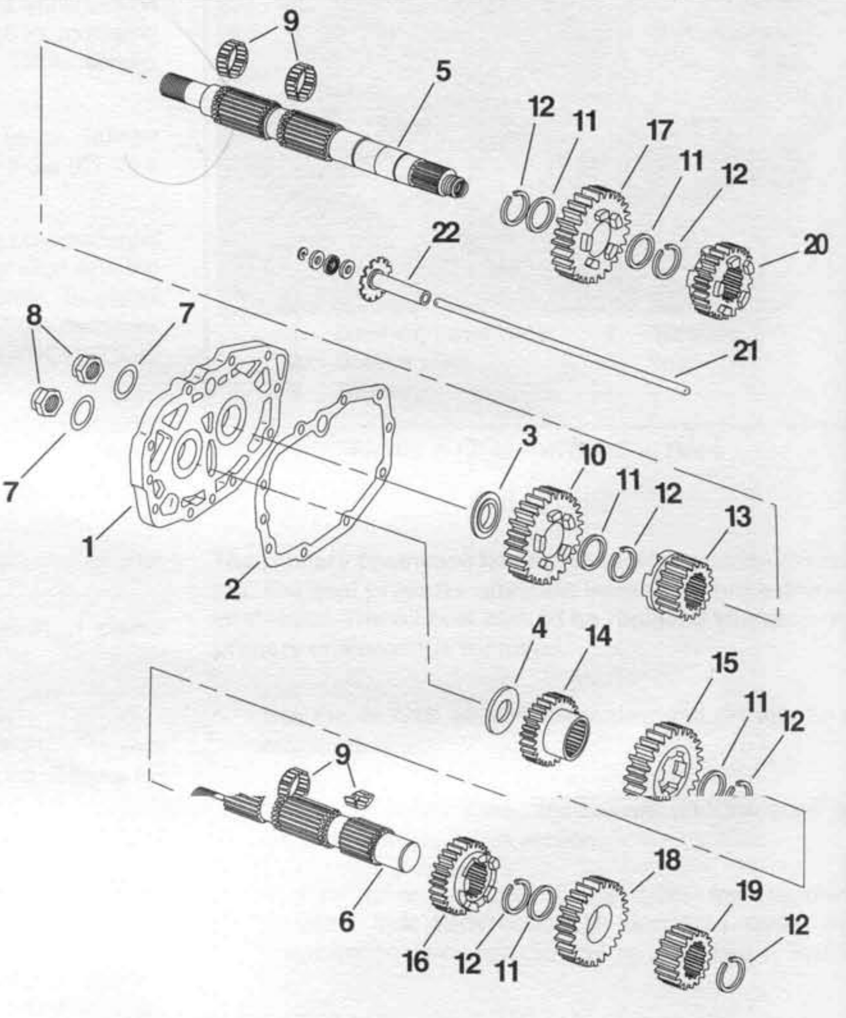


Figure 7-18. Mainshaft, Countershaft Assembly

CLEANING AND INSPECTION

1. Clean all parts in cleaning solvent and blow dry with compressed air.

2. Check gear teeth for damage. If gears are pitted, scored, rounded, cracked or chipped, they should be replaced.

3. Inspect the engaging dogs on the gears. Replace the gears if dogs are rounded, battered or chipped.

4. See Figure 7-19. Inspect the bearings in the side door. If bearings are pitted or grooved or feel rough when turned, replace the bearings.

REPLACE THE SIDE DOOR BEARINGS

1. See Figure 7-19. Remove the retaining rings 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 with beveled edge facing outside of case.

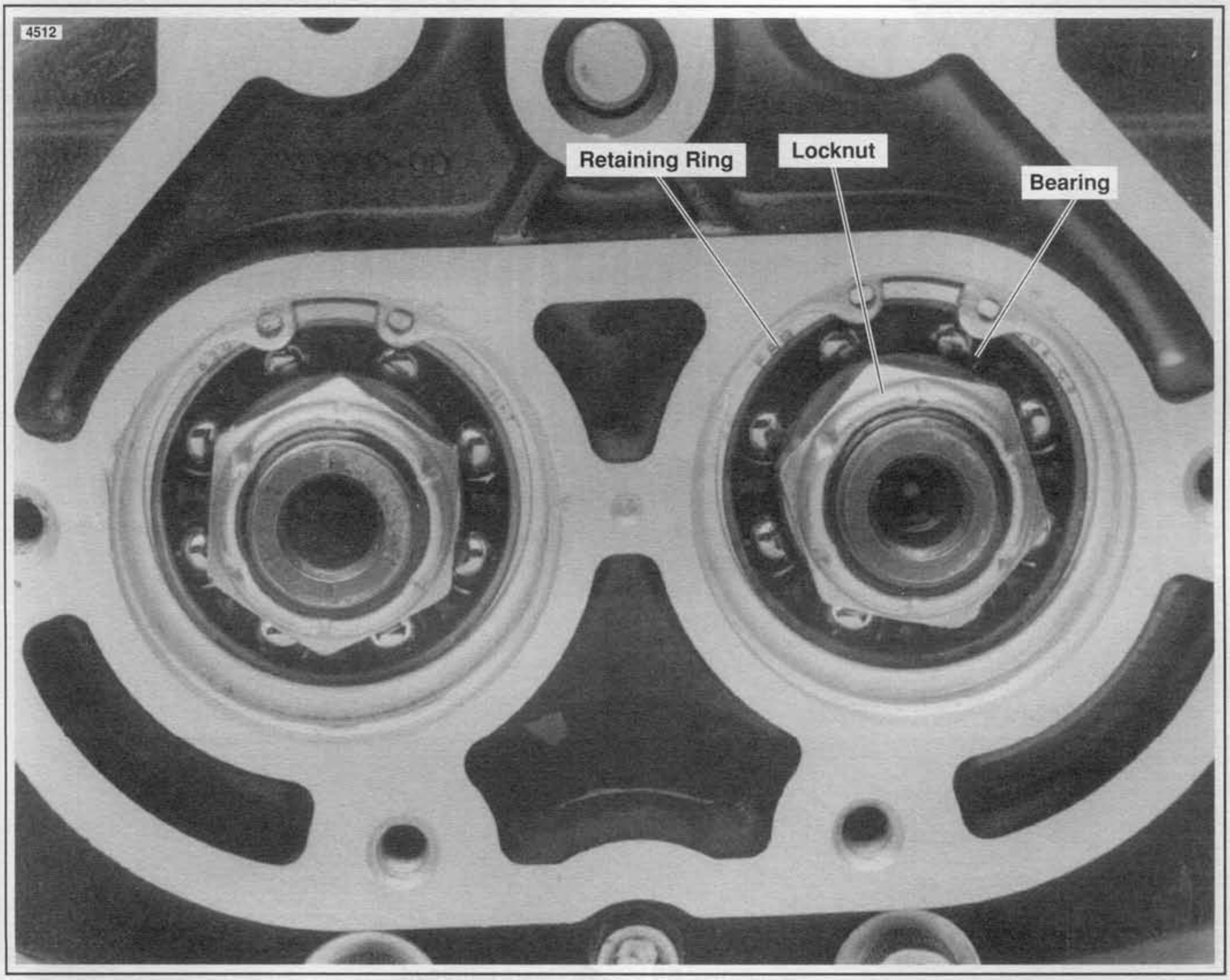


Figure 7-19. Side Door Bearings

ASSEMBLY

Special Tools	Torque Values
HD-34902 Puller and installation tool	Mainshaft and countershaft nuts 45-55 ft-lb (61-75 Nm)

1. See Figures 7-18 and 7-20. Slip thrust washers (11) and retaining rings (12) on mainshaft and countershaft. Slip mainshaft 4th gear on mainshaft and countershaft 1st gear on countershaft.
2. Lightly coat bearings (9) with oil and install the bearings on the mainshaft (5) bottom race. Slide mainshaft 4th gear (10) over the bearings. Install one thrust washer (11) on top of the gear and secure with a retaining ring (12). Install mainshaft 1st gear (13) with the shifter fork slot facing the side door.
3. Slide countershaft 4th gear (14) onto the countershaft (6).
4. Place bearing in countershaft race and install the countershaft 1st gear (15) with the lip on the gear resting on the spacer and the pockets in the gear facing away from the side door. Install a thrust washer (11) on top of the gear and secure with a retaining ring (12).
5. Slip spacers (3 and 4) on the shafts with the tapers facing the access door bearings. The mainshaft spacer has a shoulder while the countershaft spacer does not.

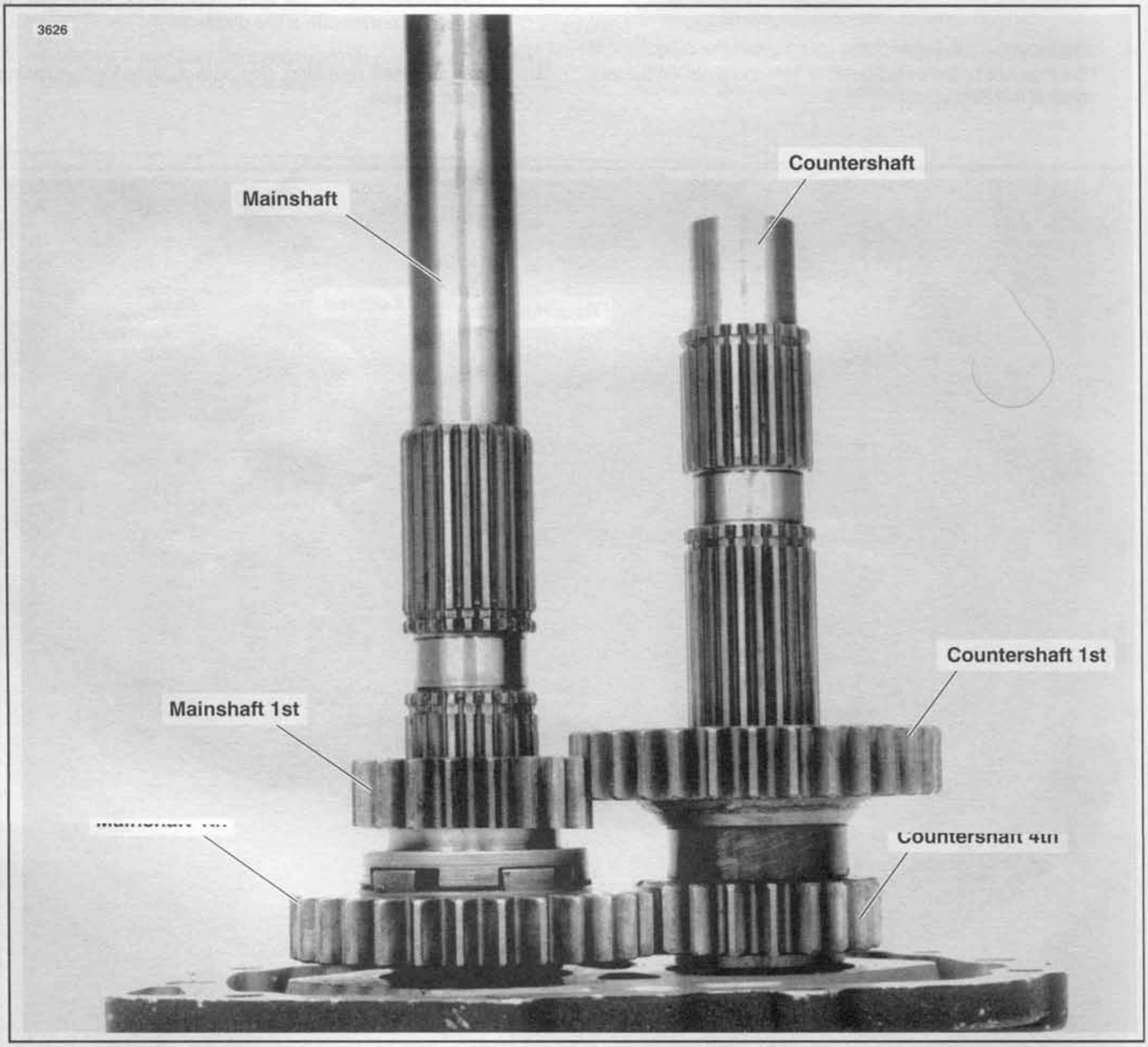


Figure 7-20. 4th and 1st Gears on Shafts

CAUTION

Failure to support inner bearing races while pressing shafts through the bearings will damage the bearings.

6. See Figures 7-18 and 7-21. Place side door (1) in an arbor press. Support inner bearing races with a suitable socket. Press the shafts into the bearings. With the shafts properly pressed into the side door, spacers (3 and 4) will have no end play. The mainshaft (5) is installed to the left of the transmission top cover access cover hole when viewing the side door from the top.

7. Install one spacer (7) and nut (8) on each shaft and tighten the nuts finger tight. Do not tighten at this time. See REMOVAL/INSTALLATION.

8. Install a retaining ring (12) in the mainshaft groove just above 1st gear. Insert a thrust washer (11) on top of the retaining ring and place the bearings into the mainshaft race.

9. Place mainshaft 3rd gear (17) over bearings and secure 3rd gear with a thrust washer (11) and retaining ring (12).

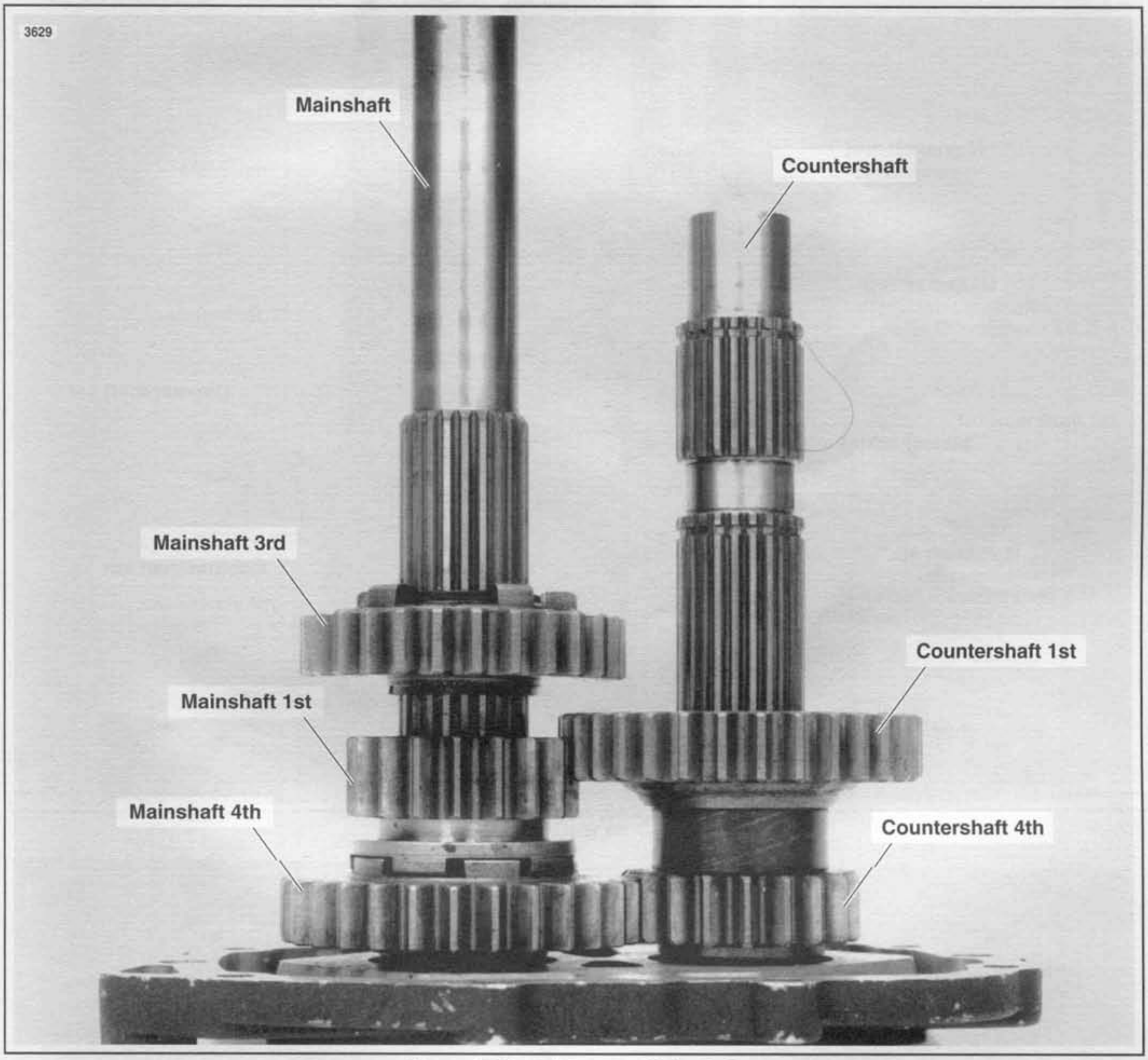


Figure 7-21. 3rd Gear on Mainshaft

10. See Figures 7-18 and 7-22. Install the mainshaft 2nd gear (20) on the shaft with the shifter fork slot towards the side door.

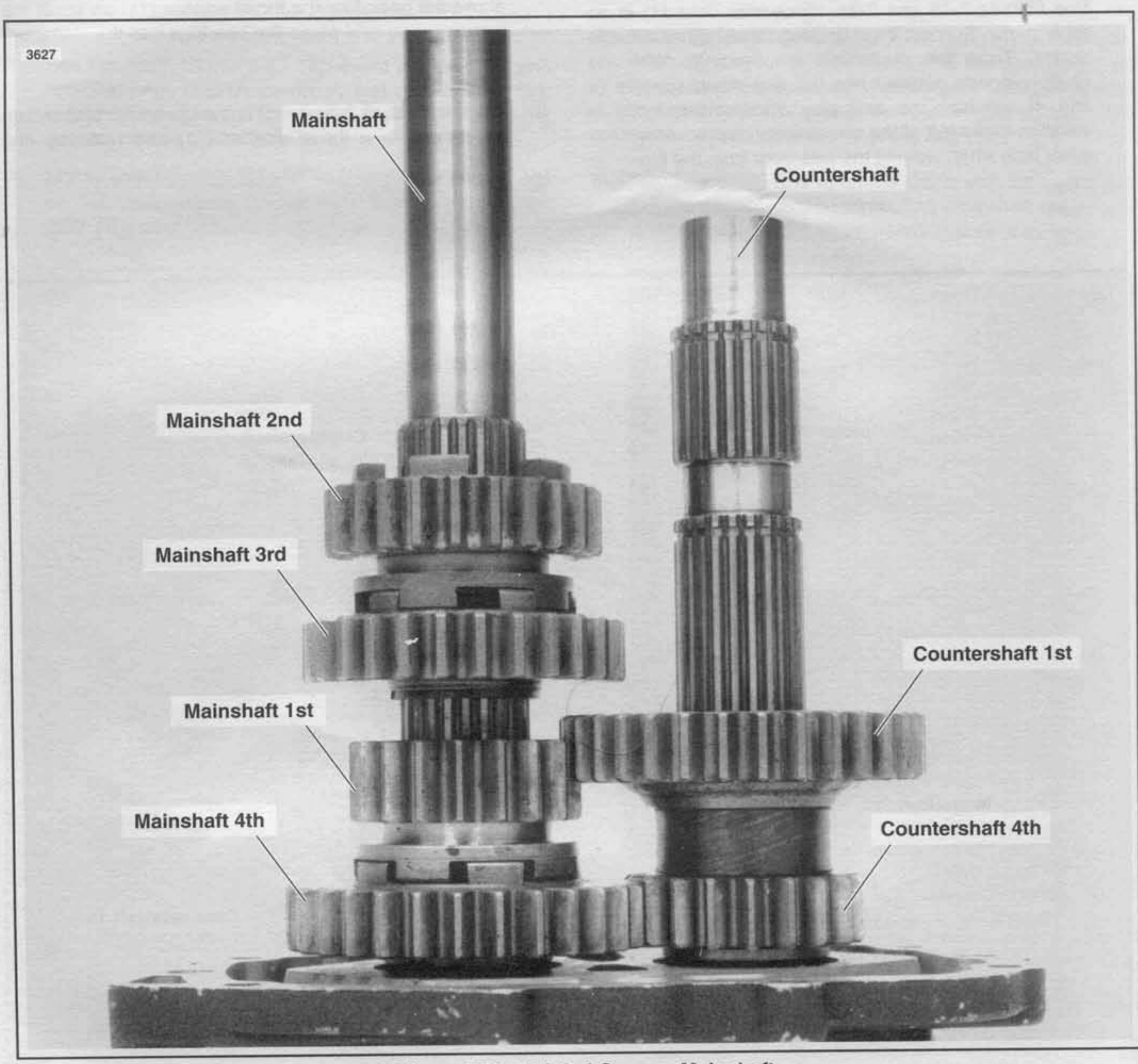


Figure 7-22. 2nd, 3rd Gear on Mainshaft

11. See Figures 7-18 and 7-23. Install countershaft 3rd gear (16) with shifter fork slot facing away from the side door.

12. Install a retaining ring (12) in the countershaft groove above 3rd gear (16). Slide a thrust washer (11) on top of the ring and place the bearings in the countershaft race.

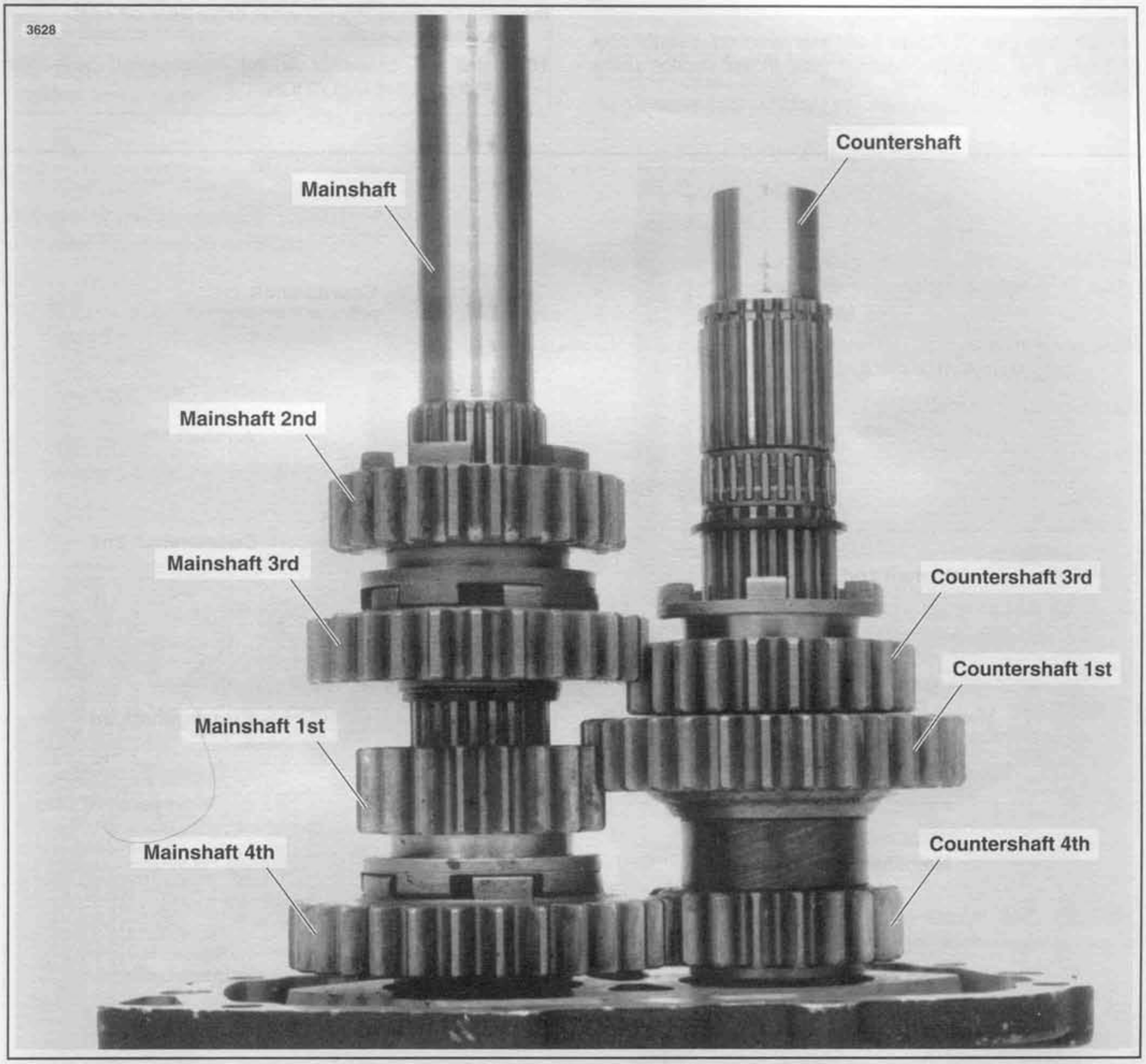


Figure 7-23. 3rd Gear on Countershaft

13. See Figures 7-18 and 7-24. Install the countershaft 2nd gear (18) over the bearings.

14. Install the countershaft 5th gear (19) on the countershaft. Secure 5th gear with a retaining ring.

NOTE

If main drive gear (9, Figure 7-26) was removed, install it now, following the procedure outlined later in the section under MAIN DRIVE GEAR.

15. Lock the transmission by engaging two gears. Tighten mainshaft and countershaft nuts (8) to 45-55 ft-lbs (61-75 Nm).

⚠CAUTION

Cover mainshaft clutch hub splines with tape to prevent the splines damaging the main drive gear oil seal.

16. Install the assembly in the transmission case. See REMOVAL/INSTALLATION.

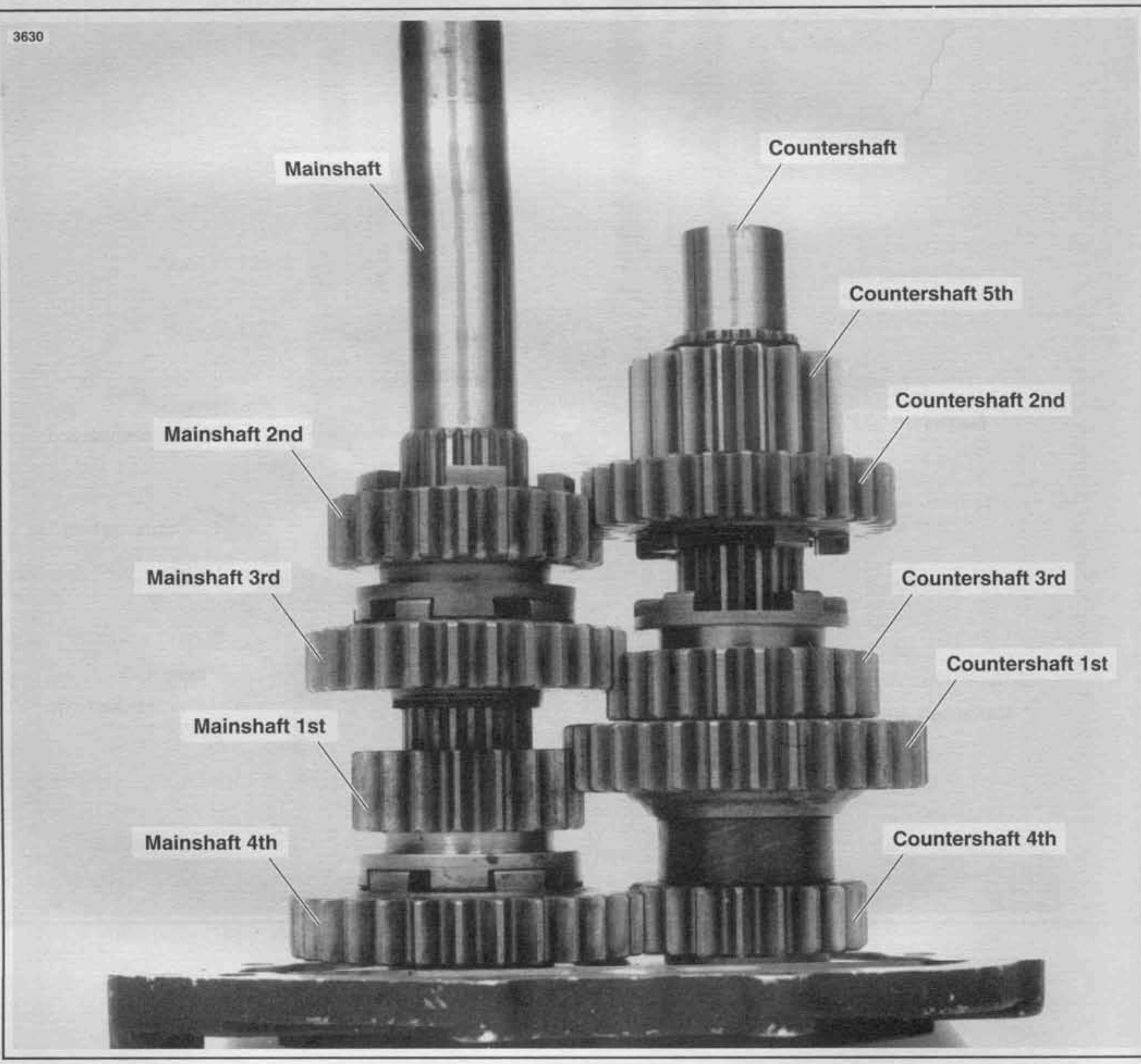


Figure 7-24. Side Door, Mainshaft and Countershaft – Final Assembly

TRANSMISSION CASE

REMOVAL

Special Tools	Torque Values
HD-35316A Main drive gear remover and installer	None

NOTE

Removal of the transmission case is only necessary if it is damaged and has to be replaced.

1. Remove primary cover, primary drive, and clutch. See Section 6.
2. Remove starter. See Section 5.
3. See Figure 7-25. Remove engine and transmission mounting bolts and locking tabs. Remove primary chaincase.

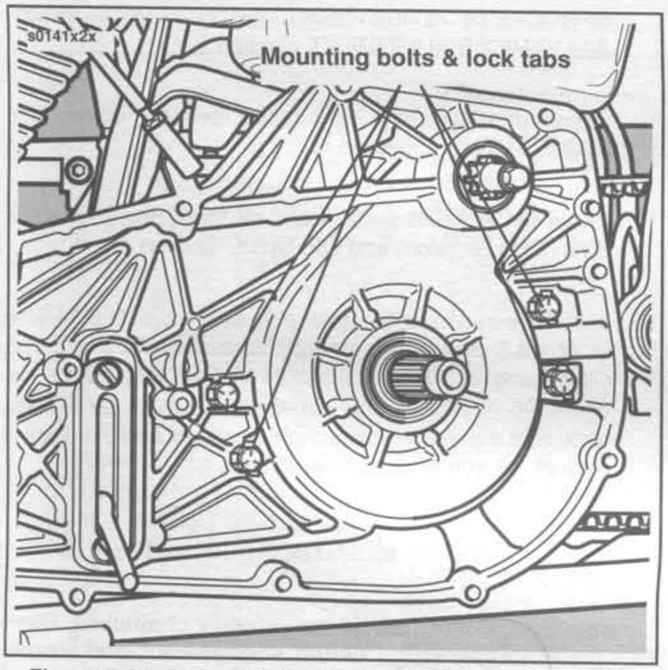


Figure 7-25. Transmission to Primary Mounting Bolts

4. Remove oil tank. See OIL TANK Section 3.
5. Remove sprocket. See TRANSMISSION SPROCKET Section 6.
6. Remove mainshaft and countershaft assemblies with access door. See MAINSHAFT AND COUNTERSHAFT REMOVAL.

Main Drive Gear and Bearing

NOTE

Main drive gear and bearing can be removed with the transmission case in the frame. Use MAIN DRIVE GEAR REMOVER AND INSTALLER, Part No. HD-35316A.

7. See Figure 7-26. To remove main drive gear:
   a. Remove retaining ring (7).

   NOTE

   The main drive gear bearing must be replaced if the main drive gear is removed. The bearing will be damaged during the removal procedure.

   b. Pull main drive gear (9), using HD-35316A, MAIN DRIVE GEAR REMOVER AND INSTALLER.
   c. Gently remove bearing (8) from case using a block of wood and a hammer.

INSTALLATION

Special Tools	Torque Values
HD-35316A Main drive gear remover and installer	Sprocket nut 50 ft-lbs (67.8 Nm) initial then 30-40 degrees additional
	Sprocket nut lockscrew 50-60 **in-lbs** (5.6-6.8 Nm)
	Lockplate allen head screws 7-9 ft-lbs (9-12 Nm)

Main Drive Gear

⚠CAUTION

Failure to use the MAIN DRIVE GEAR AND BEARING INSTALLATION TOOL will cause premature failure of bearing and related parts.

1. Install main drive gear bearing. Install the main drive gear from inside the case using MAIN DRIVE GEAR AND BEARING INSTALLATION TOOL, Part No. HD-35316A. Follow instructions provided with tool.

NOTE

Bearing retaining ring (7) must be installed with the flat side facing the bearing.

2. See Figure 7-26. Install the quad seal (25), spacer (5) and sprocket (4) on the main drive gear (9). Coat the threads of sprocket nut (2) with Loctite 262 (red) and install on the main drive gear.

NOTE

Sprocket nut has left-hand threads.

NOTE

Place belt on transmission sprocket as sprocket is placed in position.

3. Slide the countershaft and mainshaft assembly into the transmission case and tighten the transmission sprocket nut (2) to 50 ft-lbs (67.8 Nm).

⚠CAUTION

Maximum allowable tightening of sprocket nut is 45 degrees of counterclockwise rotation after 50 ft-lbs torque. Do not loosen sprocket nut while attempting to align the screw holes. Tightening too much or too little may cause the nut to come loose during vehicle operation, causing damage to drive components.

4. See Figure 7-26. Scribe a line on the transmission sprocket nut and transmission sprocket.
5. Tighten the transmission sprocket nut an additional 30 to 40 degrees (45 degrees maximum).
6. Install lockplate over transmission sprocket nut so that two of lockplate's four drilled holes (diagonally opposite) align with sprocket's two tapped holes.
7. Install Allen head screws through two of the four holes in lockplate, then into two corresponding tapped holes in sprocket.

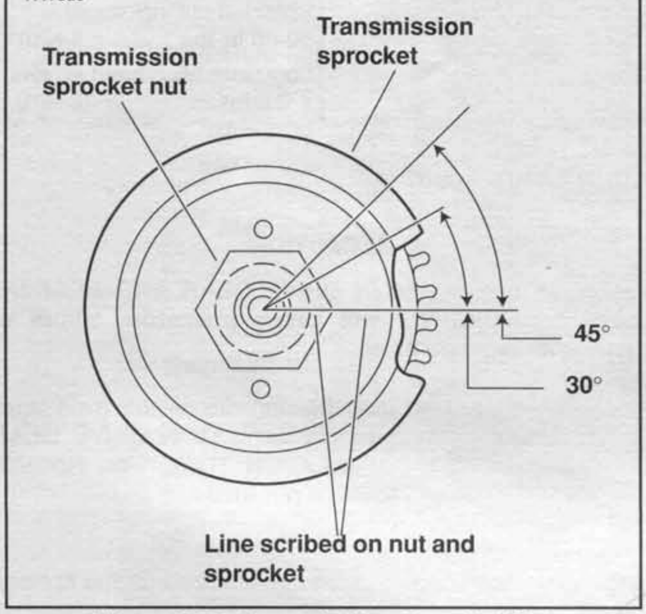


Figure 7-26. Transmission Sprocket Nut Final Tightening Procedure

NOTE

The lockplate has 4 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 hole.

⚠CAUTION

To ensure the lockplate's security, you must use BOTH screws when you install the lockplate.

8. Tighten Allen head screws to 7-9 ft-lbs (9-12 Nm).

NOTE

The Allen head screws have Loctite patches and can be re-used 3 - 5 times.

9. Install shifter cam and shifter forks. See previous subjects in this Section.
10. Install top cover, right side cover, primary case, starter, clutch, primary chain and sprocket. See previous Sections.
11. Tighten transmission mounting bolts to 33-38 ft-lbs (45-52 Nm) torque. Connect foot shifter rod to shifter arm.
12. Perform adjustments listed in TRANSMISSION, ADJUSTMENT section. Adjust belt. See BELTS AND SPROCKETS ADJUSTMENT, Section 6. Align vehicle. See VEHICLE ALIGNMENT, Section 2.
13. Adjust primary chain and install primary cover. See ADJUSTMENTS, Section 6.
14. Install the exhaust system and oil tank. See EXHAUST SYSTEM, Section 4 and OIL TANK, Section 3.
15. Install the transmission drain plug so it projects 0.16-0.18 in. (4.1-4.6 mm) above surface of housing. Fill with 24 oz. (709.8 ml) of TRANSMISSION LUBRICANT, Part No. 98853-96 or until lubricant is at the full mark on the dipstick, with the motorcycle upright and level and the dipstick dipped, not screwed, into the fill hole.

⚠CAUTION

Be sure you do not overfill the primary chaincase. Overfilling will cause rough clutch engagement and incomplete disengagement or clutch drag.

16. Place motorcycle in an upright position and fill primary chaincase with PRIMARY CHAINCASE LUBRICANT, Part No. 99887-84.
    1997 Models: Fill to the bottom edge of the diaphragm spring, approximately 32 oz. (946.4 ml).
    1998 Models: Fill to the bottom edge of the diaphragm spring, approximately 26 oz. (768.9 ml).
17. Adjust gear engagement. See ADJUSTMENT, GEAR ENGAGEMENT.

DISASSEMBLY

Shifter Arm Assembly

1. See Figure 7-27. Loosen screw (11) and remove shifter lever (12) from shifter arm (15).

2. Loosen locknut (24) and turn adjusting screw (23) out until it clears the centering plate (17). Pull shifter arm assembly out of the case.

NOTE

Do not perform step 3 if parts do not need to be replaced.

3. Remove retaining ring (21), pin (18), springs (16 and 19) and centering plate (17). Pin is a press fit.

4. Remove bolts and washers that secure transmission case to frame.

5. Remove transmission case.

CLEANING AND INSPECTION

Special Tools	Torque Values
HD-37842A Main drive gear bearing and seal installation tool	None

1. Clean all parts in solvent except the case and needle bearings. Blow dry with compressed air.

NOTE

The transmission case and needle bearings must not be cleaned because it is impossible to clean a needle bearing. Normal cleaning methods will wash dirt or other contaminates into the bearing case (behind the needles) and lead to bearing failure.

2. When replacing seals, lightly coat outside diameter of seal with Loctite RETAINING COMPOUND No. 601.

3. Inspect the main drive gear for pitting and wear. Replace if necessary.

4. Replace the sprocket if the teeth are rounded or damaged.

5. Inspect the shifter pawl and centering plate for wear. If pawl ends are damaged or the centering plate is elongated, replace them.

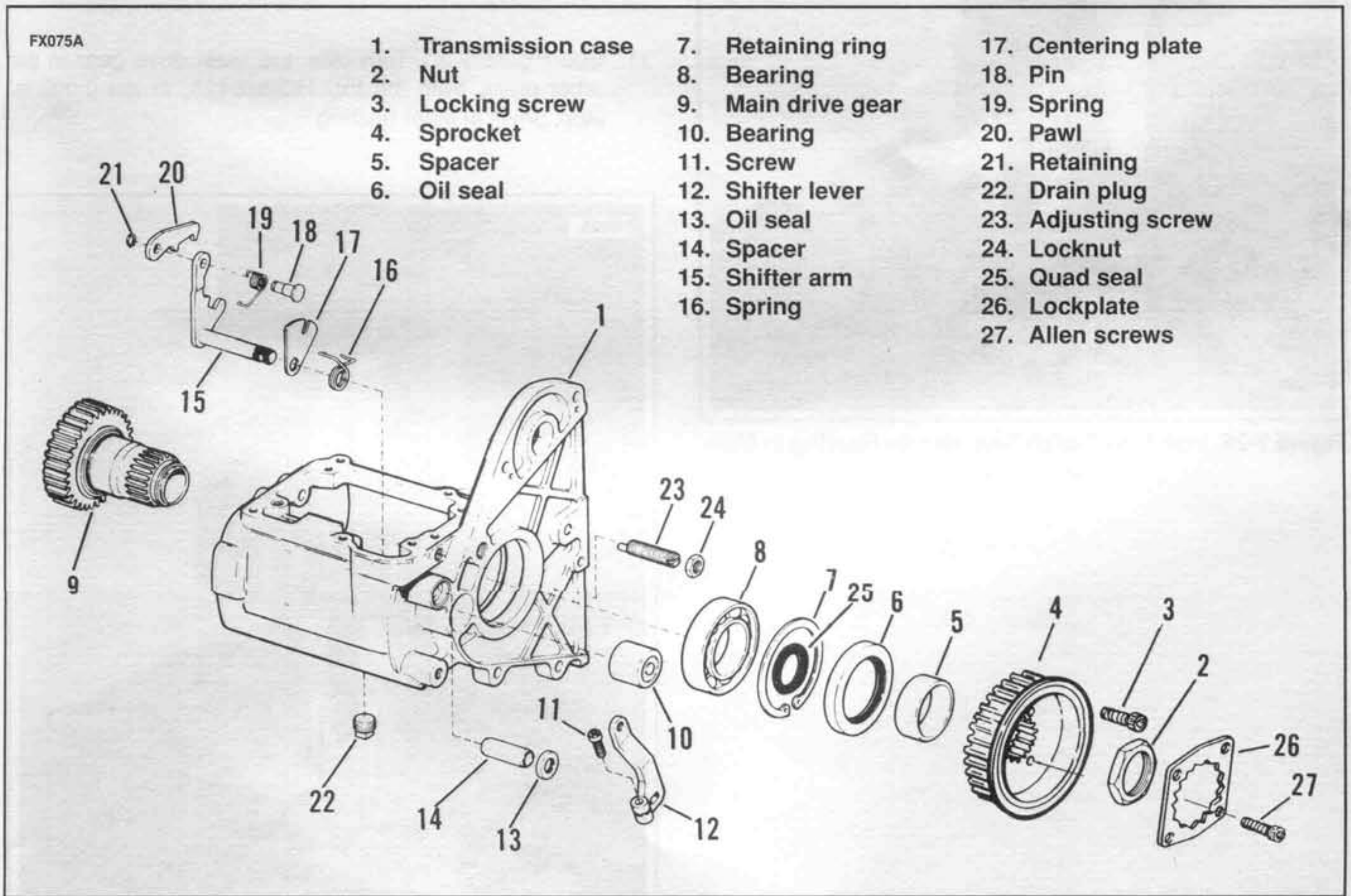


Figure 7-27. Transmission Case, Sprocket and Main Drive Gear

6. See Figure 7-27. Inspect the springs (16 and 19). Replace the pawl spring (19) if it fails to hold the pawl (20) on the cam pin (18).

7. 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, see Steps 8, 9, 10 and 11 below.

8. Remove seal and old needle bearings.

NOTE

To install the inner main drive gear needle bearings and seal, use MAIN DRIVE GEAR BEARING and SEAL INSTALLATION TOOL, Part No. HD-37842A.

9. See Figure 7-28. Install clutch side needle bearing using an arbor press and the 0.315 in. step end of tool HD-37842A as shown. Press until tool is flush.

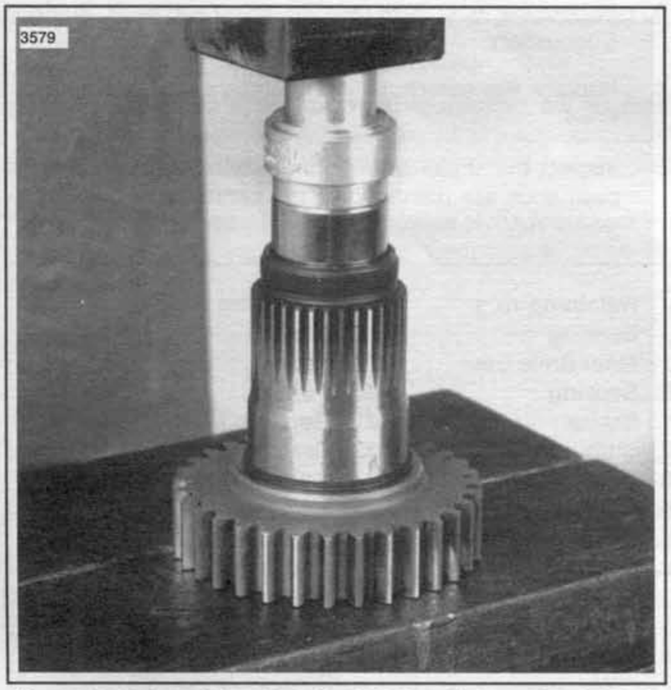


Figure 7-28. Installing Clutch Side Needle Bearing in Main Drive Gear

10. See Figure 7-29. Turn over tool and press in seal using the 0.090 in. step.

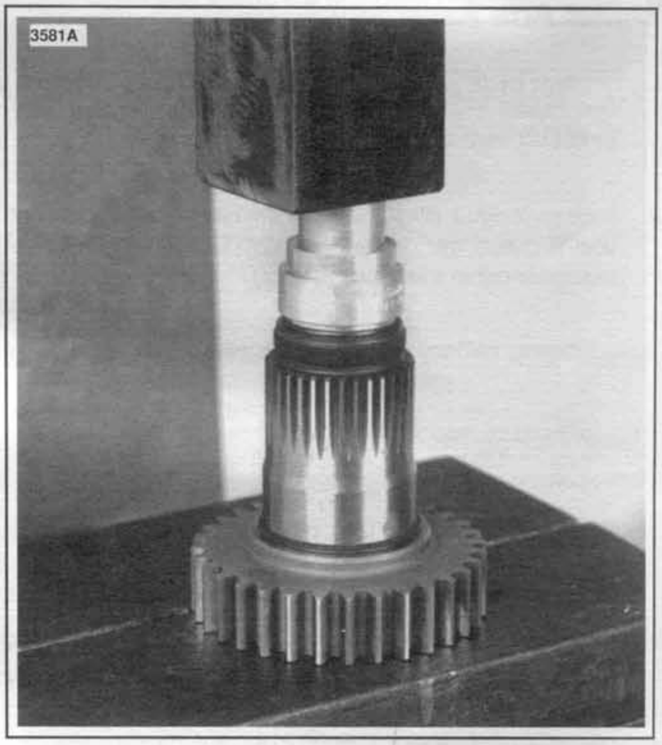


Figure 7-29. Press in Seal

11. See Figure 7-30. Turn over the main drive gear in the arbor press. With the tool HD-37842A, at the 0.090 in. step, press in inner bearing.

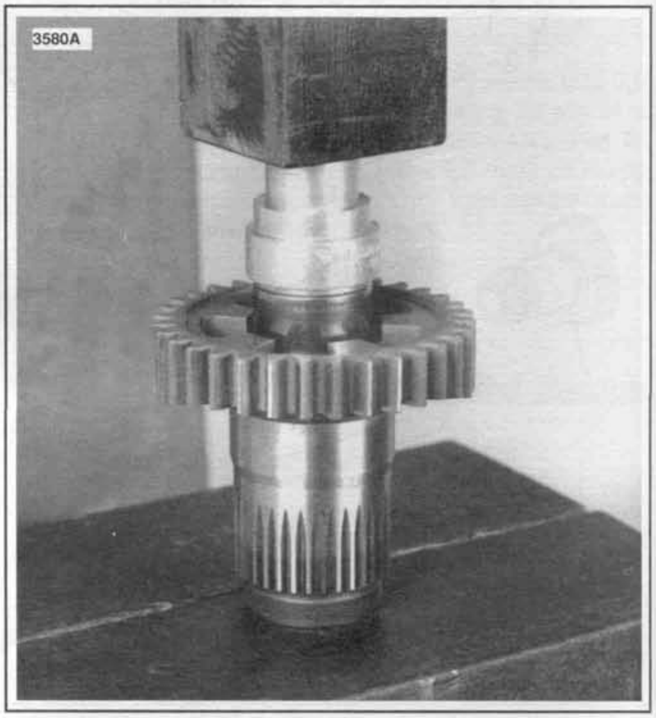


Figure 7-30. Install Transmission Side Needle Bearing in Main Drive Gear

ASSEMBLY

Special Tools	Torque Values
None	Shifter lever screw 18-22 ft-lbs (24-30 Nm)

Shifter Arm Assembly

1. Place the transmission case in the motorcycle and secure it to the frame with the original bolts, washers and nuts. Tighten bolts finger tight for now.
2. See Figures 7-27, 7-31. Place the centering plate (17) on the shaft as shown. Install the springs (16 and 19), pin (18) and retaining ring (21) if disassembled.
3. Insert the assembly into the transmission case with the adjusting screw in the centering plate slot.
4. See Figure 7-27. Install shifter lever (12) on the shaft end and tighten the screw (11) to 18-22 ft-lbs (24-30 Nm) torque. Be sure screw (11) registers in the slot on the shifter arm (15).

NOTE

Adjuster screw also functions as a stop.

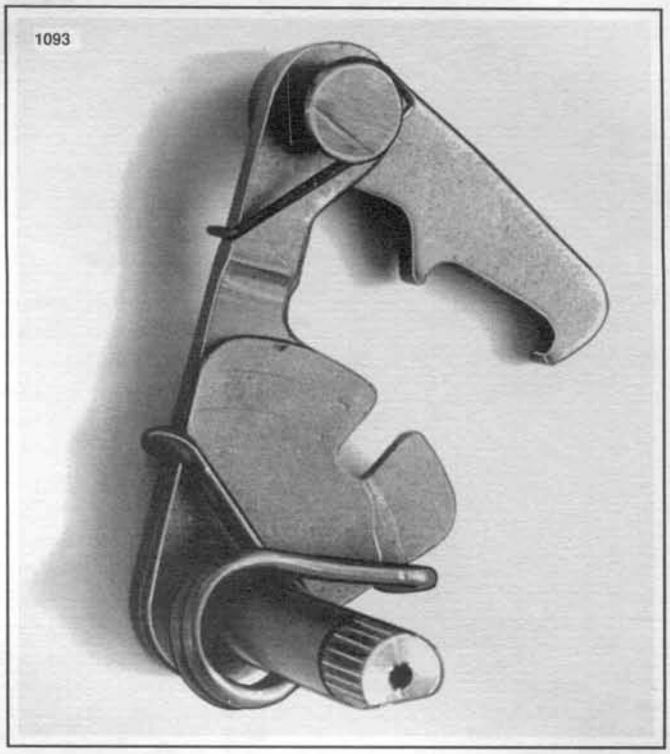


Figure 7-31. Shifter Arm Assembly

SUBJECT	PAGE NO.

