2002 Sportster Models Service Manual

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IMPORTANT NOTICE

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

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

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

Harley-Davidson Motor Company

FOREWORD

GENERAL

⚠WARNING

The rider's safety depends upon proper motorcycle service and maintenance. If a procedure in this manual is not within your capabilities or you do not have the correct tools, have a Harley-Davidson dealer perform the procedure. Improper service or maintenance could result in death or serious injury. (00627b)

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

HOW TO USE YOUR SERVICE MANUAL

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

For example, the sixth topic (BRAKES) in section one (MAINTENANCE) could be referred to as:

1.6 BRAKES

This cross reference directs the reader to section **1** (MAINTENANCE) and topic **6** (BRAKES).

A number of acronyms and abbreviations are used in this document. See the GLOSSARY for a list of acronyms, abbreviations and definitions.

SERVICE BULLETINS

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

CONTENTS

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

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

PREPARATION FOR SERVICE

⚠WARNING

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

Good preparation is very important for efficient service work. Start each job with a clean work area. This will allow the repair to proceed as smoothly as possible. It will also reduce the incidence of misplaced tools and parts.

Clean a motorcycle that is excessively dirty before work starts. Cleaning will occasionally uncover sources of trouble. Gather any tools, instruments and any parts needed for the job before work begins. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

NOTES

- *To avoid unnecessary disassembly, carefully read all related service information before repair work begins.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- *When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), first disarm the system. Keep the fob close to the vehicle or use DIGITAL TECHNICIAN II (Part No. HD-48650) to disable the system. Activate the system after service is completed.To avoid unnecessary disassembly, carefully read all related service information before repair work begins.*

USE GENUINE REPLACEMENT PARTS

⚠WARNING

Harley-Davidson parts and accessories are designed for Harley-Davidson motorcycles. Using non-Harley-Davidson parts or accessories can adversely affect performance, stability or handling, which could result in death or serious injury. (00001b)

To achieve satisfactory and lasting repairs, carefully follow the service manual instructions and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. This is your assurance that the parts you are using will fit right, operate properly and last longer.

WARNINGS AND CAUTIONS

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

⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. (00119a)

⚠CAUTION

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

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140b)

NOTE

Refers to important information. It is recommended that you take special notice of these items.

Proper service and repair are important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this manual are effective methods for performing service operations.

⚠WARNING

Always wear proper eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Flying parts could result in death or serious injury. (00496b)

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 manual. However, remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Harley-Davidson could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Harley-Davidson must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized as a result. Failure to do so could result in death or serious injury.

PRODUCT REFERENCES

⚠WARNING

Read and follow warnings and directions on all products. Failure to follow warnings and directions can result in death or serious injury. (00470b)

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

Special Tools

All tools mentioned in this manual with a part number beginning with “HD”, “J” or “B” must be ordered through your local Harley- Davidson dealer. Special tools may only be purchased, serviced or warrantied through a Harley-Davidson dealer.

LOCTITE Sealing and Threadlocking Products

Some procedures in this manual call for the use of LOCTITE products. If you have any questions regarding LOCTITE product usage or retailer/wholesaler locations, contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

Apple, Alcantara S.p.A., Allen, Amp Multilock, Bluetooth, Brembo, City Navigator, Delphi, Deutsch, Dunlop, Dynojet, Fluke, G.E. Versilube, Garmin, Gunk, Hydroseal, Hylomar, iPhone, iPod, Kevlar, Lexan, Loctite, Lubriplate, Keps, K&N, Magnaflux, Marson Thread-Setter Tool Kit, MAXI fuse, Molex, Michelin, MPZ, Mulitilock, nano, NGK, Novus, Packard, Pirelli, Permatex, Philips, PJ1, Pozidriv, Road Tech, Robinair, S100, Sems, SiriusXM, Snap-on, Teflon, Threadlocker, Torca, Torco, TORX, Tufoil, Tyco, Ultratorch, Velcro, X-Acto, XM Satellite Radio, and zumo are among the trademarks of their respective owners.

PRODUCT REGISTERED MARKS H-D U.S.A., LLC TRADEMARK INFORMATION

Bar & Shield, Boom!, Cross Bones, Cruise Drive, CVO, Digital Tech, Digital Technician, Digital Technician II, Dyna, Electra Glide, Evolution, Fat Bob, Fat Boy, Forty-Eight, Glaze, Gloss, H-D, H-Dnet.com, Harley, Harley-Davidson, HD, Heritage Softail, Iron 883, Low Rider, Night Rod, Nightster, Night Train, Profile, Reflex, Revolution, Road Glide, Road King, Road Tech, Rocker, Screamin' Eagle, Seventy-Two, Softail, Sportster, Street Glide, Street Rod, Sun Ray, Sunwash, Super Glide, SuperLow, Supersmart, Switchback, SYN3, TechLink, TechLink II, Tour-Pak, Tri Glide, Twin Cam 88, Twin Cam 88B, Twin Cam 96, Twin Cam 96B, Twin Cam 103, Twin Cam 103B, Twin Cam 110, Twin Cam 110B, Twin-Cooled, Ultra Classic, V-Rod, VRSC and Harley-Davidson Genuine Motor Parts and Genuine Motor Accessories are among the trademarks of H-D U.S.A., LLC.

PRODUCT 1

SUBJECT **PAGE NO.**

1.1 General 1-1
1.2 Storage 1-10
1.3 Fluid Requirements 1-11
1.4 Metric Conversion Table 1-13
1.5 Fastener Torque Values 1-14
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SERVICING A NEW MOTORCYCLE

⚠WARNING

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

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

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

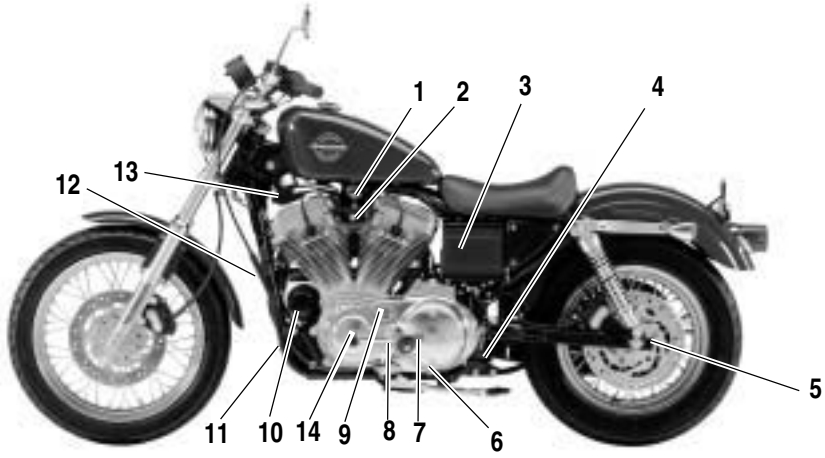
After a new motorcycle has been driven its first 1000 miles (1600 KM), and at specified intervals after that, a Harley-Davidson dealer should perform the service operations listed in the Regular Maintenance Intervals table on the next pages.

SECTION	ODOMETER READING SERVICE OPERATIONS (SEE CHART CODE BELOW)	PRERIDE	1000 MI 1600 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
2	Wheel spoke tightness	I	I		I		I		I		I		I		I		I		I		I		I
2	Tire pressure and inspect tire for wear/damage	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2	Brake fluid level and condition*		I		I		I		I		I		I		I		I		I		I		I
2	Rear brake pedal height adjustment and freeplay	I	I		I		I		I		I		I		I		I		I		I		I
2	Rear brake linkage				IL		IL		IL		IL		IL		IL		IL		IL		IL		IL
2	Brake pad linings and discs for wear		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
2	Condition of rear brake caliper mounting pins and boots				IL		IL		IL		IL		IL		IL		IL		IL		IL		IL
2	Front fork oil										R								R				
2	Front fork bearing adjustment		I		I		I		I		IL		I		I		I		IL		I		I
2	Rear fork pivot bolt		I		I		I		I		I		I		I		I		I		I		
2	Rear fork bearings*						IL				IL				IL				IL				IL
2	Condition of rear shock absorbers		I		I		I		I		I		I		I		I		I		I		I
2	Throttle control grip sleeve, speedometer cable	I			L		L		L		L		L		L		L		L		L		L
2	Front brake hand lever, throttle control cables, clutch control cable and hand lever		L		L		L		L		L		L		L		L		L		L		L
2	Jiffy stand		I		L		L		L		L		L		L		L		L		L		L
3	Engine mounts		I		I		I		I		I		I		I		I		I		I		
3	Engine Oil*	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R
3	Oil filter		R		R		R		R		R		R		R		R		R		R		R
4	Engine idle speed	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	Operation of throttle and enrichener controls	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

SECTION	ODOMETER READING SERVICE OPERATIONS (SEE CHART CODE BELOW)	PRE-RIDE	1000 MI 1600 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
4	Air cleaner		I		I		I		I		I		I		I		I		I		I		I
4	Fuel valve, lines and fittings for leaks		I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4	Fuel tank filter screen				I		I		I		I		I		I		I		I		I		I
4	Air cleaner backplate EVAP butterfly valve operation (if equipped)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
6	Primary chain		I		I		I		I		I		I		I		I		I		I		I
6	Primary chaincase/transmission lubricant		R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R	I	R
6	Rear drive belt	I	A		I		I		I		I		I		I		I		I		I		I
6	Clutch adjustment		A		A		A		A		A		A		A		A		A		A		A
7	Ignition timing and MAP sensor (1200S) or vacuum-operated electric switch (V.O.E.S.)				I		I		I		I		I		I		I		I		I		I
7	Bank Angle Sensor				I		I		I		I		I		I		I		I		I		I
7	Operation of all electrical equipment and switches	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
7	Spark plugs				I		R		I		R		I		R		I		R		I		R
7	Battery connections		T		T		T		T		T		T		T		T		T		T		T
–	All fasteners except engine head bolts		T		T		T		T		T		T		T		T		T		T		T
–	Road test	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table Code:
A - Adjust.
I - Inspect, and if necessary, correct, adjust, clean or replace.
L - Lubricate with specified lubricant.
***Also perform prior to storage or annually**
R - Replace or change.
T - Tighten to proper torque.
X - Perform.

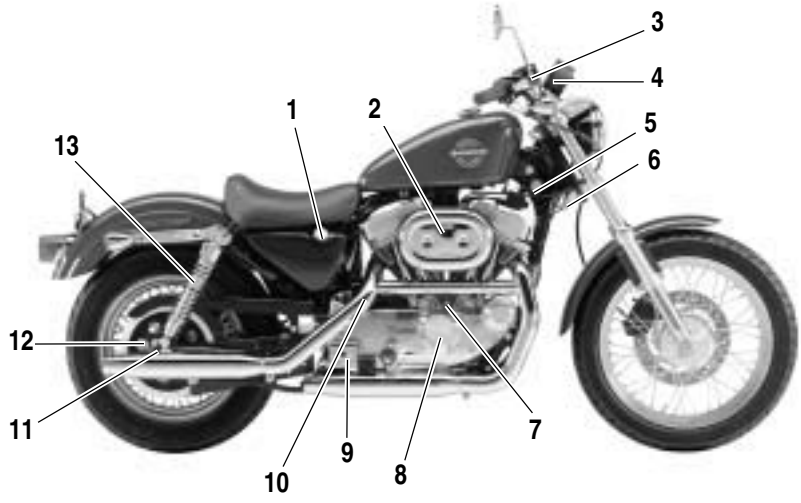
8552



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

Figure 1-1. XLH 883 – Left Side View (Typical)

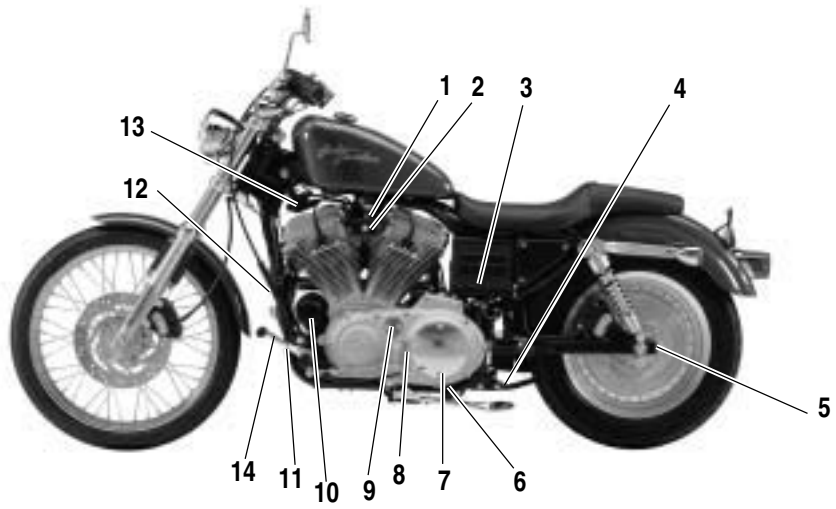
8553



1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-2. XLH 883 – Right Side View (Typical)

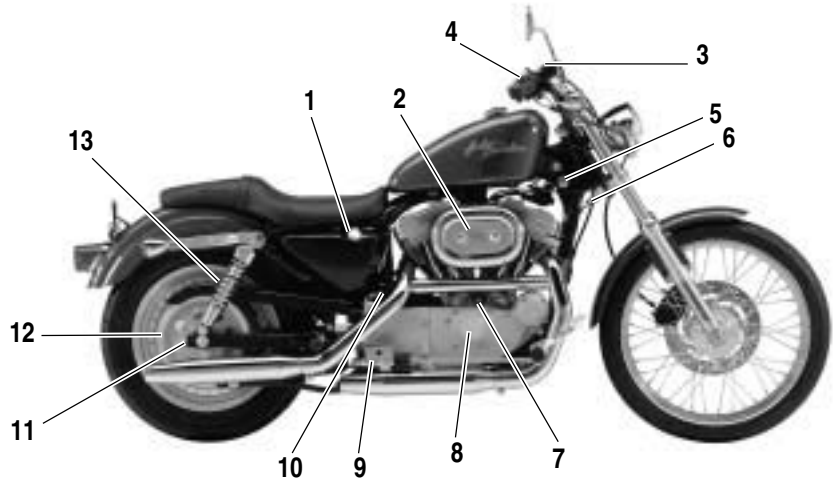
8544



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

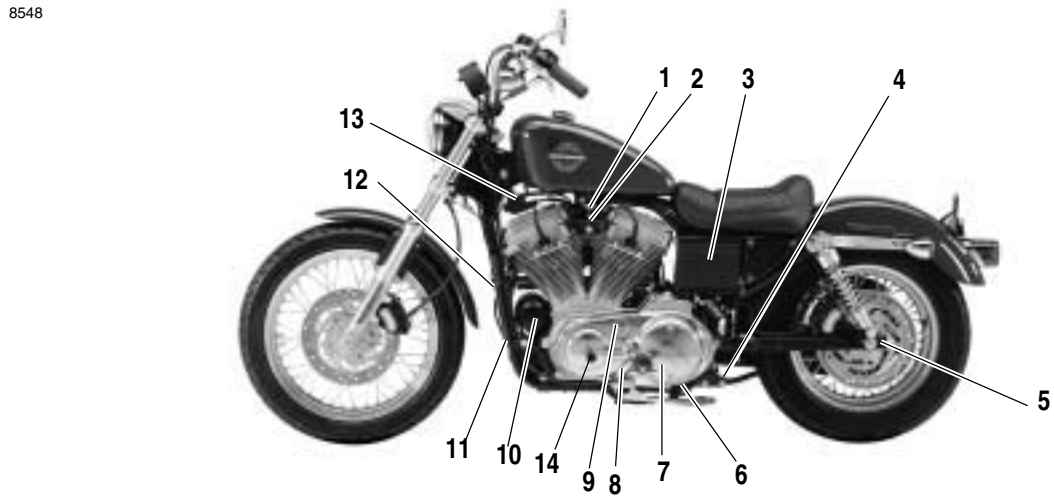
Figure 1-3. XL 883C Custom – Left Side View (Typical)

8545



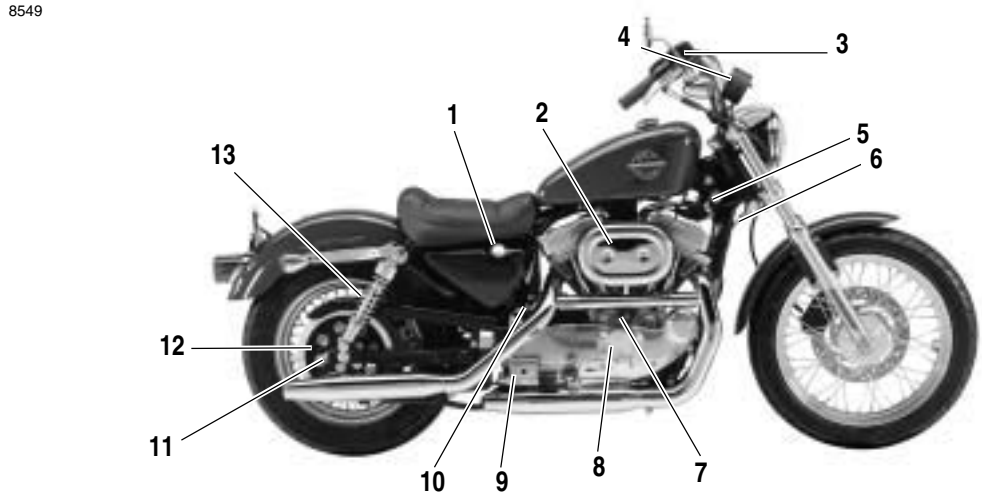
1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-4. XL 883C Custom – Right Side View (Typical)



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

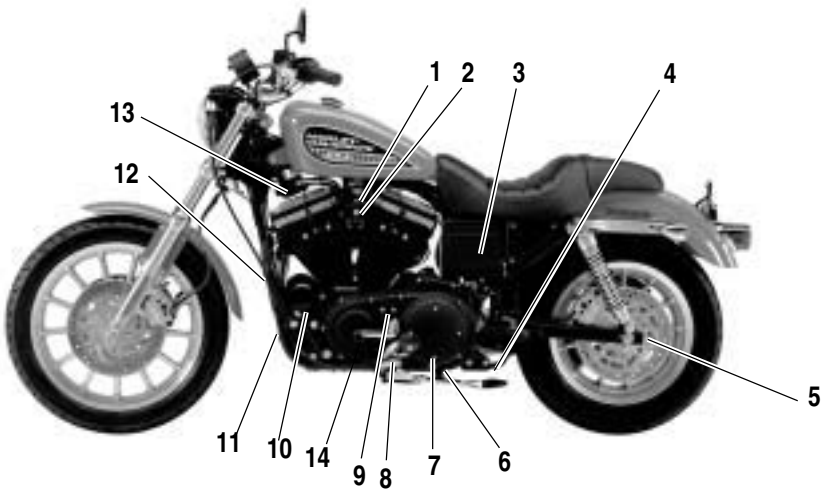
Figure 1-5. XLH 883 Hugger – Left Side View (Typical)



1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-6. XLH 883 Hugger – Right Side View (Typical)

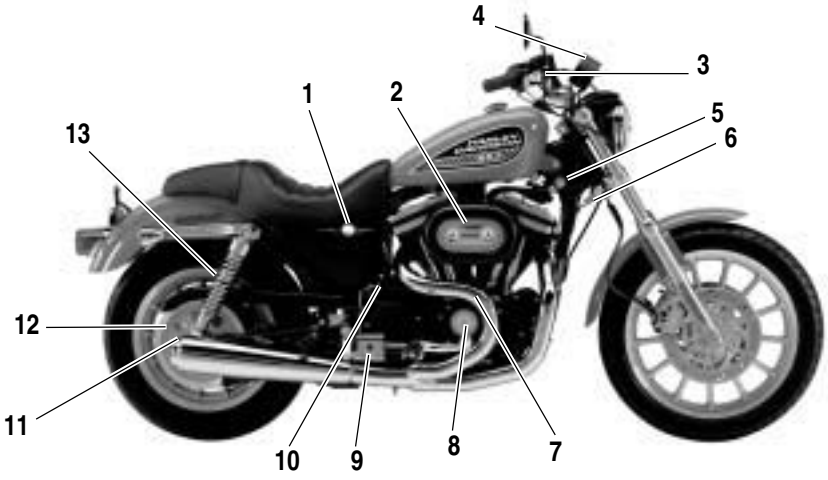
8516



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

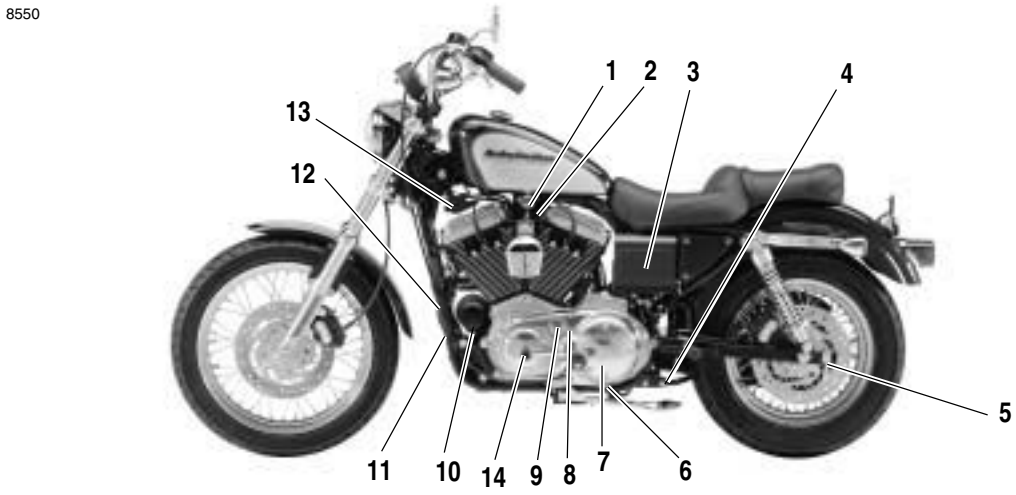
Figure 1-7. XL 883R – Left Side View (Typical)

8517



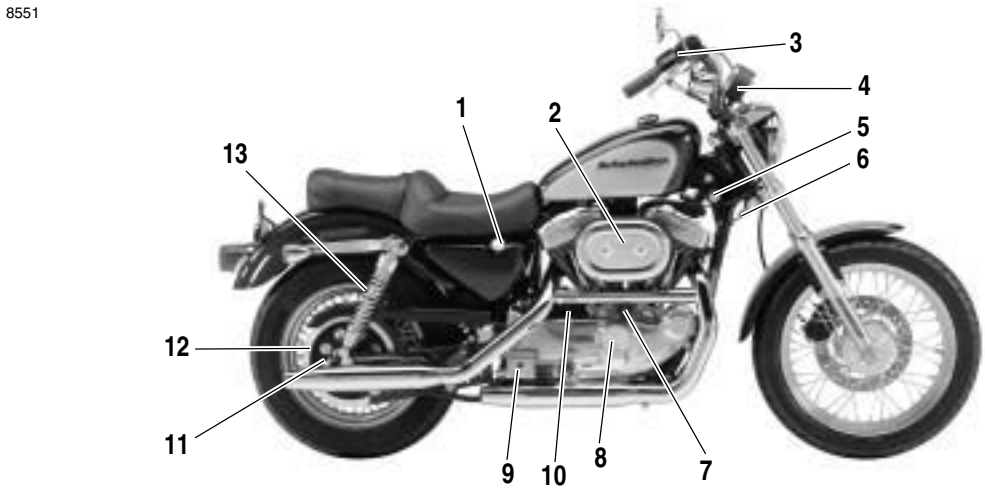
1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-8. XL 883R – Right Side View (Typical)



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

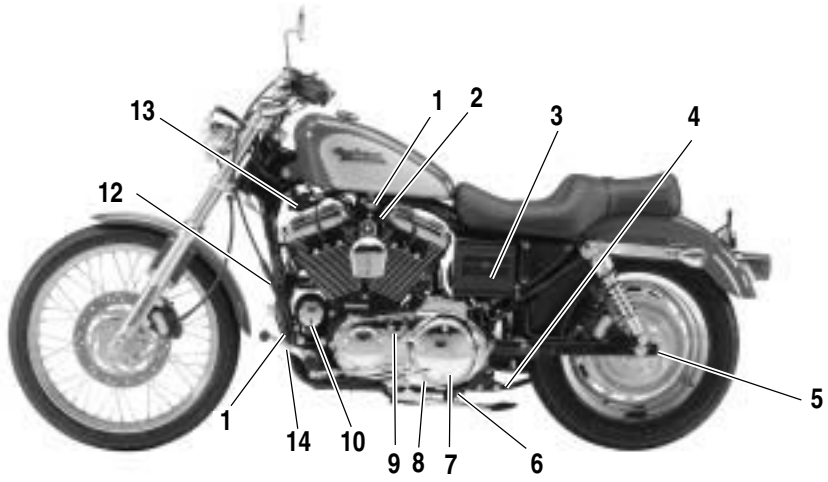
Figure 1-9. XLH 1200 – Left Side View (Typical)



1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer/tachometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-10. XLH 1200 – Right Side View (Typical)

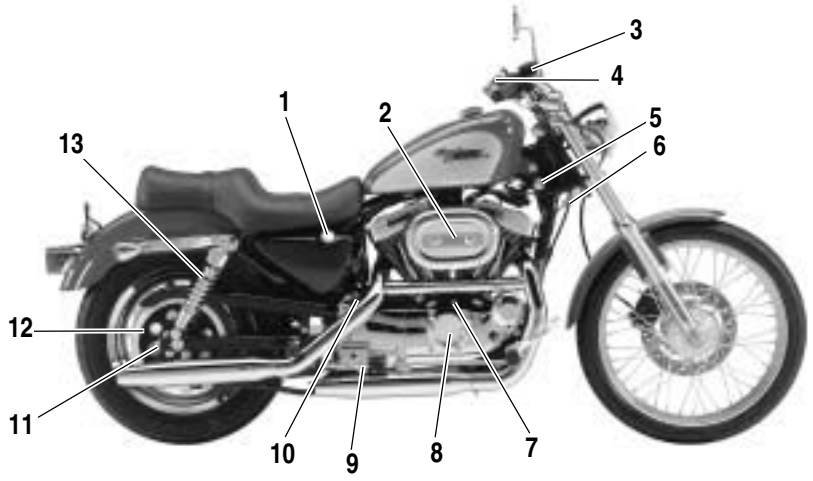
8540



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Engine oil tank drain hose
5. Rear axle adjuster
6. Primary & transmission drain plug
7. Clutch inspection cover
8. Primary chain cover
9. Primary chain inspection plug
10. Engine oil filter
11. Voltage regulator
12. Clutch cable adjuster
13. Ignition coil
14. Gear shift lever

Figure 1-11. XL 1200C Custom– Left Side View (Typical)

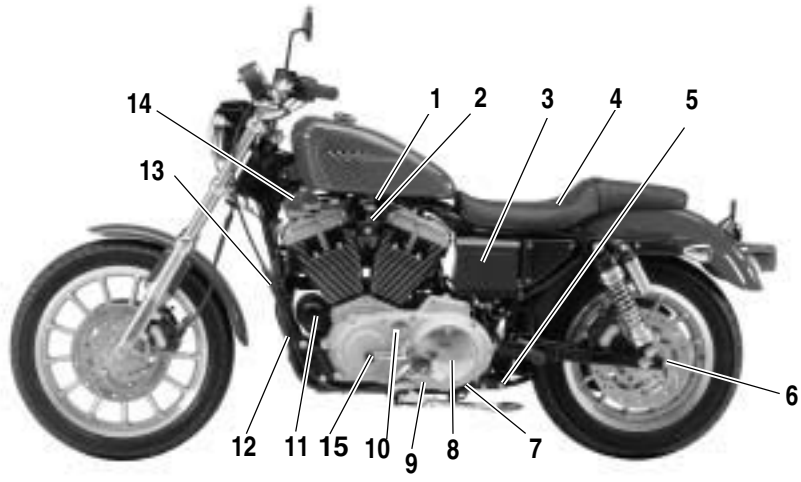
8541



1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer/tachometer
5. Ignition/light key switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Ignition module
9. Rear brake master cylinder & reservoir
10. Electric starter motor
11. Rear axle adjuster
12. Rear sprocket and drive
13. Shock absorber(s)

Figure 1-12. XL 1200C Custom – Right Side View (Typical)

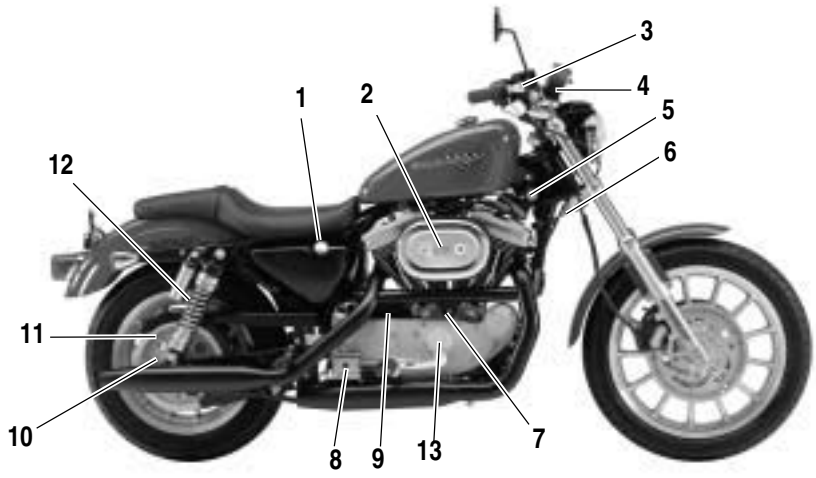
8542



1. Fuel supply valve
2. Carburetor enrichener knob
3. Battery
4. Ignition module (under seat)
5. Engine oil tank drain hose
6. Rear axle adjuster
7. Primary & transmission drain plug
8. Clutch inspection cover
9. Primary chain cover
10. Primary chain inspection plug
11. Engine oil filter
12. Voltage regulator
13. Clutch cable adjuster
14. Ignition coil
15. Gear shift lever

Figure 1-13. XL 1200S Sport– Left Side View (Typical)

8543



1. Engine oil fill plug & dipstick
2. Carburetor/air cleaner
3. Front brake master cylinder & reservoir
4. Speedometer/tachometer
5. Ignition/light switch
6. Fork lock brackets
7. Timing inspection hole plug
8. Rear brake master cylinder & reservoir
9. Electric starter motor
10. Rear axle adjuster
11. Rear sprocket and drive
12. Shock absorber(s)
13. Ignition module

Figure 1-14. XL 1200S Sport– Right Side View (Typical)

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 your local Harley-Davidson dealer or other qualified technician following Service Manual procedures.

⚠WARNING

Gasoline is flammable. Do not store motorcycle having gasoline in tank within the home or garage where open flames, pilot lights, sparks or electric motors are present. Failure to heed this warning could lead to an explosion or fire resulting in death or serious injury.

1. 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.

2. Fill the oil tank. Pinch off (or remove and plug) the line leading from the oil tank bottom to the oil pump feed fitting. This prevents oil from seeping past the check ball into the oil pump and filling the engine flywheel compartment.
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. Grease wheel bearings and install new seals.
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 resulting in death or serious injury.

8. Remove battery from vehicle. Charge battery until the correct voltage is obtained. Charge the battery every other month if it is stored at temperatures below 60˚F (16˚C). Charge battery once a month if it is stored at temperatures above 60˚F (16˚C).

⚠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 death or serious injury.

- **Store battery out of reach of children. Battery contains sulfuric acid which can cause severe burns to eyes, skin and clothing.**

9. If 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.

REMOVAL FROM STORAGE

⚠WARNING

After extended periods of storage and prior to starting vehicle, place transmission in gear, disengage clutch, and push vehicle back and forth a few times to ensure proper clutch disengagement. Incomplete clutch disengagement could cause vehicle to move unexpectedly at start-up, resulting in death or serious 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.

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.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) =128 fl. oz. (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 to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters

- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRAKE FLUID

⚠WARNING

ALWAYS KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. D.O.T. 5 SILICONE HYDRAULIC 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 accidently ingested, call a doctor immediately. Failure to do so could result in death or serious injury.

Use only Harley-Davidson brand D.O.T. 5 SILICONE BRAKE FLUID (H-D Part No. 99902-77).

FRONT FORK OIL

Use only HYDRAULIC FORK OIL TYPE “E” (H-D Part No. 99884-80).

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 the 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.

Table 1-1. Recommended Engine Oils

Harley-Davidson Type	Viscosity	Harley-Davidson Rating	Lowest Ambient Temperature	Cold Weather Starts Below 50˚F (10˚C)
HD Multi-grade	SAE 10W40	HD 260	Below 40˚F (4˚C)	Excellent
HD Multi-grade	SAE 20W50	HD 260	Above 40˚F (4˚C)	Good
HD Regular Heavy	SAE 50	HD 260	Above 60˚F (16˚C)	Poor
HD Extra Heavy	SAE 60	HD 260	Above 80˚F (27˚C)	Poor

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.

PRIMARY DRIVE/TRANSMISSION LUBRICANT

Use only Harley-Davidson SPORT TRANS FLUID (H-D Part No. 98854-96 quart (U.S.) size or H-D Part No. 98855-96 gallon (U.S.) size).

Table 1-2. Metric Equivalents

MILLIMETERS TO INCHES (MM X 0.03937 = INCHES)								INCHES TO MILLIMETERS (INCHES X 25.40 = MM)							
mm	in.	mm	in.	mm	in.	mm	in.	in.	mm	in.	mm	in.	mm	in.	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1 15/16	49.21	3 5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3 3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2 1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3 7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2 1/8	53.97	3 1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2 3/16	55.56	3 9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2 1/4	57.15	3 5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3 11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2 5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2 3/8	60.32	3 3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1 1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2 7/16	61.91	3 13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1 1/8	28.57	2 1/2	63.50	3 7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1 3/16	30.16	2 9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3 15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1 1/4	31.75	2 5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2 11/16	68.26	4 1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1 5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1 3/8	34.92	2 3/4	69.85	4 1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4 3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1 7/16	36.51	2 13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1 1/2	38.10	2 7/8	73.02	4 1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1 9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2 15/16	74.61	4 5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1 5/8	41.27	3	76.20	4 3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1 11/16	42.86	3 1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4 7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1 3/4	44.45	3 1/8	79.37	4 1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3 3/16	80.96	4 9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1 13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1 7/8	47.62	3 1/4	82.55	4 5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4 11/16	119.06

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 could result in death or serious injury.

Table 1-3. English Torque Values

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 QUENCH ED TEM-PERED					9*	16*	30*	70*	140*	18	29	43	63	100	146		
	STUDS			USE SAE 2, 5 AND 8 VALUES WHEN GRADE IS KNOWN, WITH NUT OF SUFFICIENT STRENGTH.																

*Torque values are **in-lbs.**

Table 1-4. Metric 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			Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																

foot-pounds **(ft-lbs) x 1.356 =** Newton-meters **(Nm)**inch-pounds **(in-lbs) x 0.113 =** Newton-meters **(Nm)**

NOTES

GENERAL

The following check list can be helpful in locating most operating troubles. Refer to the appropriate sections in this Service Manual for detailed procedures.

ENGINE

Starting 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 relay or solenoid not functioning.
5. Electric starter shaft pinion gear not engaging or overrunning clutch slipping.

Engine Turns Over But Does Not Start

1. Fuel tank empty.
2. Fuel valve turned off.
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 or battery connection or plug between ignition sensor and module.
9. Ignition coil not functioning.
10. Ignition module not functioning.
11. Ignition sensor not functioning.
12. Sticking or damaged valve or valves.
13. Engine flooded with gasoline as a result of over choking.
14. Engine oil too heavy (winter operation).

Starts Hard

1. Spark plugs in bad condition, have improper gap or are partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Battery nearly discharged.
4. Loose wire connection at one of the battery terminals, at coil, or at plug between ignition sensor and module.
5. Carburetor controls not adjusted correctly.
6. Ignition coil not functioning.
7. Engine oil too heavy (winter operation).
8. Ignition not timed properly.
9. Fuel tank filler cap vent 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.
14. Air cleaner backplate EVAP butterfly valve (if equipped) stuck closed or inoperative.

Starts But Runs Irregularly or Misses

1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and shorting.
3. Spark plug gap too close or too wide.
4. Ignition coil not functioning.
5. Ignition module not functioning.
6. Ignition sensor not functioning.
7. Battery nearly discharged.
8. Damaged wire or loose connection at battery terminals or coil.
9. Intermittent short circuit due to damaged wire insulation.
10. Water or dirt in fuel system and carburetor or filter.
11. Fuel tank filler cap vent plugged or carburetor float bowl vent closed off.
12. Carburetor controls improperly adjusted.
13. Air leak at intake manifold or air cleaner.
14. Damaged intake or exhaust valve.
15. Weak or broken valve springs.
16. Incorrect valve timing.
17. Air cleaner backplate EVAP butterfly valve (if equipped) stuck closed or inoperative.

Spark Plug Fouls Repeatedly

1. Incorrect spark plug.
2. Piston rings badly worn or broken.
3. Fuel mixture too rich (see 4.3 TROUBLESHOOTING).
4. Valve stem seals worn or damaged.
5. Valve guides badly worn.

Pre-Ignition or Detonation (Knocks or Pings)

1. Excessive carbon deposit on piston head or combustion chamber.
2. Incorrect heat range spark plug.
3. Spark plugs not firing.
4. Ignition timing advanced.
5. Fuel octane rating too low.
6. Intake manifold vacuum leak.

Overheating

1. Insufficient oil supply, or oil not circulating.
2. Leaking valves.
3. Heavy carbon deposit.
4. Ignition timing retarded.

Valve Train Noise

1. Hydraulic lifter not functioning properly.
2. Bent push rod.
3. Cam, cam gears, or cam bushings worn.
4. Rocker arm binding on shaft.
5. Valve sticking in guide.

Excessive Vibration

1. Upper mounting bracket loose, broken or improperly spaced.
2. Lower mounting bolts loose.
3. Broken frame.
4. Primary chain badly worn or links tight as a result of insufficient lubrication.
5. Wheels not aligned and/or tires worn.
6. Internal engine problem.

ENGINE LUBRICATION SYSTEM

Oil Does Not Return To Oil Tank

1. Oil tank empty.
2. Return pump gears damaged.
3. Oil feed pump not functioning.
4. Restricted oil lines or fittings.

Engine Uses Too Much Oil or Smokes Excessively

1. Piston rings badly worn or broken.
2. Valve stem seals worn or damaged.
3. Valve guides worn.

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

1. Loose parts.
2. Imperfect seal at gaskets, push rod cover, washers, etc. To aid locating leaks, use BLACK LIGHT LEAK DETECTOR (Part No. HD-35457).
3. Restricted oil return line to tank.
4. Restricted breather passage(s) to air cleaner.

ELECTRICAL SYSTEM

Alternator Does Not Charge

1. Regulator-rectifier module not functioning.
2. Rectifier not grounded.
3. Engine ground wire loose or broken.
4. Loose or broken wires in charging circuit.
5. Stator not functioning.
6. Rotor not functioning.

Alternator Charge Rate Is Below Normal

1. Regulator-rectifier module not functioning.
2. Stator not functioning.
3. Rotor not functioning.
4. Weak battery.
5. Loose connections.

FUEL

Carburetor Floods

1. Excessive “pumping” of hand throttle grip.
2. Inlet valve sticking.
3. Inlet valve and/or valve seat worn or damaged.
4. Dirt or other foreign matter between valve and its seat.
5. Float misadjusted or filled with fuel.

TRANSMISSION

Shifts Hard

1. Clutch dragging slightly.
2. Shifter forks (inside transmission) damaged.
3. Corners worn off shifter clutch dogs (inside transmission).

Jumps Out of Gear

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

CLUTCH

Slips

1. Clutch controls improperly adjusted.
2. Worn friction plates.

Drags or Does Not Release

1. Clutch controls improperly adjusted.
2. Clutch plates excessively warped.

Chatters

Friction or steel plates worn, warped, or dragging.

CHASSIS

Irregular/Inadequate Brake Action

1. Master cylinder low on fluid.
2. Brake line contains air bubbles.
3. Master or wheel cylinder piston worn.
4. Brake pads impregnated with grease or oil.
5. Brake pads badly worn. Minimum lining thickness is 1/16 in. (1.6 mm).
6. Brake disc badly worn or warped.
7. Brake pads dragging or excessive braking (brake fades due to heat buildup).
8. Insufficient brake pedal or hand lever free play (brake drags).

Handling Irregularities

1. Tires improperly inflated. Check TIRE DATA Section. Do not overinflate.
2. Loose wheel axle nuts. Tighten front nut to 50-55 ft-lbs (68-75 Nm). Tighten rear nut to 60-65 ft-lbs (81-88 Nm).
3. Excessive wheel hub bearing play.
4. Rear wheel out of alignment with frame and front wheel.
5. Rims and tires out-of-true sideways. Tire runout should not be more than 5/64 in. (2.0 mm).
6. Rims and tires out-of-round or eccentric with hub. Tire runout should not be more than 3/32 in. (2.4 mm).
7. Irregular or peaked front tire tread wear.
8. Tire and wheel unbalanced.
9. Steering head bearings improperly adjusted. Correct adjustment, and replace pitted or worn bearings and races. See 2.23 FORK STEM AND BRACKET ASSEMBLY.
10. Shock absorber not functioning normally.
11. Heavy front end loading. Non-standard equipment on the front end (such as heavy radio receivers, extra lighting equipment, or luggage) tends to cause unstable handling.

REPAIR NOTES

NOTE

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

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

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

SAFETY – Safety is always the most important consideration when performing any job. Be sure you have a complete understanding of the task to be performed. Use common sense. Use the proper tools. 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 vehicle is ready to go back to the customer.

REPAIR AND REPLACEMENT PROCEDURES

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

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

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. Serious vehicle damage can occur if any flange holes are blocked by the gasket. Use material that is the right type and thickness.

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. Clean bearings with permanent shields and seals in solution.

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.

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.

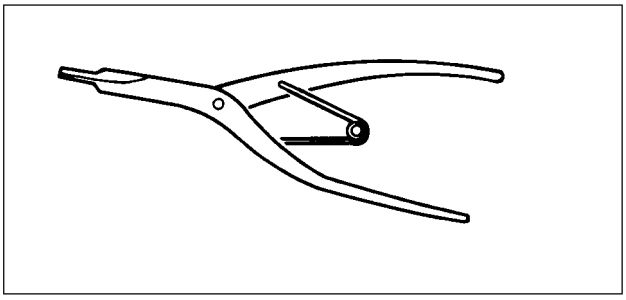
SOCKETS

- 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.

NOTES



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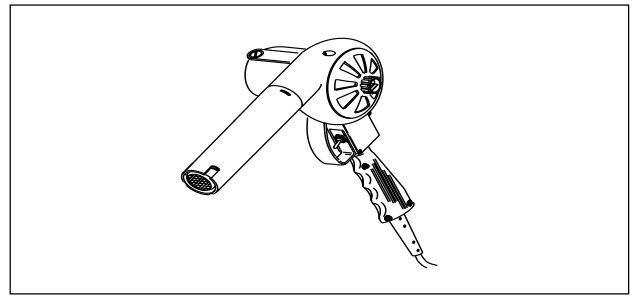

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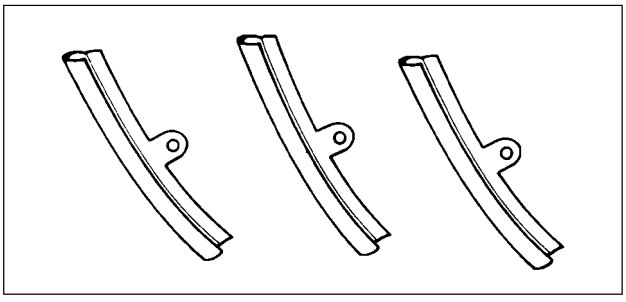

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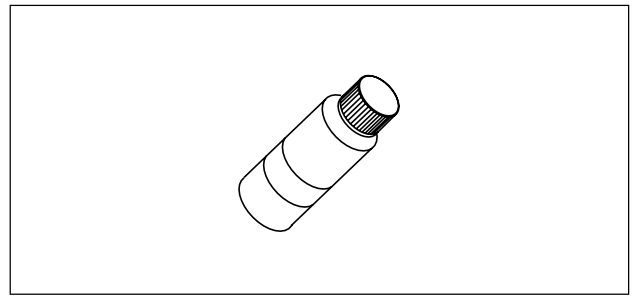

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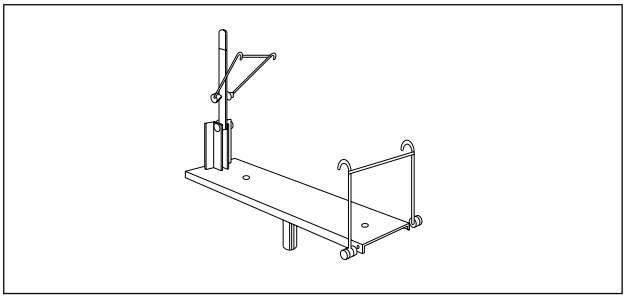

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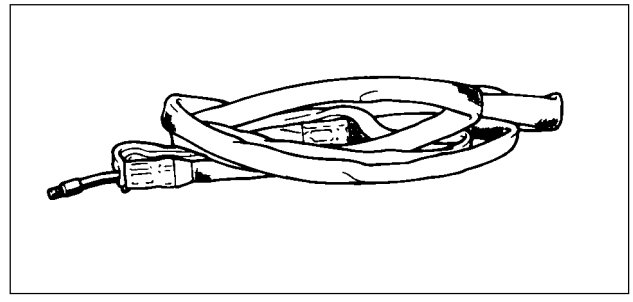
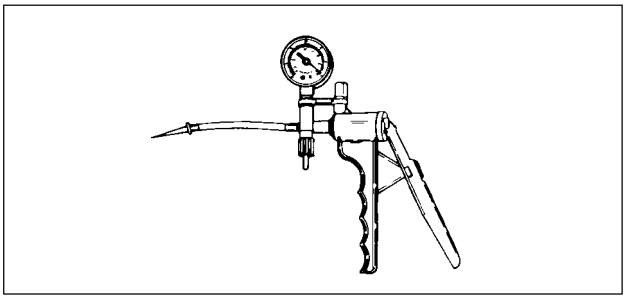
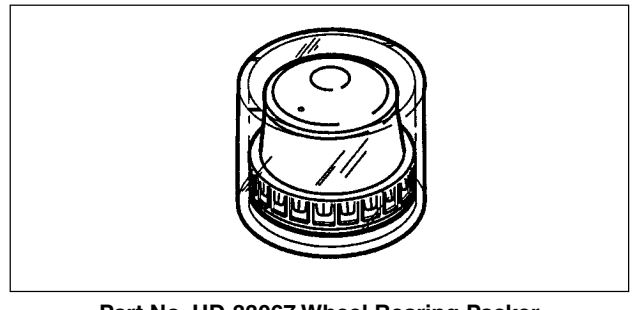


Part No. HD-28700 Tire Bead Expander



Part No. HD-23738 Vacuum Pump



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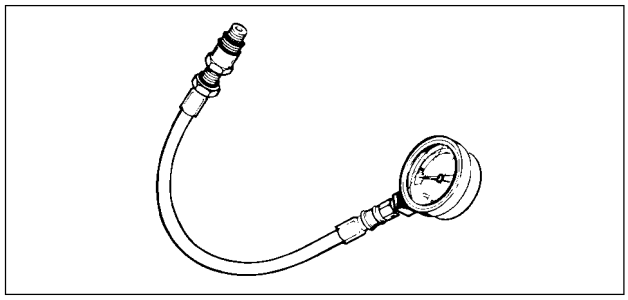
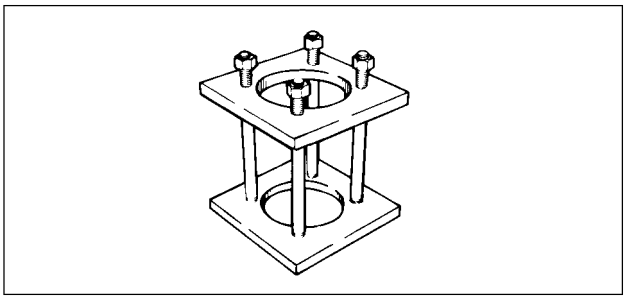


Part No. HD-33223-1 Cylinder Compression Gauge



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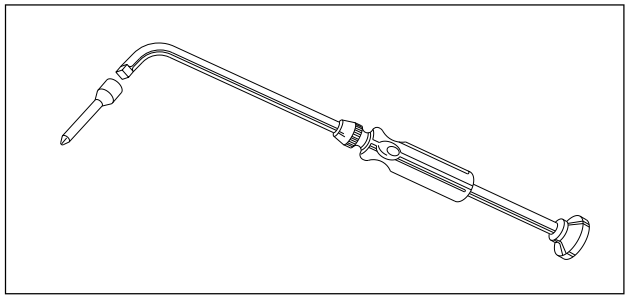
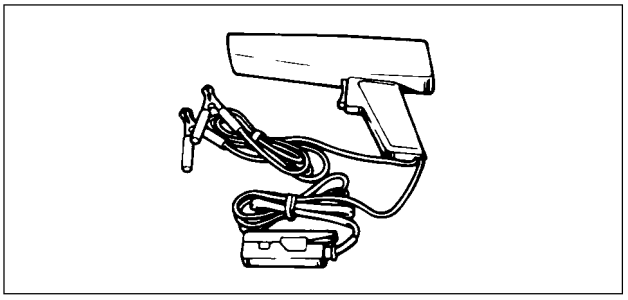


Part No. HD-33413A Carburetor Idle Adjuster
33413-1A Idle adjuster Tip



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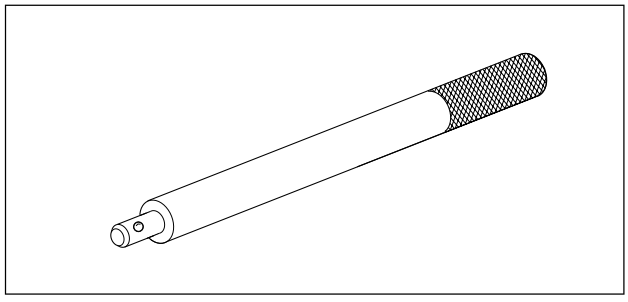

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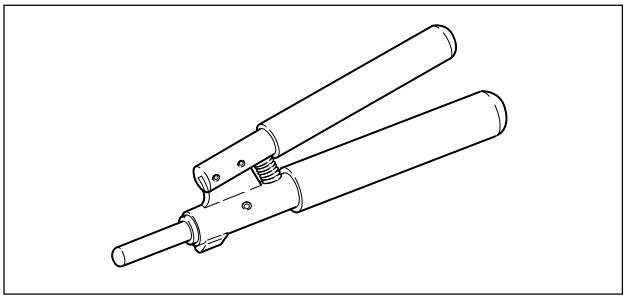

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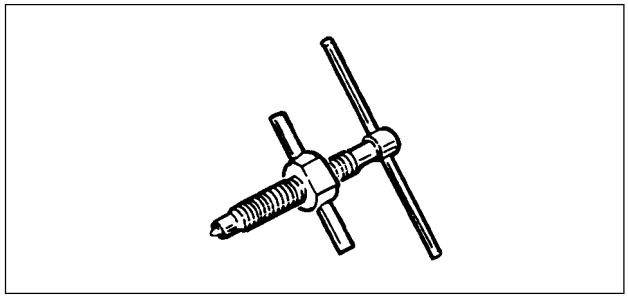

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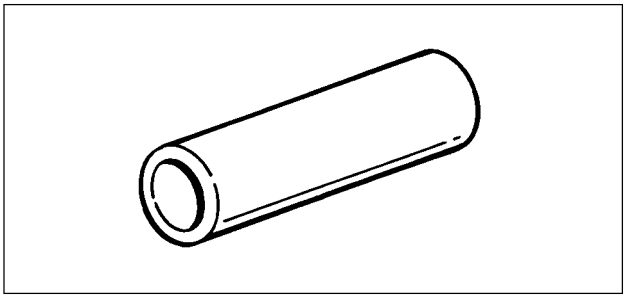
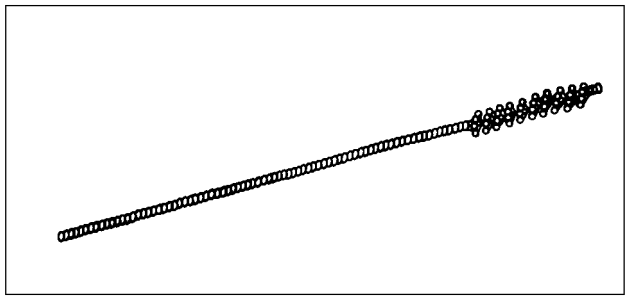


Part No. HD-34643A Shoulderless Valve Guide
Seal Installer



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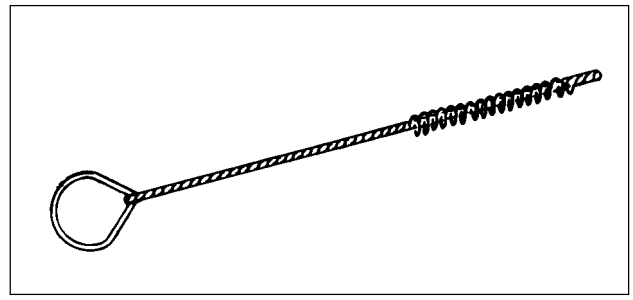
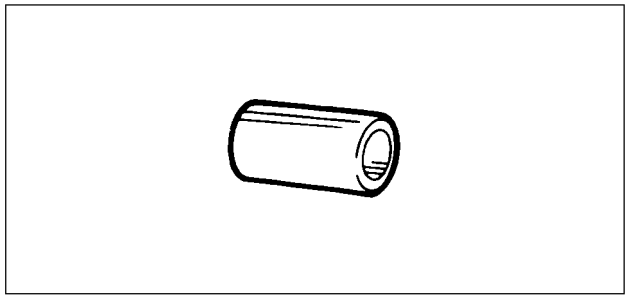


Part No. HD-34751 Nylon Valve Guide Cleaning Brush



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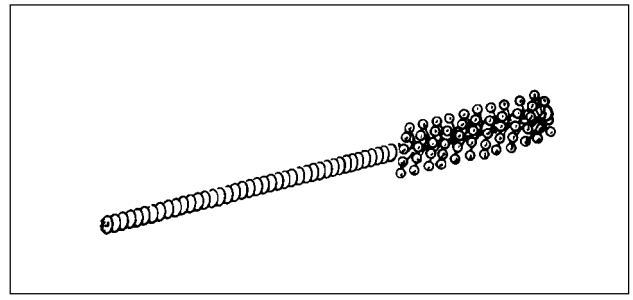
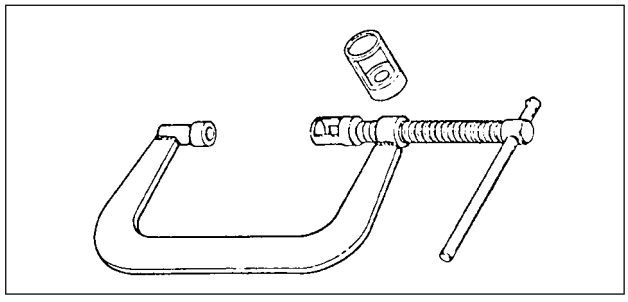
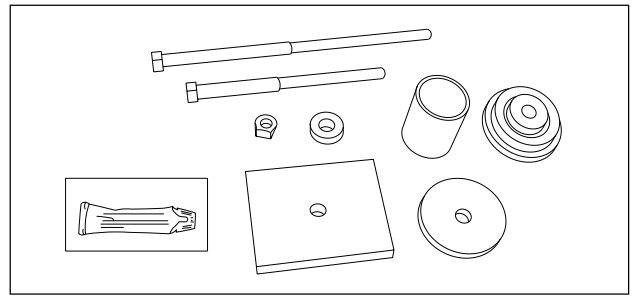


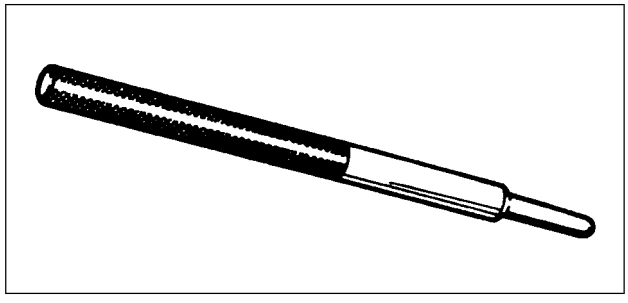
Part No. HD-35102 Wrist Pin Bushing Hone (20 mm)



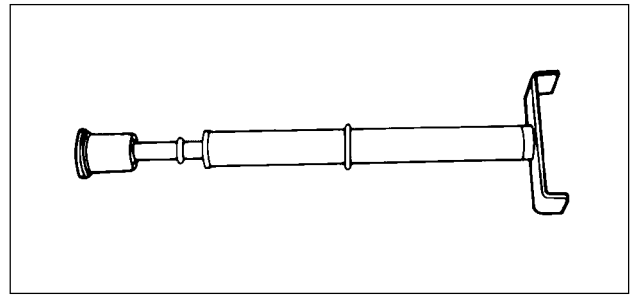
Part No. HD-34736B Valve Spring Compressor



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



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



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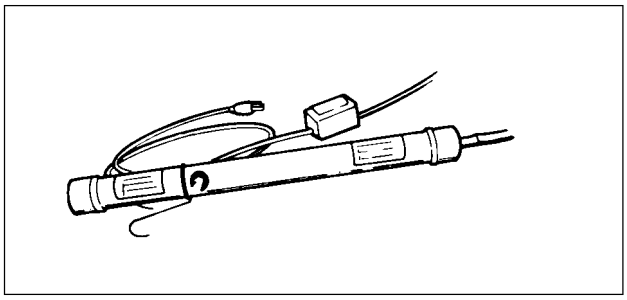
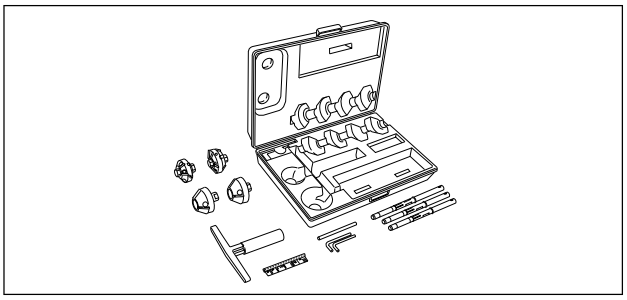
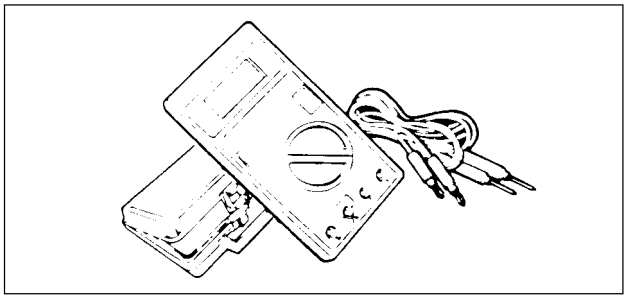


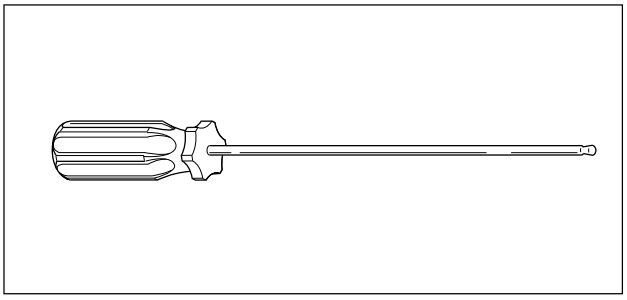
Part No. HD-35457 Black Light Leak Detector



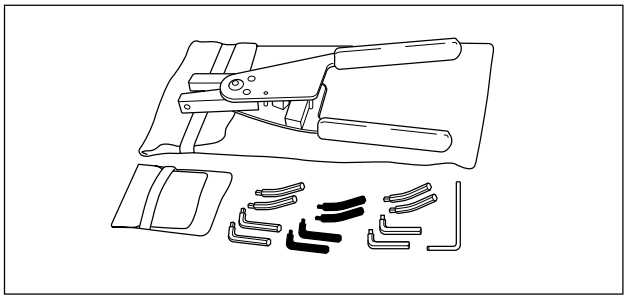
Part No. HD-35758A Neway Valve Seat Cutter Set



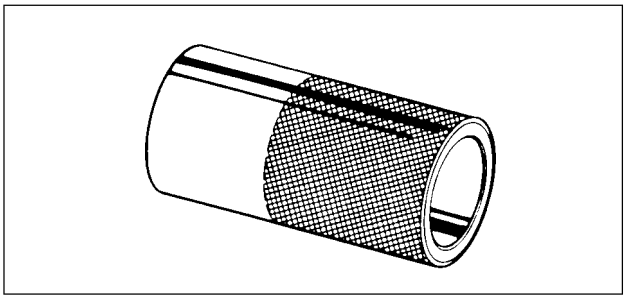
Part No. HD-35500B Digital Multi-Meter (FLUKE 23)



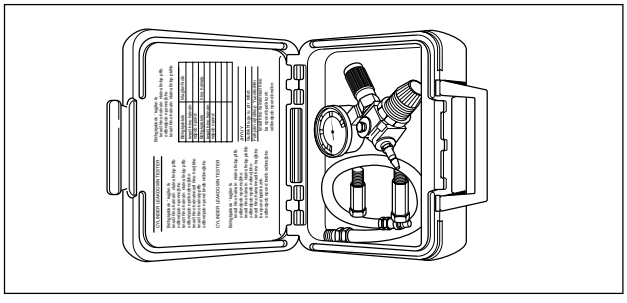
Part No. HD-35801 Intake Manifold Screw Wrench



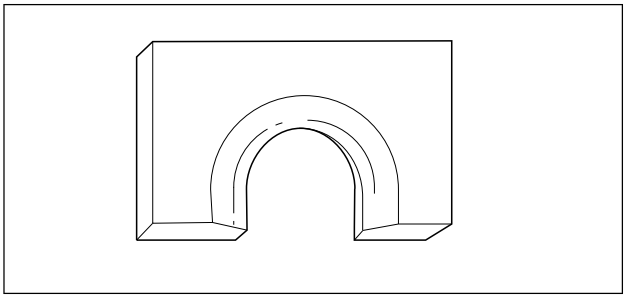
Part No. HD-35518 Internal/External Retaining Ring Pliers



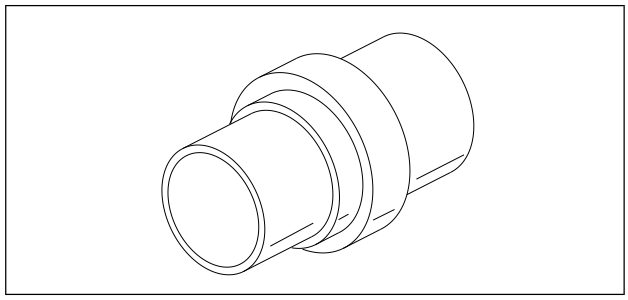
Part No. HD-36583 Fork Bushing / Seal Installer



Part No. HD-35667A Cylinder Leakdown Tester



Part No. HD-37404 Countershaft Gear Support Plate



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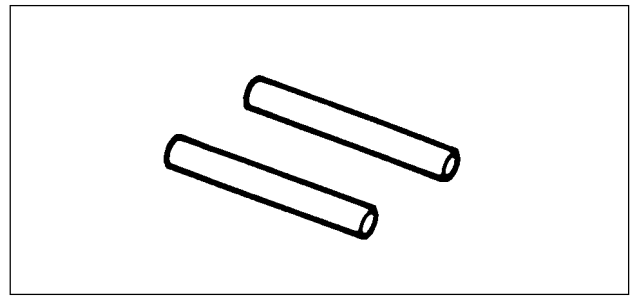
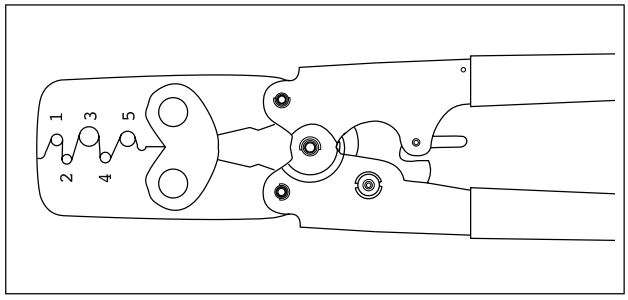
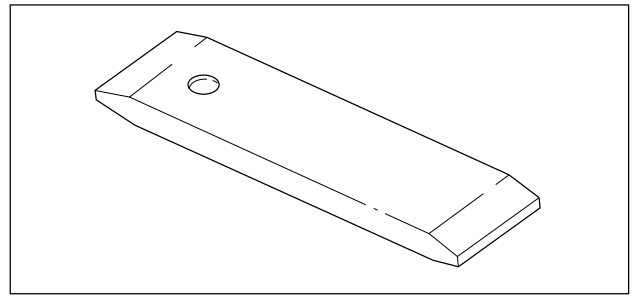


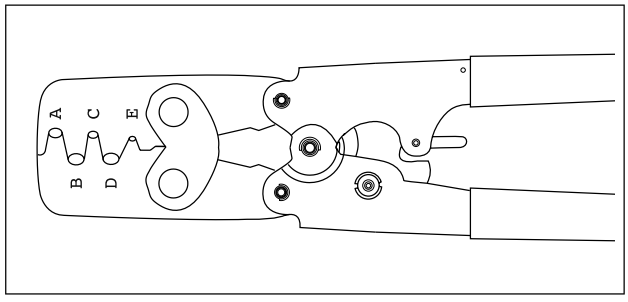
Part No. HD-38361 Cam Gear Gauge Pin Set (0.108 in. (2.74 mm) Diameter)



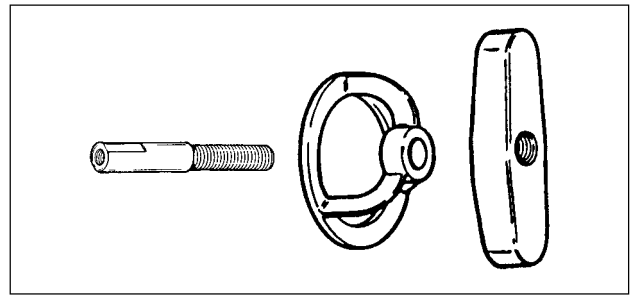
Part No. HD-38125-6 Packard Terminal Crimp Tool (Sealed)



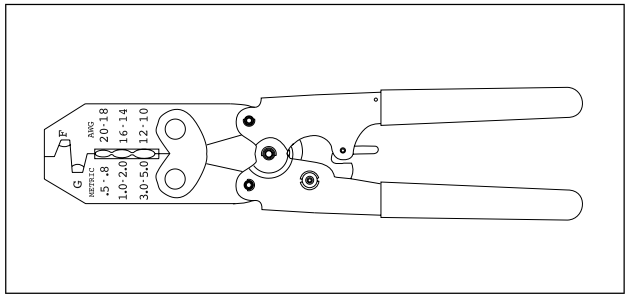
Part No. HD-38362 Sprocket Locking Link



Part No. HD-38125-7 Packard Terminal Crimp Tool (Nonsealed)



Part No. HD 38515A Clutch Spring Compressor



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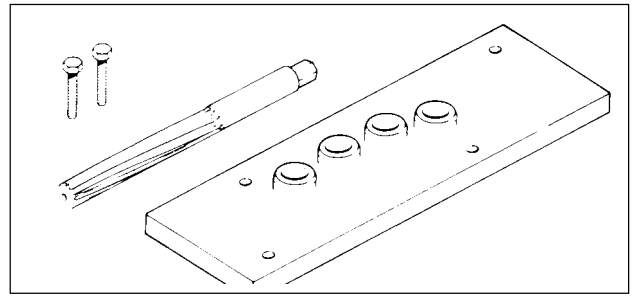
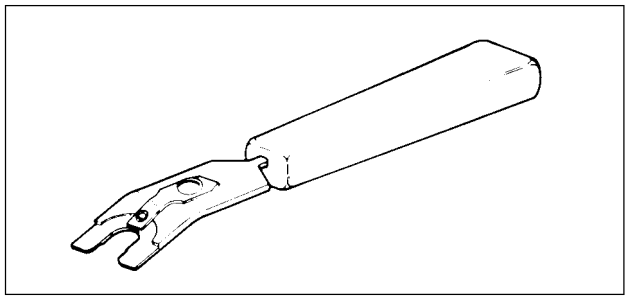
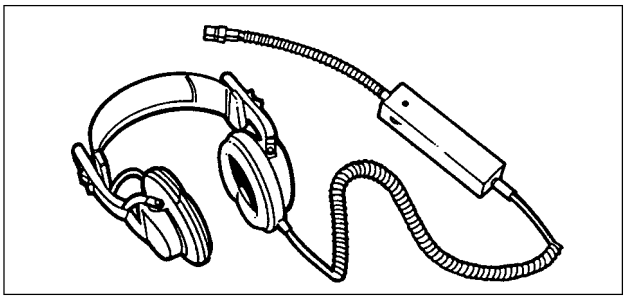


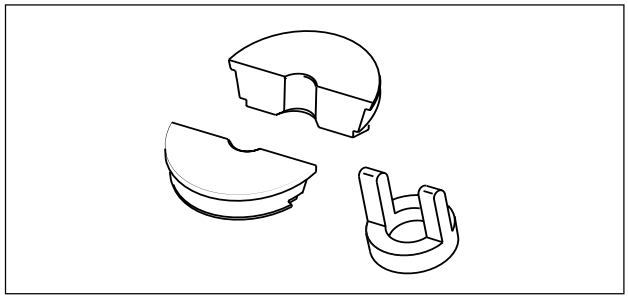
Part No. HD-38871 Camshaft Bushing Plate Pilot and Reamer



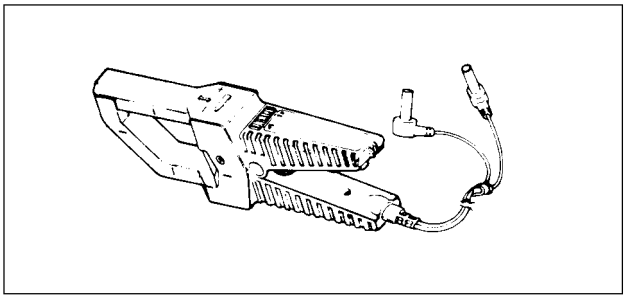
Part No. HD-39151 Shift Drum Retaining Ring Installer



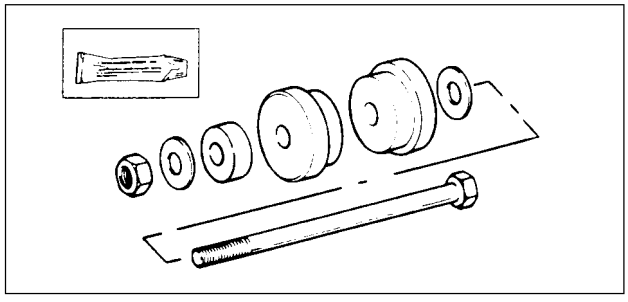
Part No. HD-39565 Engine Ear



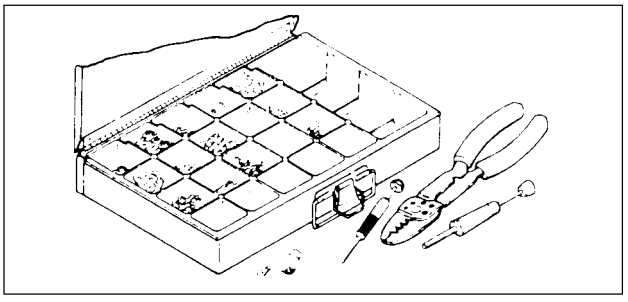
Part No. HD-39301A Steering Head Bearing Race Remover



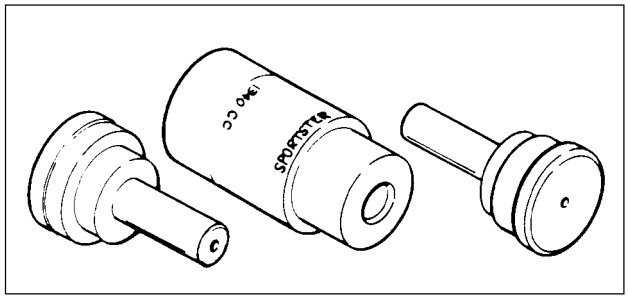
Part No. HD-39617 Inductive Amp Probe. Use with HD-35500A



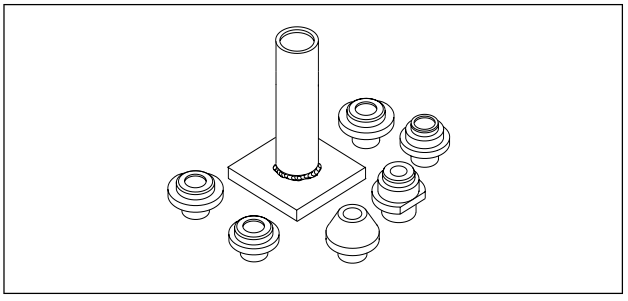
Part No. HD-39302 Steering Head Bearing Race Installer



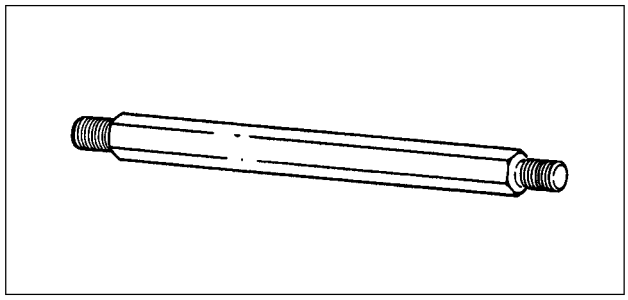
Part No. HD-39621 Electrical Terminal Repair Kit



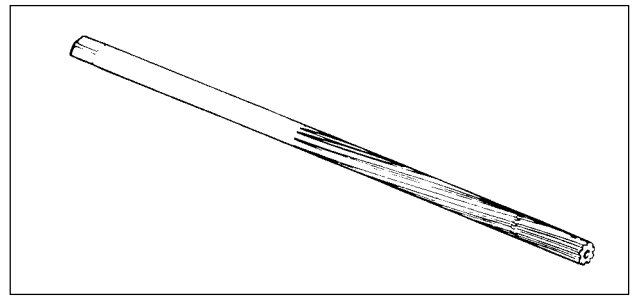
Part No. HD-39458 Sprocket Shaft Bearing Outer Race Installer



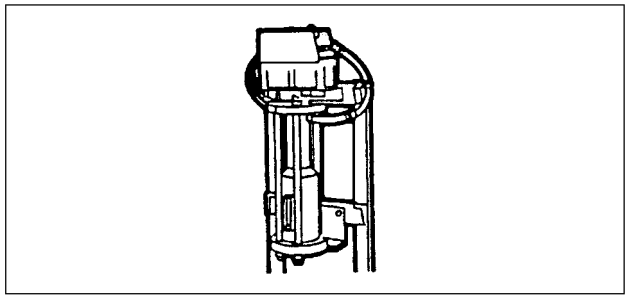
Part No. HD-39782 Cylinder Head Support



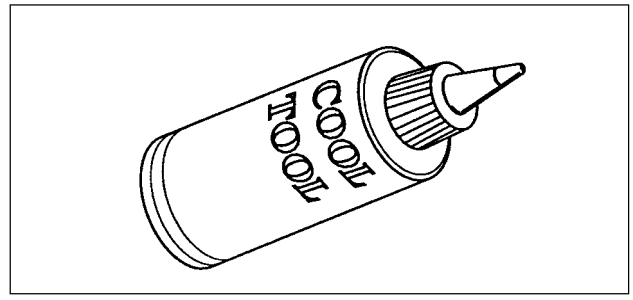
Part No. HD-39786 Cylinder Head Holding Fixture



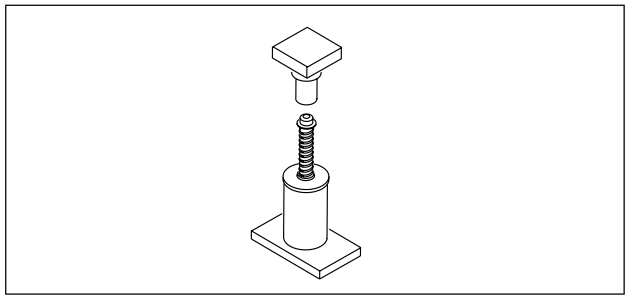
Part No. HD-39932 (Steel) or HD-39932-CAR (Carbide) Intake and Exhaust Valve Guide Reamer



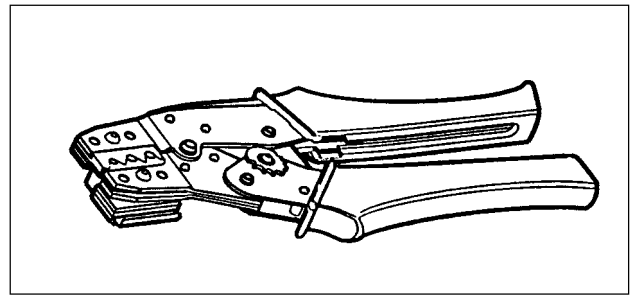
Part No. HD-39823 Oil Filter Crusher (Large)



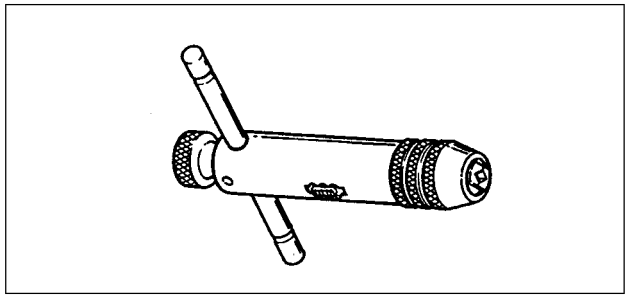
Part No. HD-39964 Reamer Lubricant (Cool Tool)



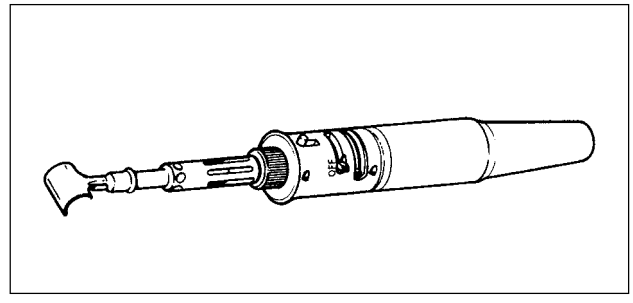
Part No. HD-39800 Oil Filter Crusher (Small)



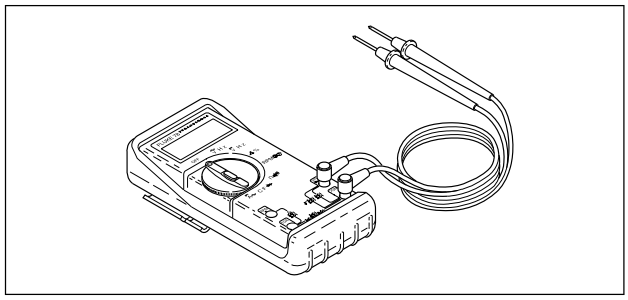
Part No. HD-39965 Deutsch Terminal Crimp Tool



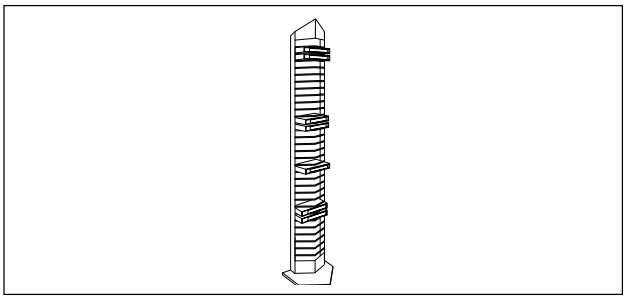
Part No. HD-39847 Universal Ratcheting Tap/Reamer Handle



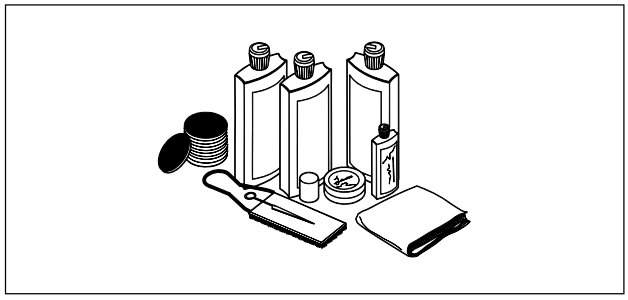
Part No. HD-39969 UltraTorch UT-100



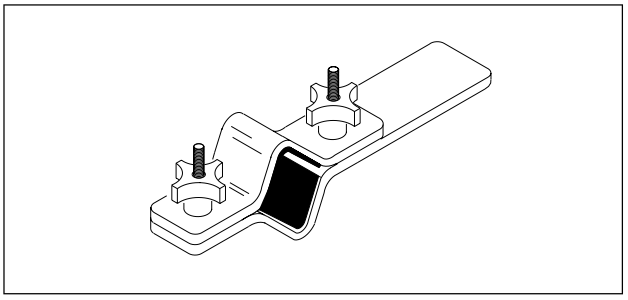
Part No. HD-39978 Digital Multimeter (Fluke 78)



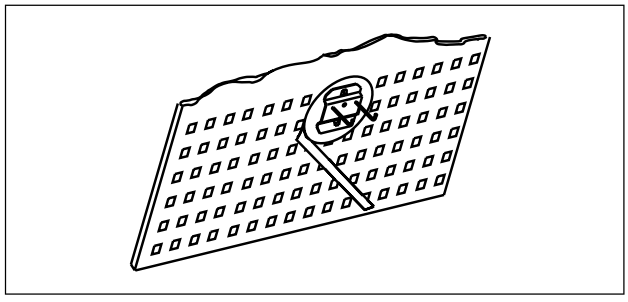
Part No. HD-41155 VHS Tape Storage Tower



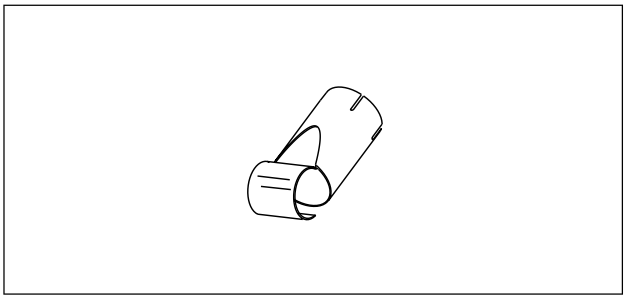
Part No. HD-39994 Paint Repair Kit



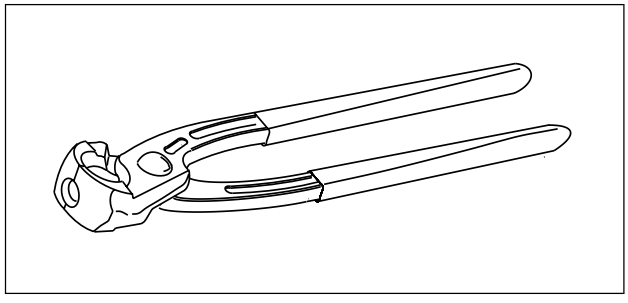
Part No. HD-41177 Fork Tube Holder



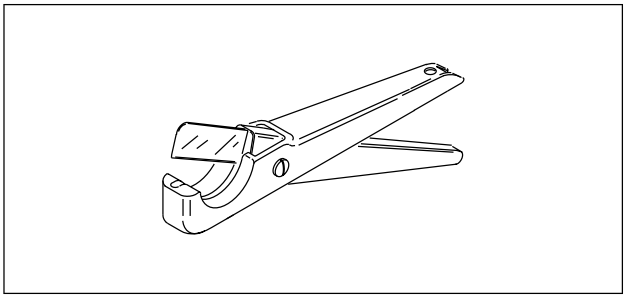
Part No. HD-41025A Tool Organizational System



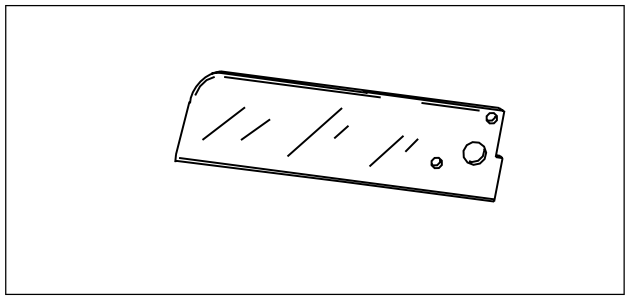
Part No. HD-41183 Shrink Attachment



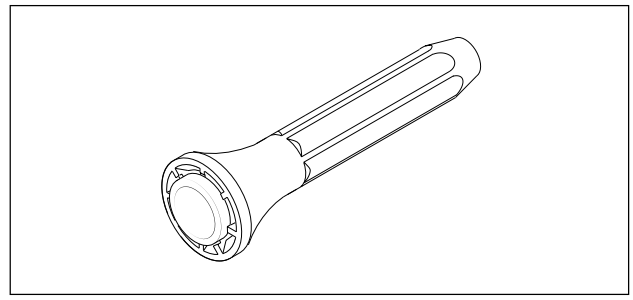
Part No. HD-41137 Hose Clamp Pliers



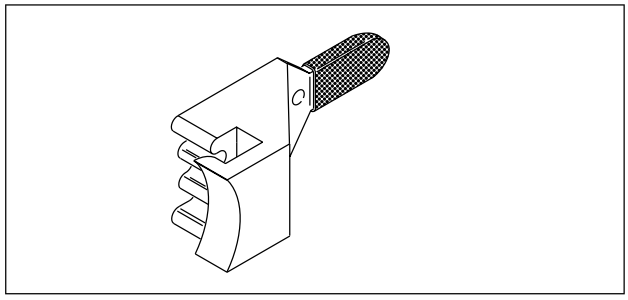
Part No. HD-41185 Hose Cutting Tool



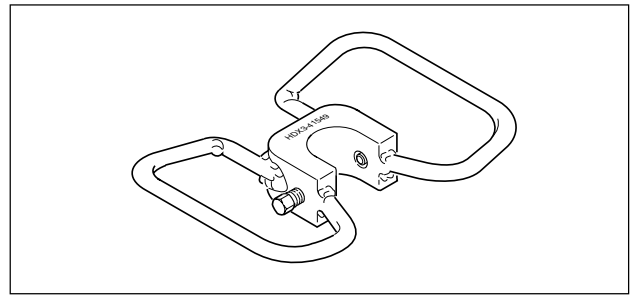
Part No. HD-41185-1 Hose Cutting Tool Blade



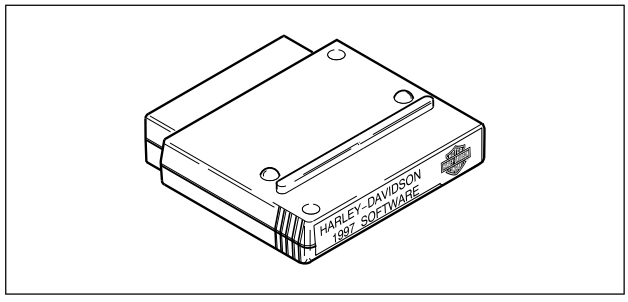
Part No. HD-41496-Transmission, Case Seal Installer



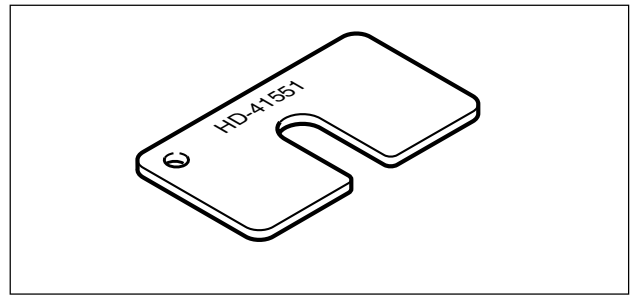
Part No. HD-41321 Sprocket Locking Tool



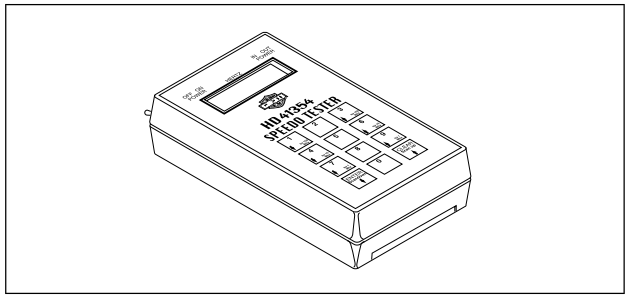
Part No. HD-41549A-Fork Spring Compressing Tool



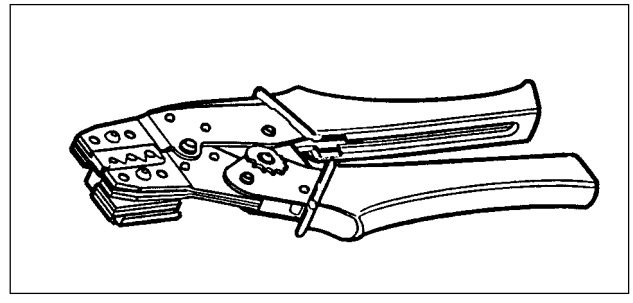
Part No. HD-41325-95C Scanalyzer Cartridge



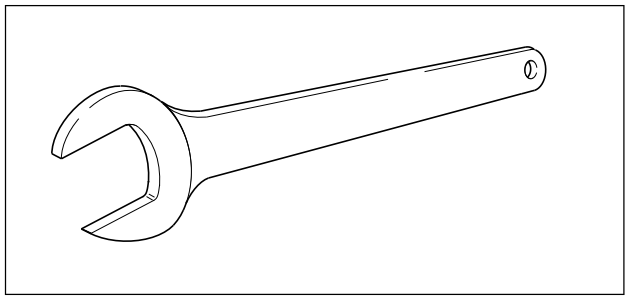
Part No. HD-41551-Fork Spring Keeper



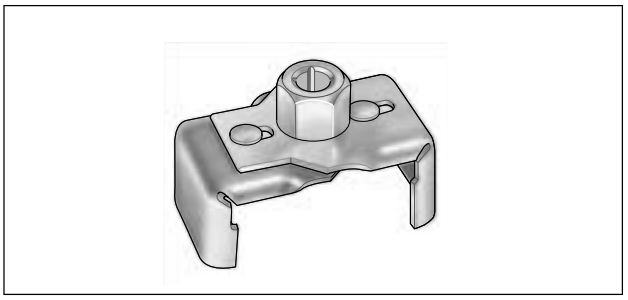
Part No. HD-41354 Speedometer Tester



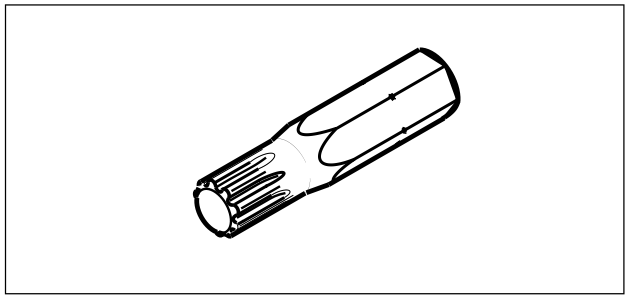
Part No. HD-41609 Amp Terminal Crimp Tool



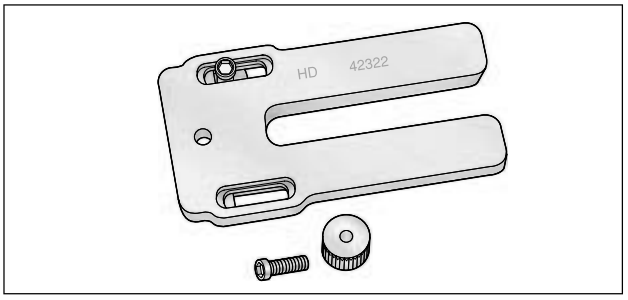
Part No. HD-41675-Oil Pressure Sending Unit Wrench



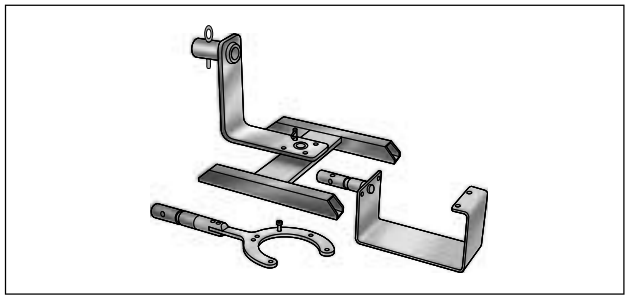
Part No. HD-42311 Oil Filter Wrench



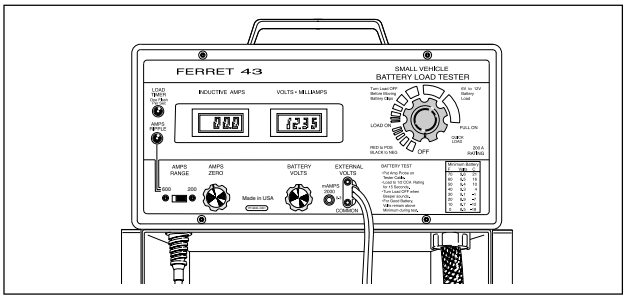
Part No. HD-42135 Spoke Nipple Driver



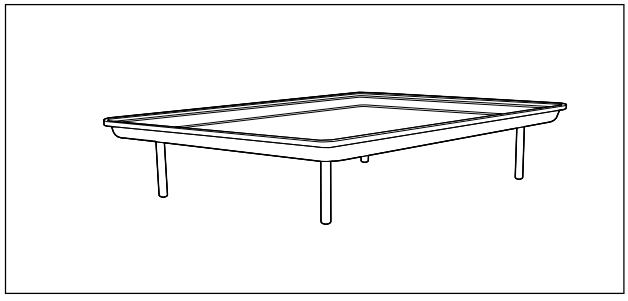
Part No. HD-42322 Piston Support Plate



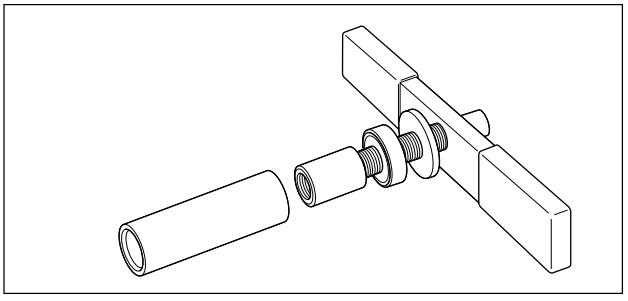
Part No. HD-42310 Engine/Transmission Stand
HD-42310-3 Sportster Cradle



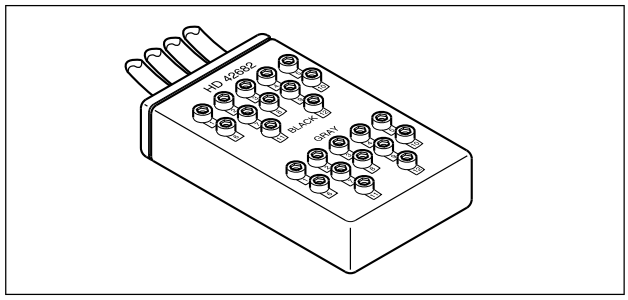
Part No. HD-42376 Battery/Charging System Load Tester



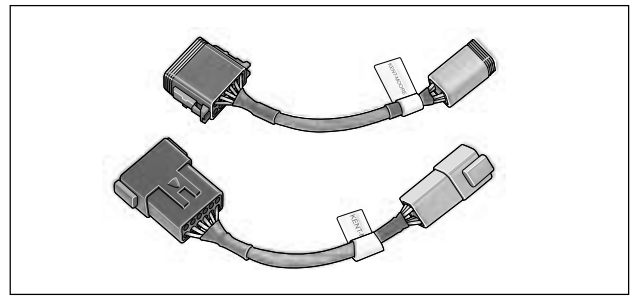
Part No. HD-42310-15 Drip Tray



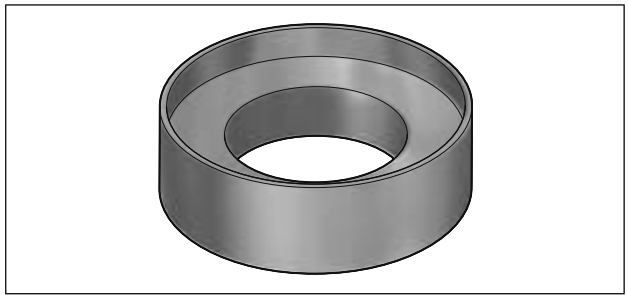
Part No. HD-42579 Sprocket Bearing/Seal Installer



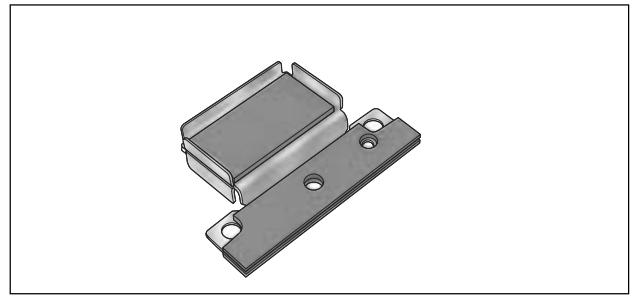
Part No. HD-42682 Breakout Box



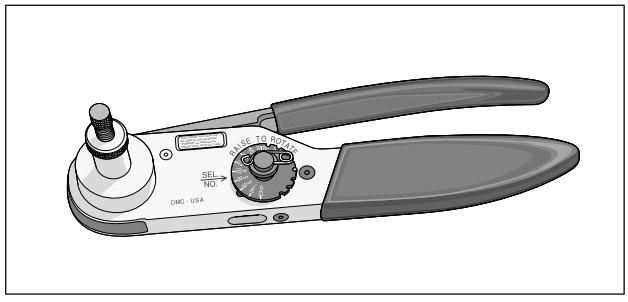
Part No. HD-42962 Breakout Box Adapters



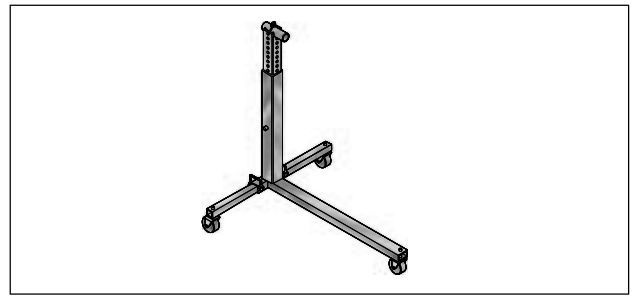
Part No. HD-45206 Sprocket Shaft Seal Installer
Use with HD-42579



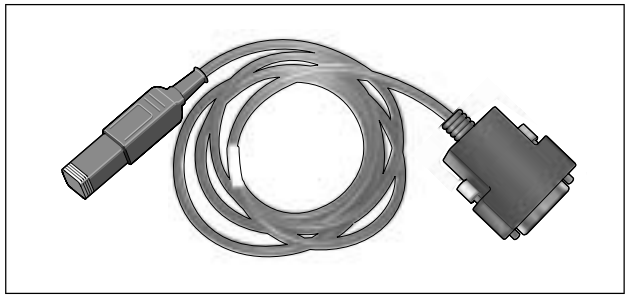
Part No. HD-43293A Brake Caliper Piston Remover



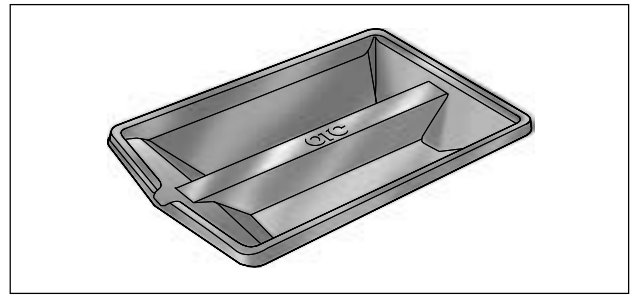
Part No. HD-42879 Electrical Crimp Tool



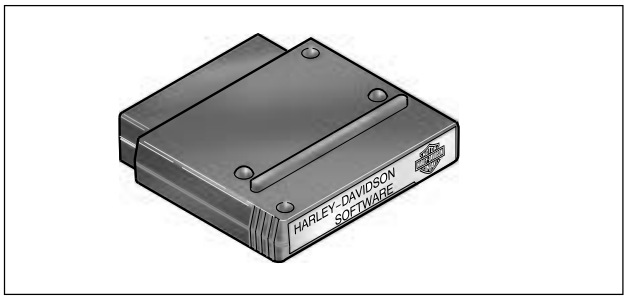
Part No. HD-43646 Rolling Engine Stand



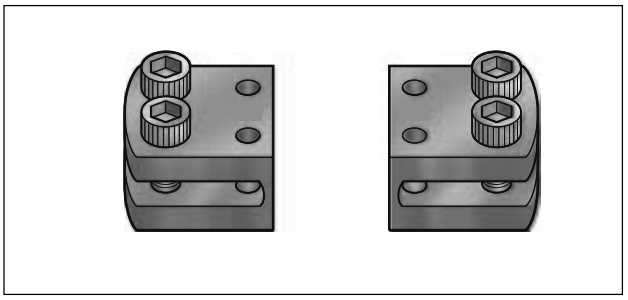
Part No. HD-42921A Scanalyzer Cable



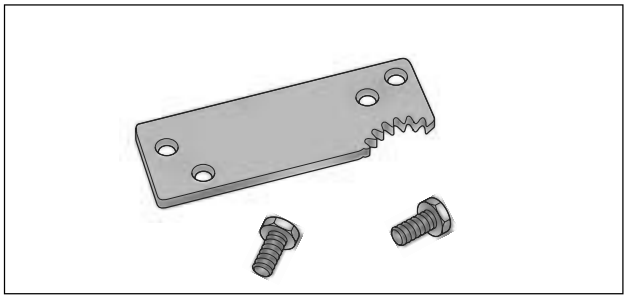
Part No. HD-43646-10 Drip pan



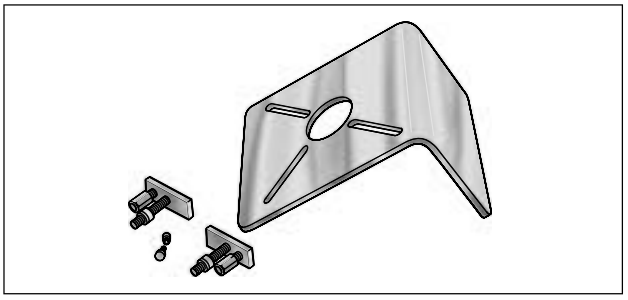
Part No. HD-43984 Scanalyzer Pro II



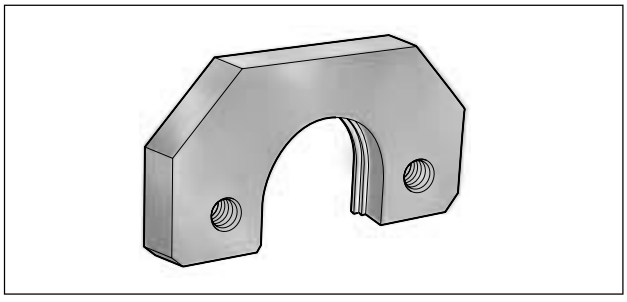
Part No. HD-44069 Timkin Snap Ring Remover/Installer



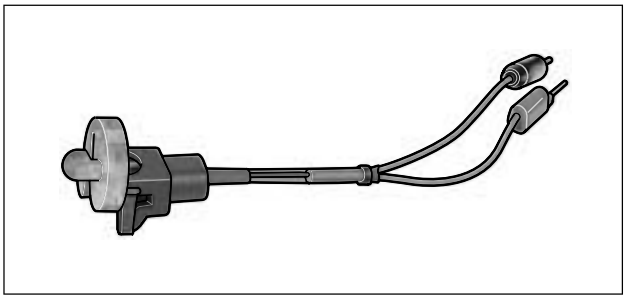
Part No. HD-43984 Crankshaft Locking Tool



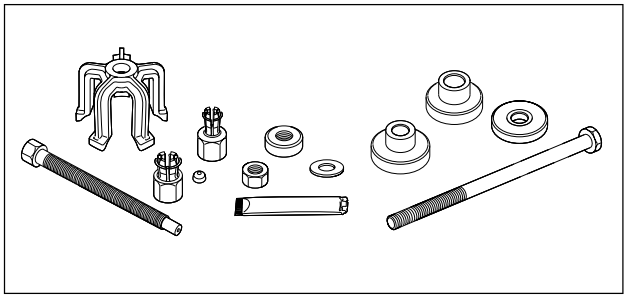
Part No. HD-44358 Flywheel Support Fixture



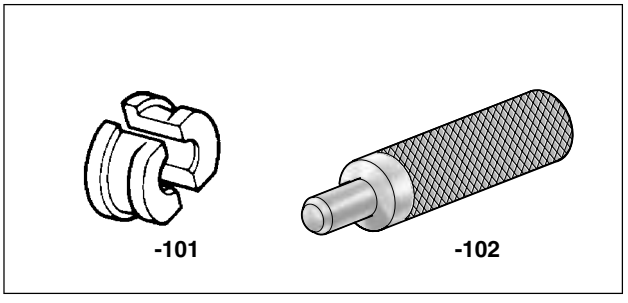
Part No. HD-44404 Timkin Bearing Remover



Part No. HD-44687 Ignition Coil Circuit Adapter



Part No. HD-44060 Wheel Bearing Remover/Installer



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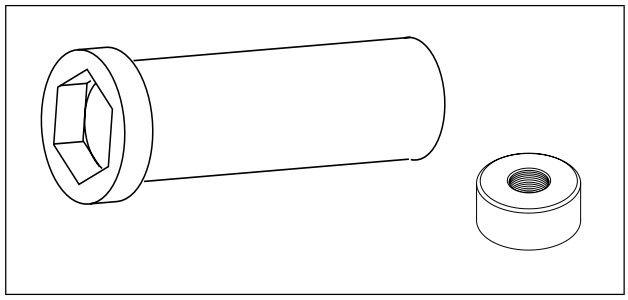
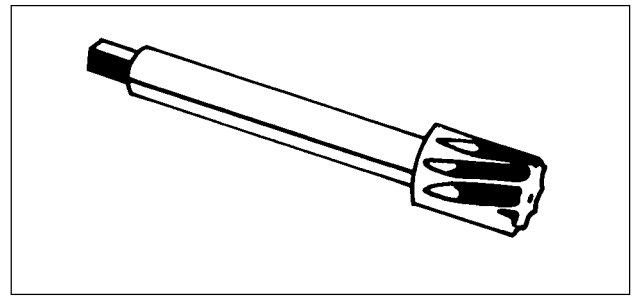
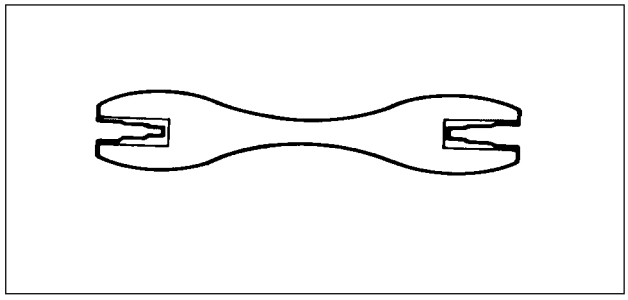
Part No. HD-94547-101 Crankshaft Bearing Outer Race Remover/Installer. Use with 94547-102 Handle



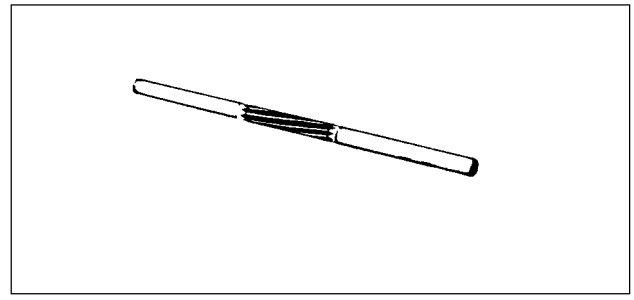
Part No. HD-94600-37B Mainshaft Locknut Wrench



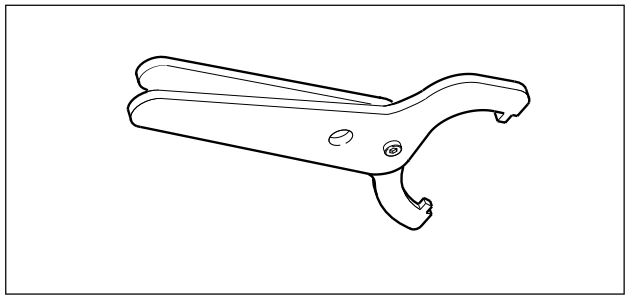
Part No. HD-94803-67 Rear Intake Camshaft Bushing Reamer



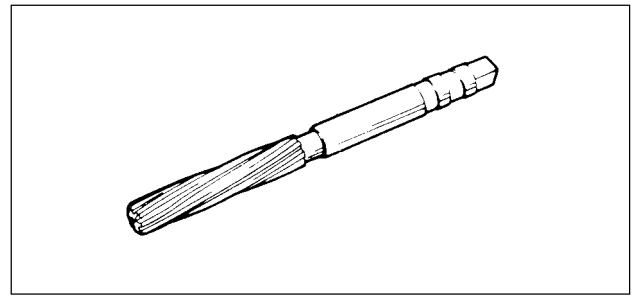
Part No. HD-94681-80 Spoke Nipple Wrench



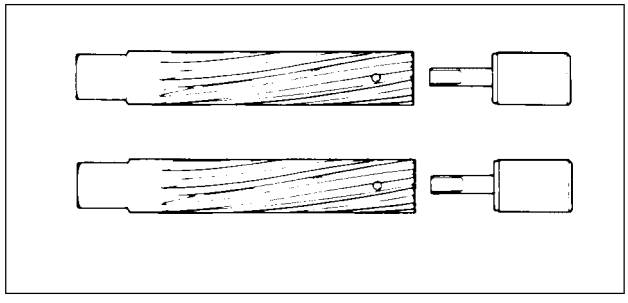
Part No. HD-94804-57 Rocker Arm Bushing Reamer



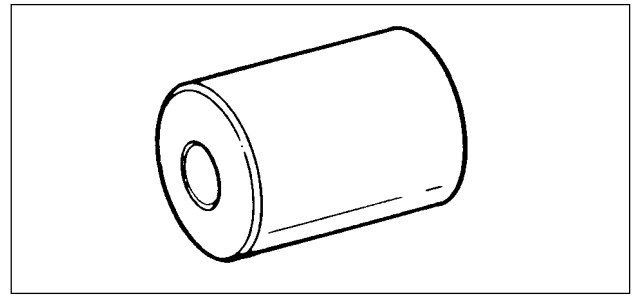
Part No. HD-94700-52C Shock Spanner



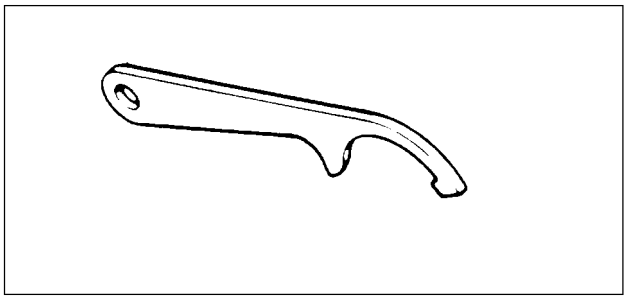
Part No. HD-94812-1 Pinion Shaft Bushing Reamer. Use with HD-94812-87



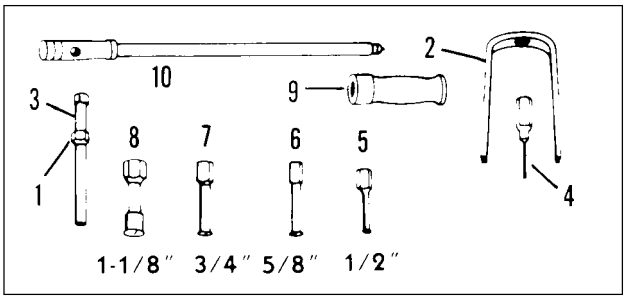
Part No. HD-94800-26A Connecting Rod Bushing Reamers and Pilots



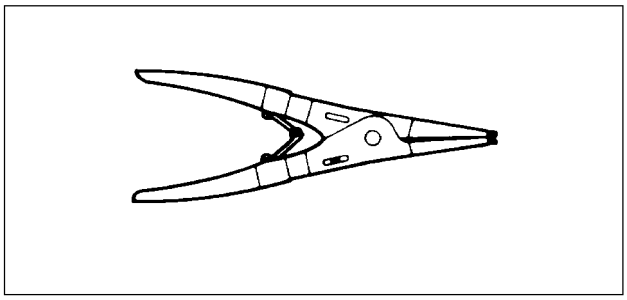
Part No. HD-94812-87 Pinion Shaft Reamer Pilot. Use with HD-94812-1.



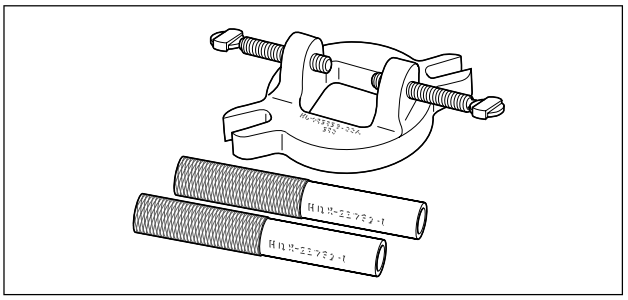
Part No. HD-94820-75A Rear Shock Spanner Wrench



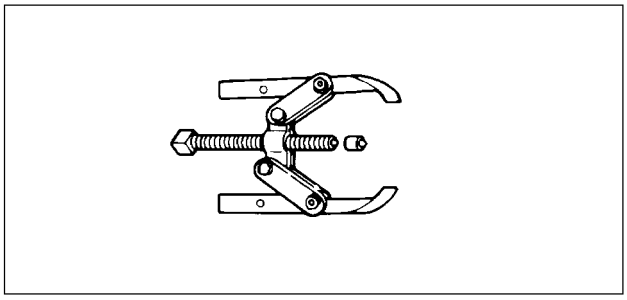
Part No. HD-95760-69A Bushing/Bearing Puller Tool Set. Set includes items 1-7. Items 8 (HD-95769-69), 9 (HD-95770-69) and 10 (HD-95771-69) are optional.



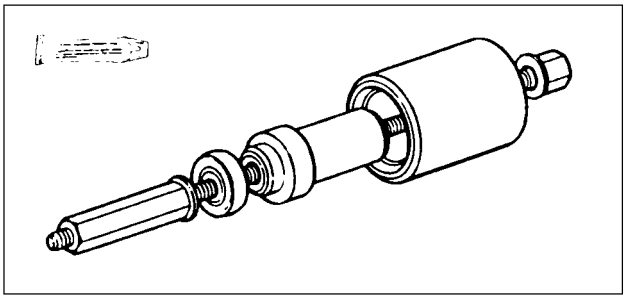
Part No. HD-95017-61 Large External Retaining Ring Pliers



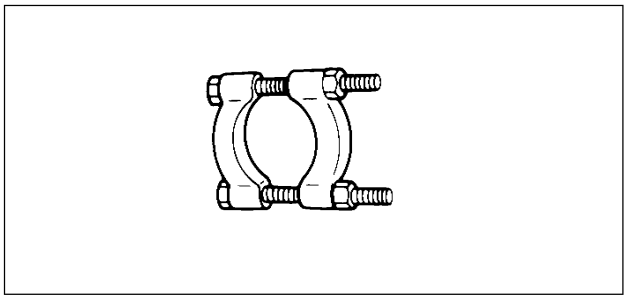
Part No. HD-95952-33B Connecting Rod Clamping Tool



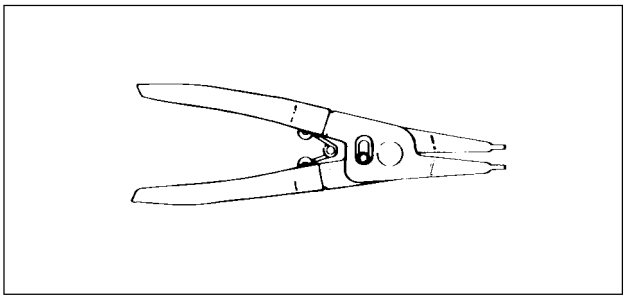
Part No. HD-95635-46 All-Purpose Claw Puller



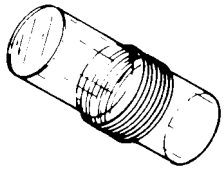
Part No. HD-95970-32D Piston Pin Bushing Tool



Part No. HD-95637-46A Wedge Attachment for Claw Puller. Use with HD-95635-46.

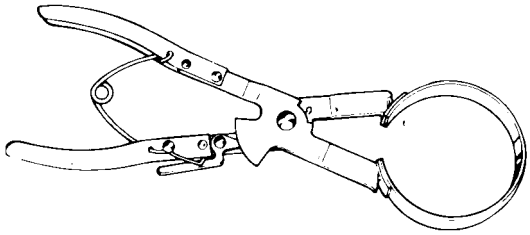


Part No. HD-96215-49 Small Internal Retaining Ring Pliers

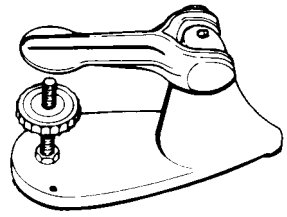


Part No. HD-96295-65D Timing Mark View Plug.
Use with HD-33813.

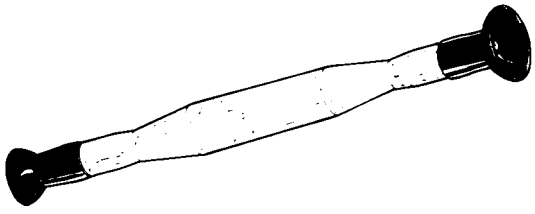
Part No. HD-96718-87 Pinion Bearing Outer Race
Lapping Kit



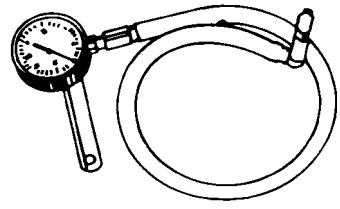
Part No. HD-96333-51C Piston Ring Compressor



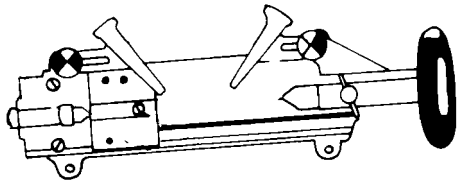
Part No. HD-96796-47 Valve Spring Tester



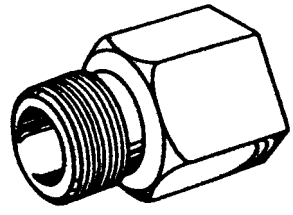
Part No. HD-96550-36A Valve Lapping Tool



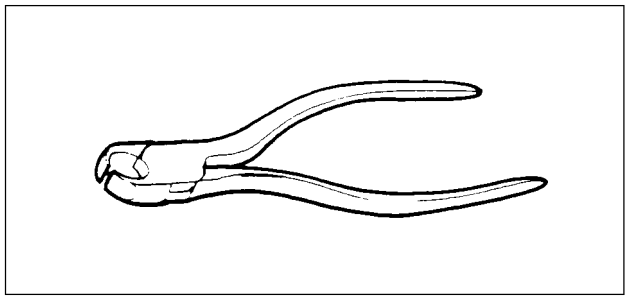
Part No. HD-96921-52B Oil Pressure Gauge



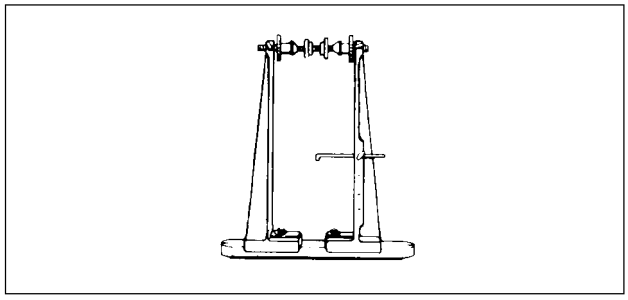
Part No. HD-96650-80 Flywheel Truing Stand



Part No. HD-96940-52A Oil Pressure Gauge Adapter.
Use with HD-96921-52B.



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



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

CHASSIS 2

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Table 2-1. Dimensions

MODEL	WHEELBASE IN. / MM.	LENGTH IN. / MM.	WIDTH IN. / MM.	HEIGHT IN. / MM.	ROAD CLEARANCE IN. / MM.
XLH883	60.0 / 1524	88.1 / 2238	33.0 / 838	47.5 / 1207	6.70 / 170.0
XLH883 HUGGER	59.0 / 1499	88.0 / 2235	35.0 / 889	49.75 / 1264	4.70 / 119.0
XL 883C CUSTOM	60.0 / 1524	89.0 / 2260	35.0 / 889	49.75 / 1264	6.70 / 170.0
XL 883R	60.0 / 1524	88.1 / 2238	33.0 / 838	47.5 / 1207	6.70 / 170.0
XLH 1200	60.0 / 1524	88.1 / 2238	35.0 / 889	49.75 / 1264	6.70 / 170.0
XL 1200C CUSTOM	60.0 / 1524	89.0 / 2260	35.0 / 889	49.75 / 1264	4.70 / 119.0
XL 1200S SPORT	60.2 / 1529	88.5 / 2248	33.0 / 838	49.5 / 1207	6.70 / 170.0

Table 2-2. Weights

MODEL	WEIGHT (AS SHIPPED) LBS / KG	GVWR LBS / KG	GAWR-FRONT LBS / KG	GAWR-REAR LBS / KG
XLH883	488 / 222	948 / 430	353 / 160	595 / 270
XLH883 HUGGER	486 / 220	948 / 430	353 / 160	595 / 270
XL 883C CUSTOM	489 / 222	998 / 453	353 / 160	595 / 270
XL 883R	503 / 228	948 / 430	353 / 160	595 / 270
XLH 1200	491 / 223	948 / 430	353 / 160	595 / 270
XL 1200C CUSTOM	491 / 223	948 / 430	353 / 160	595 / 270
XL 1200S SPORT	501 / 228	948 / 430	353 / 160	595 / 270

Table 2-3. Capacities

FUEL TANK		
Total	3.30 gal	12.5 L
Reserve	0.50 gal	1.89 L
OIL TANK – WITH FILTER	3.0 qt	2.84 L
TRANSMISSION	32 oz	946 ml
FRONT FORK (PER FORK SIDE)		
Wet	9.0 oz	266 ml
Dry	10.2 oz	302 ml

Table 2-4. Brake Disc

DIAMETER		
Front	11.5 in	292 mm
Rear	11.5 in	292 mm
MINIMUM THICKNESS		
Front	0.200 in	5.08 mm
Rear	0.230 in	5.84 mm
MAXIMUM DISC RUNOUT (FRONT AND REAR)	0.008 in	0.20 mm

Table 2-5. Torque Values

ITEM	FT-LBS *	NM
Front axle nut	50-55	68-75
Rear axle nut	60-65	81-88
Sprocket mounting bolts		
Cast wheels	55-65	75-88
Laced wheels	45-55	61-75
Brake disc mounting screws		
Front wheel	16-24	22-33
Rear wheel	30-45	41-61
Brake caliper mounting screws		
Front wheel	25-30	34-41
Rear wheel	15-20	20-27
Brake master cylinder cover screws	**10-15**	1.1-1.7
Front brake master cylinder clamp screws	**70-80**	7.9-9.0
Rear brake master cylinder mounting screws	**155-190**	17.5-21.5
Rear brake master cylinder cartridge locknut	30-40	41-54
Brake line banjo fitting bolts	17-22	23-30
Brake caliper bleeder valve	**80-100**	9.0-11.3
Front inboard brake pad retaining screw	40-50	4.5-6.8
Front fork upper bracket pinch screws	30-35	41-47
Front fork lower bracket pinch screws	30-35	41-47
Front axle pinch screw and nut	21-27	28-37
Front fender mounting fasteners	8-13	11-18
Rear fender support mounting fasteners	8-13	11-18
Clutch control clamp screws	**70-80**	7.9-9.0
Handlebar switch housing screws	**18-24**	2.0-2.7
Throttle control clamp screws	**18-24**	2.0-2.7
Handlebar clamp screws	12-15	16-20
Rear fork pivot shaft	50	68
Right footrest mount castle nut	35-40	47-54
Rear shock absorber		
Upper mounting fasteners	21-35	28-47
Lower mounting fasteners	30-50	41-68
Front muffler mounting locknut	20-40	27-54
Rear muffler mounting locknut	10-15	14-20
Exhaust pipe-to-cylinder head nuts	6-8	8-11

* Numbers in bold are **in-lbs**.

TIRES

⚠WARNING

Tires must be correctly matched to wheel rims. Only the tires listed in the fitment tables below can be used for replacement. Mismatching tires and rims can cause damage to the tire bead during mounting. Using tires other than those specified can adversely affect motorcycle stability which could result in death or serious injury.

Tire sizes are molded on the sidewall. Refer to the tire fitment tables below. Rim size and contour are cast or stamped into the exterior surface of the rim.

Example: T19 x 2.15 MT DOT. “T” indicates that the rim conforms to Tire and Rim Association standards. The “19” is the normal diameter of the rim in inches, measured at the bead seat diameter. The “2.15” is the width of the bead seat measured in inches. “MT” designates the rim contour. “DOT” means that the rim meets Department of Transportation Federal Motor Vehicle Safety Standards.

Table 2-6. Tire Fitment – Tubeless Cast Wheels

WHEEL SIZE & POSITION	RIM SIZE & CONTOUR	RIM VALVE HOLE DIA.	TIRE SIZE
			DUNLOP D401 ELITE S/T
19 in. – Front	T19 x 2.15 MT	0.45 in (11.4 mm)	100/90-19
16 in. – Rear	T16 x 3.00 D	0.35 in (8.89 mm)	130/90-16
			DUNLOP K591 S&FR ELITE SP
19 in. - Front	T19 x 2.15 MT	0.45 in (11.4 mm)	100/90-V19
16 in. - Rear	T16 x 3.00 D	0.35 in (8.89 mm)	130/90-V16

Table 2-7. Tire Fitment – Tube Type Laced Wheels

WHEEL SIZE & POSITION	RIM SIZE & CONTOUR	TUBE SIZE	TIRE SIZE
			DUNLOP D401 ELITE S/T
19 in. – Front	T19 x 2.50 TLA	MJ90-19	100/90-19
16 in. – Rear	T16 x 3.00 D	MT90-16	130/90-16
21 in. - Front	T21x 215 TLA	3.00 x 21	MH90 - 21 56H

Table 2-8. Tire Pressure – All Models

COLD - UP TO 300 LB (136 KG) LOAD (INCLUDES RIDER, PASSENGER AND CARGO)		
Front	30 psi	2.1 bar
Rear	36 psi	2.5 bar
UP TO GVWR MAXIMUM LOAD		
Front	30 psi	2.1 bar
Rear	40 psi	2.8 bar

VEHICLE IDENTIFICATION NUMBER

A 17-digit serial number, or Vehicle Identification Number (VIN), is stamped on the right side of the steering head (ex., 1HD1**CHP**132K**200062**).

See Figure 2-1. An abbreviated VIN is stamped on the front left side of the crankcase (ex.**, CHP2200062**).

NOTE

Always give the VIN or abbreviated VIN when ordering parts or making inquiries.

Figure 2-1. Abbreviated VIN Location

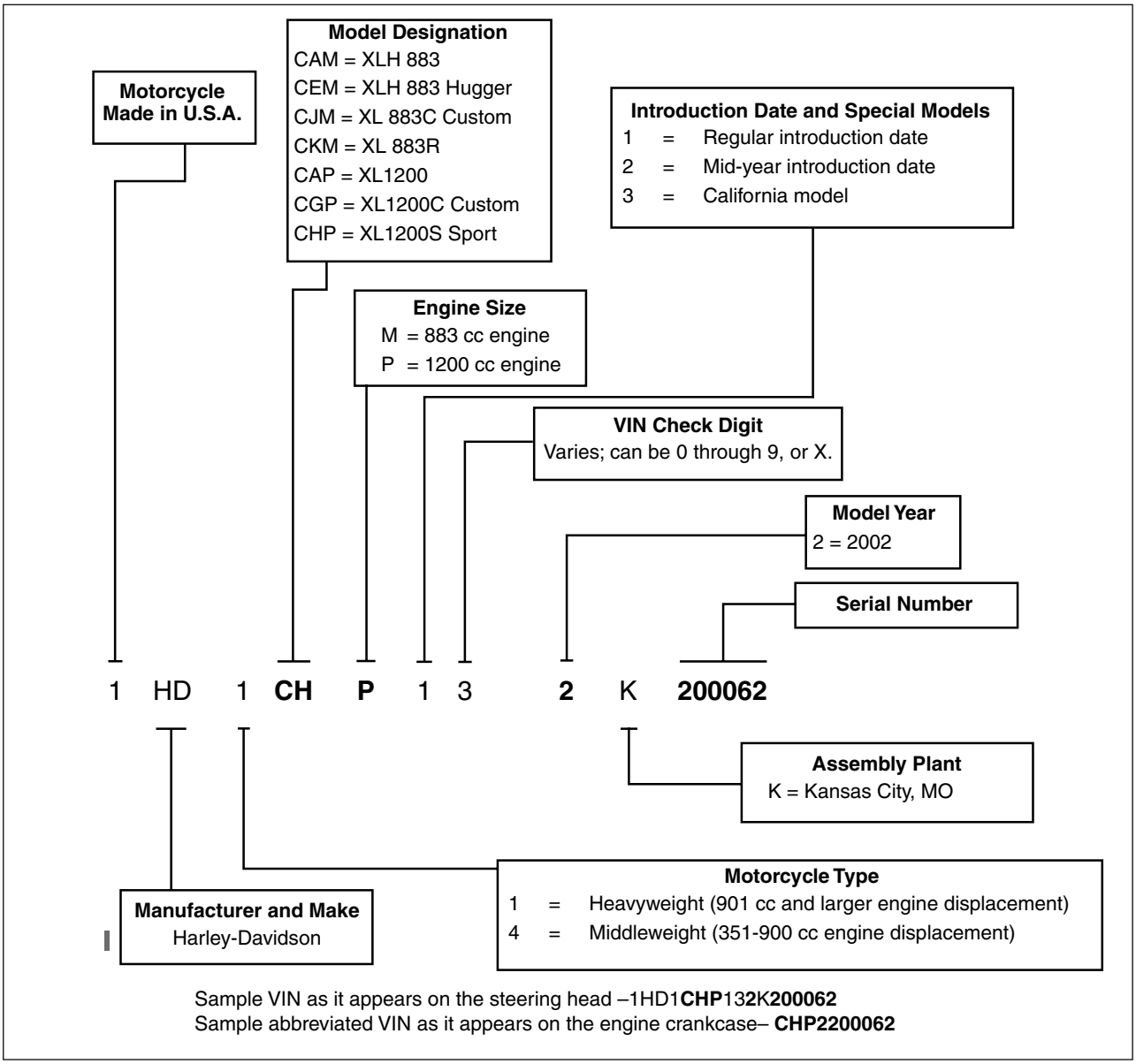


Figure 2-2. Vehicle Identification Number (VIN)

GENERAL

Good handling and maximum tire mileage are directly related to the care of wheels and tires. Regularly inspect wheels and tires for damage and wear. If handling problems occur, see 1.6 TROUBLESHOOTING or the table below for a list of probable causes.

Keep tires inflated to the recommended air pressure. Always balance the wheel after replacing a tube or tire.

⚠WARNING

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

TROUBLESHOOTING

See Figure 2-3. Check tire inflation pressure at least once each week. At the same time, inspect tire tread for punctures, cuts, breaks and other damage. Repeat the inspection before road trips.

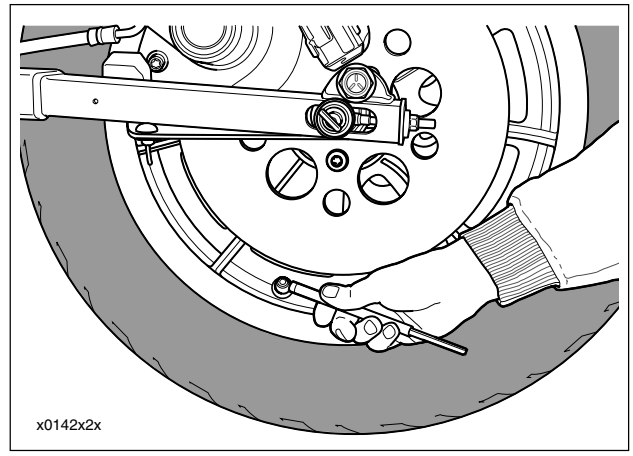


Figure 2-3. Checking Tire Pressure

Table 2-9. Wheel Service Chart

CHECK FOR	REMEDY
1. Loose axle nuts.	Tighten front axle nut to 50-55 ft-lbs (68-75 Nm). Tighten rear axle nuts to 60-65 ft-lbs (81-88 Nm).
2. Excessive side-play or radial (up-and-down) play in wheel hubs.	Replace wheel hub bearings.
3. Loose spokes.	Tighten or replace spokes. See 2.11 TRUING LACED WHEELS and 2.8 WHEEL LACING: 16 INCH RIM, 2.9 WHEEL LACING: 19 IN. RIM, or 2.10 WHEEL LACING: 21 IN. RIM.
4. Alignment of rear wheel in frame or with front wheel.	Check wheel alignment as described in this section or repair rear fork as described in 2.24 REAR FORK.
5. Rims and tires out-of-true sideways; should not be more than 5/64 in. (2.0 mm).	True wheels, replace rims or replace spokes. See 2.11 TRUING LACED WHEELS and 2.8 WHEEL LACING: 16 INCH RIM, 2.9 WHEEL LACING: 19 IN. RIM, or 2.10 WHEEL LACING: 21 IN. RIM.
6. Rims and tires out-of-round or eccentric with hub; should not be more than 3/32 in. (2.4 mm).	See Item 5 above.
7. Irregular or peaked front tire wear.	Replace as described in 2.3 WHEEL REMOVAL, 2.7 WHEEL INSTALLATION, and 2.13 TIRES.
8. Correct tire inflation.	Inflate tires to correct pressure. See 2.1 SPECIFICATIONS.
9. Correct tire and wheel balance.	Static balance may be satisfactory if dynamic balancing facilities are not available. However, dynamic balancing is strongly recommended.
10. Steering head bearings.	Correct adjustment and replace pitted or worn bearings. See 2.23 FORK STEM AND BRACKET ASSEMBLY.
11. Damper tubes.	Check for leaks. See 2.22 FRONT FORK.
12. Shock absorbers.	Check damping action and mounting stud bushings. See 2.24 REAR FORK.
13. Rear fork bearings.	Check for looseness. See 2.24 REAR FORK.

⚠WARNING

Excessively worn tires adversely affect motorcycle traction, steering and handling which could result in death or serious injury.

At regular intervals of 5000 miles (8000 km), or whenever handling irregularities are noted, see the chart on the preceding page for the recommended service procedure.

If tires must be replaced, same as original equipment tires must be used. Other tires may not fit correctly and may be hazardous to use.

⚠WARNING

Use the following guidelines when installing a new tire or repairing a flat. Failure to comply with the guidelines below could result in death or serious injury.

1. Always locate and eliminate the cause of the original tire failure.
2. Do not patch or vulcanize a tire casing. These procedures weaken the casing and increase the risk of a blowout.
3. Only patch an inner tube as an emergency measure. Replace the damaged tube as soon as possible.
4. Be sure the inner tube is the correct size for the tire casing. Any stretching or wrinkling within the casing will weaken the tube and result in premature failure.
5. The use of tires other than those specified can adversely affect handling resulting in death or serious injury.
6. Tires, tubes and wheels are critical safety items. Since the servicing of these components requires special tools and skills, Harley-Davidson recommends that you see your dealer for these services.

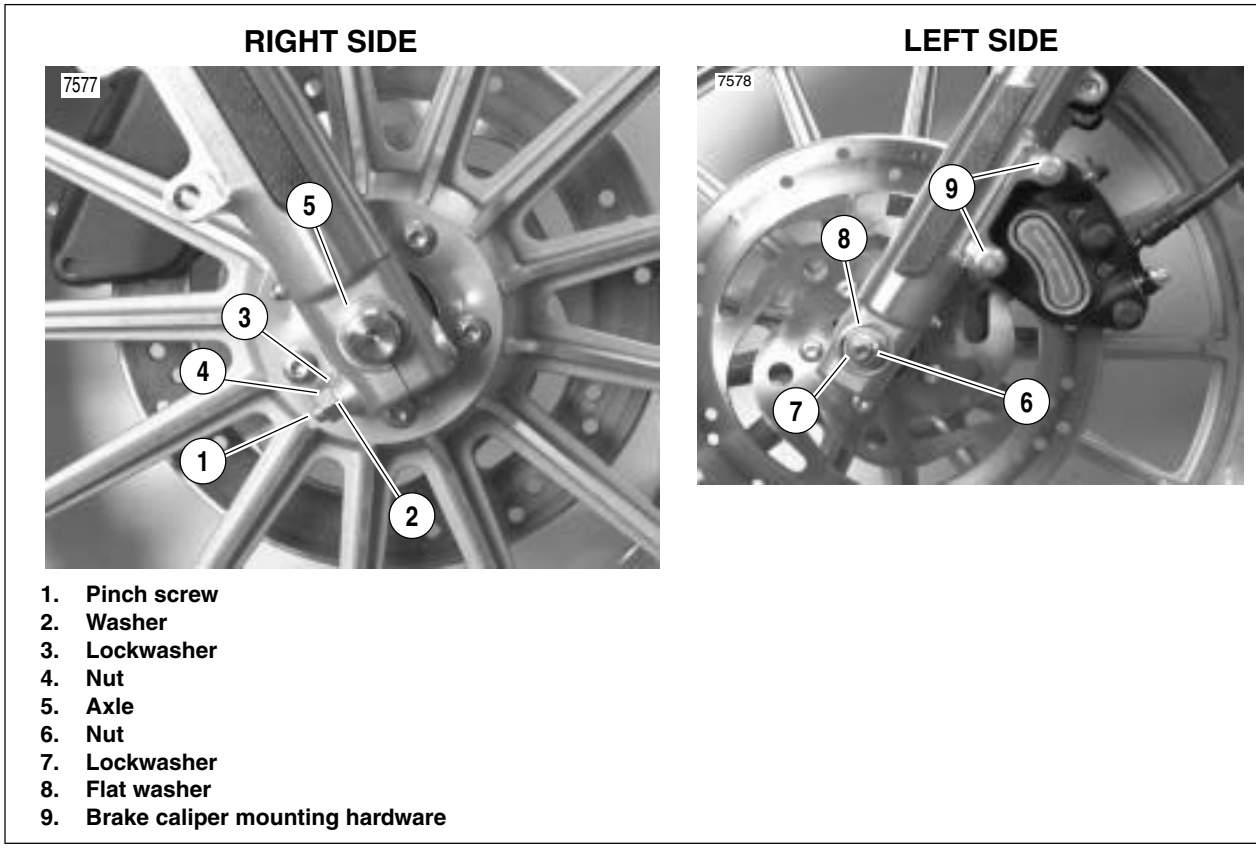
FRONT WHEEL REMOVAL

1. Block motorcycle underneath frame so front wheel is raised off the ground.
2. See Figure 2-4. Remove caliper mounting hardware (9). Let the caliper hang loose.

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. Insert screwdriver or steel rod through hole in axle (5) on right side of vehicle. While holding axle stationary, remove axle nut (6), lock washer (7) and flat washer (8) on left side of vehicle.
4. On right side loosen nut (4) on pinch screw (1). Pull axle out of hub while supporting wheel.
5. Remove spacer.



1. **Pinch screw**
2. **Washer**
3. **Lockwasher**
4. **Nut**
5. **Axle**
6. **Nut**
7. **Lockwasher**
8. **Flat washer**
9. **Brake caliper mounting hardware**

Figure 2-4. Front Wheel Mounting

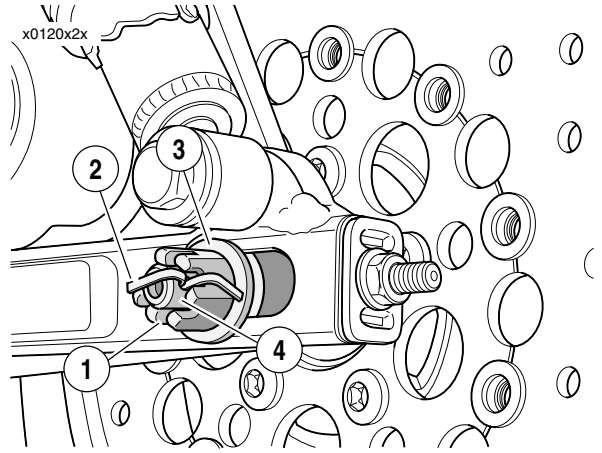
REAR WHEEL REMOVAL

1. Raise rear end of motorcycle high enough to permit wheel removal. Support motorcycle with suitable blocking underneath frame.
2. Loosen axle, slide wheel forward and slip belt off sprocket.
3. See Figure 2-5. Remove cotter pin (2), axle nut (1) and flat washer (3).
4. Gently tap end of axle (4) with a soft hammer to loosen. Pull axle free of frame assembly.

NOTE

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

5. See Figure 2-14. (8) See Figure 2-15. (8) Remove spacer and rear wheel assembly.



1. Axle nut
2. Cotter pin
3. Flat washer
4. Rear axle

Figure 2-5. Rear Wheel Mounting

INSPECTION

1. Block motorcycle underneath frame so wheel is raised off the ground.
2. See Figure 2-6. Mount a magnetic base dial indicator to the brake disc with the dial's contact point on the end of the axle.
3. Turn the wheel through several rotations, then move the wheel side to side to check for end play.
   a. If the end play is less than the service wear limit of 0.002 in. (0.051 mm), bearing passes inspection.
   b. If the end play exceeds service wear limit, remove wheel and replace both wheel bearings.

REMOVAL

NOTE

When removing wheels, use specialty tool WHEEL BEARING INSTALLER/REMOVER (part no. HD-44060).

1. See FRONT WHEEL REMOVAL or REAR WHEEL REMOVAL.
2. Remove wheel from motorcycle. On vehicles with a single front brake caliper, remove hub plate from wheel on opposite side of front brake disc.
3. See Figure 2-7. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble.
   a. Sparingly apply graphite lubricant to threads of forcing screw (1) to prolong service life and ensure smooth operation.
   b. Install nut (2), washer (6) and Nice bearing (3) on screw. Insert assembly through hole in bridge (5).
   c. Drop ball bearing inside collet (4). Fasten collet and ball bearing to forcing screw (1).
4. Hold end of forcing screw (1) and turn collet (6) to expand edges of collet.

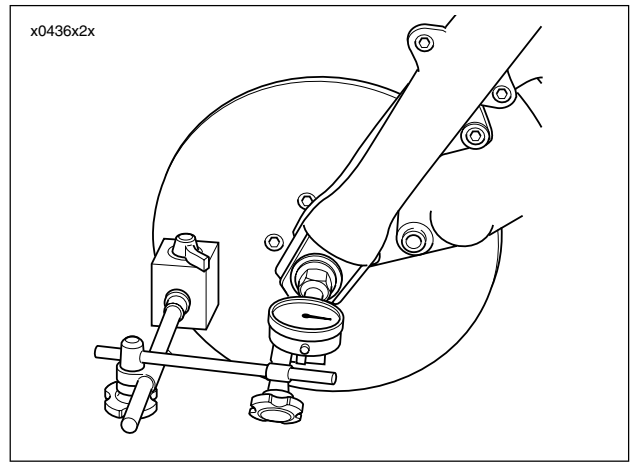
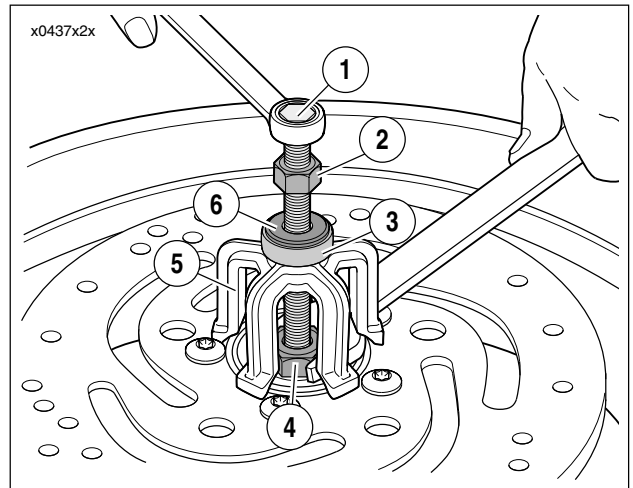


Figure 2-6. Wheel Bearing Inspection (Front Wheel Shown)



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

Figure 2-7. Removal Tool

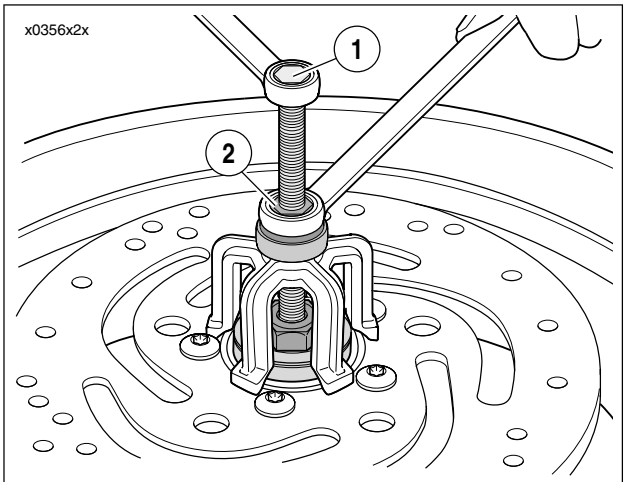
5. See Figure 2-8. When expanded collet has gripped bearing edges, hold end of forcing screw (1) and turn the nut (2) to remove bearing from wheel.
6. Remove spacer from inside wheel hub.
7. Repeat procedure for opposite side bearing. Discard all bearings upon removal.

INSTALLATION

NOTES

- *When installing wheels, use specialty tool WHEEL BEARING INSTALLER/REMOVER (part no. HD-44060).*
- *Always install first bearing on primary brake disc side. If front wheel has two brake discs, install bearing on the left side first.*

1. Obtain WHEEL BEARING INSTALLER/REMOVER (Part No. HD-44060) and assemble.
   a. Sparingly apply graphite lubricant to threads of threaded rod to prolong service life and ensure smooth operation.
   b. See Figure 2-9. Place threaded rod through support plate. Insert assembly through wheel.
   c. See Figure 2-10. Lubricate outside of bearing with a light coat of LOCTITE ANTI-SEIZE. Place the **new** bearing (4) on rod (1) with lettered side facing away from wheel centerline.
   d. Install pilot (5), Nice bearing (6), washer (3) and nut (2) over rod.
2. Hold hex end of threaded rod (1) and turn nut (2) to install bearing (6). Bearing will be fully seated when nut can no longer be turned. Remove tool.
3. Install spacer inside wheel hub.
4. Reverse tool and install opposite side bearing.
5. On cast front wheels for single caliper vehicles, install hub plate opposite front brake disc.



1. Forcing screw
2. Nut

Figure 2-8. Remove Bearing

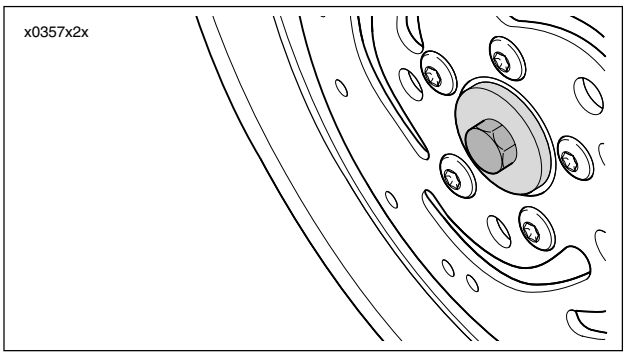
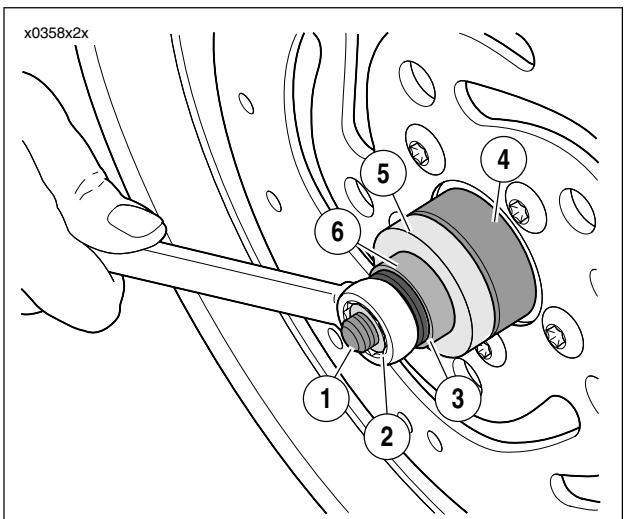


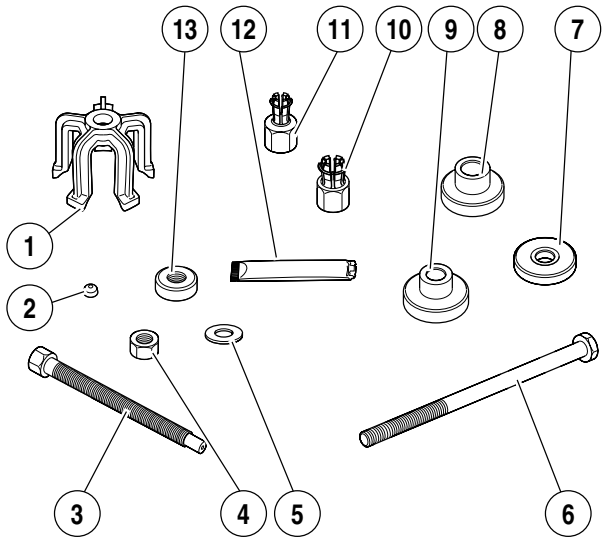
Figure 2-9. installation Tool Support Plate



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

Figure 2-10. Installing Bearing

x0440x2x

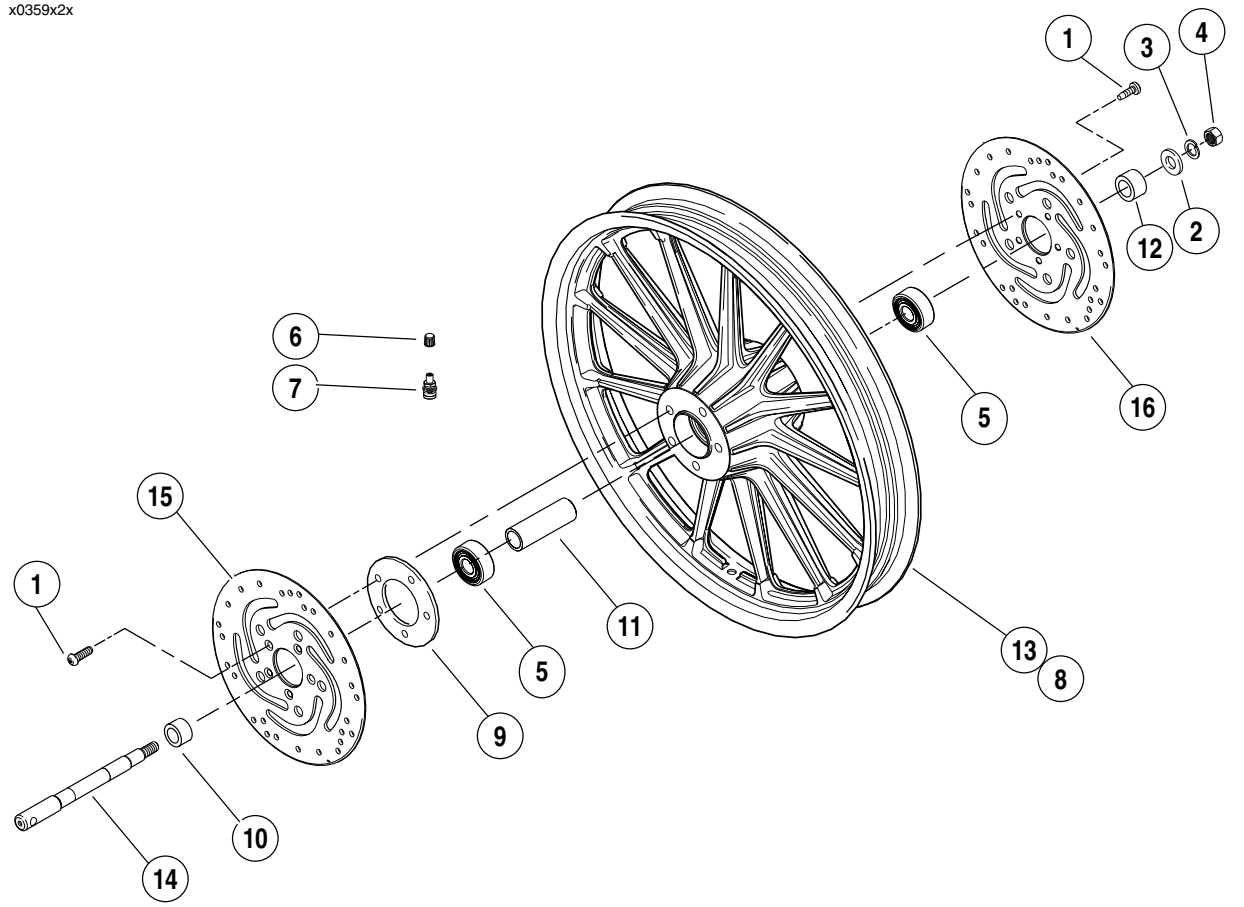


NO.	DESCRIPTION	PART NO.
1	Bridge	HD-44060-5
2	Steel ball	12547
3	Forcing screw	HD-44060-4
4	Nut	10210
5	Washer	12004
6	Threaded rod	RS25100-200
7	Support plate	J-23444A
8	Pilot, 1.0 in. (FLT front axle only)	HD-44060-3
9	Pilot, 3/4 in.	HD-44060-7
10	Collet, 1.0 in. (FLT front axle only)	HD-44060-8
11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

Parts 1-7 common to removal/installation.
Parts 8-9 used for removal only.
Parts 10-13 used for installation only.

Figure 2-11. Wheel Bearing Remover/Installer (Part No. HD-44060)

CAST FRONT WHEEL



1. Screw
2. Washer
3. Lockwasher
4. Nut
5. Roller bearing
6. Valve cap
7. Valve stem assembly
8. Wheel assembly
9. Hub plate
10. Bearing spacer
11. Hub spacer
12. Bearing spacer
13. Wheel
14. Front axle
15. Disc R.H.
16. Disc L.H.

Figure 2-12. Cast Front Wheel

LACED FRONT WHEEL

1. Screw (5)
2. Washer
3. Lockwasher
4. Nut
5. Roller bearing (2)
6. Rim
7. Valve cap
8. Spoke and nipple
9. Wheel assembly
10. Bearing spacer
11. Hub spacer
12. Bearing spacer
13. Wheel hub
14. Front axle
15. Brake disc
16. Valve stem nut
17. Wheel weight

x0439x2x

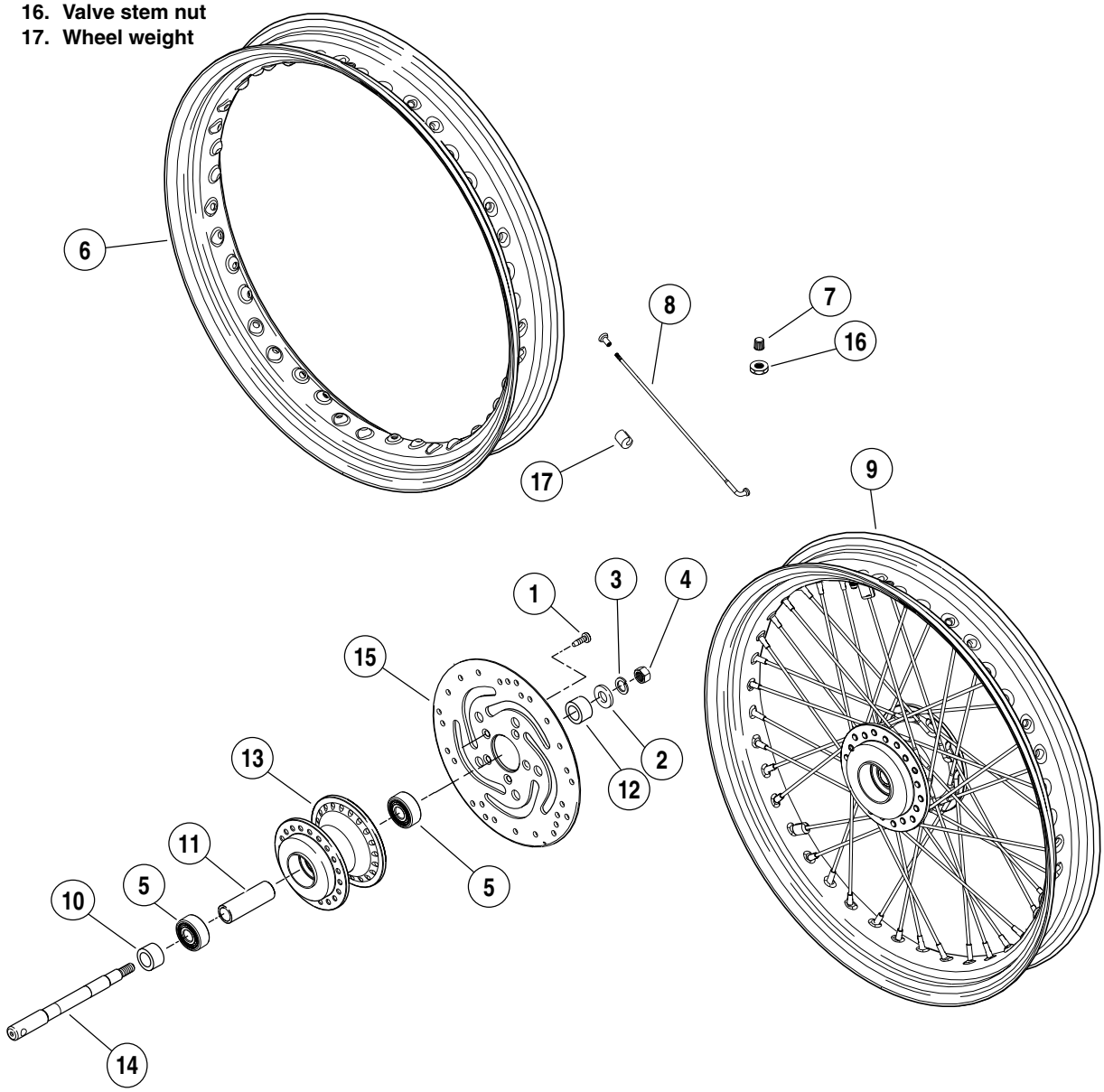


Figure 2-13. Laced Front Wheel

CAST REAR WHEEL

x0362x2x

1. Cotter pin
2. Bolt
3. Spacer
4. Washer
5. Castle nut
6. Roller bearing
7. Sprocket
8. Sprocket spacer
9. Spoke wheel
10. Disc wheel
11. Valve cap
12. Axle assembly
13. Disc spacer
14. Brake disc
15. Valve stem
16. Screw, brake disc
17. Spacer, wheel bearing

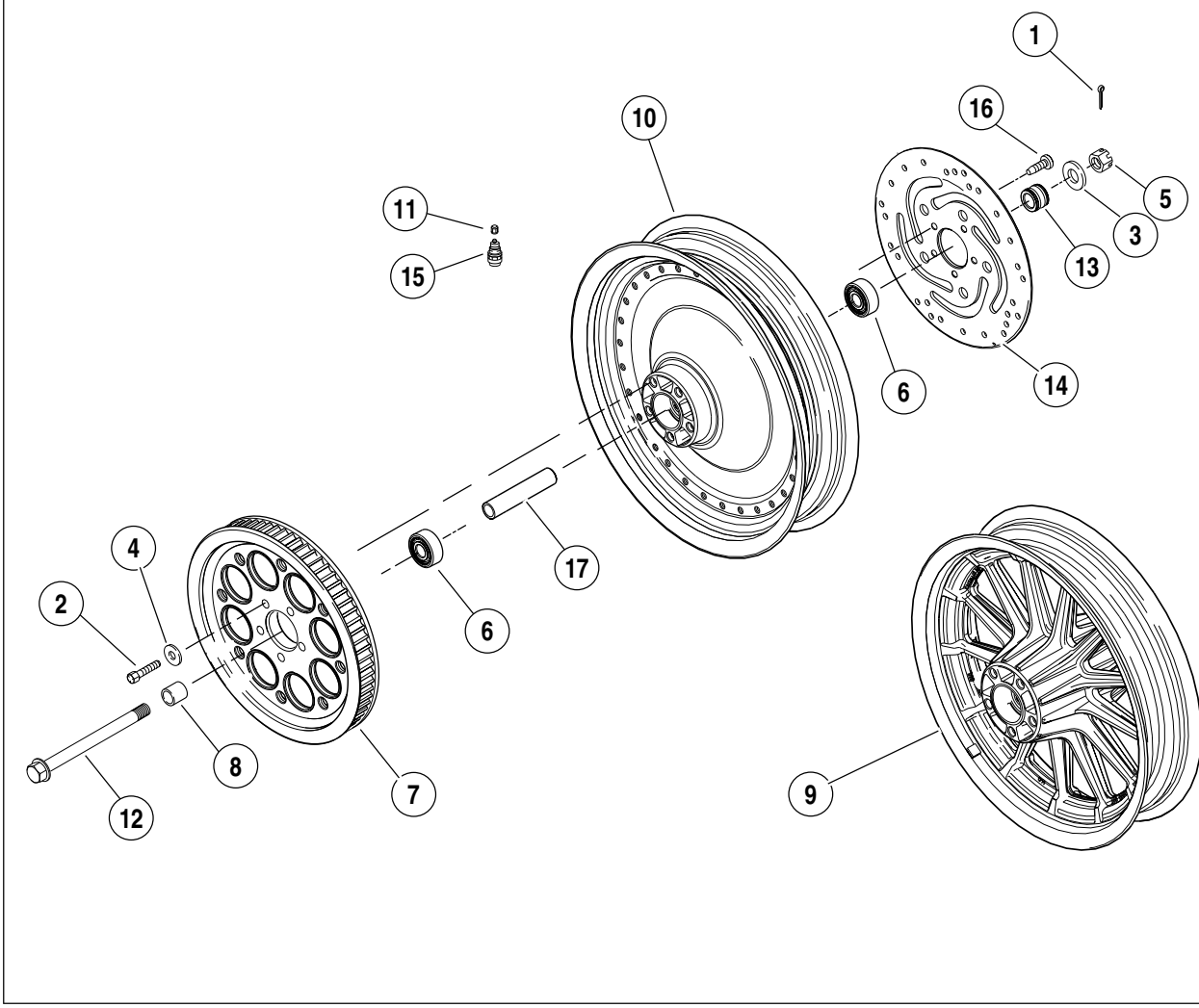


Figure 2-14. Cast Rear Wheel

LACED REAR WHEEL

x0363x2x

1. Cotter pin
2. Bolt
3. Spacer
4. Washer
5. Castle nut
6. Roller bearing
7. Sprocket
8. Sprocket spacer
9. Spoke wheel
10. Hub
11. Valve cap
12. Axle assembly
13. Disc spacer
14. Brake disc
15. Spoke and nipple
16. Rim
17. Wheel bearing spacer
18. Brake disc screw
19. Valve stem nut

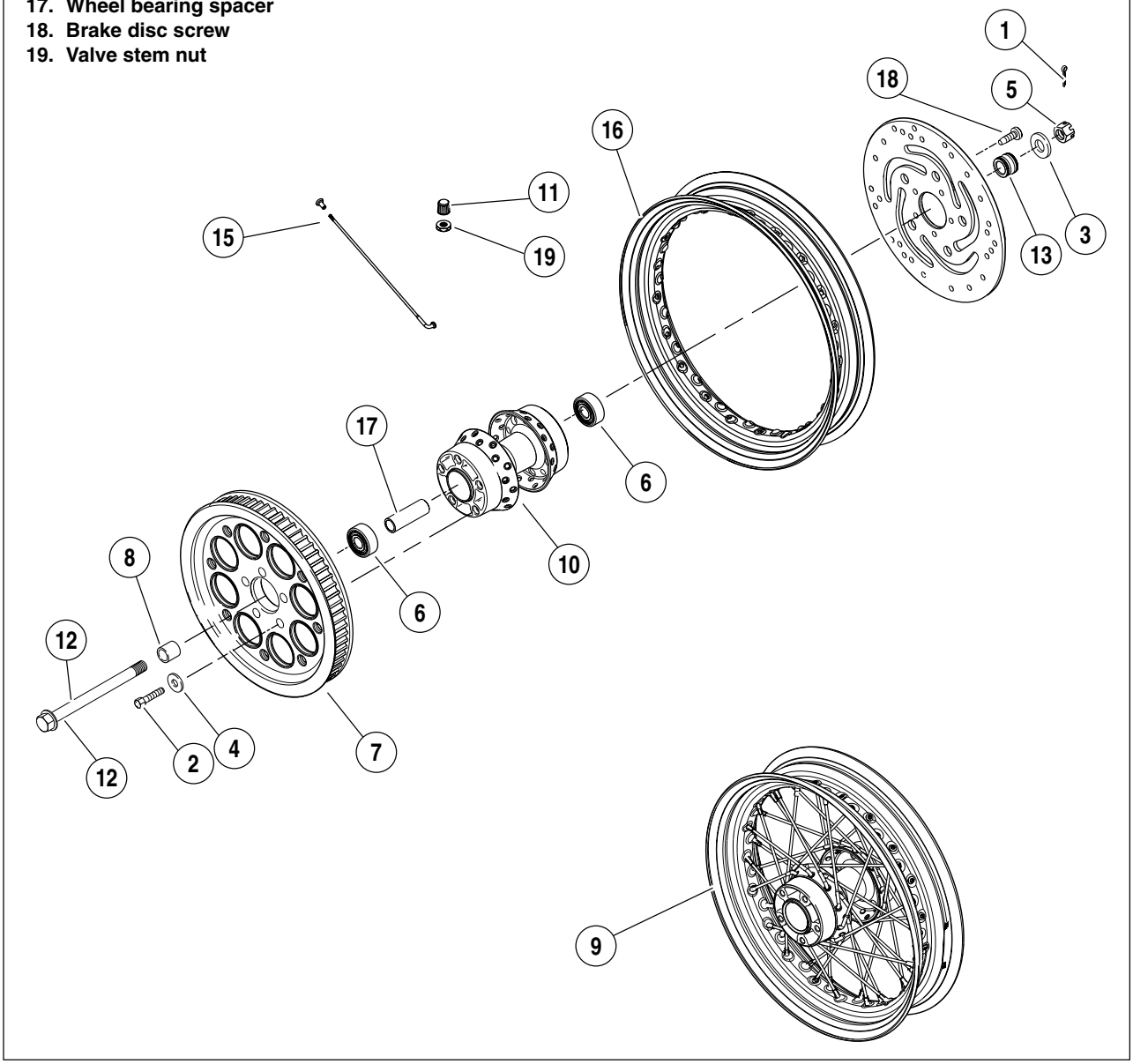


Figure 2-15. Laced Rear Wheel

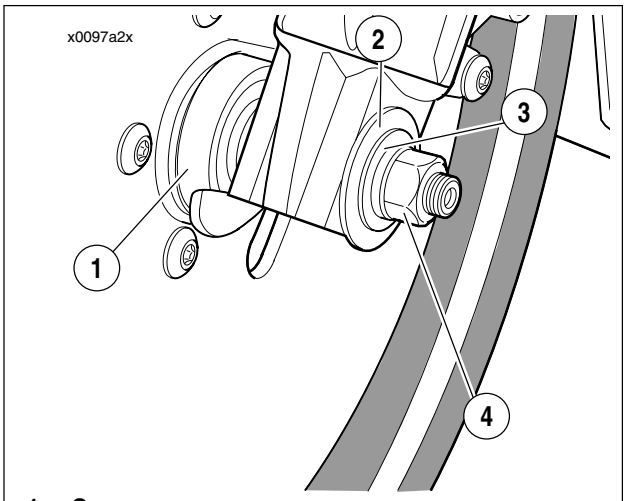
FRONT WHEEL INSTALLATION

1. Position wheel between forks with brake disc on left side of vehicle, external spacer on right. With pinch screw loose, insert threaded end of axle through right side fork. Push axle through fork and wheel hub until it begins to emerge from left side of hub.
2. Push axle through left fork, until axle shoulder contacts external wheel spacer on right fork side.
3. See Figure 2-16. Install flat washer (2), lock washer (3) and axle nut (4) over threaded end of axle. Insert screwdriver or steel rod through hole in axle on right side of vehicle. While holding axle stationary, tighten axle nut to 50-55 ft-lbs (68-75 Nm).
4. See Figure 2-4. Tighten pinch screw nut (4) to 21-27 ft-lbs (28-37 Nm).
5. Install brake caliper. Tighten brake caliper mounting screws to 25-30 ft-lbs (34-41 Nm). For more detailed information, see 2.18 FRONT BRAKE CALIPER.

⚠WARNING

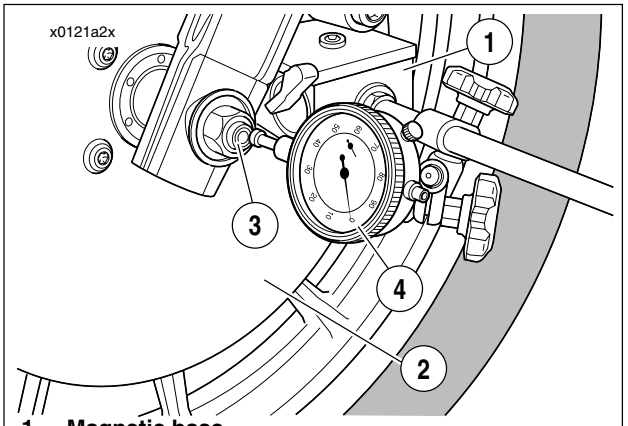
Check wheel bearing end play after tightening axle nut to proper torque. Excessive end play can adversely affect motorcycle handling. Insufficient end play can cause bearing seizure, resulting in possible loss of vehicle control and death or serious injury.

6. See Figure 2-17. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge. Move the wheel forward as far as it will go. Note the reading of the dial indicator. The lateral movement or end play must be less than 0.002 in. (.05 mm). Repeat the procedure to verify the reading.
7. If the end play is 0.002 in. (.05 mm) or more, replace the wheel bearing.



1. **Spacer**
2. **Flat washer**
3. **Lock washer**
4. **Axle nut**

Figure 2-16. install Spacer



1. **Magnetic base**
2. **Brake disc**
3. **Axle**
4. **Dial indicator**

Figure 2-17. Check wheel bearing end play

REAR WHEEL INSTALLATION

1. Place wheel centrally in the rear fork (swing arm) with the brake disc in the caliper. Slide wheel far enough forward to slip belt over sprocket and then slide the wheel back.
2. Apply LOCTITE ANTI-SEIZE LUBRICANT to axle.
3. See Figure 2-14. (12) See Figure 2-15. (12) Insert axle through right side of rear fork, spacer, wheel assembly, rear caliper bracket and left side of rear fork.
4. See Figure 2-5. Install flat washer (3) and nut (1) on end of axle (4). Tighten axle nut to 60-65 ft-lbs (81-88 Nm).