ELECTRICAL 8

SPECIFICATIONS

IGNITION

Spark Timing Advance

Range	0°-42.5° BTDC
Start	0° BTDC
Timing Setting (1050-1500 rpm)	20° BTDC

Idle Speed

Idle Speed	1000-1050 rpm

Spark Plugs

Size	14 mm
Gap	0.038-0.043 in. (0.97-1.09 mm)
Type	Harley-Davidson No. 5R6A (No Substitute)

Ignition Coil Resistance

Primary	2.5 to 3.1 ohms
Secondary	10,000 to 12,500 ohms

BATTERY

All	12 volt, 18 amp. hr. Maintenance-free

ALTERNATOR

AC Voltage Output	16-20 VAC per 1000 rpm
Stator Coil Resistance	0.1-0.2 ohms

REGULATOR

Voltage output @ 3600 rpm	14.3–14.7 @ 75° F (24° C)
Amperes @ 3600 rpm	32 amps

CIRCUIT BREAKERS

CIRCUIT	CIRCUIT BREAKER RATING (Amperes)
Main	30
Ignition	15
Lights	15
Accessory	15
Instruments	15

TORQUE VALUES

Neutral Switch (1997 Models)	3-5 ft-lbs (4-7 Nm)
Neutral Switch (1998 Models)	10-15 ft-lbs (13.6-20.3 Nm)
Sensor Plate Screws	15-30 **in-lbs** (1.7-3.4 Nm)
Inner Timer Cover Screws	12-20 **in-lbs** (1.4-2.3 Nm)
Rotor Bolt	75-80 **in-lbs** (8.5-9.0 Nm)
Alternator Stator Torx Screws	30-40 **in-lbs** (3.5-4.5 Nm)
Alternator Sprocket Nut	150-165 ft-lbs (203-224 Nm)
Battery Terminal Bolts	40 **in-lbs** (4.5 Nm)
Headlamp Adjustment Screws (FXSTS, FXSTSB, FLSTS)	30 ft-lbs (41 Nm)
Passing Lamp & Bracket Nuts (FLSTC)	18 ft-lbs (24 Nm)
Turn Signal Module Bolt	10 **in-lbs** (1.1 Nm)
Horn Cover Screws (FLSTS)	23-28 **in-lbs** (2.6-3.1 Nm)
Horn Nut (All except FLSTS)	110 **in-lbs** (12.4 Nm)
Speed Sensor Mounting Screw	7-9 ft-lbs (9.5-12 Nm)
Handlebar Clamp-Master Cylinder Torx Screws	60-80 **in-lbs** (6.8-9.0 Nm)
Upper and Lower Switch Housing Torx Screws	35-45 **in-lbs** (3.9-5.1 Nm)
Handlebar Clamp-Clutch Lever Bracket Torx Screws	60-80 **in-lbs** (6.8-9.0 Nm)

BULB CHARTS

The bulb charts below give the location and bulb requirements for Harley-Davidson Softail motorcycles.

1997 and 1998 Softail Models

LAMP DESCRIPTION (ALL LAMPS 12 V)	NUMBER OF BULBS REQUIRED	CURRENT DRAW (Amperage)	HARLEY-DAVIDSON PART NUMBER
Headlamp			
FLSTC, FLSTF	1	4.7/4.3	67713-86
FXSTC, FXSTS, FXSTSB, FLSTS	1	4.7/4.3	67697-81
or HDI FLSTC, FLSTF Position lamp (HDI)	1	0.32	53438-92
Tail and Stop Lamp			
Tail Lamp	1	0.59	68168-89
Stop Lamp	1	2.25	
Tail Lamp (HDI)	1	.42	68169-90
Stop Lamp (HDI)	1	1.75	
Instrument Lamps			
High Beam Indicator	1	0.15	68024-94
Oil Pressure Signal	1	0.15	68024-94
Neutral Indicator	1	0.15	68462-64
Turn Signal Indicator	2	0.15	68462-64
Speedometer Light	1	0.3	53439-79
Odometer Light	1	.19	67136-85
Turn Signal Lamps			
Front/Running	2	2.25/0.59	68168-89
Front (HDI)	2	1.75	68163-84
Rear	2	2.10	68572-64B
Rear (HDI)	2	1.75	68163-84
Fender Tip Lamps – FLSTC (DOM)	2	1.0	53439-79
Passing Lamps –FLSTC, FLSTS			
(**1997/1998** DOM, **1997** HDI)	2	2.5	68674-69
(**1998** HDI)	2	2.92	68847-98
License Plate Lamp			
FLSTS	1	0.35	52441-95
FLSTS (HDI)	1	0.37	53436-97
Front Fender Lamp			
FLSTS	1	0.35	52441-95

IGNITION SYSTEM

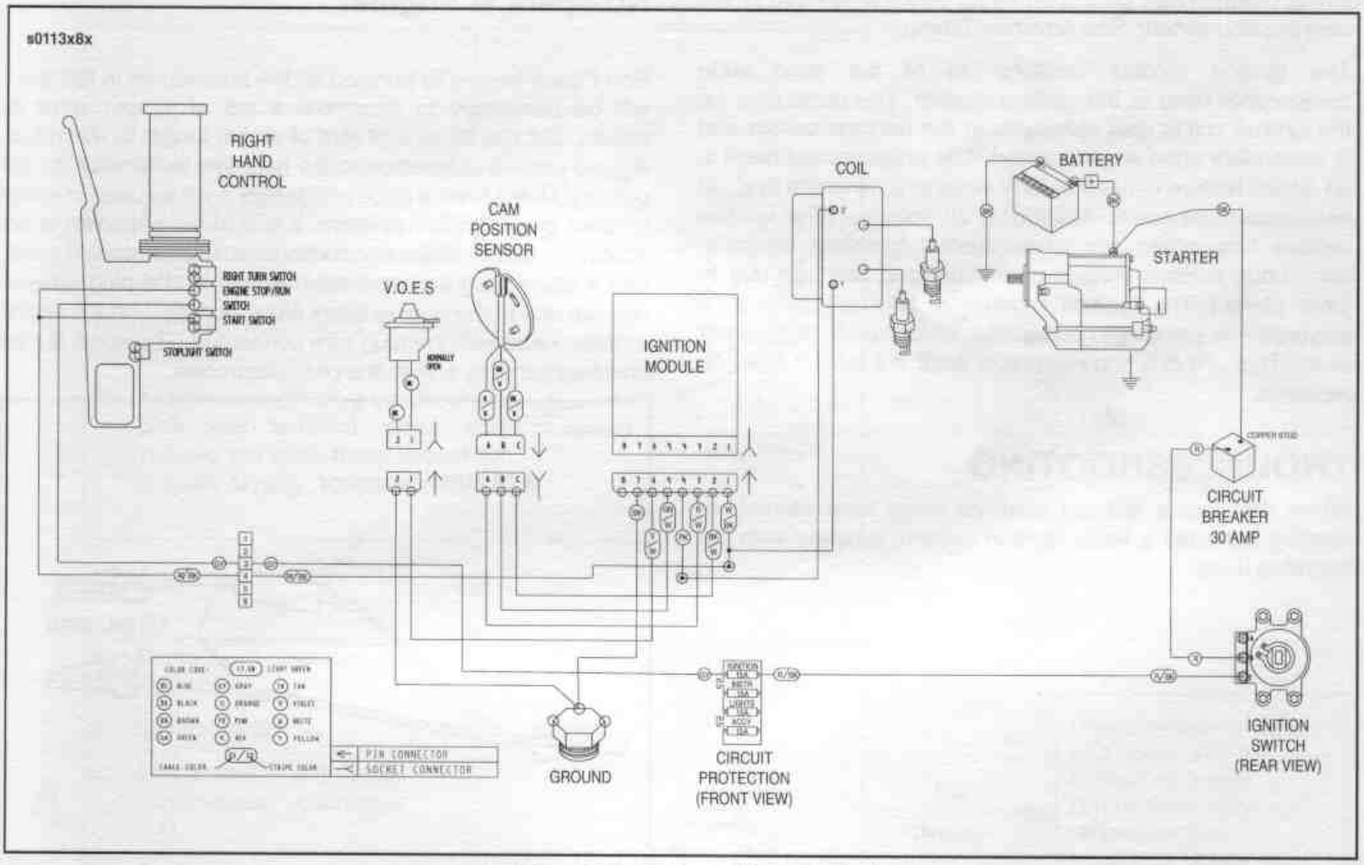
GENERAL

The ignition system is a breakerless inductive discharge ignition system. It has two circuits, the primary circuit and the secondary circuit. The primary circuit consists of the battery, ignition switch, primary coil winding, computerized ignition timer and associated wiring. The secondary circuit consists of the secondary coil, the spark plugs and associated wiring.

The computerized ignition system consists of three components, the rotor and cam position sensor, the computerized ignition module, and the vacuum operated electric switch (V.O.E.S.). The rotor and cam position sensor are located in the cam gearcase cover on the right side of the motorcycle. The ignition module is mounted above the oil tank, on a frame member. The ignition module has two functions. First, it computes the spark advance for proper ignition firing. Second, it opens and closes the low voltage circuits between the battery and ignition coil to produce high voltage discharge to the spark plugs.

The vacuum operated electric switch (V.O.E.S.) senses intake manifold vacuum through an opening in the carburetor body. The V.O.E.S. is connected to the carburetor with a vacuum hose. The switch is open under acceleration and high engine load conditions (low vacuum) and closed under low engine load conditions (high vacuum).

The ignition module is programmed with two spark advance curves to meet varying engine loads. The high vacuum curve selected for maximum spark advance under normal light load cruising conditions provides improved fuel economy and performance. The low vacuum curve (retarded spark) minimizes spark knock, while maintaining performance, under high load conditions (acceleration and highway driving). This system ensures correct timing to suit starting, low and high speed requirements.



Ignition System Circuit (simplified)

A single ignition coil fires both spark plugs at the same time, but one spark occurs with no effect during a noncompression stroke of one cylinder, while the other spark fires the combustible gasses in the other cylinder to produce the power stroke.

The rotor is bolted on to the camshaft and operates at one-half crankshaft speed. As the rotor turns, slots in its external edge break the magnetic field of a Hall-effect device mounted on the cam position sensor. The output of the Hall-effect device is a logic-type signal that corresponds to the timing information from the spinning rotor. This technique gives accurate timing information down to "0" speed.

A vehicle attitude sensor is also provided at this location. The sensor consists of a magnetic disc that rides in a V-shaped channel filled with fluid. If the vehicle is inclined at an angle that equals, or is less than, 10° from the pavement, the disc moves up the channel to create an open circuit within the CMP sensor. The open circuit is immediately detected by the ignition module, which shuts off the ignition system. Once the sensor is tripped, the motorcycle must be uprighted before the engine can be restarted.

The ignition system gives a spark near top dead center for starting. At rpms and loads above this, the system gives a spark advance that varies between 0° and 42.5°. The whole timing program can be shifted by mechanical rotation of the cam position sensor. See Advance Timing.

The ignition module contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon engine speed. The programmed dwell is an added feature to keep battery drain to a minimum and yet gives adequate spark duration at all speeds. (The ignition module has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ignition module is fully enclosed in a polyurethane material to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

TROUBLESHOOTING

When the engine will not start, or when hard starting or missing indicates a faulty ignition system, proceed with the following tests.

Check for Engine Spark

1. Disconnect spark plug cables from spark plugs. Check condition of plugs and cables. Clean or replace as necessary.

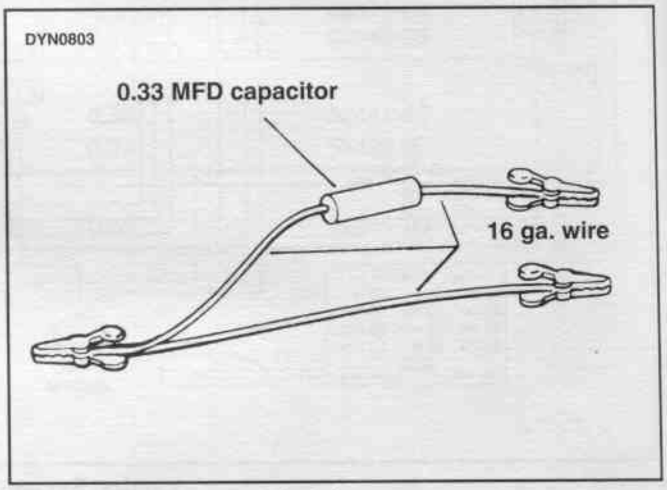
2. Insert a conductive adapter into spark plug cable nipple and establish a 3/16 in. (4.8 mm) gap between adapter and cylinder head. Turn on ignition and engine stop switches. Crank engine. Check to see if there is a spark across the gap. If there is a spark, the problem is not in the electronic system or coil. Check carburetion, choke and spark plugs.

3. If there is no spark, check battery voltage and battery connection condition.

4. Check to be sure that ignition module ground (black lead) is securely fastened to the frame and that the ground wire from the battery to the frame is in good condition. If there is still no spark at engine proceed to the tests under No Spark at Engine.

No Spark at Engine

See Figure below. To conduct all the procedures in this test it will be necessary to assemble a set of jumper wires as shown. Cut two lengths of wire of ample length to reach from a good ground connection to the negative terminal of the coil primary. Use a known good condenser such as used in earlier breaker point ignition systems if a suitable capacitor is not readily available. When conducting spark tests steps 3 and 5, use a spare plug and connect it to one of the plug wires or remove one of the engine spark plugs and lay it on the engine cylinder head with the plug wire connected. The spark is then checked jumping across the plug electrodes.



Test Jumper

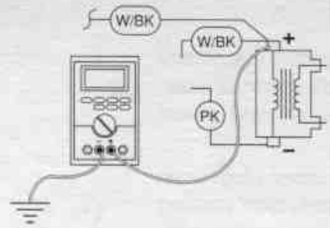
CONTINUOUS OR NO SPARK AT SPARK PLUG

1

A. Ignition switch on.

B. Multimeter red wire to white/black wire terminal, black wire to ground.

C. Meter should register 12V ± one volt.



No Power → Check Circuit breaker, loose wires, switches.

5040

Yes ↓

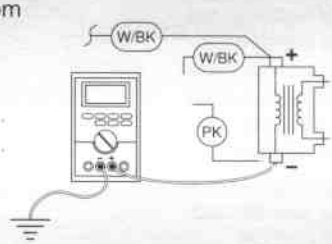
2

A. Remove pink (module) wire from coil terminal.

B. Ignition switch on.

C. Multimeter red wire alternately white/black wire terminal and pink wire terminal.

D. Meter should register 12V ± one volt at both terminals



No Power → Replace coil.

5010

Yes ↓

3

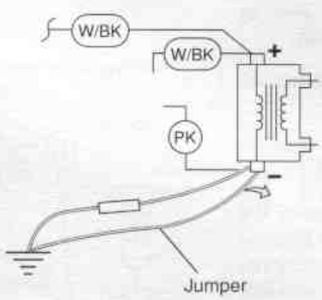
A. Pink (module) wire disconnected.

B. Ignition switch on.

C. Jumper wire – connect capacitor wire to pink wire terminal.

D Connect both wires to common ground.

E. Momentarily touch ground wire to pink wire terminal. When you remove the wire, there should be a spark at plug.



No Spark → Replace coil.

5012

Yes ↓

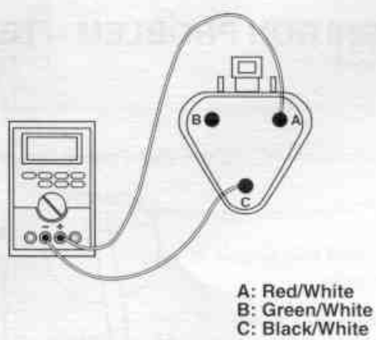
4

A. Reconnect pink wire to coil.

B. Ignition switch on.

C. Disconnect cam position sensor connector [14].

D. Connector from module-multimeter red wire to red/white wire socket and multimeter black wire to black/white socket. Should register 12V ± one volt.



No Power → Check module ground and power wire to module for loose connections. (See resistance test, following.) Check spark, step 5.

5040

Yes ↓

⚠CAUTION

Do not leave screwdriver across connector pins for more than 2 seconds or damage will result.

5

A. Test cam position sensor as follows: Remove secondary lock. Turn ignition on and momentarily (2 seconds maximum) place screwdriver across black/white and green/white connector pins.

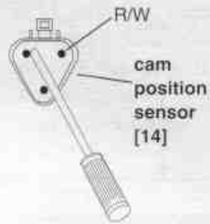
B. Look for strong evidence of spark at spark plug when screwdriver is removed. If there is a spark, cam position sensor is suspect. Install known, good cam position sensor and test again.

The cam position sensor can also be diagnosed using the Speedometer Tester, HD-41354, as follows:

Install test harness* between connectors [14A & B]. Turn tester power switch to ON, and place signal switch to the IN position. Plug tester into the test harness and turn ignition on. Press ENTER on keypad. Press motorcycle starter button. If no numbers register on the tester when starter button is pressed, cam position sensor is suspect. Install known, good cam position sensor and test again.

**For more information on the Speedometer Tester, including instructions on fabricating test harness, see SPEEDOMETER/TACHOMETER PERFORMANCE CHECK.*

① *On tachometer-equipped models, disconnect tachometer while performing resistance test. If spark is present, replace tachometer (Code 6009).*



No Spark

① Check module resistance. See Ignition Module Harness Resistance Test. Replace module if resistance is bad.

No

Recheck Connections

5040

Yes

Replace Ignition Module

5365

INTERMITTENT IGNITION PROBLEM – VIBRATION

A. Check battery connections. Disconnect module ground (scrape black paint, add star washer).

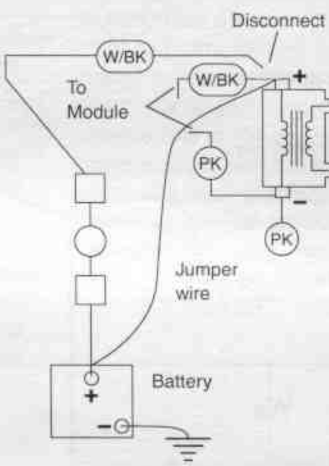
B. Disconnect white wire at coil terminal (not module feed).

C. Connect 16 ga. jumper wire from battery positive terminal to white/black wire terminal of coil.

D. Operate vehicle to see if problem is eliminated. If it is, wiggle wires and use voltage drop tests to identify broken primary circuit wires, poor connections, or defective switches or circuit breakers. If problem is not eliminated, look for broken wires or poor connections on ignition module and cam position sensor wiring.

NOTE

Vehicle no longer has an engine stop switch. Engine must be stopped by removing jumper wire.



Yes

Problem is vibration, possibly loose connection at safety switches in ignition circuit.

5040

INTERMITTENT IGNITION PROBLEM – TEMPERATURE

A. Remove outer timing cover.

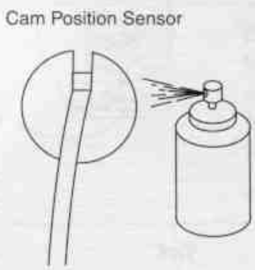
B. Remove inner timing cover and gasket.

C. Start-up vehicle.

D. Spray front of cam position sensor with coolant (obtainable at electronic supply houses) to see if engine stalls.

E. With engine hot, at operating temperature and cover off, apply heat (blow dryer) to front of cam position sensor and see if engine stalls.

F. Apply heat to module (blow dryer) and see if engine stalls.



Yes

Problem is temperature sensitive cam position sensor or ignition module. Replace sensor or ignition module.

5014

Resistance Test

⚠CAUTION

If a resistance test is performed on a "live" circuit, the multimeter will be damaged. Turn off the ignition and disconnect the battery before conducting a resistance test.

IGNITION RESISTANCE TEST

IGNITION MODULE

TEST	METER SETTING	PROBE 1	PROBE 2	METER READING
Check for grounds	RX1	To black/white harness	To chassis ground	Module: **0-1 ohm** – Good; **More than 1 ohm** – Check harness for opens. See next page. If harness is good, replace ignition module.

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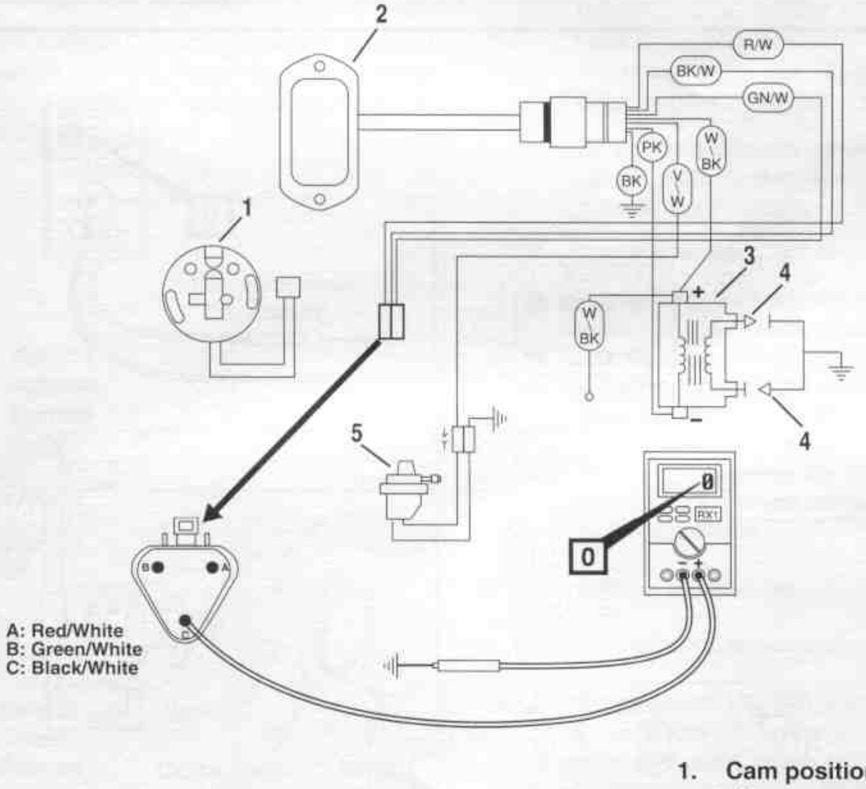


NOTE

Simplified wiring diagram shown. Refer to WIRING DIAGRAM for more detail.

1. **Cam position sensor and 3-pin plug**
2. **Ignition module**
3. **Ignition coil**
4. **Spark plugs**
5. **Vacuum operated electric switch (V.O.E.S.)**

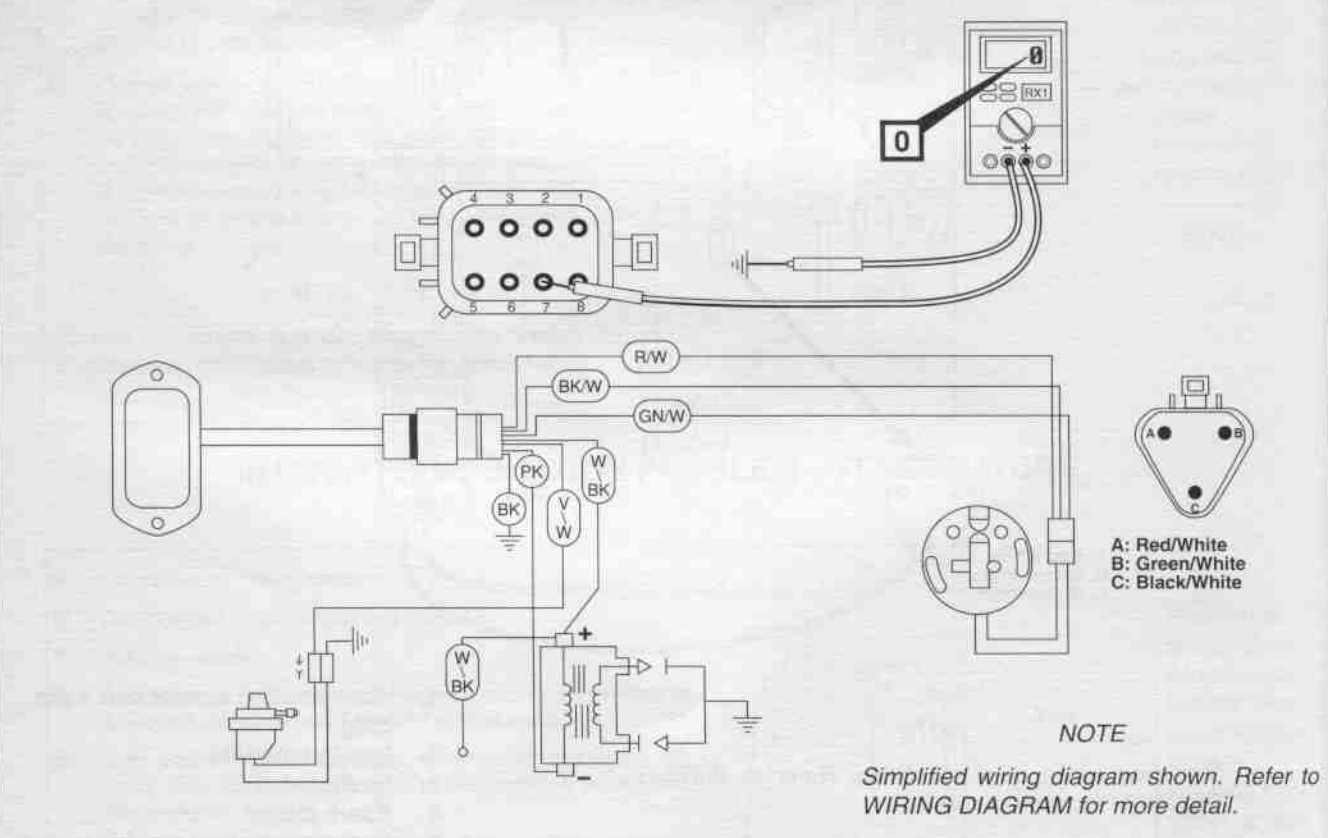
IGNITION RESISTANCE TEST

IGNITION MODULE HARNESS

TEST CONDITIONS: **Engine Stop switch on right handlebar must be in "OFF" position, and 8-place, and cam position sensor 3-place, connectors must be unplugged for these tests. Shake or wiggle the harness to detect any breaks in the wiring.**

TEST	METER SETTING	PROBE 1	PROBE 2	METER READING
Check for grounds	RX1	To pin 7 in 7 pin connector	To chassis ground	Harness: 0-1 ohm → Good; More than 1 ohm → Repair/clean ground connection.
Check for grounds	RX1	All pin terminals except pin 7	To chassis ground	Harness: Infinity → Good; Any resistance → Locate and repair short to ground.
Continuity	RX1	All pin terminals except pin 7	Opposite end of each of the 6 leads (refer to WIRING DIAGRAM)	Harness: 0-1 ohm → Good; More than 1 ohm → Repair broken wire or loose/dirty connection.

DYN0808p



NOTE

Simplified wiring diagram shown. Refer to WIRING DIAGRAM for more detail.

IGNITION TIMING

After cam position sensor replacement, perform the steps under STATIC TIMING before proceeding to the dynamic timing procedure on page 8-10. The static timing procedure is a coarse ignition timing adjustment, while dynamic timing constitutes a fine adjustment.

STATIC TIMING

Vehicle Attitude Sensor Test

1. Locate outer timer cover at bottom of gearcase cover on right side of vehicle. See Figure 8-1.

⚠WARNING

Always wear proper eye protection when drilling. Flying debris may result in eye injury.

2. Drill off heads of outer timer cover rivets using a 3/8-inch (9.525 mm) drill bit. Use a punch to tap rivet shafts inboard through holes in outer timer cover. Remove outer timer cover.

3. Remove two Phillips screws to free inner timer cover. If necessary, tap remaining rivet shafts through holes in inner timer cover.

4. Carefully check the gearcase cover timer bore for any rivet fragments.

5. Push sensor cable 3-place Deutsch connector rearward to unsnap attachment clip from T-stud. Depress external latch on socket housing side and use a rocking motion to separate pin and socket halves.

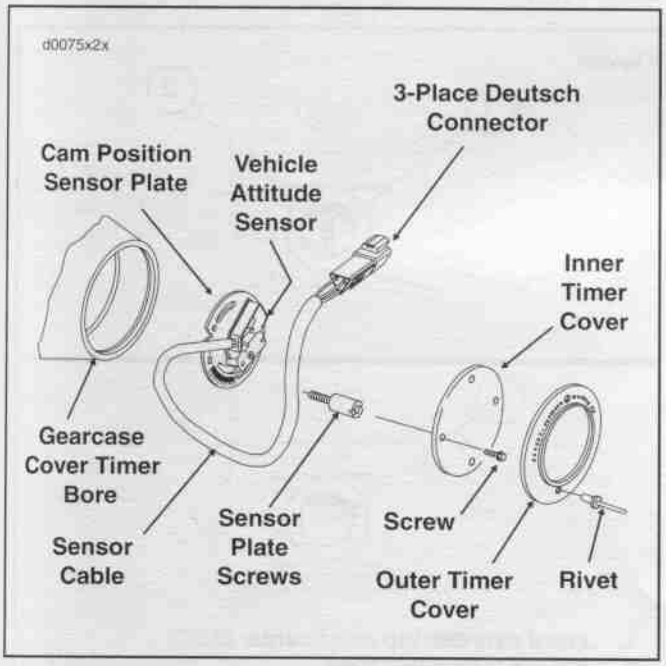


Figure 8-1. Camshaft Position Sensor Plate Assembly (Right Side View)

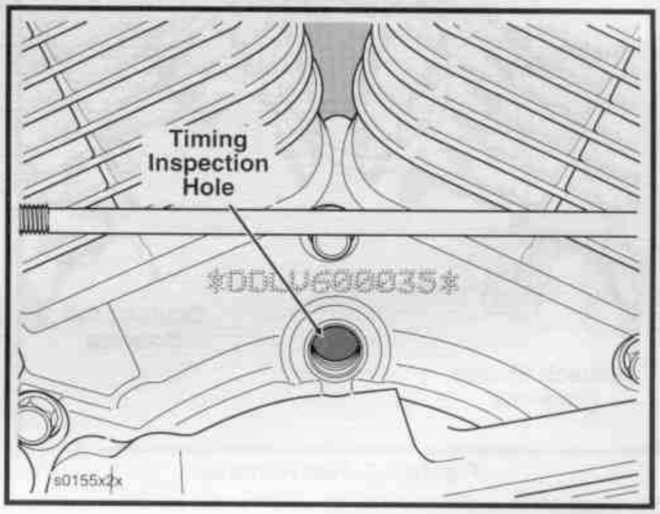


Figure 8-2. Remove Plug From Timing Inspection Hole (Left Side View)

6. Since removal of the cam position sensor plate is required to perform the Static Timing procedure, use this opportunity to do the **Vehicle Attitude Sensor Test**. Proceed as follows:

   a. Connect test harness (fabricated for use with the Speedometer Tester) between pin and socket halves of Cam position sensor connector [14]. See Figure 8-3.

   b. Using black pin probes and patch cords from Harness Connector Test Kit (HD-41404), connect voltmeter between GN (+) and BK/W (-) wires on remaining 3-way socket of test harness.

   c. Scribe cam position sensor plate at cam position sensor plate screws. Remove cam position sensor plate screws.

   d. Turn the Ignition/Light Key Switch to IGNITION.

   e. Voltmeter should register 5 VDC (+/- 0.5 volts) with plate in vertical position, and after a delay of approximately 2 seconds, 7-9 VDC with plate in horizontal position. Replace the cam position sensor plate if these results are not obtained.

7. See Figure 8-2. Remove the timing plug from the timing inspection hole centered below the cylinders on the left side of the crankcase.

8. Remove the spark plugs.

9. Jack up vehicle to allow rotation of the rear wheel.

10. Shift transmission into fifth gear, and standing on left side of vehicle, slowly rotate rear wheel in a counter-clockwise direction until front intake valve opens and closes (as viewed through spark plug holes).

11. Rotate rear wheel until TDC mark (vertical line) is centered in timing inspection hole. See upper frame of Figure 8-4.

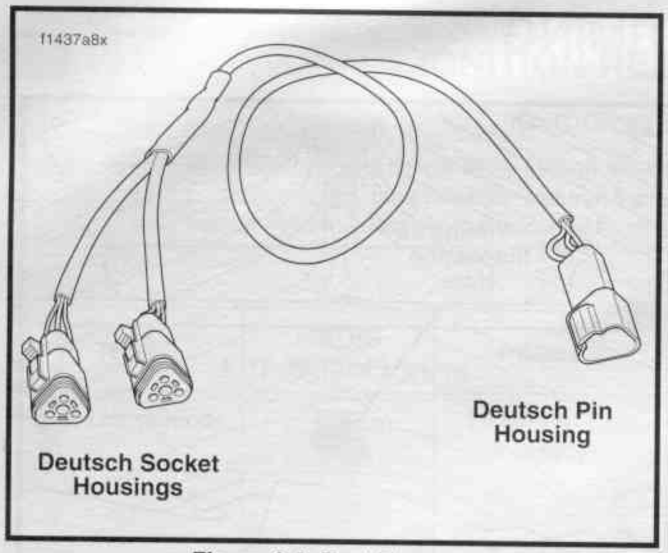


Figure 8-3. Test Harness

12. If not already performed under Vehicle Attitude Sensor Test, move to right side of vehicle and connect test harness (fabricated for use with the Speedometer Tester) between pin and socket halves of Cam position sensor connector [14]. See Figure 8-3. Using black pin probes and patch cords from Harness Connector Test Kit (HD-41404), connect voltmeter between GN (+) and BK/W (-) wires on remaining 3-way socket of test harness.
13. Turn the Ignition/Light Key Switch to IGNITION.
14. Loosen two screws and rotate the cam position sensor plate just until the voltmeter registers the change from 5 VDC (+/- 0.5 volts) to 0-1.0 VDC.
15. Tighten sensor plate screws to 15-30 **in-lbs** (1.7-3.4 Nm).
16. Install spark plugs, shift transmission into Neutral and remove jack.
17. Remove test harness and mate pin and socket halves of Cam position sensor connector [14]. Place large end of slot on attachment clip over T-stud. Push connector assembly forward to engage small end of slot.
18. Proceed to DYNAMIC TIMING. Begin at step 2.

DYNAMIC TIMING

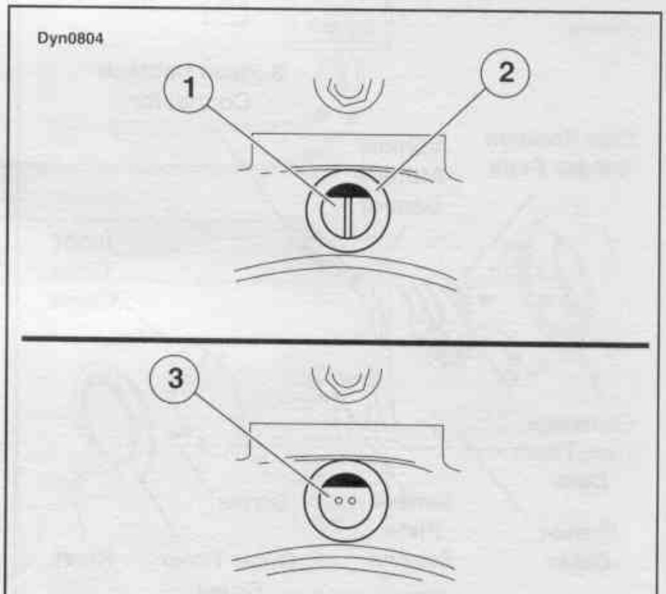
Check the ignition timing every 5000 miles (8000 km).

1. See Figure 8-2. Remove the timing plug from the timing inspection hole centered below the cylinders on the left side of the crankcase.
2. Install the TIMING MARK VIEW PLUG (Part No. HD-96295-65D) in the inspection hole. Make sure that the view plug does not touch the flywheel.
3. Connect the leads of the INDUCTIVE TIMING LIGHT (Part No. HD-33813) to the front spark plug cable, battery positive (+) terminal and a suitable ground.

⚠CAUTION

When checking advance timing, always check V.O.E.S. operation. Failure to do so may result in running engine with too much spark advance, and may cause extreme engine knock and engine failure

4. Verify that the vacuum hose is properly installed at the carburetor and the vacuum-operated electric switch (V.O.E.S.).
5. Start engine and set engine speed at 1050-1500 rpm.
6. Aim the timing light into timing inspection hole. Light will flash each time spark occurs. If the ignition is properly adjusted, the front cylinder advance timing mark will be centered in the timing inspection hole.
7. If timing mark is centered in the inspection hole, proceed to step 8. If the mark is not centered or visible in the timing inspection hole, proceed as follows:
   a. Remove outer cover rivets, outer cover, inner cover screws, inner cover and gasket. See STATIC TIMING, steps 1-5.
   b. Loosen cam position sensor screws just enough so that plate can be rotated using a screwdriver in the notch.
   c. With timing light aimed into inspection hole, rotate the cam position sensor plate until the front cylinder advance timing mark is in the center of the inspection hole.
   d. Tighten cam position sensor plate screws to 15-30 **in-lbs** (1.7-3.4 Nm).
   e. Install inner timer cover in bore using two Phillips screws. Tighten screws to 12-20 **in-lbs** (1.4-2.3 Nm).



1. **Front cylinder top dead center (TDC)**
2. **Timing inspection hole**
3. **Front cylinder advance timing mark**

Figure 8-4. Ignition Timing Mark

⚠CAUTION

Use only special rivets (HD-8699) to secure outer timer cover. The rivets are designed so that no rivet end falls off into the timing compartment. Use of regular rivets can damage ignition system components and may allow water to enter the timing compartment.

g. Secure outer timer cover to inner cover using **new** rivets.

8. Remove the TIMING MARK VIEW PLUG from the timing inspection hole and install the hex socket timing plug.

Timing Setting

1050-1500 rpm . . . . .20°BTDC

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

TESTING

Special Tools	Torque Values
Ohmmeter HD-23738 Vacuum pump	None

OPERATION CHECK

After engine has been timed with a strobe light, perform the following check:

With the engine idling, remove vacuum hose from carburetor and momentarily plug carburetor fitting. Timing will retard and engine speed should decrease. Reinstall vacuum hose to carburetor. Timing mark should reappear and engine speed should increase to preset speed.

If speed does not decrease and increase as described, check V.O.E.S. connection directly above switch. Use labor code 5040. No problem found, go to INSPECTON.

INSPECTION

1. Remove seat. See Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables, (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. Disconnect battery cables, negative cable first.
3. Remove horn.
4. Disconnect V.O.E.S. 2-place Deutsch connector located directly above switch.
5. Connect ohmmeter across two V.O.E.S. wires. Ohmmeter should indicate an open circuit (∞ ohms).
6. Attach hose of VACUUM PUMP, Part No. HD-23738, to V.O.E.S.
7. Slowly squeeze vacuum pump handle and observe vacuum gauge and ohmmeter.
8. The ohmmeter should indicate switch closure (less than one ohm) at 3.5-4.5 in. (89-114 mm) of mercury. Yes, go to step 10. No, go to step 9.
9. Closure at vacuum readings other than those listed above require V.O.E.S. replacement.
10. Check continuity on V/W and BK wires. No, repair (use labor code 5006). Yes, go to step 11.
11. Inspect vacuum lines and fittings for cracks and leaks. Repair if damaged - use labor code 5385. If OK go to step 12.
12. Replace ignition module. Use labor code 5009.

REMOVAL

1. Perform steps 1 through 4 in INSPECTION above.
2. Remove V.O.E.S. by using a pick to bend up tabs on circular retaining clip, then tap V.O.E.S. free from clip and mounting bracket.
3. Refer to the latest Harley-Davidson Parts Catalog for replacement V.O.E.S. part number.

INSTALLATION

1. Install new V.O.E.S. with new clip.
2. Connect 2-place Deutsch connector located directly above switch.
3. Install horn.
4. Connect battery, positive cable first.
5. Install seat.

d0065a8x

1. Outer cover rivet (2)
2. Outer cover
3. Inner cover screw (2)
4. Inner cover
5. Retaining ring
6. Sensor plate screw (2)
7. Cam position sensor
8. Rotor bolt
9. Rotor
10. Camshaft oil seal
11. Connector
12. Ignition module
13. Ignition coil
14. Spark plug cable (2)
15. Ignition coil terminal nut (2)
16. Vacuum operated electric switch
17. Ignition module connector

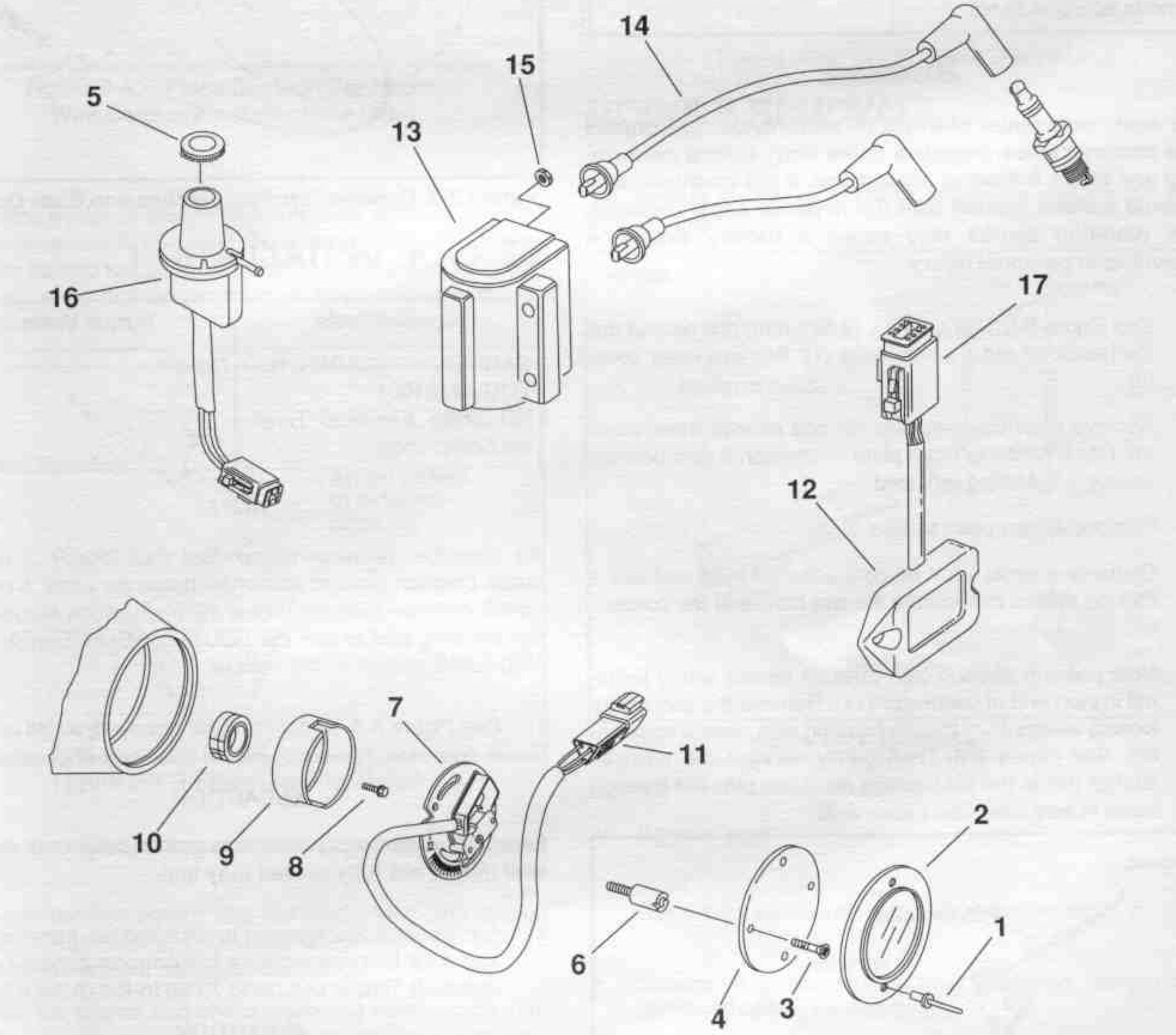


Figure 8-5. Ignition Components

IGNITION MODULE AND CAM POSITION SENSOR

SENSOR REMOVAL

Special Tools	Torque Values
CANNON CONNECTOR TOOL #201051 (Pico Corp., 444 Constitution Ave., Camarillo, CA, 93012; phone 805-388-5510)	None

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first), before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

1. See Figure 8-5. Use a 3/8 in. (9.525 mm) drill bit and drill the heads off outer cover rivets (1). Remove outer cover (2).
2. Remove inner cover screws (3) and remove inner cover (4). Use a scribe to mark plate orientation if cam position sensor is not being replaced.
3. Remove sensor plate screws (6).
4. Depress external latch on connector housing and use a rocking motion to separate the two halves of the connector.
5. Note position of each cam position sensor wiring terminal in plug end of connector (11). Remove the secondary locking wedge from the pin housing with needle nose pliers. See Figure 8-6. Then gently depress the terminal latches inside the pin housing and back pins out through holes in wire seal. See Figure 8-7.

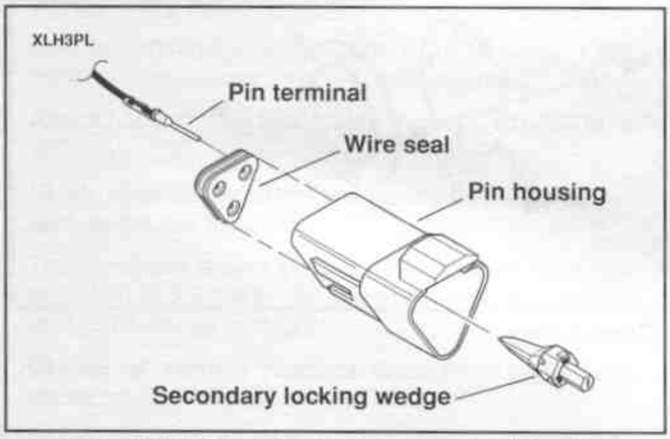


Figure 8-6. 3-Place Deutsch Connector (Pin Side)

6. Pull wires through gearcase hole one at a time.
7. Remove rotor screw (8) and rotor (9).
8. Seal (10), if damaged, can be pried out from ignition side of gearcase. Use care not to damage camshaft end and/or gear cover while prying.

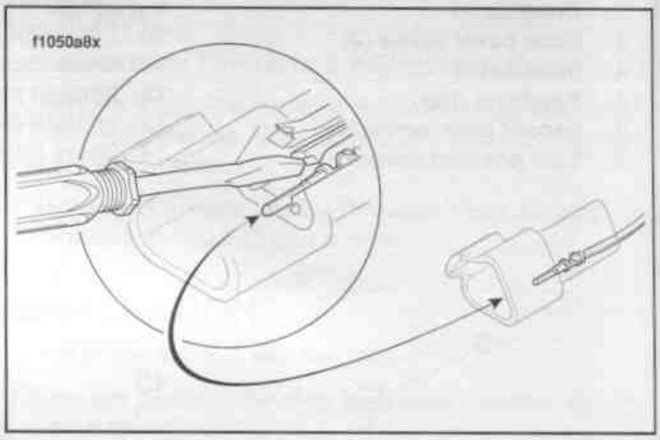


Figure 8-7. Depress Terminal Latches and Back Out Pins

SENSOR INSTALLATION

Special Tools	Torque Values
CANNON CONNECTOR TOOL #201051 HD-39965 Electrical Terminal Crimp Tool	None

NOTE

An Electrical Terminal Crimp Tool (HD-39965) is used to install Deutsch pin and socket terminals on wires. If new terminals must be installed, follow the instructions included with the crimping tool or see the DEUTSCH ELECTRICAL CONNECTORS section in this manual.

1. See Figure 8-5. If seal (10) was removed, install new seal in gearcase, lip side of seal to gear side of gearcase.

⚠CAUTION

Seal (10) must be pressed into gearcase until it stops. A seal that is not fully seated may leak.

2. Apply Loctite 222 (purple) to rotor bolt (8). Install rotor (9) with rotor bolt making sure tab on rotor engages slot in camshaft. Torque bolt (8) to 75-80 **in-lbs** (8.5-9.0 Nm).

⚠CAUTION

Use caution to avoid chafing sensor wires. Chafed insulation may cause intermittent grounding of the sensor wires resulting in engine misfire under load.

3. Install cam position sensor (7) with screws (6). Leave screws loose.
4. Insert cam position sensor wiring terminals in correct positions in connector (11) plug end. Fit wire seal into back of pin housing, if removed. Grasp crimped pin approximately 1 inch behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered chambers. See Figure 8-8 for wire color locations. Feed pin into chamber until it "clicks" in place. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place.

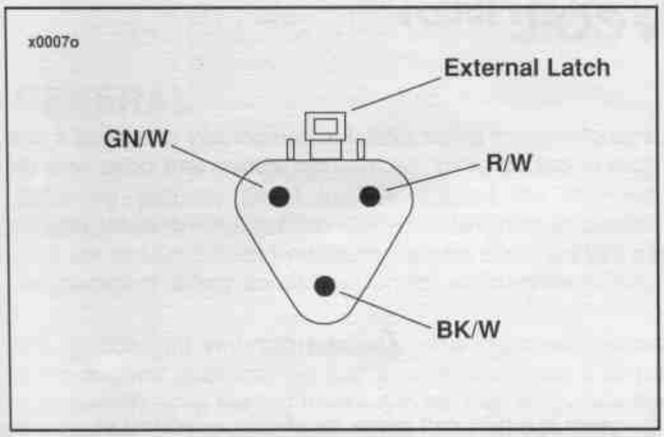


Figure 8-8. 3-Place Deutsch Connector Wire Colors (Pin Receptacle Side)

NOTE

The locking wedge of the 3-Place connector must be installed with the arrow pointing toward the external latch. See Figure 8-9. If the locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing.

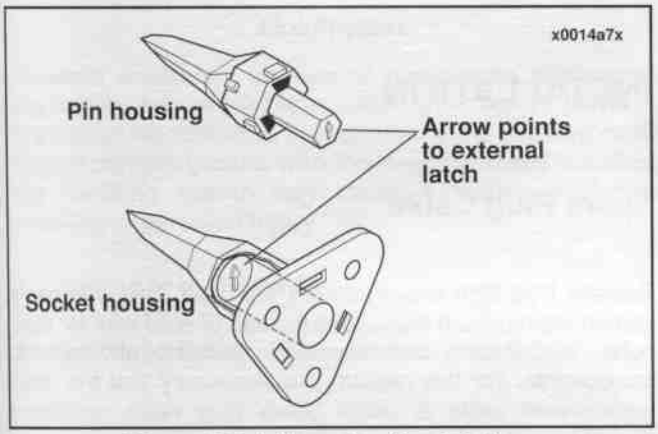


Figure 8-9. 3-Place Locking Wedge

5. See Figure 8-5. Connect cam position sensor connector (11).
6. If cam position sensor was replaced, static time ignition (see Static Timing, page 8-9). Otherwise align scribed marks on original cam position sensor.
7. Start the engine and check advanced timing under running conditions as described in previous sections. Tighten screws to 15-30 **in-lbs** (1.7-3.4 Nm).
8. Install inner cover (4) with screws (3).
9. Rivet outer cover (2) to inner cover (4) with rivets (1).

⚠CAUTION

See Figure 8-10. Use only H.D. rivets, Part No. 8699, to secure outer cover. Timing cover rivets are specially designed so there is no rivet end to fall off into timing compartment as with regular rivets. Use of regular rivets could cause damage to ignition components.

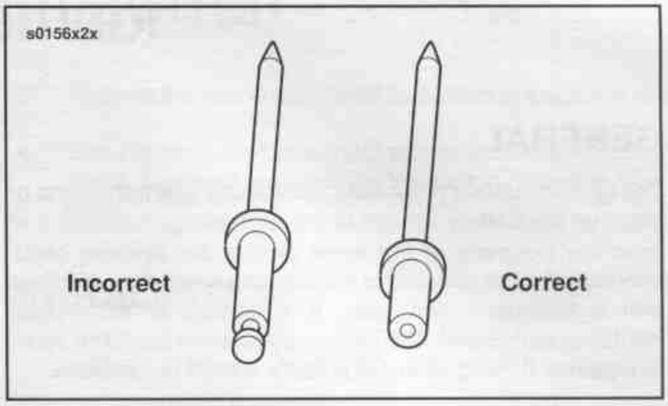


Figure 8-10. Timing Cover Rivets

MODULE REMOVAL

The ignition module is mounted above the oil tank, on the frame member.

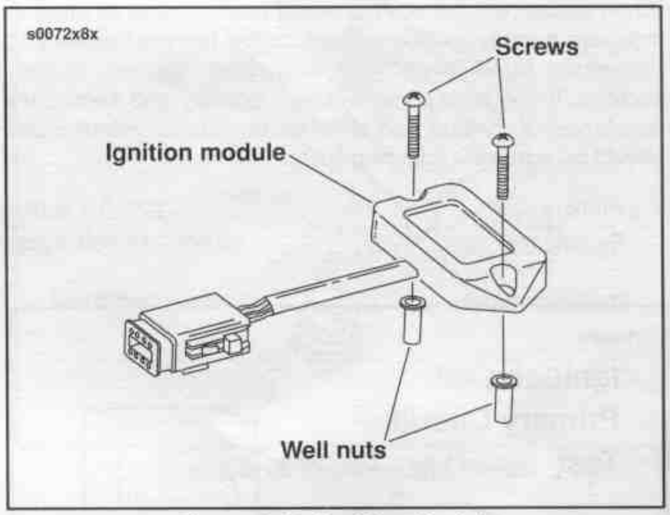


Figure 8-11. Ignition Module

1. Remove seat.
2. Disconnect ignition module at 8-pin connector.
3. To remove ignition module from the frame, remove two mounting screws from well nuts.

MODULE INSTALLATION

1. Install ignition module on frame mounting bracket by installing two mounting screws into well nuts.
2. Connect ignition module at 8-pin connector.
3. Install seat.

IGNITION COIL

GENERAL

The ignition coil is a pulse type transformer that transforms or steps up low battery voltage to the high voltage necessary to jump the electrode at the spark plug in the cylinder head. Internally the coil consists of primary and secondary windings with a laminated iron core. It is sealed in water-proof insulating compound. The ignition coil cannot be taken apart or repaired. If the ignition coil is faulty, it must be replaced.

TROUBLESHOOTING

Special Tools	Torque Values
Ohmmeter	None

When engine will not start or when hard starting or missing indicates a faulty ignition system, follow the troubleshooting procedure listed under the respective ignition system sections. If condition persists, check primary and secondary resistance of ignition coil with an ohmmeter. Resistances should be within the following limits:

Primary . . . . .2.5 - 3.1 ohms
Secondary. .10,000 - 12,500 ohms

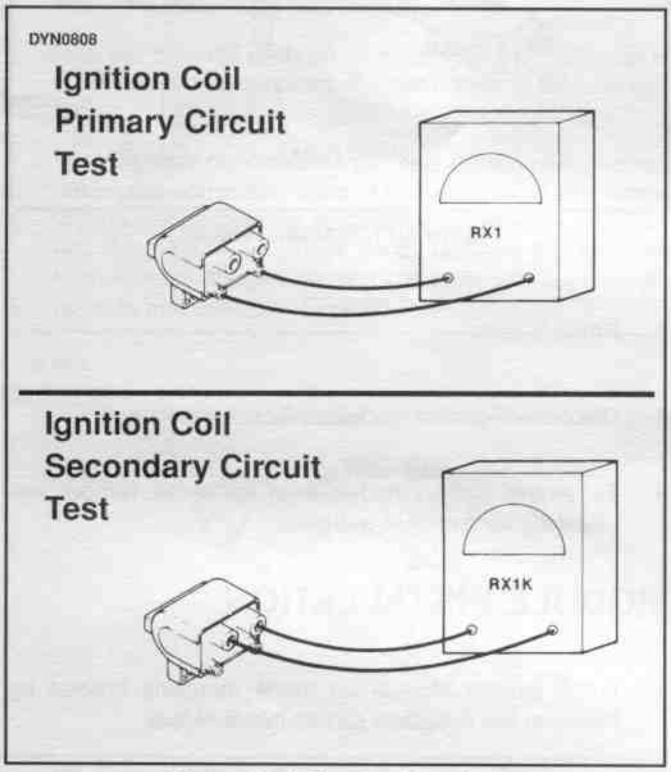


Figure 8-12. Test Ignition Coil

If an ohmmeter is not available, temporarily substitute a new ignition coil by attaching it at any convenient point near old coil (coil will function without being securely grounded). Transfer terminal wires to new coil as shown in wiring diagram for that particular model.

CAUTION

Connect ignition coil wires as shown in wiring diagrams. Reversing polarity to the ignition control module will permanently damage the control module.

Attach new spark plug cables to coil and plugs. If ignition trouble is eliminated by the temporary installation of new coil, carefully inspect old coil and cables. The insulation on cables may be cracked or otherwise damaged, allowing high tension current to short to metal parts. This is most noticeable in wet weather or when motorcycle has been washed.

INSTALLATION

Spark Plug Cable

Resistor type high tension cables are used. This type has a carbon impregnated fabric core instead of solid wire for radio noise suppression and improved reliability of electronic components. For this reason, it is necessary that the exact replacement cable is used. Spark plug cable resistance should be within the following limit:

Resistance . . . . 250-583 ohms per inch

Remove old cable from coil terminal and install new cable. Always be certain that cable boot or cap is securely tightened to the coil tower to prevent moisture and dirt from contacting the high tension lead. Replace boot or cap if damaged or loose fitting.

CAUTION

When disconnecting cable connector from spark plug terminal, do not pull on the cable itself because the cable carbon core will be damaged. Always pull on the rubber boot as close as possible to the spark plug terminal.

IGNITION/LIGHT SWITCH

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.

The ignition/light switch is located on the instrument panel. Lift lock cover and use the key to lock or unlock. It is not necessary to keep the key inserted in the lock to operate this switch after it has been unlocked. See chart below for position functions.

NOTE

The ignition/light switch is not repairable. If a switch is damaged, the entire switch must be replaced. Note position and color of wires before beginning replacement.

REMOVAL

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first), before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

1. Remove seat. See Section 2.
2. Disconnect battery cables, negative cable first.
3. Remove the instrument panel by removing the acorn nut.
4. See Figure 8-13. Disconnect all wires connected to the switch terminals and remove the switch mounting hardware.

INSTALLATION

NOTE

Use care when tightening instrument console acorn nut to avoid damaging console.

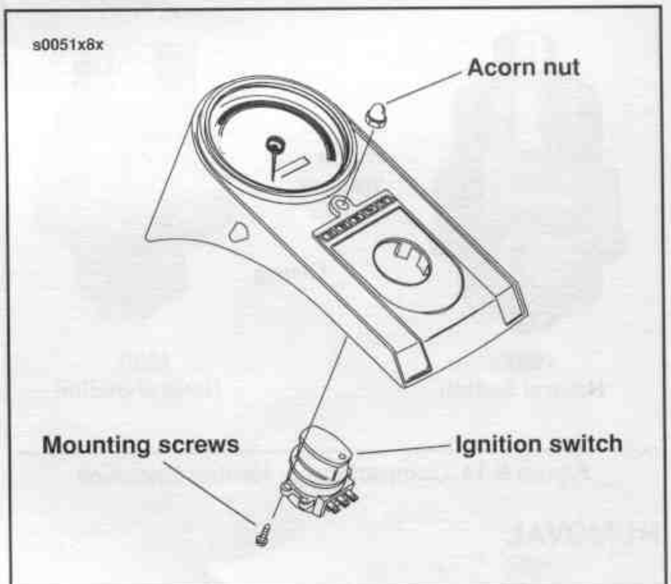


Figure 8-13. Ignition/Light Switch

SWITCH POSITIONS/FUNCTIONS

MODEL	DOMESTIC	INTERNATIONAL
ALL	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.	Same
	OFF - Ignition, lights and accessories are off. Key may be removed. Switch can be locked.	Same
	ACCESSORIES - Accessories are on. Hazard warning flashers can be operated. Instrument lights are on. Brake light and horn can be activated.	Fender tip lamps* only are ON. Switch can be locked.
	LIGHTS - Lights and accessories are on. Key may be removed.	Accessories are on. Hazard warning flashers can be operated. Instrument lights are on. Brake light and horn can be activated, tail lamp and position lamp are ON.
	IGNITION - Ignition, lights and accessories are on. Key may be removed. Switch cannot be locked.	Same; in addition, position lamp is ON and fender tip lamps* are OFF.

* if applicable

NEUTRAL SWITCH

GENERAL

Both the 1997 and 1998 Model Year Softails have a neutral switch located on the transmission top cover. The 1997 models have a *one* terminal switch (normally closed). The 1998 models have a *two* terminal switch (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 on the console to illuminate. See Figure 8-14 for a comparison of the switches.

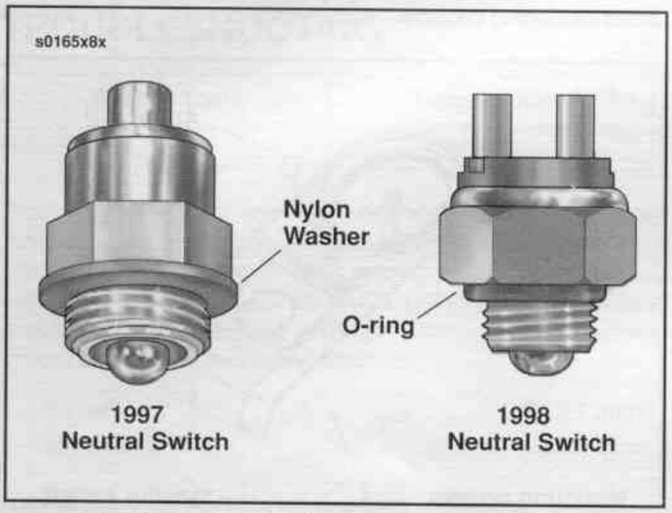


Figure 8-14. Comparison of Neutral Switches

REMOVAL

⚠CAUTION

Cover transmission top cover with masking tape while performing this task to protect chrome parts from cosmetic damage.

NOTE

For FLSTS models begin at Step 2. For all other models, begin at Step 1.

1. Remove rear exhaust pipe. See SHORTY DUAL EXHAUST, Section 4.
2. See Figure 8-15. Using fingers and flat tip screwdriver, remove connector(s) from switch stud(s).
3. **1997 Models**:
   Using a 5/8 in. box and open end wrench, remove neutral switch and nylon washer from transmission top cover.
   1998 Models:
   Using a 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 BUTT SPLICE CONNECTORS, Appendix A.

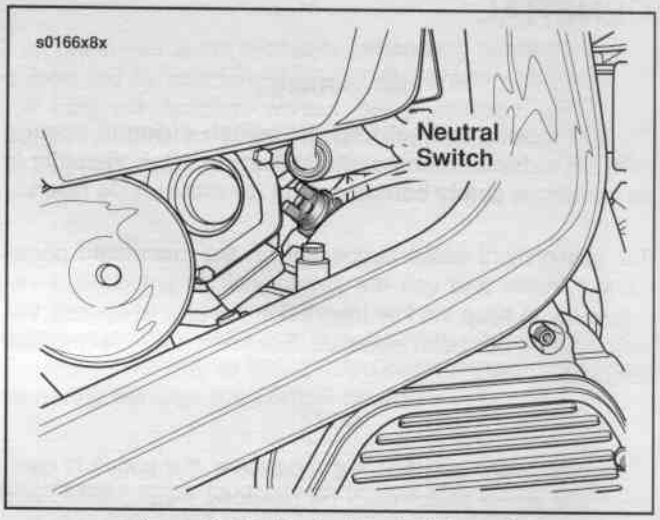


Figure 8-15. Neutral Switch Location

INSTALLATION

1. **1997 Models:**
   a. Apply Loctite PIPE SEALANT WITH TEFLON to threads of neutral switch.
   b. Install switch with nylon washer to transmission top cover.
   c. Tighten to 3-5 ft-lbs (4.1-6.8 Nm).

   1998 Models:
   a. Lubricate O-ring with transmission oil.
   b. Install switch with O-ring to transmission top cover.
   c. Tighten to 10-15 ft-lb (13.6-20.3 Nm).

NOTE

The 1998 neutral switch is not polarity sensitive, so either connector can be attached to either stud.

2. Using fingers and a flat tip screwdriver, install connector(s) to switch stud(s).

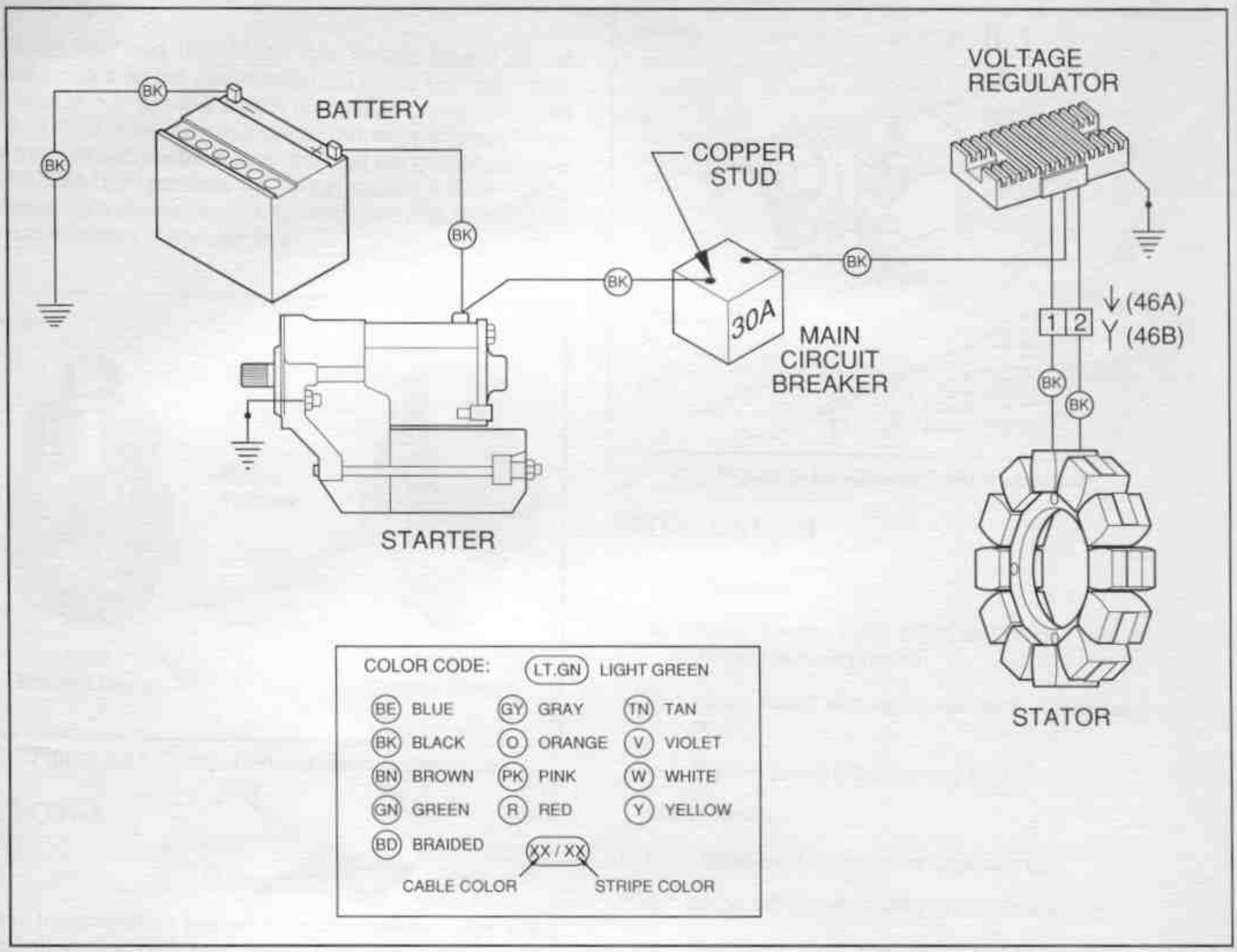
NOTE

For FLSTS models go to Step 5. All other models, do Step 4.

3. Install rear exhaust pipe. See SHORTY DUAL EXHAUST, Section 4.
4. Test neutral switch for proper operation:
   a. Turn ignition switch to IGNITION position.
   b. Put shifter in NEUTRAL.
   c. Check to see that NEUTRAL indicator light illuminates.

NOTES

CHARGING SYSTEM

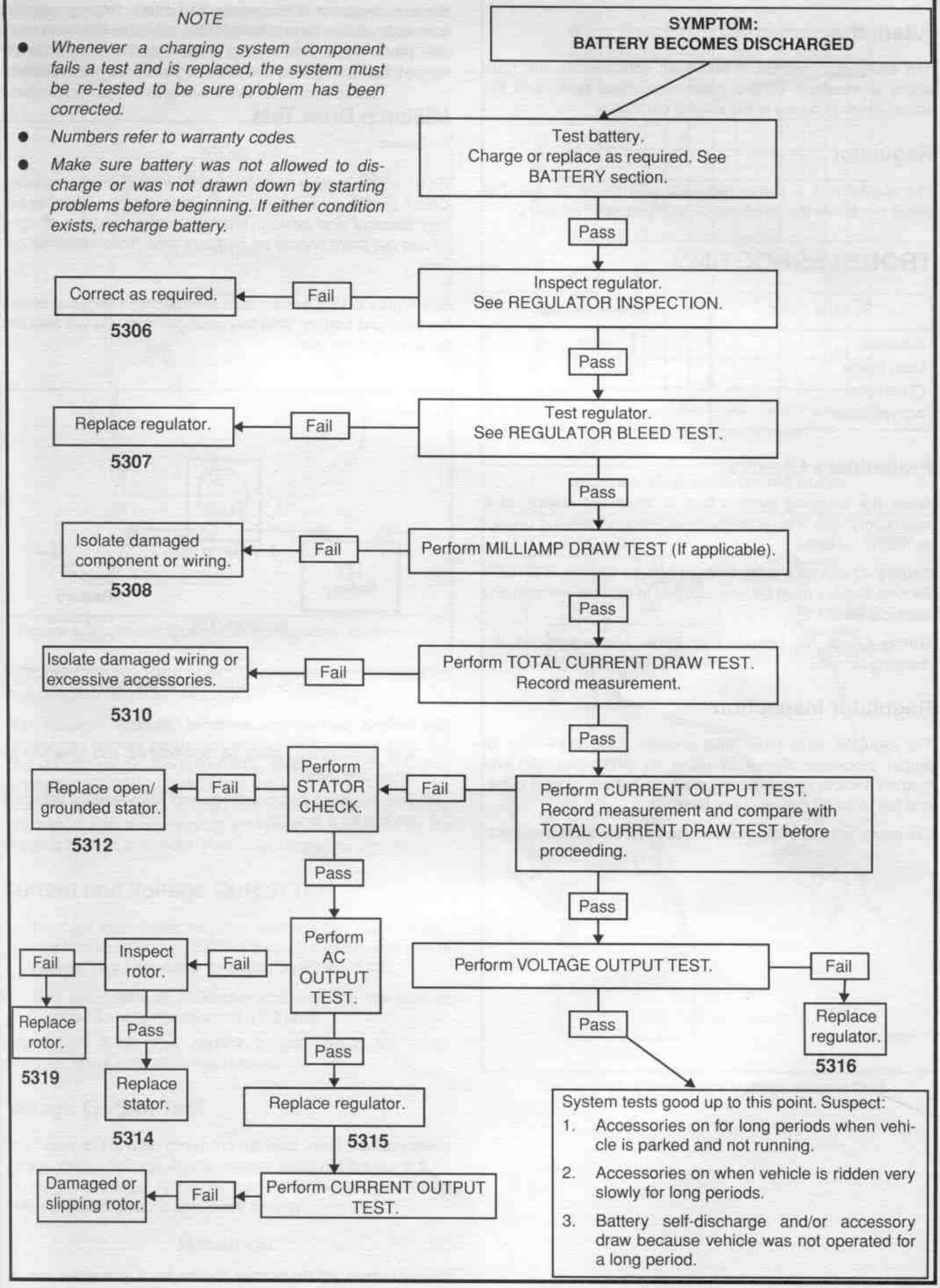


Charging Circuit Diagram

CHARGING SYSTEM TROUBLESHOOTING

NOTE

- *Whenever a charging system component fails a test and is replaced, the system must be re-tested to be sure problem has been corrected.*
- *Numbers refer to warranty codes.*
- *Make sure battery was not allowed to discharge or was not drawn down by starting problems before beginning. If either condition exists, recharge battery.*



GENERAL

Alternator

The alternator consists of two main components: the rotor which is mounted on the engine sprocket shaft, and the stator, which is bolted to the engine crankcase.

Regulator

The regulator is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

Special Tools	Torque Values
Ammeter Load tester Ohmmeter AC voltmeter	None

Preliminary Checks

When the charging system fails or does not charge at a satisfactory rate, it is recommended that the following checks be made:

Battery–Check for a weak or dead battery. See the BATTERY Section. Battery must be fully charged in order to perform any electrical tests.

Wiring–Check for corroded or loose connections in the charging circuit.

Regulator Inspection

The regulator base must have a clean, tight connection for proper grounding. Check by using an Ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator base.

Connector plug at engine crankcase must be clean and tight.

Regulator Bleed Test

Be sure regulator is connected to battery. Unplug regulator connector at engine crankcase. Use a trouble light and touch one probe to a known good ground and the other to the regulator pins, one at a time. If light glows, replace regulator.

Milliamp Draw Test

NOTE

Be sure accessories are not wired so they stay on at all times. Check for this by connecting ammeter between negative battery terminal and battery. With ignition switch and all lights turned off, there should be no more than three milliamps current.

See Figure 8-15. Connect ammeter between negative battery terminal and battery. With this arrangement, you will also pick up any regulator drain.

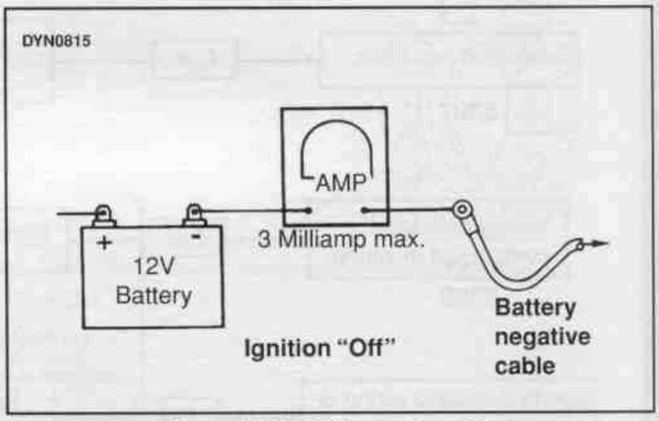


Figure 8-15. Milliamp Draw Test

The limits for these drains are listed below:

Any accessories must be considered and checked for excessive drain.

This condition could drain battery completely if vehicle is parked for a long time.

Total Current Draw Test

See Figure 8-16. If battery runs down during use, the current draw of the motorcycle components and accessories may exceed output of the charging system. To check for this condition, place load tester induction pickup or current probe pickup, over battery negative cable as shown below.

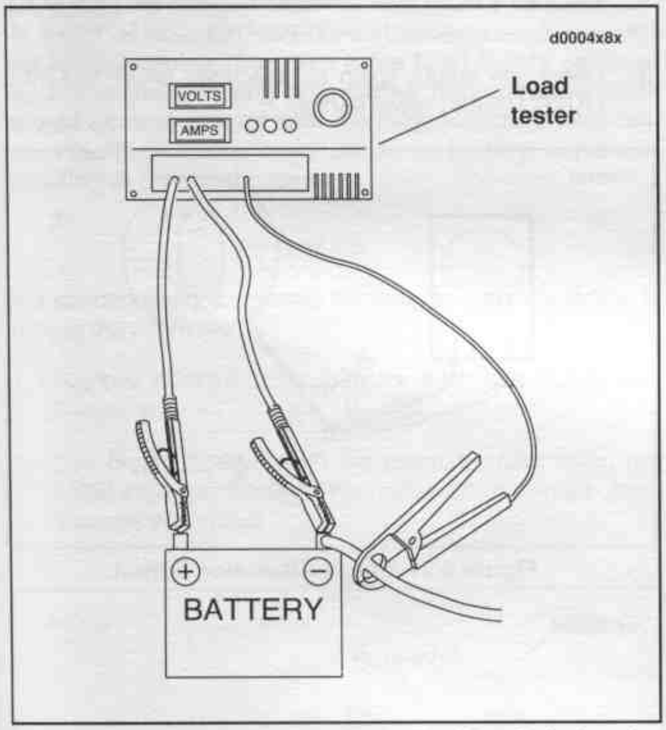


Figure 8-16. Check Current Draw (Ignition Switch on)

Disconnect the regulator from the stator at the connector on the crankcase and start motorcycle.

With ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw. Compare this reading to the reading obtained in CURRENT AND VOLTAGE OUTPUT TEST. The current output should exceed current draw by 3.5 amps, minimum. If not, there may be too many accessories for the charging system to handle. Reconnect regulator after test.

Current and Voltage Output Test

1. Connect load tester negative and positive leads to battery terminals and place load tester induction pickup over positive regulator cable as shown in Figure 8-17.
2. Run the engine at 3000 rpm and increase the load as required to obtain a constant 13.0 volts.

See Figure 8-17. The current output should be 26-32 amperes. Make note of measurement.

Voltage Output Test

See Figure 8-18. After removing the load, read the load tester voltage meter. Voltage to the battery must not be more than 15 volts. If voltage is higher, regulator is not functioning properly or connections are loose or dirty.

⚠CAUTION

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

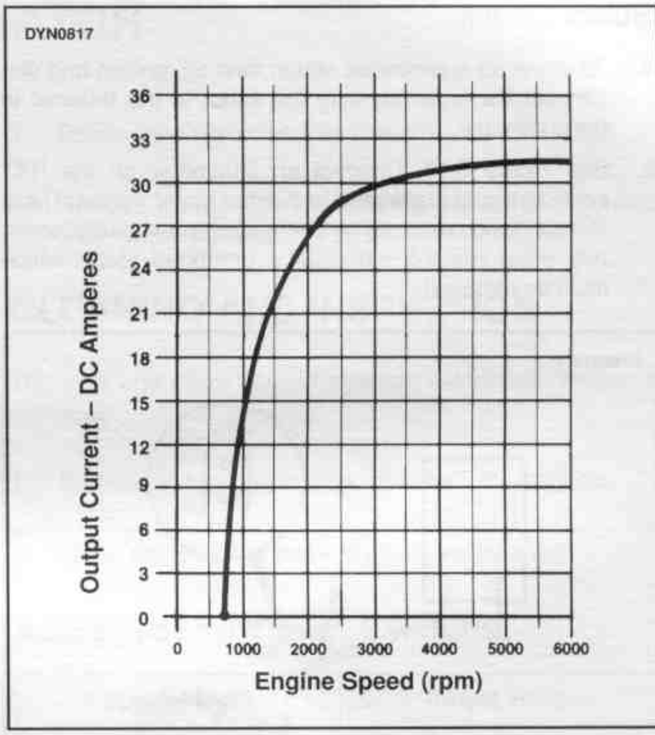


Figure 8-17. Current Output Curve

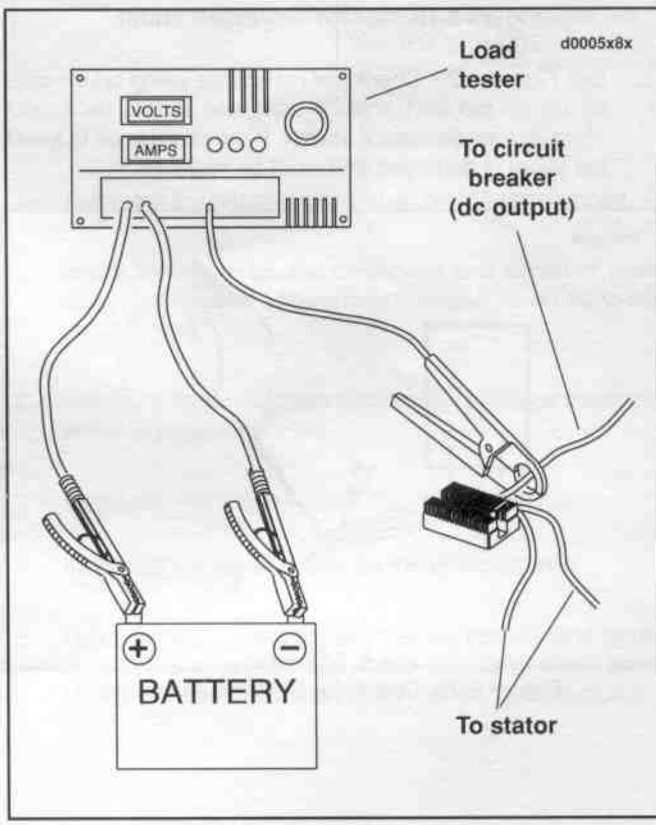


Figure 8-18. Current and Voltage Output Test

Stator Check

1. To check for a grounded stator, turn off ignition and disconnect the regulator from the stator at the terminal in the crankcase.
2. See Figure 8-19. Connect an ohmmeter on the RX1 scale between crankcase and either stator socket. There should be no continuity (∞ ohms) across either test point. Any other reading indicates a grounded stator which must be replaced.

DYN0819

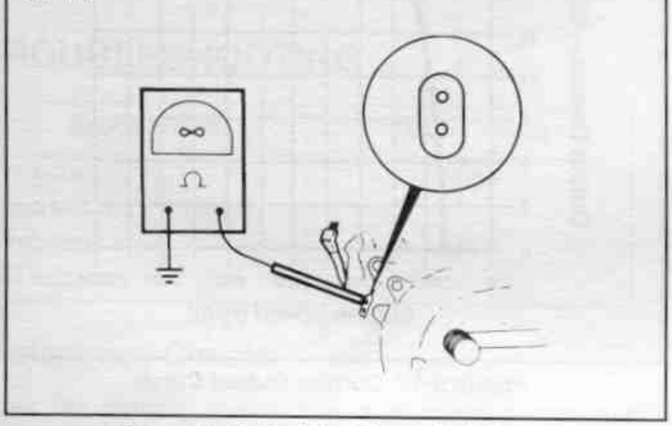


Figure 8-19. Test for Grounded Stator

3. See Figure 8-20. Check the resistance using an ohmmeter set on the RX1 scale. Resistance should be 0.1-0.2 ohms across the stator socket. If the resistance is lower, the stator is damaged and must be replaced.

DYN0820

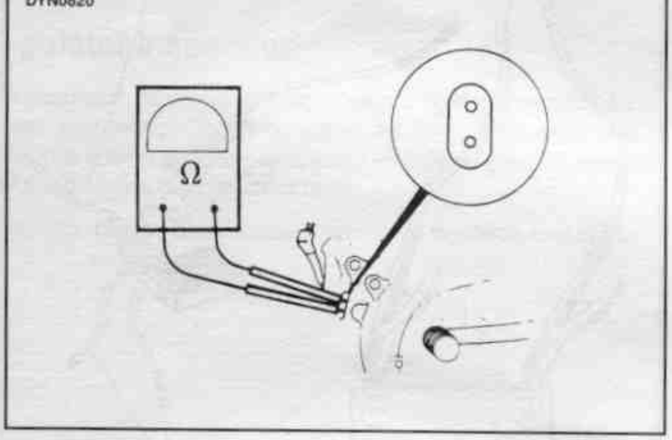


Figure 8-20. Check for Stator Resistance

AC Output Check

1. See Figure 8-21. To test AC output, disconnect the regulator and connect an AC voltmeter across both stator sockets. Run the engine at 2000 rpm. The AC output should be between 32-40 AC volts (16-20 per 1000 rpm).
2. If the output is below specifications, charging problem could be a faulty rotor or stator. Replace the rotor or stator as described under ALTERNATOR.
3. Check the output again as described under VOLTAGE OUTPUT TEST given earlier.

DYN0821

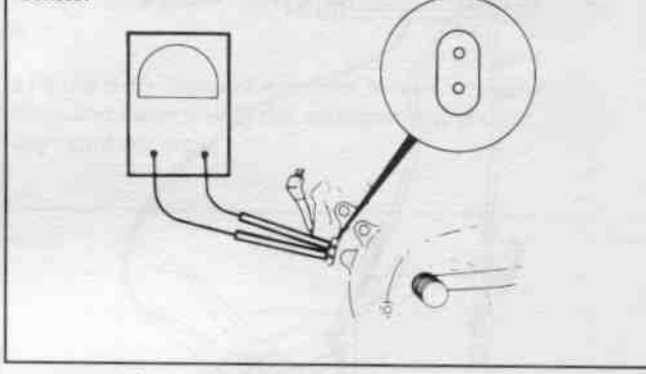


Figure 8-21. Check Alternator Output

ALTERNATOR

REMOVAL/DISASSEMBLY

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables, (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

NOTE

It is not necessary to remove the inner primary chaincase to remove the alternator.

1. Remove primary cover, primary drive and clutch. See Section 6.
2. See Figure 8-22. Pull off the alternator rotor using two bolts inserted through the holes in the rotor face. Remove the spacer.

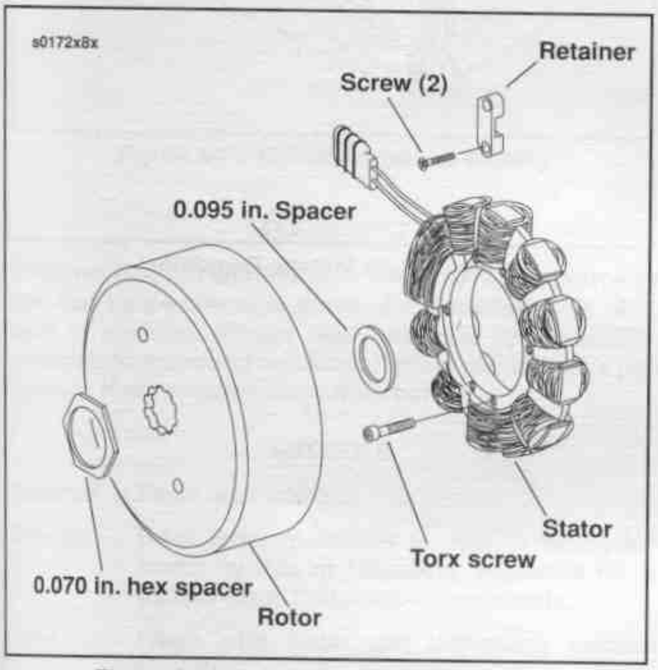


Figure 8-22. Rotor and Stator Mounting

3. Remove the two screws and retainer.
4. Remove the Torx screws. Unplug the voltage regulator and remove the stator.

CLEANING AND 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

Special Tools	Torque Values
None	Stator Torx screws 30-40 **in-lbs** (3.4-4.5 Nm) Compensating sprocket nut 150-165 ft-lbs(203-224 Nm)

NOTE

Torx fasteners are not re-usable. They MUST be replaced.

1. Install the stator on the crankcase and fasten in place using Torx screws. Tighten torx screws to 30-40 **in-lbs** (3.5-4.5 Nm).
2. Lubricate stator plug with rubber lube or soapy water and install in crankcase.
3. Install retainer using Loctite 242 (blue) on screws.
4. Install the spacer and rotor on the sprocket shaft.
5. Use Loctite 262 (red) on sprocket nut threads and tighten sprocket nut to 150-165 ft-lbs (203-224 Nm). Install clutch, primary drive and primary cover. See Section 6.

VOLTAGE REGULATOR

REMOVAL

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first), before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

NOTE

The voltage regulator is a non-repairable item and must be replaced if it fails.

1. Unplug the voltage regulator from the crankcase.
2. Disconnect the voltage regulator lead from the main circuit breaker.
3. Remove the two nuts and lockwasher that hold the regulator and ground strap in place and remove the regulator.

INSTALLATION

1. Install the regulator, placing the ground strap under the mounting nut closest to the ground strap. Place the lockwasher under the nut on the opposite side.
2. Route the wire along the bottom frame member, through two metal frame clips, and connect it to the circuit breaker terminal located on front of splash panel. Secure the wire to the frame with cable straps.
3. Plug the voltage regulator into the crankcase.

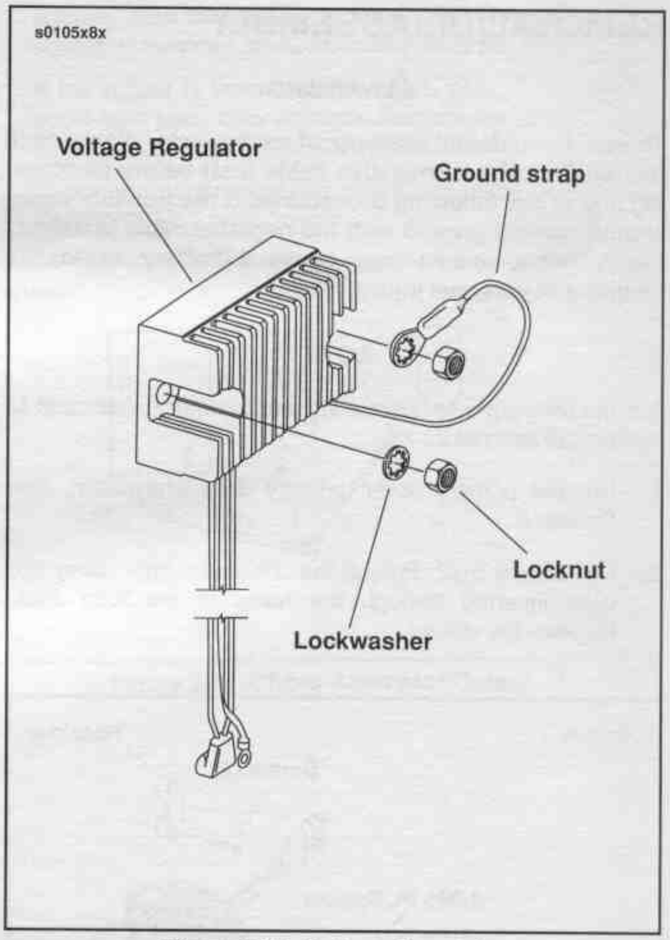


Figure 8-23. Voltage Regulator

BATTERY

GENERAL

The YTX20L-BS battery installed in 1997 and 1998 Softail motorcycles is a permanently sealed, maintenance-free, lead/calcium and sulfuric acid battery. Do not remove the cap strip to add water, or when charging the battery.

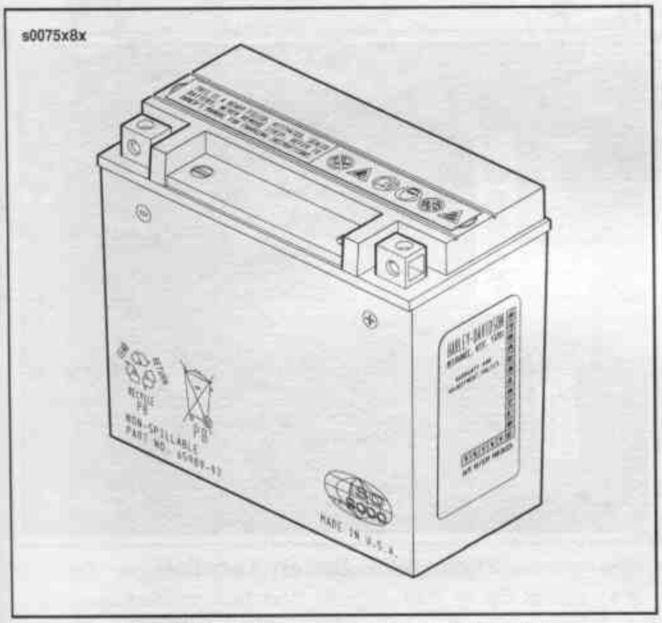


Figure 8-24. Maintenance-free Battery

⚠WARNING

Batteries contain sulfuric acid which is highly corrosive and can cause chemical burns. Avoid contact with skin, eyes or clothing. Always wear approved eye protection when working around batteries. Battery electrolyte is poisonous. Keep children away from battery.

ANTIDOTE

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.**

ACTIVATION/TESTING

Maintenance-free batteries are shipped pre-charged; however a voltage check should be performed before putting the battery into service.

Voltmeter Test

The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to make sure it is in a 100% charged condition. If the open circuit voltage reading is below 12.8 V, charge battery and recheck voltage after battery has sat 1-2 hours. If battery reads below 12.8 Volts, after 10 hours of charging using a constant current charger (set at 1.8 amps), replace the battery. Tapered-rate chargers or trickle chargers will require longer charge times.

State of Charge	Voltage
100%	13.0 V
75%	12.8 V
50%	12.5 V
25%	12.2 V

Load Test

The load test measures battery performance under full current load and is the best indicator of battery condition.

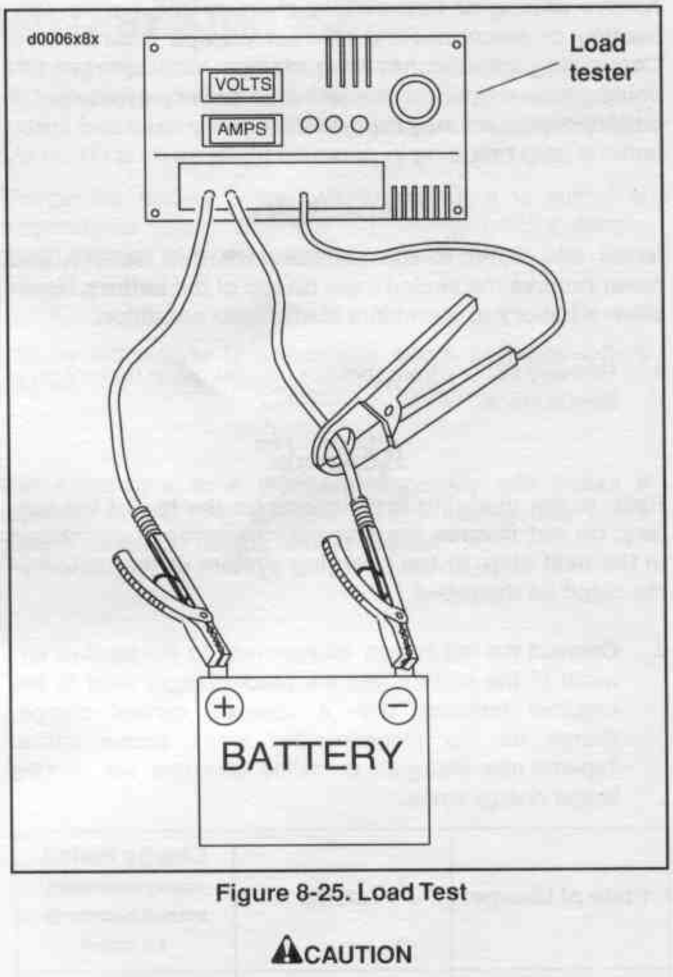


Figure 8-25. Load Test

⚠CAUTION

Fully charge the battery before testing. If battery is not fully charged, test readings will be incorrect.

Load battery to three times amp hour rating using the load tester. See Figure 8-25. Connect tester leads to battery posts and place induction pickup over negative (black) cable. The

Harley-Davidson 18 amp-hour battery should be loaded to three times its amp-hour rating, or 54 amps for 15 seconds. Voltage reading throughout the test should be 9.6V or more at 70°F (21° C).

CLEANING AND INSPECTION

1. Battery top must be clean and dry. Dirt on the top of battery may cause the battery to self-discharge at a faster than normal rate.
2. Inspect battery screws and cables for breakage, loose connections and corrosion. Coat terminals with grease.
3. Inspect battery for discoloration, raised top, or warped case which may indicate battery has been overheated or overcharged.
4. Inspect the battery case for cracks or leaks.

CHARGING BATTERY

⚠WARNING

Always unplug or turn battery charger OFF before connecting or disconnecting charger clamps from battery. Connecting or disconnecting clamps with charger ON could cause a spark and a possible battery explosion. A battery explosion may rupture the battery case and spray sulfuric acid resulting in personal injury.

⚠CAUTION

Never add water to the maintenance free battery, and never remove the sealed caps on top of the battery. Never allow a battery to stand in a discharged condition.

1. Remove battery from motorcycle and place battery on a level surface.

⚠CAUTION

Refer to the charging instructions on the top of the battery. Do not reverse the charger connections described in the next step, or the charging system of the motorcycle could be damaged.

2. Connect the red battery charger lead to the positive terminal of the battery and the black charger lead to the negative terminal. With a constant current charge, charge for the recommended times shown below. Tapered-rate chargers or trickle chargers will require longer charge times.

State of Charge	Voltage	Charge Period (using a constant current charger @ 1.8 amps)
100%	13.0 V	NONE
75%	12.8 V	3-5 hours
50%	12.5 V	4-7 hours
25%	12.2 V	10 hours

3. If battery gets hot, over 110°F (44°C) (warm to the touch), discontinue charging and let battery cool down.

REMOVAL

1. Remove seat. See Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

Figure 8-26. Battery Location

2. Remove negative connection at frame, then positive connection at battery terminal.
3. Unlatch battery strap and lift battery from tray.
4. Remove negative cable from battery.

INSTALLATION/CABLE ROUTING

1. Clean cable connectors with wire brush or sandpaper to remove oxidation.
2. See Figure 8-27. Install positive cable to starter post with nut (if removed). Orient terminal so cable faces away (towards left side of motorcycle). Torque nut to 65-80 **in-lbs** (7.3-9.0 Nm). Cover nut with protective rubber boot.

⚠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 resulting in personal injury.

3. See Figure 8-28. Install rubber battery tray cushion. Route positive cable under the battery tray and through the hole on forward edge of the cushion.
4. Position battery in battery tray.

⚠CAUTION

Connecting cables to wrong battery terminals can cause serious damage to motorcycle electrical system.

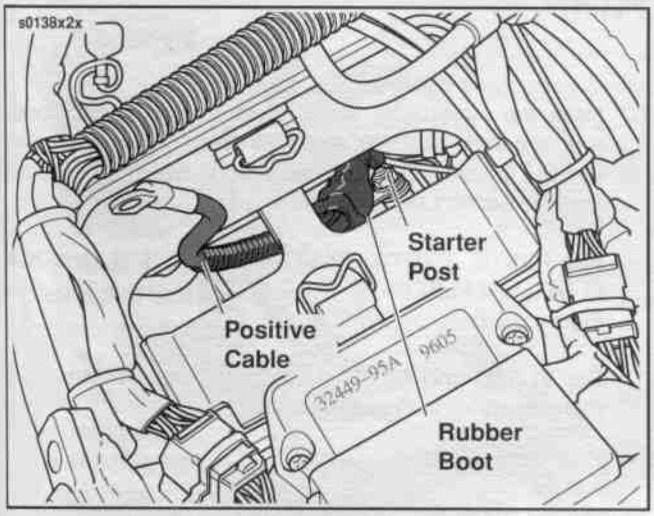


Figure 8-27. Positive Cable Routing - Starter

5. Install positive cable to positive battery terminal with spacer, washer and bolt. Torque battery terminal bolt to 40 **in-lbs** (4.5 Nm).
6. Install negative battery cable to chassis ground.
7. See Figure 8-29. Route negative cab le under wire harness to negative battery terminal.
8. Install negative cable to negative battery terminal with spacer, washer and bolt. Torque bolt to 40 **in-lbs** (4.5 Nm).
9. Latch battery strap.
10. Install seat. See SEAT, Section 2.

⚠WARNING

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

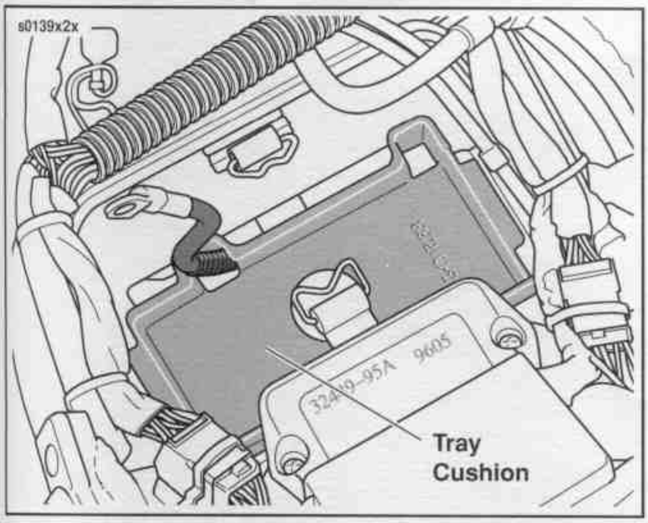


Figure 8-28. Positive Cable Routing - Tray Cushion

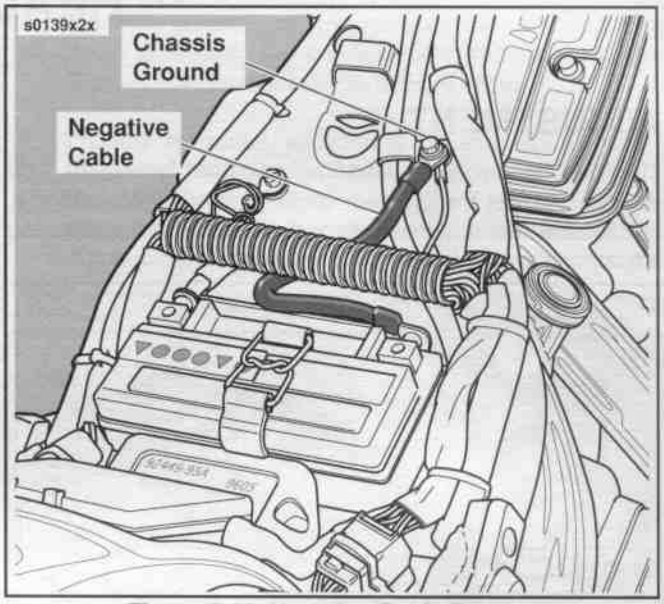


Figure 8-29. Negative Cable Routing

BATTERY STORAGE

If the motorcycle will not be operated for several months, such as during the winter season, remove battery from motorcycle and charge until the correct voltage (see CHARGING BATTERY) 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 stored in a warm area, above 60°F (16° C).

⚠WARNING

Battery electrolyte is poisonous. Store batteries where they cannot be reached by children.

⚠CAUTION

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

HEADLAMP

ADJUSTMENT

The headlamp beam must be adjusted for height and direction. To get the greatest efficiency from the headlamp, and to meet the requirements of the law, make the following adjustment in a darkened room or at night.