⚠WARNING

Check wheel bearing end play after tightening axle nut to proper torque. Excessive end play can adversely affect motorcycle handling. Insufficient end play can cause bearing seizure, resulting in possible loss of vehicle control and death or serious injury.

5. See Figure 2-14. See Figure 2-15. Mount a magnetic base dial indicator on the brake disc. Set the indicator contact point on the end of the axle. Move the wheel back as far as it will go. Holding the wheel in position, zero the dial indicator gauge. Move the wheel forward as far as it will go. Note the reading of the dial indicator. The lateral movement or end play must fall between 0.002 and 0.006 in. (0.05-0.15 mm). Repeat the procedure to verify the reading.
6. See Figure 2-14. See Figure 2-15. Remove the wheel and substitute thicker spacer shim(s) if the end play must be increased. Use thinner spacer shim(s) to reduce the end play. See the following table for the available spacer shim thicknesses.
7. Check for proper belt tension. See 6.3 SECONDARY DRIVE BELT. Align wheel. (see CHECKING WHEEL ALIGNMENT in this section).
8. See Figure 2-5. Install cotter pin (2) onto rear axle nut.

GENERAL

See Figure 2-18.T-30 I.P. (Torx Plus) head spokes are shown below.

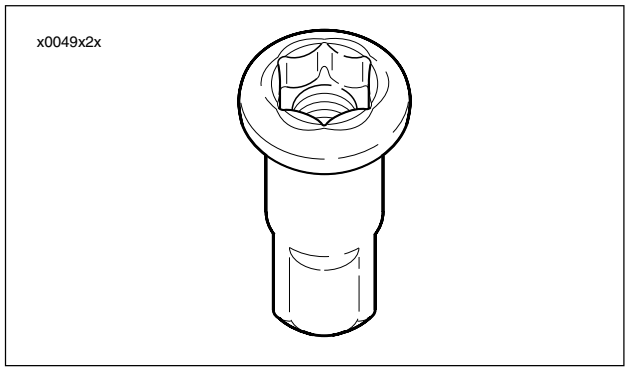


Figure 2-18.

See Figure 2-19. The 16 inch laced wheel hub is shown below.

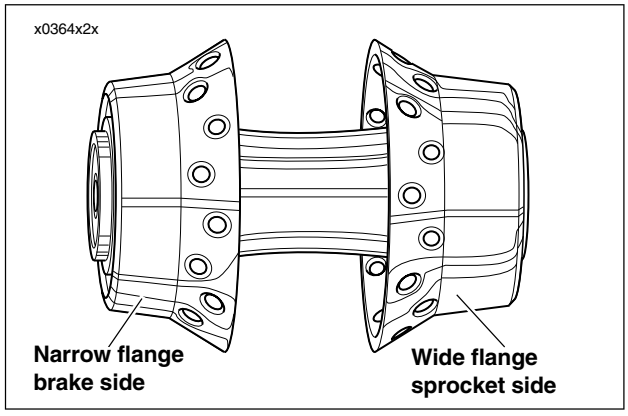


Figure 2-19.

See Figure 2-20. The new 16 inch laced wheel rim is shown below. New rims can be identified by the “half moon” shape around the valve stem hole.

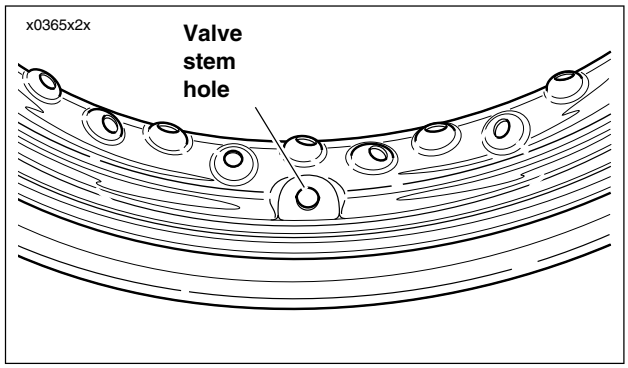


Figure 2-20.

Lacing Wheel

1. See Figure 2-21. Place hub on table with brake disc side (narrow flange) up. Insert a spoke in each hole of lower row as shown below. Angle spokes clockwise.

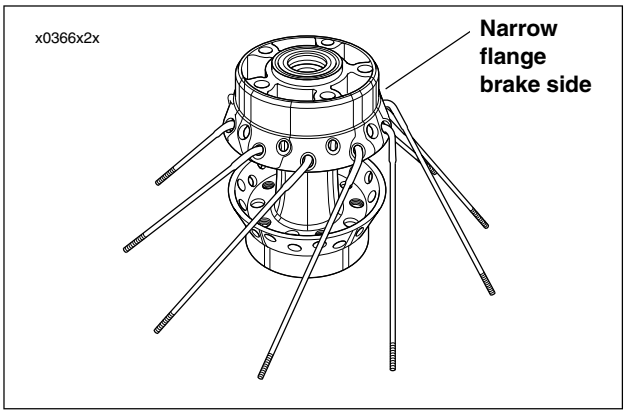


Figure 2-21.

2. See Figure 2-22. Position rim over the hub and spokes with valve stem hole up. 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.

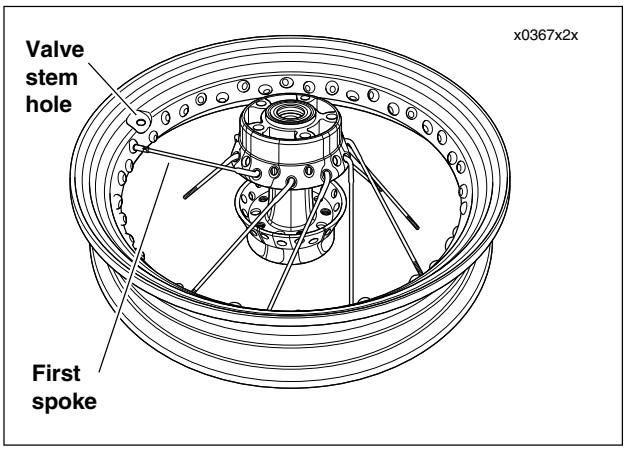


Figure 2-22.

3. See Figure 2-23. Install remaining lower row spokes in every fourth hole.

4. See Figure 2-24. 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.

5. See Figure 2-25. Install the remaining nine upper row spokes into every fourth remaining hole above the rim centerline. This completes spoke installation on brake disc side.

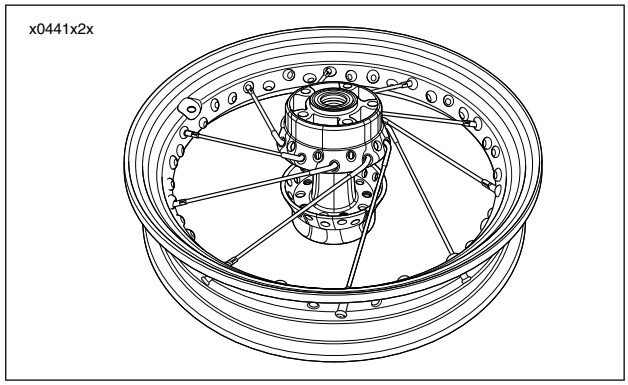


Figure 2-23.

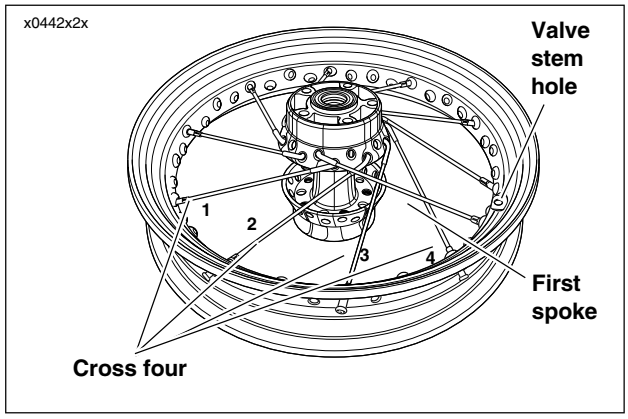


Figure 2-24.

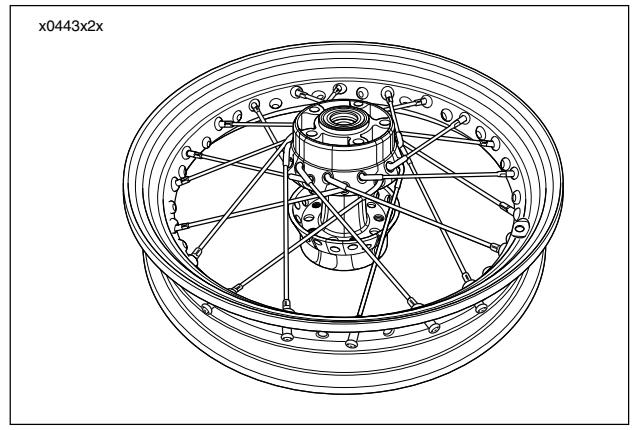


Figure 2-25.

6. See Figure 2-26. Turn wheel assembly over so the sprocket side (wide) faces up. Place any lower row spoke into hub. Angle spoke clockwise and place into rim hole angled to accept it.

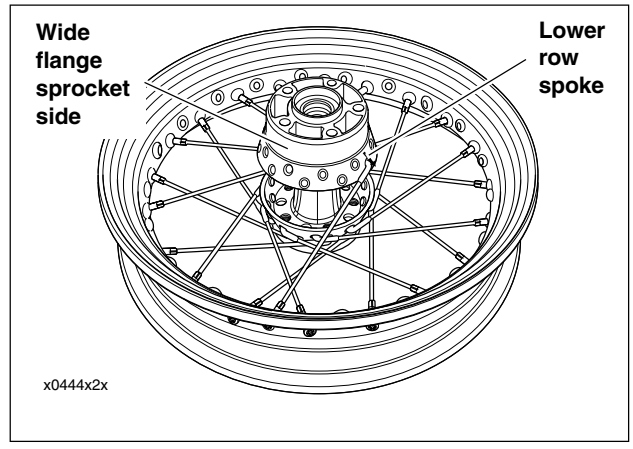


Figure 2-26.

7. See Figure 2-27. Place the remaining nine lower row spokes, angled clockwise, into hub and rim.

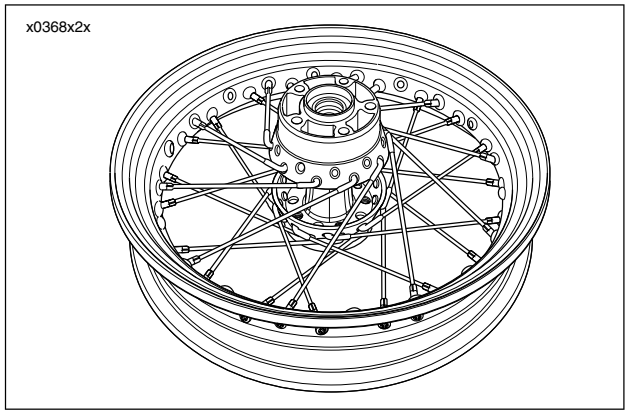


Figure 2-27.

8. See Figure 2-28. Insert any upper row spoke into hub and angle spoke counterclockwise. Place spoke into appropriate rim hole.

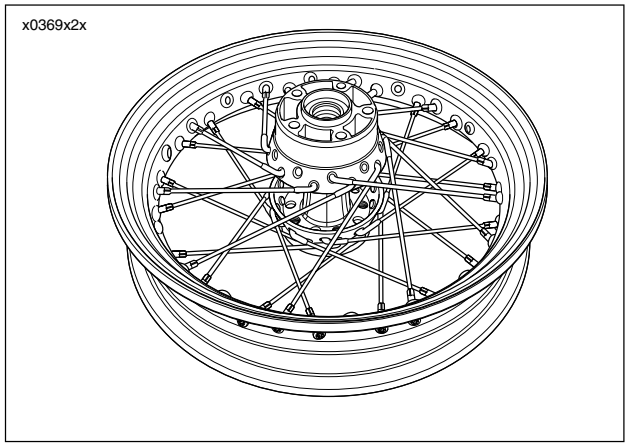


Figure 2-28.

9. See Figure 2-29. Install remaining nine upper row spokes. This completes spoke installation. Proceed to wheel truing section.

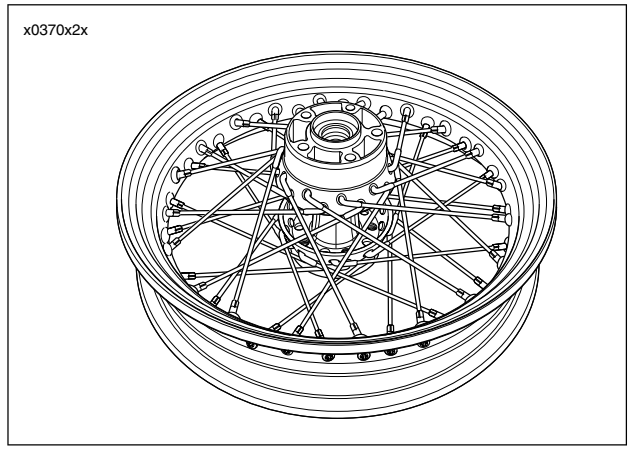


Figure 2-29.

PROCEDURE

NOTE

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

1. Divide spokes into two groups.
   - Inner spokes have long heads.
   - Outer spokes have short heads.

⚠WARNING

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

2. Lubricate spoke threads and nipple shoulders with tire mounting lubricant.
3. See Figure 2-30. Place hub on bench with the brake disc side up. Insert one outer spoke (short-head) into any bottom flange hole and swing it clockwise. Insert an inner spoke (long-head) in the next hole to the left of the outer spoke. Swing the inner spoke counterclockwise over the outer spoke.
4. Find the hole in the upper flange directly above the two spokes just inserted. This hole uses a long head inner spoke. Insert inner spoke into the hole on the upper flange that directly bisects the two spokes in the bottom flange. Insert all remaining spokes in upper flange alternating the inner and outer spokes.
5. After one flange side is completed flip wheel hub upside down and repeat to finish other flange.
6. See Figure 2-31. With all forty spokes inserted in hub, group all spokes on top flange into two bundles. Secure each group with throttle grips to keep the spokes together.
7. Swing all bottom flange outer spokes (short-head) clockwise.
8. Swing the inner spokes (long-head) counterclockwise, crossing over the outer spokes (short-head). Angle all spokes as far as they will go without overlapping the next LIKE spoke. For instance, swing an inner spoke (long-head) counter clockwise across four spokes as far as it will go before crossing another inner spoke (laced in a cross-four pattern).

NOTES

- *All inside spokes lay over all outside spokes.*
- *See Figure 2-32. The valve stem hole is centered of the rim; you do not have to worry about choosing the correct relationship between the rim and the hub.*

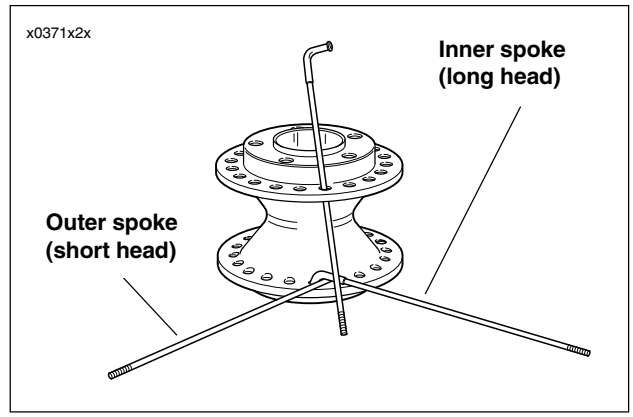


Figure 2-30. Lacing 19-in. Wheel Hub

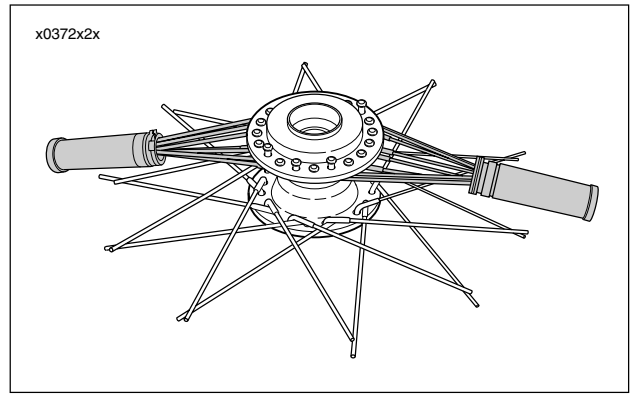


Figure 2-31. Bundling Top Spokes

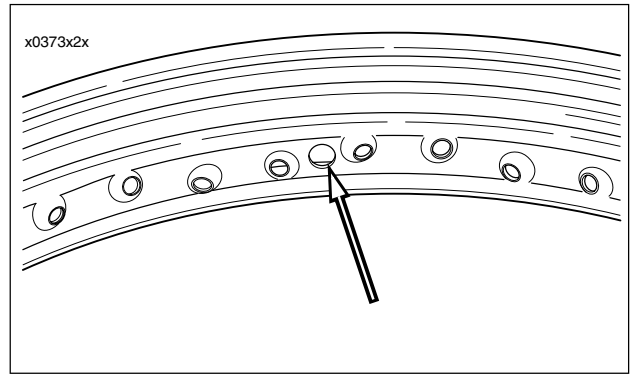


Figure 2-32. Valve Stem Hole Location

9. Center the rim over the hub assembly.

NOTE

It is recommended that you lace the first spoke next to the valve stem hole. When lacing your first spoke, place spoke nipples through several rim holes to determine the correct lacing direction. Only one spoke will fit into the spoke nipple correctly. When connecting the spoke to the spoke nipple, finger tighten two to three threads.

10. Straighten any spokes that were accidentally bumped or moved on the bottom flange.
11. Work with the bottom flange of outer spokes (short-head) first.
12. See Figure 2-33. Using the spoke alignment method discussed previously, Locate a hole pointing downward and outward toward the bottom flange of outer spokes (short-head).
    a. Verify outer spoke (short-head) reaches the spoke nipple and secure spoke loosely by hand. Skip three rim holes and repeat lacing. Follow pattern to complete bottom flange outer spokes (short-head).
    b. See Figure 2-34. Once you have completed lacing the bottom row of outer spokes (short-head) double check for three empty holes in between each spoke.
13. Work with bottom flange inner spokes (long-head) next. Choose a beginning spoke closest to the valve stem hole.
    a. See Figure 2-35. Each inner spoke (long-head) crosses four outer spokes (short-head).
    b. See Figure 2-36. Verify inner spoke reaches spoke nipple and secure spoke loosely by hand. Skip every other hole and repeat lacing. Follow pattern to complete bottom row inner spokes (long-head).

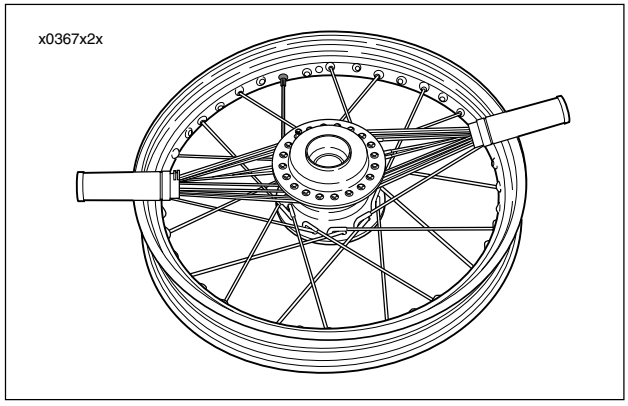


Figure 2-33. Beginning Spoke-Bottom Flange Outer

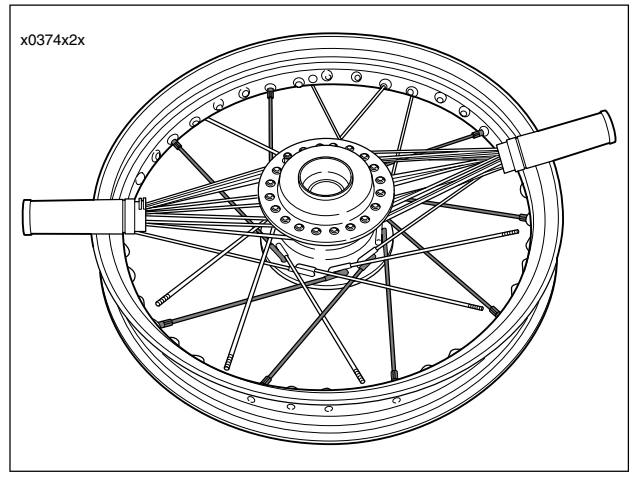


Figure 2-34. Completed Spokes-Bottom Flange Outer

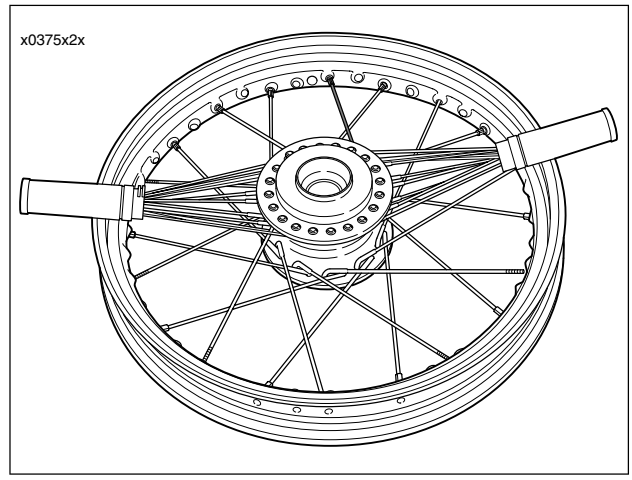


Figure 2-35. Beginning Spoke-Bottom Flange Inner

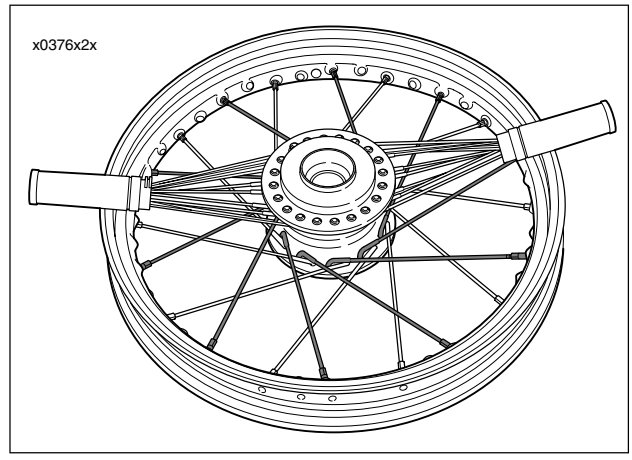


Figure 2-36. Completed Spokes-Bottom Flange Inner

14. See Figure 2-37. Undo each top bundle and fan the spokes out (in a starburst pattern) around the top rim edge.

15. See Figure 2-38. Point all the top flange inner spokes (long-head) clockwise one at a time leaving the outer spokes (short-head) resting on the rim.

NOTE

Do not knock outer spokes (short-head) *under inner spokes (long-head) or they will be trapped underneath the inner row of spokes.*

16. Using the spoke alignment method discussed previously, choose a beginning spoke closest to the valve stem hole. Start with top flange inner spokes (long-head) first.

    a. See Figure 2-39. Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange inner spokes (long-head).

    b. See Figure 2-40. Once you have completed the top flange of inner spokes (long-head) double check for one empty hole after every third spoke.

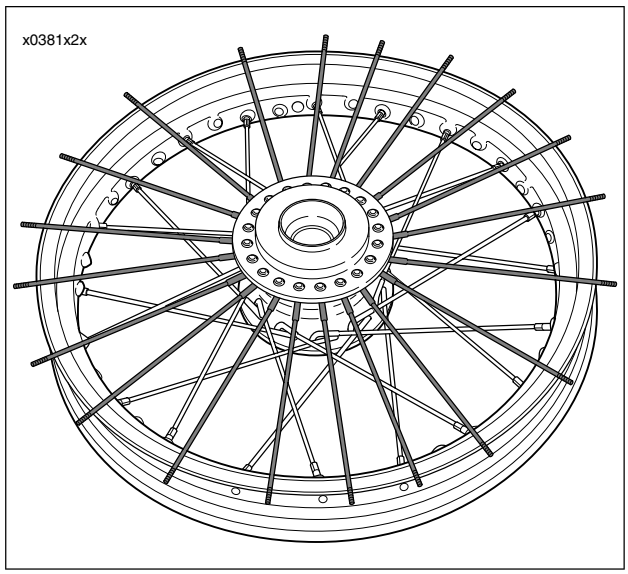


Figure 2-37. Fanning Top Flange Spokes

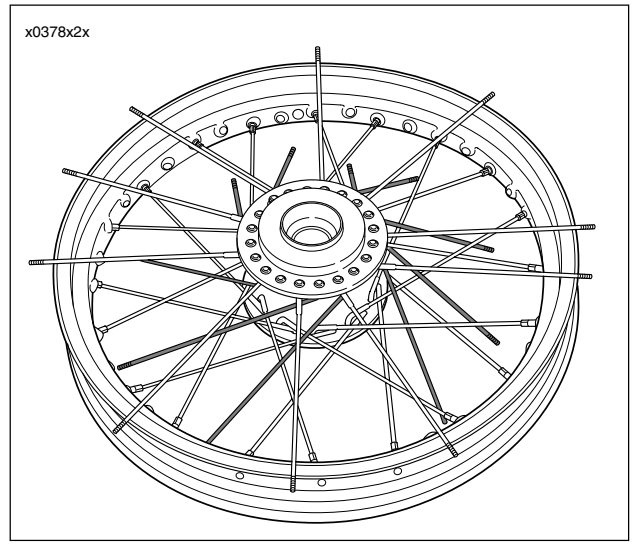


Figure 2-38. Setting Top Flange Inner Spokes

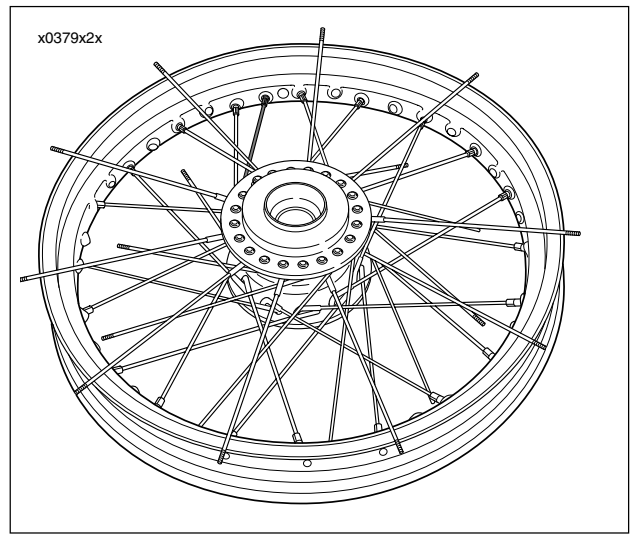


Figure 2-39. Beginning Spoke-Top Flange Inner

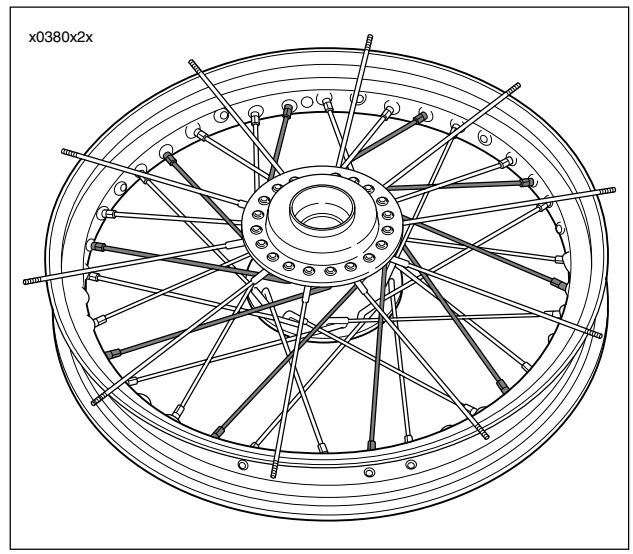


Figure 2-40. Completed Spokes-Top Flange Inner

17. See Figure 2-41. Finish with top flange outer spokes (short-head). Point the top flange outer spokes (short-head) counterclockwise and make sure each one crosses four inner spokes before securing it to the rim.

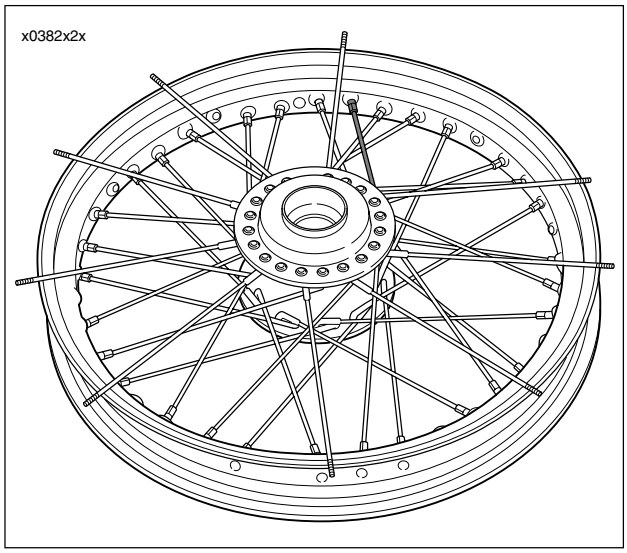


Figure 2-41. Beginning Spoke-Top Flange Outer

   a. See Figure 2-42. Verify spoke reaches spoke nipple and secure spoke by hand. Follow pattern to complete top flange outer spokes (short-head).

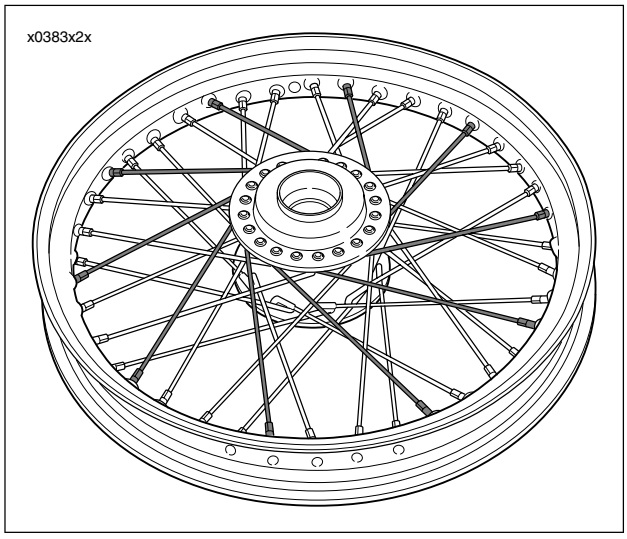


Figure 2-42. Completed Spokes-Top Flange Outer

18. Tighten spoke nipples to 40-50 **in-lbs** (4.5-5.6 Nm).
19. True the wheel. See 2.11 TRUING LACED WHEELS.

PROCEDURE

NOTE

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

⚠WARNING

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

1. See Figure 2-43. 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.

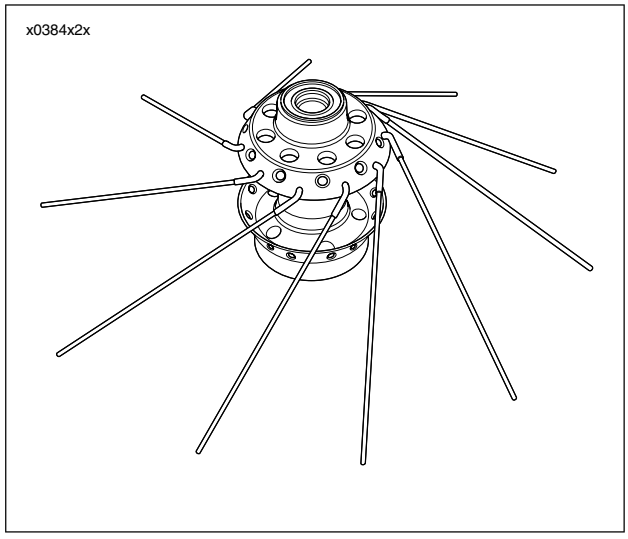


Figure 2-43.

2. See Figure 2-44. Center the rim over the hub assembly with the valve stem hole facing upward.
3. See Figure 2-45. 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.
4. Install the rest of lower row spokes in every fourth hole.
5. See Figure 2-46. 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.

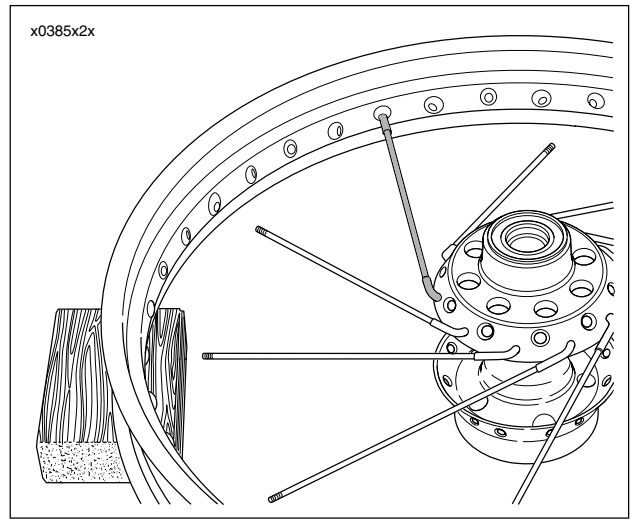


Figure 2-44.

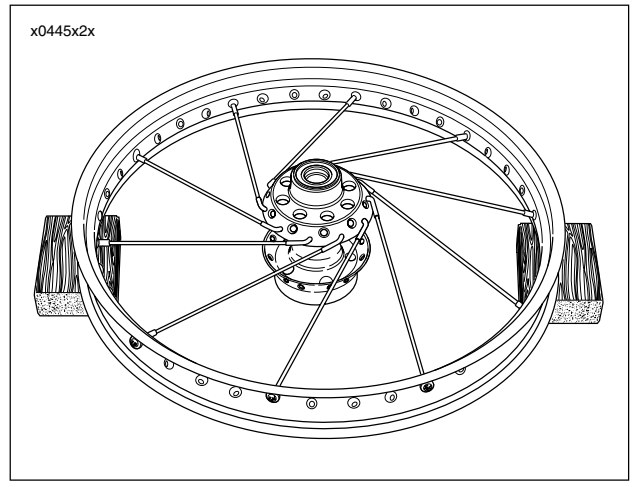


Figure 2-45.

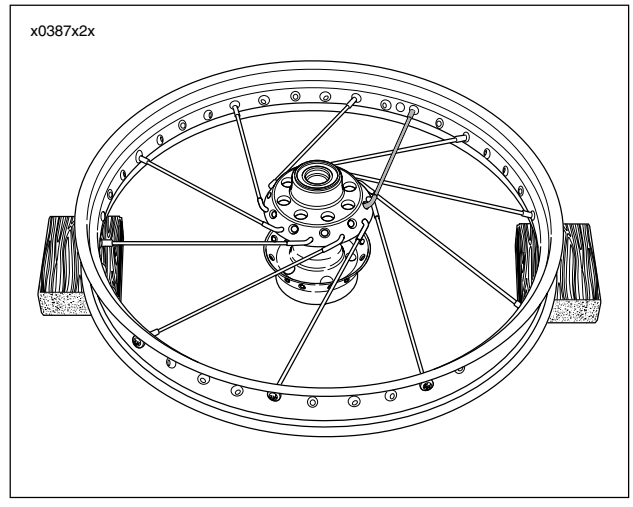


Figure 2-46.

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

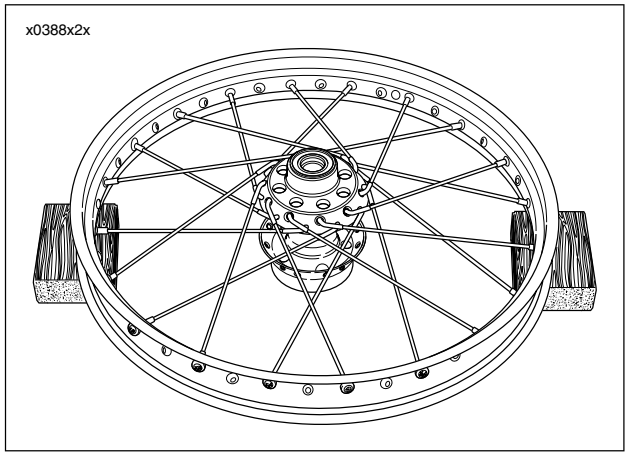


Figure 2-47.

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

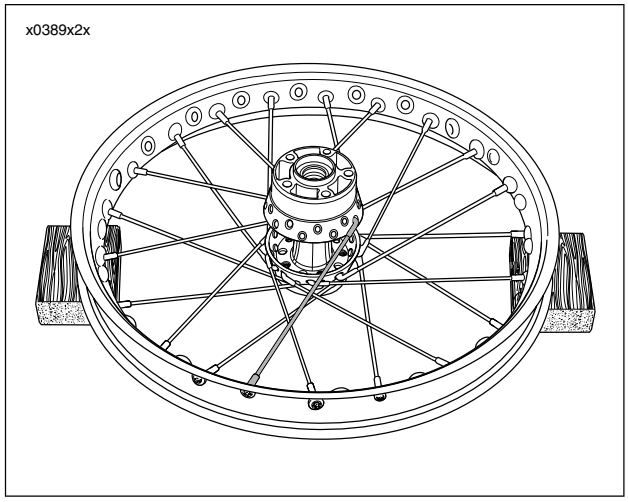


Figure 2-48.

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

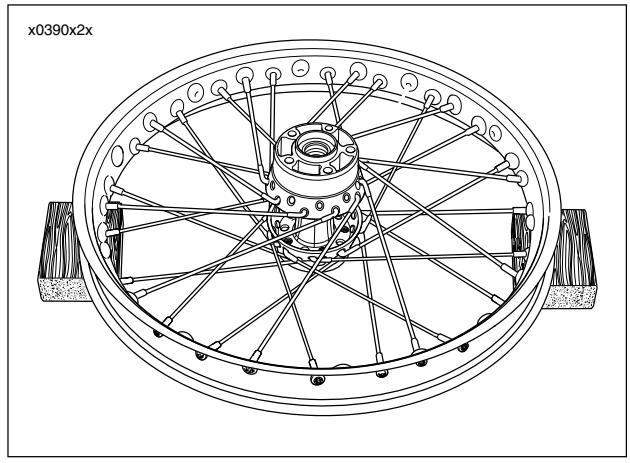


Figure 2-49.

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

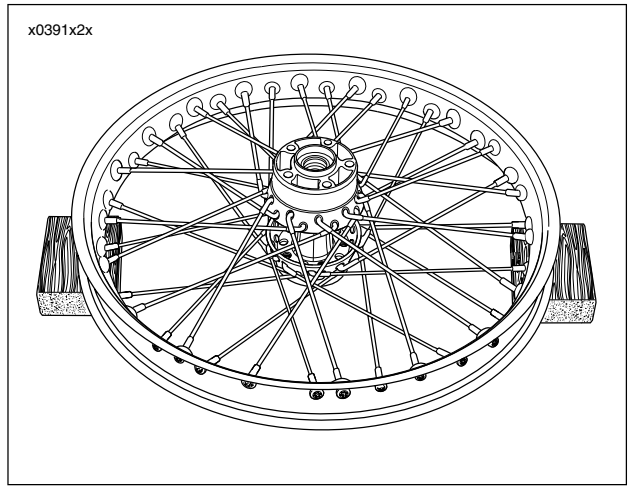


Figure 2-50.

10. Tighten spoke nipples to 40-50 **in-lbs** (4.5-5.6 Nm).
11. True wheel. See 2.11 TRUING LACED WHEELS.

PROCEDURE

1. See Figure 2-51. With a piece of tape, mark the center of each of four groups of four as shown. The groups should be directly across from one another and approximately 90˚ apart.

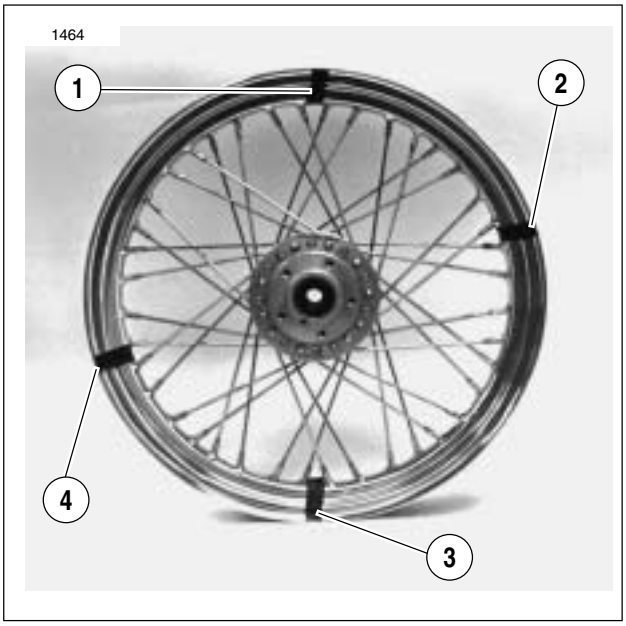


Figure 2-51. Marking Spoke Groups

NOTE

All Harley-Davidson laced wheels use a cross-4 pattern. Each outer spoke must cross four inner spokes before entering rim hole.

2. Finger tighten the spokes in these four groups. Leave all other spokes loose.
3. Install truing arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-99500-80). Tighten arbor nuts so hub will turn on its bearings.
4. See Figure 2-52. See Figure 2-53. The hub must be centered sideways with the rim. Lay a straightedge across the hub brake disc flange and one of the marked spoke groups. Measure the distance from the straightedge to the rim as shown. If this dimension is not equal on both sides of the wheel, loosen and tighten the four spokes accordingly. Use SPOKE WRENCH (Part No. HD-94681-80).

NOTE

See Figure 2-52. See Figure 2-53. Dimension "A" must be maintained to ensure centering of wheel on motorcycle.

EXAMPLE

If the measurement on the rim right side is greater than the left side, 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 dimension is equal to within 0.040 in. (1.02 mm) for both sides.

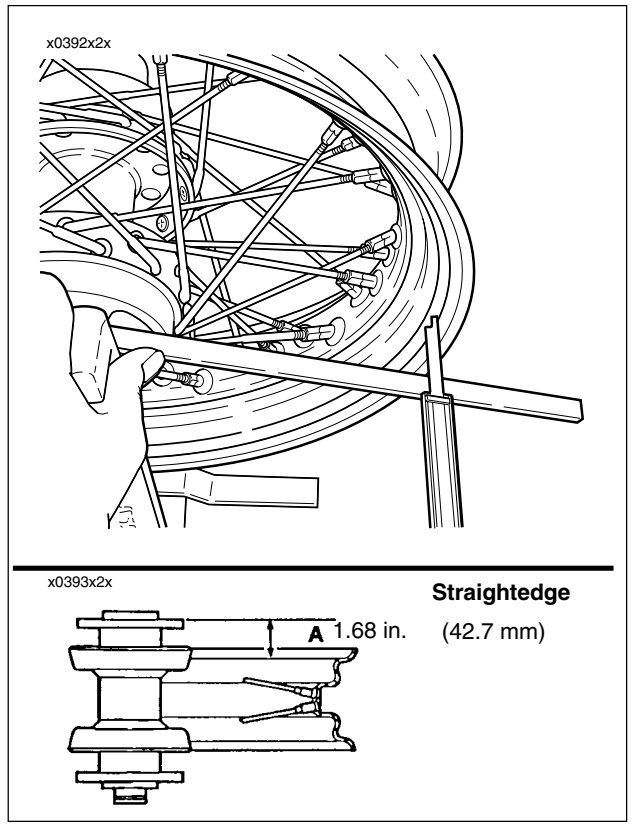


Figure 2-52. Centering 16-in. hub

NOTE

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

Repeat Step 4 for all four groups on the wheel.

5. See Figure 2-54. After rim has been centered sideways it must be checked and trued radially. Adjust truing stand gauge to the rims tire bead seat as shown. The rim should be trued within 0.030 in. (0.76 mm).
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.

   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.
7. 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 alternately until they are snug.

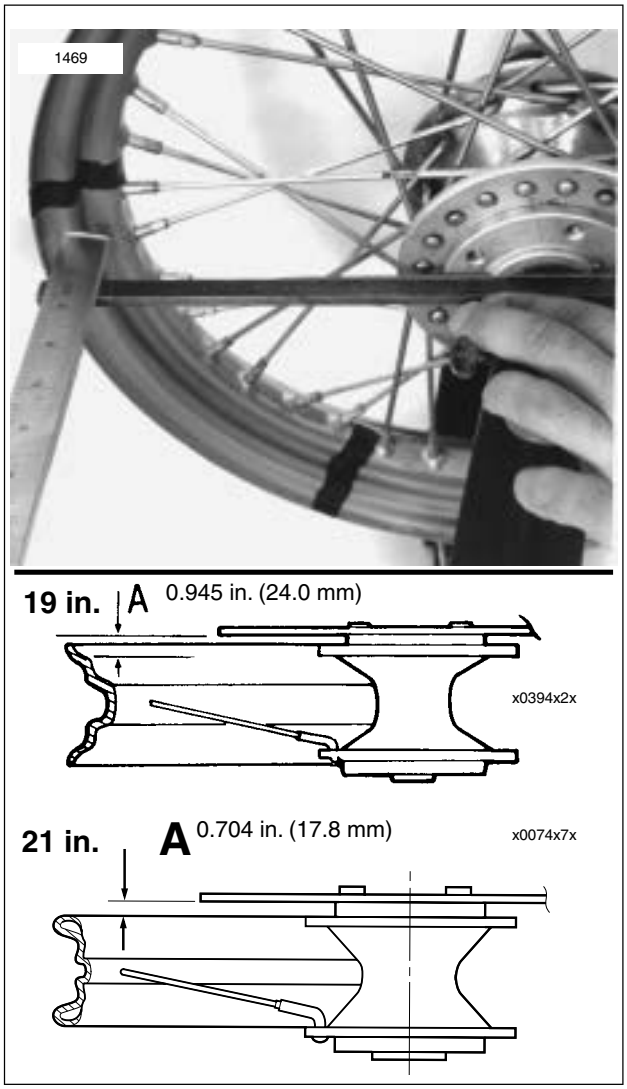


Figure 2-53. Centering 19-in and 21-in Hub

8. Seat each spoke head in the hub flange using a flat nose punch and hammer. Then check wheel trueness again and tighten the nipples accordingly.

CAUTION

Overtightening spokes may cause nipples to be drawn through rim, or hub flanges to be distorted. Spokes left too loose continue to loosen when wheel is put into service. Loose spokes will also lead to breakage of adjacent tight spokes, which are carrying a larger share of the load.

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

10. See Figure 2-52. and Figure 2-53. Check dimension A and re-true wheel if not within specifications.

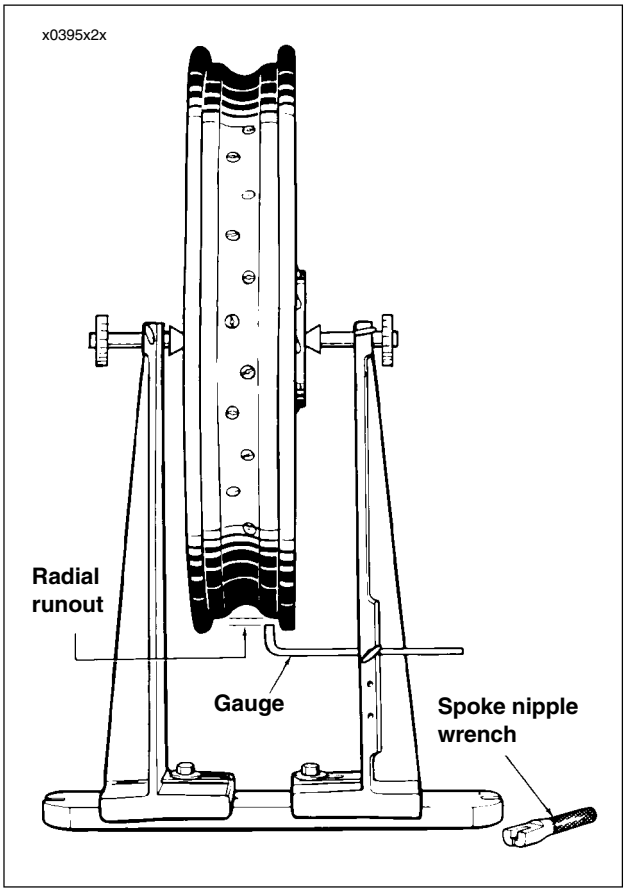


Figure 2-54. Truing Rim Radially

CHECKING LATERAL AND RADIAL RUNOUT

Check cast wheels for lateral and radial runout before installing a new tire.

1. See Figure 2-55. Install truing arbor in wheel hub and place wheel in WHEEL TRUING STAND (Part No. HD-99500-80). Tighten arbor nuts so hub will turn on its bearings. To check rim lateral runout, place a gauge rod or dial indicator near the rim bead. If lateral runout exceeds 0.040 in. (1.02 mm), replace the wheel.

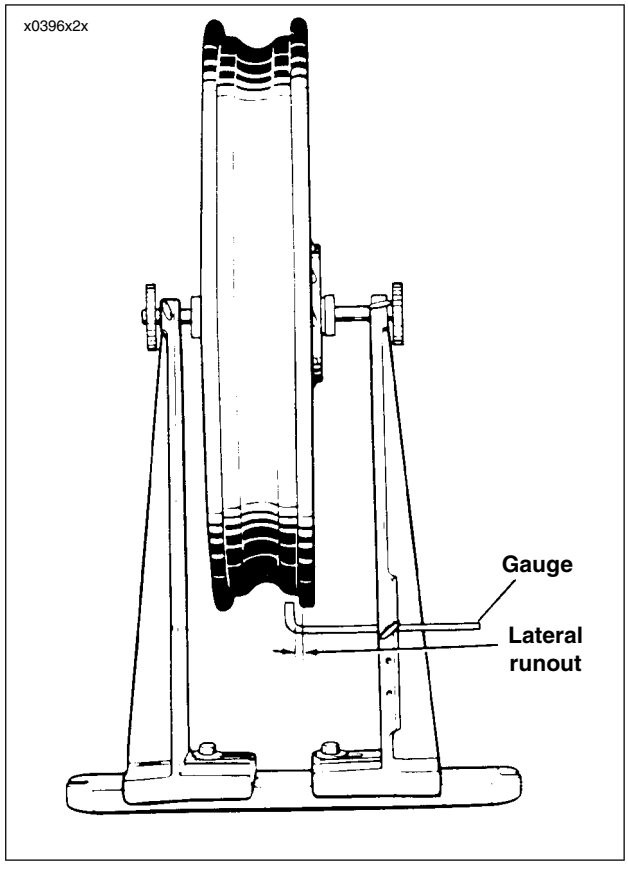


Figure 2-55. Checking Cast Rim Lateral Runout.

2. See Figure 2-56. Check for radial runout as shown. Replace the wheel if runout exceeds 0.030 in. (0.76 mm).

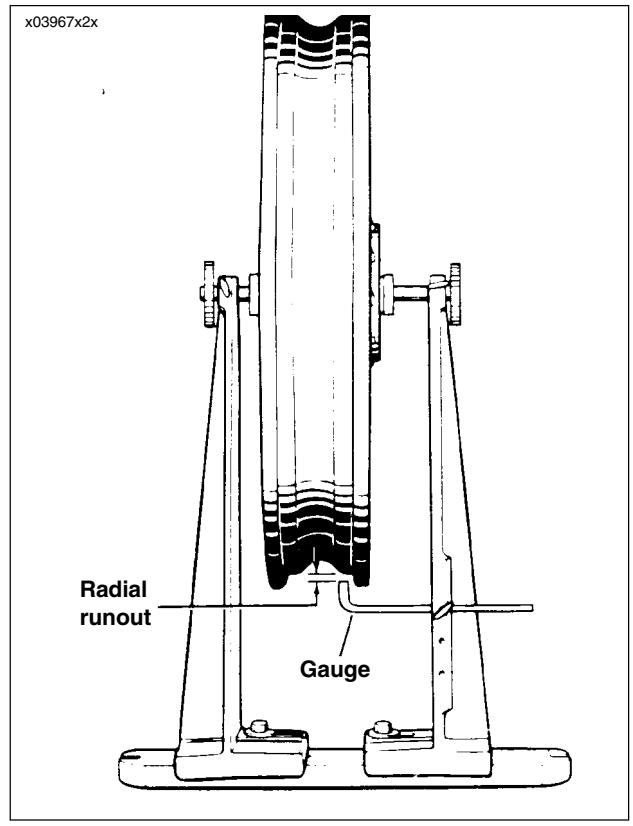


Figure 2-56. Checking Cast Rim Radial Runout

GENERAL

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

Whenever a tire on a laced wheel is replaced, the tube should also be replaced. Inner tubes should be patched only as an emergency measure. Replace a damaged or patched tube as soon as possible. Rim bands must be used on all laced wheels.

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

⚠WARNING

Always check both tire sidewalls for arrows indicating forward rotation. Some tires require different tire rotation depending on whether tire is used on front or rear wheel. Failure to observe this warning may lead to tire failure which could result in death or serious injury.

REMOVAL

1. Remove wheel from motorcycle. See 2.3 WHEEL REMOVAL.
2. Deflate tire.
3. See Figure 2-57. Loosen both tire beads from rim flange. In most cases, a bead breaker machine will be required to loosen the beads from the rim.

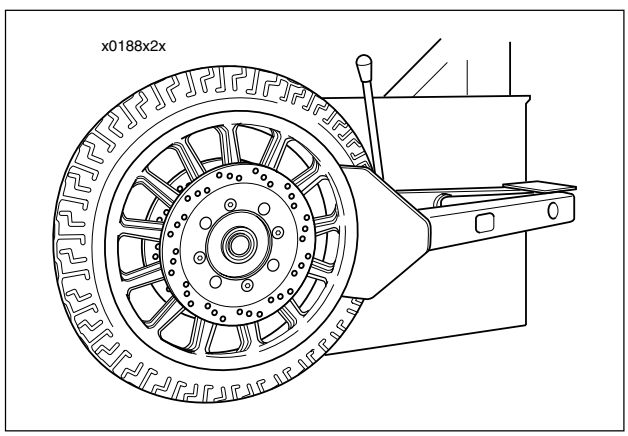


Figure 2-57. Loosening Beads from Rim Range

4. If a bead breaker machine is not available, attach RIM PROTECTORS (Part No. HD-01289) to the rim. Using tire tools (not sharp instruments), start upper bead over edge of rim at valve. Repeat all around rim until first bead is over rim. Remove the tube on tube type wheels.

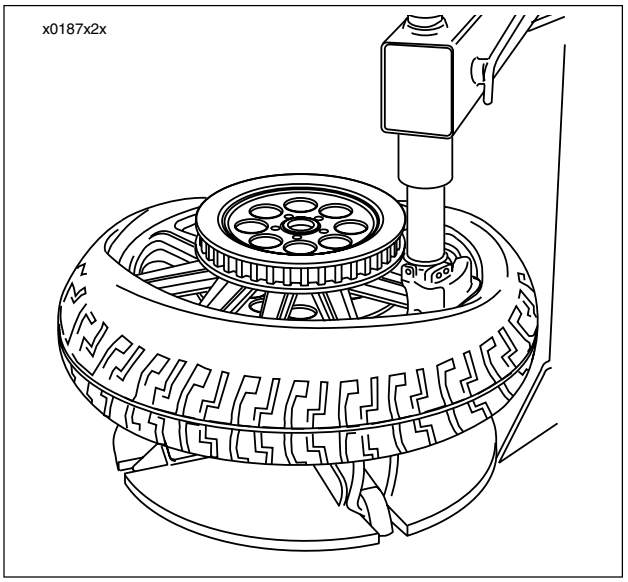


Figure 2-58. Starting Tire Off Rim

CAUTION

Do not use excessive force when starting bead over rim. Excessive force may damage wires in tire bead.

5. See Figure 2-58. 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.
6. On tubeless tire rims, remove the valve stem if it is damaged or leaks.

NOTE

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

7. Mount the tire on TIRE SPREADER (Part No. HD-21000) for inspection and repair procedures.

CLEANING, INSPECTION, AND REPAIR

1. Clean the inside of tire and outer surface of tube.
2. If rim is dirty or rusty, clean with a stiff wire brush.
3. Inspect the tire and tube for wear and damage. Replace worn tires. Replace damaged tubes. Use TIRE REPAIR KIT (Part No. HD-20000) for tire repair. Follow the kit manufacturer's instructions.

Figure 2-59. Installing Rim Strip

INSTALLATION

Tube Type Tires

⚠WARNING

Use the correct inner tube and tire as specified. See TIRE DATA in SPECIFICATIONS. Failure to do so could result in tire failure and death or serious injury.

1. See Figure 2-59. On laced wheels, install a rim strip into the rim well. Make sure no spokes protrude through nipples, and be sure to align the valve stem hole in rim strip with hole in rim.
2. Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant.

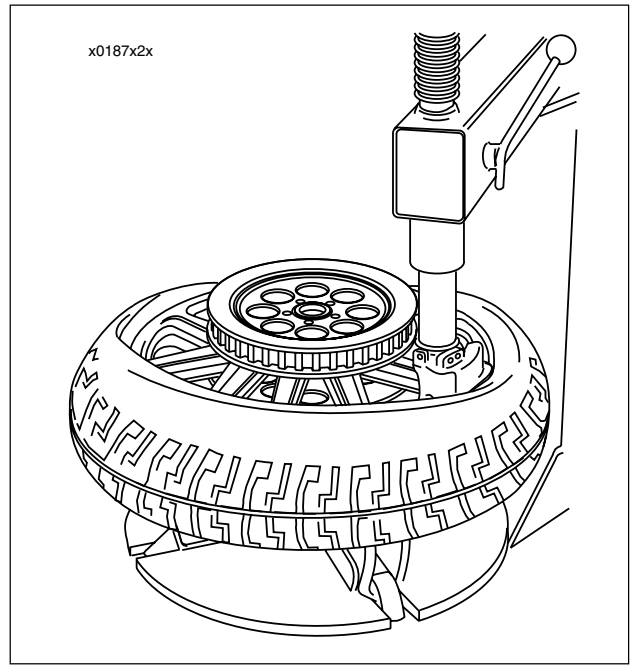


Figure 2-60. Starting Bead on Rim

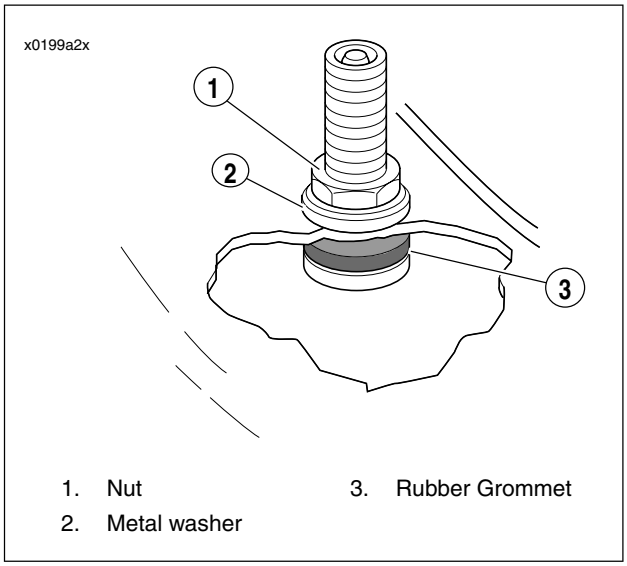
3. See Figure 2-60. Starting at the valve stem hole, start the first bead into the rim well. Work the bead on as far as possible by hand. Use the tire tool to pry the remaining bead over the rim flange.
4. Inflate tube just enough to round it out. Lubricate thoroughly 360˚ around the tube base. Insert tube in tire with valve stem in hole.
5. 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 valve stem before prying the remaining bead over the rim flange.
6. Make sure valve stem moves in and out freely, then inflate the tire to recommended pressure to seat the bead. See 2.1 SPECIFICATIONS. Then deflate tire to allow inner tube to smooth out. Install the valve core, then inflate to recommended pressure.

Tubeless Tires

⚠WARNING

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

Also, 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 death or serious injury.



1. Nut
2. Metal washer
3. Rubber Grommet

Figure 2-61. Tubeless Tire Valve Stem

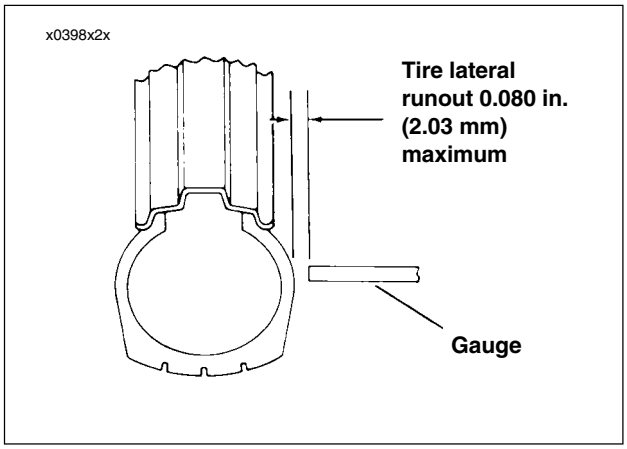


Figure 2-62. Checking Tire Lateral Runout

1. See Figure 2-61. On tubeless wheels, damaged or leaking valve stems must be replaced. Install rubber grommet (3) on valve stem.
2. Insert valve stem into rim hole.
3. Install metal washer (2).
4. Install nut and tighten to 12-15 **in-lbs** (1.3-1.7 Nm).
5. Thoroughly lubricate the rim flanges and both beads of the tire with tire lubricant.
6. See Figure 2-60. Starting at the valve stem, start the first bead into the rim well. Work the bead on as far as possible by hand. Use a tire tool to pry the remaining bead over the rim flange.
7. Start 180˚ from the valve stem hole and start the second bead on the rim. Work the bead onto the rim with tire tools, working toward the valve in both directions.
8. Apply air to the stem to seat the beads on the rim. It may be necessary to use a BEAD EXPANDER, Part No. HD-28700 on the tire until the beads seal on the rim.

⚠WARNING

Do not inflate over 40 psi (2.8 bars) to seat the beads. If the beads fail to seat to 40 psi (2.8 bars), deflate and relubricate the bead and rim and reinflate to seat the beads but do not exceed 40 psi (2.8 bars). Inflating the tire beyond 40 psi (2.8 bars) to seat the beads can cause the tire rim assembly to burst with force sufficient to cause death or serious injury.

Checking Tire Lateral Runout

1. See Figure 2-62. Turn wheel on axle and measure amount of displacement from a fixed point to tire sidewall.
2. Tire tread lateral runout should be no more than 0.080 in. (2.03 mm). If runout is more than 0.080 in. (2.03 mm), remove tire from rim, and check rim bead side runout to see if rim is at fault.
3. If rim bead seat runout is less than 0.030 in. (0.76 mm), then tire is at fault and must be replaced. If rim bead seat runout is greater than 0.030 in. (0.76 mm), correct by tightening selected spoke nipples (laced wheels) or replace wheel (cast wheels). Install tire and check tire tread radial runout again.

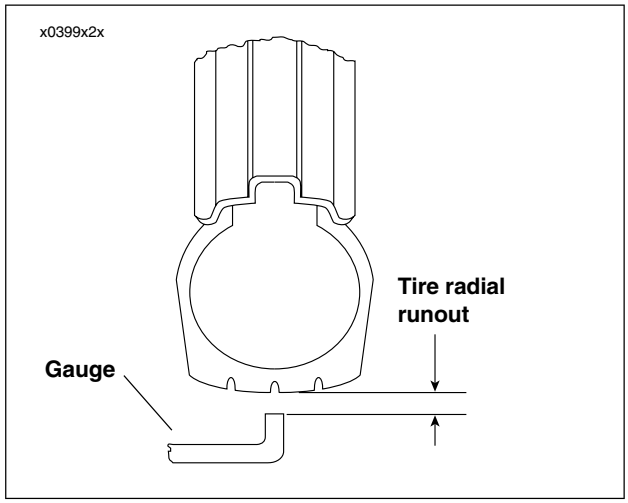


Figure 2-63. Checking Tire radial Runout

Checking Tire Radial Runout

1. See Figure 2-63. Turn wheel on axle and measure tread radial runout.
2. Tire tread radial runout should not be greater than 0.090 in. (2.29 mm). If runout exceeds specification, remove tire from rim and check rim bead runout to determine if rim is at fault.
3. If rim bead seat runout is less than 0.030 in. (0.76 mm), then tire is at fault and must be replaced. If rim bead seat runout is greater than 0.030 in. (0.76 mm), correct by tightening selected spoke nipples (laced wheels) or replace wheel (cast wheels). Install tire and check tire tread radial runout again.

Wheel Alignment

CHECKING WHEEL ALIGNMENT

⚠WARNING

Correct vehicle alignment is very important for proper vehicle handling and vibration control. Carefully check alignment according to the following procedure. Incorrect vehicle alignment could cause loss of control, resulting in death or serious injury.

1. See Figure 2-64. Fabricate an alignment tool (1) using a piece of 1/8-in. (3.175 mm) diameter aluminum welding rod 11-1/4 in. (286 mm) long. Grind one end down to a blunt point. Use pliers to bend rod 90˚ as shown. Place a snug-fitting rubber grommet (4) on rod to act as a slide measurement indicator.
2. Insert pointed end of alignment tool in index hole (2) on right side of swing arm (3). Slide rubber grommet along tool shaft until it aligns with center of rear axle. Measure distance from pointed end of alignment tool to grommet. Repeat measurement for left side of swing arm.
3. If left and right side measurements are not equal, adjust rear wheel alignment according to the following procedure – Adjusting Wheel Alignment.

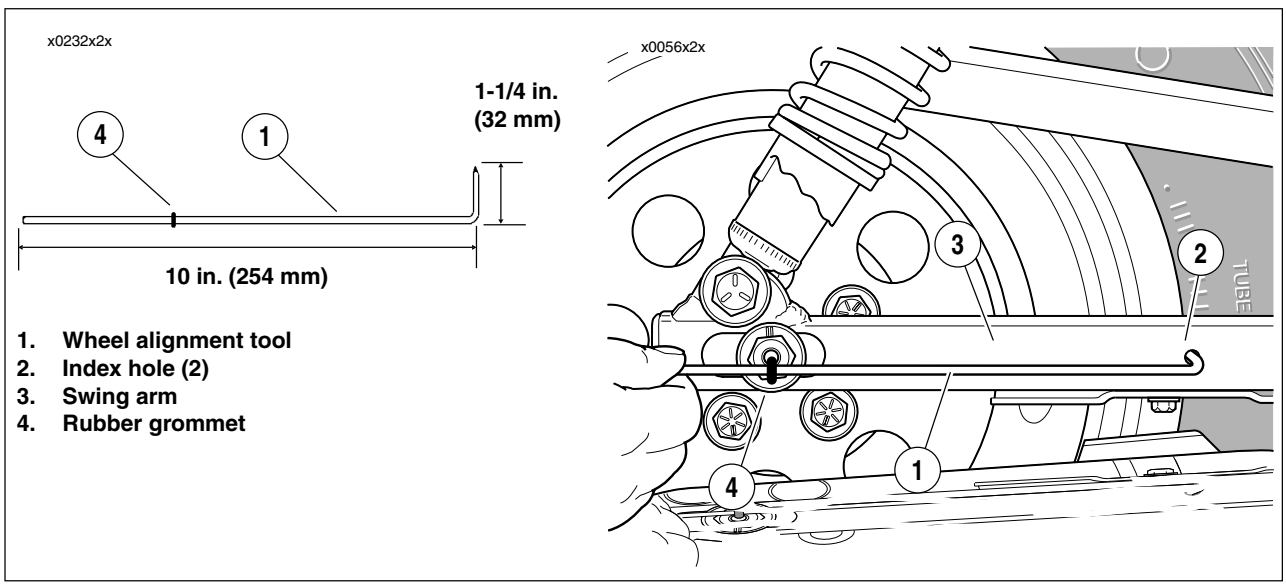
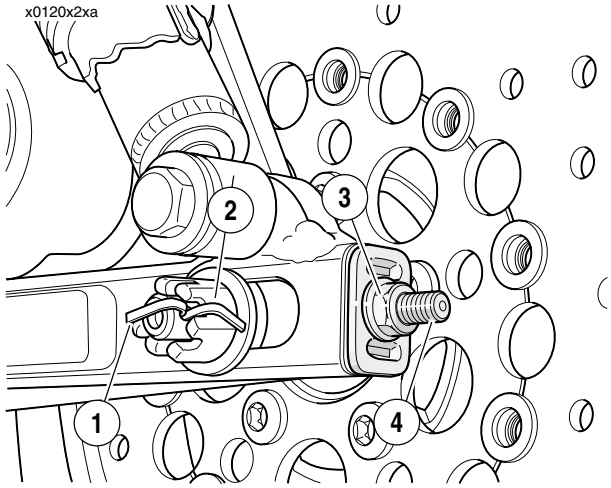


Figure 2-64. Checking Wheel Alignment Using Wheel Alignment Tool

Adjusting Wheel Alignment



1. **Cotter pin**
2. **Rear axle nut**
3. **Axle adjuster nut (2)**
4. **Axle adjuster stud (2)**

Figure 2-65.

1. See Figure 2-65. Remove and discard cotter pin (1).
2. Loosen rear axle nut (2).
3. On side of rear fork which has longer distance from index hole to axle center, turn nut (3) on axle adjuster stud (4) counterclockwise to shorten distance. Adjust axle until left and right side alignment measurements are equal.

NOTES

- *Keep axle adjuster mechanisms firmly seated (under tension) on each side of rear fork during wheel alignment procedures above. Do so by applying moderate upward force on lower span of rear belt. This tensions rear belt, which holds rear axle forward against both adjuster mechanisms.*
- *Do not tighten rear axle nut (2) or install cotter pin (1) until after checking rear drive belt tension.*

4. Check rear drive belt tension after aligning rear wheel; adjust if required. See 6.3 SECONDARY DRIVE BELT, ADJUSTMENT.
5. If not yet performed, tighten axle nut (2) to 60-65 ft-lbs (81-88 Nm) and install **new** cotter pin (1).

Wheel Balancing

Wheel balancing is recommended to improve handling, and to reduce vibration, especially at high road speeds.

In most cases, static balancing using WHEEL TRUING STAND (Part No. HD-99500-80) will produce satisfactory results. However, dynamic balancing, utilizing a wheel spinner, can 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. (866 g) (total weight applied to the rim). Wheels should be balanced to within 1/2 oz. (14 g) at 60 m.p.h. (97 km/h).

Weights For Laced Wheels

Harley-Davidson specifies the following spoke balance weights, which are crimped over the spoke nipple.

Table 2-10. Laced Wheel Balance Weights

WEIGHT (MASS)		HD PART NUMBER
1/2 oz. (U.S.)	14 g	95578-41
3/4 oz. (U.S.)	21 g	95581-47
1 oz. (U.S.)	28 g	95582-47

Weights for Cast Wheels

Harley-Davidson specifies the following cast wheel balance weights, which have special self-adhesive backings.

Table 2-11. Cast Wheel Balance Weights

WEIGHT (MASS) oz. (U.S.)	grams	FINISH	HD PART NUMBER
1/4	7	black	95594-84
1/4	7	silver	95595-84

These weights are applied to the flat surface of the wheel rim according to the following procedures.

1. Make sure that area of application is completely clean, dry, and free of oil and grease.

NOTE

If 1 oz. (28 g) or more of weight must be added at one location, split the amount so that half is applied to each side of rim.

2. Remove paper backing from weight. Apply three drops of LOCTITE® SUPERBONDER® 420 to the adhesive side of the weight. Place the weight on flat surface of wheel rim. Press weight firmly in place, and hold for ten seconds.
3. Allow eight hours for adhesive to cure completely before using wheel.

GENERAL

The front and rear brakes are fully hydraulic disc brake systems that require little maintenance. The front brake master cylinder is an integral part of the brake hand lever assembly. The rear brake master cylinder is located on the right side of the motorcycle near the brake pedal. Check the master cylinder reservoirs for proper fluid levels every 5000 miles (8000 km). With the reservoir in a level position, add **Harley-Davidson D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID (P/N 99902-77)** until the fluid level is 1/8 in. (3.2 mm) from the top.

Check brake pads and discs for wear every 2500 miles (4000 km). Replace brake pads if friction material is worn to 1/16 in. (1.6 mm) or less.

Minimum brake disc thickness is stamped on side of disc. Replace any brake disc that is worn beyond this limit. For disc removal and installation procedures, see FRONT or REAR WHEEL.

Maximum brake rotor lateral runout and warpage is 0.008 in. (0.2 mm) when measured near the outside diameter.

⚠WARNING

Clean brake system components using denatured alcohol. Do not use mineral base cleaning solvents, such as gasoline or paint thinner. Use of mineral base solvents causes deterioration of rubber parts that continues after assembly and can result in component failure and/or death or serious injury.

- **Always test motorcycle brakes at low speed after servicing or bleeding system. Harley-Davidson recommends that all brake repairs be performed by a Harley-Davidson dealer or other qualified mechanic.**
- **ALWAYS KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. D.O.T. 5 SILICONE HYDRAULIC 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 accidently ingested, call a doctor immediately. Failure to do so could result in death or serious injury.**

TROUBLESHOOTING

Use the following troubleshooting guide to help in determining probable causes of poor brake operation.

Table 2-12. Troubleshooting Brakes

CONDITION	CHECK FOR	REMEDY
Excessive lever or pedal travel or spongy feel.	Air in system. Master cylinder low on fluid.	Bleed brake(s). Fill master cylinder with approved brake fluid.
Chattering sound when brake is applied.	Worn pads. Loose mounting bolts. Warped disc.	Replace brake pads. Tighten bolts. Replace disc.
Ineffective brake – lever or pedal travels to limit.	Low fluid level. Piston cup not functioning.	Fill master cylinder with approved brake fluid, and bleed system. Rebuild cylinder.
Ineffective brake – lever or pedal travel normal.	Distorted or glazed disc. Distorted, glazed or contaminated brake pads.	Replace disc. Replace pads.
Brake pads drag on disc – will not retract.	Cup, in master cylinder not uncovering relief port. Rear brake pedal linkage out of adjustment.	Inspect master cylinder. Adjust linkage.

GENERAL

See Figure 2-66. Master cylinders designed for dual disc (two caliper) operation have an 11/16 inch (17.5 mm) bore, while those that are designed for single disc (one caliper) operation have a 9/16 inch (14.3 mm) bore. The bore size is stamped on the master cylinder assembly inboard of the handlebar clamp bracket.

⚠WARNING

Do not use a 9/16 inch (14.3 mm) bore master cylinder assembly on dual disc (two caliper) models. Likewise, do not use an 11/16 inch (17.5 mm) 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 causing death or serious injury.

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.

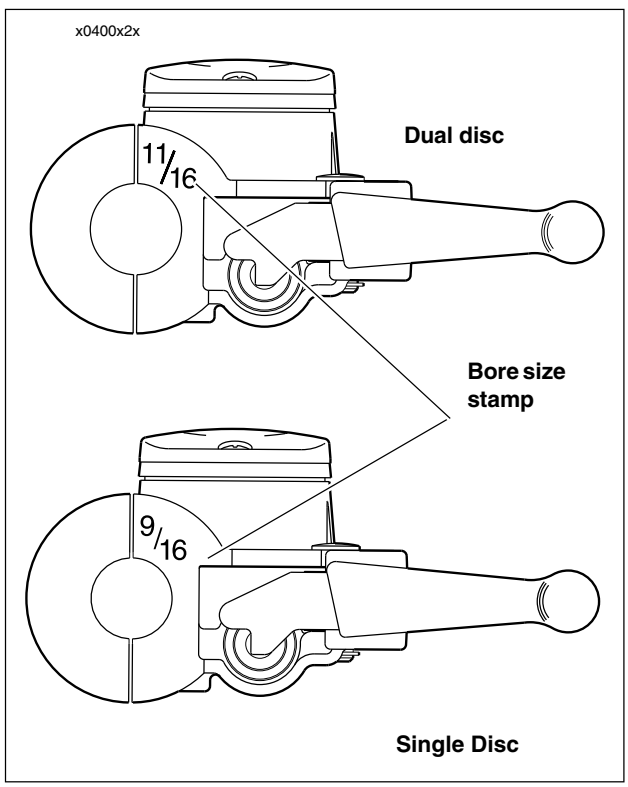


Figure 2-66. Verify Correct Bore Size Before Use

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 the 5/32 inch (4 mm) 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.

NOTE

Use the eyelet of an ordinary cable strap if the cardboard insert is not available.

3. See Figure 2-67. Place the cardboard insert between the brake lever and lever bracket.
4. See Figure 2-68. Using a T-27 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. Use the correct retaining ring pliers. Verify that the tips of the pliers are not excessively worn or damaged. Slippage may propel the ring with enough force to cause serious eye injury.

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

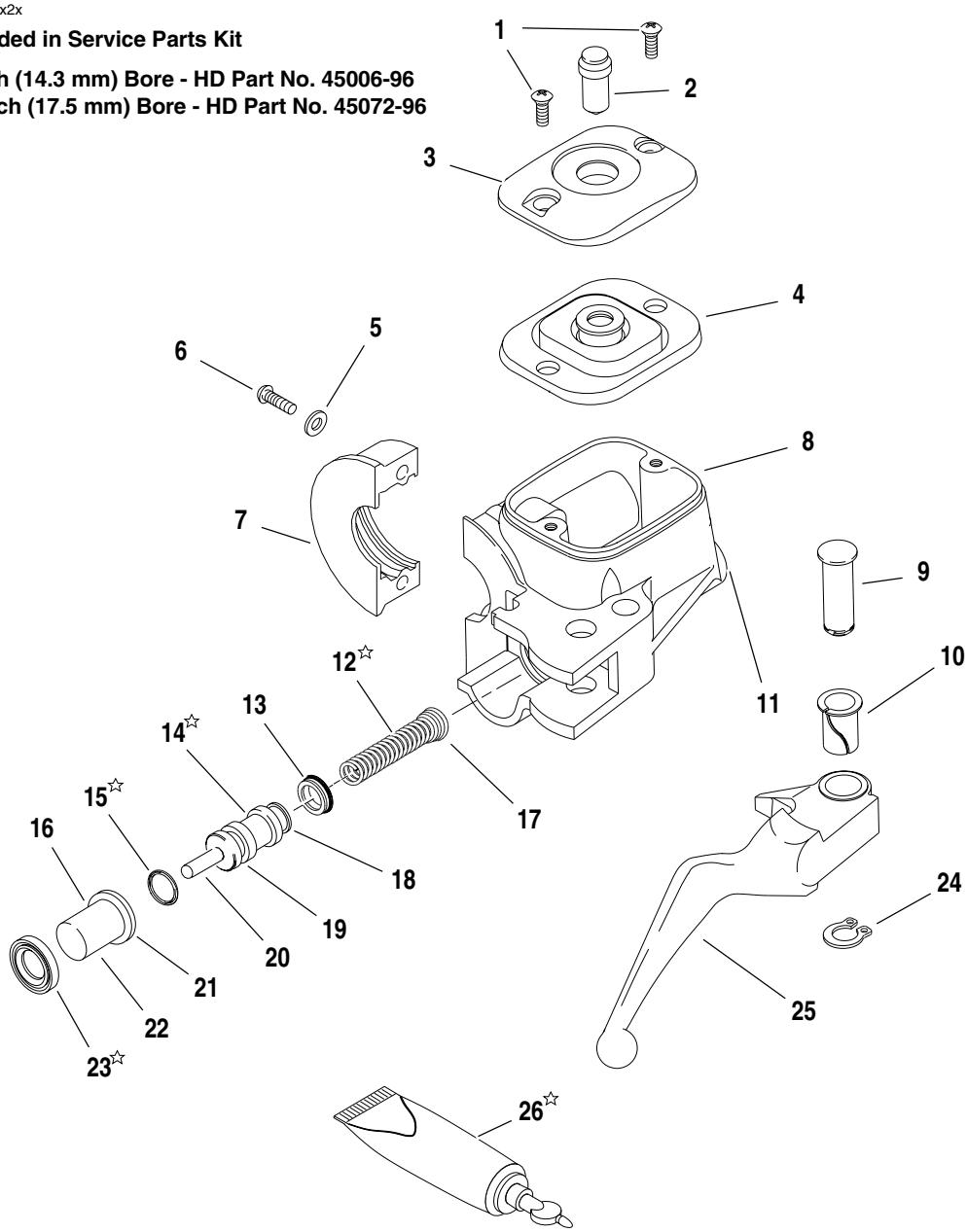
Figure 2-67. Install Cardboard Insert Before Removing Master Cylinder Assembly

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.

x0401x2x

☆ **Provided in Service Parts Kit**

9/16 Inch (14.3 mm) Bore - HD Part No. 45006-96
11/16 Inch (17.5 mm) Bore - HD Part No. 45072-96



1. Phillips screw
2. Site glass
3. Cover
4. Gasket
5. Washer
6. TORX screw
7. Handlebar clamp
8. Master cylinder reservoir
9. Pivot pin
10. Bushing
11. Brake line seating surface
12. Spring
13. Primary cup
14. Piston
15. O-ring
16. Piston cap
17. Flared end
18. Shoulder
19. O-ring groove
20. Pin
21. Shoulder
22. Flat side
23. Wiper
24. Retaining ring
25. Brake hand lever
26. Lubricant

Figure 2-68. Front Brake Master Cylinder Assembly

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, INSPECTION AND REPAIR

⚠WARNING

Do not use replacement parts from single caliper repair kits for 9/16 inch (14.3 mm) bore calipers on dual caliper models. Likewise, do not use replacement parts from dual caliper repair kits for 11/16 inch (17.5 mm) bore calipers on single caliper models. Parts are not interchangeable. Using the wrong replacement parts can adversely affect braking efficiency or result in brake failure causing death or serious injury.

1. Always reassemble the master cylinder using **new** parts from the correct repair kit: 9/16 inch (14.3 mm) bore - HD Part No. 45006-96; 11/16 inch (17.5 mm) 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 death or serious injury.

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 2-68. 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 counter bore (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 counter bore. 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. Use the correct retaining ring pliers. Verify that the tips of the pliers are not excessively worn or damaged. Slippage may propel the ring with enough force to cause serious eye injury.

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

CAUTION

See Figure 2-69. Do not install the master cylinder assembly without first placing the 5/32 inch (4 mm) 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 2-70. 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.
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.

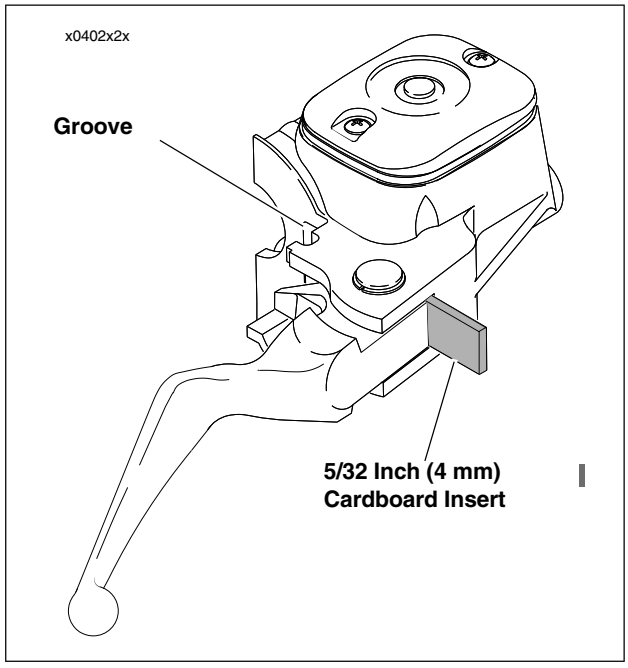


Figure 2-69. Install Cardboard Insert Before Installing Master Cylinder Assembly

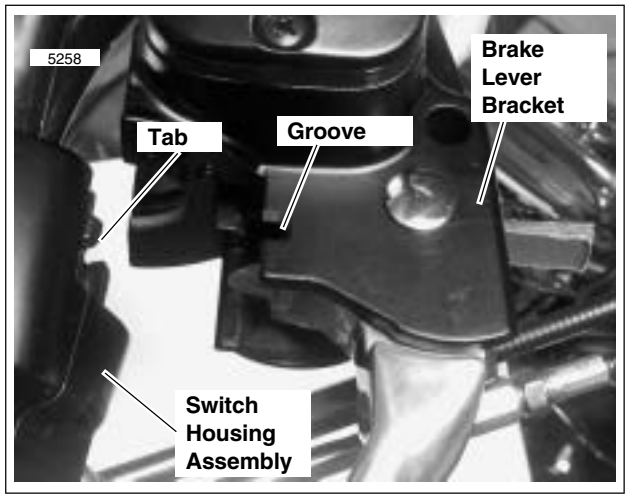


Figure 2-70. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

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.
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

Verify proper operation of the master cylinder relief port. A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible death or serious 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. Failure to do so could result in death or serious injury.

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

NOTES

ADJUSTMENT

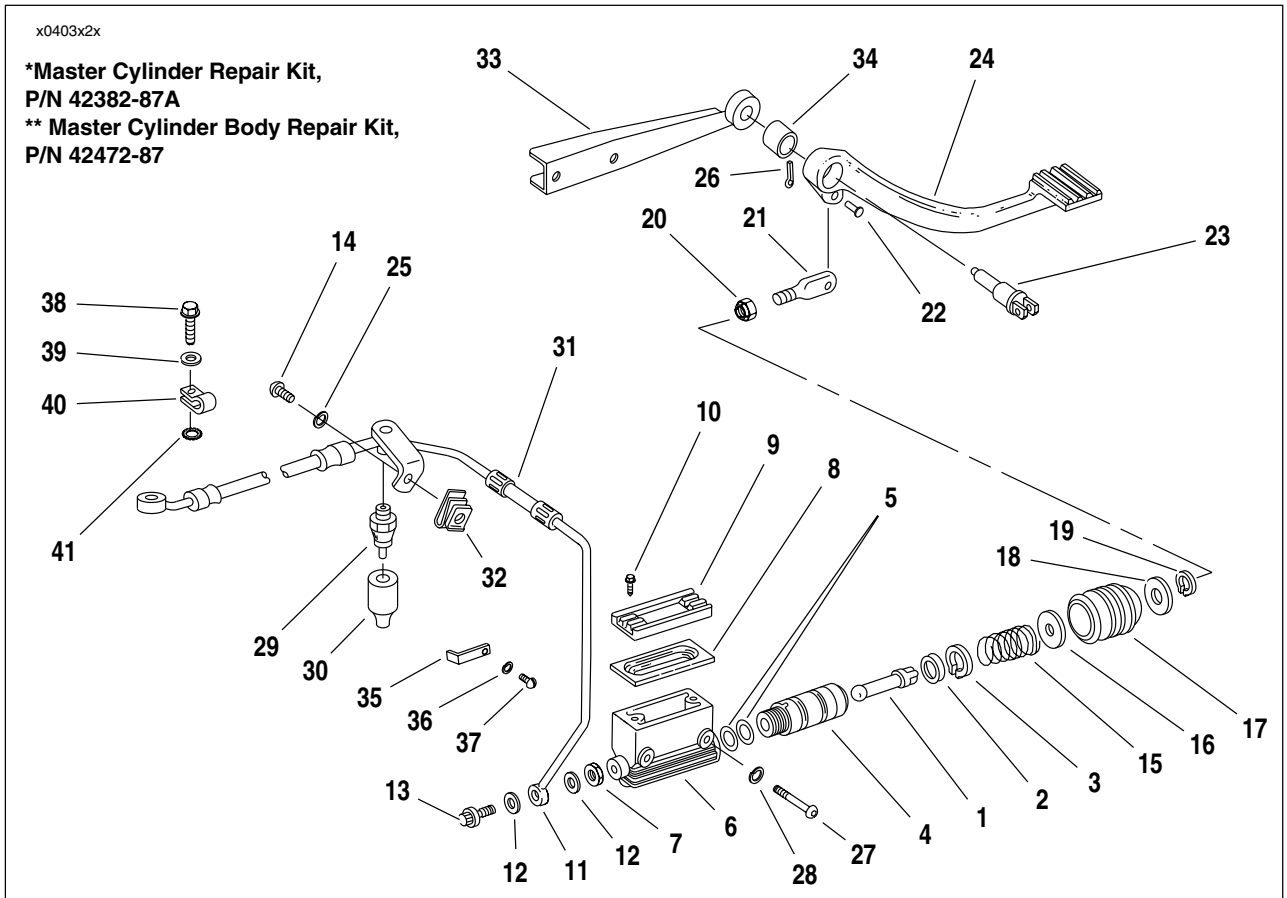
Brake Pedal

See Figure 2-71. Loosen locknut (20). With motorcycle on level surface, adjust push rod (1) so that brake pedal is parallel with floor (see Figure 2-72.). Tighten locknut.

REMOVAL/DISASSEMBLY

NOTE

See Figure 2-71. Do not disassemble the master cylinder unless problems are being experienced. Discard all seals during the disassembly procedure. Install a complete rebuild kit when the unit is assembled.



1. Push rod
2. Spacer *
3. Retaining ring *
4. Cartridge *
5. O-Ring (2) **
6. Master cylinder body **
7. Locknut
8. Gasket
9. Cover
10. Screw (2)
11. Banjo fitting
12. Steel/rubber washer (2)
13. Banjo bolt
14. Screw
15. Return spring
16. Spring retainer
17. Dust boot
18. Washer
19. Retaining ring
20. Locknut
21. Rod end
22. Pin
23. Footrest clevis
24. Brake pedal
25. Washer
26. Cotter pin
27. Socket screw (2)
28. Lock washer (2)
29. Stoplight switch
30. Rubber boot
31. Brake line
32. Clip nut
33. Master cylinder stiffener
34. Bushing
35. Clamp
36. Lock washer
37. Screw
38. Screw
39. Washer
40. Clamp
41. Lock washer

Figure 2-71. Rear Brake Master Cylinder and Linkage

1. See Figure 2-71. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake pedal (24) to drain brake fluid.

2. Remove screw (37) and lock washer (36) to detach brake line clamp (35) from sprocket cover. Remove banjo fitting bolt (13) and steel/rubber washers (12). Discard washers.

3. Lift banjo fitting (11) away from master cylinder (6). Remove two socket screws (27) and lock washers (28) holding master cylinder to sprocket cover. Loosen locknut (20). Turn push rod (1) at flats until free of rod end (21).

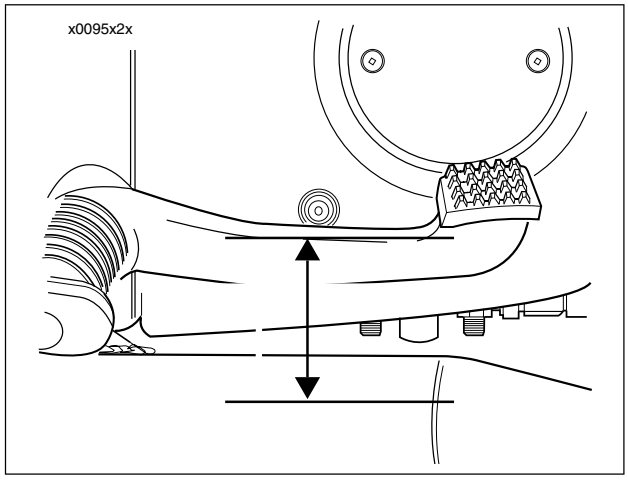


Figure 2-72. Rear Brake Pedal Adjustment

CAUTION

Do not press against banjo seating surfaces without taking precautions against damage.

4. Press down on large washer (18) to compress return spring (15). While spring is compressed, remove retaining ring (19) from push rod (1). Carefully release spring.

5. Remove washer (18), dust boot (17), spring retainer (16) and return spring (15).

6. Remove locknut (7). Pull cartridge and push rod assembly from master cylinder body (6). Remove retaining ring (3) from bore of cartridge (4). Pull the push rod (1) with spacer (2) free of cartridge. Remove two O-rings (5) from external grooves on cartridge; discard O-rings.

CAUTION

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

7. Remove master cylinder cover screws (10), cover (9) and cover gasket (8).

CLEANING, INSPECTION AND REPAIR

WARNING

Clean brake system components using denatured alcohol. DO NOT use mineral-base cleaning solvents, such as gasoline or paint thinner. Use of mineral-base solvents causes deterioration of rubber parts that continues after assembly and can result in improper and unsafe brake operation which may lead to death or serious injury.

NOTE

GE Silicone Versilube (G322L) grease is recommended for lubrication of seals prior to assembly.

1. See Figure 2-71. Thoroughly clean master cylinder and all brake system components. Examine walls of master cylinder reservoir for scratches and grooves. Replace if damaged. Verify that vent holes in master cylinder are completely open and free of dirt or debris. Stand master cylinder on wooden block or towel to protect seating surfaces.
2. Inspect cover gasket (8) for cuts, tears or general deterioration. Replace as necessary.

ASSEMBLY/INSTALLATION

1. See Figure 2-71. Insert original push rod (1) into bore at unthreaded end of cartridge (4). Install spacer (2) over end of push rod. Install retaining ring (3) in groove next to spacer inside cartridge bore. Slide two **new** O-rings (5) into external grooves on cartridge (4). Insert cartridge into master cylinder body (6). Align slot at top of cartridge with key in master cylinder body. Push cartridge through master cylinder body until cartridge bottoms in bore. Install locknut (7). Tighten locknut to 30-40 ft-lbs (41-54 Nm).
2. Place protective shields over vise jaws and lightly clamp master cylinder body in vise with push rod (1) upright.
3. Place return spring (15) over push rod (1). Place spring retainer (16) on top of spring. Slip large I.D. end of dust boot (17) over retainer and spring. Seat the small I.D. end of boot against spring retainer (16). Be sure vent/drain hole in boot is at the bottom.
4. Place washer (18) on top of boot. Push down on washer to compress spring (15). With spring compressed, install **new** retaining ring (19) in groove of push rod (1).

CAUTION

To avoid leakage after assembly, verify that washers (12), bolt (13), banjo fitting (11) and bore of master cylinder (6) are completely clean.

5. Position master cylinder next to sprocket cover. Position **new** steel/rubber washers (12) on each side of banjo fitting (11). Insert bolt (13) through washers and banjo fitting. Thread bolt into cartridge and tighten to 17-22 ft-lbs (23-30 Nm).
6. Position large I.D. end of dust boot (17) into groove in master cylinder body (6).
7. Install clamp (35), screw (37) and lock washer (36) to secure rear brake line (31) to sprocket cover. Tighten clamp screw to 45-65 **in-lbs** (5-7 Nm).
8. Install exhaust pipes. Install **new** locknut at exhaust support bracket. Tighten to 20-40 ft-lbs (27-54 Nm).
9. Turn push rod (1) at flats to thread on rod end (21).
10. Position master cylinder body (6) over mounting holes in sprocket cover. Secure with screws (27) and lock washers (28). Tighten screws to 155-190 **in-lbs** (17.5-21.5 Nm).
11. Install footrest assembly.
12. Adjust push rod until brake pedal is parallel with floor, as shown in Figure 2-72. Tighten locknut (20).
13. With the master cylinder in a level position, verify that the brake fluid level in the reservoir is 1/8 in. (3.2 mm) from the top. Add **Harley-Davidson D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID (P/N 99902-77)** if necessary.

⚠WARNING

Verify proper operation of the master cylinder relief port. A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and possible death or serious injury.

14. Verify proper operation of the master cylinder relief port. Actuate the brake pedal with the reservoir cover removed. A slight spurt of fluid will break the surface if all internal components are working properly.
15. Install cover gasket (8), cover (9) and screws (10).
16. Bleed brake system. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM.
17. Remove master cylinder cover (9). Verify proper fluid level- see Step 13.
18. Reinstall master cylinder cover. Tighten screws to 10-15 **in-lbs** (1.1-1.7 mm).
19. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.

REMOVAL

1. See Figure 2-73. Remove exhaust system. See 2.29 EXHAUST SYSTEM, REMOVAL.
2. Remove screw (9) and clip (10) to free rear brake line from sprocket cover (18).
3. Remove two socket head screws (5) and lock washers (6) to free rear brake master cylinder from sprocket cover (18).
4. Loosen locknut (8). Turn push rod (7) at flats until free of rod end (19).
5. Remove three sprocket cover screws (11) and washers (12). As a single assembly, remove sprocket cover (18), footrest mount (15), rear brake pedal (16) and master cylinder stiffener (17).
6. Remove cotter pin (13) and nut (14) from inboard side of sprocket cover. Discard cotter pin. Remove footrest mount, rear brake pedal and master cylinder stiffener.

INSTALLATION

1. Install removed components in the reverse order of the removal procedures, and in accordance with the following special installation instructions:

⚠WARNING

See Figure 2-73. Footrest mount must be installed in the orientation which allows footrest to fold toward rear of motorcycle. This angle allows footrest to fold up if it strikes the ground when making a turn. Failure to set footrest to the proper fold-up angle could result in death or serious injury.

1. Tighten footrest mount nut (14) to 35-40 ft-lbs (47-54 Nm).
2. Install a **new** cotter pin (13) through nut (14) and footrest mount (15). Bend ends of cotter pin outward to secure.
3. Tighten three sprocket cover screws (11) to 90-110 **in-lbs** (10.2-12.4 Nm).
4. Tighten two master cylinder screws (5) to 155-190 **in-lbs** (17.5-21.5 Nm).
5. Adjust rear brake pedal. See 2.16 REAR BRAKE MASTER CYLINDER, ADJUSTMENT, Brake Pedal.
6. Install exhaust system. See 2.29 EXHAUST SYSTEM, INSTALLATION.

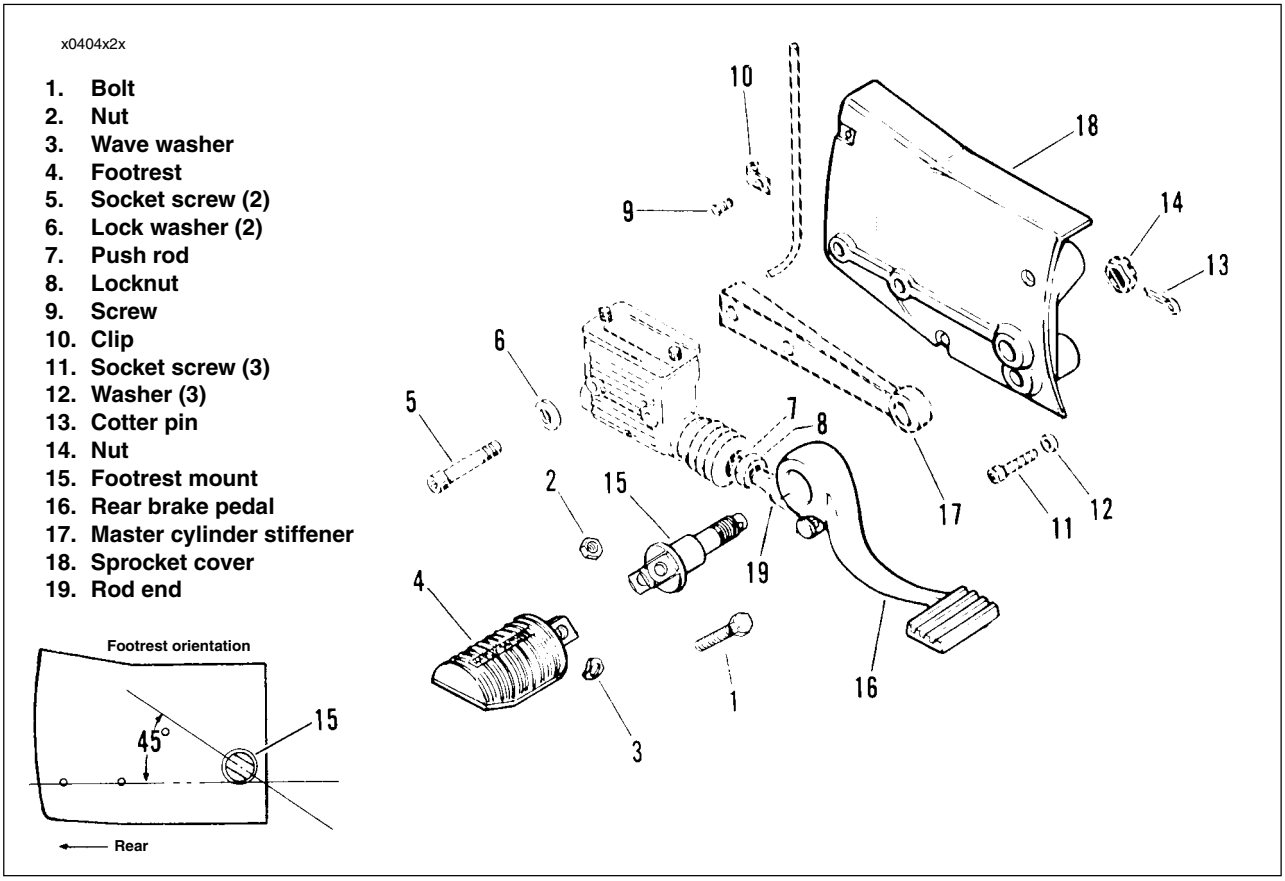


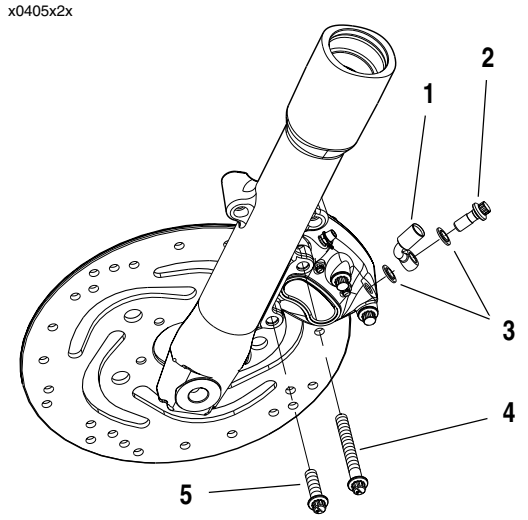
Figure 2-73. Footrest Mounting, Rear Brake Linkage and Sprocket Cover

REMOVAL

CAUTION

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

1. See Figure 2-74. Remove the banjo bolt (2) and both steel/rubber washers (3) to detach front brake line (1) from caliper. Discard washers.



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

Figure 2-74. Front Caliper Mount

2. Remove both the upper (4) and lower (5) mounting bolts (12 pt/10 mm). Lift caliper upward to remove from brake disc.

DISASSEMBLY

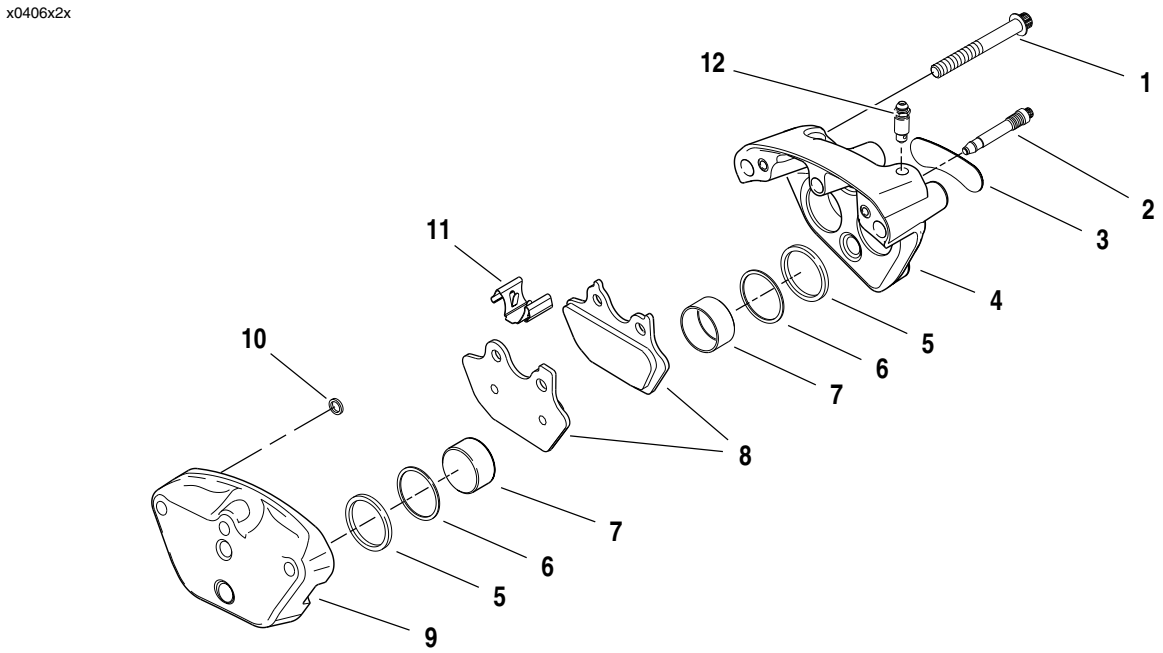
NOTE

Use brake caliper piston remover specialty tool (Part No. HD-43293) for front brake caliper disassembly.

1. See Figure 2-75. Remove pad pins (2) (12 pt/0.25 in.), brake pads (8) and bridge bolts (1) (12 pt/10 mm) to separate caliper housings (4, 9).
2. Remove anti-rattle spring (11). If necessary, remove bleeder valve (12).

⚠WARNING

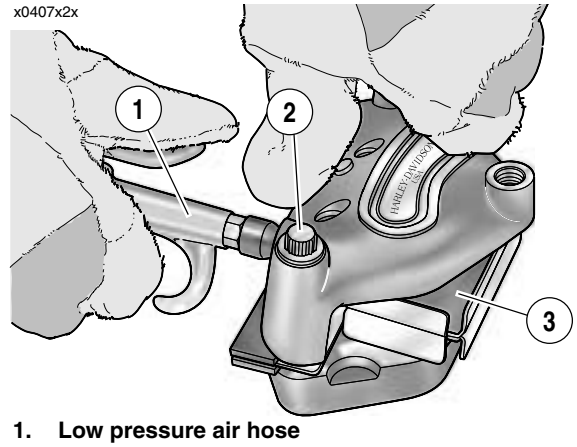
Low pressure compressed air can blow debris into your face and eyes. Always wear eye protection or a face shield when using pressurized air. Failure to take adequate safety precautions could result in death or serious injury.



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

Figure 2-75. Front Brake Caliper

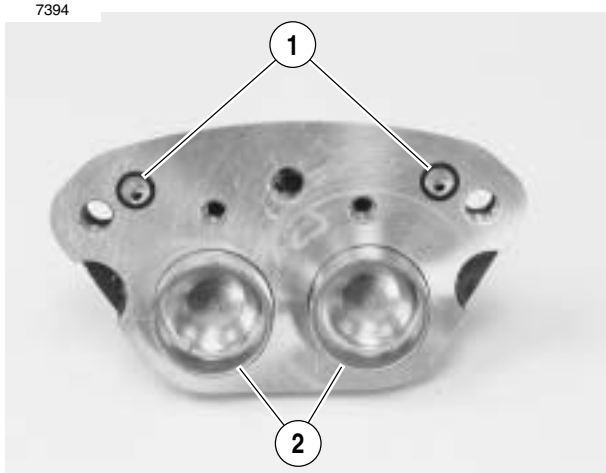
3. See Figure 2-76. Remove pistons.
   a. Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293) between caliper housings.
   b. Insert two bridge bolts (2) (12 pt/10 mm) and tighten securely.
   c. If the bleeder valve was removed, loosely reinstall or place a gloved finger over the bleeder valve hole on the outside caliper housing.
   d. Apply low pressure compressed air (1) to banjo bolt hole to remove pistons from caliper bores.
   e. Remove bridge bolts and remove tool.



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

Figure 2-76. Removing Pistons

4. See Figure 2-77. Remove and discard both crossover O-rings (1) from inside caliper housing.



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

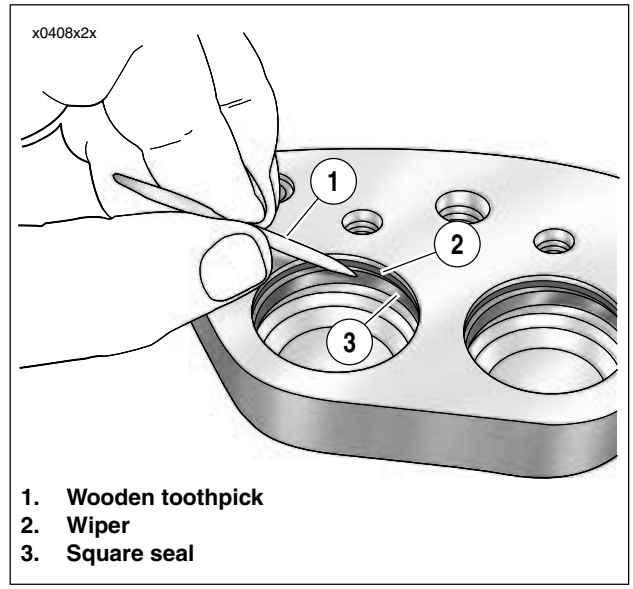
Figure 2-77. Crossover O-rings and Inside Housing

5. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

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

6. See Figure 2-78. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



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

Figure 2-78. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

⚠WARNING

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

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

⚠WARNING

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

4. Inspect brake pads and brake disc.

ASSEMBLY

CAUTION

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

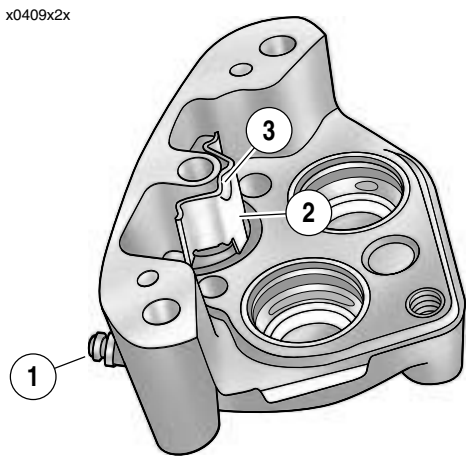
1. Lubricate the following parts prior to assembly using a light coat of G.E. VERSILUBE® #G322 L SILICONE GREASE (marked “Piston Lube”) from the service parts kit. All other surfaces must be dry for assembly.
   a. Lubricate nose radius and outside diameter of piston. Apply lube to inside of caliper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

CAUTION

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

2. See Figure 2-78. Install a **new** square seal (3) and a **new** wiper (2) into each piston bore.
3. Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
4. See Figure 2-77. Place two **new** crossover O-rings (1) on inside caliper housing.

5. Assemble caliper housings.
   a. See Figure 2-79. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm).
   b. Place outside caliper housing on workbench with decal side down. Install anti-rattle clip (2) in channel with indent (3) facing upwards.
   c. Verify that **new** crossover O-rings are installed on inside caliper housing.
   d. Mate inside and outside caliper housings using bridge bolts (12 pt/10 mm). Place one bridge bolt in the middle hole and one next to the bleeder valve. Loosely install bridge bolts.
   e. Check that anti-rattle spring is still seated between caliper housings.
   f. Tighten bridge bolts to 28-38 ft-lbs (38.0-51.5 Nm).

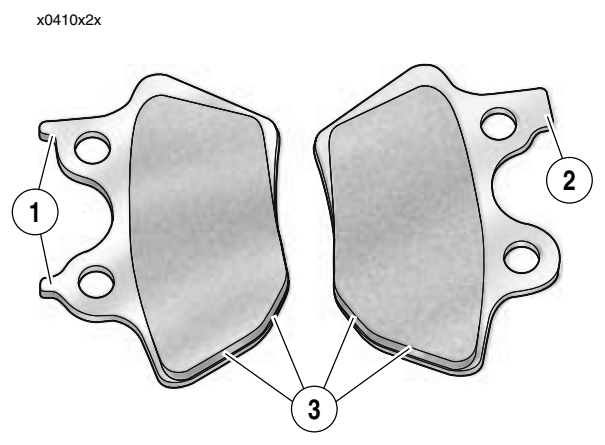


1. Bleeder valve
2. Anti-rattle clip
3. Indent

Figure 2-79. Front Caliper Anti-rattle Clip

NOTE

The front left, front right (not present on all vehicles) and rear brake calipers use the same exact brake pad set.



1. Two tabs on backing plate
2. Single square tab on backing plate
3. Curved portion

Figure 2-80. Brake Pad Alignment

- *On the right side of the vehicle, the pad with two tabs (1) installs on the inboard side of the caliper.*
- *On the left side of the vehicle, the pad with two tabs (1), installs on the outboard side of the caliper.*

6. Insert one set of brake pads into caliper with friction material on pad facing opening for brake disc. Curved portion of pad must face rear of motorcycle when caliper is installed.
7. Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 **in-lbs** (20.3-22.6 Nm).

NOTES

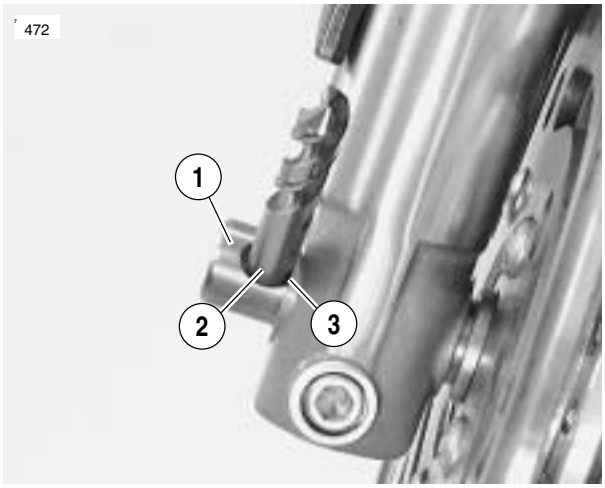
If pad pins do not fit, check the following:

- *You are using a set of pads, not two identical pads.*
- *Anti-rattle clip orientation matches Figure 2-79.*

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

INSTALLATION

1. See Figure 2-81. If servicing a vehicle with a single front brake caliper, advance to the next step. On models with dual front brakes, align calipers to brake discs.
   a. Tighten axle nut to 50-55 ft-lbs (67.8-74.6 Nm).
   b. Loosen axle pinch bolt nuts.
   c. Insert 7/16 in. drill bit (2) into hole in axle (1) as far as it will go.
   d. Position fork leg against edge of drill bit. Contact point (3) must the have edge of drill bit touching the edge of fork leg.
   e. Tighten axle pinch bolt nuts to 25-30 ft-lbs (33.9-40.7 Nm) and withdraw drill bit.



1. Axle
2. Drill bit
3. Contact point

Figure 2-81. Dual Brake Disc Alignment

2. See Figure 2-74. Attach caliper to fork leg.
   a. Place caliper over brake disc with bleeder valve facing upwards.
   b. Loosely install long mounting bolt (4) (12 pt/10 mm) into top hole on fork leg.
   c. Install short mounting bolt (5) (12 pt/10 mm) into bottom hole on fork leg. Tighten bottom mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).

Final tighten the top mounting bolt to 28-38 ft-lbs (38.0-51.5 Nm).

CAUTION

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

3. Lubricate **new** steel/rubber washers with D.O.T. 5 SILICONE BRAKE FLUID. Connect the brake line (1) to caliper using two **new** steel/rubber washers (3) and banjo bolt (2). Tighten to 17-22 ft-lbs (23.0-29.8 Nm).
4. Remove cover from front brake master cylinder. Fill master cylinder with D.O.T. 5 SILICONE BRAKE FLUID. Verify that fluid level is 1/8 in. (3.2 mm) below top of reservoir with master cylinder in a level position.

WARNING

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

5. Bleed brake system. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM.

WARNING

Verify proper operation of the master cylinder relief port. A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and could result in death or serious injury.

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

WARNING

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

9. Test brake system.
   a. Turn ignition switch ON. Pump brake hand lever to verify operation of the brake lamp.
   b. Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM.

NOTE

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

REMOVAL

NOTE

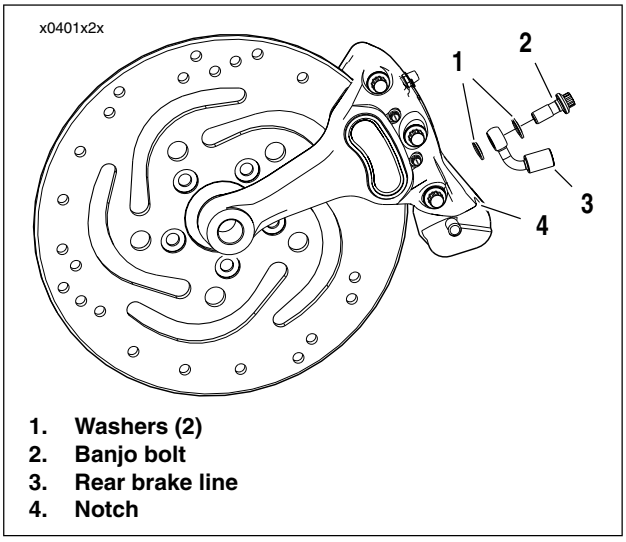
If only replacing brake pads, do not remove rear brake caliper.

1. If present, remove right saddlebag.

CAUTION

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

2. See Figure 2-82. Remove the banjo bolt (2) and both steel/rubber washers (1) to detach rear brake line (3) from caliper. Discard washers.



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

Figure 2-82. Rear Caliper Mount

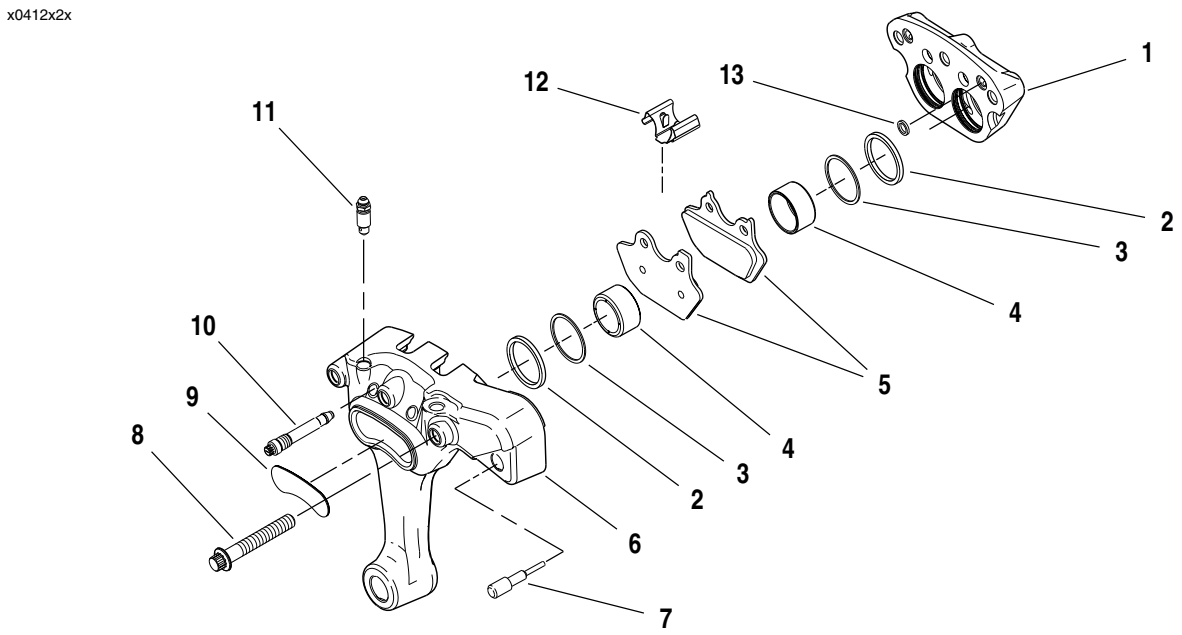
3. Pull axle from rear wheel.
4. Lift rear caliper away from axle and rear fork. Notch (4) in caliper mount must clear tab on rear fork.

DISASSEMBLY

NOTE

Use brake caliper piston remover specialty tool (Part No. HD-43293) for front brake caliper disassembly.

1. See Figure 2-83. Remove pad pins (10) (12 pt/0.25 in.), brake pads (5) and bridge bolts (8) (12 pt/10 mm) to separate caliper housings (1, 6).
2. Remove anti-rattle spring (12). If necessary, remove bleeder valve (11).
3. If necessary, cut rubber bumper (7) to remove.



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

Figure 2-83. Rear Brake Caliper

4. See Figure 2-84. Remove pistons.

   a. Place BRAKE CALIPER PISTON REMOVER (3) (Part No. HD-43293) between caliper housings.

   b. Insert three bridge bolts (2) (12 pt/10 mm) and tighten securely.

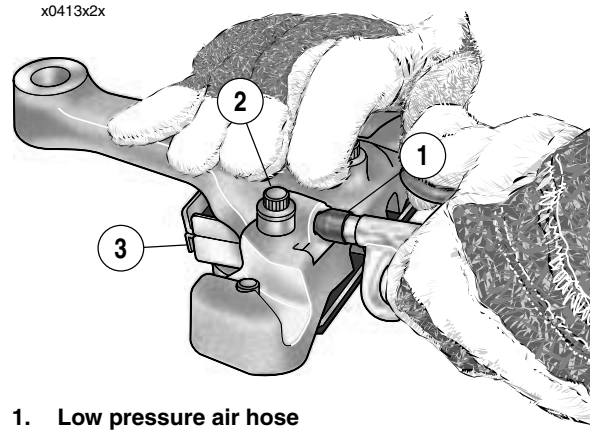
   c. If the bleeder valve was removed, loosely reinstall or place a gloved finger over the bleeder valve hole on the outside caliper housing.

⚠WARNING

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

   d. Apply low pressure compressed air (1) to banjo bolt hole to remove pistons from caliper bores.

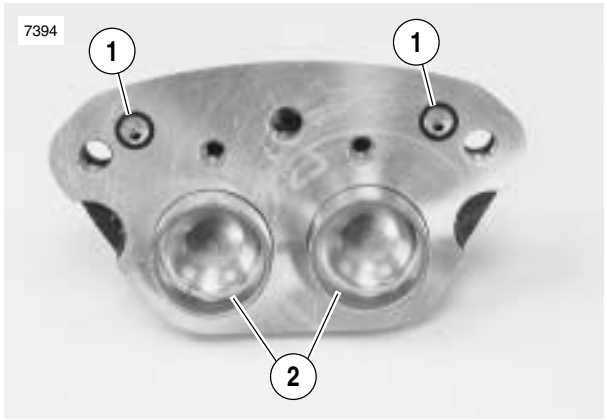
   e. Remove bridge bolts and remove tool.



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

Figure 2-84. Removing Pistons

5. See Figure 2-85. Remove and discard both crossover O-rings (1) from inside caliper housing.



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

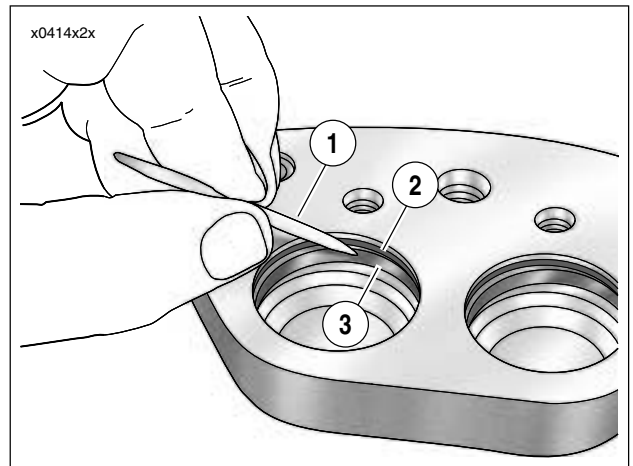
Figure 2-85. Crossover O-rings and Inside Housing

6. If necessary, wiggle pistons (2) from caliper bores to completely remove.

CAUTION

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

7. See Figure 2-86. Using a wooden toothpick (1), remove a wiper (2) and square seal (3) from each caliper bore. Discard all removed parts.



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

Figure 2-86. Wipers and Square Seals

CLEANING, INSPECTION AND REPAIR

⚠WARNING

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

1. Clean all parts with denatured alcohol or Harley-Davidson D.O.T. 5 SILICONE BRAKE FLUID. Do not contaminate with mineral oil or other solvents. Wipe parts dry with a clean, lint free cloth. Blow out drilled passages and bore with a clean air supply. Do not use a wire or similar instrument to clean drilled passages.
2. Carefully inspect all components. Replace any parts that appear damaged or worn.
   a. Check pistons for pitting, scratches or corrosion on face and also on ground surfaces.
   b. Inspect caliper piston bore. Do not hone bore. If bore should show pitting or corrosion, replace caliper.
   c. Always replace wipers, square seals and crossover O-rings after disassembly.
3. If decal on outside housing is removed, scrape remaining adhesive from surface with a razor blade.

⚠WARNING

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

4. Inspect brake pads and brake disc.

ASSEMBLY

CAUTION

Do not use D.O.T. 5 brake fluid for lubrication. Use of D.O.T. 5 brake fluid will result in increased lever effort.

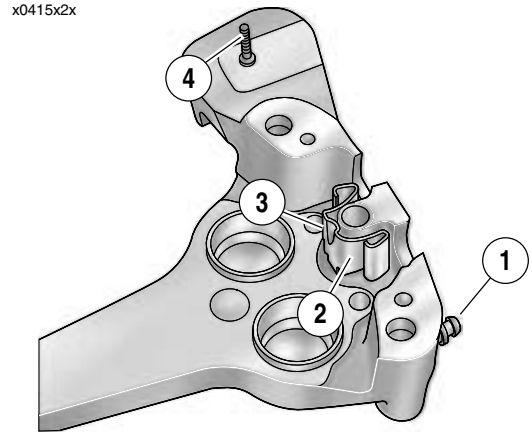
1. Lubricate the following parts prior to assembly using a light coat of G.E. VERSILUBE® #G322 L SILICONE GREASE (marked “Piston Lube”) from the service parts kit. All other surfaces must be dry for assembly.
   a. Lubricate nose radius and outside diameter of piston. Apply lube to inside of caliper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

CAUTION

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

2. See Figure 2-86. Install a **new** square seal (3) and a **new** wiper (2) into each piston bore.

3. Carefully insert pistons by hand into bores of inside and outside caliper housings. If installation shows resistance, remove piston and check that seals and wipers are properly installed.
4. See Figure 2-85. Place two **new** crossover O-rings (1) on inside caliper housing.
5. Assemble caliper housings.
   a. See Figure 2-87. Install bleeder valve (1) on outside caliper housing if removed. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm).
   b. Place outside caliper housing on workbench with decal side down. Install anti-rattle clip (2) in channel with indent (3) facing upwards.
   c. Verify that **new** crossover O-rings are installed on inside caliper housing.
   d. Mate inside and outside caliper housings using three bridge bolts (12 pt/10 mm). Loosely install bridge bolts.
   e. Check that anti-rattle spring is still seated between caliper housings.
   f. Tighten bridge bolts to 28-38 ft-lbs (38.0-51.5 Nm).
   g. If rubber bumper (4) on outside housing was removed, lubricate **new** part before installation.

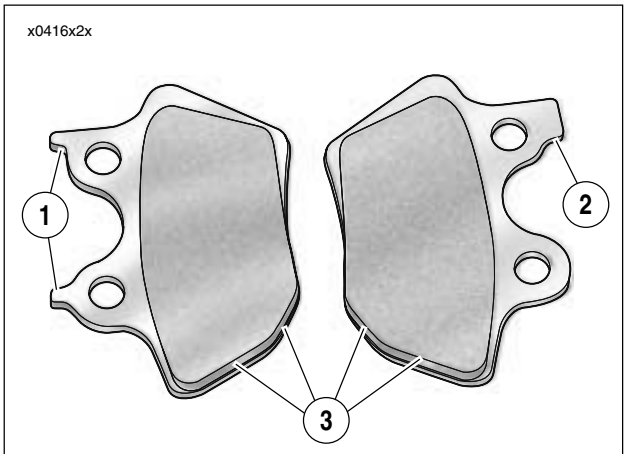


1. **Bleeder valve**
2. **Anti-rattle clip**
3. **Indent**
4. **Rubber bumper**

Figure 2-87. Anti-rattle Clip

NOTE

See Figure 2-88. The front left, front right (not present on all vehicles) and rear brake calipers use the same exact brake pad set. Install pad with two tabs (1) on the inboard side of the rear caliper.



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

Figure 2-88. Brake Pad Alignment

6. Insert one set of brake pads into caliper with friction material on pad facing opening for brake disc. Curved portion of pad must face rear of motorcycle when caliper is installed.
7. Install pad pins. Pad pins will give an audible click when inserted into inside housing. Tighten both pad pins to 180-200 **in-lbs** (20.3-22.6 Nm).

NOTES

- *If pad pins do not fit, check the following:*
- *You are using a set of pads, not two identical pads.*
- *Anti-rattle clip orientation matches Figure 2-87.*
- *Pads must be pushed tight against the anti-rattle clip before the pad pins can be installed.*

INSTALLATION

1. See Figure 2-82. Place caliper on rear axle with notch (4) inside rear fork tab. Verify that the rubber bumper is contacting the underside of the caliper mount for the full length of the bumper. Install rear axle and check drive belt tension. See 6.3 SECONDARY DRIVE BELT.

CAUTION

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

2. Lubricate **new** steel/rubber washers with Harley-Davidson D.O.T. 5 SILICONE BRAKE FLUID. Connect the brake line (3) to caliper using two **new** washers (1) and banjo bolt (2). Tighten to 17-22 ft-lbs (23.0-29.8 Nm).
3. Remove cover from rear brake master cylinder. Fill master cylinder with Harley-Davidson D.O.T. 5 SILICONE BRAKE FLUID. Verify that fluid level is 1/8 in. (3.2 mm) below top of reservoir with master cylinder in a level position.

⚠WARNING

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

4. Bleed brake system. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM.

⚠WARNING

Verify proper operation of the master cylinder relief port. A plugged or covered relief port can cause brake drag or lockup, which may result in loss of vehicle control and could result in death or serious injury.

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

⚠WARNING

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

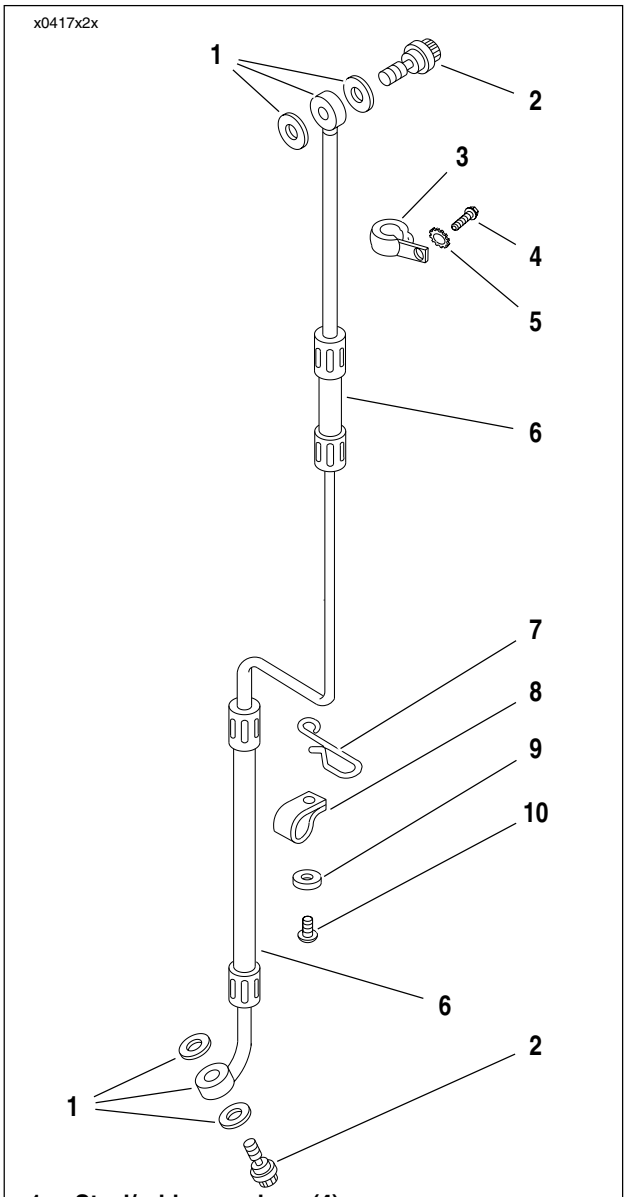
8. Test brake system.
   a. Turn ignition switch ON. Pump brake pedal to verify operation of the brake lamp.
   b. Test ride the motorcycle. If the brakes feel spongy, bleed the system again. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM.

NOTE

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

FRONT BRAKE LINE

1. See Figure 2-89. Open bleeder nipple cap on front brake caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake lever to drain brake fluid.
2. Remove screw (4) and lock washer (5) to detach brake line clamp (3) from front fork upper bracket (right side).
3. Remove socket head screw (10), flat washer (9), clamp (8) and wire form (7) to detach brake line from stem at bottom of front fork lower bracket.
4. Remove banjo fitting bolt (2) and steel/rubber washers (1) to detach brake line from master cylinder body. Discard washers.
5. Remove banjo fitting bolt (2) and steel/rubber washers (1) to detach brake line from front brake caliper. Discard washers.
6. Carefully inspect the brake line for dents, cuts or other defects. Replace the brake line if any damage is noted.
7. Note that one end of the brake line is mostly thin tube construction, while the other end is flexible hose. Position **new** steel/rubber washers (1) on each side of the banjo fitting on the tube side. Insert bolt (2) through washers and banjo fitting. Loosely install bolt into master cylinder.
8. From the master cylinder, the brake line runs downward in front of the right handlebar, where it turns inboard at the front fork upper bracket. Loosely install clamp (8), lock washer (5) and screw (10) to attach front brake line to right side of front fork upper bracket.
9. Continue running the brake line downward crossing to the left side of the vehicle under the front fork lower bracket (triple tree).
10. Loosely install wire form (7), clamp (8), flat washer (9) and socket head screw (10) to attach brake line to stem at bottom of front fork lower bracket.



1. **Steel/rubber washers (4)**
2. **Banjo fitting bolt (2)**
3. **Clamp**
4. **Screw**
5. **Lock washer**
6. **Flexible hose**
7. **Wire form**
8. **Clamp**
9. **Flat washer**
10. **Screw**

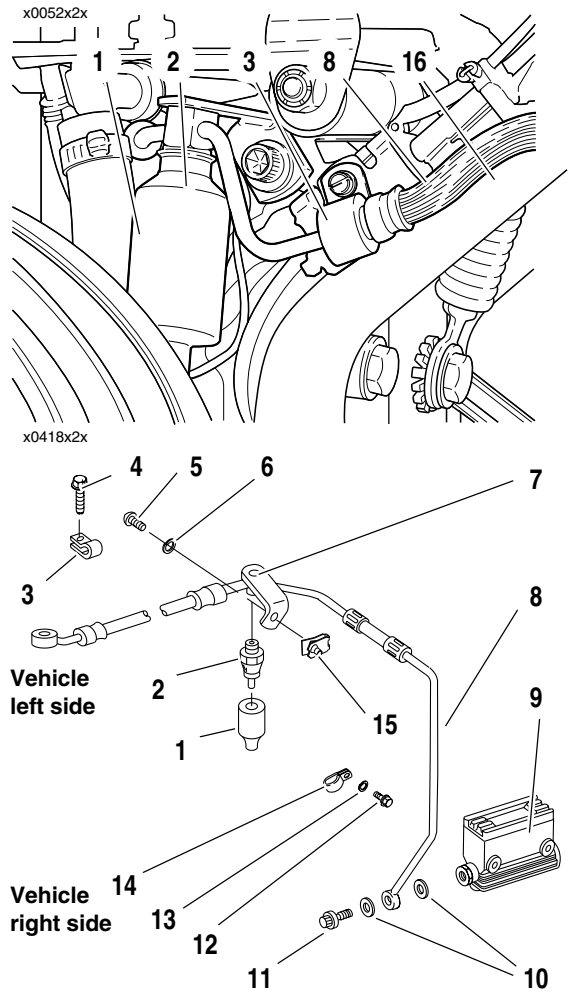
Figure 2-89. Front Brake Line

11. Position **new** steel/rubber washers (1) on each side of banjo fitting at free end of brake line. Insert bolt (2) through washers and banjo fitting. Loosely install bolt into caliper.
12. Tighten clamp screw (10) at bottom of front fork lower bracket to 48-120 **in-lbs** (5.4-13.6 Nm).
13. Tighten banjo fitting bolt (2) into master cylinder to 17-22 ft-lbs (23-30 Nm).
14. Tighten banjo fitting bolt into brake caliper to 17-22 ft-lbs (23-30 Nm).
15. Tighten clamp screw (4) to front fork upper bracket to 15-21 **in-lbs** (1.7-2.4 Nm).
16. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM. Test operation of brake lever.
17. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm). Install bleeder cap.
18. Test operation of brake lamp with the front brake applied and the ignition/light switch turned ON.

REAR BRAKE LINE

1. See Figure 2-90. Open bleeder nipple cap on rear caliper. Install end of a length of plastic tubing over caliper bleeder valve, while placing free end in a suitable container. Open bleeder valve about 1/2-turn. Pump brake pedal to drain brake fluid.
2. Remove screw (12) and lock washer (13) to detach brake line clamp (14) from sprocket cover. Remove banjo fitting bolt (11) and steel/rubber washers (10) to detach brake line (8) from master cylinder body (9). Discard washers.
3. Remove banjo fitting bolt and steel/rubber washers to detach brake line from rear brake caliper. Discard washers.
4. Remove screws (4) to detach brake line clamps (3) from swing arm and frame downtube (16).
5. Remove screw (5) and lock washer (6) securing integral brake line clamp (7) to clip nut (15) on flange of frame downtube. Pull terminal sockets from spade connections at bottom of stoplight switch. Unthread switch from tee nut. Remove rubber boot (1).
6. From left side of vehicle, feed **new** brake line beneath oil feed hose, left (forward) of negative battery cable and right (rearward) of positive battery cable to right side of vehicle.
7. Thread stoplight switch (2) to tee nut of brake line. Tighten switch assembly to 84-120 **in-lbs** (9.5-13.6 Nm). Install boot (1) on stoplight switch. Install terminal sockets on switch spade connections.
8. Install clamp (14), screw (12) and lock washer (13) to secure rear brake line (8) to sprocket cover. Tighten clamp screw to 45-65 **in-lbs** (5-7 Nm).
9. Install clamps (3), screws (4), to secure rear brake line to swing arm and frame downtube (16). Tighten clamp screws to 15-21 **in-lbs** (1.7-2.4 Nm).

10. Install clip nut (15) on flange of frame downtube. Install screw (5) and lock washer (6) to secure integral brake line clamp (7) to frame downtube flange. Tighten screw to 5-10 ft-lbs (7-14 Nm).
11. Position **new** steel/rubber washers (10) on each side of banjo fitting. Insert bolt (11) through washers and banjo fitting. Thread bolt into master cylinder and tighten to 17-22 ft-lbs (23-30 Nm).
12. Position **new** steel/rubber washers on each side of banjo fitting. Insert bolt through washers and banjo fitting into caliper. Tighten banjo fitting bolt to 17-22 ft-lbs (23-30 Nm).
13. Install bleeder valve if removed. Refill master cylinder and bleed brakes. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM. Test operation of rear brake.
14. Tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm). Install bleeder cap.
15. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.



1. **Rubber Boot**
2. **Stoplight Switch**
3. **Clamp (2)**
4. **Screw (2)**
5. **Screw**
6. **Lock washer**
7. **Integral Brake line Clamp**
8. **Brake Line**
9. **Master Cylinder Body**
10. **Steel/Rubber Washers**
11. **Banjo Fitting Bolt (2)**
12. **Screw**
13. **Lock washer**
14. **Clamp**
15. **Clip Nut**
16. **Frame Downtube**

Figure 2-90. Rear Brake Line

GENERAL

See Figure 2-91. Bleed the hydraulic brake system anytime a hydraulic brake line, brake master cylinder or brake caliper has been opened, or whenever brake lever/pedal operation feels “spongy.” Bleeding evacuates air from the system leaving only incompressible hydraulic fluid.

⚠WARNING

ALWAYS KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN. D.O.T. 5 SILICONE HYDRAULIC 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 accidently ingested, call a doctor immediately. Failure to do so could result in death or serious injury.

NOTE

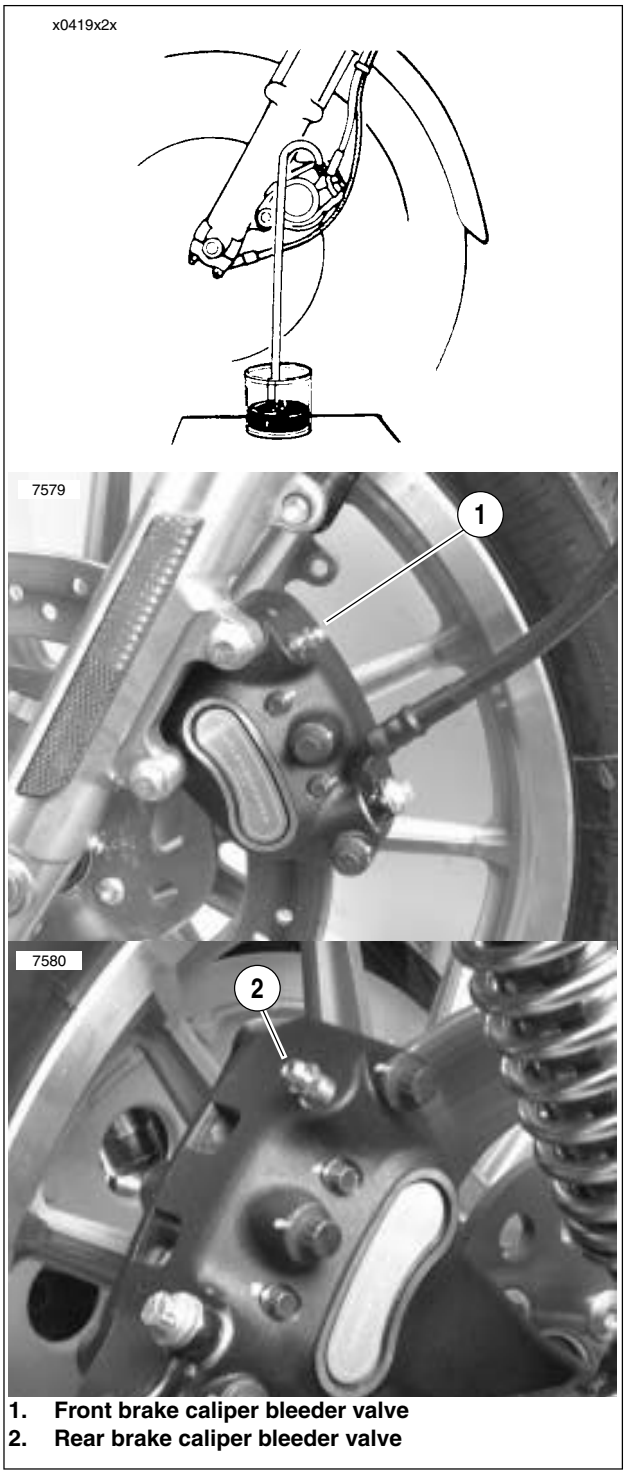
Hydraulic brake fluid bladder-type pressure equipment can be used to fill brake master cylinders through the bleeder valve. Remove master cylinder reservoir cover so that system cannot pressurize. Do not use pressure bleeding equipment when the hydraulic system is sealed with master cylinder reservoir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

1. Install end of a length of plastic tubing over caliper bleeder valve. Place free end of tube in a clean container. Stand motorcycle upright.
2. Add Harley-Davidson D.O.T. 5 SILICONE HYDRAULIC BRAKE FLUID to master cylinder reservoir until the fluid level is 1/8 in. (3.2 mm) from the top. Do not reuse brake fluid.
3. Depress and hold brake lever/pedal to build up hydraulic pressure.
4. Open bleeder valve about 1/2-turn. Brake fluid will flow from bleeder valve through tubing. Close bleeder valve when brake lever/pedal has moved 1/2 to 3/4 of its full range of travel. Allow brake lever/pedal to return slowly to its released position.
5. Repeat Steps 2-4 until all air bubbles are purged.
6. Final tighten bleeder valve to 80-100 **in-lbs** (9.0-11.3 Nm). Install bleeder cap. Add brake fluid to master cylinder reservoir until fluid level is about 1/8 in. (3.2 mm) from the top. Do not reuse brake fluid. Final tighten master cylinder reservoir cover screws to 10-15 **in-lbs** (1.1-1.7 Nm).

⚠WARNING

Always test motorcycle brakes at low speed after completing repairs or bleeding the system. Improper or unsafe brake operation could result in death or serious injury.

7. Test ride motorcycle. Repeat the above bleeding procedure if brakes feel spongy.



1. Front brake caliper bleeder valve
2. Rear brake caliper bleeder valve

Figure 2-91. Bleeding Hydraulic System

GENERAL

The front fork consists of two telescoping tube/slider assemblies. Each tube/slider assembly has an internal compression spring, which supports the forward weight of the vehicle/rider and extends and retracts to cushion the ride over rough or irregular road surfaces. An oil-filled damping mechanism controls the telescoping action of each tube/slider assembly.

Changing the Fork Oil

1. See Figure 2-92. Remove drain screw/washer (19) from bottom of one slider (16). Drain fork oil by repeatedly compressing front suspension.

NOTE

If fork oil is emulsified, aerated or light brown in color, then it has been contaminated by water. Replace fork oil seals (see Steps 1 and 2 of DISASSEMBLY procedure).

2. Repeat Step 1 for opposite side fork.

3. Block motorcycle under frame so that the front wheel is raised off the ground slightly; this enables front fork to extend fully and allows most of spring (5) preload (compression force) to be relieved.

⚠WARNING

Always wear safety glasses when servicing fork assemblies. Do not attempt to remove tube caps (7) from slider tubes (9) without first relieving spring (5) preload in the manner specified or tube caps and springs might fly outward with great force, possibly resulting in death or serious injury.

4. Remove tube cap (7) with O-ring (6) from each slider tube (9). Replace the O-ring if damaged or worn.

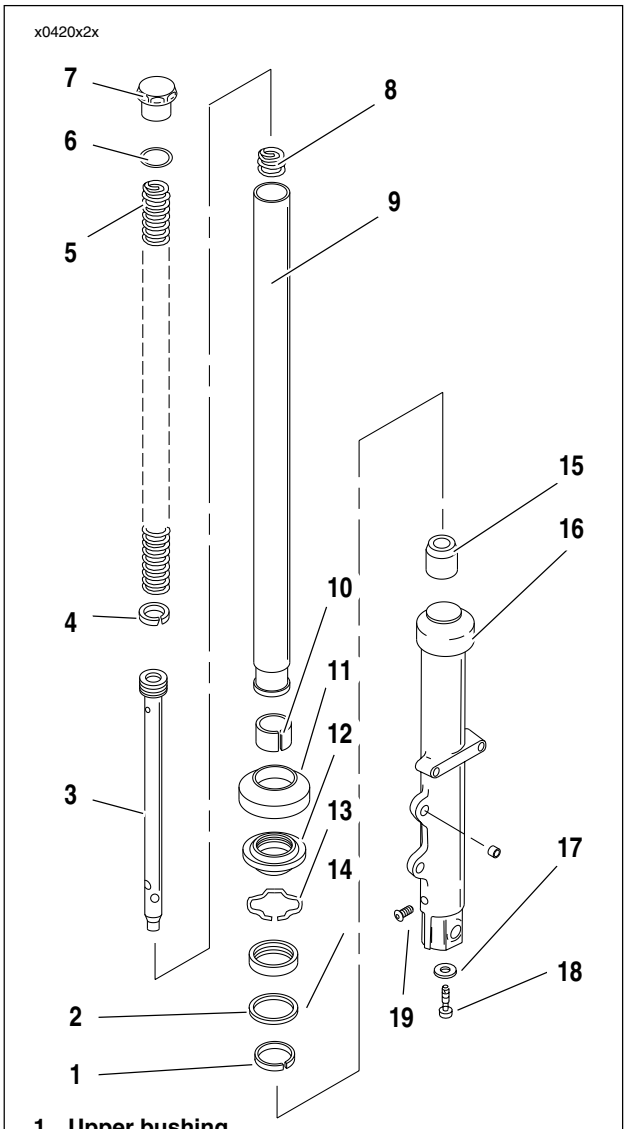
NOTE

A fork that has been disassembled, cleaned and reassembled is considered a "DRY" fork, since its internal components are completely free of oil. A fork that has just been drained of oil, but has not been disassembled and cleaned, is considered a "WET" fork, since its internal components remain coated with a quantity of residual oil. A DRY fork requires more replacement oil than a WET fork.

5. On all models, except XL1200S Sport fill each slider tube/slider assembly with 9.0 fl oz. (266 ml) (WET fork) or 10.2 fl oz. (302 ml) (DRY fork) of TYPE "E" FORK OIL.

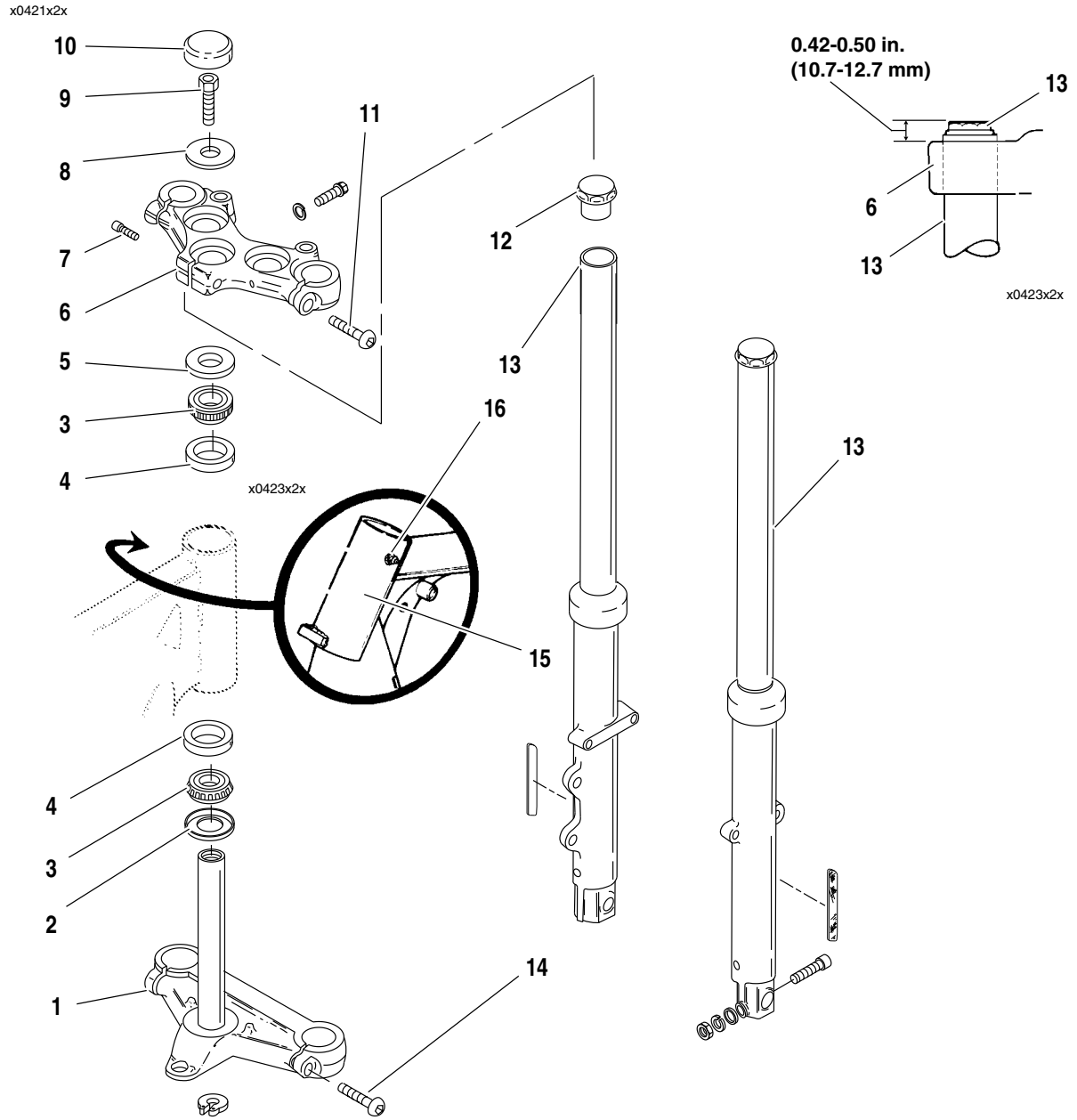
6. Install each slider tube cap (7) with O-ring (6).

7. Lower motorcycle to the ground.



1. **Upper bushing**
2. **Spacer**
3. **Damper tube**
4. **Ring**
5. **Spring**
6. **O-ring**
7. **Tube cap**
8. **Rebound spring**
9. **Tube**
10. **Lower bushing**
11. **Cover**
12. **Dust seal**
13. **Internal circle clip**
14. **Oil seal**
15. **Sleeve**
16. **Slider**
17. **Washer**
18. **Screw**
19. **Drain screw/washer**

Figure 2-92. Front Slider Tube/Slider Assembly



1. Front fork lower bracket and stem
2. Dust shield, lower
3. Bearing cone (2)
4. Bearing cup (2)
5. Dust shield, upper
6. Front upper bracket
7. Fork stem clamp screw
8. Washer
9. Fork stem bolt
10. Stem bolt cap (XLH 1200 only)
11. Pinch screw, upper (2)
12. Tube cap
13. Fork (front slider & tube assembly, RH & LH)
14. Pinch screw, lower (2)
15. Steering head (part of frame)
16. Grease fitting

Figure 2-93. Front Fork Assembly

REMOVAL

1. Remove front wheel assembly and front brake caliper. See 2.3 WHEEL REMOVAL, FRONT WHEEL REMOVAL.
2. Remove front fender mounting screws and locknuts. Remove fender.
3. See Figure 2-93. Loosen front fork upper and lower bracket pinch screws (11 and 14).

DISASSEMBLY

1. See Figure 2-92. Remove drain screw/washer (19) from slider (16). Remove tube cap (7) from slider tube (9). Drain fork oil. Remove O-ring (6) from tube cap (7). Remove spring (5) from slider tube (9).
2. Remove cover (11) and dust seal (12). Compress internal circle clip (13). Remove clip from groove in top of slider (16) bore.
3. Remove screw (18) and washer (17) from bottom of slider.

NOTE

Since there is little resistance to damper tube (3) rotation within slider tube (9) when removing screw (18), use an air impact wrench for best results.

4. Withdraw slider tube (9) from slider (16) until lower bushing (10) on slider tube contacts upper bushing (1) in slider. Use lower bushing on slider tube in a slide hammer motion to gently tap out oil seal (14), spacer (2) and upper bushing from slider bore.
5. Remove sleeve (15). Sleeve will be found within slider (16) or on bottom end of damper tube (3).
6. Insert a small diameter rod through opening in bottom of slider tube (9) to remove damper tube (3) assembly.
7. Remove rebound spring (8) from damper tube (3). Remove damper tube ring(s) (4) from damper tube. Remove lower bushing (10) from damper tube only if replacement is necessary.

CLEANING, INSPECTION, AND REPAIR

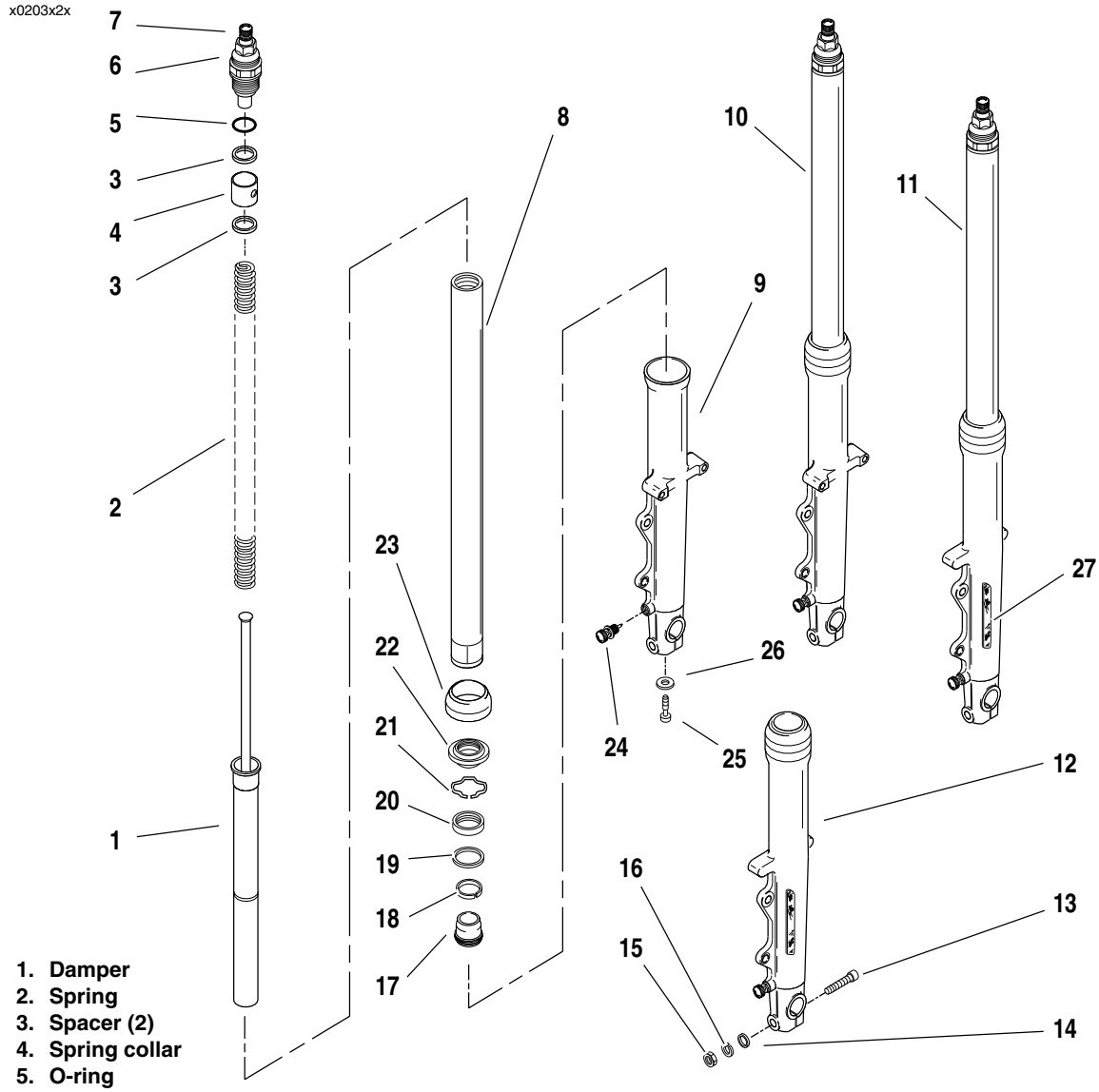
1. See Figure 2-92. Thoroughly clean and inspect all parts. Replace any parts that are bent, broken or damaged.
2. Inspect the O-ring (6) for damage, wear or general deterioration; replace as necessary. Replace all other removed seals.
3. Inspect damper tube ring(s) (4). Replace ring(s) if damaged or excessively worn.
4. Check dust seal (12) where it contacts slider tube (9). Dust seal should provide continuous contact against slider tube and should not show excessive wear. Check slider tube where it is contacted by seal. Tube surface should be shiny, smooth and free of scoring or abrasions.
5. Inspect small hole in groove of slider tube lower end. Verify that hole is unobstructed.

ASSEMBLY

1. See Figure 2-92. Install **new** lower bushing (10) in groove of slider tube (9), if removed. Expand bushing only enough to fit over tube.
2. Install damper tube ring(s) (4) into groove(s) of damper tube (3). Place rebound spring (8) over damper tube. Insert damper tube into slider tube (9).
3. Insert spring (5) into slider tube (9) with the tapered end down. Push damper tube (3) through opening at bottom of slider tube using spring (5). Place sleeve (15) over end of damper tube.
4. Install slider tube (9) assembly into slider (16). Install screw (18) with washer (17) at bottom of slider. Move slider tube through its full range of travel within slider several times to verify proper component alignment. Then, applying downward force on spring (5), final tighten screw (18).
5. Place upper bushing (1), spacer (2) (concave side downward), oil seal (14) (lettering side upward) and FORK SEAL AND BUSHING INSTALLATION TOOL (Part No. HD-36583) over slider tube (9). Install bushing, spacer and seal into slider (16) bore by tapping components downward with the installation tool. Install internal circle clip (13) into groove in top of slider bore.
6. Install dust seal (12) and cover (11) at top of slider (16). Install drain screw/washer (4) into lower end of slider.
7. Pour 10.2 fl oz. (302 ml) of TYPE “E” FORK OIL into top end of slider tube (9). Install slider tube cap (7) with O-ring (6).

INSTALLATION

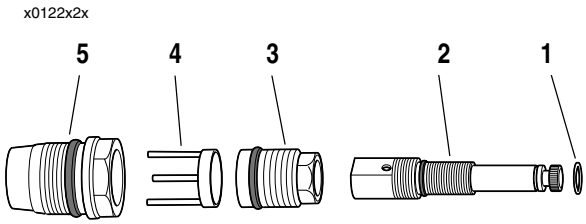
1. See Figure 2-93. Insert fork slider (13) through front fork lower (1) and upper (6) brackets. Position slider tubes so that top of each tube cap (12) extends 0.42-0.50 in. (10.7-12.7 mm) above top surface of front fork upper bracket.
2. On models with directional lamps mounted to front fork bracket, hold directional lamp mounting brackets upright. On all models, tighten front fork upper and lower bracket pinch screws (11 and 14) to 30-35 ft-lbs (41-47 Nm).
3. Install front fender using original fasteners. Tighten fasteners to 9-13 ft-lbs (12-18 Nm).
4. Install front wheel assembly and front brake caliper. See 2.7 WHEEL INSTALLATION, FRONT WHEEL INSTALLATION.



1. Damper
2. Spring
3. Spacer (2)
4. Spring collar
5. O-ring
6. Cap
7. Rebound adjuster
8. Slider tube
9. Slider - left
10. Fork slider - left
11. Fork slider - right
12. Slider - right
13. Screw
14. Washer
15. Nut
16. Lock washer
17. Lower stop
18. Bushing
19. Spacer
20. Oil seal
21. Retaining ring
22. Seal
23. Damper
24. Compression adjuster
25. Screw
26. Washer
27. Reflector

Figure 2-94. XL1200 Sport Front Fork Assembly

1. See Figure 2-95. Remove the stopper ring (1).



1. **Stopper ring**
2. **Rebound adjuster**
3. **Preload adjuster**
4. **Preload adjuster plate**
5. **Fork cap**

Figure 2-95.

2. Remove the spring preload adjuster (3).

NOTE

DO NOT unthread rebound adjuster from damper rod. Incorrect assembly could result in reduced adjustment range.

3. Unthread the fork cap (5) from the fork tube and allow the fork leg to drop, exposing the spring.
4. See Figure 2-96. Set the Fork Spring Compression tool (HD-41549A) on the spring collar. Turn screws in to engage holes in collar. Compress the spring until the Spring Plate tool (HD-41551) can be positioned between the spacer and the spring collar.

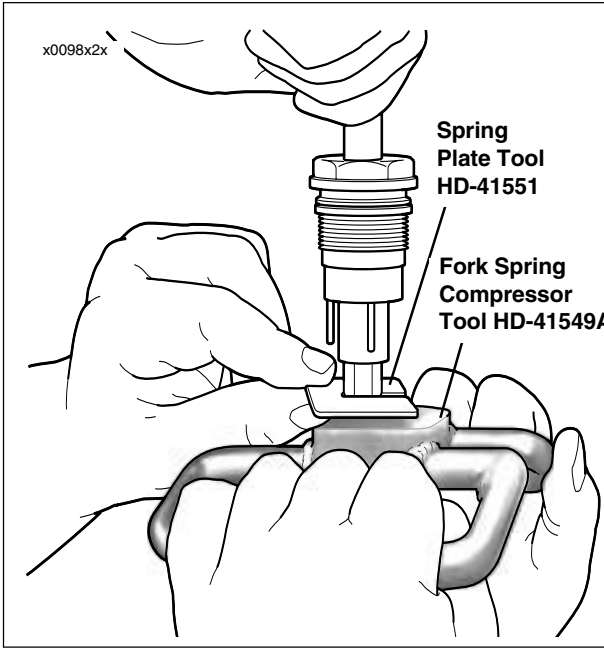


Figure 2-96.

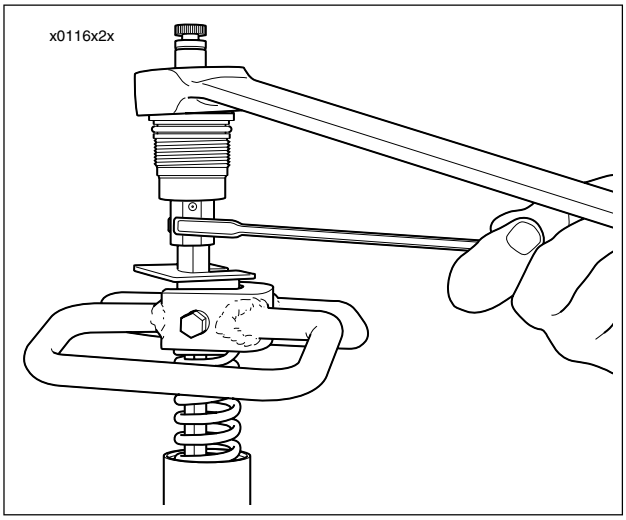


Figure 2-97.

5. See Figure 2-97. Hold the fork bolt and compression adjuster. Remove the fork bolt from the compression adjuster. Remove the spring adjuster plate from the fork bolt.
6. Remove spacer, spring collar and spring.
7. Pour out the fork oil by pumping the fork leg and rod 8-10 times until rod moves freely.
8. See Figure 2-98. and Figure 2-99. Position fork slider in vise using fork tube holder (HD-41177) to avoid damage.
9. See Figure 2-99. Remove the socket head bolt.

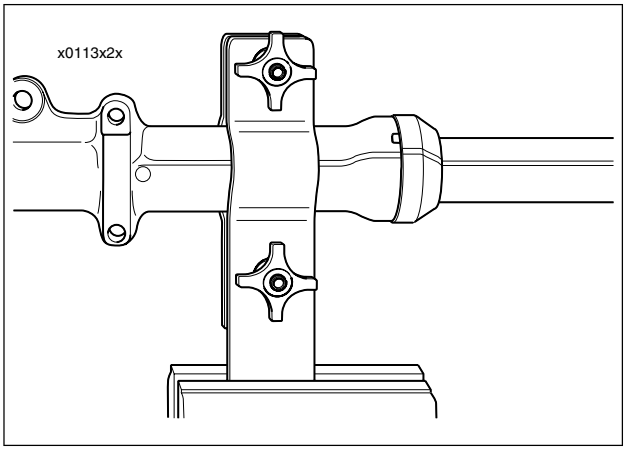


Figure 2-98.

10. Remove damper from fork tube.
11. See Figure 2-100. and Figure 2-101. Remove the cover from the slider. Remove seal and stopper ring.
12. Pull the fork tube out of the slider.
13. Remove the oil seal, spacer and guide bushing from the fork tube.

INSPECTION - XL 1200S

1. Measure fork spring free length. Replace spring if it is shorter than 16.02 in (407 mm).
2. Check the fork tube and slider for score marks, scratches or abnormal wear.
3. Check the slide and guide bushings for excessive wear or scratches.
4. Set the fork tube on V-blocks and measure runout. Runout should not exceed 0.008 in. (0.2 mm).

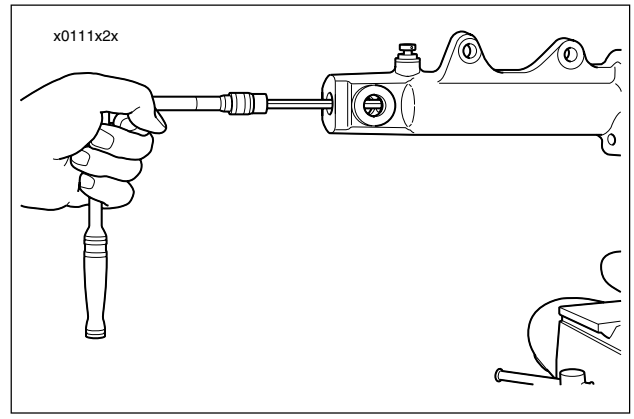


Figure 2-99.

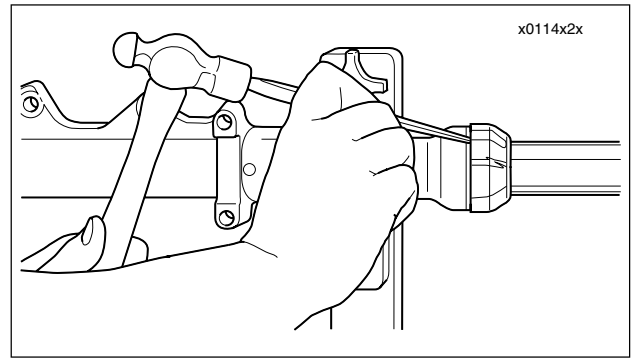


Figure 2-100.

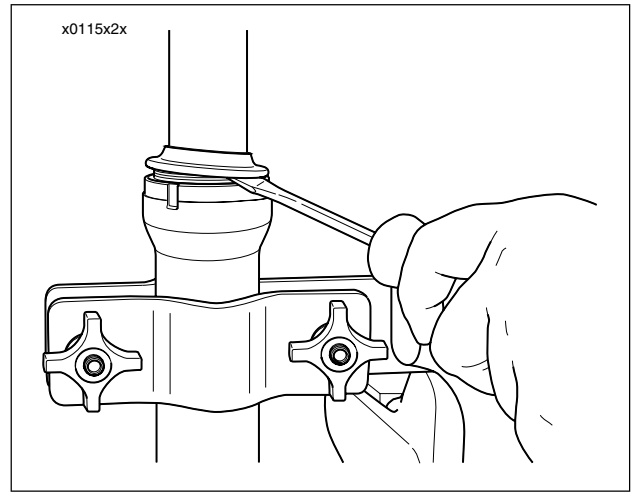


Figure 2-101.

1. Coat oil seal with TYPE “E” FORK OIL.
2. Before installing slide bushing and guide bushing, lubricate with fork oil.
3. Install guide bushing and spacer seal.

NOTE

Guide bushing opening must be oriented to the side. DO NOT position to front or rear.

4. Slip the slider into the fork tube.
5. Place the slide bushing over the fork tube until it rests on the slider.
6. See Figure 2-102. Drive the guide bushing with the spacer seal into the slider.
7. Lubricate new oil seal with TYPE “E” FORK OIl.
8. Drive the oil seal into the slider using Fork Seal Installer, HD-36583.
9. Install the stopper ring and dust seal.

NOTE

If the rebound adjuster was removed from the damper rod follow the steps below, otherwise proceed to step 10.

a. Bottom lock nut on threaded portion of damper rod.

b. See Figure 2-103. Holding thumb on detent spring and ball, back out (turn counterclockwise) rebound adjuster to last “click.” Turn down (clockwise) 13 “clicks”.

c. Thread rebound adjuster onto damper rod until adjuster stops at maximum thread engagement (Do not force).

d. See Figure 2-104. Thread locknut on damper rod up to contact base of rebound adjuster and tighten in place.

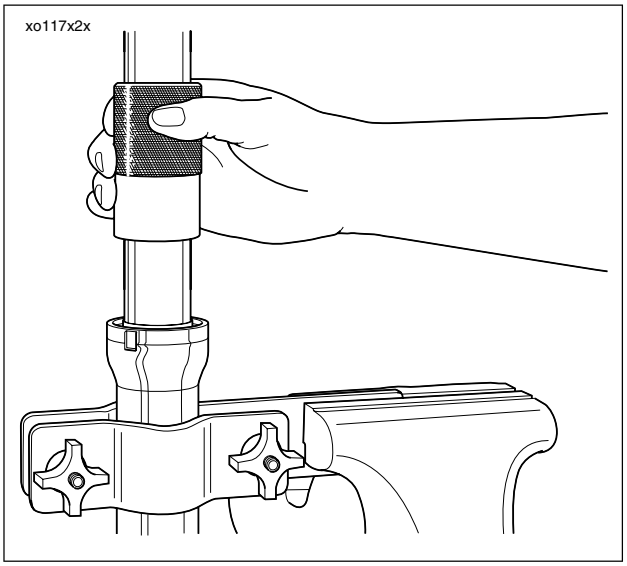


Figure 2-102.

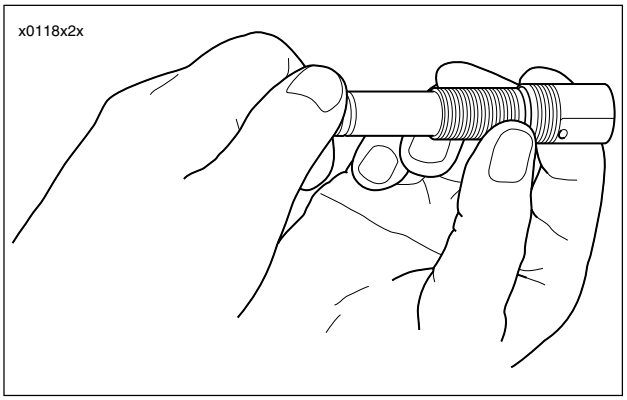


Figure 2-103.

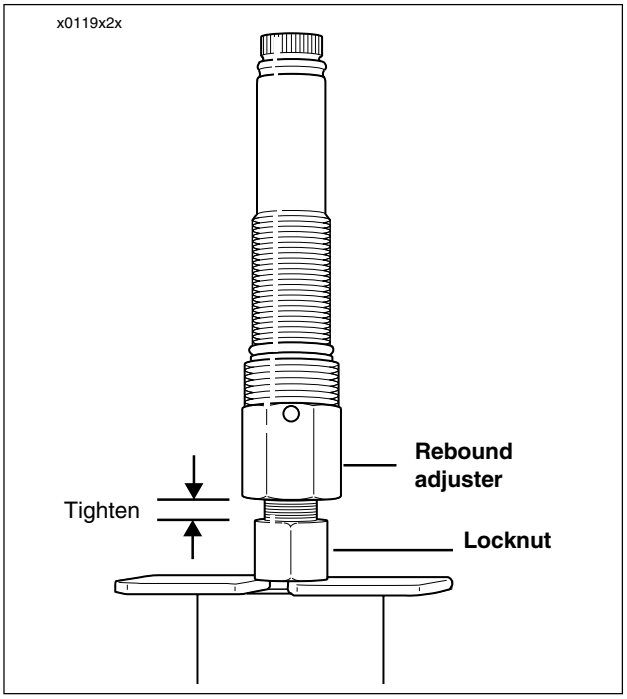


Figure 2-104.

10. Hold slider in vise taking precautions to avoid damage. Install damper tube into the fork tube. Tighten socket screw and washer. Tighten to 22-29 ft-lbs (29.8-39.3 Nm).
11. Pour half the TYPE “E” FORK OIL into fork tube.
12. See Figure 2-105. Slowly pump the damper rod 10 or more times.

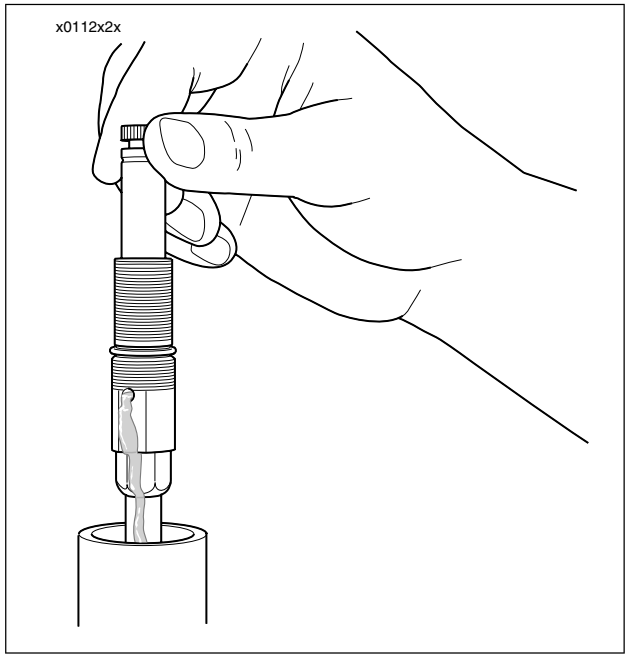


Figure 2-105.

13. Position the damper rod in the fully bottomed position.
14. Pour the remaining amount of TYPE “E” FORK OIL into the fork tube.
15. See Figure 2-106. Using the Pro-Level Oil Gauge (HD-59000A) adjust oil level to 5.6 in. (144 mm).
16. Carefully clean and install the spring, spring collar, and spacers.

NOTE

Spacers are stamped parts. Sharp edge created by stamping process must face collar.

17. See Figure 2-107. Using Fork Spring Compression Tool (HD-41549A) push spring collar down and place Spring Plate (HD-41551) between spacer and spring collar.
18. Install fork cap and tighten against rebound adjuster to 22-29 ft-lbs (29.8-39.3 Nm).
19. Tighten fork cap on fork tube to 11-22 ft-lbs (14.9-29.8 Nm).
20. Install the spring adjuster plate.
21. Replace O-rings on spring preload adjuster and lubricate with fork oil.
22. Install the spring preload adjuster.
23. Install the stopper ring.
24. Carefully drive slider cover into slider.

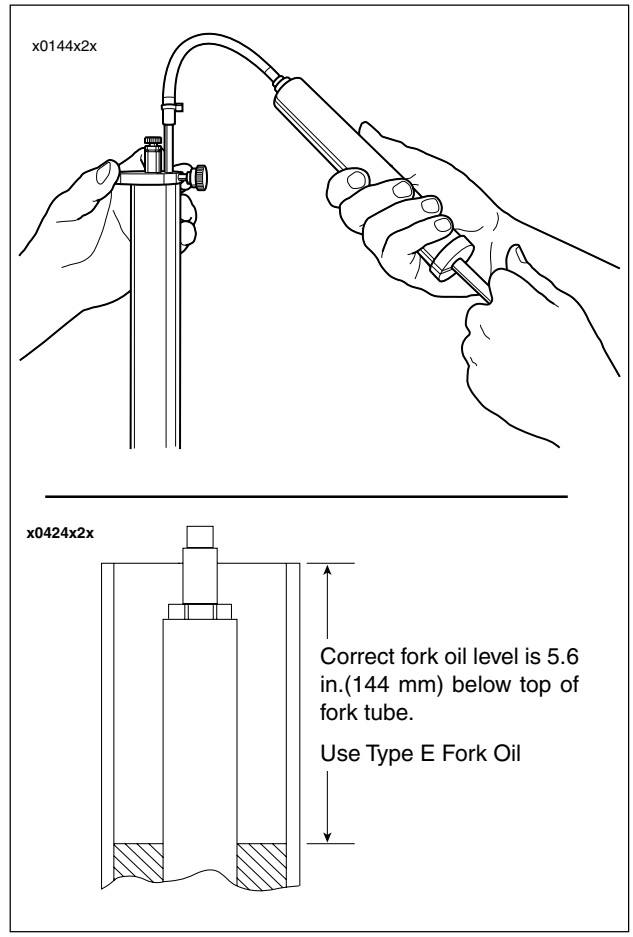


Figure 2-106.

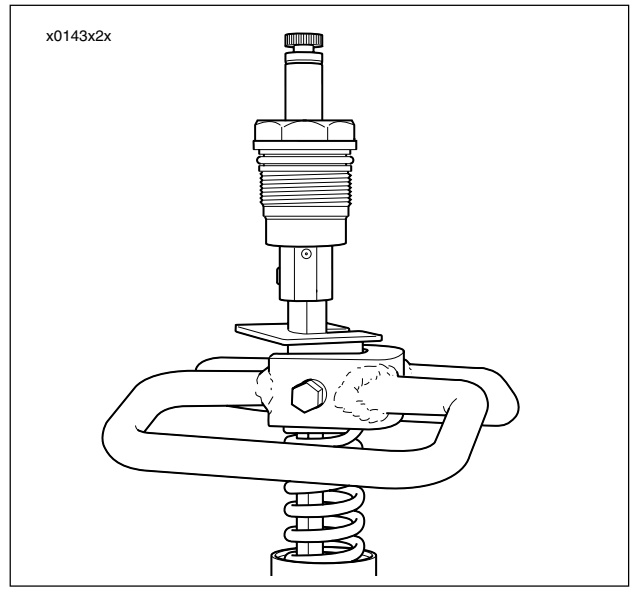


Figure 2-107.

NOTE

Rebound adjuster must be turned fully clockwise to the hardest setting before positioning the slider tubes.

1. See Figure 2-108. Insert fork sides through front fork lower and upper brackets. Position slider tubes so that top of each tube cap extends 1.735-1.745 in. (44.1-44.3 mm) above top surface of front fork upper bracket.
2. On models with directional lamps mounted to front fork bracket, hold directional lamp mounting brackets upright. On all models, tighten front fork upper and lower bracket pinch screws to 30-35 ft-lbs (41-47 Nm).
3. Install front fender using original fasteners. Tighten fasteners to 9-13 ft-lbs (12-18 Nm).
4. Install front wheel assembly and front brake caliper. See 2.7 WHEEL INSTALLATION, FRONT WHEEL INSTALLATION.

NOTE

XL Sport suspension adjustment procedures, setting recommendations and troubleshooting information may be found in the Harley-Davidson Owner's Manual.

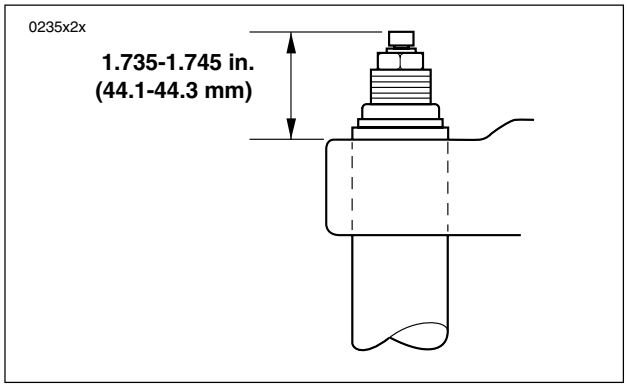


Figure 2-108.

ADJUSTMENT

1. Place suitable blocking under frame to raise front wheel several inches off floor.
2. Remove all items that could interfere with front end swing momentum. If clutch control cable inhibits front end swing, disconnect it.
3. Place a strip of masking tape over tip of front fender.
4. Install a pointer mounted to a floor stand. The pointer is positioned at the center of the fender with the front wheel pointed straight ahead.
5. Repeatedly nudge the fender a short distance on one side until the front end begins to “fall-away” (i.e., pivot about its steering head center) by itself. Mark the point on the tape where the front end begins to “fall-away.” Repeat this procedure in the opposite direction.
6. Measure the distance between the two “fall-away” marks. The distance must be 1-2 in. (25-50 mm) for proper bearing adjustment.
7. See Figure 2-93. If the distance is not correct, loosen the lower bracket pinch screws (14) and the fork stem clamp screw (7). Remove cap (10). Loosen or tighten the fork stem bolt (9) until the “fall-away” distance is 1 to 2 inches (25-50 mm).

NOTE

Loosen fork stem bolt if “fall-away” point is more than 2 in. (50 mm). If “fall-away” point is less than 1 in. (25 mm), tighten fork stem bolt.

8. Tighten fork stem clamp screw (7) to 30-35 ft-lbs (41-47 Nm). Tighten lower bracket pinch screws (14) to 30-35 ft-lbs (41-47 Nm).
9. Recheck “fall-away.”

LUBRICATION

See Figure 2-93. All XLH models are equipped with a grease fitting (16) on the left side of the steering head (15). This fitting allows greasing of the bearing cones (3) without disassembly.

At 10,000 miles (16,000 km), and every 10,000 miles (16,000 km) thereafter, grease the steering head bearings with Harley-Davidson WHEEL BEARING GREASE (Part No. 99855-89). Connect grease gun to grease fitting. Inject grease until old grease begins to ooze from top and bottom of steering head.

REMOVAL/DISASSEMBLY

1. See Figure 2-93. Remove the fork assemblies. See 2.22 FRONT FORK, REMOVAL.
2. Remove stem bolt cap (10), fork stem bolt (9) and washer (8). Loosen fork stem clamp screw (7). Lift handlebar assembly from steering head with fork upper bracket (6) attached. Carefully position assembly away from work area. Exercise caution to avoid bending control wires.

NOTE

It is not necessary to disconnect clutch and brake hand levers, wiring harnesses or control cables from handlebar, unless the handlebar assembly is to be removed from the motorcycle.

3. Remove upper dust shield (5) and upper bearing cone (3). Lower the fork stem and bracket assembly (1). The lower bearing cone is a press fit on fork stem. Chisel through outer bearing cage to allow rollers to fall free. Apply heat to remove the remaining portion of bearing cone. Continuously move flame around its entire circumference until bearing falls free. Remove lower dust shield (2).
4. If replacement of bearing cups (4) is necessary, drive cups from steering head using STEERING HEAD BEARING RACE REMOVAL TOOL (Part No. HD-39301A) and UNIVERSAL DRIVER HANDLE (Part No HD-33416).

CLEANING, INSPECTION, AND REPAIR

See Figure 2-93. Clean the dust shields (2 and 5), bearing cones (3), fork stem and bracket (1) and frame with solvent. Carefully inspect bearing races and assemblies for pitting, scoring, wear and other damage. Replace damaged bearing as a set. Check the fork stem and bracket (1) for damage. Replace damaged fork stem.

ASSEMBLY/INSTALLATION

1. See Figure 2-93. If removed, install **new** bearing cups (4) into frame steering head using STEERING HEAD BEARING RACE INSTALLATION TOOL (Part No. HD-39302).
2. Liberally coat the bearing cones (3) with grease. Work the grease into the rollers.
3. Place lower bearing dust shield (2) over fork stem. Find a section of pipe having an inside diameter slightly larger than the outside diameter of the fork stem. Press bearing cone (3) onto fork stem and bracket (1) using the pipe as a press on tool.
4. Insert fork stem and bracket (1) through the steering head. Install bearing cone (3) and dust shield (5) onto the stem.
5. Install the upper bracket (6) including the handlebar assembly and loosely install fork stem bolt (9) with washer (8).
6. Install fork assemblies (13). See 2.22 FRONT FORK, INSTALLATION.
7. Tighten the fork stem bolt (9) until the bearings have no free play. Make sure the fork stem turns freely, then tighten the fork stem clamp screw (7). Check bearing adjustment. See 2.23 FORK STEM AND BRACKET ASSEMBLY, ADJUSTMENT.

REMOVAL/DISASSEMBLY

NOTE

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

1. See Figure 2-109. Remove rear wheel. See 2.3 WHEEL REMOVAL, REAR WHEEL REMOVAL.
2. Remove rear brake caliper assembly. See 2.19 REAR BRAKE CALIPER, REMOVAL
3. Remove rear shock absorber nuts and washers from rear fork.
4. Remove rear belt guard and debris deflector. Remove belt.
5. Remove socket screw (11).
6. Remove pivot bolt (1). Support rear fork and pull fork assembly from frame.

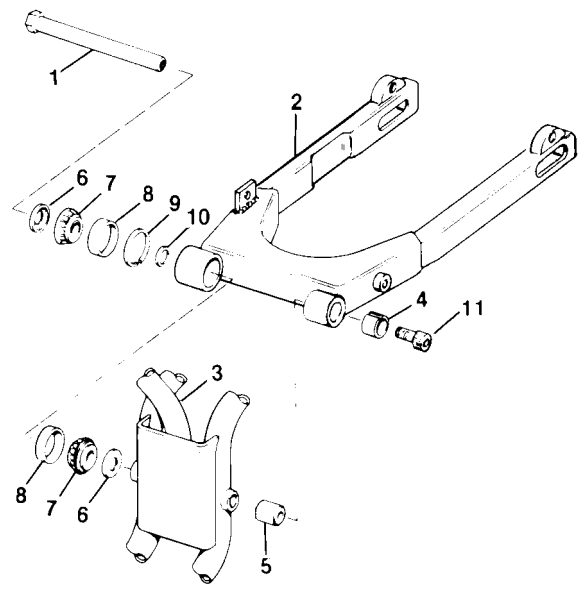
CAUTION

Carefully mark all bearing components as they are removed, so that they may be returned to their original locations. Do not intermix bearing components.

NOTE

Remove bearing races (8) and pivot bushing (4) only if replacement is required. The complete bearing assembly must be replaced as a unit when replacement is necessary. Do not intermix bearing components.

7. Carefully press bearing outer races (8) from fork. Remove lock ring (9).
8. Remove pivot spacer (5). Press pivot bushing (4) from fork assembly.



1. **Pivot Bolt**
2. **Rear Fork**
3. **Frame**
4. **Pivot Bushing**
5. **Pivot Spacer**
6. **Dust Shield (2)**
7. **Inner Race (2)**
8. **Outer Race (2)**
9. **Lock Ring**
10. **Bearing Spacer**
11. **Socket Screw**

Figure 2-109. Rear Fork

CLEANING AND INSPECTION

1. Clean all components in solvent and blow dry. Carefully inspect all bearing components for wear and/or corrosion. Replace complete bearing assembly if any component is damaged.
2. Check that rear fork is not bent or twisted. Replace if damaged.

ASSEMBLY

1. See Figure 2-109. If necessary, install new lock ring (9) and press new outer races (8) into position.

NOTE

Roller bearing assemblies are shipped assembled as a unit. Do not intermix components. Mark all components so they may be correctly installed.

2. Coat bearing components with bearing grease and assemble.

CAUTION

Bearing spacer (10) must be installed between inner races (7) or bearing failure can result.

3. Press dust shields (6) over bearing inner races (7) with the lipped side in.
4. If pivot bushing (4) must be replaced, press it into rear fork (2).
5. Insert pivot spacer (5) into pivot bushing (4) with chamfered end facing outward toward socket head screw.

⚠WARNING

Pivot spacer (5) must be installed with chamfered end outward toward socket head screw (11) or insufficient clamp load between rear fork pivot and frame may adversely affect handling which could result in death or serious injury.

6. If engine is in frame, insert screw (11) into pivot spacer.

INSTALLATION

1. See Figure 2-109. Slide rear fork assembly into position.
2. Holding fork assembly in position, install pivot bolt (1). Apply two or three drops of Loctite 242 blue on threads of screw (11). Thread screw into internal threads of pivot bolt (1) and tighten to 50 ft-lbs (68 Nm).
3. Install belt guard and debris deflector.
4. Install shock absorbers onto rear fork. See 2.25 REAR SHOCK ABSORBER, INSTALLATION.
5. Install rear brake caliper assembly. See 2.19 REAR BRAKE CALIPER, INSTALLATION.
6. Install rear wheel. See 2.7 WHEEL INSTALLATION, REAR WHEEL INSTALLATION.

ADJUSTMENT

See Figure 2-110. The rear shock absorber springs can be adjusted for the weight the motorcycle is to carry. The average-weight solo rider should use the extended spring position. A heavy solo rider might require a slightly compressed spring position.

⚠WARNING

Both shock absorber spring adjusting cams must be adjusted to the same position or vehicle handling may be adversely affected, resulting in death or serious injury.

To adjust the compression of the rear shock absorber spring, turn spring adjusting cam using SPANNER TOOL (Part No. HD-94820-75A). Adjust spring adjusting cams on both shock absorbers to the same position.

REMOVAL

1. Raise rear end of motorcycle with stand or suitable blocking underneath frame. If blocking is not available, remove one shock absorber at a time. The remaining shock absorber will hold the rear fork and frame in place.
2. See Figure 2-111. Remove upper shock mounting screw (1). Remove bottom bolt (2).

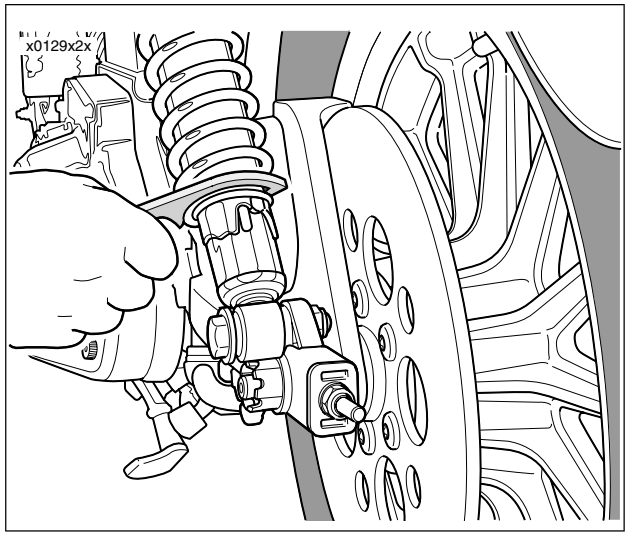


Figure 2-110. Adjust Shock Absorber Spring Adjusting Cams

DISASSEMBLY

1. See Figure 2-111. Note the position of the spring adjusting cam for proper reassembly.
2. With spring seat (7) facing up, place shock absorber in SHOCK ABSORBER TOOL (Part No. HD-97010-52A) or suitable shock or spring compressing tool. Compress spring far enough to remove spring seat (7).
3. Carefully release spring compression. Remove shock absorber from tool. Remove cover (17), spring, spring guide (8) and adjusting cam (9).

CLEANING AND INSPECTION

Clean and inspect all parts for wear and damage. Check rubber components for wear, cracking and stiffness. Examine shock assembly for signs of leakage. Unit should compress more easily than it extends. If possible, compare with new shock absorber. Replace both shock absorbers as a set if either rear shock absorber assembly is excessively worn, leaking or damaged.

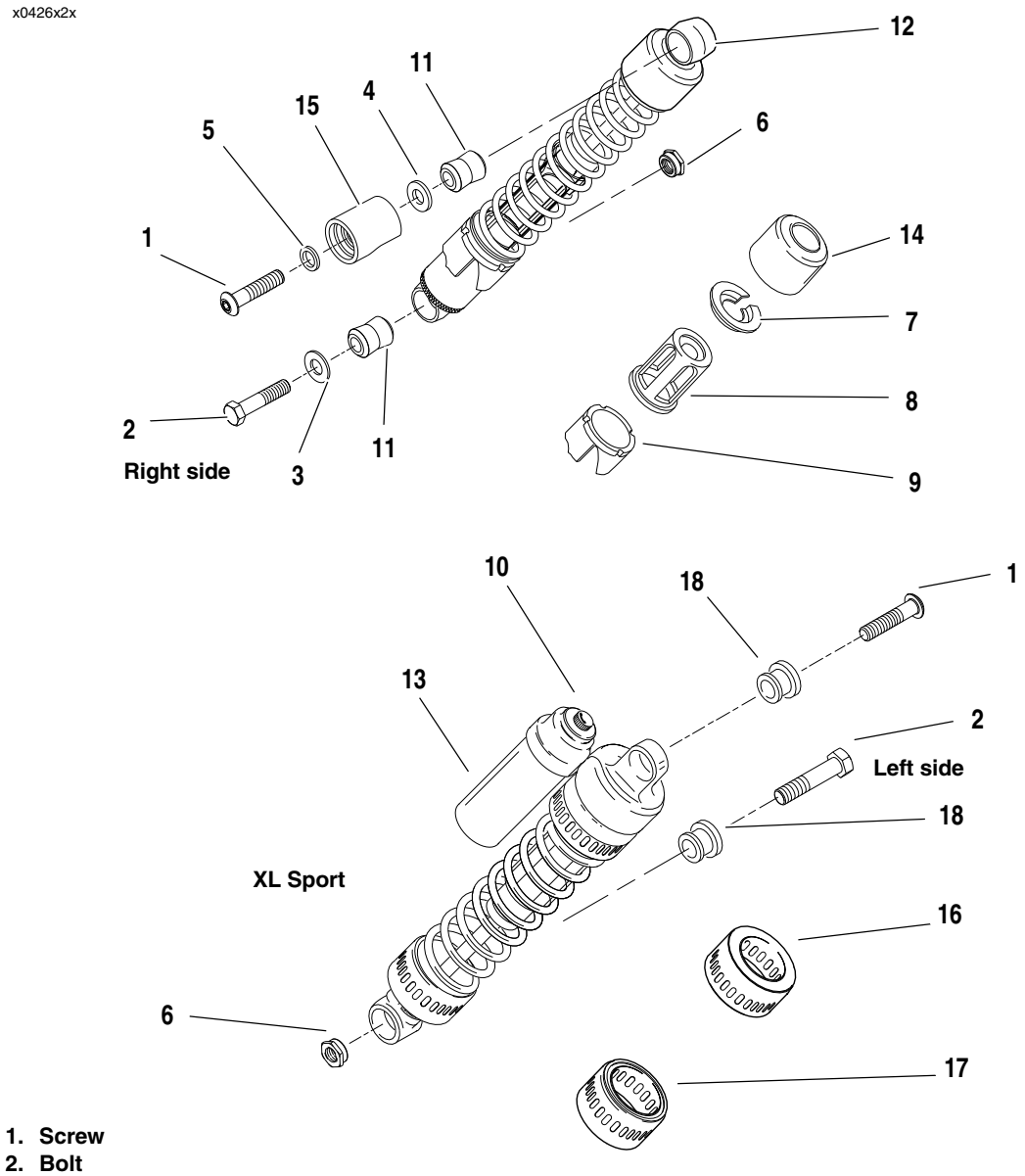
ASSEMBLY

See Figure 2-111. Assemble the components in the reverse order of the disassembly procedure.

Apply a thin coat of grease to each cam surface. Place assembly in tool and compress spring enough to insert spring seat (7). Slowly release spring compression. Be sure to place the spring adjusting cam (9) in the same adjustment position on both shock absorbers.

INSTALLATION

1. See Figure 2-111. Install shock absorber upper mounting screw (1).
2. Position bottom end of shock absorber against outboard side of rear fork mount. Insert bolt (2) with washer (3) through shock bottom bushing (11) and rear fork mount flange. Install locknut (6) on end of bolt.
3. Apply 2-3 drops of LOCTITE Threadlocker 242 (blue) to threads of upper mounting screw (1). Install washer (5), onto upper mounting screw. Insert screw through cover (15), washer (4), and damper bushing (11). Tighten to 21-35 ft-lbs (31-51 Nm)
4. Tighten bottom mount locknut (6) to 30-50 ft-lbs (41-68 Nm).



1. Screw
2. Bolt
3. Washer
4. Washer
5. Washer
6. Nut
7. Spring seat
8. Spring guide
9. Spring adjusting cam
10. Knob
11. Damper bushing
12. Shock absorber
13. Shock absorber (XL Sport)
14. Shock absorber cover
15. Stud cover
16. Upper cover
17. Lower cover
18. Damper bushing

Figure 2-111. Rear Shock Absorber

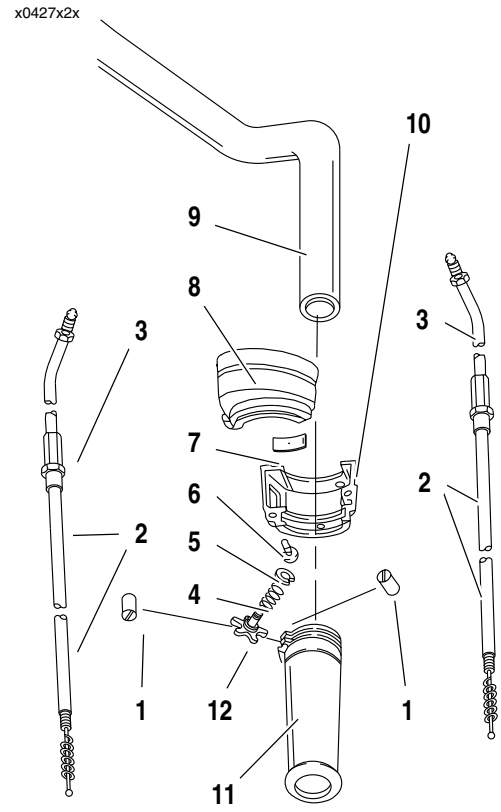
ADJUSTMENT

⚠WARNING

Check to ensure proper throttle control functions. The throttle control MUST operate freely without binding. Irregular or sticking throttle response could result in loss of control of the vehicle and death or serious injury.

See Figure 2-112. With throttle friction screw (12) backed off, the carburetor throttle must return to the closed (idle) position. Check control cable adjustment. With engine running, turn handlebars through full range of travel. If engine speed changes during this maneuver, adjust control cables according to the following procedure.

1. See Figure 2-113. Loosen throttle friction screw (1).
2. Slide rubber boot off each cable adjuster (4).
3. Loosen jam nut on each adjuster.
4. Turn adjusters in direction which will shorten cable housings to minimum length.
5. Point front wheel straight ahead. Twist throttle control grip (5) to fully open position and hold.
6. Turn adjuster (4) on throttle control cable (2) until throttle cam stop (6) touches carburetor stop plate (7). Tighten jam nut on throttle control cable adjuster (4). Release throttle control grip (5).
7. Turn handlebars fully to right. Turn adjuster (4) on idle control cable (3) until end of cable housing just touches spring within carburetor cable guide (8).
8. With throttle friction screw (1) loosened, twist and release throttle control grip (5) a few times. Carburetor throttle must return to idle position each time throttle grip is released. If this is not the case, turn adjuster (4) on idle control cable (3) (shortening cable housing) until throttle control functions properly.
9. Tighten jam nut on idle control cable adjuster (4). Recheck operation of throttle control (Step 8).
10. Slide rubber boot over each cable adjuster (4). Recheck engine slow idle speed. Adjust if required.



1. **Ferrule (2)**
2. **Cable assembly**
3. **Cable adjuster (2)**
4. **Spring**
5. **Retaining ring**
6. **Screw**
7. **Friction spring**
8. **Upper housing**
9. **Right handlebar**
10. **Lower housing**
11. **Throttle control grip**
12. **Throttle friction screw**

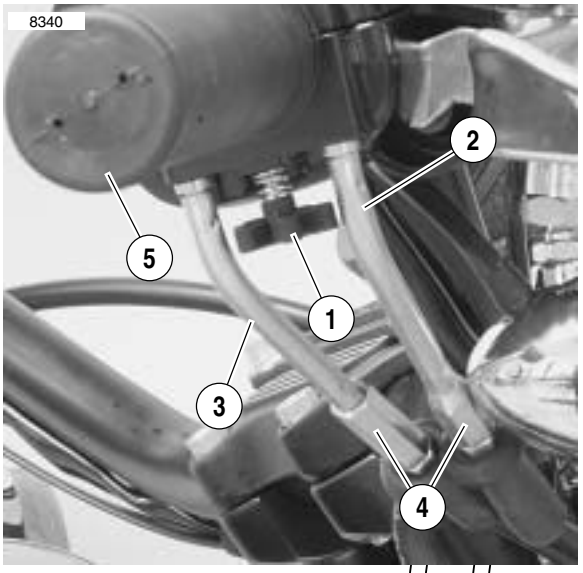
Figure 2-112. Throttle Control - Right Handlebar

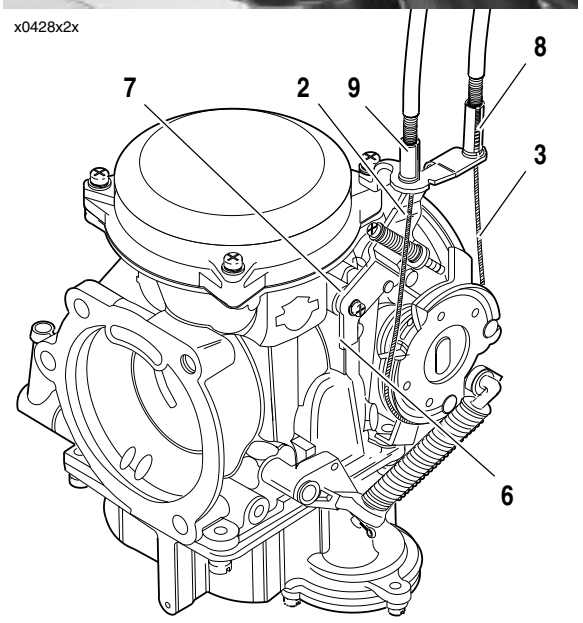
REMOVAL/DISASSEMBLY

1. See Figure 2-112. Slide rubber boot off each cable adjuster (3). Loosen jam nut on each adjuster. Turn adjusters in direction which will shorten cable housings to minimum length.
2. Remove two screws (6) and separate upper housing (8) from lower housing (10).
3. Unhook ferrules (1) and cables (2) from throttle control grip (11) and lower housing (10).
4. Remove air cleaner assembly. See 4.4 AIR CLEANER, REMOVAL.
5. Disconnect cables from carburetor.
6. Remove friction spring (7), throttle friction screw (12) and spring (4) from lower housing (10).

CLEANING, INSPECTION, AND REPAIR

Clean all parts in a non-flammable cleaning solvent. Blow dry with compressed air. Replace cables if frayed, kinked or bent.





1. **Throttle friction screw**
2. **Throttle control (pull-open) cable**
3. **Idle control (pull-close) cable**
4. **Cable adjuster (2)**
5. **Throttle control grip**
6. **Throttle cam stop**
7. **Carburetor stop plate**
8. **Idle control cable guide (on carburetor)**
9. **Throttle control cable guide (on carburetor)**

Figure 2-113. Throttle/Idle Control Cable

ASSEMBLY/INSTALLATION

1. See Figure 2-112. Apply a light coating of graphite to the handlebar (9) and the inside surface of the switch housings (8 and 10).
2. Install throttle spring (4), throttle friction screw (12) and friction spring (7) in lower housing (10).
3. Attach cable assemblies (2, 3) to lower housing (10). See Figure 2-113. Throttle control cable (2) has a 5/16 in. (7.9 mm) fitting end and is positioned to front of lower housing. Idle control cable (3) has a 1/4 in. (6.3 mm) fitting end and is positioned to rear of lower housing.
4. See Figure 2-112. Install throttle control grip (11) over end of right handlebar (9). Position lower housing (10) onto right handlebar, engaging lower housing with throttle control grip. Position ferrules (1) over cable ball ends, then seat ferrules (with cables attached) in their respective notches of the throttle control grip.
5. Install upper housing (8) over right handlebar (9) and secure to lower housing (10) using screws (6). Tighten screws to 18-24 ft-lbs (24-33 Nm).
6. See Figure 2-114. Route control cables forward from throttle control grip, forward of front fork upper bracket, downward between right slider tube and headlamp, rearward along right side of frame steering head, rearward along right side of frame backbone into retaining clip on ignition switch housing, downward to carburetor.
7. See Figure 2-113. Install idle control cable (3) housing and spring into longer, inboard (idle) cable guide (8) on carburetor.
8. Install throttle control cable (2) housing into shorter, outboard cable guide (9) on carburetor.

⚠WARNING

Throttle cables must not pull tight when handlebars are turned fully to left or right fork stops. Be sure wires and throttle cables are clear of fork stops at steering head so they will not be pinched when fork is turned against stops. Steering must be smooth and free with no binding or interference. Improperly adjusted and/or positioned throttle cables could result in loss of control of vehicle and death or serious injury.

9. Adjust control cables. See 2.26 THROTTLE CONTROL, ADJUSTMENT.

Figure 2-114. Control Cable Routing

REMOVAL

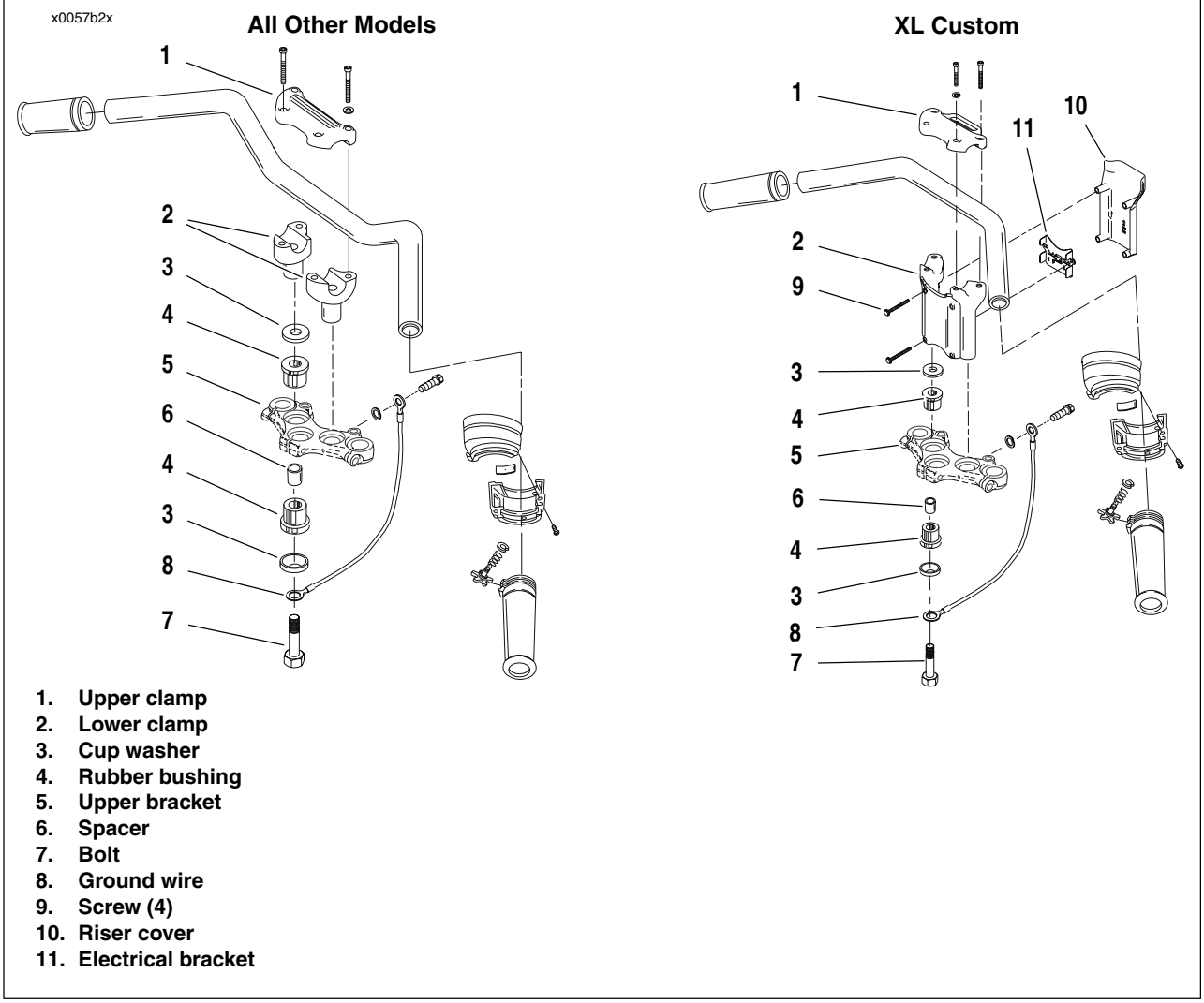
⚠WARNING

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 which could result in death or serious injury.

1. Disconnect battery negative cable.
2. See Figure 2-115. Remove left hand controls and switches. Let wires carefully support the switches.
3. Remove left handlebar grip
4. Remove right side master cylinder. Loosen switch housing screws but do not remove.
5. Remove instrument cluster and screws.
6. Remove remaining two screws holding upper clamp.
7. Right hand control assembly may now be removed from detached handlebar.
8. On XL Custom:
   a. Remove riser cover screws (9) and riser cover (10).
   b. Detach indicator lamp socket from bezel.
9. Loosen riser bolts (7). Remove cup washers (3), rubber bushings (4) and spacers (6).
10. Remove ground wire (8) from triple clamp.

INSTALLATION

1. See Figure 2-115. Install cup washers (3), rubber bushings (4) and spacers (6).
2. Insert riser bolts (7) (Finger tight only).
3. Slide right handlebar switch housing onto right handlebar end.
4. Position handlebar on lower riser clamp (2).
5. Place upper riser clamp in position and thread the two rear (front on XL Custom) screws in place.
6. Using the remaining two screws, install instrument bracket.



1. **Upper clamp**
2. **Lower clamp**
3. **Cup washer**
4. **Rubber bushing**
5. **Upper bracket**
6. **Spacer**
7. **Bolt**
8. **Ground wire**
9. **Screw (4)**
10. **Riser cover**
11. **Electrical bracket**

Figure 2-115. Handlebars

7. See Figure 2-116. Adjust the handlebars to the desired position and tighten rear screws (front screws on XL Custom) to 12-15 ft-lbs (16-20 Nm) until cast-in spacers of upper clamp contact the lower clamp.
8. See Figure 2-115. Finally, tighten front screws (rear screws on XL Custom) to 12-15 ft-lbs (16-20 Nm).
9. Tighten lower riser bolts (7) to 25-30 ft-lbs (34-41 Nm).
10. On XL Custom:
    a. Position indicator lamp socket and clip in position under bezel.
    b. Install riser cover (10) and tighten screws (9) to 8-12 **in-lbs** (.9-1.4 Nm).
11. Install new left hand grip in place as follows:
    a. Using a piece of emery cloth, rough grip end of left handlebar.

NOTE

Before applying adhesive in the next step, clean the left handlebar with acetone.

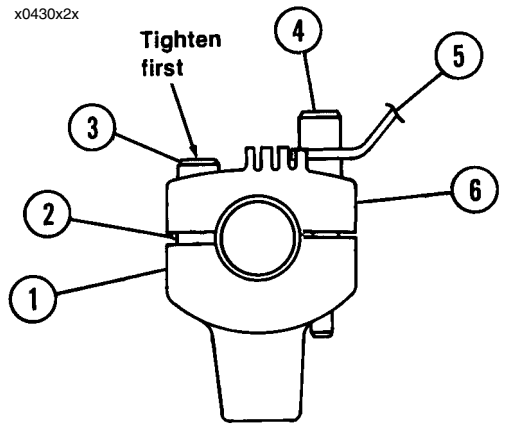
    b. Apply LOCTITE PRISM PRIMER (770) to inside of hand grip. Remove any excess PRISM PRIMER with a clean cloth. Wait two minutes for PRISM PRIMER to set before attempting the next step.
    c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of hand grip. Install new hand grip on left handlebar.

NOTE

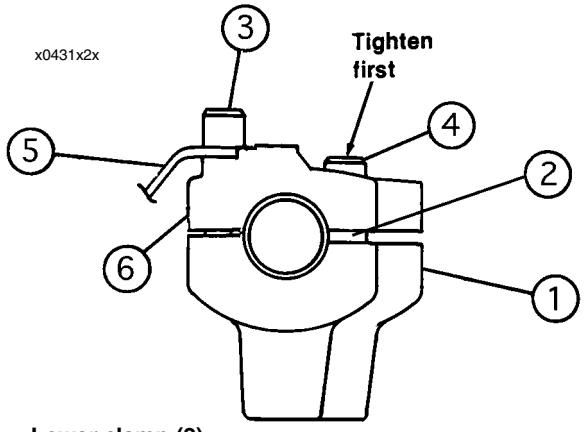
SUPERBONDER will set in four minutes and be fully cured in 24 hours.

12. Position left hand control and loosely install hand control clamp screws.
13. Attach clutch control and tighten fastener. Tighten hand control in position.
14. Push new wire harness retainers in handlebar holes
15. Attach brake hand control in place and tighten torx screws to 70-80 **in-lbs** (7.9-9.0 Nm).
16. Push new wire harness retainers in handlebar holes
17. Connect negative battery cable.
18. Verify the following:
    a. cable adjustment/operation.
    b. proper throttle cable operation.
    c. all electrical switch functions.
    d. proper brake operation and brake light function.

XLH 883, XL 883R, XLH 1200, and XL 1200S



XL 1200C and XL 883C



1. **Lower clamp (2)**
2. **Cast-in spacer (2)**
3. **Rear screw (2)**
4. **Front screw (2)**
5. **Instrument bracket**
6. **Upper clamp**
7. **Lower clamp (2)**
8. **Cast-in spacer (2)**
9. **Rear screw (2)**

Figure 2-116.

ADJUSTMENT

Refer to 6.5 CLUTCH RELEASE MECHANISM, ADJUSTMENT.

REMOVAL/DISASSEMBLY

Clutch Cable – Lower

1. See Figure 2-117. Using T-27 TORX driver, remove four TORX screws (12) with washers to remove clutch inspection cover (13). Exercise caution to avoid damaging or dislodging quad ring (3) in primary cover (1).
2. Slide spring (8) with attached hex lock plate (9) from flats of adjusting screw (2).
3. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut (10) from end of adjusting screw.
4. Remove hook of ramp (11) from button at the rear of cable end coupling (7). Remove cable end (15) from slot in coupling.
5. Turn cable end fitting (16) counterclockwise to remove clutch cable lower section from primary cover (1). Remove O-ring (14) from cable end fitting.

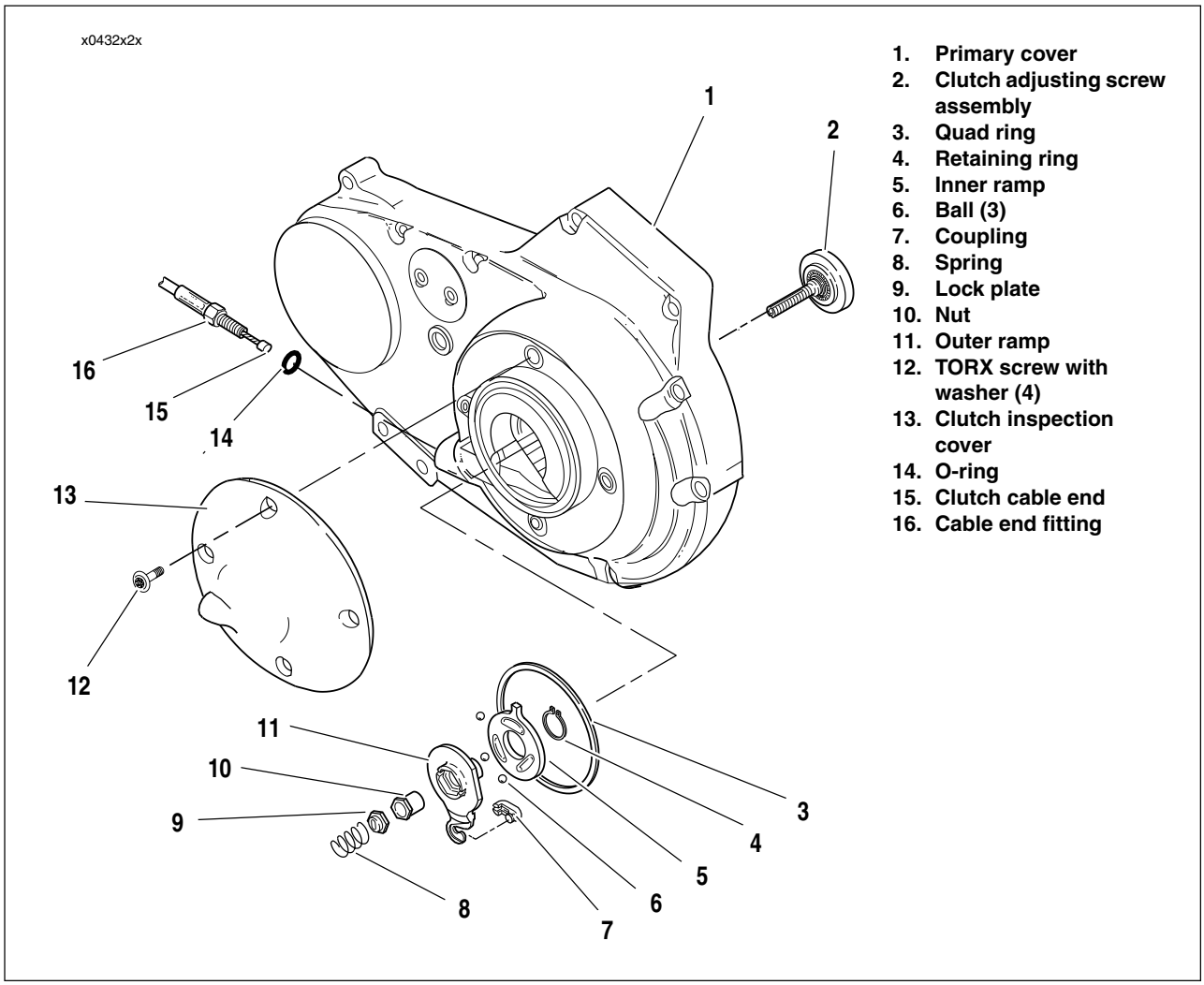


Figure 2-117. Clutch Release Mechanism

Clutch Lever and Clutch Cable – Upper

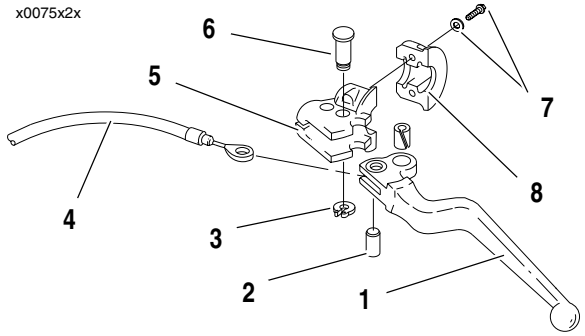
1. See Figure 2-118. Remove retaining ring (3) and pivot pin (6).
2. Remove clutch lever (1) from clutch lever bracket (5).
3. Remove clutch cable pin (2). Disconnect clutch cable (4) upper section from lever (1).

Clutch Hand Control

1. See Figure 2-118. Remove two screws and washers (7) from clutch control clamp (8).
2. Remove clutch control clamp (8) and assembly of clutch cable (4) upper section, clutch lever (1) and clutch lever bracket (5) from left handlebar.

NOTE

You may need to loosen two screws of left handlebar switch housing to remove clutch control clamp (8) and assembly of clutch cable (4) upper section, clutch lever (1) and clutch lever bracket (5) from left handlebar.



1. **Clutch lever**
2. **Clutch cable pin**
3. **Retaining ring**
4. **Clutch cable**
5. **Clutch lever bracket**
6. **Pivot pin**
7. **Screw and washer**
8. **Clutch control clamp**

Figure 2-118. Clutch Hand Control

ASSEMBLY/INSTALLATION

Clutch Cable – Lower

1. See Figure 2-117. Install O-ring (14) over cable end fitting (16) of clutch cable lower section. Turn fitting clockwise to install into primary cover (1). Tighten fitting to 3-5 ft-lbs (4-7 Nm).
2. Fit coupling (7) over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp (5) fits in slot of primary cover (1).
3. Thread nut (10) on adjusting screw (2) until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp (11) and turn adjusting screw counter-clockwise.
4. See Figure 2-119. If not yet performed, route clutch cable (3) forward from primary cover (4), upward through clip (6) on lower left front engine mount to outboard side of left front slider tube, and then rearward to clutch lever (1).

Clutch Lever and Clutch Cable – Upper

1. See Figure 2-118. Connect end of clutch cable (4) upper section to clutch lever (1) using clutch cable pin (2).
2. Position lever within clutch lever bracket (5).

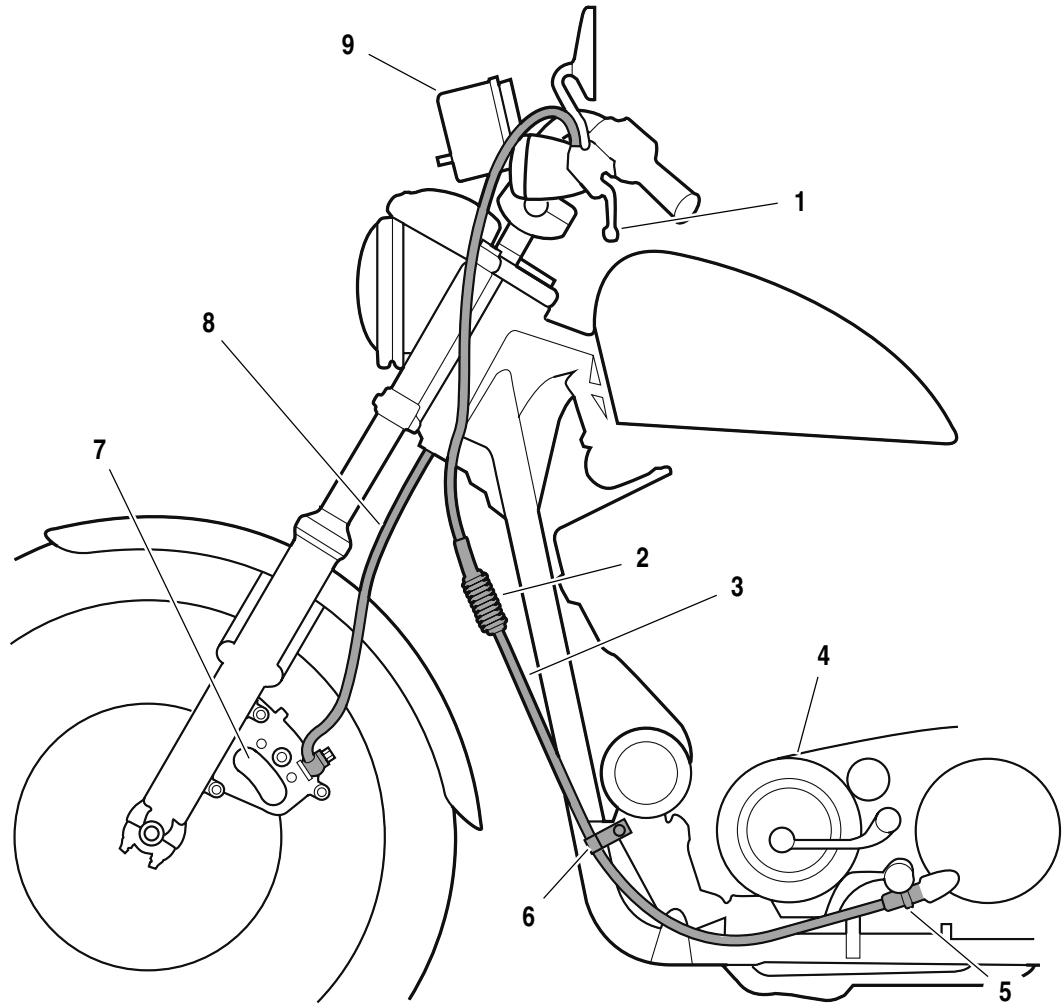
Clutch Hand Control

1. See Figure 2-118. Position clutch control clamp (8) and assembly of clutch cable (4) upper section, clutch lever (1) and clutch lever bracket (5) onto left handlebar. Hold assembly and bracket firmly against left handlebar switch housing.
2. Secure components to left handlebar using two screws and washers (7). Tighten screws to 70-80 **in-lbs** (7.9-9.0 Nm).

NOTE

*If two screws of left handlebar switch housing were loosened during removal, tighten to 18-24 **in-lbs** (2.0-2.7 Nm).*

x0205a2x



1. Clutch lever
2. Cable adjuster boot
3. Clutch cable
4. Primary cover
5. Cable end fitting
6. Clip
7. Front brake caliper
8. Front brake line
9. Speedometer

Figure 2-119. Clutch Cable and Front Brake Line Routings - Left Side

REMOVAL

NOTE

For 883R exhaust system removal, disassembly, assembly and installation, see 2.30, Exhaust System - 883R.

1. See Figure 2-120. Remove heat shields (3, 9 and 17) by opening worm drive clamps (2 and 8).
2. Remove nuts (4) from front and rear cylinder head exhaust studs.
3. To access locknut (16), remove master cylinder mounting bolts and lift brake pedal upward. Remove locknut to detach front muffler (15) from sprocket cover stud.
4. Remove locknut (21) and bolt (20) to detach rear muffler (1) from muffler support (19).
5. Remove exhaust system assembly.

DISASSEMBLY

1. See Figure 2-120. Remove Torca clamp assemblies (14) from front and rear mufflers (15 and 1). Discard Torca clamp assemblies- one time usage only.

NOTE

New 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.

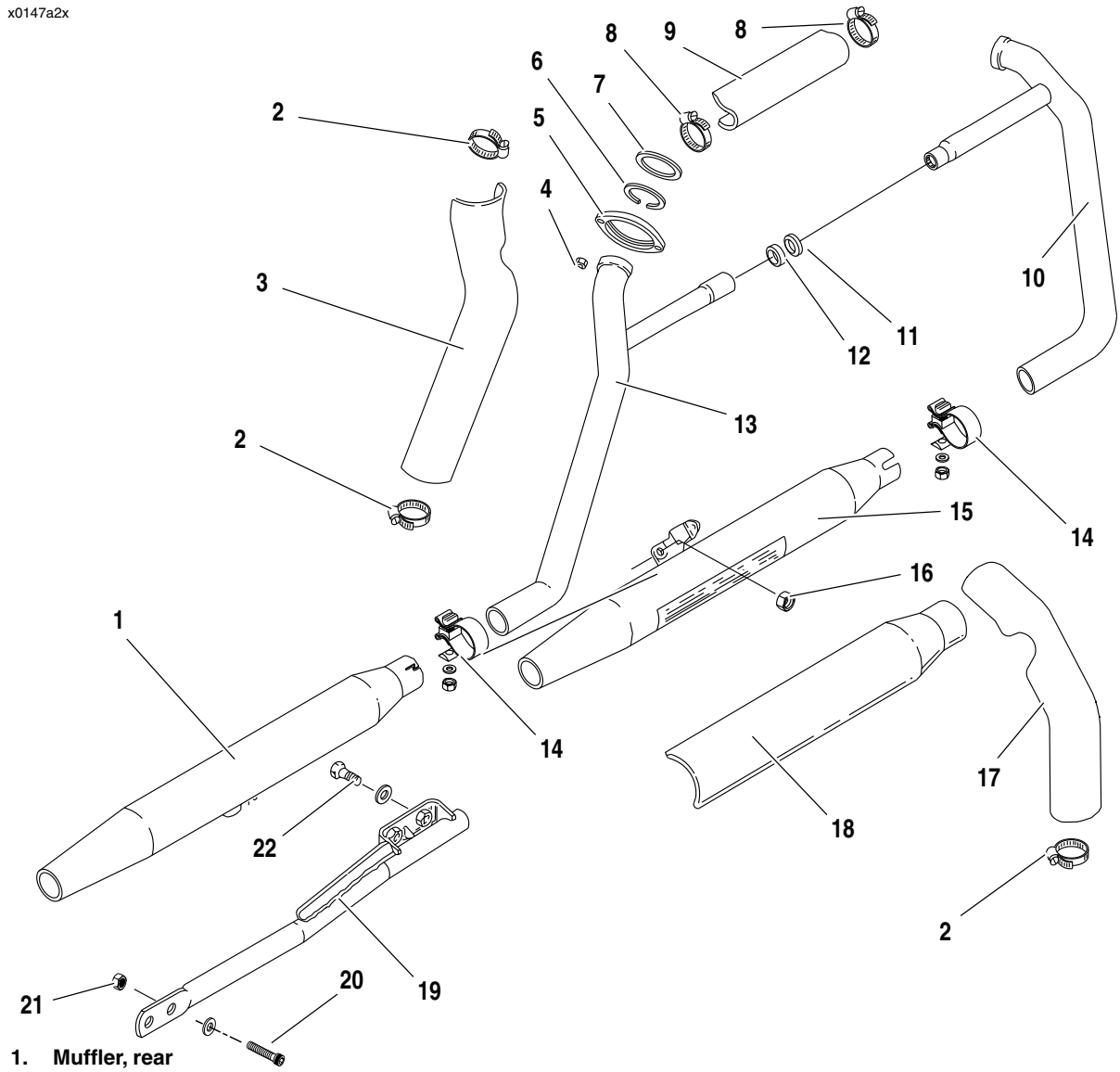
2. Remove front and rear mufflers (15 and 1) from exhaust pipes (13 and 10).
3. Separate front and rear exhaust pipes (10 and 13) at crossover pipe.

ASSEMBLY

1. See Figure 2-120. Insert **new** gasket (12) and washer (11) into crossover pipe on rear exhaust pipe (13). Connect rear exhaust pipe (13) to front exhaust pipe (10) at crossover pipe.
2. Place clamp (5), retaining ring (6) and new gasket (7) over front end of each exhaust pipe (front and rear). Position clamp so that inside counterbore faces cylinder head exhaust port.

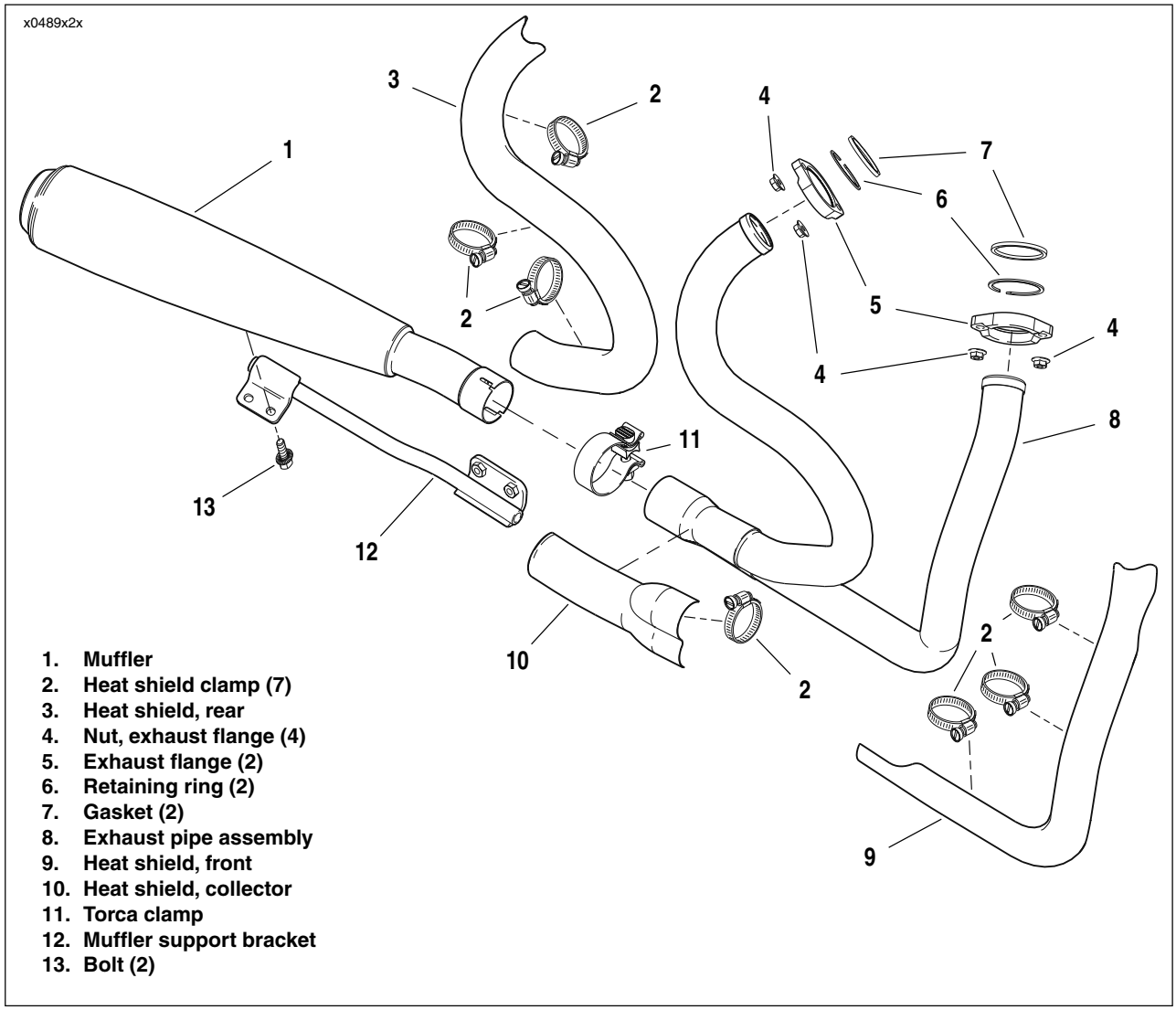
INSTALLATION

1. See Figure 2-120. Position front ends of front and rear exhaust pipes (10, 13) into front and rear cylinder heads, respectively. Position holes in clamps (5) over mounting studs and loosely install nuts (4).
2. Place **new** Torca clamps (14) over slotted end of each muffler. Install each muffler (1 and 15) onto the end of its respective exhaust pipe. Front and rear mufflers can be identified by their tabs. Both sides of tab on rear muffler are of equal length (symmetrical) and the hole is smaller; on the front muffler, one side of tab is angular and the hole is larger.
3. Rotate front muffler (15) until tab is at top. Place tab over stud at sprocket cover. Loosely install nut (16) on stud.
4. Rotate rear muffler (1) until tab is at bottom. Align tab with hole in muffler support (19). Insert bolt (20) through holes in muffler support and muffler tab. Loosely install locknut (21) on end of bolt.
5. Tighten nuts (4) at cylinder head exhaust studs to 6-8 ft-lbs (8-11 Nm). Tighten Torca clamps to 35-40 ft-lbs (47-54 Nm). Tighten locknut (16) at sprocket cover stud to 20-40 ft-lbs (27-54 Nm). Tighten locknut (21) at muffler support (15) to 10-15 ft-lbs (14-20 Nm). Install master cylinder mounting bolts, and tighten to 155-190 **in-lbs** (17.5-21.5 Nm).
6. Open worm drive clamps (2) and install heat shields (3, 9 and 17) on exhaust pipes. Position clamp so that screw is on the outboard side in the most accessible position.



1. Muffler, rear
2. Heat shield clamp
3. Heat shield, rear
4. Nut (4)
5. Clamp
6. Retaining ring
7. Gasket
8. Crossover pipe shield clamp
9. Heat shield
10. Exhaust pipe, front
11. Washer
12. Gasket
13. Exhaust pipe, rear
14. Torca clamp
15. Muffler, front
16. Locknut
17. Heat shield, front
18. Heat shield (Swiss)
19. Muffler support
20. Bolt
21. Locknut (2)
22. Screw (2)

Figure 2-120. Exhaust System



1. Muffler
2. Heat shield clamp (7)
3. Heat shield, rear
4. Nut, exhaust flange (4)
5. Exhaust flange (2)
6. Retaining ring (2)
7. Gasket (2)
8. Exhaust pipe assembly
9. Heat shield, front
10. Heat shield, collector
11. Torca clamp
12. Muffler support bracket
13. Bolt (2)

Figure 2-121. Exhaust System - 883R

REMOVAL

1. See Figure 2-121. Remove heat shields (3, 9 and 10) by opening worm drive clamps (2).
2. Remove nuts (4) from front and rear cylinder head exhaust studs.
3. Remove two bolts (13) to detach muffler (1) from muffler support bracket (12).
4. Remove exhaust system assembly.

DISASSEMBLY

1. See Figure 2-121. Remove Torca clamp assembly (11) from muffler (1). Discard Torca clamp assembly - it is a one-time usage only clamp.

NOTE

New 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.

2. Remove muffler (1) from exhaust pipe assembly (8).

ASSEMBLY

See Figure 2-121. Place clamp (5), retaining ring (6) and new gasket (7) over front end of each exhaust pipe (front and rear). Position clamp so that inside counterbore faces cylinder head exhaust port.

INSTALLATION

1. See Figure 2-121. Position front ends of exhaust pipe (8) into front and rear cylinder heads. Position holes in exhaust flanges (5) over mounting studs and loosely install nuts (4).
2. Place **new** Torca clamp (11) over slotted end of muffler. Install muffler (1) onto rear end of exhaust pipe.
3. Rotate muffler (1) until mounting bracket on muffler lines up with mounting tab on muffler support bracket (12). Loosely install bolts (13) on muffler.
4. Tighten nuts (4) at cylinder head exhaust studs to 6-8 ft-lbs (8-11 Nm). Tighten Torca clamp to 35-40 ft-lbs (47-54 Nm). Tighten bolts (13) at muffler support (12) to 10-15 ft-lbs (14-20 Nm).
5. Open worm drive clamps (2) and install heat shields (3, 9 and 10) on exhaust pipes. Position each clamp so that screw is on the outboard side in the most accessible position. Tighten each worm drive clamp securely. Do NOT overtighten!

NOTE

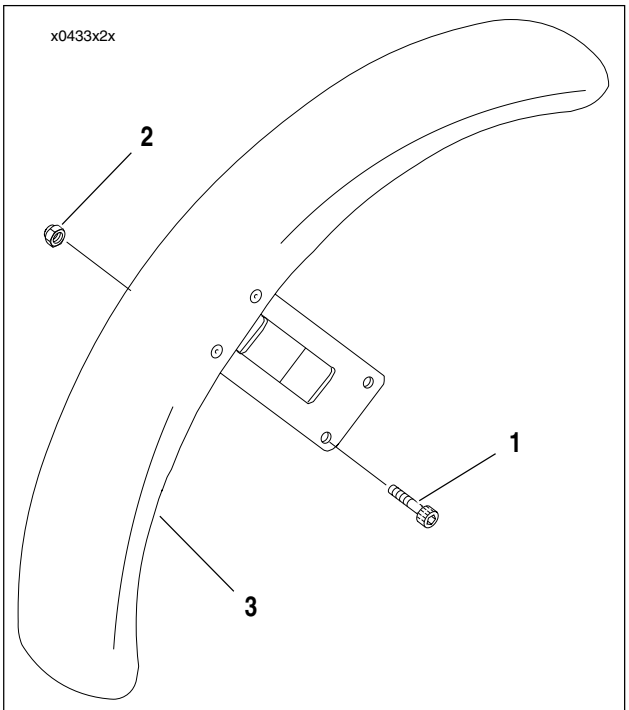
Install front (9) and rear (3) exhaust pipe heat shields FIRST, then install collector heat shield (10).

REMOVAL

1. See Figure 2-122. Remove four socket head screws (1) and locknuts (2) to detach front fender (3) from front sliders.
2. Remove fender.

INSTALLATION

1. See Figure 2-122. Carefully position front fender between right and left front sliders.
2. Secure fender (3) using four socket head screws (1) and locknuts (2). Tighten locknuts to 8-13 ft-lbs (11-18 Nm).

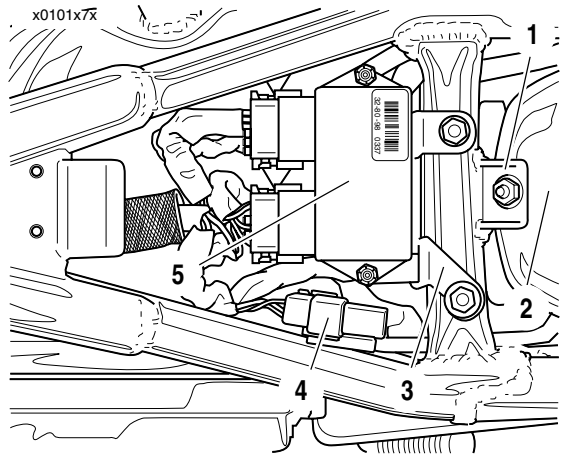


1. **Screw (4)**
2. **Locknuts (4)**
3. **Fender, front**

Figure 2-122. Front Fender

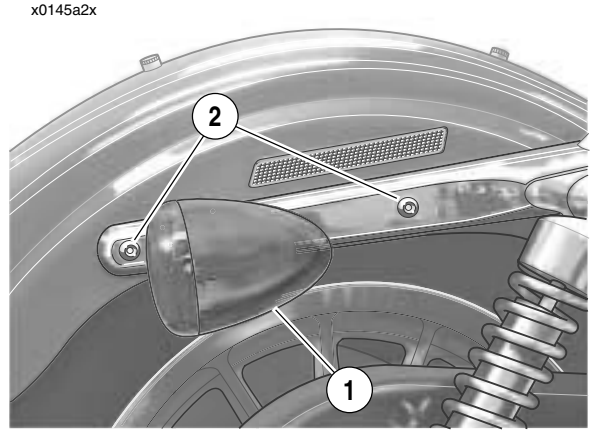
REMOVAL

1. Remove seat. See 2.34 SEAT, REMOVAL.
2. See Figure 2-123. Remove locknut, bolt and T-spacer to detach top of rear fender from tab on frame cross member.
3. See Figure 2-124. Remove rear directional stalk nut and T-spacer from inside rear fender (both sides). Remove two fender support nuts, screws and T-spacers (both sides). Move chrome steel strut covers away from rear fender.
4. See Figure 2-125. Remove the two screws and taillamp lens from base. Note the electrical connectors located on taillamp circuit board. Depress latch on connectors to disconnect from rear lighting circuit board.
5. See Figure 2-123. On 1200S remove two bolts to detach electrical bracket from frame cross member. Move electrical bracket to expose turn signal module.
6. Disconnect connector [30B] at turn signal module. Depress the two external latches and use a rocking motion to remove connector.
7. Carefully remove rear fender with attached tail/brake light assembly from motorcycle.
8. Un-clip tail/brake light lead from clamps spot welded to right inside fender at eight locations. Remove speed nuts from tapered studs on taillamp assembly. Discard speed nuts.
9. Remove tail/brake light base from fender.
10. Remove directional canceller and foam washer from fender.



1. **Locknut, bolt and T-spacer**
2. **Rear fender**
3. **Electrical bracket**
4. **Speedometer connector**
5. **Ignition module (1200S Sport)**

Figure 2-123. Rear Fender Removal



1. **Directional stalk nut (under fender)**
2. **Fender support screws**

Figure 2-124. Rear Fender, Strut Cover and Directional Lamp Assembly

INSTALLATION

NOTE

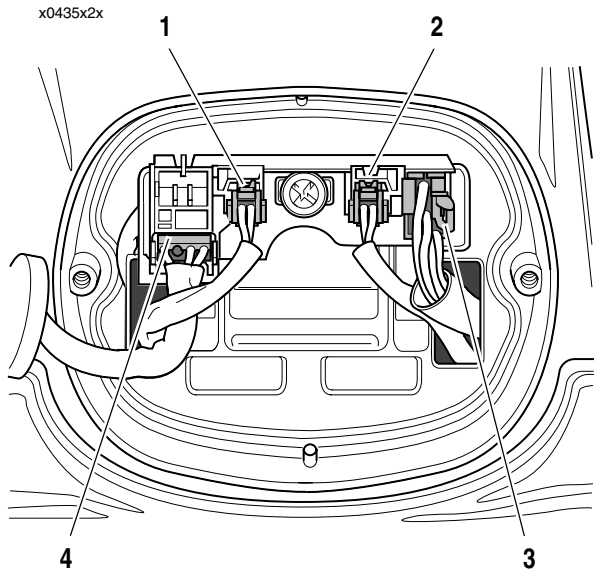
Complete steps 1-3 if a new fender is being installed, otherwise proceed to step 4.

1. Remove passenger strap from old fender, if provided. Install passenger strap on new fender. See 2.34 SEAT, REMOVAL for more information.
2. See Figure 2-127. Remove three 1/4”-28 nuts securing license plate bracket. Position assembly on new fender. Tighten screws to 6 ft-lbs (8 Nm).
3. Carefully drill out pop rivets securing plastic fender extension with a 1/4-in. (6.35 mm) diameter drill bit. Rivet fender extension to new fender.
4. Position foam washer under turn signal module and attach to fender. Tighten screw to 3-5 in-lbs (.3-.6 Nm).
5. Insert tapered studs at back of tail/brake light base through fender bracket holes. Install **new** speed nuts and tighten.
6. Position wire harness under clips attached to T-studs.
7. Verify that grommets are installed at all 7 mounting points- 3 on each side, one at the top. Install grommets so that metal of fender is completely seated in groove on grommet O.D.
8. Install T-spacers in grommets (inboard side).
9. Carefully align holes in fender with those in strut.
10. See Figure 2-125. Push 6-pin Amp connector [94] and left [18] and right [19] turn signal connectors through access hole in tail lamp base and connect as shown.
11. See Figure 2-125. Insert taillamp connector [93] in taillamp base as shown. Attach taillamp lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm).
12. See Figure 2-123. On 1200S align holes in electrical bracket with wellnuts in cross member of motorcycle frame. Install two bolts and tighten to 6-9 **in-lbs** (0.7-1.0 Nm).

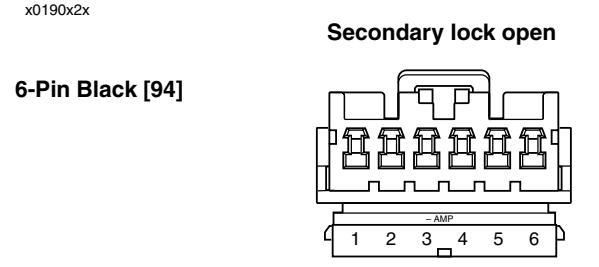
CAUTION

Always install and tighten top fender bolt first or undue stresses may lead to fender cracking.

13. Install top fender bolt. Hold bolt head at underside of fender and install nut topside. Tighten top fender nut to 10 ft-lbs (14 Nm).



1. **Left turn signal [18]**
2. **Right turn signal [19]**
3. **Power in [94]**
4. **Taillamp [93]**



1. **Orange w/white tracer**
2. **Brown**
3. **Blue**
4. **Red w/yellow tracer**
5. **Violet**
6. **Black**

Figure 2-125. Tail Lamp Connectors

14. Align holes in chrome strut cover with those in strut. Verify that directional light leads are positioned under strut cover so that they are not pinched when cover is tightened.
15. See Figure 2-124. Slide directional stalk stud through holes in strut cover, strut and fender. Install nut.
16. Install fender support screws through strut cover, strut and fender. Install nuts.

⚠WARNING

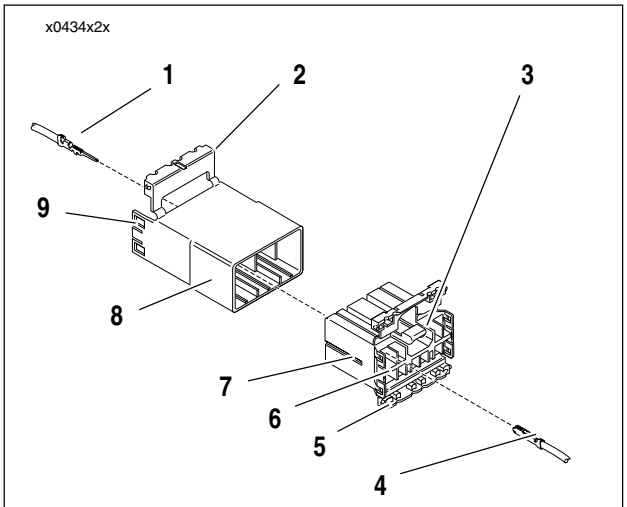
Check for proper tail lamp operation before riding motorcycle. Visibility is a major concern for motorcyclists. Improper tail lamp operation may lead to an accident which could result in death or serious injury.

17. Tighten directional stalk and fender support nuts to 8-13 ft-lbs (11-18 Nm).

⚠WARNING

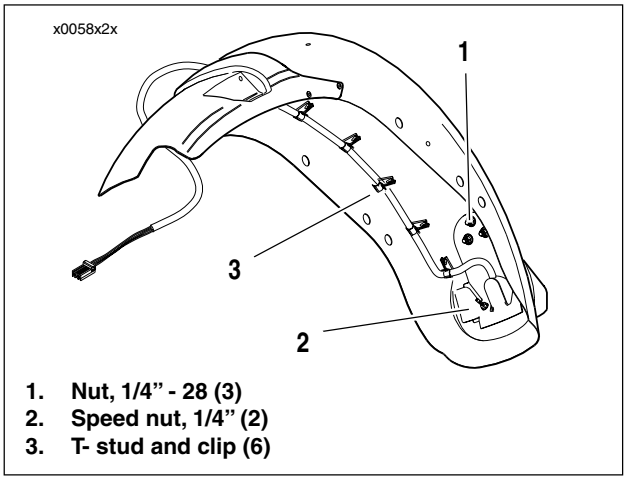
After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control and personal injury.

18. Install seat. See 2.34 SEAT, INSTALLATION.



1. **Pin Terminal**
2. **Secondary Lock (open)**
3. **Button**
4. **Socket Terminal**
5. **Secondary Lock (open)**
6. **Latch**
7. **Socket Housing**
8. **Pin Housing**
9. **Latch**

Figure 2-126. Amp Multi-lock Connector (10 Place Shown)



1. **Nut, 1/4" - 28 (3)**
2. **Speed nut, 1/4" (2)**
3. **T- stud and clip (6)**

Figure 2-127. Tail/Brake Lamp and License Plate Bracket Removal

GENERAL

The vehicle is equipped with a jiffy stand (or side stand) that locks when placed in the full forward position (down) with the full weight of the vehicle resting on it.

⚠WARNING

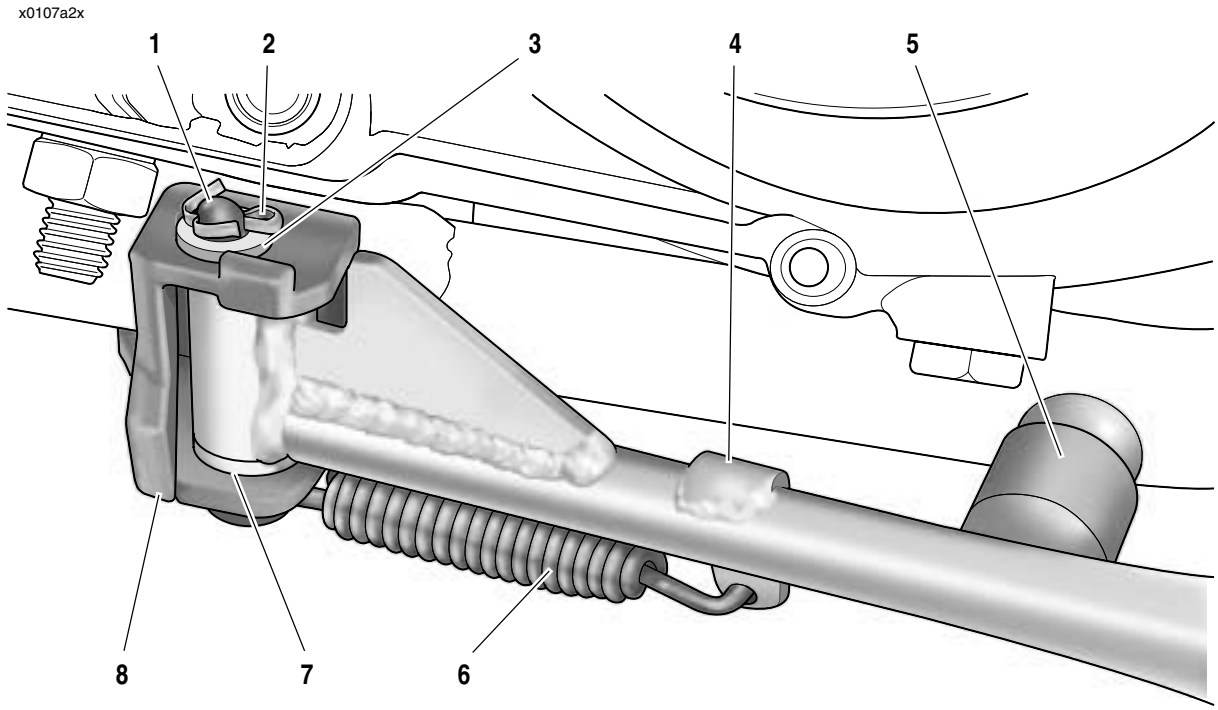
Without the weight of the motorcycle resting on the jiffy stand, any vehicle movement could cause the jiffy stand to retract slightly from the full forward position. If the jiffy stand is not in the full forward or lock position when vehicle weight is rested on it, the vehicle could fall over, resulting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

⚠WARNING

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

⚠WARNING

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



1. **Clevis pin**
2. **Cotter pin**
3. **Bushing**
4. **Jiffy stand leg**
5. **Rubber bumper**
6. **Spring**
7. **Bushing**
8. **Jiffy stand yoke**

Figure 2-128. Jiffy Stand Retracted Position

REMOVAL

⚠WARNING

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

1. Block motorcycle under frame so that motorcycle is securely upright and jiffy stand may be moved through its full range of travel.
2. See Figure 2-128. Remove rubber bumper (5) from frame to permit further retraction of jiffy stand leg (4). Additional spring tension relief allows for easier spring removal.
3. Place jiffy stand leg (4) in retracted position. Remove and discard cotter pin (2).
4. See Figure 2-129. While firmly holding jiffy stand leg (5) in fully retracted position, withdraw clevis pin (1) until it disengages with the upper pivot hole of jiffy stand yoke (4).
5. Detach spring (6) from anchor pin using pliers. Unhook other end of spring from jiffy stand leg (5).
6. Remove clevis pin (1) from lower pivot hole of jiffy stand yoke (4). Remove jiffy stand leg (5). Remove upper and lower bushings (2).

CLEANING AND LUBRICATION

Clean and lubricate jiffy stand assembly every 5,000 miles (8,000 km). Proceed as follows:

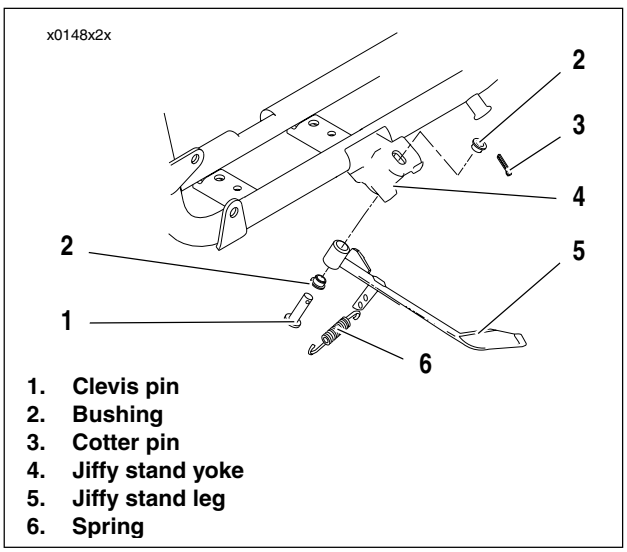
1. See Figure 2-129. Refer to 2.33 JIFFY STAND, REMOVAL to remove jiffy stand from motorcycle frame.
2. Thoroughly clean all jiffy stand components, including frame-mounted anchor pin and jiffy stand yoke (4).
3. Apply a small amount of wheel bearing grease to pivot holes of jiffy stand leg (5) and yoke (4), groove of anchor pin (3) and O.D. of clevis pin (1).
4. Refer to 2.33 JIFFY STAND, INSTALLATION to install jiffy stand to motorcycle frame.

INSTALLATION

⚠WARNING

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

1. Clean and lubricate jiffy stand components according to procedure listed in 2.33 JIFFY STAND, CLEANING AND LUBRICATION.
2. See Figure 2-129. Hook either end of spring (6) into spring mounting hole on jiffy stand leg (5). Install loose end of spring over anchor pin.
3. While holding end of spring (6) in groove of anchor pin and holding jiffy stand leg (5) in its retracted position, position pivot end of jiffy stand leg within yoke (4) on motorcycle frame. Insert clevis pin (1) through lower pivot hole of yoke and halfway into pivot hole of jiffy stand leg.
4. See Figure 2-128. Lift jiffy stand leg (4) upward, aligning pivot hole of jiffy stand leg with slotted upper hole of yoke (8). With shoulder down, position bottom bushing (7), over clevis pin (1). Insert clevis pin (1) through holes in jiffy stand leg and yoke.
5. Install upper bushing (3) over end of clevis pin (1) and against upper surface of yoke (8). Insert **new** cotter pin (2) through hole in end of clevis pin. Bend ends of cotter pin apart to secure.
6. Press rubber bumper (5) onto mounting stud on motorcycle frame.
7. Extend and retract jiffy stand leg several times to check for proper operation. In retracted position (up), jiffy stand leg should be securely seated against frame-mounted rubber bumper (5).
8. Place jiffy stand in its full forward position (down). Carefully remove support blocking from beneath motorcycle frame. Rest motorcycle on jiffy stand.



1. **Clevis pin**
2. **Bushing**
3. **Cotter pin**
4. **Jiffy stand yoke**
5. **Jiffy stand leg**
6. **Spring**

Figure 2-129. Jiffy Stand

REMOVAL

1. See Figure 2-131. Remove screw (4) to detach seat from rear fender.
2. Slide seat rearward to remove from frame.
3. If dual seat, inspect passenger strap (2) for damage or excessive wear. Remove bolt (1) and flat washer (3) to detach passenger strap from rear fender, if necessary.

INSTALLATION

1. See Figure 2-131. Install passenger strap if mounting dual seat. Align holes on each end of strap with forward hole in rear fender. With concave side up, align hole in flat washer (3) with those in strap (2). Install bolt (1) and tighten to 8-13 ft lbs (11-18 Nm).

⚠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 during vehicle operation and startle the rider, causing loss of control and death or serious injury.

2. Verify that rectangular metal plate is tightly secured to seat bottom and that no rivets are loose or missing. Position seat on frame with mounting bracket (8) at rear.
3. See Figure 2-130. Slide seat forward until the tongue welded to center frame support fits snugly in groove at bottom of seat. The groove is formed where the contoured ribs are bridged by the metal plate.
4. Pull up on seat to verify that it is locked in place.
5. See Figure 2-131. Install screw (4) to fasten seat mounting bracket to top of rear fender. Mounting bracket of solo seat uses forward hole in rear fender; dual seat uses rearward hole.
6. Tighten mounting bracket screw (4).
7. Pull up on seat again to verify that it is properly secured, front and rear.

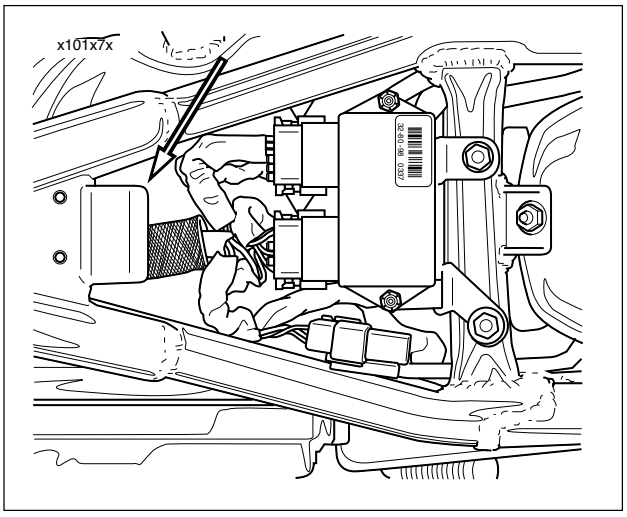
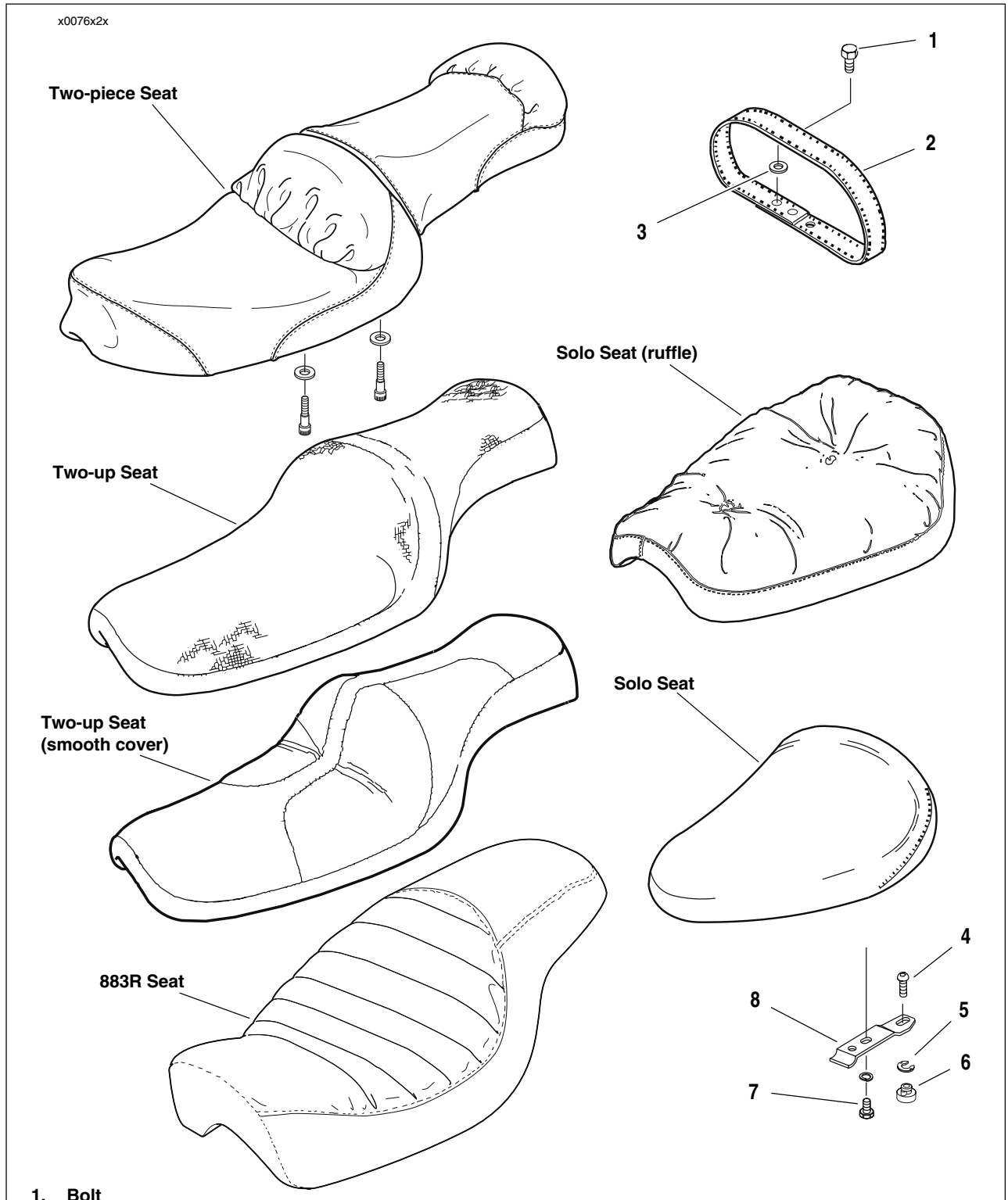


Figure 2-130. Seat Installation Tongue (1200S Shown)



1. **Bolt**
2. **Passenger strap**
3. **Flat washer**
4. **Seat mounting screw**
5. **Retaining clip**
6. **Seat nut**
7. **Screw**
8. **Mounting bracket**

NOTE

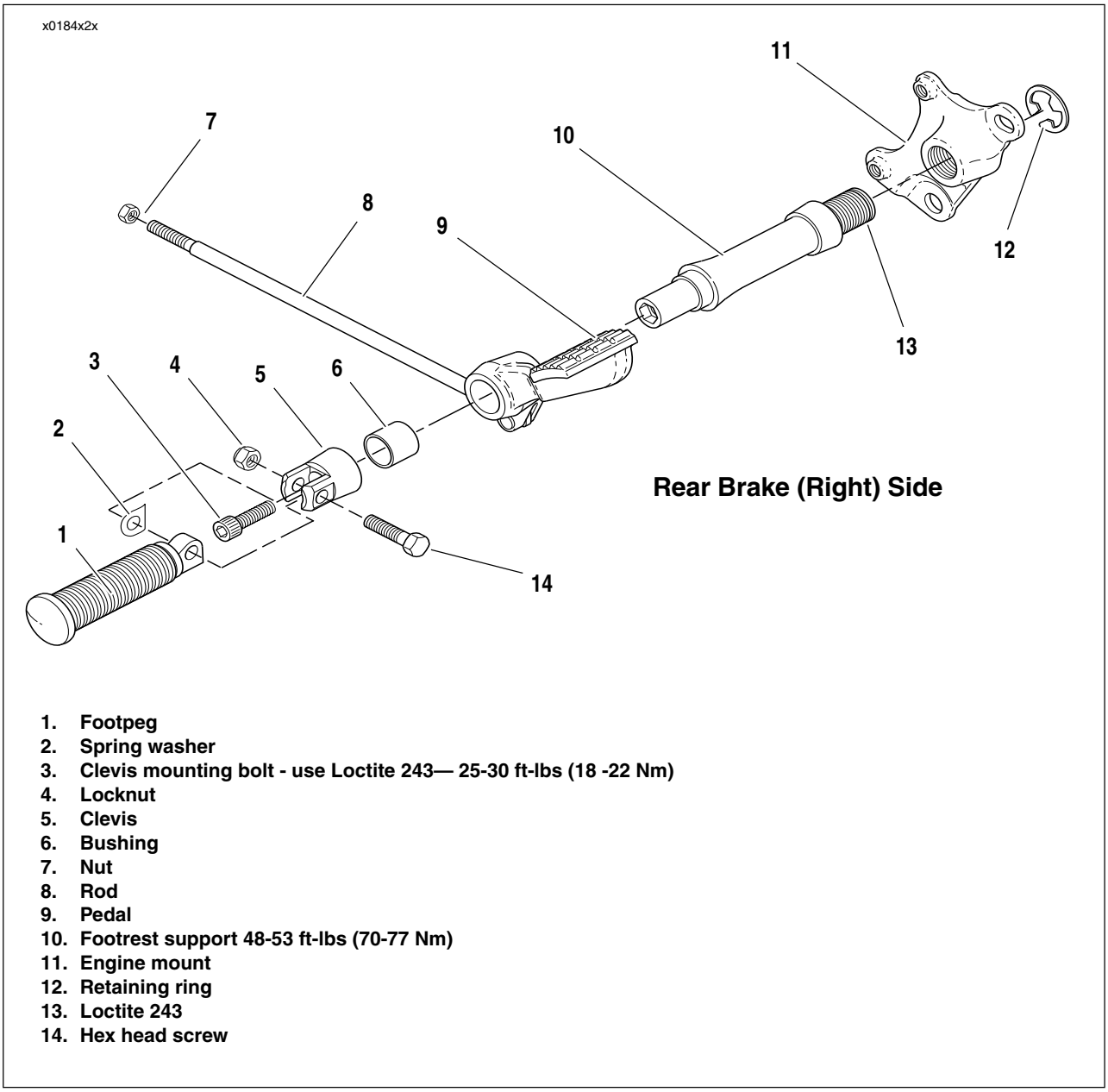
Seat nut (6) is inserted from under side of fender and retaining clip (5) is located on top side.

Figure 2-131. Seat

REMOVAL

NOTE

Right side access is improved by exhaust system removal, See 2.29 EXHAUST SYSTEM.



1. Footpeg
2. Spring washer
3. Clevis mounting bolt - use Loctite 243— 25-30 ft-lbs (18 -22 Nm)
4. Locknut
5. Clevis
6. Bushing
7. Nut
8. Rod
9. Pedal
10. Footrest support 48-53 ft-lbs (70-77 Nm)
11. Engine mount
12. Retaining ring
13. Loctite 243
14. Hex head screw

Figure 2-132. XL883C/1200C Forward Controls-Brake Side

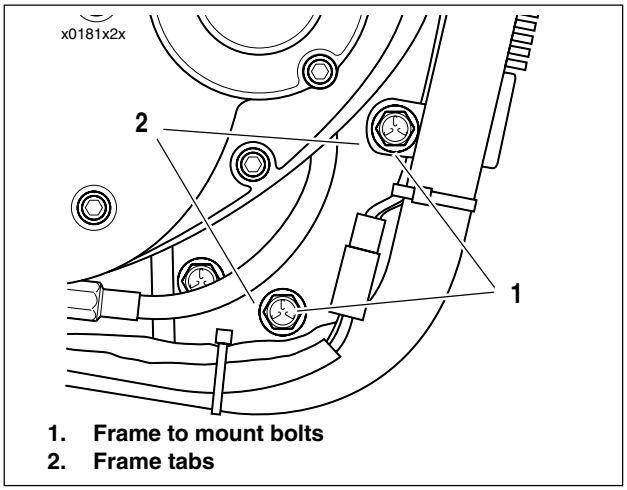
Right Side (Rear Brake) Removal

1. See Figure 2-132. On brake side remove footpeg (1) and clevis (5). Slide brake pedal assembly off of the footrest support with the brake rod still attached to the pedal.

CAUTION

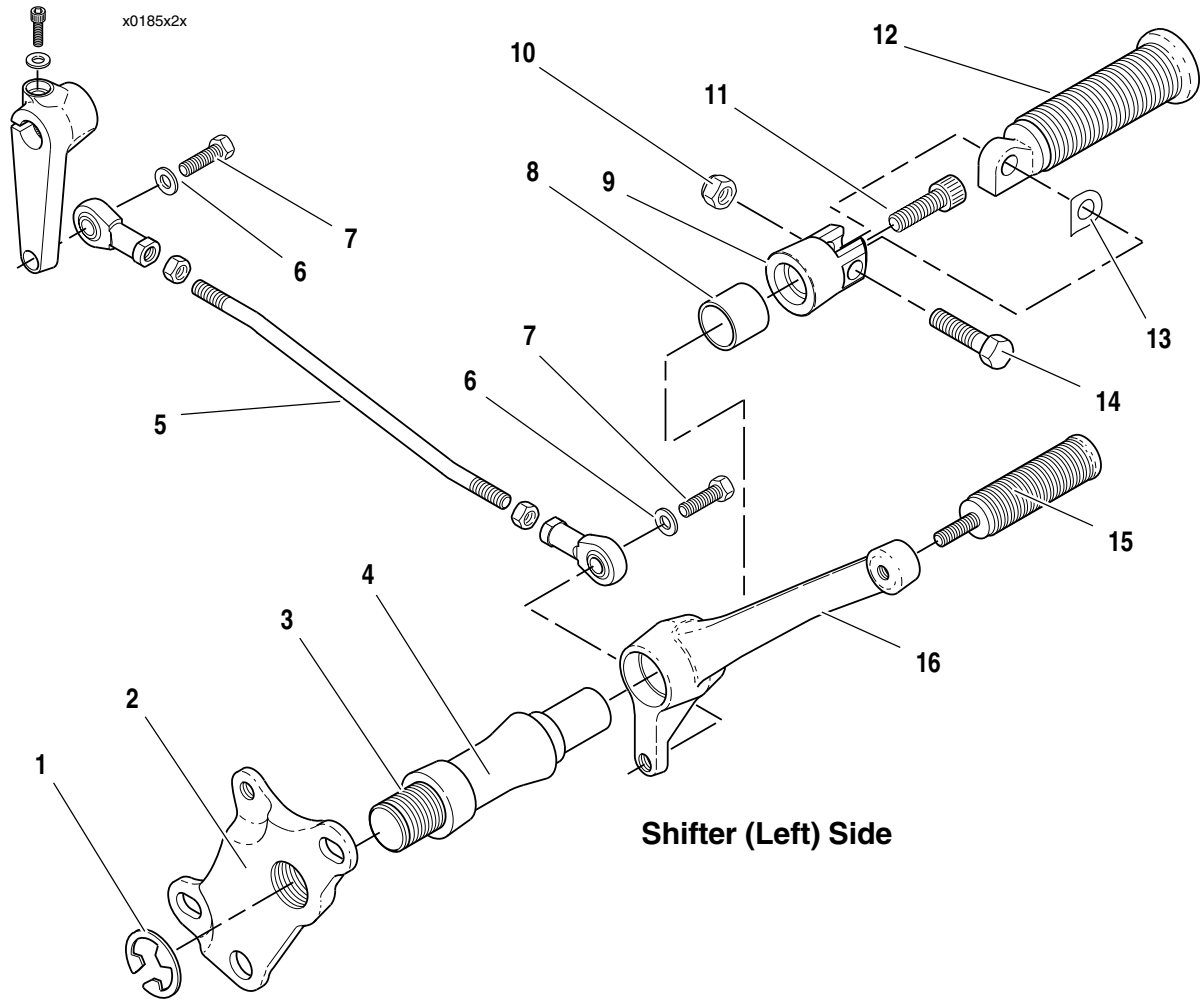
Do not remove clevis pin and cotter pin at the rod to pedal connection. The clevis pin is pressed into the pedal and is not serviceable. If pedal or rod is damaged the entire assembly must be replaced.

2. Loosen lock nut (7) then turn entire brake pedal assembly to unthread pedal and rod from master cylinder.
3. See Figure 2-133. Remove right side frame-to-mount bolts.
4. Remove mount-to-motor bolts.



1. Frame to mount bolts
2. Frame tabs

Figure 2-133. Engine Mounts - Right Side



1. Retaining ring
2. Engine mount
3. Clevis mounting bolt - use Loctite 243
4. Footrest support 48-53 ft-lbs (70-77 Nm)
5. Rod
6. Washer
7. Rod end bolts 15 ft-lbs (22 Nm)
8. Bushing
9. Clevis
10. Locknut
11. Loctite 243--- 25-30 ft-lbs (18-22 Nm)
12. Footpeg
13. Spring washer
14. Hex head screw
15. Shifter peg
16. Shifter lever

Figure 2-134. XL883C/1200C Forward Controls-Shifter Side

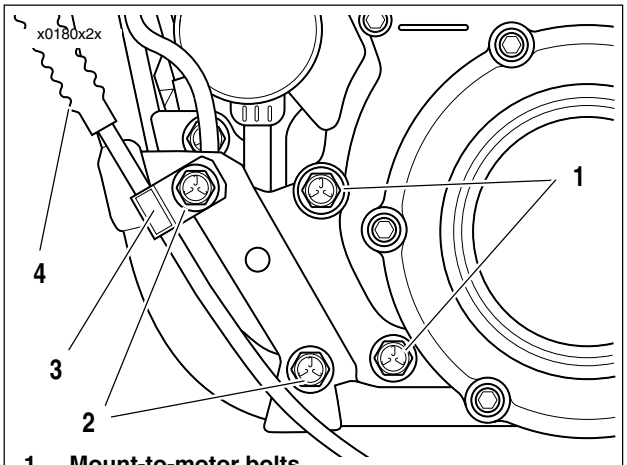
Left Side (Shifter Side) Removal

1. See Figure 2-134. Disconnect shift rod (5) on left side.
2. See Figure 2-135. On left side, remove frame-to-mount bolts (2). Note the location of the clutch cable (4) and the P-clamp (3) for later reinstallation.
3. Remove mount-to-motor bolts (1).

INSTALLATION

Right Side (Rear Brake) Installation

1. See Figure 2-133. Install right side engine mount to frame tabs. Mount must be attached inboard from the frame tabs.
2. See Figure 2-132. Using Loctite 243 (13) on threads, install footrest support (10) on right engine mount. Tighten footrest support to 48-53 ft-lbs (70-77 Nm).
4. See Figure 2-132. Install retaining ring (12) on backside of footrest support where it exits the motor mount.
3. See Figure 2-136. Install brake pedal assembly into master cylinder by turning rod by flats to catch thread at master cylinder, then slide pedal onto the foot control support.
5. See Figure 2-132. Apply Loctite 243 to clevis mounting screw (3) and install clevis (5).
6. Place a spring washer (2) and mount end of footpeg inside the slots of the clevis (5). Make sure spring washer is positioned inside clevis with the square edge towards the inside.



1. **Mount-to-motor bolts**
2. **Frame-to-mount bolts**
3. **P-Clamp**
4. **Cable clutch**

Figure 2-135. Engine Mounts - Left Side

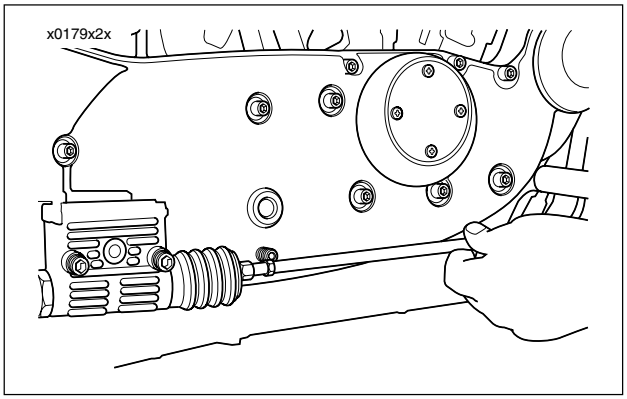


Figure 2-136. Brake Pedal Assembly

7. See Figure 2-137. Adjust the rod end lengths until controls are at 45°.

Left Side (Shifter Side) Installation

1. See Figure 2-135. Install left side engine mount to frame tabs. Mount must be attached outboard from the frame tabs. Make sure to reinstall the P-clamp and clutch cable in position as removed in step 3.
2. See Figure 2-132. Install retaining ring (12) on backside of footrest support where it exits the motor mount.
4. See Figure 2-138. Install shift lever pedal.
5. Reconnect shift rod.
6. See Figure 2-134. Using Loctite 243 on threads (3), install footrest support (4) on left engine mount and tighten to 48-53 ft-lbs (70-77 Nm).
7. Install retaining ring (1) on backside of footrest support (4) where it exits the motor mount.
8. Apply Loctite 243 to clevis mounting screw (11) and install clevis.
9. Place a spring washer and mount end of footpeg inside the slots of the clevis. Make sure spring washer is positioned inside clevis with the square edge towards the inside.
10. See Figure 2-137. Adjust the rod end lengths until controls are at 45°.

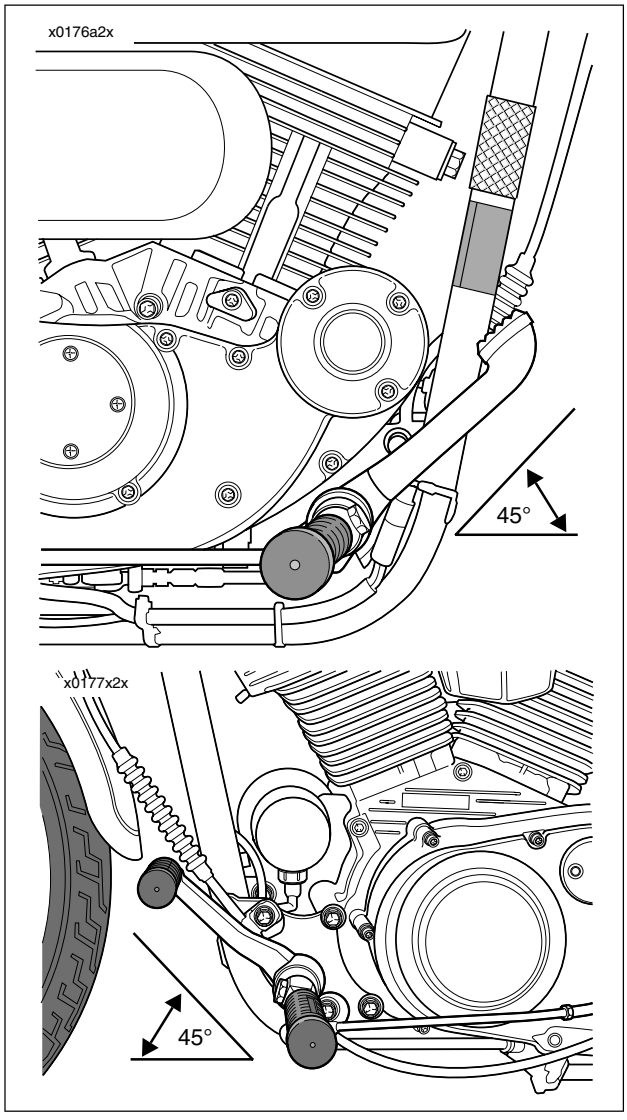


Figure 2-137. Control Adjustment

11. See Figure 2-138. Install shift lever pedal.

12. Reconnect shift rod.

13. See Figure 2-134. Using Loctite 243 on threads (3), install footrest support (4) on left engine mount and tighten to 48-53 ft-lbs (70-77 Nm)

14. Install retaining ring (1) on backside of footrest support (4) where it exits the motor mount.

15. Apply Loctite 243 to clevis mounting screw (11) and install clevis.

16. Place a spring washer and mount end of footpeg inside the slots of the clevis. Make sure spring washer is positioned inside clevis with the square edge towards the inside.

17. See Figure 2-137. Adjust the rod end lengths until controls are at 45°.

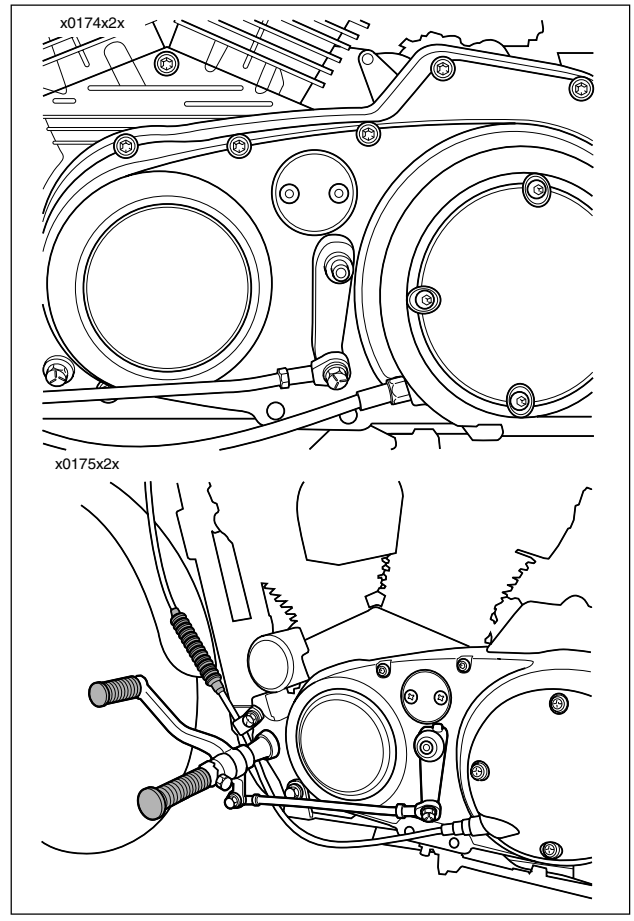


Figure 2-138. Shifter and Footrest Assembly

FORK LOCK - HDI MODELS 2.36

GENERAL

The lock pin which orients the lock assembly in the lock housing is rotated 45° toward the rear of the vehicle. This eliminates the need to remove the fuel tank to facilitate the removal of the fork lock assembly.

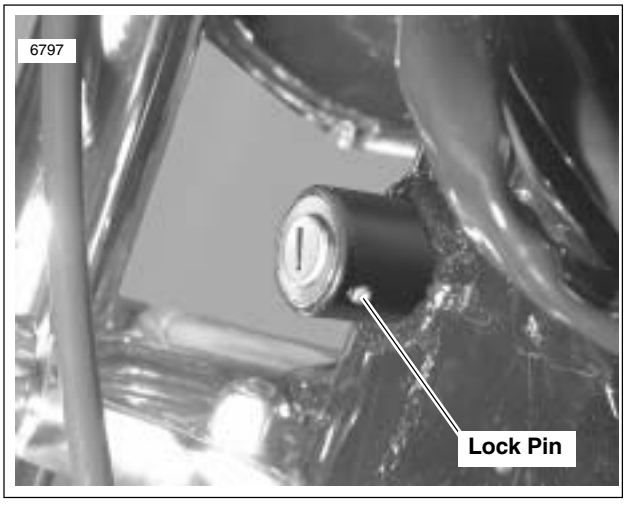


Figure 2-139. HDI Fork Lock

REMOVAL

1. Using a 5/64 inch drill bit, carefully drill a hole in the center of the lock pin.

NOTE

Take time to carefully orient drill bit to center of lock pin. If drill bit "walks" off-center, removal of lock pin will be difficult.

2. To remove lock pin, insert a screw extractor into the 5/64 inch (2 mm) hole. Hold body of screw extractor with a pliers or tap handle and using a small hammer gently "tap" on the pliers or tap handle to remove lock pin.
3. Remove lock assembly.

INSTALLATION

1. Insert new lock assembly in frame lock housing.
2. Align lock pin hole in new lock assembly with hole in the frame lock housing.
3. Drive new lock pin in position (flush with frame lock housing).

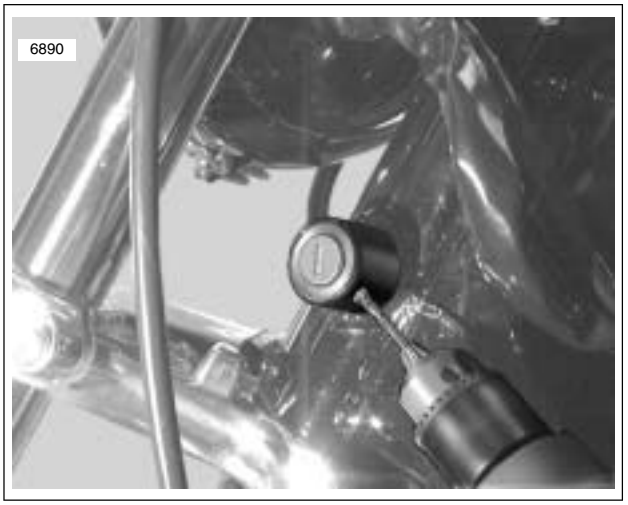


Figure 2-140. Drill Lock Pin

Figure 2-141. Removing Lock Pin

ENGINE 3

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NOTE

Service wear limits are given as a guideline for measuring components that are not new. For measurements not given under SERVICE WEAR LIMITS, see NEW COMPONENTS.

Table 3-1. General Specifications

GENERAL	883cc	1200cc	1200S SPORT
Number of Cylinders	2	2	2
Type	4-cycle, 45° V	4-cycle, 45° V	4-cycle, 45° V
Horsepower	57@ 6000 rpm	66@ 5200 rpm	69@ 5500 rpm
Bore (in.)	3.0005	3.498	3.498
Bore (mm)	76.20	88.85	88.85
Stroke (in.)	3.812	3.812	3.812
Stroke (mm)	96.82	96.82	96.82
Piston Displacement (cubic inches)	53.9	73.3	73.3
Piston Displacement (cc)	883	1203	1203
Torque (foot-pounds) (Nm)	53@ 4500 rpm	72@ 4000 rpm	76@ 4000 rpm
Compression Ratio	9.0 to 1	9.0 to 1	10.0 to 1
Oil tank capacity with filter (U.S. quarts)	3	3	3
Oil tank capacity with filter (Liters)	2.8 Liters	2.8 Liters	2.8 Liters

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
VALVE	**883cc**	**1200cc**	
Fit in guide	N/A	N/A	N/A
Exhaust (in.)	0.0015 - 0.0033	*	0.0040
Exhaust (mm)	0.038 - 0.084	*	0.102
Intake (in.)	0.0008 - 0.0026	*	0.0035
Intake (mm)	0.020 - 0.066	*	0.089
Seat Width (in.)	0.040 - 0.062	*	0.090
Seat Width (mm)	1.02 - 1.57	*	2.29
Stem protrusion from cylinder valve pocket (in.)	1.975 - 2.011	*	2.031
Stem protrusion from cylinder valve pocket (mm)	50.17 - 51.08	*	51.59
OUTER SPRING	**883cc**	**1200cc**	**SERVICE WEAR LIMITS**
Outer Spring - free length (in.)	2.105 - 2.177	*	2.105 (min.)
Outer Spring - free length (mm)	53.47 - 55.30	*	53.47

* Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
VALVE (CONTINUED)	883cc	1200cc	
OUTER SPRING INTAKE			
Closed 1.751-1.848 in. (lbs)	72 - 92	*	N/A
Closed 1.751-1.848 in. (kg)	32.6 - 41.7	*	N/A
Open 1.286-1.383 in. (lbs)	183 - 207	*	N/A
Open 1.286-1.383 in. (kg)	82.9 - 93.8	*	N/A
OUTER SPRING EXHAUST			
Closed 1.751-1.848 in. (lbs)	72 - 92	N/A	N/A
Closed 1.751-1.848 in. (kg)	32.6 - 41.7	*	1.926 in. (min.)
Open 1.286-1.429 in. (lbs)	171 - 195	*	48.82 mm
INNER SPRING			
Inner Spring - free length (in.)	1.926 - 1.996	*	N/A
Inner Spring - free length (mm)	48.92 - 20.70	*	N/A
INNER SPRING EXHAUST			
Closed 1.577-1.683 in. (lbs)	38 - 49	N/A	N/A
Closed 1.577-1.683 in. (kg)	17.2 - 22.2	*	N/A
Open 1.158-1.264 in. (lbs)	91 - 106	*	N/A
Open 1.158-1.264 in. (kg)	41.2 - 48.0	*	N/A
ROCKER ARM			
Shaft in bushing (loose) (in.)	0.0005 -.00020	*	0.0035
Shaft in bushing (loose) (mm)	0.013 -.0.051	*	0.089
End Clearance (in.)	0.003 - 0.013	*	0.025
End Clearance (mm)	0.08 - 0.33	*	0.64
Bushing fit in rocker arm (in.)	0.004 - 0.002	*	N/A
Bushing fit in rocker arm (mm)	0.10 - 0.05	*	N/A
ROCKER ARM SHAFT			
Shaft fit in rocker cover (in.)	0.0007 - 0.0022	*	0.0035
Shaft fit in rocker cover (mm)	0.018-0.056	*	0.089

*Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
PISTON	**883cc**	**1200cc**	
Compression ring gap (top & 2nd) (in.)	0.010 - 0.023	0.007 - 0.020	0.032
Compression ring gap (top & 2nd) (mm)	0.25 - 0.58	0.18 - 0.51	0.81
Oil control ring rail gap (in.)	0.0010 - 0.053	0.009 - 0.052	0.065
Oil control ring rail gap (mm)	0.25 - 1.35	0.23 - 1.32	1.65
Compression ring side clearance top (in.)	0.0020 - 0.0045	0.0020 - 0.0045	0.0065
Compression ring side clearance Top (mm)	0.051 - 0.114	0.051 - 0.114	1.65
Compression ring side clearance 2nd (in.)	0.0020 - 0.0045	0.0016 - 0.0041	0.0065
Compression ring side clearance 2nd (mm)	0.051 - 0.114	0.041 - 0.104	1.65
Oil control ring side clearance (in.)	0.0014 - 0.0074	0.0016 - 0.0076	0.0094
Oil control ring side clearance (mm)	0.036 - 0.188	0.041 - 0.193	0.239
Piston fit (loose; room temperature) (in.)	0.00005 - 0.00045	*	0.00100
Piston fit (loose; room temperature) (mm)	0.0013 - 0.0114	*	0.0254
CYLINDER HEAD			
Valve guide in head (tight) (in.)	0.0033 - 0.0020	*	N/A
Valve guide in head (tight) (mm)	0.084 - 0.051	*	N/A
Valve seat in head (in.)	0.0035 - 0.0010	*	N/A
Valve seat in head (mm)	0.089 - 0.025	*	N/A
Head gasket surface (flatness) (in.)	0.006	*	0.006
Head gasket surface (flatness) (mm)	0.15	*	0.15
CYLINDER			
Taper (in.)	N/A	N/A	0.002
Taper (mm)	N/A	N/A	0.05
Out of round (in.)	N/A	N/A	0.003
Out of round (mm)	N/A	N/A	0.08
Gasket surface warpage -Top (in.)	N/A	N/A	0.006
Gasket surface warpage -Top (mm)	N/A	N/A	.15
Gasket surface warpage -Base (in.)	N/A	N/A	0.008
Gasket surface warpage -Base (mm)	N/A	N/A	.20

* Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
CYLINDER (CONTINUED)	**883cc**	**1200cc**	
Bore Diameter ± 0.0002 (in.)			**883cc/1200cc**
Standard (in.)	3.0005	3.4978	3.0035/3.5008
Standard (mm)	76.213	88.844	76.289/88.920
0.005 Oversize (O.S.) (in.)	3.0048	3.502	3.0078/3.505
0.005 Oversize (O.S.) (mm)	76.323	88.95	76.398/89.03
0.010 O.S. Bore (in.)	3.0098	3.507	3.0128/3.510
0.010 O.S. Bore (mm)	76.449	89.08	76.525/89.15
0.020 O.S. Bore (in.)	3.0198	3.517	3.0228/3.520
0.020 O.S. Bore (mm)	76.703	89.33	76.779/89.41
0.030 O.S. Bore (in.)	3.0298	3.527	3.0328/3.530
0.030 O.S. Bore (mm)	76.957	89.59	77.033/89.66
0.040 O.S. Bore (in.)	3.0398	N/A	3.0428
0.040 O.S. Bore (mm)	77.211	N/A	77.287
ITEM	**NEW COMPONENTS**		**SERVICE WEAR LIMITS**
CONNECTING ROD	**883cc**	**1200cc**	
Piston pin fit (loose) (in.)	0.00125 - 0.00175	*	0.00200
Piston pin fit (loose) (mm)	0.0318 - 0.0445	*	0.0508
Side play between flywheels (in.)	0.005 - 0.025	*	0.030
Side play between flywheels (mm)	0.013 - 0.64	*	N/A
Fiton Crankpin (in.)	0.0004 - 0.0017	*	0.0027
Fiton Crankpin (mm)	0.010 - 0.043	*	0.069
TAPPET			
Fit in guide (in.)	0.0008 - 0.0023	*	0.003
Fit in guide (mm)	0.020 - 0.058	*	0.08
Roller fit (in.)	0.0006 - 0.0013	*	N/A
Roller fit (mm)	0.015 - 0.033	*	N/A
Roller End Clearance (in.)	0.008 - 0.022	*	0.026
Roller End Clearance (mm)	0.203 - 0.559	*	0.660
OIL PUMP			
Oil pressure at normal operating temperature (pressure reading taken at oil pressure switch fitting)			
With engine speed of 1000 rpm (psi)	7 - 12	*	N/A

* Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
OIL PUMP (CONTINUED)	**883cc**	**1200cc**	
With engine speed of 1000 rpm (kN/cm^2)	0.5 - 0.8	*	N/A
With engine speed of 2500 rpm (psi)	10 - 17	*	N/A
With engine speed of 2500 rpm (kN/cm^2)	0.7 - 1.2	*	N/A
Feed/scavenge inner/outer gerotor clearance (in.)	0.003	*	0.004
Feed/scavenge inner/outer gerotor clearance (mm)	0.08	*	0.10
Shaft to pump clearance (in.)	0.0025	*	N/A
Shaft to pump clearance (mm)	0.064	*	N/A
GEARCASE			
Cam gear shaft in bushing (loose) (in.)	0.0007 - 0.0022	*	0.003
Cam gear shaft in bushing (loose) (mm)	0.018 - 0.056	*	0.08
Cam gear shaft end play (min. except rear intake) (in.)	0.005 - 0.024	*	0.025
Cam gear shaft end play (min. except rear intake) (mm)	0.13 - 0.61	*	0.64
Rear intake cam gear shaft end play (min.) (in.)	0.006 - 0.024	*	0.040
Rear intake cam gear shaft end play (min.) (mm)	0.15 - 0.61		1.02
FLYWHEEL			
Runout (flywheels at rim) (in.)	0.000 - 0.010	*	0.010
Runout (flywheels at rim) (mm)	0.00 - 0.25	*	0.25
Runout (shaft at flywheel end) (in.)	0.000 - 0.002	*	0.002
Runout (shaft at flywheel end) (mm)	0.00 - 0.05	*	0.05
End play (in.)	0.001 - 0.005	*	0.005
End play (mm)	0.025 - 0.13	*	0.13
SPROCKET SHAFT BEARING			
Outer race fit in crankcase (tight) (in.)	0.0004 - 0.0024	*	N/A
Outer race fit in crankcase (tight) (mm)	0.010 - 0.061	*	N/A
Bearing inner reace fit on shaft (in.)	0.0002 - 0.0015	*	N/A
Bearing inner reace fit on shaft (mm)	0.005 - 0.038	*	N/A
PINION SHAFT BEARINGS			
Pinion shaft journal diameter (in.)	1.2500 - 1.2496	*	1.2494
Pinion shaft journal diameter (mm)	31.750 - 31.740	*	31.735

* Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
PINION SHAFT BEARINGS (CONTINUED)	**883cc**	**1200cc**	
Outer race diameter in right crankcase (in.)	1.5646 - 1.5652	*	1.5672
Outer race diameter in right crankcase (mm)	39.741 - 39.756	*	39.807
Bearing running clearance (in.)	0.00012 - 0.00088	*	N/A
Bearing running clearance (mm)	0.0030 - 0.0224	*	N/A
Fit in cover bushing (loose) (in.)	0.0023 - 0.0043	*	0.0050
Fit in cover bushing (loose) (mm)	0.058 - 0.109	*	0.127
IGNITION SYSTEM			
Timing during engine cranking	5° BTDC (0° BTDC)	*	N/A
Timing with engine speed at 950-1050)	20° BTDC	*	N/A
Spark plug gap (6R12) (in.)	0.038 - 0.043	*	N/A
Spark plug gap (6R12) (mm)	0.97 - 1.09	*	N/A
ENGINE SPEED			
Slow Idle (rpm)	950 - 1050	*	N/A
Setting ignition timing (rpm)	1650 - 1950	*	N/A
TORQUE VALUES			
Crank pin nut (ft-lbs)	150 - 185	*	N/A
Crank pin nut (Nm)	203 - 251	*	N/A
Pinion gear nut (ft-lbs)	35 - 45	*	N/A
Pinion gear nut (Nm)	74 - 61	*	N/A
Oil tank mounting locknuts (ft-lbs)	3 - 5	*	N/A
Oil tank mounting locknuts (Nm)	4 - 7	*	N/A
Oil pump mounting screws (in-lbs)	125 - 150	*	N/A
Oil pump mounting screws (Nm)	14.1 - 17.0	*	N/A
Push rod tube seal plate bolts (ft-lbs)	15 - 18	*	N/A
Push rod tube seal plate bolts (Nm)	20 - 24	*	N/A
Gearcase cover fasteners (in-lbs)	80 - 110	*	N/A
Gearcase cover fasteners (Nm)	9.0 - 12.4	*	N/A
ROCKER COVER			
5/16 in. bolts (ft-lbs)	15 - 18	*	N/A
5/16 in. bolts (Nm)	20 - 24	*	N/A

* Same as 883cc

Table 3-2. New Component Specifications

ITEM	NEW COMPONENTS		SERVICE WEAR LIMITS
ROCKER COVER (CONTINUED)	**883cc**	**1200cc**	
1/4 in. bolts (ft-lbs)	10 - 13	*	N/A
1/4 in. bolts (Nm)	14 - 18	*	N/A
Rear Engine mount fasteners frame to crankcase (ft-lbs)	25 - 30	*	N/A
Rear Engine mount fasteners frame to crankcase (Nm)	34 - 41	*	***NOTE*** ***Tighten engine mount fasteners in the numerical sequence shown in bold.***
Frame (ft-lbs)	25 - 30	*	
Frame (Nm)	34 - 41	*	
Upper front engine bracket fasteners cylinder head (ft-lbs)	25 - 30	*	
Upper front engine bracket fasteners cylinder head (Nm)	34 - 41	*	
Frame (ft-lbs)	30 -35	*	
Frame (Nm)	41 - 47	*	
Top center engine bracket fasteners cylinder head (ft-lbs)	25 - 30	*	
Top center engine bracket fasteners cylinder head (Nm)	34 - 41	*	
Frame (ft-lbs)	30 -35	*	N/A
Frame (Nm)	41 - 47	*	N/A
Timer screws (inner cover & sensor plate) (in-lbs)	15 - 20	*	N/A
Timer screws (inner cover & sensor plate) (Nm)	1.7 - 2.3	*	N/A
Spark Plug (ft-lbs)	11 - 18	*	N/A
Spark Plug (Nm)	15 - 24	*	N/A
Rotor bolt (in-lbs)	43 - 48	*	N/A
Rotor bolt (Nm)	4.9 - 5.4	*	N/A
Anti-rotation screws (in-lbs)	55 - 65	*	N/A
Anti-rotation screws (Nm)	6.2 - 7.3	*	N/A

* Same as 883cc

GENERAL

The V2 Evolution™ engine is a two-cylinder, four-cycle, air-cooled, overhead-valve V-twin. It has three major component assemblies: **cylinder, crankcase,** and **gear case.**

The **cylinder** assembly includes cylinder head, valves, rocker arm cover, rocker arms, and piston. Cylinders mount on the crankcase in a 45 degree “V”, with both connecting rods connected to a single crank pin.

The up-and-down motion of the piston in the cylinder is converted to circular motion in the **crankcase.** The multi-piece crankshaft consists of a crank pin mounted between two counterweighted flywheels, which rotate on two end shaft bearings. The lower end of the rear cylinder connecting rod is forked to fit around the single-end front cylinder connecting rod, allowing a single connecting rod crank pin connection to the flywheel.

The **gear case** is located on the right side of the crankcase. The gear case houses the gear train, which operates and times the valves and ignition. The cam gear train, consisting of four cam shafts with one cam lobe on each shaft, is gear driven. The engine valves are opened and closed through the mechanical linkage of tappets, push rods, and rocker arms. Hydraulic lifters, located in the tappets, automatically compensate for heat expansion to maintain the no-lash fit of valve train components. Tappets serve to transmit the cam action to the valve linkage. Valve timing is obtained by aligning timing marks when installing cam gears.

Ignition spark is produced by the operation of a microprocessor-controlled electronic ignition module, ignition coil, and spark plugs. Spark timing is determined by a trigger rotor, magnetic sensing unit, and vacuum-operated electric switch.

The trigger rotor has two openings which time the cylinders.

Both spark plugs fire simultaneously each crankshaft revolution. The spark plug in the front cylinder will fire at the end of that cylinder’s compression stroke, igniting the air/fuel mixture in the front cylinder. At the same instant, however, the spark in the rear cylinder will fire ineffectually during the end of that cylinder’s exhaust stroke. During the next engine revolution, the simultaneous firing of the spark plugs will occur during the middle of the front cylinder's exhaust stroke and at the end of the rear cylinder’s compression stroke (igniting the air/fuel mixture in the rear cylinder).

XL Sport

The 1200S model has a single fire twin plug ignition. Each head has two spark plugs which fire at the end of that cylinder’s compression stroke. The other cylinder’s spark plugs do not fire.

The trigger rotor has six openings which time the cylinders.

FUEL

Gasoline/alcohol Blends

Harley-Davidson motorcycles were designed to obtain the best performance and efficiency using unleaded gasoline (91 pump octane or higher for the XL Sport, 87 or higher for all other models). Some fuel suppliers sell gasoline/alcohol blends as a fuel. The type and amount of alcohol added to the fuel is important.

⚠WARNING

- DO NOT USE GASOLINE CONTAINING METHANOL. Using gasoline/Methanol blends will result in starting and driveability deterioration and damage to critical fuel system components.
- Gasolines containing METHYL TERTIARY BUTYL ETHER (MTBE): Gasoline/MTBE blends are a mixture of gasoline and as much as 15% MTBE. Gasoline/MTBE blends can be used in your motorcycle.
- ETHANOL (Ethanol or grain alcohol) is a mixture of 10% ethanol and 90% unleaded gasoline. It is identified as “gasohol,” “ethanol enhanced,” or “contains ethanol.” Gasoline/Ethanol blends can be used in your motorcycle.

Because of their generally higher volatility, these blends may adversely affect the starting, driveability and fuel efficiency of your motorcycle. If you experience these problems, Harley-Davidson recommends you operate your motorcycle on straight, unleaded gasoline.

Lubrication

The engine has a force-feed (pressure) type oiling system, incorporating oil feed and return pumps in one pump body, with one check valve on the oil feed side. The feed pump forces oil to the engine, lubricating lower connecting rod bearings, rocker arm bushings, valve stems, valve springs, push rods, and tappets. Cylinder walls, pistons, piston pins, timing gears and bushings, and main bearings are lubricated by oil spray thrown off connecting rods and crankshaft, and by oil draining from each rocker box through an internal drain passage in each cylinder and each tappet guide. A small amount of oil is sprayed through an oil galley jet onto the rear intake cam gear in the gear case; oil is transferred to the teeth of all the cam gears by way of the gear meshing action. The oil-scavenging section of the pump returns oil to the tank from the engine. See ENGINE LUBRICATION SYSTEM later in this section for further information.

ADJUSTMENT/TESTING

General

When an engine needs repair, it is not always possible to determine definitely beforehand whether repair is possible with only cylinder heads, cylinders, and pistons disassembled, or whether complete engine disassembly is required for crankcase repair.

Most commonly, only cylinder head and cylinder repair is needed (valves, rings, piston, etc.), and it is recommended procedure to service these units first, allowing engine crankcase to remain in frame.

Follow the procedure under 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR, to strip motorcycle for removal of cylinder heads, cylinders, and pistons.

After disassembling "upper end" only, it may be found that crankcase repair is necessary; this requires removal of engine crankcase from chassis outlined under 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR.

CAUTION

If engine is removed from chassis, do not lay engine on primary side. Laying engine on primary side will damage the clutch cable end fitting.

Symptoms indicating a need for engine repair are often misleading; but generally, if more than one symptom is present, possible causes can be narrowed down to make at least a partial diagnosis. An above-normal consumption of oil, for example, could be caused by several mechanical faults. See 1.6 TROUBLESHOOTING. However, when accompanied by blue-gray exhaust smoke and low engine compression, it indicates the piston rings need replacing. Low compression by itself, however, may indicate improperly seated valves, in addition to or in lieu of worn piston rings.

Piston slap is a condition where piston and/or cylinder are worn out-of-round and are loose fitting, 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 possible causes can be narrowed down through the process of elimination to indicate any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

Compression Test Procedure

Combustion chamber leakage can result in unsatisfactory engine performance. A compression test can help determine the source of cylinder leakage. Use CYLINDER COMPRESSION GAUGE (Part No. HD-33223-1).

A proper compression test should be performed with the engine at normal operating temperature when possible. Proceed as follows:

CAUTION

After completing the compression test(s), make sure that the throttle plate is in the closed position before starting the engine. Starting engine with throttle open may result in serious engine damage.

1. Disconnect spark plug wires. Clean around plug base, and remove plugs.
2. Connect compression tester to front cylinder.
3. With carburetor throttle plates in wide open position, crank engine continuously through 5-7 full compression strokes.
4. Note gauge readings at the end of the first and last compression strokes. Record test results.
5. Connect compression tester to rear cylinder.
6. Repeat Steps 3 and 4 on rear cylinder.
7. Compression is normal if final readings are 120 psi (8.4 kgN/cm^2) or more and do not indicate more than a 10 psi (0.7 kgN/cm^2) variance between cylinders. See diagnostic chart following.
8. Inject approximately 1/2 oz. (15 ml) of SAE 30 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.

Table 3-3. Troubleshooting

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.
Head gasket leak.	Same reaction as valve trouble.

Cylinder Leakage Test

The cylinder leakage test pinpoints 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 a CYLINDER LEAKDOWN TESTER (Part No. HD-35667A) 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 spark plugs.
3. Remove air cleaner, and set carburetor throttle in wide open position.
4. Remove timing inspection plug from crankcase.
5. The piston, in cylinder being tested, must be at top dead center of compression stroke during test.
6. To keep engine from turning over when air pressure is applied to cylinder, engage transmission in fifth gear and lock the rear brake.
7. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent leakdown. Any cylinder with 12% leakdown, or more, requires further attention.
8. Listen for air leaks at carburetor intake, exhaust, head gasket and timing inspection hole.

NOTE

If air is escaping through valves, check push rod length.

Table 3-4. Leakage Specifications

AIR LEAK LOCATION	POSSIBLE CAUSES
Carburetor intake.	Intake valve leaking.
Exhaust pipe.	Exhaust valve leaking.
Timing inspection hole.	Piston rings leaking. Worn or broken piston. Worn cylinder.
Head gasket.	Leaking gasket.

9. Repeat procedure on rear cylinder.

CAUTION

After completing the cylinder leakage test(s), make sure that the throttle plate is in the closed position before starting the engine. Starting engine with throttle open may result in serious engine damage.

Diagnosing Smoking Engine or High Oil Consumption

Perform Compression or Cylinder Leakdown Test as described previously. If further testing is needed, remove suspect head(s) and inspect the following:

- Valve guide seals.
- Valve guide-to-valve stem clearance.
- Gasket surface of both head and cylinder.
- Oil return passages for clogging.

REMOVE SEAT.

WARNING

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

REMOVE AIR CLEANER ASSEMBLY AND BACK PLATE.

DISCONNECT SPARK PLUG WIRES. REMOVE HORN, IGNITION COIL, BRACKET AND THROTTLE CLIP.

DRAIN GASOLINE. REMOVE FUEL TANK.

WARNING

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

FREE ENRICHENER CONTROL-DISCONNECT V.O.E.S./MAP HOSE AT CARBURETOR AND V.O.E.S. WIRE FROM IGNITION MODULE.

REMOVE EXHAUST SYSTEM.

DRAIN PRIMARY CHAINCASE LUBRICANT.

SEE FIGURE 3-1. REMOVE TOP CENTER ENGINE MOUNTING BRACKET AND SHIMS.

SEE FIGURE 3-2. REMOVE TOP FRONT ENGINE MOUNTING BRACKET.

WARNING

Gasoline is extremely flammable and highly explosive. When servicing the fuel system, do not smoke or allow open flame or sparks in the vicinity. Inadequate safety precautions could result in death or serious injury.

NOTE

At this point, upper end can be worked on. See 3.5 CYLINDER HEAD.

x0446x3x

1. Locknut, hex flange
2. Nut plate
3. Shim*
4. Screw (2)
5. Washer (2)
6. Washer
7. Bolt (2)
8. Bolt
9. Top center engine mounting bracket
10. V.O.E.S.

*Shim thickness
0.030 in. (0.76 mm)
0.060 in. (1.52 mm)
0.090 in. (2.29 mm)

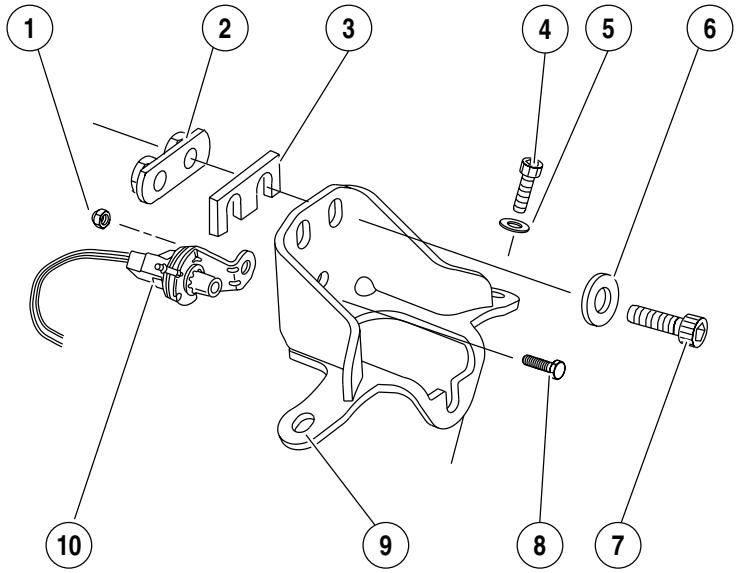


Figure 3-1. Top Center Engine Mount Bracket

x0447x3x

1. Frame
2. Nut plate
3. Front cylinder
4. Top front engine mounting bracket
5. Washer (4)
6. Bolt
7. Lock washer
8. Nut
9. Bolt (2)

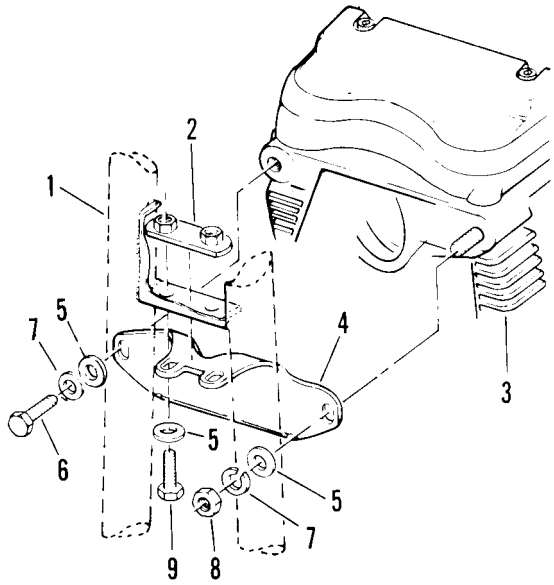


Figure 3-2. Upper Front Mount Bracket

REMOVE REAR BRAKE MASTER CYLINDER MOUNTING BOLTS. DISCONNECT BRAKE LINKAGE FROM MASTER CYLINDER.

REMOVE REAR BELT SPROCKET COVER WITH BRAKE PEDAL AND LINKAGE.

REMOVE REAR BELT.

DISCONNECT WIRE TO OIL PRESSURE SWITCH.

DISCONNECT NEUTRAL SWITCH WIRE.

UNPLUG IGNITION TIMER PLATE WIRES FROM WIRING HARNESS.

DISCONNECT POSITIVE BATTERY CABLE FROM BATTERY. DISCONNECT 18 - GAUGE GREEN WIRE FROM STARTER MOTOR.

REMOVE BATTERY. REMOVE BATTERY TRAY.

DISCONNECT THE REGULATOR/RECTIFIER FROM THE ALTERNATOR STATOR AT THE PLUG BENEATH THE REGULATOR.

DISCONNECT BATTERY GROUNDING CABLE ATTACHED TO REAR CRANKCASE BOLT.

DETACH CLUTCH CABLE. REMOVE CLUTCH HAND LEVER FROM HANDLEBAR.

DRAIN ENGINE OIL. REMOVE OIL FEED, RETURN AND VENT LINES AT OIL TANK.

SEE FIGURE 3-3. REMOVE HARDWARE ATTACHING LOWER FRONT ENGINE MOUNTING PLATES. FOR XL883CC AND XL1200 CC, SEE FIGURE 3-5.

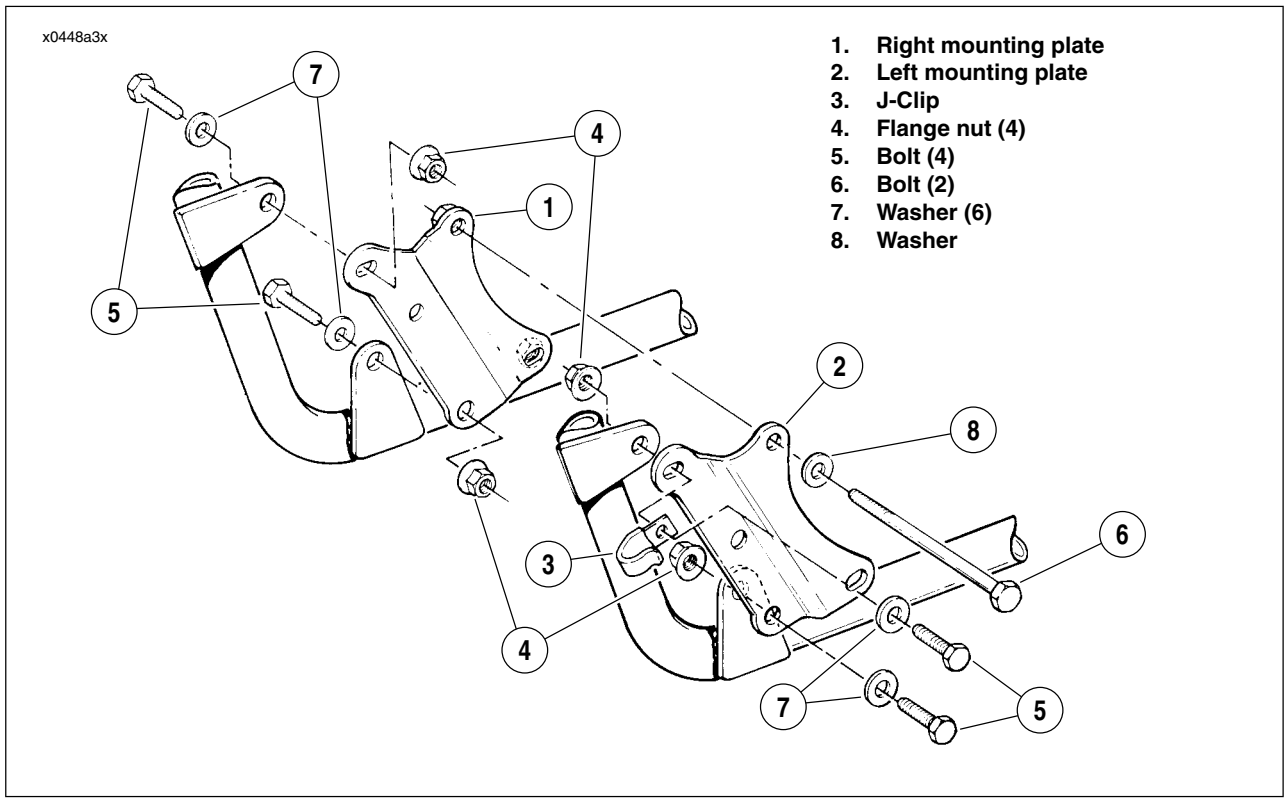


Figure 3-3. Lower Front Engine Mount Brackets

SEE FIGURE 3-4. REMOVE BOLTS (3, 4 AND 5) ATTACHING REAR OF ENGINE FRAME.

LIFT ENGINE OFF THE MOUNTING PAD. SLIP ENGINE FROM RIGHT SIDE WHILE TIPPING TOP OF ENGINE SLIGHTLY OFF CENTER OF CHASSIS.

CAUTION

Do not lay engine on primary side as damage to clutch cable connection could result.

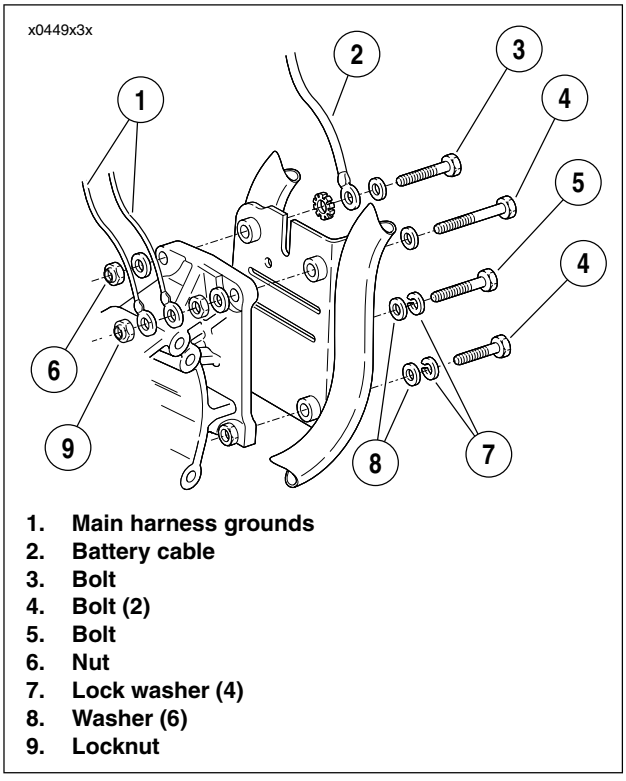
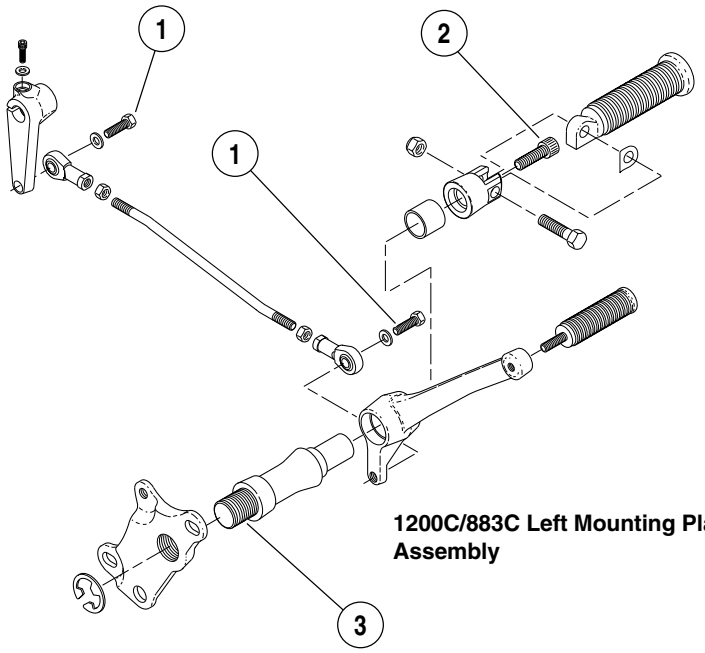


Figure 3-4. Rear Engine Mount Fasteners

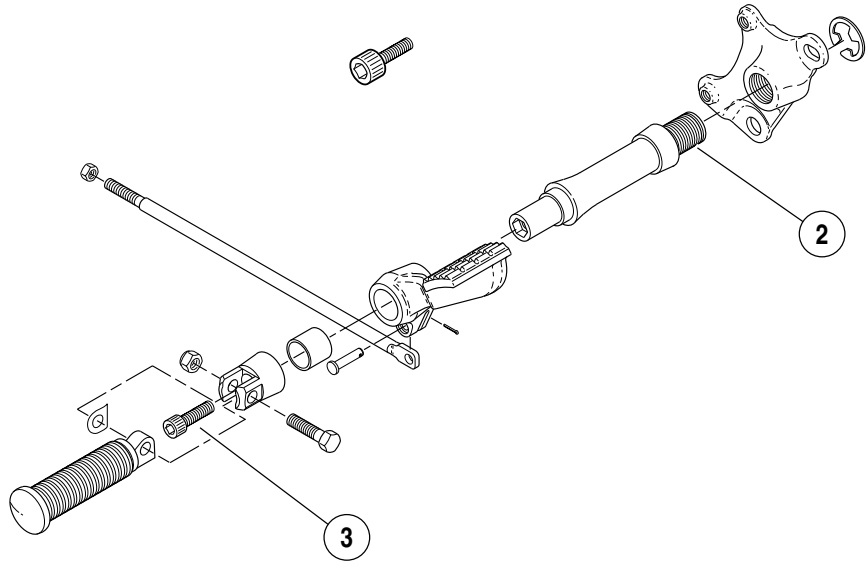
x0450x3x



1200C/883C Left Mounting Plate and Shifter Assembly

x0451x3x

1200C/883C Right Mounting Plate and Brake Assembly



1. **15 ft-lbs (2.2Nm)**
2. **Loctite 243, 25-30 ft-lbs (34-41 Nm)**
3. **Loctite 243**

Figure 3-5. XL Custom Foot Controls and Engine Mounts

PLACE ENGINE IN FRAME FROM RIGHT SIDE OF MOTORCYCLE.

SEE FIGURE 3-4. INSTALL FOUR REAR ENGINE MOUNTING BOLTS (3, 4, AND 5), WASHERS (7 & 8) AND NUTS (6 & 9). TIGHTEN FASTENERS TO 25-30 FT-LBS (34-41 NM).

SEE FIGURE 3-3. INSTALL LOWER FRONT ENGINE MOUNTING BRACKETS WITH BOLTS (6) AND WASHERS (8). SECURE PLATES TO LOWER FRONT ENGINE FRAME MOUNTS WITH BOLTS (5), WASHERS (7) AND NUTS (4). TIGHTEN ENGINE BOLTS TO 25-30 FT-LBS (34-41 NM). TIGHTEN FRAME BOLTS TO 25-30 FT-LBS (34-41 NM).

SEE FIGURE 3-2. INSTALL UPPER FRONT ENGINE MOUNTING BRACKET; LOOSELY ATTACH HARDWARE. TIGHTEN ENGINE BOLTS TO 25-30 FT-LBS (34-41 NM). TIGHTEN FRAME BOLTS TO 30-35 FT LBS (41-47 NM).

SEE FIGURE 3-1. INSTALL TOP CENTER ENGINE MOUNTING BRACKET; LOOSELY ATTACH HARDWARE. CONNECT V.O.E.S./ MAP AND IGNITION SWITCH. TIGHTEN ENGINE BOLTS TO 25-30 FT-LBS (34-41 NM). TIGHTEN FRAME BOLTS TO 30-35 FT-LBS (41-47 NM).

SEE 3.7 ENGINE LUBRICATION SYSTEM AND CONNECT FEED, RETURN, AND VENT LINES TO OIL TANK. USE NEW HOSE CLAMPS.

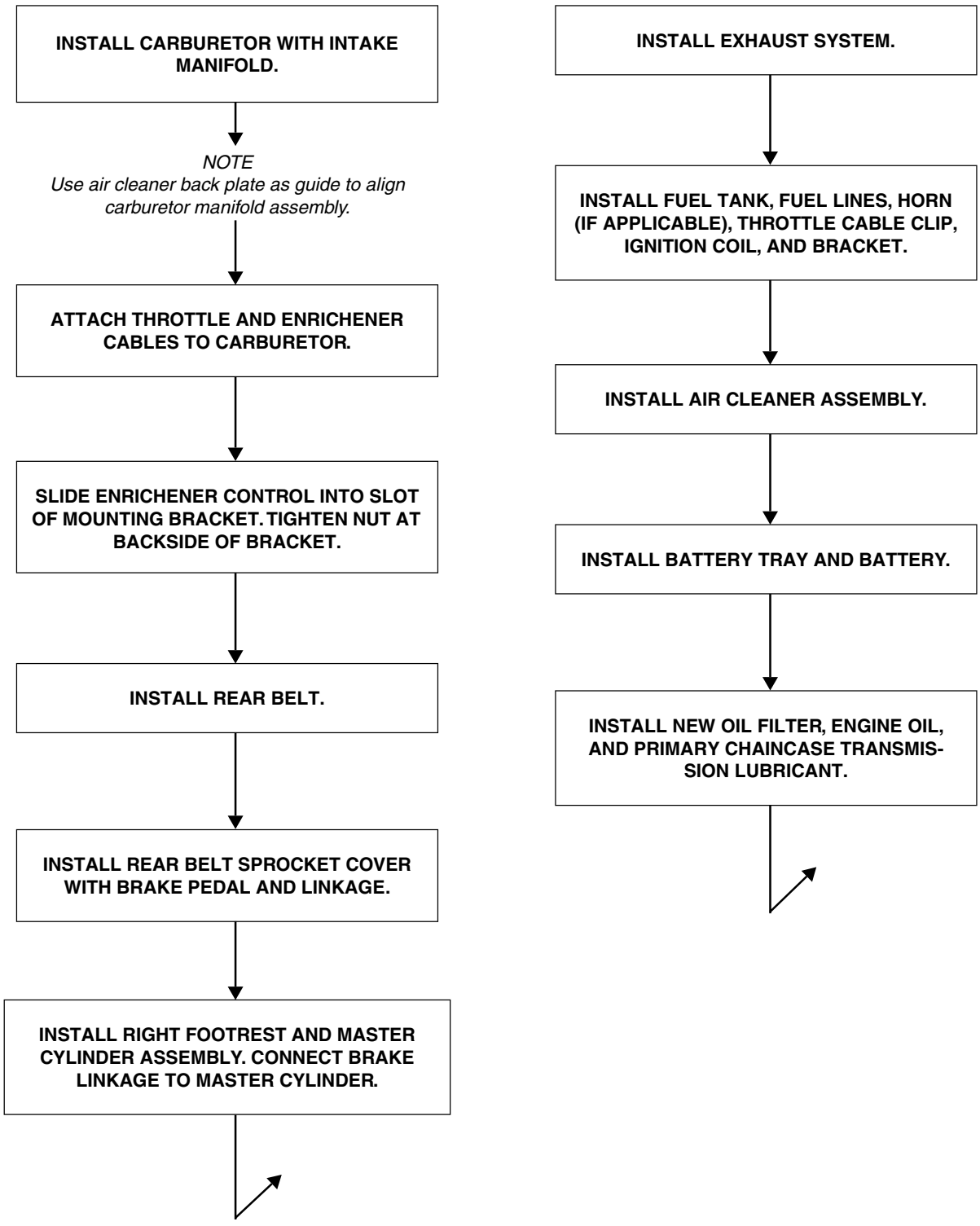
CONNECT BATTERY GROUND WIRE TO CRANKCASE BOLT.

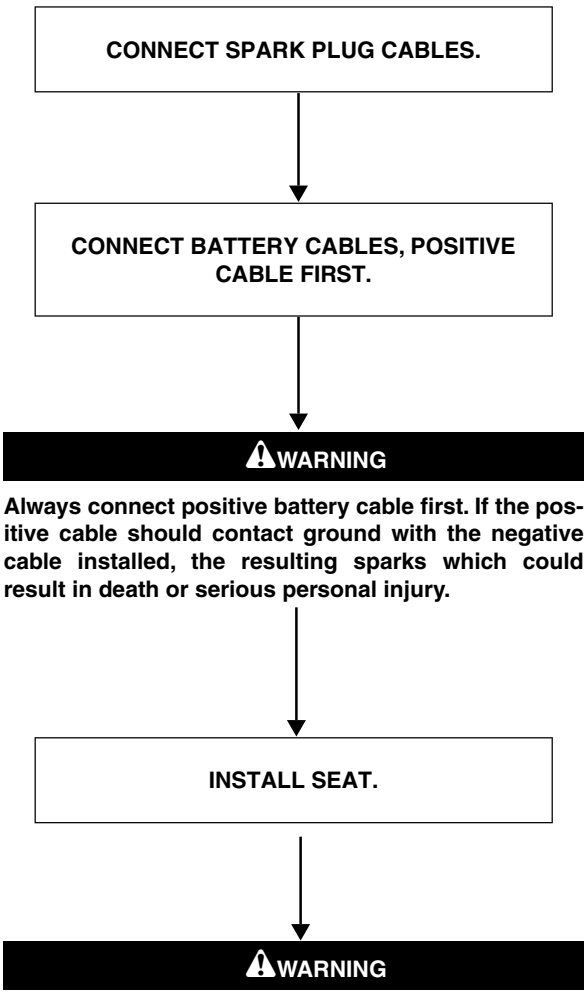
CONNECT BATTERY POSITIVE CABLE AND 18-GAUGE GREEN WIRE TO STARTER MOTOR.

PLUG REGULATOR/RECTIFIER INTO STATOR CONNECTION. ATTACH SENSOR TO WIRE HARNESS. CONNECT NEUTRAL SWITCH.

CONNECT OIL PRESSURE SWITCH WIRE.

ATTACH CLUTCH CABLE LEVER & BRACKET TO HANDLEBAR.


INSTALL CARBURETOR WITH INTAKE MANIFOLD.
NOTE
Use air cleaner back plate as guide to align carburetor manifold assembly.
ATTACH THROTTLE AND ENRICHENER CABLES TO CARBURETOR.
SLIDE ENRICHENER CONTROL INTO SLOT OF MOUNTING BRACKET. TIGHTEN NUT AT BACKSIDE OF BRACKET.
INSTALL REAR BELT.
INSTALL REAR BELT SPROCKET COVER WITH BRAKE PEDAL AND LINKAGE.
INSTALL RIGHT FOOTREST AND MASTER CYLINDER ASSEMBLY. CONNECT BRAKE LINKAGE TO MASTER CYLINDER.
INSTALL EXHAUST SYSTEM.
INSTALL FUEL TANK, FUEL LINES, HORN (IF APPLICABLE), THROTTLE CABLE CLIP, IGNITION COIL, AND BRACKET.
INSTALL AIR CLEANER ASSEMBLY.
INSTALL BATTERY TRAY AND BATTERY.
INSTALL NEW OIL FILTER, ENGINE OIL, AND PRIMARY CHAINCASE TRANSMISSION LUBRICANT.


CONNECT SPARK PLUG CABLES.
CONNECT BATTERY CABLES, POSITIVE CABLE FIRST.
WARNING
Always connect positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks which could result in death or serious personal injury.
INSTALL SEAT.
WARNING
Pull up on seat to verify that it is properly secured, front and rear. A loose seat may shift during vehicle operation and startle the rider, possibly causing loss of vehicle control that could result in death or serious injury.

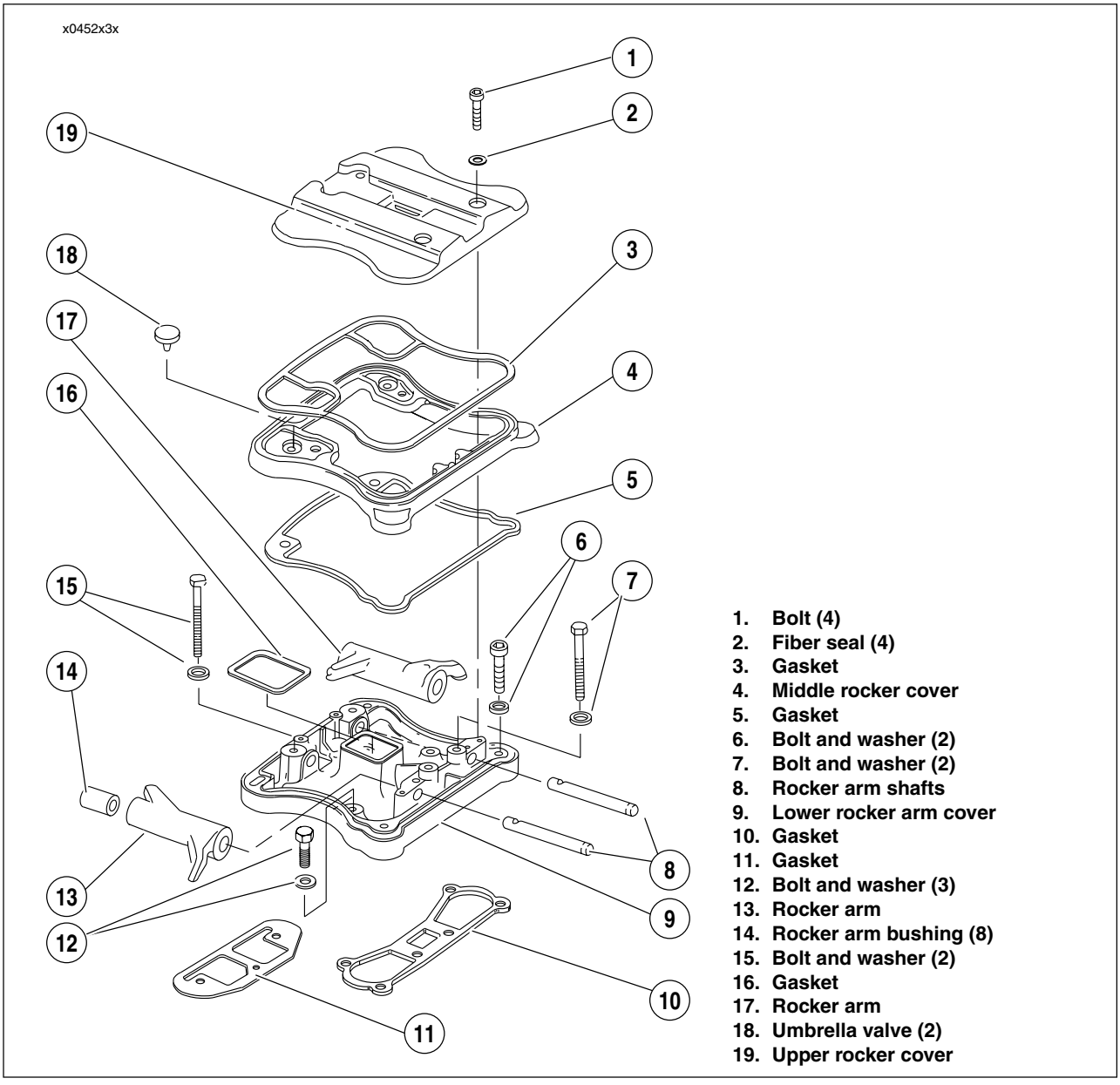
REMOVAL

Before removing the cylinder head assembly, strip motorcycle as described in 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR. The rocker arm covers and internal components must be removed before removing cylinder heads.

1. See Figure 3-6. Remove four bolts (1) and fiber seals (2). Discard fiber seals.

CAUTION

All washers and fasteners used in the V^2_{TM} engine are hardened. Do not mix or replace hardened washers and fasteners with unhardened parts. Do not reuse fiber cover seals. Engine damage may result.



1. Bolt (4)
2. Fiber seal (4)
3. Gasket
4. Middle rocker cover
5. Gasket
6. Bolt and washer (2)
7. Bolt and washer (2)
8. Rocker arm shafts
9. Lower rocker arm cover
10. Gasket
11. Gasket
12. Bolt and washer (3)
13. Rocker arm
14. Rocker arm bushing (8)
15. Bolt and washer (2)
16. Gasket
17. Rocker arm
18. Umbrella valve (2)
19. Upper rocker cover

Figure 3-6. Rocker Arm Cover

2. Remove top (19) and middle (4) sections of rocker box. Remove gaskets (10, 11, 16) and discard.
3. Rotate crankshaft until both valves are closed on head being repaired.
4. Remove two 5/16 in. rocker arm retaining bolts (15) at push rod end.
5. Remove remaining fasteners and washers (6, 7, 12) holding lower rocker arm cover to cylinder head.
6. Remove lower rocker cover (9).

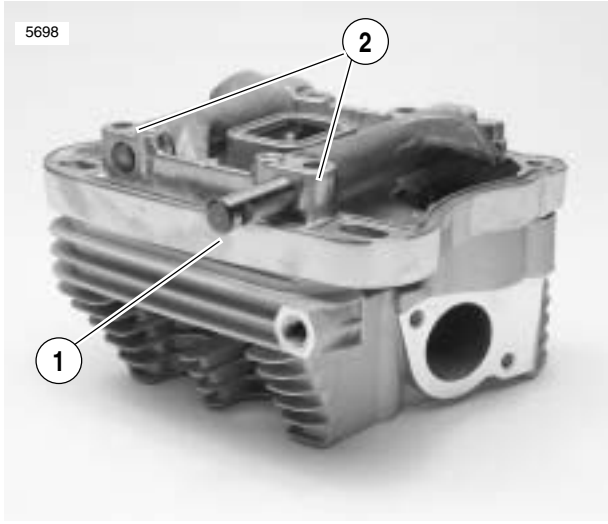
NOTE

Remove lower rocker boxes as an assembly; then disassemble as required.

CAUTION

Mark rocker arm shafts for reassembly in their original positions. Valve train components must be reinstalled in their original positions during reassembly or increased engine wear may result.

7. See Figure 3-7. Remove rocker arm shafts by tapping them out using a hammer and a soft metal punch.



1. Retaining notch
2. Position of rocker arm retaining bolts

Figure 3-7. Removing Rocker Arm Shafts

8. See Figure 3-6. Remove rocker arms (13, 17); mark them for reassembly in their original locations.

CAUTION

See Figure 3-8. Distortion to the head, cylinder, and crankcase studs may result if head screws are not loosened (or tightened) gradually in the sequence shown.