FX0823

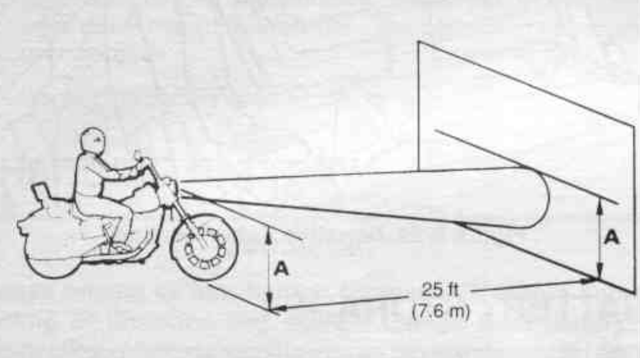


Figure 8-30. Headlamp Adjustment – FLSTC, FLSTF

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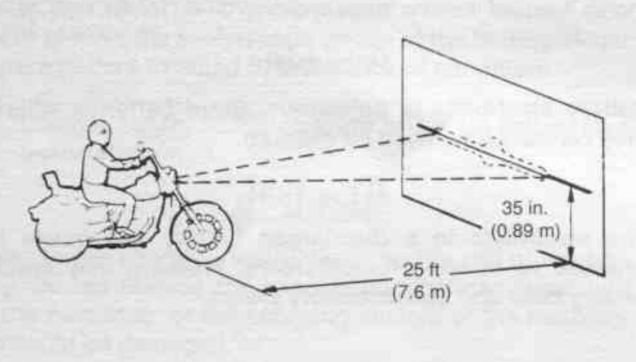


Figure 8-31. Headlamp Adjustment – FXSTC, FXSTS, FXSTSB and FLSTS

1. Have the motorcycle standing on a level surface (with tires correctly inflated) about 25 feet (7.6 m) from, and pointed toward, a wall or screen upon which a horizontal line has been drawn:

   For FXSTC, FXSTS, FXSTSB and FLSTS (and HDI FLSTC and FLSTS)–35 inches (0.89 m) above floor. See Figure 8-31.

   For FLSTC and FLSTF–Level with center of headlight (dimension "A" in Figure 8-30).

NOTE

To properly adjust the headlamp it will be necessary to have someone of about the same weight as the rider seated on the motorcycle because the weight of the rider will compress the fork slightly.

2. Check light beam for proper height alignment:

   For FXSTC, FXSTS, FXSTSB and FLSTS (and **HDI FLSTC and FLSTF**)–main beam of light, should be centered on horizontal line of wall so there is an equal area of light above and below line.

   For FLSTC and FLSTF–the top of the main beam of light should register on the wall even with, but no higher than, the horizontal line.

3. Check the light beam for proper lateral alignment. The main beam of light should be directed straight ahead so there is an equal area of light to right and left of center.

4. If beam requires adjustment, proceed as follows:

Adjustment for FXSTC, FLSTC and FLSTF Headlamp

1. See Figure 8-32. Loosen horizontal adjusting bolt to adjust headlamp beam side to side. Loosen vertical adjusting bolt to adjust headlamp beam up and down.

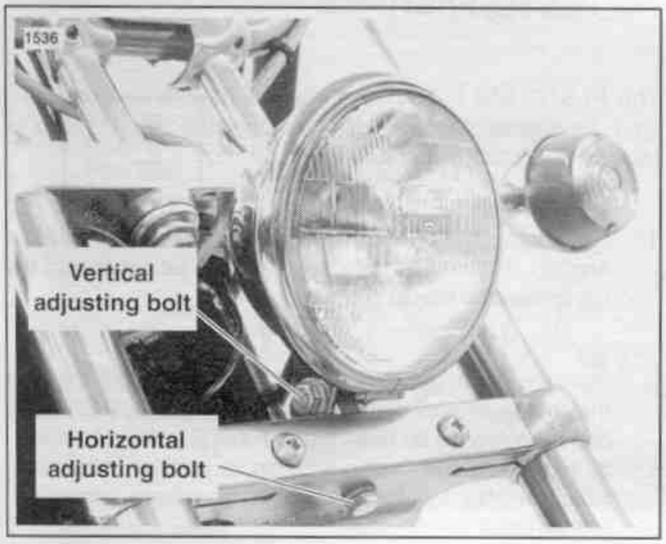


Figure 8-32. Headlamp Adjustment Fasteners

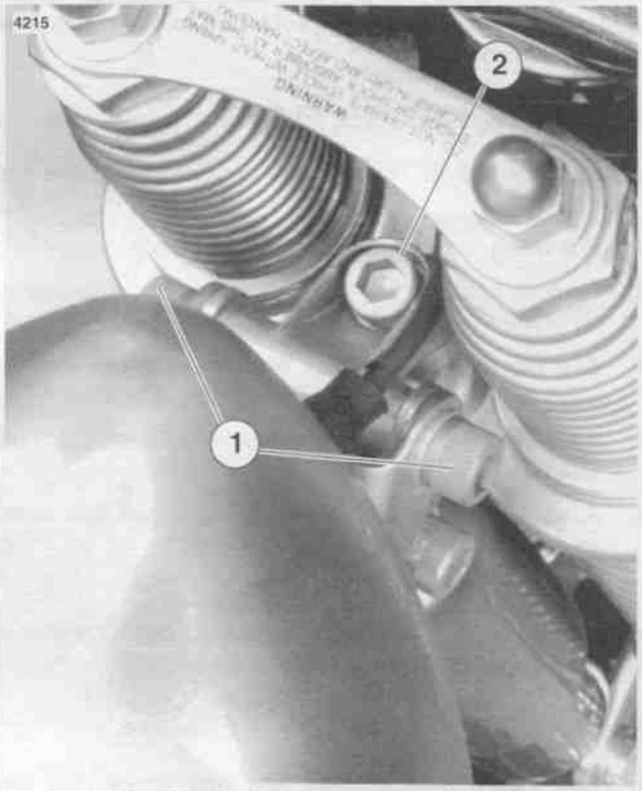
Adjustment for FXSTS, FXSTSB and FLSTS Headlamp

Special Tools	Torque Values
None	Vertical adjustment fasteners 30 ft-lbs (41 Nm) Horizontal adjustment fastener 30 ft-lbs (41 Nm)

⚠CAUTION

Headlamp mounting for the FXSTS and FXSTSB is similar to the FXSTC, except the headlamp mounting block has a slot instead of a hole. Position the FXSTS and FXSTSB headlamp as far forward as the slot will allow. This will prevent the headlamp from contacting the springs.

1. See Figure 8-33. Loosen two vertical adjustment fasteners (1) to adjust headlamp vertically. Tilt headlamp up or down to properly aim it in relation to the horizontal line. Tighten both fasteners to 30 ft-lbs (41 Nm).
2. Loosen horizontal adjustment fastener (2) to adjust headlamp horizontally. Turn headlamp right or left to direct light beam straight ahead. Move headlamp adjustment mechanism forward to the end of the bracket slot. Tighten fastener to 30 ft-lbs (41 Nm).



1. **Vertical adjustment fastener (2)**
2. **Horizontal adjustment fastener**

Figure 8-33. Headlamp Adjustment – FXSTS, FXSTSB, FLSTS

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 to avoid possible personal injury.

For FXSTS, FXSTSB, FLSTS

1. See Figure 8-35. 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 8-34. 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 and adjust light beam as described under ADJUSTMENT.

NOTE

When reassembling headlamp, make sure slots and tabs in headlamp, adapter ring, and trim ring are aligned.

For FXSTC

1. See Figure 8-35. 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 8-34. 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 and adjust light beam as described under ADJUSTMENT.

NOTE

When reassembling headlamp, make sure slots and tabs in headlamp, adapter ring, and trim ring are aligned.

For FLSTC, FLSTF

The FLSTC and FLSTF motorcycles have a sealed beam type headlamp (except HDI motorcycles which have a Halogen bulb similar to FXSTC).

1. See Figure 8-35. 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 (21) and mounting ring that holds sealed beam headlamp in place. (HDI bulbs can be replaced by referring to FXSTC removal steps 3-5. HDI headlamps also contain a position lamp bulb which is also located under the headlamp assembly's rubber boot).
3. Pull connector block from bulb prongs. Replace old bulb with new bulb.
4. Assemble headlight components and adjust light beam as described under ADJUSTMENT.

NOTE

When reassembling headlamp, make sure slots and tabs in headlamp, mounting ring, and trim ring are aligned.

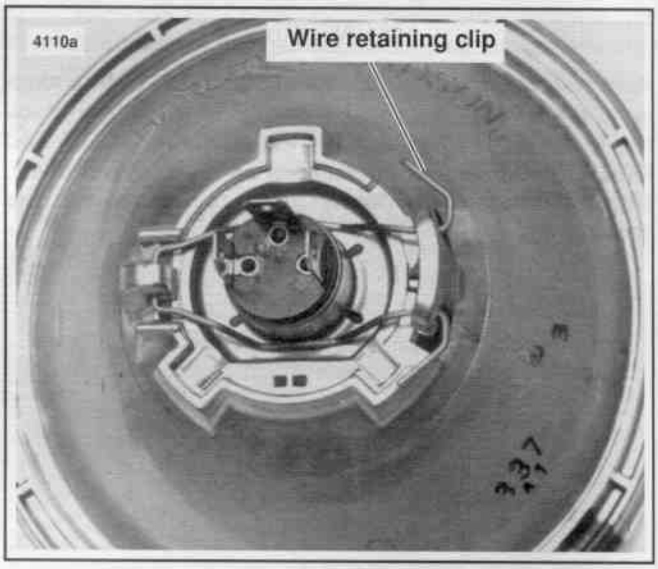
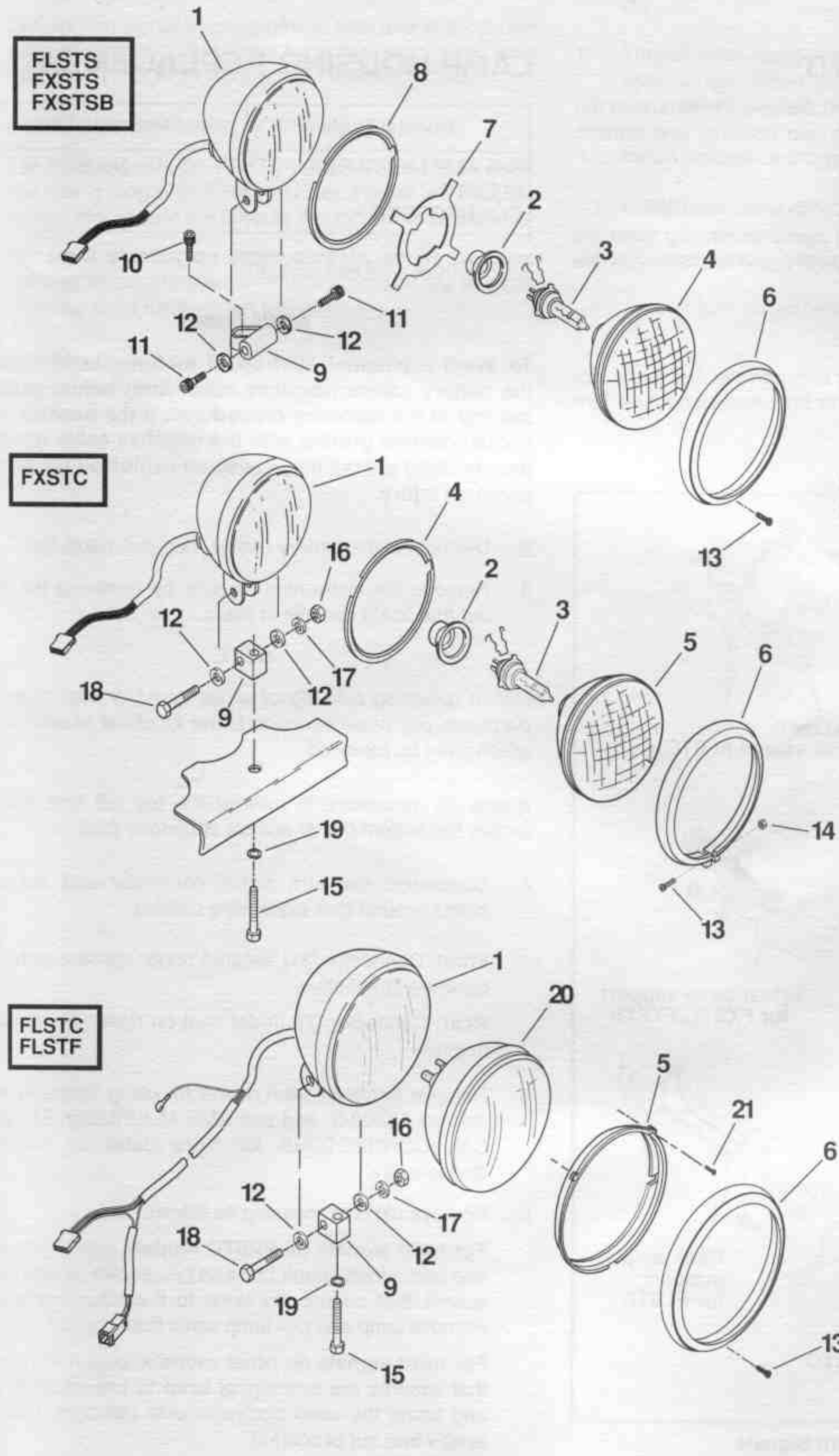


Figure 8-34. Wire Retaining Clip



1. Headlamp housing
2. Boot
3. Halogen Bulb
4. Headlamp
5. Mounting ring
6. Trim ring
7. Gasket
8. Adapter ring
9. Mounting block
10. Bolt
11. Screw
12. Washer
13. Screw
14. Nut
15. Bolt
16. Nut
17. Lockwasher
18. Bolt
19. Lockwasher
20. Sealed beam headlamp
21. Screw

Figure 8-35. Softail Headlamps

TURN SIGNALS/RUNNING LIGHTS

BULB REPLACEMENT

See Figure 8-36. To change a bulb, remove the lens, turn the bulb 1/4 turn while pressing bulb into housing, and remove the bulb. Replace the bulb and install the lens.

NOTE

After replacing a bulb, if the turn signal or running lamp will not light, check the wiring, the ground at the socket and/or the switch.

NOTE

The turn signal flasher is located between the fuel tanks. For more information on operation and troubleshooting, see Turn Signal Canceller (Page 8-38).

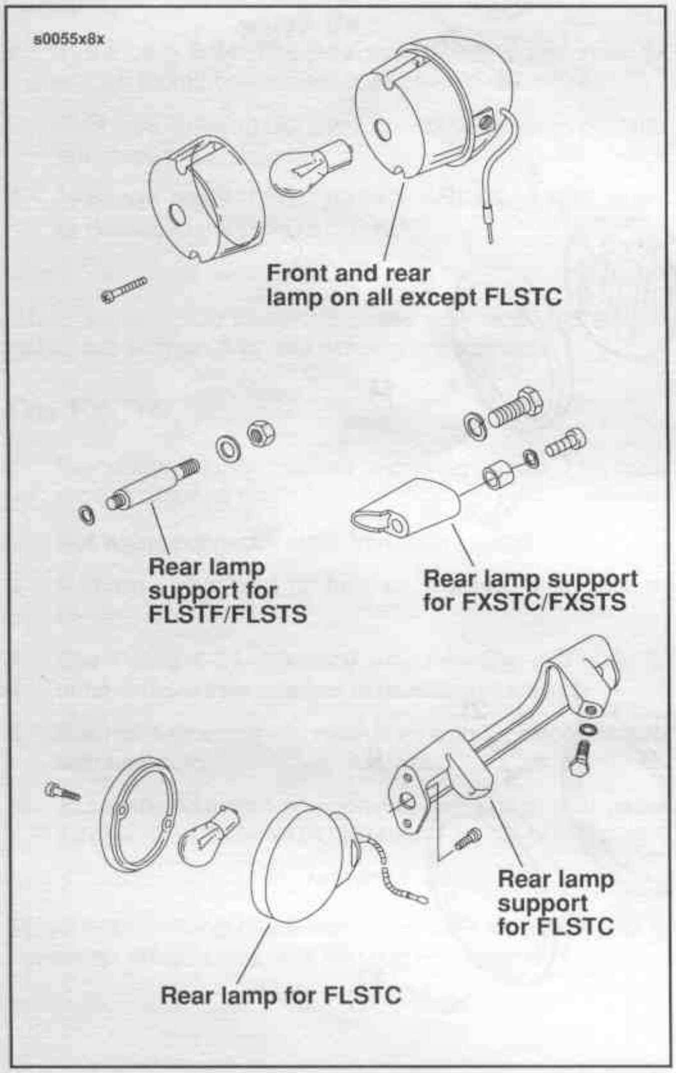


Figure 8-36. Turn Signals

LAMP HOUSING REPLACEMENT

Special Tools	Torque Values
See AMP MULTILOCK ELECTRICAL CONNECTORS	None

1. Remove seat see Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause an explosion resulting in personal injury.

2. Disconnect the battery cables, negative cable first.
3. Remove the instrument console by removing the acorn nut that holds console in place.

NOTE

Before removing turn signal wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

It may be necessary to remove the top left tank bolt and loosen the bottom bolt to access connector (31).

4. Disconnect the turn signal connector and cut cable straps around turn signal wire conduit.

   Front: Connector [31], located under console on bracket between tank halves.

   Rear: Connector [7], under seat on right side of ignition module.

5. Remove terminals from connector using Snap-On terminal tool TT600-3, and see AMP MULTILOCK ELECTRICAL CONNECTORS for more detail on connector disassembly.
6. Remove old lamp housing as follows:

   For front signals on FLSTC models, see Figure 8-34, and use a long shank ball end hex socket to remove the screws that secure the lamp to the mounting bracket. Remove lamp and pull lamp wires from conduit.

   For front signals on other models, loosen the jam nut that secures the turn signal lamp to the mounting stud and rotate the lamp clockwise until removed. Then pull lamp wires out of conduit.

For rear signals, remove the lamp bracket hardware and pull lamp and lamp wires out of conduit.

7. Lay old turn signal housing next to new one and cut new wires to length. Crimp new terminals onto wires, see AMP MULTILOCK ELECTRICAL CONNECTORS.

8. Install new lamp housing as follows:

   For front signals on FLSTC models, see Figure 8-38, and use a long shank ball end hex socket to install the screws that secure the lamp to the mounting bracket.

   For front signals on other models, screw the lamp housing on counterclockwise until it contact the jam nut. Align the lamp then tighten the jam nut.

   For rear signals, install the lamp housing to the bracket hardware and then install the assembly on the motorcycle.

9. Thread new wires back through conduit and replace cable straps. Insert turn signal terminals into connector and mate connector.

10. Install and tighten fuel tank bolts if loosened or removed.

11. Install instrument console.

12. Connect battery, positive cable first, and install seat.

13. Turn ignition on and test for proper turn signal operation.

BULB REPLACEMENT

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 (FLSTS)

1. Remove top license plate clamp.
2. See Figure 8-37. Remove the three lens screws (1) and remove the lens and lamp housing with license plate as an assembly.
3. Remove pillion and seat, see Section 2. Disconnect tail lamp connector [7].

NOTE

Before removing tail lamp wires from connector, or harness from fender clips, carefully note routing for reinstallation.

4. Remove tail lamp wire terminals from connectors. See AMP MULTILOCK ELECTRICAL CONNECTORS.
5. Remove right saddlebag assembly and reach inside the rear fender and carefully remove harness from clips inside fender.
6. Remove three nuts (5) from behind tail lamp, pull rubber grommet from fender, and pull harness out of fender to remove tail lamp assembly.
7. To install tail lamp, route harness through hole in fender and lubricate rubber grommet with alcohol or glass cleaner. Place grommet into position.
8. Place lamp into position and install nuts (5).
9. Route new wires back into place, install terminals into connector, and routing harness through fender clips. See AMP MULTILOCK ELECTRICAL CONNECTORS.
10. Install lens and lamp housing with license plate as an assembly using the three lens screws (1).
11. Install saddlebag assembly and seat.

TAIL LAMP REPLACEMENT (All Models Except FLSTS)

1. Remove the seat. See Section 2.
2. Disconnect tail lamp connector [7] and cut cable straps around tail lamp conduit:

NOTE

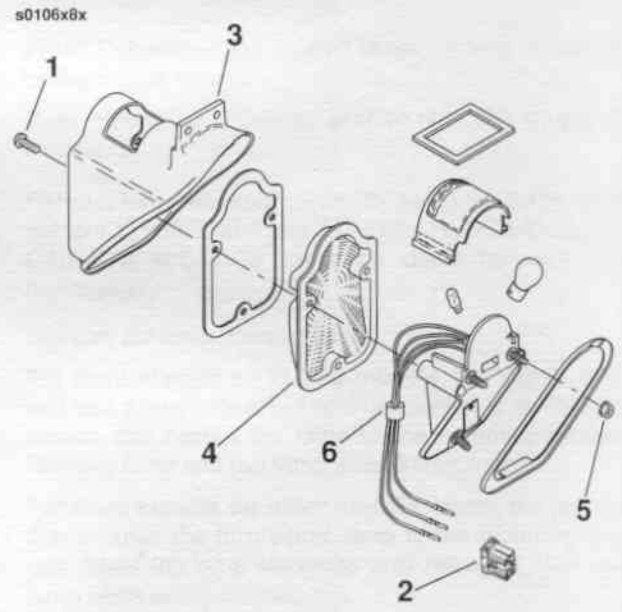
Before removing tail lamp wires, carefully note routing. In particular, pay close attention to the locations of cable straps which must be replaced.

3. Remove tail lamp wire terminals from connectors. See AMP MULTILOCK ELECTRICAL CONNECTORS.
4. Reach inside the rear fender and carefully remove harness from clips inside fender.

NOTE

To aid in installing new tail lamp wires, attach thin wire to terminals on old tail lamp wires before pulling old wires out of conduit. This thin wire can then be used to guide new wires back through conduit.

5. Remove the speednuts that secure the tail lamp to the fender. Remove tail lamp from fender. Slide the tail lamp wires out of the hole in the fender.
6. Lay old tail lamp housing next to new one, cut new wires to length.
7. Route new wires back into place by pulling new wires back through conduit and crimping new terminals on wires. See AMP MULTILOCK ELECTRICAL CONNECTORS.
8. Insert wire terminals into connector and mate connectors.
9. Route the harness into clips under fender.
10. Attach tail lamp housing to fender with new speed nuts.



1. **Screws (3)**
2. **Tail lamp connector**
3. **Lamp housing**
4. **Lens**
5. **Nuts (3)**
6. **Rubber grommet**

Figure 8-37. FLSTS Tail Lamp Assembly

PASSING LAMPS

REMOVAL (FLSTC)

Special Tools	Torque Values
See AMP MULTILOCK ELECTRICAL CONNECTORS	None

1. Remove the screws that secure the turn signal lamp to the mounting bracket. Remove turn signal lamp.

2. Locate 2-place Multilock connector [67] for passing lamps behind left fork panel. Disconnect connector and remove passing lamp terminal. See AMP MULTILOCK ELECTRICAL TERMINALS.

3. Use a flare nut socket to remove the nut that secures passing lamp to bracket. Remove passing lamp and pull wires through vinyl conduit.

INSTALLATION (FLSTC)

Special Tools	Torque Values
	Passing lamp nut 18 ft-lbs (24 Nm)

1. Lay old passing lamp next to new lamp and cut wires to length. Crimp new terminals to the new lamp wires. See AMP MULTILOCK ELECTRICAL CONNECTORS.

2. Place passing lamp in position. Use a flare nut socket to snug the nut that secures the lamp to the bracket.

3. Push lamp wires back into the vinyl conduit.

4. Insert wire terminals into connector and mate connectors.

5. Route the harness back into position.

6. Turn ignition switch and passing lamp switch on, and aim passing lamp so that it is directed straight ahead at 30 feet. Tighten passing lamp nut to 18 ft-lbs (24 Nm) maximum torque.

7. Install the screws that secure the turn signal lamp to the mounting bracket.

REMOVAL (FLSTS)

1. Remove instrument console. See IGNITION/LIGHT SWITCH.

2. Remove left fuel tank.

3. Disconnect passing lamp wire connector and remove passing lamp terminals. See AMP MULTILOCK ELECTRICAL TERMINALS.

4. Disconnect horn wires from back of horn.

5. Pull wires through spring bridge.

6. Loosen, but do not remove, buttonhead screws that fasten passing lamp assembly to spring fork.

7. Remove upper shock mounting bolt.

8. Remove buttonhead screws that hold passing lamp to spring fork.

INSTALLATION (FLSTS)

1. Install buttonhead screws that secure passing lamp bracket to spring fork.

2. Pull wires through spring bridge.

3. Apply Loctite 242 (blue) to threads of upper shock mount bolts and install. Torque to 45-50 ft-lbs. (61-68 Nm).

⚠CAUTION

Be sure there is no free play between shock absorber eye and shock absorber brackets.

4. Install the passing lamp wire connector to main wiring harness connector under instrument console.

5. Install left fuel tank.

6. Install instrument console. See IGNITION/LIGHT SWITCH.

PASSING LAMP BRACKET (FLSTC)

REMOVAL

1. Remove fasteners that hold windshield to passing lamp bracket and remove windshield.

2. See Figure 8-40. Remove screws (1) and washers (2) that secure the turn signal lamp to the passing lamp bracket (3). Remove lamp(s) (4).

3. Disconnect passing lamp connector.

4. Remove passing lamp terminals, see AMP MULTILOCK ELECTRICAL CONNECTORS. Slide lamp wires out of conduit.

5. Use a flare nut socket to remove the nut (5) that secures lamp (6) to bracket. Remove passing lamp(s) (6).

6. Remove bolts (7), lockwashers (8) and washers (9) securing passing lamp bracket to fork brackets. Remove passing lamp bracket.

INSTALLATION

1. Place passing lamp bracket in position. Install bolts, lockwashers and washers that secure bracket to the fork bracket and snug bolts. Install an upper bracket bolt to hold passing lamp bracket in place.

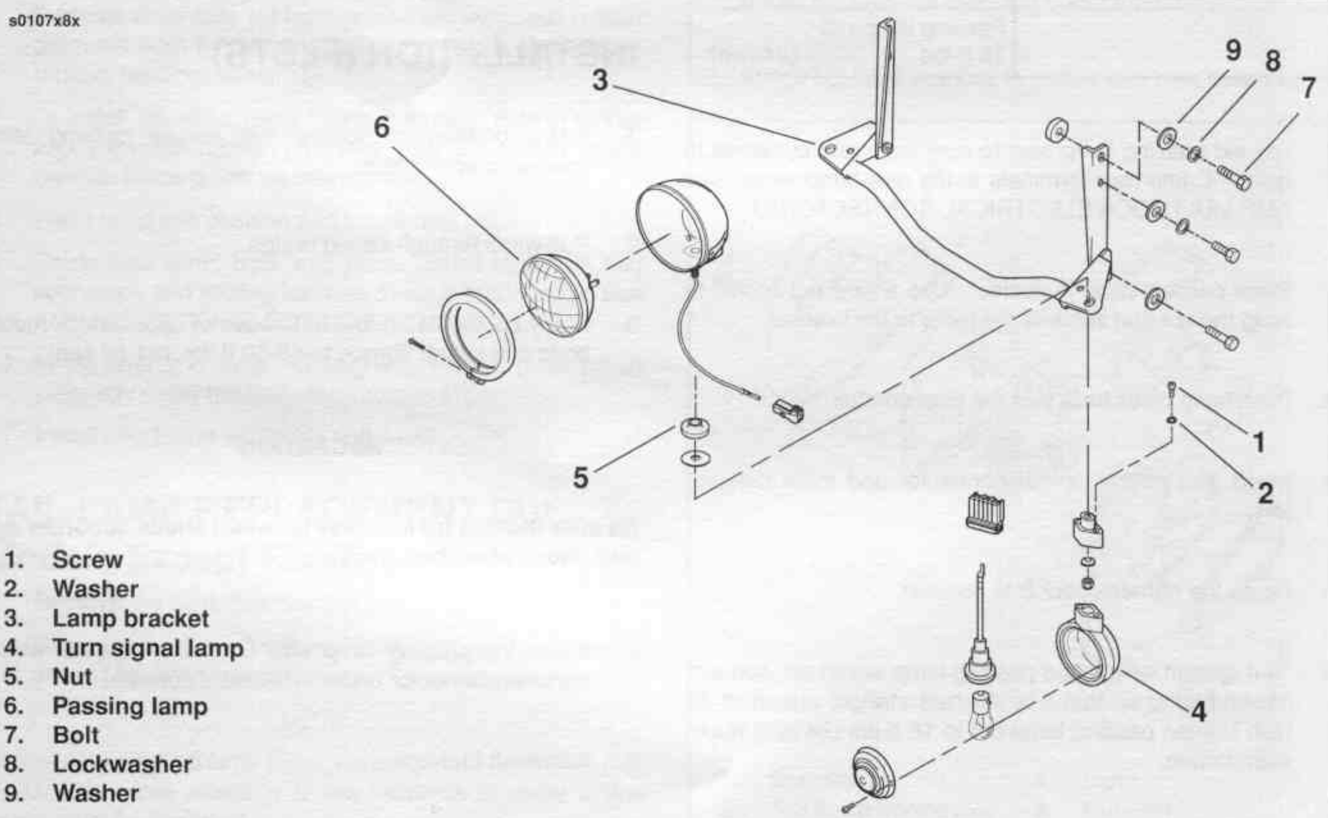
2. Place lamps in position. Use a flare nut socket to snug the nut (5) that secures the lamp to the bracket.

3. Install terminals back into the connector and connect the connector. See AMP MULTILOCK ELECTRICAL CONNECTORS

4. Turn ignition switch on and test for proper operation and alignment. See PASSING LAMPS. Loosen and readjust if necessary. Tighten nuts to 18 ft-lbs (24 Nm) maximum torque.

5. Install the screws that secure the turn signal lamps to the mounting bracket.

6. Place windshield in position and install bolts loosely. Adjust windshield height so that top of windshield is at rider's eye level while seated on motorcycle, and tighten bolts.



1. Screw
2. Washer
3. Lamp bracket
4. Turn signal lamp
5. Nut
6. Passing lamp
7. Bolt
8. Lockwasher
9. Washer

Figure 8-40. FLSTC Passing Lamp Bracket

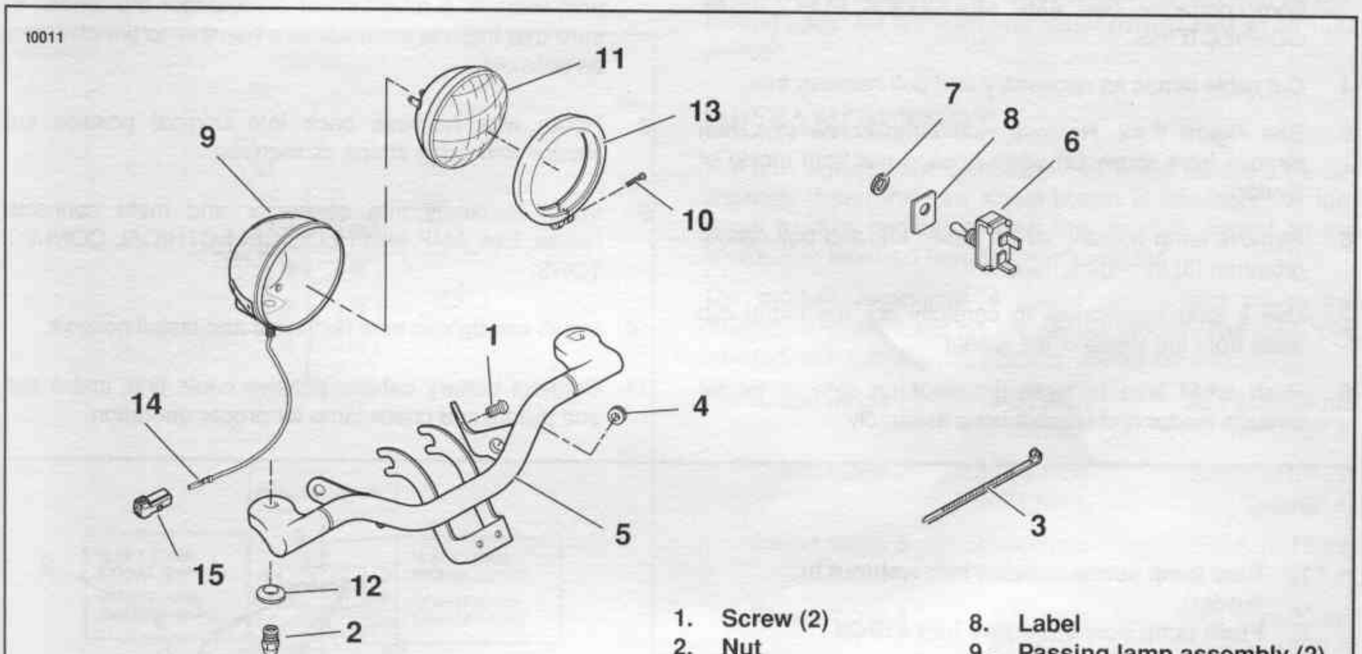
PASSING LAMP BRACKET (FLSTS)

REMOVAL

1. Disconnect passing lamp connectors (15).
2. Remove the nuts (2) that secure lamps (9) to passing lamp bracket (5). Remove lamps (9).
3. Remove screws (1) that secure passing lamp bracket to fork brackets. Remove passing lamp bracket.

INSTALLATION

1. Place passing lamp bracket in position. Install and tighten screws (1).
2. Place lamps in position. Install and tighten nuts (2) that secure the lamps to the passing lamp bracket.
3. Connect the passing lamp connectors (15).
4. Turn ignition switch on and test for proper operation and alignment. See PASSING LAMPS. Loosen and readjust if necessary. Tighten nuts to 18 ft-lbs (24 Nm) maximum torque.



1. Screw (2)
2. Nut
3. Cable strap (2)
4. Grommet (2)
5. Bracket
6. Toggle switch
7. Nut
8. Label
9. Passing lamp assembly (2)
10. Screw (2)
11. Sealed unit (2)
12. Clamp block (2)
13. Molding (2)
14. Socket contact (8)
15. Socket housing

Figure 8-41. FLSTS Passing Lamp Bracket

FRONT FENDER LAMP (FLSTS)

REMOVAL

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause an explosion resulting in personal injury.

1. Remove seat, disconnect battery cables, negative cable first, and remove the instrument console.
2. Remove top tank fasteners on left side, and loosen, but do not remove, lower tank fastener.

NOTE

Before removing wires from connector, or harness from frame, carefully note routing for reinstallation.

3. Disconnect connector [32B] and remove socket terminals from connector. See AMP MULTILOCK ELECTRICAL CONNECTORS.
4. Cut cable straps as necessary and pull harness free.
5. See Figure 8-42. Remove rear lamp screw (1), then remove front screw (2) while holding nut from inside of fender.
6. Remove lamp housing as an assembly, and pull rubber grommet (3) through fender.
7. Use a long screwdriver to carefully pry the metal clip away from the inside of the fender.
8. 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. 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.
5. Install front lamp screw while holding nut from inside of fender and tighten screw securely.
6. Tighten rear lamp screw 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 AMP MULTILOCK ELECTRICAL CONNECTORS.
10. Install and tighten tank fasteners and install console.
11. Connect battery cables, positive cable first; install seat and pillion; and check lamp for proper operation.

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1. **Rear lamp screw (screws into weldnut in fender)**
2. **Front lamp screw (screws into #10-24 Keps nut under fender)**
3. **Rubber grommet**
4. **Bulb**

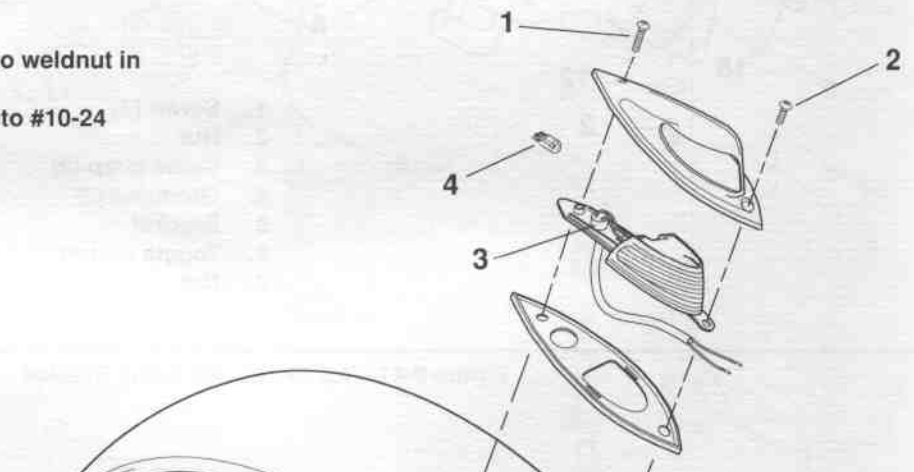


Figure 8-42. Front Fender Lamp (FLSTS)

TURN SIGNAL CANCELLER

OPERATION

General

The turn signals and 4-way hazard flasher are controlled by an electronic module mounted on the top frame tube between the fuel tanks. The module contains computer chips and circuitry programmed to generate 12 VDC pulses for "flashing" the turn signal lamps.

Theory of Operation

The following example explains what happens when a rider signals for a left turn.

1. Pressing a turn signal switch causes a momentary 12 VDC pulse to be sent to the module. The module responds to this signal by sending a series of 12 VDC pulses to flash front and rear signal lamps.

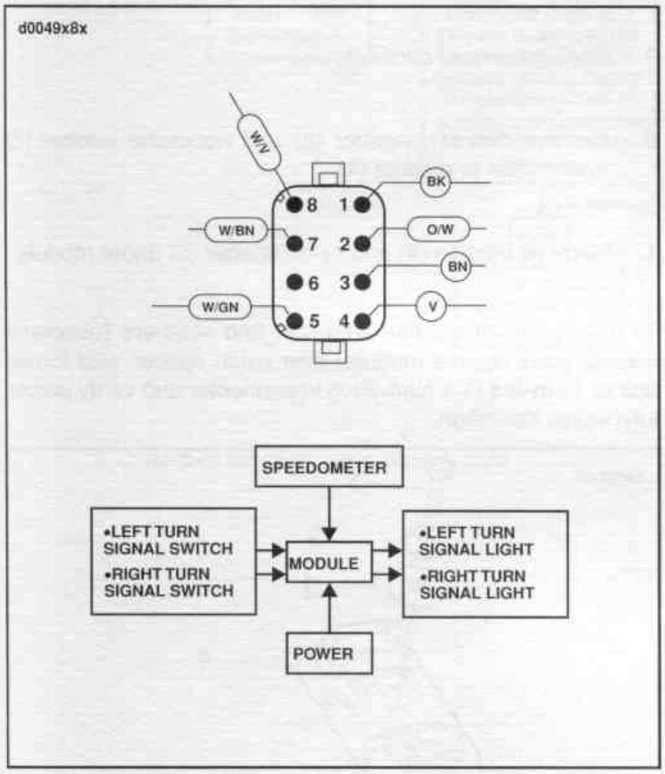


Figure 8-43. Turn Signal Module

2. The module monitors the number of vehicle speed sensor pulses from the speedometer. These pulses indicate distance traveled. When the number of pulses equals the quantity preset in the module program, the left signal is canceled.

⚠CAUTION

During troubleshooting, operating module without pin 1 grounded will cause module to burn out.

Turn Signal Microprocessor Pin Connections

Pin No.	Description/Function
1	Module ground to motorcycle.
2	12 VDC input from accessory circuit breaker.
3	Pulsed 12 VDC for flashing right signal lights.
4	Pulsed 12 VDC for flashing left signal lights.
5	Vehicle speed sensor input (from speedometer)
6	Not used.
7	12 VDC input from right switch.
8	12 VDC input from left switch.

NOTE

Distance test and time test described below can also be performed using the speedometer tester (HD-41354) as an input device.

DISTANCE TEST

The turn signals cancel after the rear wheel travels a certain distance. When the turn signal button is released, the turn signal module begins counting the distance, based on the information received from the speedometer.

The module recognizes 4 speed ranges and bases the distance it is activated on the speed ranges. The distances traveled, with turn signals flashing, are as follows:

Speed range 1	0-34 mph 0-56 km/h	221 ft. (0.04 mi) 67 m
Speed range 2	35-44 mph 56-71 km/h	339 ft. (0.06 mi) 103 m
Speed range 3	45-60 mph 72-97 km/h	680 ft. (0.13 mi) 207 m
Speed range 4	61+ mph 98+ km/h	1051 ft. (0.20 mi) 320 m

To check module operation, do the following:

1. Operate the motorcycle at the midpoint of speed range 1 (15 mph) (24 km/h).
2. Press and release the right turn button and closely monitor the vehicle speed and odometer reading at the time the button is released and at the time the turn signal cancels.

NOTE

Because the odometer's lowest indication is 1/10 of a mile, 0.04 mi. is 4/10 the distance between numbers on the tenth of a mile odometer wheel.

3. Repeat steps 1 and 2 for left turn and for right and left turns at midpoint of speed ranges 2 through 4.
4. If the distances observed in steps 1 through 3 are not correct, check the following:
   a. Turn signal module ground and module pin connections.
   b. Lamp grounds and lamp connections.
   c. Vehicle speed sensor connections and grounds.
      - Use a voltmeter. Place red probe on the speedometer white/green wire and the other probe on a suitable ground.
      - Spin rear wheel. Voltmeter reading should vary from 8-12 VDC to less than 1 volt and back again.
   d. Replace module with known good module and repeat DISTANCE TEST.

NOTE

It is very important that the turn signal module and the turn signal lamps are at the same ground potential; that is, the grounds for both the module and the lamps must have good continuity to each other.

TIME TEST (ALTERNATE)

An alternate method of checking the module for correct operation is to measure the turn signal "ON" time at a constant speed. The approximate "ON" times at four constant speeds are as follows:

CONSTANT SPEED	TURN SIGNAL "ON" TIME (SECONDS)
25 mph (40 km/h)	5-7
38 mph (61 km/h)	5-7
52 mph (84 km/h)	8-10
65 mph (105 km/h)	10-12

Rider Preference

The module begins counting the instant the rider pushes the switch. If the rider prefers a longer distance with turn signals "ON", the button can be held in longer and released closer to the turning point. For a shorter distance (with turn signals "ON"), the button can be pressed a second time to cancel the turn signal.

TROUBLESHOOTING

CAUTION

Do not apply 12 VDC to module with pin 1 not connected to ground. Module will be burned out.

See the chart on the following page for troubleshooting procedures.

REPLACEMENT

See Figure 8-44. The turn signal module is mounted between the fuel tanks.

1. Remove fuel tank console and loosen front fuel tank bolts. See FUEL TANK, Section 2.
2. Unplug harness connector.
3. Remove bolt (1), washer (2) and neoprene washer (3) from center of module (4).
4. Remove module (4) and nylon spacer (5) under module.

To install, mount module with bolt and washers (neoprene washer goes against module) over nylon spacer, and torque bolt to 10 **in-lbs** (1.1 Nm). Plug in connector and verify proper turn signal operation.

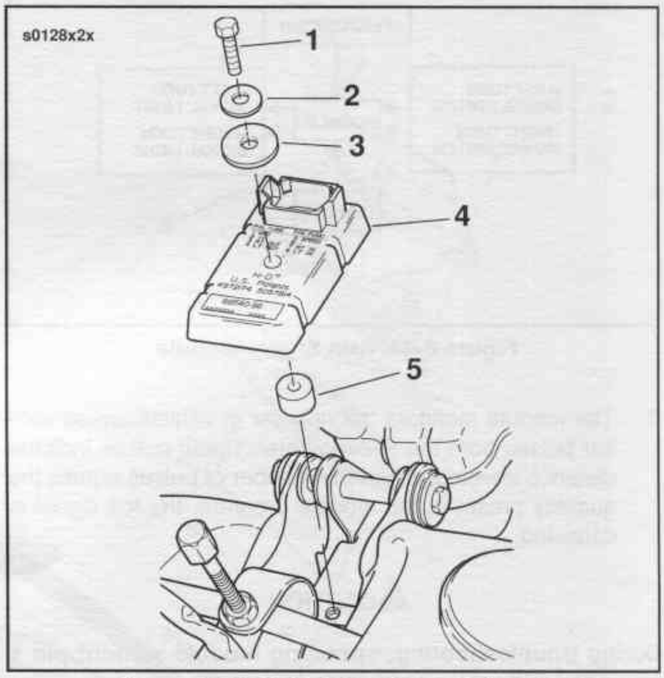


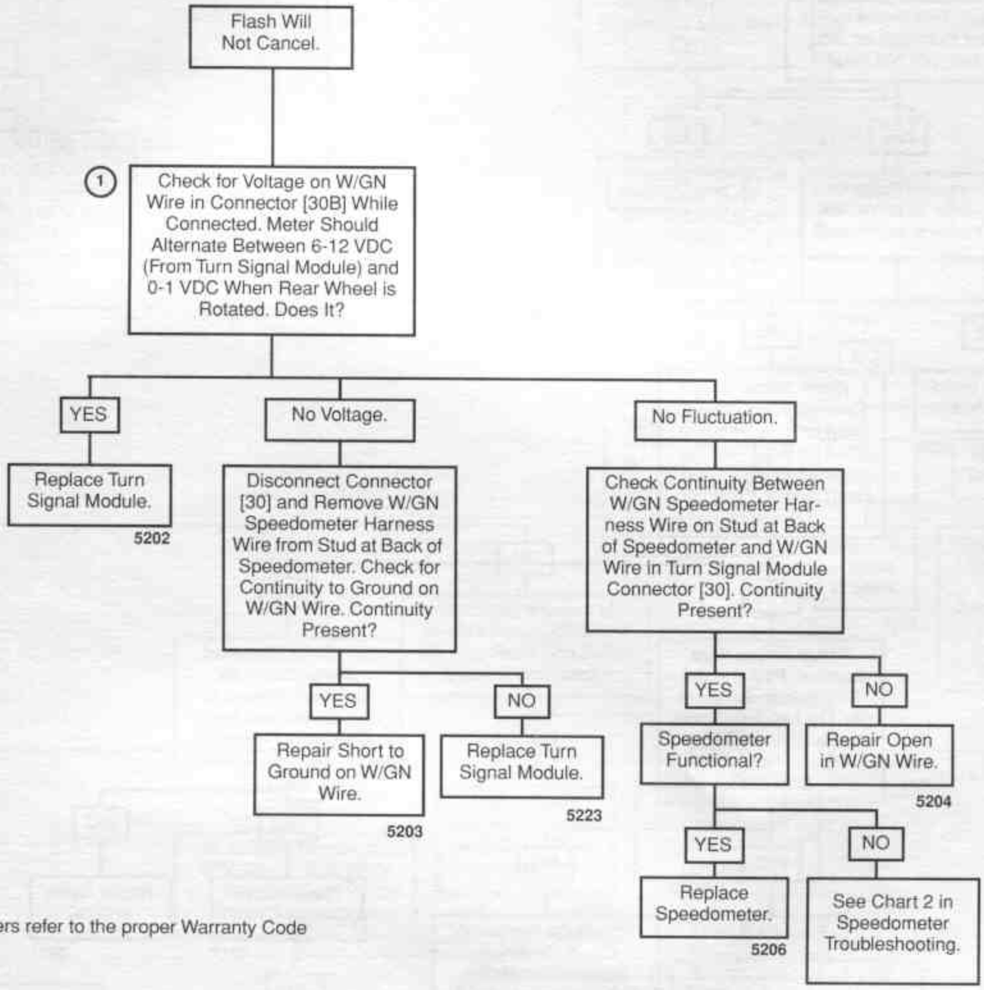
Figure 8-44. Softail Turn Signal Module

Chart 1: Turn Signals Will Not Cancel.

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

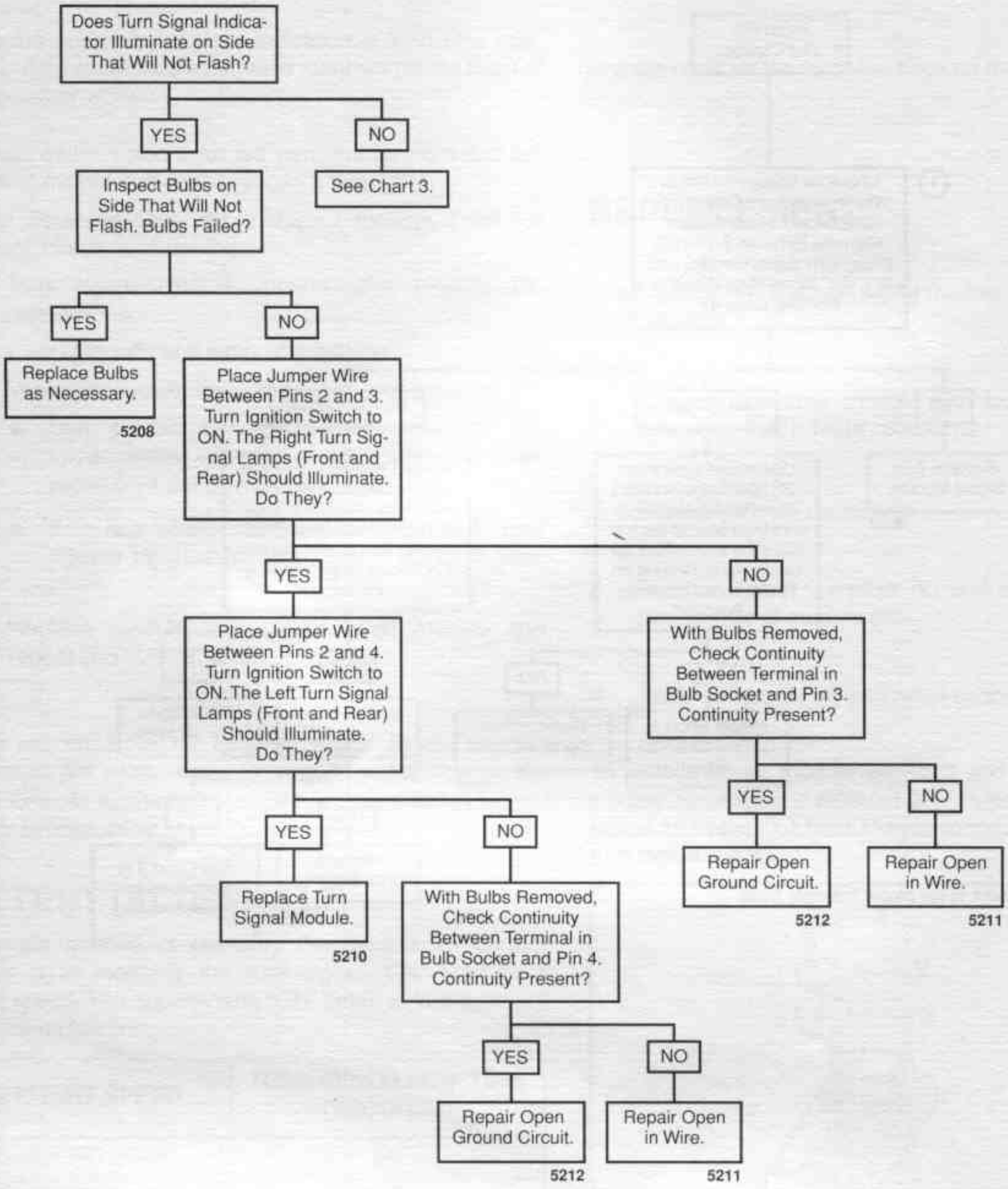
1. Remove instrument panel. See IGNITION LIGHT SWITCH, Removal, steps 1-3.