9. See Figure 3-8. Loosen each head screw 1/8-turn following the sequence shown:

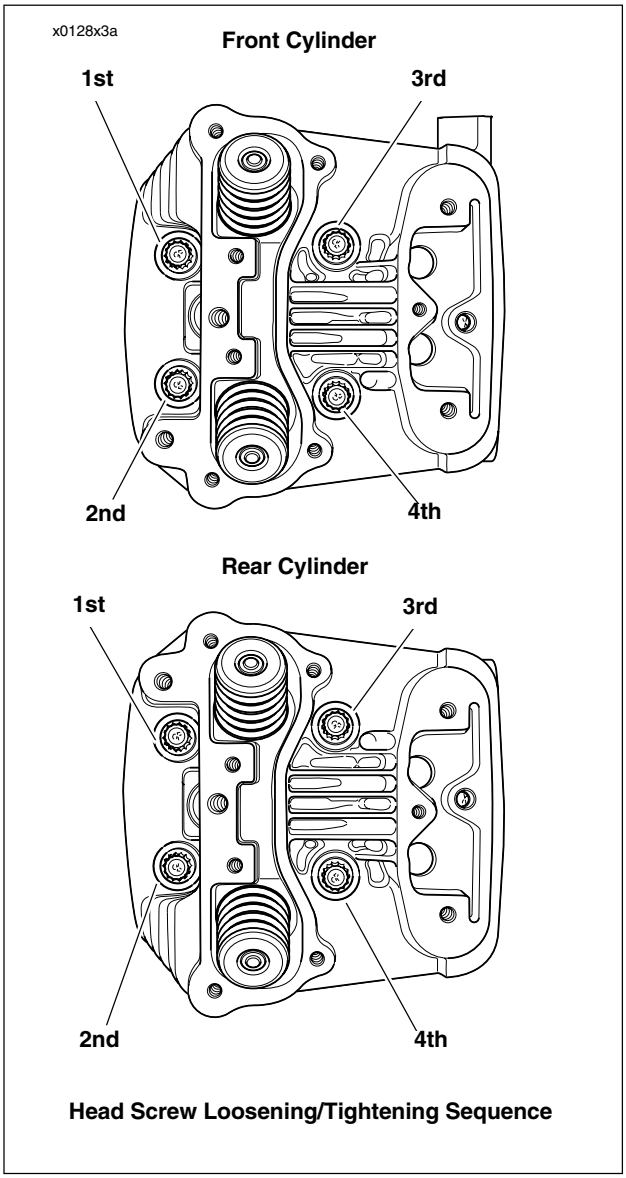
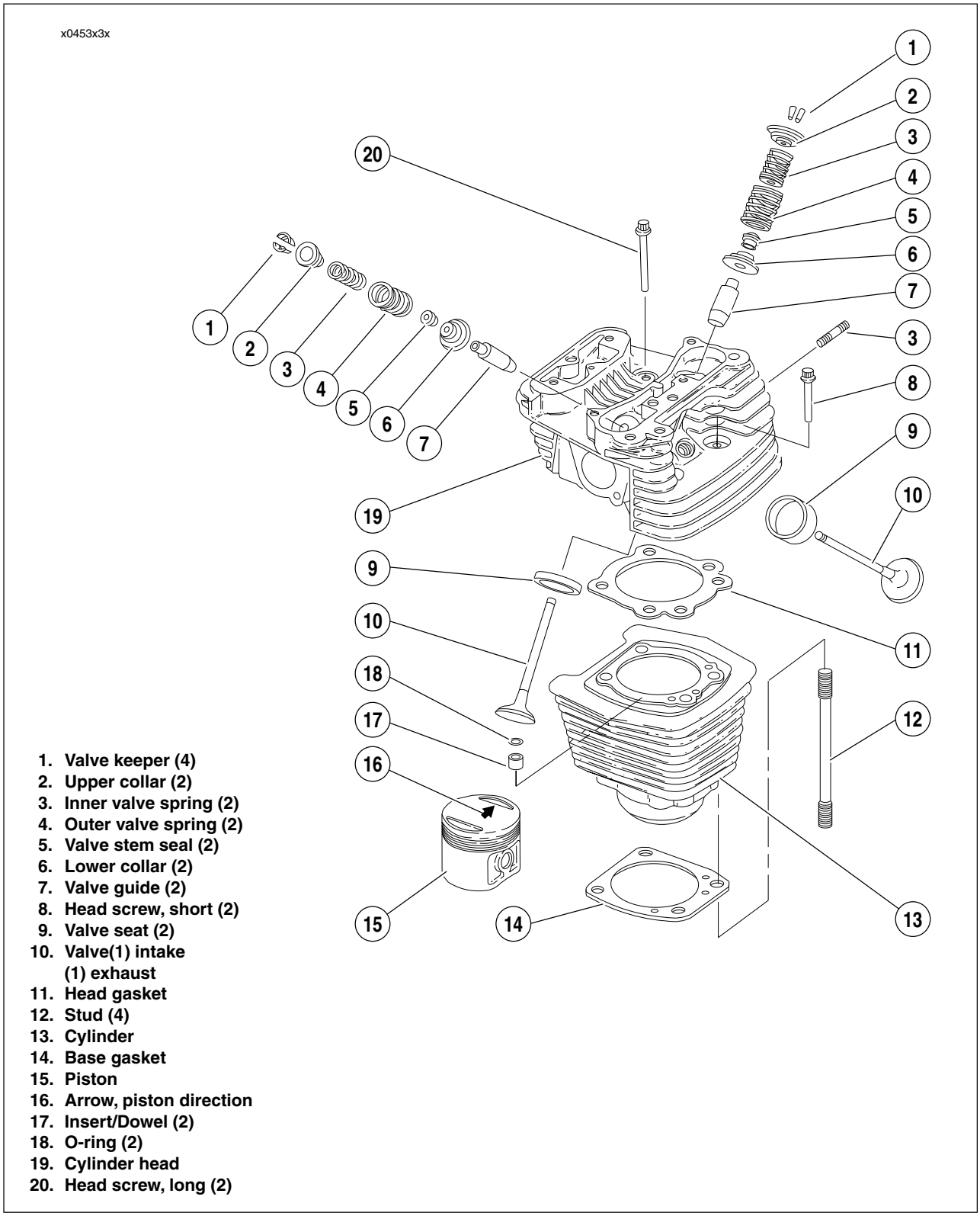


Figure 3-8. Head Screw Sequence

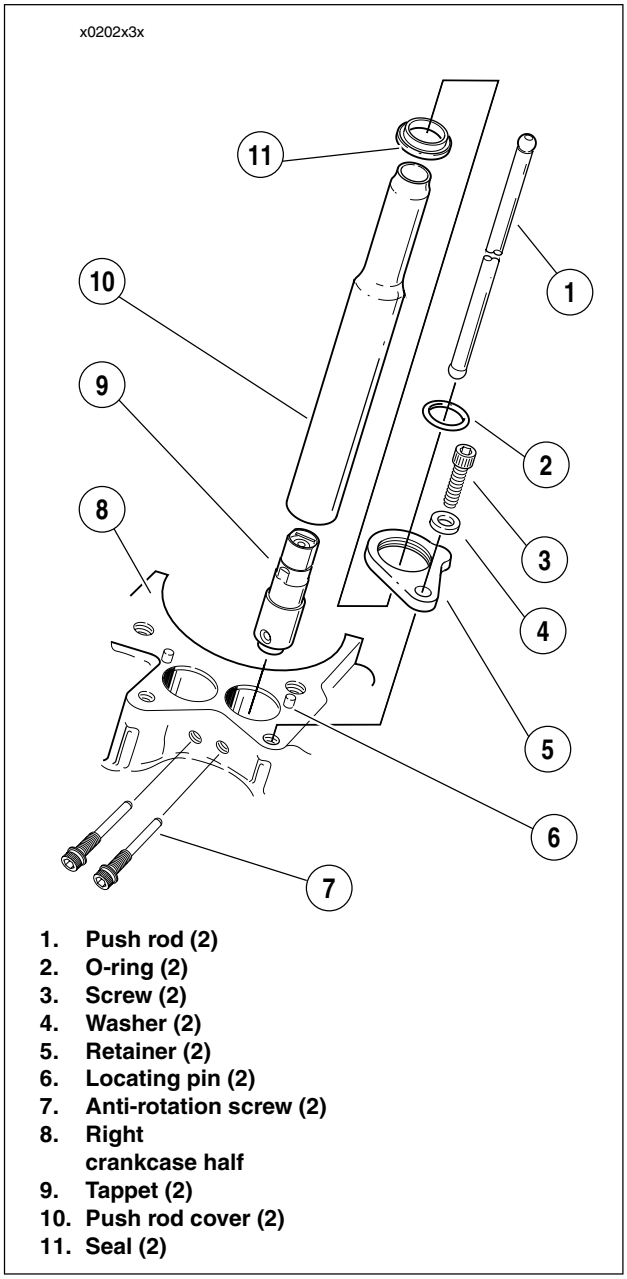
10. Continue loosening in 1/8-turn increments until screws are loose. Remove screws and thick washers.
11. See Figure 3-9. Remove cylinder head (19), head gasket (11), and O-rings (18).



1. Valve keeper (4)
2. Upper collar (2)
3. Inner valve spring (2)
4. Outer valve spring (2)
5. Valve stem seal (2)
6. Lower collar (2)
7. Valve guide (2)
8. Head screw, short (2)
9. Valve seat (2)
10. Valve(1) intake
    (1) exhaust
11. Head gasket
12. Stud (4)
13. Cylinder
14. Base gasket
15. Piston
16. Arrow, piston direction
17. Insert/Dowel (2)
18. O-ring (2)
19. Cylinder head
20. Head screw, long (2)

Figure 3-9. Cylinder Head, Cylinder and Piston

12. See Figure 3-10. Remove socket screws (3), washers (4), and retainers (5). Remove push rod covers (10), seals (11), O-rings (2), and push rods (1). Mark the location and orientation (top and bottom) of each push rod.



1. **Push rod (2)**
2. **O-ring (2)**
3. **Screw (2)**
4. **Washer (2)**
5. **Retainer (2)**
6. **Locating pin (2)**
7. **Anti-rotation screw (2)**
8. **Right crankcase half**
9. **Tappet (2)**
10. **Push rod cover (2)**
11. **Seal (2)**

Figure 3-10. Middle Valve Train Components (Qty. per Engine Cylinder)

13. Remove anti-rotation screws (7). Lift tappets (9) out of crankcase bore.
14. Repeat Steps 1-13 for the other head.

DISASSEMBLY

1. See Figure 3-9. Compress valve springs (3 and 4) with VALVE SPRING COMPRESSOR (Part No. HD-34736B) (as shown in Figure 3-11).

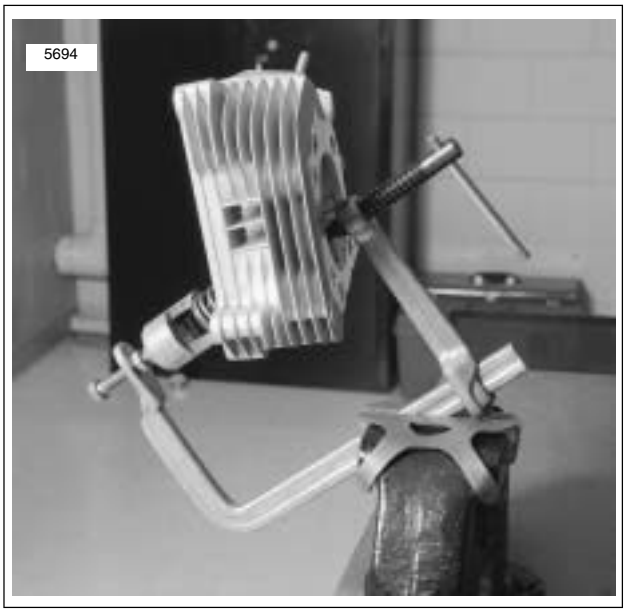


Figure 3-11. Compressing Valve Springs

2. See Figure 3-9. Remove keepers (1), upper collar (2) and springs (3 and 4). Mark keepers for reassembly in original position.
3. Use a fine tooth file to remove any burrs on the valve stem at the keeper groove.
4. Mark valve to ensure that it will be reassembled in the same head.
5. Remove valve (10), valve stem seal (5) and lower collar (6).
6. Repeat Steps 1-5 for the other valve.
7. Disassemble the other head following Steps 1-6.

CLEANING, INSPECTION, AND REPAIR

1. Bead blast or scrape carbon from head, top of cylinder and valve ports. Be careful to avoid scratching or nicking cylinder head and cylinder joint faces. Blow off loosened carbon or dirt with compressed air.
2. Soak cylinder head in an aluminum-compatible cleaner/ solvent to loosen carbon deposits.
3. Wash all parts in non-flammable solvent, followed by a thorough washing with hot, soapy water. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem using a wire wheel. Never use a file or other hardened tool which could scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool.
4. Check each rocker arm, at pad end and push rod end, for uneven wear or pitting. Replace rocker arm if either condition exists.
5. See Figure 3-12. Measure rocker arm shaft diameter at the positions where shaft fits in lower rocker arm cover and where rocker arm bushings ride. Record the measurements.

Figure 3-12. Measuring Rocker Arm Shaft Diameter (Cover & Bushing Positions)

6. See Figure 3-13. and Figure 3-14. Measure rocker arm shaft bore diameter in lower rocker cover and rocker arm bushing inner diameter. Record the measurements.
7. Check the clearances and measurements obtained in Steps 5 and 6 against the SERVICE WEAR LIMITS.
8. Repair or replace parts exceeding the SERVICE WEAR LIMITS
9. Assemble rocker arms and rocker arm shafts into lower rocker cover.
10. Check end play of rocker arm with feeler gauge.
11. Replace rocker arm or lower cover or both if end play exceeds 0.025 in. (0.63 mm).

Figure 3-13. Measuring Rocker Arm Shaft Bore Diameter in Lower Rocker Cover

Figure 3-14. Measuring Rocker Arm Bushing Inner Diameter

12. Valve heads should have a seating surface width of 0.040-0.062 in. (1.02-1.57 mm), and should be free of pit marks and burn spots. The color of carbon on exhaust valves should be black or dark brown. White or light buff carbon indicates excessive heat and burning.
13. Valve seats are also subject to wear, pitting, and burning. They should be resurfaced whenever valves are refinished.
14. Clean valve guides by lightly honing with VALVE GUIDE HONE (Part No. HD-34723).
15. Scrub guides with VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water. Measure valve stem outer diameter and valve guide inner diameter. Check measurements against SERVICE WEAR LIMITS.
16. Inspect spark plug threads for damage. If threads in head are damaged, a special plug type insert can be installed using a 12mm spark plug repair kit.
17. Inspect valve springs for broken or discolored coils.
18. See Figure 3-15. Check free length and compression force of each spring. Compare with ENGINE SPECIFICATIONS. If spring length is shorter than specification, or if spring compression force is below specification, replace spring.
19. Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored, or broken.
20. See Figure 3-16. Check head gasket surface on head for flatness. Machine or replace any head which exceeds SERVICE WEAR LIMIT of 0.006 in. (0.15 mm).

Rocker Arms and Bushings

1. See Figure 3-17. To replace worn bushings, press or drive them from the rocker arm. 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.
2. Press replacement bushing into rocker arm, flush with arm end, and split portion of bushing towards top of arm.
3. Using remaining old bushing as a pilot, line ream new bushing with Harley-Davidson ROCKER ARM BUSHING REAMER (Part No. HD-94804-57).
4. Repeat for other end of rocker arm.

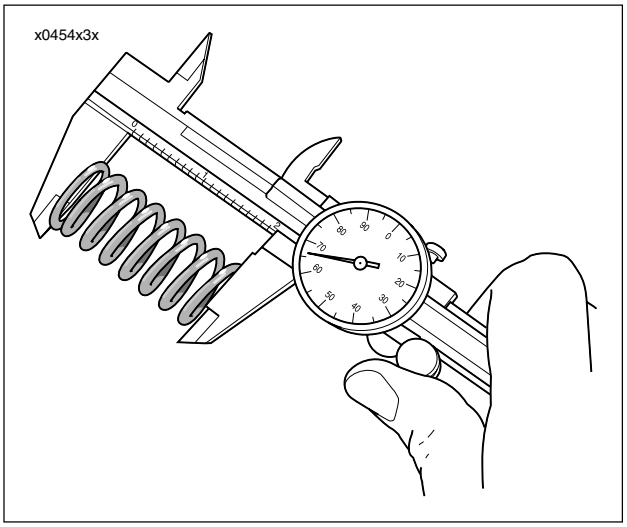


Figure 3-15. Checking Spring Free Length

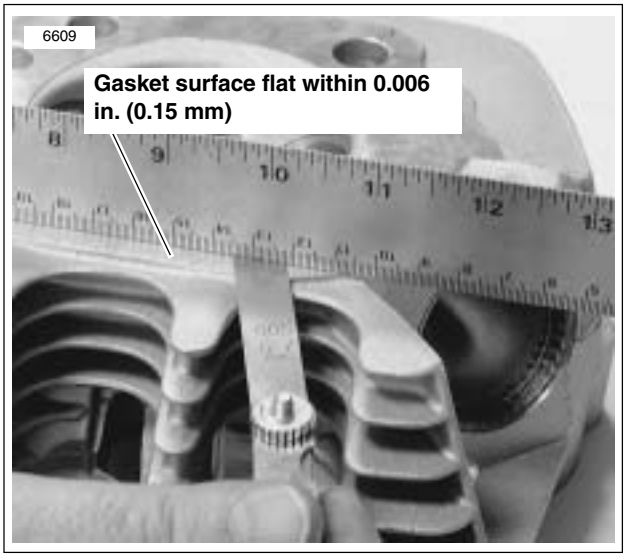


Figure 3-16. Checking Gasket Surface

Replacing Valve Guides

Valve guide replacement, if necessary, must be done before valve seat is ground. It is the valve stem hole in valve guide that determines seat grinding location. Valve stem-to-valve guide clearances are listed in the following chart. If valve stems and/or guides are worn beyond service wear limits, install new parts.

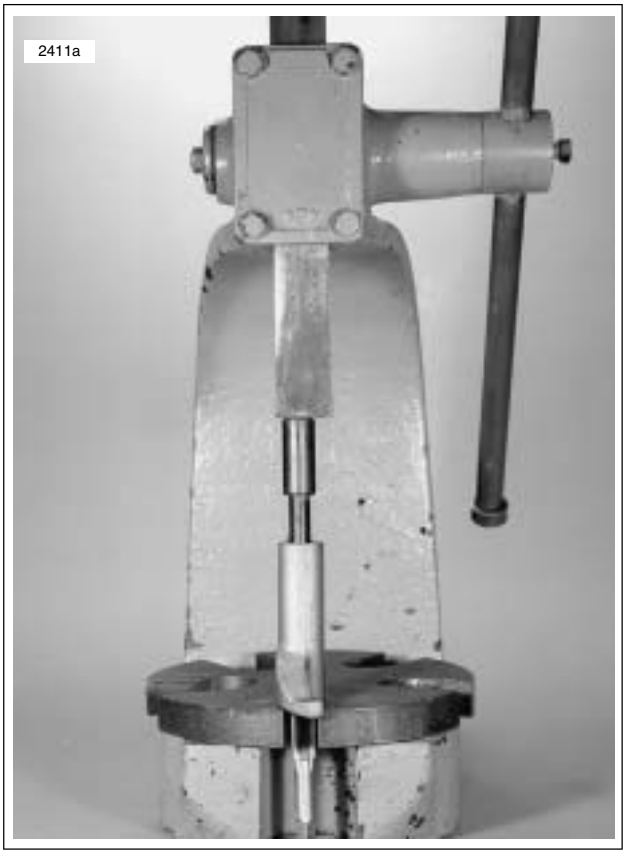
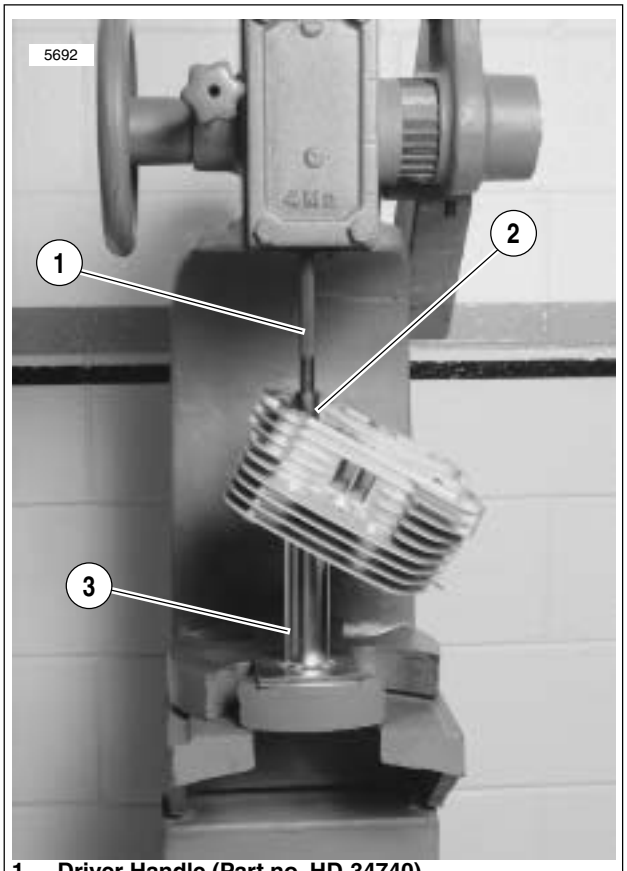


Figure 3-17. Removing Rocker Arm Bushing

Table 3-5. Valve Stem Clearance/Service Limits

MEASUREMENT	INTAKE	EXHAUST
Clearance (in.)	0.0008-0.0026	0.0015-0.0033
Clearance (mm)	0.020-0.066	0.038-0.084
Service Wear Limit (in.)	0.0035	0.0040
Service Wear Limit (mm)	0.089	0.102

1. To remove shoulderless guides, press or tap guides toward combustion chamber using DRIVER HANDLE AND REMOVER (Part No. HD-34740).
2. Clean and measure valve guide bore in head.
3. Measure outer diameter of a new standard valve guide. 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: +0.001 in., +0.002 in., or +0.003 in. (+0.025, +0.05 +0.08 mm) (intake and exhaust).
4. See Figure 3-18. Install shoulderless guides using VALVE GUIDE INSTALLATION TOOL (Part No. HD-34731A) and DRIVER HANDLE (Part No. HD-34740). Press or drive guide until the tool touches the machined surface surrounding the guide. At this point, the correct guide height has been reached.



1. Driver Handle (Part no. HD-34740)
2. Valve Guide Installation Tool (Part no. HD-34731A)
3. Cylinder Head Stand (Part no. HD-39782)

Figure 3-18. Installing Shoulderless Valve Guide

5. See Figure 3-19. Apply the proper surface finish to the valve guide bores using the VALVE GUIDE HONE (Part No. HD-34723). Lubricate hone with honing oil. Driving hone with an electric drill, work for a crosshatch pattern with an angle of approximately 60˚.

NOTE

The hone is not intended for the removal of material.

6. Thoroughly clean valve guide bores using VALVE GUIDE BRUSH (Part No. HD-34751) and hot soapy water.

Grinding Valve Faces and Seats

After installing valve guides, valve seats must be refused to make them concentric with guides.

Valve face angle is 45˚ for both intake and exhaust valves. If a valve refusing grinder is used, it must be adjusted exactly to this angle. It is important to remove no more metal than is necessary to clean up and true valve face. Install a new valve if grinding leaves the valve edge (the margin) with a width of less than 1/32 in. (0.8 mm). A valve with too thin a margin does not seat normally, burns easily, may cause pre-ignition and can also lead to valve cracking. Valves that do not clean up quickly are probably warped or too deeply pitted to be reused. Replace the valve if end of valve stem shows uneven wear. After valves have been ground, handle with care to prevent damage to the ground faces.

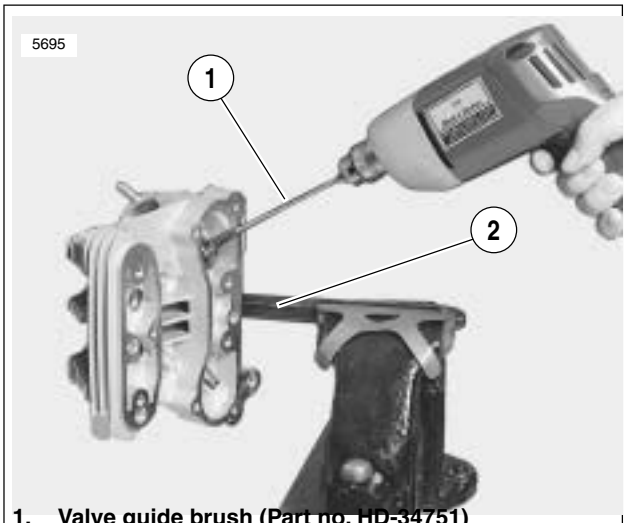
The valve seats may be refinished with cutters or grinders. Cut seats to a 46˚ angle or grind seats to a 45˚ angle. Valve seat tools and fixtures are available commercially. Seat each valve in the same position from which it was removed.

See Figure 3-20. Correct 3-angle valve seat angles are shown. Use NEWAY VALVE SEAT CUTTERS; which are part of NEWAY VALVE SEAT CUTTER SET, (Part No. HD-35758A) to cut the seats. Always grind valves before cutting seats.

1. Using the #622 cutter, cut 46˚ (or grind 45˚) valve seat angle first. Use cutting oil to avoid chatter marks. Cut or grind only enough to clean up the seat.
2. Apply a small amount of lapping compound to the valve face. Rotate valve against seat using VALVE LAPPING TOOL (Part No. HD-96550-36A).
3. See Figure 3-20. Check the contact pattern on valve face. It should be 0.040-0.062 in. (1.02-1.57 mm) wide, and its center should be positioned 2/3 of the way toward the outside edge of face.

NOTE

If valve seat pattern is too close to the stem side of valve face, use the #205 cutter to cut the 60˚ angle to raise the seat. If pattern is too close to the edge of valve face, use cutter #622 to cut a 31˚ angle to lower the seat.



1. Valve guide brush (Part no. HD-34751)
2. Cylinder head holding fixture (Part no. HD-39786)

Figure 3-19. Honing Valve Guides

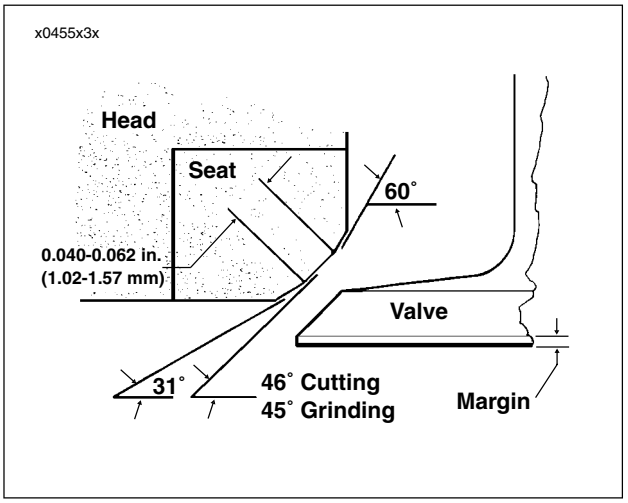


Figure 3-20. Valve Seat Angles

4. After cutting either or both 31˚ or 60˚ angles to position seat, final cut 46˚ (or grind 45˚) seat angle to obtain proper 0.040-0.062 in. (1.02-1.57 mm) width.
5. Recheck valve seat width and location with lapping compound as described in Step 2.
6. To achieve a smooth even finish, place a piece of 280 grit emery paper under the cutter head and rotate cutter.
7. See Figure 3-21. Wipe valve seats and valve faces clean. Measure valve stem protrusion. If valve stem protrudes more than 2.034 in. (51.66 mm), valve seat or cylinder head must be replaced. If valve stem protrusion is within the acceptable range, valves and seats are ready for lapping.

CAUTION

Do not grind valve to shorten. Grinding will remove the case hardening and expose the stem's mild steel core resulting in rapid end wear.

Replacing Valve Seats

Replacing a valve seat is a complex operation requiring special equipment. If the seat is loose or is not fully seated in the head, then seat movement will prevent the proper transfer of heat from the valve. The seat surface must be flush with (or below) the head surface. See 3.1 SPECIFICATIONS for valve seat-to-cylinder head fit.

CAUTION

To remove the old seat, lay a bead of weld material around the inside diameter of the seat. This will shrink the seat outside diameter and provide a surface for driving the seat out the port side.

Figure 3-21. Measuring Valve Stem Protrusion

Lapping Valve Faces and Seats

NOTE

If valve faces and seats have been smoothly and accurately re-faced, very little lapping will be required to complete the seating operation.

1. See Figure 3-22. Apply a light coat of fine lapping compound to valve face. Insert valve in guide. Position one rubber cup end of VALVE LAPPING TOOL (Part No. HD-96550-36A) onto head of valve. Holding lapping tool as shown, apply only very light pressure against valve head, and rotate lapping tool and valve alternately clockwise and counterclockwise a few times.
2. Lift valve and rotate it about 1/3 of a turn clockwise. Repeat lapping procedure in Step 1.
3. Repeat Step 2. Then, remove valve.
4. Wash valve face and seat; dry with a new, clean cloth or towel.
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.

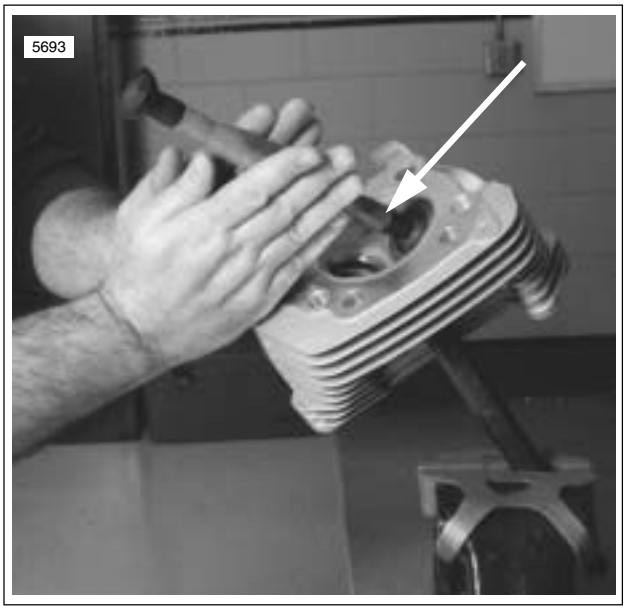


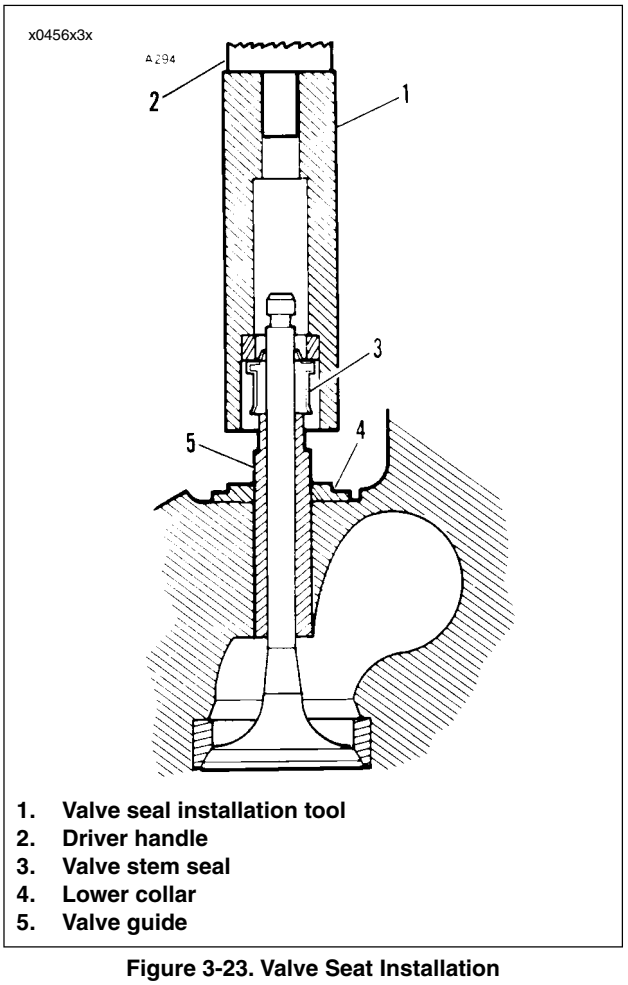
Figure 3-22. Valve Lapping Tool

ASSEMBLY

CAUTION

Make sure all lapping compound is removed from cylinder head and valves after lapping is completed. If lapping compound contaminates any internal engine components or engine oil, excessive engine wear and damage may result.

1. Wash cylinder head and valves in warm, soapy water to remove all lapping compound.
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 and install lower collar (4).



1. **Valve seal installation tool**
2. **Driver handle**
3. **Valve stem seal**
4. **Lower collar**
5. **Valve guide**

Figure 3-23. Valve Seat Installation

6. See Figure 3-24. Place a protective sleeve over the valve stem keeper groove. Coat the sleeve with oil and place a new seal over the valve stem.

CAUTION

Always use a protective sleeve on the valve stem keeper groove when installing valve stem seal. If the seal is installed without using the protective sleeve, the seal will be damaged.

CAUTION

Do not remove valve after seal is installed. Otherwise, sharp edges on keeper groove will damage seal.

Figure 3-24. Valve Guide Seal Protector Sleeve

7. See Figure 3-25. Tap the seal onto the guide using the VALVE SEAL INSTALLATION TOOL (Part No. HD-34643B) and DRIVER HANDLE (Part No. HD-34740). The seal is completely installed when the tool touches the lower collar (4).
8. See Figure 3-9. Install valve springs (3 and 4) and upper collar (2).
9. Compress springs with VALVE SPRING COMPRESSOR (Part No. HD-34736B).
10. Insert keepers (1) into upper collar (2), making sure they engage groove in valve stem. The keeper gaps should be equal.
11. Release and remove VALVE SPRING COMPRESSOR.
12. Repeat Steps 4 - 11 for the remaining valve(s).

INSTALLATION

If only cylinder head work was needed, reinstall cylinder head following these instructions. If further repair is required, see 3.6 CYLINDER AND PISTON.

1. See Figure 3-9. Coat mating surfaces of cylinder studs (12) and head screws (8 and 20) with parts cleaning solution.
2. Scrape old oil and any carbon deposits from threads by using a back-and-forth motion, threading each head screw onto its mating cylinder stud.
3. Remove head screws from studs. Wipe or blow dry thread surfaces.
4. Apply oil to stud threads and to the underside of the head screw shoulder.

CAUTION

Only oil film must remain on the head screw surfaces. Too much oil will pool in the head screw sleeve preventing full thread engagement.

5. Blow or wipe off excess oil from head screws.
6. Thoroughly clean and dry the gasket surfaces of cylinder (13) and cylinder head (19).
7. Install a new O-ring (18) on each dowel (17).

CAUTION

O-rings (18) help to properly position the head gasket (11). O-rings must be installed before the head gasket.

8. Install a new head gasket (11) to cylinder.
9. Carefully lower cylinder head over studs and position on dowels. Use great care so as not to disturb head gasket.
10. Install head screws (8 and 20) finger tight.

CAUTION

The procedure for tightening the head screws is critical to proper distribution of pressure over gasket area. It prevents gasket leaks, stud failure, and head and cylinder distortion.

11. See Figure 3-8. For each cylinder head, start with screw numbered one, as shown. In increasing numerical sequence (i.e. – 1, 2, 3, 4), tighten head screws in the following steps:
    a. Tighten each screw to 13-15 ft-lbs (16-19 Nm).
    b. **Loosen all screws**
    c. Tighten each screw to 7-9 ft-lbs (9-12 Nm).
    d. Tighten each screw to 12-14 ft-lbs (16-19 Nm).
    e. See Figure 3-25. Mark cylinder head and head screw shoulder with a line as shown (View A). Tighten each screw a quarter turn (90˚) (View B).

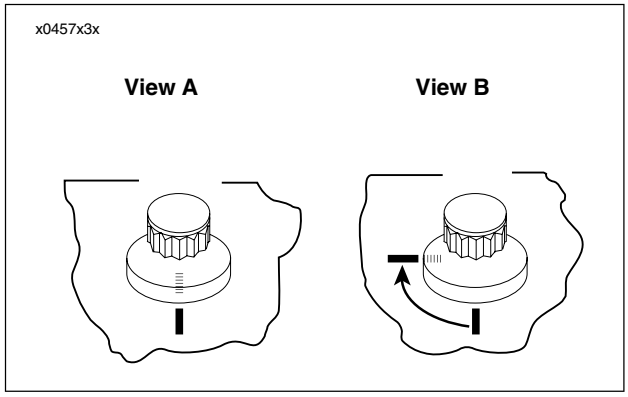


Figure 3-25. Tightening Head Screws

12. See Figure 3-10. Rotate engine so that both tappets (9), from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.
13. Apply a liberal amount of engine oil to tappet assembly (especially roller needles), to ensure smooth initial operation.
14. Insert tappet (9) into bore in crankcase (8). Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, anti-rotation screw (7) cannot be inserted.
15. See Figure 3-10. Insert anti-rotation screws (7). Tighten to 55-65 **in-lbs** (6.2-7.3 Nm).
16. Slide **new** seal (11), and place retainer (5), over top of push rod cover (10). Position **new** O-ring (2) at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer (5) with seal (11) onto crankcase, aligning locating pin (6) with hole in retainer.
17. Insert screw (3) with washer (4) through hole in retainer (5), and thread into tapped hole in crankcase. Tighten screw (3) to 15-18 ft-lbs (20-24 Nm).
18. Identify push rod color coding and length, and respective push rod positions in engine (see Table 3-6.). Place intake and exhaust push rods (1) onto seat at top of tappet (9).
19. See Figure 3-6. Install **new** gaskets (10 and 11), with the bead facing up. Place lower rocker box assembly (with rocker arms and shafts) into position. Place push rods in rocker arm sockets.

CAUTION

Do not turn engine over until both push rods can be turned with fingers. Otherwise, damage to push rods or rocker arms may result.

20. Install bolts (6), (7), (12), and (15). Slowly snug all fasteners in small increments (one turn at a time). Use a cross pattern on the four large bolts that fasten the lower rocker box to head. This will bleed the lifters.
    a. Tighten bolts (6) to 90-120 in-lbs (10.2-13.6 Nm).
    b. Tighten bolts (12) to 10-13 ft-lbs (14-18 Nm).
    c. Tighten bolts (15) and (7) to 15-18 ft-lbs (20-24 Nm).
21. Place new gasket (5), middle rocker cover (4), (with breather valve on intake side) new gasket (3) and upper rocker cover (19) on lower rocker box. Install bolts (1) with new fiber seals (2). Tighten bolts (1) to 10-13 ft-lbs (14-18 Nm).
22. Repeat above procedures for other cylinder.

Table 3-6. Push Rod Specifications

POSITION	COLOR CODE, PART NUMBER & LENGTH
Exhaust (Front & Rear)	3 Band - Pink, 17904-89, 10.800 in. (27.432 cm)
Intake (Front & Rear)	1 band - Brown, 17897-89, 10.746 in. (27.295 cm)

REMOVAL/DISASSEMBLY

1. See Figure 3-26. Strip motorcycle as described under 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR.
2. Remove cylinder head as described under 3.5 CYLINDER HEAD, REMOVAL.
3. Clean crankcase around base of cylinder to prevent dirt and debris from entering crankcase while removing cylinder.
4. Turn engine over until one piston (6) is at bottom of its stroke.
5. Carefully raise cylinder (7) just enough to permit placing clean towel under piston to prevent any foreign matter from falling into crankcase.

NOTE

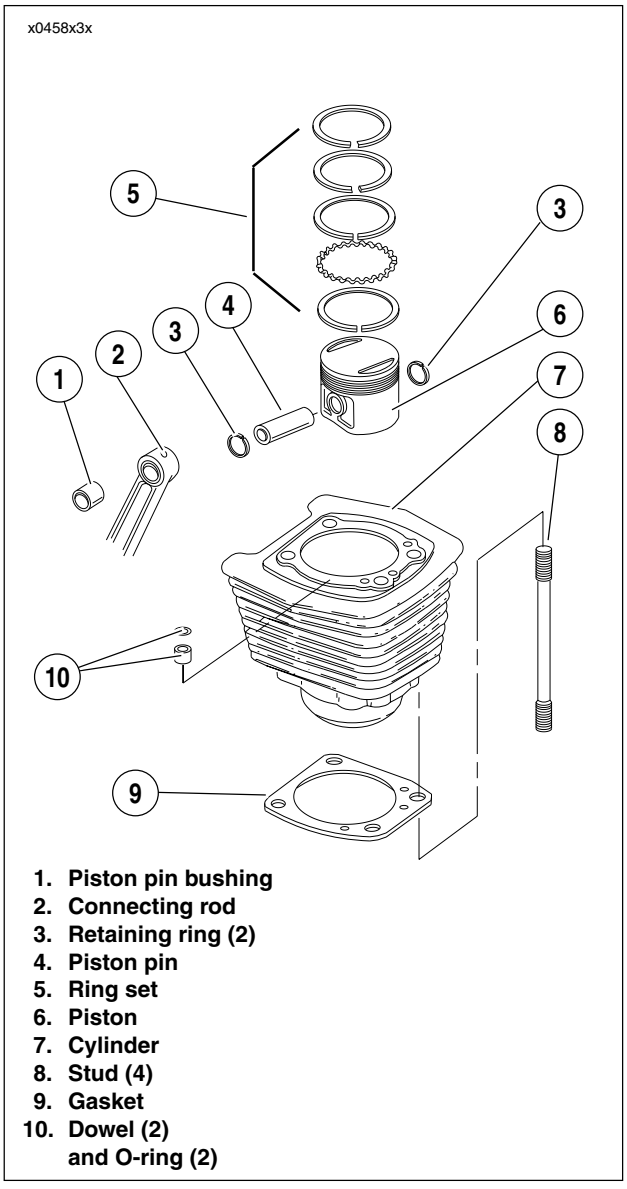
If cylinder does not come loose, tap lightly with rawhide hammer. Never try to pry cylinder up.

6. Carefully lift cylinder (7) over piston (6) and studs (8). Do not allow piston (6) to fall against cylinder studs. Discard cylinder base gasket (9).

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.

7. Install a 6-in. (150 mm) length of 1/2-in. (12.7 mm) I.D. plastic or rubber hose over each stud. This will protect the studs and the pistons.



1. **Piston pin bushing**
2. **Connecting rod**
3. **Retaining ring (2)**
4. **Piston pin**
5. **Ring set**
6. **Piston**
7. **Cylinder**
8. **Stud (4)**
9. **Gasket**
10. **Dowel (2) and O-ring (2)**

Figure 3-26. Cylinder and Piston

⚠WARNING

The next step covers removing the piston pin retaining rings. These rings are highly compressed in the ring groove and may "fly out" with considerable force when pried out of the groove, possibly resulting in personal injury. Safety glasses or goggles must be worn while removing or installing retaining rings. Inadequate safety precautions could result in death or serious injury.

8. Insert an awl in the recessed area below the piston pin bore, and pry out the piston pin retaining rings. To prevent the ring from flying out, place your thumb over the retaining ring.

CAUTION

The piston pin retaining rings must not be reused. Removal may weaken retaining rings and they may break or dislodge. Either occurrence will damage engine.

NOTE

Since the piston pin is a loose fit in the piston, the pin will easily slide out. The pins have tapered ends to help seat the round retaining rings. See Figure 3-27. 1200cc piston pins are stamped with a V-groove at one end.

9. See Figure 3-27. Mark each pin boss with either an "F" or an "R" to indicate front or rear cylinder, respectively. The arrow at the top of 883cc and 1200cc pistons must always point toward the front of the engine.

CAUTION

Handle the piston with extreme care. The alloy used in these pistons is very hard. Any scratches, gouges or other marks in the piston could score the cylinder during engine operation.

10. See Figure 3-26. Spread piston rings (5) outward until they clear grooves in piston (6) and lift off.

CLEANING, INSPECTION, AND REPAIR

1. Soak cylinder and piston in an aluminum-compatible cleaner/solvent until deposits are soft, then clean with a brush. Blow off loosened carbon and dirt particles and wash in solvent.
2. Clean oil passage in cylinder with compressed air.
3. Clean piston ring grooves with a piece of compression ring ground to a chisel shape.
4. Examine piston pin to see that it is not pitted or scored.
5. Check piston pin bushing to see that it is not loose in connecting rod, grooved, pitted or scored. A piston pin properly fitted to upper connecting rod bushing has a 0.00125 to 0.00175 in. (0.0317-0.0444 mm) clearance in bushing. If piston pin-to-bushing clearance exceeds 0.00200 in. (0.0508 mm), replace worn parts. See 3.6 CYLINDER AND PISTON, CLEANING, INSPECTION, AND REPAIR, Connecting Rod Bushing.
6. Clean piston pin retaining ring grooves.
7. Examine piston and cylinder for cracks, burnt spots, grooves and gouges.

NOTE

Check connecting rod for up and down play in lower bearings. When up and down play is detected, lower bearing should be refitted. This requires removing and disassembling engine crankcase.

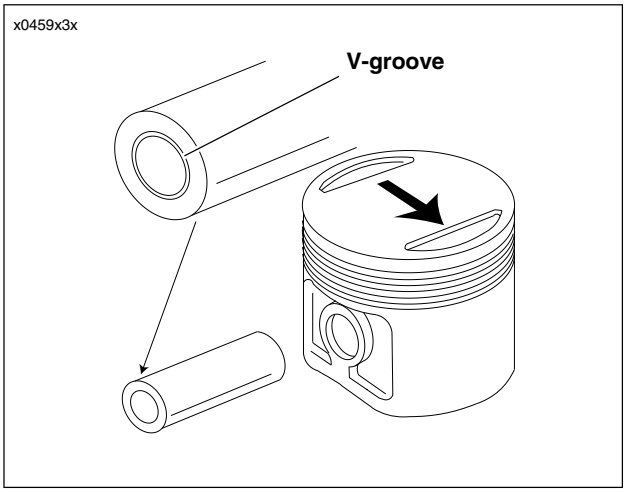


Figure 3-27. Piston Pin and Piston Identification

Checking Gasket Surface

CAUTION

If either cylinder gasket surface does not meet flatness specifications, replace cylinder and piston.

1. See Figure 3-28. Check that cylinder top (head) gasket surface is flat within 0.006 in. (0.15 mm). Lay a straight edge across the surface, then try to insert a feeler gauge between the straightedge and the gasket surface.
2. Check that the cylinder base gasket surface is flat within 0.008 in. (0.20 mm). Lay a straightedge across the surface, then try to insert a feeler gauge between the straightedge and the gasket surface.

Figure 3-28. Checking Gasket Surfaces

Measuring Cylinder Bore

1. See Figure 3-29. Remove any burrs from the cylinder gasket surfaces.
2. Install a head and base gasket, and CYLINDER TORQUE PLATES (Part No. HD-33446) and TORQUE PLATE BOLTS (Part No. HD-33446-86). Tighten the bolts using the same method used when installing the cylinder head screws. See 3.5 CYLINDER HEAD, INSTALLATION.

NOTE

Torque plates, properly tightened and installed with gaskets, simulate engine operating conditions. Measurements will vary as much as 0.001 in. (0.025 mm) without torque plates.

3. Take cylinder bore measurement in ring path, starting about 1/2 in. (13 mm) from top of cylinder, measuring from front to rear, and then side to side. Record readings.
4. Repeat measurement at center, and then at bottom of 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. See Table 3-7. If cylinder is not scuffed or scored and is within service limit, see 3.6 CYLINDER AND PISTON, CLEANING, INSPECTION, AND REPAIR, Fitting Cylinder to Piston.

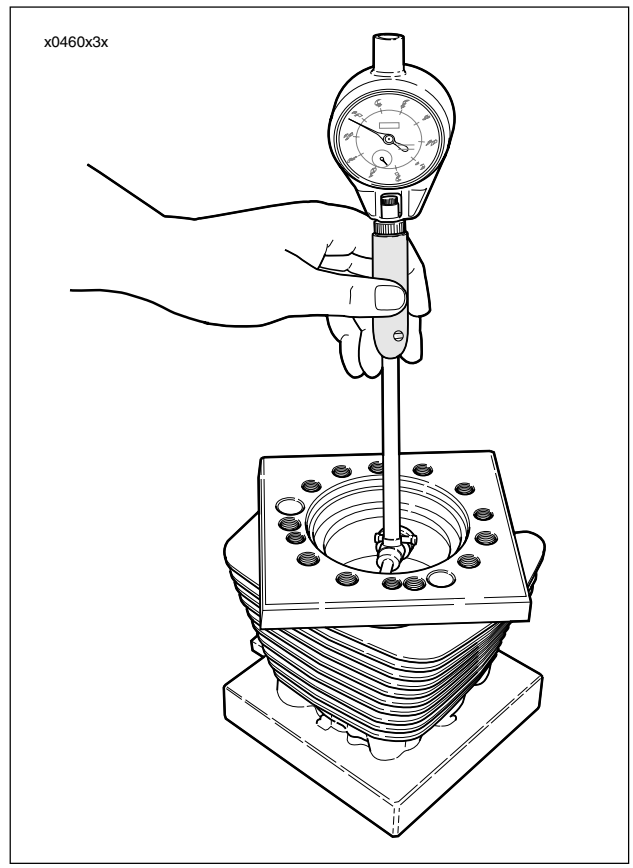


Figure 3-29. Measuring Cylinder Bore

Table 3-7. Cylinder Bore Service Wear Limits

BORE SIZES	883cc	1200cc
Standard Bore	3.0035 in. 76.289 mm	3.5008 in. 88.920 mm
0.005 in. O.S. bore 0.13 mm	3.0078 in. 76.398 mm	3.5050 in. 89.027 mm
0.010 in. O.S. bore 0.25 mm	3.0128 in. 76.525 mm	3.5100 in. 89.154 mm
0.020 in. O.S. bore 0.51 mm	3.0228 in. 76.779 mm	3.5200 in. 89.408 mm
0.030 in. O.S. bore 0.76 mm	3.0328 in. 77.033 mm	3.5300 in. 89.662 mm
0.040 in. O.S. bore 1.02 mm	3.0428 in. 77.287 mm	N/A

NOTE

If piston clearance exceeds service limit, cylinders should be re-bored and/or honed to next standard oversize, and refitted with the corresponding piston and rings. Do not fit piston tighter than 0.0007 in. (0.018 mm). See 3.1 SPECIFICATIONS.

Measuring 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.

Any damage to the piston will change its shape, which will lead to problems.

Fitting Cylinder to Piston

Since pistons cannot be accurately measured with standard measuring instruments, the bore sizes, given in Step 2 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 3.0048 in. ± 0.0002 in. (76.322 mm ± 0.005 mm) for the 883cc engine.

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 a 280 grit rigid hone followed by a 240 grit flexible ball hone. Honing must be done with the torque plates attached. All honing must be done from the bottom (crankcase) end of the cylinder. Work for a 60˚ crosshatch pattern.

Final cylinder bore sizes, after honing are as follows:

Table 3-8. Final Cylinder Bore Sizes

BORE SIZES	883CC	1200CC
Standard bore*	3.0005 in. 76.213 mm	3.4978 in. 88.844 mm
0.005 in. O.S. bore 0.13 mm	3.0048 in. 76.323 mm	3.502 in. 88.95 mm
0.010 in. O.S. bore 0.25 mm	3.0098 in. 76.449 mm	3.507 in. 89.08 mm
0.020 in. O.S. bore 0.51 mm	3.0198 in. 76.703 mm	3.517 in. 89.33 mm
0.030 in. O.S. bore 0.76 mm	3.0298 in. 76.957 mm	3.527 in. 89.59 mm
0.040 in. O.S. bore 1.02 mm	3.0398 in. 77.211 mm	N/A

*All bore sizes + 0.0002 in.

NOTES

- *When cylinder requires oversize re-boring to beyond 0.040 in. (1.02 mm) on 883cc engines, or 0.30 in. (7.6 mm) on 1200cc engines, the oversize limit has been exceeded and cylinder must be replaced.*
- *The same piston may be used if cylinder bore was not changed, unless it is scuffed or grooved. However, replace rings and hone the cylinder walls with a No. 240 grit flexible ball hone.*

Fitting Piston Rings

NOTE

Ring sets and pistons, 0.040 in. (1.02 mm) oversize, are not available on 1200cc engines.

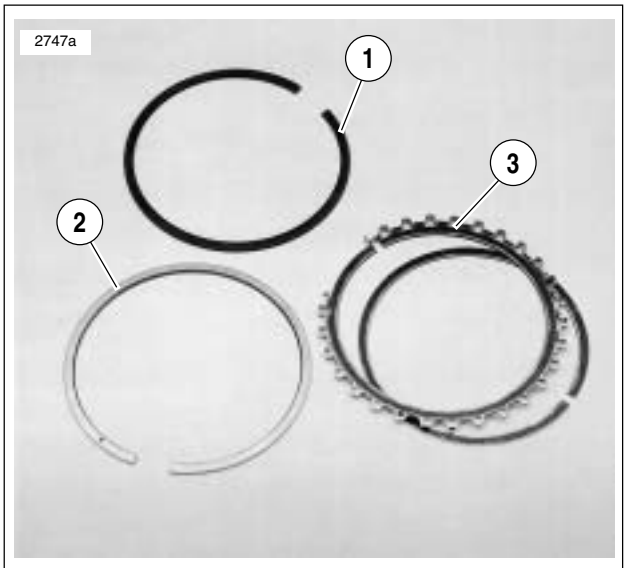
See Figure 3-30. Piston rings are of two types: compression and oil control. The two compression rings are positioned in the two upper piston ring grooves. The dot on the second compression ring must face upward. Ring sets are available to fit standard and oversize pistons.

Piston ring sets must be properly fitted to piston and cylinder:

1. See Figure 3-31. Place piston in cylinder about 1/2 in. (13 mm) from top. Set ring to be checked squarely against piston as shown. Check end gap with thickness gauge. See 3.1 SPECIFICATIONS for tolerance.

NOTE

See SERVICE WEAR LIMITS for end gap dimensions. Do not file rings to obtain proper gap.



1. Top ring – Install either side up
2. Second ring – Install dot toward top
3. Oil control rings

Figure 3-30. Piston Rings

Figure 3-31. Measuring Ring End Gap

2. See Figure 3-32. Apply engine oil to piston grooves. Use a piston ring expander tool to slip compression rings over piston into their respective grooves. Be extremely careful not to over expand, twist rings, or damage piston surface when installing rings.

NOTE

Install second ring with dot towards top.

Figure 3-32. Installing Piston Rings

3. See Figure 3-33. Install rings so end gaps of adjacent rings are a minimum of 90˚ apart. Ring gaps are not to be within 10˚ of the thrust face centerline.

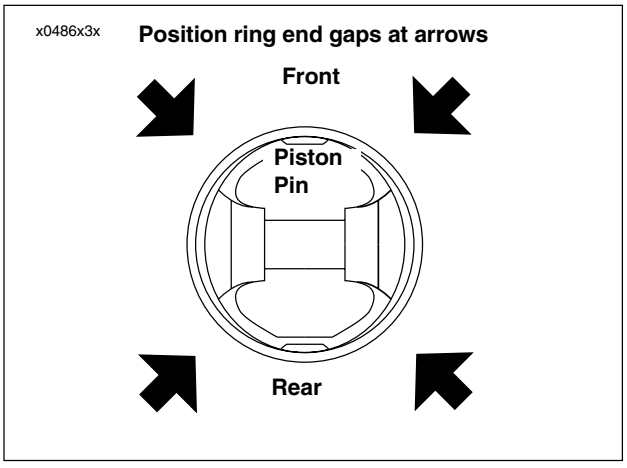


Figure 3-33. Ring End Gap Position

4. See Figure 3-34. Check for proper side clearance with thickness gauge, as shown. See 3.1 SPECIFICATIONS for tolerance.

NOTE

If the ring grooves are clean, and the side play is still not correct, replace the rings, the piston, or both.

Figure 3-34. Measuring Ring Clearance in Groove

Connecting Rod Bushing

REMOVAL/INSTALLATION

When connecting rod bushing is worn to excessive pin clearance (0.002 in. or more) (0.05 mm) it must be replaced.

1. See Figure 3-35. Install plastic hoses over studs.
2. Secure connecting rod with ROD CLAMPING FIXTURE (Part No. HD-95952-33A).

NOTE

If CONNECTING ROD CLAMPING TOOL holes are too small, enlarge the holes in the tool.

3. See Figure 3-36. Attach PISTON PIN BUSHING TOOL (Part No. HD-95984-32C) to the connecting rod (receiver cup on one side of the rod and the driver on the opposite side) as shown.
4. Use two box wrenches and push the worn bushing from the connecting rod.
5. Remove the piston pin bushing tool from the connecting rod.
6. Remove the bushing from the receiver cup.
7. See Figure 3-36. Attach the PISTON PIN BUSHING TOOL (Part No. HD-95984-32C) to the connecting rod; place the new bushing between the connecting rod and the driver.

NOTE

The driver must be attached facing the opposite direction as it was for removal of the bushing.

8. Clean up and size bushing to 0.0010-0.0005 in. (0.025-0.013 mm) undersize using REAMER (Part No. HD-94800-26A).

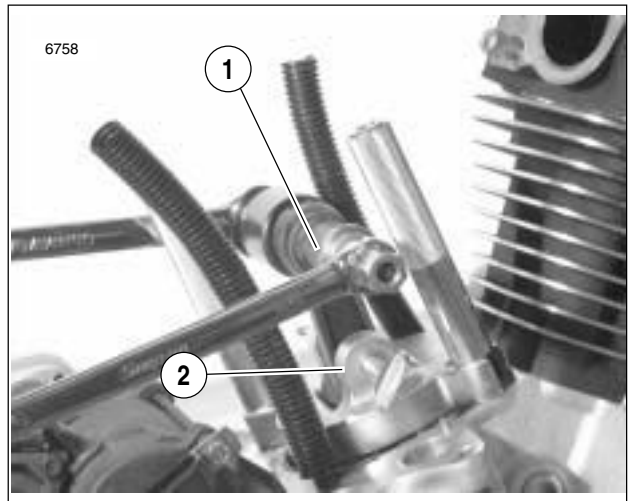
NOTE

Sizing bushing with less than 0.00125 in. (0.0317 mm) clearance can result in a bushing loosening and/or seized pin in rod.

9. Hone bushing to final size using CONNECTING ROD BUSHING HONE (Part No. HD-35102). Use a liberal amount of honing oil to prevent damage to hone or bushing. Use care to prevent foreign material from falling into the crankcase.

REPAIR

Replace bent rods. Do not attempt to straighten. Straightening rods by bending will damage the bearing on the crank pin and the piston pin bushing.



1. Piston Bushing Tool (Part no. HD-95984-32C)
2. Rod Clamping Fixture (part no. HD-95952-33A)

Figure 3-35. Installing New Piston Pin Bushing

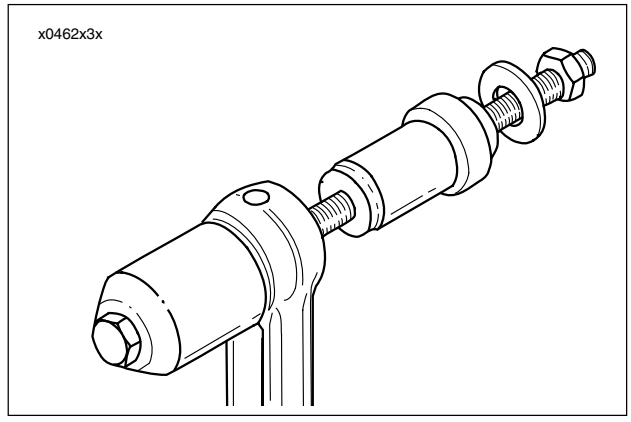


Figure 3-36. Assembly for Bushing Removal

ASSEMBLY/INSTALLATION

1. Install the piston assembly over connecting rod.

NOTE

New 1200cc and 883cc pistons must be installed with the arrow, at the top of the piston, pointing toward the front of the engine.

2. Install piston pin.
3. See Figure 3-37. Install new piston pin retaining rings with the PISTON PIN RETAINING RING INSTALLER (Part No. HD-34623A). Make 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.

CAUTION

Always use new retaining ring. Make sure retaining ring groove is clean and that ring seats firmly in groove. If it does not, discard the ring. Never install a used retaining ring or a new one if it has been installed and then removed for any reason. A loosely installed ring will come out of the piston groove and damage cylinder and piston beyond repair.

4. See Figure 3-33. Make sure the piston ring end gaps are properly positioned as shown.
5. Lubricate cylinder wall, piston, pin and rod bushing with engine oil
6. See Figure 3-38. Turn engine to rest piston on piston support plate as shown.

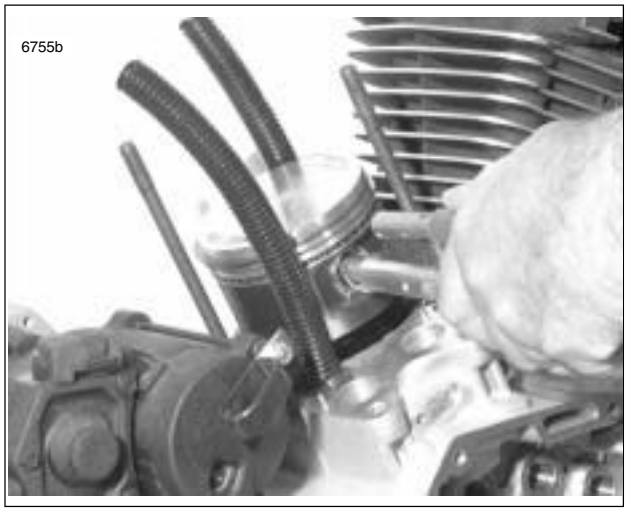


Figure 3-37. Installing Piston Retaining Rings

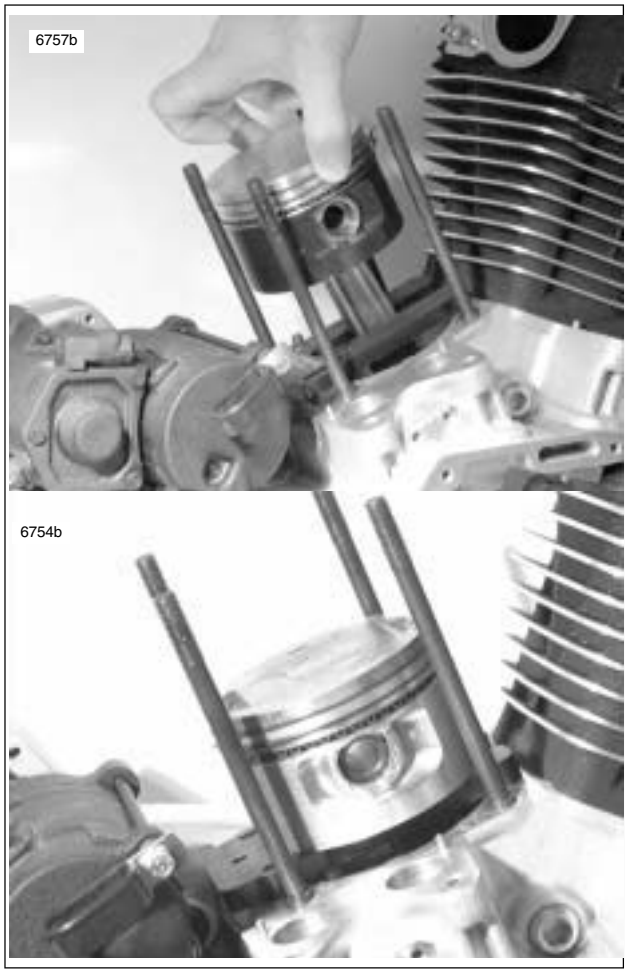


Figure 3-38. Piston Support Plate

7. See Figure 3-39. Compress the piston rings using PISTON RING COMPRESSOR (Part No. HD-96333-51C).
8. Remove cylinder stud sleeves. Install a new cylinder base gasket. Make sure the piston does not bump the studs or crankcase.
9. Install the cylinder over the piston as shown.
10. Remove the piston ring compressor.
11. Assemble and install cylinder head. See 3.5 CYLINDER HEAD, ASSEMBLY and INSTALLATION.
12. Install assembled engine to motorcycle. See 3.4 INSTALLING THE ENGINE.

Figure 3-39. Installing Cylinder Over Piston

NOTES

CHECKING AND ADDING OIL

Check engine oil level in oil tank at least once every 500 miles (800 km). Check level more frequently if engine uses more oil than normal or if vehicle is operated under harsh conditions. Oil tank capacity is three quarts (U.S.) (2.8 liters). Check table in 3.7 ENGINE LUBRICATION SYSTEM, CHANGING OIL AND FILTER for recommended engine oil viscosity.

1. Run engine until engine oil is at normal operating temperature. Turn engine off.
2. Hold motorcycle upright so that it is not leaning on jiffy stand. Remove filler cap from oil tank on right side of vehicle. Wipe attached dipstick clean.
3. Install filler cap onto oil tank. Make sure cap is fully seated on tank.
4. See Figure 3-40. Remove filler cap and check warm oil level on dipstick. Dipstick has two marks. If oil level in tank is at or below lower mark, add one quart (0.946 liter) of Harley-Davidson oil to tank.
5. Repeat Steps 2-4 to verify correct engine oil level in oil tank. Do not fill oil tank to the level above upper mark on dipstick.

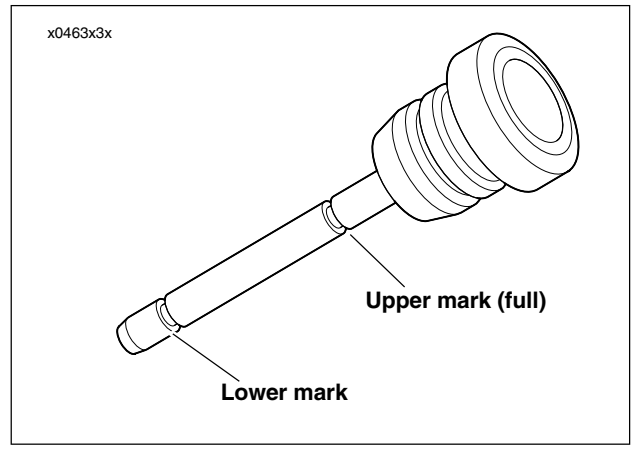


Figure 3-40. Oil Tank Filler Cap/Dipstick

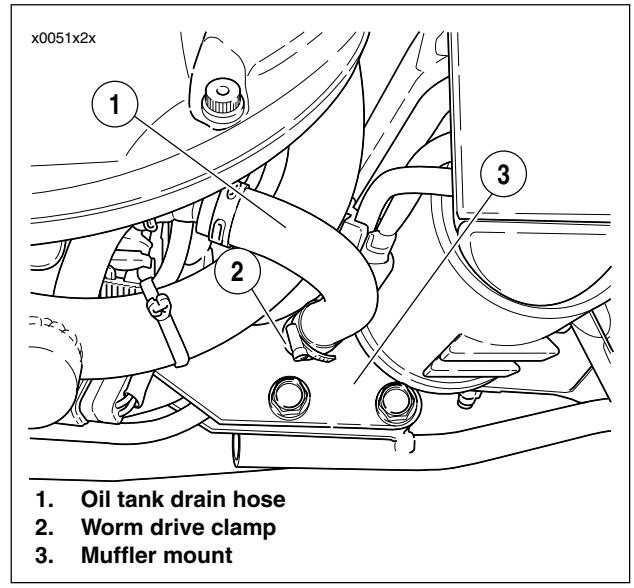
CHANGING OIL AND FILTER

General

After a new engine has run its first 1000 miles (1600 km), and at 5000 mile (8000 km) intervals or annually thereafter, completely drain oil tank of used oil. Refill with fresh oil. If vehicle is driven extremely hard, used in competition, or driven on dusty roads, change engine oil at shorter intervals. Always change oil filter when changing engine oil. Proceed as follows:

Removal

1. Run engine until engine oil has reached normal operating temperature.
2. Place a suitable container under the engine crankcase. The container must be able to hold approximately three U.S. quarts (2.8 liters).
3. See Figure 3-41. Locate the oil tank drain hose. The drain hose is secured to a lug on the rear muffler mount.



1. **Oil tank drain hose**
2. **Worm drive clamp**
3. **Muffler mount**

Figure 3-41. Oil Tank Drain Hose

4. Remove the Corbin clamp, pull the drain hose from the lug and insert the free end into the container. Completely drain engine oil from oil tank. It is not necessary to drain engine crankcase.

NOTE

Oil will flow more quickly if the filler cap/dipstick is removed from the oil tank.

5. Move drain pan beneath front of engine crankcase.
6. See Figure 3-42. Turn oil filter counterclockwise to remove from filter mount.
7. Discard oil filter.

Installation

1. Pour about 4 fluid ounces (U.S.) (120 ml) of fresh, clean engine oil into **new** oil filter. Allow time for oil to soak into filter element.

NOTE

Partially fill oil filter before installation to minimize the time required for buildup of oil pressure when engine is first started.

2. Wipe filter gasket contact surface of oil filter mount with a clean cloth. Coat filter gasket with clean engine oil.
3. Install oil filter. Hand tighten filter 1/2 to 3/4-turn after gasket contacts filter mount surface.

CAUTION

Remove Corbin clamp and drain hose from rear muffler mount lug. Allow a small amount of oil to flow from hose before reconnection. This action removes air from the drain hose and prevents the possibility of oil pump cavitation.Install filler cap onto oil tank. Make sure cap is fully seated.

4. See Figure 3-40. Use worm drive clamp to secure oil tank drain hose to lug on muffler mount.
5. See Table 3-9. Install 3 quarts (U.S.) (2.8 liters) to engine oil tank minus the 4 fl. oz. (120 ml) added in step 1. Always use the proper grade of oil for the lowest expected air temperature before the next regularly scheduled oil change.
6. Start engine. Verify that oil pressure signal light turns off when engine speed is 1000 rpm or above.
7. Check for oil leaks at oil filter and oil tank drain hose. Turn engine off.

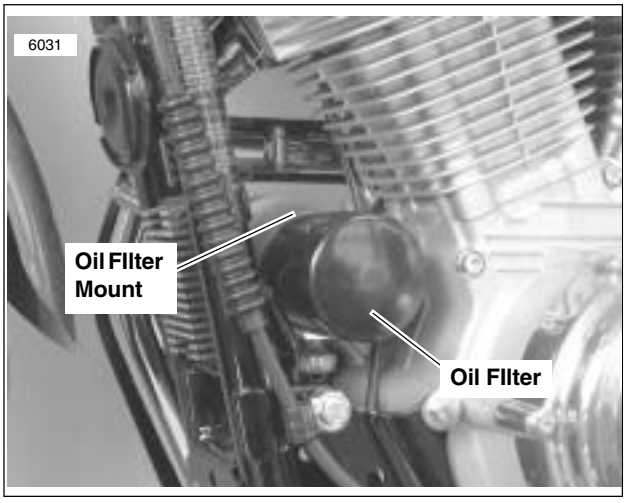


Figure 3-42. Oil Filter

Table 3-9. Recommended Engine Oil Viscosity

HARLEY-DAVIDSON TYPE	VISCOSITY	HARLEY-DAVIDSON RATING	LOWEST AMBIENT TEMPERATURE	COLD WEATHER STARTS BELOW 50˚F (10˚C)
HD Multigrade	SAE 10W40	HD 360	Below 40˚ (4˚C)	Excellent
HD Multigrade	SAE 20W50	HD 360	Above 40˚ (4˚C)	Good
HD Regular Heavy	SAE 50	HD 360	Above 60˚ (16˚C)	Poor
HD Extra Heavy	SAE 60	HD 360	Above 80˚ (27˚C)	Poor

WINTER LUBRICATION

Normal fuel combustion in a gasoline engine produces water vapor and carbon dioxide along with other gases and particulates. When first starting and warming an engine, some of the water vapor that gets into the engine crankcase condenses to form liquid water. If the engine is driven long enough to thoroughly warm the crankcase, most of this liquid water is again vaporized and exhausted through the crankcase breather system.

A moderately driven vehicle making short runs may not be able to vacate water vapors allowing liquid water to accumulates in the oil tank. This is especially true if the vehicle is operated in cold weather. In freezing weather, an accumulation of water in the engine oil may become slush or ice, which can block oil lines and lead to severe engine damage. Water remaining in the engine oil for long periods of time can form an acidic sludge that is corrosive to metal engine parts and causes accelerated wear of moving components.

In winter the oil change interval should be shorter than normal. The colder the weather, the shorter the recommended oil change interval. A vehicle used only for short runs in cold weather must have the engine oil drained frequently.

OIL HOSE ROUTING

See Figure 3-43. The feed, vent and return ports are located on the bottom of the oil tank to reduce under seat congestion A short hose routes the oil from the feed port at the lower front corner (inboard side) to a pipe elbow. The elbow ensures that the hose does not become crimped or kinked, thereby depriving the engine of oil during operation (oil starvation). The elbow routes the oil flow straight down to a pipe tee. The short hose (oil drain) from the pipe tee goes to the rear muffler mount lug where it is held in place by a worm drive clamp. From the other port of the pipe tee the oil flow crosses to the right side of the vehicle where the hose runs forward to the oil pump inlet. From the feed section of the oil pump, another feed hose directs the flow up to the oil filter mount. Eventually, oil drains to the sump where it collects in the scavenge section of the oil pump. The return hose, which is tie-wrapped to the feed hose, routes the oil back to the tank where the cycle is repeated.

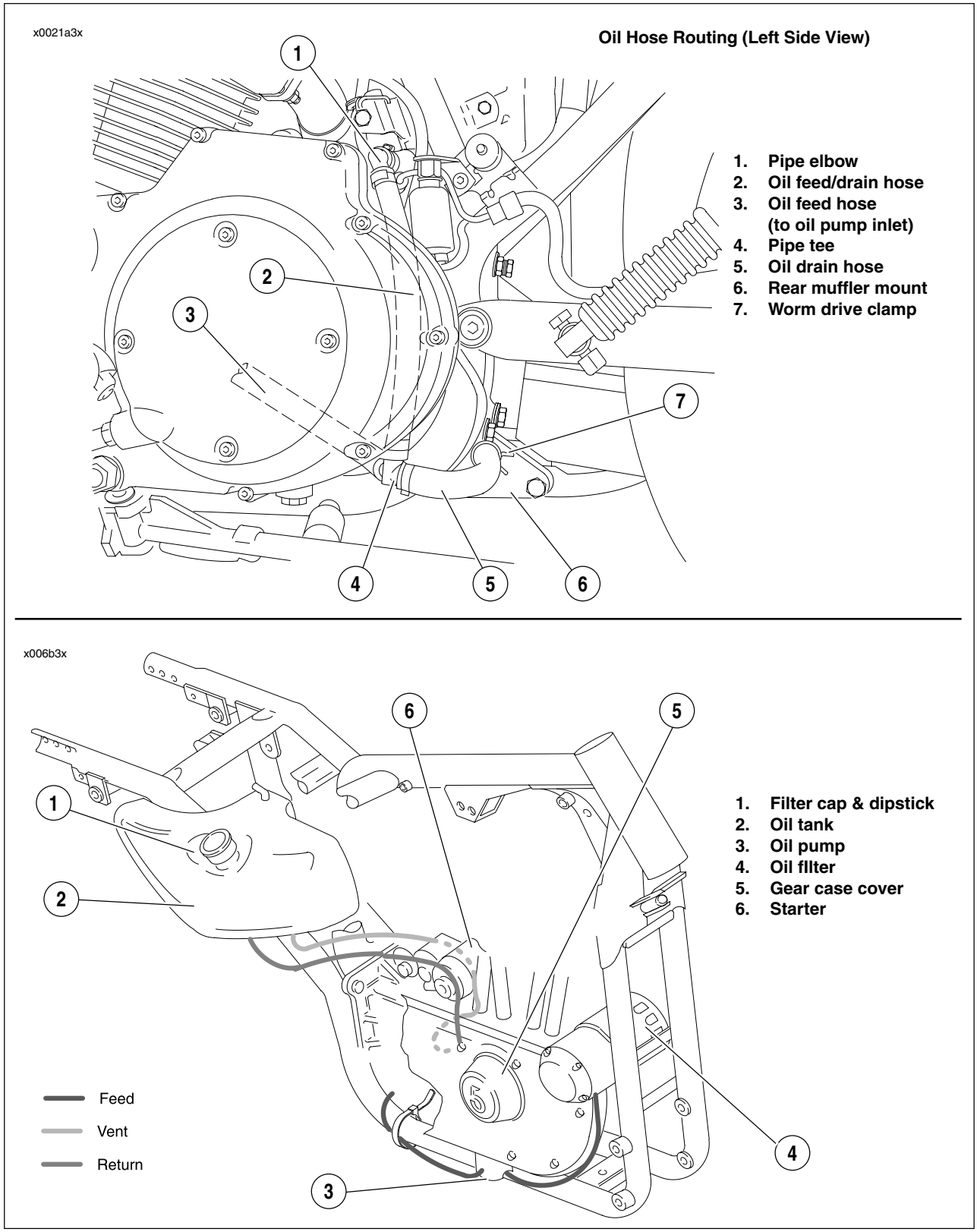


Figure 3-43. Engine Oil Tank, Oil Filter and Hose Routing Locations

OIL TANK

Removal and Disassembly

1. Remove seat. See 2.34 SEAT, REMOVAL.

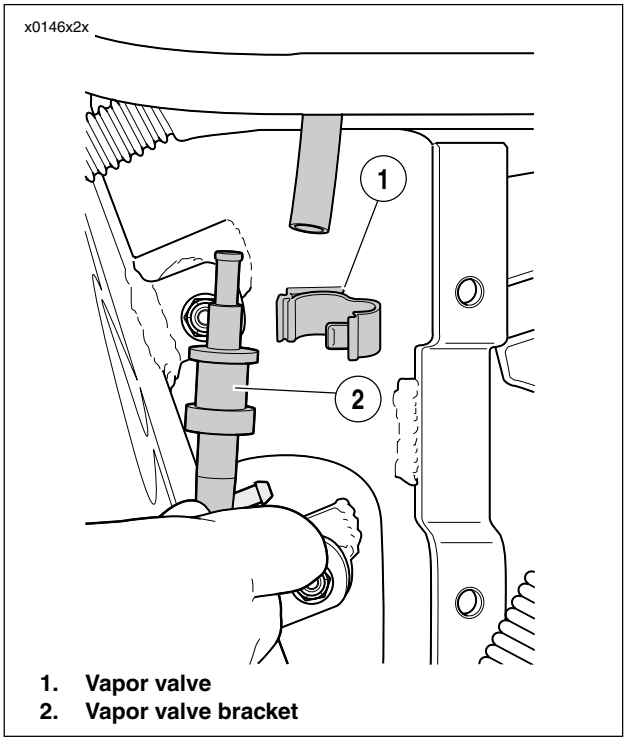
⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Inadequate safety precautions could result in death or serious injury.

⚠WARNING

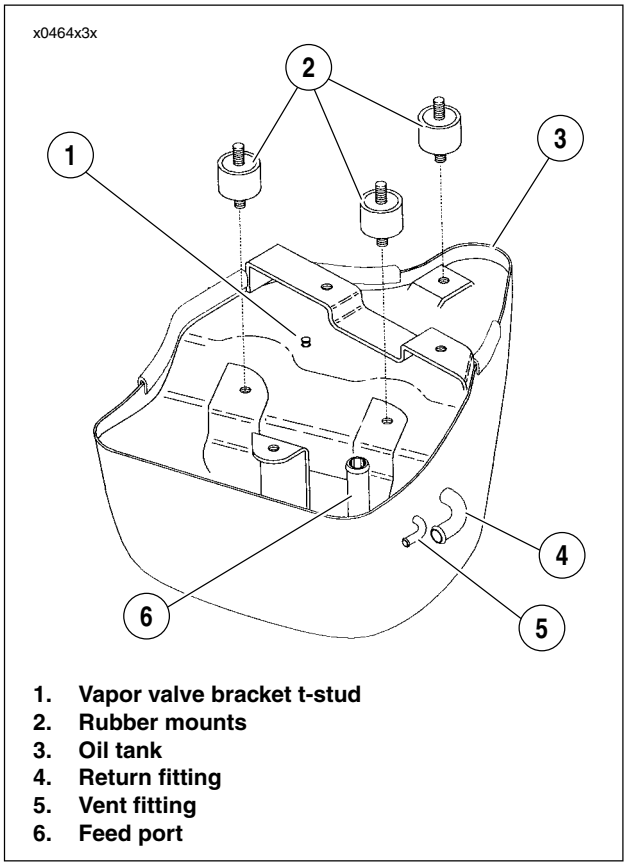
Always disconnect the negative battery cable first. If the positive battery cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion which could result in death or serious personal injury.

2. Disconnect battery cables, negative cable first. See 7.18 BATTERY, DISCONNECTION AND REMOVAL.
3. Remove battery from battery tray. Push ignition module connector on rear side plate of battery tray upward to unsnap attachment clip from T-stud. Lift connector off T-stud.
4. Drain oil tank. See 3.7 ENGINE LUBRICATION SYSTEM, CHANGING OIL AND FILTER, Removal. The oil filter need not be removed unless it is due to be replaced. Leave oil tank drain hose disconnected from lug on muffler mount.
5. Remove locknut securing tab at bottom of battery tray to frame-mounted rubber mount stud. Remove bolts and washers securing three corners of tray to oil tank brackets. Note that wire form retainer for positive battery cable is secured under front bolt. Remove battery tray.
6. Remove two bolts to detach electrical bracket from motorcycle frame. Remove rubber wellnuts from frame. Inspect for cuts, tears or general deterioration. Replace as necessary.
7. See Figure 3-44. Remove vapor valve assembly from inboard side of oil tank. Insert thin blade of screwdriver into slot of vapor valve bracket. Turn screwdriver gently to unsnap clip. Remove vapor valve body from bracket. Remove hose connection from neck of vapor valve. (On California models, remove carbon canister-to-carburetor purge hose from groove of vapor valve bracket.).
8. Cut cable strap securing wire harness to bracket welded next to top inboard seam of oil tank.
9. Slightly move electrical bracket to access upper rear rubber mount on oil tank. Remove locknuts from three oil tank rubber mount studs. Lift oil tank slightly away from motorcycle frame to access oil hoses. All hose connections are on the bottom of the tank.
10. For ease of assembly, mark oil tank hoses for identification- oil feed, vent and return. The straight tube on inboard side of tank next to lower front rubber mount is the feed port. Vent and return tubes can be identified by their 90 degree bends; the smaller O.D. tube is the vent fitting, the larger O.D. tube is the return oil fitting. Disconnect hoses from oil tank.
11. Remove oil tank from motorcycle. Remove vapor valve bracket from T-stud on inboard side of oil tank.
12. Mark position of trim strips on upper and lower inboard seams of oil tank. Remove trim strips.
13. See Figure 3-45. Remove three rubber mounts from oil tank. Inspect rubber mounts for cuts, tears or general deterioration. Replace as necessary.



1. Vapor valve
2. Vapor valve bracket

Figure 3-44. Vapor Valve and Bracket



1. **Vapor valve bracket t-stud**
2. **Rubber mounts**
3. **Oil tank**
4. **Return fitting**
5. **Vent fitting**
6. **Feed port**

Figure 3-45. Remove/Inspect Rubber Mounts

Assembly and Installation

1. See Figure 3-46. Install three rubber mounts (7) onto oil tank (8). Note that washers are **not** used.
2. Install trim strips (10) in marked positions on upper and lower inboard seams of oil tank (8). Apply upper trim strips to seams on each side of battery tray bracket (9). Use a rubber mallet to seat strips on seams, if necessary. Verify that strips butt up against bracket.
3. Install vapor valve bracket on T-stud on inboard side of oil tank. Position oil tank near its installed location on motorcycle.
4. See Figure 3-42. and Figure 3-46. Install marked oil feed, drain, vent and return hoses in their proper locations on oil tank fittings. Be sure that installed hoses (and battery cables) do not touch brake line.

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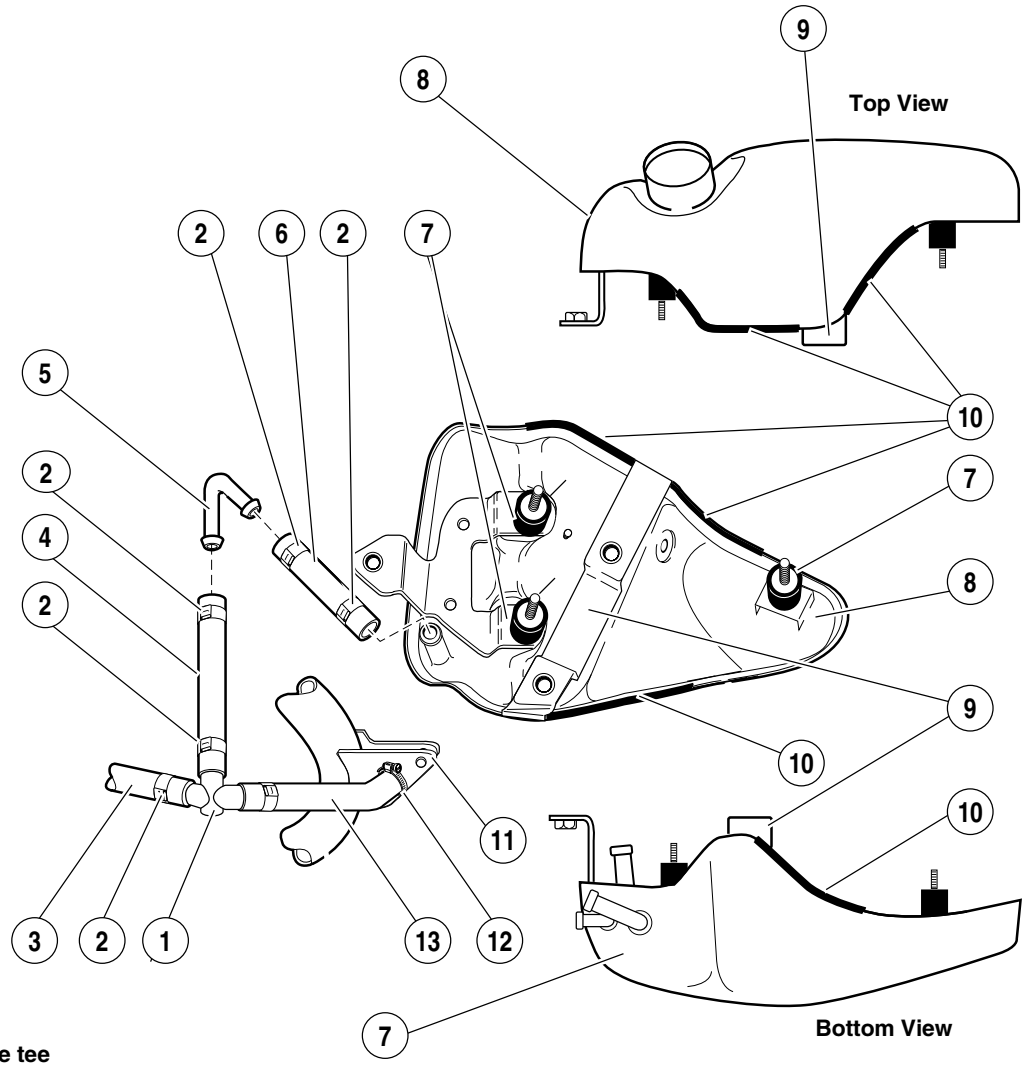


1. Pipe tee
2. Hose clamp
3. Feed hose
4. Feed/drain hose, 8 inch (203 mm)
5. Pipe elbow
6. Feed/drain hose, 3 inch (76 mm)
7. Rubber mount (3)
8. Oil tank
9. Battery tray bracket
10. Trim strip (3)
11. Rear muffler mount
12. Worm drive clamp
13. Drain hose, 4-1/4 inch (108 mm)

Figure 3-46. Engine Oil Tank Assembly

5. See Figure 3-47. Position oil tank in its installed location on motorcycle. Align studs on inboard side of rubber mounts with flanges welded to frame members. Install locknuts to secure oil tank to frame. Tighten locknuts to 3-5 ft-lbs (4-7 Nm).
6. See Figure 3-44. Hold fuel tank vapor valve in an upright position with the long necked end at the top. Insert neck of vapor valve into hose until hose end contacts shoulder. Position body of vapor valve in bracket. Snap bracket closed. (On California models, install carbon canister-to-carburetor purge hose in groove of vapor valve bracket.)

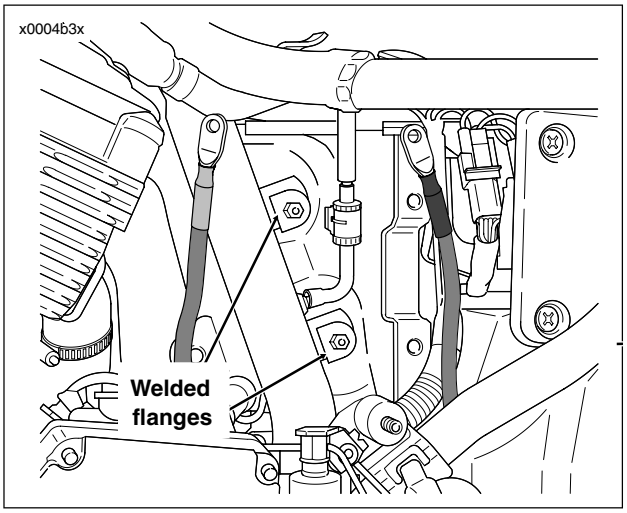
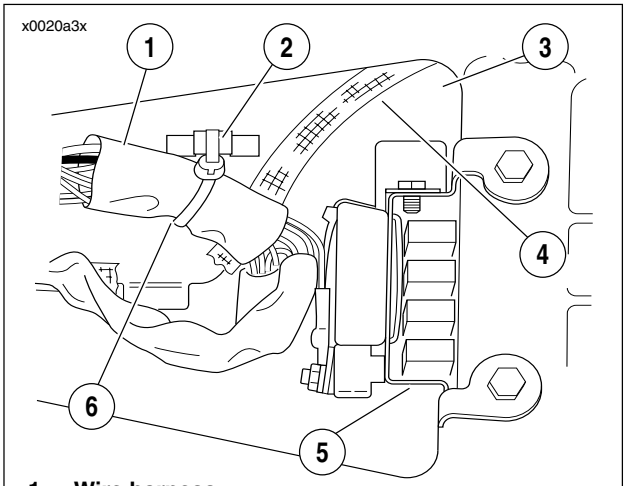


Figure 3-47. Install Oil Tank (Left Side View)

7. See Figure 3-48. Align holes in electrical bracket with wellnuts in cross member of motorcycle frame. Install two bolts. Tighten bolts to 6-9 **in-lbs** (0.7-1.0 Nm).
8. Secure wire harness to bracket welded next to top inboard seam of oil tank. Cable strap should pull harness onto trim strip and off unprotected metal seam of oil tank.



1. **Wire harness**
2. **Welded bracket**
3. **Oil tank**
4. **Trim strip**
5. **Cable strip**
6. **Electrical bracket**

Figure 3-48. Secure Wire Harness

9. See Figure 3-49. Position battery tray onto motorcycle fitting tab at bottom of tray over frame-mounted rubber mount stud. Secure three corners of battery tray to brackets on oil tank using bolts and washers. Position wire form retainer for positive battery cable under front bolt. Install locknut on frame-mounted rubber mount stud. Tighten three bolts to 12-15 ft-lbs (16-20 Nm). Tighten locknut on rubber mount stud to 36-60 **in lbs** (4.1-6.8 Nm).

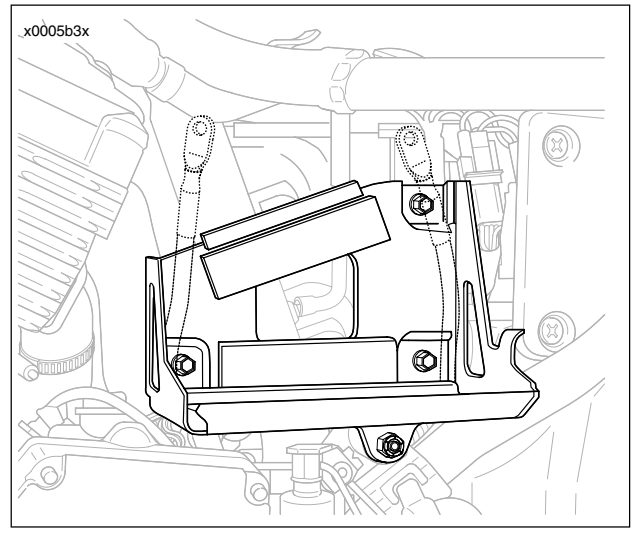


Figure 3-49. Install Battery Tray

10. See Figure 3-50. Use worm drive clamp to secure free end of oil tank drain hose to rear muffler mount lug.
11. Fill oil tank. See 3.7 ENGINE LUBRICATION SYSTEM, CHECKING AND ADDING OIL.

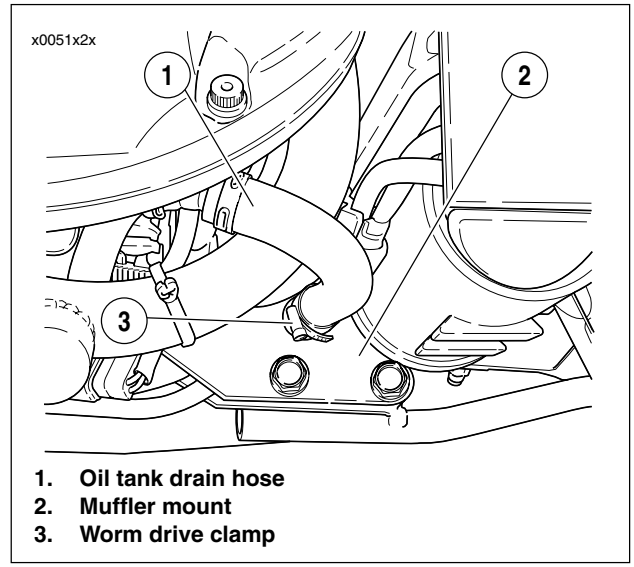
CAUTION

Remove worm drive clamp and drain hose from rear muffler mount lug. Allow a small amount of oil to flow from hose before reconnection. This action removes air from the hose and prevents the possibility of oil pump cavitation.

12. Place large end of slot on attachment clip (of ignition module connector) over T-stud on rear side plate of battery tray; push connector assembly to engage small end of slot. Install battery pad and battery onto battery tray.
13. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.
14. Install seat. See 2.34 SEAT, INSTALLATION.

⚠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 during vehicle operation and startle the rider, causing loss of control and death or serious injury.



1. **Oil tank drain hose**
2. **Muffler mount**
3. **Worm drive clamp**

Figure 3-50. Secure Oil Tank Drain Hose

OIL PRESSURE SIGNAL LIGHT SWITCH

See Figure 3-51. The oil pressure signal light switch is a pressure-actuated diaphragm-type switch. When oil is not circulating through the system or when oil pressure is abnormally low, spring tension holds the switch contacts closed, thereby completing the signal light circuit and causing the indicator lamp to illuminate.

OIL PRESSURE SIGNAL LIGHT

See Table 3-10. The oil pressure signal light turns ON when:

- Ignition switch is turned on prior to starting engine.
- Oil is not circulating through the running engine.
- Oil pressure is abnormally low on the running engine.
- Engine is idling far below 1000 rpm.

The oil pressure signal light turns OFF when oil is circulating with adequate pressure through the engine running at 1000 rpm or greater.

NOTE

If the ignition is turned back on immediately after the engine is stopped, the oil light may not turn on right away because of oil pressure retained in the filter housing.

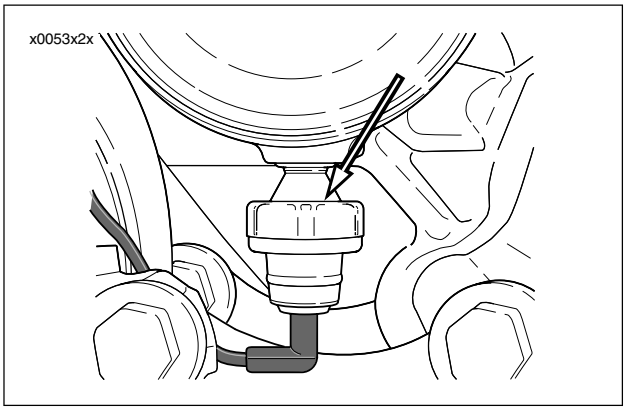


Figure 3-51. Oil Pressure Signal Light Switch

Table 3-10. Oil Light Troubleshooting

OIL PRESSURE SIGNAL LIGHT	PROBABLE CAUSES
Stays on at speeds above idle.	● Empty oil tank. ● Clogged feed line (ice and sludge, freezing temperatures). ● Air-bound oil line ● Grounded oil switch wire. ● Malfunctioning signal switch. ● Diluted oil. ● Malfunctioning check valve (see OIL FILTER MOUNT).
Flickers at idle.	● Incorrect idle speed. Malfunctioning or improperly installed check valve (see OIL FILTER MOUNT).
Does not glow when ignition is turned on (prior to operating engine).	● Malfunctioning signal switch. ● Malfunction in wiring. ● Burned-out signal bulb. ● Dead battery (see NOTE above).

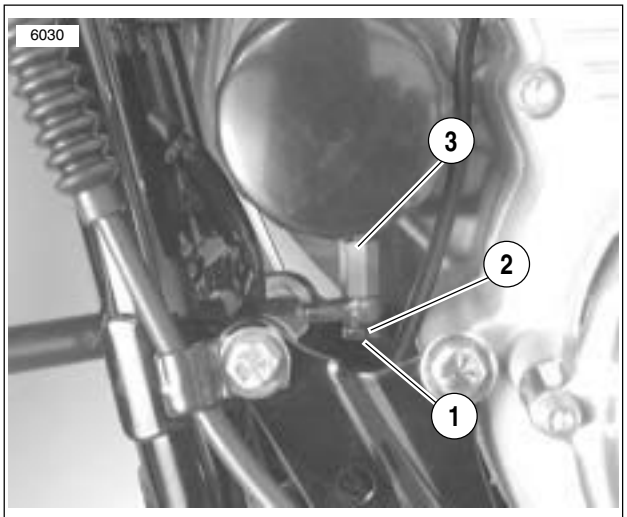
OIL PRESSURE

See Figure 3-52. The oil pump is non regulatory and delivers its entire volume of oil under pressure to the oil filter mount. When an engine is cold, the engine oil will be more viscous (i.e., thicker). During start-up of a cold engine, oil pressure will be higher than normal and oil circulation will be somewhat restricted within the oiling system. As the engine warms to normal operating temperature, the engine oil will warm up and become less viscous — oil pressure decreases.

When an engine is operated at high speeds, the volume of oil circulated through the oiling system increases, resulting in higher oil pressure. As engine speed is reduced, the volume of oil pumped is also reduced, resulting in lower oil pressure.

To check oil pressure, use OIL PRESSURE GAUGE (Part No. HD-96921-52A) and OIL PRESSURE GAUGE ADAPTER (Part No. HD-96940-52A). Remove oil pressure switch and insert pressure gauge fitting.

Run the engine until oil reaches normal operating temperature (motorcycle should be driven at least 20 miles (32 km) at or above 50 mph (80 km/h)). At 2500 rpm, oil pressure will vary from 10-17 psi (69-117 kN/m^2). At idle speed (950-1050 rpm), oil pressure will vary from 7-12 psi (48-83 kN/m^2).

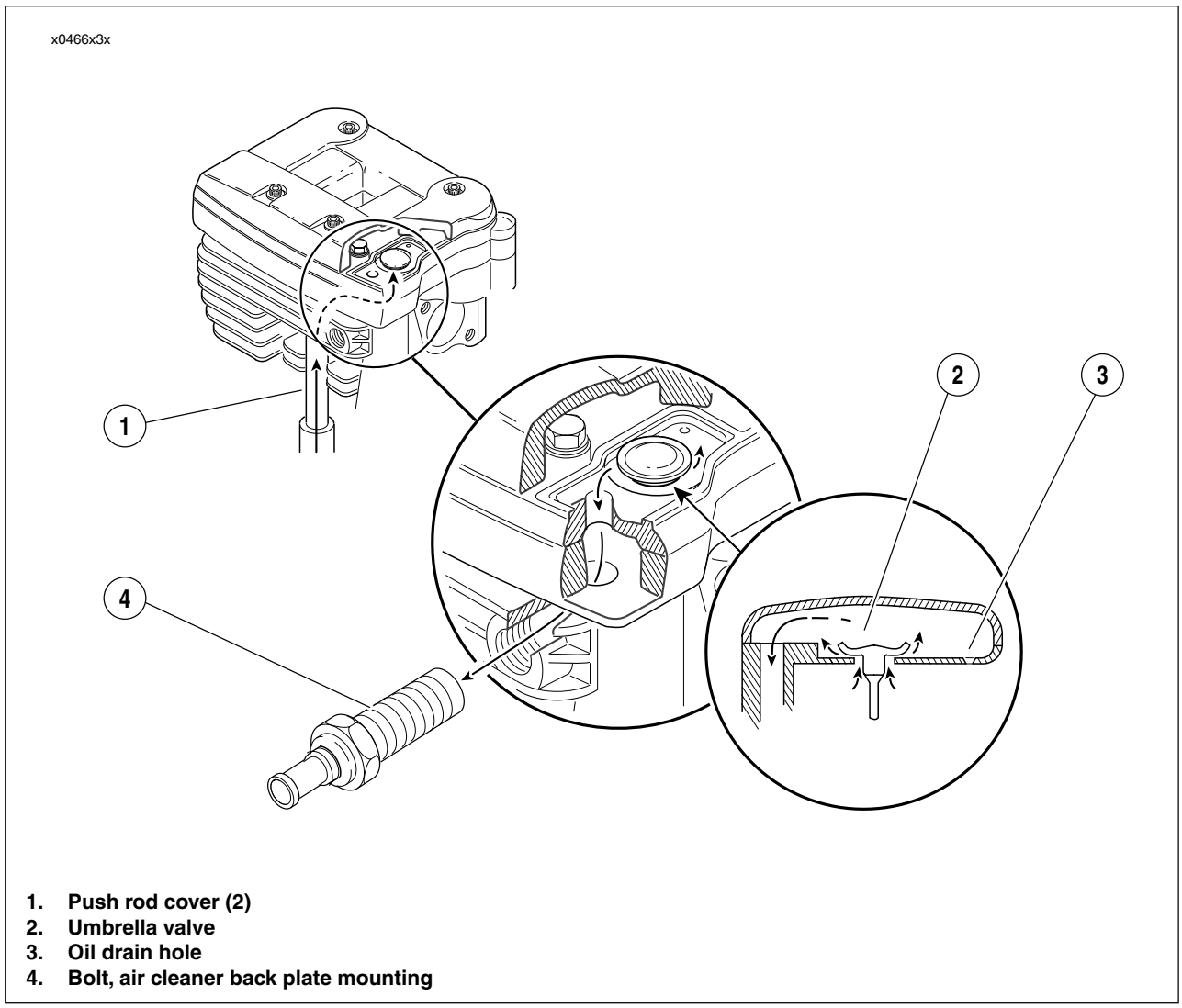


1. Oil pressure gauge adapter
2. Oil pressure gauge
3. Nipple adapter

Figure 3-52. Checking Oil Pressure

See Figure 3-53. On piston downstroke, a mixture of crankcase air and oil mist is vented up the push rod covers through an umbrella valve in each middle rocker box section.

The oil mist separates from the crankcase air, collects and passes through a small drain hole where it eventually returns to the crankcase. The crankcase air is routed through a passage in each cylinder head. The crankcase air then travels through each air cleaner backing plate mounting bolt into the filtered side of the air cleaner.



1. **Push rod cover (2)**
2. **Umbrella valve**
3. **Oil drain hole**
4. **Bolt, air cleaner back plate mounting**

Figure 3-53. Crankcase Breathing System – Typical Cylinder

NOTE

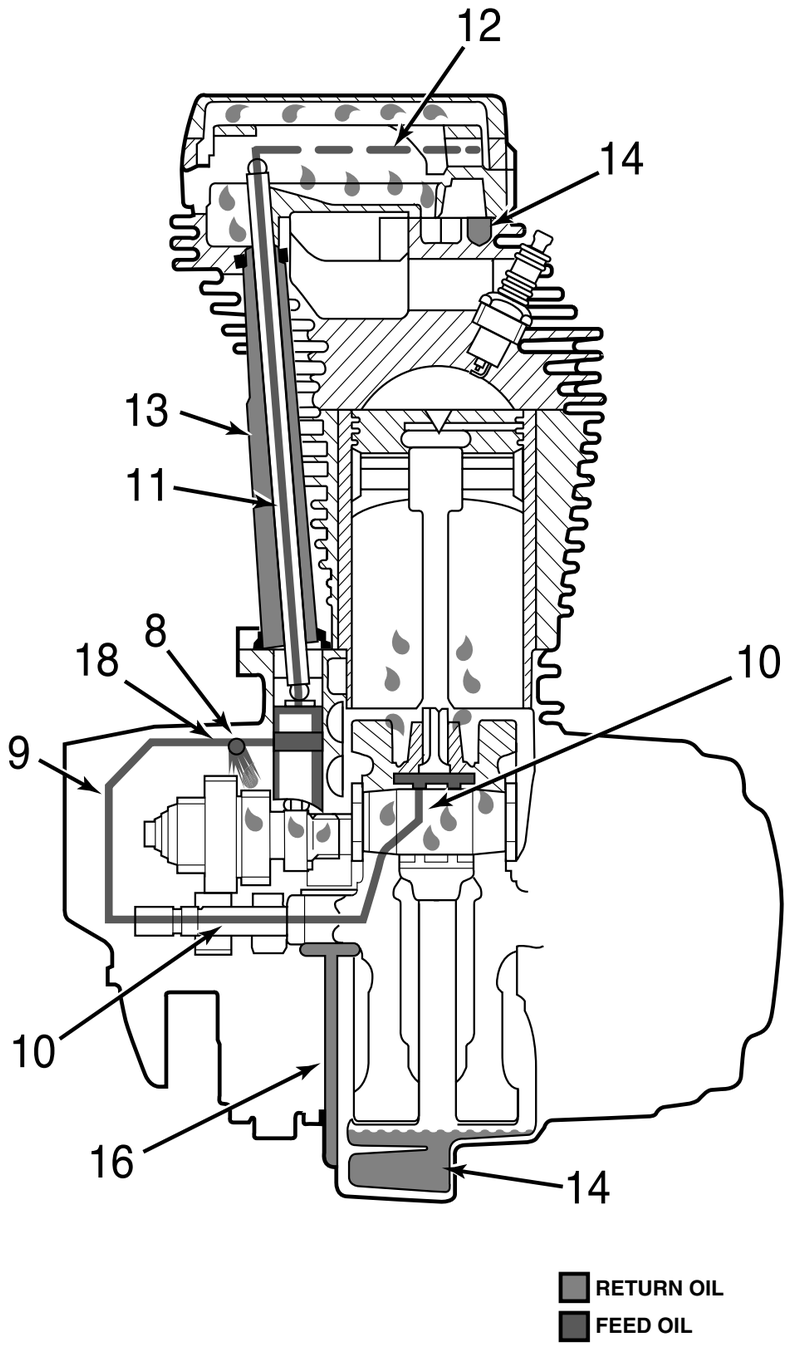
The following paragraph numbers correspond with the numbered callouts in the Lubrication Diagram foldout.

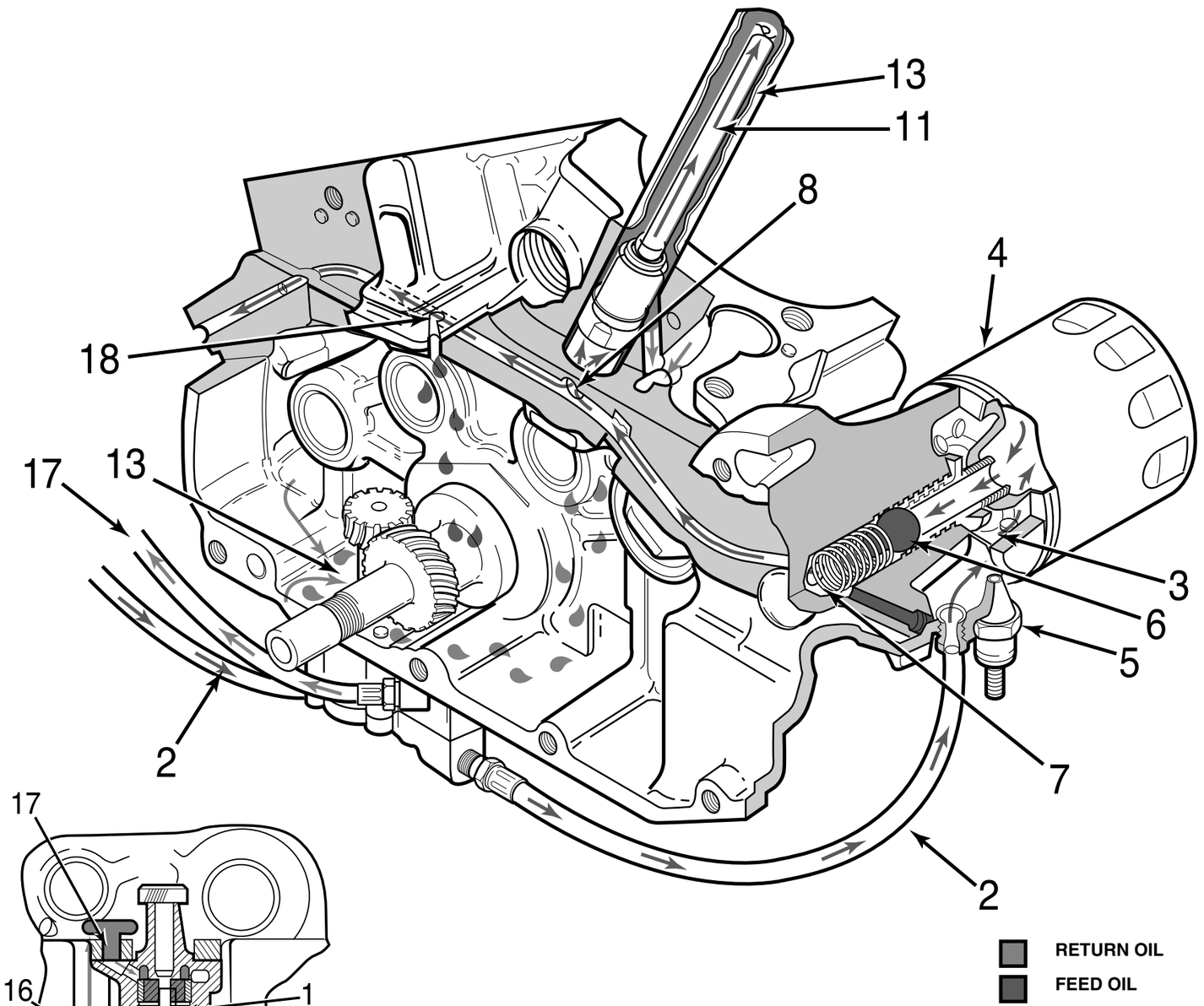
1. Oil is gravity-fed from the oil tank to the gerotor-style oil pump through a **feed hose.** Oil enters the **feed section** and fills a cavity located under the feed pump.

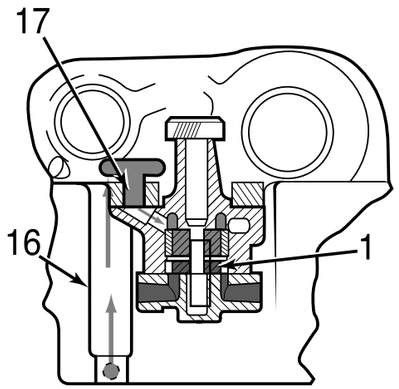
NOTE

A complete explanation of the gerotor pump is given under OIL PUMP.

2. The feed pump transfers oil from the inlet cavity through the **feed hose** to the oil filter mount.
3. Oil flows through the **filter mount cavity** to the oil filter.
4. Oil enters the peripheral cavity of the **oil filter,** passes through the filtering medium into the central cavity of the oil filter, and flows into the filter adapter (fitting which connects filter to filter mount).
5. Adequate oil pressure in the filter mount cavity activates the **oil pressure signal light switch** and shuts off the oil pressure signal light.
6. Oil flowing from the filter adapter opens the **check ball.** The check ball opens at 4-6 psi (28-41 kN/m^2) oil pressure.
7. With the check ball open, oil flows into the **crankcase feed galley.**
8. Oil flows through the feed galley in the crankcase to the tappet blocks and hydraulic lifters. **Cross-drilled passages** intersect the main feed galley and carry oil to each hydraulic lifter.
9. Oil also enters an **intersecting passage** in the gearcase cover. Oil flow is then routed to the crankshaft area.
10. Oil enters a hole in the end of the **pinion gear shaft** and travels to the right flywheel where it is routed through the flywheel to the **crankpin.** Oil is forced through the crankpin to properly lubricate the rod bearing assembly.
11. Oil flows up passages in the **push rods** to the rocker arm shafts and bushings.
12. The valve stems are lubricated by oil supplied through drilled oil holes in the **rocker arms.**
13. Oil collected in the push rod areas of the cylinder heads flows down the **push rod covers,** through drain holes in the **tappet blocks** and into the gearcase. After providing lubrication to the gearcase components the oil flows to the return side of the oil pump.
14. Feed oil to the rocker area is returned to the crankcase through a **passage** in the head and cylinder.
15. Oil collected in the **sump** is splash-fed to the pistons, cylinder walls and flywheel components.
16. Oil collected in the sump area returns to the scavenge section of the oil pump through a **passage** located in the rear section of the sump. Oil flow to the pump is accomplished by the scavenging effect of the pump and by the pressure created by the downward stroke of the pistons.
17. Return oil fills a **cavity** above the pump's return gears. The return gears pump oil back to the oil tank.
18. A small amount of oil flows from the feed galley in the right crankcase half through a **restricted orifice,** which sprays the oil onto the rear intake cam gear in the gearcase. Oil is transferred to the teeth of all the cam gears through the gear meshing action.







Lubrication Diagram

OIL PUMP

General

See Figure 3-54. The oil pump consists of two gerotor gear sets, feed and scavenge (return), housed in one pump body. The feed pump distributes oil to the engine, the scavenge pump returns oil to the tank.

A gerotor-type gear set has two parts — an inner and an outer gerotor. The inner gerotor has one less tooth than the outer gerotor. Both gerotors have fixed centers which are offset to each other.

In a gerotor gear set, oil is transferred from inlet to outlet as it is trapped between the rotating inner and outer gerotors. The illustration shows the principle of gerotor operation:

1. During the first 180˚ of rotation, the cavity between inner and outer gerotors gradually increases in size until it reaches its maximum size, equivalent to the full volume of the “missing tooth.” The gradually enlarging cavity creates a vacuum into which oil flows from the inlet.

2. During the next 180˚ of rotation, the size of the cavity decreases forcing oil into the outlet. See Figure 3-55. Gravity-fed oil from the oil tank enters the pump through fitting (5). It is forced by gerotor set (6) through a hose to the oil filter.

   Return oil from the flywheel compartment is drawn back into the pump. Returning oil from the gearcase compartment drains directly into the pump and is forced by gerotor set (8) back to the oil tank.

See Lubrication Diagram foldout. for oil passages within the engine.

The oil pump seldom needs servicing. Before you disassemble an oil pump suspected of not producing adequate oil pressure, be absolutely certain that all possible related malfunctions have been eliminated:

1. Make sure all oil line clamps are tight and that lines are not pinched or damaged.

2. Check oil level and condition of oil in tank. Pressure will be affected if oil is diluted. In freezing weather, proper circulation of oil can be affected if the oil feed line becomes clogged with ice and sludge.

3. Check for a grounded oil pressure switch wire or a faulty switch if oil indicator light fails to go out with engine running.

4. See 3.7 ENGINE LUBRICATION SYSTEM for additional information.

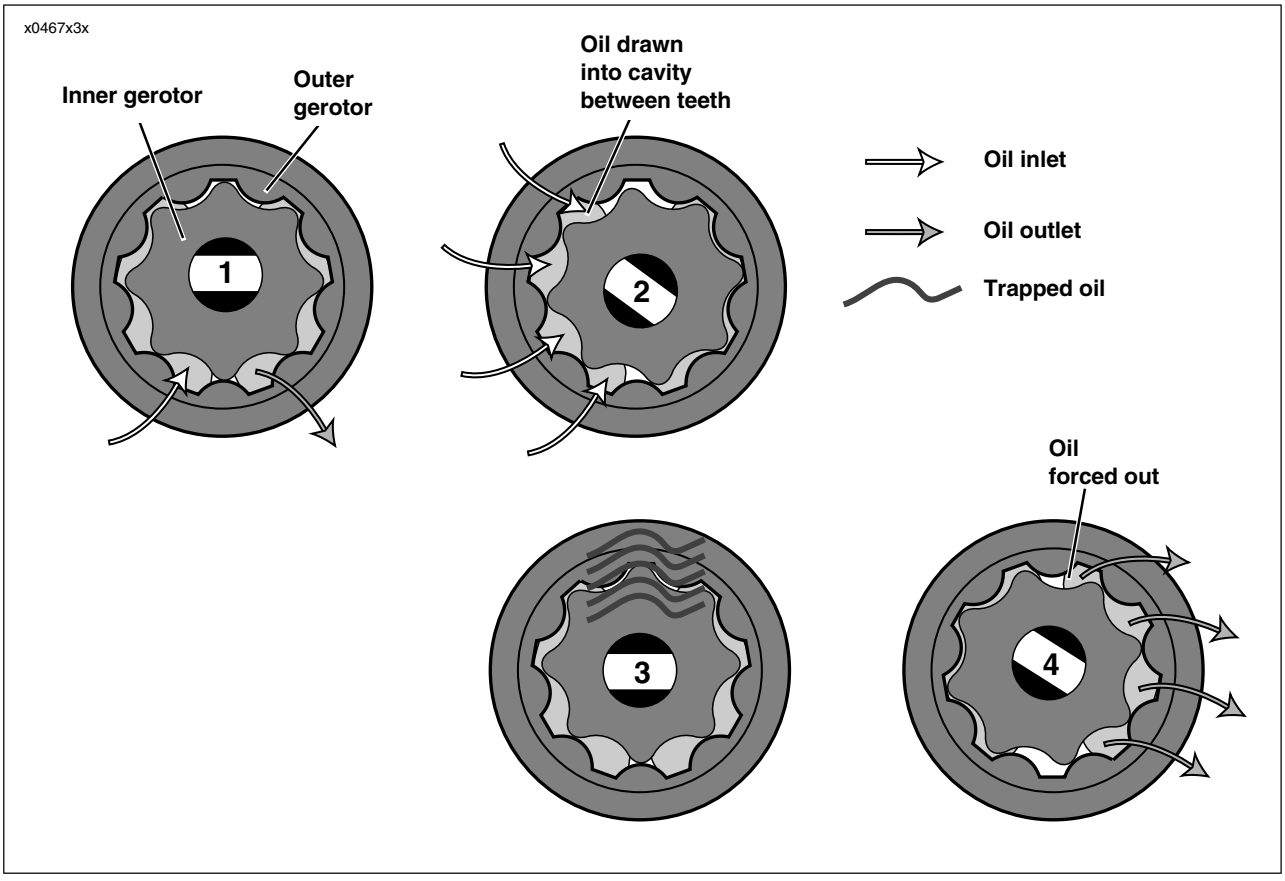


Figure 3-54. Principle of Gerotor Operation

Removal/Disassembly

NOTE

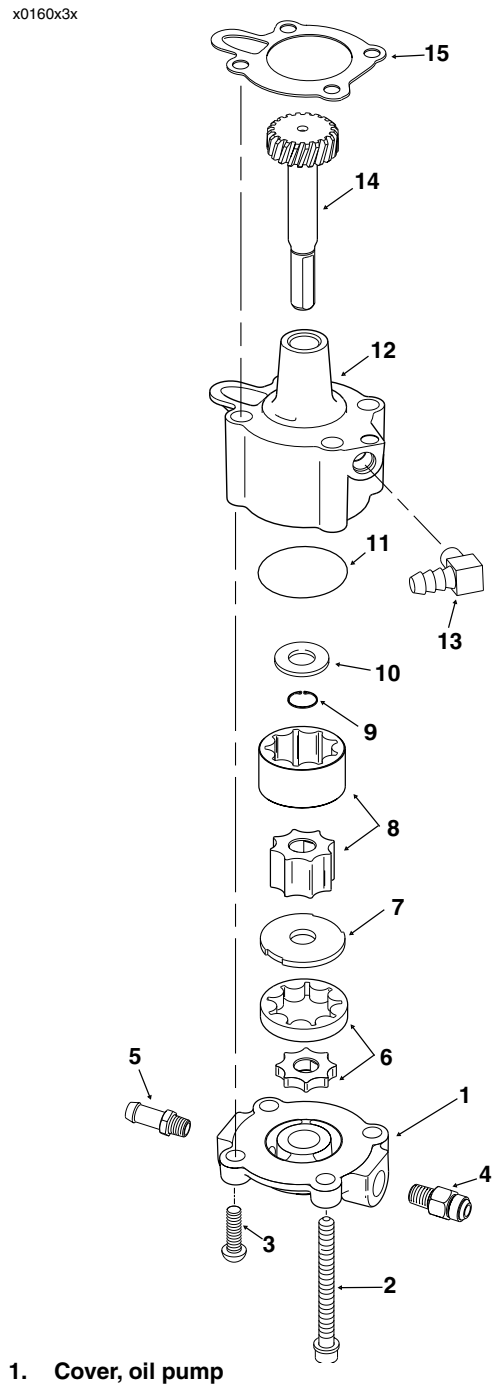
Oil pump can be removed with engine in frame and without removing gearcase cover.

1. Drain oil from oil tank.
2. Disconnect and tag the three oil hoses from the pump.

NOTE

Do not remove feed hose fitting from the pump. Loosen large nut connected to fitting and then remove pressurized feed hose.

3. See Figure 3-55. Carefully remove two screws (2) that secure pump to crankcase. Pump will drop with screws removed. Discard mounting gasket.
4. Remove two Torx screws (3). Lift cover off body. Remove and discard O-ring.
5. Slide both pieces of feed gerotor set, separator plate and both pieces of scavenge gerotor set off gear shaft.
6. Remove and discard retaining ring. Remove thrust washer and gear shaft.



1. **Cover, oil pump**
2. **Screw, w/washer (2)**
3. **Screw, Torx (2)**
4. **Connector**
5. **Hose fitting**
6. **Gerotor assy, feed**
7. **Gerotor separator plate**
8. **Gerotor assy, scavenge**
9. **Retaining ring**
10. **Washer, thrust**
11. **O-ring**
12. **Body, oil pump**
13. **Elbow fitting**
14. **Gear shaft**
15. **Gasket**

Figure 3-55. Oil Pump

Cleaning, Inspection, and Repair

1. Clean all parts in cleaning solvent. Blow out holes and oil passages with compressed air.
2. See Figure 3-56. Inspect both gerotor sets for wear. Mesh pieces of each set together as shown. Use a feeler gauge to determine clearance.

NOTE

The maximum allowable clearance between gerotors is 0.004 in. (0.10 mm). Replace gerotors as a set if clearance exceeds this dimension.

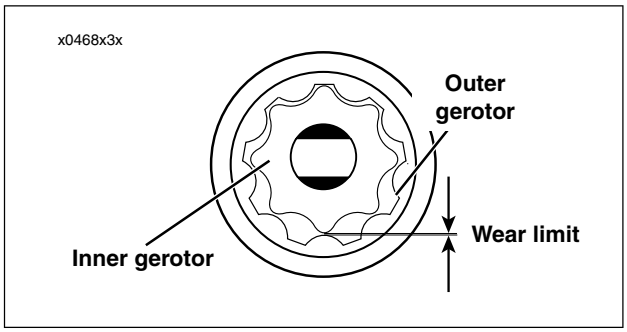


Figure 3-56. Gerotor Wear Limits

3. Measure thickness of feed gerotors with a micrometer. If they are not the same thickness, replace as a set.
4. Figure 3-55. Check gear shaft (14) teeth for damage or wear. Replace if necessary.

Assembly

1. See Figure 3-55. Install gear shaft through body. Position thrust washer over end of shaft. Install **new** retaining ring into groove in shaft.

NOTE

Liberally coat all moving parts with clean engine oil to ensure easy assembly and smooth operation at start-up.

2. Insert inner gerotor of the scavenge gerotor set over gear shaft.
3. Place outer gerotor over inner to complete scavenge set.
4. Position separator plate into case and line up slots on perimeter with tabs inside oil pump body.
5. Place feed gerotor set over gear shaft.
6. Install a **new** O-ring into groove in cover. Place cover onto pump body. Install two Torx cover screws. Tighten screws to 70-80 **in-lbs** (7.9-9.1 Nm).
7. Place new mounting gasket in position.
8. Secure pump to crankcase with two screws. Tighten screws to 125-150 **in-lbs** (14.1-16.9 Nm).
9. See Figure 3-43. Install oil pump hoses at pump.

NOTE

Use new hose clamps. If fittings were removed, use TEFLON® PIPE SEALANT or HYLOMAR® on fitting threads.

OIL FILTER MOUNT

General

Oil is pressure-fed from the oil pump to the oil filter mount via a hose connection. Oil travels through the filter mount into the filter via outer filter holes.

Adequate oil pressure activates the oil pressure signal light switch in the filter mount, which turns off the oil pressure indicator lamp.

The check ball in the filter adapter “opens” at 4-6 psi (28-41 kN/m^2) oil pressure. Filtered oil leaves the filter, flowing past the check ball.

Disassembly

1. Remove oil filter adapter from oil filter mount. Remove check ball and spring.
2. Remove oil pressure signal light switch.

Cleaning and Inspection

See Figure 3-57. Thoroughly clean all parts in cleaning solvent. Blow out holes and passages using compressed air.

Assembly

NOTE

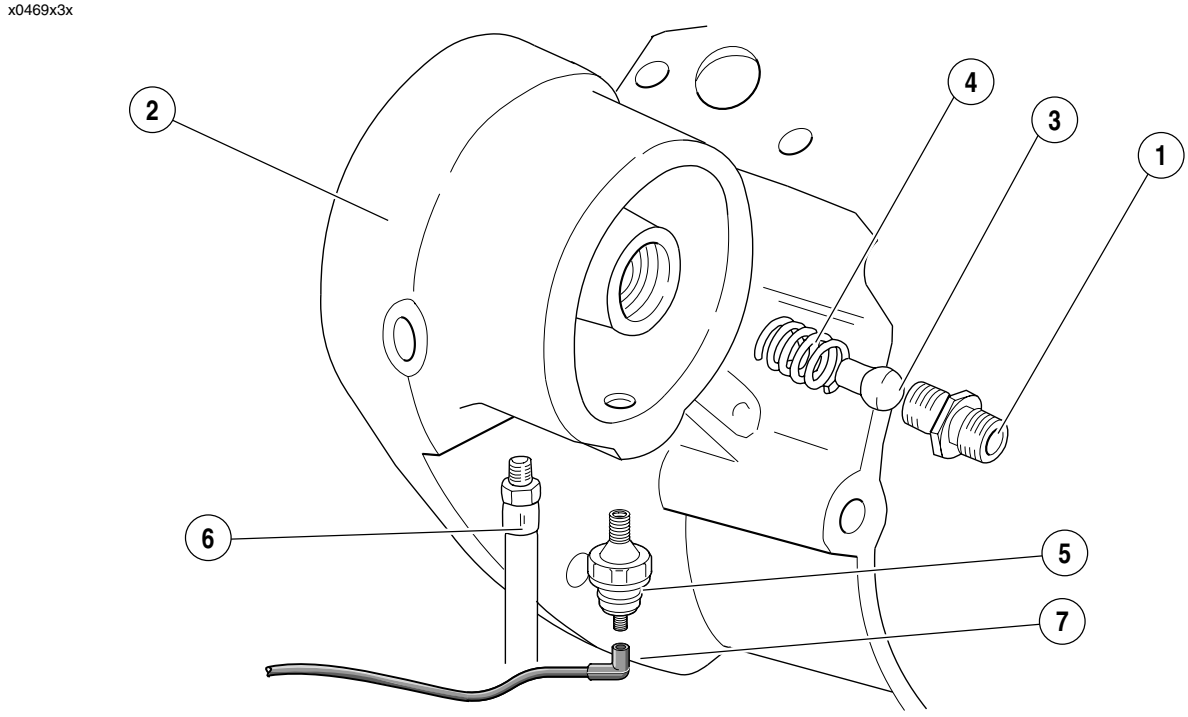
See Figure 3-57. Use TEFLON® PIPE SEALANT or HYLOMAR® on all fittings installed to oil filter mount.

1. Install oil pressure signal light switch. Tighten to 5-7 ft-lbs (7-9 Nm).
2. Apply LOCTITE® THREADLOCKER 243 (blue) to the threads on that end of the adapter which is installed into oil filter mount. Do not apply LOCTITE to adapter threads on oil filter element side.

NOTE

The oil filter adapter has identical ends; either end may be installed into the oil filter mount.

3. Place spring and check ball into threaded hole at center of mount. Push adapter against ball to compress spring. Install threaded end (with LOCTITE) into threaded hole at center of mount. Tighten adapter to 8-12 ft-lbs (11-16 Nm).
4. Connect pressure switch wire.
5. Pour about 4 fl oz. (120 ml) of clean engine oil into filter. Apply a light coat of oil to oil filter gasket. Install oil filter onto oil filter mount/adapter assembly; tighten filter an additional 1/2 to 3/4 turn after gasket contacts filter mount surface.
6. Fill oil tank with proper oil. See LUBRICATION.



1. **Oil filter adapter**
2. **Oil filter mount (part of right crankcase half)**
3. **Check ball**
4. **Spring**
5. **Oil pressure signal light switch**
6. **Feed hose**
7. **Indicator lamp wire**

Figure 3-57. Oil Filter Mount

GENERAL

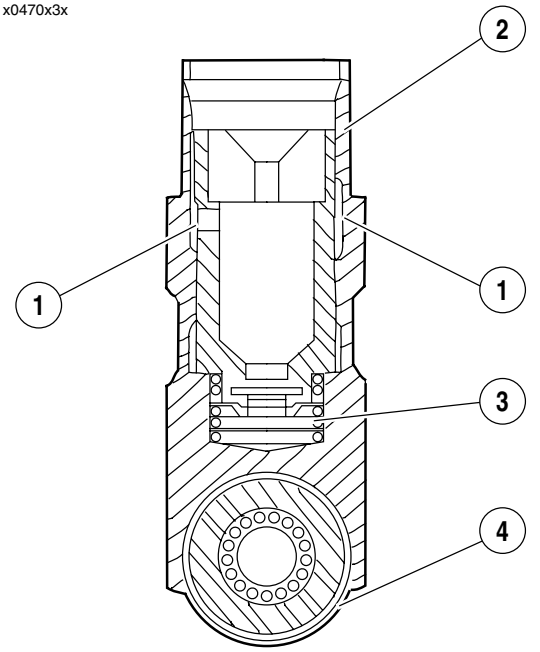
See Figure 3-58. The tappet assembly consists of tappet and roller. The tappet and roller, under compression force from valve spring, follow the surface of the revolving cam. The up-and-down motion produced is transmitted to the valve by the push rod and rocker arm. The tappet contains a piston (or plunger) and cylinder; it also contains a check valve, which allows the unit to fill with engine oil, thereby reducing clearance in the valve train.

When a tappet is functioning properly, the assembly operates with minimal tappet clearance. The unit automatically compensates for heat expansion to maintain a no-clearance condition.

It is normal for tappets to click when engine is started after standing for some time. Tappets have a definite leakdown rate which permits the oil in the tappets to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain correct clearance operation. Tappets are functioning properly if they become quiet after a few minutes of engine operation.

REMOVAL

1. See Figure 3-10. Clean all dirt from around crankcase, and blow loose particles from area with compressed air.
2. Remove the upper, middle, and lower rocker covers. See 3.5 CYLINDER HEAD. Pull the push rod upward through top of cylinder head.
3. Remove socket screw and washer. Lift retainer plate and seal upward a few inches on push rod cover. Push upward on push rod cover while pulling bottom of cover clear of crankcase. Remove cover.
4. Remove socket screw. With a thin-bladed screwdriver in the retainer groove at the top of the tappet, pry upward on the tappet until it extends above the gearcase and can be pulled out by hand.



1. **Oil**
2. **Piston**
3. **Check valve**
4. **Roller**

Figure 3-58. Tappet Assembly

CLEANING AND INSPECTION

1. Clean all parts, except roller/tappet assembly, thoroughly in solvent. Blow dry with compressed air.
2. Inspect valve tappets for excessive clearance in guide. Clearance should be 0.0008-0.0020 in. (0.020-0.051 mm).
   Accurately measure tappet bore inner diameter with a gauge. Service wear limit is 0.0030 in. (0.076 mm). Excessive tappet guide clearance is corrected by fitting a new tappet and/or replacing crankcases.

NOTE

Inside and outside micrometers used for measuring tappets and tappet guides must be calibrated to ensure accurate readings.

3. Check tappet roller free play. Roller clearance on pin should be within 0.0006-0.0010 in. (0.015-0.025 mm). Recommended service practice is tappet replacement. Service wear limit is 0.0015 in. (0.038 mm).
4. Check tappet roller end clearance. Clearance should be 0.008-0.022 in. (0.203-0.559 mm). Service wear limit is 0.026 in. (0.660 mm).
5. Tappets should be soaked in clean engine oil and kept covered until assembly.

INSTALLATION

1. See Figure 3-10. Rotate engine so that both tappets, from the cylinder being serviced, will be installed on the base circle (lowest position) of the cam.
2. Apply a liberal amount of engine oil to tappet assembly (especially roller needles), to ensure smooth initial operation.
3. Insert tappet into bore in crankcase. Rotate tappet so that flats at upper end of tappet face the front and rear of the engine. If the tappet is installed incorrectly, screws cannot be inserted.
4. Tighten screw to 80-110 **in-lbs** (9.0-12.4 Nm).
5. Slide new seal, and place retainer, over top of push rod cover. Position new O-ring at top of push rod cover. Hold cover at an angle and insert top through hole in cylinder head. Push up on cover while aligning bottom of cover with tappet bore in crankcase. Lower retainer with seal onto crankcase, aligning locating pin with hole in retainer.
6. Insert screw with washer through hole in retainer, and thread into tapped hole in crankcase. Tighten screw to 15-18 ft-lbs (20-24 Nm).
7. Install rocker covers. See 3.5 CYLINDER HEAD.

GENERAL

Read the complete gearcase section carefully before you begin any service work.

For the gearcase components to operate at their optimum, all components must be properly fitted and matched. Changing one component can affect many others. It is important to know and understand all inspection procedures and how components interact.

REMOVAL/DISASSEMBLY

1. See Figure 3-59. Thoroughly clean area around gearcase cover (17) and tappets. Blow loose dirt from crankcase with compressed air.
2. Remove any parts that will interfere with gearcase disassembly (i.e., exhaust pipe, footrest, air cleaner, brake pedal, etc.).
3. Remove push rods; see 3.5 CYLINDER HEAD.
4. Remove tappets; see 3.9 VALVE TAPPETS.
5. Check for minimum cam gear end play; see 3.10 GEARCASE COVER AND CAM GEARS, ASSEMBLY/INSTALLATION. Record readings.
6. Remove cam position sensor and rotor; see Section 7.
7. Place a pan under gearcase to collect oil. Remove cover screws. Carefully remove gearcase cover. Discard old gasket (9).

NOTE

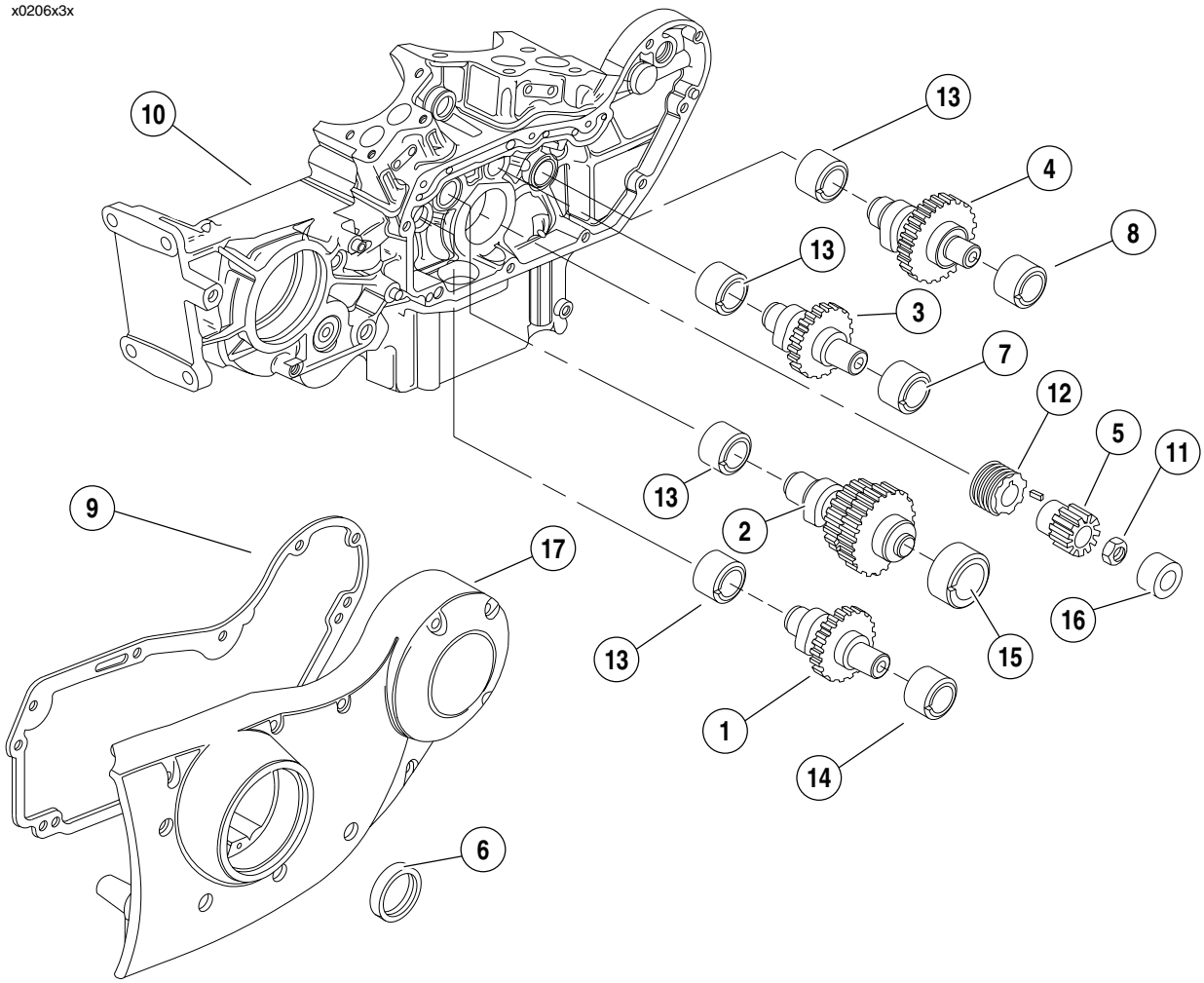
If cover does not come loose on removal of screws, tap lightly with a rawhide hammer. Never pry cover off.

8. Remove cam gears (1, 2, 3, and 4). Carefully mark each component to ensure correct installation.

NOTE

Nut (11) is secured by Loctite-272 on the nut threads.

9. Remove nut (11). Slide pinion gear (5) and oil pump drive gear (12) off pinion shaft.



1. Rear exhaust cam gear
2. Rear intake cam gear
3. Front intake cam gear
4. Front exhaust cam gear
5. Pinion gear
6. Seal
7. Front intake cam gear bushing
8. Front exhaust cam gear bushing
9. Gearcase cover gasket
10. Right crankcase half
11. Nut
12. Oil pump drive gear
13. Cam gear bushing (4)
14. Rear exhaust cam gear bushing
15. Rear intake cam gear bushing
16. Pinion shaft bushing
17. Gearcase cover

Figure 3-59. Gearcase and Valve Train Components

CLEANING, INSPECTION, AND REPAIR

1. Thoroughly clean gearcase compartment, gearcase cover, and gears in solvent to remove oil and carbon deposits.
2. Blow out all cover oil passages and bushings with compressed air.
3. Clean old gasket material from gearcase and cover faces with cleaning solvent.

Cam and Pinion Gear Identification, Inspection, and Selection

See Figure 3-60. Cam lobes are stamped with a number (1, 2, 3, or 4) followed by letter “D” or “W.” The number identifies the cam location/function; the letter “D” or “W” indicates model year application:

1D (or W) = rear exhaust
2D (or W) = rear intake
3D (or W) = front intake
4D (or W) = front exhaust

Use only “W” cams on 2002 XL Sport models. “D” cams are used on all other models.

NOTE

Prior to changing any cam gears, check gear shaft fit within corresponding bushings. Worn bushings can cause excessive backlash.

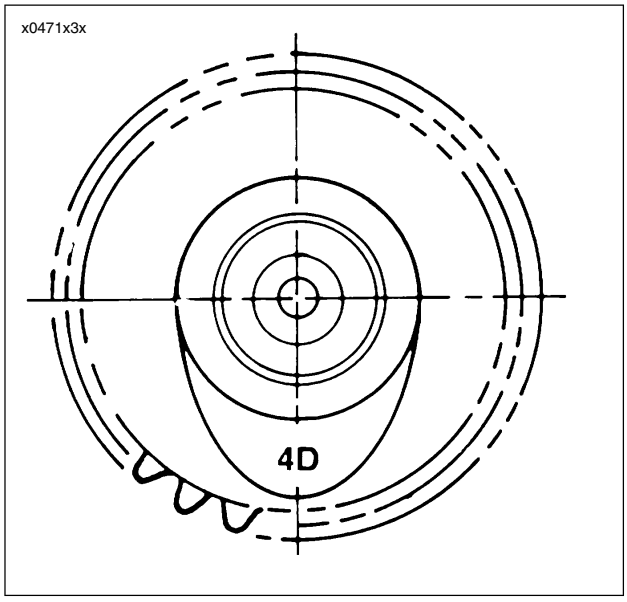


Figure 3-60. Cam Identification

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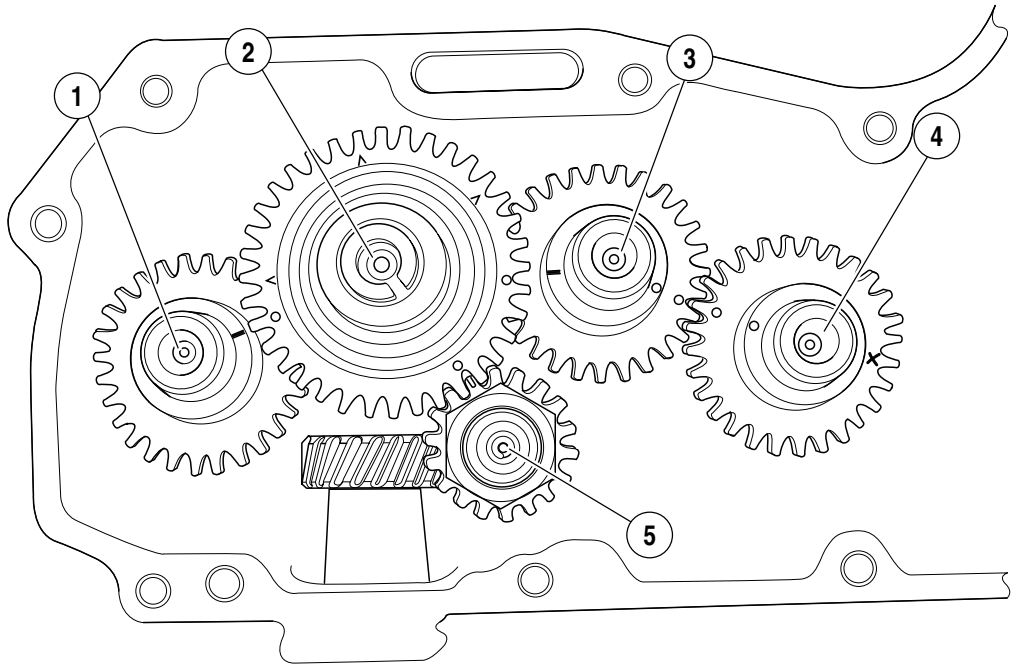


Cam #2 “V” marks are not used for timing

1. **Rear exhaust cam gear 1D (or 1W)**
2. **Rear intake cam gear 2D (or 2W)**
3. **Front intake cam gear 3D (or 3W)**
4. **Front exhaust cam gear 4D (or 4W)**
5. **Pinion gear**

Figure 3-61. Cam, Pinion Gear and Timing Mark Indexing

Bushing Inspection and Removal

1. See Figure 3-59. Bushings are press fit in gearcase cover and crankcase. Inspect each bushing against its corresponding cam gear shaft or pinion gear shaft.

2. See Figure 3-62. Use a BUSHING AND BEARING PULLER (Part No. HD-95760-69A) to remove bushings from gearcase cover and crankcase

Figure 3-62. Removing Bushing

BUSHING INSTALLATION

NOTE

Installing and reaming crankcase and gearcase cover bushings may alter the center distances between mating gears and may result in an increase in gear noise. For quiet-running gears, the gears should be matched to the center distances.

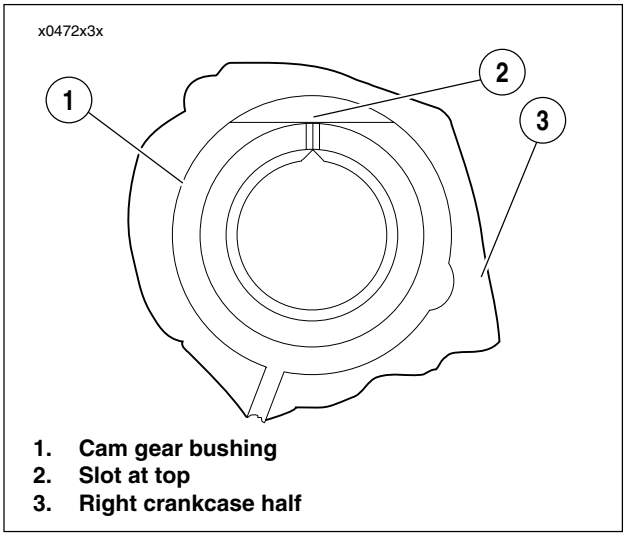
Cam Gear Bushings In Right Crankcase Half

See Figure 3-63. Each cam gear bushing, to be installed in right crankcase half, must be positioned in crankcase bore with its oiling slot at exact top of bore (12 o'clock position)

1. Using an arbor press, install each bushing in its crankcase bore so that bushing shoulder contacts crankcase boss.
2. After you install a new bushing in right crankcase half, ream the bushing to correct size. See 3.10 GEARCASE COVER AND CAM GEARS, BUSHING REAMING.

Table 3-11. Inspection

GEAR SHAFT	CORRECT CLEARANCE	SERVICE WEAR LIMIT
Cam	0.0007-0.0022 in. 0.018-0.056 mm	0.003 in. 0.08 mm
Pinion	0.0023-0.0043 in. 0.058-0.109 mm	0.005 0.13 mm



1. **Cam gear bushing**
2. **Slot at top**
3. **Right crankcase half**

Figure 3-63. Cam Gear Bushing Installed in Crankcase

CAM GEAR BUSHINGS (EXCEPT REAR INTAKE BUSHING) IN GEARCASE COVER

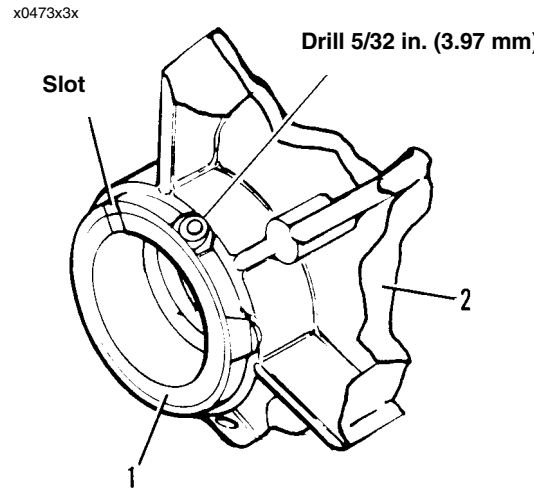
1. See Figure 3-59. Using an arbor press, install each bushing (7, 8, and 14) in its gearcase cover (17) bore so that bushing shoulder contacts cover boss. There is no need to orient these particular bushings in any specific position of rotation within gearcase cover bores.
2. After you install a new bushing in gearcase cover, ream the bushing to correct size. See 3.10 GEARCASE COVER AND CAM GEARS, BUSHING REAMING.

Rear Intake Cam Gear Bushings In Gearcase Cover

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in its gearcase cover (17) bore using an arbor press. You will need to orient the bushing in a specific position of rotation within the cover bore, and will need to drill a lubrication hole in the bushing, according to the following procedures.
2. See Figure 3-64. Position bushing (1) over bore of gearcase cover (2) with chamfered edge downward and slot upward. Align slot in bushing with slot in gearcase cover boss. Press bushing into cover bore until bushing is flush with cover boss.
3. Drill a 5/32-in. (3.97 mm) diameter hole through bushing using existing hole in gearcase cover as a guide.
4. After you install a new bushing in gearcase cover, ream the bushing to the correct size. See 3.10 GEARCASE COVER AND CAM GEARS, BUSHING REAMING.

Pinion Shaft Bushing In Gearcase Cover

1. See Figure 3-59. Using an arbor press, install pinion shaft bushing in its gearcase cover so that bushing is flush with cover boss. There is no need to orient this particular bushing in any specific position of rotation within the gearcase cover bore.
2. See Figure 3-65. Although the original pinion shaft bushing is not “pinned,” the replacement bushing must be secured, from possible rotation within the cover bore, by installation of a dowel pin. Drill a No. 31 hole, 0.281 in. (7.14 mm) deep, at top side of boss (side toward top of gearcase cover), centering the drill bit on the cover bore circle (hole is drilled half in bushing O.D. and half in cover bore I.D.).
3. Drive a new dowel pin no more than 0.20 in. (5.1 mm) below the bushing face. Carefully peen edges of hole to lock the pin in place.
4. After you install a new bushing in gearcase cover, ream the bushing to the correct size. See 3.10 GEARCASE COVER AND CAM GEARS, BUSHING REAMING.



1. **Rear intake cam gear bushing**
2. **Gearcase cover**

Figure 3-64. Rear Intake Cam Gear Bushing Installed in Gearcase Cover

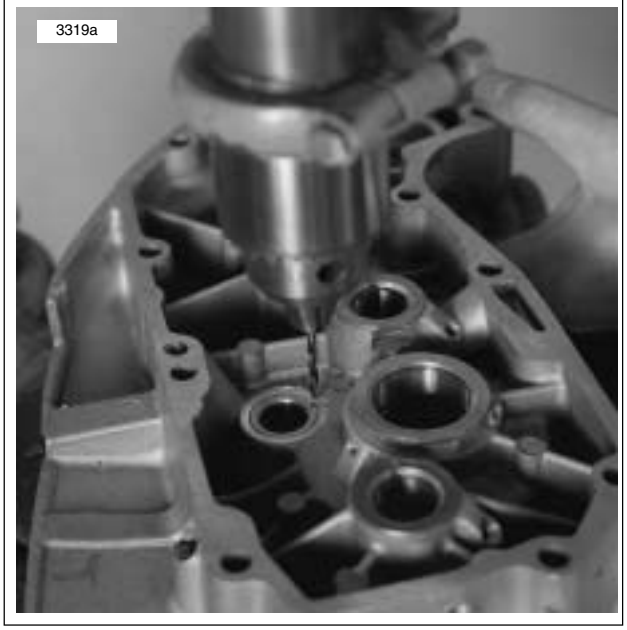


Figure 3-65. Drilling Dowel Pin Hole

BUSHING REAMING

NOTES

- *Installing and reaming crankcase and gearcase cover bushings may alter the center distances between mating gears and may result in an increase in gear noise. For quiet-running gears, the gears should be matched to the center distances.*
- *Bushings in right crankcase half serve as pilots for reaming gearcase cover bushings and must, therefore, be reamed to size first.*
- *After reaming any bushing, check shaft fit in the bushing. It may be necessary to make a second pass with reamer to attain proper fit.*

Cam Gear Bushings In Right Crankcase Half

1. Separate two halves of crankcase, if not already accomplished. Place right crankcase half on flat surface with gearcase side upward. Bushing to be reamed must be oriented as shown.
2. See Figure 3-66. Position CAMSHAFT BUSHING REAMER PILOT (Part No. HD-38871) onto gearcase side of crankcase half; upper right and lower left indexing holes in pilot must be placed over dowels in crankcase half. Insert two bolts (supplied with pilot) through two remaining holes in pilot, and into threaded holes of crankcase half. Tighten bolts securely.
3. Insert the 11/16-in. diameter reamer through pilot hole and into bushing while turning reamer clockwise. Continue turning reamer clockwise through bushing until smooth shank of reamer passes through hole in pilot.
4. Detach reamer from handle. Pull reamer out opposite side of crankcase half.
5. Thoroughly clean right crankcase half, removing all metal chips/shavings. Blow out all oil passages using compressed air.

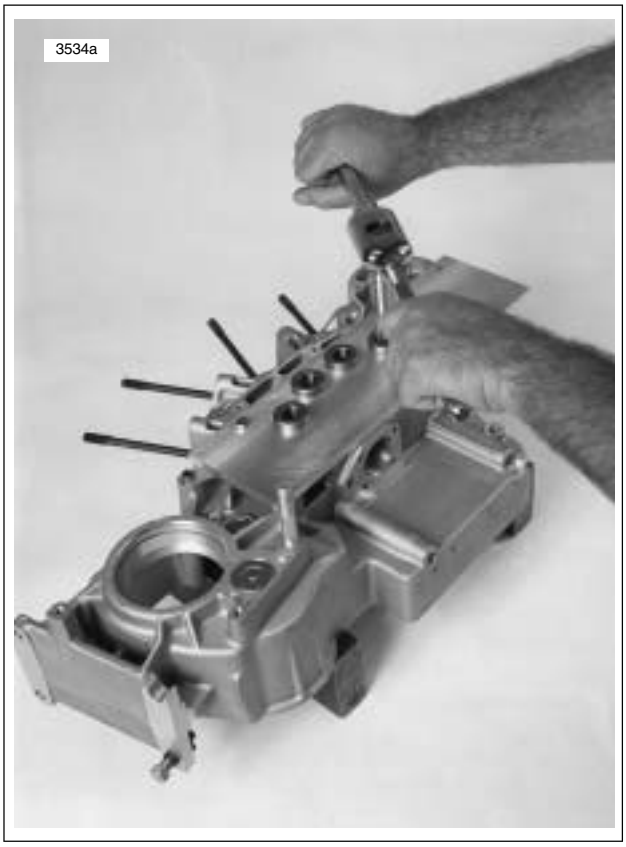


Figure 3-66. Reaming Cam Gear Bushing in Right Crankcase Half

Cam Gear Bushings (Except Rear Intake Bushing) In Gearcase Cover

NOTE

Newly installed cam gear bushings in the gearcase cover must be line reamed, using the right crankcase half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Bushings be reamed must be installed in gearcase cover as described in BUSHING INSTALLATION under 3.10 GEARCASE COVER AND CAM GEARS. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.
2. Insert a standard 11/16-in. diameter reamer through the previously reamed cam gear bushing (13) in right crankcase half, which is in line with one of the bushings to be reamed in gearcase cover.
3. Turn reamer clockwise through bushing in cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
4. Repeat Steps 2 and 3 for remaining two cam gear bushings (except rear intake bushing) in gearcase cover, if required.
5. Separate gearcase cover from right crankcase half. Inspect bushings for proper cam gear shaft fit. Repeat line reaming operation if necessary.
6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

Rear Intake Cam Gear Bushings In Gearcase Cover

NOTE

A newly installed rear intake cam gear bushing in the gearcase cover must be line reamed, using the right crankcase half as a pilot for the reamer, to establish correct clearance and to ensure perfect alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Rear intake cam gear bushing (15) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION under 3.10 GEARCASE COVER AND CAM GEARS.
2. Identify the previously reamed rear intake cam gear bushing (13) in right crankcase half (10), which has been disassembled from left crankcase half. Insert the shank end of REAR INTAKE CAM GEAR BUSHING REAMER (Part No. HD-94803-67) through gearcase side of this bushing.
3. With reamer inserted into bushing in right crankcase half, attach gearcase cover to right crankcase half, securing with a minimum of three mounting screws.
4. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
5. Separate gearcase cover from right crankcase half. Inspect bushing for proper cam gear shaft fit. Repeat line reaming operation if necessary.
6. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

Pinion Shaft Bushing In Gearcase Cover

NOTE

A newly installed pinion shaft bushing in the gearcase cover must be line reamed, using both the right crankcase half and Part No. HD-94812-87 as pilots for the reamer, to establish correct clearance and to ensure proper alignment. If crankcase halves are not separated on your motorcycle, use a spare right crankcase half to perform the following line reaming procedures.

1. See Figure 3-59. Pinion shaft bushing (16) must be installed in gearcase cover (17) as described in BUSHING INSTALLATION under 3.10 GEARCASE COVER AND CAM GEARS. Attach gearcase cover to right crankcase half (10), which has been disassembled from left crankcase half, securing with a minimum of three mounting screws.
2. See Figure 3-67. Install PINION SHAFT BUSHING REAMER PILOT (Part No. HD-94812-87) into right crankcase roller race. Insert PINION SHAFT BUSHING REAMER (Part No. HD-94812-1) through the pilot.
3. Turn reamer clockwise through bushing in gearcase cover until reamer bottoms. Then give reamer one complete clockwise turn to size the bushing. Continue turning reamer clockwise while extracting reamer from bushing.
4. Separate gearcase cover from right crankcase half. Inspect bushing for proper pinion shaft fit. Repeat line reaming operation if necessary.
5. Remove pilot from right crankcase roller race. Thoroughly clean gearcase cover, removing all metal chips/shavings. Blow out all oil passages using compressed air.

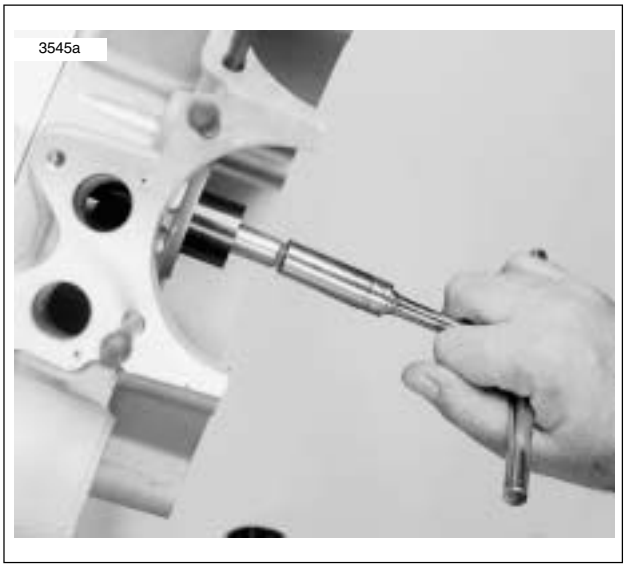


Figure 3-67. Line Reaming Pinion Shaft Bushing

ASSEMBLY/INSTALLATION

1. See Figure 3-59. See Figure 3-67. Install oil pump drive gear and pinion gear (to pinion shaft. Note that timing mark on pinion gear tooth is aligned with keyway in I.D. of pinion gear, as shown in Figure 3-68. The timing mark will allow you to easily position pinion gear over shaft key and against oil pump drive gear on pinion shaft.
2. Clean pinion shaft threads and nut) threads. Apply several drops of LOCTITE® Thread locker 272 (red) to threads of nut.

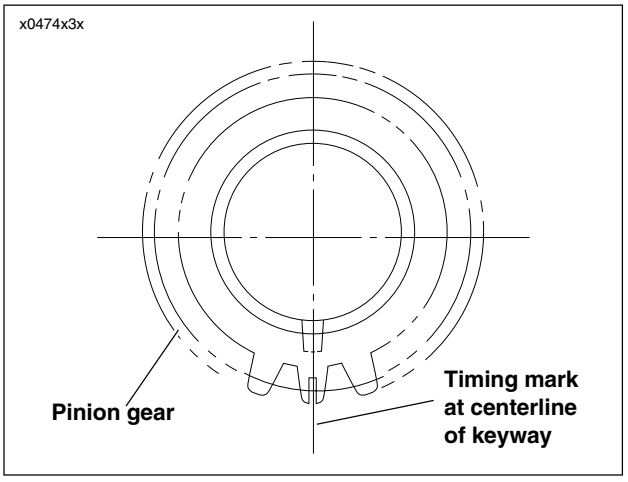
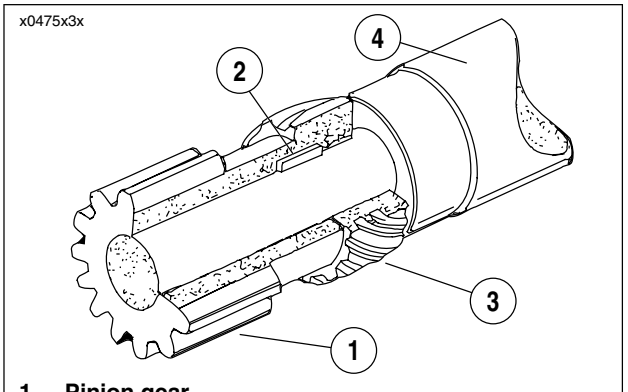


Figure 3-68. Pinion Gear Timing Mark and Keyway



1. **Pinion gear**
2. **Shaft key**
3. **Oil pump drive gear**
4. **Pinion shaft**

Figure 3-69. Oil Pump Drive Gear and Pinion Gear Installed on Pinion Shaft

3. See Figure 3-70. Install CRANKSHAFT LOCKING TOOL (Part No. HD-41506) over pinion shaft. Install nut to pinion shaft, tightening to 35-45 ft-lbs (47-61 Nm).

NOTE

Because of the larger diameter additional gear (which meshes with the pinion gear) on the outboard end of the rear intake (2D) cam gear, the rear exhaust (1D) and front intake (3D) cam gears must both be installed before the rear intake (2D) cam gear is installed.

4. See Figure 3-59. Install a new seal and new dry gasket on gearcase cover.
5. See Figure 3-71. Install gearcase cover over all gears and onto right crankcase half. Secure cover to crankcase half with 11 socket head screws. Tighten screws evenly to 80-110 **in-lbs** (9.0-12.4 Nm) according to the torque sequence shown.
6. Check cam gear end play for each cam gear as follows:
   a. Turn engine over until lobe of cam gear being checked is pointing toward its respective tappet guide hole.
   b. Using a flat blade screwdriver, gently pry the cam gear toward gearcase cover.
   c. Using a feeler gauge, measure gap between bushing (in crankcase half) and cam gear shaft thrust face (shoulder). This is cam gear end play.
   d. Compare your cam gear end play measurements with the 3.1 SPECIFICATIONS. Make repairs as required if end gap is less than the minimum specified, or greater than the maximum specified (Service Wear Limits).
7. Install valve tappets and push rods (see 3.9 VALVE TAPPETS).
8. Install cam position sensor and rotor. Static time or align scribed marks with sensor screws (see Section 7).
9. Install any components removed to gain access to gearcase (i.e. exhaust system components, footrest, air cleaner).

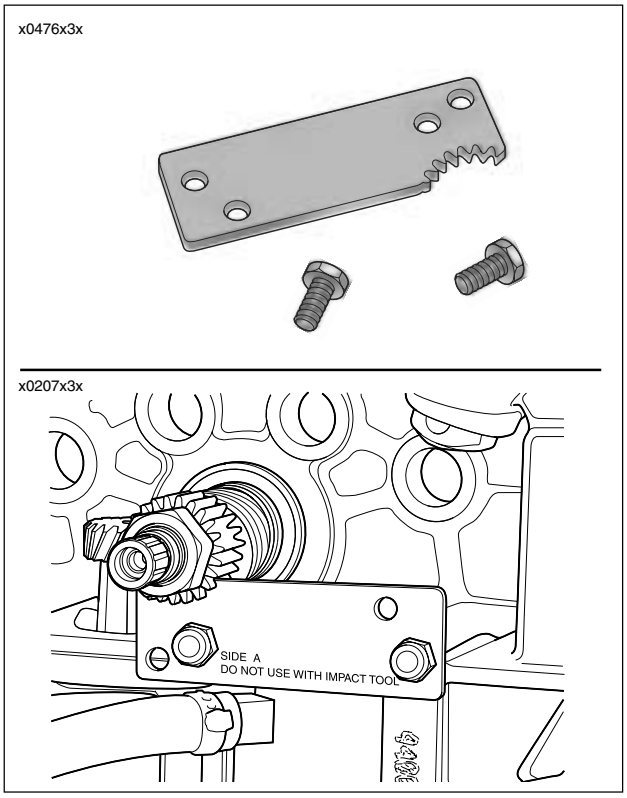


Figure 3-70. Crankshaft Locking Tool

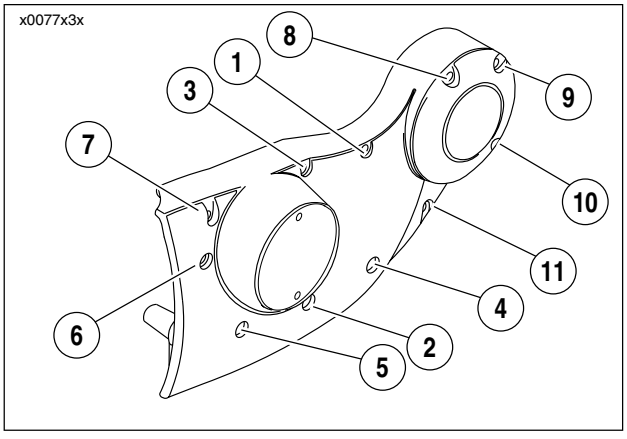


Figure 3-71. Gearcase Cover Mounting Screw Torque Sequence

GENERAL

When rod bearings, pinion shaft bearing, or sprocket shaft bearing are in need of repair, the engine must be removed from the chassis; see 3.3 STRIPPING MOTORCYCLE FOR ENGINE REPAIR in this section. It is recommended procedure to check and make repairs to cylinder heads, cylinders, gear case and transmission at the same time (perform entire engine overhaul).

CAUTION

Laying engine on primary side will damage clutch cable end fitting.

ADJUSTMENT/TESTING

Flywheel End Play

See Figure 3-72. Before completely disassembling crankcases, check flywheel end play.

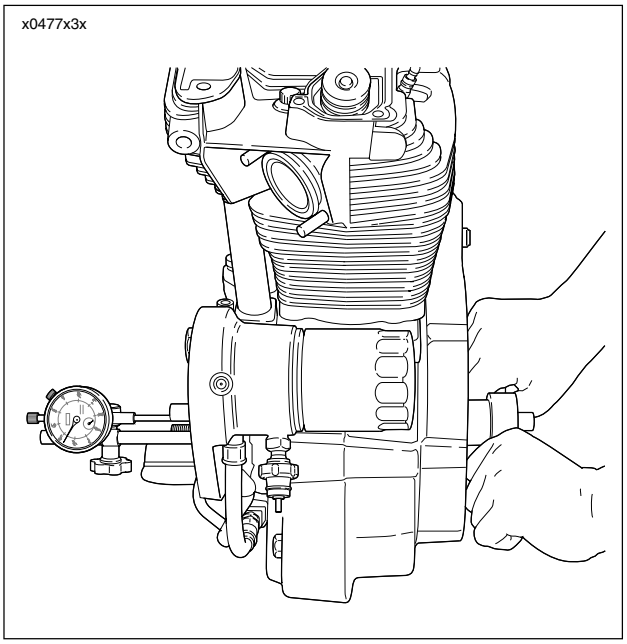


Figure 3-72. Checking Flywheel End Play

1. After engine has been removed from chassis, securely fasten it to a stand or workbench.
2. Remove gear case cover. Attach a dial indicator to gear side crankcase with indicator stem on end of gear shaft.
3. Sprocket shaft bearings must be pre-loaded to obtain an accurate flywheel end play reading. A suitable tool can be made by welding two handles to an old sprocket shaft nut. Install the nut and sprocket. Tighten nut to 190-210 ft-lbs (277-306 Nm).

4. Rotate and push on sprocket shaft while reading dial indicator. Then rotate and pull on sprocket shaft while reading dial indicator. If difference (end play) in indicator readings is not 0.001-0.005 in. (0.025-0.13 mm), bearing inner spacer (shim) (item 6, Figure 3-75.) must be replaced. Choose spacer from following table. Use a thinner spacer for less end play; use a thicker spacer for more end play.

Table 3-12. Flywheel End Play Spacers (Shims)

Part Number	Thickness	
	inches	mm
9155	0.0975-0.0985	2.476-2.502
9142	0.0995 - 0.1005	2.527-2.553
9143	0.1015-0.1025	2.578-2.603
9144	0.1035 - 0.1045	2.629-2.654
9145	0.1055 - 0.1065	2.680-2.705
9146	0.1075 - 0.1085	2.730-2.756
9147	0.1095 - 0.1105	2.781-2.807
9148	0.1115 - 0.1125	2.832-2.857
9149	0.1135 - 0.1145	2.883-2.908

DISASSEMBLY

Crankcase Halves

1. Remove cylinder heads; see 3.5 CYLINDER HEAD REMOVAL.
2. Remove cylinders and pistons; see 3.6 CYLINDER AND PISTON REMOVAL/DISASSEMBLY.

CAUTION

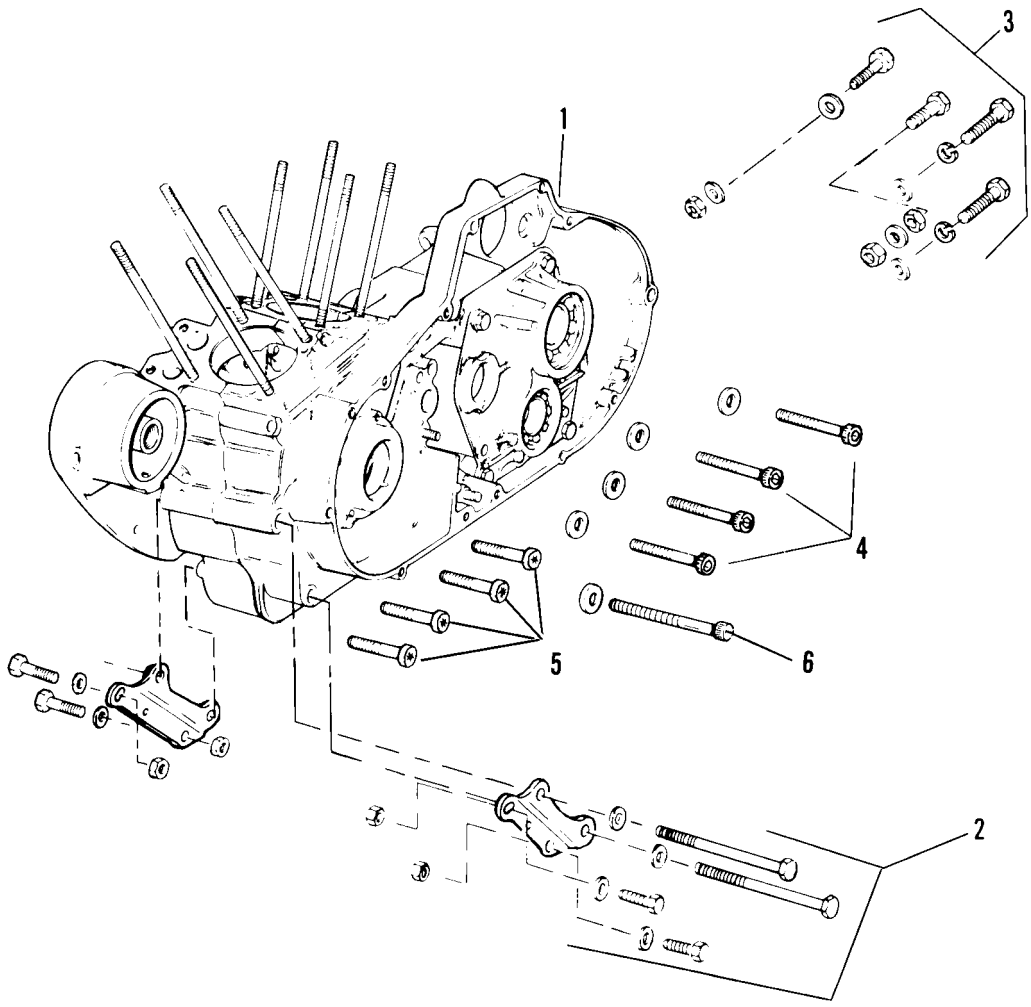
After removing cylinders, install plastic or rubber hose over cylinder studs. Never lift or move crankcase by grasping cylinder studs.

3. Remove oil pump and gear case components; see OIL PUMP Removal/Disassembly under 3.8 OILING SYSTEM and 3.10 GEARCASE COVER AND CAM GEARS REMOVAL/DISASSEMBLY.
4. Remove clutch and primary drive components; see 6.6 PRIMARY DRIVE/CLUTCH REMOVAL.
5. Remove starter motor; see REMOVAL under 5.2 ELECTRIC STARTER SYSTEM.
6. Remove transmission; see 6.8 TRANSMISSION CASE REMOVAL.
7. See Figure 3-73. Remove screws (4) and rear engine mount bolt securing crankcase halves together.
8. Position crankcase on work bench, gear case side up. Tap crankcase with rawhide mallet to loosen top half and separate the halves.

⚠WARNING

The following step requires using a press. Wear eye protection and make certain set-up is stable. The force involved could cause parts to "fly out" and cause bodily injury possibly resulting in death or serious injury.

x0478x3x



1. Crankcase
2. Engine front mounting hardware
3. Engine rear mounting hardware
4. Upper case hex socket head screw (4), 2-1/2 in. (63.5 mm) long
5. Bottom case hex head bolt (4), 3/4 in. (19.05 mm) long
6. Access door hex socket head screw, 3-3/4 in. (95.25 mm) long

Figure 3-73. Crankcase Hardware

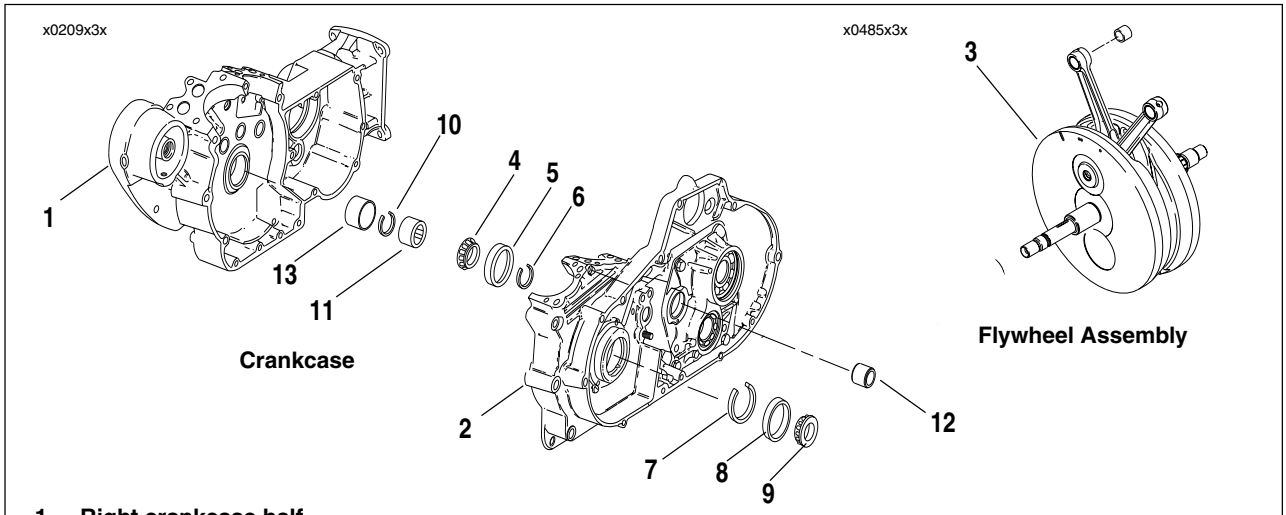
9. See Figure 3-74. Mount the left case half and flywheel assembly on a press table, supporting crankcase on parallel bars. Press on end of sprocket shaft with arbor press until flywheel assembly is free from case half. Do not drive flywheel assembly from case half as flywheels may be knocked out of alignment.

NOTE

See Figure 3-75. *If it is necessary to remove either the pinion shaft bearing (11) or sprocket shaft bearing (4 and 9), proceed as follows:*

10. Pinion bearing (11) will remain on pinion shaft. Remove retaining ring (10), and bearing (11) may be slipped off pinion shaft.

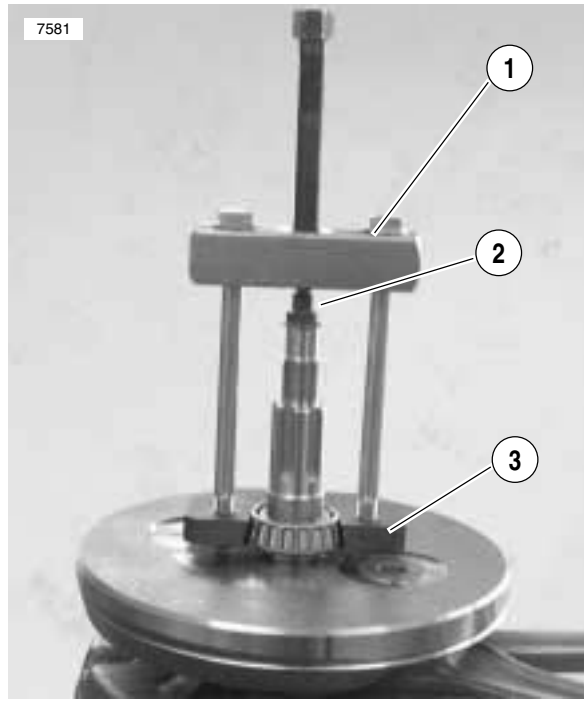
Figure 3-74. Pressing Flywheel from Crankcase



1. **Right crankcase half**
2. **Left crankcase half**
3. **Connecting rod and flywheel assembly**
4. **Sprocket right bearing**
5. **Sprocket right outer race**
6. **Spacer**
7. **Retaining ring**
8. **Sprocket left outer race**
9. **Sprocket left bearing**
10. **Retaining ring**
11. **Pinion shaft bearing**
12. **Pinion shaft bearing inner race**
13. **Pinion shaft bearing outer race**

Figure 3-75. Crankcase and Flywheel

11. See Figure 3-76. Pull sprocket shaft bearing with WEDGE ATTACHMENT FOR CLAW PULLER (Part No. HD-95637-46) and TWO JAW PULLER (Part No. HD-97292-61) using bolts in place of jaws.



1. **Puller**
2. **Center cap**
3. **Bearing remover (HD-44404)**

Figure 3-76. Removing Sprocket Shaft Roller Bearing

12. See Figure 3-77. Use CRANKSHAFT BEARING TOOL (Part No. HD-94547-101) to remove sprocket shaft outer races.

NOTE

See Figure 3-75. Do not remove retaining ring (7); the crankcase can easily be damaged during the removal process. Removal of the retaining ring is not necessary for the removal or installation of the outer bearing races.

Figure 3-77. Sprocket Shaft Outer Race Removal

FITTING PINION BEARINGS

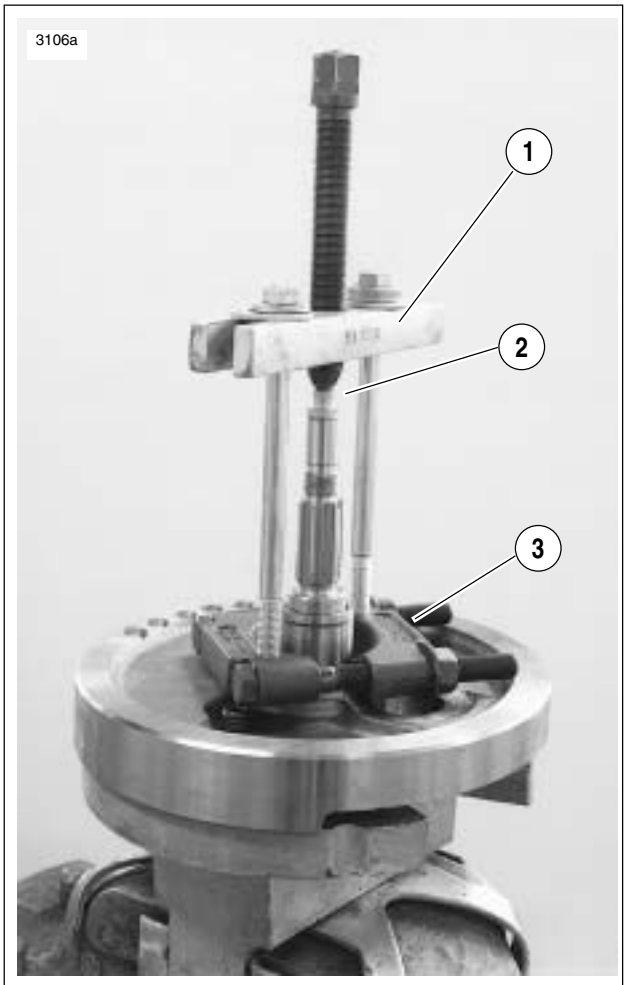
See Figure 3-75. A pressed-in bushing in the right crankcase half is the outer race (13). The inner race (12) is pressed on the pinion shaft.

See Figure 3-78. To remove pinion shaft inner race, use PULLER (Part No. HD-97292-61), CENTER CAP (Part HD-95652-43A), and BEARING SEPARATOR (Snap-on Tools Stock No. CJ950). Apply heat to race to aid removal. Four sizes of pinion bearings are available.

Pinion bearing selection at the factory, during engine rebuild, or replacement of crankcase set or flywheel assembly is based on the largest measured outside diameter (OD) of the inner race and the smallest measured inside diameter (ID) of the outer race (crankcase bushing).

A running clearance of 0.0002-0.0008 in. (0.005-0.020 mm.) is established during crankcase set or flywheel assembly replacement and engine rebuild.

See Figure 3-79. Installed inner races are identified at the factory as shown.



1. **Puller**
2. **Center cap**
3. **Bearing separator**

Figure 3-78. Pulling Pinion Shaft Inner Bearing

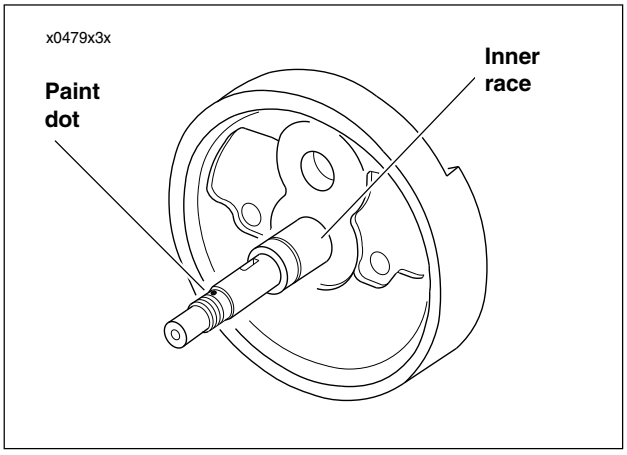


Figure 3-79. Factory Inner Race Sizes

See Figure 3-80. Outer races are identified at the factory as shown.

NOTE

The different sizes of crankcase sets and flywheel assemblies will not have separate part numbers. That is, a replacement crankcase set may have a class 1, 2 or 3 pinion outer race. Replacement flywheel assemblies will have either a class A or B inner race.

See Figure 3-81. Pinion bearings are identified as shown.

Bearing Selection

Select bearings using the identification information given for inner and outer races and bearings. See Table 3-16.

NOTE

If either inner or outer race show wear, measure both races to confirm correct bearing fit.

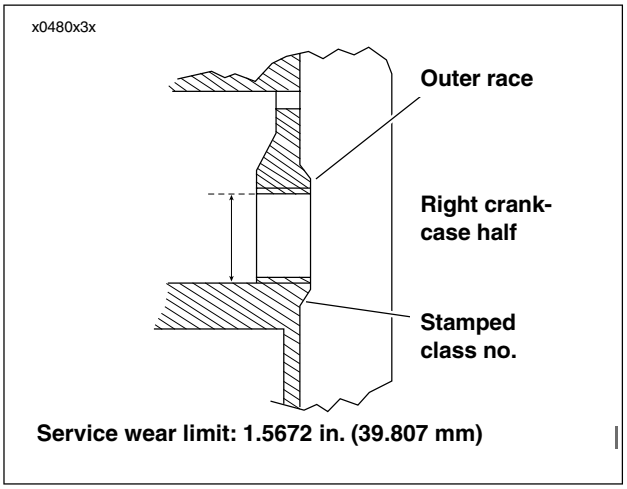


Figure 3-80. Factory Outer Race Sizes

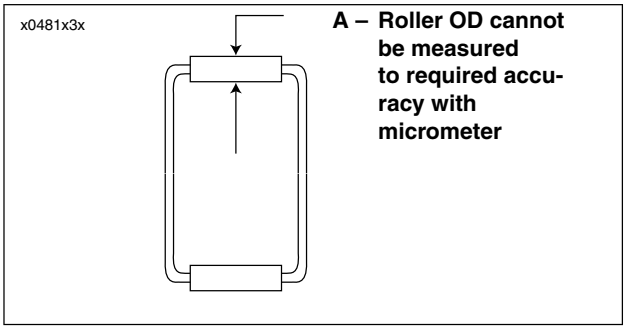


Figure 3-81. Bearing Identification

Table 3-13. Paint Dot Specifications

RACE OD	CLASS	IDENTIFICATION*
1.2498-1.2500 in. 31.745-31.750 mm	A	White
1.2496-1.2498 in. 31.740-31.745 mm	B	Green

* Paint dot on end of spline.

Table 3-14. Roller Specifications

ROLLER OD (A)	IDENTIFICATION (PACKAGE COLOR)
Largest	Red
	Blue
	White (Grey)
Smallest	Green

Table 3-15. Stamp Specifications

RACE ID	CLASS NO.	STAMPED IDENTIFICATION*
1.5646-1.5648 in. 39.741-39.746 mm	1	1
1.5648-1.5650 in. 39.746-39751 mm	2	2
1.5650-1.5652 in. 39.751-39756 mm	3	3

*Stamped number inside crankcase near race

Table 3-16. Pinion Shaft Bearing Selection

FACTORY STAMPED NUMBER	OUTER RACE ID	BEARING SIZE AS IDENTIFIED BY COLOR CODING										
	over 1.5672 in. 39.807 mm	Service Wear Limit Exceeded – Replace Outer Race and Resize										
	1.5670-1.5672 in. 39.802-39.807 mm											Red
	1.5668-1.5670 in. 39.797-39.802 mm										Red	Blue
	1.5666-1.5668 in. 39.792-39.797 mm									Red	Blue	White-Gray
	1.5664-1.5666 in. 39.787-39.792 mm								Red	Blue	White-Gray	Green
	1.5662-1.5664 in. 39.781-39-787 mm							Red	Blue	White-Gray	Green	
	1.5660-1.5662 in. 39.776-39.781 mm						Red	Blue	White-Gray	Green		
	1.5658-1.5660 in. 39.771-39.776 mm					Red	Blue	White-Gray	Green			
	1.5656-1.5658 in. 39.766-39.771 mm				Red	Blue	White-Gray	Green				
	1.5654-1.5656 in. 39.761-39.766 mm			Red	Blue	White-Gray	Green					
	1.5652-1.5654 in. 39.756-39.761 mm		Red	Blue	White-Gray	Green						
3	**1.5650-1.5652 in. 39.751-39.756 mm**	**Red**	**Blue**	White-Gray	Green							
2	**1.5648-1.5650 in. 39.746-39.751 mm**	**Blue**	**White-Gray**	Green								
1	**1.5646-1.5648 in. 39.741-39.746 mm**	**White-Gray**	**Green**									
INNER RACE OD (In)		**1.2496-1.2498 in.**	**1.2498-1.2500 in.**	1.2500-1.2502 in.	1.2502-1.2504 in.	1.2504-1.2506 in.	1.2506-1.2508 in.	1.2508-1.2510 in.	1.2510-1.2512 in.	1.2512-1.2514 in.	1.2514-1.2516 in.	1.2516-1.2518 in.
		31.740 31.745 mm	31.745 31.750 mm	31.750-31.755 mm	31.755-31.760 mm	31.760-31.765 mm	31.765-31.770 mm	31.770-31.775 mm	31.775-31.780 mm	31.780-31.786 mm	31.786-31.791 mm	3.791-31.796 mm
FACTORY COLOR CODE		**Green**	**White**									

1. Measure ID of outer race at four places with a dial bore gauge. Take measurement on ID where bearing rollers ride. Record the four measurements.
2. If the largest measurement is larger than 1.5672 in. (39.807 mm) or the required lapping to remove wear marks would enlarge bore beyond 1.5672 in. (39.807 mm), continue at Step 8.
3. If the largest measurement is 1.5672 in. (39.807 mm) or less, cover the cam bearings with masking tape to prevent debris from entering bearings. Assemble crankcase halves.

NOTE

The next step requires lapping the outer race. To keep sprocket shaft and pinion shaft bearings aligned the lap must be supported by an adaptor or pilot in the left crankcase half.

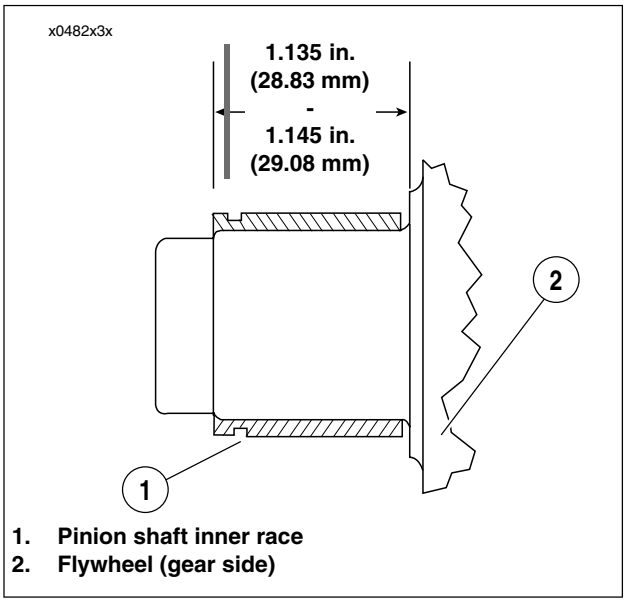
4. See LAPPING ENGINE MAIN BEARING RACES under 3.11 CRANKCASE. Race must be lapped until all wear marks are removed.
5. Measure ID of race at four places and record the measurements.
6. Check measurements against these specifications:

Largest I.D. measured: 1.5672 in. (39.807 mm) or less
Roundness of I.D.: within 0.0002 in. (0.005 mm)
Taper: within 0.0002 in. (0.005 mm)

7. If lapping increased bore ID to larger than 1.5672 in. (39.807 mm), go to Step 8. If roundness or taper do not meet specifications, continue lapping until specifications are met. If all specifications are met, continue at Step 10 to remove and size inner race.
8. Press the outer race from the right crankcase. Press new outer race into crankcase flush with inside edge of cast-in insert.

   See Figure 3-83. Dimensions are shown for fabrication of tools used in pressing the outer race into or out of crankcase.
9. The new outer race must be lapped slightly to true and align with left case bearing and to meet the following specifications; see LAPPING ENGINE MAIN BEARING RACES under 3.11 CRANKCASE.

   I.D.: 1.5646-1.5652 in. (39.741 - 39.756 mm)
   Roundness: within 0.0002 in. (0.005 mm)
   Taper: within 0.0002 in. (0.005 mm)
   Surface finish: 16 RMS
10. See Figure 3-78. Pull inner race from pinion shaft using PULLER (Part No. HD-97292-61), CENTER CAP (Part No. HD-95652-43A), and BEARING SEPARATOR (Snap-on Tools Stock No. CJ950). Apply heat to race to aid removal.
11. See Figure 3-82. Press new inner race on pinion shaft as shown. The new inner race must be ground by a machinist to OD dimension range (given in Table 3-16.) for the finished lapped ID of the outer race. The finished inner race must meet these specifications.



1. Pinion shaft inner race
2. Flywheel (gear side)

Figure 3-82. Inner Race Location

12. See Figure 3-83. for necessary dimensions for constructing a press-on tool. When the tool bottoms against the flywheel, correct inner race location is automatically established.

Roundness: within 0.0002 in. (0.005 mm)
Taper: within 0.0002 in. (0.005 mm)
Surface finish: 16 RMS

13. The following example illustrates how to determine the required inner race OD.

EXAMPLE:

a. If smallest measured ID of outer race is 1.5651 in. (39.754 mm) the Pinion Shaft Bearing Selection table indicates an inner race OD range of 1.2496-1.2504 in. (31.740 - 31.760 mm) is required.

NOTE

Have machinist grind outer race to center or middle of required OD range. This will prevent grinding outer race undersize and gives a more easily achieved tolerance range.

b. Grind inner race. Measure OD at four places and check that specifications in Step 11 are met.

c. For example purposes, the largest measured OD of inner race after grinding is 1.2499 in. (31.747 mm) OD.

d. See Table 3-16. With a 1.5651 in. (39.754 mm) ID outer race and a 1.2499 in. (31.747 mm) OD inner race, a blue bearing is required.

NOTE

Always use the smallest outer race ID measurement and the largest OD inner race measurement when selecting bearings.

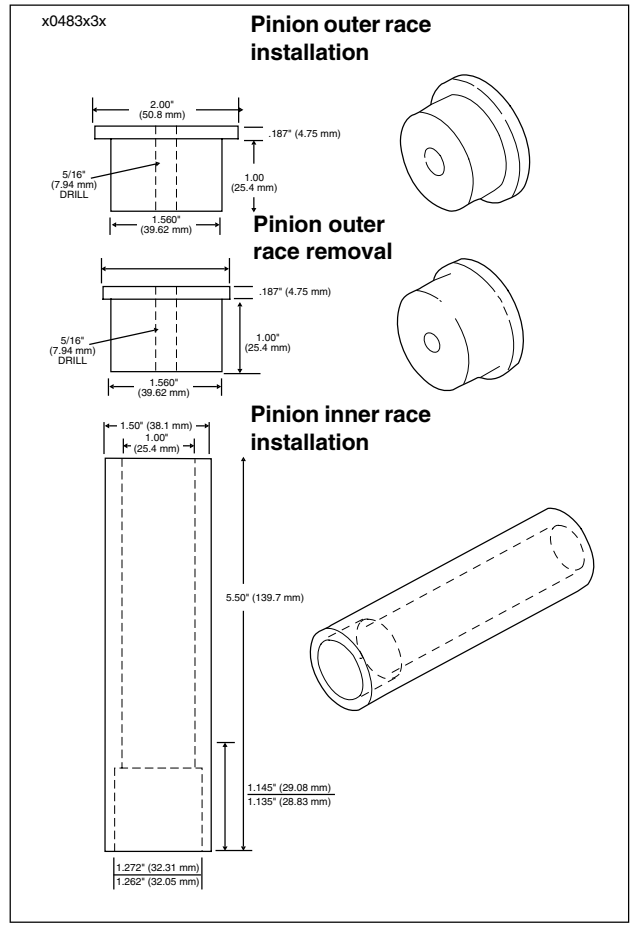


Figure 3-83. Pinion Shaft Bearing Tools

LAPPING ENGINE MAIN BEARING RACES

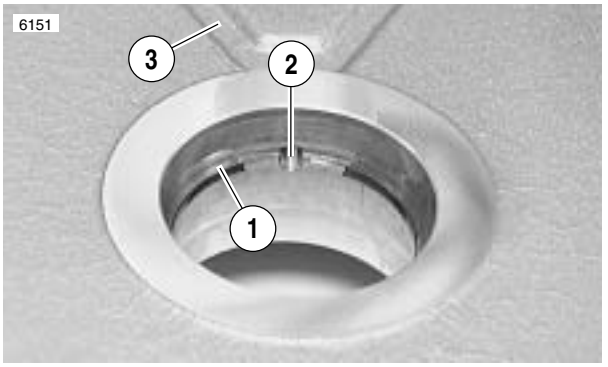
1. Secure right and left crankcase halves with three crankcase stud bolts (top center and bottom left and right). The sprocket shaft bearing outer races and large spacer must be installed in left crankcase.
2. See Figure 3-84. Obtain CRANKCASE MAIN BEARING LAPPING TOOL (Part No. HD-96710-40B). Assemble CRANKCASE MAIN BEARING LAP (Part No. HD-96718-87) to lapping handle. Assemble guide sleeve to sprocket shaft bearing bushing. Sleeves, for use with tapered bearing, are assembled to case with bearings and small spacer collar. Finger-tighten the sleeve parts
3. Insert lap shaft with arbor assembled through pinion bearing 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.
4. Withdraw arbor far enough to coat lightly with 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.
5. 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, flush off lap in cleaning solvent, air dry and apply fresh, light coat of fine lapping compound.

Crankcase Halves

Lubricate all parts with Harley-Davidson 20W50 engine oil, and proceed as follows:

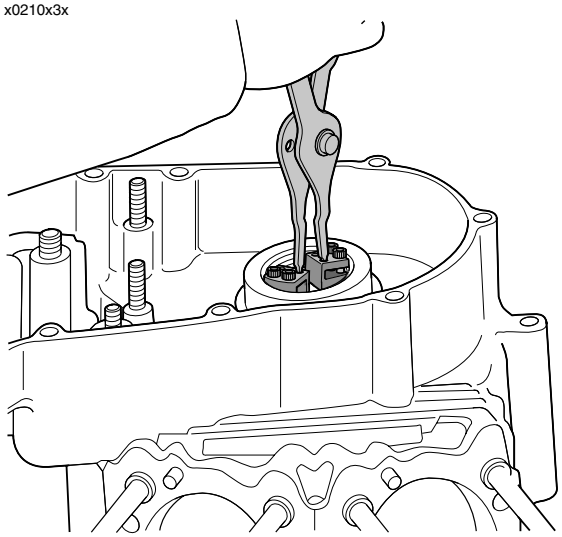
1. See Figure 3-85. Verify that gap in retaining ring (1) is aligned with oil supply hole (2) in left crankcase half bearing bore.

Figure 3-84. Lapping Pinion Shaft Main Bearing

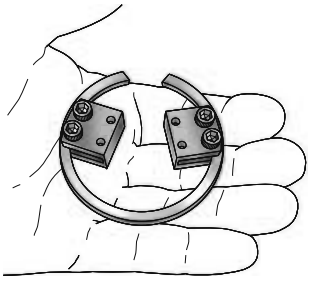


1. **Retaining ring**
2. **Oil supply hole**
3. **Oil supply channel**

x0210x3x



x0201x3x



HD-44069 Retaining Ring Remover/Installer

Figure 3-85. Retaining Ring

NOTE

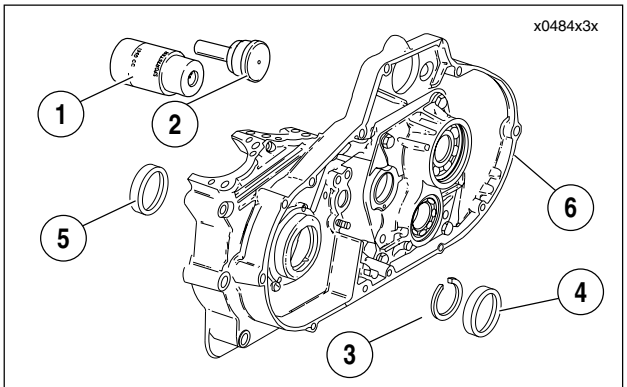
See Figure 3-86. Use SPROCKET SHAFT BEARING OUTER RACE INSTALLATION TOOL (1, 2) (Part No. HD-39458) to install left and right outer races (4, 5) of sprocket shaft tapered roller bearings into left crankcase half (6). Always install left outer race (4) prior to installing right outer race (5) because the installer base (1) is usable only when you follow this sequence of race installation.

2. See Figure 3-86. Insert “SPORTSTER” end of installer base into inboard side of left crankcase half (6) bearing bore until base contacts installed retaining ring (3).
3. Position left outer race over bearing bore on outboard side of left crankcase half.
4. Insert shaft of installer plug through left outer race and into installer base. Press race into bore until firmly seated against retaining ring.
5. Insert “SPORTSTER” end of installer base into outboard side of left crankcase half bearing bore until base contacts outboard surface of installed left outer race.
6. Position right outer race (5) over bearing bore on inboard side of left crankcase half (6).
7. Insert shaft of installer plug (2) through right outer race (5) and into installer base (1). Press race into bore until firmly seated against retaining ring (3).

NOTE

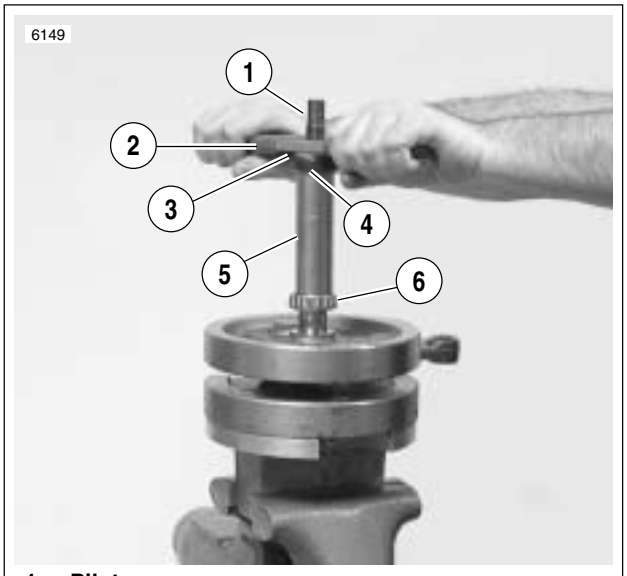
Use SPROCKET SHAFT BEARING/SEAL INSTALLATION TOOL (Part No. HD-42579) to install sprocket shaft tapered roller bearings and seal.

8. See Figure 3-87. Install inner bearing (6).
   a. Place **new** bearing, small end upward, over end of sprocket shaft.
   b. Thread pilot (1) onto sprocket shaft until pilot bottoms on sprocket shaft shoulder.
   c. Sparingly apply graphite lubricant to threads of pilot shaft to ensure smooth operation.
   d. Slide sleeve (5) over pilot (1) until sleeve contacts inner bearing race. Install Nice bearing (4), washer (3) and handle (2) on top of sleeve.
   e. Rotate handle clockwise until bearing (6) contacts flywheel shoulder. Remove tool from sprocket shaft.
9. See Figure 3-75. Install spacer (6) and outer bearing (9).
   a. Carefully place crankcase half over sprocket shaft so that it rests flat on inner bearing.
   b. Slide **new** inner spacer over sprocket shaft until it contacts inner bearing race.
   c. Place **new** outer bearing, small end downward, over sprocket shaft.
   d. See Figure 3-88. Assemble Sprocket Shaft Bearing/Seal Installation Tool (Part No. HD-42579) onto sprocket shaft. Follow procedure in Step 8.
   e. Rotate handle clockwise until bearing firmly contacts inner spacer. Inner and outer bearings must be tight against inner spacer for correct bearing clearance. Remove tool from sprocket shaft.
   f. Spin crankcase half to verify that flywheel assembly is free.



1. **Installer base**
2. **Installer plug**
3. **Retaining ring**
4. **Left outer race**
5. **Right outer race**
6. **Left crankcase half**

Figure 3-86. Installing Sprocket Shaft Bear Outer Races



1. **Pilot**
2. **Handle**
3. **Washer**
4. **Nice bearing**
5. **Sleeve**
6. **Inner bearing**

Figure 3-87. Inner Bearing Installation

10. See Figure 3-89. Install **new** spacer in seal ID. With the open (lipped) side facing outward, center seal/spacer assembly over bearing bore.

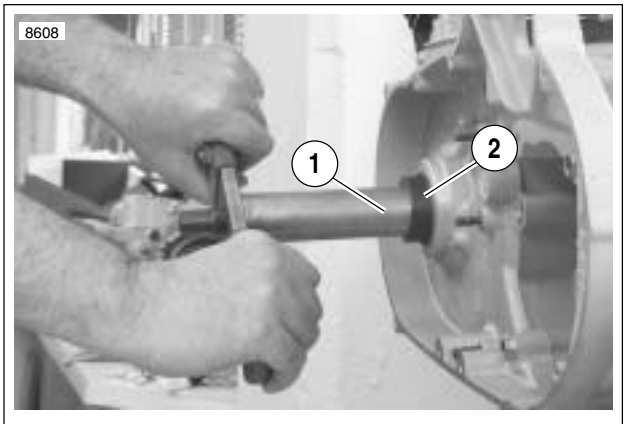
CAUTION

Do not remove the spacer after installation or the new seal will have to be discarded and the procedure repeated.

11. See Figure 3-90. Install bearing seal and spacer.
    a. Center seal/spacer driver (2) over seal, so that the sleeve (smaller OD) seats between seal wall and garter spring.
    b. See Figure 3-90. Assemble Sprocket Shaft Bearing/ Seal Installation Tool (1) (Part No. HD-42579) and SPROCKET SHAFT SEAL/SPACER INSTALLER (Part No. HD-45206) onto sprocket shaft. Follow procedure in Step 8.
    c. Rotate handle clockwise until the spacer makes contact with the bearing. Remove tool from sprocket shaft.
12. See Figure 3-91. Install pinion shaft bearing.
    a. Lubricate pinion shaft bearing with engine oil.
    b. Slip bearing on pinion shaft.
    c. Install **new** retaining ring in groove of pinion shaft bearing inner race.
13. Assemble crankcase halves together.
    a. Apply a thin coat of DOW CORNING SILASTIC or 3-M 800 sealant to crankcase joint faces.
    b. Slide pinion shaft through outer race in right crankcase.
    c. Attach crankcase halves using hardware shown in Figure 3-73.Tighten 1/4-in. fasteners to 70-110 **in-lbs** (7.9-12.4 Nm)
    d. Tighten 5/16-in. fasteners to 15-18 ft-lbs (20.3-24.4 Nm).

Figure 3-88. Installing Flywheel Spacer and Outer Bearing

Figure 3-89. install Spacer in Seal



1. **Bearing/seal installer (Part No. HD-42579)**
2. **Seal/spacer installer (Part No. 45206)**

Figure 3-90. Install Bearing Seal/Spacer

14. See Figure 3-92. Install cylinder studs.
    a. Pack clean towels into crankcase opening.
    b. Place a steel ball into a head screw (1).
    c. The cylinder studs (2) have a shoulder (3) at the lower end. Place the end of the stud without the shoulder into the head screw.
    d. Install the stud in the crankcase with the shoulder end down. Use an air gun (4) to drive the stud until the shoulder reaches the crankcase.
    e. Remove air gun. Use a torque wrench to tighten stud to 10 ft-lbs (13.6 Nm).
15. Install pistons and cylinders. See 3.6 CYLINDER AND PISTON ASSEMBLY/INSTALLATION.
16. Install oil pump. See OIL PUMP Assembly under 3.8 OILING SYSTEM.
17. Install cam gears, gear case cover, tappet guides and tappets. See ASSEMBLY/INSTALLATION under 3.10 GEARCASE COVER AND CAM GEARS.
18. Install cylinder heads. See 3.5 CYLINDER HEAD INSTALLATION.
19. Install transmission. See 6.14 TRANSMISSION INSTALLATION /SHIFTER PAWL ADJUSTMENT.
20. Install all primary drive components. This includes engine sprocket, primary chain, complete clutch assembly, engine sprocket nut and main shaft nut. See 6.6 PRIMARY DRIVE/CLUTCH INSTALLATION.
21. Install primary cover. See Primary Cover under 6.2 PRIMARY CHAIN INSTALLATION

NOTE

Be sure to refill transmission to proper level with fresh lubricant. See 6.7 TRANSMISSION LUBRICATION.

22. See 3.4 INSTALLING THE ENGINE and perform the applicable steps.

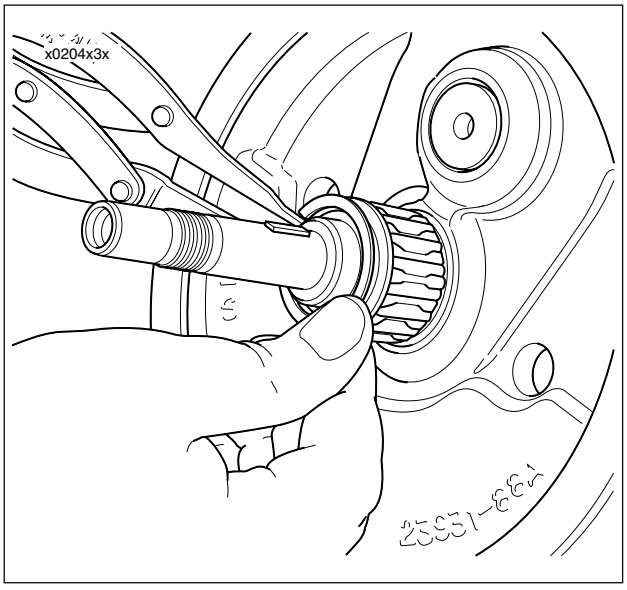
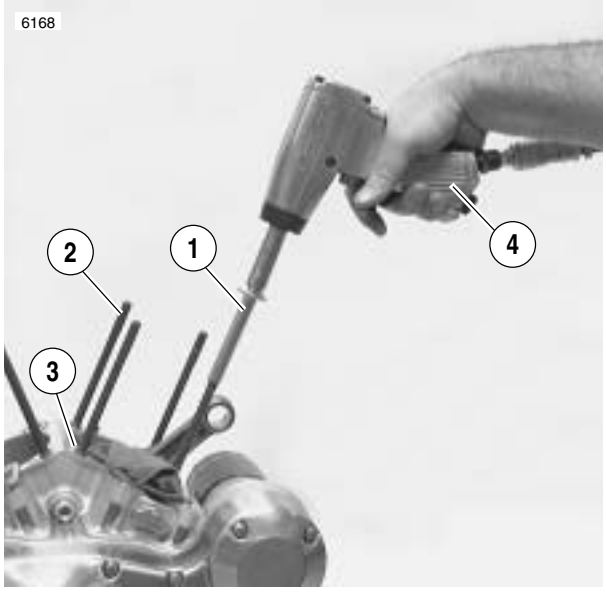


Figure 3-91. Pinion Shaft Bearing



1. **Head screw with ball inside**
2. **Cylinder stud**
3. **Shoulder on cylinder stud**
4. **Air gun**

Figure 3-92. Cylinder Studs

NOTES

FUEL SYSTEM 4

SUBJECT **PAGE NO.**

4.1 Specifications 4-1
4.2 Carburetor 4-2
4.3 Troubleshooting 4-10
4.4 Air Cleaner 4-12
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4.7 Evaporative Emissions Control 4-18

Table 4-1. Sportster Specifications

Carburetor Jet Sizes	XLH 883			XLH 1200 / 1200S SPORT		
	49 State	Calif.	HDI, Swiss	49 State	Calif.	HDI, Swiss
Main jet	160	170	190	170/195	185/195	200
Slow jet	42	42	42	42	42	42
CARBURETOR ADJUSTMENTS						
Engine slow idle speed	1050 rpm					
Engine speed for setting ignition timing	1050-1500 rpm					
FUEL TANK CAPACITY						
Total	3.30 gallons (U.S.)					
	12.5 liters					
Reserve	0.50 gallon (U.S.)					
	1.9 liters					
TORQUE VALUES						
Intake manifold flange bolts	8-12 ft-lbs					
	10.9-16.3 Nm					
Air cleaner backplate to cylinder bolts	10-20 ft-lbs					
	14-27 Nm					
Air cleaner backplate to carburetor bolts	3-5 ft-lbs					
	4-7 Nm					
Fuel tank mounting bolts	8-16 ft-lbs					
	11-22 Nm					
Air cleaner cover screws	3-5 ft-lbs					
	4-7 Nm					

GENERAL

See Figure 4-1. 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 local regulations.

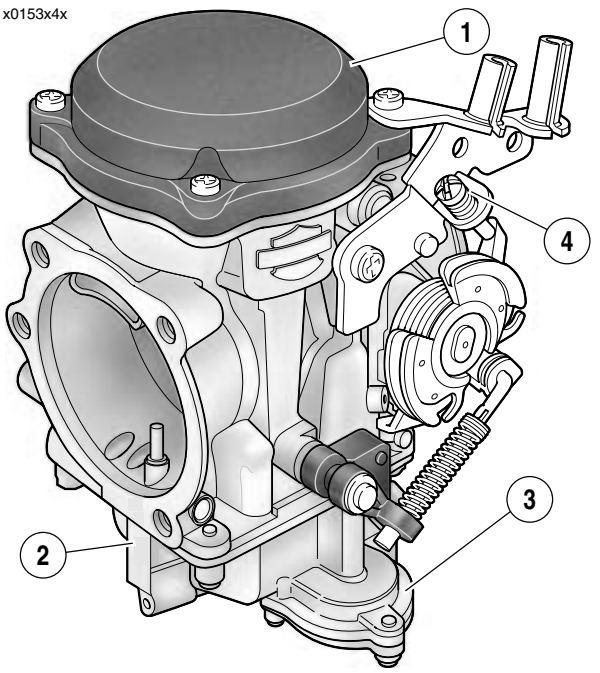
This system partially compensates for changes in the mixture that are normally caused by changes in altitude. Because atmospheric pressures drop as altitude increases, the pressure difference in the upper and lower chambers is reduced; this results in less fuel being delivered to the engine, thereby maintaining the correct air/fuel ratio for better engine performance and reduced exhaust emissions.

All models except the 1200S have a drain for emptying the float chamber during seasonal or extended periods of storage.

NOTE

The XL1200S Sport model does NOT have a drain for emptying the float chamber.

The carburetor is equipped with an accelerator pump. The accelerator pump system uses sudden throttle openings (rapid accelerations) to quickly inject raw fuel into the carburetor venturi; this provides extra fuel for smooth acceleration.



1. **Vacuum piston chamber**
2. **Float chamber**
3. **Accelerator pump**
4. **Idle speed adjusting screw**

Figure 4-1. Carburetor

OPERATION

Enrichener

The enrichener knob, next to the ignition switch, controls the opening and closing of the enrichener valve at the carburetor.

Cool Engine

BE SURE THROTTLE IS CLOSED. Pull enrichener knob fully out. Turn the ignition switch on and press starter switch to operate the electric starter.

CAUTION

You must pay close attention to a C. V. carburetor equipped vehicle's warm-up time. Both excessive use and insufficient use of the enrichener may cause poor performance, erratic idle, poor fuel economy and spark plug fouling.

Outside Temperature Less Than 50˚F (10˚C)

The vehicle should be allowed to warm up for only 15-30 seconds before being driven. Initial warm-up periods longer than 30 seconds are not recommended. For temperatures well below 50˚F (10˚C), you may need to twist the throttle once or twice immediately before attempting engine start-up. This will add extra fuel from the carburetor accelerator pump to assist the start-up.

1. If the outside temperature is less than 50˚ F (10˚C), ride for five minutes or three miles (5 km) with enrichener knob fully out.
2. Push the enrichener knob in to approximately 1/2 way. Ride another two minutes or two miles (3 km).

See Figure 4-2. Then push enrichener knob fully in. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride another two minutes or two miles (3 km); then push enrichener knob fully in.

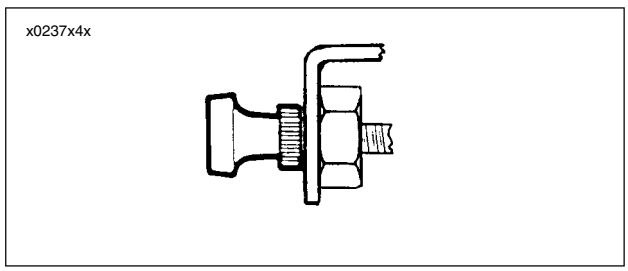


Figure 4-2. Enrichener Knob Fully In

Outside Temperature Greater Than 50˚F (10˚C)

The vehicle should be allowed to warm up for only 15-30 seconds before being driven. Initial warm-up periods longer than 30 seconds are not recommended.

1. If the outside temperature is greater than 50˚F (10˚C), ride for three minutes or two miles (3 km) with enrichener knob fully out.
2. Push the enrichener knob in to approximately 1/2 way. Ride another two minutes or two miles (3 km).
3. Then push enrichener knob fully in. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride another two minutes or two miles (3 km); then push enrichener knob fully in.

Warm or Hot Engine

See Figure 4-2. Open throttle 1/8-1/4 of full travel. Turn on ignition switch and operate electric starter. DO NOT USE ENRICHENER, unless engine will not idle at specified rpm. If engine will not idle at specified rpm, pull out enrichener knob enough to allow correct idle speed. Ride two minutes or two miles (3 km); then push enrichener knob fully in.

ADJUSTMENT

Slow Idle

NOTE

Make certain enrichener knob is pushed in all the way before adjusting engine idle. The CV carburetor enrichener circuit will cause engine idle speed to increase to approximately 2000 rpm with enrichener knob pulled out fully and engine running at normal operating temperature. With enrichener knob pulled out partially, and engine running at normal operating temperature, engine idle speed will also increase above normal idle speed. The increase in idle speed is intended to alert the rider that engine is warmed up, and that enrichener knob should be pushed in all the way. Continued use of enrichener, after engine is at normal operating temperature, may cause fouled spark plugs.

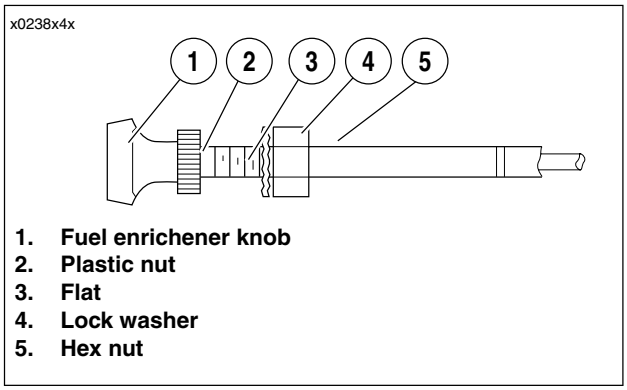
See Figure 4-1. With engine at normal operating temperature and enrichener pushed in all the way (enrichener valve closed), adjust idle speed adjusting screw (4) so engine idles at 950-1050 rpm.

NOTE

Use a test tachometer, connected to negative ignition coil terminal, to measure engine rpm on XLH 883 models.

Enrichener Control

See Figure 4-3. Check fuel enrichener operation. Fuel enrichener knob should open (and remain open) and close without binding. Plastic nut, next to the enrichener knob, controls the sliding resistance of the enrichener control cable within the cable conduit. If adjustment is needed, perform the following:



1. **Fuel enrichener knob**
2. **Plastic nut**
3. **Flat**
4. **Lock washer**
5. **Hex nut**

Figure 4-3. Fuel Enrichener Control

1. Loosen hex nut at backside of mounting bracket.
2. Move cable assembly free of slot in mounting bracket.
3. Hold cable assembly at flats with a wrench. Turn plastic nut by hand counterclockwise (reducing sliding resistance) until knob slides inward unaided.
4. Turn plastic nut clockwise (increasing sliding resistance) until knob remains fully open without holding, and closes with relative ease.
5. Position cable assembly into slot in mounting bracket. Tighten hex nut at backside of bracket.

NOTE

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

Float Level

1. See Figure 4-4. Place carburetor on a flat, clean surface on engine manifold side. This is the “base.” Tilt carburetor counterclockwise 15˚ to 20˚ from base until float comes to rest.

NOTE

If carburetor is tilted less than 15˚ or more than 20˚, your measurements will be inaccurate.

2. Use a vernier or dial caliper depth gauge to measure from the carburetor flange face to the perimeter of the float. Be careful not to push on float while measuring. The measurement must be 0.413-0.453 in. (10.49-11.51 mm). If measurement is not within given dimension, remove float and carefully bend tab in order to reposition float at proper level.
3. Install float, and recheck setting.
4. Install float bowl. Install carburetor as described in 4.2 CARBURETOR INSTALLATION.

OPERATION
CHECK – VACUUM PISTON

Opening Malfunction

⚠WARNING

While observing piston slide movement, be sure to maintain a safe distance from the carburetor and to wear suitable eye protection. An unexpected engine backfire could cause death or serious injury.

1. See Figure 4-5. With air cleaner cover off and engine running, twist throttle control partially open and closed several times while observing whether or not vacuum piston (6) has upward movement. If piston does not rise, see PISTON DOES NOT RISE PROPERLY in Table 4-2.
2. With engine not running, lift vacuum piston (6) with finger. Feel whether piston lifts fully and smoothly or whether there is a binding condition.

Closing Malfunction

1. With engine not running, lift vacuum piston (6) to full open position, then release. Observe whether 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. If problems are noted, see PISTON DOES NOT CLOSE PROPERLY in Table 4-2.

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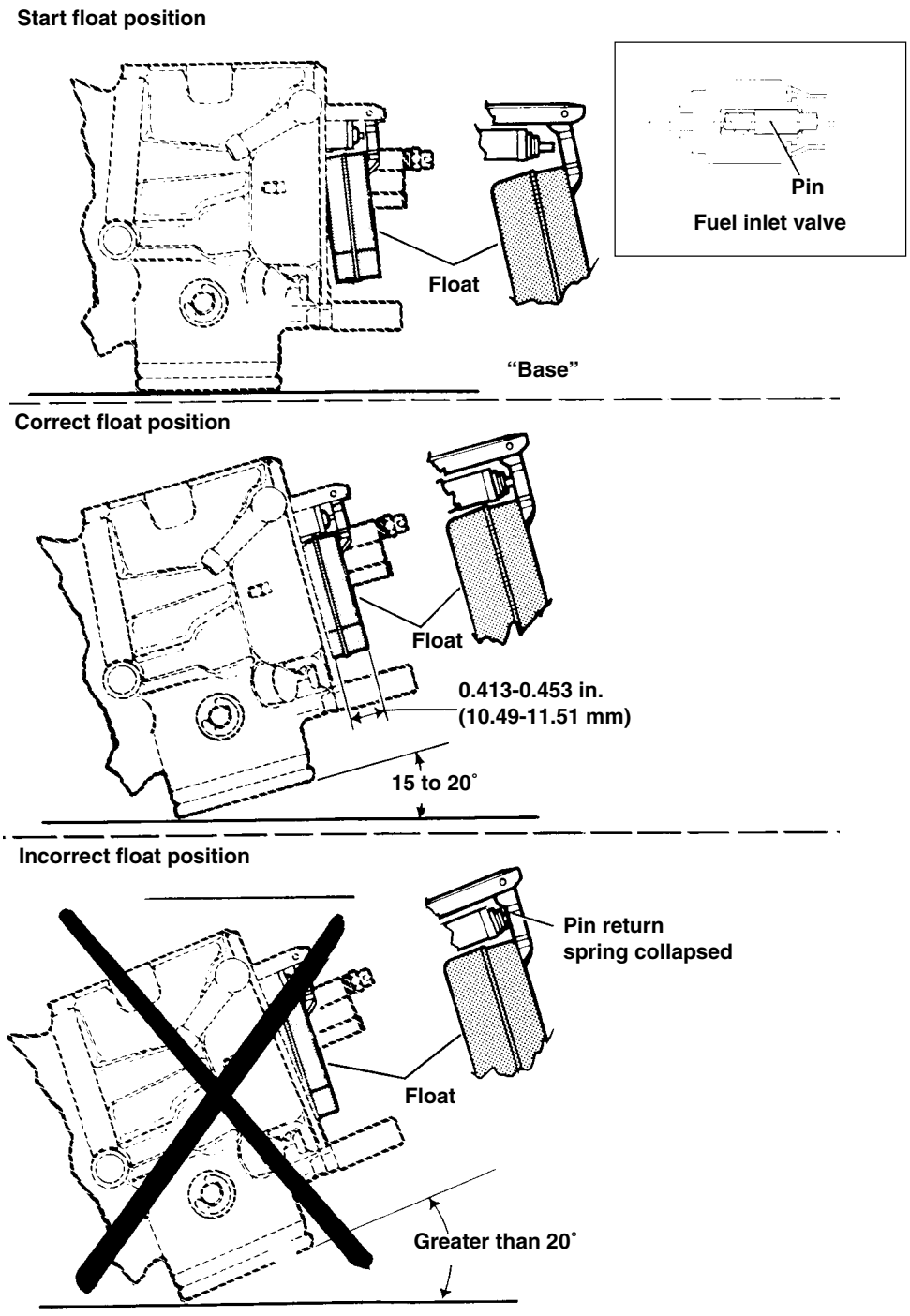


Figure 4-4. Carburetor Float Adjustment

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in death or serious injury.

1. Turn the fuel supply valve to OFF.
2. Remove the air cleaner and backplate. See 4.4 AIR CLEANER REMOVAL.

⚠WARNING

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilled fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in death or serious injury.

3. See Figure 4-6. Disconnect fuel hose and throttle cables from carburetor.
4. See Figure 4-5. Disconnect fuel overflow/drain hose (19) from fuel overflow fitting (except XL-Sport). Disconnect vacuum hose from V.O.E.S. fitting. Disconnect enrichener valve assembly.

   On California models only, disconnect canister purge hose from fitting on carburetor body. See 4.7 EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS.
5. Remove the fuel tank. See 4.6 FUEL TANK REMOVAL.
6. See Figure 4-7. Pull carburetor free of intake manifold. If removing intake manifold, remove four manifold mounting screws. Remove intake manifold, seal ring, mounting flanges (1 and 2) and two intake manifold seals.

DISASSEMBLY

Vacuum Piston Chamber

1. Remove screws and bracket.
2. Remove three screws and washers. Remove cover and spring.
3. Lift out vacuum piston with needle and spring seat. Remove loose parts from vacuum piston.

Carburetor Body

1. See Figure 4-5. Remove four screws and washers (28). Remove float bowl assembly.
2. Remove pin, float and fuel inlet valve.
3. Back out main jet and needle jet holder. Needle jet is free to be removed from bottom end of passage.
4. Insert thin-bladed screwdriver into slow jet passage to remove slow jet.

Accelerator Pump

Remove three screws, lock washers, accelerator pump housing, spring and diaphragm. Remove O-ring from housing.

CLEANING, INSPECTION AND REPAIR

Vacuum Piston Components

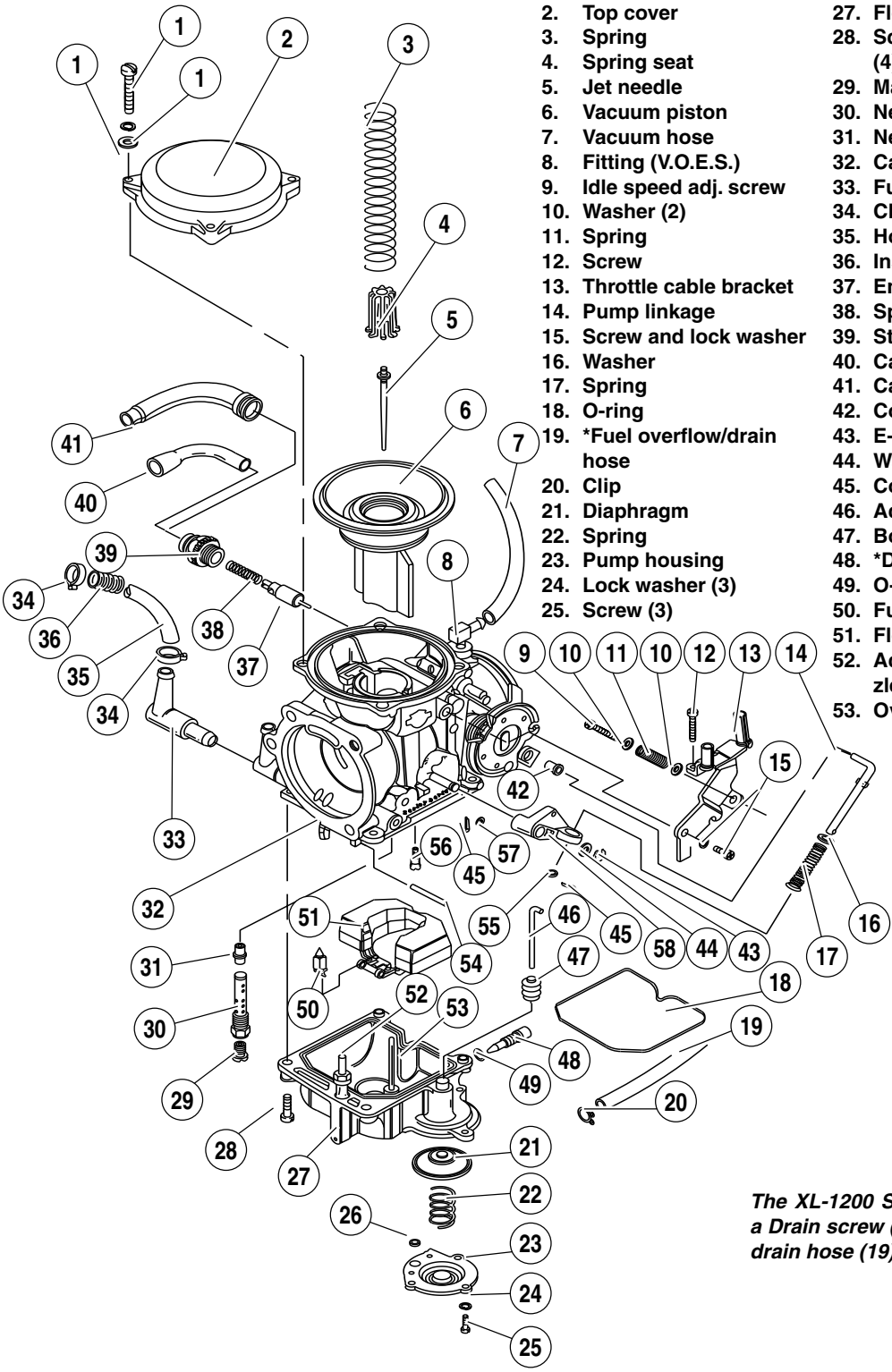
1. See Figure 4-5. Hold vacuum piston (6) up to strong light. Examine diaphragm at top of vacuum piston for evidence of pinching, holes or tears. Replace if damaged.
2. Examine vacuum passage through bottom of piston. Clean passage if restricted.
3. Examine spring for stretching, crimping, distortion or damage. Replace if necessary.
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. Needle should be straight; surface of taper should be smooth and even.

Carburetor Body Components

1. See Figure 4-5. Check float bowl O-ring for any distortion or damage. Replace if seating surfaces are damaged.
2. Examine fuel inlet valve and inlet valve seat. Clean with carburetor cleaner. Replace if seating surfaces are damaged.
3. Clean slow jet with carburetor cleaner. Check to be sure all orifices are open.
4. Check enrichener valve. Be sure needle guide is clean, straight and undamaged. Check composition seating surface 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. 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. Clean bleed tube orifices. Replace holder if damaged.
9. Check float for cracks or other leaks. Replace if damaged.
10. Clean main jet with carburetor cleaner and inspect for damage. Replace if damaged.

Accelerator Pump

1. See Figure 4-5. Inspect the accelerator pump diaphragm for holes, cracks or deformation. Replace as necessary.
2. Replace the pump rod if it is bent; replace the boot if it is cracked.

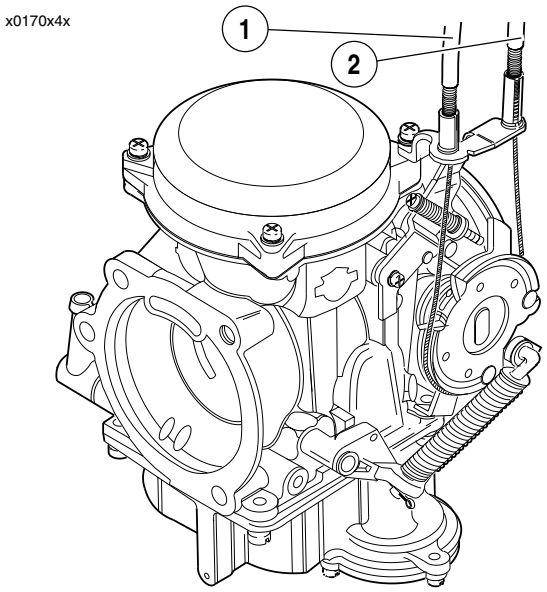


1. Screw and washers (3)
2. Top cover
3. Spring
4. Spring seat
5. Jet needle
6. Vacuum piston
7. Vacuum hose
8. Fitting (V.O.E.S.)
9. Idle speed adj. screw
10. Washer (2)
11. Spring
12. Screw
13. Throttle cable bracket
14. Pump linkage
15. Screw and lock washer
16. Washer
17. Spring
18. O-ring
19. *Fuel overflow/drain hose
20. Clip
21. Diaphragm
22. Spring
23. Pump housing
24. Lock washer (3)
25. Screw (3)
26. O-ring
27. Float bowl
28. Screw w/lock washer (4)
29. Main jet
30. Needle jet holder
31. Needle jet
32. Carburetor body
33. Fuel inlet fitting
34. Clamp (2)
35. Hose
36. Insulator
37. Enrichener valve
38. Spring
39. Starter cap
40. Cable guide
41. Cable sealing cap
42. Collar
43. E-clip
44. Washer
45. Cotter pin (2)
46. Accelerator pump rod
47. Boot
48. *Drain screw
49. O-ring
50. Fuel inlet valve
51. Float
52. Accelerator pump nozzle
53. Overflow pipe
54. Pin
55. Washer
56. Slow jet
57. Washer
58. Lever

NOTE

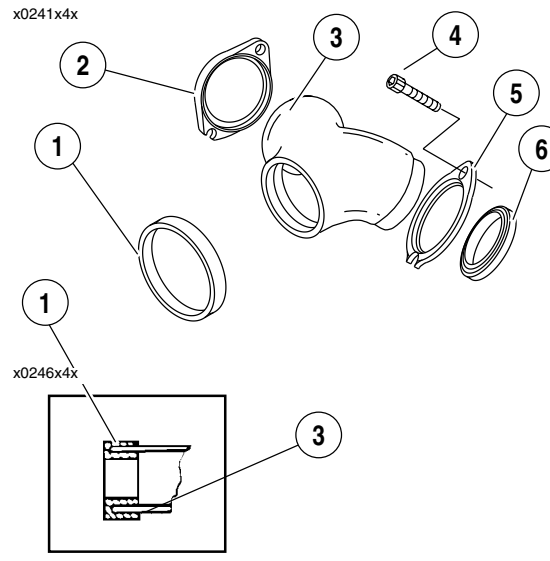
The XL-1200 Sport does NOT have a Drain screw (48) or Fuel overflow/drain hose (19).

Figure 4-5. Constant-Velocity (CV) Carburetor



1. **Throttle control cable**
2. **Idle control cable**

Figure 4-6. Throttle Cables



1. **Seal ring**
2. **Rear mounting flange**
3. **Intake manifold**
4. **Screw (4)**
5. **Front mounting flange**
6. **Intake manifold seal (2)**

Figure 4-7. Intake Manifold

ASSEMBLY

Vacuum Piston Chamber

1. See Figure 4-5. Place needle through center hole in vacuum piston. Place spring seat 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 one way only. If piston does not fit, rotate 180 degrees.
3. Check to be sure diaphragm is seated evenly into groove at top of carburetor body. Place spring over spring seat, and carefully lower top cover. Keep spring straight while lowering top cover.
4. After top cover is seated, hold top cover while lifting vacuum piston upward. Piston should raise to top smoothly. If piston movement is restricted, spring is cocked; lift up top cover, then lower carefully, keeping spring coils straight.
5. Once top cover is installed correctly, install screws and washers. Place bracket in position with idle screw, resting on top of throttle cam stop. Install body screw and washer first, then top screw to prevent bending bracket or throttle cam.

Carburetor Body

CAUTION

Slow jets from fixed-venturi carburetors look the same as the slow jet of the CV carburetor. However, the air bleed hole sizes are different on fixed-venturi carburetors, and they must not be installed on CV carburetors.

1. See Figure 4-5. Thread slow jet into slow jet passage with narrow-bladed screwdriver.
2. Turn carburetor upside down. Place needle jet 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 into main jet passage with needle inserted into center of holder. Thread holder into passage and tighten. Thread and tighten main jet in tapped hole in holder.
4. Place float assembly into position with fuel inlet valve inserted into valve seat and with pivot arm aligned with holes in mounting posts (at bottom of carburetor body). Insert pin through float pivot arm and float mounting posts.
5. Check float level setting and adjust if necessary. See Float Level under 4.2 CARBURETOR ADJUSTMENT.
6. Place float bowl over float and onto carburetor body flange. Bowl will only fit in one position. Install and tighten screws and washers.

Accelerator Pump

See Figure 4-5. Install diaphragm, spring, O-ring and pump housing. Secure with three screws and lock washers.

INSTALLATION

Carburetor

1. See Figure 4-7. Place flanges onto aluminum manifold.
2. Place intake manifold seals onto each spigot of manifold with chamfered edge against flanges.
3. Place channel of seal ring over inlet end of manifold.
4. Position manifold against intake ports of cylinder head, with slotted and round holes in flanges aligned with holes in cylinder head. Insert screws through manifold flanges and loosely thread into tapped holes in cylinder head.

NOTE

The fit between the carburetor and the seal ring is tight. For ease of installation, lubricate the mating surfaces, carburetor body and seal ring with liquid dish soap or tire mounting lube prior to assembly.

5. Lubricate only the inside surface of seal ring that will be in contact with the carburetor. Also apply a light coat of lubricant to the spigot of the carburetor body. Push carburetor body into seal ring.
6. Install air cleaner backplate and air cleaner. See 4.4 AIR CLEANER INSTALLATION.
7. See Figure 4-7. Final tighten intake manifold screws to 8-12 ft-lbs (10.9-16.3 Nm).
8. Install fuel tank. See 4.6 FUEL TANK INSTALLATION.
9. On California models only, connect canister purge hose onto fitting on carburetor body. See 4.7 EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS.
10. See Figure 4-5. Connect fuel overflow/drain hose to fuel overflow fitting. Connect vacuum hose to V.O.E.S. fitting. Connect enrichener valve assembly to carburetor body.
11. See Figure 4-6. Install throttle cables and fuel hose onto carburetor.

Carburetor Fuel Overflow / Drain Hose Routing

See Figure 4-5. On non-California models, route fuel overflow/drain hose from the carburetor fuel overflow fitting downward and forward through the space between the engine front cylinder and the front cylinder push rod covers (intake and exhaust), and then downward through the space between the engine crankcase and the oil filter.

On all California models, route the fuel overflow/drain (vent) hose from the carburetor fuel overflow fitting forward, along the inboard side of the carburetor float bowl, to a plastic fitting on the inboard side of the air cleaner backplate. Refer to 4.7 EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS and 4.4 AIR CLEANER INSTALLATION.

Table 4-2. Troubleshooting

OVERFLOW	
Check for:	**Remedy:**
Restricted fuel tank vent system.	Correct restricted hose. Replace vapor valve.
Loose float bowl screws.	Tighten screws.
Damaged float bowl O-ring.	Replace O-ring.
Damaged or leaking float assembly.	Replace float assembly.
Particle contamination in fuel inlet fitting cavity.	Clean and clear cavity and fuel supply tract.
Worn or dirty inlet valve or seat.	Clean or replace valve and clean seat.
Improper fuel level in float bowl.	Adjust float tab for correct fuel level.
POOR IDLING	
Check for:	**Remedy:**
Idle speed improperly adjusted.	Adjust operating idle speed.
Inlet system air leak (faster idling).	Correct as required.
Loose low speed jet.	Tighten jet.
Contaminated or plugged low speed system.	Clean contaminants and clear passages.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Leaking accelerator pump.	Repair.
POOR FUEL ECONOMY	
Check for:	**Remedy:**
Excessive use of enrichener system.	Limit system use.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Dirty air cleaner element.	Clean or replace as required.
Restricted fuel tank vent system.	Correct restricted hose. Replace vapor valve.
High speed riding style.	Modify riding habits.
Idle speed improperly adjusted.	Adjust operating idle speed.
Loose jets.	Tighten jets.
Fuel level too high.	Adjust float level.
Plugged or restricted bowl vent.	Clean and clear passages.
Worn or damaged needle or needle jet.	Replace needle or needle jet.
Vacuum piston assembly malfunction.	See Vacuum Piston Troubleshooting at end of this table.
Plugged air jets or passages.	Clean and clear passages.
Excessive accelerator pump output.	Check and clean accelerator pump bypass orifice.
POOR ACCELERATION	
Check for:	**Remedy:**
Throttle cables misaligned.	Adjust throttle cables.
Inlet system air leak.	Correct as required.
Restricted fuel tank vent system.	Correct restricted hose. Replace vapor valve.
Restricted fuel supply passages.	Correct and clear restriction.
Plugged bowl vent or overflow.	Clean and clear passages.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Worn or damaged needle or needle jet.	Replace assembly.
Vacuum piston malfunction.	See Vacuum Piston Troubleshooting at end of this table.
Plugged jets or passages.	Clean and clear as required.
Fuel level (float chamber) too low.	Adjust float level.
Accelerator pump leaking or no output.	Repair as necessary.

Table 4-2. Troubleshooting

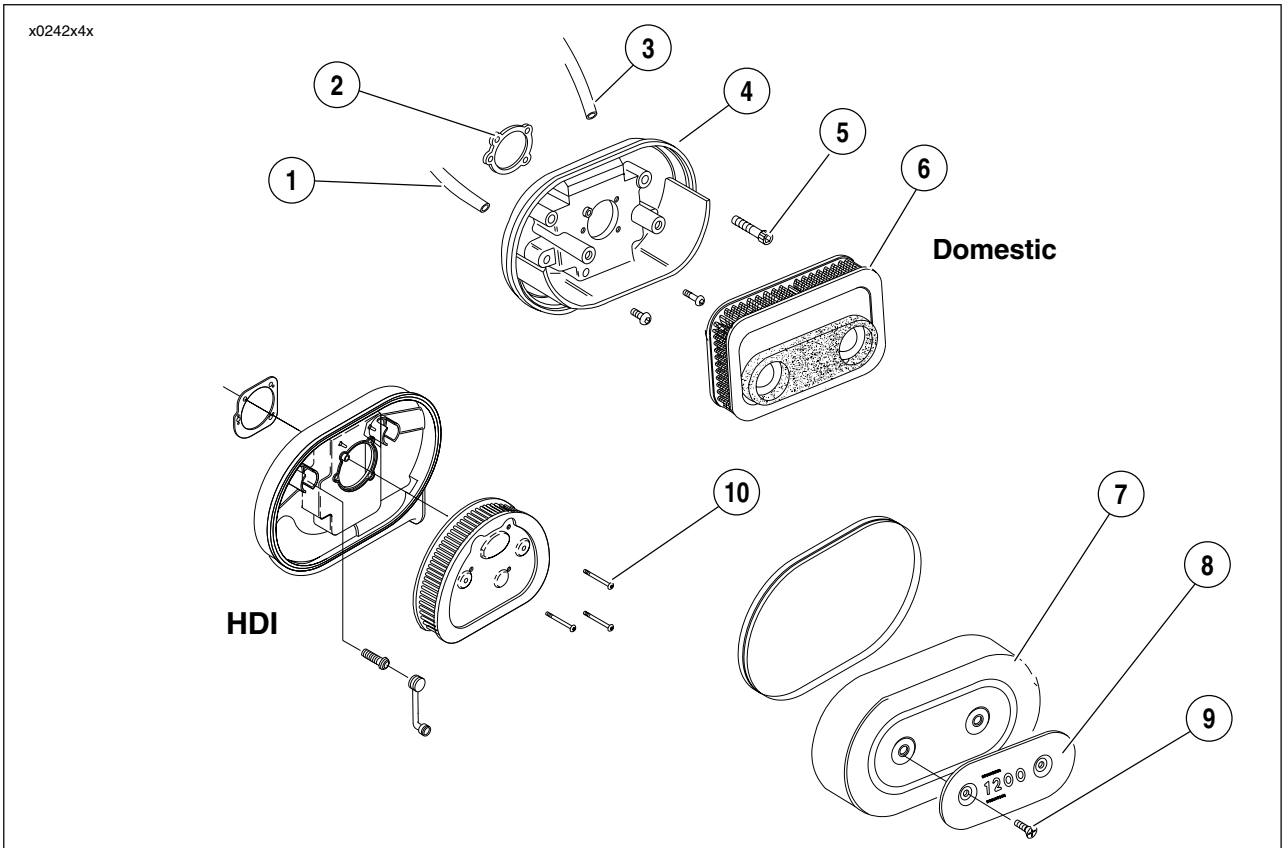
HARD STARTING	
Check for:	**Remedy:**
Enrichener system plugged, not properly functioning or improperly operated.	Clean, adjust, or replace; or read Owner's Manual.
Inlet system air leak.	Correct as required.
Restricted fuel supply	Correct fuel supply or passages
Fuel overflow.	See Overflow Troubleshooting at beginning of this table.
Plugged slow jet or passages.	Clean and clear jet or passages.
POOR PERFORMANCE ON ROAD	
Check for:	**Remedy:**
Idle speed improperly adjusted.	Adjust operating idle speed.
Inlet system air leak	Correct as required.
Restricted fuel tank vent system	Correct restricted hose. Replace vapor valve
Dirty or damaged air cleaner element.	Clean or replace.
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Restricted fuel supply tract.	Correct and clear restriction.
Plugged bowl vent or overflow.	Clean and clear passages
Loose or plugged fuel and air jets or passages.	Clean, clear and correct as required.
Worn or damaged needle or needle jet.	Replace assembly.
Vacuum piston assembly malfunction.	See Vacuum Piston Troubleshooting below
Accelerator pump inoperative.	Repair as required
POOR HIGH-SPEED PERFORMANCE	
Check for:	**Remedy:**
Inlet system air leak.	Clean or replace
Enrichener valve not seated or leaking.	Adjust, clean or replace.
Restricted fuel tank vent system.	Correct restricted hose. Replace vapor valve.
Restricted fuel supply tract.	Correct and clean restriction.
Dirty or damaged air cleaner element.	Clean or replace.
Plugged bowl, vent or overflow.	Clean and clear passages.
Worn or damaged needle or needle jet.	Replace assembly
Vacuum piston assembly malfunction.	See Vacuum Piston Troubleshooting below
Loose or plugged main jets or passages.	Tighten, clean, clear as required.
Improper fuel level.	Adjust float level.
Accelerator pump inoperative.	Repair as required.
PISTON DOES NOT RISE PROPERLY	
Check for:	**Remedy:**
Piston atmosphere vent blocked	Clear vent.
Diaphragm cap loose, damaged or leaking.	Tighten or replace cap
Spring binding.	Correct or replace spring.
Diaphragm pinched at lip groove	Reposition diaphragm lip.
Torn diaphragm.	Replace piston diaphragm assembly.
Piston binding.	Clean piston slides and body or replace piston.
Piston vacuum passage plugged.	Clean and clear passage
PISTON DOES NOT CLOSE PROPERLY	
Check for:	**Remedy:**
Spring damaged.	Replace spring.
Piston binding.	Clean piston slides and body or replace piston.
Piston diaphragm ring dirty or damaged.	Clean or replace piston.

GENERAL

The air cleaner prevents foreign material from entering the carburetor and engine, trapping airborne dust and dirt in the filter element. Service the air cleaner filter element every 5,000 miles (8,000 km), or more often if the motorcycle is run in a dusty environment.

REMOVAL

1. See Figure 4-8. Remove two screws from air cleaner cover. Remove cover [and air cleaner trim on XLH 1200 models] from backplate.
2. Remove filter element from backplate. If filter element is being removed for cleaning only, proceed to CLEANING, INSPECTION AND REPAIR under 4.4 AIR CLEANER.



1. **Canister-to-air cleaner hose (canister clean air inlet hose) (California models)**
2. **Gasket**
3. **Carburetor overflow (vent) hose (California models)**
4. **Backplate**
5. **Screw (2)**
6. **Filter element**
7. **Cover**
8. **Air cleaner trim (XLH 1200 models)**
9. **Screw (2)**
10. **Screw (3)**

Figure 4-8. Air Cleaner Assembly

3. See Figure 4-8. Remove two cylinder head screws from backplate.

CAUTION

To prevent damage to backplate during removal of captive screws, do not allow threads of screws to engage threads of backplate insert sleeves.

4. Alternately loosen each of three captive screws a couple of turns while pulling backplate away from carburetor. Repeat this loosening procedure until all screws disengage from threaded holes in carburetor. Lift backplate (with screws) away from carburetor.On California models, disconnect clean air inlet hose and carburetor overflow (vent) hose from backplate assembly. Disconnect solenoid wiring at 4-pin connector.
5. Remove backplate and gasket.

CLEANING, INSPECTION AND REPAIR

1. See Figure 4-8. Remove filter element from backplate.

CAUTION

Do not run engine with air cleaner filter element removed. Engine damage may result.

2. Thoroughly clean backplate and inside of cover.
3. Replace filter element if damaged or if filter media cannot be adequately cleaned.

⚠WARNING

Do not use gasoline or solvents to clean the filter element. Volatile / flammable cleaning agents may cause an intake system fire, which can result in death or serious injury.

4. Wash filter element thoroughly in warm, soapy water. To remove soot and carbon, soak element for 30 minutes in warm water with mild detergent.
5. Dry the filter element using low-pressure (32 psi/221 kPa maximum) compressed air. Rotate element while moving air nozzle up and down the element interior. Do not rap the element on a hard surface.
6. Hold filter element up to strong light source. The element can be considered sufficiently clean if light is uniformly visible through the element.

INSTALLATION

CAUTION

If installing a new backplate, thread captive screws all the way into backplate prior to installation. This will reduce the possibility of cross-threading the screws into the carburetor.

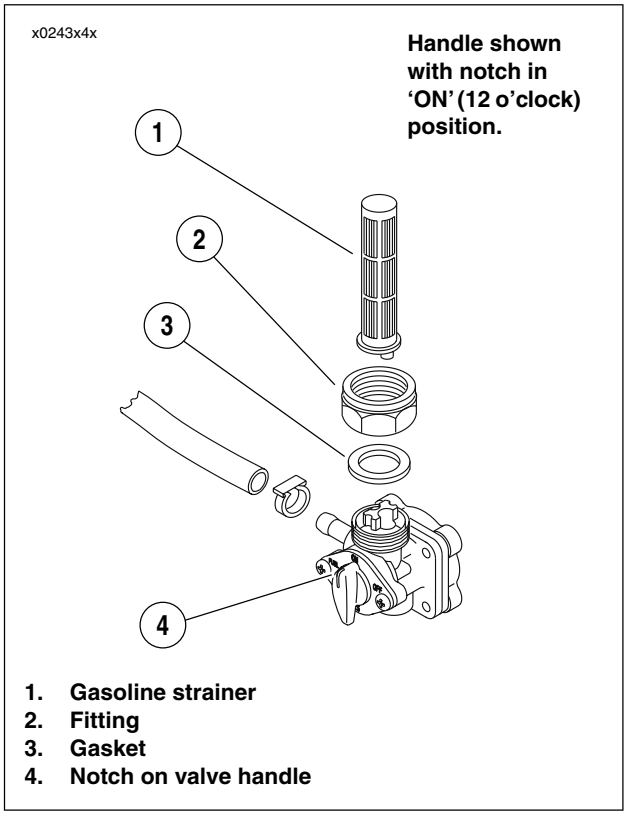
1. See Figure 4-8. On California models, connect butterfly valve solenoid wiring at 4-pin connector. Connect carburetor overflow (vent) hose, and clean air inlet hose to backplate assembly.
2. Position gasket and backplate at carburetor air inlet. Start each captive screw into threaded holes of carburetor. Alternately tighten each screw a couple of turns until backplate is drawn to a loose fit at carburetor mounting surface.
3. Loosely install screws through backplate into cylinder heads.
4. Tighten three captive screws to 36-60 **in-lbs** (4.1-6.8 Nm). On HDI model, tighten to 20 **in-lbs** (2.26 Nm).
5. Tighten two cylinder head screws to 10-20 ft-lbs (14-27 Nm).
6. Service the air cleaner filter element, if necessary. See CLEANING, INSPECTION AND REPAIR under 4.4 AIR CLEANER.
7. Install air cleaner filter element onto backplate. The words “This Side Out” should be readable on the upper edge of the filter element when installed.
8. Fit air cleaner cover onto backplate and install screws [with air cleaner trim on XLH 1200 models]. Tighten screws to 36-60 **in-lbs** (4.1-6.8 Nm).

GENERAL

See Figure 4-9. The fuel supply valve is located on the left side, below the fuel tank.

- The gasoline supply to the carburetor is shut off when the handle is in the horizontal position.
- For gasoline main supply, turn the handle counterclockwise until it stops in the vertical position and the notch is at 12 o'clock.
- For gasoline reserve supply, turn the handle clockwise until it stops in the vertical position and the notch is at 6o'clock.

The valve should always be in the OFF position when engine is not running.



1. **Gasoline strainer**
2. **Fitting**
3. **Gasket**
4. **Notch on valve handle**

Figure 4-9. Fuel Supply Valve

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in death or serious injury.

1. See Figure 4-9. Turn the fuel supply valve to OFF.

⚠CAUTION

A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilled fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in personal injury and/or property damage.

2. Remove fuel hose from carburetor.
3. Place end of fuel hose into a proper, clean container of adequate size.
4. Turn supply valve to reserve (RES). Drain gasoline from tank into container.

⚠WARNING

Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilled fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in death or serious injury.

5. Turn fitting and remove fuel supply valve assembly.

CLEANING, INSPECTION, AND REPAIR

1. See Figure 4-9. Clean or replace filter strainer (located inside fuel tank above fuel supply valve).
2. Flush fuel tank to remove all dirt.

INSTALLATION

1. See Figure 4-9. Coat supply valve threads with Loctite Pipe Sealant with Teflon and securely install fitting onto fuel tank.
2. Connect fuel hose to carburetor.

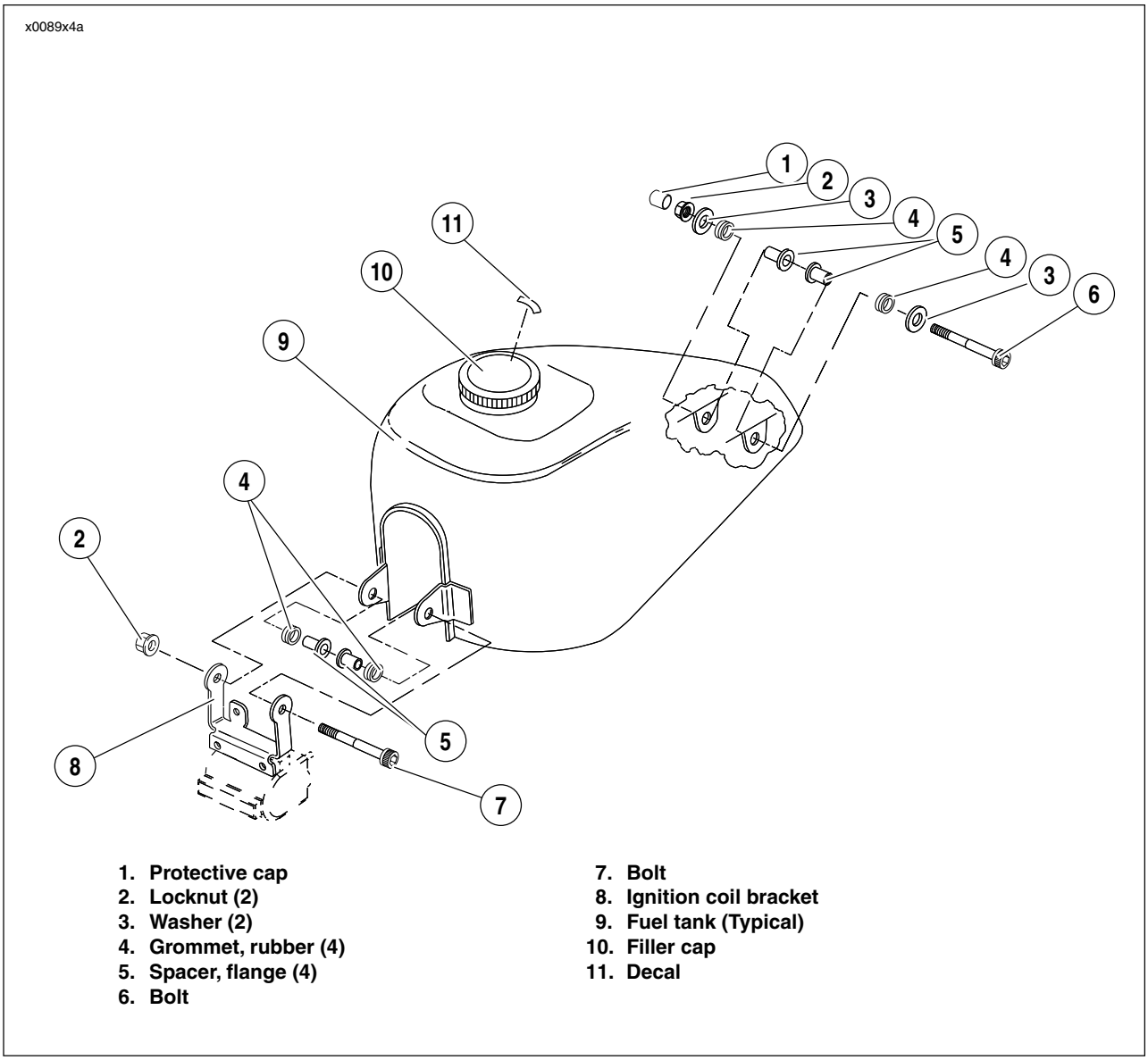
GENERAL

See Figure 4-10. The fuel tank is a one-piece welded tank. Although the tank interior is treated to resist rusting, further protection is required if the motorcycle is to be placed in storage. Drain the tank completely and apply a one-to-one oil/fuel mixture (or a commercially available fuel tank rust preventative) to the tank interior.

NOTE

Turn the filler cap until at least three clicks are heard in order to verify that it is securely fastened to the tank.

To reduce the level of vibration transmitted to the fuel tank through the vehicle frame, the tank is isolated by rubber grommets at its front and rear mounting points.



1. **Protective cap**
2. **Locknut (2)**
3. **Washer (2)**
4. **Grommet, rubber (4)**
5. **Spacer, flange (4)**
6. **Bolt**
7. **Bolt**
8. **Ignition coil bracket**
9. **Fuel tank (Typical)**
10. **Filler cap**
11. **Decal**

Figure 4-10. Fuel Tank Mounting Hardware

See Figure 4-11. The fuel tank is vented through a standpipe (vent tube) within the tank. A hose at the base of the fuel tank is connected to the standpipe.

⚠WARNING

Verify that the fuel tank vapor hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in death or serious injury.

See Figure 4-12. The fuel tank vapor hose is connected to a vapor valve located beneath the seat between the oil tank and the battery tray. On non-California models, another hose connects the vapor valve bottom fitting to a hollow frame member. On California models, the bottom hose is routed to the carbon canister (See 4.7 EVAPORATIVE EMISSIONS CONTROL – CALIFORNIA MODELS).

⚠CAUTION

See Figure 4-13. Mount the vapor valve (1) in an upright position with the longer fitting positioned at the top or excessive fuel vapor pressure may build up within the fuel tank.

REMOVAL

⚠WARNING

Gasoline can be extremely flammable and highly explosive. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system. Inadequate safety precautions may result in death or serious injury.

1. See Figure 4-9. Turn fuel supply valve to OFF.

⚠WARNING

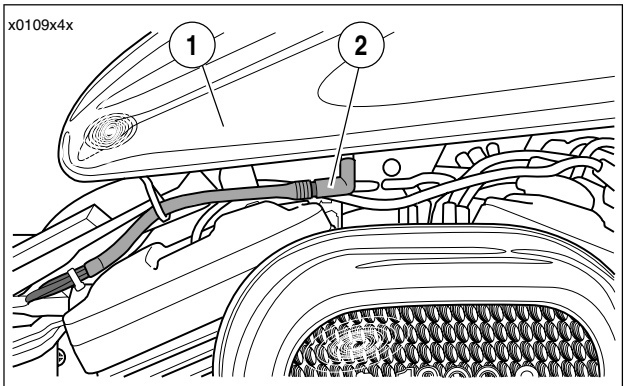
A small amount of gasoline may drain from the fuel hose when disconnected from the carburetor. Thoroughly wipe up any spilled fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in death or serious injury.

2. Remove fuel supply hose from carburetor fitting. Place free end of fuel hose into a suitable, clean container. Turn supply valve to "RES(ERVE)." Drain gasoline from tank.
3. See Figure 4-10. Remove mounting hardware from front and rear of fuel tank.
4. See Figure 4-11. Disconnect fuel tank-to-vapor valve hose from fitting at base of fuel tank. Lift fuel tank off motorcycle.

⚠WARNING

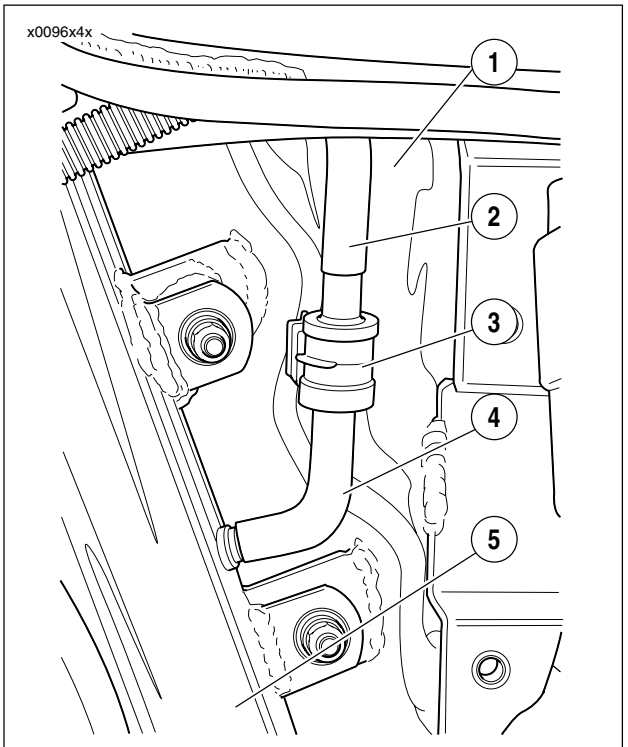
Even with the fuel tank completely drained, a small amount of gasoline may leak from the bore when the fuel supply valve is loosened or removed. Thoroughly wipe up any spilled fuel immediately and dispose of rags in a suitable manner. Gasoline can be extremely flammable and highly explosive. Inadequate safety precautions may result in death or serious injury.

5. See Figure 4-9. If the fuel supply valve requires cleaning or repair, turn the valve fitting counter-clockwise to remove it from the fuel tank.



1. Fuel tank
2. Fuel tank-to-vapor valve hose

Figure 4-11. Fuel Tank Venting System (Right side view w/seat removed)



1. Oil tank
2. Fuel tank-to-vapor valve hose
3. Vapor valve bracket
4. Vapor-valve-to-frame hose (non-California models)
5. Frame member

Figure 4-12. Vapor Valve Assembly

CLEANING, INSPECTION AND REPAIR

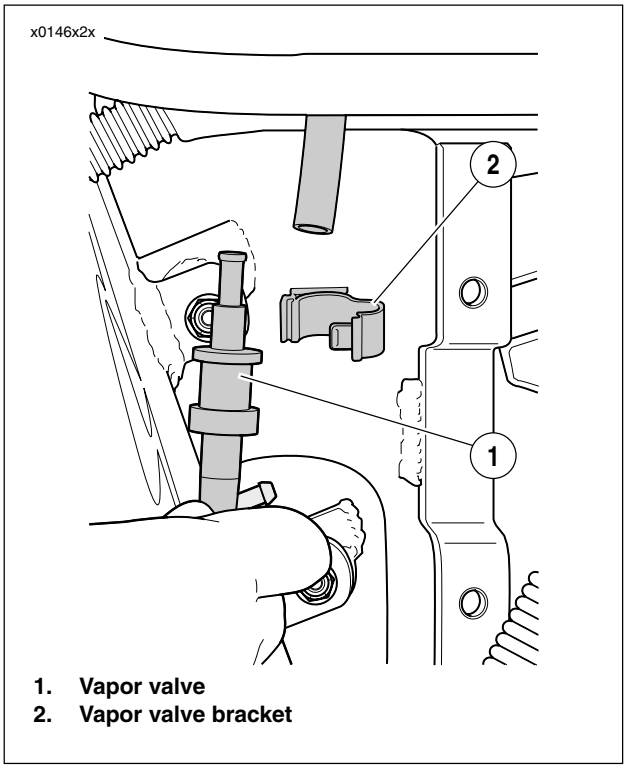
⚠WARNING

An open flame or spark may cause a fuel tank explosion if all traces of fuel are not purged from the tank. Use extreme caution when servicing fuel tanks. Inadequate safety precautions may result in death or serious injury.

⚠WARNING

To assist in loosening deposits, use only non-ferrous metal balls (such as lead pellets) with fuel tank cleaning solutions. The use of ferrous materials may cause a spark, which can then ignite fuel vapors inside the tank. The resulting flames or explosion could cause death or serious injury.

Clean the tank interior with commercial cleaning solvent or a soap and water solution. Plug fuel tank openings. Shake the tank to agitate the cleaning agent. If necessary, non-ferrous metallic balls or pellets may be added to the tank to help loosen deposits. Thoroughly flush the fuel tank after cleaning. Allow tank to air dry. Carefully inspect fuel line for damage, wear or general deterioration. Replace as necessary.



1. **Vapor valve**
2. **Vapor valve bracket**

Figure 4-13. Vapor Valve Mounting

INSTALLATION

1. If removed, install fuel supply valve onto fuel tank. See 4.5 FUEL SUPPLY VALVE INSTALLATION.

CAUTION

Be sure that wiring harness does not get pinched between fuel tank and frame during tank installation.

2. See Figure 4-11. Install fuel tank-to-vapor valve hose onto fitting at base of fuel tank. Position fuel tank on motorcycle.
3. See Figure 4-10. Install front and rear mounting hardware. Tighten fasteners to 8-16 ft-lbs (11-22 Nm).

NOTE

On XLH 883, position horn so that it does not contact ignition coil bracket or frame.

4. Connect fuel supply hose to carburetor using a **new** clamp.
5. Fill the fuel tank with fuel supply valve turned OFF.
6. Open the fuel supply valve and carefully inspect for leaks. Turn the valve OFF after the inspection is performed.

CALIFORNIA MODELS

General

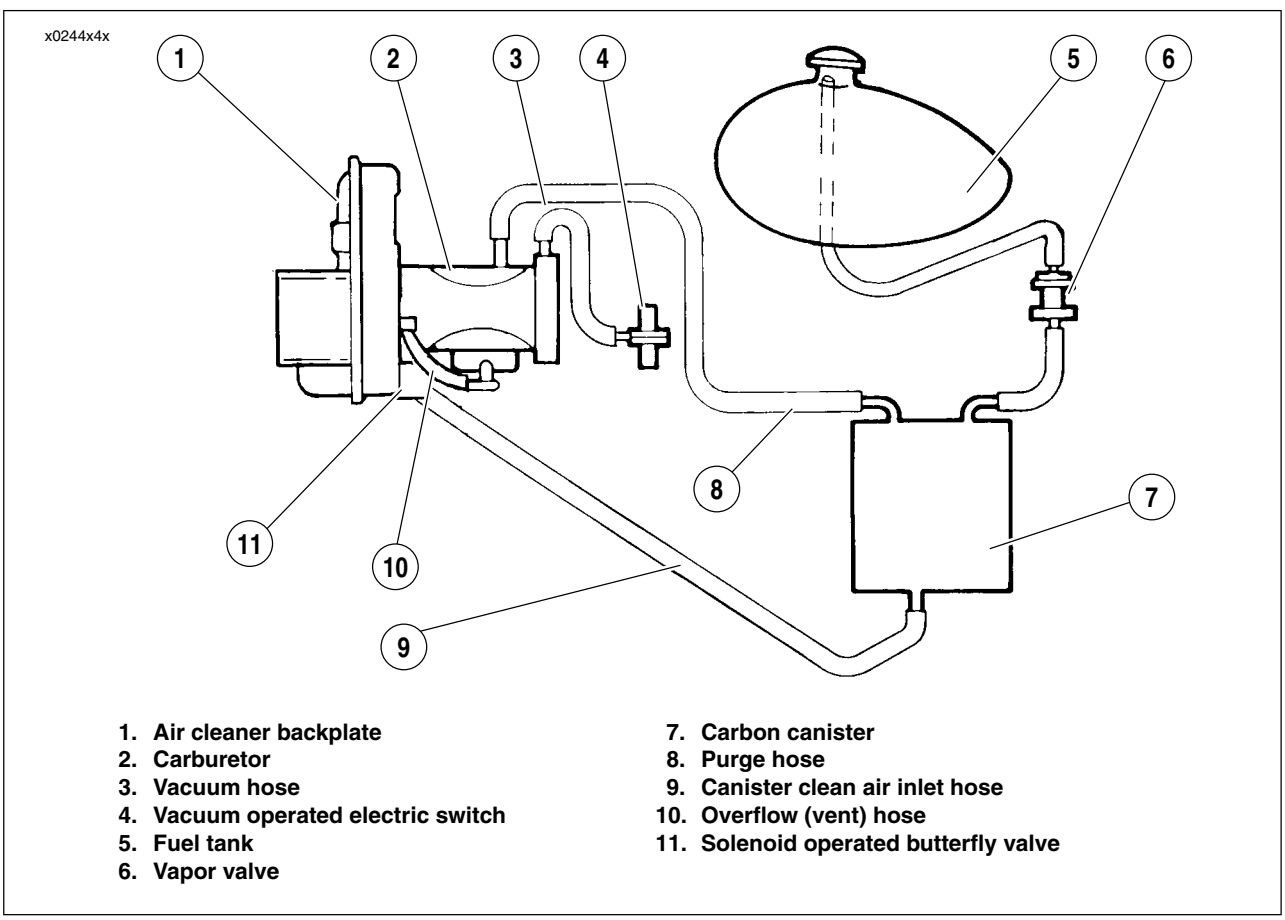
See Figure 4-14. Harley-Davidson motorcycles sold in the state of California are equipped with an evaporative (EVAP) emissions control system. The EVAP system prevents fuel hydrocarbon vapors from escaping into the atmosphere and is designed to meet the California Air Resource Board (CARB) regulations 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/light switch is OFF, 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/light 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/light 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 large diameter 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, thereby resulting in death or serious injury.



1. **Air cleaner backplate**
2. **Carburetor**
3. **Vacuum hose**
4. **Vacuum operated electric switch**
5. **Fuel tank**
6. **Vapor valve**
7. **Carbon canister**
8. **Purge hose**
9. **Canister clean air inlet hose**
10. **Overflow (vent) hose**
11. **Solenoid operated butterfly valve**

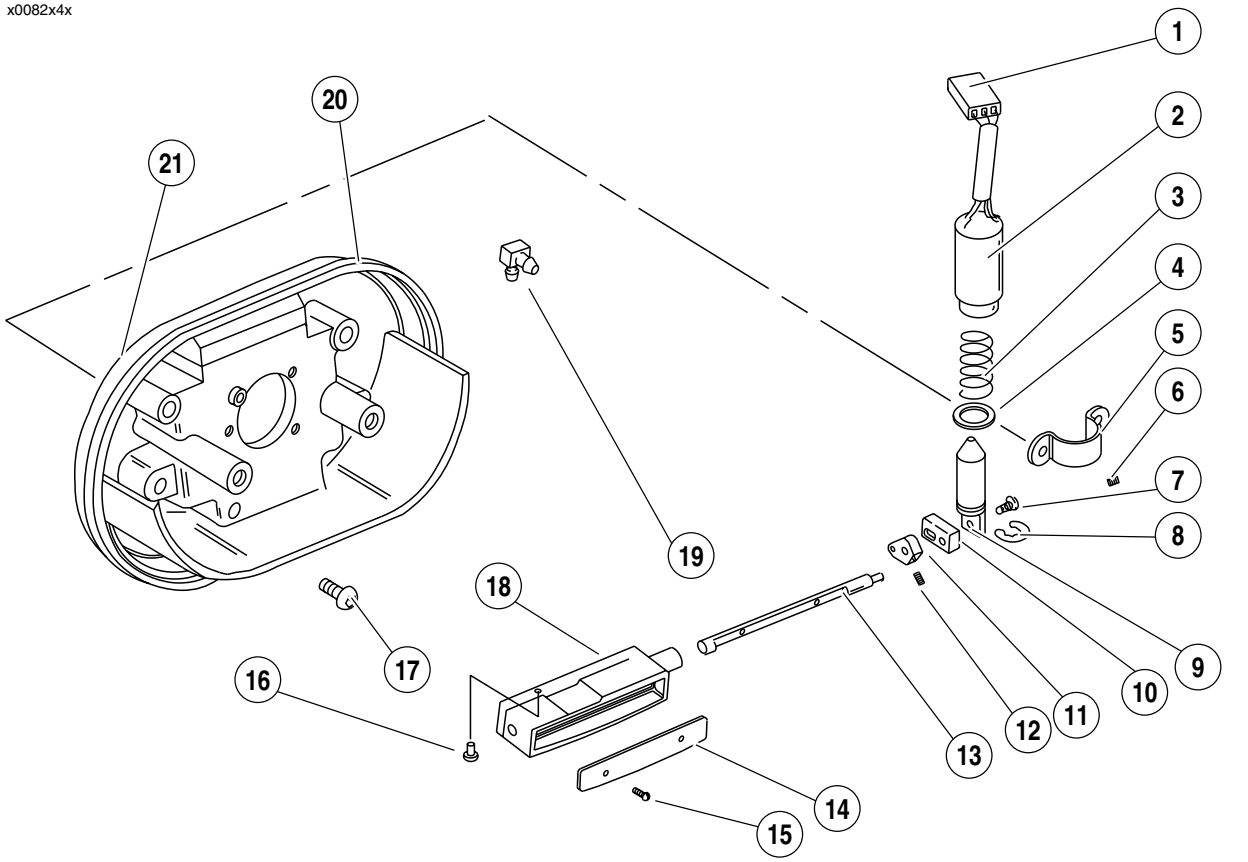
Figure 4-14. California Evaporative Emissions Control System

TROUBLESHOOTING

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. The solenoid troubleshooting procedure is shown in the following chart:

Table 4-3. 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 due to electrical malfunction.	1.1.1 See Figure 4-15. Check that connector (1) 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 or rear wheel may skid. Do not use more than 1/4 throttle or motorcycle may lurch forward. Both conditions can cause loss of vehicle control resulting in death or serious 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 (item 3, Figure 4-15.) will prevent butterfly valve closure.	1.3.1 See Figure 4-15. Check that all linkage parts are properly assembled and functioning. A broken solenoid spring will require replacing the solenoid. See REMOVAL, Butterfly Valve/Solenoid and INSTALLATION/ADJUSTMENT, Butterfly Valve/Solenoid under 4.7 EVAPORATIVE EMISSIONS CONTROL.



1. Connector
2. Solenoid assembly
3. Spring
4. Plastic washer
5. Clamp
6. Set screw
7. Screw
8. E-clip
9. Plunger
10. Link (plastic)
11. Lever arm
12. Set screw
13. Shaft
14. Butterfly plate
15. Screw (2)
16. Rivet (2)
17. Screw (2
18. Housing
19. Fitting, overflow (vent) hose
20. Backplate (carburetor side)
21. Nipple, canister clean air inlet hose

Figure 4-15. Air Cleaner Backplate – California Models

SOLENOID ELECTRICAL TESTS AIR CLEANER/BUTTERFLY VALVE

See Figure 4-16. Fabricate the solenoid test harness as shown. The harness allows the following tests to performed without removing the air cleaner backplate.

Winding Resistance Test

1. See Figure 4-15. Unplug 3-place connector (1) from solenoid.
2. See Figure 4-17. Connect the test harness to the solenoid as shown.
3. 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.

Table 4-4. Solenoid Winding Resistance Specifications

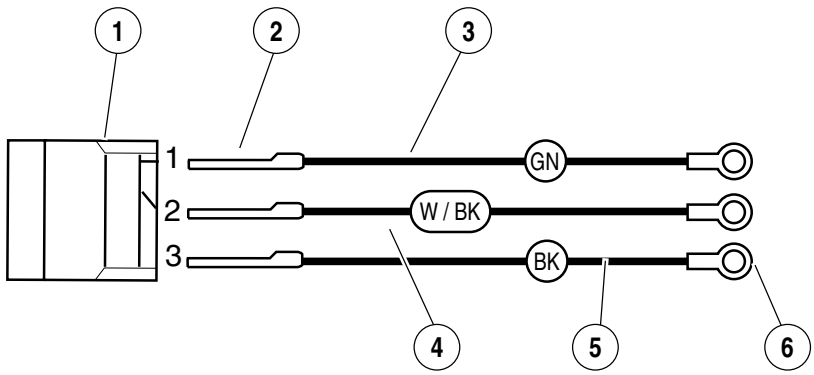
TEST	POSITIVE PROBE	NEGATIVE PROBE	WINDING RESISTANCE
Pull-in	Green	Black	4-6 Ohms
Hold-in	White/Black	Black	21-27 Ohms

4. If the resistance measurements are not within specification, the solenoid must be replaced. Refer to REMOVAL, Butterfly Valve/Solenoid and INSTALLATION/ADJUSTMENT, Butterfly Valve/Solenoid under 4.7 EVAPORATIVE EMISSIONS CONTROL.
5. If winding resistance measurements are within specification, perform the following Pull-In Coil Test.

Pull-In Coil Test

1. See Figure 4-18. Connect a 12-volt battery to the solenoid test harness as shown. The butterfly valve must open.
2. If the butterfly valve opens, but does not open with solenoid connected to motorcycle harness, refer to applicable wiring diagram and check for the following:
   a. See Figure 4-17. A good ground (1 Ohm or less) at BK wire in the 3-place mating connector.
   b. Connect the positive probe of a voltmeter to the GN wire in the 3-place mating 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 are measured in Steps 2A and 2B, check the hold-in coil.

x0083x4x



NOTE
The ring terminals (6) will ensure good connections for test probes. Blade or spade terminals may also be used.

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, 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)**

TEST HARNESS

Figure 4-16. Solenoid Test Harness

Hold-In Coil Test

1. See Figure 4-19. Connect a 12-volt battery to the solenoid test harness as shown.
2. See Figure 4-15. Using a screwdriver, open the butterfly valve by gently pushing inward on the top side of the butterfly 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, then the hold-in coil is functioning properly.
6. If butterfly valve does not remain open in Step 3, check that a good ground exists on the BK lead of the 3-place mating connector.
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 W/BK wire at the 3-place mating connector has 12VDC when the ignition/light switch is ON.
9. If 12 VDC is not present when the ignition/light switch is ON, 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 the solenoid is functioning properly, but butterfly valve is not opening and closing as it should, then refer to Table 4-3.

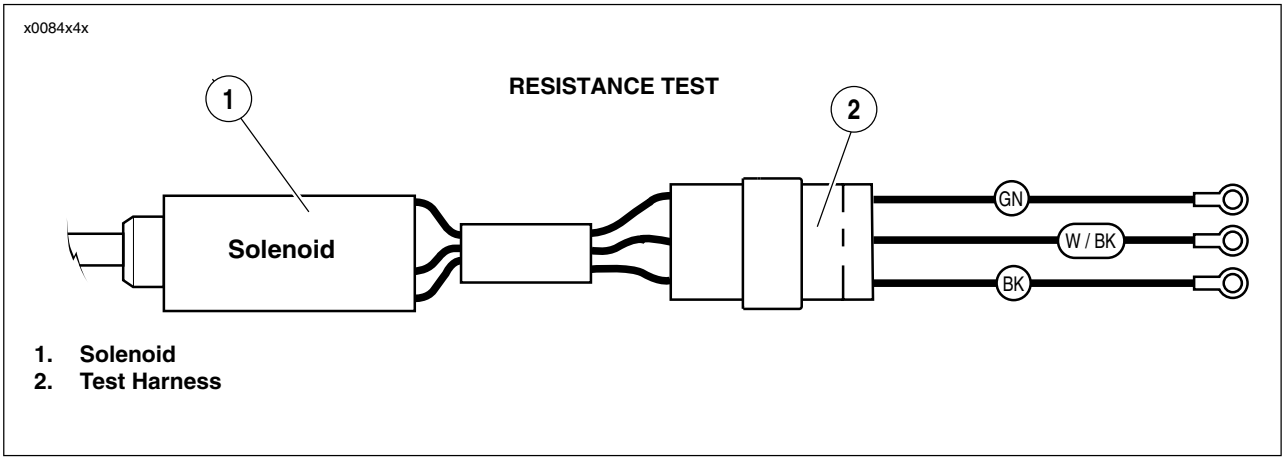


Figure 4-17. Resistance Test Connectors

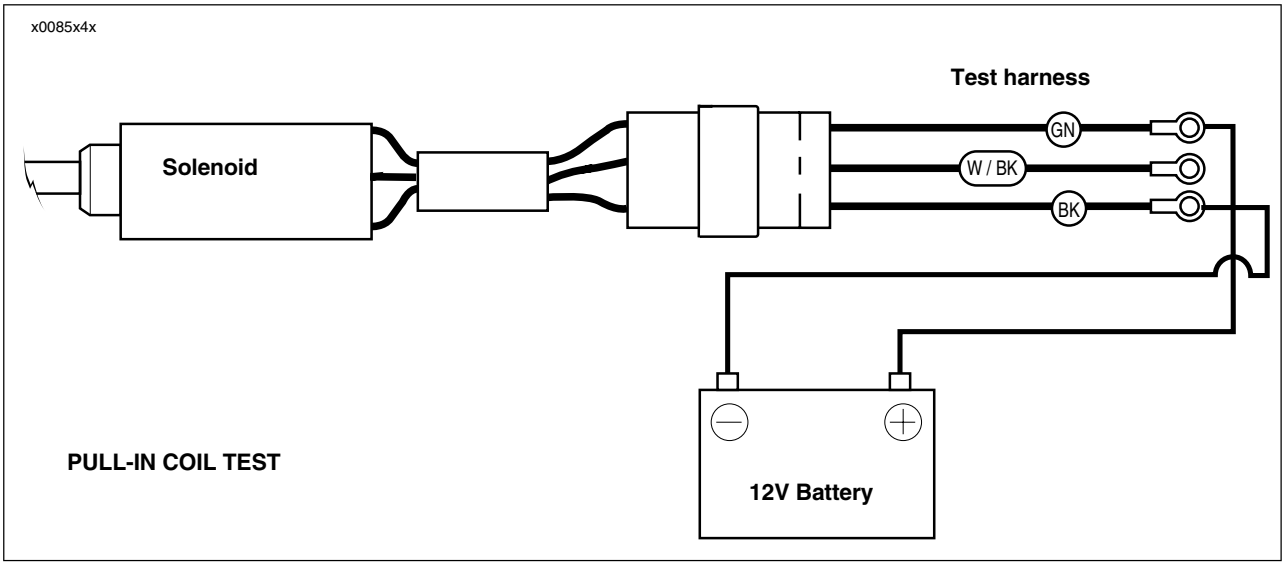


Figure 4-18. Pull-in Coil Test

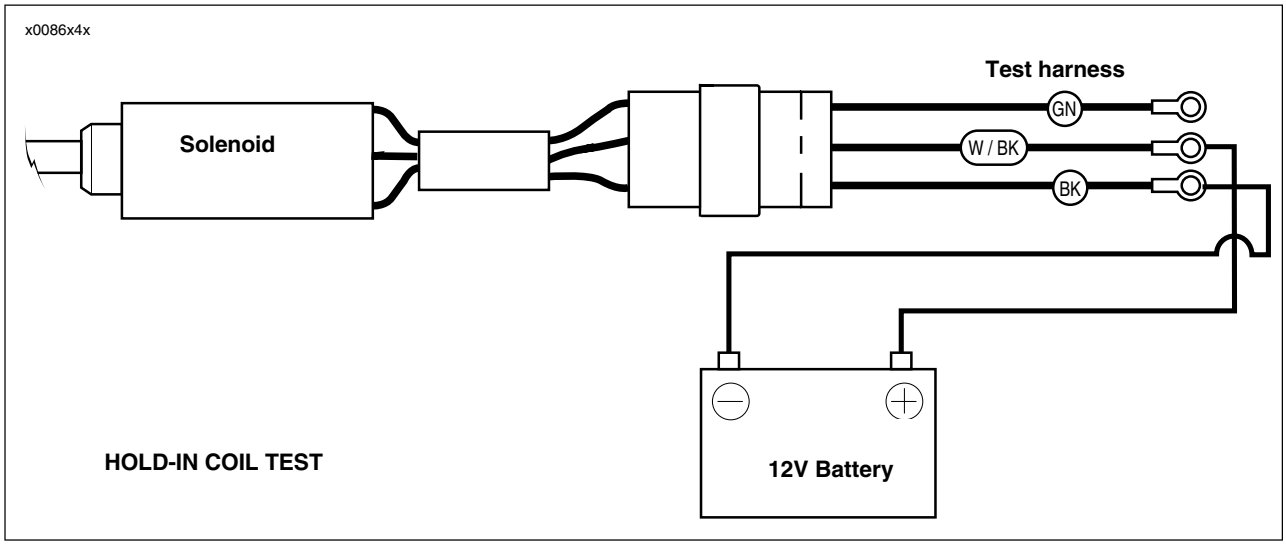


Figure 4-19. Hold-in Coil Test

REMOVAL

Butterfly Valve/Solenoid

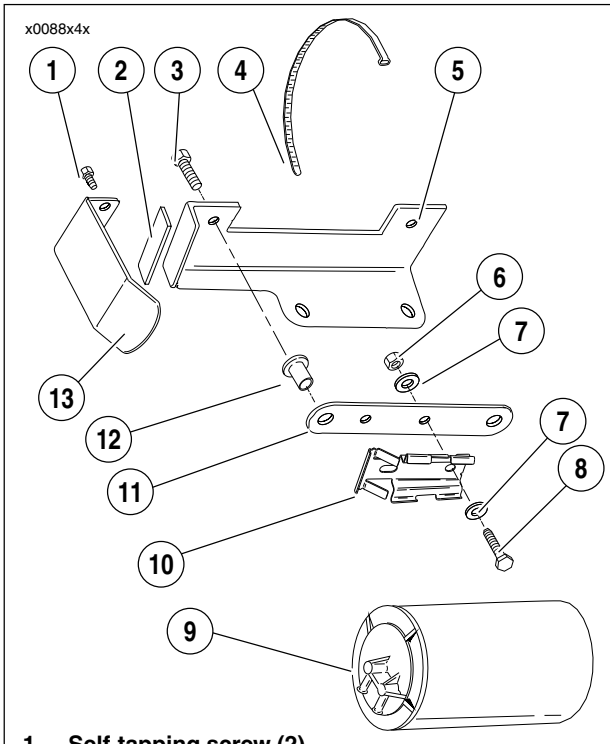
1. See Figure 4-15. Remove air cleaner and backplate. See 4.4 AIR CLEANER REMOVAL.
2. Remove screw. Loosen set screw.
3. Slide solenoid upward until free of clamp.

Canister

1. See Figure 4-20. The canister is mounted to the underside of the rear fork. Remove screws and guard.
2. Mark the three hoses connected to the canister (9). Disconnect hoses from canister.
3. Depress locking tab at left end of canister bracket (10). Slide canister towards the left side of the vehicle until it disengages from bracket.
4. Remove bolts to detach mounting plate assembly from mounting bracket. Remove well nuts from mounting plate.
5. Remove locknuts, washers and bolts to detach canister bracket from mounting plate.

Vapor Valve

1. See Figure 4-21. The vapor valve is located beneath the seat between the oil tank and the battery tray. Remove battery to gain access to valve. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. The vapor valve assembly is attached to inboard side of oil tank. Remove carbon canister-to-carburetor purge hose from groove of vapor valve bracket. Insert thin blade of screwdriver into slot of bracket. Turn screwdriver gently to unsnap clip. Remove vapor valve body from bracket.
3. Mark the two hoses connected to upper and lower fittings of vapor valve. Remove hoses from fittings.



1. **Self-tapping screw (2)**
2. **Foam pad**
3. **Bolt, 1/4 - 20 x 7/8 in. (2)**
4. **Cable strap**
5. **Mounting bracket**
6. **Locknut (2)**
7. **Washer (4)**
8. **Bolt, 1/4 - 20 x 5/8 in. (2) Canister**
9. **Canister**
10. **Canister bracket**
11. **Mounting plate**
12. **Wellnut (2)**
13. **Canister guard**

Figure 4-20. Carbon Canister Mounting

CLEANING, INSPECTION, REPAIR, AND LUBRICATION

Butterfly Valve/Solenoid

1. See Figure 4-15. At 2,500 miles (4,000 km), and at every 2,500 miles (4,000 km) thereafter, inspect butterfly valve and solenoid for proper operation.
2. At 5,000 miles (8,000 km), and at every 5,000 miles (8,000 km) thereafter, clean butterfly valve linkage and plunger using carburetor cleaner. After cleaning, lubricate linkage and plunger using a thin-film spray lubricant (such as TRI-FLOW™ or equivalent).

INSTALLATION/ADJUSTMENT

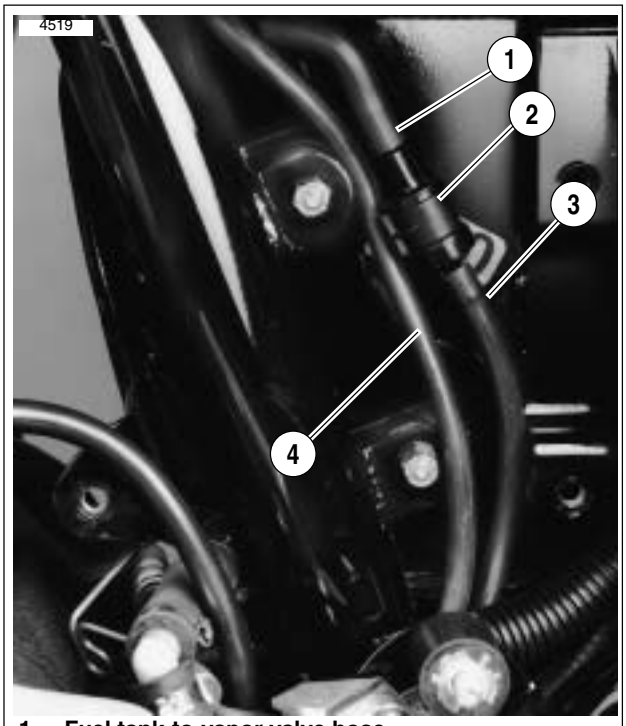
Butterfly Valve/Solenoid

1. See Figure 4-15. Slide solenoid assembly downward into clamp on inboard side of air cleaner backplate.
2. Apply one to two drops of LOCTITE Threadlocker 222 (purple) to threads of screw and set screw. Attach plunger to plastic link using screw. Tighten screw to 5-7 **in-lbs** (0.6-0.8 Nm).

NOTE

Slot in link must face pin on lever arm. Link must be attached to deep, flat side of plunger.

3. With solenoid set screw loose, push upward on bottom of plunger until butterfly valve plate fully opens; solenoid body may slide upward within clamp during this procedure.
4. While firmly lifting upward on bottom of plunger, and maintaining a fully open butterfly valve, press downward on top of solenoid body until bottom of solenoid body just touches plastic washer. Tighten set screw firmly.
5. Release plunger and verify that solenoid spring closes butterfly valve plate.



1. Fuel tank-to-vapor valve hose
2. Vapor valve
3. Vapor valve-to-canister hose
4. Canister-to-carburetor purge hose

Figure 4-21. Vapor Valve and Hose Routing - California

Electrical Connections

1. See Figure 4-22. Replacement solenoids do not include pin housing, pin terminals and conduit.
2. Install pin terminals on solenoid wires and reuse conduit and pin housing removed from old solenoid.

Canister

1. See Figure 4-20. Attach canister bracket to mounting plate using bolts, washers, and locknuts. Tighten locknuts to 3-5 ft-lbs (4-7 Nm).
2. Insert well nuts into holes in mounting plate. Install mounting plate assembly onto bracket by securing bolts through mounting plate and into well nuts. Tighten bolts to 5-8 **in-lbs** (0.6-0.8 Nm).
3. Starting at the left side of canister bracket, slide canister to the right and into locked position on canister bracket. Clip at left end of canister bracket must engage top left side of canister mount; bend clip outward somewhat if canister is not held securely.
4. Connect three marked hoses to their proper fittings on canister.
5. Install canister guard using self-tapping screws. Tighten screws to 15-21 **in-lbs** (1.7-2.4 Nm).

Vapor Valve

⚠WARNING

See Figure 4-21. Verify that the fuel tank vapor valve hoses do not contact hot exhaust or engine parts. The hoses contain flammable vapors that can be ignited if damaged, thereby resulting in death or serious injury.

CAUTION

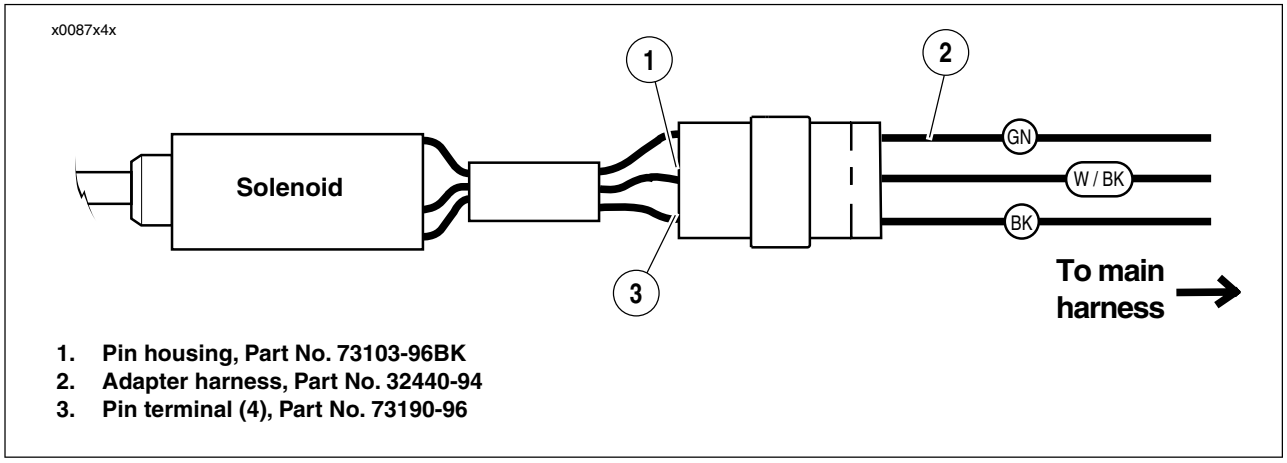
See Figure 4-15. Mount the vapor valve in an upright position with the longer fitting positioned at the top or excessive fuel vapor pressure may build up within the fuel tank. Mounting the vapor valve upside down will result in fuel flow problems.

1. Hold vapor valve in an upright position with the long necked end at the top. Insert neck of vapor valve into hose from fuel tank. Install lower hose to carbon canister.
2. Position body of vapor valve in bracket attached to T-stud on inboard side of oil tank. Snap bracket closed. Install carbon canister-to-carburetor purge hose in groove of vapor valve bracket.

NOTE

See Figure 4-12. On non-California models, the carbon canister is absent and the bottom hose of the vapor valve is connected to a fitting in the hollow frame member.

3. Install battery. See BATTERY INSTALLATION AND CONNECTION under 7.18 BATTERY.



1. **Pin housing, Part No. 73103-96BK**
2. **Adapter harness, Part No. 32440-94**
3. **Pin terminal (4), Part No. 73190-96**

Figure 4-22.

HOSE ROUTING

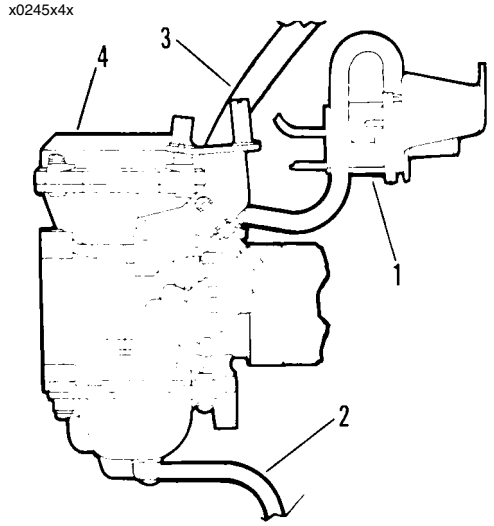
See Figure 4-14., California Evaporative Emissions Control System schematic, and then see Canister Hose Routings.

Carburetor

See Figure 4-23. Route the evaporative emissions control hoses at the carburetor as shown. To gain access to the V.O.E.S. and hoses, remove the fuel tank and/or air cleaner/ backplate assembly if necessary.

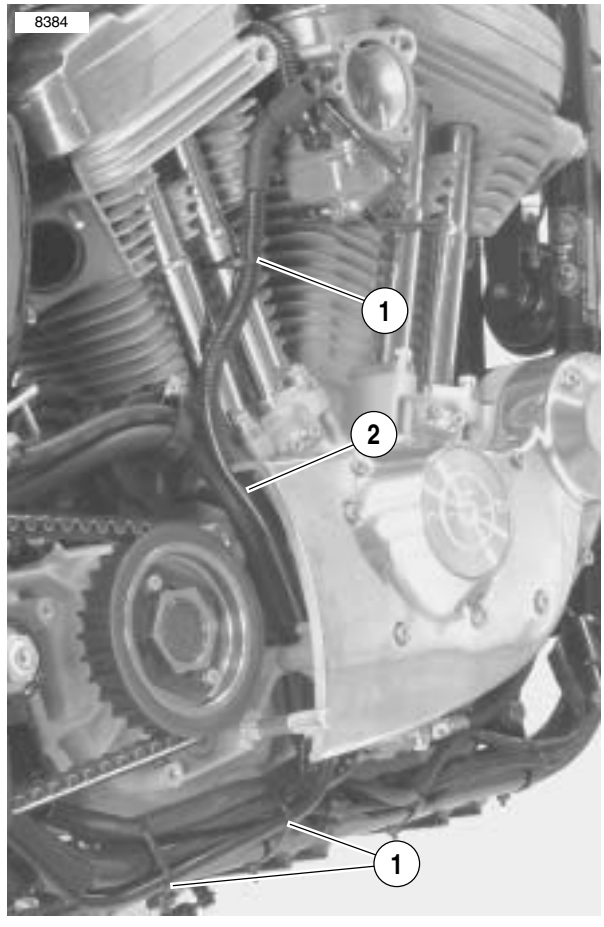
Canister Hose Routings

1. See Figure 4-24. Connect one end of the canister-to-air cleaner hose (canister clean air inlet hose) to the fitting on the right side of the carbon canister. Route the hose forward along the right frame bottom tube and then upward through the rear section of the gearcase cover. Continue running the hose upward along the starter motor (right front side) and rear exhaust push rod cover before routing it forward to the air cleaner backplate fitting. Secure the hose at three points using cable straps.



1. Vacuum-operated electric switch (V.O.E.S.)
2. Overflow (vent) hose (to air cleaner backplate)
3. Purge hose (to canister)

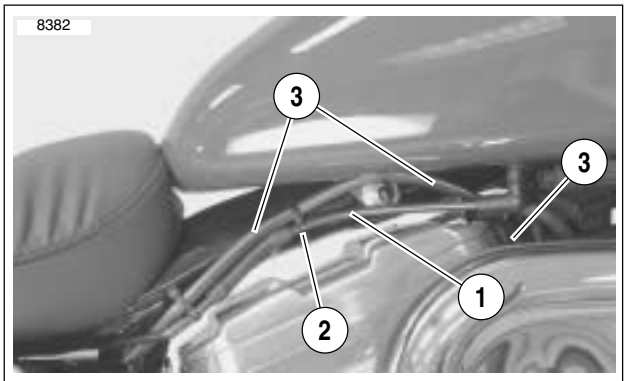
Figure 4-23. Emissions Hose Routing at Carburetor



1. Cable straps (3)
2. Canister-to-air cleaner hose

Figure 4-24. Canister-to-Air Cleaner Hose

2. See Figure 4-21. Connect the vapor valve-to-canister hose and the canister-to-carburetor purge hose to fittings on the left side of the carbon canister. Route both hoses forward through the clip on the left frame bottom tube. After running the hoses forward and then upward along the inboard side of the primary chaincase, route the hoses between the oil tank and battery tray. Connect the vapor valve-to-canister hose to the bottom of the vapor valve. Connect the fuel tank-to-vapor valve hose at the top.
3. See Figure 4-25. Route both the canister-to-carburetor purge hose and the fuel tank-to-vapor valve hose forward along the right side of the frame backbone.
4. Connect the canister-to-carburetor purge hose to the vacuum fitting on the carburetor. Connect the fuel tank-to-vapor valve hose to the fitting under the fuel tank.
5. Secure the hoses to the vehicle frame using two cable straps.



1. Fuel tank-to-vapor hose
2. Cable strap (2)
3. Canister-to-carburetor purge hose

Figure 4-25. Emissions Control Hose Routing

NOTES

ELECTRIC STARTER 5

SUBJECT **PAGE NO.**

5.1 Specifications 5-1
5.2 Electric Starter System 5-2
5.3 Starter Solenoid 5-7

Table 5-1. Starter

Free (no load) speed	3000 rpm (min.) @ 11.5 V
Free (no load) current	90 amp (max.) @ 11.5 V
Stall torque	8.1 ft-lbs (11.0 Nm) (min.) @ 2.4 V

Table 5-2. Service Wear Limits

Brush length minimum (in.)	0.443
Brush length minimum (mm)	11.0
Commutator diameter minimum (in.)	1.141
Commutator diameter minimum (mm)	28.98

Table 5-3. Torque Values

Thru-bolts (in-lbs)	39-65
Thru-bolts (Nm)	4.4-7.3
Cable terminal nuts (in-lbs)	65-80
Cable terminal nuts (Nm)	7.3-9.0
Starter to crankcase mounting bolts (ft-lbs)	13-20
Starter to crankcase mounting bolts (Nm)	18-27
Hose clamp mounting nut (in-lbs)	50-60
Hose clamp mounting nut (Nm)	5.6-6.8

GENERAL

The starter is made up of an armature, field winding assembly, solenoid, drive assembly, idler gear and drive housing.

The starter motor torque is increased through gear reduction. The gear reduction consists of the drive pinion on the armature, an idler gear and a clutch gear in the drive housing. The idler gear is supported by rollers. The clutch gear is part of the overrunning clutch/drive assembly.

The overrunning clutch is the part which engages and drives the clutch ring gear. It also prevents the starter from overrunning. The field windings are connected in series with the armature through brushes and commutator segments.

Wiring Diagrams

For additional information concerning the starting system circuit, see the wiring diagrams at the end of Section 7, ELECTRICAL.

Starter Relay

The starter relay is a non-repairable part that must be replaced as a unit if it fails.

Operation

See Figure 5-2.The starter relay is activated when the starter switch is pushed. This allows battery current to flow into the pull-in winding and also into the hold-in winding to ground. The magnetic forces of the pull-in and hold-in windings in the solenoid push the plunger causing it to shift to the left. This action engages the pinion gear with the clutch ring gear. At the same time, the main solenoid contacts are closed, so battery current flows directly through the field windings to the armature and to ground. Simultaneously, the pull-in winding is shorted. 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. The overrunning clutch prevents the clutch ring gear (which is now rotating under power from the engine) from turning the armature too fast.

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, which causes the pinion gear to disengage from the clutch ring gear.

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle 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 death or serious injury.

1. Remove primary cover. See Primary Cover REMOVAL under 6.2 PRIMARY CHAIN.
2. See Figure 5-1. Remove the two starter mounting bolts and washers.

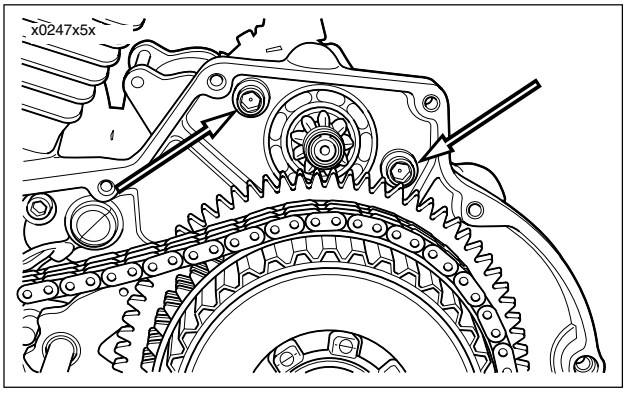


Figure 5-1. Starter Mounting Bolts

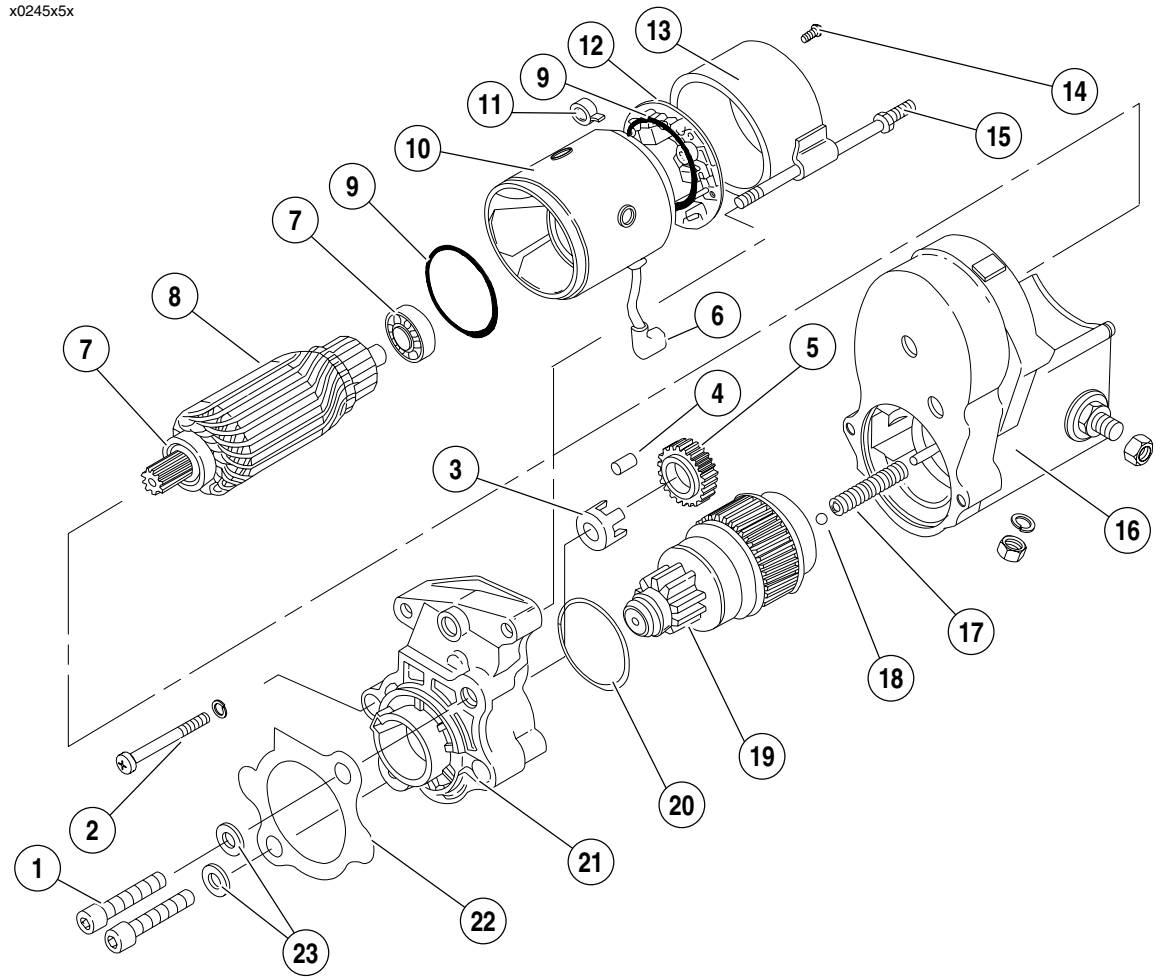
NOTE

A ball hex driver may be required to gain access to the starter mounting bolts.

3. Remove rear exhaust pipe.
4. Remove positive battery lead and solenoid wire from starter.
5. Remove starter and gasket from right side of motorcycle.

DISASSEMBLY, INSPECTION, AND REPAIR

1. See Figure 5-2. Remove field wire (6).
2. See Figure 5-3. Remove thru-bolts.
3. See Figure 5-4. Remove two cover screws, O-rings, and cover.
4. See Figure 5-5. Use a wire hook to pull upward on brush springs, and lift brushes out of holder. Remove brush holder.



1. **Mounting bolt (2)**
2. **Drive housing mounting bolt and lock washer (2)**
3. **Idler gear bearing cage**
4. **Idler gear roller (5)**
5. **Idler gear**
6. **Field wire**
7. **Armature bearings**
8. **Armature**
9. **O-ring (2)**
10. **Field frame**
11. **Brush spring (4)**
12. **Brush holder**
13. **End cover**
14. **End cover screw (2)**
15. **Thru-bolt (2)**
16. **Solenoid housing**
17. **Return spring**
18. **Ball**
19. **Drive assembly/overrunning clutch**
20. **O-ring**
21. **Drive housing**
22. **Gasket**
23. **Washer (2)**

Figure 5-2. Starter Assembly

5. Check brush length. Replace all four brushes if length of any one brush is less than 0.433 in. (11.0 mm). **Replace brushes in sets of four only.**
6. See Figure 5-2. Remove armature (8) and field frame (10).
7. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.016 in. (0.41 mm) of runout should be replaced, or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (28.98 mm).

CAUTION

Do not use sandpaper or emery cloth to remove burrs on commutator. Otherwise, abrasive grit may remain on commutator segments; this could lead to excessive brush wear. Use only the recommended crocus cloth.

Figure 5-3. Removing the Thru-Bolts

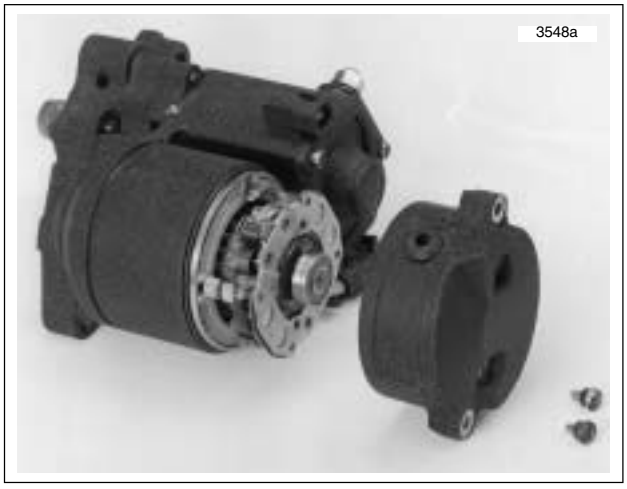


Figure 5-4. Removing End Cover

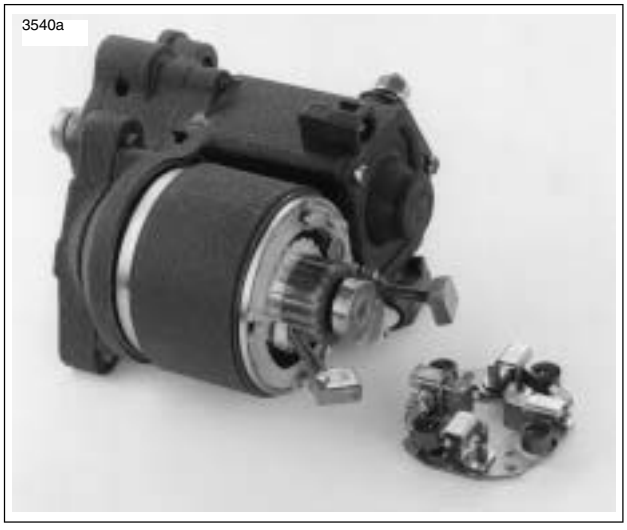


Figure 5-5. Removing Brush Holder

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. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the commutator with crocus cloth to remove any burrs
9. See Figure 5-6. 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. Replace armatures if shorted.
10. See Figure 5-7. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester. Touch one probe to any commutator segment. Touch the other probe to the armature core. There should be no continuity (infinite ohms). If there is continuity, then the armature is grounded. Replace a grounded armature.
11. See Figure 5-8. Check for OPEN ARMATURE with an ohmmeter or continuity tester. Check for continuity between all commutator segments. There should be continuity (0 ohms) at all test points. No continuity at any test point indicates armature is open and must be replaced.

Figure 5-6. Shorted Armature Test Using Growler

Figure 5-7. Grounded Armature Test

Figure 5-8. Open Armature Test

12. See Figure 5-9. Check for GROUNDED FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the frame. Touch the other probe to each of the brushes attached to the field winding. There should be no continuity (infinite ohms). If there is any continuity at either brush, then the field winding(s) are grounded and the field frame must be replaced.
13. See Figure 5-9. Check for OPEN FIELD WINDING with an ohmmeter or continuity tester. Touch one probe to the field wire. Touch the other probe to each of the brushes attached to the field coils. There should be continuity. If there is no continuity at either brush, then the field winding(s) are open and the field frame must be replaced.
14. See Figure 5-10. Test BRUSH HOLDER INSULATION with an ohmmeter or continuity tester. Touch one probe to holder plate. Touch 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, replace the brush holder assembly.
15. See Figure 5-2. Check armature bearings (7) and replace if necessary.
16. See Figure 5-11. Remove two drive housing mounting screws (with washers and lock washers). Remove drive housing from solenoid housing.

Figure 5-9. Open and Grounded Field Test

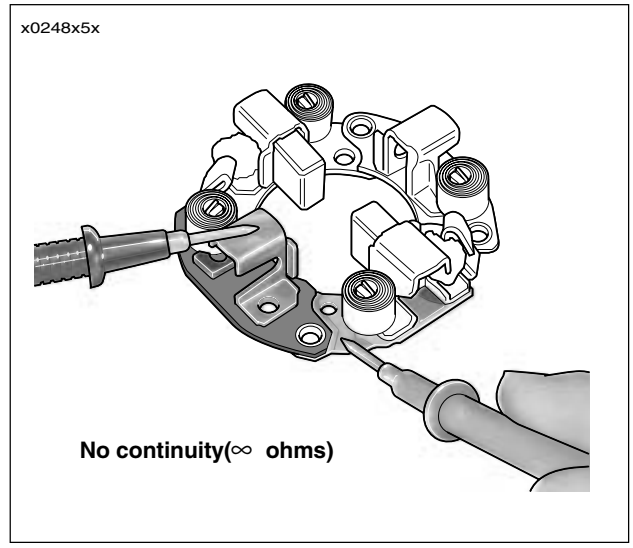


Figure 5-10. Brush Holder Insulation Test

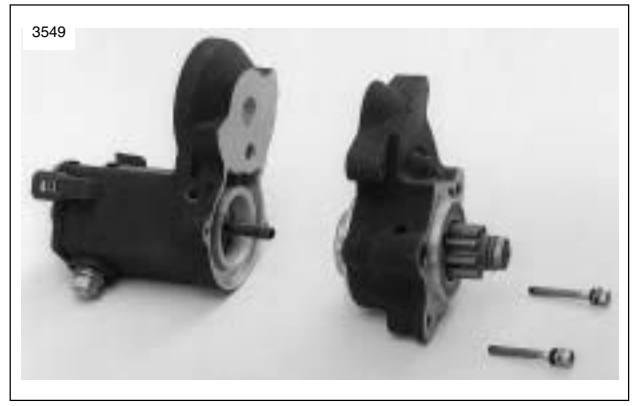


Figure 5-11. Removing Starter Drive Housing

17. See Figure 5-12. Remove drive, idler gear, idler gear bearing, and O-ring from drive housing (O-ring is located in drive housing groove).

ASSEMBLY

1. See Figure 5-12. Clean, inspect, and lubricate drive assembly components. Lubricate parts with high temperature grease, such as LUBRIPLATE 110.
2. See Figure 5-2. When installing drive assembly components, open end of idler bearing cage (3) faces toward solenoid.
3. When installing drive housing (21) to solenoid housing (16), use new O-ring (20). Be sure to install return spring (17) and ball (18).
4. Lubricate armature bearings (7) and felt washer (883 only) with high temperature grease, such as LUBRIPLATE 110. Install armature (8) and field frame (10) to solenoid housing.
5. Install brushes and brush holder (12).
6. Install end cover (13) with screws (14) and O-rings (1200 only).

Figure 5-12. Starter Drive Assembly

7. Install bolts (1).
8. Install solenoid wire to terminal.

INSTALLATION

1. Install starter and starter gasket from right side of motorcycle.
2. Install positive battery cable and solenoid wire to solenoid.
3. See Figure 5-1. Install the two starter mounting bolts and washers. Tighten mounting bolts to 13-20 ft-lbs (18-27 Nm).
4. Install primary cover. See Primary Cover INSTALLATION under 6.2 PRIMARY CHAIN.
5. Fill primary chaincase / transmission with proper lubricant; refer to Primary Cover INSTALLATION under 6.2 PRIMARY CHAIN for details.
6. Install rear exhaust pipe.
7. Connect battery cables, positive cable first.

⚠WARNING

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

GENERAL

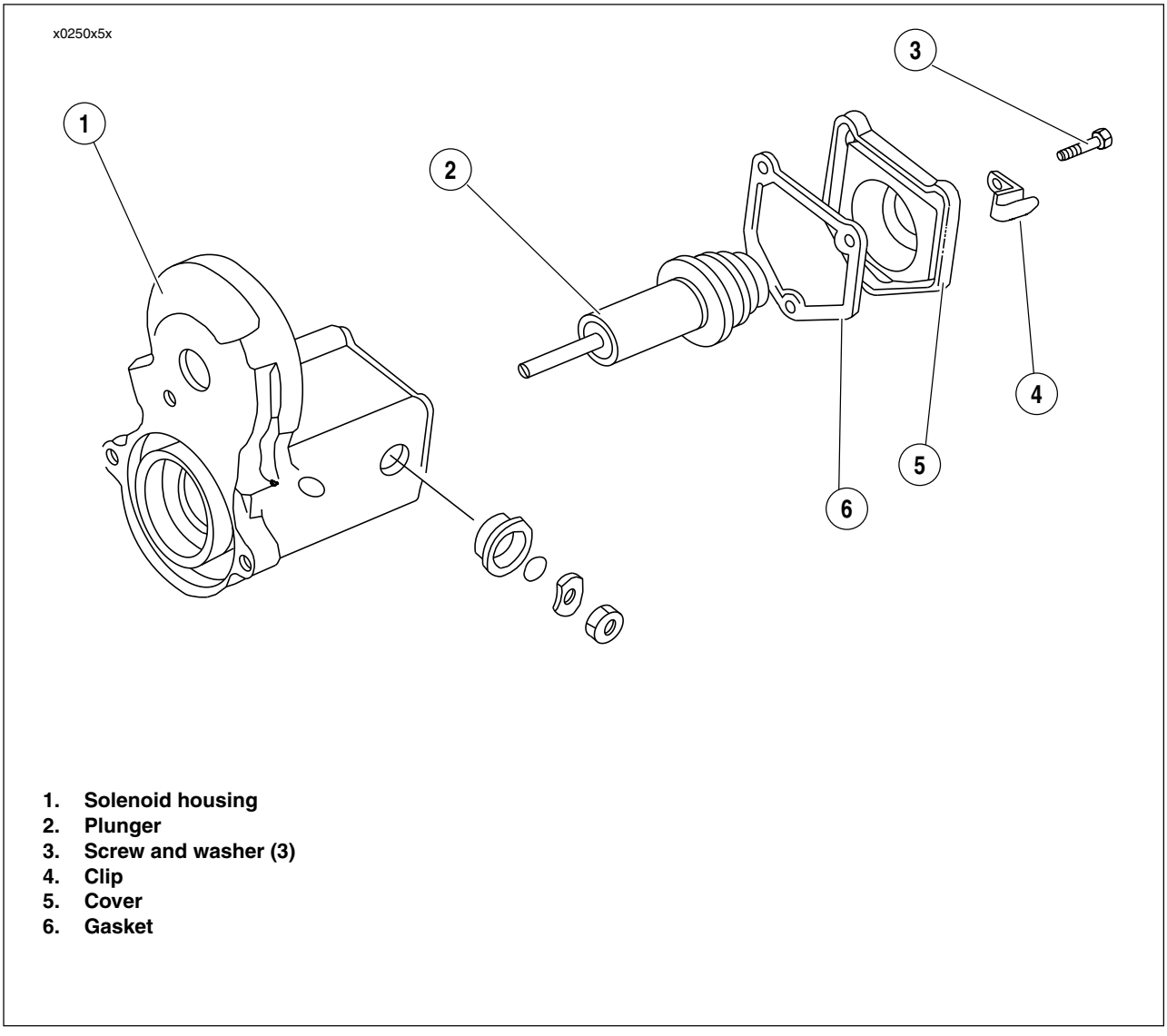
See Figure 5-13. The starter solenoid is a switch that is designed to open and close the starting circuit electromagnetically. The switch consists of contacts and a winding around a hollow cylinder containing a movable plunger.

DISASSEMBLY

1. See Figure 5-13. Remove screws/washers (3) and clip (4).
2. Remove cover (5) and gasket (6); discard gasket.
3. Remove plunger (2) from solenoid housing (1).

ASSEMBLY

1. See Figure 5-13. Replace wire connection hardware as necessary.
2. Install plunger (2) in solenoid housing (1).
3. Install new gasket (6) onto cover (5).
4. Position cover with gasket onto solenoid housing. Install clip (4) and screws/washers (3).



1. **Solenoid housing**
2. **Plunger**
3. **Screw and washer (3)**
4. **Clip**
5. **Cover**
6. **Gasket**

Figure 5-13. Starter Solenoid

NOTES

DRIVE/TRANSMISSION 6

SUBJECT	PAGE NO.
6.1 Specifications	6-1
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6.3 Secondary Drive Belt	6-7
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6.5 Clutch Release Mechanism	6-13
6.6 Primary Drive/Clutch	6-16
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NOTE

Service wear limits are given as a guideline for measuring components that are not new. For measurement specifications not given under SERVICE WEAR LIMITS, see NEW COMPONENTS.

Table 6-1. Primary Drive (Engine-to-Transmission)

ITEM	VALUE
Engine sprocket	35 teeth
Clutch sprocket	56 teeth
Ratio*	1.60:1

*Internal gear ratios indicate number of mainshaft revolutions required to drive output sprocket one revolution.

Table 6-2. Final Drive (Transmission-to-Rear Wheel)

ITEM	VALUE
Transmission sprocket (883cc Engine)	27 teeth
Transmission sprocket (1200cc Engine)	29 teeth
Rear wheel sprocket	61 teeth
Secondary drive belt (orange color code)	128 teeth
Ratio (883cc Engine)	2.26:1
Ratio (1200cc Engine)	2.10:1

Table 6-3. Transmission

ITEM	U.S. FL OZ.	ML
Primary drive / transmission lubricant capacity	32	946
OVERALL GEAR RATIOS* - DOMESTIC & HDI	**883 CC**	**1200 CC**
First gear (low)	9.71	9.04
Second gear	7.12	6.62
Third gear	5.18	4.82
Fourth gear	4.26	3.97
Fifth gear (high)	3.61	3.36
* Overall gear ratios indicate number of engine revolutions required to drive rear wheel one revolution.		

Table 6-4. Component Specifications

ITEM	NEW COMPONENTS	SERVICE WEAR LIMITS
WET CLUTCH MULTIPLE DISC		
CLUTCH PLATE THICKNESS		
Friction plate (fiber) (in.)	0.0866 + 0.0031	N/A
Friction plate (fiber) (mm)	2.200 + 0.079	N/A
Steel plate (in.)	0.0629 + 0.0020	N/A
Steel plate (mm)	1.598 + 0.051	N/A
Clutch pack (in.)	N/A	0.6610 in. (minimum)
Clutch pack (mm)	N/A	(16.787)
MAXIMUM ALLOWABLE WARPAGE		
Friction plate (fiber) (in.)	N/A	0.0059
Friction plate (fiber) (mm)	N/A	0.150
Steel plate (in.)	N/A	0.0059
Steel plate (mm)	N/A	0.150

Table 6-5. Torque Values

ITEM	TORQUE	
Transmission sprocket nut lockplate screws	**90-110 in-lbs**	10.2-12.4 Nm
Transmission sprocket nut **(left-hand threads)**	**See page 6-40**	
Transmission access door bolts	13-17 ft-lbs	18-23 Nm
Drain plug	14-21 ft-lbs	19-28 Nm
Primary cover fasteners	**80-110 in-lbs**	9.0-12.4 Nm
Primary drive/transmission lubricant level screw	**90-110 in-lbs**	10.2-12.4 Nm
Chain tensioner stud nut	20-25 ft-lbs	27-34 Nm
Torx fasteners	**30-40 in-lbs**	3.4-4.5 Nm
Engine sprocket nut	190-210 ft-lbs	258-285 Nm
Sprocket cover screws	**90-110 in-lbs**	10.2-12.4 Nm
Shift lever pinch bolt	**90-110 in-lbs**	10.2-12.4 Nm
Footrest fasteners	**16-28 in-lbs**	1.8-3.2 Nm
Clutch release mechanism screws	**22-30 in-lbs**	2.5-3.4 Nm
Inspection cover screws	**40-60 in-lbs**	4.5-6.8 Nm
Clutch hub nut **(left-hand threads)**	70-80 ft-lbs	95-108 Nm
Countershaft retaining screw	13-17 ft-lbs	18-23 Nm

GENERAL

1. See Figure 6-1. Check the primary chain for correct tension by measuring its vertical free play through the primary chain inspection cover (1) opening located near the top of the primary cover (2).

NOTE

See Figure 6-2. A properly adjusted primary chain should have the specified vertical free play in its upper strand.

2. Be sure the measurement is taken midway between engine and clutch sprockets with sprockets rotated to the tightest chain position.

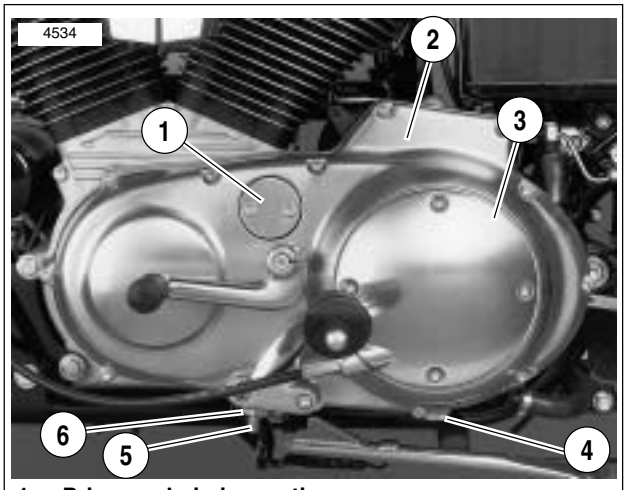
NOTE

Always measure vertical free play with the sprockets rotated to several different positions. The tightest measurement observed must be within the specifications shown in Figure 6-2.

The initial primary chain vertical free play specification used at the Harley-Davidson assembly plant is 1/4 -1/2 in. (6.3-12.7 mm) with a cold engine. The 1/4 in. (6.3 mm) minimum is only allowed at the absolute tightest point in the drive, as measured with specialized factory equipment. If a chain has less than 1/4 in. vertical free play (with a cold engine), adjust free play to the "field" specification of 3/8-1/2 in. (9.5-12.7 mm). The looser specification will avoid overtightening, which might otherwise occur during adjustment using "non-factory" equipment and methods.

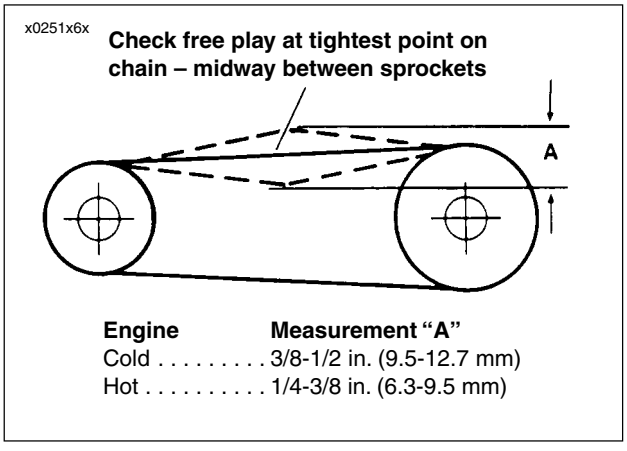
An opening between the primary drive and transmission compartments allows the same lubricant supply to lubricate moving parts in both compartments. For complete lubrication service on the primary chain, see 6.7 TRANSMISSION LUBRICATION.

Since the primary chain runs in lubricant, little service will be required other than checking lubricant level and chain tension. If, through hard usage, the primary chain does become worn, it must be replaced. Remove and install the chain following the procedure under 6.6 PRIMARY DRIVE/CLUTCH REMOVAL.



1. **Primary chain inspection cover**
2. **Primary cover**
3. **Clutch inspection cover**
4. **Drain plug**
5. **Chain adjuster screw**
6. **Locknut**

Figure 6-1. Primary Cover



Engine	Measurement "A"
Cold	3/8-1/2 in. (9.5-12.7 mm)
Hot	1/4-3/8 in. (6.3-9.5 mm)

Figure 6-2. Primary Chain Vertical Free Play

ADJUSTMENT

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

See Figure 6-1. The primary chain can be adjusted without removing the primary cover (2). Proceed as follows:

1. Remove the two hex socket screws which secure primary chain inspection cover (1).
2. Rotate sprockets to find tightest point on primary chain.
3. Loosen locknut (6). Turn chain adjuster screw (5) clockwise (inward) to reduce free play or counter-clockwise (outward) to increase free play. Vertical free play must fall within the limits specified in Figure 6-2.

NOTE

If vertical free play cannot be set within the limits specified in Figure 6-2., then primary chain and/or chain adjuster are worn beyond adjustment limits. Replace parts as necessary.

4. See Figure 6-1. When tension is set correctly, tighten locknut (6) to 20-25 ft-lbs (27-34 Nm).
5. Install primary chain inspection cover (1). Tighten hex socket screws to 40-60 in-lbs (4.5-6.8 Nm).

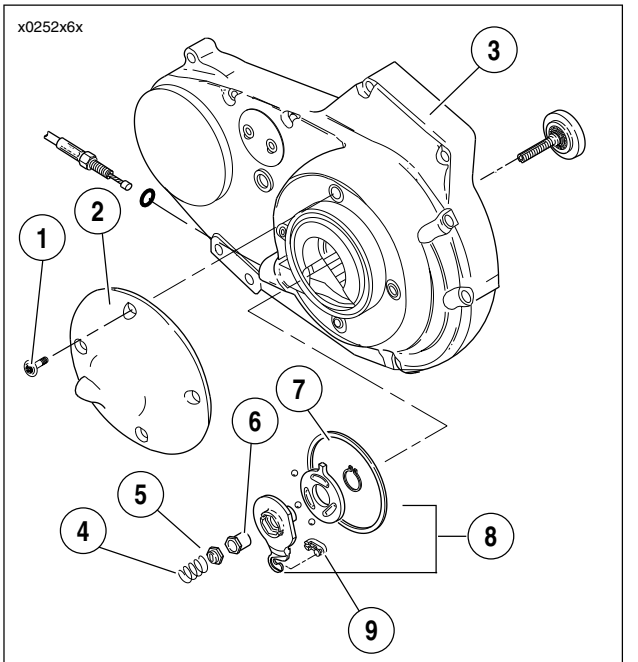
REMOVAL

Primary Cover

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. See Figure 6-1. Place a drain pan under the engine. Remove drain plug (4) and drain lubricant from primary drive.
2. Remove gear shifter lever and left footrest assembly.
3. Loosen locknut (6). Turn chain adjuster screw (5) counter-clockwise to relax primary chain tension.
4. See Figure 6-3. Remove clutch inspection cover (2). Remove quad ring (7) from groove in primary cover.
5. Slide spring (4) with attached hex lockplate (5) from flats of adjusting screw.
6. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly (8) moves forward. Unscrew nut (6) from end of adjusting screw.



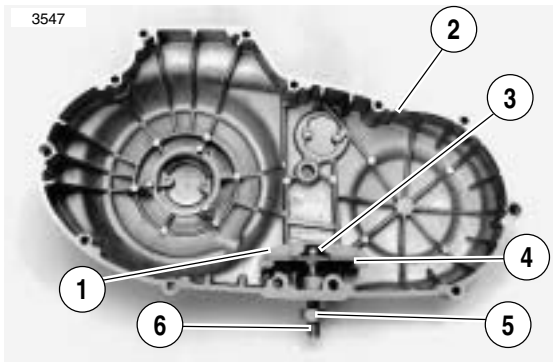
1.	**TORX screw (4)**	**5.**	**Lockplate**
2.	**Clutch inspection cover**	**6.**	**Nut**
		7.	**Quad ring**
3.	**Primary cover**	**8.**	**Ramp assembly**
4.	**Spring**	**9.**	**Coupling**

Figure 6-3. Clutch Inspection Cover

7. Remove hook of ramp from button to the rear of cable end coupling (9). Remove cable end from slot in coupling. Remove coupling and ramp assembly.
8. Remove screws which secure primary cover. Remove cover and gasket.
9. Remove and discard shifter shaft oil seal.

Primary Chain Adjuster

1. See Figure 6-4. Remove primary cover (2). See Primary Cover REMOVAL under 6.2 PRIMARY CHAIN.



1. **Shoe**
2. **Primary cover**
3. **Locknut (interior)**
4. **Plate**
5. **Locknut (exterior)**
6. **Chain adjuster screw**

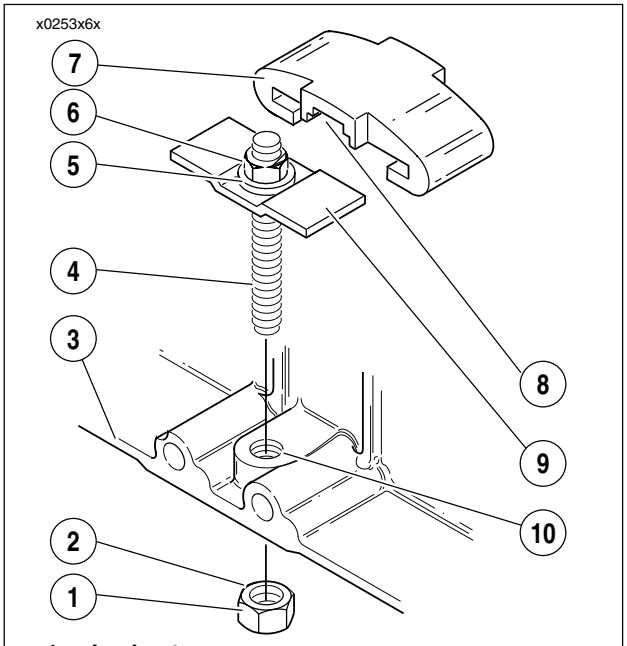
Figure 6-4. Removing Primary Chain Adjuster

2. Remove locknut (3) from adjuster screw (6). Turn adjuster screw out of threaded boss in primary cover.
3. Slide shoe (1) off plate (4) (shoe must be slid off plate toward closed or blind side of shoe). Remove locknut (3) and plate (4).

INSTALLATION

Primary Chain Adjuster

1. See Figure 6-5. If shoe (7) is badly worn, replace it or adjuster assembly.



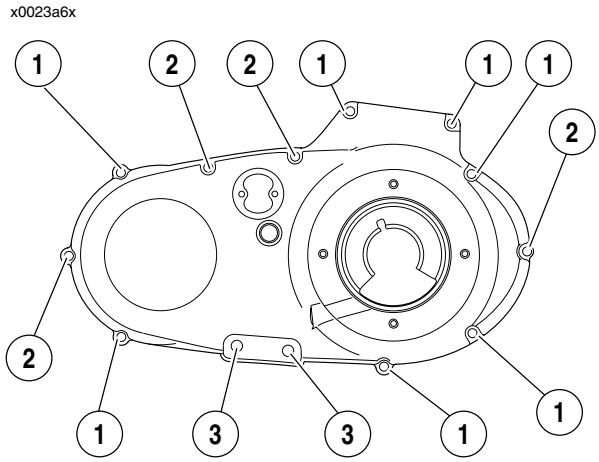
1. **Locknut**
2. **Nylon sealing surface**
3. **Primary cover**
4. **Adjuster screw**
5. **Spacer**
6. **Locknut**
7. **Shoe**
8. **Open side**
9. **Plate**
10. **Threaded boss**

Figure 6-5. Primary Chain Adjuster

2. Install plate (9) over top of adjuster screw (4). Place spacer (5) over top of adjuster screw next to plate. Secure plate and spacer to adjuster screw by threading on locknut (6). Tighten locknut to 10-12 ft-lbs (14-16 Nm).
3. Place plate into slots at open end of shoe (7) (8). Slide shoe over plate until locknut at top end of adjuster screw is against closed (blind) side of shoe.
4. Position adjuster inside primary cover (3) with closed side of shoe against cover. Thread adjuster screw into tapped boss at bottom of primary cover. At outside of cover, install locknut (1) onto adjuster screw with nylon sealing surface toward cover.
5. Install primary cover. See Primary Cover INSTALLATION under 6.2 PRIMARY CHAIN.

Primary Cover

1. Remove foreign material from magnetic drain plug. Install plug and tighten to 14-21 ft-lbs (19-28 Nm).
2. Install a new gasket on primary cover.
3. See Figure 6-6. Install primary cover and gasket onto left crankcase half using mounting screws. Tighten screws to 80-110 **in-lbs** (9.0-12.4 Nm).



Primary Cover

1. **1/4-20 x 1-3/4 in. bolt with washers (7)**
2. **1/4-20 x 2-1/4 in. bolt with washers (4)**

Left Footrest Support

3. **5/16-18 x 3-1/2 in. bolt (2)**

Figure 6-6. Install Primary Cover Bolts

4. Install **new** shifter shaft oil seal.
5. Fit coupling over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp fits in slot of primary cover.
6. See Figure 6-3. Thread nut on adjusting screw until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counter-clockwise.
7. Adjust clutch. See 6.5 CLUTCH RELEASE MECHANISM ADJUSTMENT, steps 1-2 and 5-9.
8. Adjust primary chain tension. See 6.2 PRIMARY CHAIN ADJUSTMENT.
9. Add transmission fluid. See 6.7 TRANSMISSION LUBRICATION, steps 6-8.
10. Install the gear shift lever. Tighten pinch bolt to 80-110 **in-lbs** (9.0-12.4 Nm).
11. Install left footrest. Tighten footrest mounting bolts to 16-28 ft-lbs (22-38 Nm).

⚠WARNING

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

12. Connect battery cables, positive cable first.

GENERAL

The secondary drive belt should be checked for unusual wear, cracking, or loss of teeth. Check the belt sprocket for unusual wear, broken teeth, or damaged flange.

See Figure 6-7. Check belt deflection with no rider or cargo on motorcycle, with transmission in neutral, with belt and sprockets at ambient temperature (cold engine), and with motorcycle resting on side stand. At position “A,” midway between transmission sprocket and rear wheel sprocket, apply 10 lbs (4.5 Kg) of upward force on lower span of rear belt using BELT TENSION GAUGE (Part No. HD-35381). Measure belt deflection “B” several times, each time with belt moved (by rotating rear wheel) to a different position on sprockets.

NOTE

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

With sprockets rotated to the tightest belt position, belt deflection “B” should be as shown in Table 6-6.

Table 6-6. Belt Deflection

MODEL	DEFLECTION
883 Hugger **883 Custom**	1/4 in. to 5/16 in. (6.35-7.93 mm) with 10 lbs (4.5 Kg) of force measured at position “A”.
883/1200 Standard **1200 Sport**	5/16 in. to 3/8 in. (7.93-9.52 mm) with 10 lbs (4.5 Kg) of force measured at position “A”.

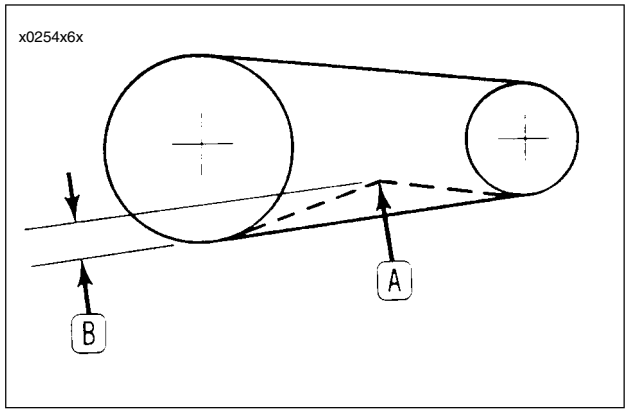
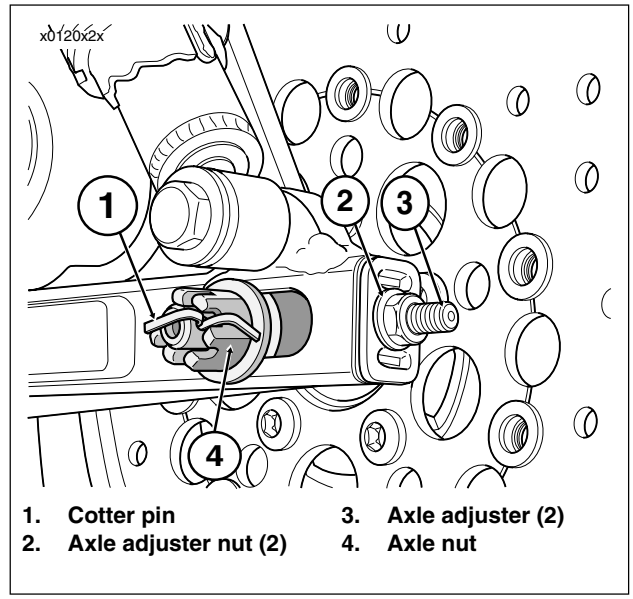


Figure 6-7. Secondary Drive Belt Deflection

ADJUSTMENT

1. See Figure 6-7. Determine belt deflection in manner specified in GENERAL. If belt deflection “B” is not correct, adjust per the following procedures.
2. See Figure 6-8. Remove cotter pin (1) and loosen rear axle nut (4). Turn axle adjuster nuts 2) (on each side of rear fork) clockwise to decrease belt deflection (increase tension), or counterclockwise to increase belt deflection (decrease tension). Turn each adjuster nut exactly the same number of turns in order to maintain alignment of rear wheel.



1. Cotter pin
2. Axle adjuster nut (2)
3. Axle adjuster (2)
4. Axle nut

Figure 6-8. Secondary Drive Belt Adjustment

3. Check rear wheel alignment. Wheel must be centered between swing arm. See Wheel Alignment under 2.13 TIRES, INSTALLATION.
4. After belt deflection is properly adjusted, tighten axle nut (2) to 60-65 ft-lbs (81-88 Nm). Install cotter pin (1).