Numbers refer to the proper Warranty Code

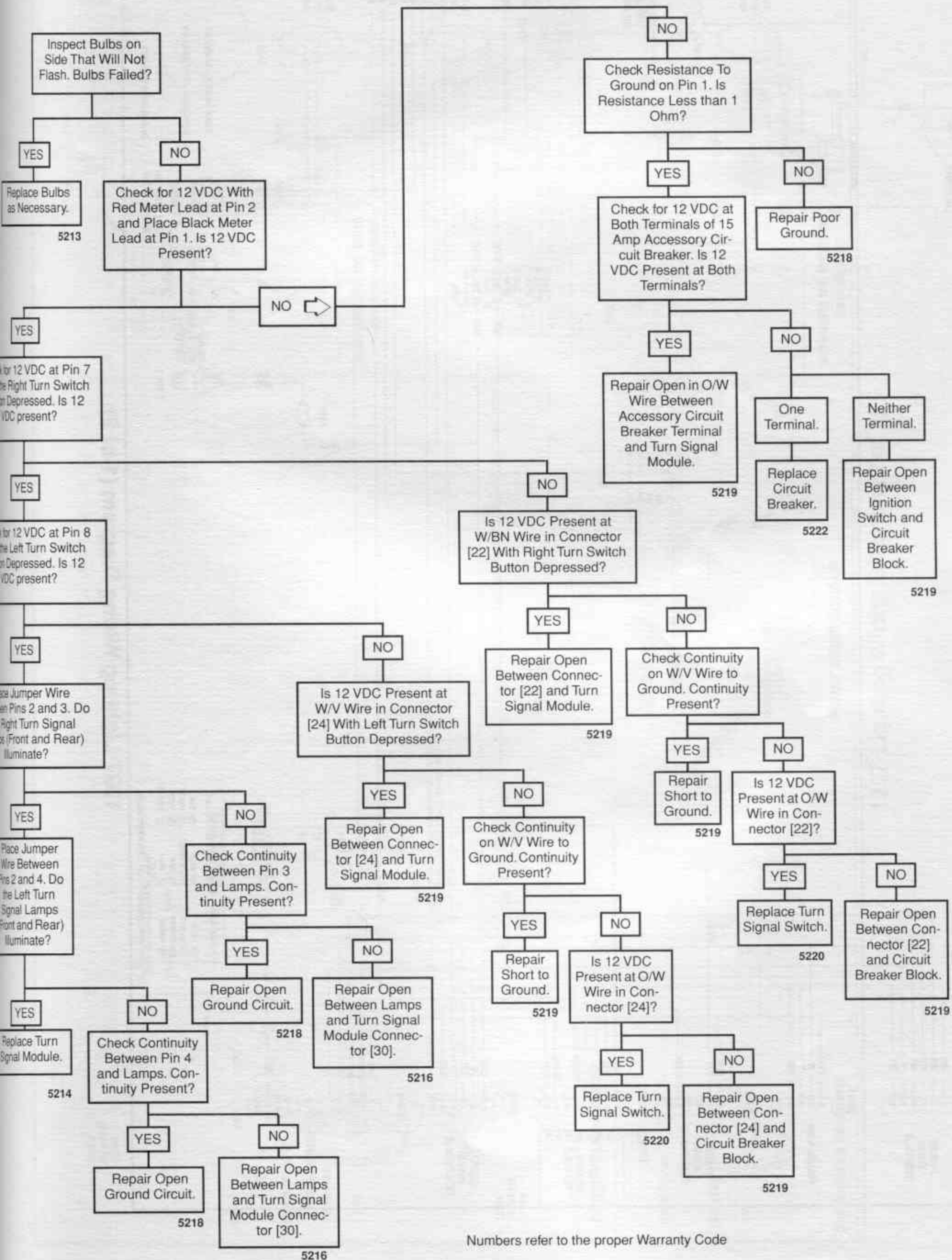
Turn Signal Troubleshooting

Chart 2: Turn Signals Will Not Flash Right, Will Not Flash Left.

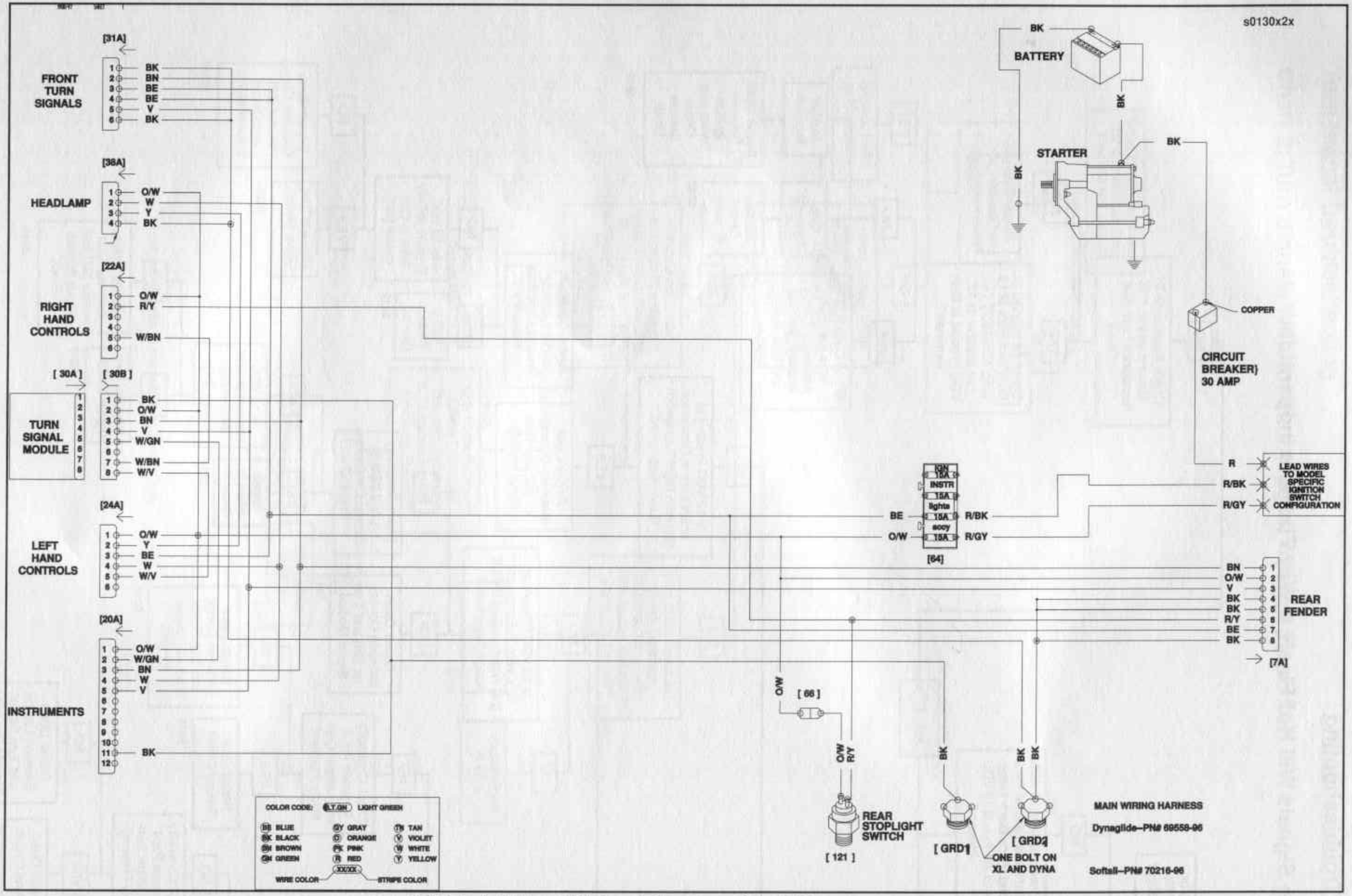


Numbers refer to the proper Warranty Code

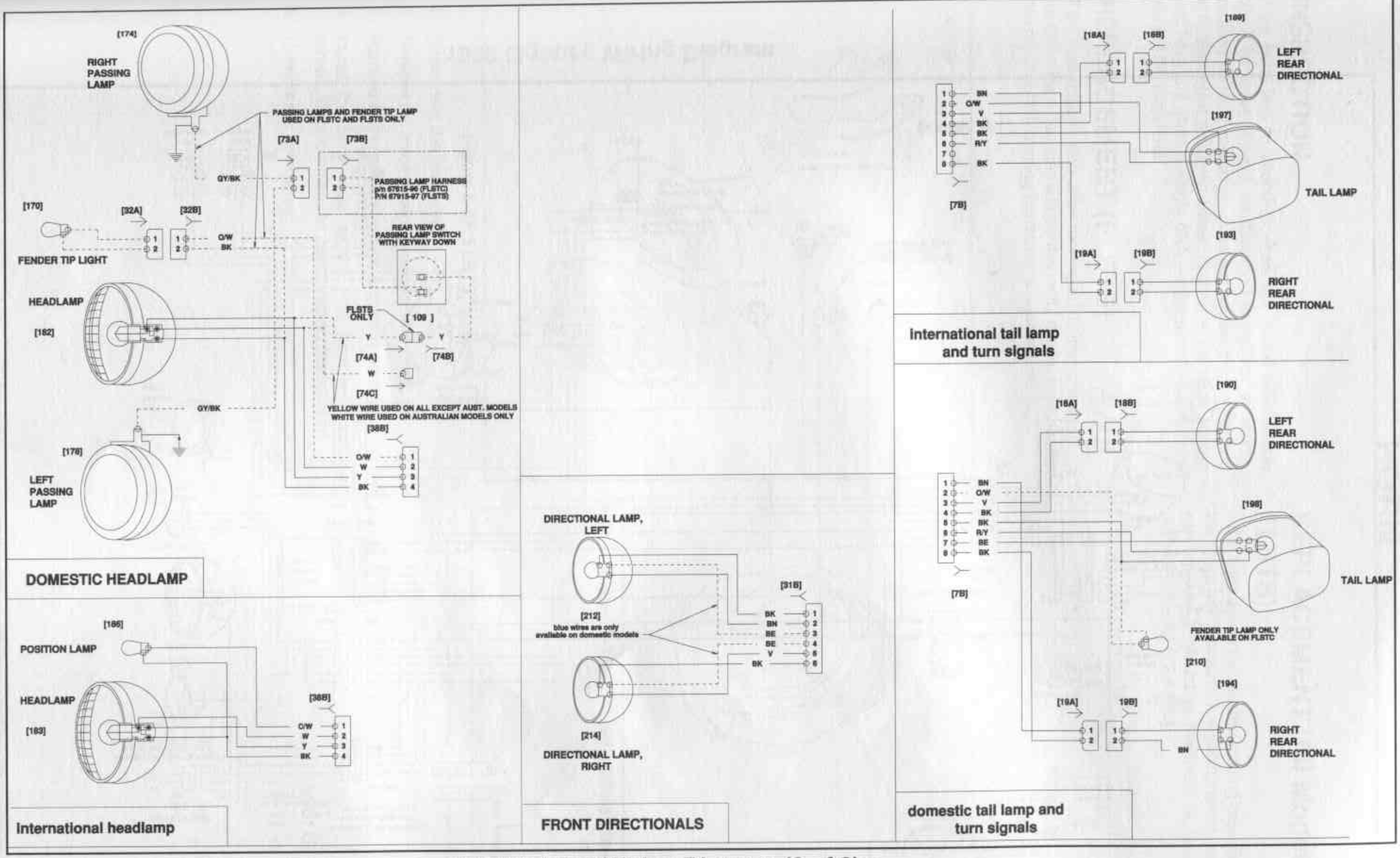
Chart 3: Turn Signals Will Not Flash, 4-Way Flashers Inoperable.



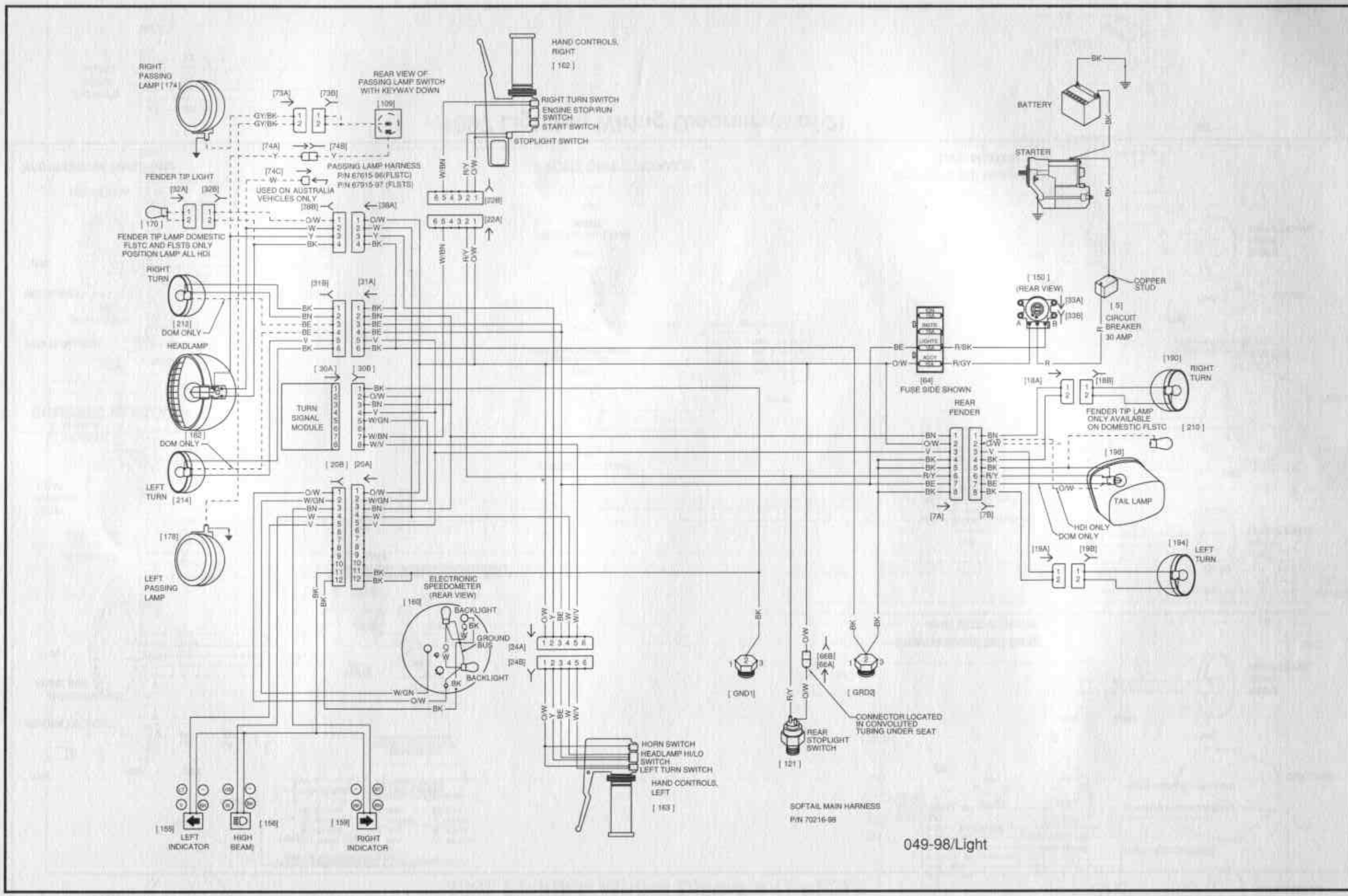
Numbers refer to the proper Warranty Code



1997 Lighting Wiring Diagram (1 of 2)



1997 Lighting Wiring Diagram (2 of 2)



1998 Lighting Wiring Diagram

INSPECTION

If the horn fails to sound or does not sound satisfactorily, check for loose, frayed, or damaged wires. For all models except FLSTS, if the above does not correct the trouble, turn in contact point adjusting screw, located at the back of horn, until horn just gives a single click – then unscrew screw until you get the best tone.

REPLACEMENT (FLSTS)

If the horn doesn't work after moving adjusting screw, replace the entire horn because it is permanently riveted together and non-repairable. Mounting hardware is replaceable.

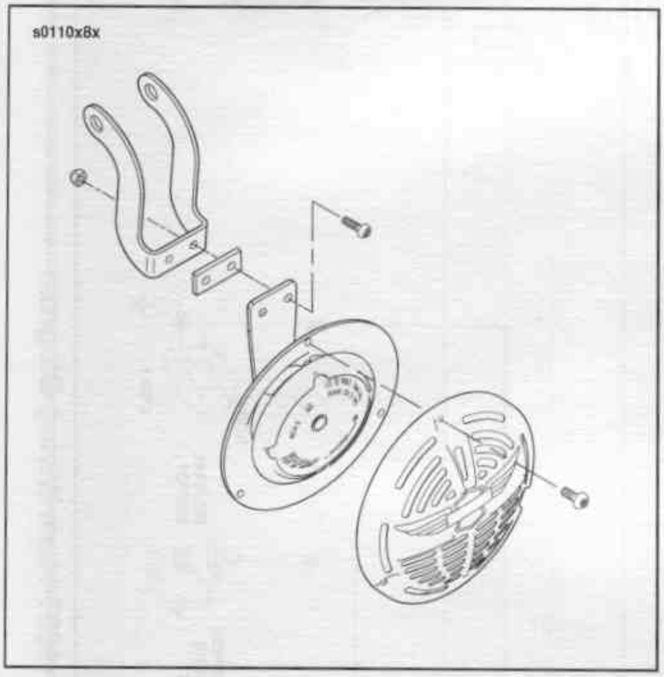


Figure 8-45. FLSTS Horn

1. Disconnect the horn wires.
2. Remove the three retaining screws and cover.
3. Remove two mounting screws and horn assembly.
4. Install the horn cover to the new horn with existing screws. Torque screws to 23-28 **in-lbs** (2.6-3.1 Nm).
5. Connect the horn wires.

REPLACEMENT (All Models Except FLSTS)

If the horn doesn't work after moving adjusting screw, replace the entire horn because it is permanently riveted together and non-repairable. Mounting hardware is replaceable. Tighten nut to 110 **in-lbs** (12.4 Nm).

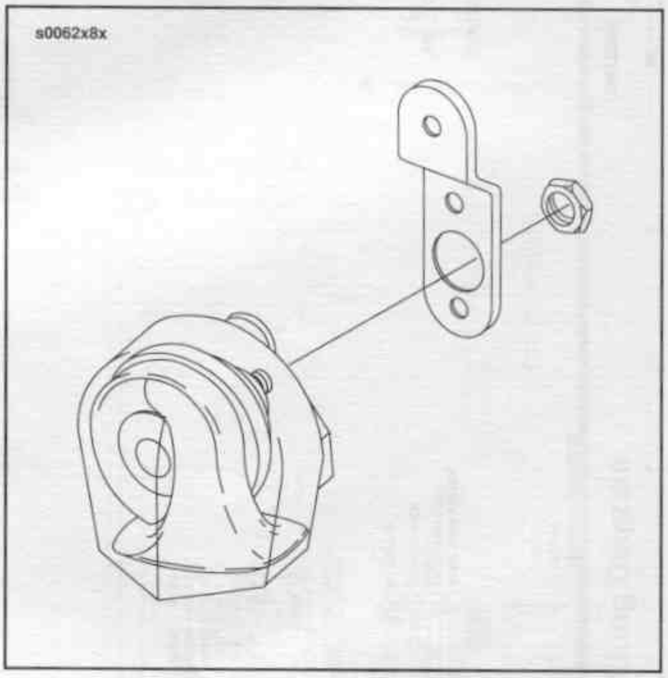
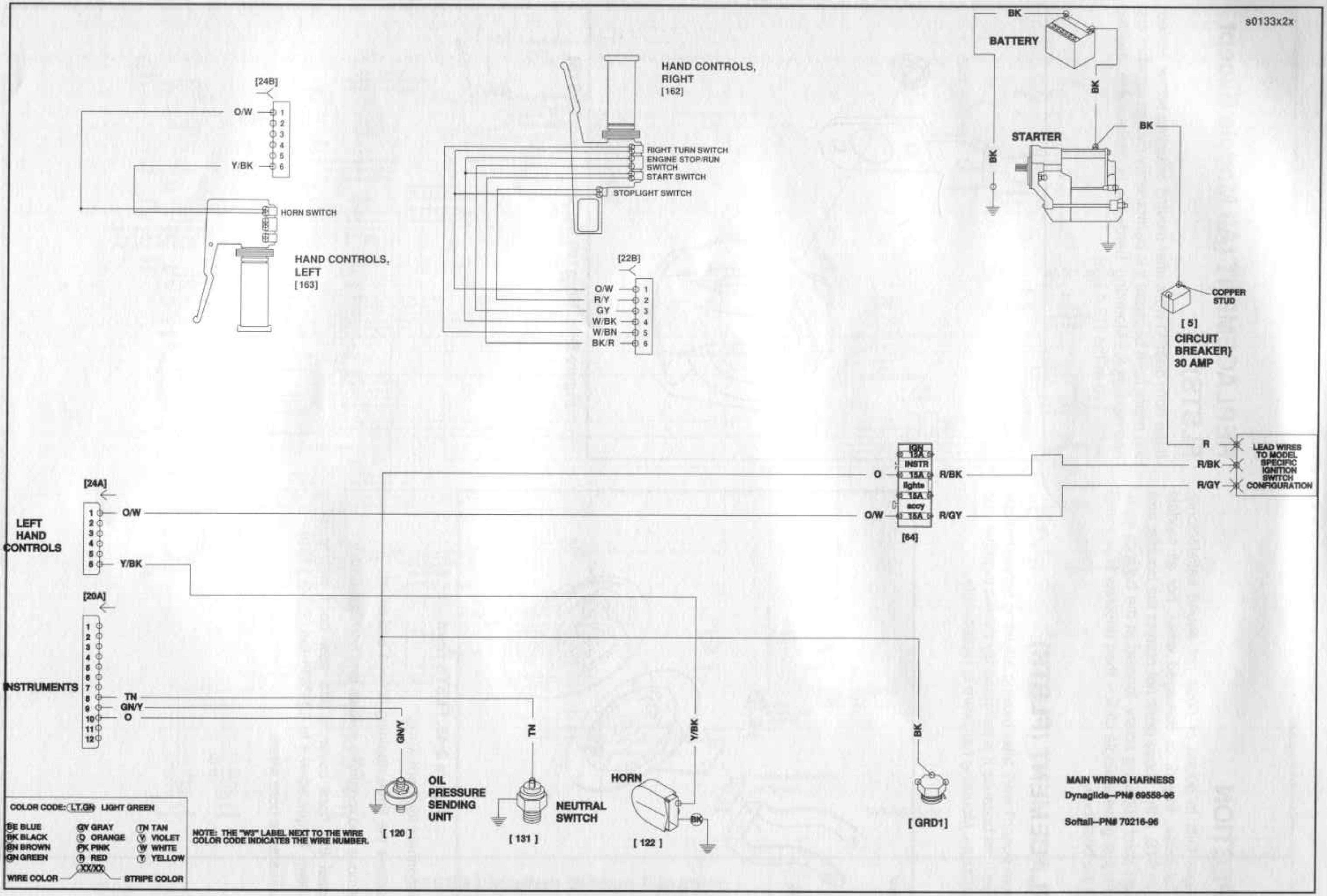
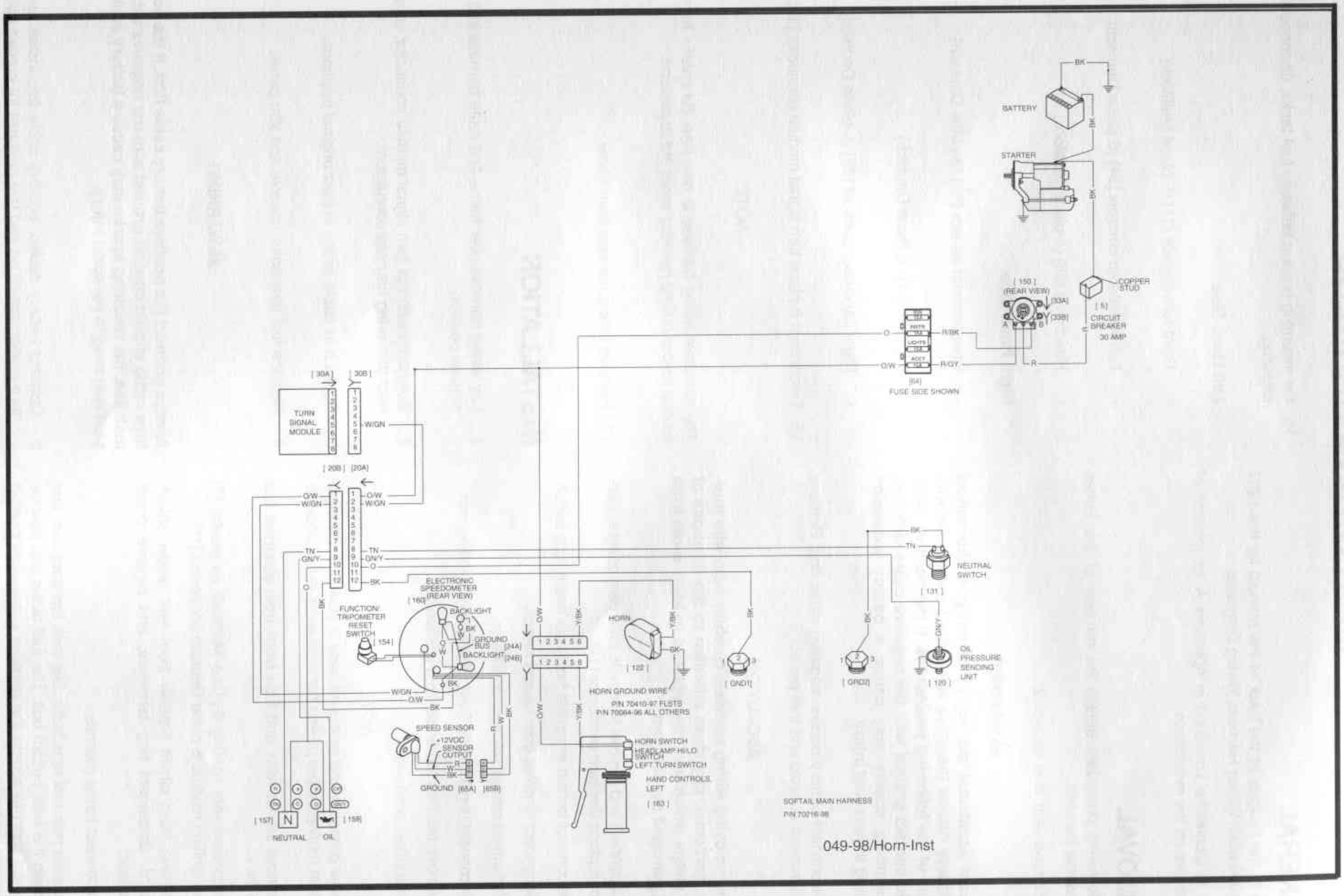


Figure 8-46. Horn (all models except FLSTS)



1997 Horn Wiring Diagram



1998 Horn Wiring Diagram

MAIN WIRING HARNESS

GENERAL

Refer to the foldouts at the back of the manual for the 1997 and 1998 Main Wiring Harness Wiring Diagrams.

Refer to Connector Locations in Appendix A for location of connectors on the motorcycle.

REMOVAL

The following procedure details the removal of the Softail main wiring harness:

1. Remove seat. See Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. Disconnect battery cables, negative cable first. Remove instrument console and trim panel.

⚠CAUTION

Before removing wiring harness, carefully note wire routing. In particular, pay close attention to the locations of cable straps which must be replaced to keep wires from being damaged by vibration.

3. Disconnect and remove terminals from cam position sensor 3-place Deutsch connector [14].
4. Disconnect female terminals from rear brake light switch.
5. Disconnect terminal from neutral switch.
6. Disconnect starter solenoid connector.
7. Disconnect ring terminal from oil pressure sending unit.
8. Remove two ring terminals from ignition coil.
9. Disconnect horn wires.

NOTE

The lower portion of the wiring harness is now free. Be careful to note routing before pulling harness wires out of position.

10. Remove starter relay and fuse block from electrical box cover.
11. Disconnect rear lighting 8-place Multilock connector [7] and ignition module 8-place Deutsch connector [10].
12. Remove main circuit breaker from rear fender splash guard, disconnect ring terminals, and remove circuit breaker.
13. Disconnect frame grounds.
14. Remove rear fuel tank bolts, fuel tank top front bolt, and loosen the tank bottom bolt. The fuel tanks can now be spread apart to access the harness connectors located between the tanks.
15. On mounting bracket between fuel tanks, disconnect the following:

Left Hand Side

- Front turn signals [31] (6-place Multilock)
- Left handlebar controls [24] (6-place Deutsch)
- Headlamp [38] (4-place Multilock)

Right Hand SIde

- Speedometer sensor [65] (3-place Deutsch)
- V.O.E.S. [11] (2-place Deutsch)
- Right handlebar controls [22] (6-place Deutsch)

16. Disconnect 8-place turn signal module connector [30].

NOTE

The complete wiring harness is now free. Be careful to note routing before pulling harness wires out of position.

17. Remove wiring harness from frame.

INSTALLATION

1. Lay wiring harness over frame and route harness into its original position.
2. Beginning with the turn signal module connector, reconnect the wiring harness connectors.
3. Replace all cable straps in their original positions.
4. Replace fuel tank bolts, console and trim panel.

⚠WARNING

Always connect the positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

5. Connect battery cables, positive cable fist. Install seat, turn ignition switch on and test switches for correct operation.

NOTES

ELECTRONIC SPEEDOMETER

THEORY OF OPERATION

The electronic speedometer consists of a speed sensor, function switch and the speedometer. The speed sensor is mounted on the right side of transmission case below the starter. The sensor circuitry consists of a Hall-Effect sensor that is triggered by the gear teeth of 4th gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by speedometer circuitry to control the position of the speedometer needle and the liquid crystal (LCD) odometer display.

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The function switch allows switching between the odometer and trip odometer displays.

To zero the trip odometer, have the odometer display visible, press and keep the function switch depressed. The trip odometer mileage will be displayed for 2-3 seconds and then the trip mileage will return to zero miles.

The odometer can display seven numbers to indicate a maximum of 999999.9 miles. The trip odometer can display five numbers for a maximum of 9999.9 miles.

Circuitry in the speedometer also uses the sensor input to provide an input to the turn signal canceler. This turn signal canceler input was previously supplied by the reed switch in mechanical speedometers.

TROUBLESHOOTING

See Troubleshooting chart on following page for troubleshooting procedures.

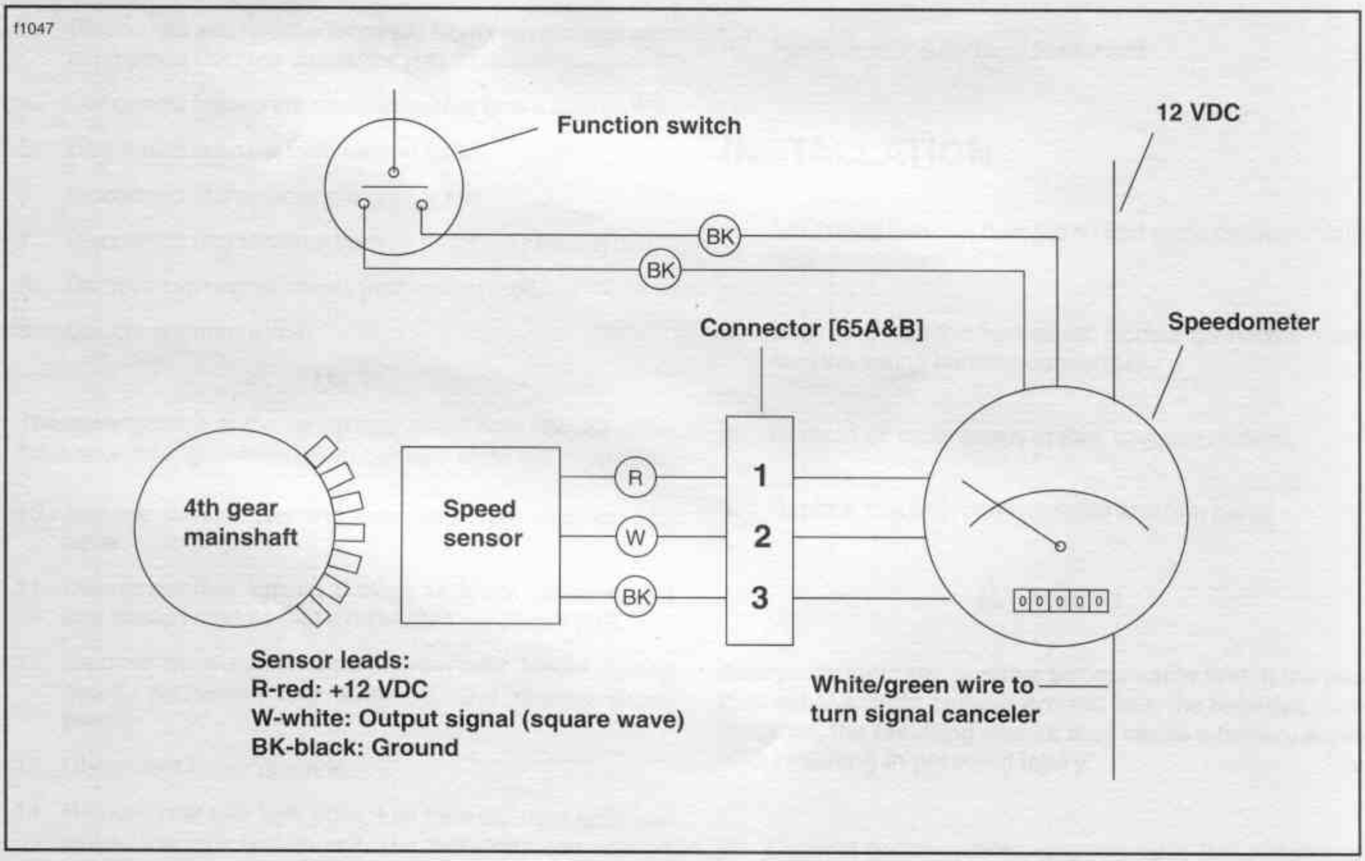
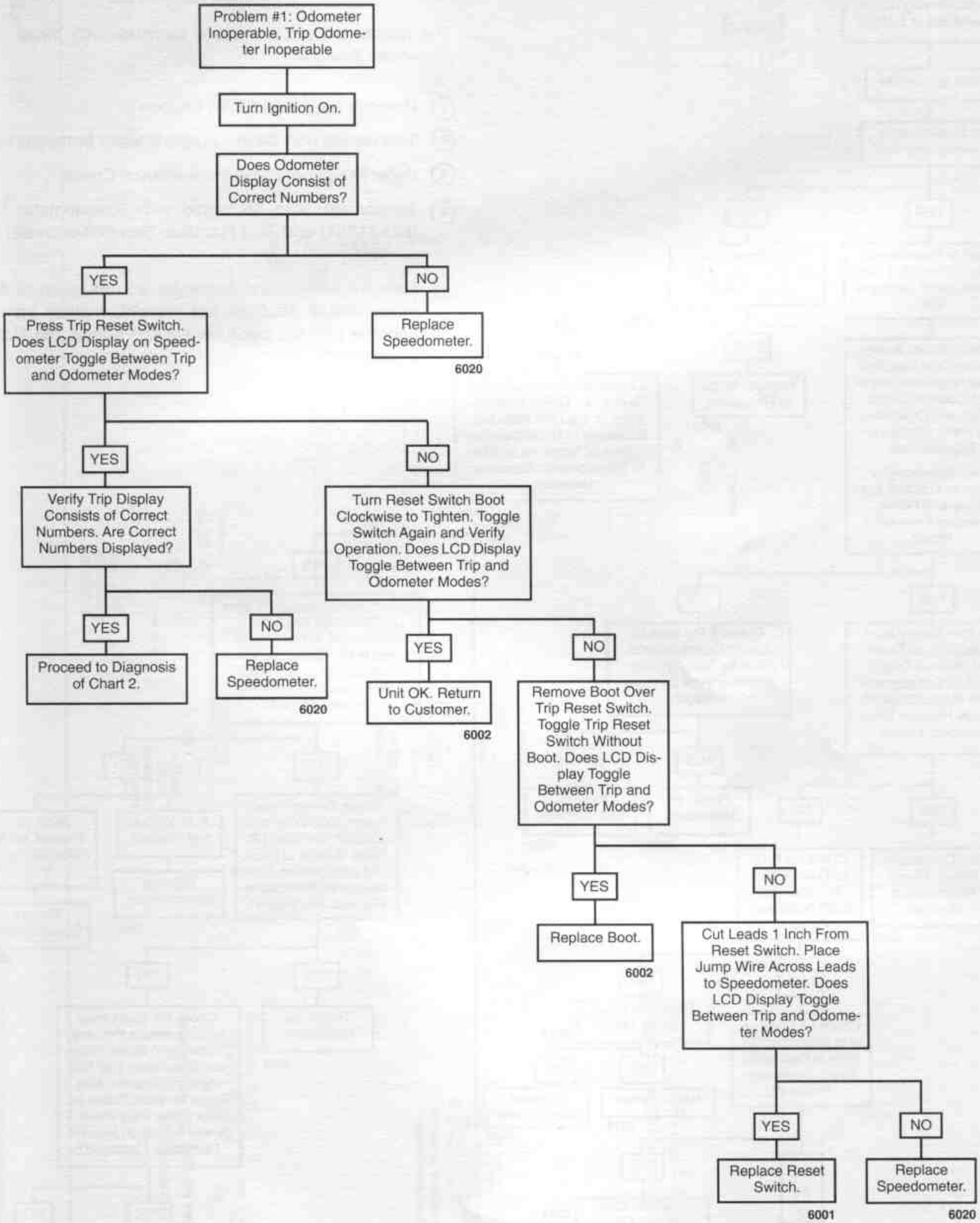


Figure 8-47. Electronic Speedometer Connectors

Speedometer Troubleshooting

Chart 1: Odometer, Trip Odometer and Reset Switch



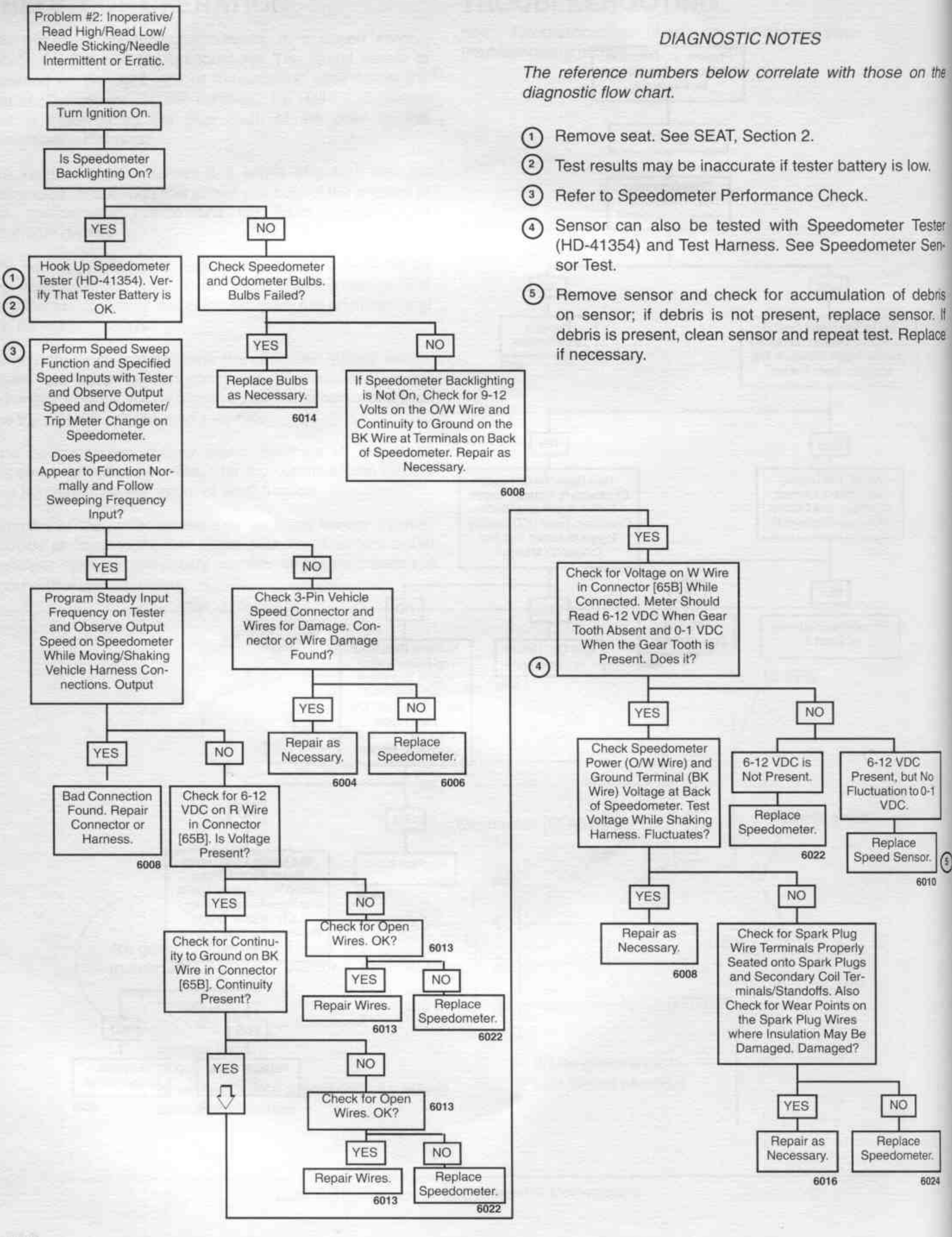
Speedometer Troubleshooting

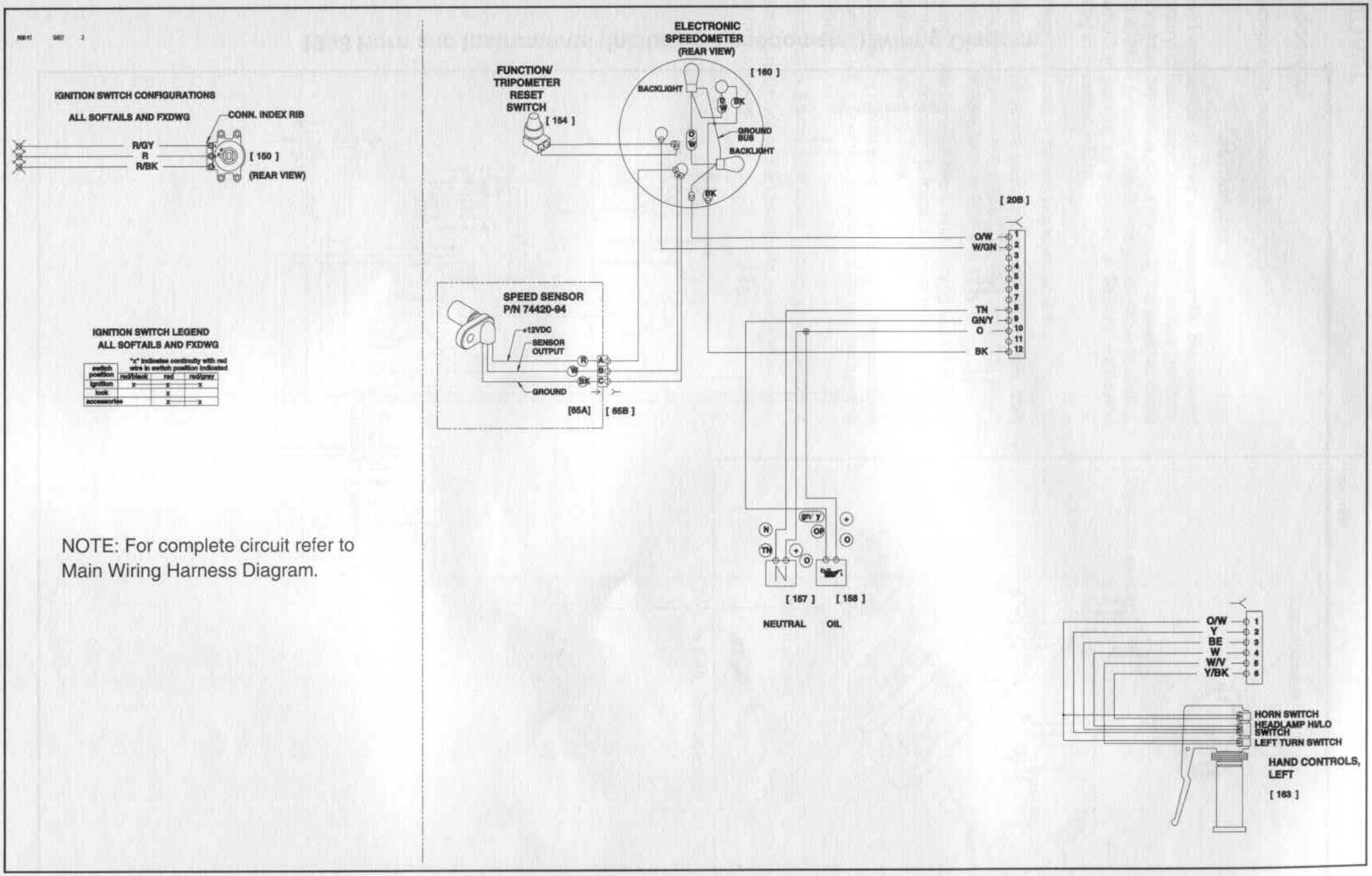
Chart 2: Inoperative, Inaccurate or Eratic Speedometer

DIAGNOSTIC NOTES

The reference numbers below correlate with those on the diagnostic flow chart.

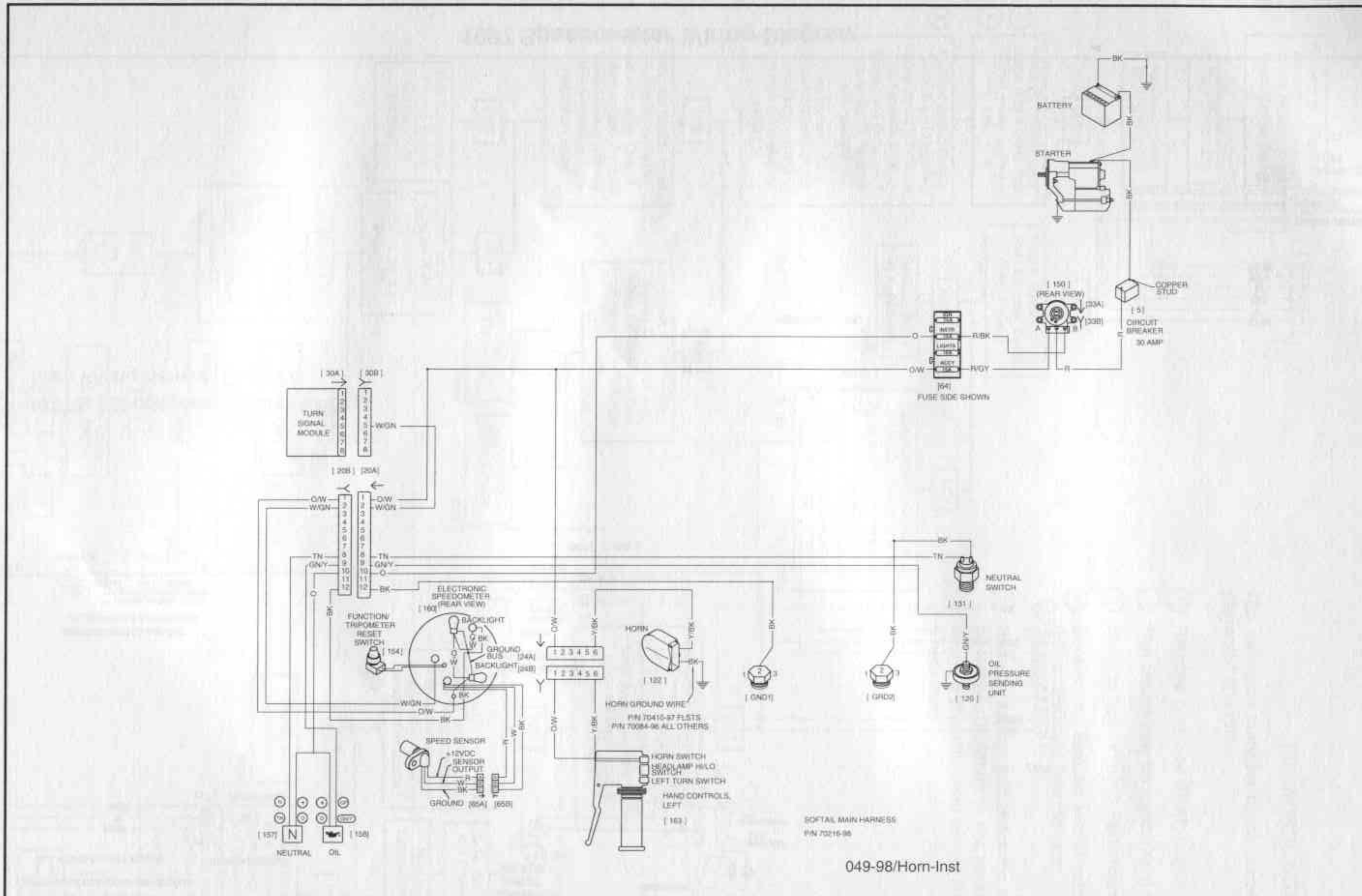
1. Remove seat. See SEAT, Section 2.
2. Test results may be inaccurate if tester battery is low.
3. Refer to Speedometer Performance Check.
4. Sensor can also be tested with Speedometer Tester (HD-41354) and Test Harness. See Speedometer Sensor Test.
5. Remove sensor and check for accumulation of debris on sensor; if debris is not present, replace sensor. If debris is present, clean sensor and repeat test. Replace if necessary.





NOTE: For complete circuit refer to Main Wiring Harness Diagram.

1997 Speedometer Wiring Diagram



1998 Horn and Instruments (Including Speedometer) Wiring Diagram

REMOVAL

Speedometer

1. Remove seat, see Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. Disconnect battery cables, negative cable first.
3. Remove instrument console nut and lift console from tank. Disconnect connectors [20], [33], and [65] under console. Remove console from fuel tank.
4. Remove the harness screw and clamp from the bottom of the speedometer. Cut cable straps retaining sensor cable to ignition harness.
5. Unscrew the rubber function switch cover that protrudes from the left side of the console and remove the function switch.
6. Remove the 3 wires from posts on back of speedometer.
7. Gently pry latches on back clamps to release speedometer from console.