CLEANING

Keep dirt, grease, oil, and debris off the belt and sprockets. Clean the belt with a rag which is slightly damp with light cleaning agent.

INSPECTION

Drive Belt

1. See Figure 6-10. Inspect the drive belt at the 1000 mile (1600 km) service interval, and at every 2500 mile (4000 km) service interval thereafter.

NOTES

- *When a drive belt is replaced for any reason other than stone damage, it is recommended that the transmission and rear sprockets also be replaced to increase the longevity of the new drive belt. In the case of stone damage, inspect sprockets for damage and replace as required.*
- *Condition #1 may develop into #2 or #3 over time. Condition #1 is not grounds for replacing the belt, but it should be watched closely before condition #2 develops which will required belt replacement.*

Inspect drive belt for:

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

2. See Figure 6-9. Remove two socket head screws (1) and lockwashers (2) which secure rear brake master cylinder to sprocket cover.
3. At rear brake linkage, loosen locknut (7). Turn push rod (6) at flats until rod end is free of push rod.
4. Remove three sprocket cover screws (8) and washers (9). Remove sprocket cover (5)
5. See Figure 6-8. Remove cotter pin (1) and loosen rear axle nut (4). Decrease belt tension by turning the axle adjuster nut (2) on each side of rear fork an equal number of turns counterclockwise.

CAUTION

Do not bend secondary belt backwards or into loops smaller than 5 inches (130 mm) in diameter. Damage to belt cords will result.

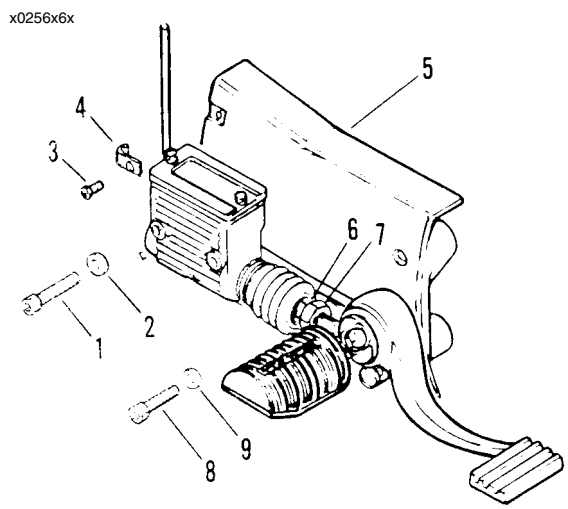
6. Remove right lower shock absorber bolt and belt guard. Remove belt.
7. Install new belt.
8. Reinstall removed components in reverse order of removal procedures.

Rear Sprocket

1. Inspect each tooth of rear sprocket for:
   - major tooth damage
   - large chrome chips with sharp edges
   - gouges caused by hard objects
   - excessive loss of chrome plating (see Step 3).
2. If chrome chips or gouges are large enough to be harmful, they will leave a pattern on the belt face.
3. To check if chrome plating has worn off, drag a scribe or sharp knife point across the bottom of a groove (between two teeth) with medium pressure.
   - If scribe or knife point slides across groove without digging in or leaving a visible mark, chrome plating is still good.
   - If scribe or knife points digs in and leaves a visible mark, it is cutting the bare aluminum. A knife point will not penetrate the chrome plating.
4. Replace rear sprocket if major tooth damage or loss of chrome exists.

REMOVAL AND INSTALLATION

1. Raise rear of vehicle off the floor using a center stand beneath frame.
2. Remove exhaust system. See 2.29 EXHAUST SYSTEM REMOVAL.
3. See Figure 6-9. Remove screw (3) and clip (4) which secure rear brake line to sprocket cover (5).



1. **Socket screw (2)**
2. **Lock washer (2)**
3. **Screw**
4. **Clip**
5. **Sprocket cover**
6. **Push rod**
7. **Locknut**
8. **Socket screw (3)**
9. **Washer (3)**

Figure 6-9. Sprocket Cover

4. Remove two socket head screws (1) and lock washers (2) that secure rear brake master cylinder to sprocket cover.
5. At rear brake linkage, loosen locknut (7). Turn push rod (6) at flats until rod end is free of push rod.
6. Remove three sprocket cover screws (8) and washers (9). Remove sprocket cover (5).
7. See Figure 6-8. Remove cotter pin (1) and loosen rear axle nut (4). Decrease belt tension by turning the axle adjuster nut (2) on each side of rear fork an equal number of turns counterclockwise.

CAUTION

Do not bend secondary belt backwards or into loops smaller than 5 inches (130 mm) in diameter. Damage to belt cords will result.

8. Remove right lower shock absorber bolt and belt guard. Remove belt.
9. See Figure 6-9. Install belt. Reinstall removed components in reverse order of removal procedure.
   - Tighten sprocket cover screws (8) to 90-110 **in-lbs** (10.2-12.4 Nm).
   - Tighten master cylinder screws (1) to 155-190 **in-lbs** (17.5-21.5 Nm).
   - Install exhaust system. See 2.29 EXHAUST SYSTEM INSTALLATION.
   - Adjust brake pedal. See 2.16 REAR BRAKE MASTER CYLINDER ADJUSTMENT, Brake Pedal.
   - Adjust belt tension. See 6.3 SECONDARY DRIVE BELT ADJUSTMENT.

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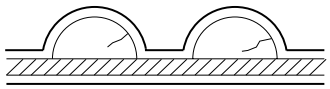
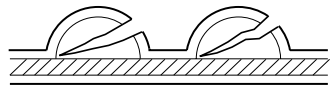
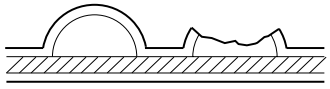


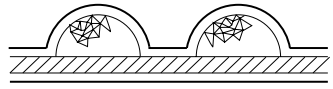
#1. Internal Tooth Crack (Hairline)
OK to run, but monitor condition



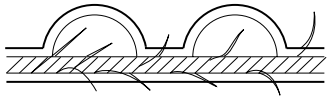
#2. External Tooth Cracks
Replace Belt



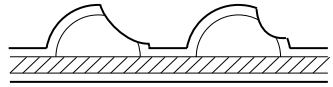
#3. Missing Teeth
Replace Belt



#4. Chipping (Not Serious)
OK to run, but monitor condition

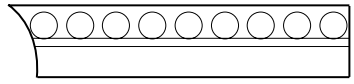


#5. Fuzzy Edge Cord (Not Serious)
OK to run, but monitor condition



#6. Hook Wear
Replace Belt

#7. Stone Damage
Replace Belt if damage is on edge



#8. Bevel Wear (Outboard Edge Only)
OK to run, but monitor condition

Figure 6-10. Secondary Drive Belt Inspection

GENERAL

See Figure 6-11. The purpose of the clutch is to smoothly disengage and engage the engine from the rear wheel for starting, stopping, and shifting gears.

The clutch is a wet, multiple-disc clutch with six steel plates (9), one spring plate (8), and eight fiber (friction) plates (10) stacked alternately in the clutch shell (2). The order of plate assembly, from inboard to outboard, is as follows:

F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

(F = Friction plate, St = Steel plate, **Sp** = Spring plate)

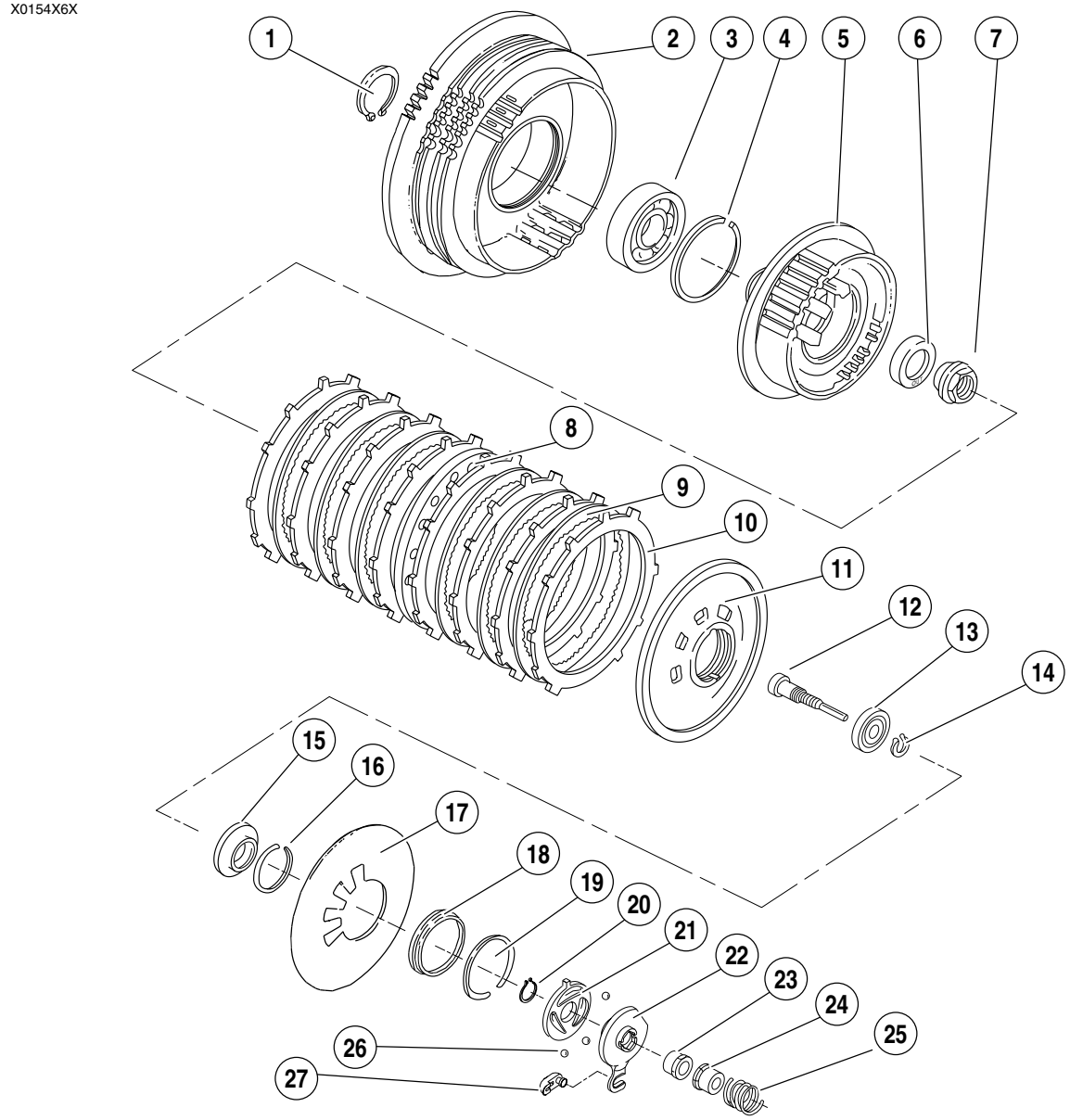
The friction plates (clutch driving plates) are keyed to the clutch shell (2), which is driven by the engine through the primary chain. The steel plates (clutch driven plates) and the centrally located spring plate (also a clutch driven plate) are keyed to the clutch hub (5), which drives the rear wheel through the transmission and secondary drive belt.

a. When the clutch is engaged (clutch lever released), the diaphragm spring (17) applies strong inward force against the pressure plate (11); the pressure plate then presses the clutch plates (8, 9, and 10) together, allowing no slippage between the plates and causing the plates to turn as a single unit. The result is that the rotational force of the clutch shell (2) is fully transmitted through the “locked” clutch plates to the clutch hub (5). As long as the transmission is set in a forward gear, power from the engine will be transmitted to the rear wheel.

b. When the clutch is disengaged (clutch lever pulled to left handlebar grip), the pressure plate (11) is pulled outward (by clutch cable action) against the diaphragm spring (17), thereby compressing the diaphragm spring. With the pressure plate retracted, strong inward force no longer squeezes the clutch plates (8, 9, and 10) together. The friction plates (10) are now free to rotate at a different relative speed than that of the steel and spring plates (8 and 9) (i.e. – slippage between the clutch plates occurs). The result is that the rotational force of the clutch shell (2) is no longer fully transmitted through the “unlocked” clutch plates to the clutch hub (5). The engine is free to rotate at a different speed than the rear wheel.

Table 6-7. Clutch Troubleshooting

SYMPTOM	CAUSE (CHECK IN FOLLOWING ORDER)	REMEDY
Clutch slips.	Incorrect clutch release adjustment. Worn clutch plates.	Check and adjust clutch release mechanism. Check service wear limits. Replace plates.
Clutch drags	Incorrect clutch release adjustment. Worn clutch release ramps or balls. Warped clutch steel plates. Blade worn or damaged clutch gear splines. Overfilled primary.	Check and adjust clutch release mechanism. Replace release ramps and/or balls. Replace clutch steel plates. Replace clutch gear or hub as required. Drain lubricant to correct level.



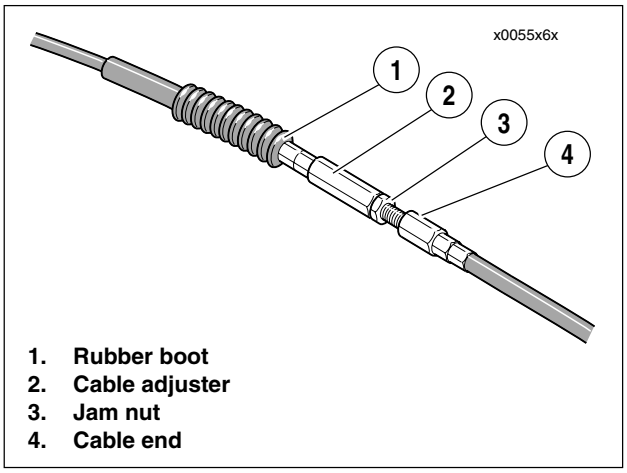
1. Retaining ring
2. Clutch shell
3. Bearing
4. Retaining ring
5. Clutch hub
6. Washer
7. Nut mainshaft
8. Spring plate
9. Steel plate (6)
10. Friction plate (8)
11. Pressure plate
12. Adjusting screw
13. Bearing
14. Retaining ring
15. Release plate
16. Retaining ring
17. Diaphragm spring
18. Spring seat
19. Snap ring
20. Retaining ring
21. Inner ramp
22. Outer ramp
23. Nut
24. Locking plate
25. Spring
26. Ball (3)
27. Coupling

Figure 6-11. Clutch Assembly

ADJUSTMENT

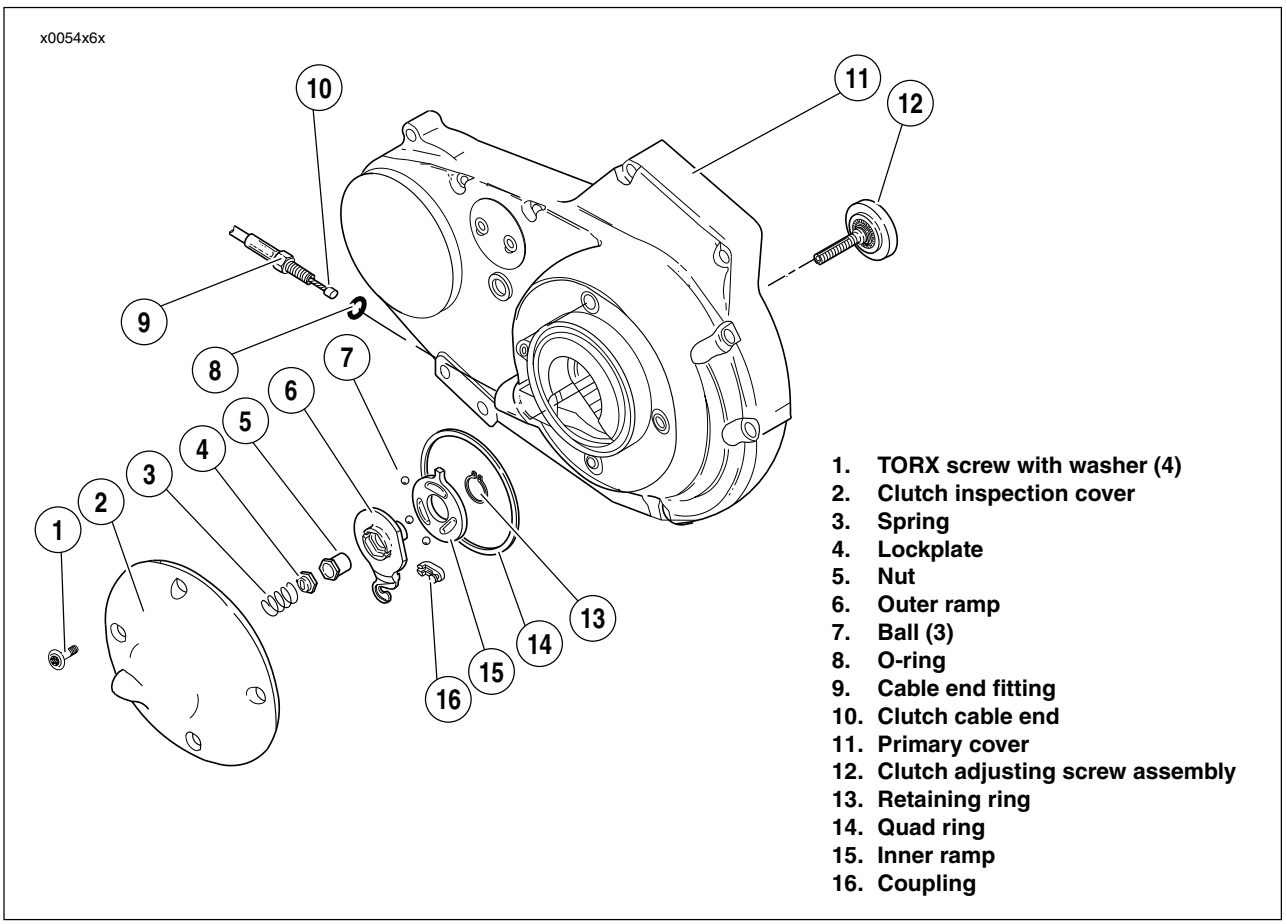
All models feature a new primary cover and a quick-release clutch cable to simplify both clutch service and adjustment.

1. See Figure 6-12. Slide rubber boot off cable adjuster.
2. Holding cable adjuster with 1/2 inch wrench, loosen jam nut using a 9/16 inch wrench. Back jam nut away from cable adjuster. Move adjuster toward jam nut to introduce a large amount of free play at hand lever.
3. Remove locknut and bolt to free left side footrest from footrest support. Remove footrest and spring washer.



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

Figure 6-12. Clutch Cable Adjuster Mechanism



1. **TORX screw with washer (4)**
2. **Clutch inspection cover**
3. **Spring**
4. **Lockplate**
5. **Nut**
6. **Outer ramp**
7. **Ball (3)**
8. **O-ring**
9. **Cable end fitting**
10. **Clutch cable end**
11. **Primary cover**
12. **Clutch adjusting screw assembly**
13. **Retaining ring**
14. **Quad ring**
15. **Inner ramp**
16. **Coupling**

Figure 6-13. Clutch Release Mechanism

4. See Figure 6-13. Using T-27 TORX driver, remove four TORX screws with washers to remove clutch inspection cover. Exercise caution to avoid damaging or dislodging quad ring in primary cover.
5. Slide spring with attached hex lockplate from flats of adjusting screw. Turn adjusting screw counter-clockwise until resistance is felt. Back off adjusting screw 1/4 turn.
6. Slide spring with hex lockplate onto flats of adjusting screw. If necessary, turn adjusting screw clockwise slightly so that lockplate slides onto flats while also fitting within recess of outer ramp.
7. Verify that quad ring is fully seated in groove of primary cover. Using T-27 TORX driver, install four TORX screws with washers to secure clutch inspection cover. Tighten screws in a crosswise pattern to 7-9 ft-lbs (9-12 Nm).
8. See Figure 6-12. Turn cable adjuster clockwise away from jam nut until slack is eliminated. Pull clutch cable ferrule away from clutch lever bracket to check free play. Turn cable adjuster as necessary to obtain 1/16 to 1/8 inch free play between end of cable ferrule and clutch lever bracket, as shown in Figure 6-14.

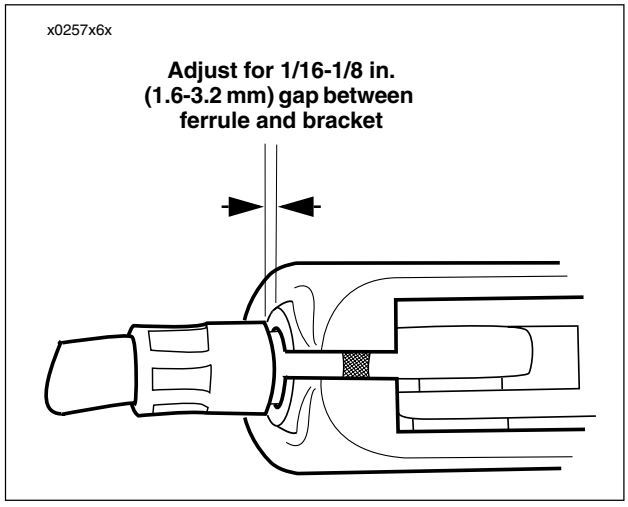


Figure 6-14. Adjusting Clutch Free Play

9. Hold adjuster with 1/2 inch wrench. Using 9/16 inch wrench, tighten jam nut against cable adjuster. Cover cable adjuster mechanism with rubber boot.
10. Position spring washer over lower inside hole of left footrest support. The concave side of the spring washer should face the support flange. Align holes in footrest with those in support and spring washer. Install bolt and
11. locknut. Tighten locknut to 8-16 ft-lbs (11-22 Nm).

DISASSEMBLY

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. See 6.5 CLUTCH RELEASE MECHANISM ADJUSTMENT, steps 1-4.
2. See Figure 6-13. Slide spring with attached hex lockplate from flats of adjusting screw.
3. Turn adjusting screw clockwise to release ramp and coupling mechanism. As the adjusting screw is turned, ramp assembly moves forward. Unscrew nut from end of adjusting screw.
4. Remove hook of ramp from button to the rear of cable end coupling. Remove cable end from slot in coupling.
5. Remove retaining ring from ramp assembly to separate inner and outer halves. Remove balls from ramp sockets.

CLEANING, INSPECTION, AND REPAIR

1. See Figure 6-13. Thoroughly clean all parts in cleaning solvent.
2. Inspect three balls of release mechanism and ball socket surfaces of inner and outer ramps for wear, pitting, surface breakdown and other damage. Replace parts as necessary.
3. Check hub fit of inner and outer ramps. Replace ramps if excessively worn.
4. Check clutch cable for frayed or worn ends. Replace cable if damaged or worn.
5. Change or add transmission fluid if necessary. See 6.7 TRANSMISSION LUBRICATION.

ASSEMBLY

1. See Figure 6-13. Apply multi-purpose grease to balls and ramps. Insert balls in sockets of outer ramp. Install inner ramp on hub of outer ramp with tang 180˚ from hook of outer ramp. Install retaining ring in groove of outer ramp hub.
2. Fit coupling over cable end with the rounded side inboard, the ramp connector button outboard. With retaining ring side of ramp assembly facing inward, place hook of ramp around coupling button and rotate assembly counter-clockwise until tang on inner ramp fits in slot of primary cover.
3. Thread nut on adjusting screw until slot of screw is accessible with a screwdriver. Fit nut hex into recess of outer ramp and turn adjusting screw counter-clockwise until resistance is felt. Back off adjusting screw 1/4 turn.
4. See 6.5 CLUTCH RELEASE MECHANISM ADJUSTMENT, steps 6-10.

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

NOTE

See Figure 6-15. *If replacement of clutch pack (8, 9, 10) is the only service work to be performed, perform REMOVAL Step 1 only, and then proceed to the NOTE under DISASSEMBLY.*

1. See Figure 6-15. Remove primary cover, as described under Primary Cover REMOVAL under 6.2 PRIMARY CHAIN.
2. Install SPROCKET LOCKING LINK (Part No. HD-38362). Remove the engine sprocket nut. Loosen, but do not remove, engine sprocket. If necessary, use the slotted portion of PULLER (Part No. HD-97292-61) and two bolts to loosen the engine sprocket.
3. Remove retaining ring (14). Remove adjusting screw assembly (12, 13, 14, and 15) from pressure plate (11).

NOTE

Clutch hub nut (5) has left-hand threads. Turn nut clockwise to loosen and remove from main shaft.

4. Remove nut (7) and washer (6). Remove the clutch assembly, primary chain, and engine sprocket as an assembly from the vehicle.
5. If primary chain is damaged or excessively worn, remove it from engine sprocket and clutch assembly; replace original primary chain with a new one.

DISASSEMBLY

NOTES

See Figure 6-15. If replacement of clutch pack (8, 9, 10) is the only service work to be performed, perform DISASSEMBLY Steps 2, 3, 4, 5, and 7 only, and then proceed to the NOTE under INSPECTION AND REPAIR.

Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.

1. See Figure 6-15. With clutch assembly removed from primary chaincase, reinstall adjusting screw assembly (12, 13, 14, and 15) into pressure plate (11), noting that two tabs on perimeter of release plate (15) must be inserted into corresponding recesses in pressure plate (11). Secure the adjusting screw assembly with retaining ring (14).

⚠WARNING

See Figure 6-16. Do not attempt to disassemble the clutch without SPRING COMPRESSING TOOL (Part No. HD-38515A) and CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91). Otherwise, the highly compressed diaphragm spring could fly out with great force, which could result in death or serious injury.

2. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-16.) onto the clutch adjusting screw (item 12, Figure 6-15.). Place the bridge (item 2, Figure 6-16.) of SPRING COMPRESSING TOOL (Part No. HD-38515A) against diaphragm spring (item 17, Figure 6-15.). Thread the tool handle (item 3, Figure 6-16.) onto end of forcing screw.

CAUTION

See Figure 6-15. Turn compressing tool handle only the amount required to remove spring seat (18) and snap ring (19). Excessive compression of diaphragm spring could damage clutch pressure plate.

3. See Figure 6-15. With a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning, turn handle clockwise until tool relieves pressure on snap ring (19) and spring seat (18).
4. Remove snap ring (19) and spring seat (18) from the groove in clutch hub (5) prongs. Remove the assembly of diaphragm spring (17), pressure plate (11), adjusting screw components, and compressing tool.

5. See Figure 6-15. Turn the compressing tool handle counterclockwise until the clutch spring forcing screw disconnects from the clutch adjusting screw (12). Remove snap ring (19), spring seat (18), and diaphragm spring (17) from pressure plate (11) assembly.
6. Remove retaining ring (16) and adjusting screw assembly (12, 13, 14, and 15) from pressure plate (11). If necessary, disassemble adjusting screw assembly by removing retaining ring (14), and then separating the remaining adjusting screw components (12, 13, and 15).
7. Remove the clutch pack, which consists of eight friction plates (10), six steel plates (9), and a spring plate (8), from the clutch hub (5).

CAUTION

See Figure 6-15. Due to the possible damage to the bearing (3), the clutch hub (5) and shell (2) assembly should not be disassembled unless the bearing, hub, or shell require replacement. If the assembly is pressed apart, the bearing must be replaced.

8. Remove retaining ring (4) from inboard end of clutch hub (5). Using an arbor press, separate clutch hub (5) from assembly of clutch shell (2), bearing (3), and retaining ring (4).
9. Remove retaining ring (4) from groove in clutch shell (2). Press on the inboard side of bearing (3) outer race to remove bearing from clutch shell.

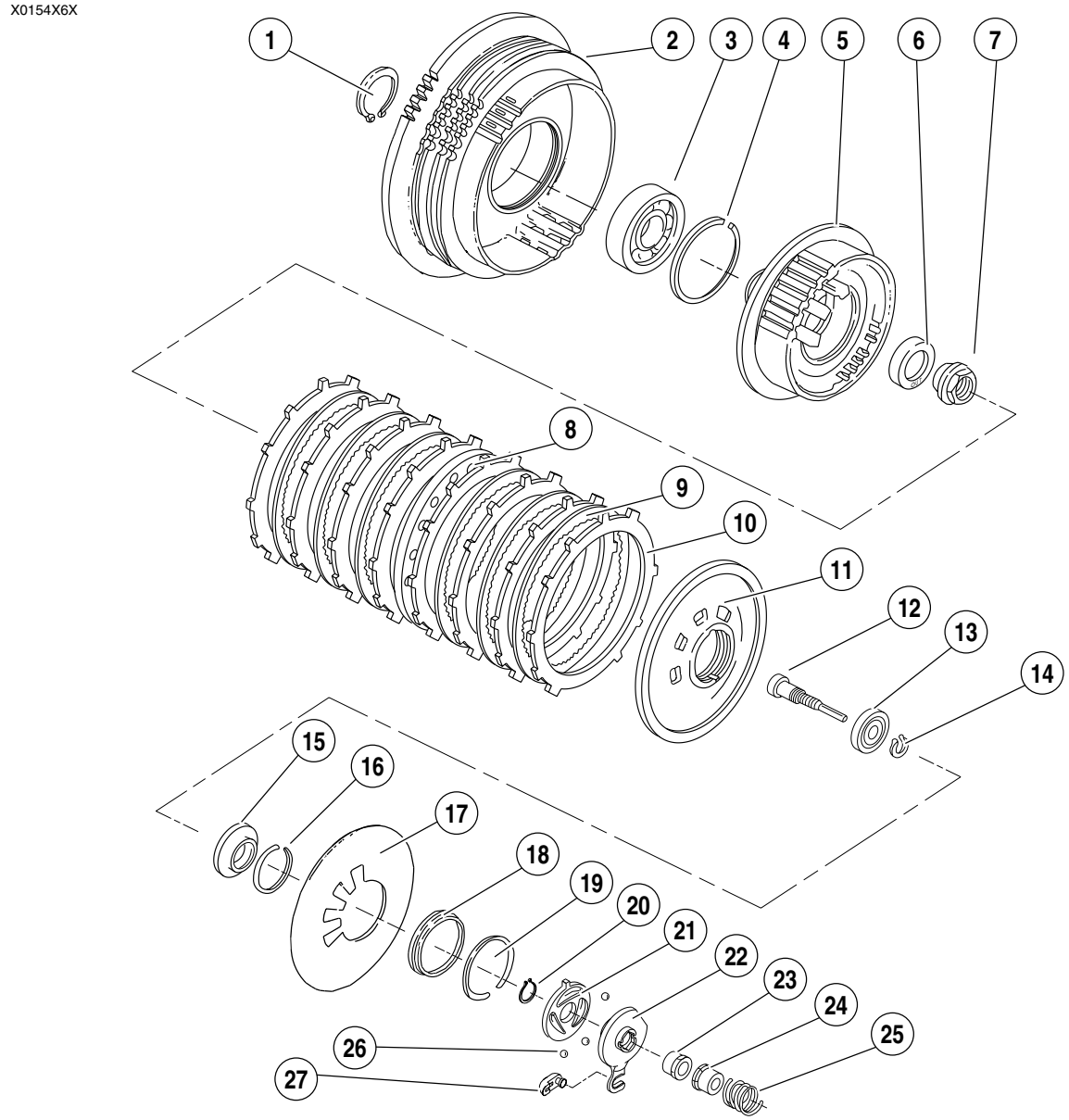
INSPECTION AND REPAIR

NOTE

If replacement of clutch pack friction plates [10], steel plates [9], and spring plate [8] is the only service work to be performed, perform all INSPECTION AND REPAIR steps (except Step 5), and then proceed to the NOTE under ASSEMBLY.

See Figure 6-15. Wash all parts, except the friction (driven) plates (10) and bearing (3), in cleaning solvent. Blow dry with compressed air. Examine the clutch components as follows:

1. Check for worn lining surface.
2. Inspect for checked or chipped lining.
3. Inspect each steel (drive) plate (9) for grooves. Also, check each steel plate for flatness in several places using a feeler gauge; the plate must be placed on a surface plate or flat surface. Replace any plates that are damaged or that are warped more than 0.006 in. (0.15 mm).
4. 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 0.661 in. (16.79 mm). If the thickness is less than specified, the friction plates and steel plates must be discarded, and a new set of both friction and steel plates must be installed.
5. Check the bearing (3) for smoothness by rotating the clutch shell while holding the clutch hub. If bearing is rough or binds, it must be replaced.
6. Check the primary chain sprocket and the starter ring gear on the clutch shell (2). If either sprocket or ring gear are badly worn or damaged, replace the clutch shell.
7. 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.
8. Check the diaphragm spring (17) for cracks or bent tabs. Install a new spring if either condition exists.



1. Retaining ring
2. Clutch shell
3. Bearing
4. Retaining ring
5. Clutch hub
6. Washer
7. Nut, Mainshaft
8. Spring plate
9. Steel plate (6)
10. Friction plate (8)
11. Pressure plate
12. Adjusting screw
13. Bearing
14. Retaining ring
15. Release plate
16. Retaining ring
17. Diaphragm spring
18. Spring seat
19. Snap ring
20. Retaining ring
21. Inner ramp
22. Outer ramp
23. Nut
24. Locking plate
25. Spring
26. Ball (3)
27. Coupling

Figure 6-15. Clutch Assembly

ASSEMBLY

NOTES

See Figure 6-15. If replacement of clutch pack (8, 9, 10) is the only service work to be performed, perform ASSEMBLY Steps 2, 5, 6, 7, and 8 only, and then proceed to the NOTE under INSTALLATION.

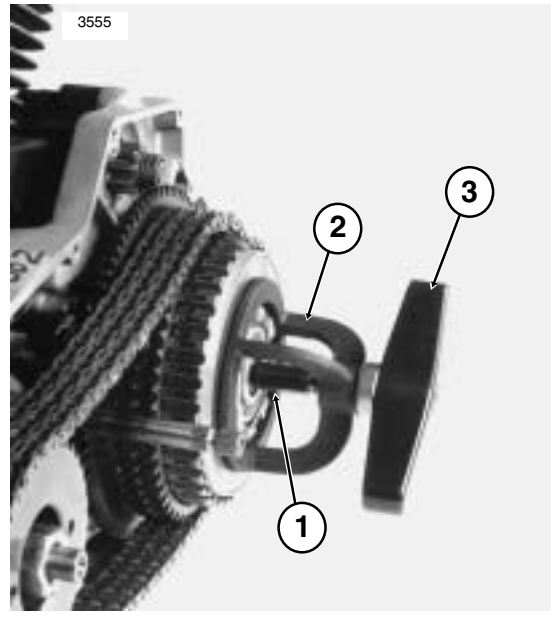
Observe all ⚠WARNING and ⚠CAUTION statements which apply to the steps specified.

1. See Figure 6-15. If the assembly of the clutch hub (5) and shell (2) was disassembled, press **new** bearing (3) in clutch shell; secure bearing with a **new** retaining ring (4). Press inboard end of clutch hub into shell bearing; secure with **new** retaining ring (1) on end of hub.
2. Install the clutch pack, which consists of eight friction plates (10), six steel plates (9), and a spring plate (8), into the clutch hub (5). The order of plate assembly, from inboard to outboard, is as follows:

F - St - F - St - F - St - F - **Sp** - F - St - F - St - F - St - F

(F = Friction plate, St = Steel plate, **Sp** = Spring plate)

3. If disassembled, assemble bearing (13) and adjusting screw (12) in release plate (15); secure with **new** retaining ring (14).
4. Install adjusting screw assembly (12, 13, 14, and 15) into pressure plate (11), noting that two tabs on perimeter of release plate (15) must be inserted into corresponding recesses in pressure plate (11). Secure the adjusting screw assembly with retaining ring (16).
5. Position diaphragm spring (17), with its concave side facing inboard (toward pressure plate), onto pressure plate (11) assembly. Position spring seat (18), with its flat, larger O.D. side facing inboard (toward diaphragm spring), and a **new** snap ring (19) onto convex (outboard) side of diaphragm spring (17).
6. See Figure 6-15. See Figure 6-16. Thread the CLUTCH SPRING FORCING SCREW (Part No. HD-38515-91) (item 1, Figure 6-16.) onto the clutch adjusting screw (item 12, Figure 6-15.). Place the bridge (item 2, Figure 6-16.) of SPRING COMPRESSING TOOL (Part No. HD-38515A) against diaphragm spring (item 17, Figure 6-15.). Thread the tool handle (item 3, Figure 6-16.) onto end of forcing screw. Do not tighten compressing tool against diaphragm spring at this time.
7. See Figure 6-15. Align square openings of pressure plate (11) and diaphragm spring (17) so that the assembly can be installed over prongs of clutch hub (5). Place assembly of spring seat, snap ring, diaphragm spring, pressure plate, adjusting screw components, and compressing tool onto clutch hub (5), and against clutch pack.



1. Forcing screw
2. Bridge
3. Handle

Figure 6-16. Compressing Clutch Diaphragm Spring

CAUTION

Turn compressing tool handle only the amount required to install spring seat (18) and snap ring (19). Excessive compression of diaphragm spring (17) could damage clutch pressure plate.

8. Place a wrench on the clutch spring forcing screw flats to prevent the forcing screw from turning. Turn compressing tool handle clockwise until diaphragm spring (17) compresses just enough to install spring seat (18) and snap ring (19) into the groove in clutch hub (5) prongs. With snap ring positioned against flange face (outboard side) of spring seat, and fully seated in groove of clutch hub, carefully loosen and remove compression tool.
9. Remove retaining ring (16). Remove adjusting screw assembly (12, 13, 14, and 15) from pressure plate (11).

INSTALLATION

NOTE

See Figure 6-15. If replacement of clutch pack (friction plates [10], steel plates [9], and spring plate [8]) was the only service work performed, perform INSTALLATION Step 5 only.

1. Install the engine sprocket, clutch assembly, and primary chain as a unit into primary chaincase.
2. Install SPROCKET LOCKING LINK (Part No. HD-38362). Apply two or three drops of LOCTITE Threadlocker 262 (red) onto threads of sprocket shaft. Install the engine sprocket nut. Tighten nut to 190-210 ft-lbs (258-285 Nm).

CAUTION

See Figure 6-15. Washer (6) must be installed with the word "out" facing the main shaft nut (7). Incorrect assembly can result in clutch and/or transmission failure.

3. See Figure 6-15. Apply two or three drops of LOCTITE Threadlocker 262 (red) onto threads on end of main shaft. Install washer (6) and nut (7) **(left-hand threads)** on main shaft. Tighten nut (7) to 70-80 ft-lbs (95-108 Nm).
4. Install adjusting screw assembly (12, 13, 14, and 15) in the pressure plate (11), noting that two tabs on perimeter of release plate (15) must be inserted into corresponding recesses in pressure plate (11). Secure assembly with a **new** retaining ring (16).
5. Install primary cover as described under Primary Cover INSTALLATION under 6.2 PRIMARY CHAIN. Connect battery cables (positive cable first).

GENERAL

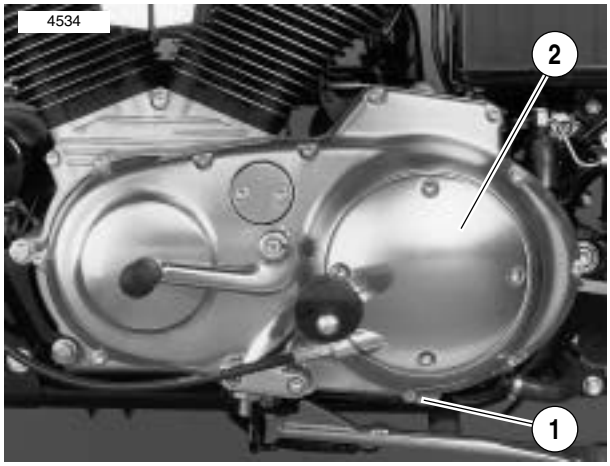
See Figure 6-19. The transmission is a five-speed constant-mesh type housed in an extension of the crankcase. The transmission permits the rider to vary the ratio of engine speed-to-rear driving wheel speed in order to meet the varying conditions of operation.

The transmission is foot-operated by the gear shifter lever, which transmits the force through a gear shifter shaft. The shifter shaft actuates a pawl and a shifter fork drum. The shifter fork drum moves shifter forks, which slide a series of shifter clutch gears, on the main shaft and counter shaft, into and out of mesh with the other gears.

LUBRICATION

Drain transmission and refill to correct level with fresh, clean lubricant at least once each year or every 5000 miles (8000 km), whichever comes first. For best results, drain lubricant while hot. Proceed as follows:

1. On level surface, stand vehicle upright (not leaning on jiffy stand) to prevent chaincase lubricant from draining out of clutch cover opening when refilled.
2. See Figure 6-17. Position a suitable container under transmission lubricant drain plug (1). Remove drain plug and drain lubricant.



1. Drain plug
2. Clutch inspection cover

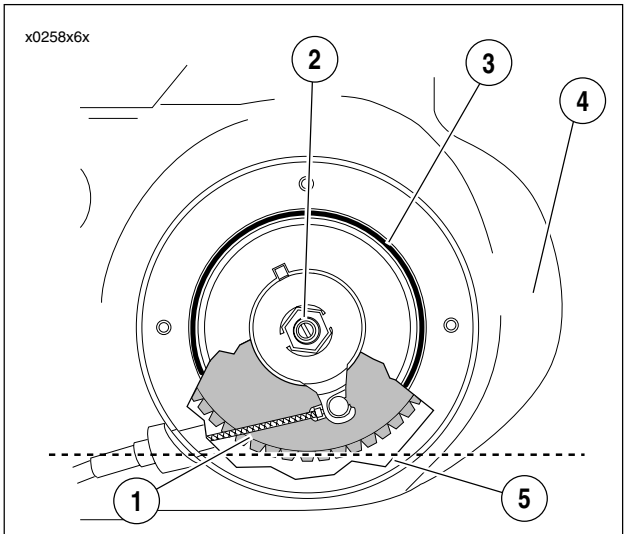
Figure 6-17. Primary Cover

3. Remove foreign material from magnetic drain plug. Reinstall plug and tighten to 14-21 ft-lbs (19-28 Nm).
4. Using a T-27 TORX driver, remove screws with washers from clutch inspection cover (2). Remove clutch inspection cover from primary cover. Exercise caution to avoid damaging or dislodging quad ring in primary cover.

CAUTION

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

5. Add 32 fluid ounces (946 ml) of Harley-Davidson Sport-Trans Fluid (Part No. 98854-96 quart size; Part No. 98855-96 gallon size) through clutch inspection cover opening.
6. See Figure 6-18. Verify that lubricant level (5) is even with bottom of clutch diaphragm spring (1).



1. Clutch diaphragm spring
2. Clutch adjusting screw
3. Quad ring
4. Primary cover
5. Chaincase lubricant level

Figure 6-18. Chaincase Lubricant Level

7. Install clutch inspection cover on primary cover using T-27 TORX screws with washers. Tighten screws in a crosswise pattern to 7-9 ft-lbs (9-12 Nm).

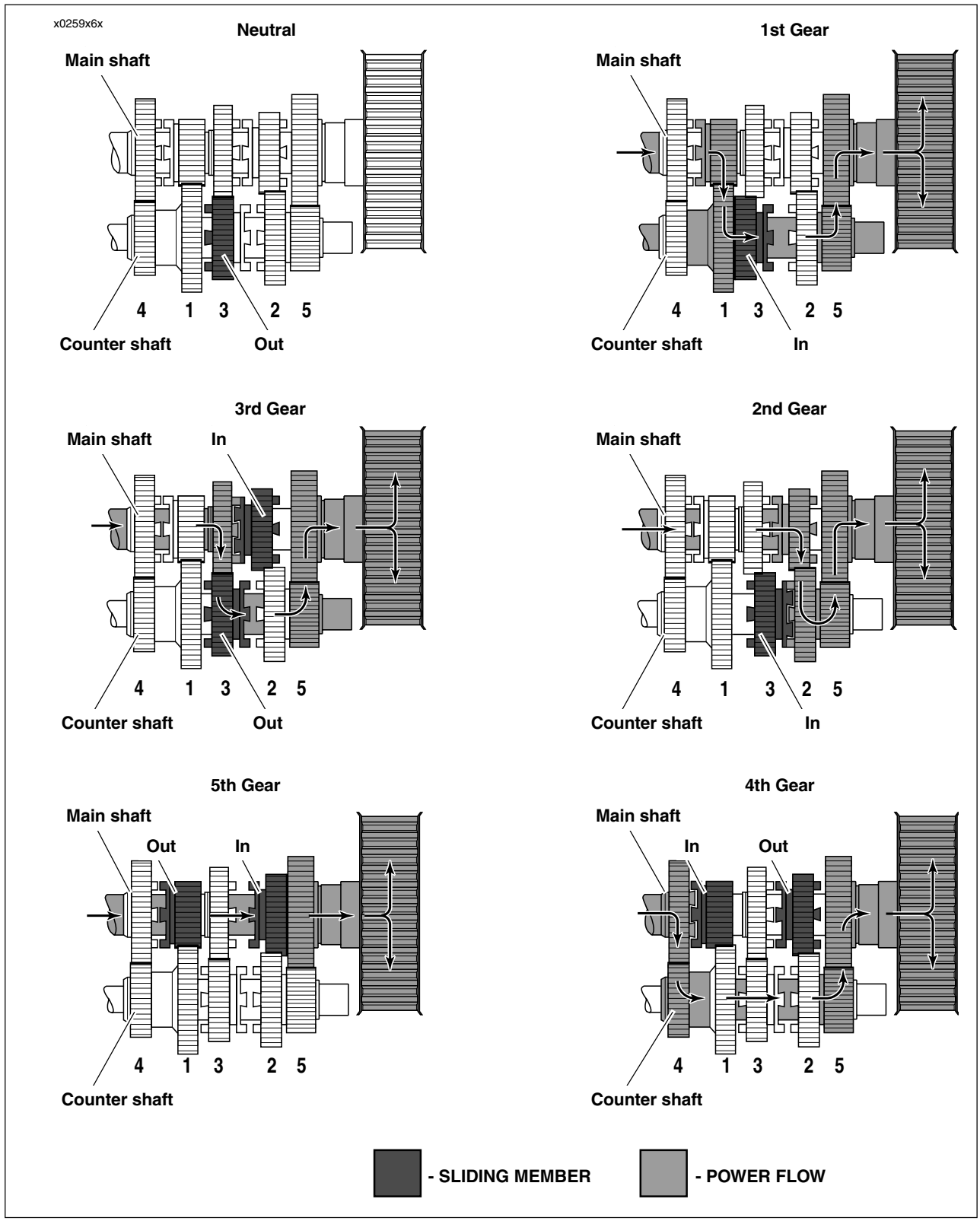


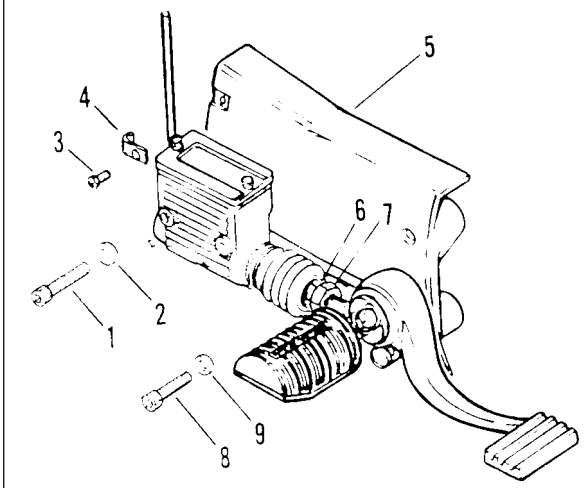
Figure 6-19. Transmission Power Flow

GENERAL

The rear compartment of the left and right crankcase halves form the transmission case. An access cover (door) allows removal of transmission components without removing the engine or disassembling (splitting) the crankcase.

REMOVAL

1. Remove exhaust system. See 2.29 EXHAUST SYSTEM.
2. See Figure 6-20. Remove footrest, brake pedal, sprocket cover (5), and rear brake master cylinder from right side of motorcycle.



1. **Socket screw (2)**
2. **Lock washer (2)**
3. **Screw**
4. **Clip**
5. **Sprocket cover**
6. **Push rod**
7. **Locknut**
8. **Socket screw (3)**
9. **Washer (3)**

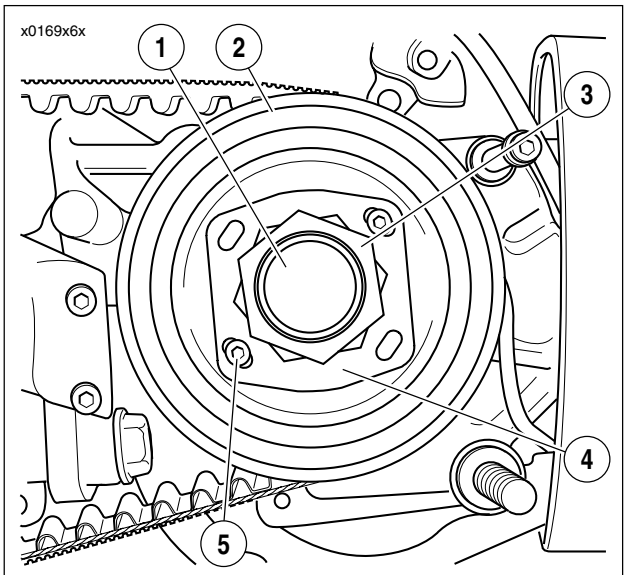
Figure 6-20. Sprocket Cover

3. Place a drain pan under the engine. Remove drain plug, and drain lubricant from primary drive/transmission.
4. See Figure 6-21. Place transmission in first gear. Remove two socket head screws (5) and lockplate (4).

NOTE

Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft.

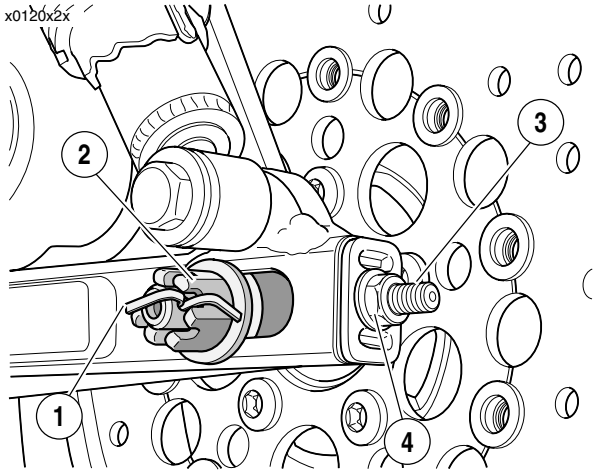
5. Remove transmission sprocket nut (3) from main drive gear shaft (1).



1. **Main drive gear shaft**
2. **Transmission sprocket**
3. **Transmission sprocket nut**
4. **Lockplate**
5. **Socket head**

Figure 6-21. Transmission Sprocket

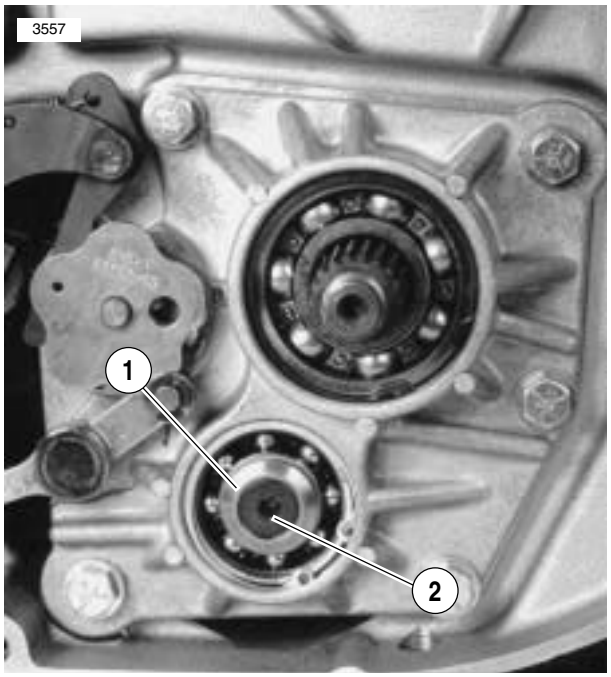
6. See Figure 6-22. Remove cotter pin (1) and loosen rear axle nut (2). Reduce tension on secondary drive belt by turning axle adjuster nuts (4), on each side of rear fork, an equal number of turns counterclockwise.



1. **Cotter pin**
2. **Axle nut**
3. **Axle adjuster (2)**
4. **Axle adjuster nut (2)**

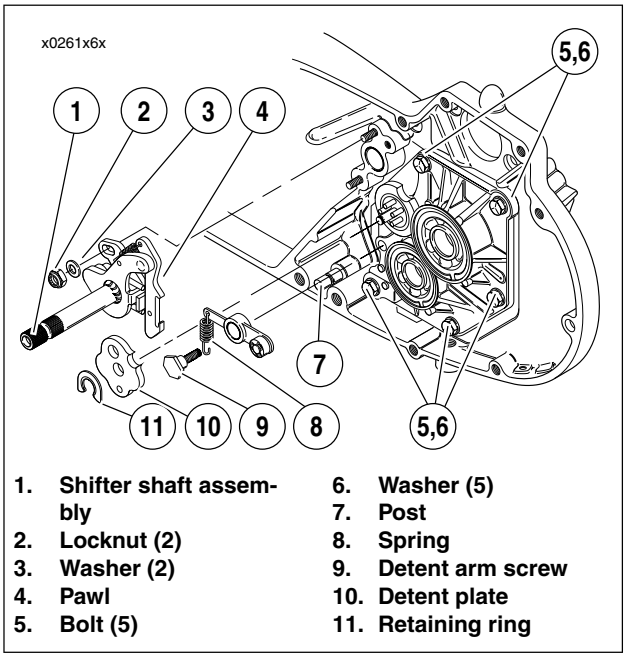
Figure 6-22. Secondary Drive Belt Adjustment

7. See Figure 6-21. Remove secondary drive belt from transmission sprocket (2). Remove transmission sprocket from main drive gear shaft (1).
8. Remove primary cover; see Primary Cover REMOVAL under 6.2 PRIMARY CHAIN.
9. Remove clutch assembly, primary chain, and engine sprocket as described under 6.6 PRIMARY DRIVE/ CLUTCH REMOVAL.
10. See Figure 6-23. Lock transmission in gear. Remove counter shaft Torx screw and retainer.
11. See Figure 6-24. Detach spring (8) from groove in post (7).
12. Remove retaining ring (11) and detent plate (10). You will need to use a new retaining ring for installation.
13. Remove two locknuts (2) and washers (3) which attach shifter shaft assembly (1) to studs at transmission case. Remove shifter shaft assembly.
14. Remove five access door bolts (5) and washers (6). Remove transmission assembly by pulling it straight outward, away from transmission case.



1. **Retainer axle nut**
2. **TORX screw**

Figure 6-23. Counter shaft Retainer



1. **Shifter shaft assembly**
2. **Locknut (2)**
3. **Washer (2)**
4. **Pawl**
5. **Bolt (5)**
6. **Washer (5)**
7. **Post**
8. **Spring**
9. **Detent arm screw**
10. **Detent plate**
11. **Retaining ring**

Figure 6-24. Shifter Shaft Assembly

CLEANING, INSPECTION AND REPAIR

Thoroughly clean transmission compartment with cleaning solvent. Blow parts dry with compressed air. Inspect parts to determine if any must be replaced. Replace all parts that are badly worn or damaged.

Neutral Indicator Switch

See Figure 6-25. The neutral indicator switch is threaded into the transmission portion of the right crankcase half. See 7.24 NEUTRAL INDICATOR SWITCH for testing, removal and installation procedures.

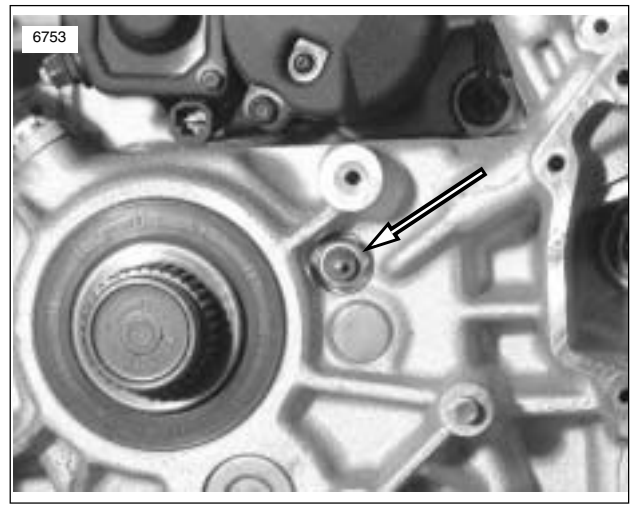
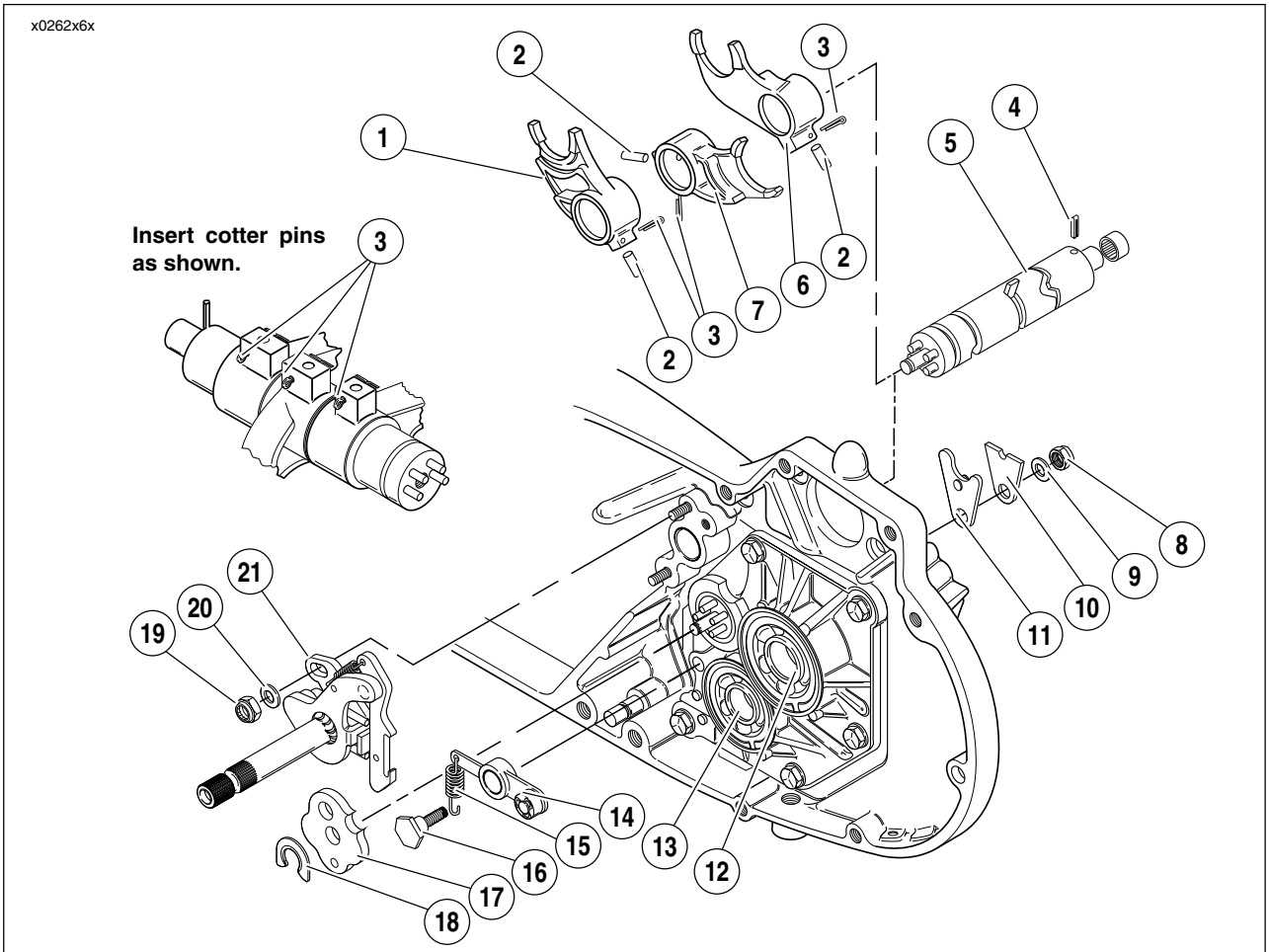


Figure 6-25. Neutral Indicator Switch

DISASSEMBLY

1. Remove the transmission assembly as described under 6.8 TRANSMISSION CASE. Mount transmission assembly in vise with protective jaws.
2. See Figure 6-26. Remove nut (8), washer (9), screw(16), drum lock plates (10,11), detent arm (14), and spring (15).
3. Remove and discard the three fork cotter pins (3).
4. Remove three shift fork pins (2). A small magnet is useful in freeing the fork pins (2).
5. Slide shift drum (5) away from access door, through shifter forks. The neutral switch pin prevents removal in the other direction.
6. Remove shift forks (1,6 and 7).



1. Shifter fork 4th gear
2. Pin, shifter fork
3. Cotter pin
4. Pin, neutral indicator
5. Shifter fork drum
6. Shifter fork 3rd and 5th gear
7. Shifter fork 1st and 2nd gear
8. Nut (2)
9. Washer
10. Plate, reinforcing
11. Plate, shifter drum locating
12. Bearing, main shaft
13. Bearing counter shaft
14. Detent arm
15. Spring
16. Screw, detent
17. Plate, detent
18. Bowed snap ring
19. Nut
20. Washer
21. Shifter shaft assembly

Figure 6-26. Shifter Mechanism

CLEANING, INSPECTION AND REPAIR

1. See Figure 6-26. Clean all parts except bearings (12 and 13) with solvent.
2. Inspect bearings (12 and 13) and shifter drum ends. If ends of shifter drum are pitted or grooved, replace the shifter drum and bearings. If replacing bearings, see 6.12 ACCESS DOOR BEARINGS.
3. Inspect shifter drum (6) for cracks or wear; replace if necessary.

ASSEMBLY

1. See Figure 6-27. for shifter fork identification. See Figure 6-26. Lubricate the shaft bore in fork (6) with Sport Transmission Lube. Place 3rd and 5th gear shifter fork (6) in the fork groove of main shaft 2nd gear. Be sure the flat side of fork is facing the access cover.
2. Lubricate the shaft bore in fork (7) with Sport Transmission Lube. Place 1st and 2nd gear shifter fork (7) in the fork groove of counter shaft 3rd gear. Be sure the flat side of fork is facing away from the access door.
3. Lubricate the shaft bore in fork (1) with Sport Transmission Lube. Place 4th gear shifter fork (1) in the fork groove of main shaft 1st gear. Be sure the flat side of fork is facing away from the access door.
4. See Figure 6-26. Position the shifter drum shaft so that the neutral indicator switch activator pin (4) is upward. The shaft is then in the neutral position. Insert the pin end of drum shaft (5) through the hubs of shifter forks (1), (6) and (7) and through the bearing in access cover.

CAUTION

To prevent possible cotter pin damage, the pins must be inserted through the shifter forks as shown in the inset of Figure 6-26.

5. Align the hole through the top of each shifter fork with the appropriate cam groove in the shifter drum. Lubricate pins (2) with Sport Transmission Lube. Drop pins (2) through the holes in shifter forks. With a small screwdriver press on the pins while manipulating the forks back and forth until the pin seats in the drum groove. Secure pins in place with **new** cotter pins (3).

NOTE

See Figure 6-27. See Figure 6-26. Detent plate (17) and bowed snap ring (18) are not installed at this time. These parts are installed during transmission installation after the final shifter pawl adjustment is completed. See 6.14 TRANSMISSION INSTALLATION /SHIFTER PAWL ADJUSTMENT.

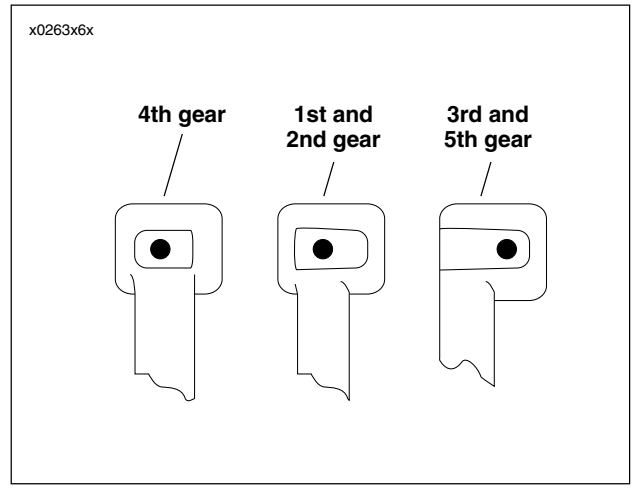
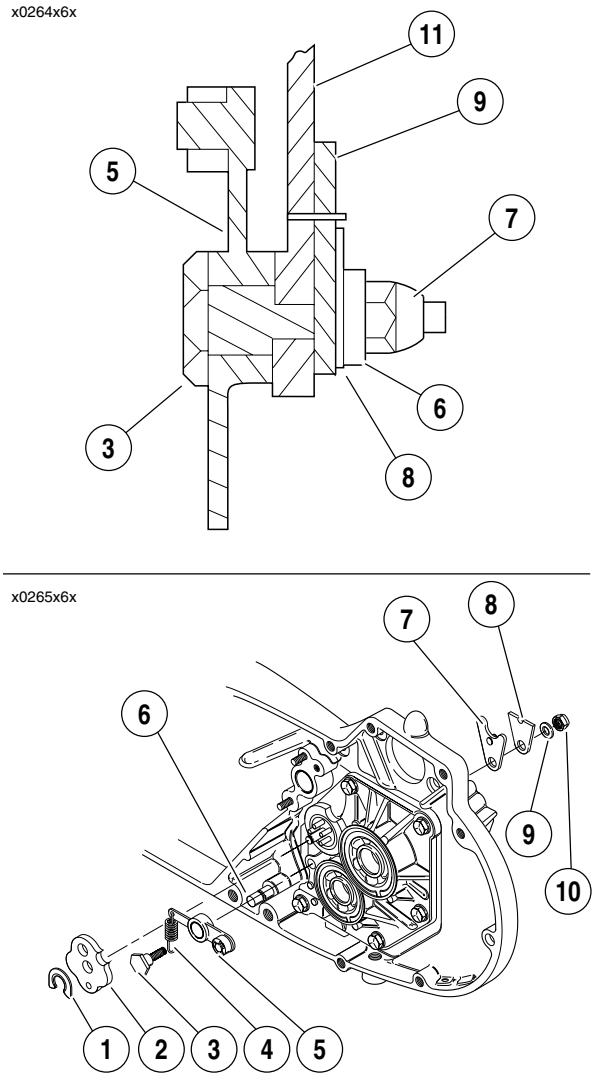


Figure 6-27. Shifter Fork Identification

6. See Figure 6-28. At the inside of the access door (11), place the shifter drum retention plate (7) in the groove of the drum shaft. Take care to correctly align the shifter drum retention plate and drum reinforcement plate (8) with the retaining pin pressed in the retention plate. Insert detent screw (3) through detent arm (5), transmission access door, shifter drum retention plate, drum reinforcement plate and washer (9). Thread nut (10) on detent screw (3) and tighten to 13-17 ft-lbs (18-23 Nm).



1. **Retainer**
2. **Detent plate**
3. **Detent screw**
4. **Spring**
5. **Detent**
6. **Post**
7. **Shifter drum retention plate/ pin assembly**
8. **Reinforcement plate**
9. **Washer**
10. **Nut**
11. **Transmission access door**

Figure 6-28. Detent Plate Mounting

DISASSEMBLY

1. See Figure 6-29. Clamp transmission assembly in vise, with protective jaws, as shown, to work on disassembly.

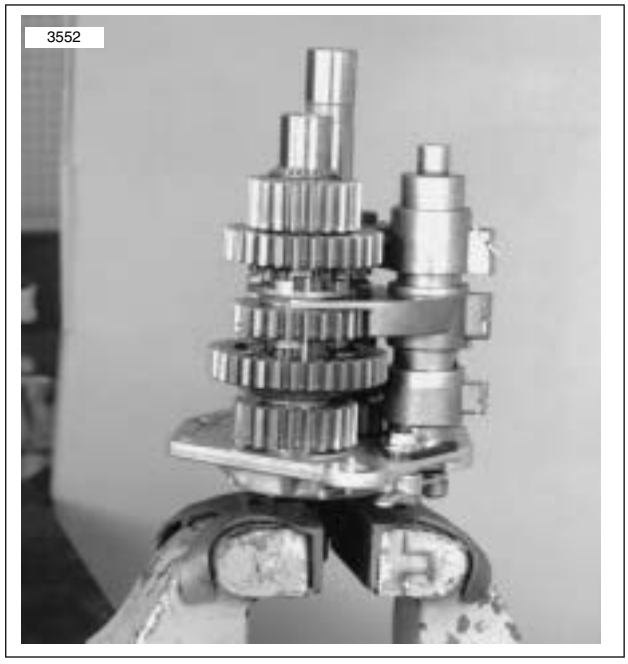


Figure 6-29. Protective Jaws with Vise

2. Remove transmission assembly as described under 6.8 TRANSMISSION CASE, remove shifter forks and drum as described under 6.9 SHIFTER FORKS AND DRUM.

NOTE

As the transmission runs, each part develops a certain wear pattern and a kind of "set" with its mating parts. For this reason, it is important that each component be reinstalled in its original location and facing its original direction.

3. See Figure 6-30. As each component is removed, place it on a clean surface in the exact order of removal.

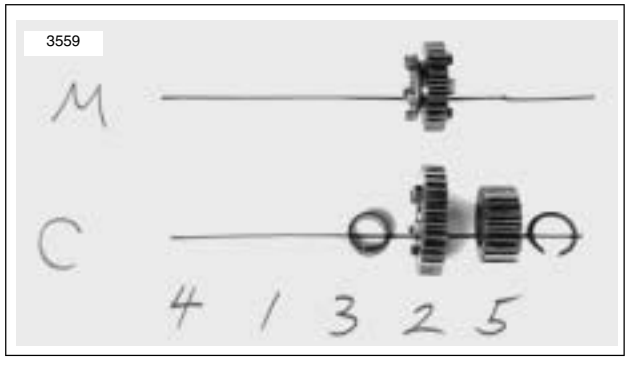


Figure 6-30. Recording Order

4. See Figure 6-31. Using retaining ring pliers Part No. J5586 remove and discard retaining ring (5) next to counter shaft 5th gear (12). Slide counter shaft 5th (12), main shaft 2nd (22) and counter shaft 2nd (11) off end of shafts.

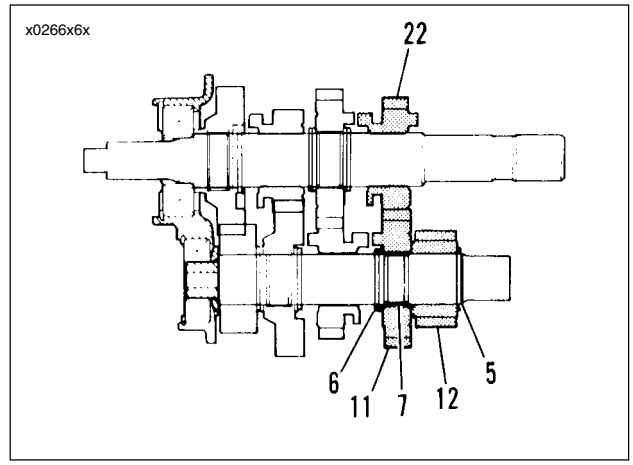
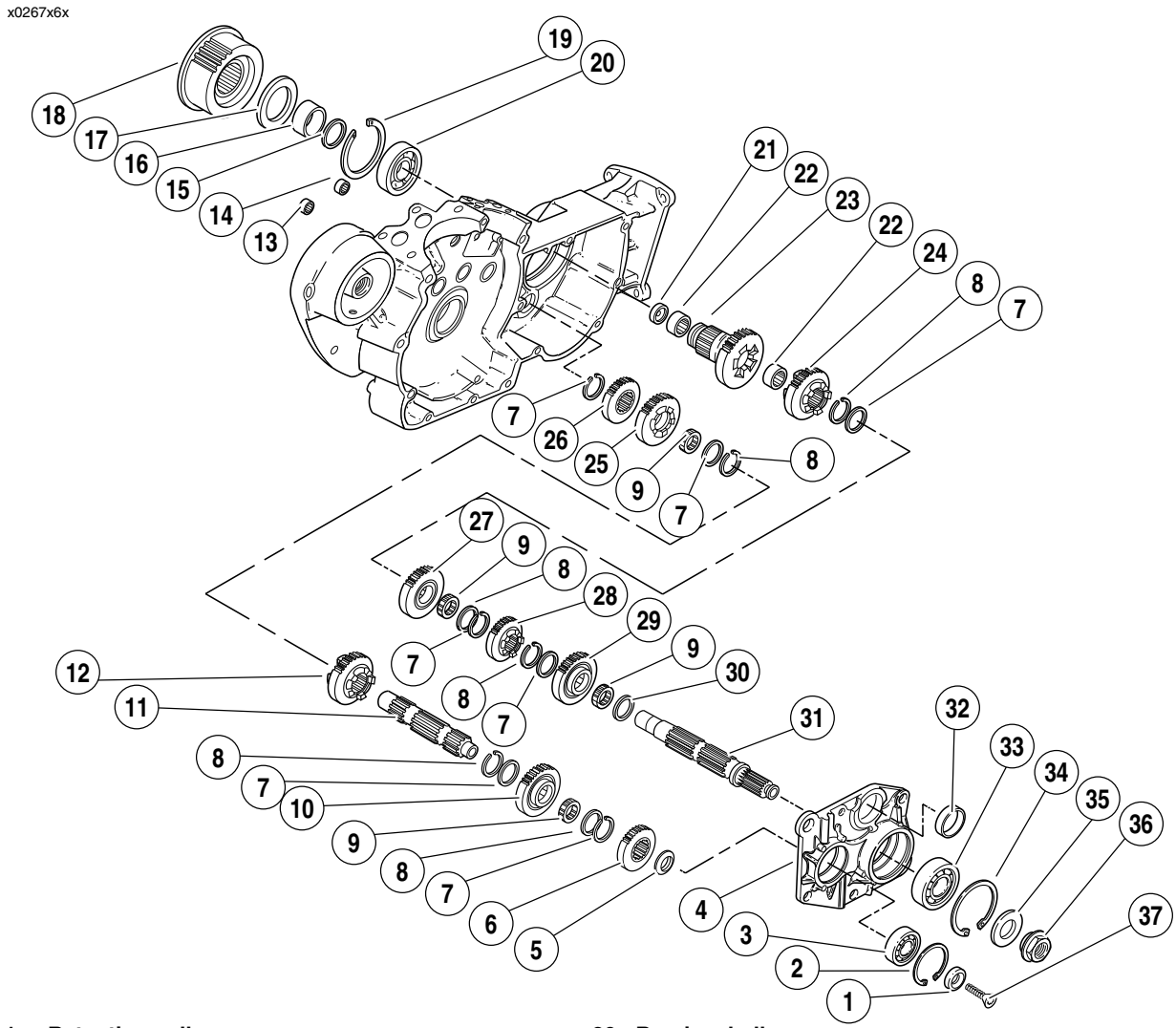


Figure 6-31. Cross Section View

5. Remove split bearing (7) that was under gear (11) and thrust washer (6) on the counter shaft.



1. Retention collar
2. Ring, retaining
3. Bearing
4. Door, access
5. Spacer, bevel
6. Gear, counter shaft 4th
7. Ring, retaining (7)
8. Washer, thrust (6)
9. Bearing, split (4)
10. Gear, counter shaft 1st
11. Counter shaft
12. Gear, counter shaft 3rd
13. Bearing, closed (counter shaft)
14. Bearing closed (shifter shaft)
15. Ring, quad
16. Spacer (belt drive)
17. Seal, oil
18. Sprocket, chain/belt
19. Ring, retaining
20. Bearing, ball
21. Seal
22. Bearing, needle
23. Gear, main shaft 5th
24. Gear, main shaft 2nd
25. Gear, counter shaft 2nd
26. Gear, counter shaft 5th
27. Gear, main shaft 3rd
28. Gear, main shaft 1st
29. Gear, main shaft 4th
30. Spacer
31. Main shaft
32. Bushing
33. Bearing
34. Ring, retaining
35. Washer, spring
36. Nut, main shaft
37. Torx screw

Figure 6-32. Transmission Assembly

6. See Figure 6-33. Remove retaining ring (5) next to counter shaft 3rd gear (10). Slide counter shaft 3rd gear (10) off free end of shaft.
7. At main shaft, between main shaft 1st gear (24) and main shaft 3rd gear (23), expand retaining ring (5) and move next to main shaft 1st gear along with thrust washer (6). Move main shaft 3rd gear as far as possible toward main shaft 1st gear (24). Expand retaining ring (5) at opposite side of main shaft 3rd gear and slide off end of shaft. Remove main shaft 3rd gear (23) and its split bearing (7).
8. Slide thrust washer (6) off end of main shaft. Expand retaining ring (5), which is next to main shaft 1st gear (24), and slide off end of shaft
9. See Figure 6-34. Place COUNTERSHAFT GEAR SUPPORT PLATE (Part No. HD-37404) under counter shaft 4th gear (4). Place assembly on press with suitable metal blocks under the support plate. Place a socket or mandrel, smaller than inside diameter of bearing, and press counter shaft free of access cover. Slide main shaft 1st gear (24) off main shaft.
10. See Figure 6-35. Remove beveled spacer (3) and counter shaft 4th gear (4).
11. Expand retaining ring (5) located next to counter shaft 1st gear (8). Remove retaining ring (5) and thrust washer (6). Slide counter shaft 1st gear off end of shaft. Remove split bearing (7).
12. Remove thrust washer (6). Expand remaining retaining ring (5) and slide off shaft. This completes disassembly of counter shaft.

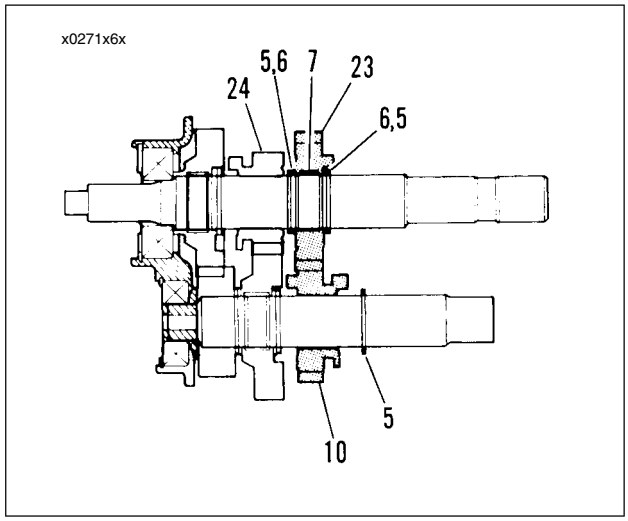


Figure 6-33.

13. See Figure 6-36. Place mainshaft and access door assembly on arbor press with support under mainshaft 4th gear (25). Press on end of shaft until mainshaft is free of access door bearing. Remove spacer (26), mainshaft 4th gear (25) and split bearing (7).

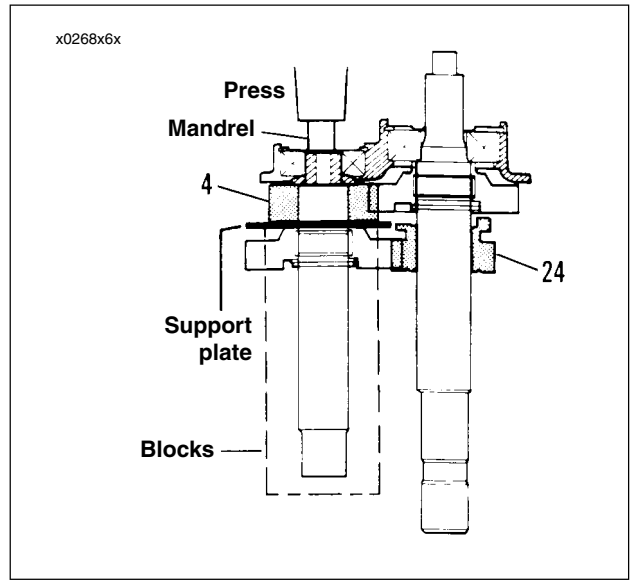


Figure 6-34.

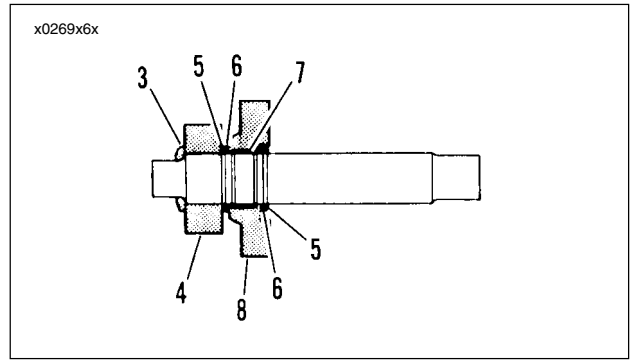


Figure 6-35.

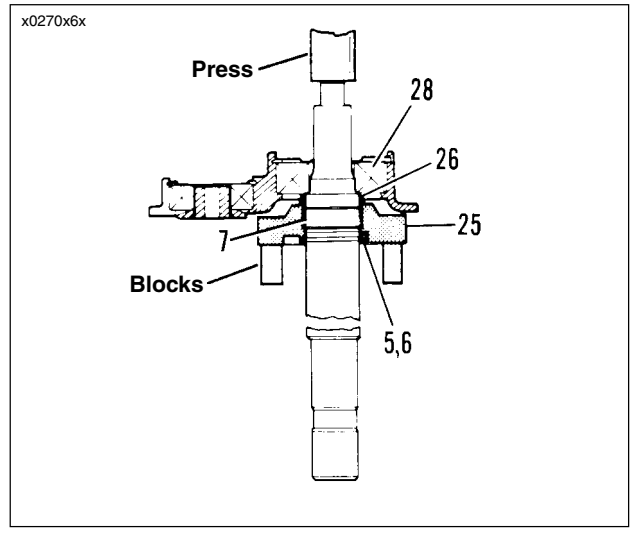


Figure 6-36.

14. Remove thrust washer (6). Expand and remove remaining retaining ring (5).

CLEANING, INSPECTION AND REPAIR

1. Clean all parts (except bearings) 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, cracked, battered, chipped, or dimpled.
4. Discard all retaining rings that were removed.

ASSEMBLY

CAUTION

During assembly, the split bearings (Item 7, Figure 6-36.) and the internal bores of the gears must be lubricated with SPORT TRANSMISSION FLUID prior to assembly. Leaving these parts dry could accelerate wear at start-up.

1. Find a section of pipe that matches the inner race of bearing (28).
2. See Figure 6-37. Place the door assembly, outside downward, on a press with the inner race of bearing (28) resting on the section of pipe. Insert the splined end of the shaft through the bearing and hold in a vertical position. Press the shaft into the bearing until the bearing bottoms against the shaft shoulder.

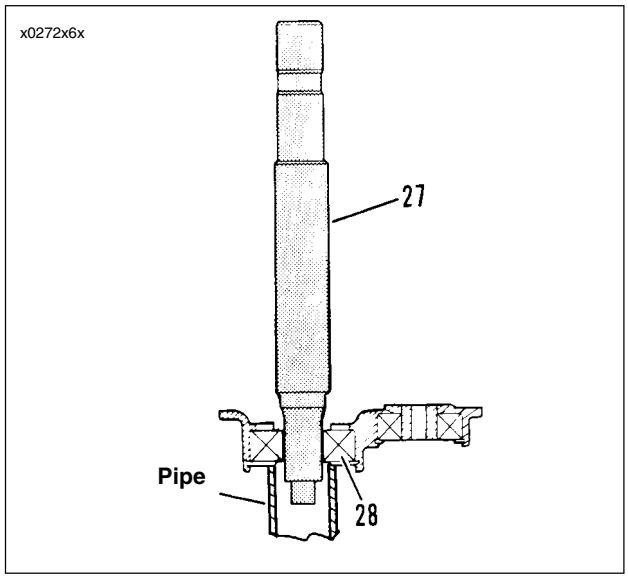


Figure 6-37.

3. See Figure 6-38. Place spacer (26) over main shaft and position next to bearing (28). Position split bearing (7) into machined seat next to spacer (26). Locate main shaft 4th gear (25), which can be identified by the two radial grooves at one side. Slide gear (25) onto shaft with radial grooves facing door. Position gear over bearing next to spacer (26).
4. Install thrust washer (6) and retaining ring (5) next to gear (25). It will be necessary to push the retaining ring into final position with a screwdriver.
5. Slide main shaft 1st gear (24) onto main shaft with the locking dogs facing gear (25).

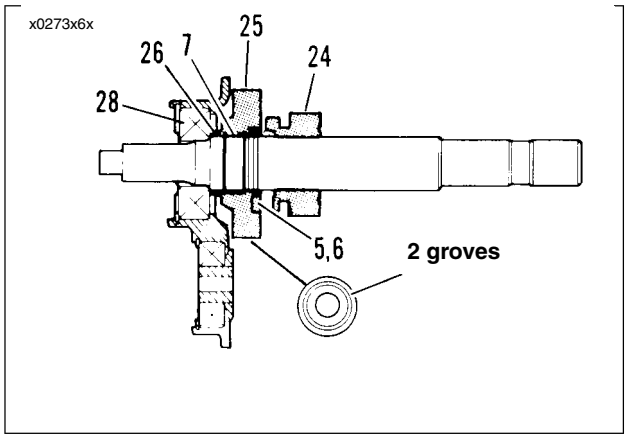


Figure 6-38.

6. See Figure 6-39. Install retaining ring (5). Position retaining ring in the second ring groove from the end with internal threads. Install thrust washer (6) next to retaining ring. Install split bearing (7) in seat next to washer (6).
7. Locate counter shaft first gear (8). Gear (8) has a ring groove at one side of the gear. Install gear (8) over split bearing (7).
8. Install thrust washer (6) and retaining ring (5) next to gear (8).
9. Locate counter shaft 4th gear (4). This gear is splined and has a single radial groove at one side. Position gear next to snap ring (5). Place beveled washer (3) over end of shaft with beveled side away from gear (4).

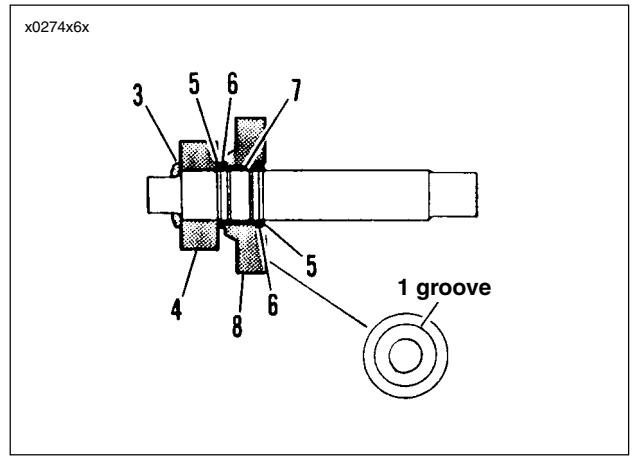


Figure 6-39.

10. See Figure 6-40. Stand counter shaft assembly on press with small end (end with threaded hole) upward. Place access cover and main shaft assembly on top of counter shaft with bearing (1) in access cover over end of countershaft. Place a socket or section of pipe on inner race of bearing (1). Hold assembly straight, making sure gear teeth on counter shaft are engaged with gear teeth on main shaft, and press bearing onto shaft until beveled spacer bottoms against bearing.

NOTE

When correctly installed, counter shaft 4th gear should have zero end play.

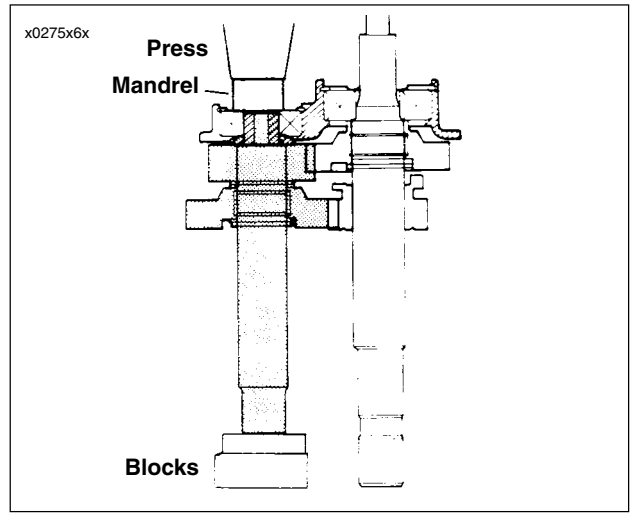


Figure 6-40.

11. See Figure 6-41. At main shaft, install retaining ring (5) and thrust washer (6). Install split bearing (7) in seat next to thrust washer (6).
12. Install main shaft 3rd gear (23) onto shaft over bearing (7).
13. Install thrust washer (6) and retaining ring (5) next to gear (23).
14. Install counter shaft 3rd gear (10) onto shaft.

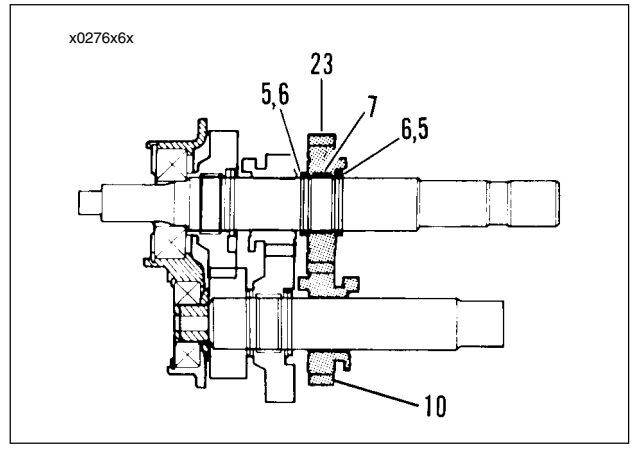


Figure 6-41.

15. See Figure 6-42. Install retaining ring (5) and thrust washer (6). Install split bearing (7) into seat next to thrust washer (6).
16. Install counter shaft 2nd gear (11) over bearing (7).
17. Install main shaft 2nd gear (22) onto shaft.
18. Install counter shaft 5th gear (12).
19. Expand retaining ring (5) and slide into groove next to counter shaft 5th gear (12).

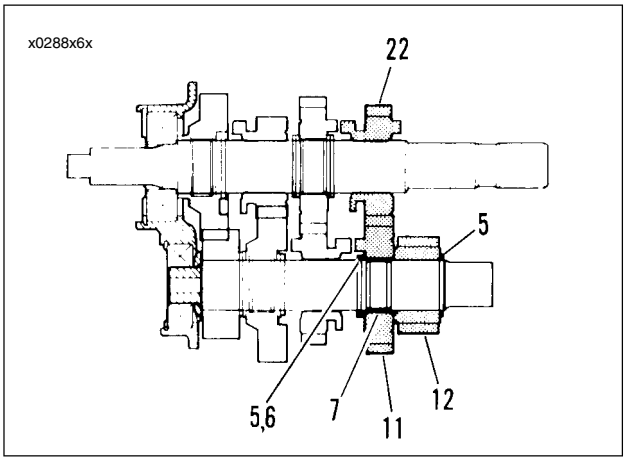
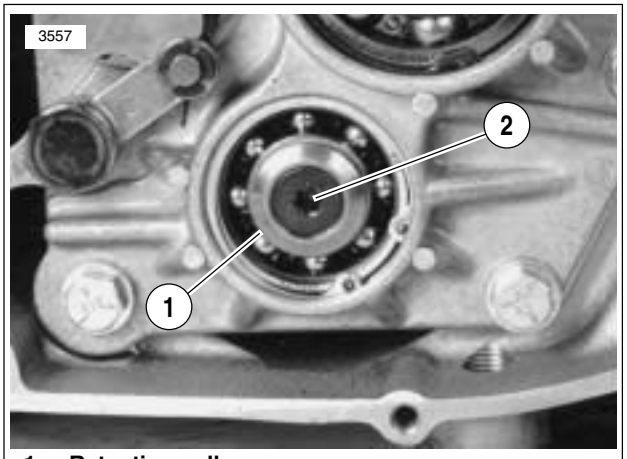


Figure 6-42.

20. See Figure 6-43. At outside of access door, position retention collar (1) next to end of counter shaft with beveled side facing outward. Apply a few drops of Loctite 242 blue to the threads of screw (2). Insert screw (2) through retention collar, and thread into end of shaft. Place transmission in gear, and tighten TORX screw to 13-17 ft-lbs (18-23 Nm).

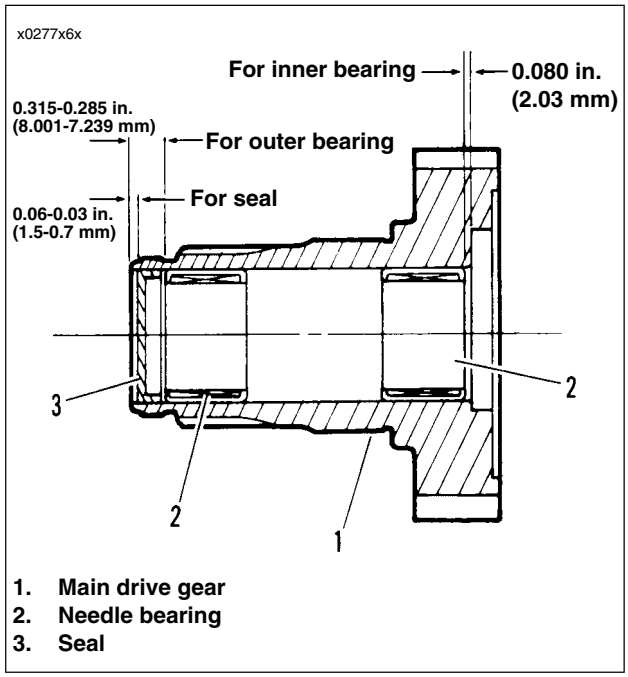


1. Retention collar
2. Screw

Figure 6-43.

REMOVAL

1. Remove transmission as described under 6.8 TRANSMISSION CASE.
2. See Figure 6-44. From inside case tap out seal (3) at end of main shaft 5th gear (1). Discard seal (3).



1. **Main drive gear**
2. **Needle bearing**
3. **Seal**

Figure 6-44. Main Drive Gear Assembly

CAUTION

When removing the main drive gear, the gear is pressed out against the resistance of the bearing inner race. Without any support at the inner race, the bearing is destroyed. Whenever the main drive gear is removed the main drive gear bearing will also have to be replaced

3. See Figure 6-45. See Figure 6-46. Use MAIN DRIVE GEAR REMOVER AND INSTALLER (Part No. HD-35316A) with CROSS PLATE (Part No. HD-35316-91). Take support bracket (1) and insert pins, at one side, into holes which are now exposed under access cover.
4. See Figure 6-46. Insert bolt (2) through support bracket (1) and 5th gear (3).
5. At outside of case, place driver (4) and thrust washer (5) over end of bolt (2). Install and tighten nut (6) until 5th gear (3) is free.

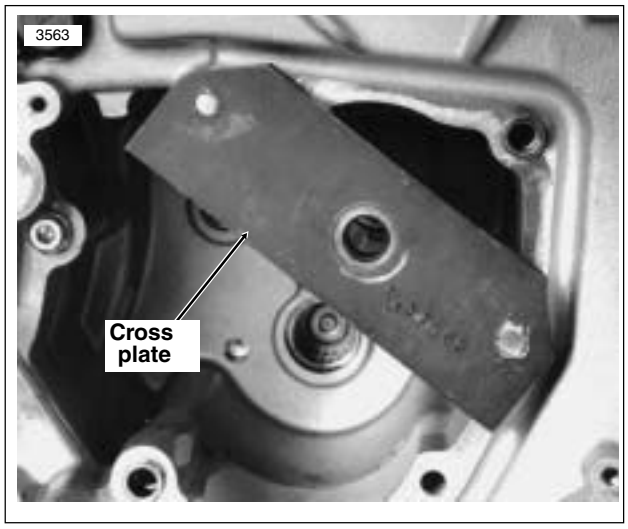
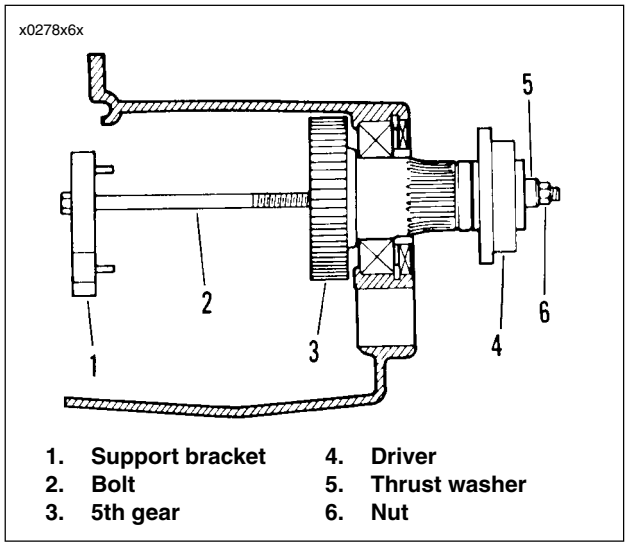


Figure 6-45. Support Bracket Mounting



1. **Support bracket**
2. **Bolt**
3. **5th gear**
4. **Driver**
5. **Thrust washer**
6. **Nut**

Figure 6-46. Removing Main Drive Gear

DISASSEMBLY

Drive out needle bearings, from inside bore of main drive gear. Do not reuse bearings after removal.

ASSEMBLY

1. Use INNER/OUTER MAIN DRIVE GEAR NEEDLE BEARING INSTALLATION TOOL (Part No. HD-37842A). See Figure 6-47. The tool is stamped 0.080 in. (2.032 mm) for the end of the tool to be used for driving the bearing into the inner end and 0.315 (8.001 mm) for the outer end bearing.
2. Place main drive gear on a press. With the bearing installation tool, press in the outer bearing to a depth of 0.315-0.285 in. (8.001-7.239 mm). Press in the inner bearing to a depth of 0.080 in. (2.032 mm). The installation tool will automatically bottom on the gear when the correct depth is reached.

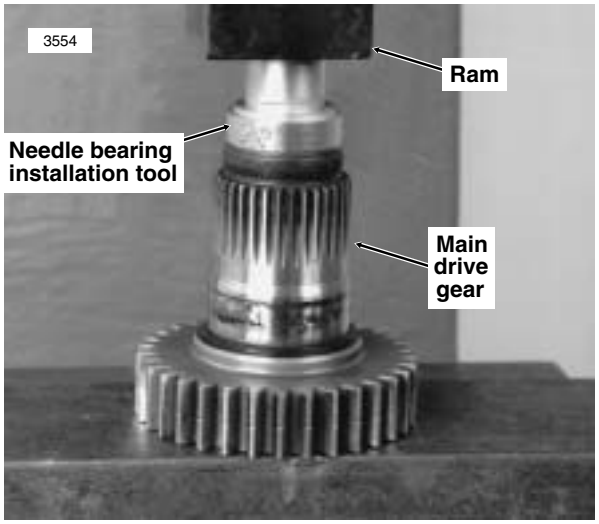
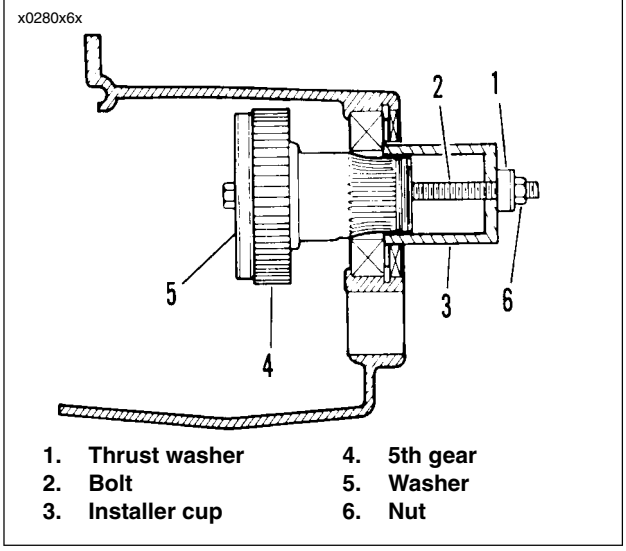


Figure 6-47. Needle Bearing Installation Tool

INSTALLATION

1. Replace main drive gear bearing as instructed under 6.13 RIGHT TRANSMISSION CASE BEARINGS.
2. See Figure 6-48. Use Main Drive Gear Remover and Installer Tool. Take bolt (2) and place washer (5) followed by main drive gear (4) over end of bolt. From inside of case insert bolt and main drive gear through inner race of ball bearing.
3. Insert threaded end of bolt (2) through installer cup (3) and thrust washer (1). Thread nut (6) onto end of bolt (2). Tighten nut (6) until shoulder on gear (4) bottoms against inner race of bearing.
4. See Figure 6-44. Tap in new seal (3) at threaded end of 5th gear.



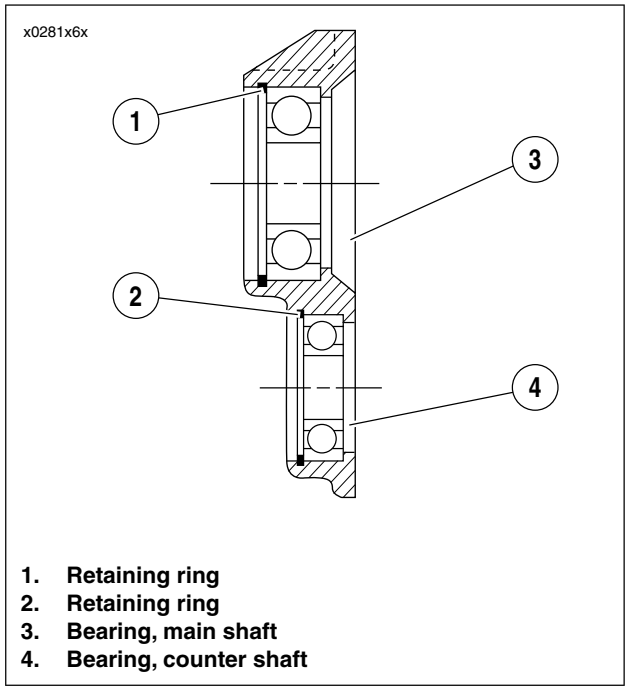
1.	**Thrust washer**	**4.**	**5th gear**
2.	**Bolt**	**5.**	**Washer**
3.	**Installer cup**	**6.**	**Nut**

Figure 6-48. Main Drive Gear Installation

REMOVAL

Mainshaft and Countershaft Bearings

1. Remove transmission assembly as described under 6.8 TRANSMISSION CASE. Remove shifter forks and drum as described under 6.9 SHIFTER FORKS AND DRUM. Remove counter shaft and main shaft as described under 6.10 MAIN SHAFT AND COUNTER SHAFT.
2. Inspect the main shaft and counter shaft ball bearings for pitting, scoring, discoloration, or other damage.
3. See Figure 6-49. If bearing replacement is required, remove retaining rings (1) and (2). Press out bearings (3) and (4) from the inside of the door.



1. Retaining ring
2. Retaining ring
3. Bearing, main shaft
4. Bearing, counter shaft

Figure 6-49. Ball Bearing Assembly

Shift Drum Bushing

Inspect the shifter drum bushing for pitting, scoring, discoloration, or excessive wear.

If bushing requires replacement press bushing out of door from either side.

INSTALLATION

Mainshaft and Countershaft Bearings

1. Lay access door on press with inside surface of door downward.
2. Lay bearing squarely over bore with printed side of bearing upward. Place section of pipe or tubing (slightly smaller than outside diameter of bearing) against outer race. Press bearing into bore until bearing bottoms against shoulder.
3. Install new retaining ring with beveled side facing away from bearing.

Shift Drum Bushing

1. Lay access door on press with outside surface of door downward.
2. See Figure 6-50. Lay bushing squarely over bore. Locate socket or pipe that is slightly larger than diameter of bushing. Place socket or pipe on bushing and press into bore until bushing is flush with or 0.020 in. (0.51 mm) below inside surface. If using a pressing tool larger than diameter of bushing, the pressing tool will bottom against door when bushing is flush with top surface.

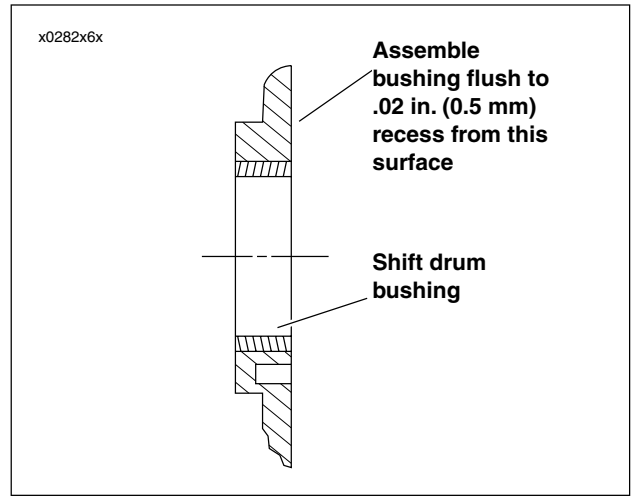


Figure 6-50. Shift Drum Bushing Assembly

REMOVAL

1. Remove transmission assembly as described under 6.8 TRANSMISSION CASE earlier in this section. Remove main drive 5th Gear as described under 6.11 MAIN DRIVE GEAR.
2. At outside of case remove seal next to 5th gear bearing retainer. Remove retaining ring.
3. From inside transmission case drive bearings (5th gear, counter shaft or shifter shaft) out of bores. Carefully tap bearings free by working around bearing diameter to keep bearing from skewing.

INSTALLATION

Mainshaft 5th Gear Ball Bearing

1. See Figure 6-51. Locate Main Drive Gear Remover and Installer Tool. Place support bracket pins in appropriate holes in transmission case.
2. See Figure 6-52. Insert bolt (2) through cross plate (1), new bearing (3), driver (4) and thrust washer (5). Thread nut (6) on end of bolt. Tighten nut carefully until bearing is started in bore squarely. Tighten nut (6) until bearing is seated against shoulder in bore.
3. At outside of case install beveled retaining ring in groove inside bearing bore with beveled side facing outside of case.
4. Lubricate bearing with Sport Transmission Lube.

Countershaft Needle Bearing

1. Find a suitable bearing driver 1-1/4 in. (31.75 mm) in diameter.
2. From the outside of the case place the needle bearing open end first next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when it is driven inward flush or 0.030 in. (0.76 mm) below the outside surface of the case.
3. Lubricate bearing with Sport Transmission Lube.

Shift Drum Needle Bearing

1. Find a suitable bearing driver 13/16 in. (20.64 mm) in diameter.
2. From the outside of the case place the needle bearing, open end first, next to the bearing bore. Hold the driver squarely against the closed end of the bearing and tap the bearing into place. The bearing is properly positioned when driven inward flush or 0.030 in. (0.76 mm) below the outside surface.
3. Lubricate bearing with Sport Transmission Lube.

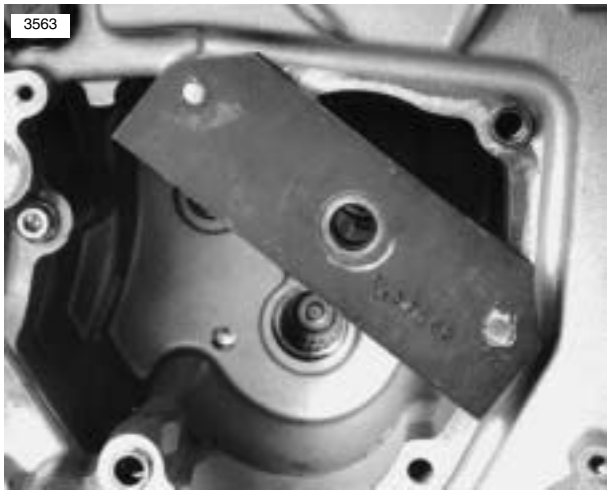
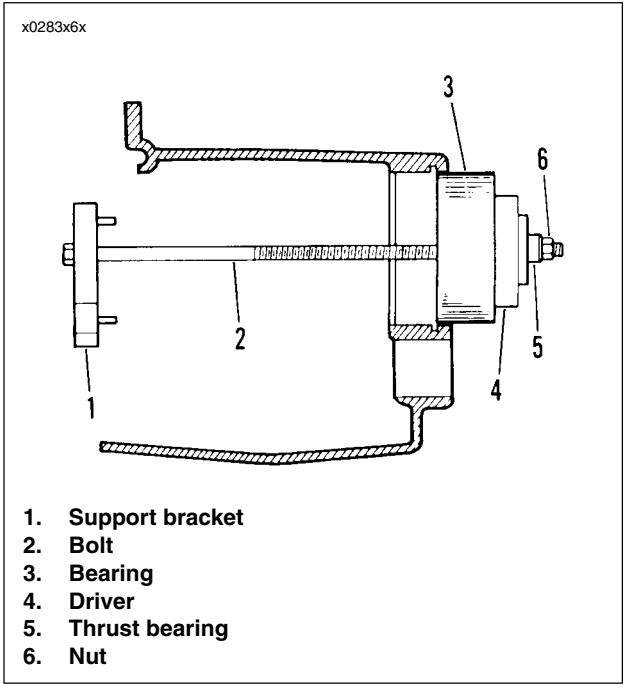


Figure 6-51. Cross Plate Mounting



1. **Support bracket**
2. **Bolt**
3. **Bearing**
4. **Driver**
5. **Thrust bearing**
6. **Nut**

Figure 6-52. Installing Main shaft Ball Bearing

PROCEDURE

Verify that all parts have been properly installed, as described under 6.13 RIGHT TRANSMISSION CASE BEARINGS, 6.11 MAIN DRIVE GEAR, 6.10 MAIN SHAFT AND COUNTER SHAFT, and 6.9 SHIFTER FORKS AND DRUM.

1. Carefully insert transmission into case opening. Position the assembly so that the main shaft enters fifth gear, and so that the counter shaft and drum shifter shaft enter their respective bearings.

2. See Figure 6-24. Apply a few drops of LOCTITE Threadlocker 242 (blue) to the threads of the five access door mounting bolts (5). Insert the bolts with washers (6) through holes in access door, and thread into tapped holes in right transmission case. Tighten bolts to 13-17 ft-lbs (18-23 Nm).

3. Lift pawl (4) over drum pins, and place shifter shaft assembly (1) on studs at transmission case. Loosely install a washer (3) and locknut (2) on each stud.

4. Attach the loop of spring (8) over and into groove in post (7).

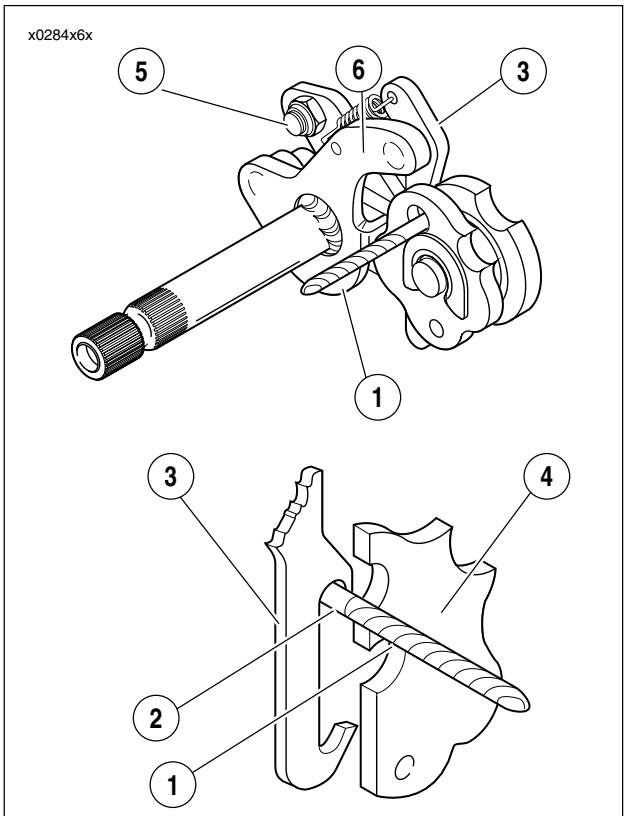
5. Place detent plate (10) over drum pins. Rotate plate until blind holes in plate align with pins in end of drum shaft. Install new retaining ring (11) using TRANSMISSION SNAP RING TOOL (Part No. HD-39151). Verify that retaining ring is fully engaged with drum groove.

6. See Figure 6-53. Place transmission in third gear. Place a No. 32 drill bit (0.116 in. dia.) (1) through hole in detent plate (4), and between pawl (3) and drive pin at end of shifter drum shaft. Push down top of crank (6) to remove all clearance between pawl and drill bit; this will correctly align pawl to shift drum pins (do not push down with too great a force, as this might cause the shifter drum to rotate). With bit in place, tighten shifter shaft assembly bottom nut (5) first to 90-110 **in-lbs** (10.2-12.4 Nm). Then, tighten shifter shaft assembly top nut (5) to the same torque.

7. Remove drill bit.

8. See Figure 6-32. Place new quad ring (15) over threaded end of fifth gear (23), and position next to the gear taper. Install spacer (16) over threaded end of fifth gear with chamfered end toward quad ring. Slide spacer up against bearing (20).

9. Coat lips of seal (17) with SPORT TRANS FLUID. Position seal over spacer (16) with lips of seal toward case. Gently tap seal into bore of case until the outside of seal is flush with outer edge of bore. It is acceptable to recess seal to about 0.030 in. (0.76 mm) below outer edge of bore; seal recession will be limited by seal bottoming against retaining ring (19).



1. No. 32 drill bit (0.116 in. dia.)
2. Shifter drum pin
3. Pawl
4. Detent plate
5. Nut
6. Crank

Figure 6-53. Shifter Shaft Assembly Alignment

TRANSMISSION SPROCKET INSTALLATION

1. See Figure 6-54. Install transmission sprocket (2) with secondary drive belt onto main drive gear shaft (1).
2. Place transmission in neutral. Apply a few drops of LOCTITE THREADLOCKER 262 (red) to the **left-hand threads** of transmission sprocket nut (3). Position nut with washer-faced side facing transmission sprocket. Turn the nut **counterclockwise** to install it onto main drive gear shaft.
   a. Use TRANSMISSION SPROCKET HOLDING TOOL, HD-41321 and MAINSHAFT LOCKNUT WRENCH, Part No. HD-94660-37B, and a torque wrench. Tighten nut to 50 ft-lbs (67.8 Nm) **initial** torque, ONLY.
   b. See Figure 6-55. Scribe a line on the transmission sprocket nut and continue the line on the transmission sprocket as shown.
   c. Tighten the transmission sprocket nut an additional 30° - 40°.
   d. See Figure 6-54. Install lock plate (4) over nut (3) so that two of lock plate's four drilled holes (diagonally opposite) align with sprocket's (2) two tapped holes.

NOTE

The lock plate has four screw holes and can be turned to either side, so you should be able to find a position without having to additionally tighten the nut. If you cannot align the screw holes properly, the nut may be additionally TIGHTENED until he screw holes line up, but do not exceed 45° as specified above. Never LOOSEN nut to align the screw holes.

CAUTION

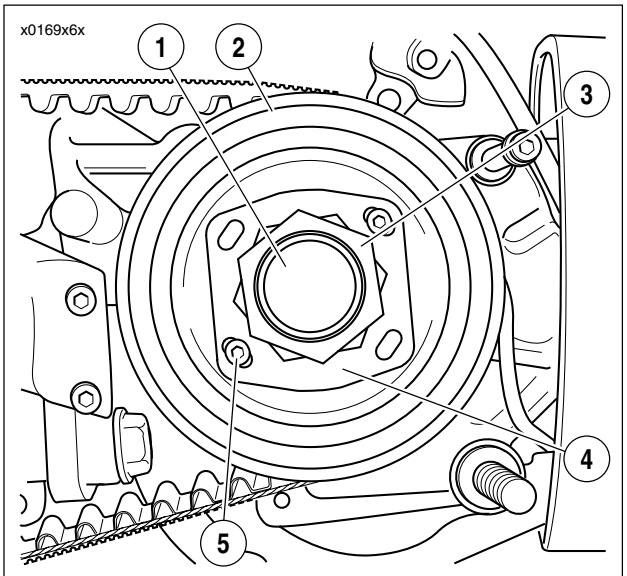
Maximum allowable tightening of sprocket nut is 45° of counterclockwise rotation, after initially tightening to 50 ft-lbs. Do not loosen sprocket nut while attempting to align the screw holes. If you cannot align lock plate and sprocket screw holes, nut may be additionally tightened until screw holes line up, but do not exceed 45° as specified above. Tightening too much or little may cause the nut to come loose during vehicle operation.

   e. Install socket head screws through two of the four holes in lock plate (4), then into two corresponding tapped holes in sprocket.

CAUTION

To ensure the lock plate's security, you must use BOTH screws when you install the lock plate.

3. Tighten socket head screws (5) to 7-9 ft-lbs (9-12 Nm).
4. Install primary chain and chain case as described under 6.6 PRIMARY DRIVE/CLUTCH ASSEMBLY.
5. Align vehicle and adjust belt tension. See INSTALLATION, Adjusting Wheel Alignment under 2.13 TIRES.



1. Main drive gear shaft
2. Transmission sprocket
3. Transmission sprocket nut
4. Lockplate
5. Socket head screw (2)

Figure 6-54. Transmission Sprocket

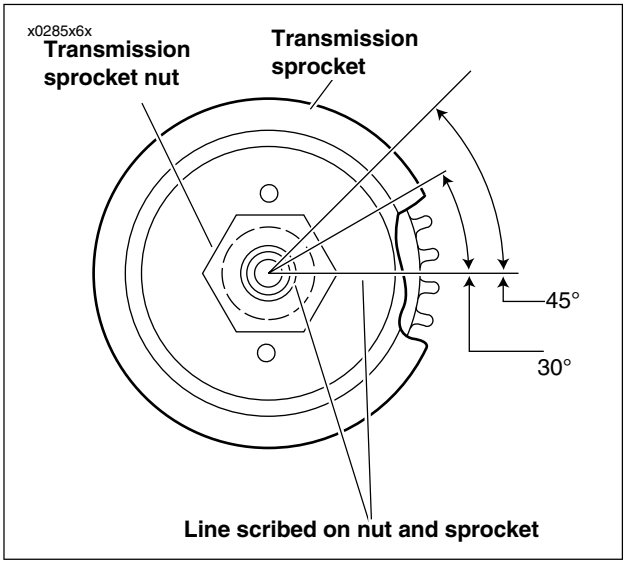


Figure 6-55. Transmission Sprocket Nut Final Tightening Procedure

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7.4 Ignition Timing	7-11
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ELECTRICAL 7

IGNITION

Spark Plugs

Size . . . . . 12 mm
Gap (in.) 0.038-0.043
Gap (mm) . . . . . 0.97-1.09 mm
Type HD-6R12
Torque Value (ft-lbs) 11-18
Torque Value (Nm) 15-24

Table 7-1. Ignition Coil Resistance

RESISTANCE	PRIMARY	SECONDARY
ALL EXCEPT 1200S	2.5-3.1 Ohms	10,000-12,500 Ohms
1200S	.4 -.6 Ohms	11,500-12,700 Ohms

Table 7-2. Ignition Timing Spark Occurrence

IDLE	V.O.E.S.	
	CONNECTED	DISCONNECTED
All models except 1200S Normal 1000 - 1050 RPM*	20˚ BTDC	Approximately 7.5˚ BTDC

*Set timing at 1000-1050 RPM with V.O.E.S. connected.

Timing plug torque . . . . . 10-15 ft-lbs (14-21 Nm)

NOTE

XL1200S Sport-set timing at 1000-1050 RPM-15˚ BTDC

ALTERNATOR

AC Voltage Output . . . . . .19-26 VAC per 1000 engine RPM
Stator Coil Resistance . . . . . 0.2-0.4 Ohms

REGULATOR

Voltage output @ 75˚F . . . . . 14.3-14.7 VDC
Amperes @ 3600 engine RPM . . . . . 22 Amps
BATTERY
All Models. . . . . .12 volt, 19 Ampere Hours

FUSES

Table 7-3. Amp Ratings

ITEM	AMP RATING
IGNITION	15
LIGHTS	15
ACCESSORY	15
INSTRUMENTS	15

MAIN CIRCUIT BREAKER

All Models. . . . . 30 Amps

BULB CHART

Refer to the table below for information regarding bulbs and lamps used on the Harley-Davidson XLH motorcycle.

Table 7-4. Bulb Chart

LAMP DESCRIPTION (ALL LAMPS 12 V)	NUMBER OF BULBS REQUIRED	CURRENT DRAW (AMPERES)	HARLEY-DAVIDSON PART NUMBER
Headlamp – H4 Bulb Element High Beam/Low Beam	1	5.00/4.58	67697-81
Position Lamp (HDI)	1	.32	53438-92
INDICATOR LAMPS			
High Beam	1	0.15	68024-94
Oil Pressure	1	0.15	68024-94
Neutral	1	0.15	68024-94

Table 7-4. Bulb Chart

LAMP DESCRIPTION (ALL LAMPS 12 V)	NUMBER OF BULBS REQUIRED	CURRENT DRAW (AMPERES)	HARLEY-DAVIDSON PART NUMBER
Directional	2	0.15	68024-94
DIRECTIONAL/RUNNING LAMPS			
Front Directional/Running Lamps	2	2.25/0.59	68168-89
Rear Directional	2	2.25	68572-64B
Front/Rear (HDI)	2	1.75	68163-84
Tail/Stop Lamp	1	0.59/2.25	68168-89
Tail/Stop Lamp (HDI)	1	0.42/1.75	68169-90

GENERAL

See Figure 7-1. To provide for easy access and servicing, the electrical bracket is located under the left side cover and includes the following electrical components:

- Main circuit breaker (30 Amp)
- Fuse Block (under starter relay and data port)
- Starter relay
- Data link (1200S only)

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. If necessary, disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. Gently pull side cover away from frame tubes (no tools required).

INSTALLATION

1. Align barbed studs in side cover with grommets in frame and push firmly into place (no tools required).

⚠WARNING

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

2. If necessary, install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.

REPLACE FUSE(S)

Removal

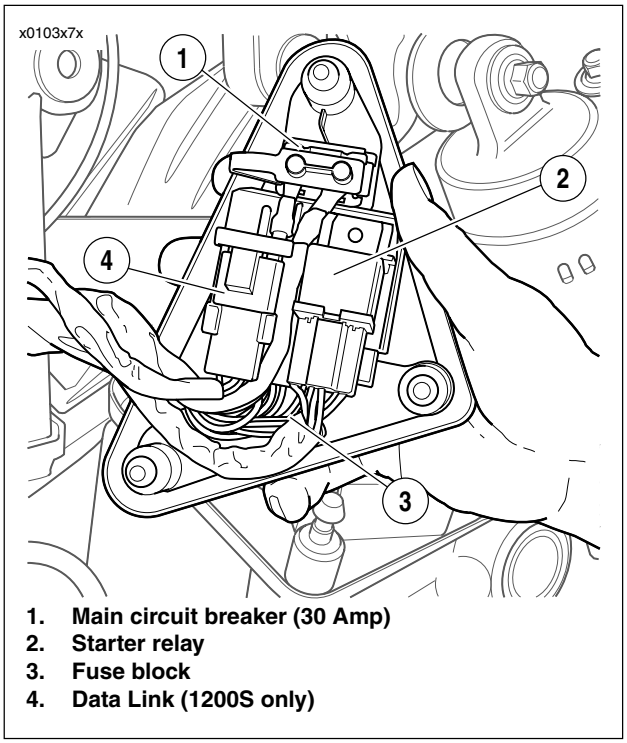
1. Remove side cover.
2. See Figure 7-2. Pull up on latch to release fuse block and slide fuse block from electrical bracket.
3. Pull fuses from slots in fuse holder and inspect for damage. Replace as necessary.

NOTE

A fuse puller tool and two spare 15 amp fuses are located in the base of the electrical bracket under the fuse block.

⚠CAUTION

Always use replacement fuses that are of the correct type and value. Use of incorrect fuses can result in damage to the electrical system.



1. **Main circuit breaker (30 Amp)**
2. **Starter relay**
3. **Fuse block**
4. **Data Link (1200S only)**

Figure 7-1. Electrical Bracket

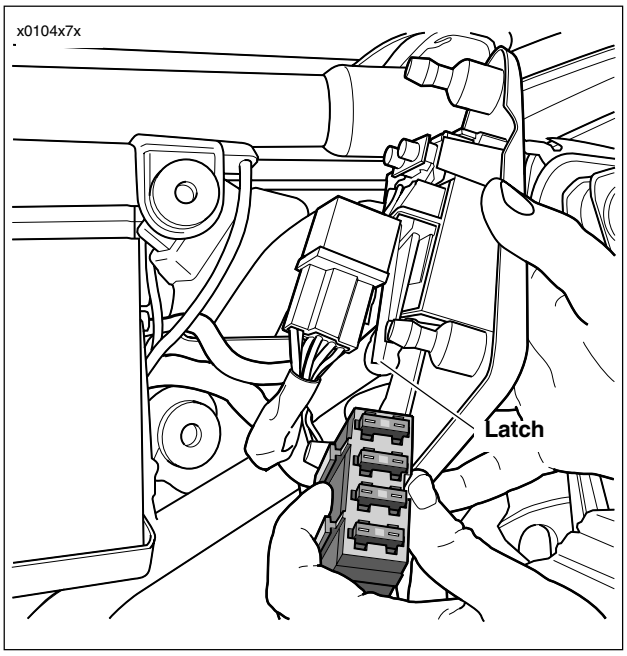


Figure 7-2. Fuse Block

INSTALLATION

1. Insert fuse(s) (15 amp) in appropriate slot.
2. Align fuse block so guides engage slots in bracket assembly.
3. Slide fuse block into bracket assembly until latch engages.
4. Install side cover.

REPLACE MAIN CIRCUIT BREAKER

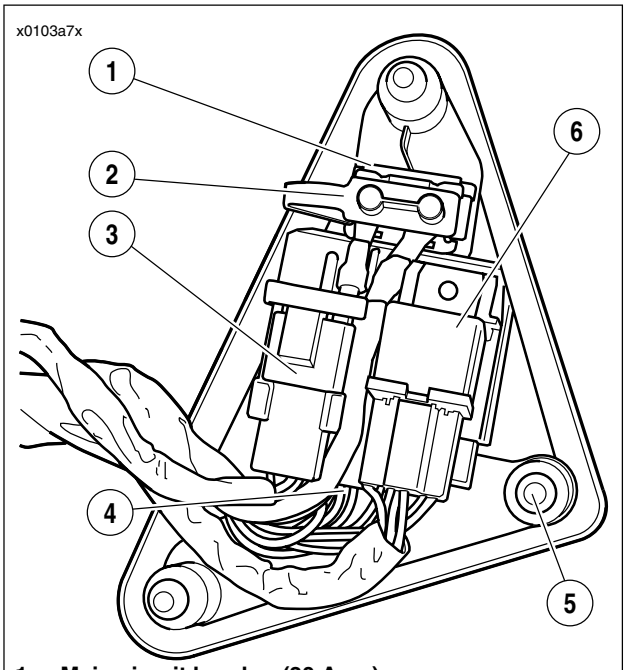
1. Remove left side cover.
2. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
3. See Figure 7-3. Remove plastic cover (2) from terminal studs of main circuit breaker (1). Remove hex nuts from terminals. Remove ring connections.
4. Gently pry up latch holding main breaker and remove.
5. Obtain new main circuit breaker.
6. Install single black lead on copper terminal. Install double red lead on remaining terminal. Install and tighten terminal nuts. Install plastic cover on terminal studs.
7. Push main circuit breaker into clip on electrical bracket.
8. Install electrical bracket. See 7.2 ELECTRICAL BRACKET INSTALLATION.

REPLACE STARTER RELAY

1. Remove left side cover.
2. See Figure 7-3. Unplug starter relay (6).
3. Lift gently on the connector end to release tab and free relay.
4. See Figure 7-4. Position locating hole in relay over raised tab on electrical bracket and push into position.
5. Connect plug to new relay.
6. Install electrical bracket. See 7.2 ELECTRICAL BRACKET INSTALLATION.

REPLACE ELECTRICAL BRACKET

1. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. Access electrical bracket. See 7.2 ELECTRICAL BRACKET REMOVAL.
3. See Figure 7-3. Remove main breaker (1).
4. Remove fuse block (4).
5. Remove starter relay (6).
6. On 1200S-remove Data Link (3).
7. Remove the three screws holding the bracket to the side cover.
8. Position new electrical bracket in place and fasten with three screws.
9. Install main breaker, fuse block, starter relay and, on 1200S models, the data link.
10. Install side cover.



1. **Main circuit breaker (30 Amp)**
2. **Plastic cover**
3. **Data Link (1200S only)**
4. **Fuse block**
5. **Retaining studs**
6. **Starter relay**

Figure 7-3. Electrical Bracket Components

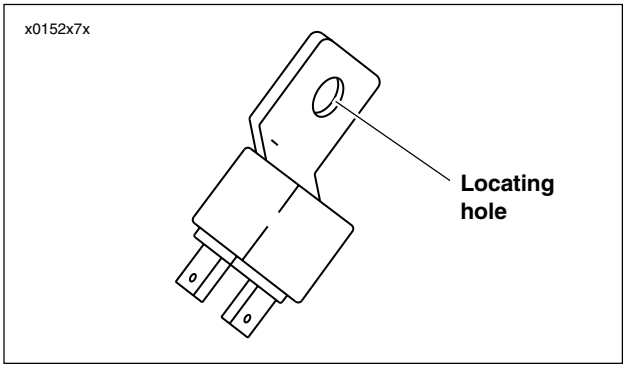


Figure 7-4. Starter Relay

GENERAL

See Figure 7-5. See Figure 7-6. The vehicle is provided with a breakerless inductive-discharge ignition system. The system has both a primary and 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, spark plugs and associated wiring.

The computerized ignition system consists of four assemblies – the computerized ignition module, vacuum-operated electric switch (V.O.E.S.), the bank angle sensor and the rotor.

The ignition module is mounted in the gear case cover. The ignition module has two functions. First, it computes the spark advance for proper ignition timing. 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.) is attached to the top center engine mounting bracket above the intake manifold. The V.O.E.S. senses intake passage vacuum through a carburetor hose connection. The switch is open during acceleration and high engine load conditions (low vacuum) and is closed during deceleration and low engine load conditions (high vacuum). The ignition module is programmed with two spark advance curves to meet varying engine loads.

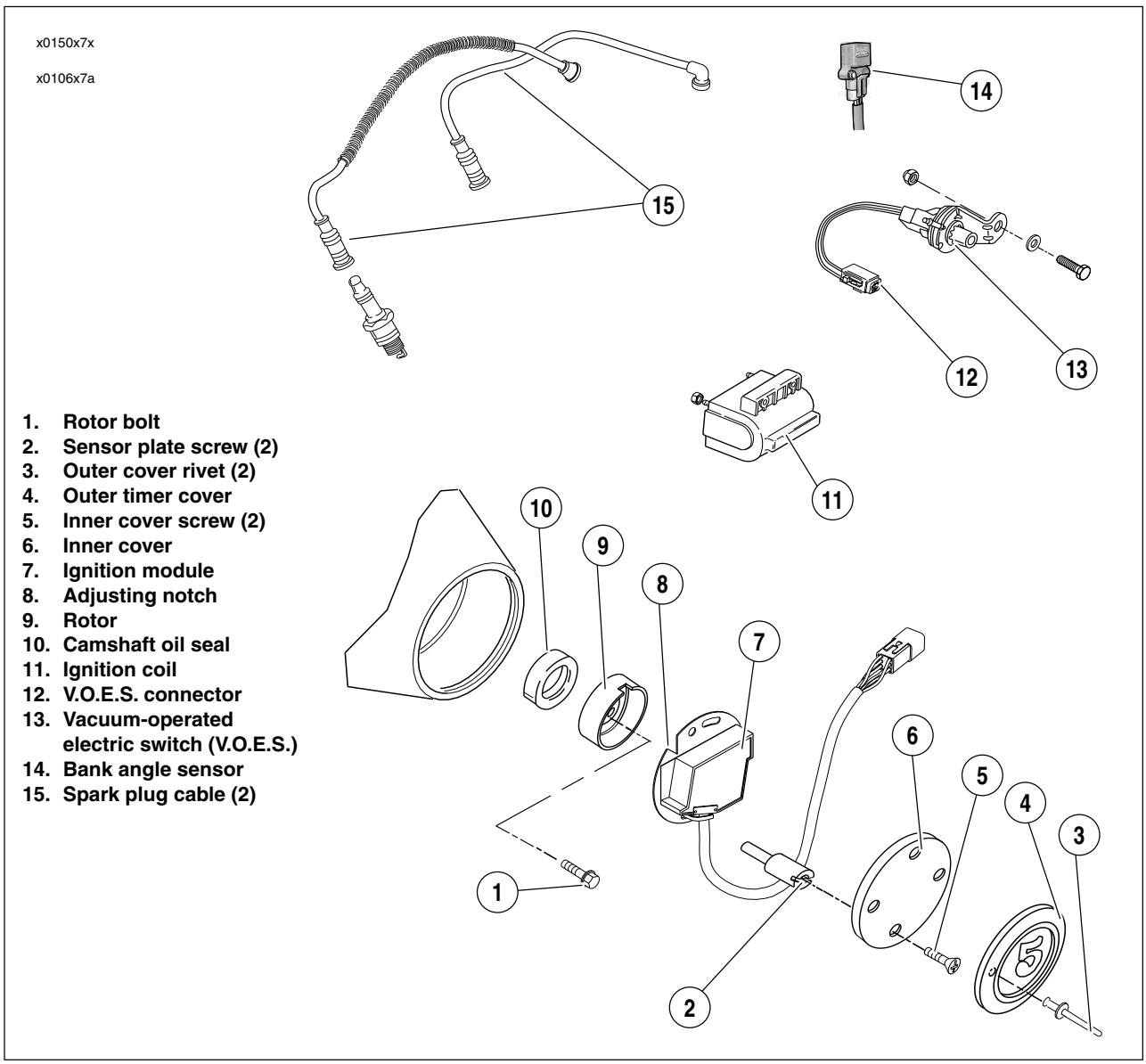


Figure 7-5. Ignition System Components (except 1200S)

See Figure 7-5. See Figure 7-6. 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).

The ignition module selects the proper curve when it receives an open or closed electrical signal from the V.O.E.S. This system ensures correct timing to suit starting and low- and high-speed requirements.

The bank angle sensor is attached to the side of the battery tray. The sensor consists of a magnet that rides in a channel filled with fluid. If the vehicle lean angle exceeds 55°, the magnet moves to create an open circuit. The open circuit is detected by the ignition module and the ignition system is shut off.

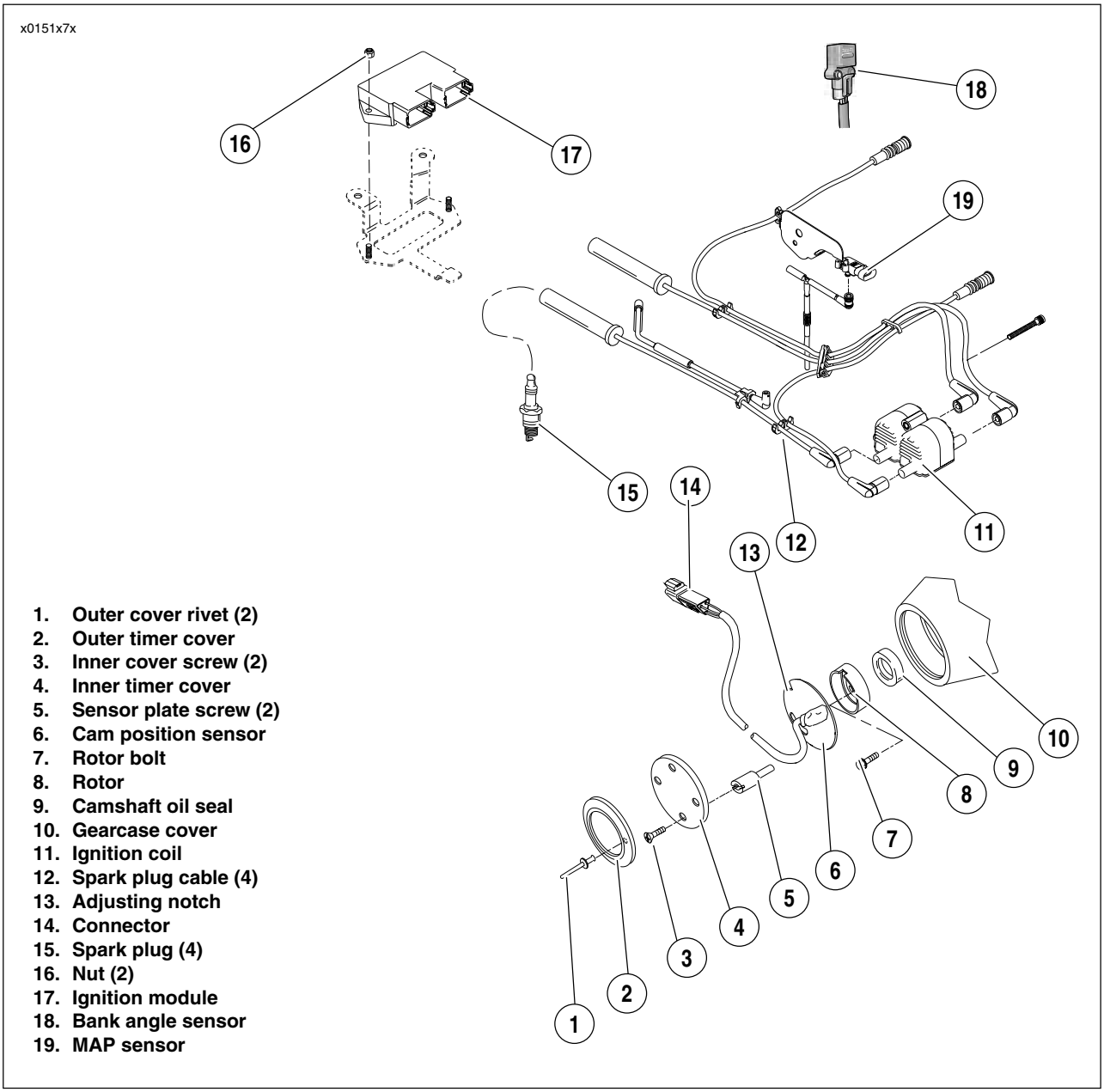


Figure 7-6. Ignition System Components 1200S Sport

A single ignition coil fires both spark plugs simultaneously. The spark plug in the front cylinder fires at the end of that cylinder's compression stroke, thereby igniting the air/fuel mixture. At the same instant, the spark in the rear cylinder fires ineffectually during the end of that cylinder's exhaust stroke. During the next engine revolution, the simultaneous firing of the spark plugs will occur during the middle of the front cylinder's exhaust stroke and at the end of the rear cylinder's compression stroke (thereby igniting the air/fuel mixture in the rear cylinder).

The rotor and cam position sensor (intigrated with the Ignition Module) are located in the gearcase cover on the right side of the motorcycle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. As the rotor turns, slots in its outside diameter break the magnetic field of a Hall-effect device in the ignition module. 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.

The ignition system produces a spark near top dead center (TDC) for starting. At rpm's and loads above this, the system produces a spark 0˚ to 45˚ before TDC on 883 and 1200 models. The whole timing program can be shifted by mechanical rotation of the cam position sensor. See 7.4 IGNITION TIMING.

The ignition module contains all the solid-state components used in the ignition system. The dwell time for the ignition coil is also calculated by the microprocessor and is dependent upon engine speed. The programmed dwell is an added feature to keep battery drain to a minimum and to adequately charge the coil at all speeds. The ignition module has added protection against transient voltages, continuous reverse voltage protection and damage due to jump starts. The system will operate down to 5.7 volts DC. The ignition module is fully enclosed in a "potting" material to protect it from vibration, dust, water and oil. The unit is not repairable –it must be replaced if it fails.

See the wiring diagrams at the end of this section for additional information on ignition system circuits.

1200 Sport

The XL Sport ignition differs from other Sportsters. The ignition system consists of five assemblies, the ignition module, cam position sensor, rotor, Bank angle sensor, and the MAP (Manifold Absolute Pressure) sensor.

The ignition module is located under the seat. It computes the spark advance for proper ignition timing and regulates the low-voltage circuits between battery and ignition coil.

The ignition timer includes a rotor, cam position sensor, ignition module and MAP sensor. A twin coil fires each pair of spark plugs in single fire mode (i.e. both spark plugs fire in one cylinder but not the other-no wasted spark).

The MAP sensor is located on a bracket along the frame backbone under the fuel tank. The sensor monitors the intake manifold pressure and adjusts the advance curve for optimum performance.

The bank angle sensor is attached to the side of the battery tray. The sensor consists of a magnet that rides in a V-shaped channel. If the vehicle lean angle exceeds 55º, the magnet moves to create an open circuit. The open circuit is detected by the ignition module and the ignition system is shut off.

TROUBLESHOOTING

Perform the following tests if the engine will not start, or if hard starting or missing indicates a faulty operating ignition system.

Check for Ignition 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 end and establish a 3/16 inch (4.8 mm) gap between adapter and cylinder head. Turn on ignition and "engine stop" switches. With transmission in neutral, press "engine start" button. Check for a spark across plug electrode gap. If a spark is produced, problem is not in electronic system or coil – check carburetion, enrichener and spark plugs. If no spark is produced, check battery voltage and battery connection condition. Battery voltage must be 11-13 vdc. Charge battery if voltage is low.
3. Verify that the ground wire from battery to frame is in good condition. If there is still no spark, then perform the tests under No Ignition Spark.

No Ignition Spark

See Figure 7-7. To conduct the following tests, it will be necessary to assemble a set of jumper wires. Cut two wires of ample length to reach from a good ground connection to the negative terminal of the coil primary. If a suitable capacitor is not available, use a condenser (such as the type used in earlier breaker point ignition systems). When conducting Steps 3 and 5 of the following spark tests, connect a spare spark plug to one of the plug wires and lay the spark plug on the engine cylinder head. During the testing procedures, check for spark across the spark plug electrodes.

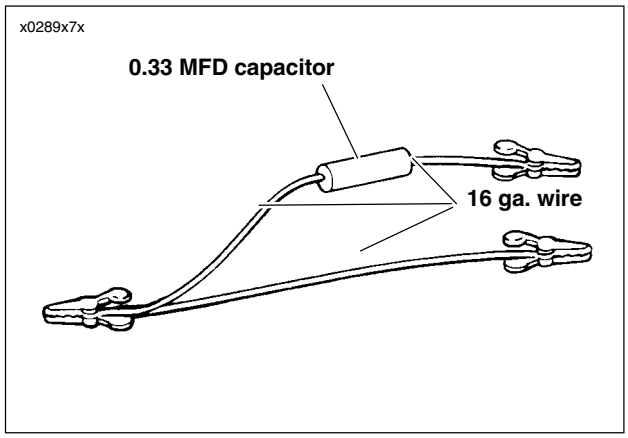


Figure 7-7. Test Jumper

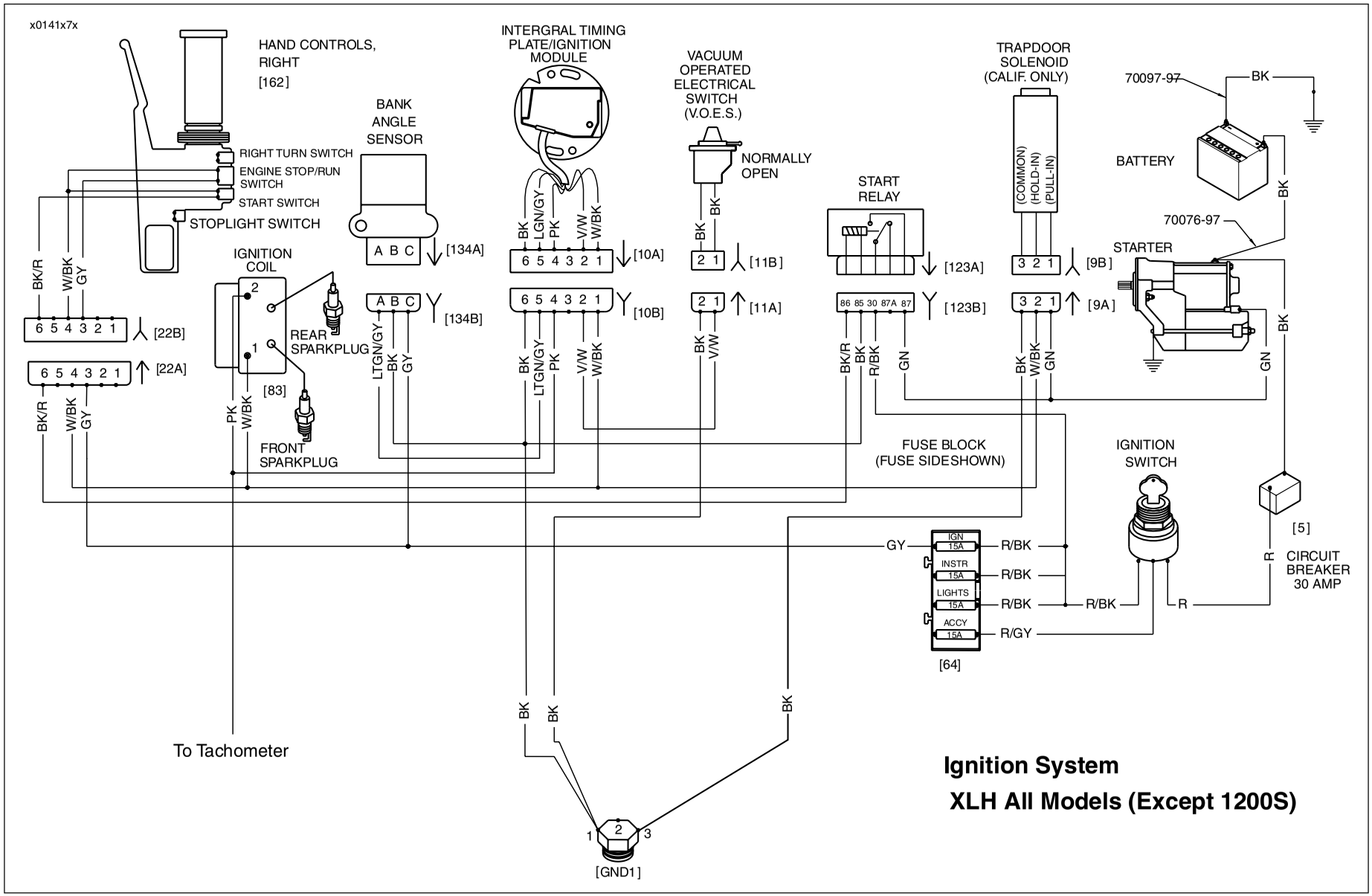


Figure 7-8. Ignition System-All except 1200S

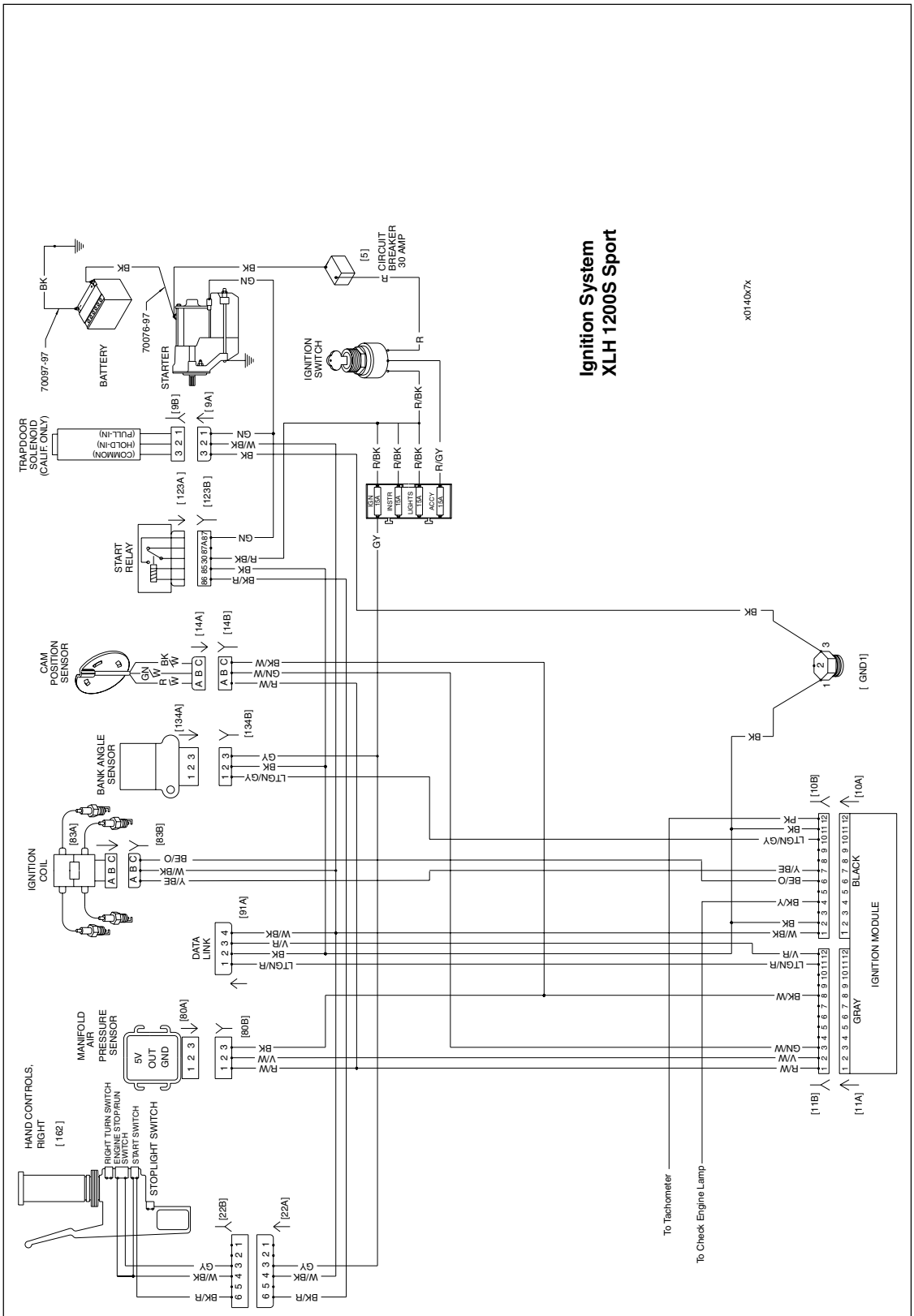


Figure 7-9. Ignition System-1200S

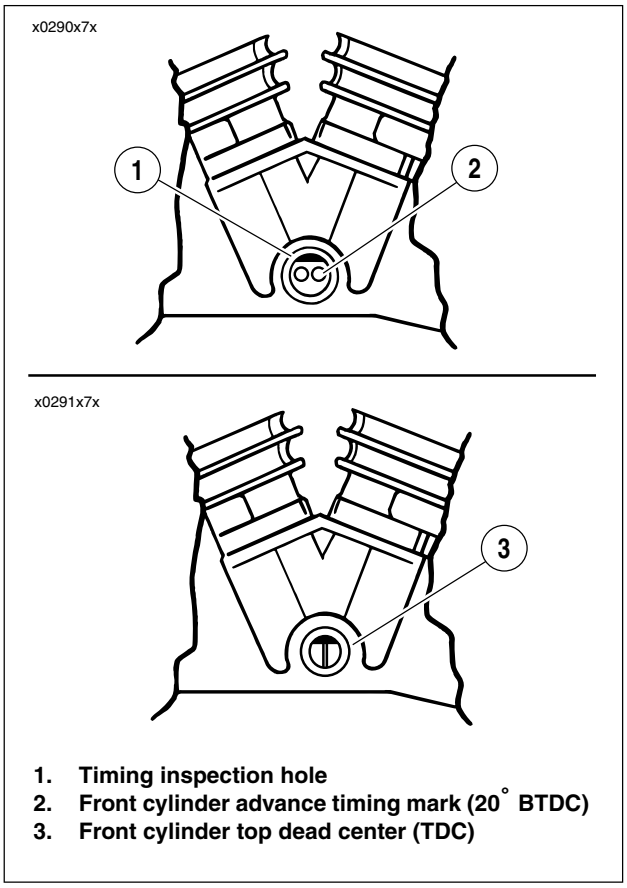
STATIC TIMING-1200S

1. See Figure 7-6. Locate outer timer cover (2) at bottom of gearcase cover (10) on right side of vehicle.

⚠WARNING

Always wear proper eye protection when drilling. Flying debris may result in serious eye injury.

2. Drill off heads of outer timer cover rivets (1) using a 1/8-inch drill bit. Use a punch to tap rivet shafts inboard through holes in outer timer cover. Remove outer timer cover (2).
3. Remove two Phillips screws (3) to free inner timer cover (4). 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. Remove the timing plug from the timing inspection hole centered below the cylinders on the right side of the crankcase.
6. Remove the spark plugs.
7. Jack up vehicle to allow rotation of the rear wheel.
8. 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).
9. See Figure 7-10. Rotate rear wheel until TDC mark (vertical line, see lower frame) is centered in timing inspection hole.
10. Install Breakout Box. See SPORTSTER MODELS ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02) for more information on Breakout Box (Part No.HD-42682).
11. Turn the Ignition/Light Key Switch to IGNITION.
12. Loosen two screws and rotate the cam position sensor plate just until the voltmeter registers the change from 5 VDC (±0.5 VDC) to 0-1 VDC.
13. Tighten sensor plate screws to 15-30 **in-lbs** (1.7-3.4 Nm).
14. Install spark plugs, shift transmission into Neutral and remove jack.
15. Remove Breakout Box.
16. Proceed to DYNAMIC TIMING under 7.4 IGNITION TIMING. Begin at step 2.



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

Figure 7-10. Timing marks.

ADJUST TIMING USING SCANALYZER (HD-41325)-1200S ONLY

1. Gently pull left side cover from frame downtubes (no tools required).

2. See Figure 7-11. Note the Data Link connector (pin side of 4-place Deutsch) on the side cover.

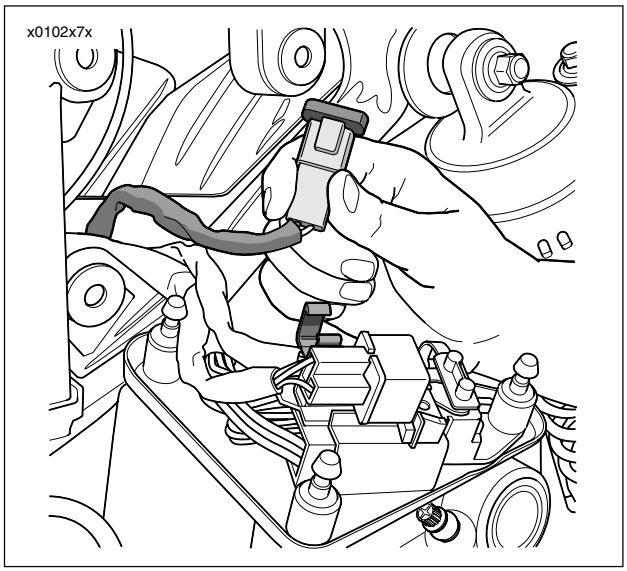


Figure 7-11. Data Link Connector-1200S

3. Remove rubber protective plug from open end of Data Link connector.

4. Plug the Scanalyzer (HD-41325) into the Data Link Connector.

5. Turn the Ignition/Light Key Switch to IGNITION. Turn the handlebar mounted Engine Stop Switch to the RUN position (but do not start the engine).

6. Insert the diagnostic application cartridge HD-41325-95A, into the Scanalyzer. Once communication is established with the ignition module, the DIAGNOSTIC MENU appears.

7. Select item 7- CALIBRATION from the DIAGNOSTIC MENU.

8. Press 1, TDCO Adjust on the key pad.

9. Connect Timing light (See Dynamic Timing) and observe timing mark.

10. Timing may be electronically adjusted by pressing the up arrow key to advance the timing offset or the down arrow key to retard the timing offset. Each press of the arrow key will change the timing one degree.

11. Press MODE to exit.

STATIC TIMING-ALL EXCEPT 1200S

1. Follow steps 1- 10 on next page. Turn ignition switch on.

2. See Figure 7-12. Loosen two screws and slowly rotate module plate until red LED illuminates. Rotate back until LED is extinguished. Tighten in position.

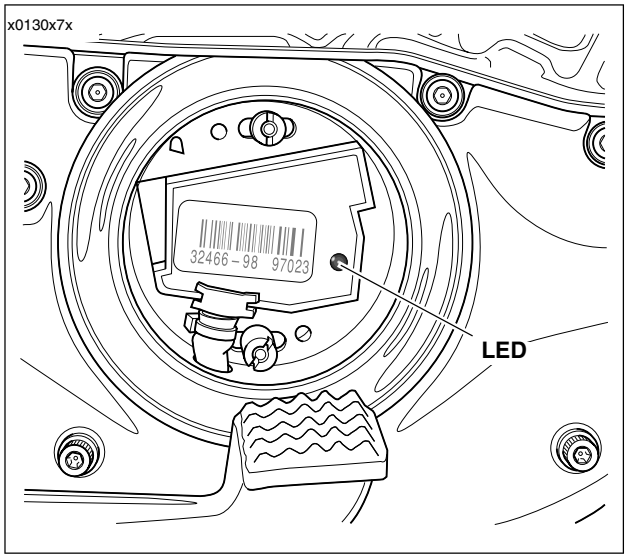


Figure 7-12. Ignition timing-all except 1200S

3. Proceed to DYNAMIC TIMING under 7.4 IGNITION TIMING Begin at step 2.

DYNAMIC TIMING

NOTE

The XL1200S Sport ignition timing spark occurrence is 15˚ BTDC. See Figure 7-10. The flywheel has a mark at 20˚ BTDC and a mark at TDC but does NOT have a mark at 15˚ BTDC. To Dynamically set timing on the XL Sport a programmable timing light must be used and referenced from one of the marks. Consult the timing light instruction manual for details.

1. Remove hex socket timing plug from timing inspection hole, which is located on right crankcase half and centered below engine cylinders. Install TIMING MARK VIEW PLUG (Part No. HD-96295-65D) into timing inspection hole. Make sure view plug does not touch flywheel.
2. Connect leads of INDUCTIVE TIMING LIGHT (Part No. HD-33813) to front spark plug cable, battery positive (+) terminal, and suitable ground.
3. Make sure vacuum hose is properly installed at carburetor and V.O.E.S. (MAP sensor on 1200S). Start engine.

   Set engine speed to1000-1050 rpm on all models.

CAUTION

See 7.7 VACUUM-OPERATED ELECTRIC SWITCH (V.O.E.S). When checking ignition 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. See Figure 7-10. Timing light will flash each time an ignition system spark occurs. Aim timing light into timing inspection hole. Front cylinder advance timing mark (2) should be centered in timing inspection hole. If this is the case, ignition timing is properly adjusted. Remove TIMING MARK VIEW PLUG from timing inspection hole and install hex socket timing plug. If timing mark is not centered or is not visible in the timing inspection hole, proceed to Step 5.
5. See Figure 7-5. Remove outer cover rivets (3), outer cover (4), inner cover screws (5), and inner cover (6).
6. Loosen cam position sensor screws (2) just enough to allow ignition module (7) to be rotated using a screwdriver in the plate's notch (8).
7. With timing light aimed into inspection hole, rotate ignition module until front cylinder advance timing mark is centered in timing inspection hole (as shown in Figure 7-10.).
8. See Figure 7-5. Tighten cam position sensor screws (2).
9. Install inner cover (6), inner cover screws (5), outer cover (4) and **new** outer cover rivets (3).
10. Remove TIMING MARK VIEW PLUG from timing inspection hole. Install hex socket timing plug. Tighten timing plug to 10-15 ft. lbs (14-21 Nm).

GENERAL

The Bank Angle Sensor turns off the ignition system if the motorcycle lean angle exceeds 55 degrees.

Bank Angle Sensor operation may be verified by placing a magnet at top of switch- Engine will stop if switch is operating correctly. Remove magnet and turn Ignition switch OFF to reset.

REMOVAL

1. Gently pull left side cover from frame downtubes (no tools required).
2. See Figure 7-13. Locate bank angle sensor on battery box. Remove screw.

NOTE

To avoid damage to terminals, remove Bank Angle Sensor from side of battery box before disconnecting connector [134].

3. Carefully unplug connector [134].

INSTALLATION

1. Plug in new sensor.
2. Install new sensor. Make sure locating pin on sensor body is positioned in hole.
3. Install sensor screw. Tighten to 15-20 **in-lbs** (1.7-2.3 Nm)**.**
4. Install left side cover.

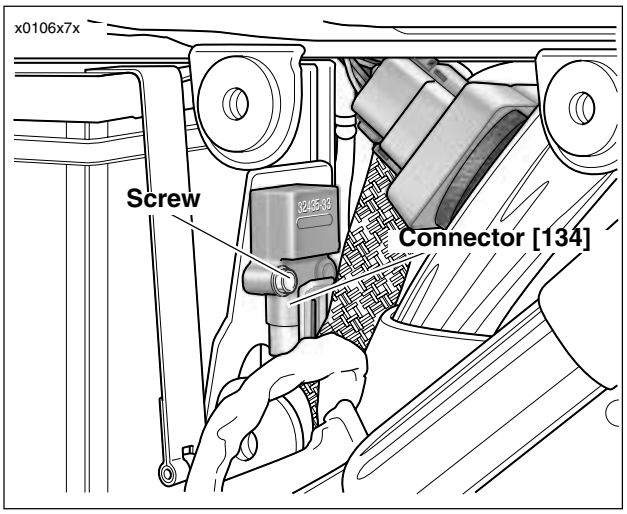


Figure 7-13. Bank Angle Sensor

REMOVAL

1. Loosen fuel tank rear mounting bolt.
2. Remove fuel tank front mounting bolt. Carefully pivot tank upward and prop in position to allow access to the MAP sensor.
3. Remove vacuum hose from bottom of MAP sensor.
4. See Figure 7-14. Using appropriate tool gently release tang holding sensor-Push sensor down.
5. Remove connector [80].

INSTALLATION

1. Plug connector [80] into **new** MAP sensor.
2. Slide MAP Sensor upward onto holding bracket until tang is engaged.
3. Attach vacuum hose to MAP Sensor.
4. Lower fuel tank into position and install front mounting bolt.
5. Tighten fuel tank rear mounting bolt.

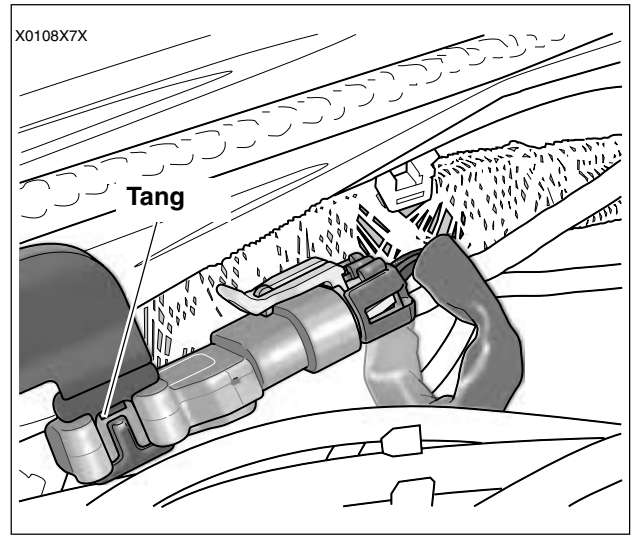


Figure 7-14. MAP Sensor Connector [80]

ADJUSTMENT/TESTING

Timing Mark Method

See Figure 7-15. See Figure 7-16.Verify engine ignition timing. See 7.4 IGNITION TIMING. Adjust ignition timing, if necessary, and then perform the following V.O.E.S. check:

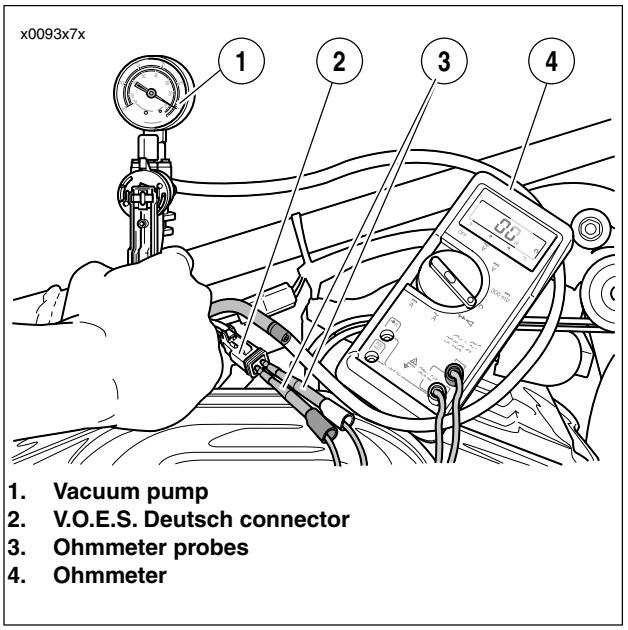
1. With engine running at 1000-1050 rpm, disconnect V.O.E.S. vacuum hose from carburetor fitting.
2. Temporarily plug the open carburetor fitting. Ignition timing should retard (front cylinder advance timing mark disappears from view in timing inspection hole) and engine rpm should decrease.
3. Connect V.O.E.S. vacuum hose to carburetor fitting. Timing mark should reappear and engine speed should increase to previous rpm.

If speed does not first decrease and then increase as described, check V.O.E.S. wire connection to ignition module.

Ohmmeter and Vacuum Pump Method

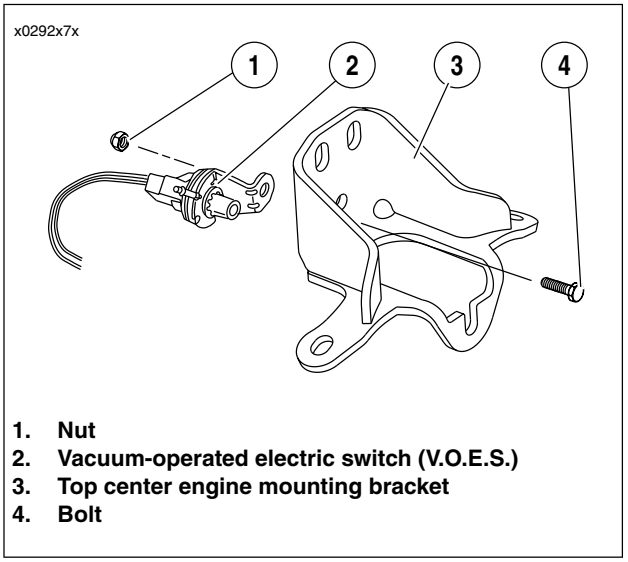
The V.O.E.S. can also be checked using an ohmmeter, a Harley-Davidson VACUUM PUMP (Part No. HD-23738) and Harness Connector Test Kit (HD-41404).

1. See Figure 7-15. See Figure 7-16. Disconnect V.O.E.S. Deutsch connector.
2. Insert black male probes in socket terminals of 2-place Deutsch connector.
3. Disconnect vacuum hose and connect vacuum pump to V.O.E.S. vacuum fitting.
4. Slowly squeeze vacuum pump handle. Observe vacuum gauge and ohmmeter readings. Ohmmeter should indicate switch closed (zero ohms) with an applied vacuum of 3.5-4.5 inches (89-114 mm) mercury (Hg). If a vacuum reading of more than 4.5 in. (114 mm) Hg or less than 3.5 in. (89 mm) Hg is required to close the switch, then the switch must be replaced.



1. **Vacuum pump**
2. **V.O.E.S. Deutsch connector**
3. **Ohmmeter probes**
4. **Ohmmeter**

Figure 7-15. Checking V.O.E.S. Using Ohmmeter and Vacuum Pump



1. **Nut**
2. **Vacuum-operated electric switch (V.O.E.S.)**
3. **Top center engine mounting bracket**
4. **Bolt**

Figure 7-16. V.O.E.S. mounting

REMOVAL

1. Remove air cleaner. See 4.4 AIR CLEANER REMOVAL.
2. Remove rear mounting bolt, locknut and 2 flat washers to free fuel tank from frame member.
3. From right side of motorcycle, raise rear of fuel tank slightly and push 2-pin Deutsch connector on top motor mount rearward to unsnap attachment clip from T-stud.
4. Depress latch on connector to separate pin and socket housings. For best results, use a rocking motion while pulling the halves apart.
5. Remove bolt and nut attaching V.O.E.S. to top center engine mounting bracket..
6. Pull V.O.E.S. assembly out of cavity and disconnect hose from V.O.E.S. fitting. Note the blue mark on hose fitting.

INSTALLATION

CAUTION

Verify that V.O.E.S. switch, wiring and hose connection do not contact engine rocker box. Normal engine vibration and heat can damage V.O.E.S. assembly if it is mounted in contact with the engine.

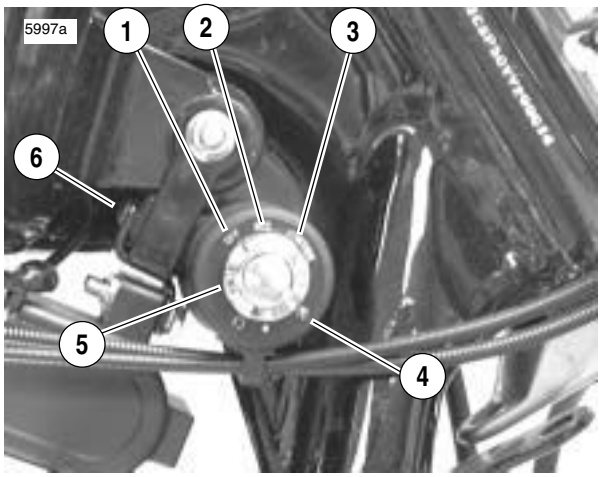
NOTE

The correct V.O.E.S. for XLH Sportster models is identified by a blue paint mark on the hose fitting.

1. Install hose on V.O.E.S. fitting.
2. Insert bolt through hole in back of top center engine mounting bracket. Mount tab of V.O.E.S. on bolt and Rotate V.O.E.S. so that rounded edge of bracket faces upward toward fuel tank. Install nut to secure V.O.E.S. to top center engine mounting bracket. Tighten locknut to 5-12 ft-lbs (7-16 Nm).
3. Press socket housing into pin housing until it snaps in place. Place large end of slot on attachment clip over T-stud on right side of top motor mount; push assembly forward to engage small end of slot.
4. Slide flat washer on rear fuel tank mounting bolt. Insert bolt through grommet of right fuel tank flange, frame member and grommet of left fuel tank flange. Install flat washer and locknut on end of bolt. Tighten bolt to 8-16 ft-lbs (11-22 Nm).
5. Install air cleaner. See 4.4 AIR CLEANER INSTALLATION.

GENERAL

See Figure 7-17. The ignition/light switch is not repairable and must be replaced as a unit if it fails.



1. **OFF position**
2. **ACC(ESSORY) position**
3. **IGNITION position**
4. **Switch cover**
5. **Face nut**
6. **Mounting screw**

Figure 7-17. Ignition/Light Switch

⚠WARNING

DO NOT modify the ignition/light switch wiring to circumvent the automatic-on headlight feature. High visibility is an important safety consideration for motorcycle riders. Failure to observe this Warning may result in death or serious injury.