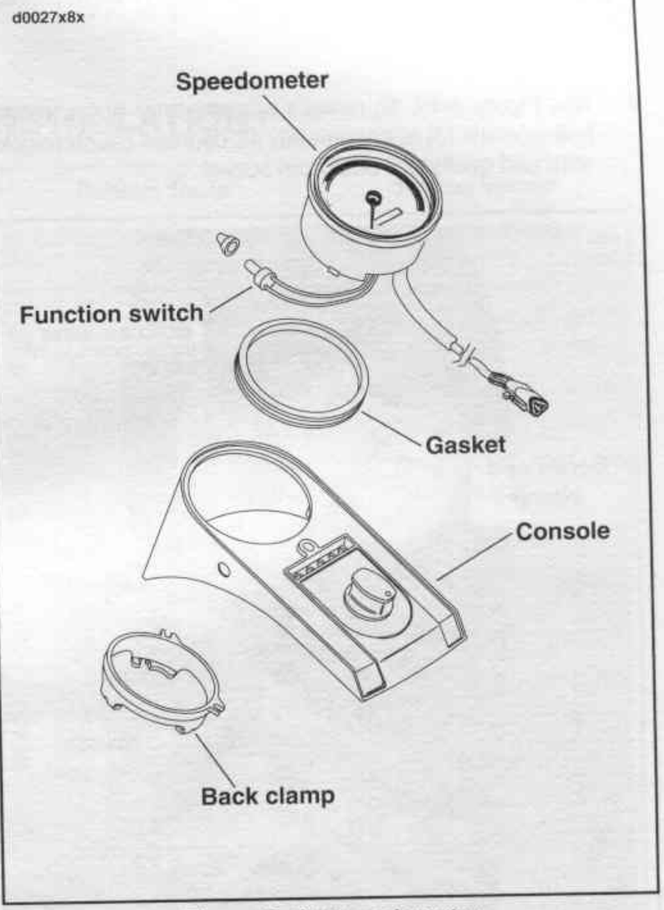


Figure 8-48. Speedometer

1. See Figure 8-49. To replace speedometer bulbs, rotate bulb sockets (3) approximately 45 degrees counterclockwise and gently pull bulb from socket.

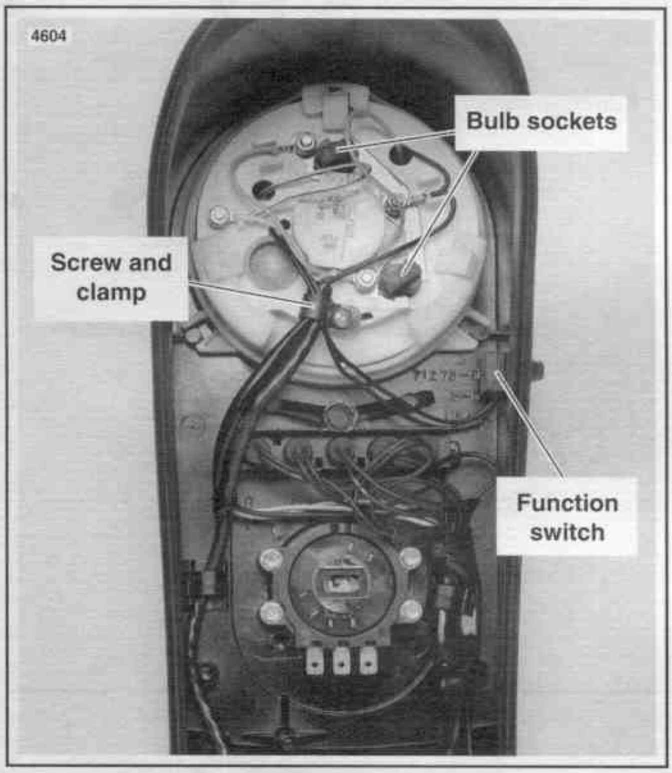


Figure 8-49. Electronic Speedometer

2. See Figure 8-50. To replace indicator bulbs, grasp indicator light socket and gently pull it from console. Pull bulb from socket. Apply a film of alcohol to the new indicator lamp sockets to lubricate the rubber, then push the sockets into their appropriate holes while rocking them until the lamp sockets are firmly seated.

INSTALLATION

Speedometer

1. Install gasket into instrument console. Lubricate inner bore of gasket with isopropyl alcohol or glass cleaner to ease installation. Install speedometer from top side of console and seat back clamp until the latches are locked into position.
2. Insert the function switch into the housing and tighten button boot.
3. Install the harness screw and clamp to the bottom of the speedometer and tighten securely. Route sensor cable into position. Replace cable straps retaining speedometer sensor cable to speedometer wiring harness.
4. Connect the harness connector [20], the 3-place ignition switch connector [33], and 3-place speedometer sensor connector [65].
5. Place the console assembly onto fuel tank. Install console nut.
6. Connect battery, positive cable first, and install seat.

.

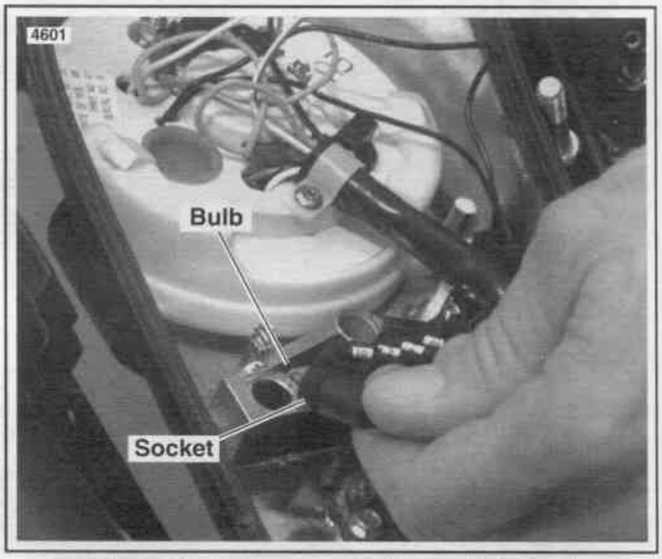


Figure 8-50. Removing Indicator Light Bulb

SPEEDOMETER SPEED SENSOR

REMOVAL

1. Remove seat. See Section 2.

⚠WARNING

To avoid accidental start-up of motorcycle, disconnect the battery cables (negative cable first) before performing any of the following procedures. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

2. Disconnect the battery cables, negative cable first.
3. Remove instrument console nut and lift console from tank.
4. Place a thick towel over the horn and air cleaner to protect the fuel tank paint, then remove rear tank bolts, front tank bolt, and loosen the tank bottom bolt. The fuel tanks can now be spread apart to access the connectors located between the tanks.
5. See Figure 8-51. The 3-place speedometer sensor connector [65] is located on a bracket behind the right side fuel tank. Remove connector from t-stud and disconnect.

Figure 8-51. Speedometer Sensor Connector

6. See Figure 8-52. Remove sensor mounting screw and lift sensor from crankcase.

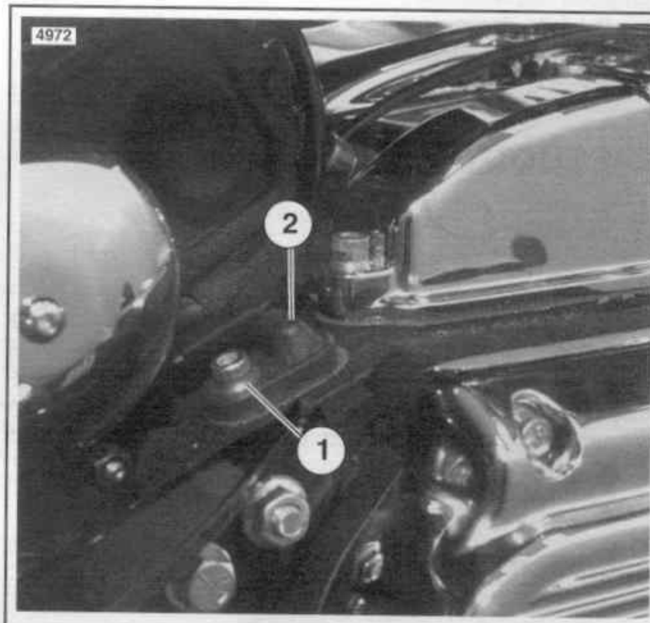
NOTE

Before removing sensor wire, carefully note wire routing. It is a good idea to lay the new sensor wire next to the old wire and remove and replace the wires together, one cable strap at a time, to ensure proper routing.

INSTALLATION

Special Tools	Torque Values
None	Sensor mounting screw 7 - 9 ft-lbs (9.5 - 12 Nm)

1. Install sensor into transmission case. Install sensor mounting screw and tighten to 7-9 ft-lbs (9.5 - 12 Nm).
2. Mate connector halves and attach 3-place connector [65] to t-stud on bracket.
3. Connect battery, positive cable first. Install seat. See SEAT, Section 2 and BATTERY, in this section.



1. Bolt 2. Speed sensor

Figure 8-52. Electronic Speedometer Speed Sensor

SPEEDOMETER PERFORMANCE CHECK

GENERAL

The performance (proper operation and sweeping action) of the speedometer can be evaluated with the speedometer tester, HD-41354. This tester generates a signal that simulates the signal from the speedometer sensor for checking speedometer operation.

Also, the signal generated by the speedometer tester can be used to simulate running engine conditions for ignition system troubleshooting. See IGNITION SYSTEM for more information on performing tests.

NOTE

Use the following procedures in conjunction with the manual supplied with the speedometer tester.

SPEEDOMETER TESTS

NOTE

The speedometer tester, HD-41354, cannot be used to verify the calibration of a speedometer and it will not verify the speedometer's function to support legal proceedings. It's purpose is to verify speedometer function when performing service diagnosis or repair, and to assist in determining if speedometer replacement is necessary.

Operation Test

1. See Figure 8-53. Disconnect speedometer sensor connector [65]. Install speedometer tester connector into speedometer sensor connector as shown.

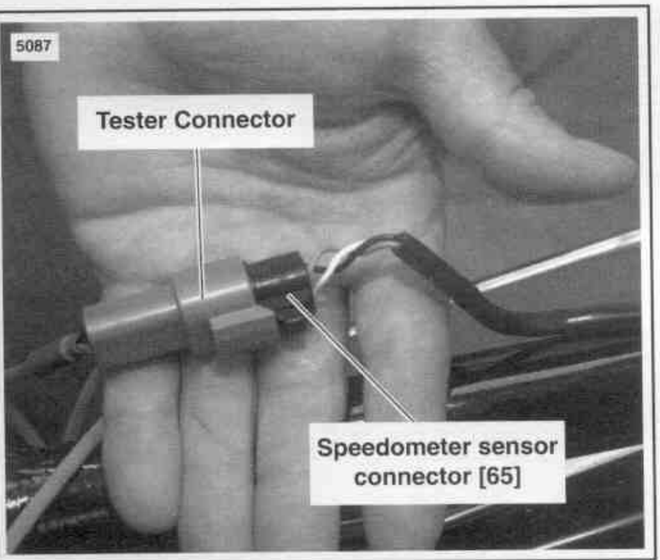


Figure 8-53. Test Connection

2. Place speedometer tester power switch in the "ON" position, and the signal switch in the "OUT" position.

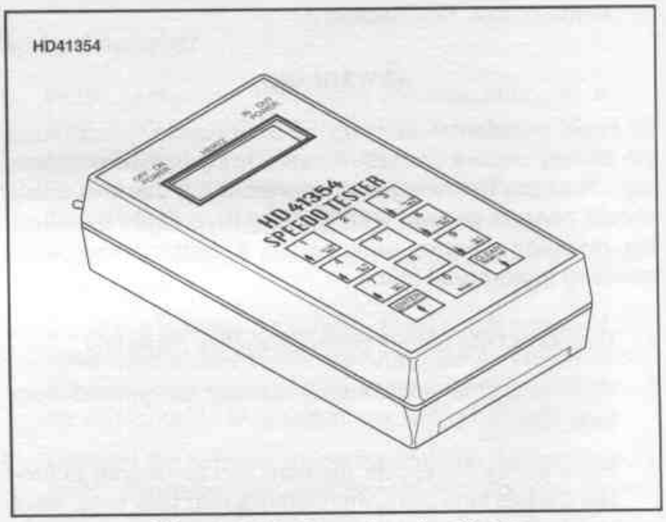


Figure 8-54. Speedometer Tester

3. Turn the ignition switch "ON". Press 1, then press "ENTER" on the tester keypad. Enter the frequency shown on the table below, press "ENTER", then check that the speedometer reads the corresponding speed. To change the frequency, press "CLEAR" to cancel, and enter the new frequency, and press "ENTER" to begin. The speedometer should be accurate within -0 to +4 mph (-0 to +6.5 kph).

Model	Tester Frequency (in Hz) Corresponding to			
	20 mph (30 kph)	40 mph (60 kph)	60 mph (100 kph)	80 mph (130 kph)
Domestic	431	859	1283	1702
HDI	402	801	1328	1719
Great Britain	431	859	1283	1702

Sweep Test

The tester's sweep function moves the speedometer needle through the full range of needle movement to allow testing for smoothness of operation, hesitancy, or needle sticking.

1. With tester connected as in operation test, place speedometer tester power switch in the "ON" position, and the signal switch in the "OUT" position.
2. Turn the ignition switch "ON". Press 0, then press "ENTER" on the tester keypad. The tester will scan for two seconds, then the tester will put out 1 Hz.
3. Use the 2, 5, and 8 keys to select one of three ranges, LO (1-20 Hz), CEN (21-999 Hz), or HI (1000-20,000 Hz).
4. After selecting a range, use the corresponding arrow keys to accelerate through the range. For example keys 1 and 3 move through the LO range. As you move through the speed range, check for smooth needle movement.

SPEEDOMETER SENSOR TEST

If the speedometer is inoperative, but backlighting and odometer work, the speedometer sensor may not be working.

To test the speedometer sensor as described below, as well as the cam position sensor test using the tachometer tester (described in IGNITION SYSTEM), a test harness is required. Fabricate the test harness by splicing together two Deutsch 3-place socket housings (72113-94BK) and one Deutsch 3-place pin housing (72103-94BK). Use six inch lengths of 18 gage wire. Install the test harness at the cam position sensor connector [14].

To diagnose the speedometer sensor, first test for voltage to sensor by checking for 8-12 VDC on Red wire in connector [65B]. Then check for continuity to ground on Black wire in connector [65B]. The following test will only work if voltage and proper ground are present at speedometer sensor.

Install the test harness between the speedometer sensor connectors [65A & B]. Turn tester power switch to ON, and place signal switch in the IN position. Plug the speedometer tester into the test harness and turn the ignition ON. Press ENTER on the keypad. Rotate the motorcycle's rear wheel. The numbers on the speedometer tester readout should change with changes in wheel speed. If the readout doesn't change, the speedometer sensor is suspect. Install a known, good speedometer sensor and test again for proper operation.

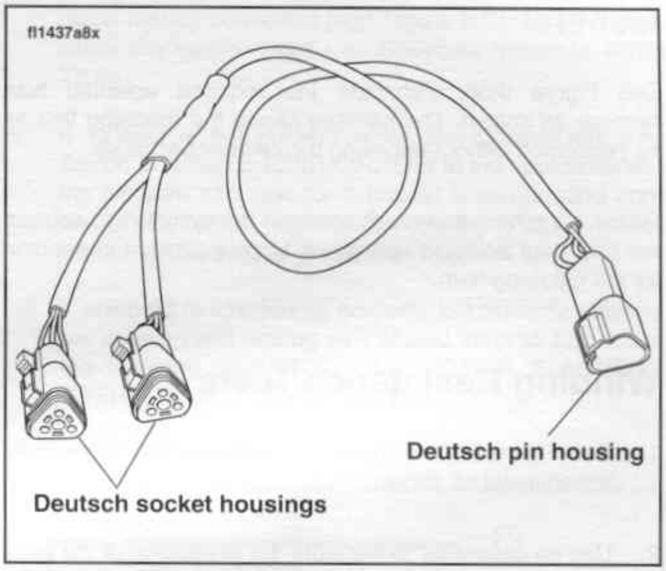


Figure 8-55. Test Harness

SOLENOID ELECTRICAL TESTS (on California air cleaner backplate assembly)

General

See Figure 8-56. Fabricate the required solenoid test harness as shown. The harness allows the following test to be performed without removing the cleaner backplate.

Remove the horn and reach between the cylinders to access the trap door solenoid connector. Unplug 3-place connector for the following test.

Winding Resistance Tests

1. See Figure 8-57. Connect the solenoid test harness to the solenoid as shown.

2. Use an ohmmeter to measure the resistance of the pull-in and hold-in windings. See the following table for probe placement instructions and resistance specifications.

Solenoid Winding Resistance Specifications

Positive Probe	Negative Probe	Winding Resistance
Green	Black	4.5-5.5 Ohms (Pull-in)
White/Black	Black	21.6-26.4 Ohms (Hold-in)

3. If resistance measurements are not within specification, the solenoid must be replaced. See AIR CLEANER BACKPLATE ASSEMBLY – CALIFORNIA MODELS.

4. If measured winding resistances were within the above test specifications, perform the PULL-IN COIL TEST described below.

Pull-in Coil Test

1. See Figure 8-58. Connect a 12V battery to the solenoid test harness as shown. The butterfly valve must open.

2. If butterfly valve opens, but does not open with solenoid connected to motorcycle harness, refer to the applicable wiring diagram and check for following:

   a. A good ground (1 Ohm or less) at the BK wire in the 3-place connector (See Figure 8-54).

   b. Connect the positive probe of a voltmeter to the GN lead in the 3-place connector. Connect the negative probe to a good ground. Press the START switch and verify that 12 VDC is indicated on the voltmeter.

3. If a good ground and/or 12 VDC are not present in the above tests, use continuity or voltage tests to isolate and correct the problem.

4. If both a good ground and 12 VDC were measured in 2a and 2b, check the hold-in coil (by performing the hold-in coil tests).

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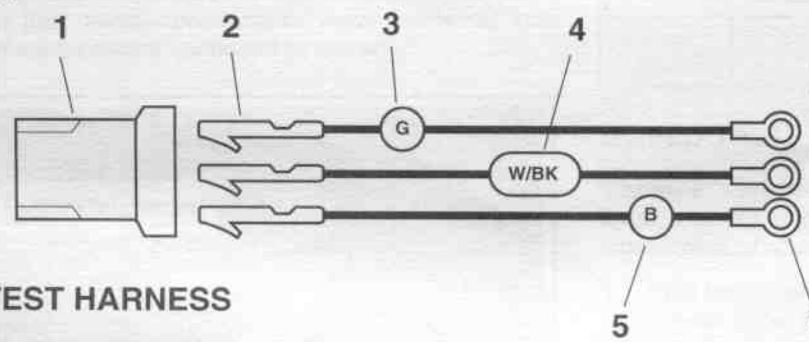


NOTE

The ring terminals (6) will ensure good connections for test probes. Blade or spade terminals may also be used.

TEST HARNESS

1. **Pin housing, Part No. 73103-96BK**
2. **Pin terminal (4), Part No. 73190-96**
3. **Green (GN) 18 gauge wire, 6 in. (152 mm) long**
4. **White/Black stripe (W/BK) 18 gauge wire, 6 in. (152 mm) long**
5. **Black (BK) 18 gauge wire, 6 in. (152 mm) long**
6. **Ring terminal, Part No. 9858 or similar (4)**

Figure 8-56. Fabricated Solenoid Test Harness

Hold-in Coil Tests

1. See Figure 8-58. Connect a 12V battery to the solenoid test harness as shown.
2. Use a screwdriver and gently open the butterfly valve by pushing upward on the left side of the valve plate.
3. The butterfly valve must remain open with the hold-in coil energized.
4. Disconnect the negative battery cable. The butterfly valve should close.
5. If butterfly valve remains open in step 3 and closes in step 4, the hold-in coil is functioning properly.
6. If butterfly valve does not remain open in step 3, check that the black lead at the 3-place mating connector has a good ground. See Figure 8-54.
7. If there is not a good ground at the BK lead, refer to the applicable wiring diagram and correct the high-resistance ground.
8. Using a voltmeter, verify that the W/BK wire at the 3-place mating connector (see Figure 8-54) has 12 VDC when the ignition/Light Key Switch is turned to IGNITION.
9. If 12VDC is not present when the Ignition/Light Key Switch is turned to IGNITION, refer to the applicable wiring diagram and look for a broken wire, corroded connection or other malfunction causing the no power condition. Correct the problem as required.
10. If solenoid is functioning properly, but butterfly valve is not opening and closing as it should, refer to item 1.3 in the following table (TROUBLEHOOTING SOLENOID-OPERATED BUTTERFLY VALVE).

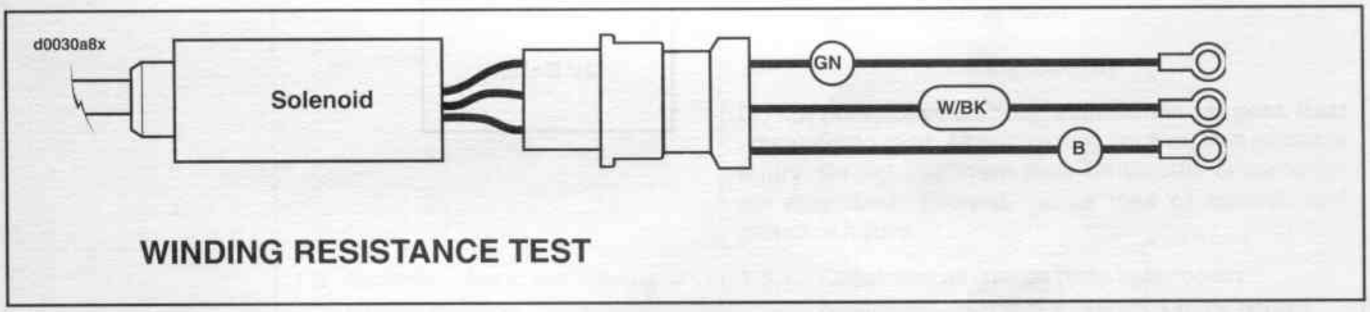


Figure 8-57. Resistance Test Hookup

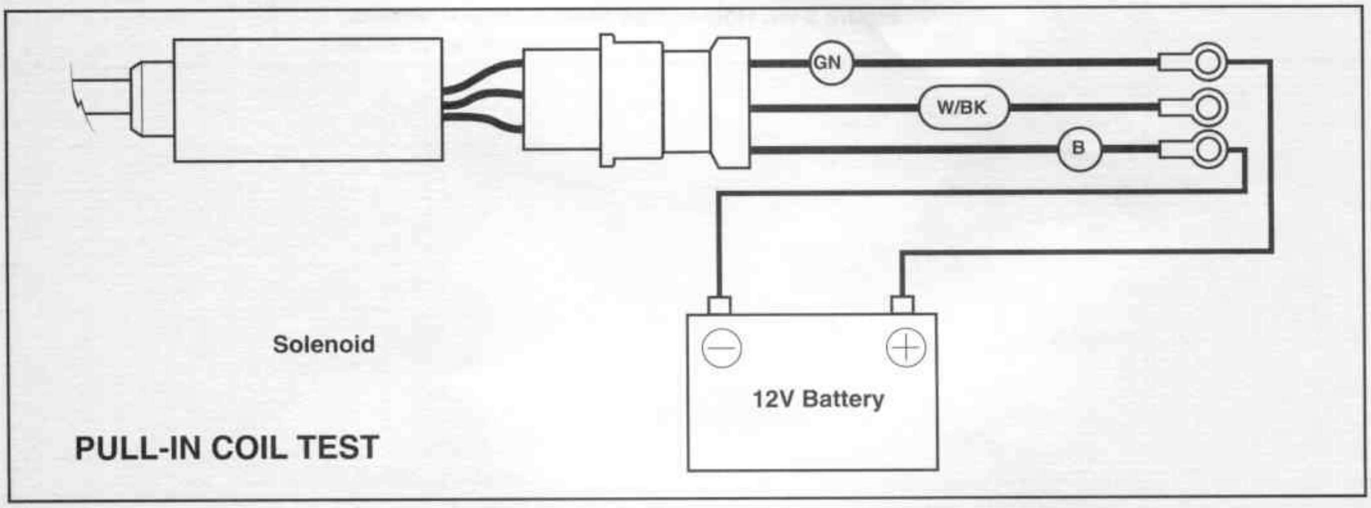


Figure 8-58. Pull-in Coil Test Hookup

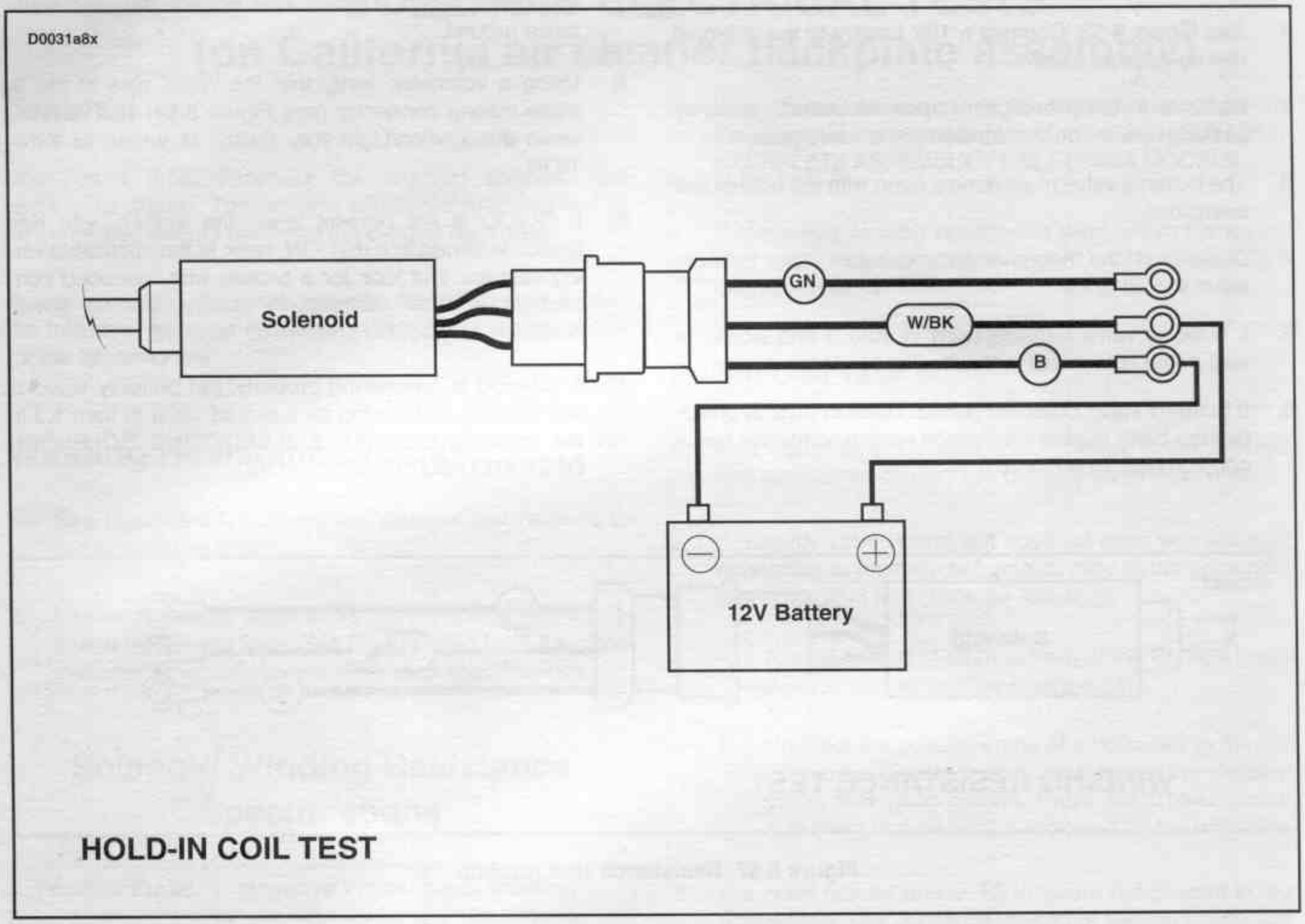


Figure 8-59. Hold-in Coil Test Hookup

Troubleshooting Solenoid-Operated Butterfly Valve

Problem	Cause	Solution
1. Motorcycle acceleration is sluggish and top speed is approximately 40 mph(64 km/h).	1.1 Butterfly valve is not opening because of electrical malfunction.	1.1.1 Check that solenoid connector is connected. If unplugged, connect and check for proper operation by starting engine. If butterfly valve is still inoperative, proceed to 1.1.2 1.1.2 Perform the SOLENOID ELECTRICAL TESTS which follow this troubleshooting chart.
	1.2 Rider started engine without using starter by coasting downhill and engaging clutch with transmission in gear. (Bump starting.)	1.2.1 Instruct rider to use starter or press start button momentarily with ignition switch ON before starting in the manner described in 1.2. Explain that the start switch input to the starter relay is also required to energize the pull-in winding and open the butterfly valve. ⚠WARNING **Do not bump start with transmission in 1st gear. Rear wheel could skid, cause loss of control, and possible injury. Do not use more than 1/4 throttle or motorcycle may lurch forward, cause loss of control, and possible injury.**
	1.3 Butterfly valve is not opening or closing because mechanical linkage, connecting butterfly valve to solenoid plunger, is broken or missing. A broken solenoid spring will prevent butterfly valve closure.	1.3.1 Check that all linkage parts are properly assembled and functioning. A broken solenoid spring will require replacing the solenoid. See Solenoid Adjustment.

NOTES

HANDLEBAR SWITCH ASSEMBLIES

GENERAL

The individual switches in the switch assemblies 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.

The following removal and installation steps apply when replacing the entire switch assembly, switch housing, or handlebars.

REMOVAL

Right Handlebar Controls

⚠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 8-60. Place the cardboard insert between the brake lever and lever bracket.

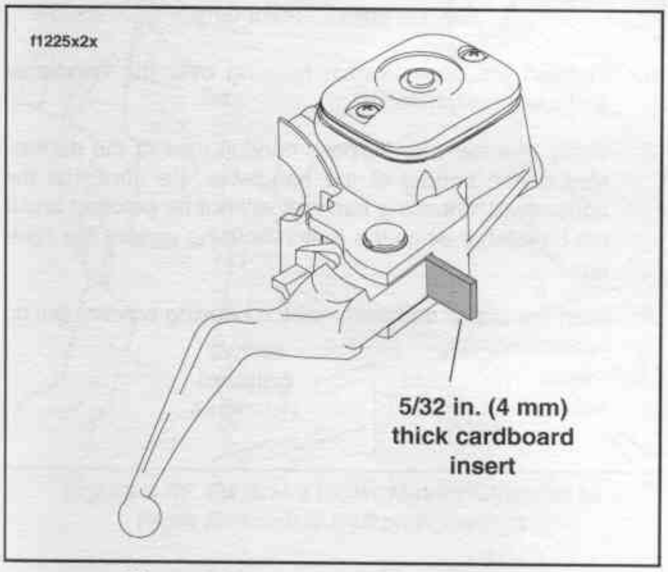


Figure 8-60. Install Cardboard Insert

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.

Left Handlebar Controls

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

Right Handlebar Controls

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 screw is a loose fit and may fall out or become dislodged if the lower switch housing is turned upside down or shaken.

2. Push the throttle and idle control cables into the lower switch housing until they snap in place. Proceed as follows:

   Note the different diameter inserts crimped into the end of the throttle and idle cable housings. See Figure 8-61.

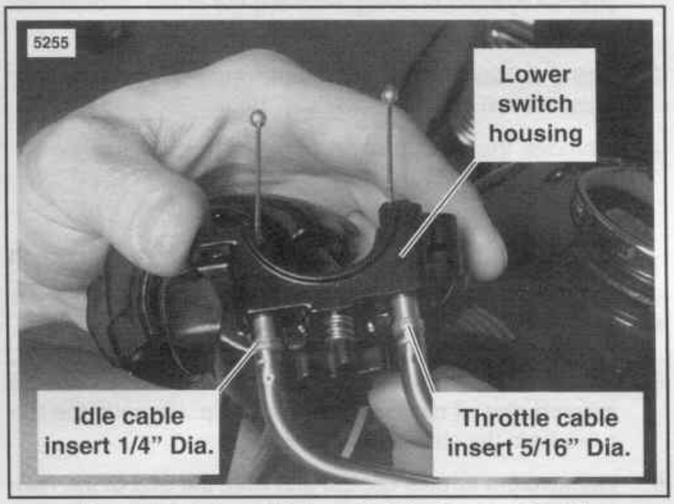


Figure 8-61. Install Throttle/Idle Control Cables in Lower Switch Housing

   Push the larger diameter insert (5/16 inch; 7.9 mm) of the throttle cable housing into the larger hole in front of the tension adjuster screw.

   Push the smaller diameter insert (1/4 inch; 6.3 mm) of the idle cable housing into the smaller hole at the rear of the tension adjuster screw.

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 8-62. Route the cable 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 8-63. Position the lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cable so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.

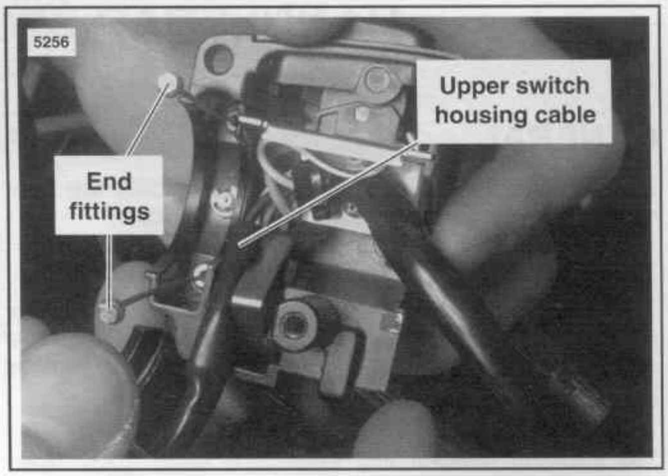


Figure 8-62. Route Cable to Upper Switch Housing

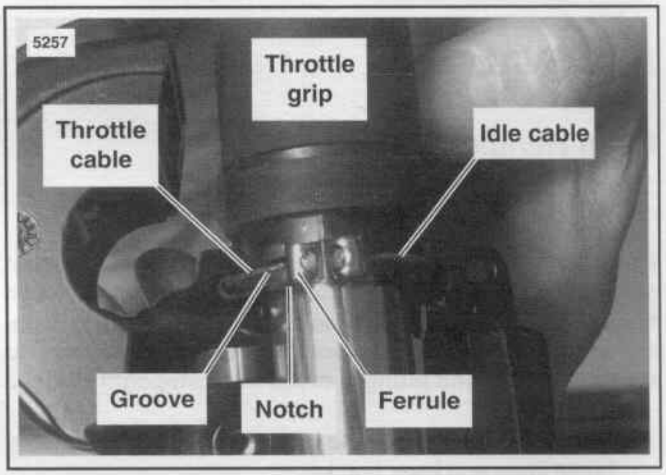


Figure 8-63. Install Throttle/Idle Control Cables on Throttle Control Grip

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 8-64. Do not remove the 5/32 in. (4 mm) thick cardboard insert wedged between the brake lever and lever bracket. Removal will result in damage to the rubber boot and plunger of the front stoplight switch during installation of the master cylinder assembly.

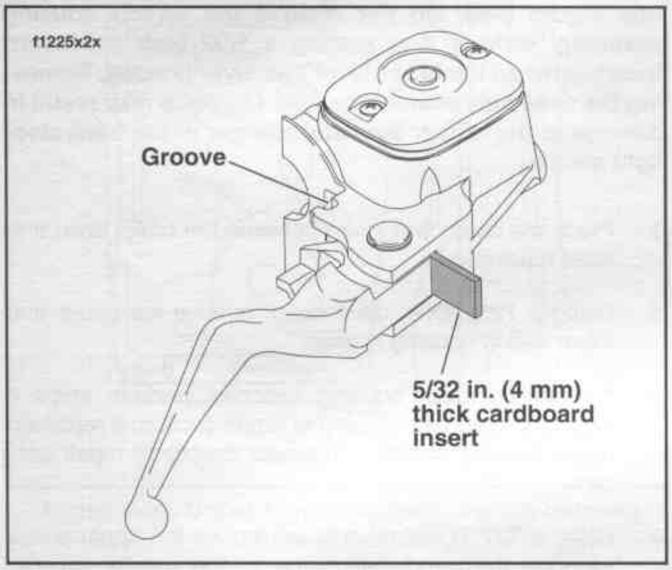


Figure 8-64. Leave Cardboard Insert in Place

9. See Figure 8-65. Position the brake lever/master cylinder assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.

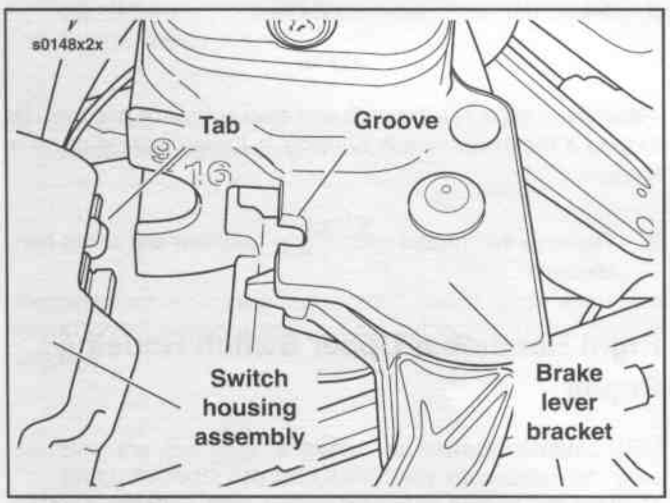


Figure 8-65. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

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 the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.

11. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.9-5.1 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.

13. Test the switches for proper operation.

14. If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4-5 inches from handlebar clamp. Cut any excess cable strap material.

Left Handlebar Controls

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 8-66. Install upper and lower switch housings on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip.

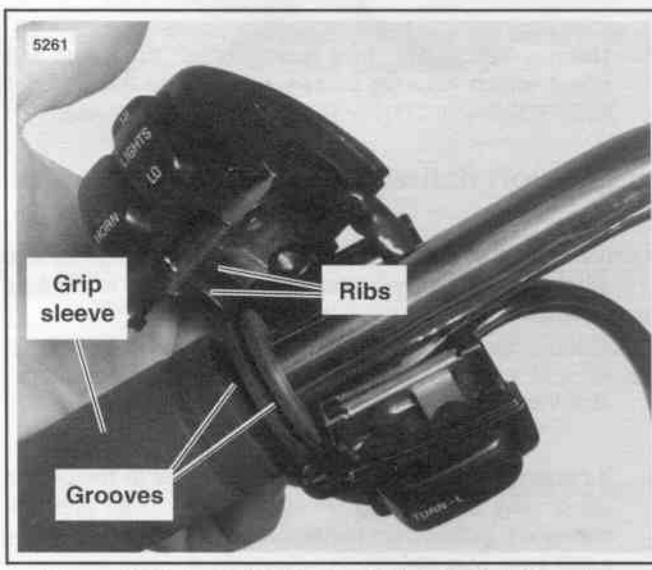


Figure 8-66. Install Left Handlebar Switch Housings

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 8-67. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the bottom of the clutch lever bracket.

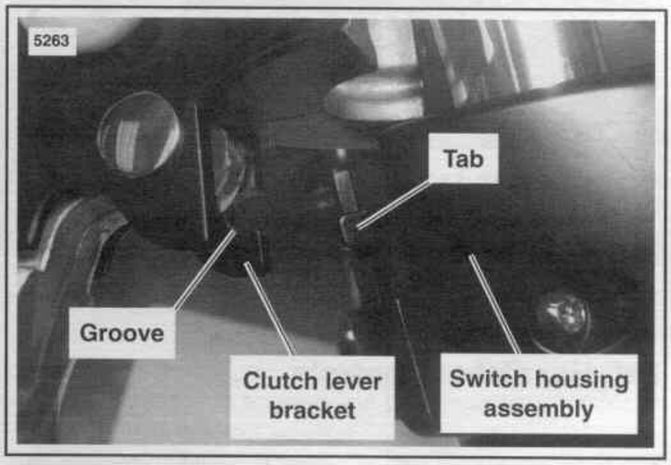


Figure 8-67. Fit Clutch Lever Bracket to Left Handlebar Switch Housings

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 the 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 the lower and upper switch housing screws to 35-45 **in-lbs** (3.9-5.1 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.

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 inches from handlebar clamp. Cut any excess cable strap material.

SWITCH REPAIR/REPLACEMENT

Right Handlebar Switches–Disassembly

⚠CAUTION

See Figure 8-60. Do not remove the switch housing assembly without first placing a 5/32 inch 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. Using a T27 TORX drive head, loosen the upper screw securing the handlebar clamp to the master cylinder housing. Remove the lower clamp screw with flat washer.

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.

Right Handlebar Upper Switch 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 8-68. From inside the switch housing, remove the Phillips screw with lockwasher to release the bracket. Remove the bracket and switch assembly from the housing.

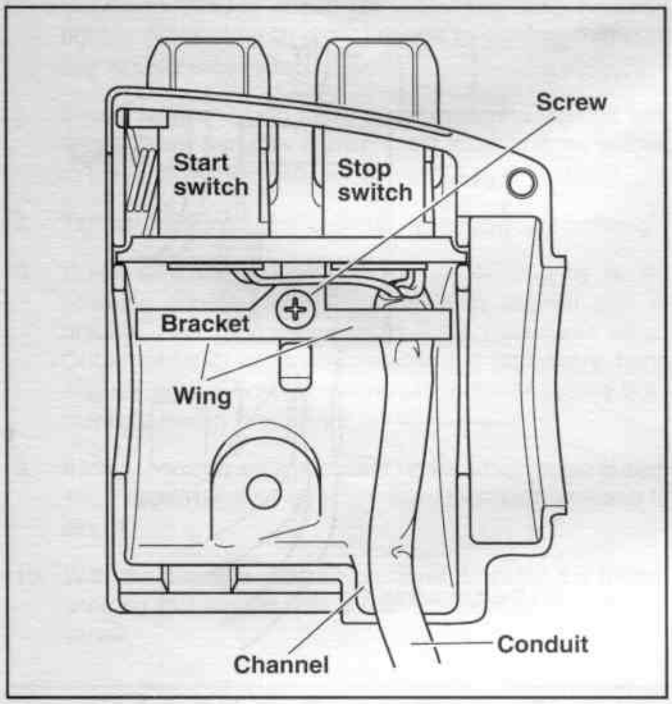


Figure 8-68. Upper Right Handlebar Switch Housing (Without Splices)

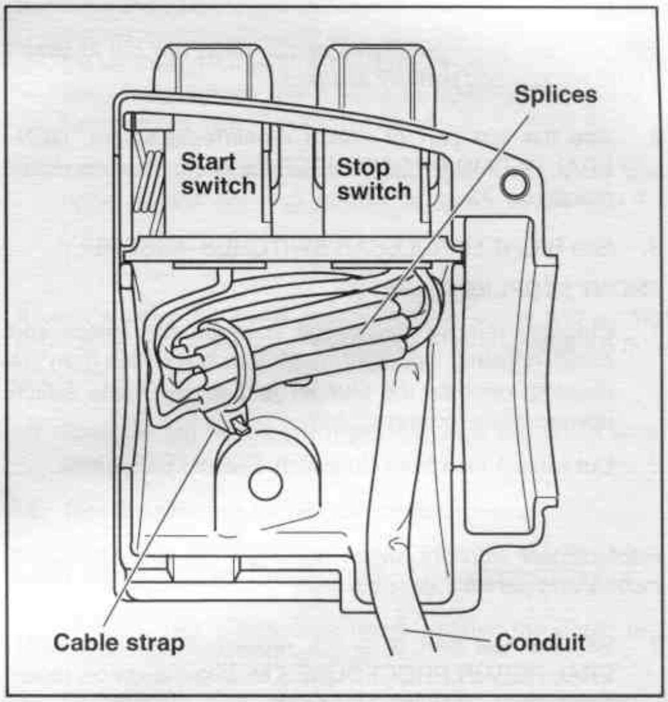


Figure 8-69. Upper Right Handlebar Switch Housing (With Splices)

2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch from old switches. Discard old switch and bracket assembly.

3. Slide conduit forward over cut ends of switch wires and cut off 1/2 inch of conduit material. Push conduit back to access switch wires.

4. Separate **new** engine stop switch and engine start switch wires into two bundles.

NOTE

Replacement stop switch and start switch wires are cut to length (2-1/2 inches and 2 inches, respectively) and partially stripped.

5. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.

6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-69. Route wires downstream of splices beneath wing on engine stop switch side of bracket as seen in Figure 8-68.

7. Install a **new** 7 inch cable strap beneath wing on engine start switch side of bracket and capture wire splices.

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. Install Phillips screw (with lockwasher) to secure bracket inside housing. Verify that wing on engine stop switch side of bracket captures edge of conduit as shown in Figure 8-66.

10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.

11. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

Right Handlebar Lower Switch Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.

2. Remove the Phillips 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 1-1/2 inches from old switch. Discard old switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length (1-1/2 inches) and partially stripped.

2. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.
3. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

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 inch from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length (2-1/2 inches) and partially stripped.

3. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES 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.
6. See Figure 8-70. Push down on switch so that it bottoms against housing and wires run in groove at base of cavity. With the concave side facing outward, insert wedge 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. See RIGHT HANDLEBAR SWITCHES–ASSEMBLY.

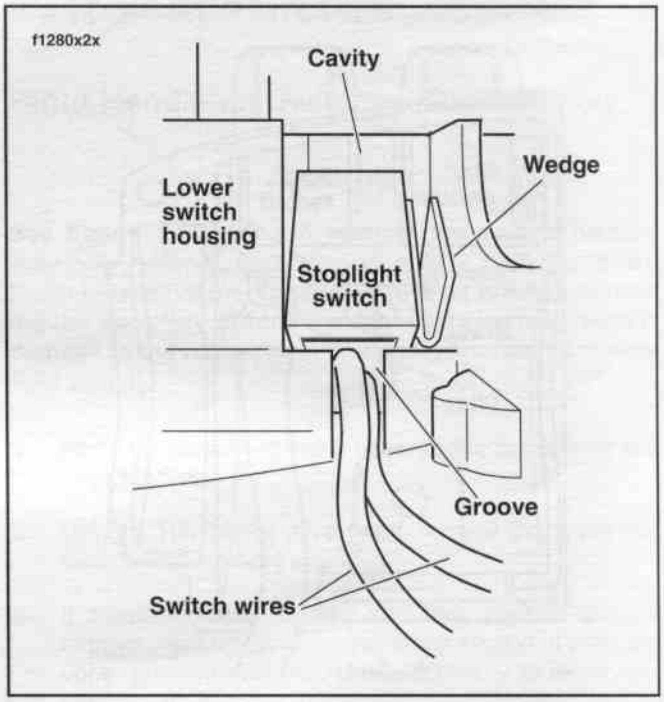


Figure 8-70. Install Stoplight Switch

Right Handlebar Switches–Assembly

1. See Figure 8-71. Insert tapered end of **new** 7 inch cable strap into round hole in turn signal switch bracket 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.

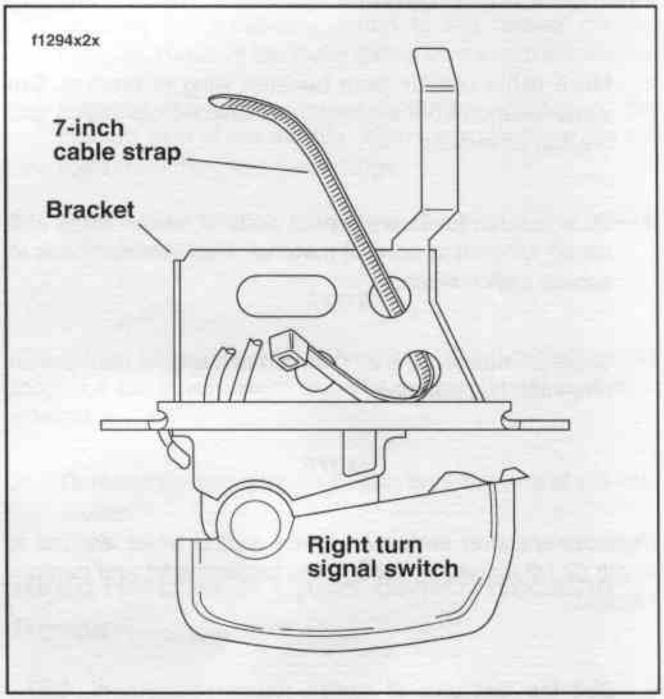


Figure 8-71. Insert Cable Strap in Switch Bracket

3. Start Phillips 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 inside lower housing so that spliced lengths lie across lower bracket.

5. Capturing conduit about 1/4 inch from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Install second 7 inch cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.
7. Tighten Phillips 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. If lower housing switches were replaced, proceed to step 10. If upper housing switches were replaced, proceed to step 17.
10. 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.

11. 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.
12. Position the lower switch housing beneath the throttle control grip. Install the brass ferrules onto the cables so that the end fittings seat in the ferrule recess. Seat the ferrules in their respective notches on the throttle control grip. Verify that the cables are captured in the grooves molded into the grip.
13. Position the upper switch housing over the handlebar and lower switch housing. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar.
14. Start the upper and lower switch housing screws, but do not tighten.
15. Position the brake lever/master cylinder assembly inboard of the switch housing assembly engaging the tab on the lower switch housing in the groove at the top of the brake lever bracket.
16. Align the holes in the handlebar clamp with those in the master cylinder housing and start the lower screw (with flat washer). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
17. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.9-5.1 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.

18. Remove the cardboard insert between the brake lever and lever bracket.
19. Test the switches for proper operation.

Left Handlebar Switches–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.

Left Handlebar Upper Switch 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 8-72. From inside the switch housing, remove Phillips screw and lockwasher to release bracket. Remove bracket and switch assembly from the housing.

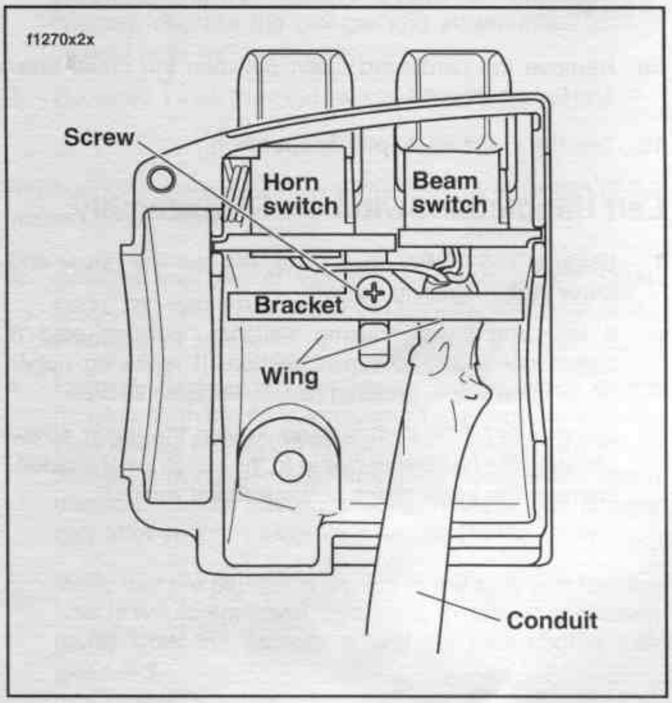


Figure 8-72. Upper Left Handlebar Switch Housing (Without Splices)

2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch from old switches. Discard old switch and bracket assembly.
3. Slide conduit forward over cut ends of switch wires and cut off 1/2 inch of conduit material. Push conduit back to access switch wires.
4. Separate new horn switch and high/low beam switch wires into two bundles.

NOTE

Replacement high/low beam switch wires and horn switch wires are cut to length (2-1/2 inches and 2 inches, respectively) and partially stripped.

5. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.
6. Loop switch wires so that spliced lengths are positioned as shown in Figure 8-73. Route wires downstream of splices beneath wing on high/low beam switch side of bracket as seen in Figure 8-72.

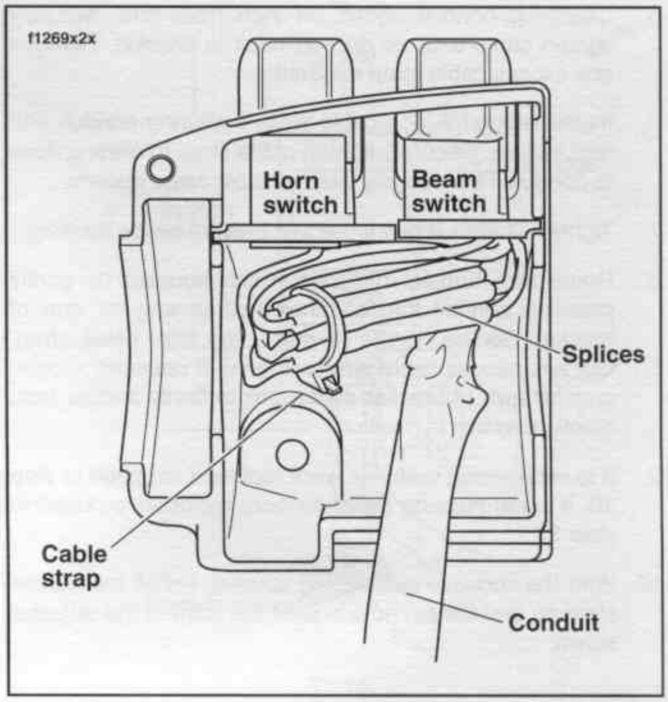


Figure 8-73. Upper Left Handlebar Switch Housing (With Splices)

7. Install a new 7 inch cable strap beneath wing on horn switch side of bracket and capture wire splices.
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. Install Phillips screw (with lockwasher) to secure bracket inside housing. Verify that wing on high/low beam switch side of bracket captures edge of conduit as shown in Figure 8-72.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. See LEFT HANDLEBAR SWITCHES–ASSEMBLY.

Left Handlebar Lower Switch Housing Repair

1. From inside the switch housing, carefully cut cable strap to free conduit from the turn signal switch bracket.
2. Remove the Phillips screw with lockwasher to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Cut wires 1-1/2 inches from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.
4. See the last part of switch repair/replacement, GENERAL REPAIR PROCEDURES for information on repair practices.
5. See LEFT HANDLEBAR SWITCHES–ASSEMBLY.

Left Handlebar Switches–Assembly

1. See Figure 8-74. Insert tapered end of **new** 7 inch cable strap into round hole in turn signal switch bracket and then feed back through using the adjacent hole. Reserve the oblong hole for the bracket screw.

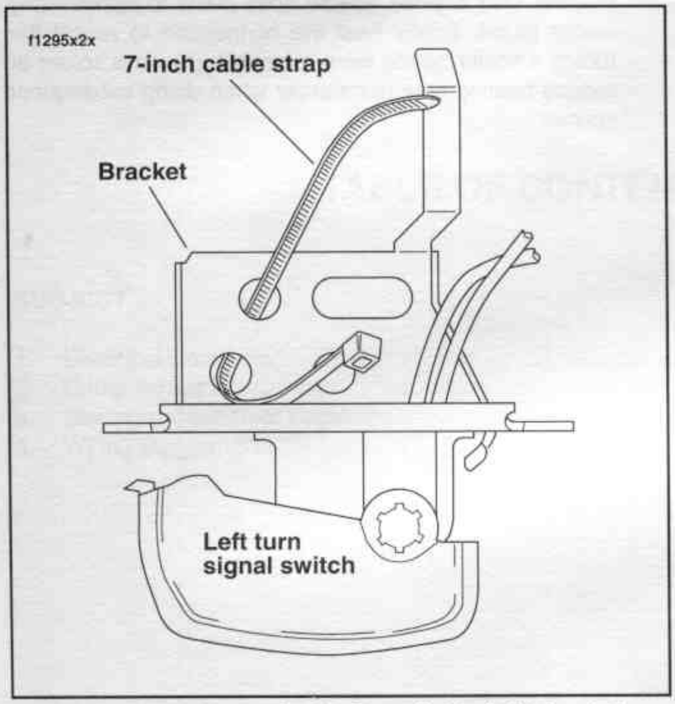


Figure 8-74. Insert Cable Strap in Switch Bracket

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 Phillips screw (with lockwasher) to secure bracket inside housing.
4. Loop switch wires inside lower housing so that spliced lengths lie across lower bracket.
5. Capturing conduit about 1/4 inch from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.
6. Tighten Phillips 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. If lower housing switches were replaced, proceed to step 9. If upper housing switches were replaced, proceed to step 13.
9. Install upper and lower switch housing on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip. Verify that the wire harness conduit runs in the depression at the bottom of the handlebar.
10. Start the upper and lower switch housing screws, but do not tighten.
11. Position the clutch hand lever assembly inboard of the switch housing assembly, engaging the tab on the lower switch housing in the groove at the bottom of the clutch lever bracket.
12. Align the holes in the handlebar clamp with those in the clutch lever bracket and start the lower screw (with flat washer). Position for rider comfort. Beginning with the top screw, tighten the screws to 60-80 **in-lbs** (6.8-9.0 Nm) using a T27 TORX drive head.
13. Using a T27 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.9-5.1 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.

14. Test the switches for proper operation.

General Repair Procedures

1. To better access wires and avoid damaging conduit with radiant heating device, push conduit back and secure with extra 7 inch cable strap in kit.
2. Strip 1/2 inch 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 kit) into one-inch 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

Use caution when operating the UltraTorch UT-100, or any other radiant heating device. Read the manufacturer's instructions carefully before use. Improper handling can result in personal injury. Always keep hands away from tool tip area and heat shrink attachment. Avoid directing the heat towards any fuel system component. Extreme heat can cause fuel ignition or explosion. Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed. Be sure to turn the "ON/OFF" switch to the "OFF" position after use.

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.

ELECTRICAL CONNECTORS

TABLE OF CONTENTS

APPENDIX A

A-1. ELECTRICAL CONNECTORS

SUBJECT **PAGE NO.**

AMP MULTILOCK ELECTRICAL CONNECTORS

REMOVING SOCKET/PIN TERMINALS

1. Remove connector from the retaining device, either attachment or rosebud clip.

2. Depress the button on the socket terminal side of the connector (plug) and pull apart the pin and socket halves.

3. Bend back the latch slightly and free one side of secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access terminals in chambers of connector housing.

4. Looking in the terminal side of the connector (opposite the secondary lock), take note of the cavity next to each terminal.

5. See Figure A-1. With the flat edge against the terminal, insert the pick tool (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A "click" is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

If pick tool is not available, a small screwdriver may be used instead.

NOTE

An Electrical Terminal Crimp Tool (Part No. HD-41609) is used to install Amp Multilock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.

INSTALLING SOCKET/PIN TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings. See Figure A-2.

1. From the secondary lock side of the connector, insert the terminal into its respective numbered chamber until it snaps in place. For proper fit, the slot in the terminal must face the tang in the chamber.

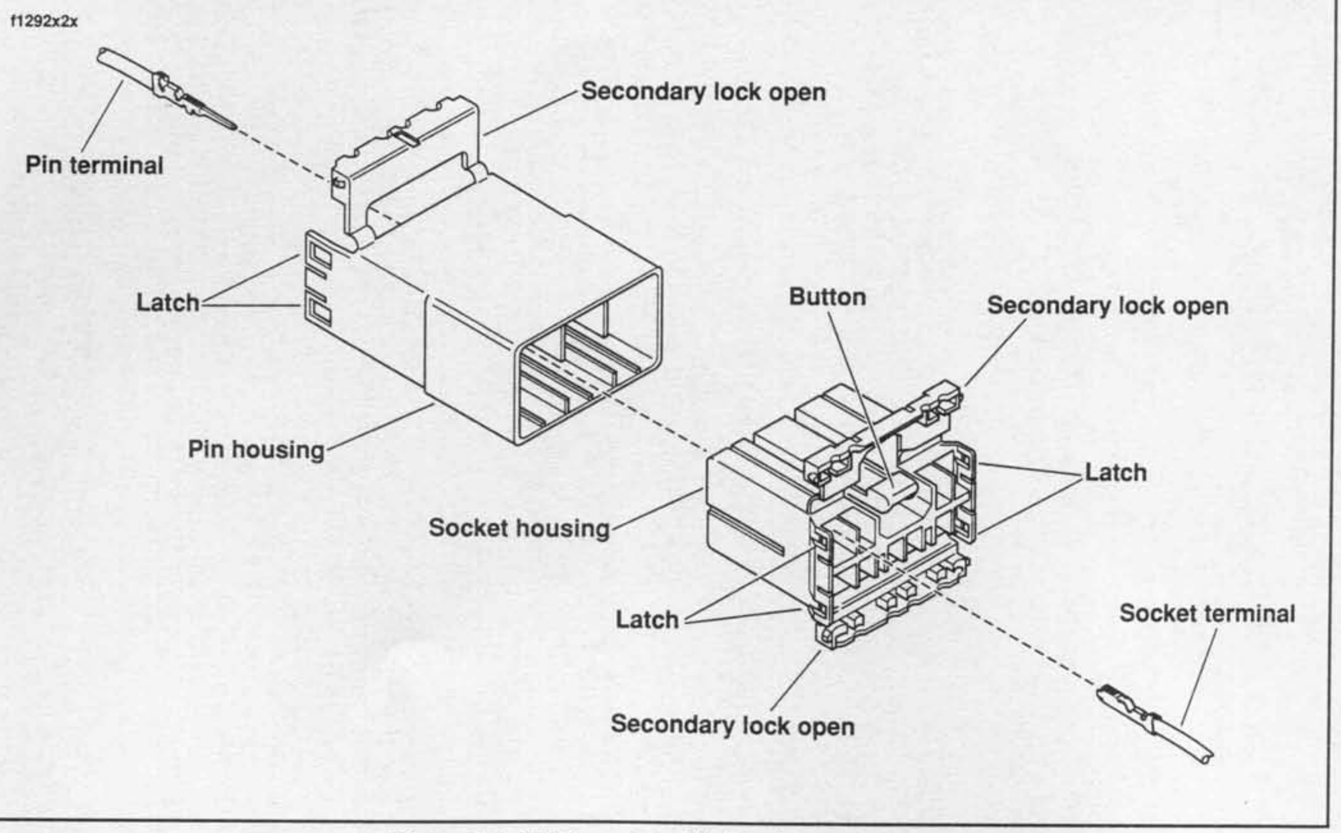


Figure A-1. 10-Place Amp Multilock Connector

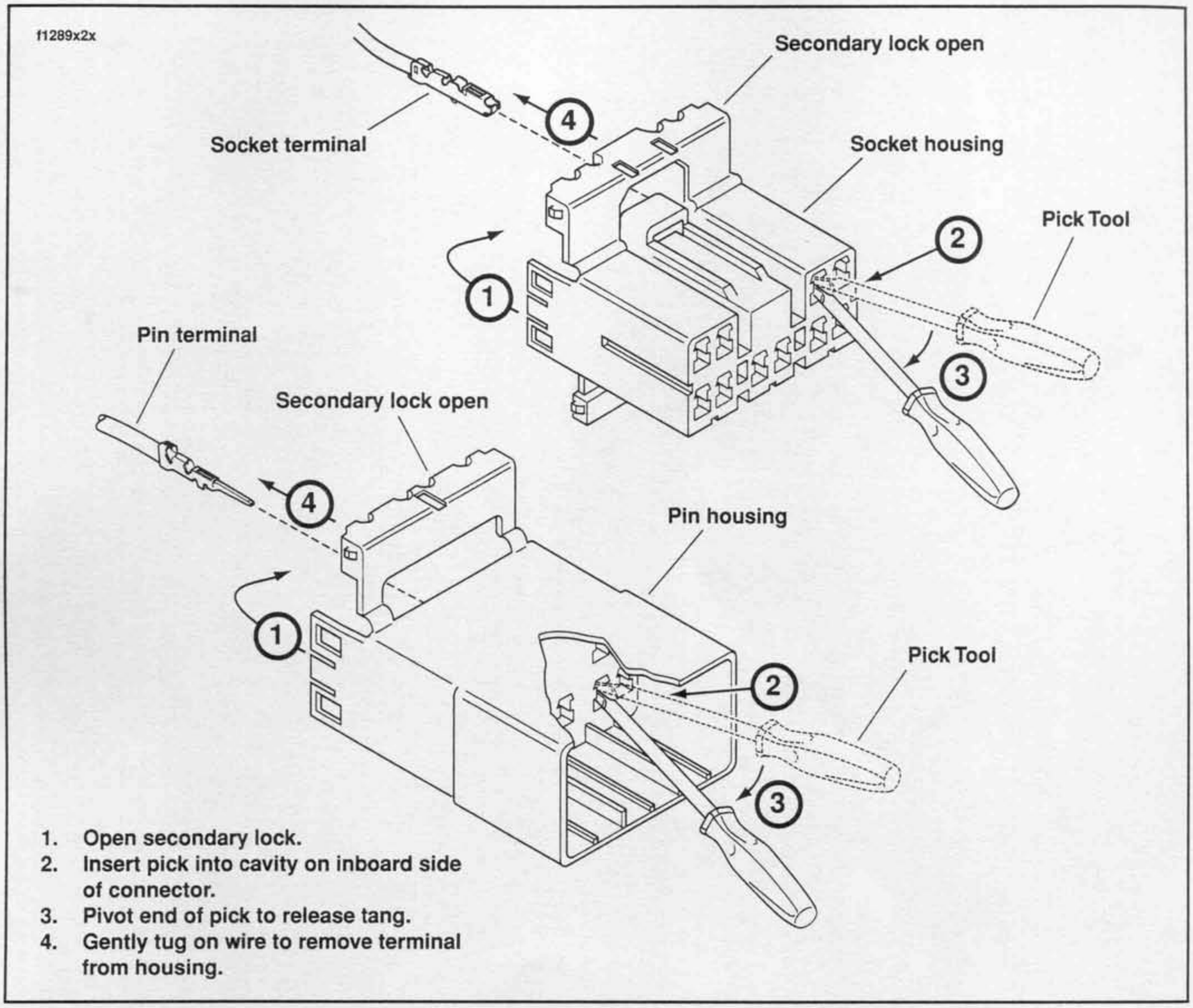


Figure A-2. Release Tang and Back Out Terminals

NOTE

The tang in the chamber engages the slot to lock the terminal in position. On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward. On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward. Up and down can be determined by the position of the release button (used to separate the pin and socket halves), the button always being the top of the connector. See Figure A-3.

2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.

3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.

5. Install connector on retaining device, either attachment or rosebud clip.

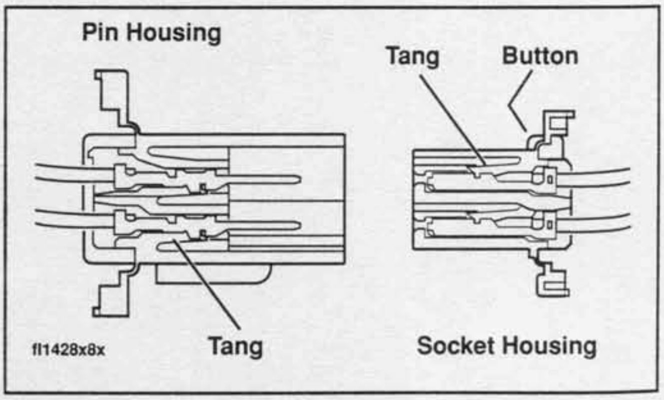


Figure A-3. Deutsch Connector Pick Tool (HD-41475-100)

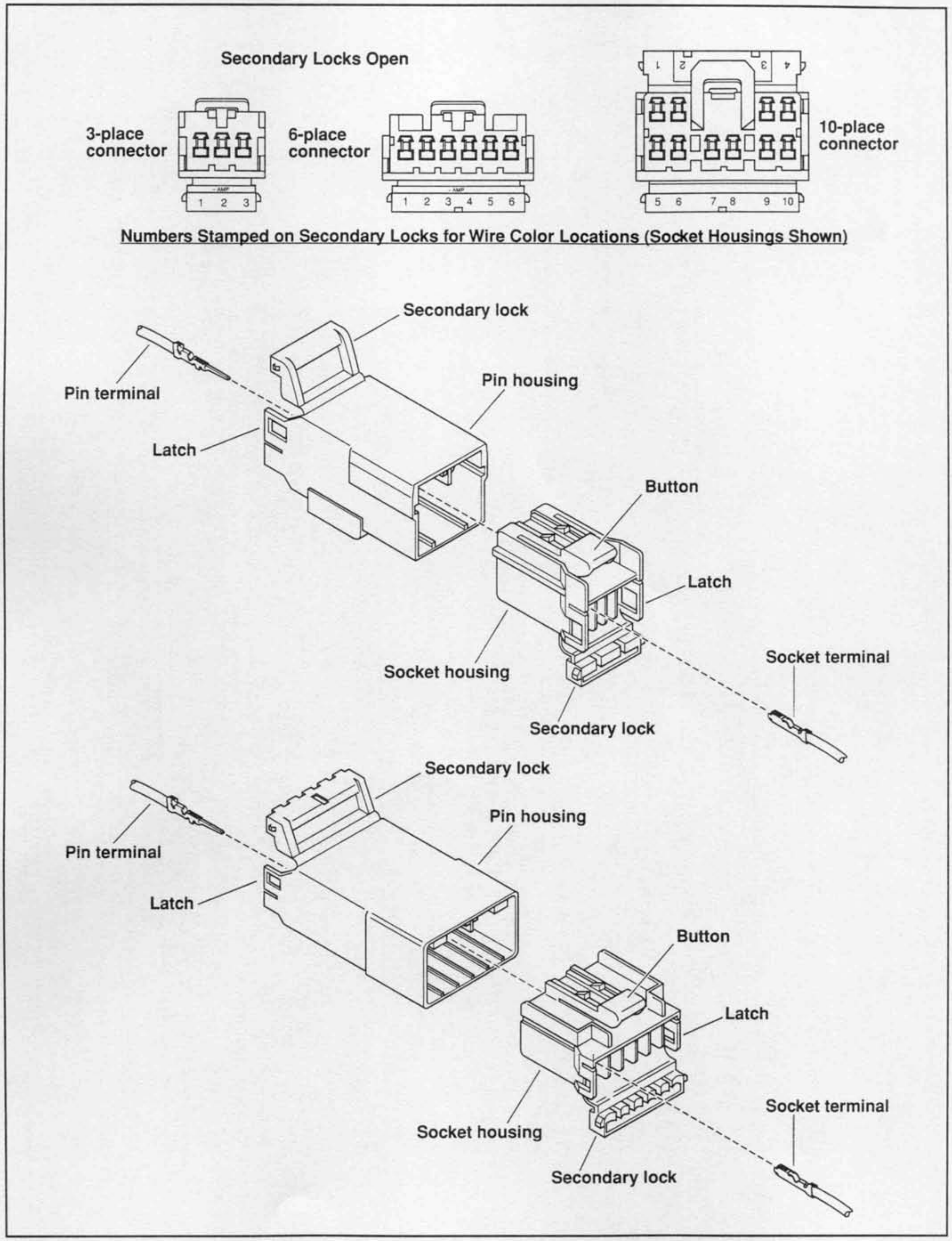


Figure A-4. 3-Place and 6-Place Amp Multilock Connectors

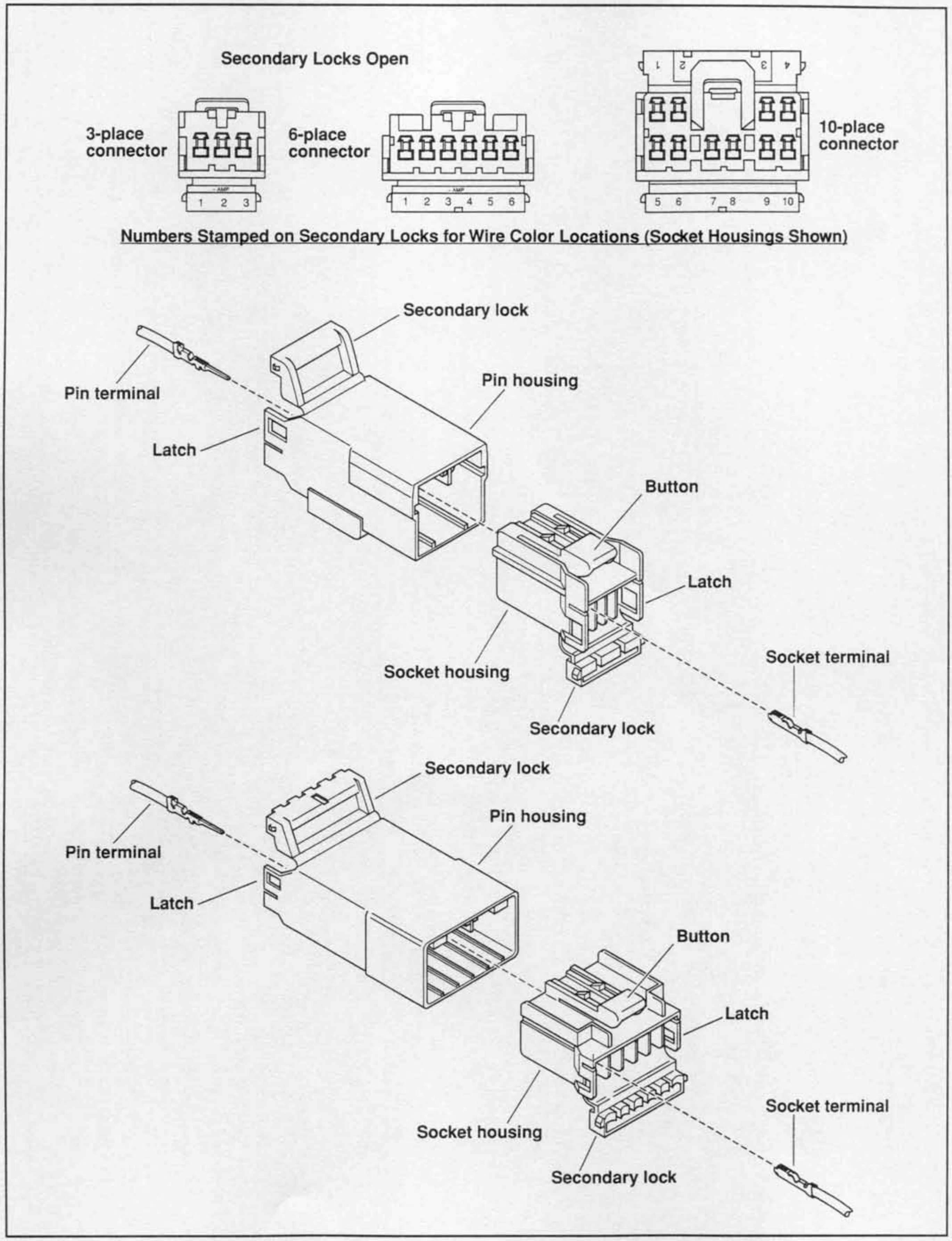


Figure A-4. 3-Place and 6-Place Amp Multilock Connectors

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool (Part No. HD-41609) to the fully open position.

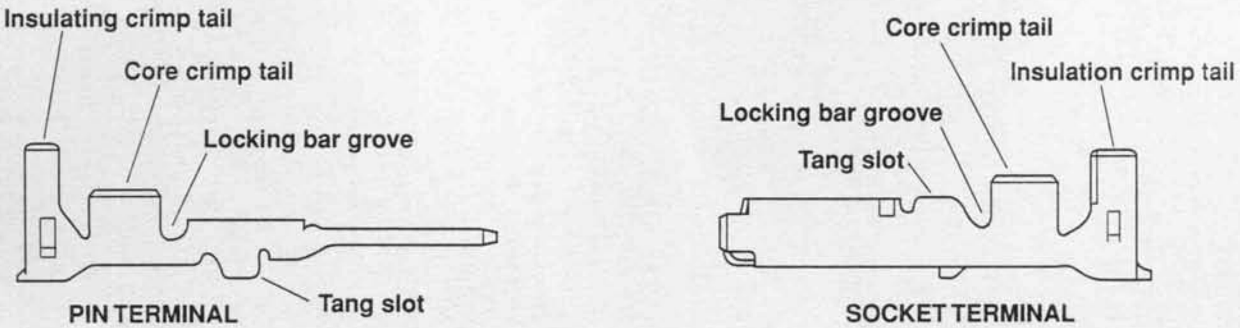
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward, insert contact (socket/pin) through locking bar, so that the closed side of the contact rests on the front nest (concave split level area of the crimp tool). See Figure A-3.

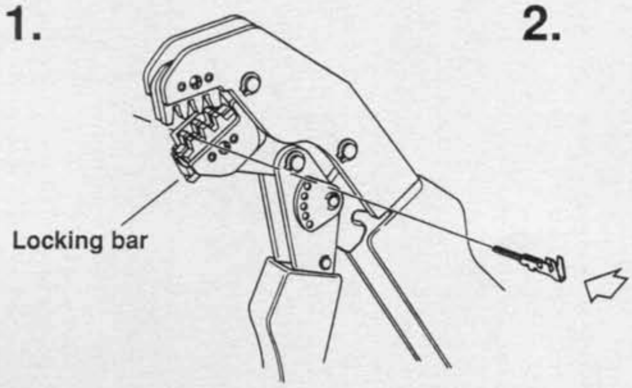
3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.

4. Strip lead removing 5/32 inch (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.

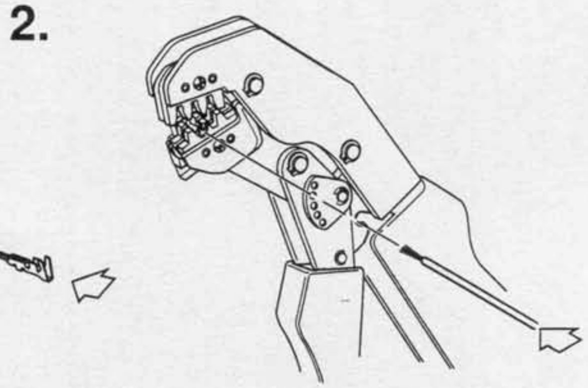
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.

6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.



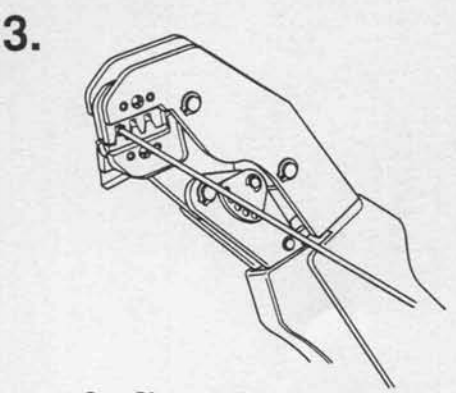


1. **Raise locking bar and seat contact on front nest of crimp tool. Release locking bar.**

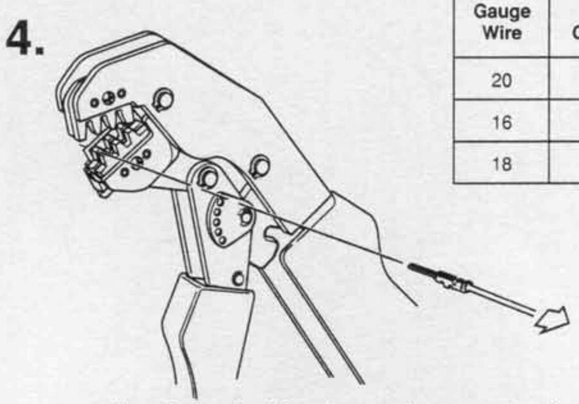


2. **Insert stripped lead until it contacts locking bar.**

Gauge Wire	Nest of Crimp Tool
20	Front
16	Middle
18	Rear



3. **Close and squeeze crimp tool.**



4. **Raise locking bar and remove contact.**

Figure A-5. Amp Multilock Crimping Procedure

DEUTSCH ELECTRICAL CONNECTORS

Deutsch Connectors feature a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides better pin retention than previous connectors.

A 12-pin connector is illustrated in Figure A-7 to show the various parts of the Deutsch connector. The following instructions may be followed for all 2-pin through 12-pin Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal pin.

NOTE

Seal pins or plugs are installed in the wire seals of unused pin and socket locations. If removed, seal pins must be replaced to maintain the integrity of the environmental seal.

Pin housing: alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, wire seal, seal pin.

REMOVING/DISASSEMBLING

Attachment clips are attached to the pin housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector to disengage small end of slot on attachment clip fromT-stud. Lift connector off T-stud.
2. Depress the external latch(es) on the socket housing side and use a rocking motion to separate the pin and socket halves. Two-, three-, four- and six-pin Deutsch connectors have one external latch, while eight- and twelve-pin connectors have two, both of which must be pressed simultaneously to separate the connector halves.

NOTE

With few exceptions, the socket housing can always be found on the accessory side, while the pin side of the connector is connected to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure A-6. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge inline with the groove (inline with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. See Figure A-7. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

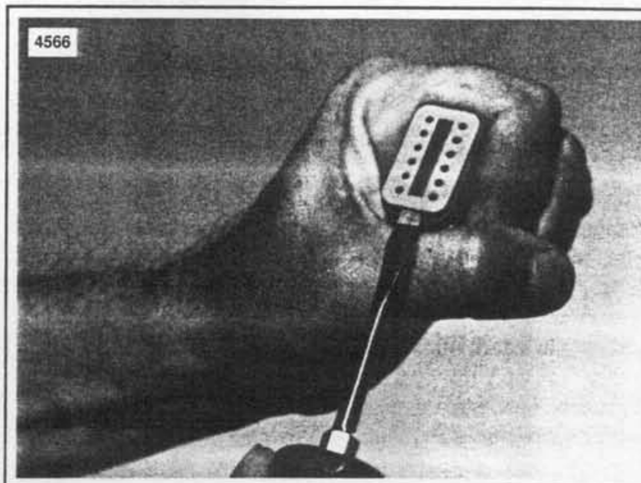


Figure A-6. Remove Secondary Locking Wedge

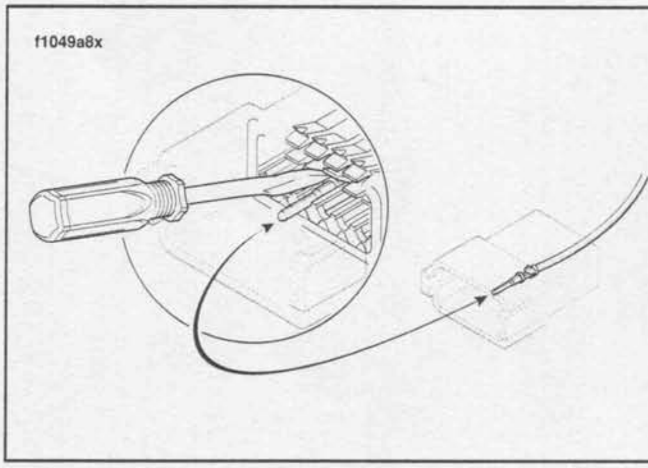


Figure A-7. Depress Terminal Latches/Back Out Pins

NOTE

An Electrical Terminal Crimp Tool (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If new terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.

3. Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1 inch (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers. Feed socket into chamber until it "clicks" in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

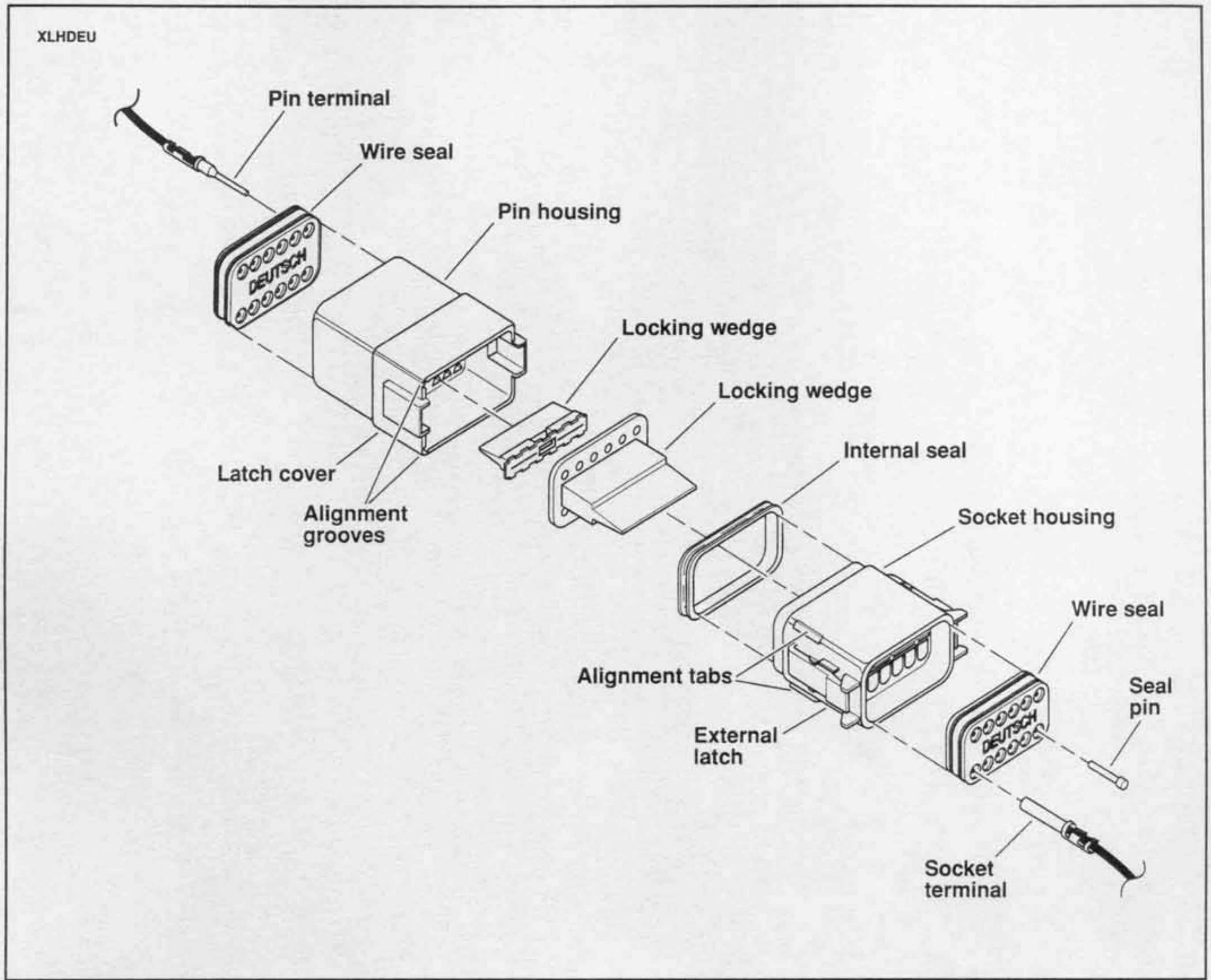


Figure A-8. 12-pin Deutsch Connector (Exploded View)

4. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTE

While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure A-9.

NOTE

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.

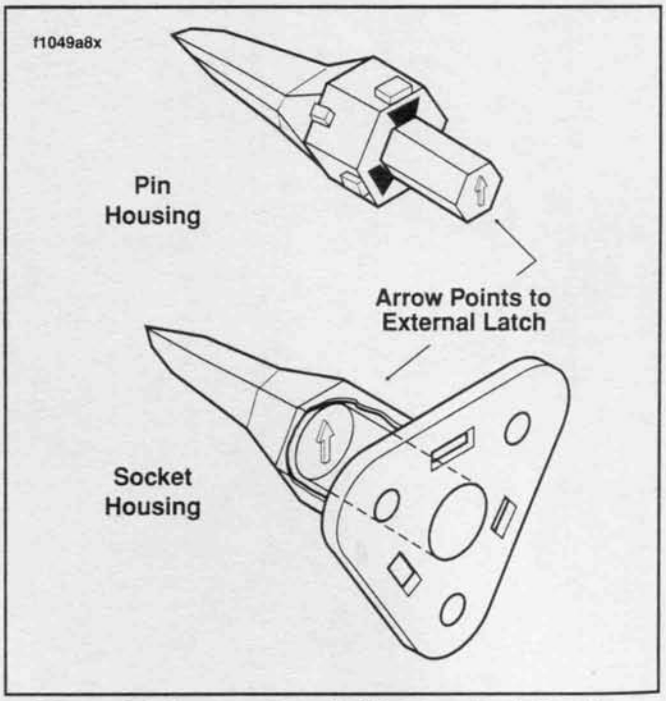


Figure A-9. Depress Terminal Latches/Back Out Pins

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire a needle nose pliers, or a suitable pick tool (HD-41475-100). See Figure A-10.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTE

An Electrical Terminal Crimp Tool (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions in this section.

3. Fit wire seal into back of pin housing. Grasp crimped pin approximately 1 inch (25.4 mm) behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered locations. Feed pin into chamber until it "clicks" in place. Verify that pin will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.
4. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place. The wedge fits in the center groove within the pin housing and holds the terminal latches tightly closed.

NOTE

While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure A-9.

NOTE

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.

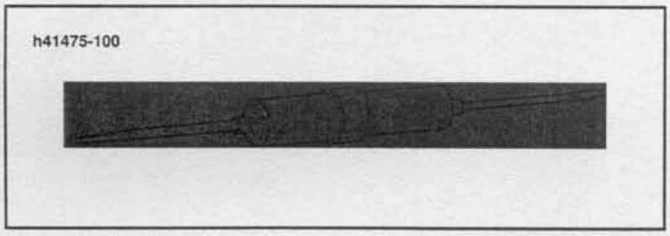


Figure A-10. Deutsch Connector Pick Tool (HD-41475-100)

ASSEMBLING/INSTALLING

1. Insert socket housing into pin housing until it snaps in place. Two-, three-, four- and six-pin Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.

   For those connectors with two external latches (8-pin and 12-pin), a different system is used to prevent improper assembly. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latches "click." If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.

NOTE

*Deutsch connectors are 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.*

If it should become necessary to replace a plug or receptacle, please note that the 8-pin and 12-pin gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and pin halves, then the black may be substituted for the gray, and vice versa. The socket and pin halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

2. See Figure A-11. Fit the attachment clip to the pin housing, if removed. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.

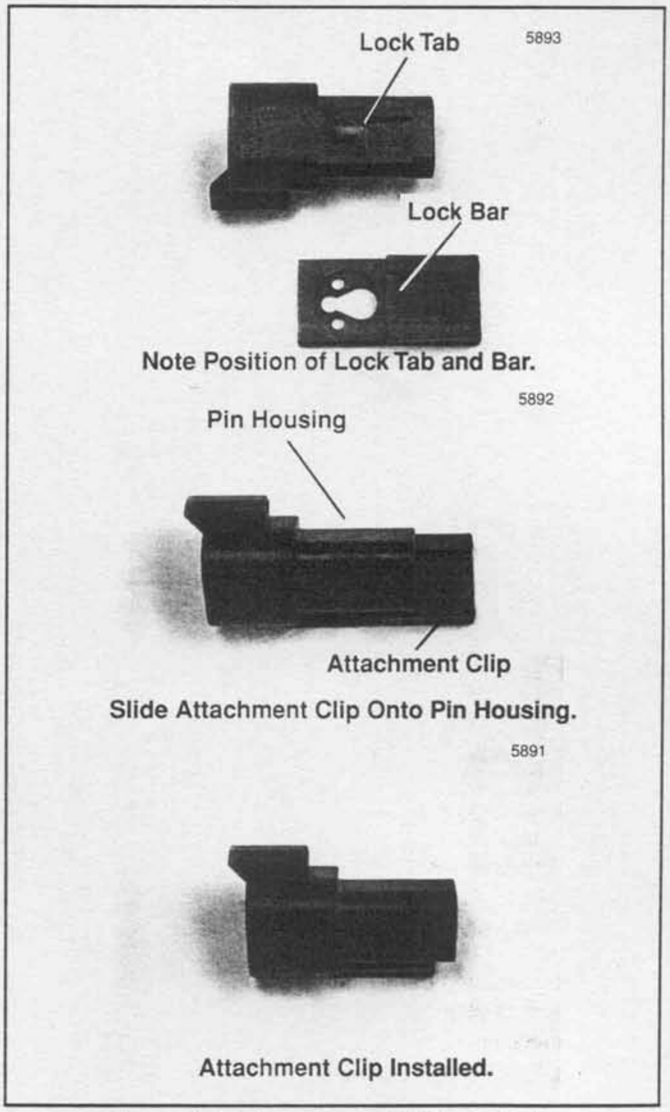


Figure A-11. Attachment Clip Installation

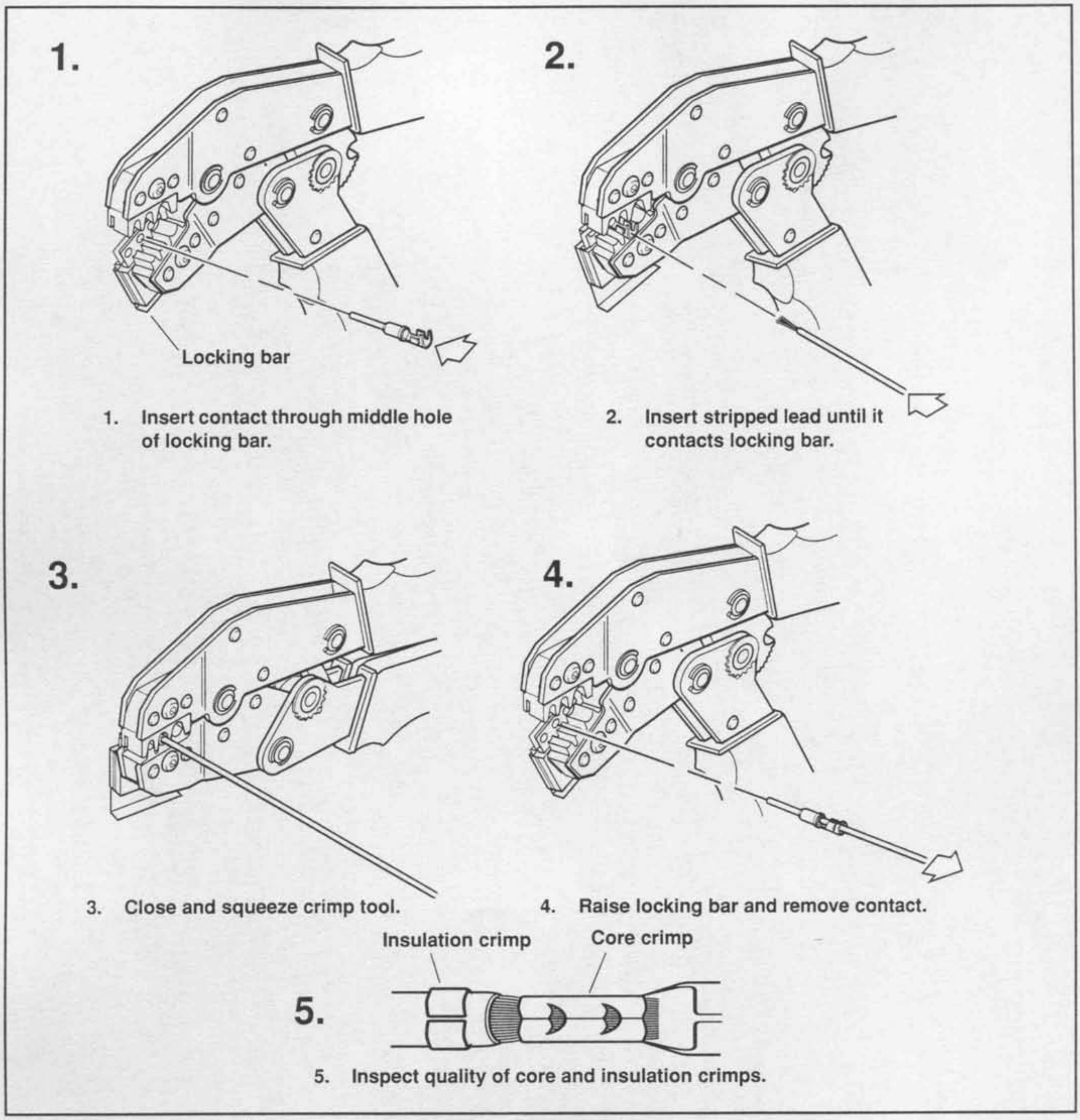
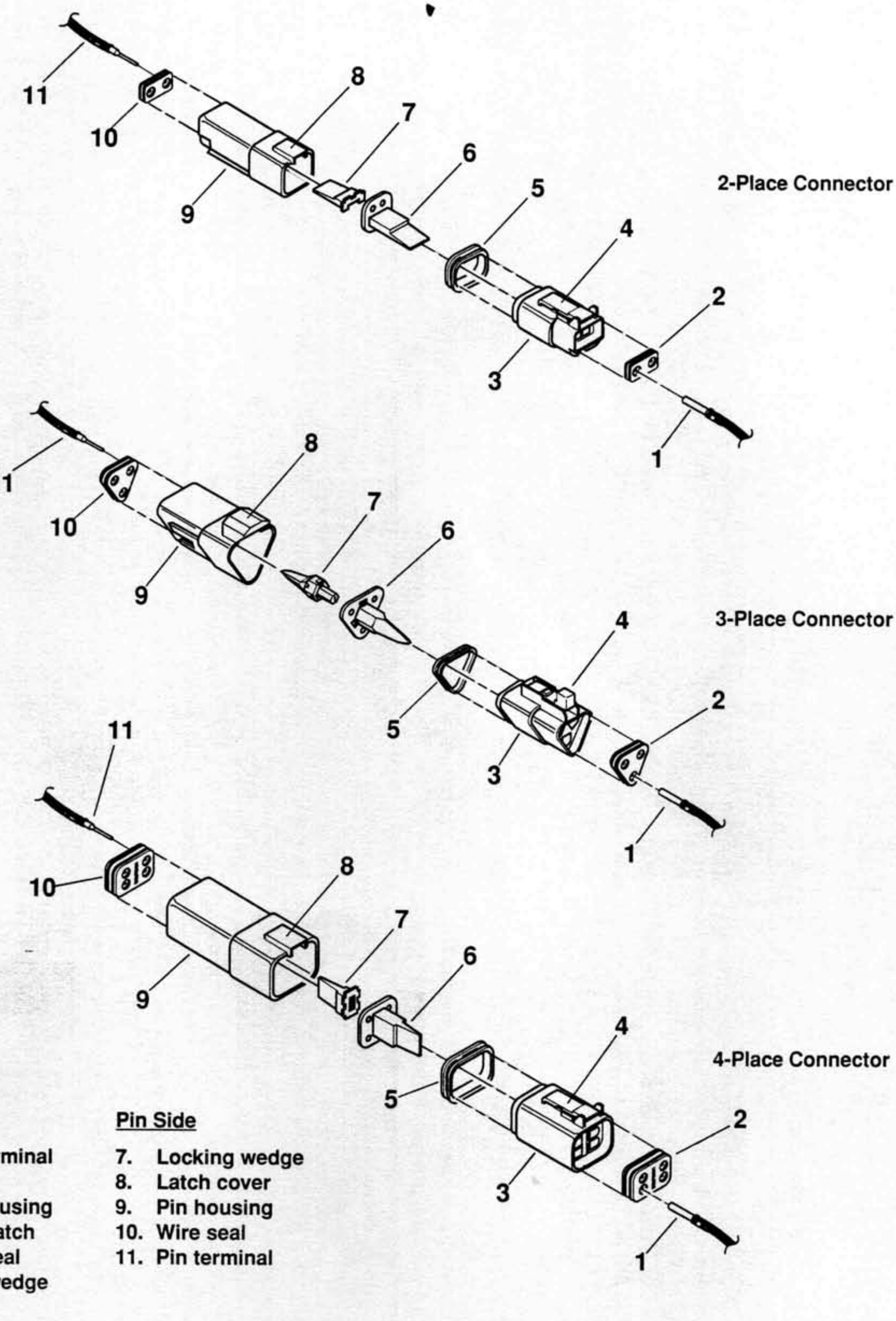


Figure A-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

1. See Figure A-12. Squeeze the handles to cycle the crimp tool to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/pin) through middle hole of locking bar.
3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.
4. Strip lead removing 5/32 inch (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.



Socket Side

1. Socket terminal
2. Wire seal
3. Socket housing
4. External latch
5. Internal seal
6. Locking wedge

Pin Side

7. Locking wedge
8. Latch cover
9. Pin housing
10. Wire seal
11. Pin terminal

Figure A-13. 2-Pin, 3-Pin, and 4-Pin Deutsch Connectors

INSTALLING SEALED BUTT CONNECTORS

Butt splicing may be a necessary procedure for the replacement of some components.

Proceed as follows:

1. Strip 3/8 inch of insulation off the ends of the wires.
2. Compress the handles of the Packard Crimp Tool (HD-38125-8) until the ratchet automatically opens.
3. Since the size of the connectors varies with the gauge of the wire, reference the following table to ensure properly sealed splices are used.

Gauge Wire	Connector Color	Part Number
18-20	Red	P/N 70585-93
14-16	Blue	P/N 70586-93
10-12	Yellow	P/N 70587-93

4. Determine the correct dye or nest for the crimping operation. Match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool. See Figure A-14.
5. Gently apply pressure to the handles until the crimper lightly secures one side of the metal insert inside the butt splice connector. The connector must be crimped in two stages; one side then the other.
6. See Figure A-15. Feed the wire into the butt splice connector until the stripped end contacts the wire stop inside the metal insert.
7. Squeeze the handles of the crimp tool until tightly closed. The tool automatically opens when the crimping sequence is complete.
8. Repeat steps 5, 6, and 7 on the other side of the butt splice connector.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

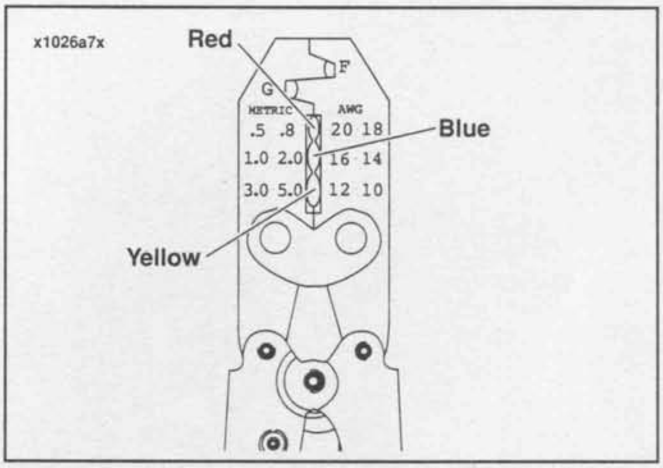


Figure A-14. Packard Crimp Tool (HD-38125-8)

⚠WARNING

Use caution when operating the UltraTorch UT-100 or any other radiant heating device. Read the manufacturers instructions carefully before use. Improper handling can result in personal injury. Always keep hands aways from tool tip area and heat shrink attachment. Avoid directing the heat toward any fuel system component. Extreme heat can cause fuel ignition or explosion. Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed. Be sure to turn the "ON/OFF" switch to the "OFF" position after use.