The vehicle is provided with a three-position combination ignition/light switch. The three positions are as follows:

OFF-Ignition locked, lights off; key removable.

ACC(ESSORY)-Ignition locked, instrument lights on; key removable (HDI- position lamp and tail lamp on).

IGNITION-Ignition unlocked, lights on; key not removable.

Note that the key locks the ignition system and is removable in both the OFF and ACC(ESSORY) positions. The accessory position is located between the OFF and IGNITION positions and allows the rider to remove the key while leaving the instrument lights on. In this position, the instrument (icon) lamps, 4-way flashers (front and rear directional) and tail/brake light are on or can be activated. On HDI vehicles the position lamp and taillight are on.

CAUTION

When turning off the ignition, verify that the key is removed in the OFF position or that the lights are not left on. If the rider stops the engine and inadvertently removes the key in the ACC(ESSORY) position, the battery will be drained of its charge if the vehicle is left standing too long.

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables before proceeding. Inadequate safety precautions could result in death or serious injury.

⚠WARNING

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

1. Remove seat.
2. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
3. See Figure 7-18. Remove ignition switch face nut (5).
4. Remove Fuel tank. See 4.6 FUEL TANK REMOVAL.
5. Remove mounting screw (7). Remove switch cover (3). Remove switch (2) from switch cover (3).
6. Remove harness covering and cut switch wires 3 inches from switch.

INSTALLATION

1. Slide replacement conduit on harness wires.
2. Observing color codes, install butt connectors to harness wires. Complete butt splice to **new** ignition switch. Seal butt splice connectors using UltraTorch UT-100 or other radiant heating device. See 7.31 SEALED BUTT CONNECTORS for more detailed information.
3. Slide conduit over butt splice connectors.
4. Insert ignition switch into hole of switch cover. The word “TOP” stamped on the switch body should face upward toward the lettering on the switch position decal. Loosely install face nut (5).
5. Install and tighten mounting screw (7) to 36-84 **in-lbs** (4-9 Nm).
6. Tighten face nut to secure switch within cover.
7. Using two **new** cable straps (6), secure main harness to frame backbone.

⚠WARNING

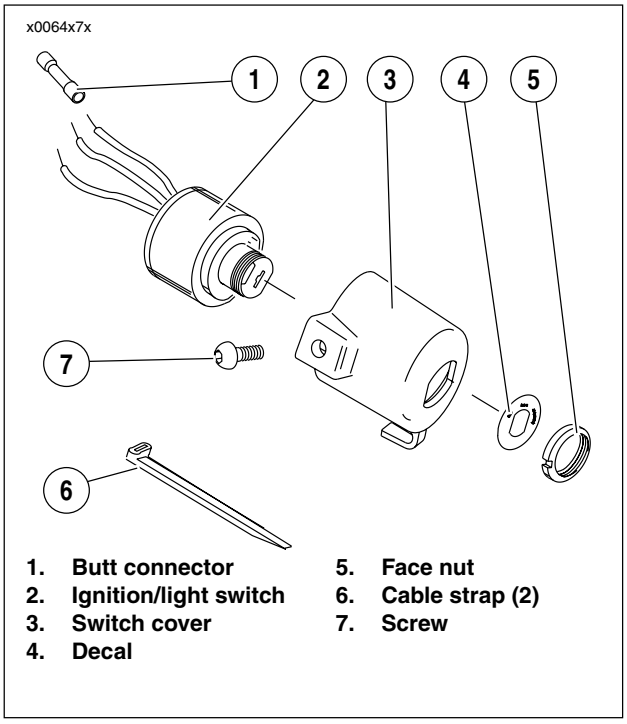
Always connect positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks which could result in death or serious personal injury.

8. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.
9. Check ignition/light switch for proper operation.

⚠WARNING

In the next step, you will be installing the seat. Pull up on seat to verify that it is properly secured, front and rear. A loose seat may shift during vehicle operation and startle the rider, possibly causing loss of vehicle control that could result in death or serious injury.

10. Install seat.

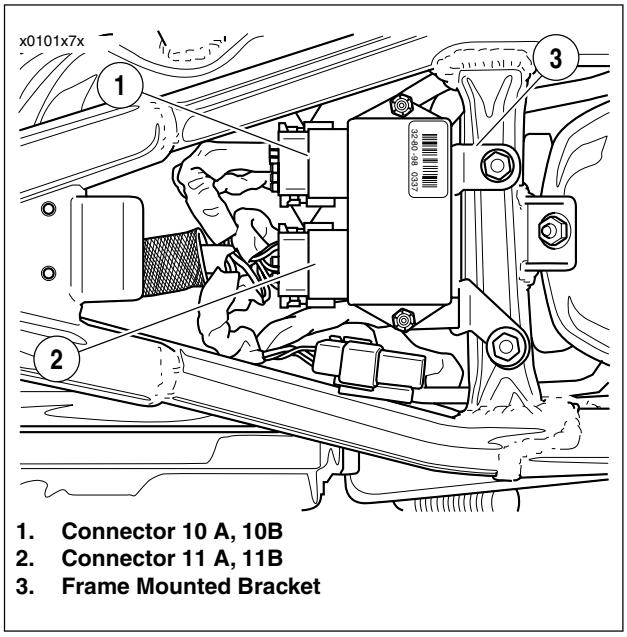


1. **Butt connector**
2. **Ignition/light switch**
3. **Switch cover**
4. **Decal**
5. **Face nut**
6. **Cable strap (2)**
7. **Screw**

Figure 7-18. Ignition/Light Switch Assembly

GENERAL

See Figure 7-19. The ignition module is mounted to a bracket located under the seat.



1. **Connector 10 A, 10B**
2. **Connector 11 A, 11B**
3. **Frame Mounted Bracket**

Figure 7-19. Ignition Module-1200S

Refer to 7.3 IGNITION SYSTEM for information on the function and testing of the ignition module. The ignition module is not repairable and must be replaced if defective.

REMOVAL

1. Remove seat. See 2.34 SEAT REMOVAL.

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

2. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
3. See Figure 7-19. Disconnect ignition module from wiring harness at Deutsch connectors 10 and 11.
4. Depress external latches on socket housing side and use a rocking motion to separate pin and socket halves.
5. Remove screws to free the ignition module from the frame-mounted bracket.

INSTALLATION

1. See Figure 7-19. Align holes in ignition module with those in frame-mounted bracket.
2. Secure module to bracket using screws. Tighten screws to 15-21 **in-lbs** (1.7-2.4 Nm).
3. Connect ignition module Deutsch connectors and to module.

   Align tabs on socket housing with grooves on pin housing. Push connector halves together until latches “click.” If latches do not click (latch), press on one side of the connector until that latch engages, then press on opposite side to engage other latch.

   Fit attachment clip to pin housing, if removed. Place large end of slot on attachment clip over T-stud on battery tray. Push assembly toward plug end (socket side) to engage small end of slot.

⚠WARNING

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

4. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.

⚠WARNING

In the next step, you will be installing the seat. Pull up on seat to verify that it is properly secured, front and rear. A loose seat may shift during vehicle operation and startle the rider, possibly causing loss of vehicle control that could result in death or serious injury.

5. Install seat. See 2.34 SEAT INSTALLATION.
6. Test engine for proper ignition system operation.

GENERAL

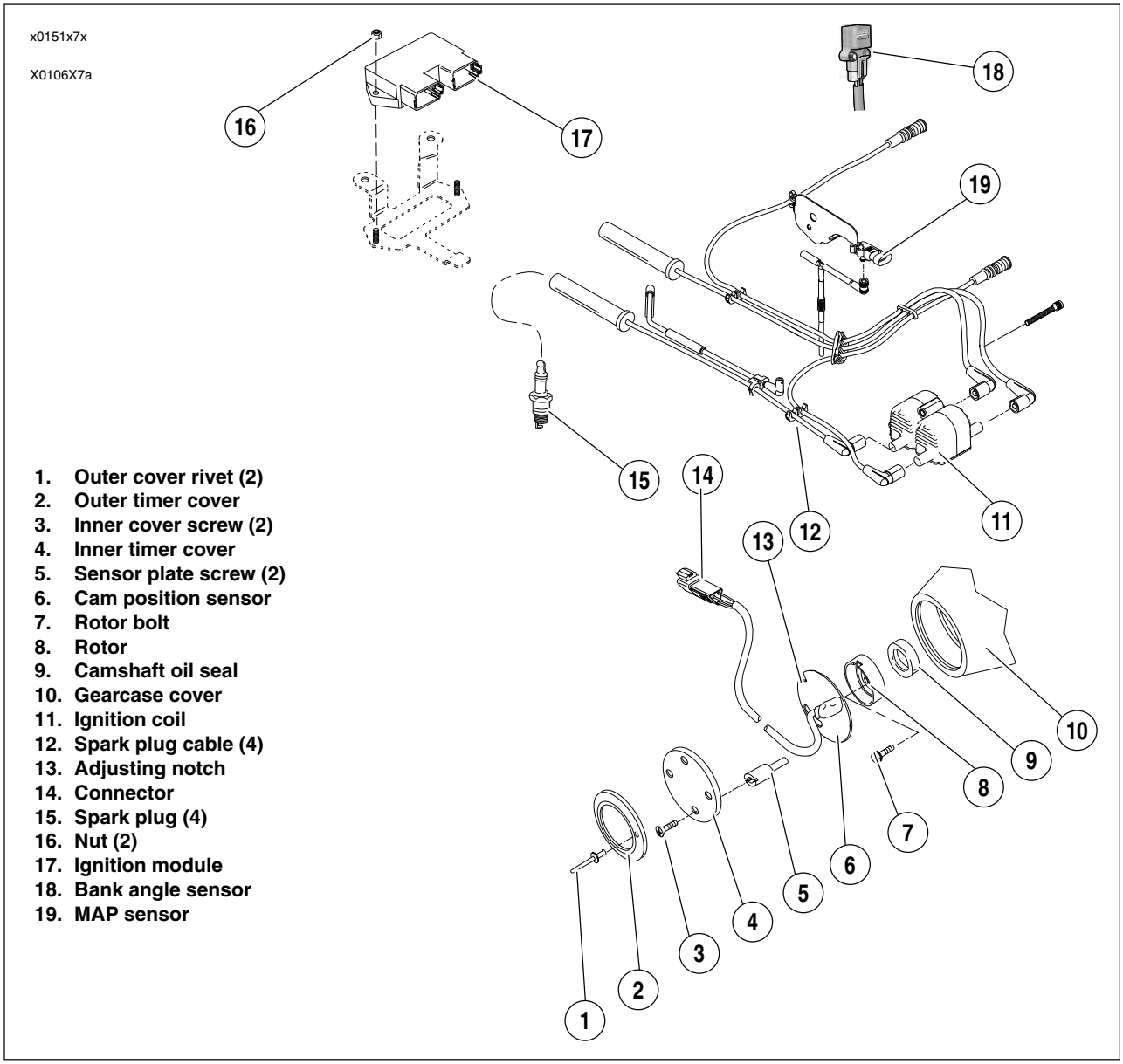
The cam position sensor (6) and rotor (8) are located in the gearcase cover (10) on the right side of the vehicle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. The cam position sensor wiring is connected to the ignition module (17) wiring harness. Refer to 7.4 IGNITION TIMING for information on the function, testing and adjustment of the cam position sensor and rotor assembly.

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.



1. **Outer cover rivet (2)**
2. **Outer timer cover**
3. **Inner cover screw (2)**
4. **Inner timer cover**
5. **Sensor plate screw (2)**
6. **Cam position sensor**
7. **Rotor bolt**
8. **Rotor**
9. **Camshaft oil seal**
10. **Gearcase cover**
11. **Ignition coil**
12. **Spark plug cable (4)**
13. **Adjusting notch**
14. **Connector**
15. **Spark plug (4)**
16. **Nut (2)**
17. **Ignition module**
18. **Bank angle sensor**
19. **MAP sensor**

Figure 7-20. Ignition System Components 1200S Sport

2. See Figure 7-20. Disconnect cam position sensor (6) wiring at connector (14) located on left frame tube under motor.
3. Note position of each cam position sensor wiring terminal in plug end of connector (14).
4. Remove terminals following procedure outlined under 7.28 DEUTSCH ELECTRICAL CONNECTORS.
5. Drill off heads of outer timer cover rivets (1) using a 1/8-inch drill bit. Tap remaining rivet shafts inboard through holes in outer timer cover (2) and inner timer cover (4). Remove outer cover.
6. Remove inner cover screws (3) and inner cover (4). Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
7. To obtain approximate ignition timing during installation, mark position of cam position sensor screws (5) on cam position sensor (6).
8. Remove cam position sensor screws. Carefully remove cam position sensor. Remove rotor bolt (7) and rotor (8).
9. Carefully remove camshaft oil seal (9) if damaged or if there is any evidence of oil leakage past the seal.

INSTALLATION

1. See Figure 7-20. With the lipped side facing inboard, install **new** camshaft oil seal (9) into gearcase cover (10), if removed. Press seal into position until flush with surface of timer bore.
2. Position rotor (8) onto end of camshaft aligning notch with camshaft slot. Apply LOCTITE THREADLOCKER 242 (blue) to rotor bolt (7). Install bolt to secure rotor. Tighten bolt to 43-53 **in-lbs** (4.9-6 Nm).
3. Install cam position sensor (6) and cam position sensor screws (5). Rotate sensor plate to its previously marked position to obtain approximate ignition timing.
4. Route cam position sensor wiring leads downward through hole (7 o'clock position) in timer bore of gearcase cover (10). Route leads upward through bottom opening between right crankcase half and rear of gearcase cover.

CAUTION

Route cam position sensor wires about 1-1/2 inches (38 mm) forward of gearcase cover rear edge. If wires are routed too far to the rear of this position, they could contact the moving secondary drive belt and/or sprocket resulting in damage to cam position sensor wiring.

5. Install cam position sensor wiring terminals into correct positions in plug end of connector (14). Red, green and black wires of plug end (from cam position sensor) must match same color wires in receptacle end of connector (from ignition module wiring harness). Install terminals following procedure outlined under 7.28 DEUTSCH ELECTRICAL CONNECTORS.

   Connect cam position sensor (6) wiring to ignition module (17) at wiring harness connector (14).
6. Check ignition timing as described in STATIC TIMING-1200S under 7.4 IGNITION TIMING if cam position sensor has been replaced or proceed to DYNAMIC TIMING under 7.4 IGNITION TIMING if aligning marks on original sensor. Finally, tighten cam position sensor screws (5) to 12-20 **in-lbs** (1.4-2.3 Nm).
7. Install inner cover (4) using screws (3). Tighten screws to 12-20 **in-lbs** (1.4-2.3 Nm).
8. Secure outer cover (2) to inner cover using **new** rivets.

CAUTION

Use only H-D Part No. 8699 rivets to secure outer timing cover. These rivets are specially 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.

9. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.

GENERAL

See Figure 7-21. See Figure 7-22. The ignition module (7) and rotor (9) are located in the gearcase cover on the right side of the vehicle. The rotor is mounted on the camshaft and operates at one-half crankshaft speed. The cam position sensor wiring is connected to the ignition module wiring harness. Refer to 7.4 IGNITION TIMING for information on the function, testing and adjustment of the cam position sensor and rotor assembly.

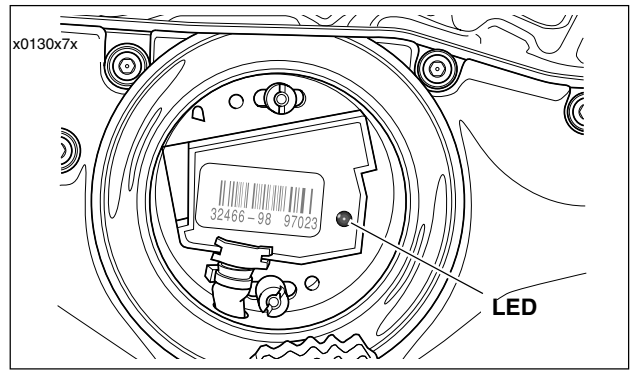


Figure 7-21. Ignition Module -all except 1200S

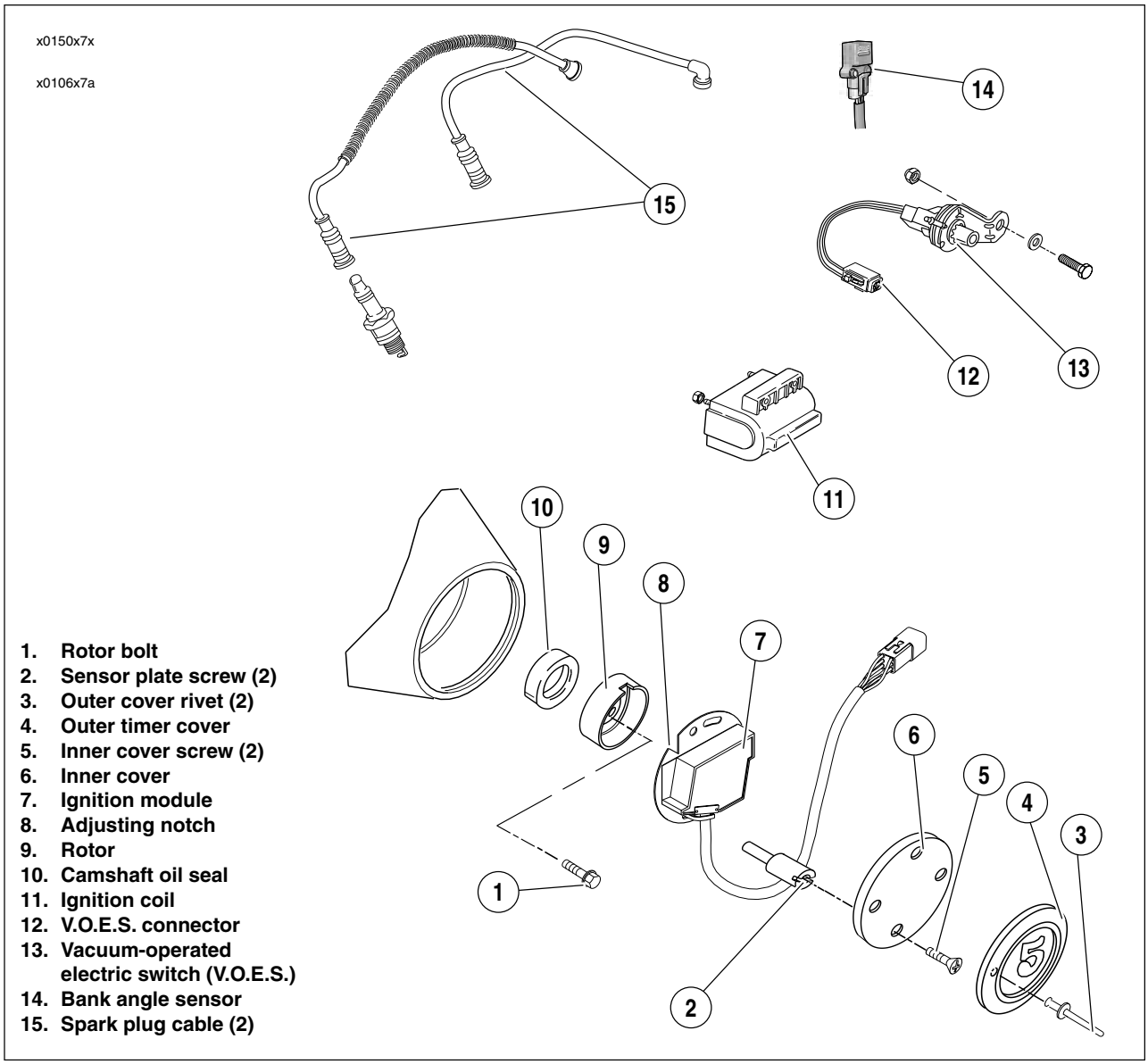


Figure 7-22. Ignition System Components (except 1200S)

REMOVAL

⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. See Figure 7-5. Drill off heads of outer timer cover rivets (3) using a 1/8-inch (9.525 mm) drill bit. Tap remaining rivet shafts inboard through holes in outer timer cover (4) and inner timer cover (6). Remove outer cover.
3. Remove inner cover screws (5) and inner cover (6). Carefully remove any remaining pieces of rivets from gearcase cover timer bore.
4. To obtain approximate ignition timing during installation, mark position of cam position sensor on gear case.
5. Remove cam position sensor screws. Carefully remove cam position sensor. If oil leak is present inside timer cover, remove rotor bolt (1) and rotor (9).
6. Carefully remove camshaft oil seal (10) if damaged or if there is any evidence of oil leakage past the seal.

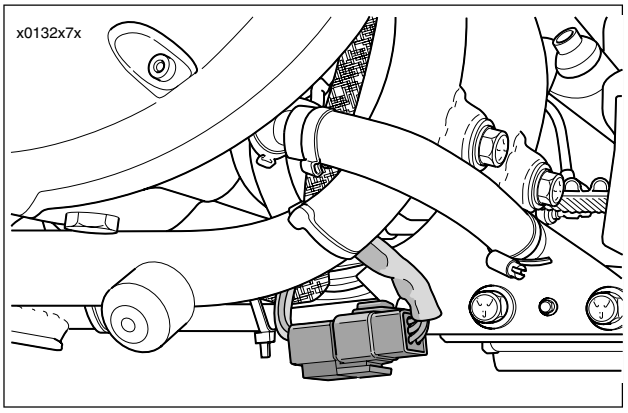


Figure 7-23. Ignition Module Connector

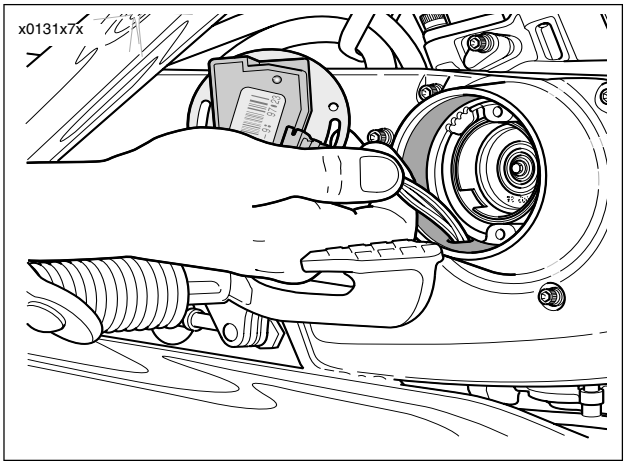


Figure 7-24. Remove Module Plate and Wires

INSTALLATION

1. See Figure 7-22. If the camshaft oil seal (10) was removed, install as follows: With the lipped side facing inboard, install **new** camshaft oil seal into gearcase cover, if removed. Press seal into position until flush with surface of timer bore.
2. Position rotor onto end of camshaft aligning notch with camshaft slot. Apply LOCTITE THREADLOCKER 243 (blue) to rotor bolt. Install bolt to secure rotor. Tighten bolt to 43-53 **in-lbs** (4.9-6 Nm).
3. Install cam position sensor and cam position sensor screws. Rotate sensor plate to its previously marked position to obtain approximate ignition timing.
4. Route cam position sensor wiring leads downward through hole (7o'clock position) in timer bore of gearcase cover. Route leads upward through bottom opening between right crankcase half and rear of gearcase cover.

CAUTION

Route cam position sensor wires about 1-1/2 inches (38 mm) forward of gearcase cover rear edge. If wires are routed too far to the rear of this position, they could contact the moving secondary drive belt and/or sprocket resulting in damage to cam position sensor wiring.

5. Install cam position sensor wiring terminals into correct positions in plug end of connector. Red, green and black wires of plug end (from cam position sensor) must match same color wires in receptacle end of connector (from ignition module wiring harness). Install terminals following procedure outlined under 7.28 DEUTSCH ELECTRICAL CONNECTORS. Also, see *SPORTSTER MODELS ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02) for more information.*
6. Connect cam position sensor wiring to ignition module at wiring harness connector.
7. Check ignition timing as described in STATIC TIMING-ALL EXCEPT 1200S under 7.4 IGNITION TIMING if cam position sensor has been replaced or proceed to DYNAMIC TIMING under 7.4 IGNITION TIMING if aligning marks on original sensor. Final tighten cam position sensor screws to 12-20 **in-lbs** (1.4-2.3 Nm).
8. Install inner cover using screws. Tighten screws to 12-20 **in-lbs** (1.4-2.3 Nm).
9. Secure outer cover to inner cover using **new** rivets.

CAUTION

Use only H-D Part No. 8699 rivets to secure outer timing cover. These rivets are specially 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.

10. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.

GENERAL

Harley-Davidson 6R12 spark plugs have a resistor element to reduce the radio interference which originates in the motorcycle ignition system. Spark plugs should be replaced every 10,000 miles (16,000 km). Use only the resistor-type spark plugs specified.

ADJUSTMENT

Spark plug gap is 0.038-0.043 in. (0.96-1.09 mm). Use only a wire-type feeler gauge. Bend the outside electrode so a slight drag on the gauge is felt when passing it between electrodes. Never make adjustments by bending the center electrode.

CLEANING AND INSPECTION

Inspection

Examine spark plugs as soon as they have been removed. The deposits on the plug base are an indication of the plug efficiency and are a guide to the general condition of pistons, piston rings, valves, valve guides, valve seals, carburetor and ignition system.

Spark Plug Condition

See Figure 7-25. Compare your observations of the plug deposits with the descriptions provided below.

a. A wet, black and shiny deposit on plug base, electrodes and ceramic insulator tip indicates an oil fouled plug. The condition may be caused by one or more of the following: worn pistons, worn piston rings, worn valves, worn valve guides, worn valve seals, a weak battery or a faulty ignition system.

b. A dry, fluffy or sooty black deposit indicates a carburetor air-fuel mixture that is too rich, engine idling for excessive periods of time and/or enrichener usage for excessive periods of time.

c. A light brown, glassy deposit indicates an overheated plug. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes and is caused by an air-fuel mixture that is too lean, a hot-running engine, valves not seating or improper ignition timing. The glassy deposit on the spark plug is a conductor when hot and may cause high-speed misfiring. A plug with eroded electrodes, heavy deposits or a cracked insulator must be replaced.

d. A plug with a white, yellow, tan or rusty brown powdery deposit indicates balanced combustion. Clean off spark plug deposits at regular intervals. See Cleaning.

Figure 7-25. Typical Spark Plug Deposits

Cleaning

Inspect spark plugs every 5,000 miles (8047 km). Replace spark plugs every 10,000 miles (16,093 km). If the plugs require cleaning between tune-ups, proceed as follows:

1. Degrease firing end of spark plug using ELECTRICAL CONTACT CLEANER. Dry spark plug with compressed air.

2. Use a thin file to flatten spark plug electrodes. A spark plug with sharp edges on its electrodes requires 25%-40% less firing voltage than one with rounded edges.

3. Adjust spark plug gap. See ADJUSTMENT under 7.12 SPARK PLUGS.

INSTALLATION

1. 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.

2. Apply a very light coating of ANTISEIZE LUBRICANT to spark plug threads. Install spark plug. Tighten spark plug to 11-18 ft-lbs (15-24 Nm).

   If a torque wrench is not available, finger-tighten spark plug and then using a spark plug wrench, tighten plug an additional 1/4-turn.

3. Check engine idle speed. Adjust as necessary.

GENERAL

See Figure 7-26. Resistor-type high-tension spark plug cables have a carbon-impregnated fabric core (instead of solid wire) for radio noise suppression and improved reliability of electronic components. Use the exact replacement cable for best results.

REMOVAL

⚠WARNING

Never disconnect a spark plug cable with the engine running. If you disconnect a spark plug cable with the engine running, you may receive a shock from the ignition system which could result in death or serious injury.

CAUTION

When disconnecting each spark plug cable from its spark plug terminal, always grasp and pull on the rubber boot at the end of the cable assembly (as close as possible to the spark plug terminal). Do not pull on the cable portion itself. Pulling on the cable will damage the cable's carbon core.

Disconnect spark plug cables from ignition coil and spark plug terminals.

INSPECTION

Check cables for cracks or loose terminals.

- Check spark plug cable resistance with an ohmmeter. Resistance must be 1,625-3,796 ohms for 6-1/2-in. (165 mm) cable, and 5,000-11,680 ohms for 20-in. (508 mm) cable. For 1200S resistance values see ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02) for more information.

Replace cables that are worn/damaged or that do not meet resistance specifications. Check cable boots/caps for cracks or tears; also check for loose fit on ignition coil and spark plugs. Replace boots/caps if you find any of the detrimental conditions mentioned above.

INSTALLATION

Connect spark plug cables to ignition coil and spark plugs. Make sure boots/caps are secured properly; this will provide the necessary moisture-proof environment for the ignition coil and spark plug terminals.

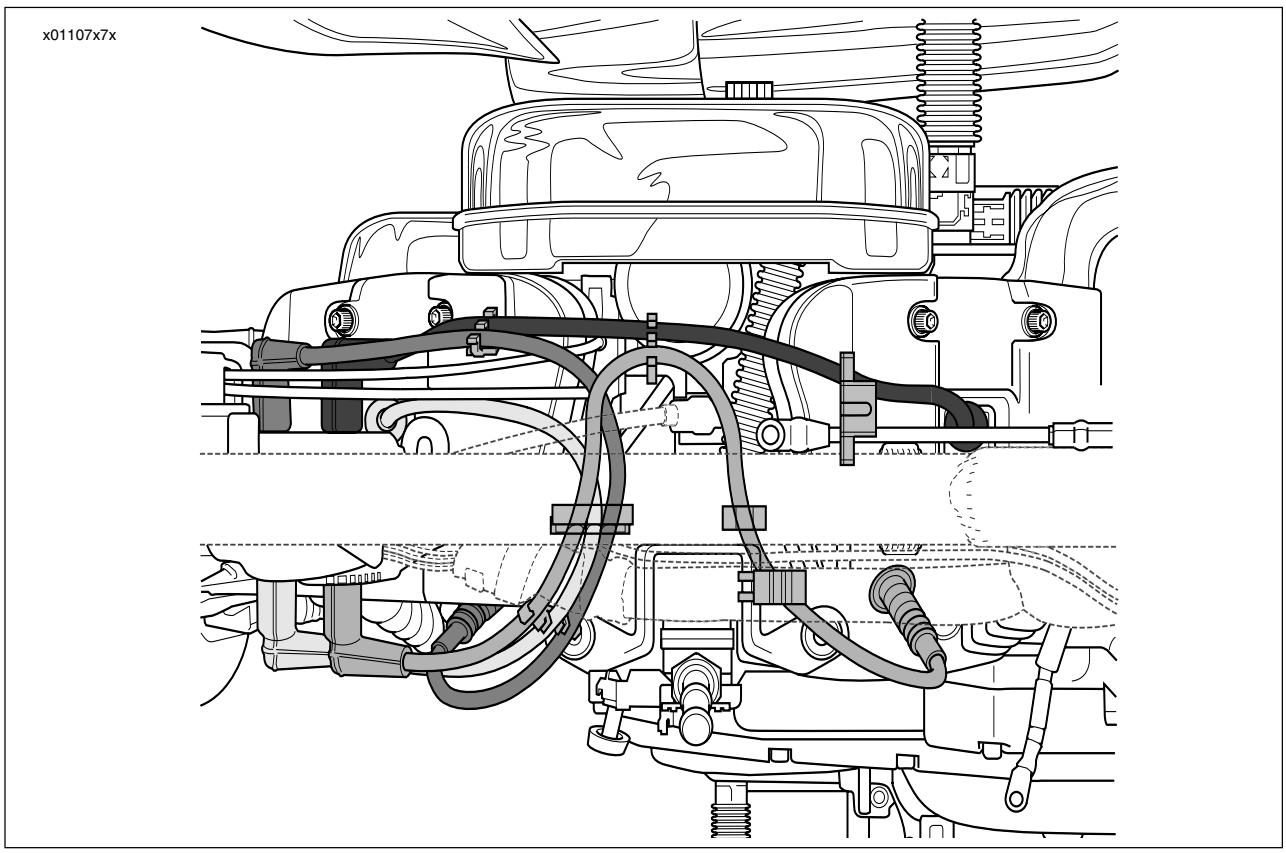


Figure 7-26. 1200S Spark Plug Cable Routing

GENERAL

The ignition coil is attached to a mounting bracket secured by the fuel tank front mounting bolt.

See Figure 7-5. or Figure 7-6. The ignition coil is a pulse-type transformer. Internally, the coil consists of primary and secondary windings with a laminated iron core. The contents are sealed in a waterproof insulating compound. The ignition coil is not repairable. Replace the ignition coil if it is not functioning properly.

The low-voltage ignition primary circuit consists of the coil primary winding, ignition module and battery. When the circuit is closed, current flows through the coil primary winding creating a strong magnetic field in the iron core of the ignition coil.

When the ignition module receives a signal from the ignition sensor plate and rotor, the ignition module interrupts (opens) the ignition primary circuit, which causes the magnetic field in the coil core to collapse suddenly.

The collapsing magnetic field induces a high-voltage electrical discharge in the ignition secondary circuit, which consists of the coil secondary winding, spark plug cables and spark plugs. The high-voltage discharge produces a spark to bridge the electrode gap of each spark plug.

The ignition coil fires both spark plugs simultaneously. In one spark plug, the spark jumps from the center electrode to the outer electrode, but on the other plug, the spark jumps in the reverse direction (from the outer electrode to the center electrode).

TROUBLESHOOTING

Follow the troubleshooting procedures listed under 7.3 IGNITION SYSTEM if the engine will not start, is difficult to start or runs roughly. Also check condition of spark plug cables. Insulation on cables may be cracked or damaged allowing high tension current to short to metal parts. This problem is most noticeable when cables are wet.

See Figure 7-27. If poor starting/running condition persists, check resistance of ignition coil primary and secondary windings using an ohmmeter. See Table 7-5. Resistance values should be within the limits shown in the following table.

- A low resistance value indicates a short in the coil winding; replace coil.
- A high resistance value might indicate that there is some corrosion/oxidation of the coil terminals; clean terminals, and repeat resistance test. If resistance is still high after cleaning terminals, replace coil.
- An infinite ohms (no continuity) resistance value indicates an open circuit – a break in the coil winding – replace coil.

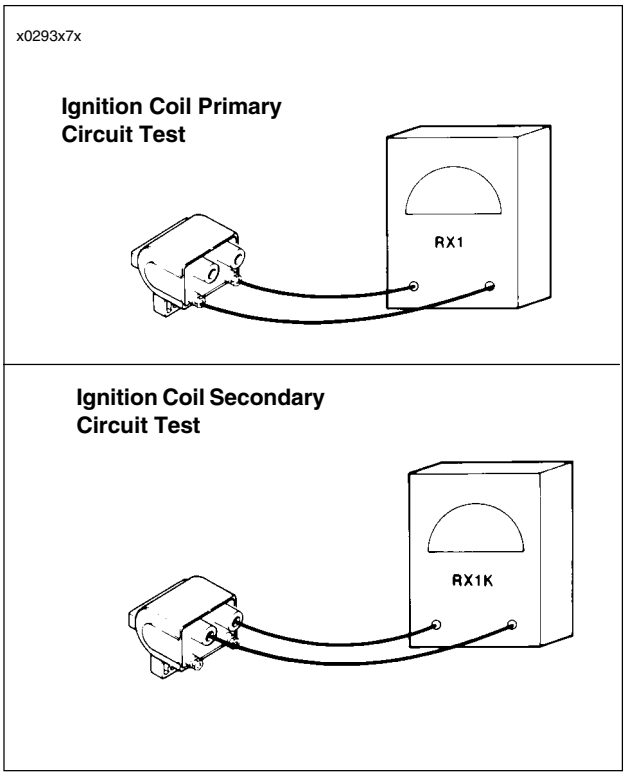


Figure 7-27. Test Ignition Coil Resistance Test

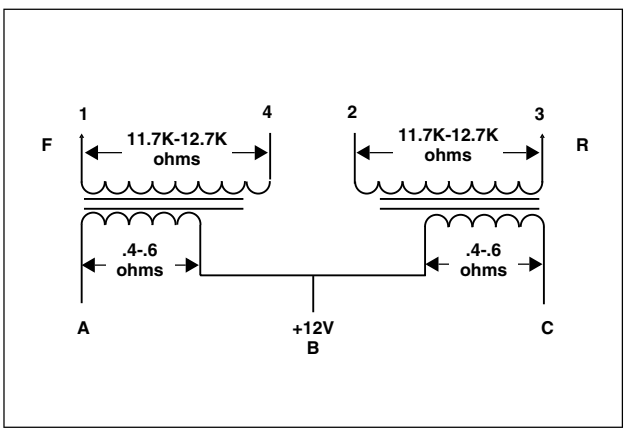


Figure 7-28. 1200S Ignition Coil Winding Resistance

Table 7-5. Ignition Coil Winding Resistance-All except 1200S

IGNITION COIL WINDING	OHMMETER SCALE	NORMAL RESISTANCE RANGE (IN OHMS)
Primary	R x 1	2.5-3.1
Secondary	R x 1K	10,000-12,500

REMOVAL-ALL EXCEPT 1200S

⚠WARNING

To avoid accidental start-up of vehicle 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 death or serious injury.

1. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. See Figure 7-29. Disconnect spark plug cables (2) from ignition coil (1).
3. Disconnect ring terminals of white with black tracer from coil positive terminal (3). Disconnect ring terminal of pink wires from coil negative terminal (4).
4. Remove two bolts and lockwashers (6). Remove nut plate (5) and ignition coil.

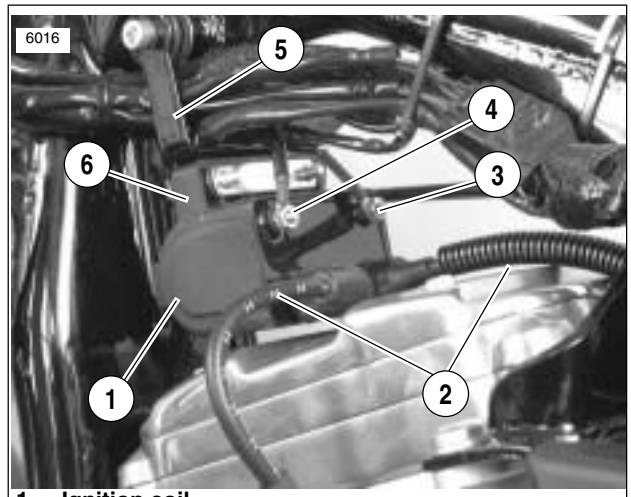
INSTALLATION-ALL EXCEPT 1200S

1. See Figure 7-29. Position ignition coil (1) onto ignition coil mounting bracket (5).
2. Secure ignition coil using nut plate and two bolts and lockwashers (6). Tighten bolts to 2-6 ft-lbs (3-8 Nm).
3. Connect ring terminal of pink wires to coil negative terminal (4). Connect ring terminals of white with black tracer wires to coil positive terminal (3).
4. Connect spark plug cables (2) to ignition coil (1).

⚠WARNING

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

5. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.



1. **Ignition coil**
2. **Spark plug cables**
3. **Positive terminal (white with black tracer)**
4. **Negative terminal (pink)**
5. **Ignition coil mounting bracket**
6. **Bolt and lock washer (2)**

Figure 7-29. Coil Mounting- All except 1200S

REMOVAL -1200S

1. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL.
2. Remove fuel tank front mounting bolt and raise tank.
3. See Figure 7-30. Remove plug wires from coil towers.
4. Disconnect primary wires connector [83B].
5. Remove mounting bolt to free coil.

INSTALLATION-1200S

1. See Figure 7-30. Position coil under mounting bracket and install bolt.
2. Tighten coil mounting bolt to 2-6 ft-lbs (2.7-8.1 Nm).
3. See Figure 7-30. Connect primary wire connector [83B].
4. Attach plug wires to coil towers.
5. Lower fuel tank into position and install bolt.

⚠WARNING

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

6. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.

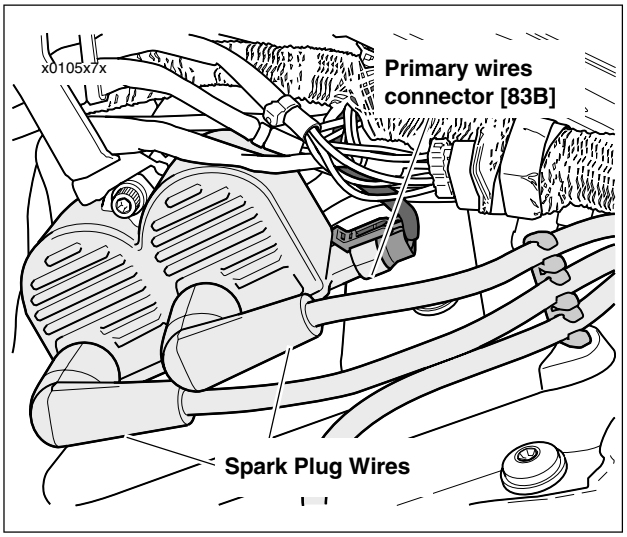


Figure 7-30. Coil Mounting-1200S

GENERAL

The charging system consists of the alternator and regulator. See next page for charging system circuit.

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

NOTE

Special tools needed for troubleshooting include a:

- Ammeter
- Load Tester
- Ohmmeter
- AC Voltmeter

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 7.18 BATTERY. 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.

The stator connector plug located on the right front down tube must be clean and tight.

Regulator Bleed Test

Be sure regulator is connected to battery. See Figure 7-32. Unplug two-pin stator connector. 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.

See Figure 7-31. Connect ammeter between negative battery terminal and battery. With this arrangement, you will also pick up any regulator drain. With ignition switch and all lights and accessories turned to OFF, amperage reading should be 3 milliamperes maximum. A higher reading indicates excessive current draw.

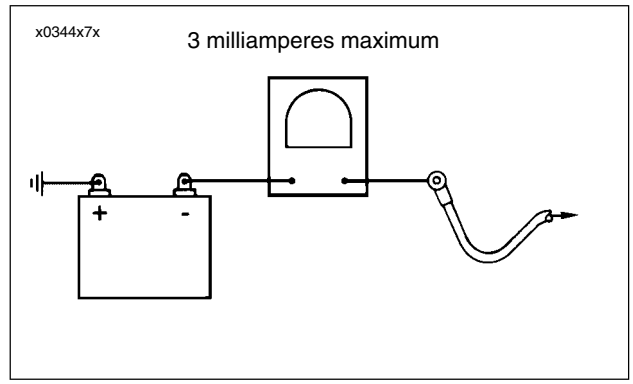


Figure 7-31. Milliampere Draw Test

Any accessories must be considered and checked for excessive drain. Isolate the source of the excessive current draw by disconnecting regulator or accessories until current draw is reduced.

This condition could drain battery completely if vehicle is parked for a long time.

NOTE

A battery with surface discharge condition could cause a static drain. Correct by cleaning battery case.

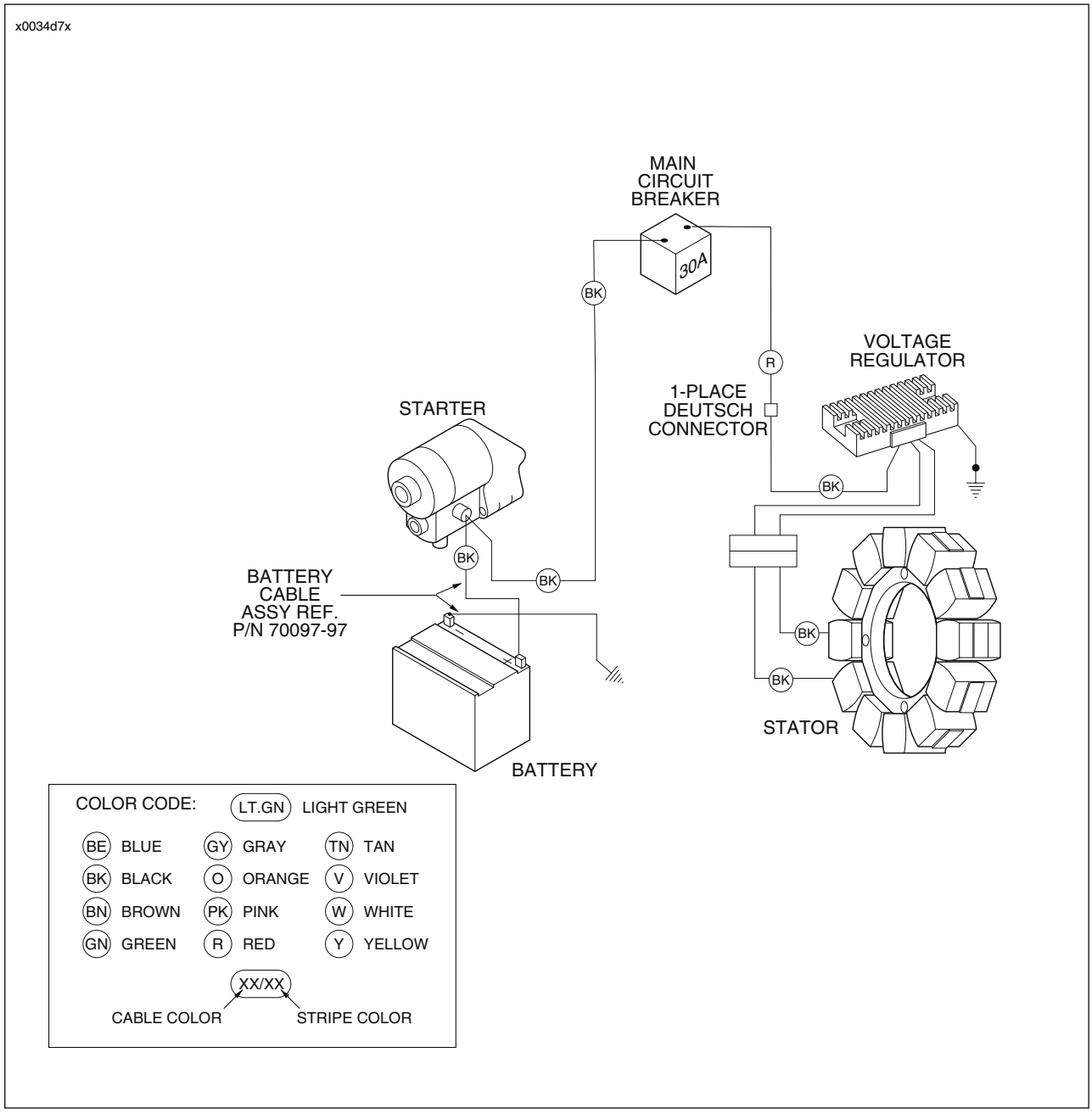


Figure 7-32. XLH Models Charging System Circuit

REMOVAL AND DISASSEMBLY

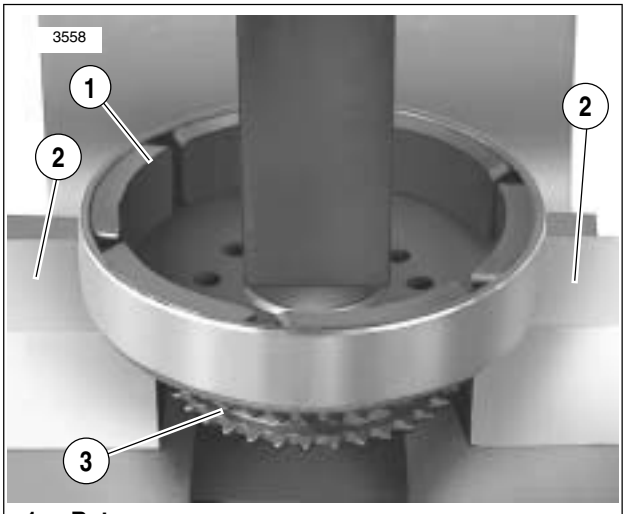
⚠WARNING

To avoid accidental start-up of vehicle 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 which could result in death or serious injury.

1. Remove primary cover. See Primary Cover REMOVAL under 6.2 PRIMARY CHAIN.
2. Remove clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. Refer to 6.6 PRIMARY DRIVE/CLUTCH REMOVAL. Remove/disassemble rotor and/or stator, as required. Refer to the following procedures.

Rotor

1. See Figure 7-33. Remove bolts which secure alternator rotor to engine sprocket.



1. **Rotor**
2. **Blocking**
3. **Sprocket**

Figure 7-33. Removing Rotor From Sprocket

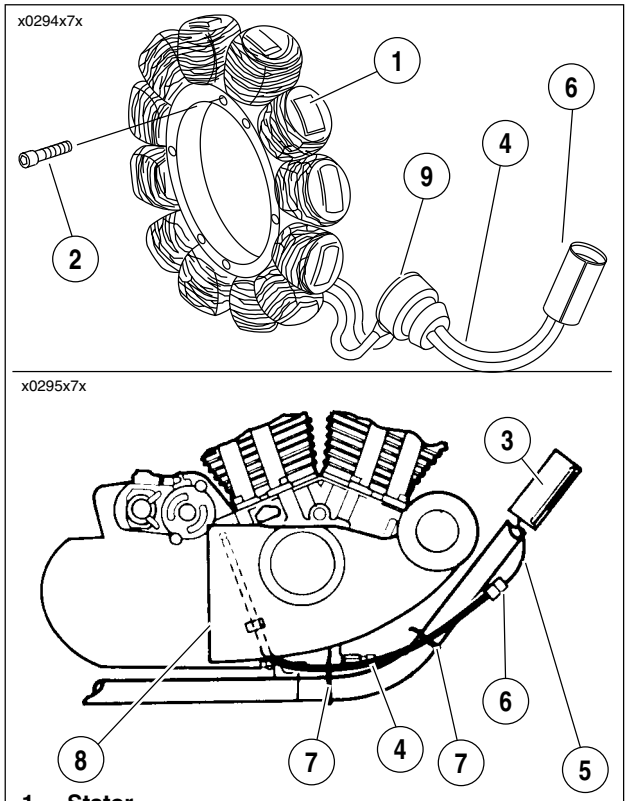
2. Position blocking (2) under rotor (1). Press sprocket (3) free of rotor.

NOTE

Resistance to sprocket/rotor disassembly is due in part to the magnetic force of the permanent rotor magnets.

Stator

1. See Figure 7-34. Disconnect stator wiring (4) from voltage regulator wiring (5) at connector (6).
2. Remove cable straps (7).
3. Withdraw stator wiring (4) from opening between right crankcase half and gear case cover (8).



1. **Stator**
2. **Screw (4)**
3. **Voltage regulator**
4. **Stator wiring**
5. **Regulator wiring**
6. **Connector**
7. **Cable strap (2)**
8. **Gear case cover**
9. **Grommet**

Figure 7-34. Stator Assembly and Stator Cable Routing

3. Using a T-27 TORX driver, remove and discard screws (2) which secure stator (1) to left crankcase half.

CAUTION

Stator TORX screws contain a thread locking compound. Do not reuse existing screws. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners could result in alternator damage.

4. Remove stator wiring grommet (9) from left crankcase half.
5. Withdraw stator wiring (4) from grommet hole in left crankcase half. Remove stator (1).

CLEANING, INSPECTION AND REPAIR

CAUTION

Do not strike or drop alternator rotor or damage to magnet adhesive may occur. Magnet adhesive damage can result in rotor failure.

1. Clean rotor with a petroleum-base solvent. Remove all foreign material from rotor magnets. Replace rotor if rotor magnets are cracked or loose.
2. Clean stator by wiping with a clean cloth.
3. Examine stator leads for cracked or damaged insulation.

NOTE

The rotor and stator can be replaced individually if either is damaged.

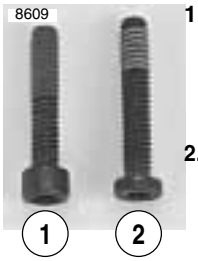
ASSEMBLY AND INSTALLATION

Depending on whether the rotor, the stator, or both the rotor and stator were removed/disassembled, perform the applicable procedures which follow:

1. See Figure 7-34. Feed stator wiring (4) with attached grommet (9) into open grommet hole in left crankcase half.
2. Apply a light coating of clean engine oil or chaincase lubricant to grommet (9). Install grommet into hole in left crankcase half.

CAUTION

Stator TORX screws contain a thread locking compound. Do not reuse existing screws. See Figure 7-35. Always use new screws with the proper thread locking compound. Loss of torque on TORX fasteners can result in alternator damage.



1. Old-style stator screw: identified by thicker head and red thread locking compound. Used on 2001 and earlier engines. Use T-25 TORX driver.
2. New-style stator screw: thinner head and gray thread locking compound. Used on 2002 engines ONLY. Use T-15 TORX driver.

Figure 7-35. TORX Screws

3. See Figure 7-34. Position stator (1) on left crankcase half. Secure stator using **new** TORX screws (2). Use appropriate TORX driver to tighten screws to 30-40 **in-lbs** (3.4-3.5 Nm).

CAUTION

Make sure stator wiring is routed about 1-1/2 in. (38 mm) forward of gear case cover rear edge. If routed too far to the rear of this position, wiring could contact the moving secondary drive belt and/or sprocket, resulting in damage to stator wiring and charging system.

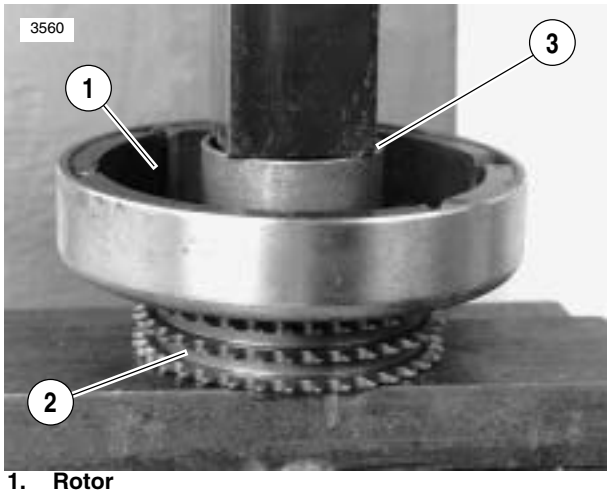
4. Route stator wiring (4) across top of crankcase halves to right side of engine. Route stator wiring downward through opening between right crankcase half and gear case cover (8).

NOTE

Temporarily attach a thin flexible "feed" or mechanic's wire to the connector end of the stator wiring to assist in the routing of the wiring.

5. Route stator wiring (4) forward and then upward along inboard side of right frame downtube. Connect stator wiring (4) to voltage regulator wiring (5) at connector (6).
6. Secure stator wiring (4), along with any other wires and hoses routed in the same location, to right frame downtube using cable straps (7).

7. See Figure 7-36. Position rotor (1) on sprocket (2). Align holes in sprocket with holes in rotor. Apply a drop of LOCTITE THREADLOCKER 243 (blue) to threads of each mounting bolt. Insert mounting bolts through rotor and start bolts into tapped holes in sprocket. Position a section of pipe (3) with an inside diameter larger than the sprocket mounting hub over center of rotor. Press rotor onto sprocket. Tighten bolts to 90-110 **in-lbs** (10.2-12.4 Nm).



1. Rotor
2. Sprocket
3. Pipe Section

Figure 7-36. Pressing Rotor onto Sprocket

8. Install clutch assembly, primary chain and engine sprocket/rotor assembly as a unit. See 6.6 PRIMARY DRIVE/CLUTCH INSTALLATION.
9. Install primary cover, left footrest assembly and gear shift lever. See Primary Cover INSTALLATION under 6.2 PRIMARY CHAIN.
10. Connect battery cables to battery (positive cable first).

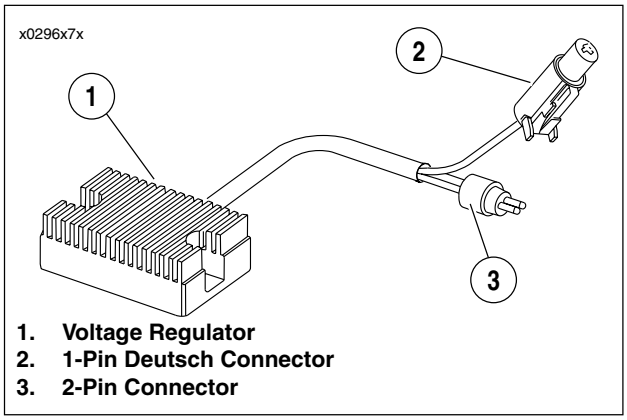
⚠WARNING

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

11. Test charging system. Refer to SPORTSTER MODELS ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02).

GENERAL

See Figure 7-37. The voltage regulator is not repairable. The unit must be replaced if it fails.



1. Voltage Regulator
2. 1-Pin Deutsch Connector
3. 2-Pin Connector

Figure 7-37. Voltage Regulator

REMOVAL

⚠WARNING

To avoid accidental vehicle start-up and possible death or serious injury, disconnect the battery cables (negative cable first) before proceeding.

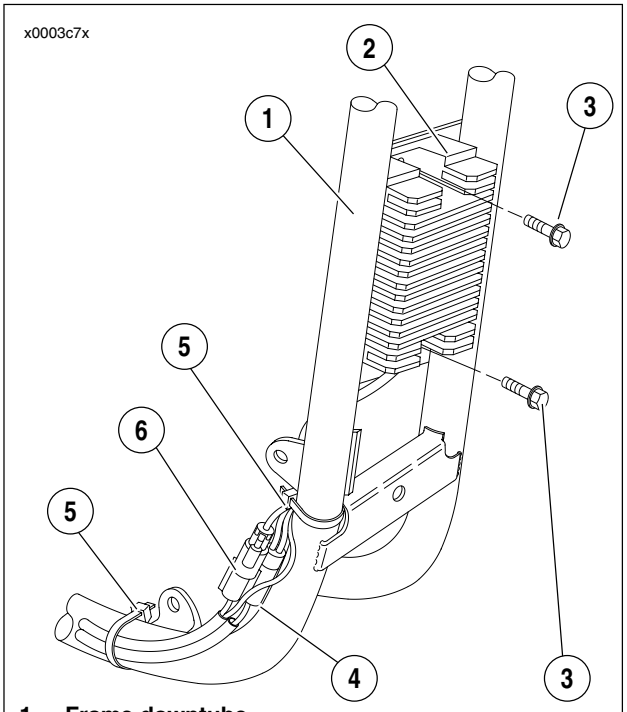
CAUTION

When disconnecting the alternator stator wiring, pull apart the connector by firmly grasping both connector halves. Do not pull on leads or damage to the wires and/or terminals may result.

1. See Figure 7-38. Locate the voltage regulator (2) between the right and left frame down-tubes at the front of the vehicle.
2. Disconnect voltage regulator wiring to alternator stator wiring at 2-pin connector (4).
3. Disconnect voltage regulator charging wire to 50 amp main circuit breaker at 1-pin Deutsch connector (6). Depress the external latch on the socket housing side and use a rocking motion to separate the pin and socket halves.
4. Cut upper cable strap (5) which secures voltage regulator wiring to right side motorcycle frame down tube.
5. Remove bolts (3) to free voltage regulator from frame downtubes.
6. Discard voltage regulator.

INSTALLATION

1. See Figure 7-38. Install **new** voltage regulator (2) between frame downtubes using mounting bolts (3). Tighten to 36-60 **in-lbs** (4.1-6.8 Nm).
2. Connect voltage regulator charging wire to 50 amp main circuit breaker at 1-pin Deutsch connector (6). Insert socket housing into pin housing until it snaps in place.
3. Connect voltage regulator wiring to alternator stator wiring at 2-pin connector (4).
4. Secure voltage regulator wiring to right side motorcycle frame downtube using **new** cable strap (5).
5. Connect battery cables to battery (positive cable first). Test charging system. Refer to SPORTSTER MODELS ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02).



1. Frame downtube
2. Voltage regulator
3. Bolt (2)
4. 2-Pin Connector (to Alternator stator)
5. Cable strap (2)
6. 1-Pin Connector (Charging wire to Main Circuit Breaker)

Figure 7-38. Voltage Regulator Mounting

GENERAL

⚠WARNING

All batteries contain electrolyte. Electrolyte is a sulfuric acid solution that is highly corrosive and can cause severe chemical burns. Avoid contact with skin, eyes, and clothing. Avoid spillage. Always wear protective face shield, rubberized gloves and protective clothing when working with batteries. See Figure 7-39. A warning label is attached to the top of the battery. Never remove warning label from battery. Failure to read and understand all precautions contained in warning label before performing any service on batteries could result in death or serious injury. See Figure 7-40.

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

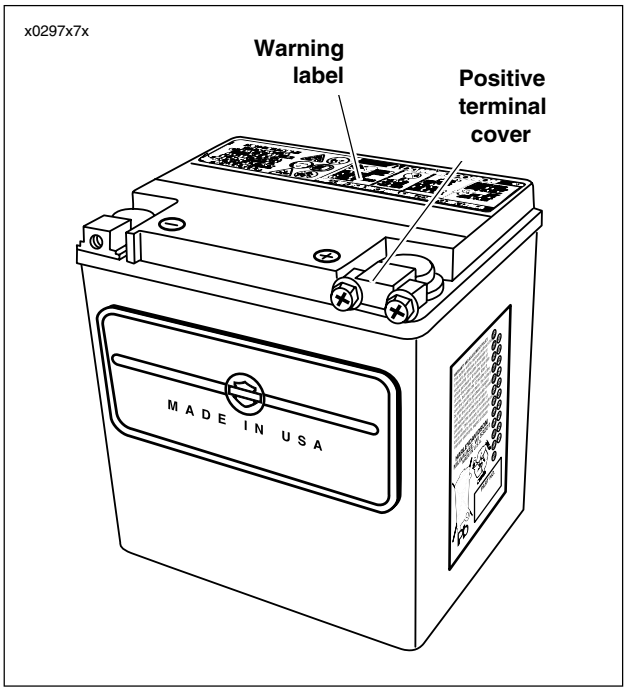


Figure 7-39. Battery

Table 7-6. Battery Electrolyte Antidotes

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

Figure 7-40. Battery Warning Label

INSPECTION

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

STORAGE

⚠CAUTION

Store the battery out of the reach of children. Inadequate safety precautions may result in minor or moderate injury.

CAUTION

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

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

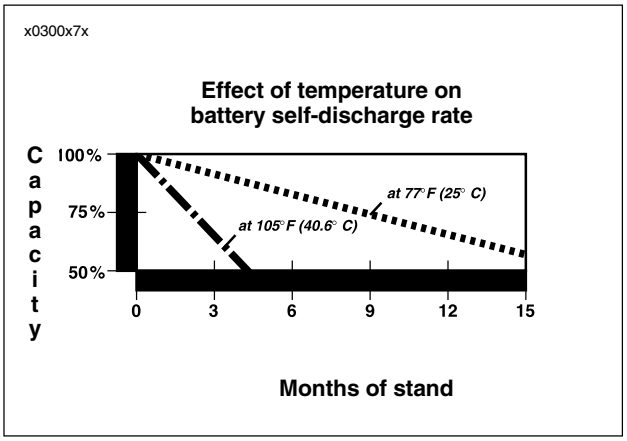


Figure 7-41. Battery Self-Discharge Rate

See Figure 7-41. Self-discharge is a normal condition and occurs continuously at a rate that depends on the ambient temperature and the battery's state of charge. Batteries discharge at a faster rate at higher ambient temperatures. To reduce the self-discharge rate, store battery in a cool (not freezing), dry place.

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

NOTE

The BATTERY TENDER AUTOMATIC BATTERY CHARGER (Part No. 99863-93TA) may be used to maintain battery charge for extended periods of time without risk of overcharging or boiling.

BATTERY TESTING

Voltmeter Test

See Table 7-7. The voltmeter test provides a general indicator of battery condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.8V or above, perform the load test described below.

Load Test

The load test measures battery performance under full current load and is the best indicator of battery condition. To load test the battery, proceed as follows:

1. Remove battery from motorcycle.

CAUTION

Load testing a discharged battery can result in permanent battery damage.

2. Always fully charge the battery before testing or test readings will be incorrect. See CHARGING BATTERY which follows. Load testing a discharged battery can also result in permanent battery damage.
3. After charging, allow battery to stand for at least one hour before testing.

⚠WARNING

Always turn the battery load tester OFF before connecting the tester cables to the battery terminals. Connecting tester cables with the load tester ON could cause a spark resulting in a battery explosion. A battery explosion may rupture the battery case causing a discharge or spray of sulfuric acid that could result in death or serious injury.

4. See Figure 7-42. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

CAUTION

To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

5. See Table 7-8. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 70°F (21°C).

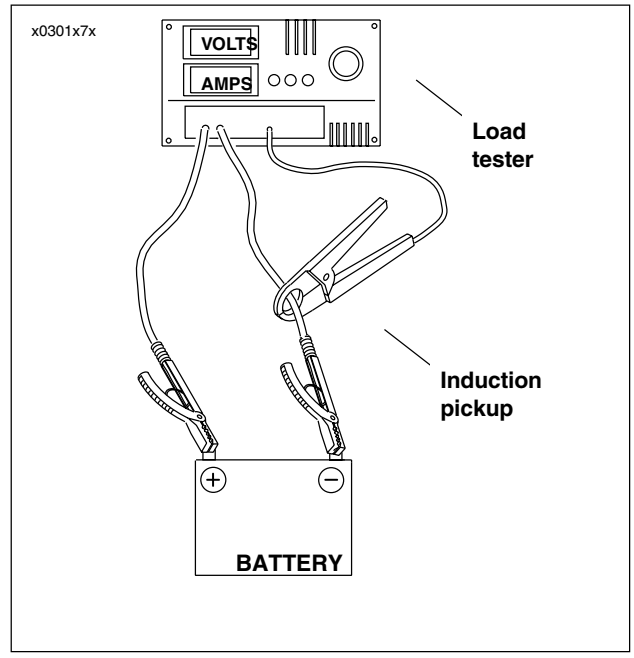


Figure 7-42. Load Test Battery

Table 7-7. Voltmeter Test For Battery Charge Conditions

VOLTAGE (OCV)	STATE OF CHARGE
12.8	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

Table 7-8. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
XL models	270	135

⚠WARNING

Always turn the battery load tester OFF before disconnecting the tester cables from the battery terminals. Disconnecting tester cables with the load tester ON could cause a spark resulting in a battery explosion. A battery explosion may rupture the battery case causing a discharge or spray of sulfuric acid that could result in death or serious injury.

6. Install the battery on the motorcycle.

CHARGING BATTERY

Safety Precautions

Never charge a battery without first reviewing the instructions for the charger being used. In addition to the manufacturer's instructions, follow these general safety precautions:

- Always wear proper eye, face and hand protection.
- Always charge batteries in a well-ventilated area.
- Turn the charger "OFF" before connecting the leads to the battery to avoid dangerous sparks.
- Never try to charge a visibly damaged or frozen battery.
- Connect the charger leads to the battery; red positive (+) lead to the positive (+) terminal and black negative (–) lead to the negative (–) terminal. If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.
- Make sure that the charger leads to the battery are not broken, frayed or loose.
- If the battery becomes hot, or if violent gassing or spewing of electrolyte occurs, reduce the charging rate or turn off the charger temporarily.
- Always turn the charger "OFF" before removing charger leads from the battery to avoid dangerous sparks.

Using a Battery Charger

Charge the battery if any of the following conditions exist:

- Vehicle lights appear dim.
- Electric starter sounds weak.
- Battery has not been used for an extended period of time.

⚠WARNING

Charge the battery in a well ventilated area. Explosive hydrogen gas escapes from the battery during charging. Keep open flames, electrical sparks and smoking materials away from the battery at all times. Inadequate safety precautions could result in death or serious injury.

CAUTION

If the battery releases an excessive amount of gas during charging, decrease the charging rate. If the battery gets hotter than 110˚F. (43˚C) during charging, discontinue charger and allow the battery to cool. Overheating may result in plate distortion, internal shorting, dry-out or other damage.

1. Perform a voltmeter test to determine the state of charge. See Voltmeter Test on the previous page. If battery needs to be charged, proceed to step 2.

Table 7-9. Battery Charging Rates/Times (Approximate)

BATTERY AMP HOUR	STATE OF CHARGE		3 AMP CHARGER	6 AMP CHARGER	10 AMP CHARGER	20 AMP CHARGER
	VOLTAGE	% OF CHARGE				
19	12.8	100%	-	-	-	-
	12.6	75%	1.75 hours	50 minutes	30 minutes	15 minutes
	12.3	50%	3.5 hours	1.75 hours	1 hour	30 minutes
	12.0	25%	5 hours	2.5 hours	1.5 hours	45 minutes
	11.8	0%	6 hours, 40 minutes	3 hours, 20 minutes	2 hours	1 hour

NOTE

The figures listed above assume that the battery is charging at room temperature. If warmer than room temperature, use a slightly shorter charging time. If colder, use a slightly longer charging time.

NOTE

*The use of constant current chargers to charge sealed maintenance-free batteries is not recommended. Any overcharge will cause dry-out and premature battery failure. If a constant current charger is the only type available, do **not** exceed the charge times listed above and do **not** continue charging the battery if it gets hot. When charging, never exceed 15 volts.*

CAUTION

Always remove the battery from the motorcycle before charging. Accidental electrolyte leakage will damage motorcycle parts.

2. Remove the battery from the motorcycle and place on a level surface.

⚠WARNING

Always unplug or turn OFF the battery charger before connecting the charger clamps to the battery. Connecting clamps with the charger ON could cause a spark resulting in a battery explosion. A battery explosion may rupture the battery case causing a discharge or spray of sulfuric acid that could result in death or serious injury.

CAUTION

Do not reverse the charger connections described in the following steps or the charging system of the motorcycle could be damaged.

3. Connect the red battery charger lead to the positive (+) terminal of the battery.
4. Connect the black battery charger lead to the negative (–) terminal of the battery.

NOTE

If the battery is still in the vehicle, connect the negative lead to the chassis ground. Be sure that the ignition and all electrical accessories are turned off.

5. Step away from the battery and turn on the charger. See the charging instructions in Table 7-9.

⚠WARNING

Always unplug or turn OFF the battery charger before disconnecting the charger clamps from the battery. Disconnecting clamps with the charger ON could cause a spark resulting in a battery explosion. A battery explosion may rupture the battery case causing a discharge or spray of sulfuric acid that could result in death or serious injury.

6. After the battery is fully charged, disconnect the black battery charger lead to the negative (–) terminal of the battery.
7. Disconnect the red battery charger lead to the positive (+) terminal of the battery.
8. Mark the charging date on the battery.
9. Perform a load test to determine the condition of the battery. See Load Test under BATTERY TESTING.

DISCONNECTION AND REMOVAL

1. Remove motorcycle seat. See 2.34 SEAT REMOVAL.
2. Remove battery strap nut and flat washer. Remove battery strap and top cover.

⚠WARNING

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

3. Unthread bolt from terminal nut to remove negative (–) battery cable and spacer from battery terminal.
4. Unthread bolt from terminal nut to remove positive (+) battery cable and spacer from battery terminal.
5. Remove battery from battery tray.

BATTERY INSTALLATION AND CONNECTION

1. Place fully charged battery on battery tray.

⚠WARNING

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

2. With negative (–) battery cable disconnected from negative (–) battery terminal, insert bolt through red wire lead, positive (+) battery cable, spacer and positive (+) battery terminal. Thread bolt into terminal nut. Tighten bolt to 40 **in lbs** (4.5 Nm).
3. Insert bolt through negative (-) battery cable, spacer and negative battery terminal. Thread the bolt into terminal nut. Tighten bolt to 40 **in lbs** (4.5 Nm).
4. Apply a light coat of petroleum jelly or corrosion retardant material to both battery terminals.
5. Position cover on top of battery. Hook end of battery strap under forward side of battery tray; draw strap over and into groove of battery cover inserting threaded stud in hole on rear side plate of battery tray. Install flat washer and strap nut.
6. Install motorcycle seat. See 2.34 SEAT INSTALLATION.

⚠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 during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

BATTERY CABLE REPLACEMENT

Removal

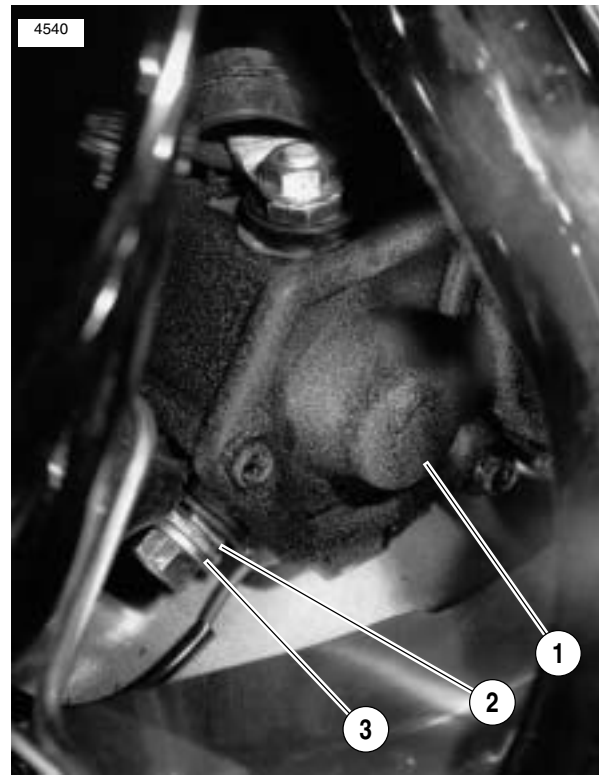
1. Remove seat. See 2.34 SEAT REMOVAL.
2. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL. Remove battery from tray.
3. Negative cable - Loosen nut on rear engine mount bolt (upper right). Remove negative battery cable from bolt.
4. Positive cable - See Figure 7-43. Moving to right side of vehicle, remove nut on starter motor post (12mm socket required). Remove positive battery cable from post.
5. Remove battery cable from vehicle. Inspect cables for cuts, fraying or other damage. Replace as necessary.

Installation

1. Positive cable - See Figure 7-43. See Figure 7-44. See Figure 7-45. Route positive cable through front hole in battery tray and battery pad. Moving to the right side of the vehicle, verify that the positive lead to the main circuit breaker is in place on the starter post. Place the lower terminal (booted end) of the positive battery cable on the starter post. The terminal has a 30 degree bend to make installation easier. Install starter post lock washer and locknut (12mm socket required).
2. Negative cable - Route cable through rear hole in battery tray and battery pad. Insert right rear motor mount bolt.
3. Tighten starter post nut (positive battery cable) to 60-85 **in-lbs** (7-10 Nm). Bias negative battery cable toward center of vehicle (to compensate for opposite torque reaction) and tighten bolt on rear engine mount bolt to 25-30 ft-lbs (34-41 Nm).
4. Install screws, flat washers and lock washers to secure rear brake line clamps to left rear fork and frame down-tube. Tighten clamp screws to 15-21 **in-lbs** (1.7-2.4 Nm).
5. Install battery onto battery tray. Install battery cables, positive cable first. See 7.18 BATTERY, BATTERY INSTALLATION AND CONNECTION.
6. Install seat. See 2.34 SEAT INSTALLATION.

⚠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 during vehicle operation and startle the rider, causing loss of control and which could result in death or serious injury.



1. **Starter**
2. **Positive lead (to main circuit breaker)**
3. **Positive cable terminal**

Figure 7-43. Positive Cable Starter Post Connection (Right Side View)

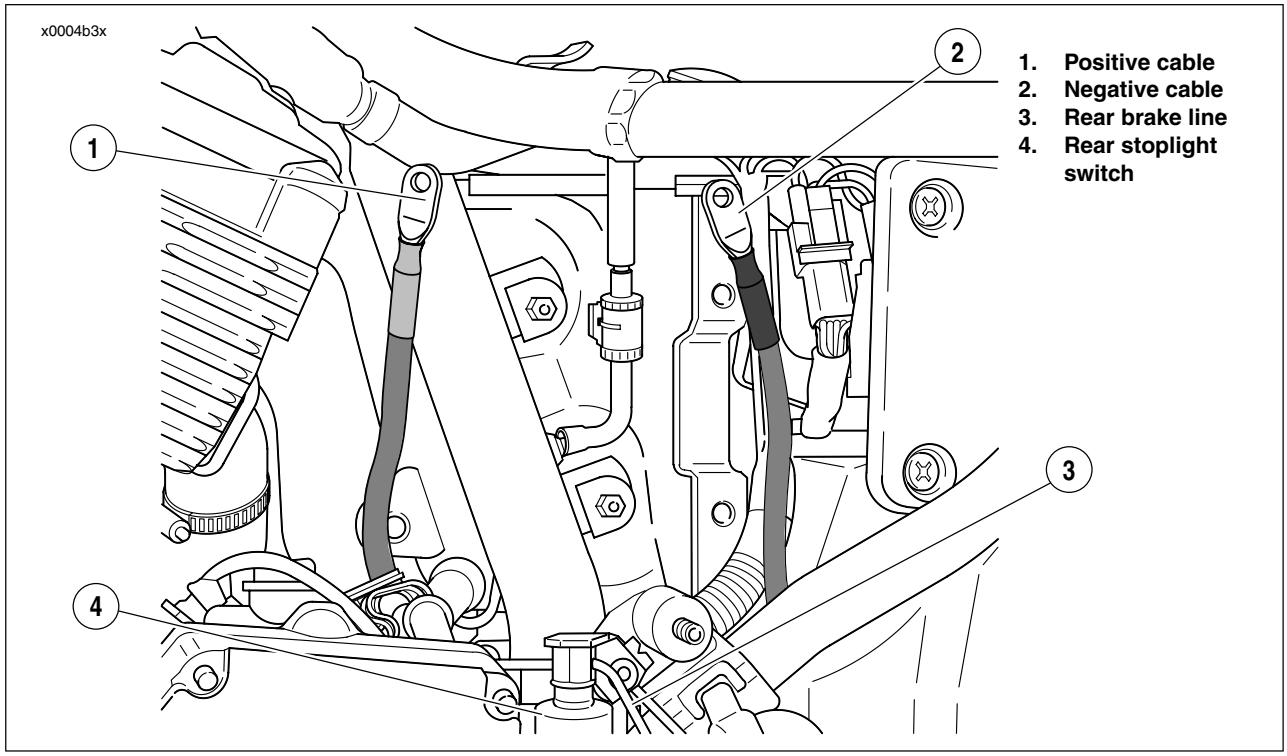


Figure 7-44. Battery Cable Routing (Left Side View)

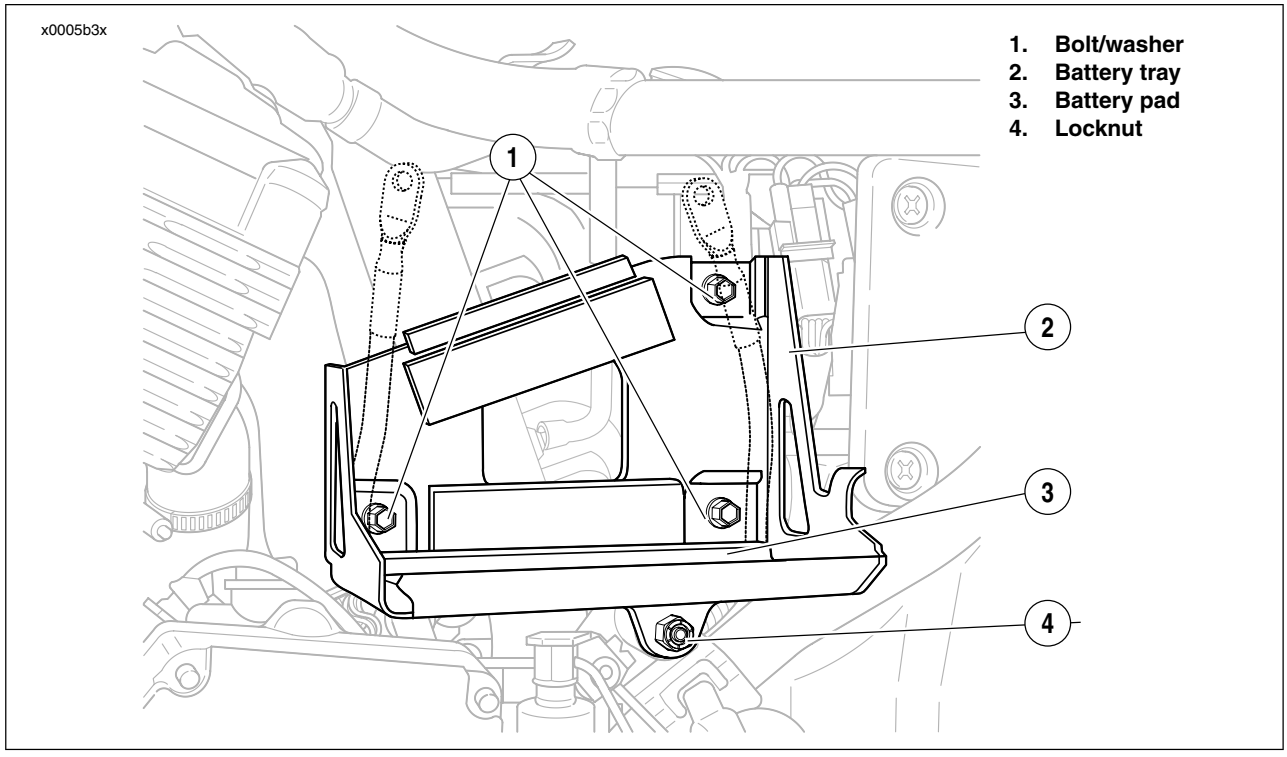


Figure 7-45. Battery Tray

GENERAL

The headlamp is a replaceable bulb (element) type. When bulb replacement is required, use only the specified “H4” halogen bulb (Part No. 67697-81).

The high beam, oil pressure, neutral, and turn signal indicator lamps do not have replaceable bulbs; the entire unit must be replaced if faulty.

The speedometer and tachometer have backlight bulbs that are not replaceable. The entire unit must be replaced if a bulb is faulty.

Domestic front directional/running lamps have double-filament bulbs. HDI front directional and all rear directional lamps have single-filament bulbs.

The tail lamp uses a double-filament bulb.

ADJUSTMENT

Headlamp

⚠WARNING

Do not modify ignition wiring to permit motorcycle operation with headlamp off. Operation without headlamp reduces your visibility to other motorists and could result in death or serious injury.

1. See Figure 7-46. Check headlamp beam for proper height and lateral alignment. Proceed as follows:

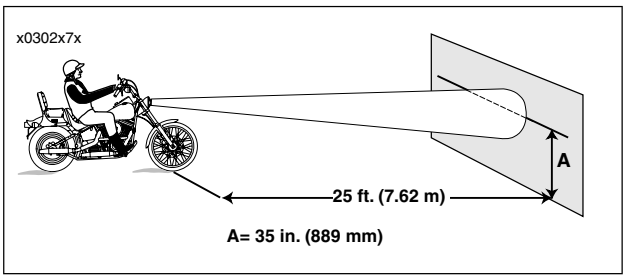
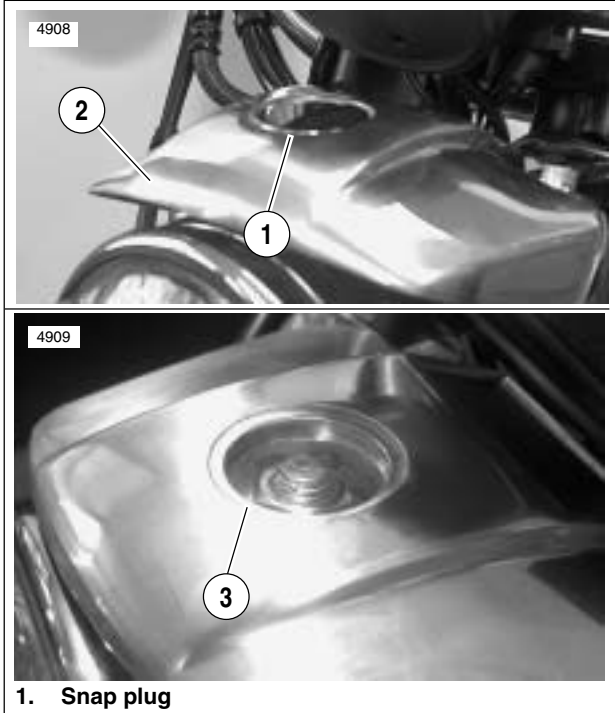


Figure 7-46. Headlamp Alignment

2. Verify correct front and rear tire inflation pressure.
3. Place motorcycle on level floor (or pavement) in an area with minimum light.
4. Point front of motorcycle toward a screen or wall which is 25 ft (7.62 m) away from front tire contact patch on floor (i.e. directly below front axle).
5. Draw a horizontal line, on screen or wall, which is 35 in. (889 mm) above floor.
6. Have a person, whose weight is roughly the same as that of the principal rider, sit on motorcycle seat. Weight of rider will compress vehicle suspension slightly.
7. Stand motorcycle upright with both tires resting on floor and with front wheel held in straight alignment (directly forward).
8. Turn ignition/light switch to “IGNITION” position. Set handlebar switch to high beam position.
9. Check light beam for proper height alignment. Main beam of light (broad, flat pattern of light) should be centered on horizontal line of screen or wall (i.e. equal area of light above and below line).
10. Check light beam for proper lateral alignment. Main beam of light should be directed straight ahead (i.e. equal area of light to right and left of center).

    Adjust headlamp alignment, if necessary.
11. See Figure 7-47. Remove snap plug (1) on top of headlamp bracket (2). Loosen headlamp clamp nut (3).
12. Tilt headlamp up or down to properly aim it in relation to the horizontal line and, at the same time, turn it right or left to direct light beam straight ahead.
13. Tighten headlamp clamp nut to 10-20 ft-lbs (14-27 Nm) after lamp is properly positioned. Install snap plug in headlamp bracket.



1. Snap plug
2. Headlamp bracket
3. Headlamp clamp nut

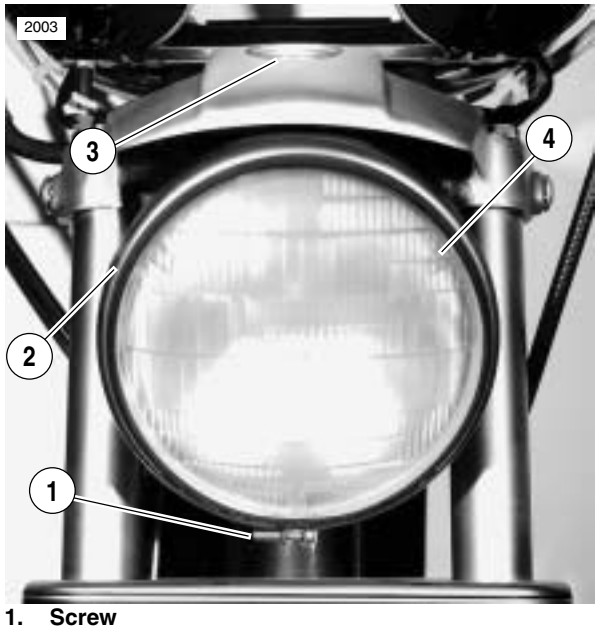
Figure 7-47. Headlamp Adjustments

Headlamp and Bulb (Element)

CAUTION

Do not touch glass bulb portion of headlamp bulb with bare hands. Oil from your skin deposited on the bulb will create temperature variances in the glass during normal lamp operation; this can cause the bulb to fracture. When removing or installing any halogen bulb, touch only the terminal side or metal base of the bulb. Keep glass bulb clean and free of any foreign material.

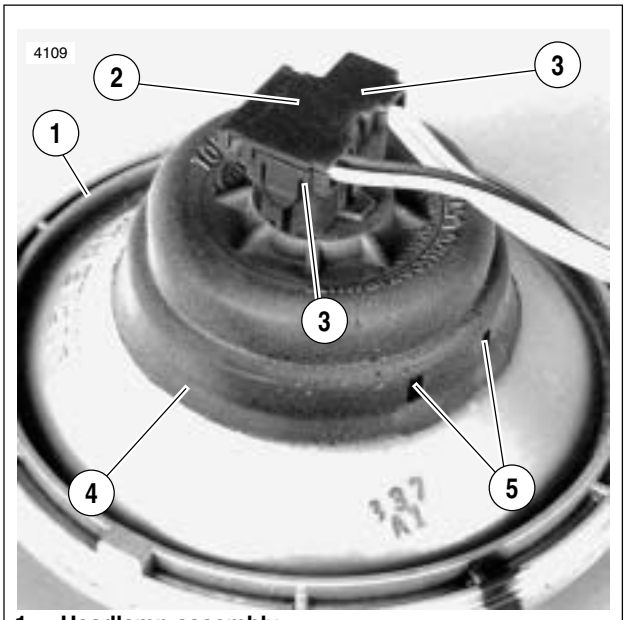
1. See Figure 7-48. Remove screw (1) and outer molding ring (2). Pry headlamp assembly (4) from rubber mounting.



1. **Screw**
2. **Molding ring**
3. **Headlamp bracket**
4. **Headlamp assembly**

Figure 7-48. Headlamp Assembly

2. See Figure 7-49. Firmly depress lock release tabs (3) on left and right sides of locking connector (2). While holding both lock release tabs down, carefully pull connector from headlamp (1) terminals.
3. Remove rubber boot (4) from back of headlamp assembly (1).



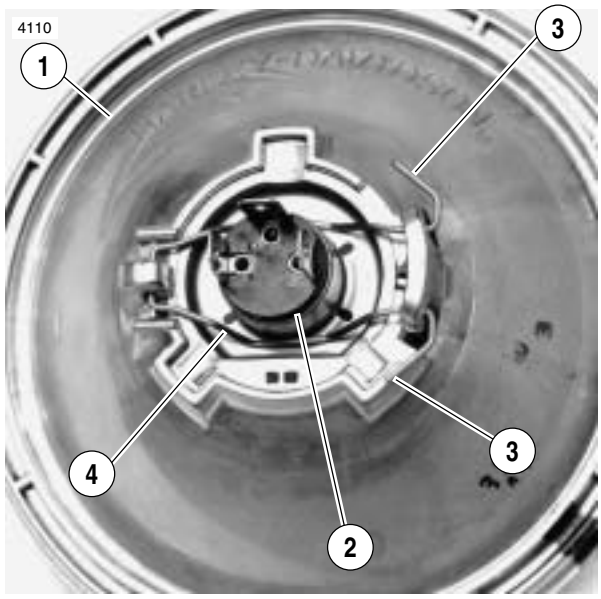
1. **Headlamp assembly**
2. **Locking connector**
3. **Lock release tab (2)**
4. **Rubber boot**
5. **Vent/drain hole**

Figure 7-49. Headlamp Locking Wiring Harness Connector

CAUTION

Do not touch glass bulb portion of headlamp bulb with bare hands. Oil from your skin deposited on the bulb will create temperature variances in the glass during normal lamp operation; this can cause the bulb to fracture. When removing or installing any halogen bulb, touch only the terminal side or metal base of the bulb. Keep glass bulb clean and free of any foreign material.

4. See Figure 7-50. Depress ends (3) of retaining clip (4) to unhook them from slots in headlamp assembly (1).



1. **Headlamp assembly**
2. **Bulb (element)**
3. **Retaining clip end (2)**
4. **Retaining clip**

Figure 7-50. Replaceable Headlamp Bulb

5. Pivot wire retaining clip (4) away from bulb (2). Remove bulb from headlamp assembly (1).
6. See Figure 7-49. Installation is the reverse order of removal. When installing rubber boot (4), position vent/drain holes (5) to the bottom. Be sure headlamp and connector block terminals are clean to ensure a good electrical contact.
7. After final assembly, align headlamp as described in Headlamp ADJUSTMENT under 7.19 LAMPS.

INDICATOR LAMP SOCKET

Replace indicator assemblies as follows:

1. Remove two bolts with lock washers to remove headlamp bracket (with attached headlamp assembly) from upper stem bracket.
2. See Figure 7-51. On XL Custom remove four screws from the rear of the riser cover. See Figure 7-53. See Figure 7-54. Remove front of riser cover to expose electrical bracket. Slide electrical bracket off center studs. Indicator lamp socket is on backside of bracket.

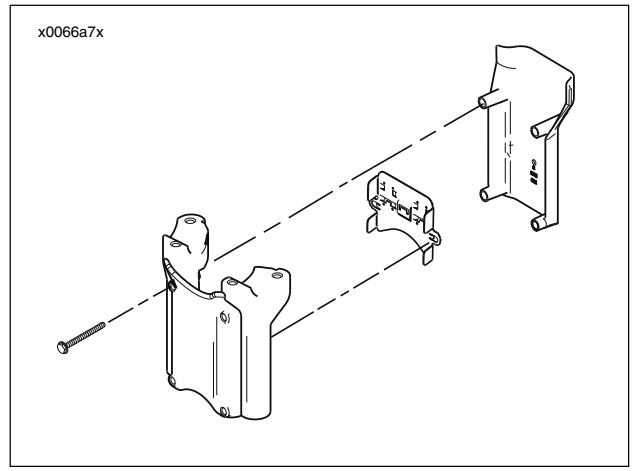


Figure 7-51. XL Custom riser cover

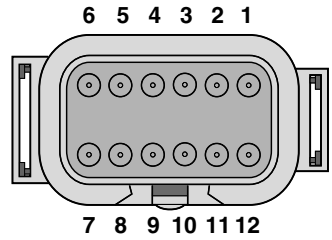
3. Locate the black 12-pin Mini-Deutsch connector located between the headlamp bracket and element housing. Depress the button and separate pin and socket halves.
4. Open the secondary lock from the socket side (plug end of connector). See 7.28 DEUTSCH ELECTRICAL CONNECTORS.
5. Gently depress terminal latches inside socket housing and back out all sockets through holes in rear wire seal.
6. Cut cable strap on wire bundle leading to connector and remove conduit.
7. Use a rocking motion while pulling on indicator lamp to remove indicator lamp from housing.
8. See Figure 7-52. Cut wire from bulb assembly approximately 1-1/2 inches (38 mm) before the splices (this leaves the splice as well as the other bulb connections intact). The neutral and oil lamps lead to a 3-wire splice on 883 and Custom, 4-wire on 1200/S. The turn signal and high beam lamps lead to the 4-wire splice.
9. Push on bulb socket to move bulb assembly out through the front of indicator lamp housing. Discard.
10. Trim wires of replacement bulb assembly to proper lengths. Install new Mini-Deutsch socket terminal to lead of replacement bulb assembly. The correct lead can be identified by the colored tape. If necessary, see CRIMPING INSTRUCTIONS under 7.28 DEUTSCH ELECTRICAL CONNECTORS.

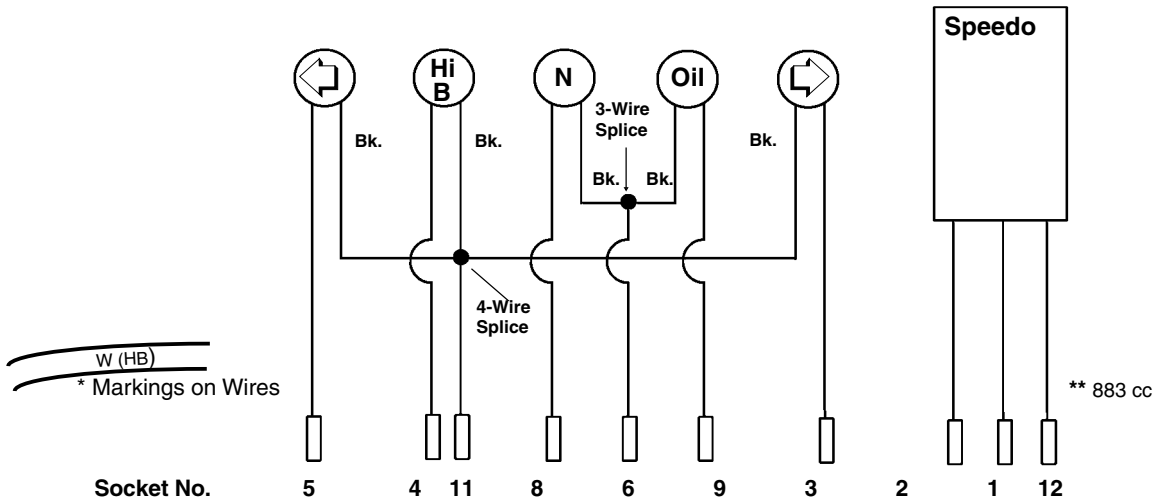
x0303x7x

12-Pin Grey

x0182x7x

1. **Orange** w/ White Tracer
2. **White** w/ Green Tracer
3. **BN (RT)***
4. **W (HB)***
5. **V (LT)***
6. **O (+)***
7. **N/A**
8. **TN (N)***
9. **GN/Y (OP)***
10. **N/A**
11. **BK (-)***
12. **Black**





Instrument Plug - Speedometer only**

Figure 7-52. Single Instrument Plug- Schematic and Wire Colors

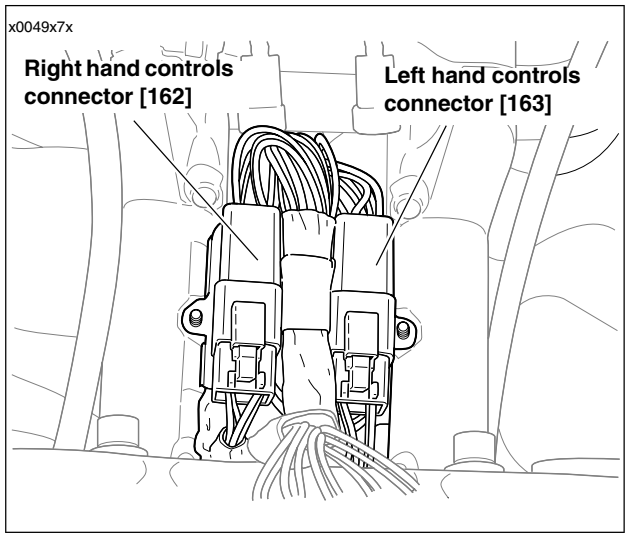


Figure 7-53. XL Custom - Riser cover removed

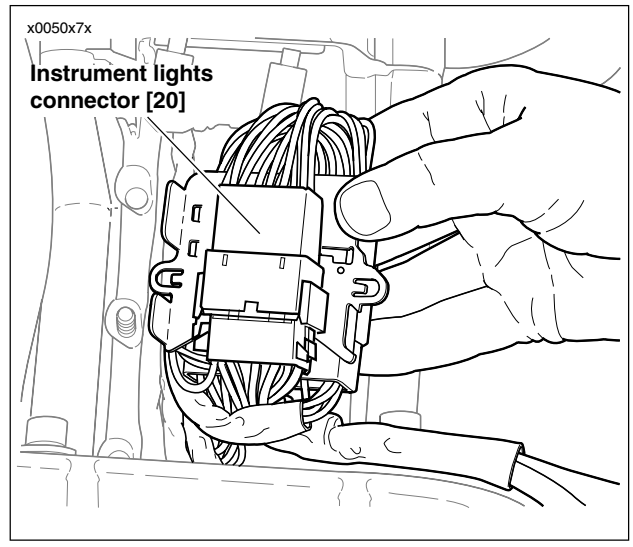


Figure 7-54. XL Custom - Electrical bracket removed

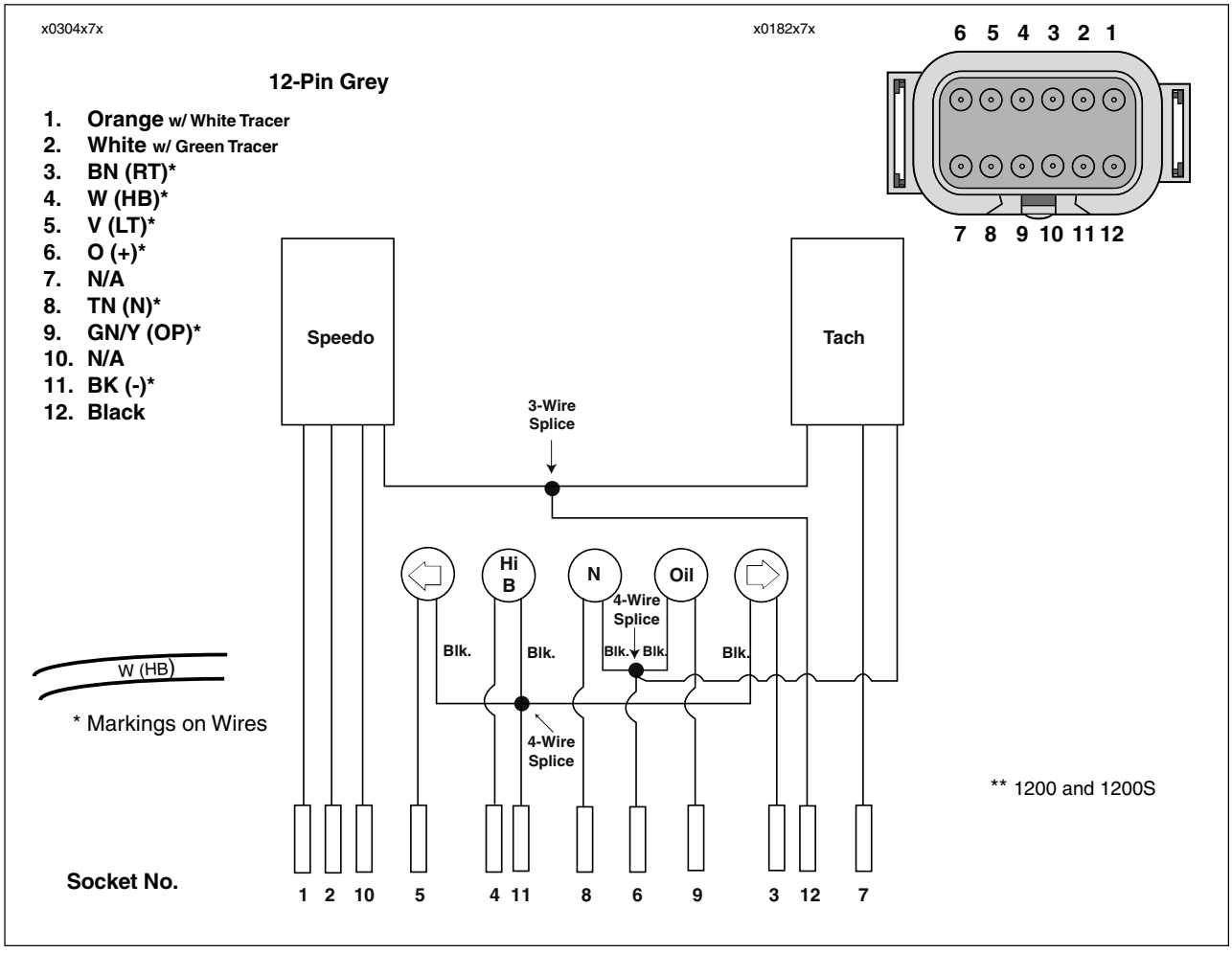
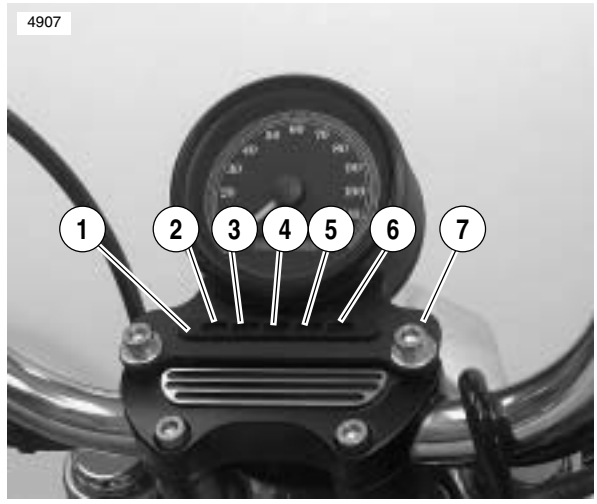


Figure 7-55. Dual Instrument Plug- Schematic and Wire Colors

6. Socket end first, insert replacement bulb back into housing.
7. Install butt connector to remaining wire (black, untaped) of replacement bulb assembly. Complete butt splice to 1-1/2 inch (38 mm) lead remaining from old bulb assembly. See 7.31 SEALED BUTT CONNECTORS.
8. Slide conduit over butt splices and wire crimps. Install **new** cable strap to secure conduit to wire bundle.
9. See Figure 7-52. See Figure 7-53. See Figure 7-55. Fit rear wire seal into back of socket housing, if removed. Grasp sockets approximately 1 inch (25.4 mm) behind contact barrel. Push sockets into their respective chambers. Feed each 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 locked in place.
10. Install secondary lock of socket housing and press down until it snaps in place.
11. Align the tabs on the socket housing with the grooves on the pin housing. Push the connector halves together until the latch “clicks”.
12. Position Deutsch connector beneath bracket at back of headlamp assembly (inside riser cover on XL 1200C).
13. Align holes in headlamp bracket with holes in upper stem bracket. Install two bolts with lockwashers. Tighten bolts to 10-16 ft-lbs (14-22 Nm). On XL 1200C, install riser cover.



1. **Trim cover**
2. **Left turn**
3. **High beam**
4. **Neutral**
5. **Oil pressure**
6. **Right turn**
7. **Instrument bracket**

Figure 7-56. Indicator Lamp Assembly

BULB REPLACEMENT

NOTE

Sportsters are equipped with a tail lamp incorporating a rear lighting harness and circuit board to simplify replacement.

1. See Figure 7-57. Remove two screws and lens from base.
2. Depress locking tab and remove 4-Pin multi-lock connector from circuit board.
3. Remove (pull) bulb assembly from lens. Remove bulb from socket.
4. Coat base of **new** bulb with electrical contact grease (Part No. 99861-90). Install **new** bulb in socket.
5. Install (push) bulb assembly to lens.
6. Connect 4-Pin multi-lock connector to circuit board.
7. Install lens to base with two screws.Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm).
8. Turn ignition on and test for proper tail lamp operation.

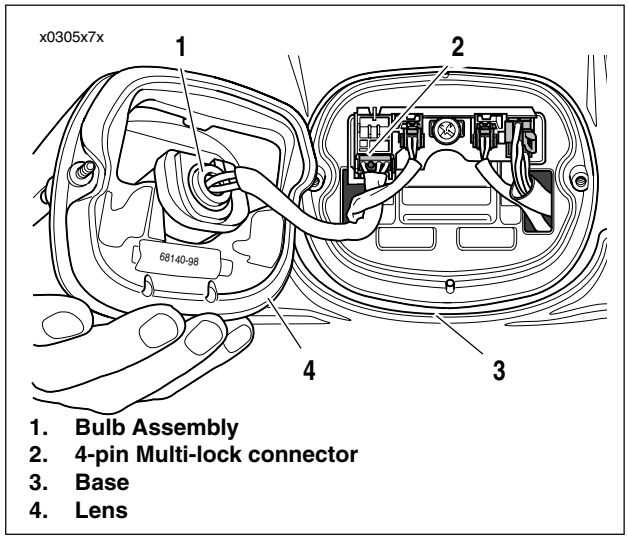


Figure 7-57. Tail Lamp

BASE REPLACEMENT

Table 7-10. Lamp Tools

SPECIAL TOOLS	TORQUE VALUES
HD-39621-28 Terminal tool See 7.29 AMP MULTILOCK ELECTRICAL CONNECTORS	None

1. Remove two screws and lens from base.
2. Depress locking tab and remove 4-Pin multi-lock connector from circuit board.
3. See Figure 7-58. Using a terminal pick, depress locking tabs and remove two 2-Pin turn signal connectors and 6-Pin Power In connector from circuit board.
4. Remove screw, pin housing and circuit board from base.

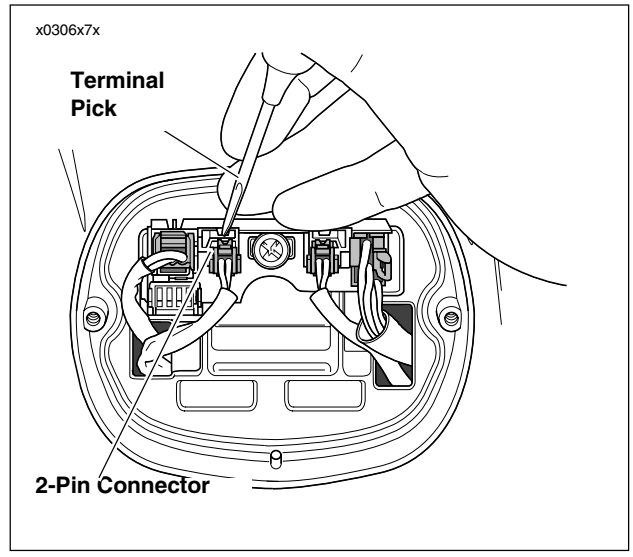


Figure 7-58. Removing 2-Pin Connectors

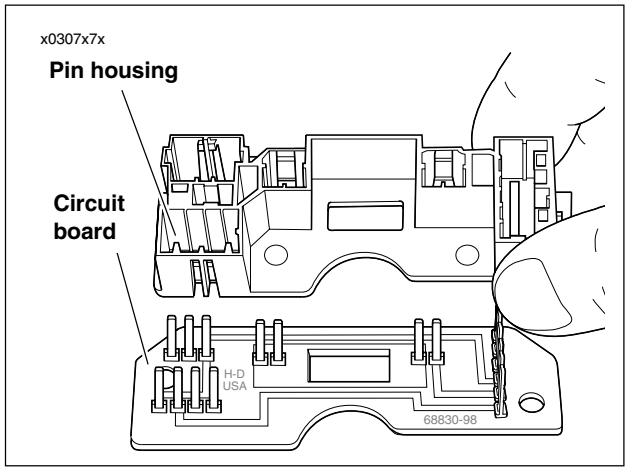


Figure 7-59. Pin Housing and Circuit Board

1. See Figure 7-60. Remove two nuts, screws and base from rear fender.
2. Install **new** base to rear fender with two screws and nuts. Tighten screws to 40-48 **in-lbs** (4.5-5.4 Nm)
3. See Figure 7-59. Install circuit board/pin housing to base with screw.

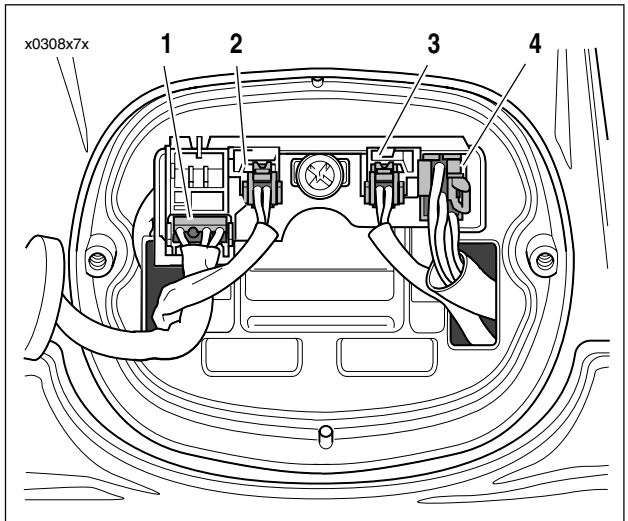
NOTE

Circuit board snaps in on bottom.

4. Install connectors to circuit board.
5. Install lens to base with two screws. Tighten screws to 20-24 **in-lbs** (2.3-2.7 Nm).
6. Turn ignition on and test for proper tail lamp and turn signal operation.

NOTE

Cavity numbers are on the back side of secondary blocks.



1. Tail light [93]
2. Left turn signal [18]
3. Right turn signal [19]
4. Power in [94]

Figure 7-60. Wire Location at Connectors

Table 7-11. Connector Specifications

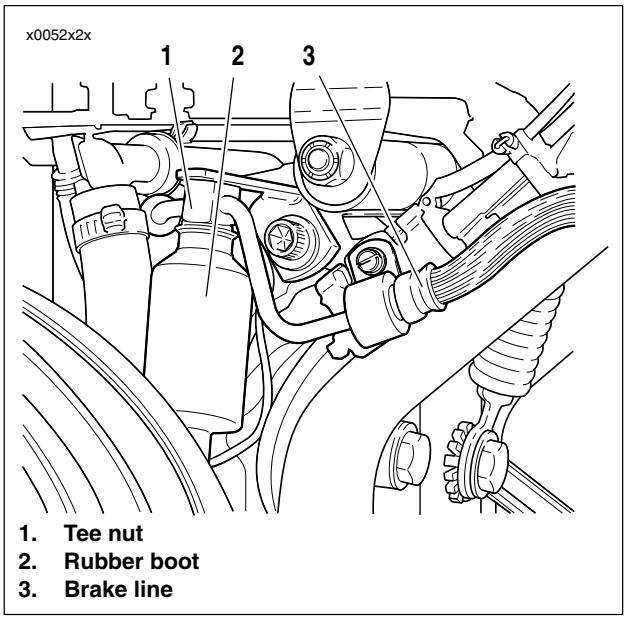
HARNESS	WIRE COLOR	CAVITY
Right Turn Signal (2-Pin Multilock Connector) [19]	V/BN BK	1 2
Left Turn Signal (2-Pin Multilock Connector) [18]	V/BN BK	1 2
Tail Lamp (4-Pin Multilock Connector) [93]	BE * HDI Only (O/W) OPEN on DOM R/Y BK	1 2 3 4
Power In (6-Pin Multilock Connector) [94]	O/W BN BE R/Y V BK	1 2 3 4 5 6

SWITCH REPLACEMENT

See Figure 7-61. The rear stoplight switch is threaded into a tee in the rear brake line. A protective rubber boot keeps out dust and dirt.

The stoplight switch is an open type switch which closes with hydraulic pressure. The individual parts of the switch are not serviceable, so the unit must be replaced if it fails.

1. Pull terminal sockets from spade connections at bottom of stoplight switch.
2. Stretch rubber boot (2) to remove from switch body. Unthread switch from tee nut (1) on rear brake line (3).
3. Thread **new** stoplight switch to tee nut (2) on brake line (3). Tighten switch assembly to 7-10 ft-lbs (9-14 Nm).
4. Install boot (2) on stoplight switch.
5. Install terminal sockets on switch spade connections.
6. Refill master cylinder and bleed brakes. See 2.21 BLEEDING HYDRAULIC BRAKE SYSTEM. Test operation of rear brake.
7. Test operation of brake lamp with the rear brake applied and the ignition/light switch turned ON.



1. Tee nut
2. Rubber boot
3. Brake line

Figure 7-61. Rear Stoplight Switch (Left Side View)

GENERAL

The switches are of rugged construction and feature a superior seal to protect electrical contacts and components from dirt and moisture in harsh environments.

The left handlebar switches include the headlamp HI - LO switch, horn and left turn signal switch. The right handlebar switches include the engine start and RUN - OFF switch and right turn signal switch. The individual switches are non-repairable and must be replaced if they malfunction.

NOTES

- *To replace or repair individual switches in either the right or left handlebar switch assemblies, see SWITCH REPAIR/REPLACEMENT under 7.22 HANDLEBAR SWITCHES following the REMOVAL and 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 inch (3.96 mm) cardboard insert between the brake lever and lever bracket. Removing the assembly without the insert in place may result in damage to the rubber boot and plunger of the front stoplight switch.

1. See Figure 7-62. Place the cardboard insert between the brake lever and lever bracket.

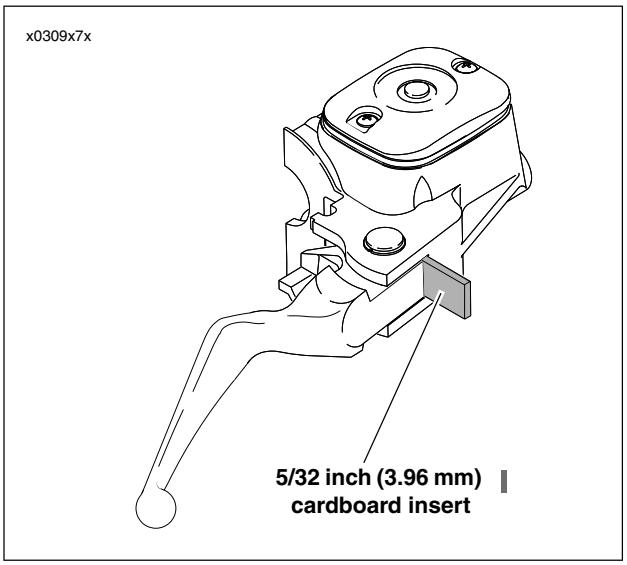


Figure 7-62. Install Cardboard Insert

2. Using a T-27 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 T-25 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 T-27 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 T-25 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:

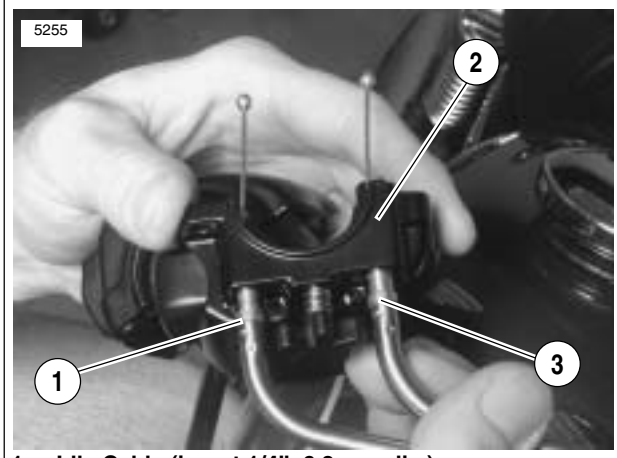
See Figure 7-63. Note the different diameter inserts crimped into the end of the throttle and idle cable housings.

3. Push the larger diameter insert (silver colored, 5/16 inch; 7.9 mm) of the throttle cable housing into the larger hole in front of the tension adjuster screw.
4. Push the smaller diameter insert (gold colored,1/4 inch; 6.3 mm) of the idle cable housing into the smaller hole at the rear of the tension adjuster screw.

NOTE

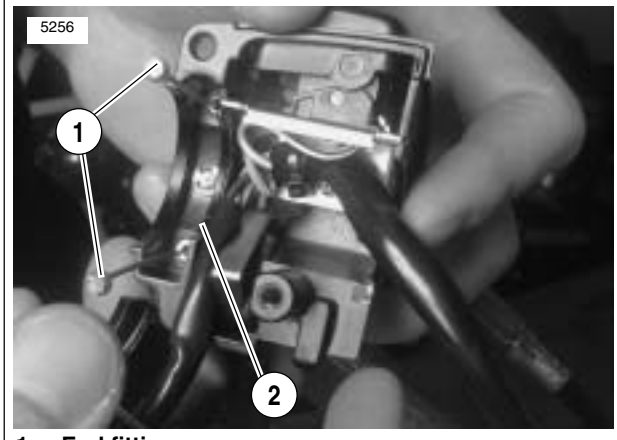
To aid assembly, place a drop of light oil on the retaining rings of the crimped inserts. Always replace the retaining rings if damaged or distorted.

5. See Figure 7-64. Route the cable to the upper switch housing as shown
6. 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).



1. Idle Cable (insert 1/4"; 6.3 mm dia.)
2. Lower Switch Housing
3. Throttle Cable (insert 5/16"; 7.9 mm dia.)

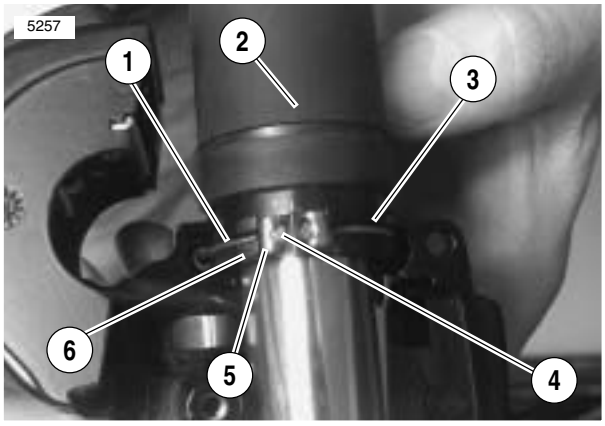
Figure 7-63. Install Throttle/Idle Control Cables in Lower Switch Housing



1. End fitting
2. Upper switch housing cable

Figure 7-64. Route Cable to Upper Switch Housing

7. See Figure 7-65. 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.



1. **Throttle Cable**
2. **Throttle Grip**
3. **Idle Cable**
4. **Ferrule**
5. **Notch**
6. **Groove**

Figure 7-65. Install Throttle/Idle Control Cables on Throttle Control Grip

8. Position the upper switch housing over the handlebar and lower switch housing.
9. 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.
10. Start the upper and lower switch housing screws, but do not tighten.

CAUTION

See Figure 7-66. Do not remove the 5/32 inch (3.96 mm) 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.

11. See Figure 7-67. 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

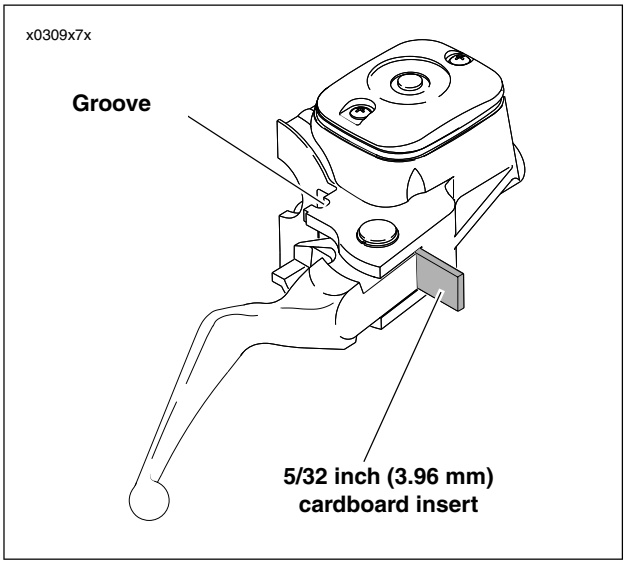
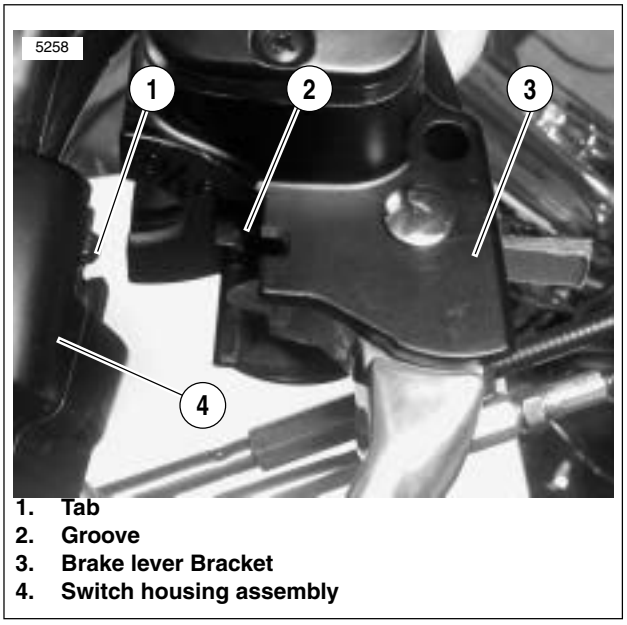


Figure 7-66. Leave Cardboard Insert in Place



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

Figure 7-67. Fit Brake Lever/Master Cylinder to Right Handlebar Switch Housings

12. 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.
13. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 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. Remove the cardboard insert between the brake lever and lever bracket.
15. Test the switches for proper operation.
16. If necessary, secure wire harness conduit to handlebar using **new** cable strap. Position cable strap approximately 4-5 inches (102-127 mm) 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.

    a. Using a piece of emery cloth, rough grip end of left side of handlebar.

NOTE

Before applying adhesive in the next step, clean the left side of handlebar with acetone.

    b. Apply LOCTITE PRISM PRIMER (770) to inside of handgrip. Remove any excess PRISM PRIMER. Wait two minutes for PRISM PRIMER to set before beginning the next step.

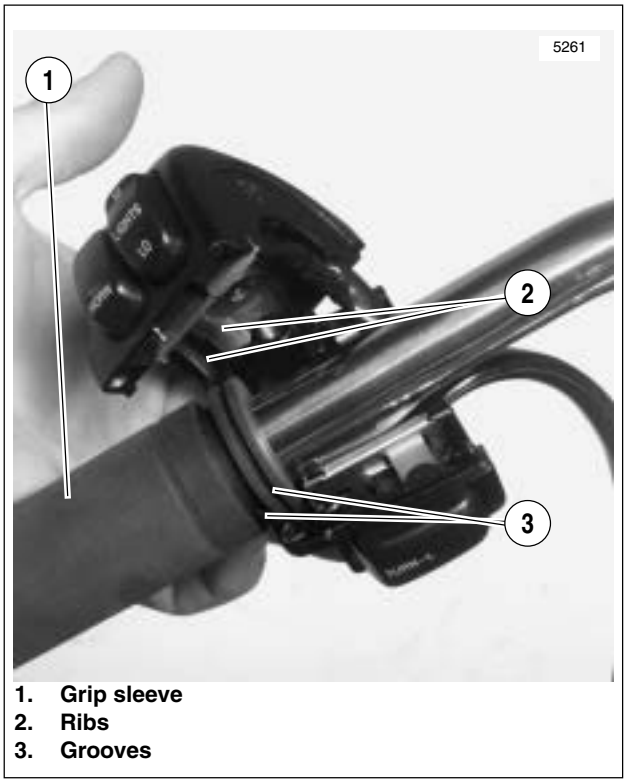
    c. Apply LOCTITE PRISM SUPERBONDER (411) to inside of handgrip. Place new handgrip on left buckhorn handlebar.

NOTE

SUPERBONDER will set in four minutes and be fully cured in 24 hours.

    Roll grip to evenly distribute adhesive on inside surfaces. Install grip on handlebar with a twisting motion.

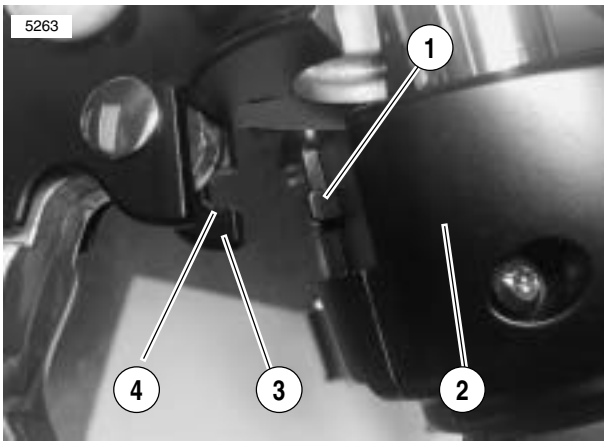
2. See Figure 7-68. Install upper and lower switch housings on handlebar. Be sure that ribs on outboard side of switch housings fit in grooves molded into grip.



1. Grip sleeve
2. Ribs
3. Grooves

Figure 7-68. 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 7-69. 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.



1. **Tab**
2. **Switch Housing Assembly**
3. **Clutch Lever Bracket**
4. **Groove**

Figure 7-69. Fit Clutch Lever Bracket to Left Handlebar Switch Housings

6. 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.
7. Using a T25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.4-4.5 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 (102-127 mm) from handlebar clamp. Cut any excess cable strap material.

SWITCH REPAIR/REPLACEMENT

Right Handlebar Switches–Disassembly

CAUTION

See Figure 7-62. 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 7-70. From inside the switch housing, remove the Phillips screw with lock washer to release the bracket. Remove the bracket and switch assembly from the housing.
2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch (6.3 mm) 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 (12.7 mm) of conduit material. Push conduit back to access switch wires.

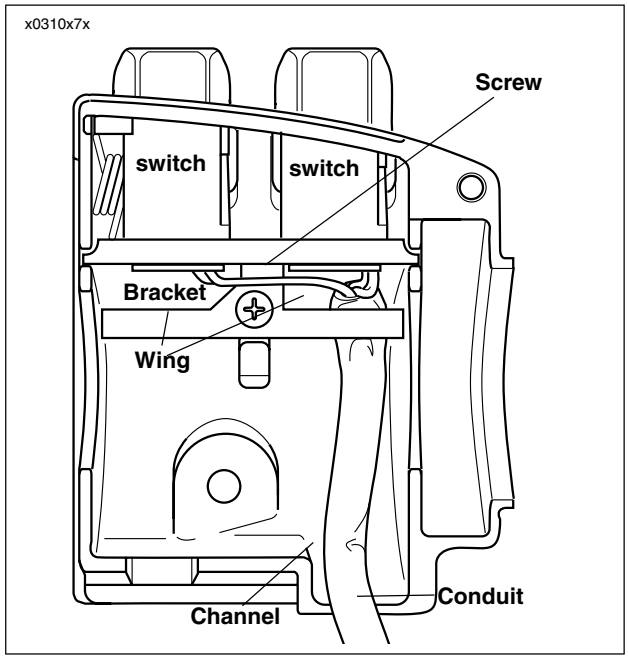


Figure 7-70. Upper Right Handlebar Switch Housing (Without Splices)

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 (63.5 mm) and 2 inches (50.8 mm), respectively, and partially stripped.

5. See the last part of 7.22 HANDLEBAR SWITCHES, SWITCH REPAIR/REPLACEMENT, General Repair Procedures for information on repair practices.

6. See Figure 7-71. See Figure 7-70. Loop switch wires so that spliced lengths are positioned as shown. Route wires downstream of splices beneath wing on engine stop switch side of bracket as shown.

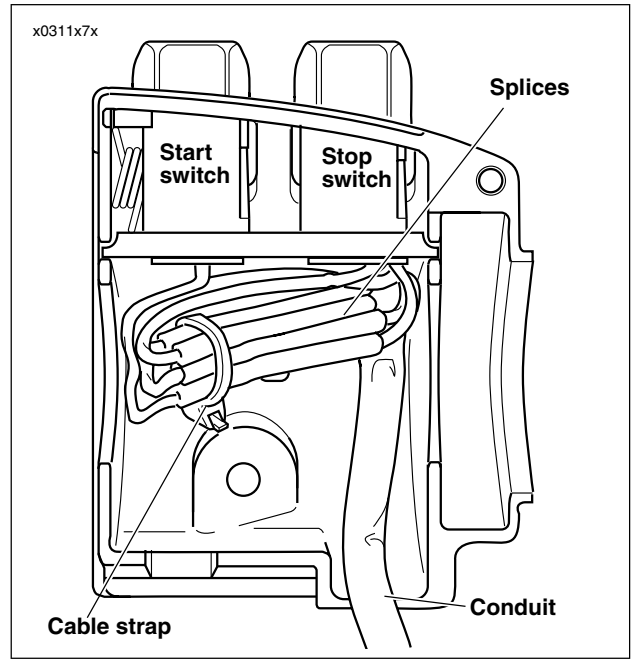


Figure 7-71. Upper Right Handlebar Switch Housing (With Splices)

7. Install a **new** 7 inch (178 mm) 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. See Figure 7-70. Install Phillips screw (with lock washer) to secure bracket inside housing. Verify that wing on engine stop switch side of bracket captures edge of conduit as shown.
10. Securely tighten cable strap to draw splices to bracket. Remove any excess cable strap material.
11. See SWITCH REPAIR/REPLACEMENT, Right Handlebar Switches–Assembly under 7.22 HANDLEBAR SWITCHES.

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 lock washer 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 (38 mm) from old switch. Discard old switch assembly.

NOTE

Replacement turn-right signal switch wires are cut to length; 1-1/2 inches (38 mm), and partially stripped.

2. See the last part of 7.22 HANDLEBAR SWITCHES, 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 (25.4 mm) from old switch. Discard old switch.

NOTE

Replacement stoplight switch wires are cut to length; 2-1/2 inches (63.5 mm), and partially stripped.

3. See the last part of 7.22 HANDLEBAR SWITCHES, 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 7-72. 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.

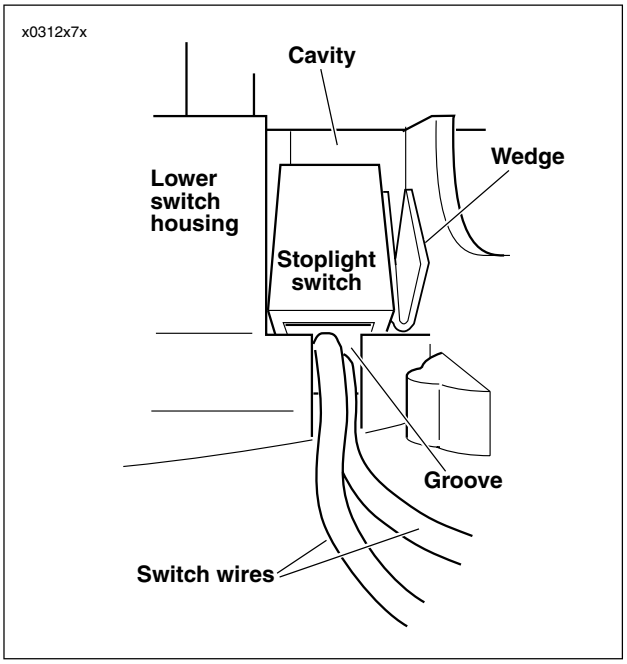


Figure 7-72. Install Stoplight Switch

Right Handlebar Switches–Assembly

1. See Figure 7-73. Insert tapered end of **new** 7 inch (178 mm) 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.

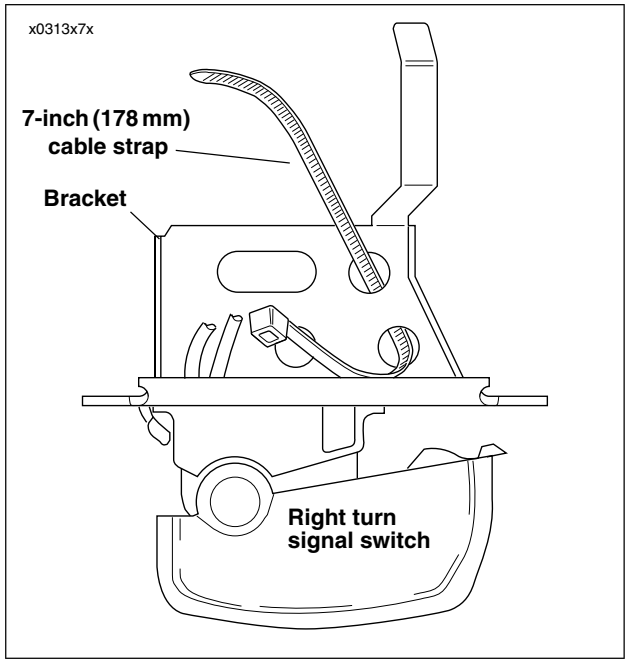


Figure 7-73. Insert Cable Strap in Switch Bracket

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 lock washer) to secure bracket inside housing.

CAUTION

If routed incorrectly, wires may be pinched by casting or handlebar resulting in switch failure.

4. Loop switch wires so that spliced lengths are positioned as shown.

5. Capturing conduit about 1/4 inch (6.3 mm) from end, securely tighten cable strap to draw conduit to bracket. Remove any excess cable strap material.

6. Install second 7 inch (178 mm) cable strap capturing conduit and wire splices. Securely tighten cable strap to draw splices to conduit. Remove any excess cable strap material.

7. Tighten 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 (3.2 mm).

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 T-27 TORX drive head.

17. Using a T-25 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.95-5.08 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 7-74. From inside the switch housing, remove the Phillips screw and lock washer to release the bracket. Remove the bracket and switch assembly from the housing.

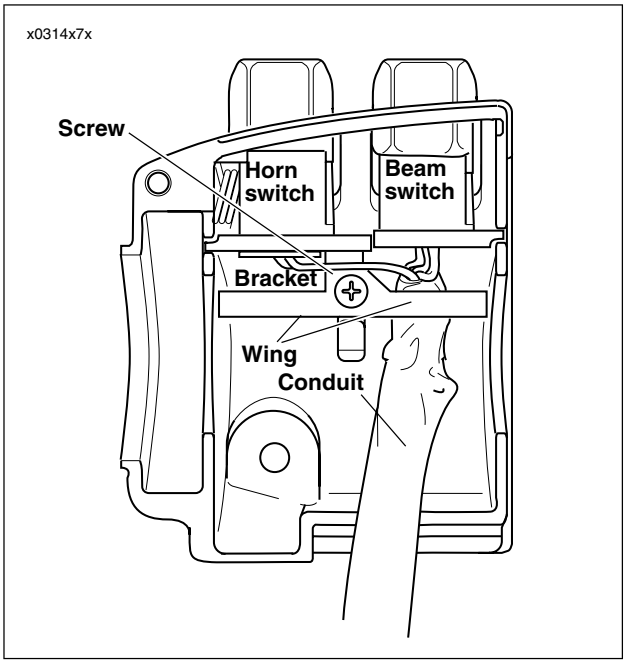


Figure 7-74. Upper Left Handlebar Switch Housing (Without Splices)

2. Move cable conduit from beneath wing of bracket. Cut wires 1/4 inch (6.3 mm) 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 (12.7 mm) 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 (63.5 mm) and 2 inches (50.8 mm) respectively, and partially stripped.

5. See the last part of 7.22 HANDLEBAR SWITCHES, SWITCH REPAIR/REPLACEMENT, General Repair Procedures for information on repair practices.
6. See Figure 7-75. Loop switch wires so that spliced lengths are positioned as shown. Route wires downstream of splices beneath wing on high/low beam switch side of bracket.

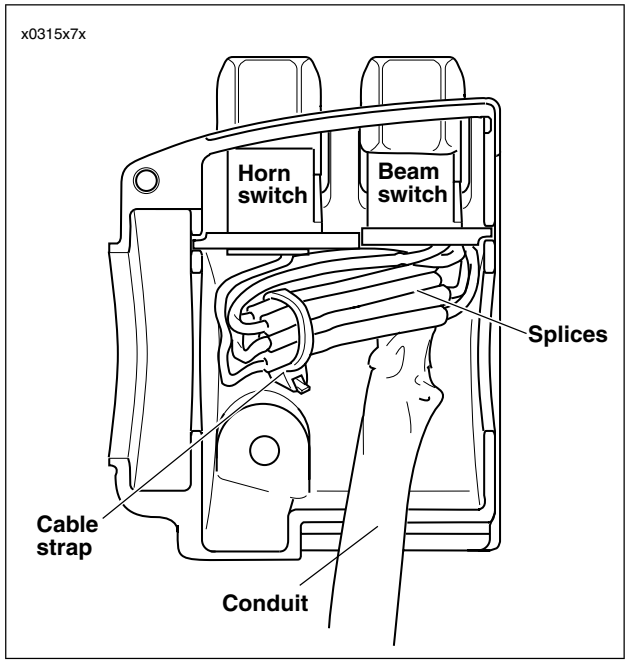


Figure 7-75. Upper Left Handlebar Switch Housing (With Splices)

7. Install a new 7 inch (178 mm) 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. See Figure 7-74. Install Phillips screw (with lock washer) to secure bracket inside housing. Verify that wing on high/low beam switch side of bracket captures edge of conduit as shown.
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 lock washer to release the turn signal switch bracket. Remove the bracket and switch assembly from the housing.
3. Cut wires 1-1/2 inches (38 mm) from old switch (Turn-L(eft) Signal Switch). Discard switch assembly.
4. See the last part of 7.22 HANDLEBAR SWITCHES, SWITCH REPAIR/REPLACEMENT, General Repair Procedures for information on repair practices.
5. See Left Handlebar Switches–Assembly.

Left Handlebar Switches–Assembly

1. See Figure 7-76. 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.

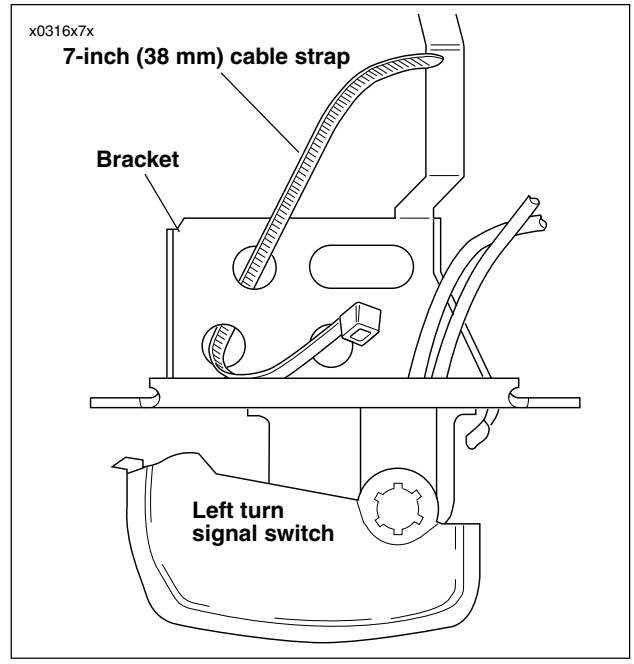


Figure 7-76. Insert Cable Strap in Switch Bracket

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 lock washer) to secure bracket inside housing.
4. See Figure 7-75. Loop switch wires so that spliced lengths are positioned as shown.
5. Capturing conduit about 1/4 inch (6.3 mm) 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 T-27 TORX drive head.

13. Using a T-27 TORX drive head, tighten the lower and upper switch housing screws to 35-45 **in-lbs** (3.95-5.08 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 (178 mm) cable strap in kit.

2. Strip 1/2 inch (12.7 mm) of insulation off switch wires. Twist stripped ends of switch wires until all strands are tightly coiled.

3. Cut dual wall heat-shrink tubing (supplied in kit) into 1 inch (25.4 mm) segments. Slide tubing over each wire of new switch assembly.

4. Splice existing and new switch wires, matching wire colors. Solder the spliced connections. For best results, do one wire at a time.

5. Center the heat-shrink tubing over the soldered splices.

⚠WARNING

Use caution when operating the UltraTorch UT-100, or any other radiant heating device. Read the manufacturer's instructions carefully before use. Improper handling could result in death or serious 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.

6. Using the UltraTorch UT-100 Robinair Heat Gun with heat shrink 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.

XLH-883

Removal

1. See Figure 7-77. Turn wheel to the right to access horn area. The horn is located between the front downtubes.
2. Remove terminal clips from horn spade connections.
3. Remove the two screws (2) threaded into well nuts (10) on horn bracket.

Installation

1. See Figure 7-77. Thread two screws (2) into well nuts (10) and tighten to 6-9 in/lbs (0.7-1 Nm).
2. Install harness terminal clips on horn spade connections. Attach the yellow wire with black tracer to rear terminal, black wire to front terminal.

XLH 1200/S

Removal

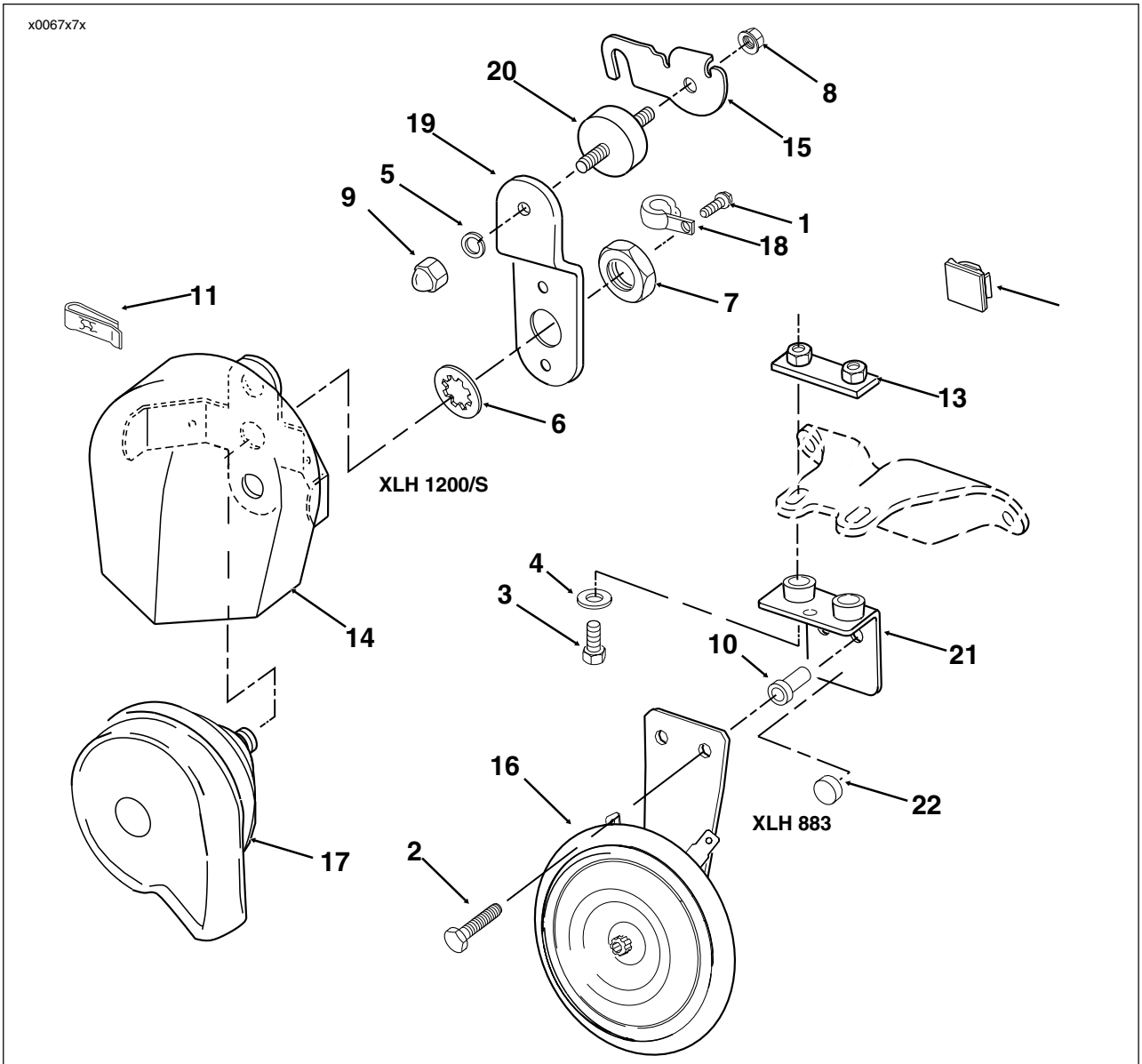
1. See Figure 7-77. Locate the horn on the left side of the vehicle.
2. Remove terminal clips from horn spade connections.
3. Remove acorn nut (9) and lock washer (5) to free horn assembly from rubber mount stud (20).
4. Remove wire conduit from clamp (18) at back of horn bracket (19).
5. Remove nut (7) from circular recess at back of horn bracket. Remove horn (17) from chrome horn cover (14). Remove internal tooth lock washer (6) from horn stud.

Installation

1. See Figure 7-77. Install internal tooth lock washer (6) on horn stud.
2. Slide horn (17) into chrome cover (14) pushing stud at back of horn assembly through hole in horn bracket (19). Apply two drops of LOCTITE THREADLOCKER 222 (purple) to threads of locknut (7). Install locknut on horn stud and tighten to110 in/lbs (12.4 Nm).
3. Install harness terminal clips on horn spade connections. Attach the yellow wire with black tracer to front terminal, black wire to rear terminal. Push wire conduit into clip at back of horn bracket.
4. Install horn on rubber mount stud (20) of frame mounting bracket. Install lock washer (5) and acorn nut (9) on rubber mount stud. Tighten acorn nut to 5-15 ft-lbs (7-20 Nm).

TROUBLESHOOTING

1. See Figure 7-77. If the horn does not sound or fails to function satisfactorily, check for the following conditions.
   - Discharged battery
   - Loose, frayed or damaged wiring leading to horn terminal
2. If battery has a satisfactory charge and wiring appears to be in good condition, check for the following:
   - Poor ground to frame through mounting hardware or ground wire (see Steps 3-6 below)
   - Inoperative horn switch (see Steps 3-6 below)
3. Remove terminal clips from horn spade connections.
4. Connect a voltmeter as follows:
   - Positive (+) lead to wire terminal
   - Negative (–) lead to ground
5. Turn ignition switch ON. Depress horn switch. If battery voltage is present, horn or horn grounding is faulty. If battery voltage is not present, either horn switch or wiring to horn is faulty.
6. If the horn is faulty, then it must be replaced as an assembly. The horn is not repairable. If the horn switch is faulty, replace the switch according to the procedures outlined in REMOVAL and INSTALLATION under 7.22 HANDLEBAR SWITCHES.



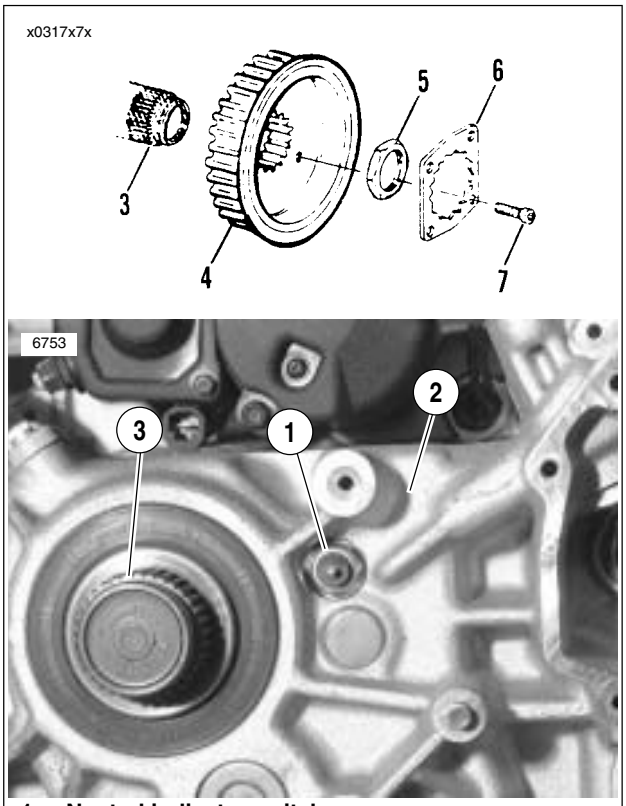
1. Screw
2. Screw
3. Bolt
4. Washer
5. Lock washer
6. Lock washer
7. Nut
8. Locknut
9. Acorn nut
10. Well nut
11. Clip nut
12. Clip
13. Nut plate
14. Cover
15. Support bracket
16. Horn
17. Horn
18. Clamp
19. Horn bracket
20. Rubber mount
21. Horn bracket
22. Bumper

Figure 7-77. Horn assemblies

GENERAL

See Figure 7-78. The neutral indicator switch (1) is threaded into the transmission portion of the right crankcase half (2); it is immediately forward of the main drive gear shaft (3). The sprocket cover must be removed to test the switch. If switch requires replacement, secondary drive belt and transmission sprocket must also be removed; there is not enough clearance to allow the removal of the switch without first removing the transmission sprocket.

A pin on the shifter drum contacts the neutral indicator switch plunger, completing the neutral indicator circuit. The switch is not repairable; if it malfunctions, it must be replaced.



1. **Neutral indicator switch**
2. **Right crankcase half**
3. **Main drive gear shaft**
4. **Transmission sprocket**
5. **Transmission sprocket nut (LH threads)**
6. **Lockplate**
7. **Socket head screw (2)**

Figure 7-78. Neutral Indicator Switch

TESTING

1. See Figure 7-78. Remove sprocket cover; see 2.17 REAR BRAKE LINKAGE AND SPROCKET COVER REMOVAL.
2. Disconnect wire lead from neutral indicator switch (1).
3. With ignition switch ON, touch the neutral indicator wire lead to a suitable ground.
   - If indicator lamp lights, then problem is at indicator switch. Replace switch.
   - If indicator lamp does not light, then problem is elsewhere in circuit (i.e. indicator lamp burned out, loose connection, or faulty wiring).
4. After testing, connect wire lead to indicator switch (1). Install sprocket cover and any other removed components; see 2.17 REAR BRAKE LINKAGE AND SPROCKET COVER INSTALLATION.

REMOVAL AND INSTALLATION

1. Verify that the ignition/light switch is turned to OFF.
2. Remove sprocket cover; see 2.17 REAR BRAKE LINKAGE AND SPROCKET COVER REMOVAL.
3. Place transmission in first gear. Remove two socket head screws (7) and lockplate (6).

CAUTION

Transmission sprocket nut has left-hand threads. Turn nut clockwise to loosen and remove from main drive gear shaft. Improper removal may damage sprocket nut or drive gear shaft.

4. Remove transmission sprocket nut (5) from main drive gear shaft (3).
5. Decrease secondary drive belt tension according to the applicable procedures listed in 6.3 SECONDARY DRIVE BELT REMOVAL AND INSTALLATION. Remove transmission sprocket (4) (with secondary drive belt) from main drive gear shaft (3).
6. Remove wire lead from neutral indicator switch (1). Remove switch from right crankcase half (2).
7. Install switch (1) in crankcase (2), and tighten switch to 3-5 ft-lbs (4-7 Nm). Connect wire lead to switch.
8. Install transmission sprocket (4) (with secondary drive belt) onto main drive gear shaft (3) according to applicable procedures listed in 6.14 TRANSMISSION INSTALLATION /SHIFTER PAWL ADJUSTMENT.
9. Install sprocket cover and any other removed components; see 2.17 REAR BRAKE LINKAGE AND SPROCKET COVER INSTALLATION.
10. Adjust secondary drive belt tension; see 6.3 SECONDARY DRIVE BELT ADJUSTMENT.

OPERATION

General

See Figure 7-79. Both the directional (turn signals) and 4-way flashers are controlled by an electronic module (self-canceller).

The module is secured to the rear fender, under the seat.

The canceller contains circuitry to generate pulses for "flashing" the appropriate directional lamps, thereby eliminating the previously used directional and hazard flashers. Steps 1 and 2 below explain canceller operation when a rider signals for a left turn; step 3 explains canceller operation when a right turn is signalled.

1. Pressing and releasing the left turn signal switch causes a momentary 12 vdc to be applied to Pin 8. The module sends a series of 12 vdc pulses (Pin 4) to flash the left directional lamps (front and rear).
2. The module monitors the number of vehicle speed sensor pulses from the speedometer at Pin 5. The switch closures indicate vehicle distance traveled. When the number of switch closure pulses equals a quantity preset in the self-cancelling module, the left turn signal is automatically canceled.
3. Pressing and releasing the right turn signal switch causes a momentary 12 vdc to be applied to Pin 7 and an output at Pin 3 identical to that just described for a left turn signal.

Manual or Rider Control

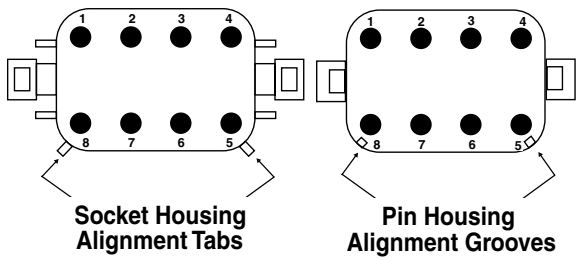
Directionals may be cancelled by pressing the turn signal switch a second time. Pressing the left turn signal switch while the right turn signal lamps are flashing will cancel the right turn lamps and activate the left turn lamps (and vice versa).

Hazard Flasher (4-Way)

To activate the hazard flashers, simultaneously press and hold both right and left turn signal switches for 1-1/2 seconds. To cancel hazard flashers, momentarily press and release right and left turn signal switches simultaneously.

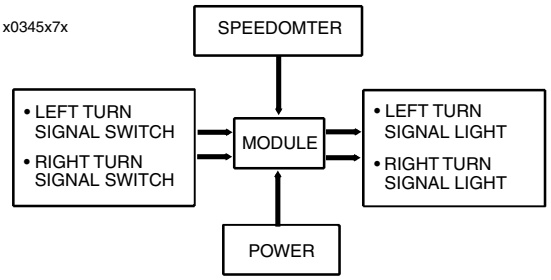
x0318x7x x0319x7x

8-Place Gray Deutsch Connector



Socket Housing Alignment Tabs **Pin Housing Alignment Grooves**

x0345x7x



PIN NUMBER	WIRE COLOR	DESCRIPTION/FUNCTION
1	BK	Module ground to motorcycle
2	O \ W	12vdc input from accessory circuit breaker
3	BN	Pulsed 12vdc for flashing right turn signal lights
4	V	Pulsed 12vdc for flashing left turn signal lights
5	W \ GN	Vehicle speed sensor input
6	–	Not used
7	W \ BN	12vdc from right turn signal switch (when pressed)
8	W \ V	12vdc from left turn signal switch (when pressed)

Figure 7-79. Turn Signal Module Pinout

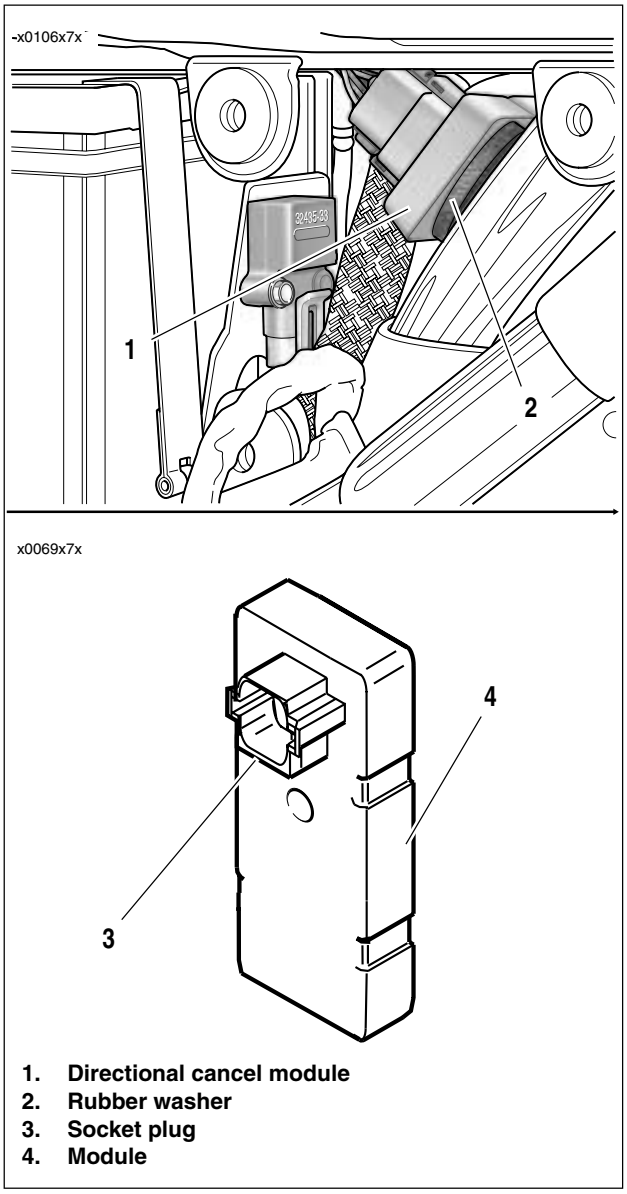
RIDER PREFERENCE AND CONTROL

To extend the distance/time that directionals flash, simply press and hold the turn signal switch button. Since the module does not begin to measure distance traveled and time elapsed until the switch button is released, the flashing sequence is prolonged.

To shorten the distance/time that directionals flash, press the turn signal switch button a second time while the directionals are still flashing. This procedure immediately cancels the turn signal.

REMOVAL/INSTALLATION DIRECTIONAL CANCELLER

1. See Figure 7-80. Remove seat. See 2.34 SEAT REMOVAL.
2. Verify that the ignition/light switch is turned to OFF.
3. On 1200S models:
   - Remove two bolts to detach electrical bracket from frame cross member.
   - Lift up electrical bracket.
4. Disconnect connector [30B]. Simultaneously depress the two external latches and use a rocking motion to separate pin and socket halves of directional canceller connector.
5. Remove screw securing module to rear fender. Remove module.
6. Align new self-cancelling turn signal module and insert screw. Tighten screw to 3-5 **in-lbs** (.3-.6 Nm)
7. Align tabs on socket housing with grooves on socket plug of module. Push connector until latches “click.”
8. On 1200S models:
   - Align holes in electrical bracket with wellnuts in cross member of motorcycle frame.
   - Install two bolts in electrical bracket.
   - Tighten bolts to 6-9 **in-lbs** (0.7-1.0 Nm).
9. Test all turn signal functions. See SPORTSTER MODELS ELECTRICAL DIAGNOSTIC MANUAL (Part No. 99495-02).
10. Install seat. See 2.34 SEAT INSTALLATION.



1. Directional cancel module
2. Rubber washer
3. Socket plug
4. Module

Figure 7-80. Directional Canceller

GENERAL

See Figure 7-81. Fuses function to prevent electrical overload of a circuit. The fuse completes the circuit as long as current (amperage) flowing through the fuse does not exceed the ampere rating of the fuse. If the circuit current happens to exceed the fuse ampere rating, the fuse opens and the current flow in the circuit is interrupted.

The Main circuit breaker is the automatic-reset type, the bimetallic breaker contact automatically closes (completing the circuit) once it has cooled down from the initial overload. If the overload condition still exists, the breaker contact will again open to interrupt current flow. This “cycling effect” (opening and closing) of the breaker contact continues as long as the current circuit overload condition exists.

⚠WARNING

To prevent accidental start-up of vehicle and possible personal injury, disconnect battery cables (negative cable first) before performing any electrical work.

See Figure 7-82. XLH models have 4 fuses and one circuit breaker, all of which are installed on the electrical bracket (under side cover). The fuses are all rated at 15 amperes. The main circuit breaker is rated at 30 amperes.

- See REPLACE FUSE(S) under 7.2 ELECTRICAL BRACKET INSTALLATION.
- See REPLACE MAIN CIRCUIT BREAKER under 7.2 ELECTRICAL BRACKET INSTALLATION.

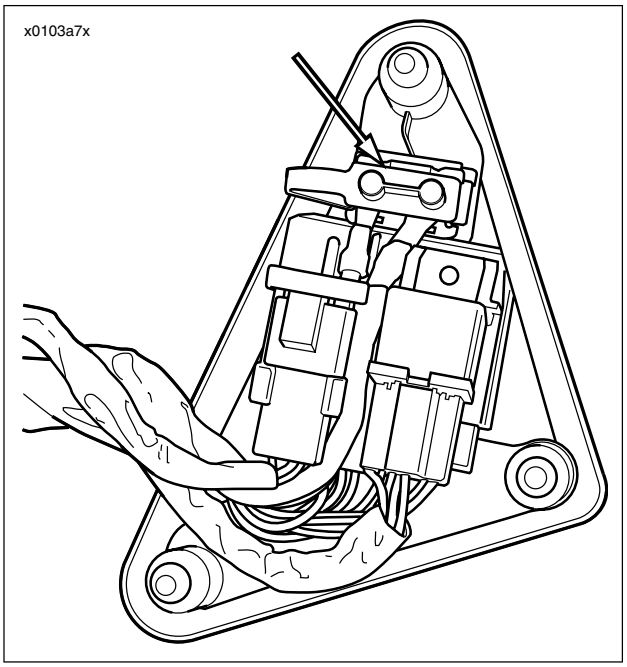


Figure 7-81. Main Circuit Breaker (30-amp)

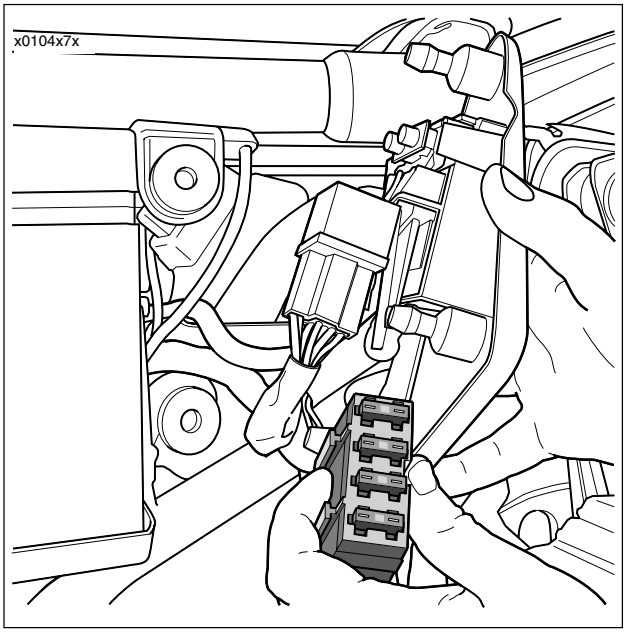


Figure 7-82. Fuse Block

SPEEDOMETER REMOVAL

1. See Figure 7-83. Remove odometer reset boot from back of housing.
2. Remove socket head screws holding back of speedometer housing.
3. Depress tab and remove connector.
4. Loosen back gasket and push instrument through front of housing toward rear of motorcycle. Remove gasket from instrument.

SPEEDOMETER INSTALLATION

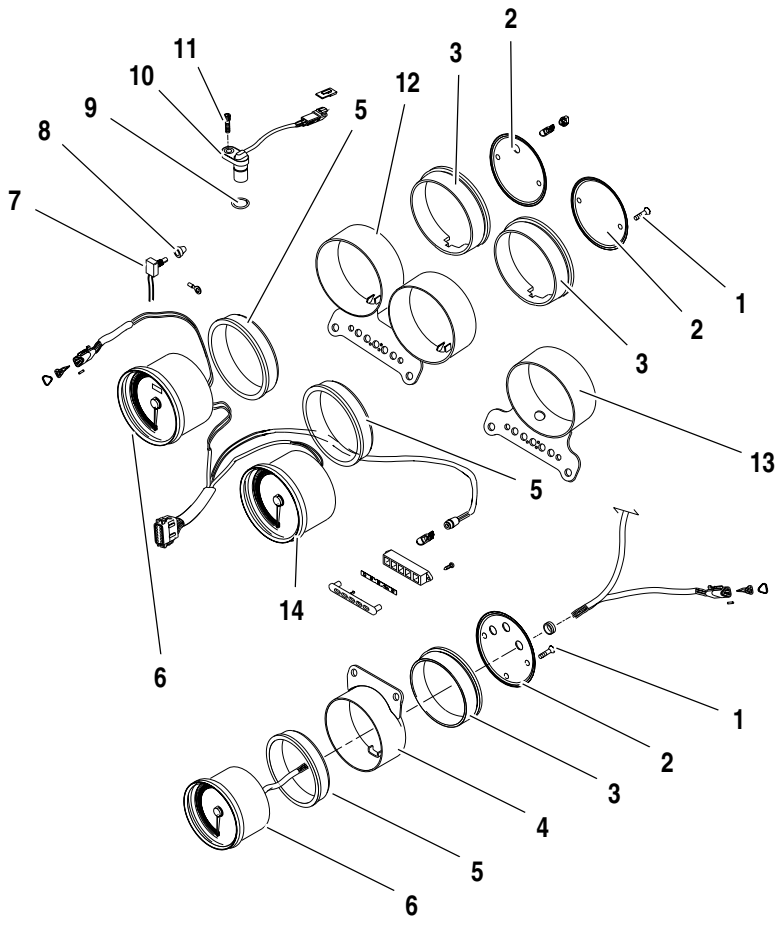
1. See Figure 7-83. Install gasket removed in Step 4.
2. Slide speedometer into instrument housing and press firmly until fully seated.

NOTE

If necessary lubricate housing with alcohol or glass cleaner to aid installation.

3. Insert connector [39].
4. Route wires through slot in back of instrument housing. Install gasket on back of housing.
5. Position reset switch in squared boss on back of speedometer housing.
6. Align back cover. Install back cover screws and tighten. Replace rubber boot on odometer reset switch.

x0068a7x



1. **Screw**
2. **Cover**
3. **Cushion (rear)**
4. **Bracket (1200C)**
5. **Cushion (front)**
6. **Speedometer**
7. **Reset switch**
8. **Boot**
9. **O-ring**
10. **Sensor**
11. **Screw**
12. **Bracket (1200)**
13. **Bracket (883)**
14. **Tachometer (1200)**
15. **Connector (883) - not shown**

Figure 7-83. Speedometer and Tachometer

TACHOMETER REPLACEMENT

Removal

1. Remove socket head screws holding back of tachometer housing.
2. See Figure 7-84. Remove connector [108].

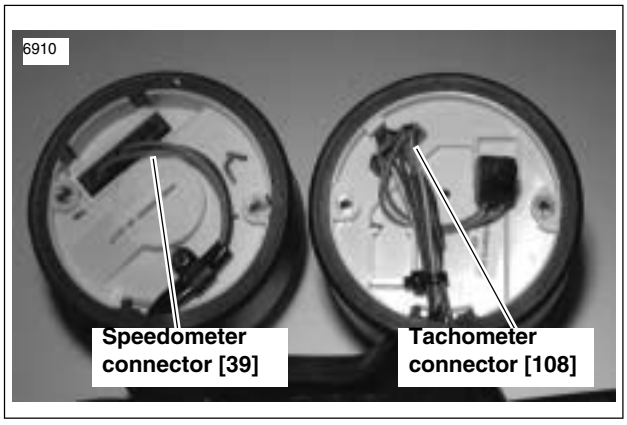


Figure 7-84. Speedometer and Tachometer

3. Loosen back gasket and push instrument through front of housing toward rear of motorcycle. Remove gasket from instrument.

Installation

1. Install gasket removed in Step 3, above.
2. Slide Tachometer into instrument housing and press firmly until fully seated.
3. See Figure 7-84. Install connector [108].
4. Route wires through slot in back of instrument housing. Install gasket on back of housing.
5. Align back cover. Install back cover screws and tighten.

SPEEDOMETER SENSOR REPLACEMENT

Removal

1. Remove seat. See 2.34 SEAT REMOVAL.
2. Disconnect battery cables, negative cable first. See 7.18 BATTERY DISCONNECTION AND REMOVAL. Remove battery from tray.
3. See Figure 7-85. Push the 3-place connector [65] located on the frame underneath the seat forward to dislodge connector from t-stud and disconnect the connector. Cut the cable straps that retain sensor wires to main harness bundle.
4. Remove sensor mounting screw using allen socket tool (Snap-On P/N TMAXS6) and lift sensor from crankcase. Remove assembly from left side by lifting the transmission vent hose up far enough to allow the sensor to pass and then remove it.

Installation

1. Route the speedometer sensor underneath the transmission vent hose from left and install sensor into crankcase from right side of vehicle. Install sensor mounting screw and tighten to **80-100 in/lbs** (9-11 Nm).
2. Route the sensor cable back into position along main wiring harness bundle and retain with cable straps.
3. Check speedometer for proper operation.
4. Install seat. See 2.34 SEAT INSTALLATION.

⚠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 during vehicle operation and startle the rider, causing loss of control and death or serious injury.

RESET SWITCH REPLACEMENT

Removal

1. Remove odometer reset boot from back of housing.
2. Remove socket head screws holding back of speedometer housing.
3. Cut wires from switch.

Installation

1. See Figure 7-85. Follow instructions for installing SEALED WIRE SPLICES.
2. Position reset switch in squared boss on back of speedometer housing.
3. Align back cover. Install back cover screws and tighten. Replace rubber boot on odometer reset switch.

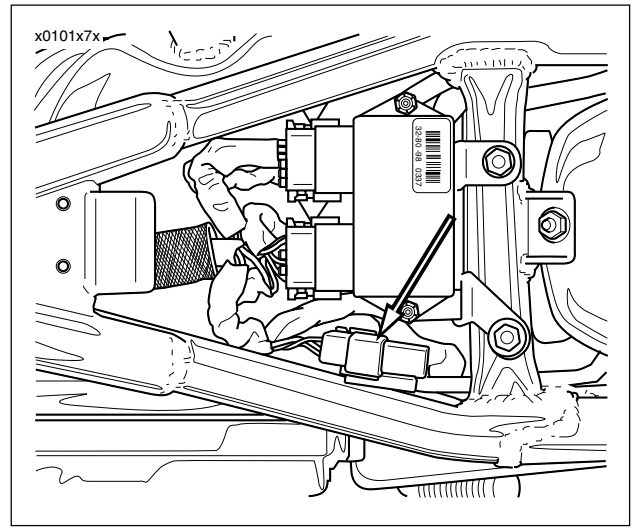


Figure 7-85. Speedometer Sensor Connector [65] (1200S shown)

DEUTSCH ELECTRICAL CONNECTORS 7.28

GENERAL

The XLH models utilize Deutsch DT and DTM Series Electrical Connectors. The Deutsch Connector features a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides better pin retention than previous connectors.