9. Using the UltraTorch UT-100 (HD-39969), Robinair Heat Gun (HD-25070) with heatshrink attachment (HD-41183) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector. See Figure A-15.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

10. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

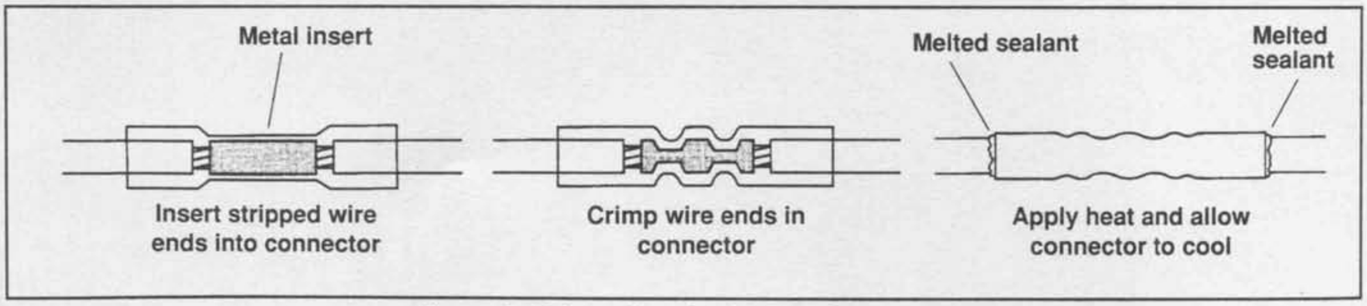


Figure A-15. Installing Sealed Butt Connectors

PACKARD ELECTRICAL CONNECTORS

PUSH-TO-SEAT TERMINALS

The Packard push-to-seat terminal connectors found on Softail model vehicles are listed below.

- Ignition Switch [33]

Removing Push-to-seat Terminals

Like most connectors, Packard push-to-seat terminals are pulled out the wire end of the connector. To remove a push-to-seat terminal, proceed as follows:

1. Remove the connector from the retaining device, if present.

2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.

NOTE

The Ignition Switch is provided with a secondary lock. The secondary lock, which may be molded onto the connector or exist as a separate piece, aids in terminal retention. Secondary locks must be opened (or removed) before the terminals can be extracted from the connector housing.

3. Open or remove the secondary lock. Proceed as follows:

   Bend back the latch slightly and free one side of the secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access the terminals in the chambers of the connector housing.

4. Looking in the mating end or terminal side of the connector (opposite the secondary lock), take note of the larger cavity next to each terminal.

5. Insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick toward the terminal to depress the locking tang. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat the step if the terminal is still locked in place.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on this page.

Installing Push-to-seat Terminals

NOTE

For wire location purposes, alpha characters are stamped onto the secondary locks or onto the wire end of the connector housing.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body.

2. 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. Close or install the secondary lock. Proceed as follows:

   Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

5. Push the pin and socket halves of the connector together until the latches "click."

6. Install connector on retaining device, if present.

CRIMPING INSTRUCTIONS

1. Strip wire lead removing 5/32 inch (4 mm) of insulation.

2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. See Figure A-18. Determine the correct dye or nest for the core crimp based on the information presented in the Crimp Tables.

NOTE

When the word "TIP" appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure A-17.

4. Lay the back of the core crimp tails on the appropriate nest. Be sure the core crimp tails are pointing towards the forming jaws.

5. Gently apply pressure to handles of tool until crimpers slightly secure the core crimp tails.
6. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation or seal material.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. See Figure A-18. Determine the correct dye or nest for the insulation/seal crimp based on the information presented in the Crimp Tables.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. Inspect the quality of the core and insulation/seal crimps. Distortion should be minimal. See Figure A-18.

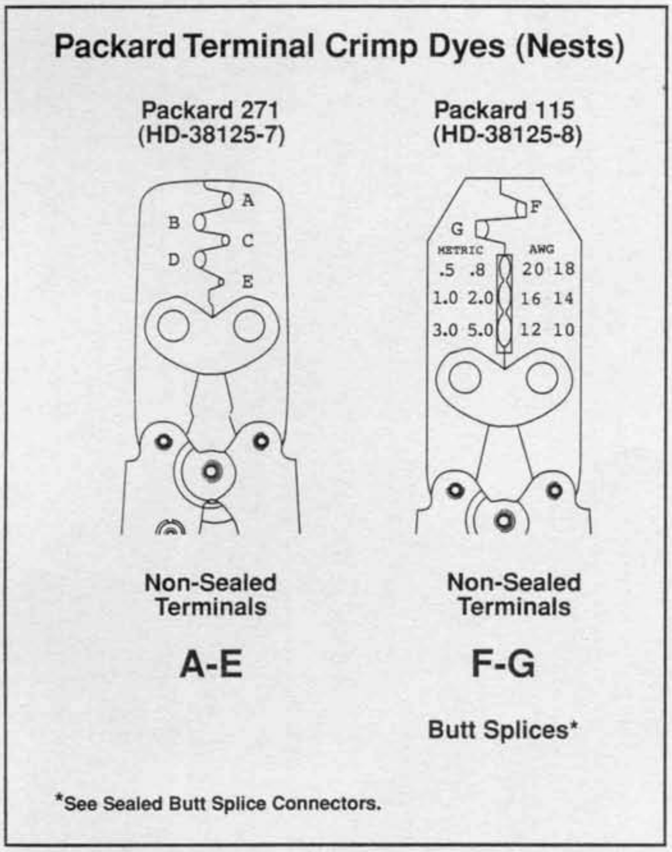


Figure A-16. Packard Terminal Crimp Tools

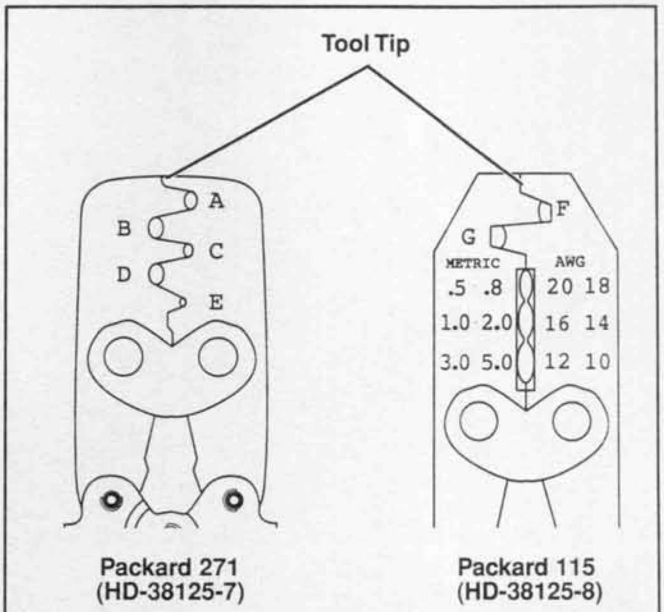


Figure A-17. Tool Tips Used on Selected Core Crimps

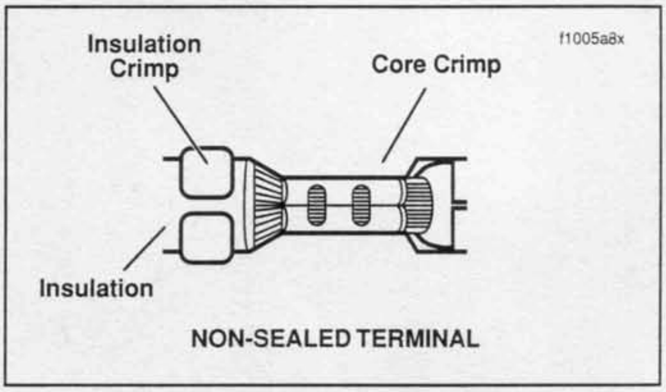


Figure A-18. Inspect Core and Insulation/Seal Crimps

AMP ELECTRICAL CONNECTORS

1-Place Connector

The Amp 1-place connector found on Softail model vehicles is listed below.

- **Brake Light Switch [66]**

NOTE

The brake light switch [66] (in convolute), is located under the seat.

SOCKET TERMINAL

Removal

1. Bend back the ears on the pin housing slightly and separate the pin and socket halves of the connector.
2. Grasp the lead on the wire end of the socket housing and push the terminal forward toward the mating end of the connector until it stops.
3. Looking into the mating end of the connector, note the split or seam in the socket terminal. The locking tang is positioned directly opposite this seam.
4. Fit the barrel of the Amp Socket Terminal Remover (HD-39621-27) over the socket until it bottoms in the housing. See Figure A-19.
5. Holding the socket housing, tilt the tool toward the tang and depress the plunger while pushing down. The terminal 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.

Installation

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.
4. Push the pin and socket halves of the connector together until the latches "click."

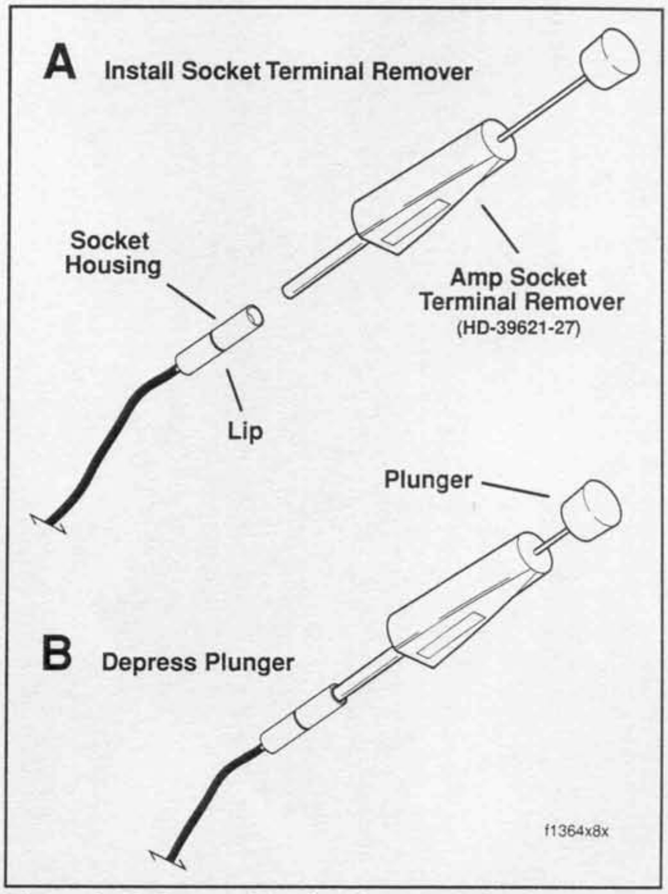


Figure A-19. Remove Terminal from Amp Socket Housing

PIN TERMINAL

Removal

1. Bend back the ears on the pin housing slightly and separate the pin and socket halves of the connector.
2. 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.
3. Fit the barrel of the Amp Pin Terminal Remover (HD-39621-28) over the pin until it bottoms in the housing. See Figure A-20.
4. Holding the pin housing, depress the plunger while pushing down. 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.

Installation

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.
3. Push the pin and socket halves of the connector together until the latches "click."

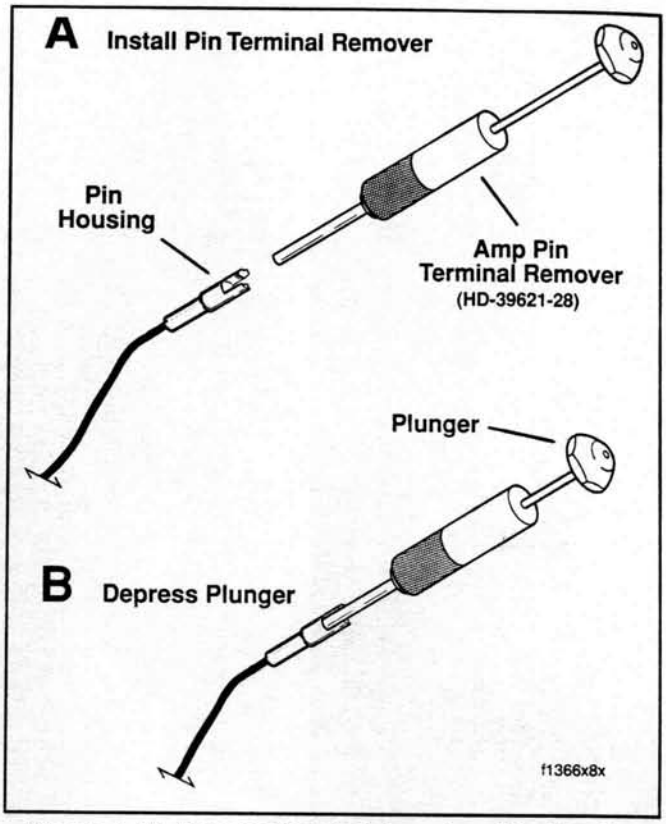


Figure A-20. Remove Terminal from Amp Pin Housing

A-2. CRIMP TABLES

SUBJECT **PAGE NO.**

CRIMPING TABLES

GENERAL

The following tables contain crimping information for 1997 Softail models:

Table Number	Model/Harness
1	Components
2	Main Harness, Part No. 70216-96
3	Starter to 30 A Circuit Breaker, Part No. 70044-96
4	Passing Lamp Harness, Part Nos. 67615-96, 67615-97
5	Rear Lighting Harness, Part Nos. 68653-96, 68655-96

The following tables contain crimping information for 1998 Softail models:

Table Number	Model/Harness
6	Components
7	Main Harness, Part No. 70216-98
8	Starter to 30 A Circuit Breaker, Part No. 70044-96
9	Passing Lamp Harness, Part Nos. 67615-96, 67615-97
10	Rear Lighting Harness, Part Nos. 68653-96, 68655-96

CRIMPING INFORMATION

The crimping tables contain the following information:

A. The connector number used in the wiring diagrams, for example, [14A].

B. The terminal part number.

C. The crimping tool identification. Both the tool manufacturer and Kent Moore numbers are listed.

D. Wire gauge.

E. Crimp type and crimper die (opening) position.

NOTE

Part numbers are given in the crimping tables for reference only. Always refer to the applicable parts catalog when ordering parts.

CRIMPING TABLE LEGEND

(a) Double lugged

(b) Heat sealed butt connector

(c) Requires the use of a 72249-94 heat shrink tubing

(d) Uses a unique 3-pin Deutsch connector housing (72163-94BK)

(e) Uses a unique 3-socket Deutsch connector housing (72113-94BK)

(f) Requires soldering after crimping

(g) Use with 7629 nut

Table 1. 1997 Components

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
CAM POSITION SENSOR [14A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
TRAP DOOR SOLENOID [9B]	ALL	73191-96	HD-41609	20	FRONT	FRONT
REAR LIGHTING [7B]	ALL	73191-96	HD-41609	18	REAR	REAR
V.O.E.S. [11B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
IGNITION MODULE [10B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
FRONT DIRECTIONALS [31B]	ALL	73191-96	HD-41609	18	REAR	REAR
REAR DIRECTIONALS[18B,19B]	ALL	73191-96	HD-41609	18	REAR	REAR
HEADLAMP [38B]	ALL	73191-96	HD-41609	16	CENTER	CENTER
INSTRUMENT CLUSTER [20B]	ALL	73191-96	HD-41609	18	REAR	REAR
LEFT HANDLEBAR CONTROL [24B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
RIGHT HANDLEBAR CONTROL [22B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
SPEED SENSOR [65A]	ALL	72190-94 (d)(f)	DTT-16-00	20	FRONT	FRONT
SPEED SENSOR [65B]	ALL	72191-94 (d)(f)	DTT-16-00	20	FRONT	FRONT
SPEEDOMETER TERMINALS		72241-94 (d)(f)	PACKARD 271	18	C	A
PASSING LAMPS [73B]	ALL	73191-96	HD-41609	18	REAR	REAR
PASSING LAMP SWITCH		9937 (c)	PACKARD 271	16	C	D
FRONT FENDERTIP [32B]	ALL	73191-96	HD-41609	18	REAR	REAR
FRONT FENDERTIP [32A]	ALL	73190-96	HD-41609	16	CENTER	CENTER
HEADLAMP CONN. KIT 68705-93A	ALL	70586-93 (b)	PACKARD 115	18	14-16 GA.	
POSITION LAMP		9898	PACKARD 271		TIP	
POSITION LAMP		9898	PACKARD 115		TIP	

Table 2. 1997 Main Harness, Part No. 70216-96

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
OIL PRESSURE SENDING UNIT		72241-94 (c)	PACKARD 271	18	C	A
REAR BRAKE LIGHT SWITCH		9898	PACKARD 271	18	TIP	
REAR BRAKE LIGHT SWITCH		9898	PACKARD 115	18	TIP	
HORN		9898	PACKARD 271	18	TIP	
HORN		9898	PACKARD 115	18	TIP	
STARTER RELAY 30,87 TERMINALS (R/BK,GN)		9937	PACKARD 271	14	C	A
STARTER RELAY 85,86 TERMINALS (BK,BK/R)		9937	PACKARD 271	18	C	D
FUSEBLOCK (GY,O,BE,O/W)	1,2,3,4	72217-94	PACKARD 271	18	E	A
FUSEBLOCK (R/BK,R/BK,R/BK,R/GY)	5,6,7,8	72218-94	PACKARD 271	14	C	A
MAIN CIRCUIT BREAKER		9866	PACKARD 115	12	12-10 GA.	12-10 GA.
SOLENOID		72291-94	PACKARD 271,115	14	A	G
HARNESS GROUNDS (4) UNDER SEAT		72255-94	PACKARD 270	16	4 (f)	3,5,1
NEUTRAL SWITCH		9905	PACKARD 115	18	20-18 GA.	
COIL	ALL	72241-94	PACKARD 271	18	C (c)	A
TAIL LIGHT & REAR TURN SIGNALS [7A]	EXCEPT 7	73190-96	HD-41609	18	REAR	REAR
IGNITION MODULE [10A]	7	72190-94	DTT-16-00	18	CENTER	CENTER
IGNITION MODULE [10A]	1	72190-94	DTT-16-00	16	CENTER	CENTER
CALIFORNIA TRAP DOOR [9A] (GN)	2,3	73190-96	HD-41609	16	CENTER	CENTER
CALIFORNIA TRAP DOOR [9A]	ALL	73190-96	HD-41609	18	REAR	REAR
V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
CAM POSITION SENSOR [14A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
CONSOLE [20A]	ALL	73190-96	HD-41609	18	REAR	REAR
RIGHT HAND CONTROLS [22A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
LEFT HAND CONTROLS [24A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
TURN SIGNAL MODULE [30B]		72191-94	DTT-16-00	18	CENTER	CENTER
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR	REAR
HEADLAMP [38A]	ALL	73190-96	HD-41609	18	REAR	REAR
IGNITION SWITCH [33B] (R/BK, R/GY)	1,3	72291-94	PACKARD 271,115	14	A	G
IGNITION SWITCH [33B] (R)	ALL	72292-94	PACKARD 115	12	F (f)	G
TO REAR BRAKE SWITCH (IN CONVOLUTE) [66A]		72039-71A	PACKARD 271	18	E	A
TO REAR BRAKE SWITCH (IN CONVOLUTE) [66B]		72038-71A	PACKARD 271	18	E	A

Table 3. 1997 Starter to 30 A Circuit Breaker, Part No. 70044-96

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842	PACKARD 270,271	10	B	3
CIRCUIT BREAKER TERMINAL		9843	PACKARD 270,271	10	B	3

Table 4. 1997 Passing Lamp Harness, Part No. 67615-96, 67915-97

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
TO PASSING LAMP SWITCH		9937 (c)	PACKARD 271	18	C	D
PASSING LAMPS [73A]	ALL	73190-96	HD-41609	18	REAR	REAR
TO HEAD LAMP (67915-97 Only)		72253-94	PACKARD 271	18	C	A

Table 5. 1997 Rear Lighting Harness, Part No.'s 68653-96 and 68655-96

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
REAR LIGHTING [7B]	ALL	73191-96	AMP	18	X	X
REAR DIRECTIONALS[18A,19A]	ALL	73190-96	AMP	18	X	X
FENDERTIP LAMP [45A] (DOM)	ALL	73190-96	AMP	18	X	X

Table 6. 1998 Components

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
CAM POSITION SENSOR [14A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
TRAP DOOR SOLENOID [9B]	ALL	73191-96	HD-41609	20	FRONT	FRONT
REAR LIGHTING [7B]	ALL	73191-96	HD-41609	18	REAR	REAR
V.O.E.S. [11B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
IGNITION MODULE [10B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
FRONT DIRECTIONALS [31B]	ALL	73191-96	HD-41609	18	REAR	REAR
REAR DIRECTIONALS[18B,19B]	ALL	73191-96	HD-41609	18	REAR	REAR
HEADLAMP [38B]	ALL	73191-96	HD-41609	16	CENTER	CENTER
INSTRUMENT CLUSTER [20B]	ALL	73191-96	HD-41609	18	REAR	REAR
LEFT HANDLEBAR CONTROL [24B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
RIGHT HANDLEBAR CONTROL [22B]	ALL	72191-94	DTT-16-00	18	CENTER	CENTER
SPEED SENSOR [65A]	ALL	72190-94 (d)(f)	DTT-16-00	20	FRONT	FRONT
SPEED SENSOR [65B]	ALL	72191-94 (d)(f)	DTT-16-00	20	FRONT	FRONT
SPEEDOMETER TERMINALS		72241-94 (d)(f)	PACKARD 271	18	C	A
PASSING LAMPS [73B]	ALL	73191-96	HD-41609	18	REAR	REAR
PASSING LAMP SWITCH		9937 (c)	PACKARD 271	16	C	D
FRONT FENDERTIP [32B]	ALL	73191-96	HD-41609	18	REAR	REAR
FRONT FENDERTIP [32A]	ALL	73190-96	HD-41609	16	CENTER	CENTER
HEADLAMP CONN. KIT 68705-93A	ALL	70586-93 (b)	PACKARD 115	18	14-16 GA.	
POSITION LAMP		9898	PACKARD 271		TIP	
POSITION LAMP		9898	PACKARD 115		TIP	

Table 7. 1998 Main Harness, Part No. 70216-98

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
OIL PRESSURE SENDING UNIT		72241-94 (c)(g)	PACKARD 271	18	C	A
REAR BRAKE LIGHT SWITCH		9898	PACKARD 271	18	TIP	
REAR BRAKE LIGHT SWITCH		9898	PACKARD 115	18	TIP	
HORN		9898	PACKARD 271	18	TIP	
HORN		9898	PACKARD 115	18	TIP	
STARTER RELAY 30,87 TERMINALS (R/BK,GN)		9937	PACKARD 271	14	C	A
STARTER RELAY 85,86 TERMINALS (BK,BK/R)		9937	PACKARD 271	18	C	D
FUSEBLOCK (GY,O,BE,O/W)	1,2,3,4	72217-94	PACKARD 271	18	E	A
FUSEBLOCK (R/BK,R/BK,R/BK,R/GY)	5,6,7,8	72218-94	PACKARD 271	14	C	A
MAIN CIRCUIT BREAKER		9866	PACKARD 115	12	12-10 GA.	12-10 GA.
SOLENOID		72291-94	PACKARD 271,115	14	A	G
HARNESS GROUNDS (4) UNDER SEAT		72255-94 (f)	PACKARD 270	16	4	3,5,1
NEUTRAL SWITCH		72405-98BK (b)	PACKARD 115	18	20-18 GA.	20-18 GA.
		72405-98TN (b)	PACKARD 115	18	20-18 GA.	20-18 GA.
COIL	ALL	72241-94 (c)(g)	PACKARD 271	18	C	A
TAIL LIGHT & REAR TURN SIGNALS [7A]	EXCEPT 7	73190-96	HD-41609	18	REAR	REAR
IGNITION MODULE [10A]	7	72190-94	DTT-16-00	18	CENTER	CENTER
IGNITION MODULE [10A]	1	72190-94	DTT-16-00	16	CENTER	CENTER
CALIFORNIA TRAP DOOR [9A] (GN)	2,3	73190-96	HD-41609	16	CENTER	CENTER
CALIFORNIA TRAP DOOR [9A]	ALL	73190-96	HD-41609	18	REAR	REAR
V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
CAM POSITION SENSOR [14A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
CONSOLE [20A]	ALL	73190-96	HD-41609	18	REAR	REAR
RIGHT HAND CONTROLS [22A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
LEFT HAND CONTROLS [24A]	ALL	72190-94	DTT-16-00	18	CENTER	CENTER
TURN SIGNAL MODULE [30B]		72191-94	DTT-16-00	18	CENTER	CENTER
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR	REAR
HEADLAMP [38A]	ALL	73190-96	HD-41609	18	REAR	REAR
IGNITION SWITCH [33B] (R/BK, R/GY)	1,3	72291-94	PACKARD 271,115	14	A	G
IGNITION SWITCH [33B] (R)	ALL	72292-94 (f)	PACKARD 115	12	F	G
TO REAR BRAKE SWITCH (IN CONVOLUTE) [66A]		72039-71A	PACKARD 271	18	E	A
TO REAR BRAKE SWITCH (IN CONVOLUTE) [66B]		72038-71A	PACKARD 271	18	E	A

Table 8. 1998 Starter to 30 A Circuit Breaker, Part No. 70044-96

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842	PACKARD 270,271	10	B	3
CIRCUIT BREAKER TERMINAL		9843	PACKARD 270,271	10	B	3

Table 9. 1998 Passing Lamp Harness, Part No. 67615-96, 67915-97

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
TO PASSING LAMP SWITCH PASSING LAMPS [73A]	ALL	9937 (c) 73190-96	PACKARD 271 HD-41609	18 18	C REAR	D REAR
TO HEAD LAMP (67915-97 Only)		72253-94	PACKARD 271	18	C	A

Table 10. 1998 Rear Lighting Harness, Part No.'s 68653-96 and 68655-96

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
REAR LIGHTING [7B]	ALL	73191-96	AMP	18	X	X
REAR DIRECTIONALS[18A,19A]	ALL	73190-96	AMP	18	X	X
FENDERTIP LAMP [45A] (DOM)	ALL	73190-96	AMP	18	X	X

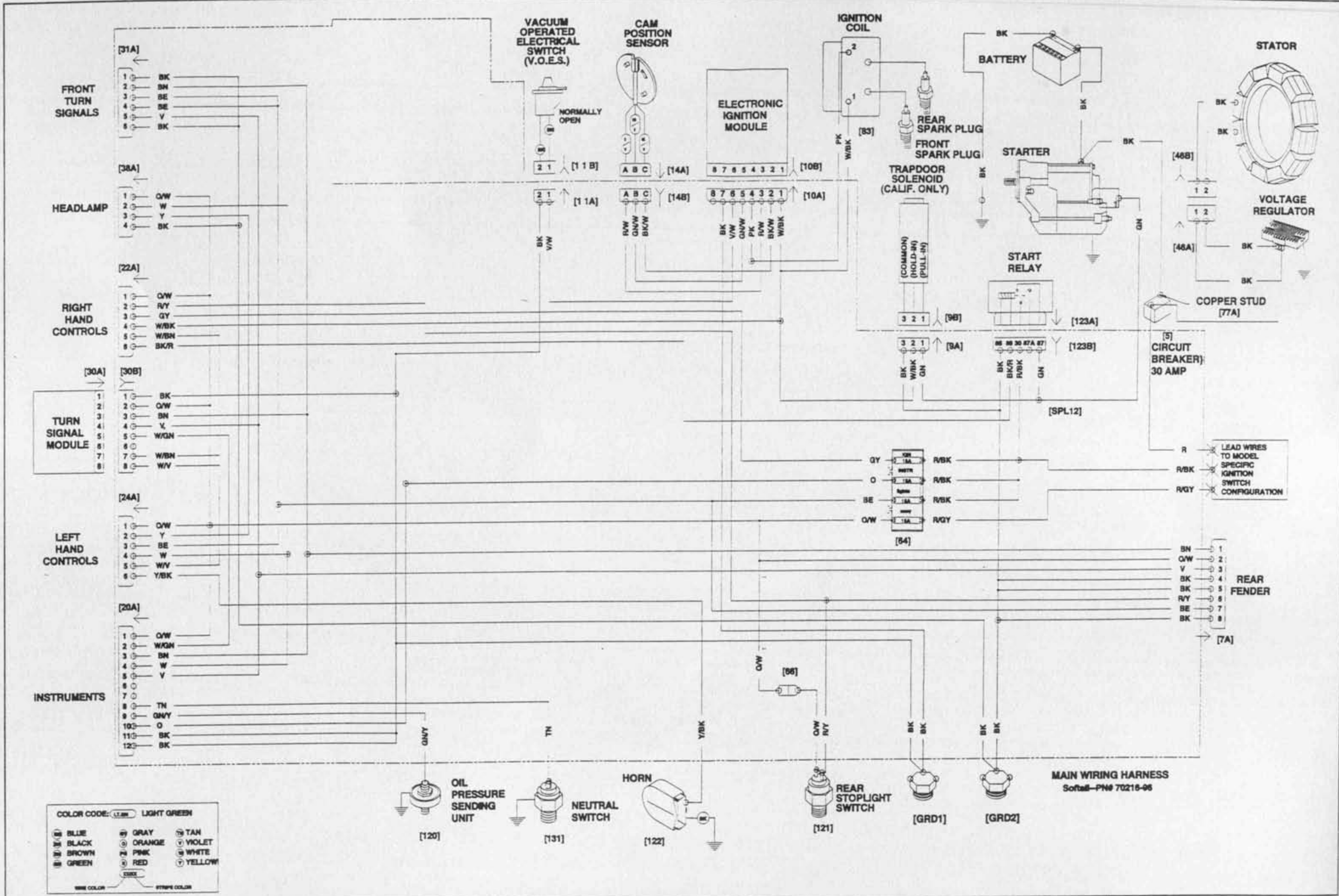
A-3. CONNECTOR LOCATIONS

SUBJECT	PAGE NO.

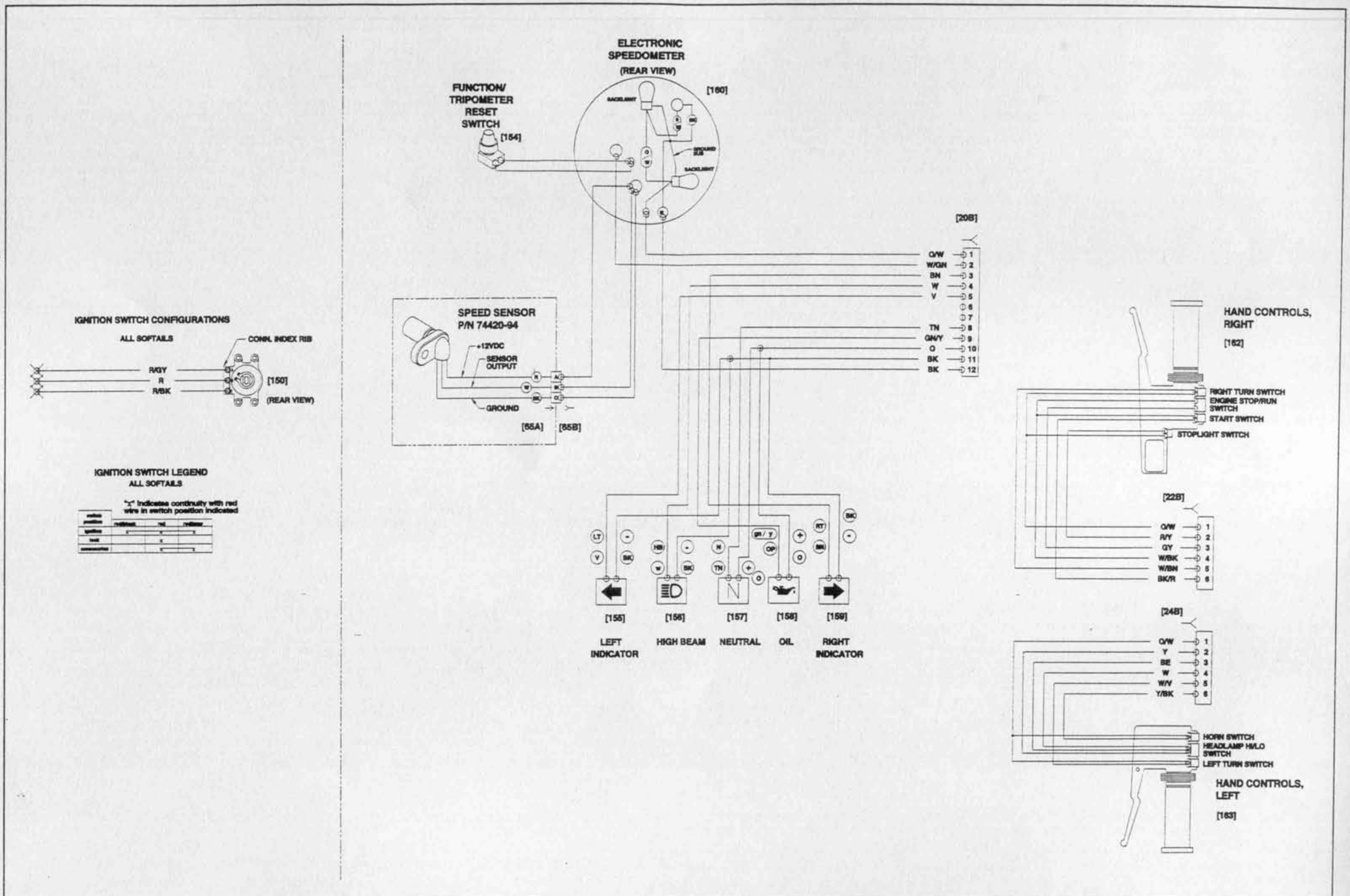
Connector Number (from Wiring Diagram)	Description	Type	Location
[7]	Tail Light and Rear Turn Signals	8-Place Multilock	Under seat on right side of ignition module.
[10]	Ignition Module	8-Place Deutsch	Under seat on left side of ignition module.
[11]	V.O.E.S.	2-Place Deutsch	Electrical bracket between fuel tanks-right hand side.
[14]	Cam Position Sensor	3-Place Deutsch	Below transmission on right side support bracket.
[20]	Console Gauges	12-Place Multilock	Electrical bracket between fuel tanks
[22]	Right Handlebar Controls	6-Place Deutsch	Electrical bracket between fuel tanks-right hand sides
[24]	Left Handlebar Controls	6-Place Deutsch	Electrical bracket between fuel tanks-left hand sides
[30]	Turn Signal Module	8-Place Deutsch	Electrical bracket between fuel tanks.
[31]	Front Turn Signals	6-Place Multilock	Electrical bracket between fuel tanks-left hand side.
[38]	Headlamp	4-Place Multilock	Electrical bracket between fuel tanks-left hand side.
[65]	Speedometer Sensor	3-Place Deutsch	Electrical bracket between fuel tanks-right hand side.
-	Rear Stoplight Switch	Spade Terminals	Behind transmission.
-	Neutral Switch	Post Terminal(s)	Top of transmission.
-	Starter Solenoid	Spade Terminals	Top of starter.
-	Oil Pressure Sending Unit	Ring Terminal	Top of engine crankcase.
-	Coil	Ring Terminals	At coil.
-	Horn	Spade Terminals	Between cylinders (all models except FLSTS) Front Fork (FLSTS)
-	Main Circuit Breaker	Ring Terminals	On rear fender splash guard.
-	Frame Grounds	Ring Terminals	Under Seat.

1997 and 1998 SOFTAIL ELECTRICAL CONNECTOR LOCATIONS

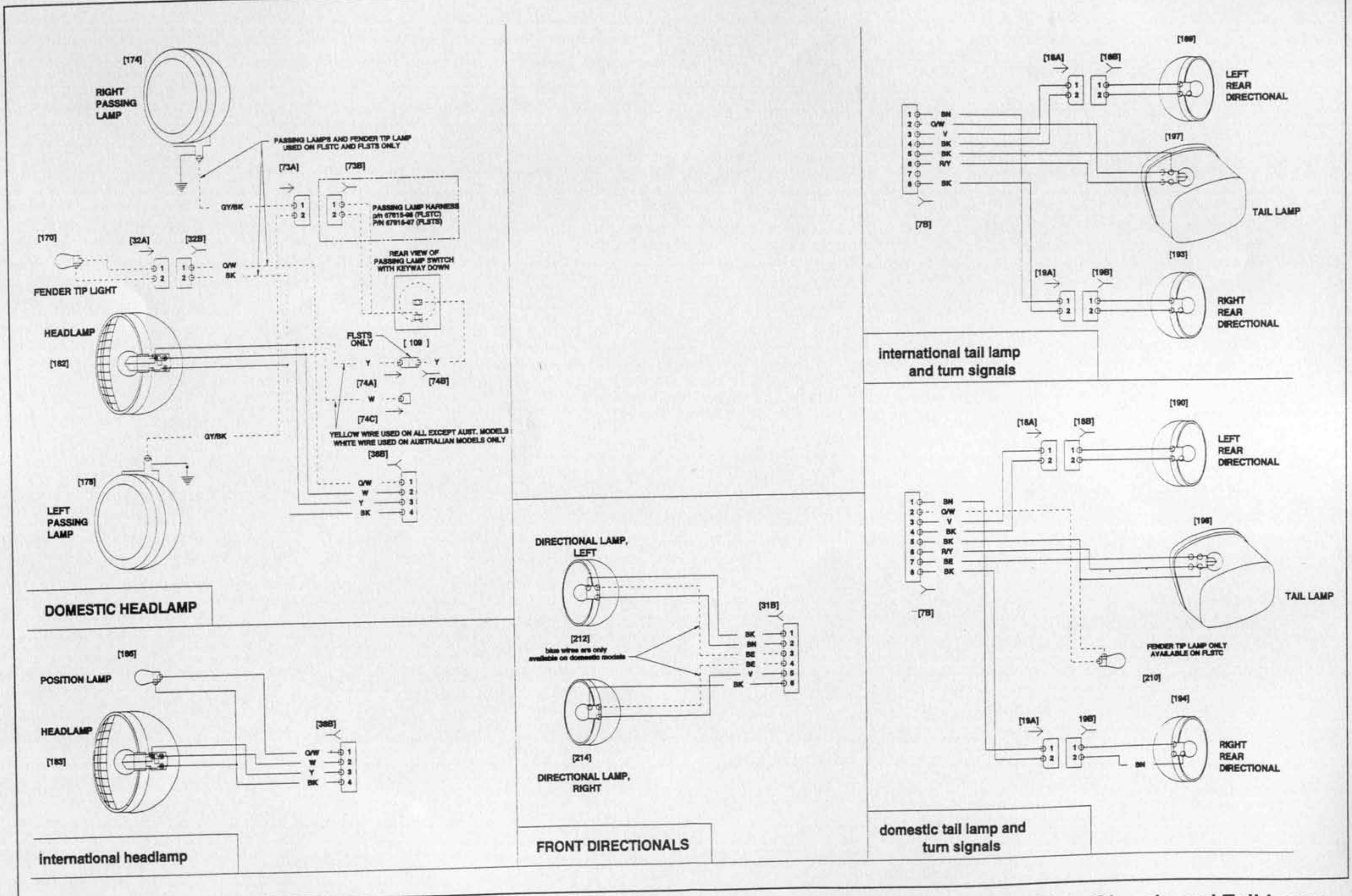
A-4. WIRING DIAGRAMS



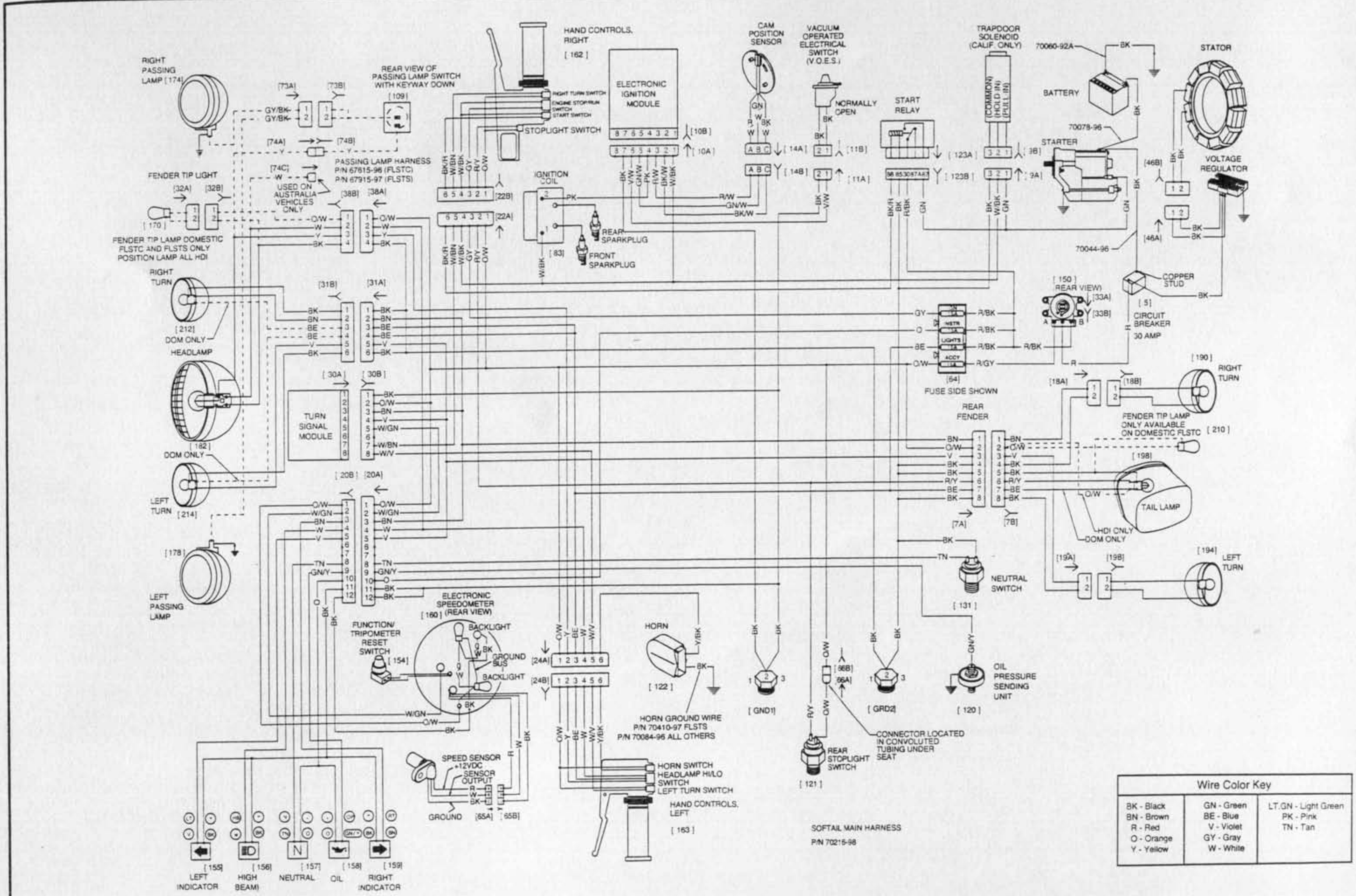
1997 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Main Harness



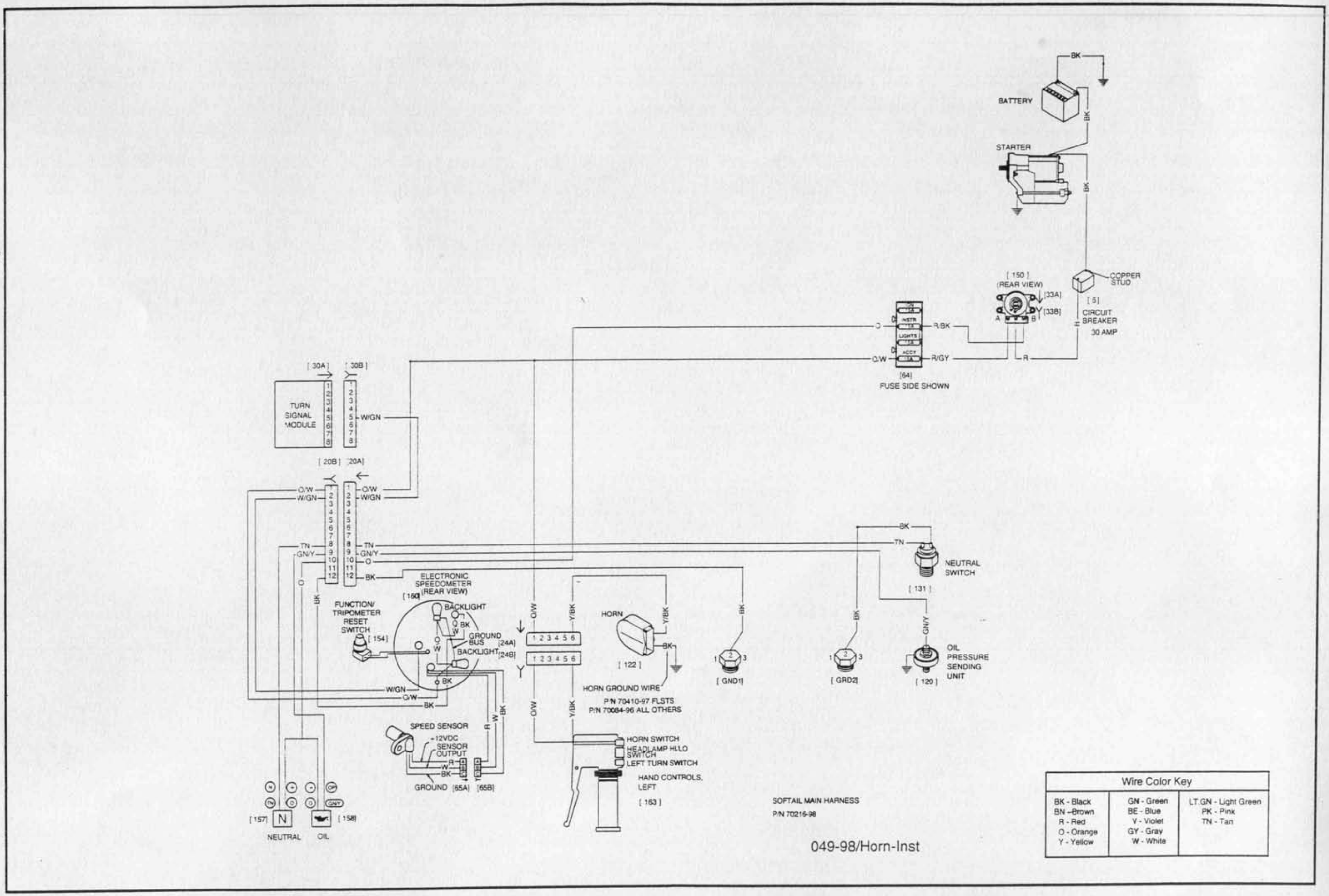
1997 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Instruments



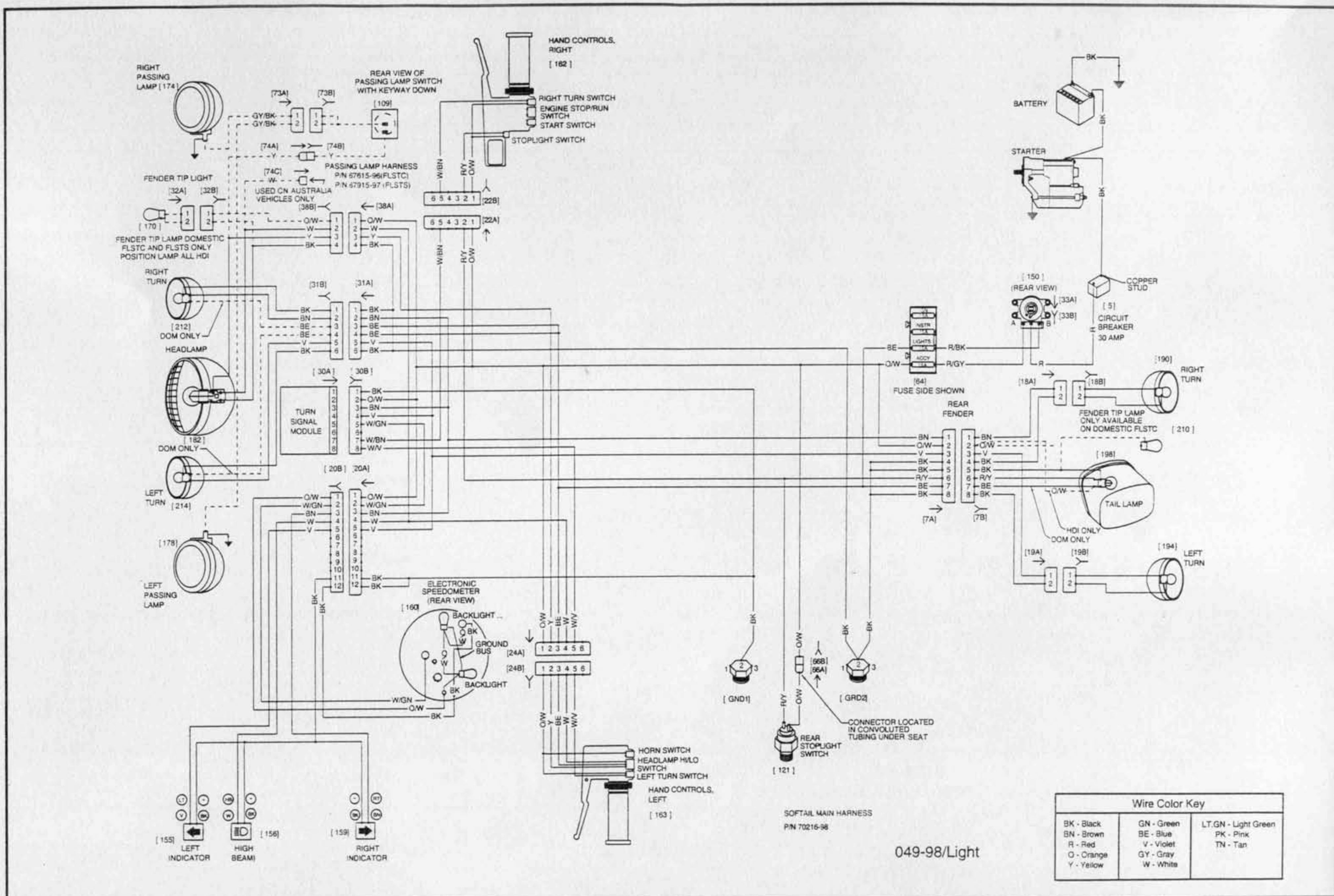
1997 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Headlamp, Front /Rear Turn Signals and Tail Lamp



1998 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Main Harness



1998 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Instruments



1998 SOFTAIL WIRING DIAGRAM (Domestic and International Models), Headlamp, Front/Rear Turn Signals and Tail Lamp

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V

W

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