See Figure 7-88. A 12-pin connector is illustrated 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 toward the rear to disengage small end of slot on attachment clip from T-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 plumbed to the wiring harness.

REMOVING/INSTALLING SOCKETS

1. See Figure 7-87. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge in line with the groove (in line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. Gently depress terminal latches inside socket housing and back out sockets through holes in rear 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, 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.
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.

NOTES

- *See Figure 7-86. 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.*
- *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.*

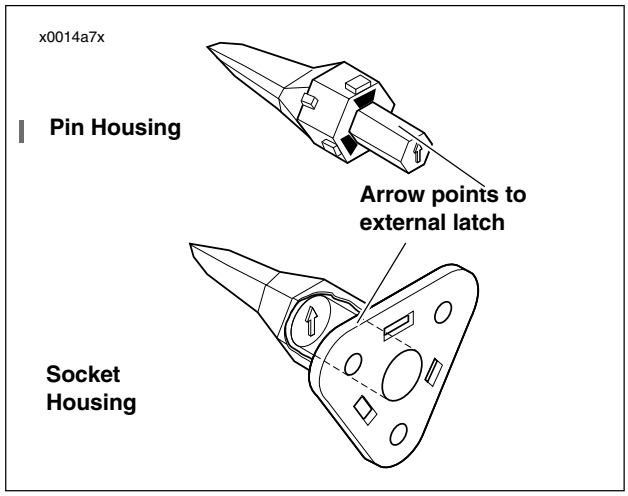


Figure 7-86. 3-pin Locking Wedge Orientation

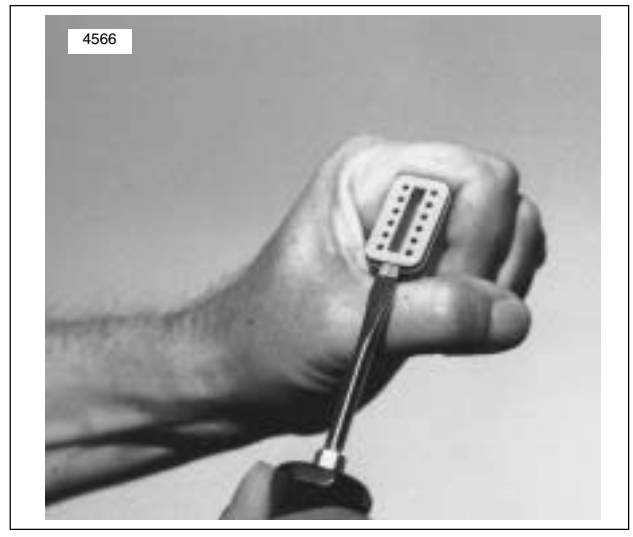
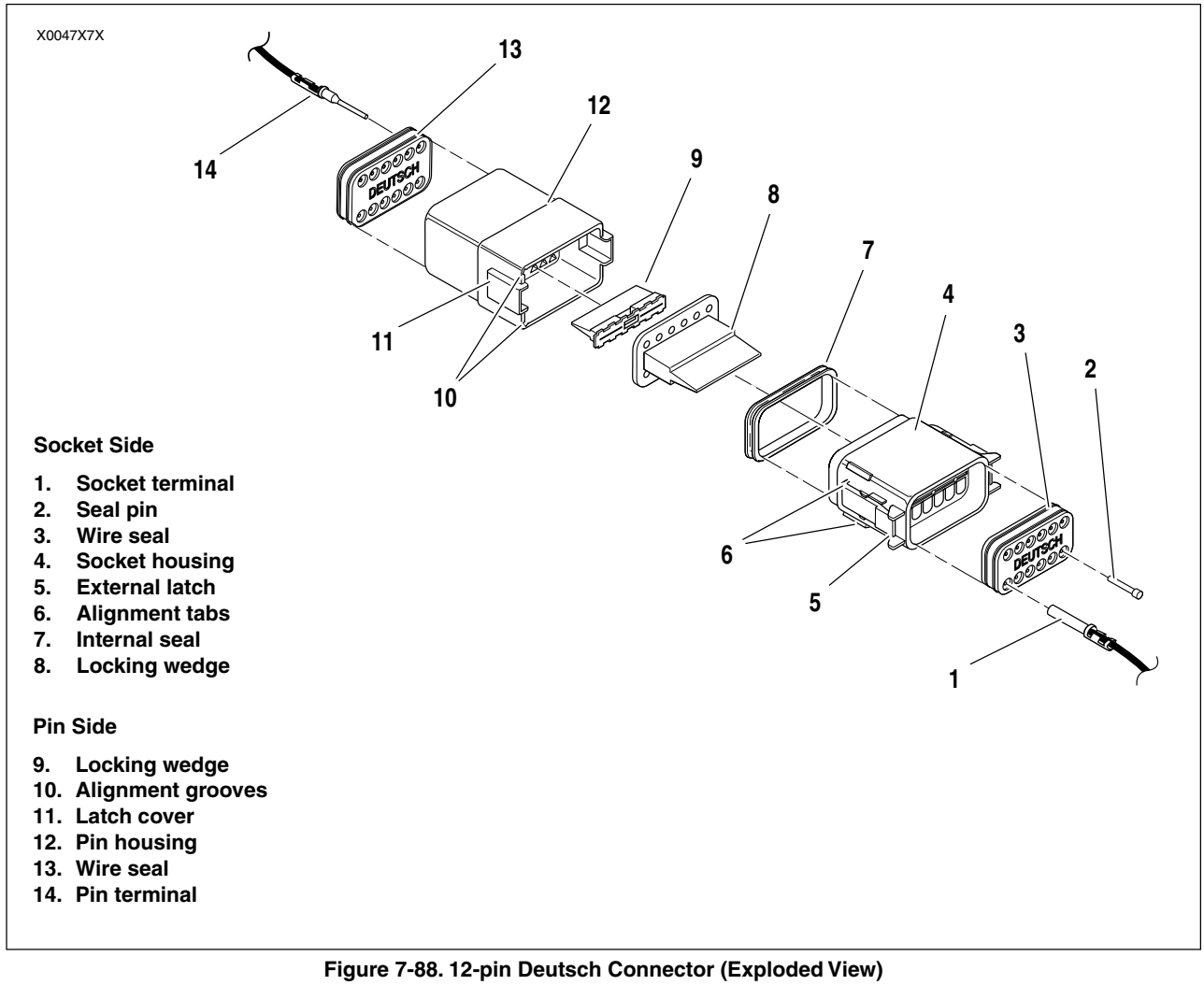


Figure 7-87. Remove Secondary Locking Wedge



Socket Side

1. Socket terminal
2. Seal pin
3. Wire seal
4. Socket housing
5. External latch
6. Alignment tabs
7. Internal seal
8. Locking wedge

Pin Side

9. Locking wedge
10. Alignment grooves
11. Latch cover
12. Pin housing
13. Wire seal
14. Pin terminal

Figure 7-88. 12-pin Deutsch Connector (Exploded View)

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire or a needle nose pliers, whichever is most suitable.
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.

NOTES

- *See Figure 7-86. 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.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

ASSEMBLING/INSTALLING

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.

NOTES

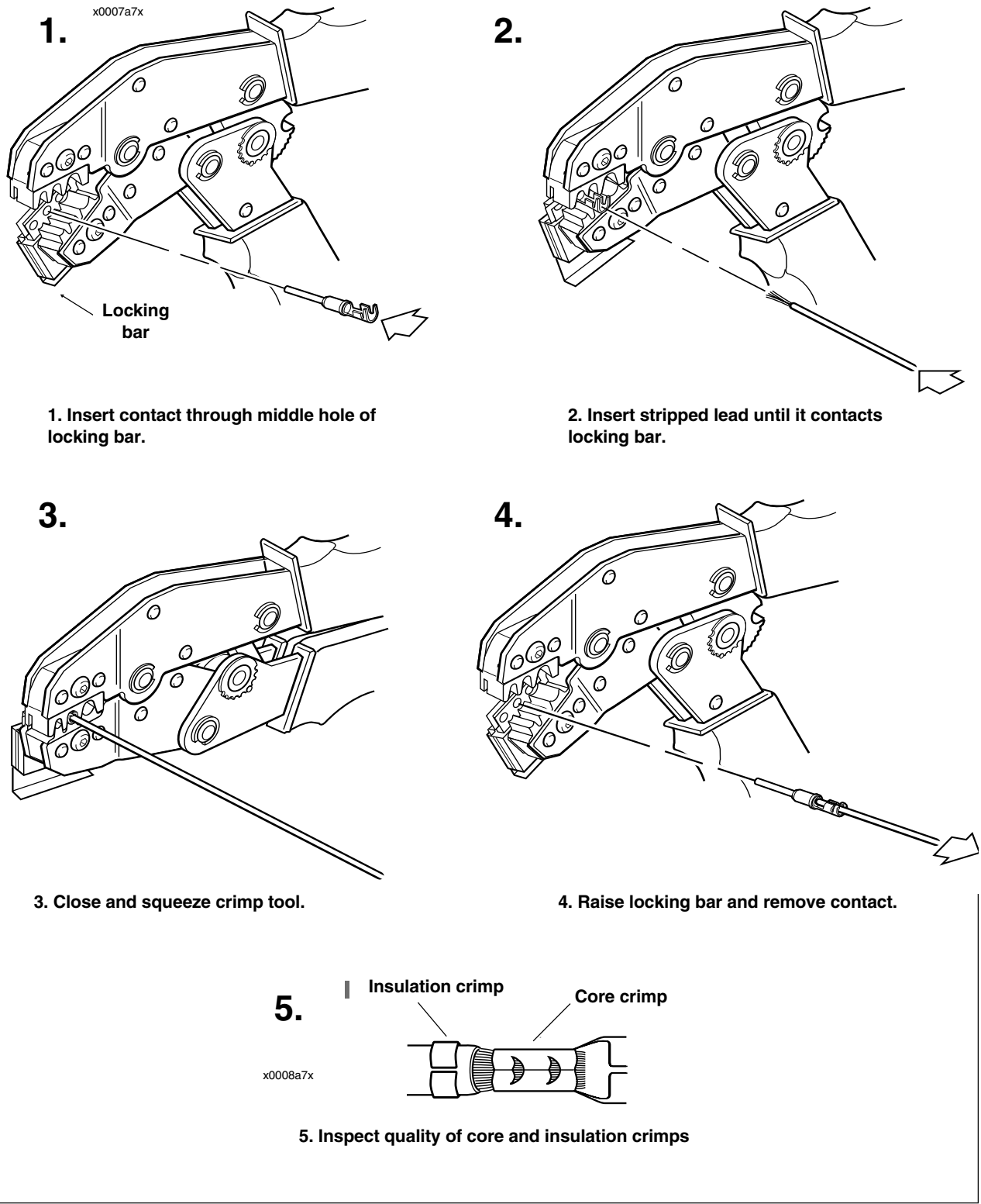
- *Deutsch connectors are colored coded for location purposes. Those connectors associated with left side accessories, such as the front and rear left turn signals, are gray. All other connectors, including those associated with right side accessories, are black.*
- *If it should become necessary to 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. 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.

CRIMPING INSTRUCTIONS

1. See Figure 7-89. 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 (3.96 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.

Inspect the quality of the core and insulation crimps. Distortion should be minimal.



1. Insert contact through middle hole of locking bar.

2. Insert stripped lead until it contacts locking bar.

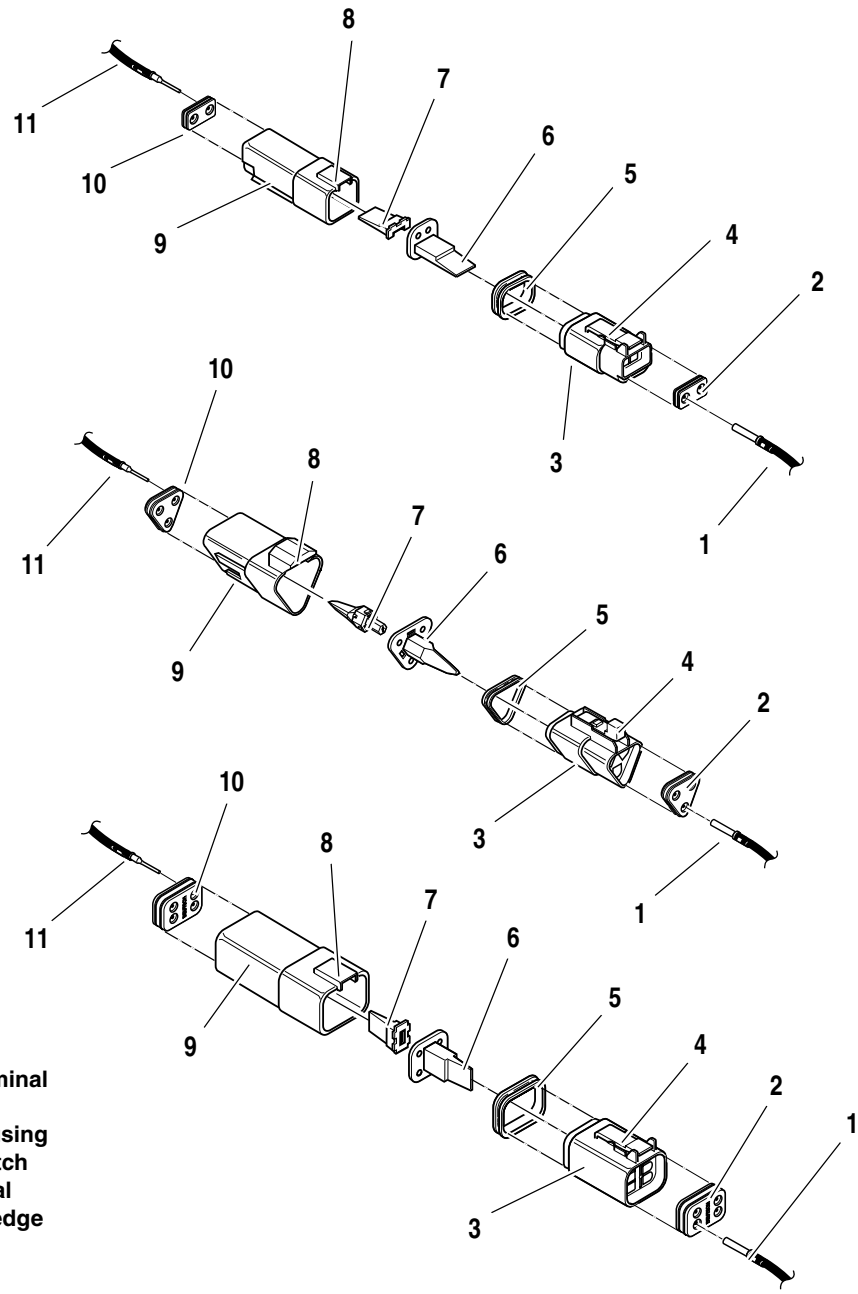
3. Close and squeeze crimp tool.

4. Raise locking bar and remove contact.

5. Inspect quality of core and insulation crimps

Figure 7-89. Deutsch Crimping Procedure

x320x7x



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 7-90. 2-Pin, 3-Pin and 4-Pin Deutsch Connectors

DEUTSCH SOLID BARREL CONTACT CRIMPING INSTRUCTIONS

For Size 20, 16 and 12 Contacts Wire Range 26-12 AWG

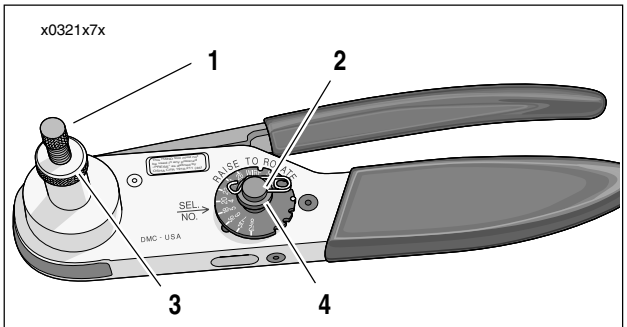
NOTE

Mini-Deutsch connectors make use of a solid barrel contact without crimp tails. As a result, a special Terminal Crimp Tool (Part No. HD-42879) is needed to install pin and socket terminals on wires. See Crimping Instructions below for details.

1. Squeeze the handles to cycle the crimp tool to the fully open position.
2. See Figure 7-91. Remove locking pin from selector knob.
3. See Figure 7-92. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with “SEL. NO.” arrow.
4. Loosen knurled locknut and turn adjusting screw clockwise (in) until it stops.
5. Turn tool over and drop contact into indentor cover hole with the wire end out.
6. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
7. See Figure 7-92. Slowly squeeze handles of crimp tool until contact is centered between indentor points.
8. Strip wire lead removing 1/4 inch (6.3 mm) of insulation.
9. See Figure 7-92. Insert bare wire strands into contact barrel.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. Remove crimped contact from indentor.
12. Inspect the quality of the crimp. Verify that all wire strands are in crimp barrel.

NOTE

Tool must be readjusted when changing contact size/type.

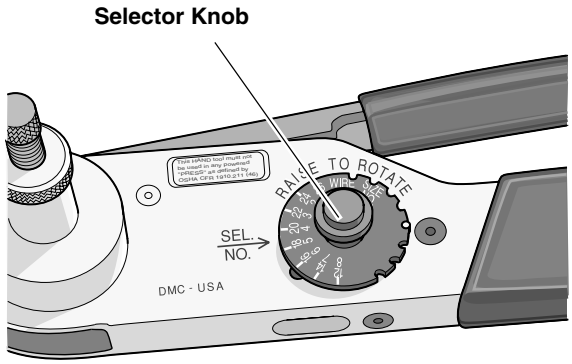


1. **Adjusting screw**
2. **Locking pin**
3. **Locknut**
4. **Selector knob**

Figure 7-91. Deutsch Solid Barrel Contact Crimp Tool (Part No. HD-42879)

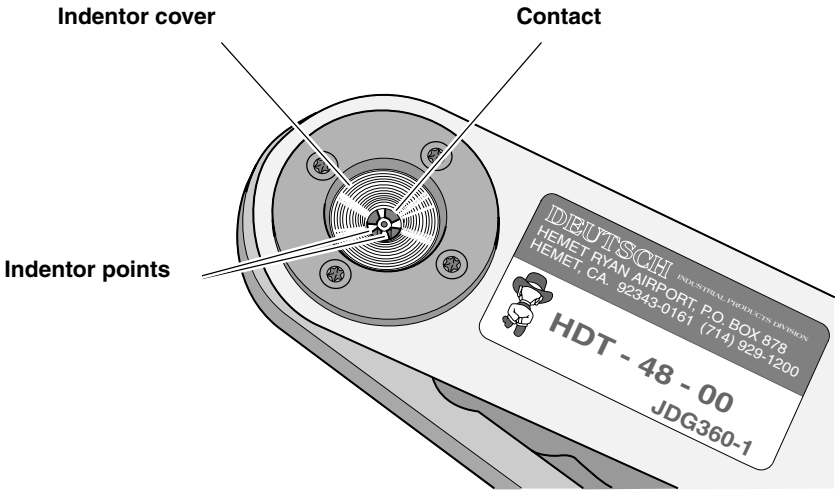
x0322x7x

Rotate selector knob to align wire size on wheel with arrow stamped in tool.



x0323x7x

Turn adjusting screw as described in text. When contact is flush with bottom of depression in indentor cover, squeeze handles to center contact between indentor points.



x0324x7x

Insert bare wire strands into contact barrel. Squeeze handle of crimp tool until tightly closed.

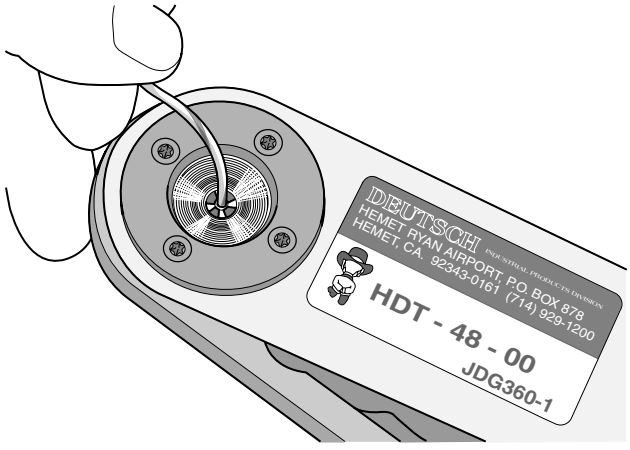
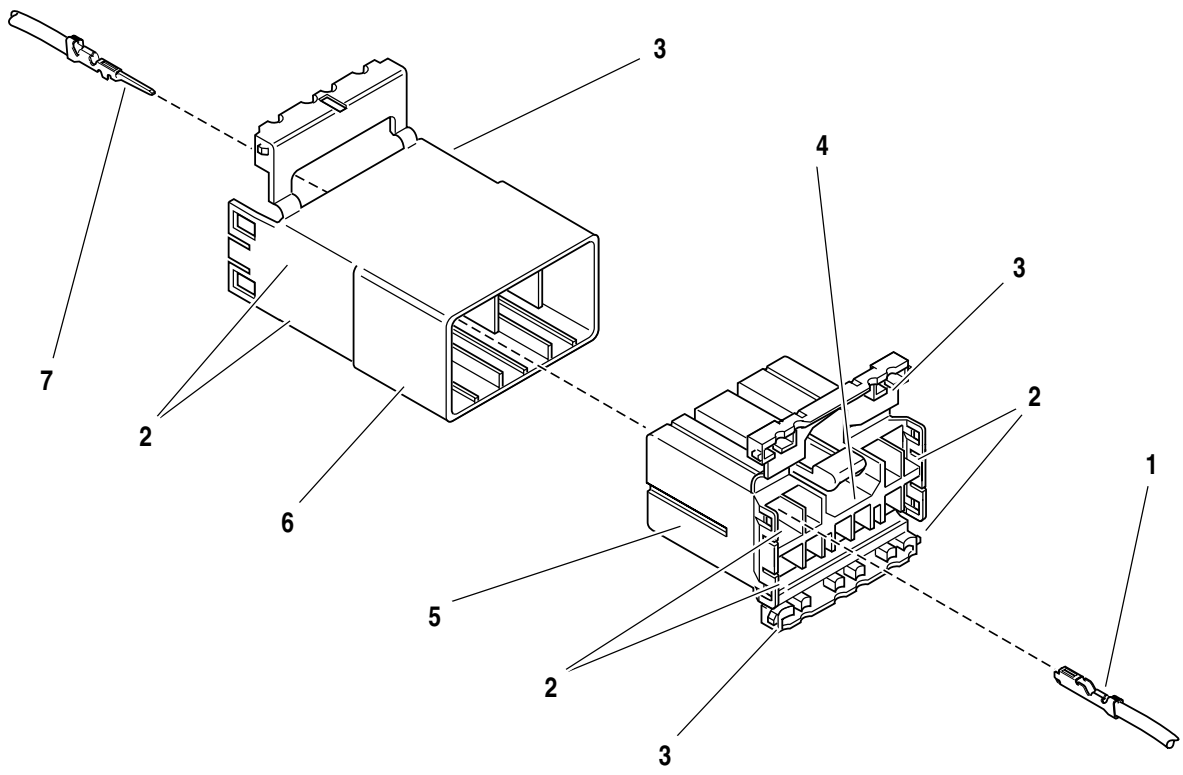


Figure 7-92. Deutsch Solid Barrel Contact Crimping Procedure

REMOVING SOCKET/PIN TERMINALS

1. See Figure 7-93. 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.



1. **Socket terminal**
2. **Latch**
3. **Secondary lock open**
4. **Button**
5. **Socket housing**
6. **Pin housing**
7. **Pin terminal**

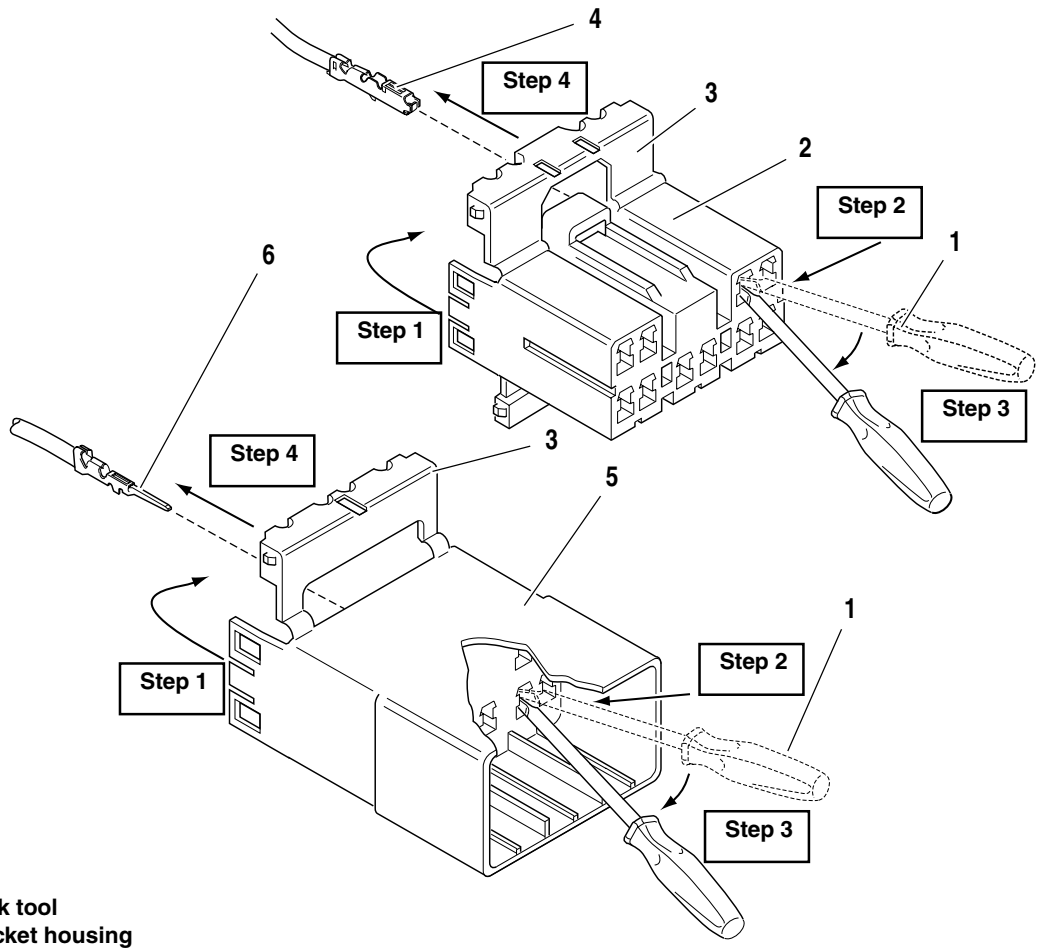
Figure 7-93. 10-Place Amp Multi-Lock Connector

5. See Figure 7-94. With the flat side 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 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

An Electrical Terminal Crimp Tool (Part No. HD-41609) is used to install Amp Multi-lock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.

x0325x7x



1. **Pick tool**
2. **Socket housing**
3. **Secondary lock open**
4. **Socket terminal**
5. **Pin housing**
6. **Pin terminal**

Read the following steps:

1. **Open secondary lock**
2. **Insert pick into cavity on inboard side of connector.**
3. **Pivot end of pick to release tang.**
4. **Gently tug on wire to remove terminal from housing**

Figure 7-94. Amp Multi-lock Connector

INSTALLING SOCKET/PIN TERMINALS

NOTE

See Figure 7-95. For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings.

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.

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.

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.

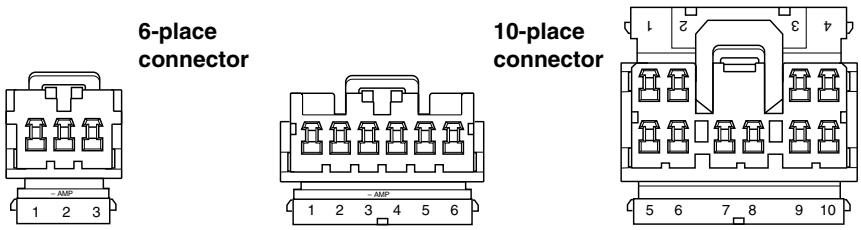
x0326x7x

Secondary Locks Open

3-place connector

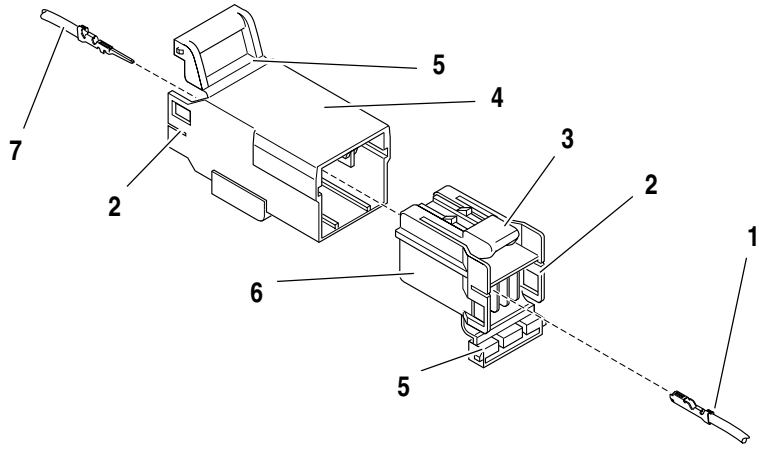
6-place connector

10-place connector

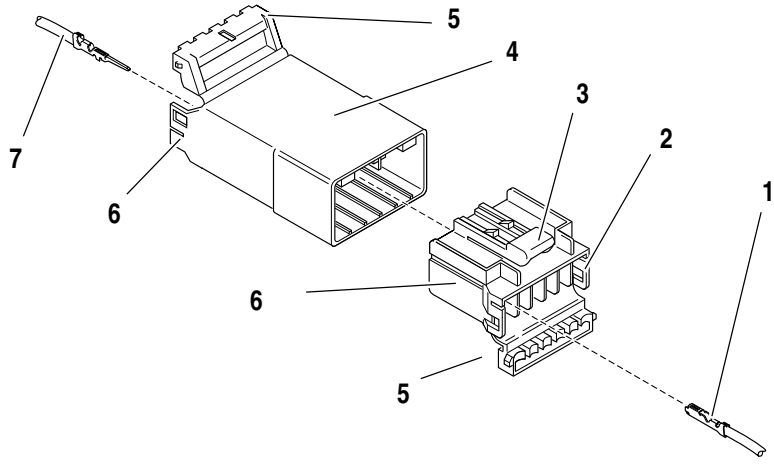


Numbers Stamped on Secondary Locks for Wire Color Locations (Socket Housings Shown)

x0327x7x



x0328x7x



1. **Socket terminal**
2. **Latch**
3. **Button**
4. **Pin housing**
5. **Secondary lock open**
6. **Socket housing**
7. **Pin terminal**

Figure 7-95. 3-Place and 6-Place Amp Multi-lock Connectors

CRIMPING INSTRUCTIONS

1. See Figure 7-96. 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).
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.

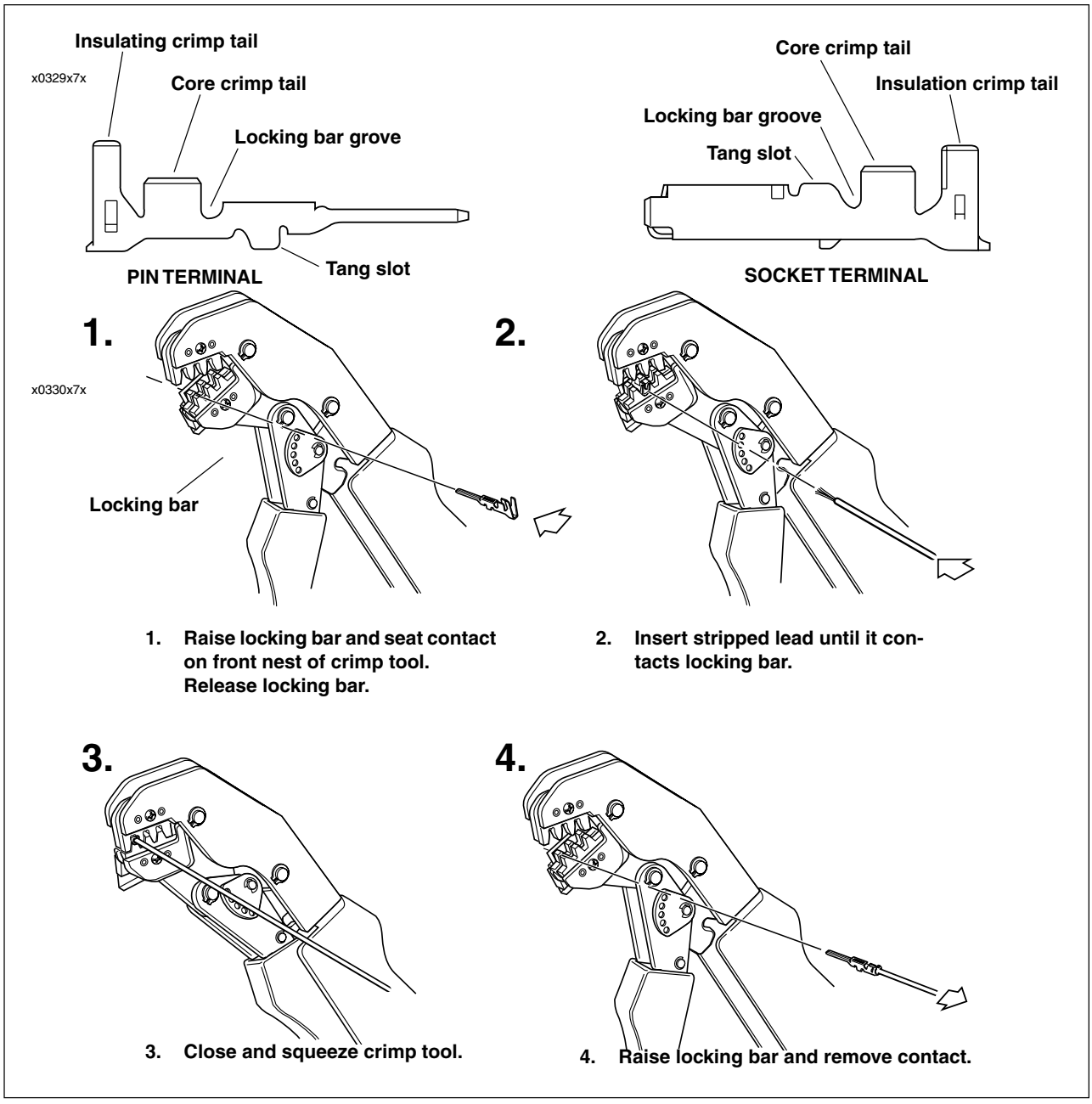


Figure 7-96. Amp Multi-lock Crimping Procedure

GENERAL

See Figure 7-97. From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber.

Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a new terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

The Packard pull-to-seat terminal connectors found on XL model vehicles are listed below.

- Bank Angle Sensor [134]
- 1200S Coil [83]
- MAP Sensor [80]

Packard pull-to-seat electrical connectors have an external latch to lock the pin and socket halves together.

Removing Pull-to-seat Terminals External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.
3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure 7-98. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
4. At a slight angle, gently insert the point of a one-inch (25.4 mm) safety pin about 1/8 inch (3.2 mm) down the middle of the chamber and pivot the end of the pin toward the terminal body. When a click is heard, remove the pin and repeat the procedure. See B in Figure 7-98. The click is the sound of the tang returning to the locked position as it slips from the point of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

NOTES

- *On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.*
- *When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.*

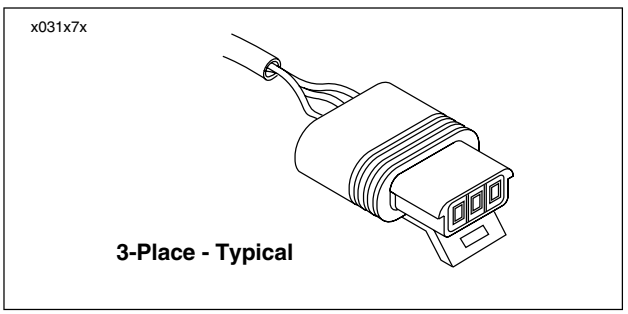


Figure 7-97. Packard Pull-to-Seat Terminal Connectors (Socket Sides)

5. See Figure 7-98. Remove the pin and push on the wire end of the lead to extract the terminal from the mating end of the connector. See item C. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see CRIMPING INSTRUCTIONS below.

Installing Pull-to-seat Terminals External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. See Figure 7-98. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See item D.
2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Push on the lead to verify that the terminal is locked in place.
4. Push the pin and socket halves of the connector together until the latches “click.”

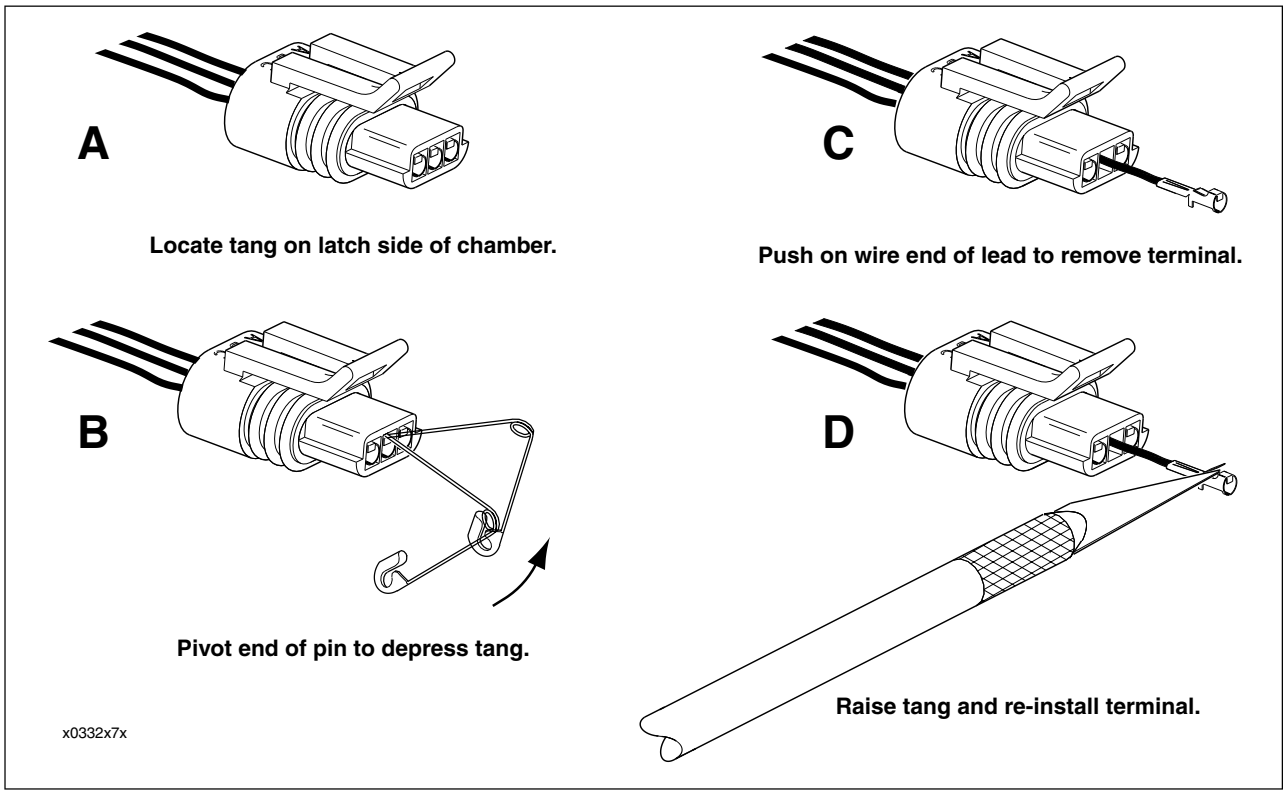


Figure 7-98. Depress Tang and Extract Terminal From Mating End of Connector

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. Determine the correct dye or nest for the core crimp based on the information presented in the Crimp Tables

INSTALLING SEALED BUTT CONNECTORS

Butt splicing is a necessary procedure for replacement of several components. These components are:

- Ignition switch
- Indicator (icon) lamps

Proceed as follows:

1. Strip 3/8 inch (9.5 mm) of insulation off the ends of the wires.
2. See Figure 7-71. Insert wires into opposite ends of the butt splice connector. Feed the wires into the connector until the stripped ends are housed within the metal insert. Since the size of the connectors vary with the gauge of the wire, reference the following table to ensure properly sealed splices.
3. See Figure 7-99. Crimp the wires within the connector using the Packard Crimp Tool (HD-38125-8). Be sure to match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

⚠WARNING

Use extreme caution when operating the UltraTorch UT-100 or any other radiant heating device. Read the manufacturers instructions carefully before use. Improper handling could result in death or serious injury. Always keep hands always from tool tip area and heat shrink attachment. Avoid directing the heat toward any fuel system component. Extreme heat can cause fuel ignition/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.

4. See Figure 7-100. Using the UltraTorch UT-100 (HD-39969), Robinair Heat Gun (HD-25070) with heat shrink 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.

Table 7-12. Wire Specifications

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

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

5. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

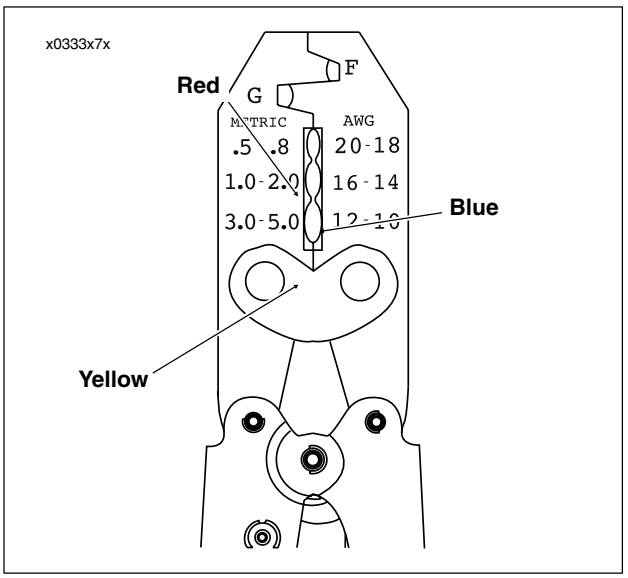


Figure 7-99. Packard Crimp Tool (HD-38125-8)

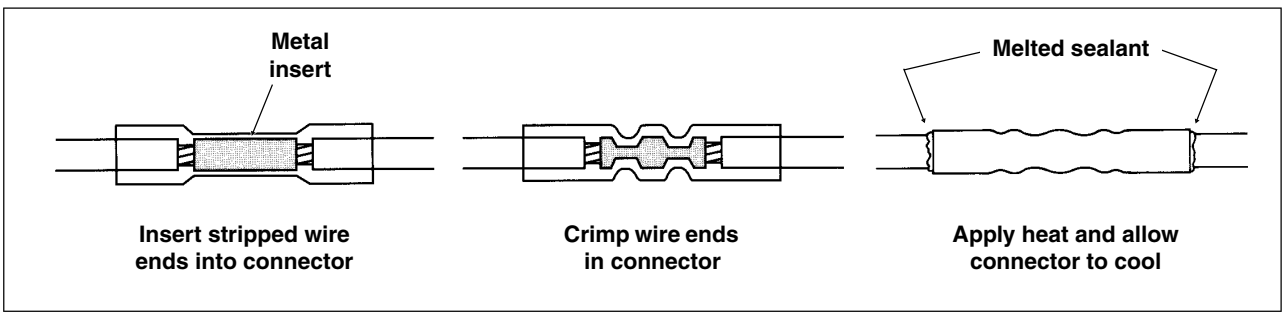


Figure 7-100. Installing Sealed Butt Connectors

Table 7-13. 2000 Components

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
IGNITION MODULE [14A] (except 1200S)	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR [14A] (1200S)	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TRAP DOOR SOLENOID [15A]	ALL	72039-71A	PACKARD 270	20	2	4
REAR LIGHTING HARNESS [7B], [94B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
REAR DIRECTIONALS [18B, 19B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
V.O.E.S. [11B]	ALL	72191-94	HD-41609	18	CENTER POSITION	CENTER POSITION
FRONT DIRECTIONALS [31B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP (XL CUSTOM ONLY) [38B]	ALL	74191-96	HD-42879	16	MIDDLE POSITION	MIDDLE POSITION
INSTRUMENT CLUSTER [20B]	ALL	74191-96	DTT-16-00	18	REAR POSITION	N/A
LEFT HANDLEBAR CONTROL [24B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
RIGHT HANDLEBAR CONTROL [22B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
SPEED SENSOR [65A]	ALL	72191-94	DTT-16-00	20 (a)	CENTER POSITION	CENTER POSITION
SPEED SENSOR [65B]	ALL	72191-94	PACKARD 271	20 (a)	CENTER POSITION	CENTER POSITION
POSITION LAMP	ALL	9898	HD-41609	N/A	TIP	N/A
POSITION LAMP	N/A	9898	PACKARD 115	N/A	TIP	N/A
HEADLAMP 68705-93A	N/A	70586-93 (j)	PACKARD 115	16	14-16 GA.	N/A
REGULATOR [77B]	ALL	72197-94	HD-42879	12	12	N/A

Table 7-14. XL Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL	N/A	9842 (a)	PACKARD 270, 271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)	N/A	9843 (a)	PACKARD 270, 271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)	N/A	9866 (h)	PACKARD 115	12,14	12-10 GA. (h)	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85, 86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937 (h)	PACKARD 271	14,16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72219-94 (h)	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72217-94	PACKARD 271	18	E	A
FUSE BLOCK (2-BE)	3	72220-94 (h)	PACKARD 271	16	A (h	G (h)
FUSE BLOCK (2-O/W)	4	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-R/BK	5	72220-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK	6	72220-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT	N/A	72241-94 (q) (z)	PACKARD 271	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115, 270	14,16(h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271, 115	14	A	G

Table 7-14. XL Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HORN	N/A	9898	PACKARD 271	18	TIP	X
HORN	N/A	9898	PACKARD 115	18	TIP	X
COIL (W/BK)	N/A	72241-94 (q)	PACKARD 271	18	C (q)	A
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B,C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	EXCEPT 6	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	6	72191-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 3	72190-94	DTT-16-00	16	CENTER POSITION	N/A
TO RIGHT HAND CONTROLS [22A]	3	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1,5,6	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2,3,4	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
HEADLAMP [38A]	1	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP [38A]	2,3,4	73190-96	HD-41609	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION

Table 7-14. XL Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HEADLAMP 68705-93A	ALL	70586-93 (j)	PACKARD 115	16	14-16 GA.	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (j)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Table 7-15. 1999 XL Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842 (a)	PACKARD 270, 271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)		9843 (a)	PACKARD 270, 271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)		9866 (h)	PACKARD 115	12,14	12-10 GA. (h)	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937 (h)	PACKARD 271	14,16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72219-94 (h)	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72217-94	PACKARD 271	18	E	A
FUSE BLOCK (2-BE)	3	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-O/W)	4	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-R/BK)	5	72220-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK)	6	72220-94 (h)	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A

Table 7-15. 1999 XL Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
OIL PRESSURE SENDING UNIT	N/A	72241-94 (q) (z)	PACKARD 271	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA.	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115, 270	14,16 (h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271, 115	14	A	G
HORN	N/A	9898	PACKARD 271	18	TIP	X
HORN	N/A	9898	PACKARD 115	18	TIP	X
COIL	N/A	72241-94 (q)	PACKARD 271	18	C (q)	A
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B,C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	EXCEPT 6	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	ALL	72191-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 3	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS [22A]	3	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1,5,6	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2,3,4	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION

Table 7-15. 1999 XL Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68705-93A	Y	70586-93 (j)	PACKARD 115	16	14-16 GA.	N/A
HEADLAMP 68705-93A	W,BK	70586-93 (j)	PACKARD 115	16,18	14-16 GA	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (j) (h)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Crimp Table Legend

(a) - requires solder after crimping

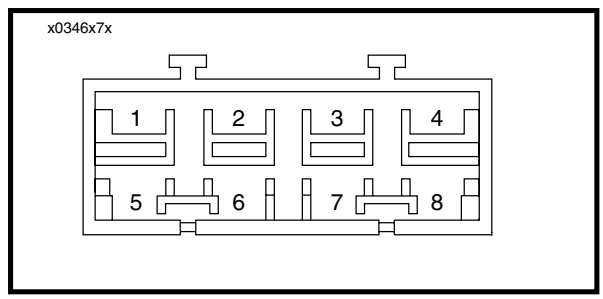
(b) - 9937 terminals require use of 72249-94 heat shrink tubing

(h) - double lug crimp

(j) - heat sealed butt splice connector

(q) - requires use of 72249-94 heat shrink tube

(z) - use with 7629 nut



The cavity numbers or positions in the fuse block are identified in the above illustration.

Table 7-16. 1999 XL Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842 (a)	PACKARD 270, 271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)		9843 (a)	PACKARD 270, 271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)		9866 (h)	PACKARD 115	12, 14	12-10 GA.	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937	PACKARD 271	14, 16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72217-94	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-BE)	3	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-O/W)	4	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-R/BK)	5	72220-94	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK)	6	72220-94	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT	N/A	9857 (z)	PACKARD 115	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA.	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115, 270	14, 16 (h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271, 115	14	A	G

Table 7-16. 1999 XL Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HORN	N/A	9898	PACKARD 271	18	TIP	N/A
HORN	N/A	9898	PACKARD 115	18	TIP	N/A
COIL [130B]	ALL	72033-93	PACKARD 271	18	E	C
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B, C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR [14B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
MAP SENSOR	ALL	72213-94 (X)	PACKARD 271, 270	18	E	1
TO IGNITION MODULE [10B] (BK)	EXCEPT 2, 11	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [10B] (BK)	2, 11	73191-94	DTT-16-00	18	REAR POSITION	REAR POSITION
TO IGNITION MODULE [11B] (GY)	ALL	73191-94	DTT-16-00	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS [22A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1, 5, 6	72190-94	DTT-16-00	14	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2, 3, 4	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68705-93A	Y	70586-93 (I)	PACKARD 115	16	14-16 GA.	N/A

Table 7-16. 1999 XL Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HEADLAMP 68705-93A	W,BK	70586-93 (I)	PACKARD 115	16,18	14-16 GA	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (I)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Crimp Table Legend

(a) - requires solder after crimping

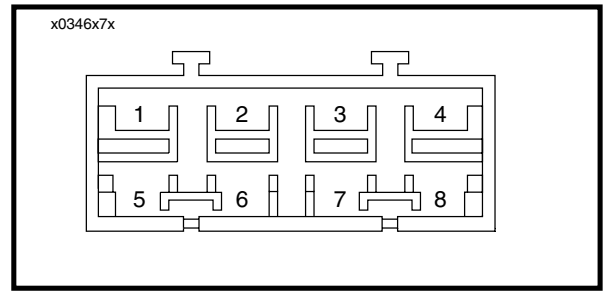
(b) - 9937 terminals require use of 72249-94 heat shrink tubing

(h) - double lug crimp

(j) - heat sealed butt splice connector

(q) - requires use of 72249-94 heat shrink tube

(z) - use with 7629 nut



The cavity numbers or positions in the fuse block are identified in the above illustration.

NOTES

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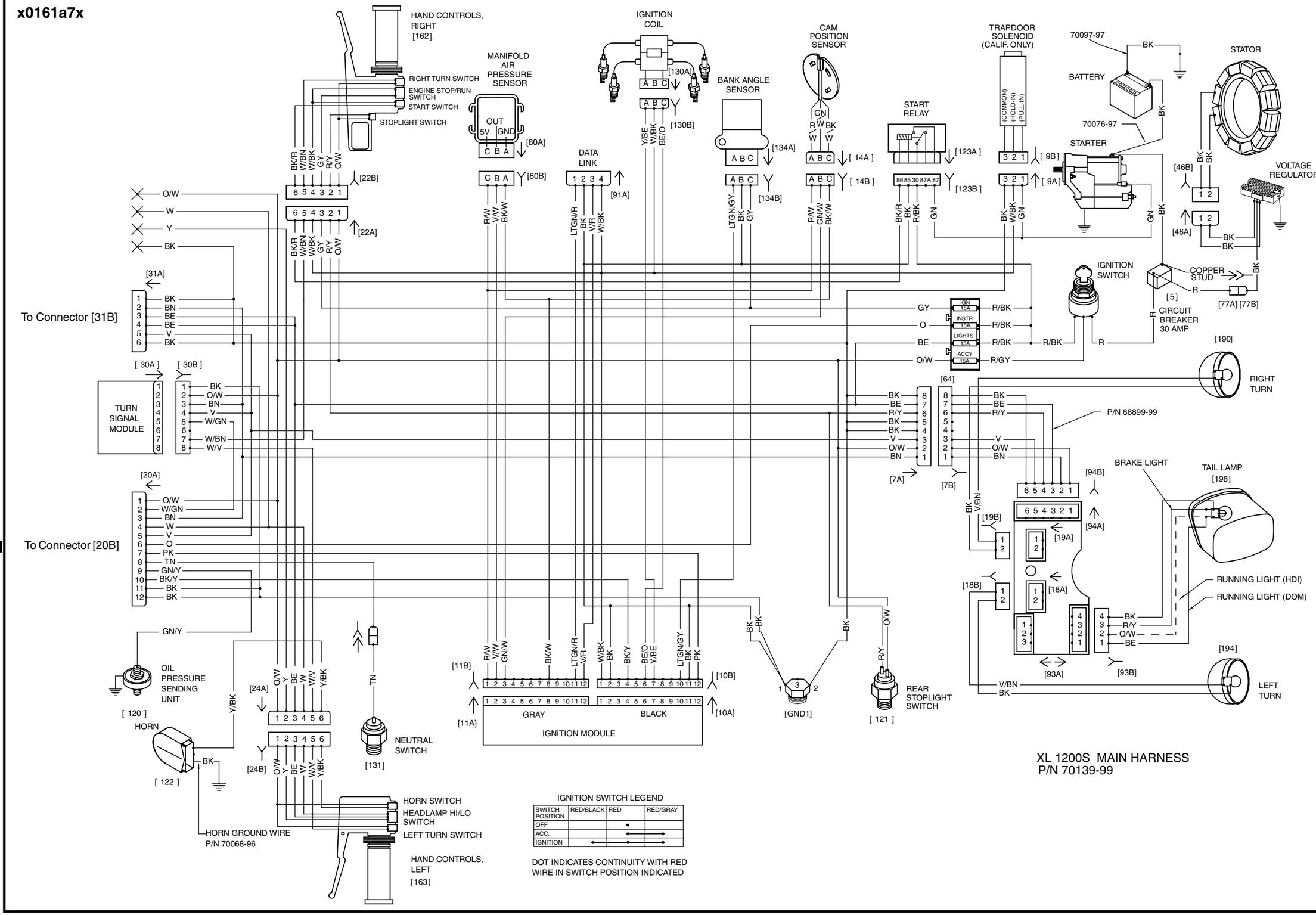

XL 1200S Domestic and International Models - Main Harness

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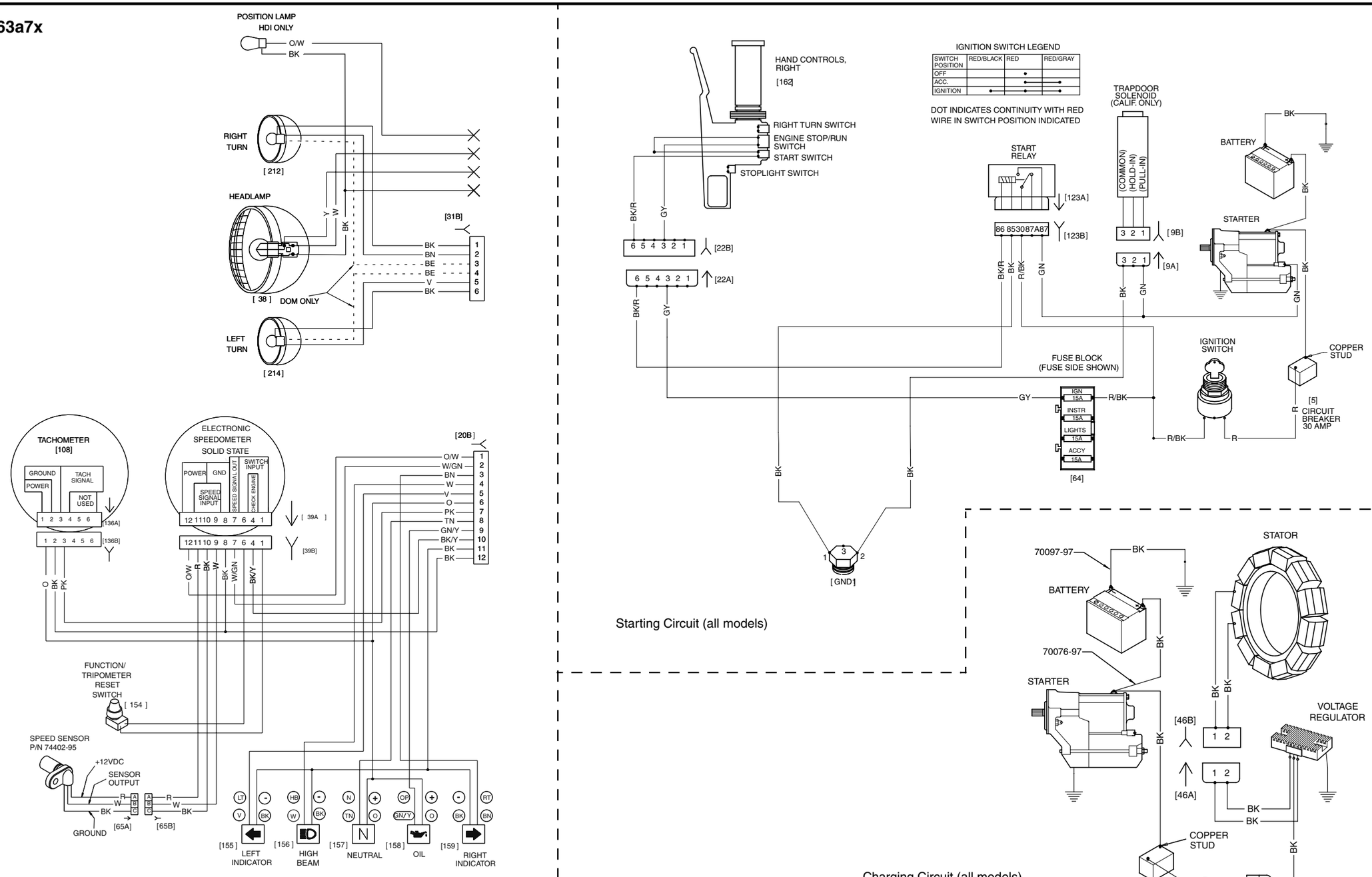
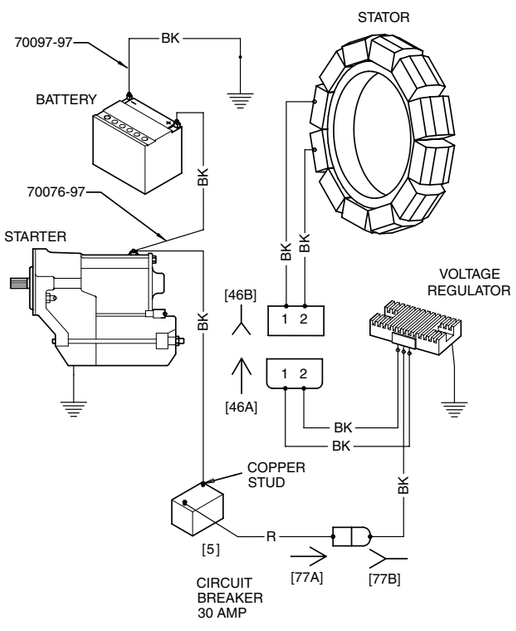


XL 1200S Front Lamps and Instruments

Starting Circuit (all models)



Charging Circuit (all models)

XLH All Models, Starting and Charging

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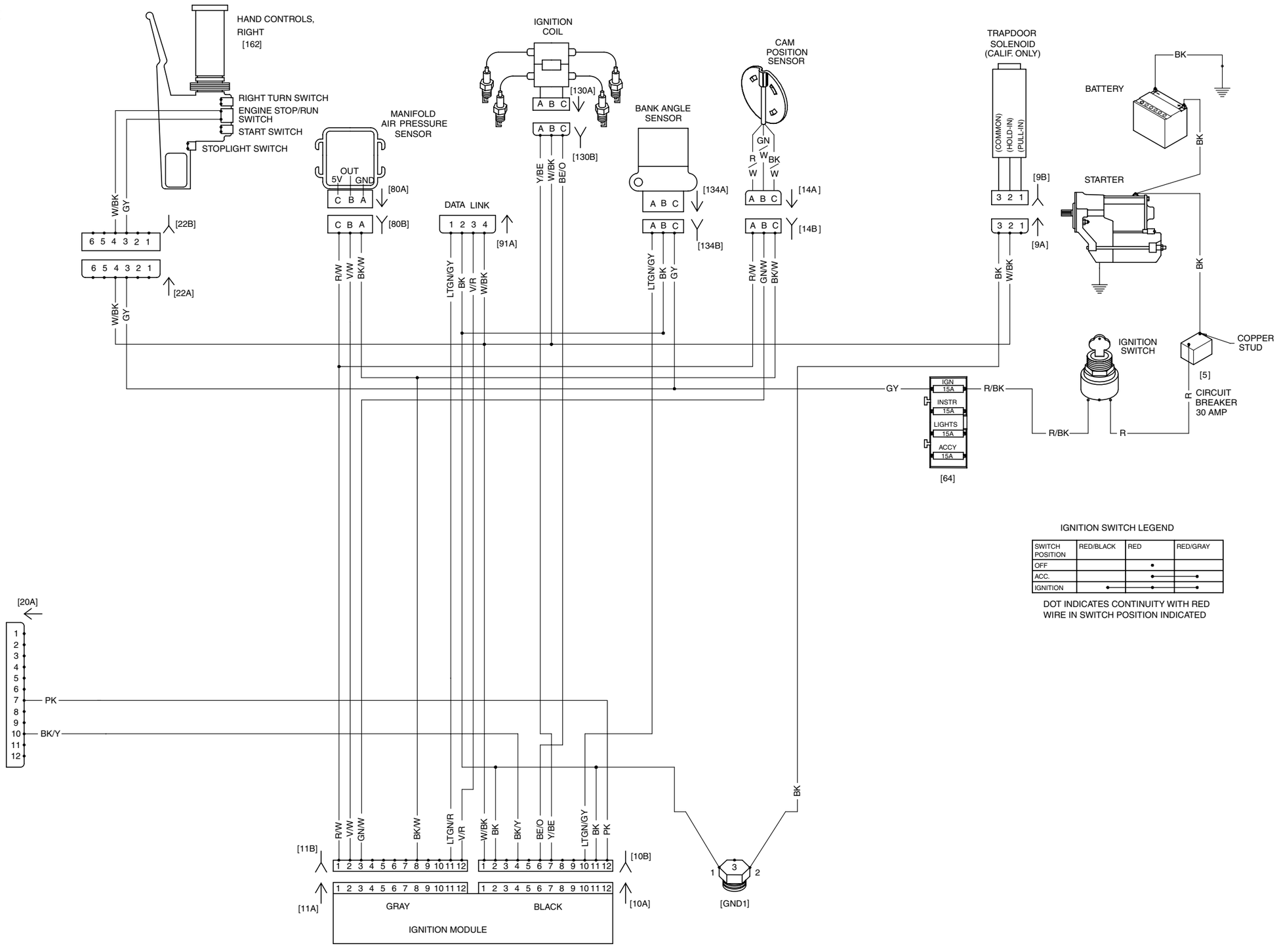

IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

XLH 1200S Domestic and International - Ignition Circuit

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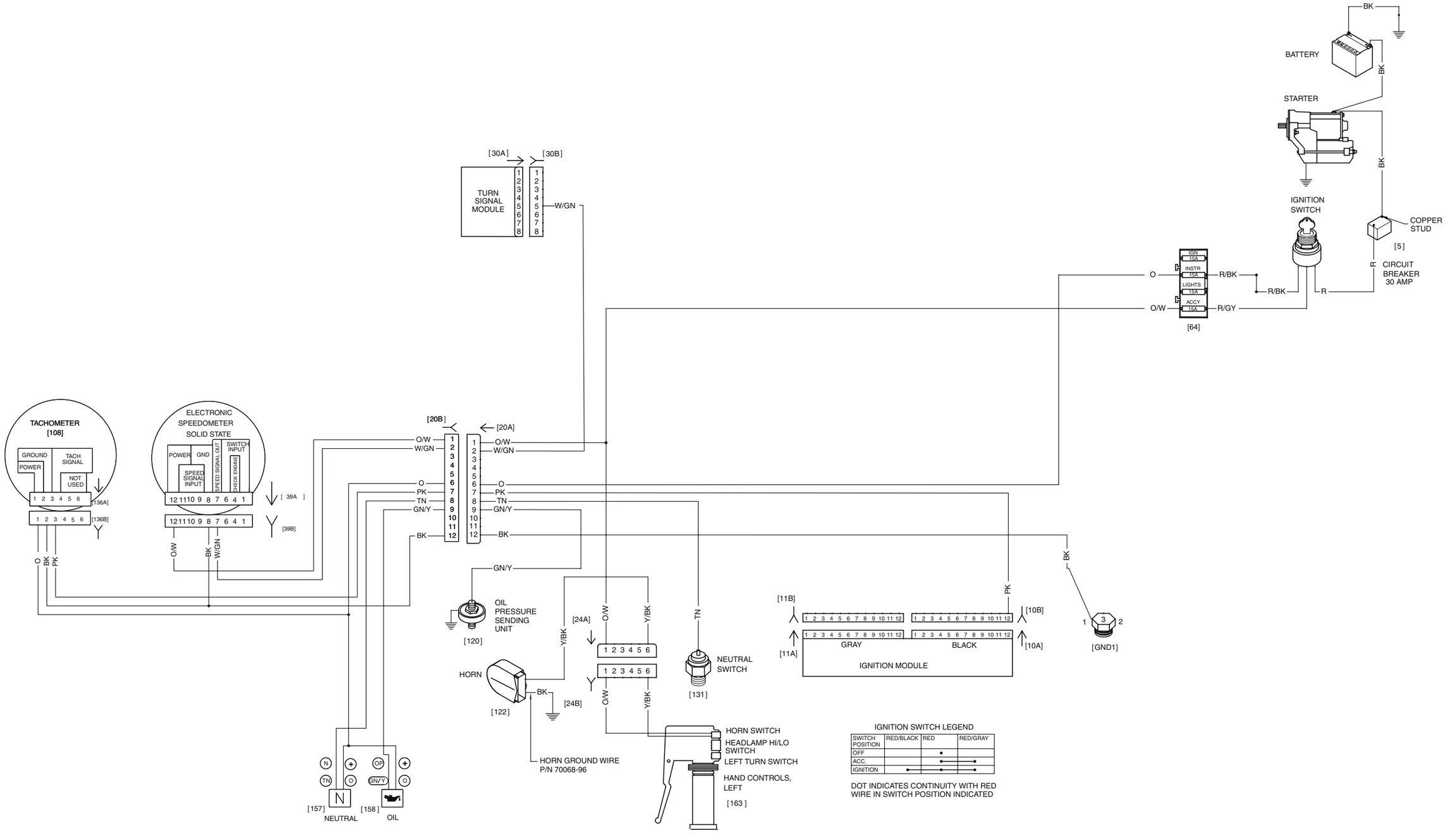

XLH 1200S Domestic and International - Horn and Instruments

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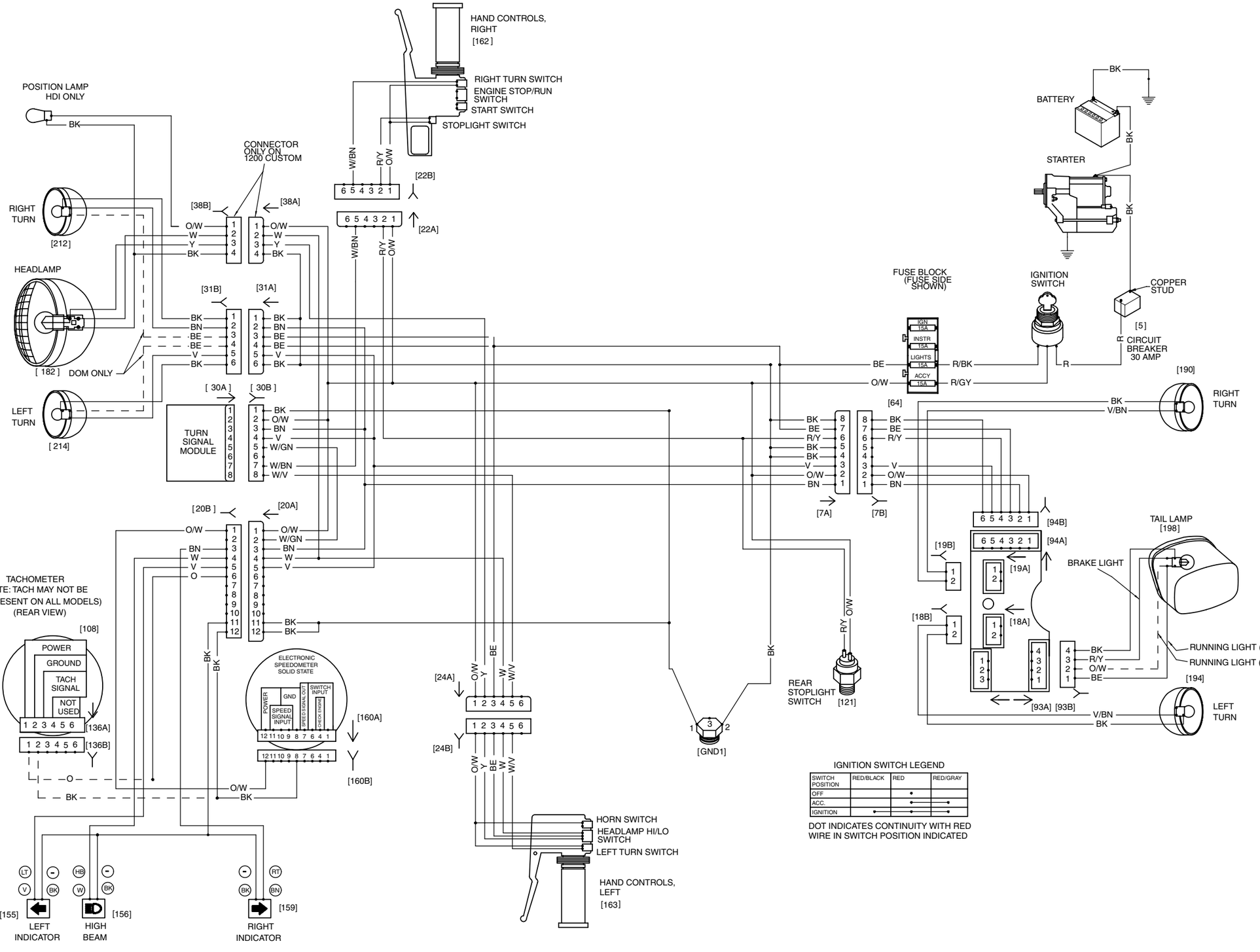

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

XLH 1200S Domestic and International - Lights

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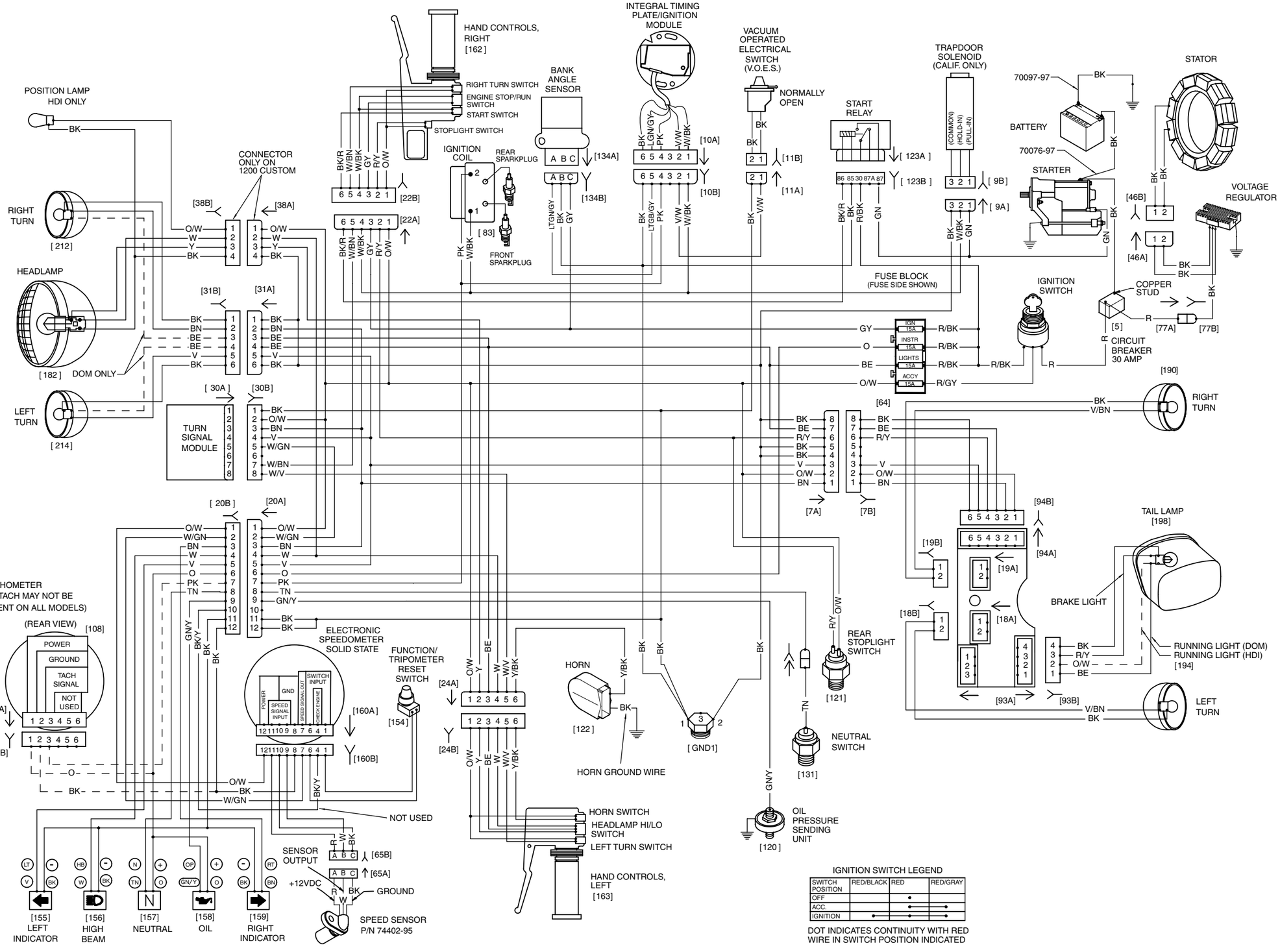

All XL Domestic and International (Except 1200S) - Main Harness

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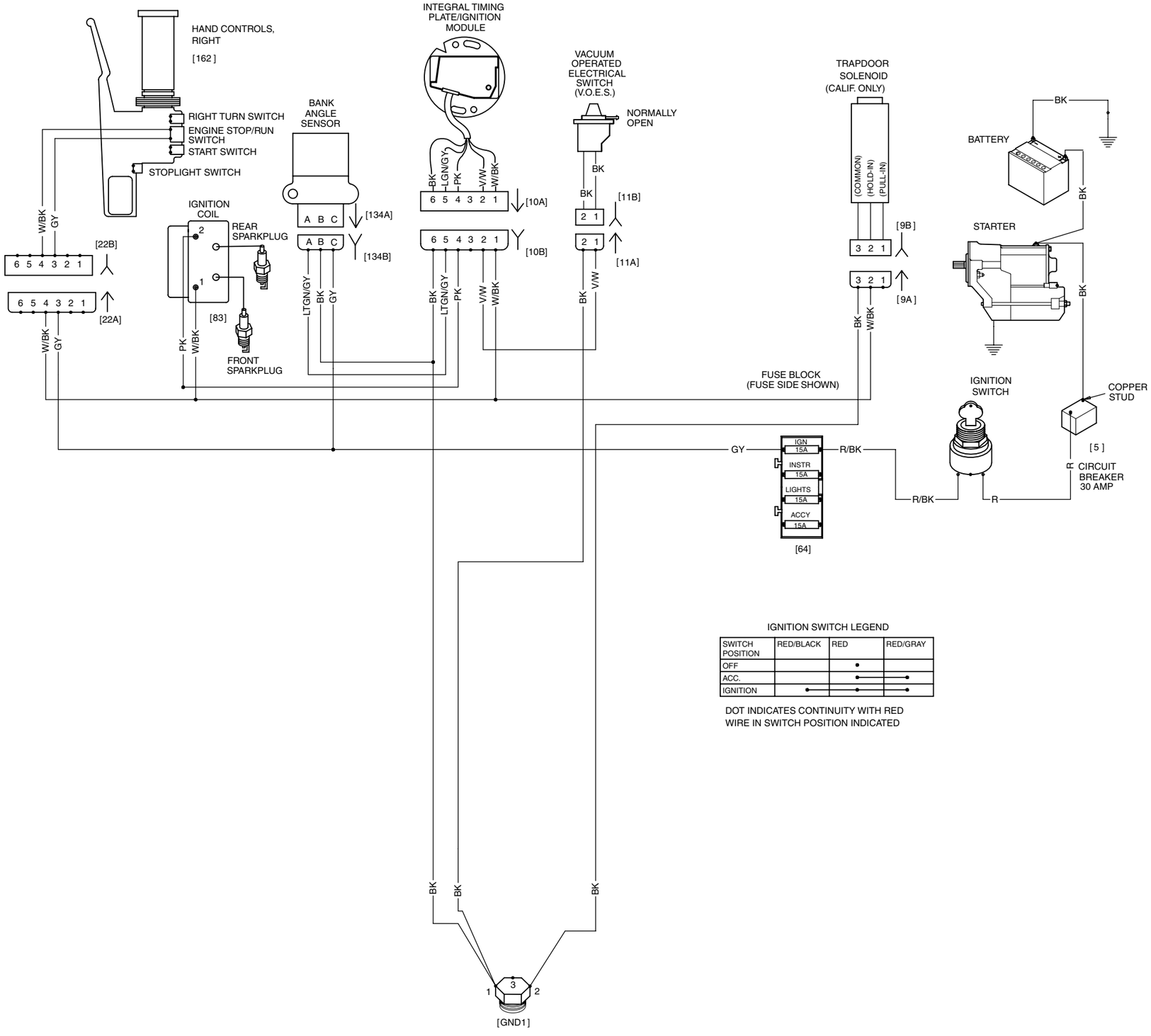

IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

All XL Domestic and International (Except 1200S) - Ignition Circuit

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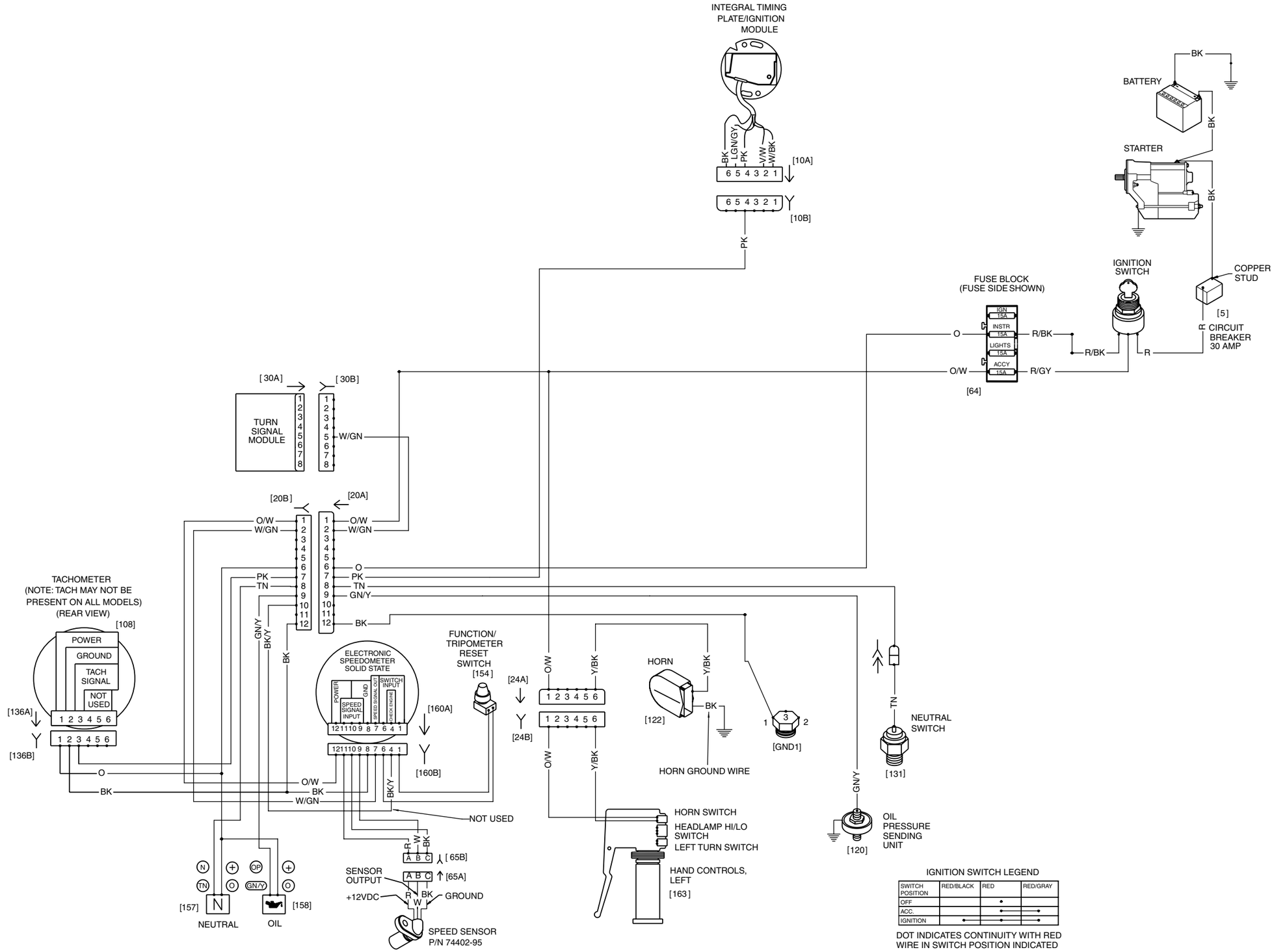

IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

All XL Domestic and International (Except 1200S) - Horn and Instruments

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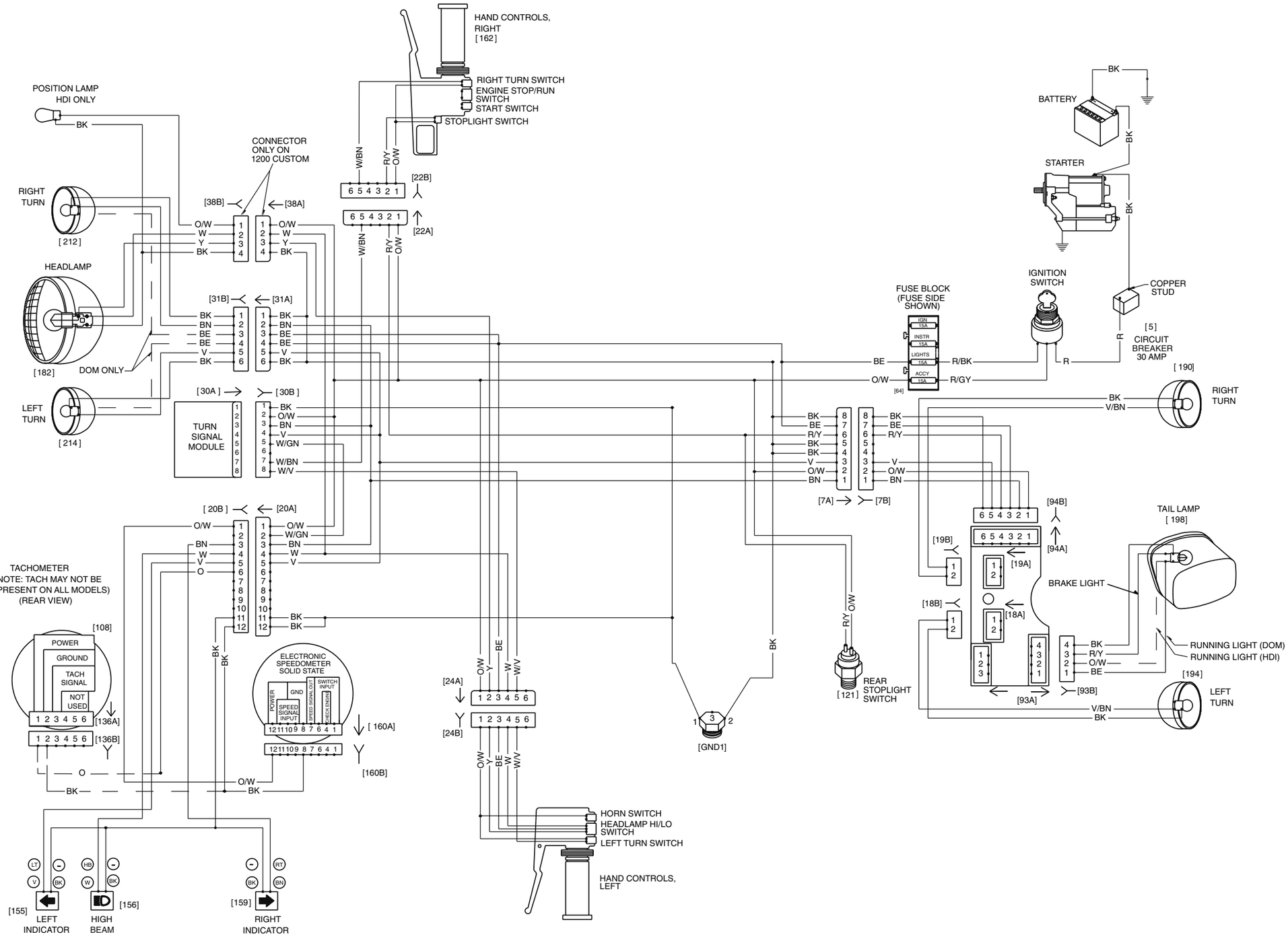

All XL Domestic and International (Except 1200S) - Lights

NOTES

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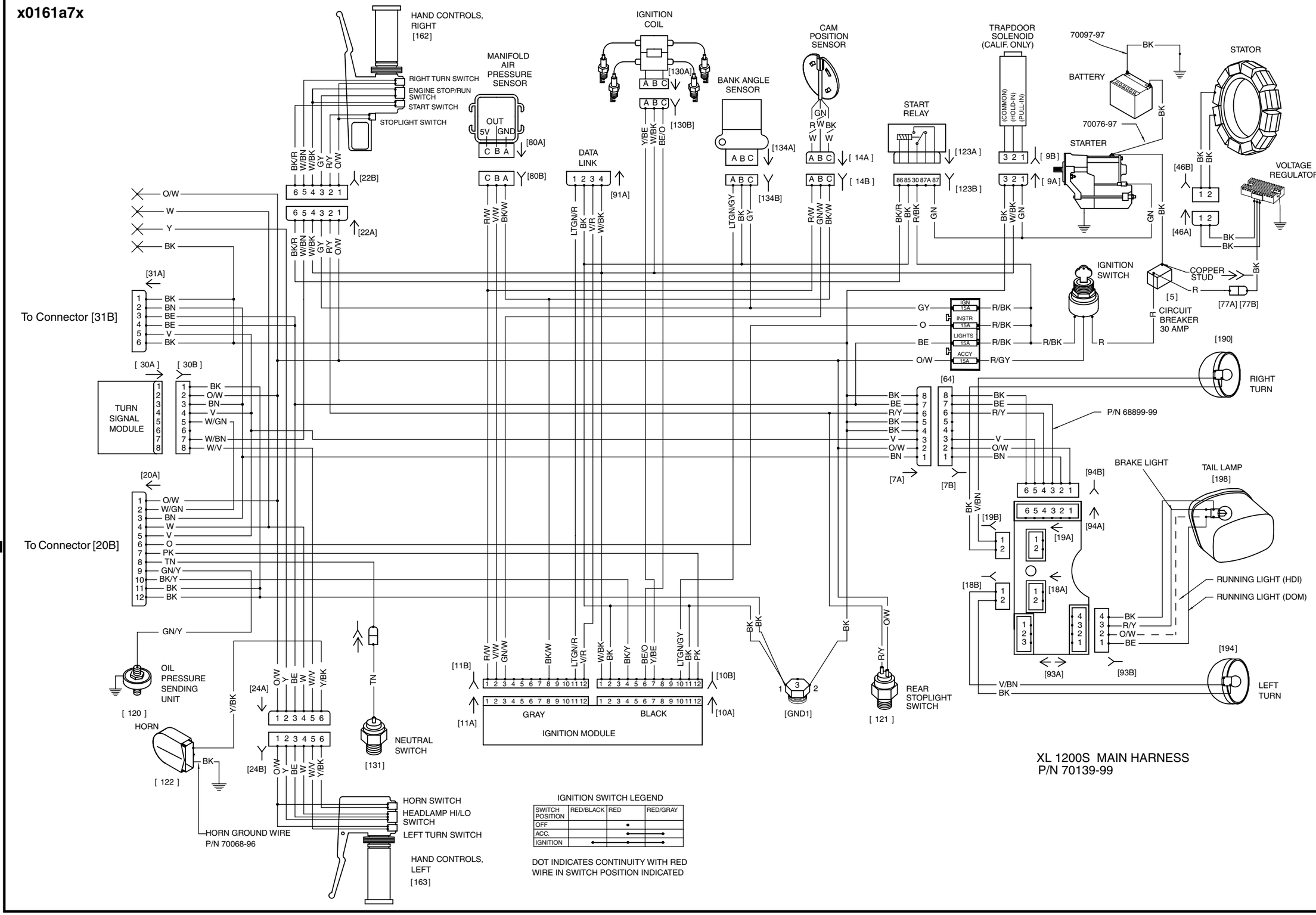

XL 1200S Domestic and International Models - Main Harness

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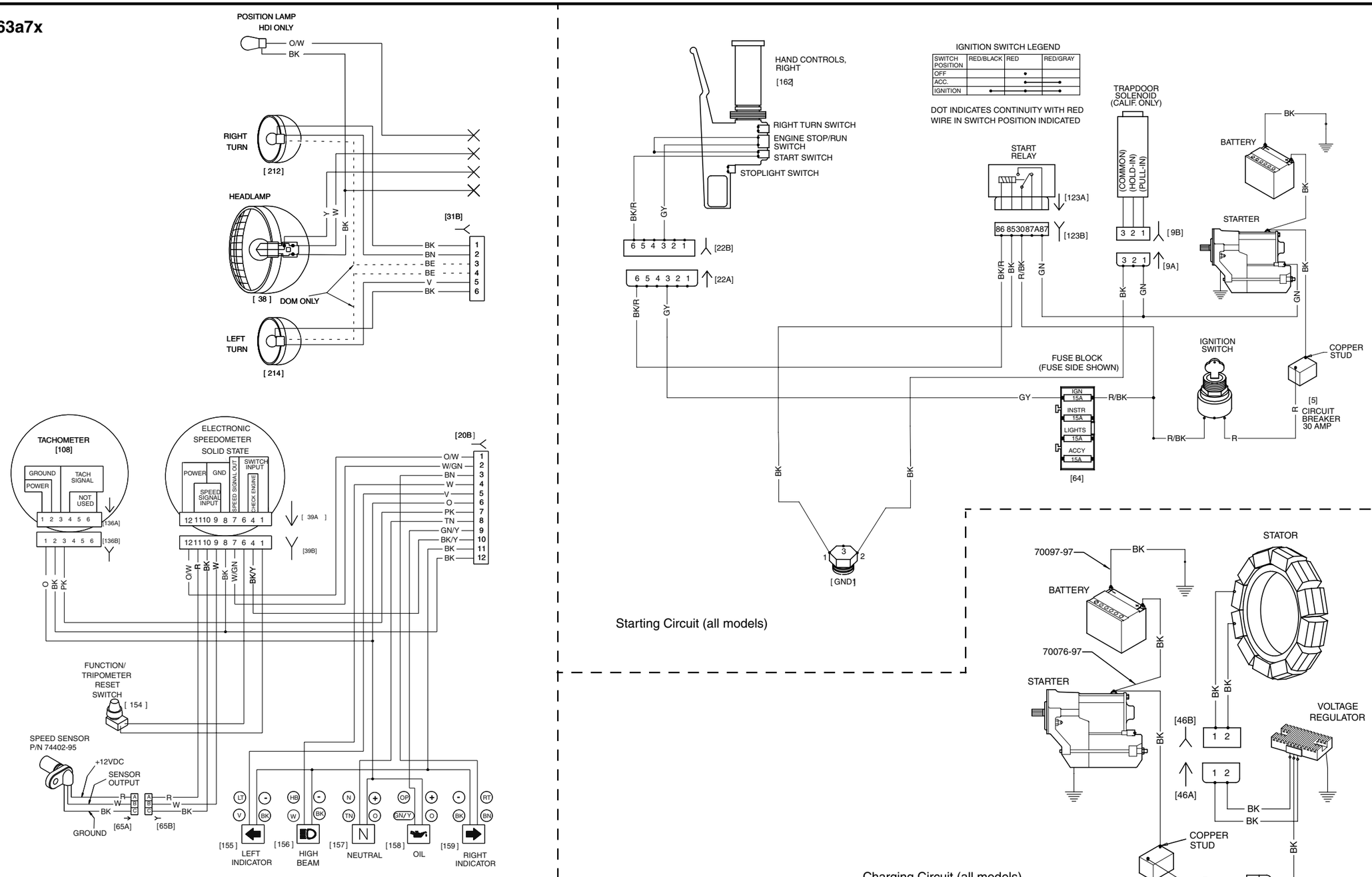
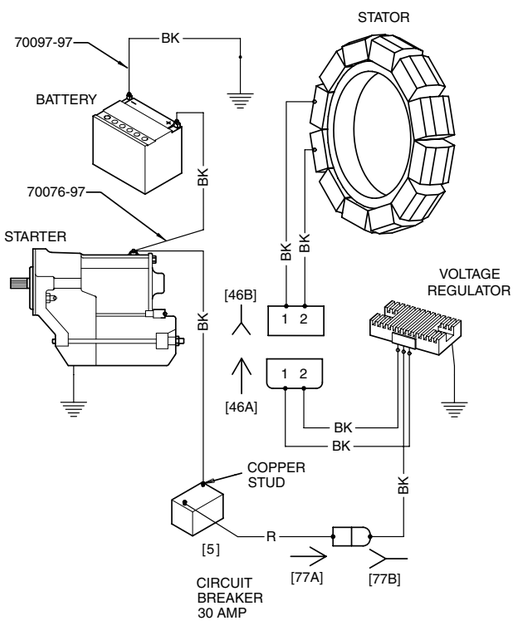


XL 1200S Front Lamps and Instruments

Starting Circuit (all models)



Charging Circuit (all models)

XLH All Models, Starting and Charging

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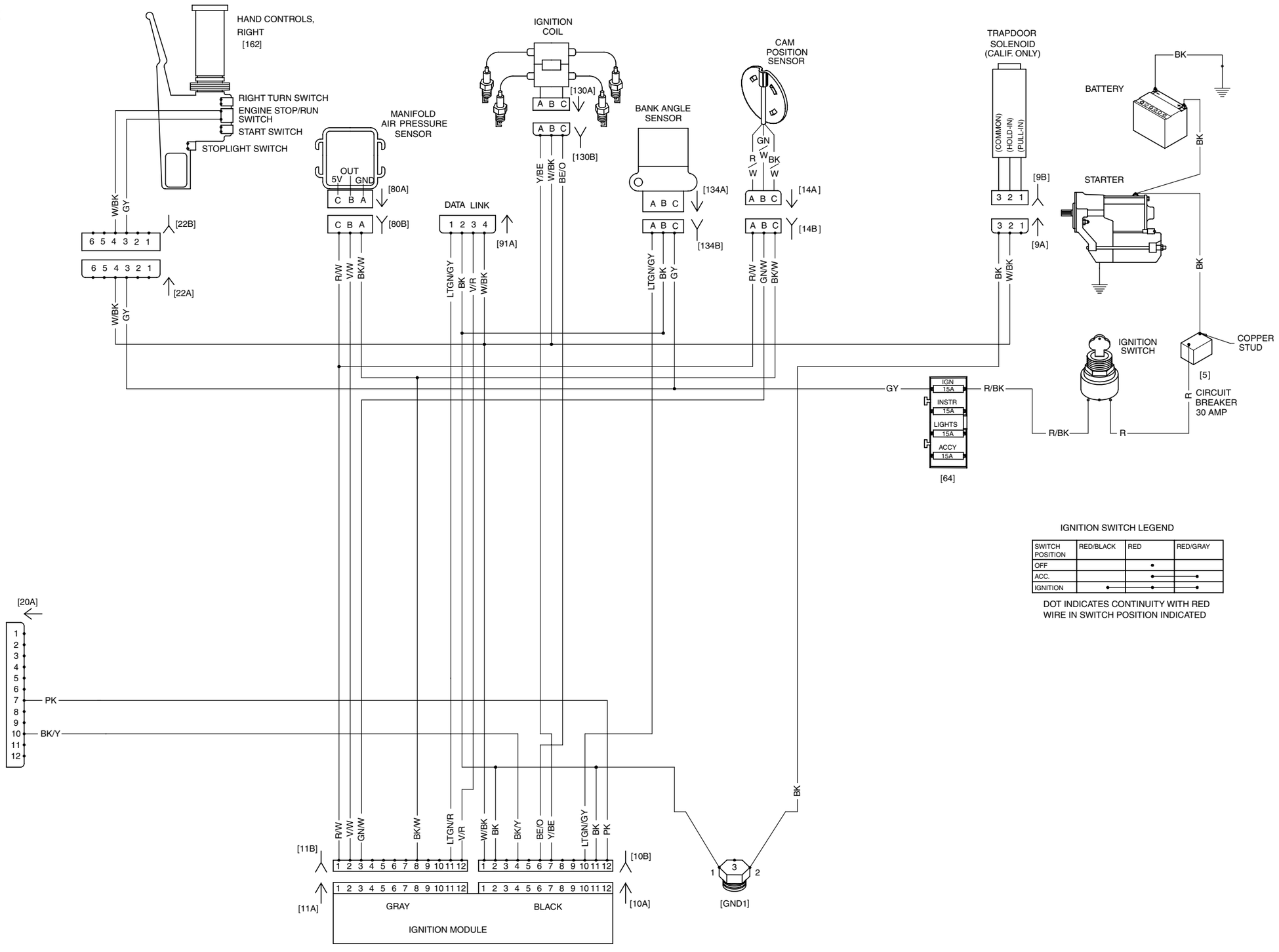

IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

XLH 1200S Domestic and International - Ignition Circuit

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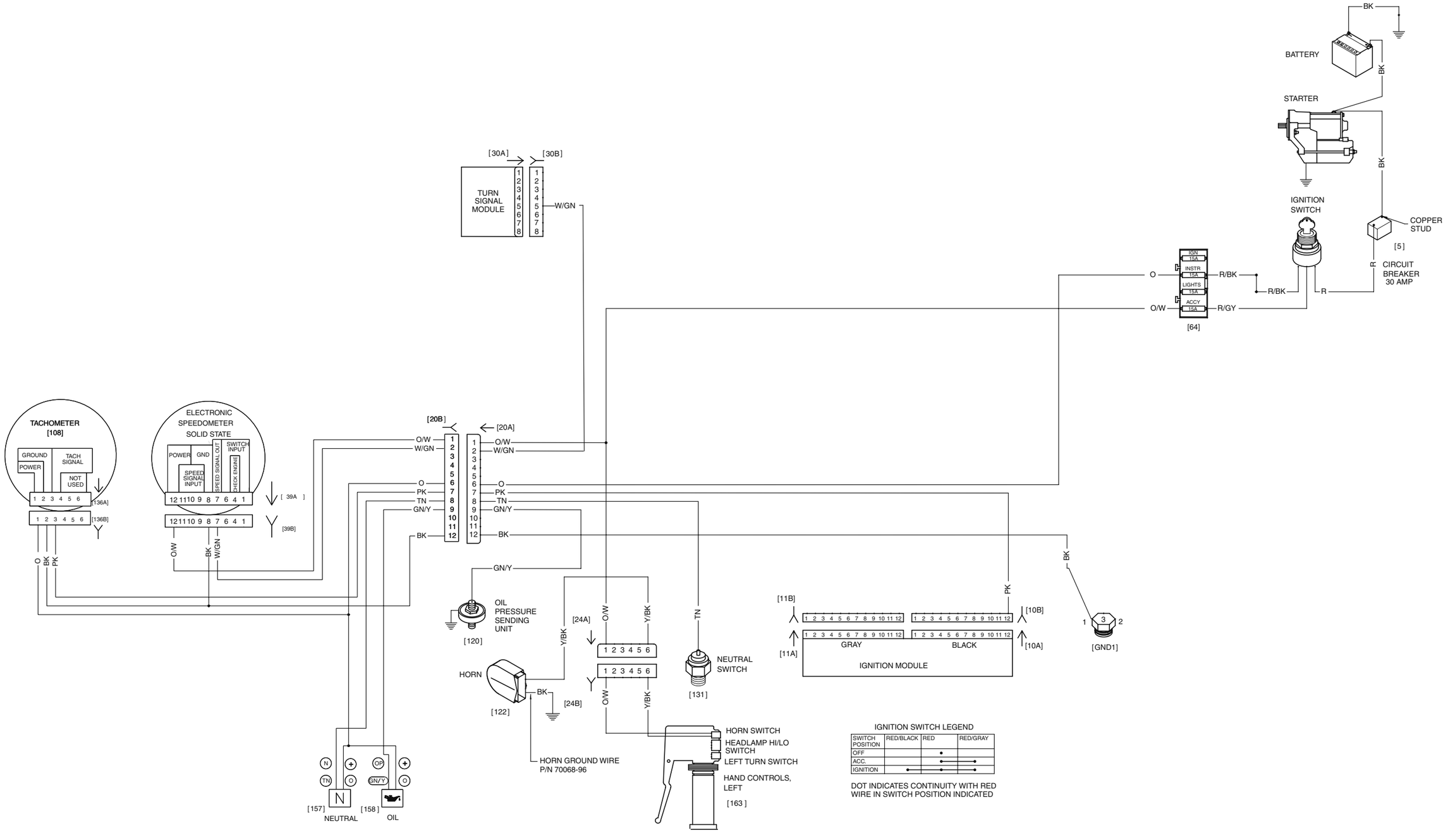

XLH 1200S Domestic and International - Horn and Instruments

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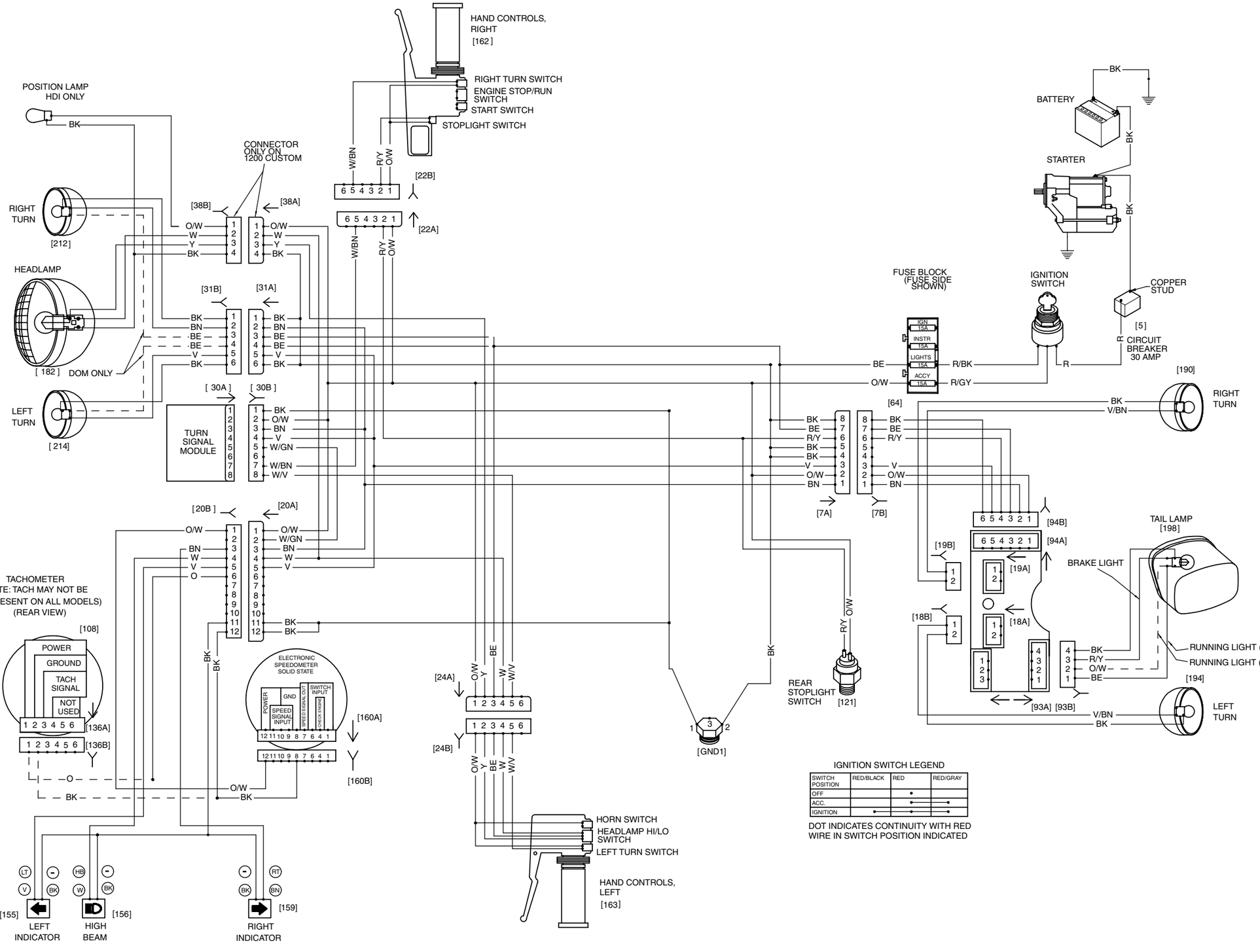

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

XLH 1200S Domestic and International - Lights

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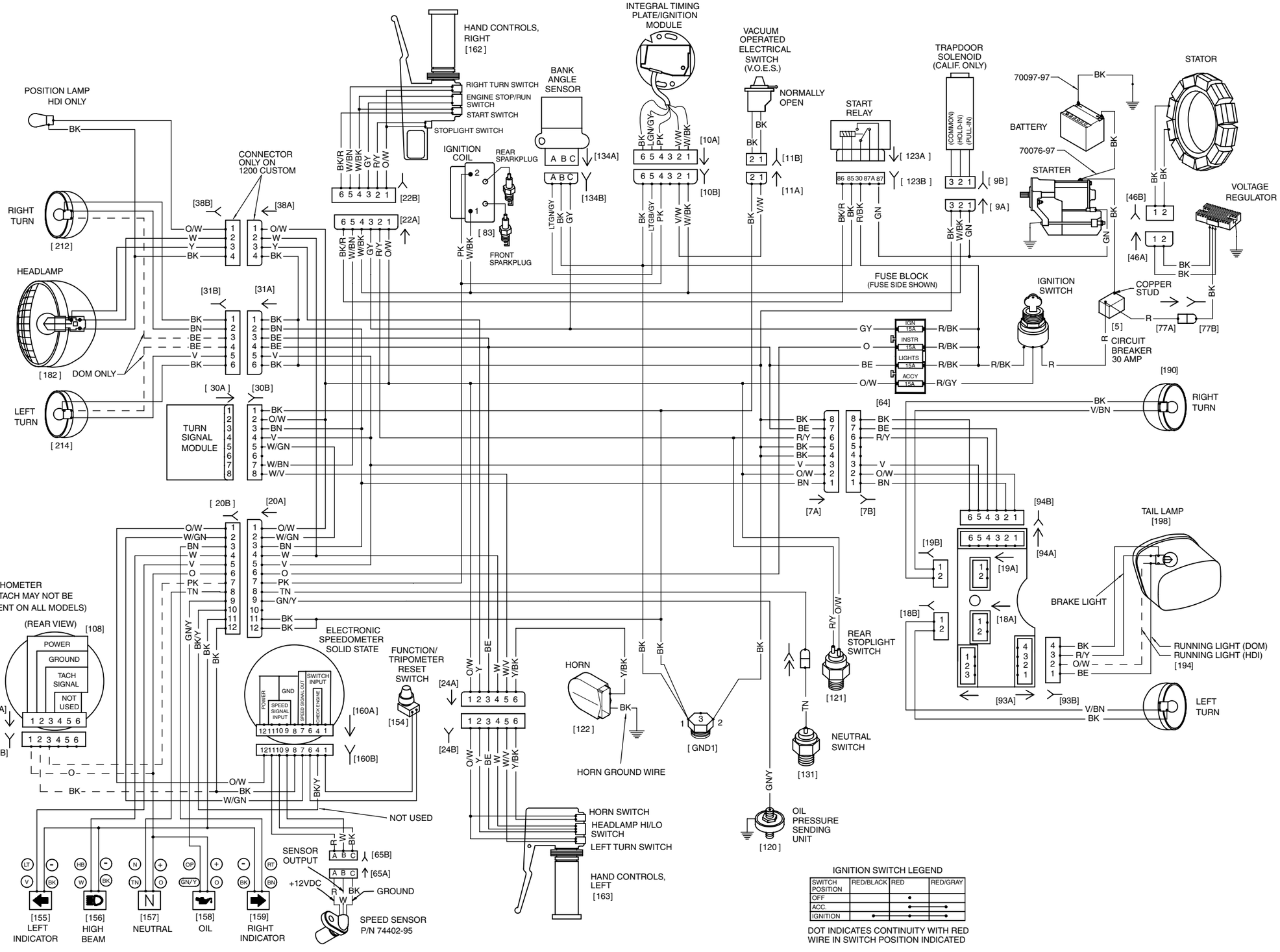

All XL Domestic and International (Except 1200S) - Main Harness

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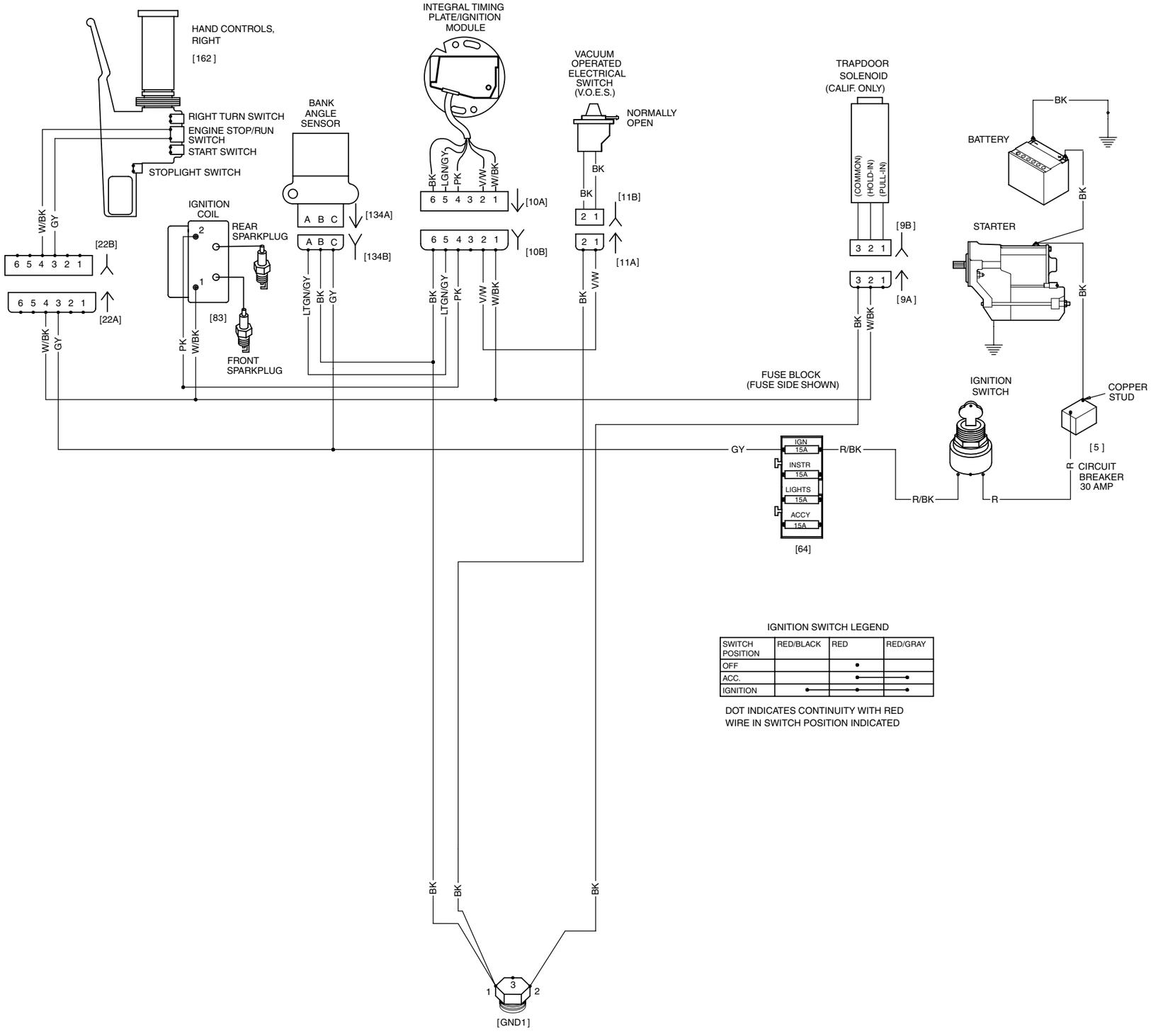


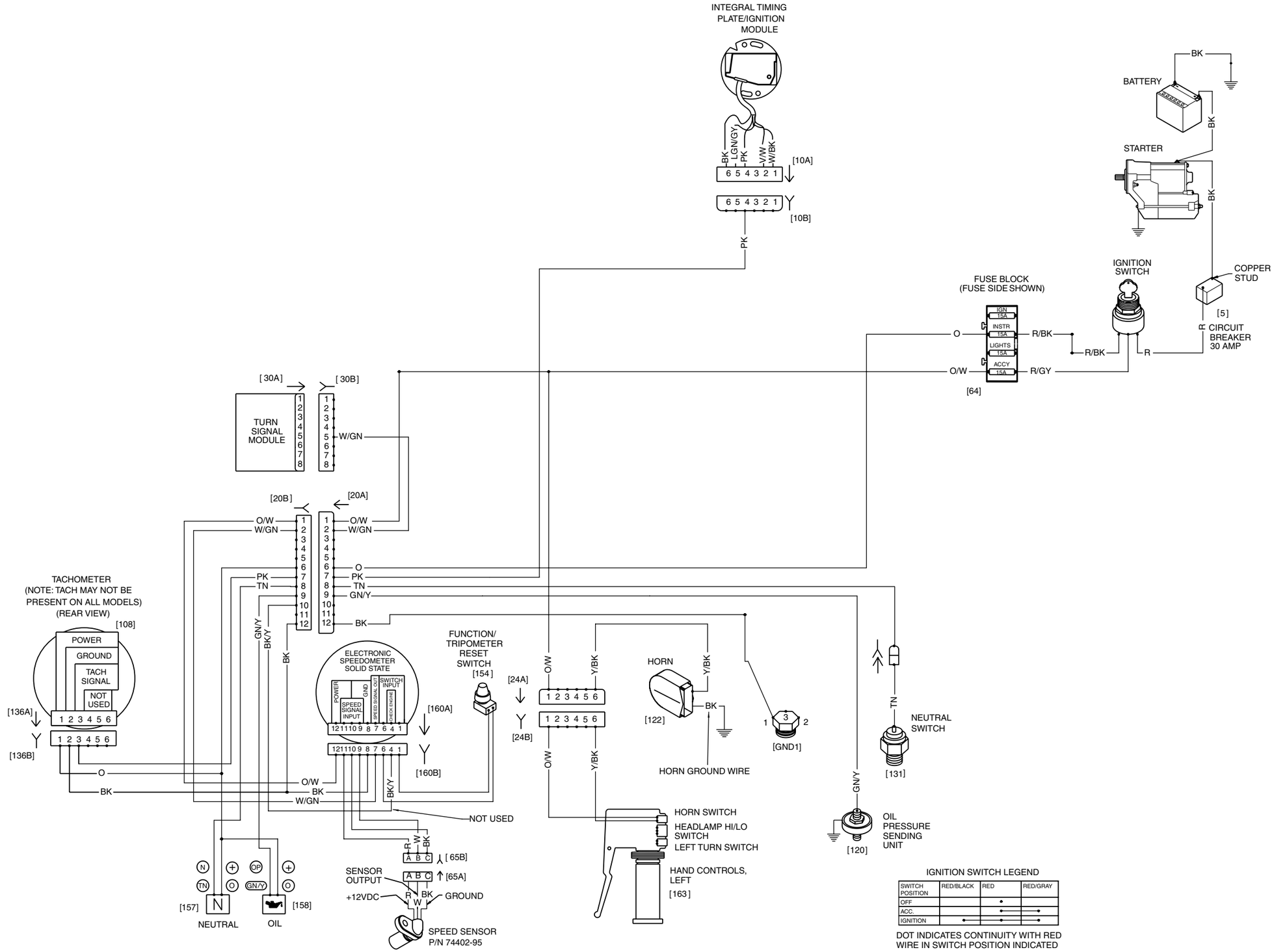
IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

All XL Domestic and International (Except 1200S) - Ignition Circuit

x0165x7x



IGNITION SWITCH LEGEND

SWITCH POSITION	RED/BLACK	RED	RED/GRAY
OFF		•	
ACC.		•	•
IGNITION	•	•	•

DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED

All XL Domestic and International (Except 1200S) - Horn and Instruments

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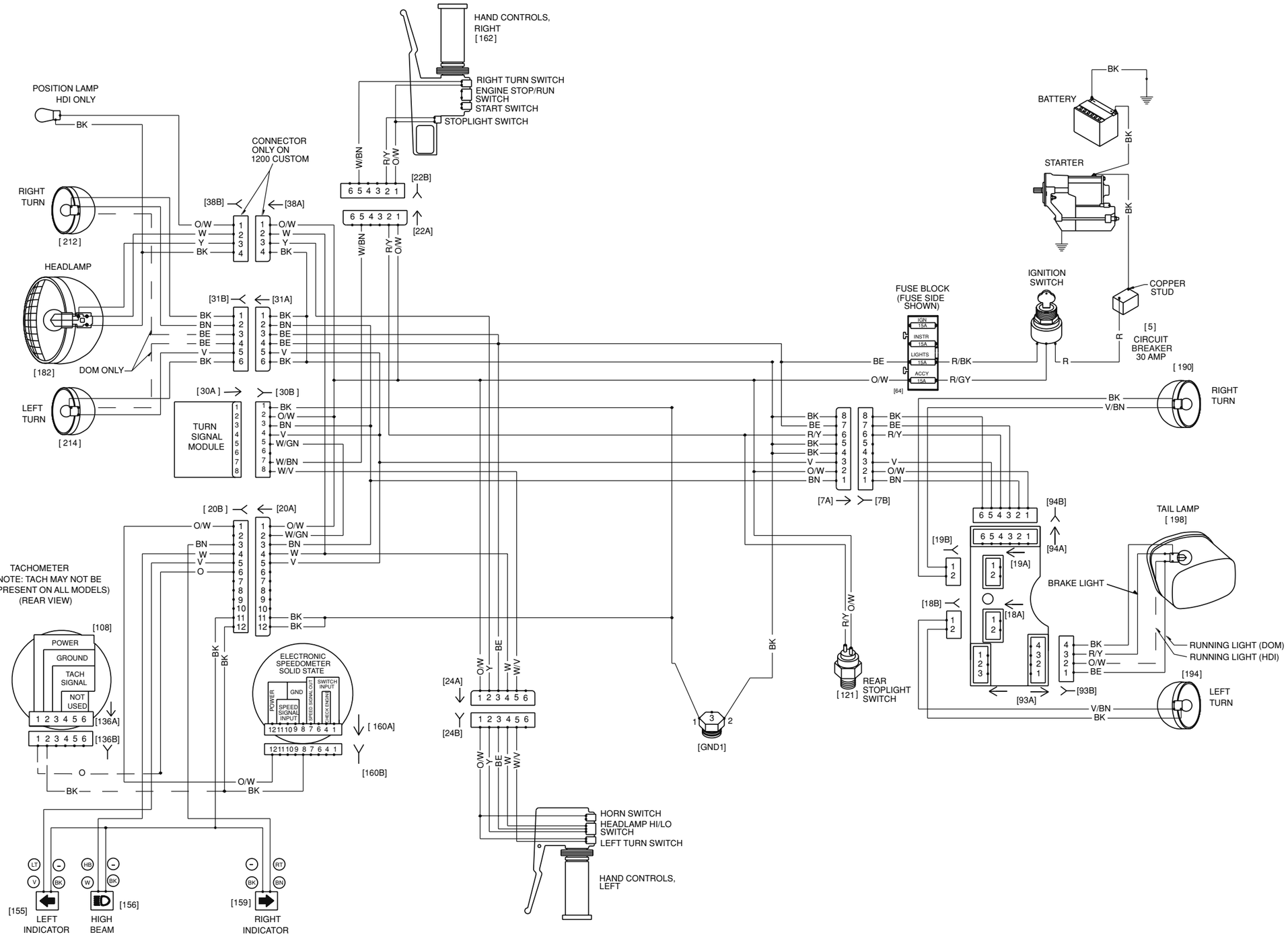

All XL Domestic and International (Except 1200S) - Lights

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      - 2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, MAIN HARNESS
      - 2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, MAIN HARNESS
      - 2002 ALL SPORTSTER DOM. and INT. MODELS, STARTING & CHARGING
      - 2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, IGNITION CIRCUIT
      - 2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, LIGHTS
      - 2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, HORN & INSTRUMENTS
      - 2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, HORN & INSTRUMENTS
      - 2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, LIGHTS
      - 2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, IGNITION CIRCUIT

IMPORTANT NOTICE

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

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

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

Harley-Davidson Motor Company

FOREWORD

GENERAL

⚠WARNING

The rider's safety depends upon proper motorcycle service and maintenance. If a procedure in this manual is not within your capabilities or you do not have the correct tools, have a Harley-Davidson dealer perform the procedure. Improper service or maintenance could result in death or serious injury. (00627b)

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

HOW TO USE YOUR SERVICE MANUAL

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

For example, the sixth topic (BRAKES) in section one (MAINTENANCE) could be referred to as:

1.6 BRAKES

This cross reference directs the reader to section **1** (MAINTENANCE) and topic **6** (BRAKES).

A number of acronyms and abbreviations are used in this document. See the GLOSSARY for a list of acronyms, abbreviations and definitions.

SERVICE BULLETINS

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

CONTENTS

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

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

PREPARATION FOR SERVICE

⚠WARNING

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

Good preparation is very important for efficient service work. Start each job with a clean work area. This will allow the repair to proceed as smoothly as possible. It will also reduce the incidence of misplaced tools and parts.

Clean a motorcycle that is excessively dirty before work starts. Cleaning will occasionally uncover sources of trouble. Gather any tools, instruments and any parts needed for the job before work begins. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

NOTES

- *To avoid unnecessary disassembly, carefully read all related service information before repair work begins.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- *When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), first disarm the system. Keep the fob close to the vehicle or use DIGITAL TECHNICIAN II (Part No. HD-48650) to disable the system. Activate the system after service is completed.To avoid unnecessary disassembly, carefully read all related service information before repair work begins.*

USE GENUINE REPLACEMENT PARTS

⚠WARNING

Harley-Davidson parts and accessories are designed for Harley-Davidson motorcycles. Using non-Harley-Davidson parts or accessories can adversely affect performance, stability or handling, which could result in death or serious injury. (00001b)

To achieve satisfactory and lasting repairs, carefully follow the service manual instructions and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. This is your assurance that the parts you are using will fit right, operate properly and last longer.

WARNINGS AND CAUTIONS

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

⚠WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. (00119a)

⚠CAUTION

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

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140b)

NOTE

Refers to important information. It is recommended that you take special notice of these items.

Proper service and repair are important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this manual are effective methods for performing service operations.

⚠WARNING

Always wear proper eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Flying parts could result in death or serious injury. (00496b)

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 manual. However, remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Harley-Davidson could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Harley-Davidson must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized as a result. Failure to do so could result in death or serious injury.

PRODUCT REFERENCES

⚠WARNING

Read and follow warnings and directions on all products. Failure to follow warnings and directions can result in death or serious injury. (00470b)

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

Special Tools

All tools mentioned in this manual with a part number beginning with “HD”, “J” or “B” must be ordered through your local Harley- Davidson dealer. Special tools may only be purchased, serviced or warrantied through a Harley-Davidson dealer.

LOCTITE Sealing and Threadlocking Products

Some procedures in this manual call for the use of LOCTITE products. If you have any questions regarding LOCTITE product usage or retailer/wholesaler locations, contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

Apple, Alcantara S.p.A., Allen, Amp Multilock, Bluetooth, Brembo, City Navigator, Delphi, Deutsch, Dunlop, Dynojet, Fluke, G.E. Versilube, Garmin, Gunk, Hydroseal, Hylomar, iPhone, iPod, Kevlar, Lexan, Loctite, Lubriplate, Keps, K&N, Magnaflux, Marson Thread-Setter Tool Kit, MAXI fuse, Molex, Michelin, MPZ, Mulitilock, nano, NGK, Novus, Packard, Pirelli, Permatex, Philips, PJ1, Pozidriv, Road Tech, Robinair, S100, Sems, SiriusXM, Snap-on, Teflon, Threadlocker, Torca, Torco, TORX, Tufoil, Tyco, Ultratorch, Velcro, X-Acto, XM Satellite Radio, and zumo are among the trademarks of their respective owners.

PRODUCT REGISTERED MARKS H-D U.S.A., LLC TRADEMARK INFORMATION

Bar & Shield, Boom!, Cross Bones, Cruise Drive, CVO, Digital Tech, Digital Technician, Digital Technician II, Dyna, Electra Glide, Evolution, Fat Bob, Fat Boy, Forty-Eight, Glaze, Gloss, H-D, H-Dnet.com, Harley, Harley-Davidson, HD, Heritage Softail, Iron 883, Low Rider, Night Rod, Nightster, Night Train, Profile, Reflex, Revolution, Road Glide, Road King, Road Tech, Rocker, Screamin' Eagle, Seventy-Two, Softail, Sportster, Street Glide, Street Rod, Sun Ray, Sunwash, Super Glide, SuperLow, Supersmart, Switchback, SYN3, TechLink, TechLink II, Tour-Pak, Tri Glide, Twin Cam 88, Twin Cam 88B, Twin Cam 96, Twin Cam 96B, Twin Cam 103, Twin Cam 103B, Twin Cam 110, Twin Cam 110B, Twin-Cooled, Ultra Classic, V-Rod, VRSC and Harley-Davidson Genuine Motor Parts and Genuine Motor Accessories are among the trademarks of H-D U.S.A., LLC.

STARTING & CHARGING

SUBJECT	PAGE NO.
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1.2 Starting System Diagnosis	1-3
1.3 Starter Activation Circuits	1-7
1.4 Diagnostics/Troubleshooting	1-8
1.5 Testing Starter On Motorcycle	1-10
1.6 Testing Assembled Starter	1-11
1.7 Charging System	1-13
1.8 Ignition Coil	1-20
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STARTER TROUBLESHOOTING 1.1

Table 1-1. Starter Does Not Run or Runs At Very Low Speeds

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Worn or defective battery.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Wiring	Poor or no connection at either battery positive or negative cable, at either end.	Repair or replace cable(s).
	Cracked or corroded battery cable ends.	Clean, tighten or replace cable(s) as needed.
	Open wire(s) or poor connection at handlebar switch or starter relay, especially relay ground wire.	Tighten connections or repair or replace wire(s).
Handlebar start switch	Poor switch contacts or open switch.	Replace switch.
Starter relay	Open coil winding.	Replace relay.
	Poor or no continuity at relay points.	Replace relay.
Solenoid	Poor contact condition of brushes.	Replace solenoid assembly.
	Pull-in winding open or short-circuited.	Replace solenoid assembly.
	Hold-in winding open or short-circuited.	Replace solenoid assembly.
Starting motor	Brushes worn below specification.	Check brush spring tension. Replace field frame and holder.
	Commutator burnt.	Re-face or replace.
	Commutator high mica.	Replace.
	Field winding grounded.	Replace.
	Armature winding grounded or short-circuited.	Replace.
	Reduction gears damaged.	Replace.
	Insufficient brush spring tension.	Replace.
	Disconnected lead wire between solenoid and field windings.	Repair or replace lead wire.
	Ball bearing sticks.	Replace bearing.

Table 1-2. Pinion Does Not Engage With Ring Gear While Starter is Cranked or Engine Cannot Be Cranked

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Worn or defective battery.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Overrunning clutch.	Overrunning clutch malfunction (rollers or compression spring).	Replace overrunning clutch.
	Pinion teeth worn out.	Replace overrunning clutch.
	Pinion does not run in overrunning direction.	Replace overrunning clutch.
	Poor sliding condition of spline teeth.	Remove foreign materials, dirt or replace overrunning clutch.
	Reduction gears damaged.	Replace overrunning clutch and idler gear.
Gear teeth on clutch shell	Excessively worn teeth.	Replace ring gear.

Table 1-3. Starter Does Not Stop Running

SOURCE OF PROBLEM	PROBABLE CAUSE	SOLUTION
Starting switch or starter relay.	Unopened contacts.	Replace starting switch or starter relay.
	Poor return caused by sticky switch or relay contacts.	Replace starting switch or starter relay.
Gear teeth on clutch shell	Excessively worn teeth.	Replace ring gear.
Solenoid.	Return spring worn.	Replace spring.
	Coil layer shorted.	Replace solenoid.
	Contact plate melted and stuck.	Replace solenoid.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the starter system flow charts.

1. Remove starter motor. Connect jumper wires as described under FREE RUNNING CURRENT DRAW TEST under 1.6 TESTING ASSEMBLED STARTER.
2. See VOLTAGE DROPS under 1.4 DIAGNOSTICS/ TROUBLESHOOTING.
3. See STARTER CURRENT DRAW TEST under 1.5 TESTING STARTER ON MOTORCYCLE.
4. See FREE RUNNING CURRENT DRAW TEST under 1.6 TESTING ASSEMBLED STARTER.

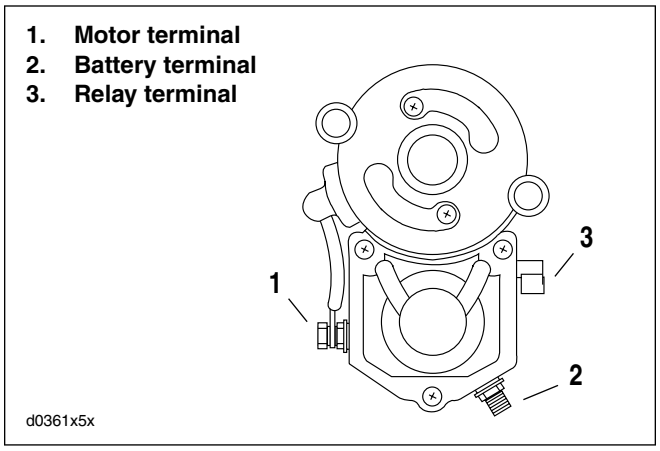
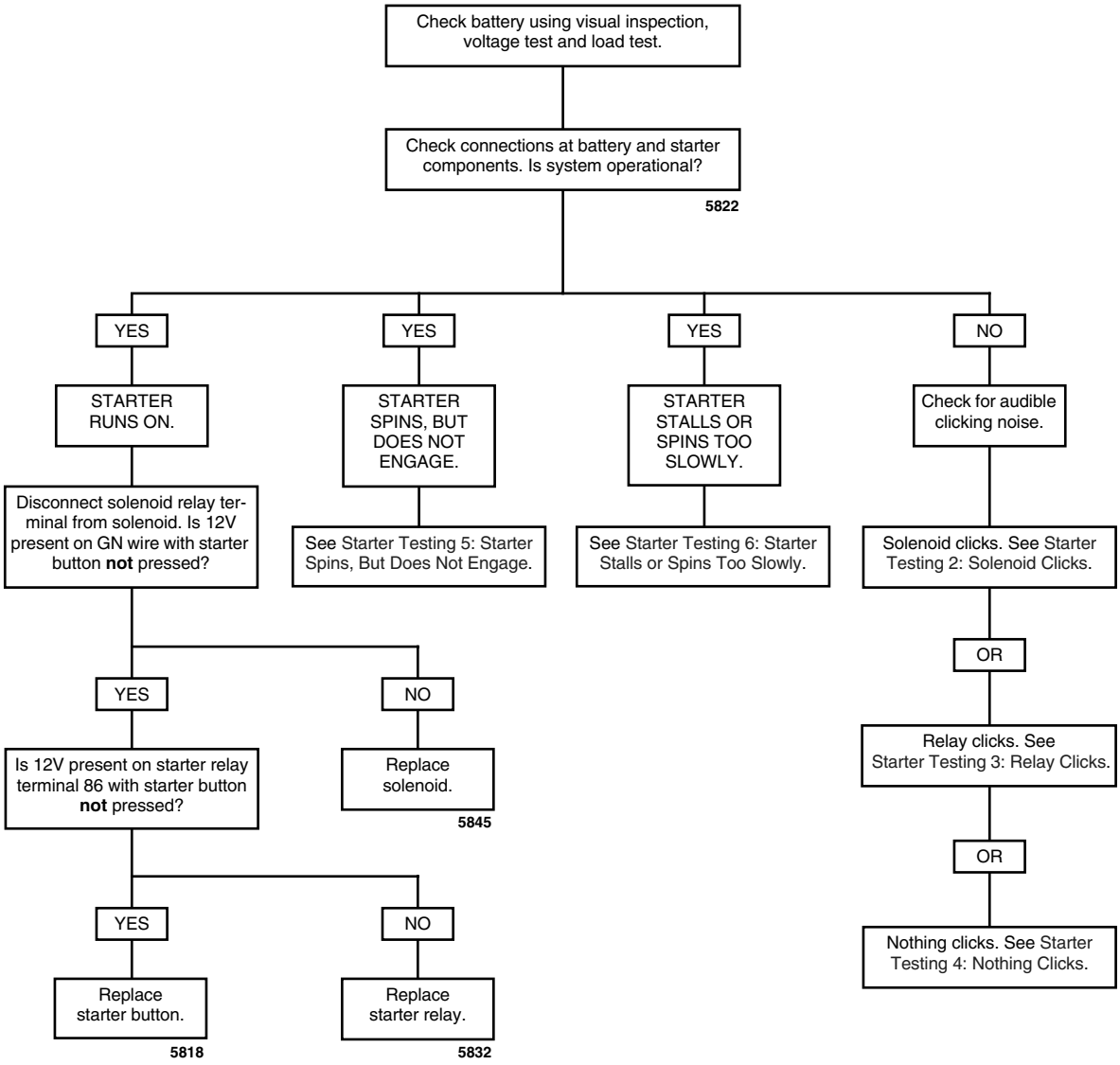
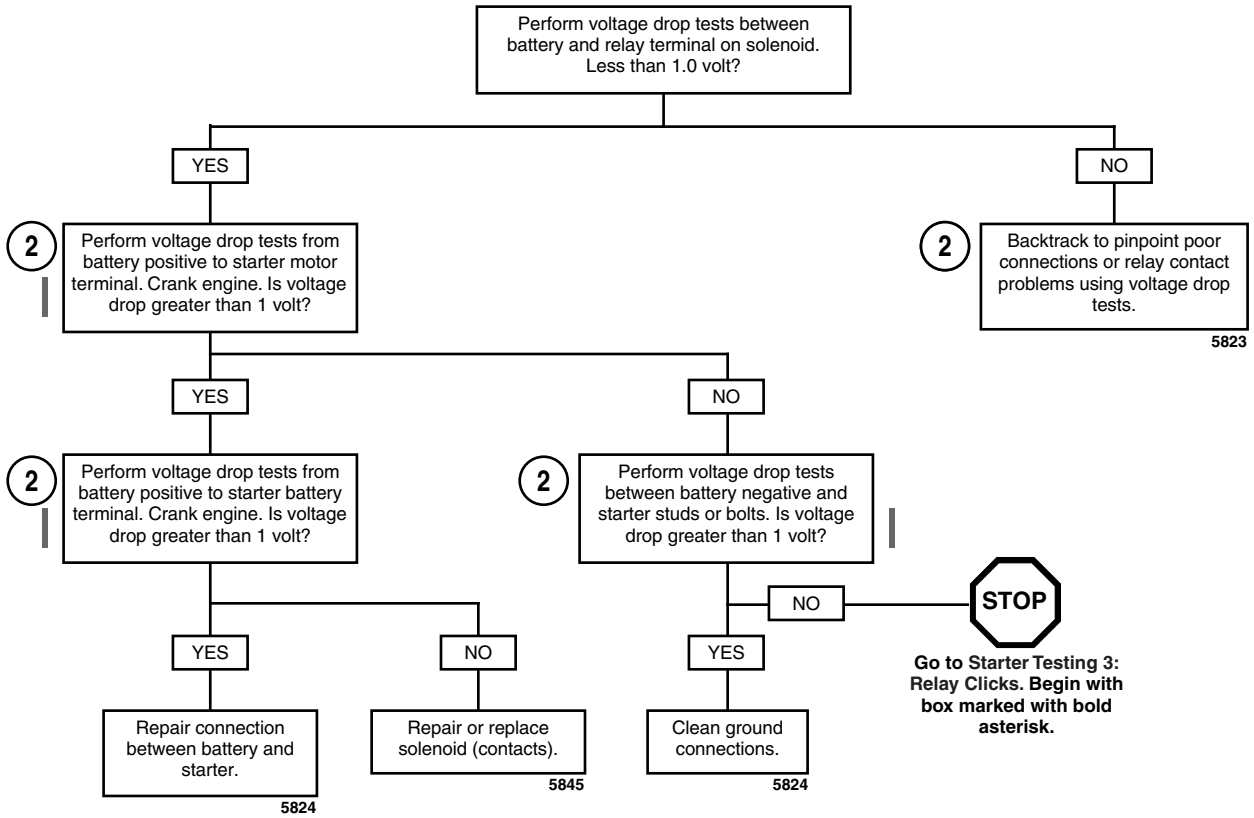


Figure 1-1. Starter Terminals

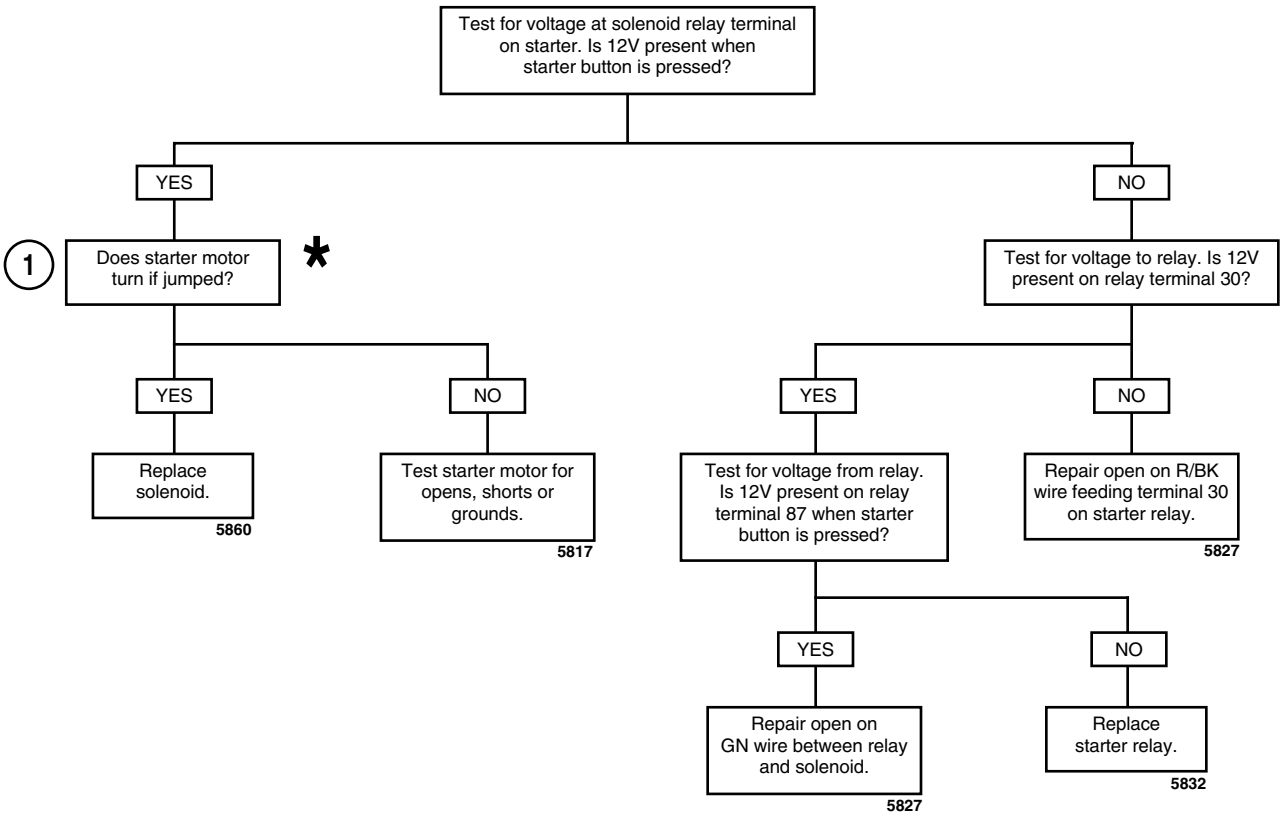
Starter Testing 1



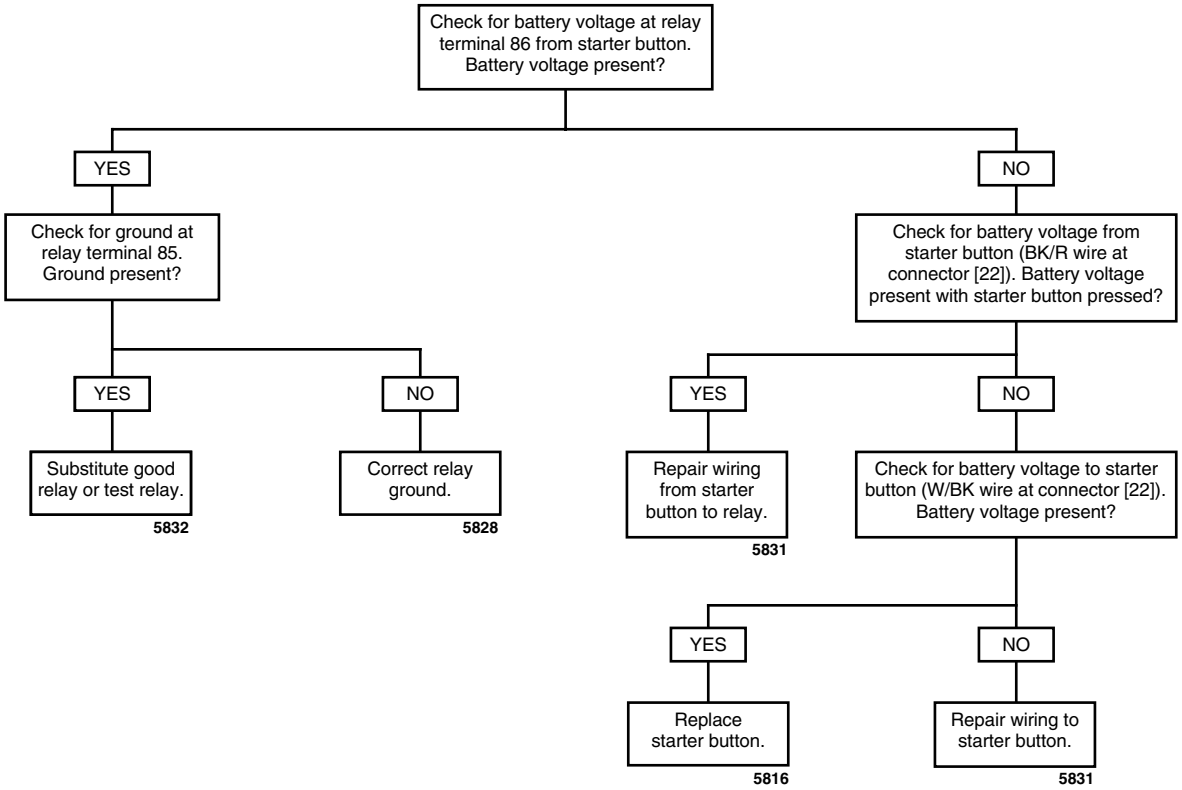
Starter Testing 2: Solenoid Clicks



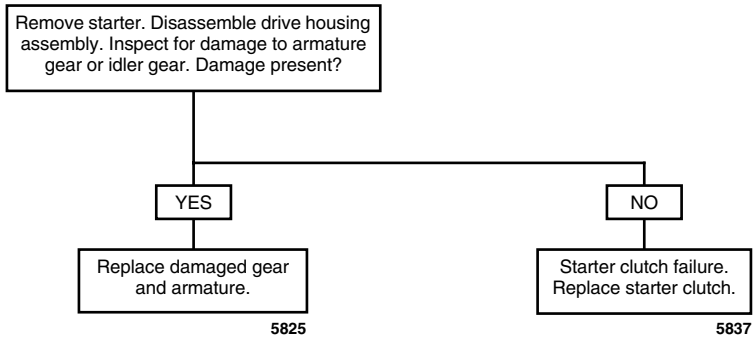
Starter Testing 3: Relay Clicks



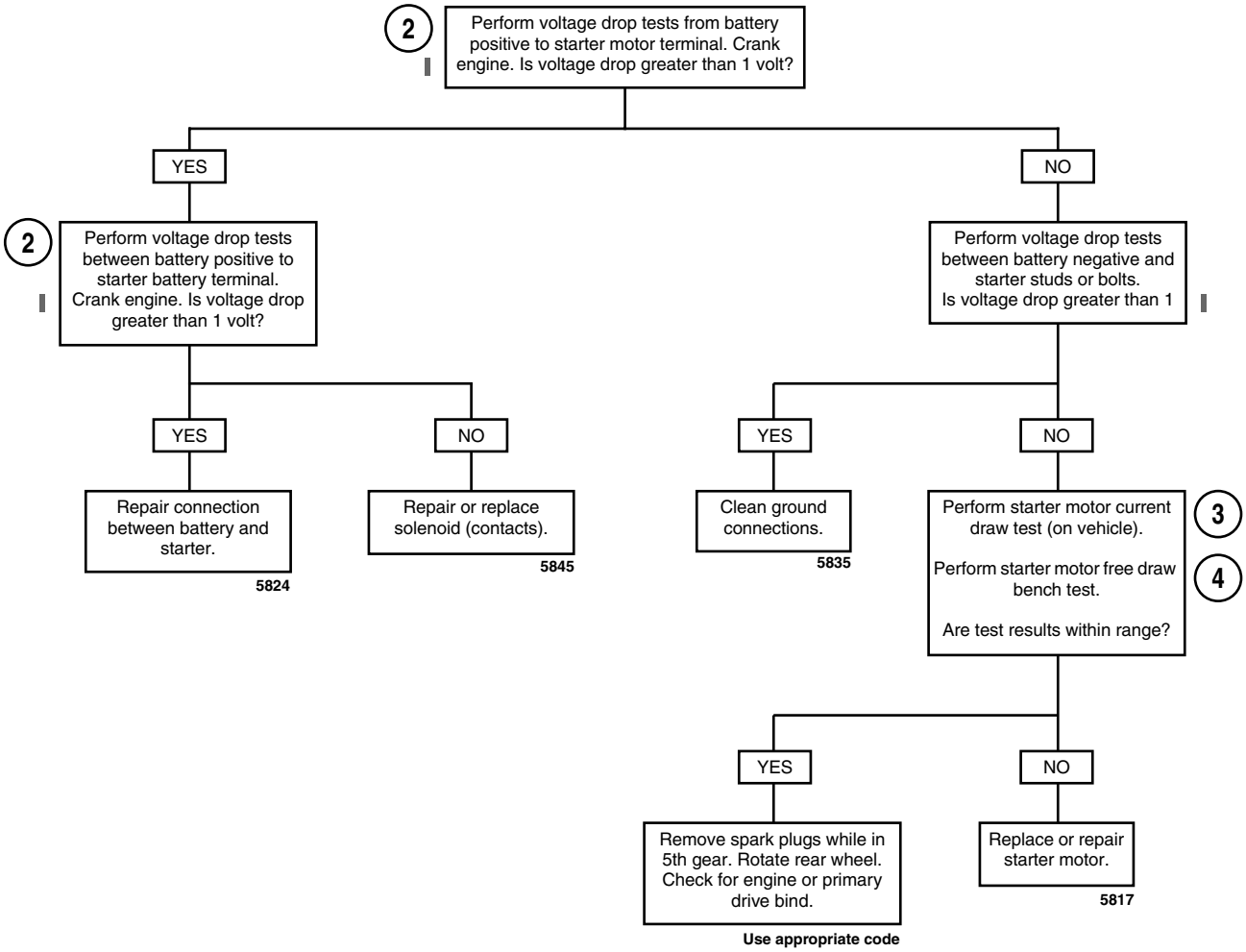
Starter Testing 4: Nothing Clicks



Starter Testing 5: Starter Spins, But Does Not Engage



Starter Testing 6: Starter Stalls or Spins Too Slowly



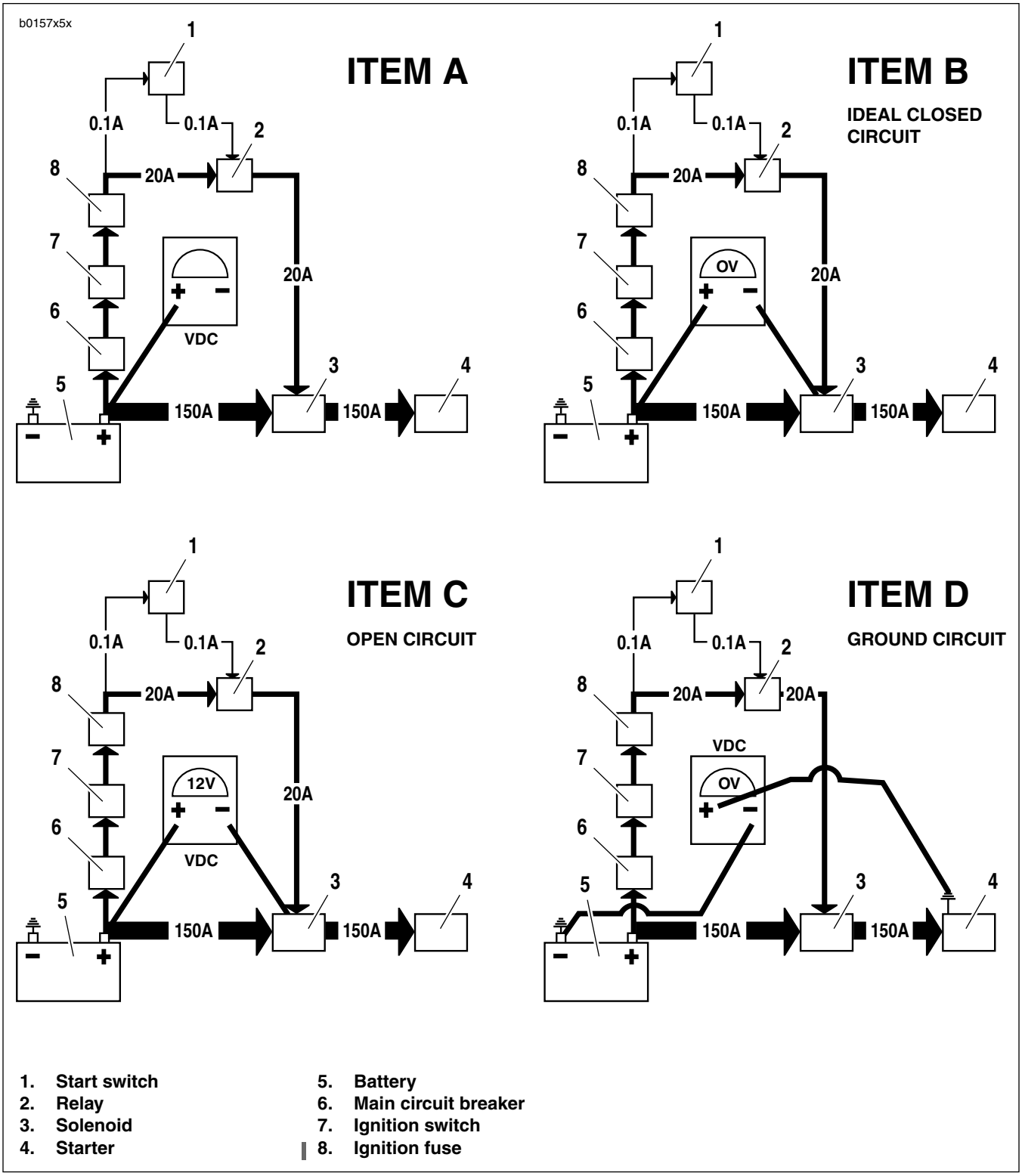


Figure 1-2. Typical Circuity. Refer to wiring diagrams for more information.

GENERAL

The troubleshooting tables beginning on page 1-1 contain detailed procedures to solve and correct problems. Follow the 1.2 STARTING SYSTEM DIAGNOSIS diagram to diagnose starting system problems. The VOLTAGE DROPS procedure below will help you to locate poor connections or components with excessive voltage drops.

VOLTAGE DROPS

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 ITEM A in Figure 1-2. 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 (5).
2. See ITEM B in Figure 1-2. Attach the black meter lead to the final destination or component in the circuit (solenoid terminal from relay).
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 ITEM C in Figure 1-2. An open circuit should read 12 volts, displaying all the voltage dropped, and the entire difference in potential displayed on the meter.

NOTE

Open circuits on the ground side will read zero.

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 and accuracy.
   a. Readings aren't as sensitive to real battery voltage.
   b. 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, ignition circuits, etc. Start from most positive and go to most negative (the destination or component).
8. See ITEM D in Figure 1-2. The negative or ground circuit can be checked as well.
   a. 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.
   b. Place the positive lead to the ground you wish to check.
   c. Activate the circuit. This will allow you to read the potential difference or voltage dropped on the negative or ground circuit. This technique 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.

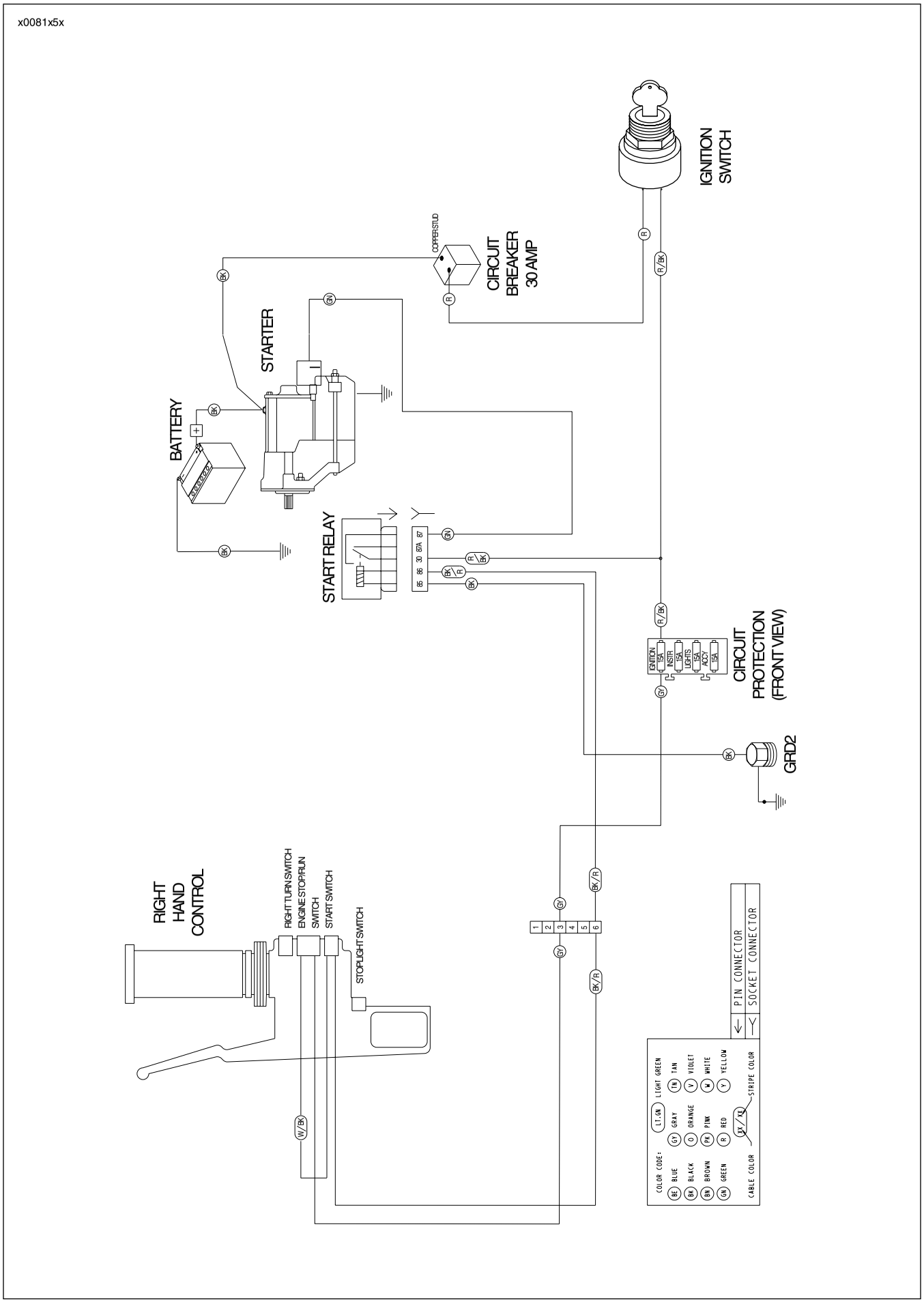


Figure 1-3. Starting Circuit

STARTER RELAY

1. See Figure 1-4. Locate the starter relay. The relay is located on the ignition bracket behind the left side cover. Unplug the relay connector.

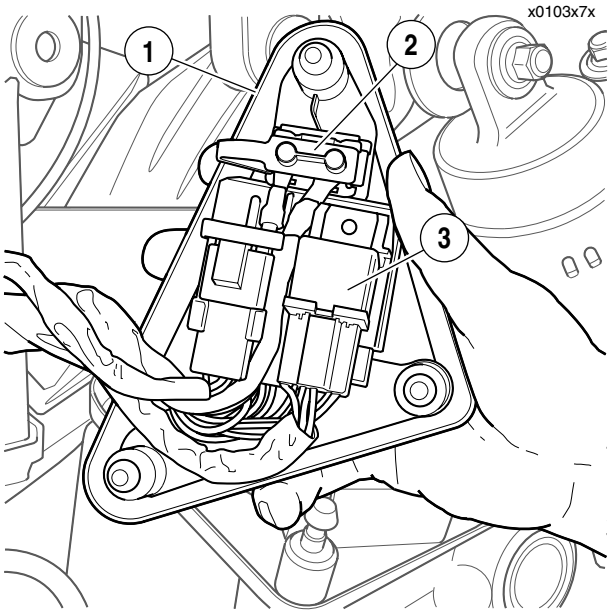
2. To install a **new** starter relay, refer to ELECTRICAL BRACKET, REPLACE STARTER RELAY in Section 7 of the 2002 Sportster Service Manual (Part Number 99484-02). To test the relay, proceed to step 3.

3. See Figure 1-5. Obtain a 12 volt battery and a continuity tester or ohmmeter. Connect the battery leads to the 86 and 85 terminals to energize the relay. Check for continuity between the 30 and 87 terminals.

   a. A good relay shows continuity, continuity tester lamp "on" or a zero ohm reading on the ohmmeter.

   b. A malfunctioning relay will not show continuity and must be replaced.

4. If the starter relay is functioning properly, proceed to the STARTER CURRENT DRAW TEST.



1. Left side cover
2. Main breaker
3. Starter relay

Figure 1-4. Starter Relay Location

STARTER CURRENT DRAW TEST

NOTE

- *Engine temperature should be stable and at room temperature.*

- *Battery should be fully charged.*

See Figure 1-6. Check starter current draw with an induction ammeter before disconnecting the battery. Proceed as follows:

1. Verify that transmission is in neutral. Disconnect spark plug wires from spark plug terminals.

2. Clamp induction ammeter over the positive battery cable next to starter.

3. With the ignition switch ON, turn engine over by pressing starter switch while taking a reading on the ammeter. Disregard initial high current reading which is normal when the engine is first turned over.

   a. Typical starter current draw will range between 140 and 180 amperes.

   b. If starter current draw exceeds 180 amperes, then the problem may be in the starter or starter drive. Remove the starter for further tests. See STARTER, REMOVAL in the 2002 Sportster Service Manual (Part Number 99484-02).

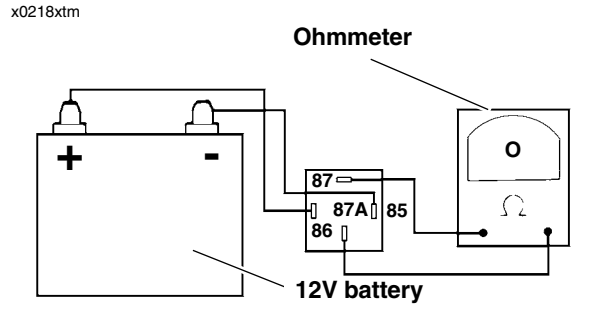


Figure 1-5. Starter Relay Test

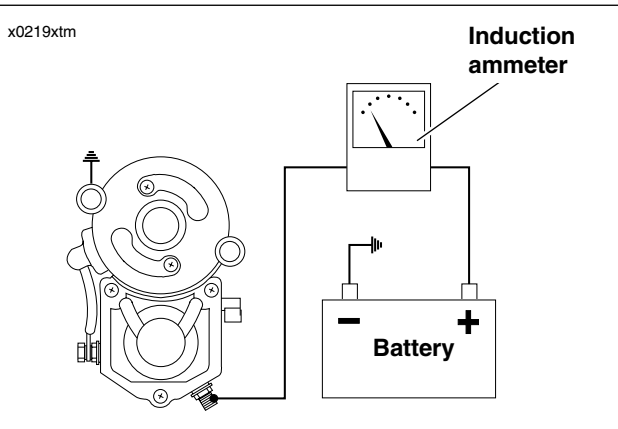
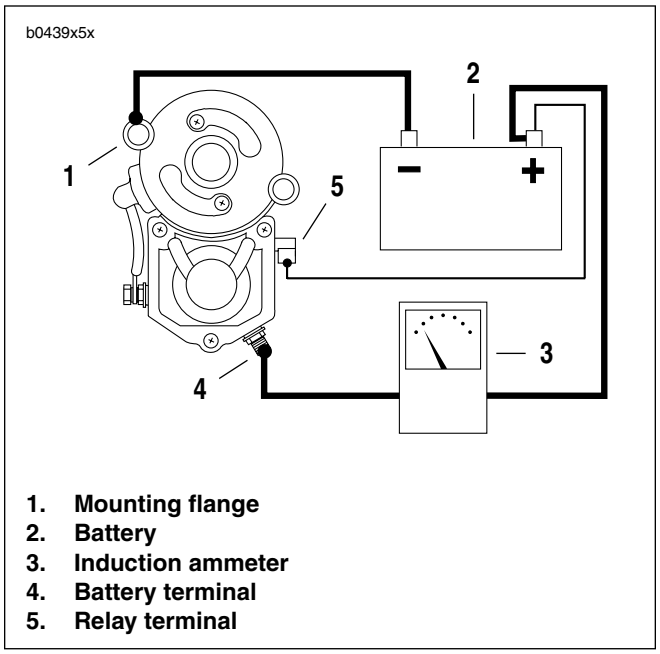


Figure 1-6. Starter Draw Test

FREE RUNNING CURRENT DRAW TEST

1. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. See Figure 1-7. Attach one heavy jumper cable (6 gauge minimum).
   a. Connect to starter mounting flange (1).
   b. Connect to negative (-) terminal of a fully charged battery (2).
3. Connect a second heavy jumper cable (6 gauge minimum).
   a. Connect to positive (+) terminal of the battery (2).
   b. Place an inductive ammeter (3) over cable. Continue on to the battery terminal (4) on the starter solenoid.
4. Connect a smaller jumper cable (14 gauge minimum).
   a. Connect to positive (+) terminal of the battery (2).
   b. Connect to solenoid relay terminal (5).
5. Check ammeter reading.
   a. Ammeter should show 90 amps maximum.
   b. If reading is higher, disassemble starter for inspection. See the 2002 Sportster Service Manual (Part Number 99484-02).
   c. If starter current draw on vehicle was over 200 amps and this test was within specification, there may be a problem with engine or primary drive.



1. Mounting flange
2. Battery
3. Induction ammeter
4. Battery terminal
5. Relay terminal

Figure 1-7. Free Running Current Draw Test

STARTER SOLENOID

⚠WARNING

Wear eye protection during this series of tests. These tests may produce flying sparks which could result in death or serious injury.

NOTE

Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in Figure 1-8.

CAUTION

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

NOTE

The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. Conduct all three tests one after the other in the sequence given without interruption.

SOLENOID PULL-IN TEST

1. See Figure 1-8. Using a 12 volt battery, connect three separate test leads as follows:
   a. Solenoid housing to negative battery post.
   b. Solenoid motor terminal to negative battery post.
   c. Solenoid relay terminal to positive battery post.
2. Observe starter pinion.
   a. If starter pinion pulls strongly, solenoid is working properly.
   b. If starter pinion does not pull strongly, replace the solenoid.

SOLENOID HOLD-IN TEST

1. See Figure 1-9. With test leads still connected in the manner specified in the previous SOLENOID PULL-IN TEST, **disconnect solenoid motor terminal/battery negative test lead (B) at negative battery post only; reconnect loose end of this test lead to positive battery post instead.**
2. Observe starter pinion.
   a. If starter pinion remains in pull-in position, solenoid is working properly.
   b. If starter pinion does not remain in pull-in position, replace the solenoid.

SOLENOID RETURN TEST

1. See Figure 1-10. With test leads still connected in the manner specified at the end of the previous SOLENOID HOLD-IN TEST, **disconnect solenoid relay terminal/positive battery post test lead (C) at either end.**
2. Observe starter pinion.
   a. If starter pinion returns to its original position, solenoid is working properly.
   b. If starter pinion does not return to its original position, replace the solenoid.

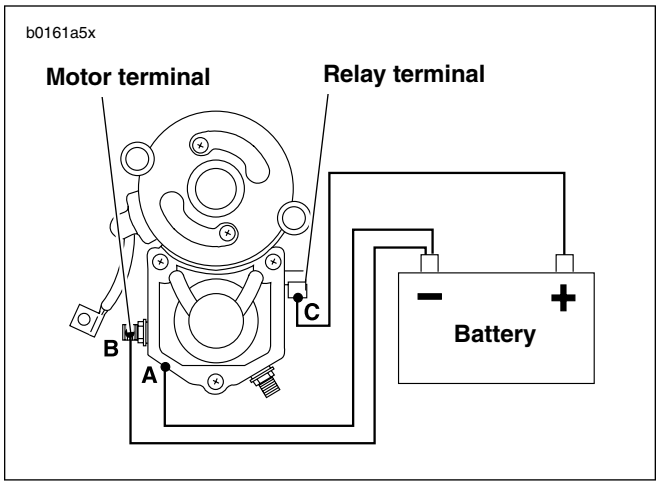


Figure 1-8. Test 1: Pull-In Test

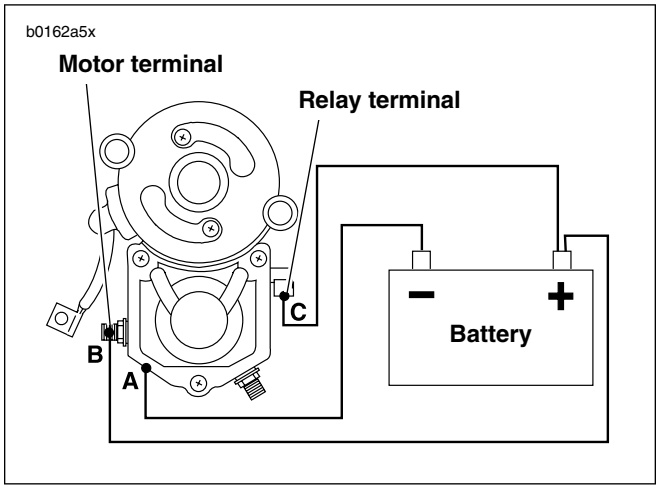


Figure 1-9. Test 2: Hold-In Test

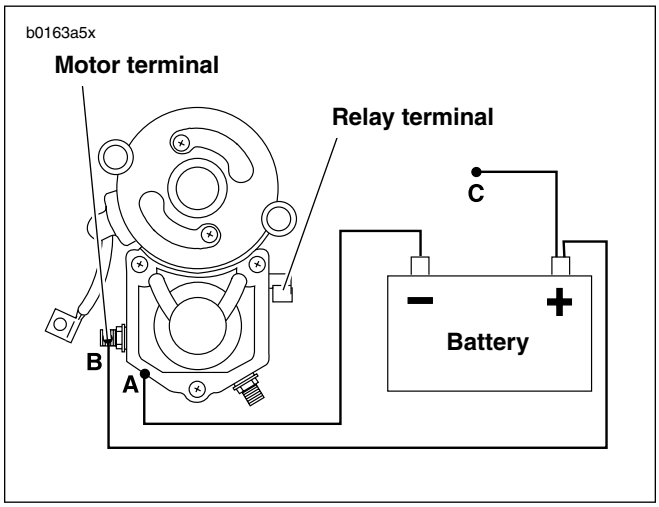


Figure 1-10. Test 3: Return Test

GENERAL

The charging system consists of the alternator and regulator. Charging system circuits are shown in Figure 1-13.

Alternator

The alternator consists of two main components:

- The rotor which mounts to the engine sprocket shaft.
- The stator which bolts to the engine crankcase.

Voltage Regulator

See Figure 1-11. The voltage regulator is a series regulator with shunt control. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

When the charging system fails to charge or does not charge at a satisfactory rate, make the following recommended checks.

Battery

Check for a weak or dead battery. See BATTERY in Section 8 of the 2002 Sportster Service Manual (Part Number 99484-02). Battery must be fully charged in order to perform any electrical tests.

Wiring

Check for corroded or loose connections in the charging circuit. See Figure 1-13.

Voltage Regulator Inspection

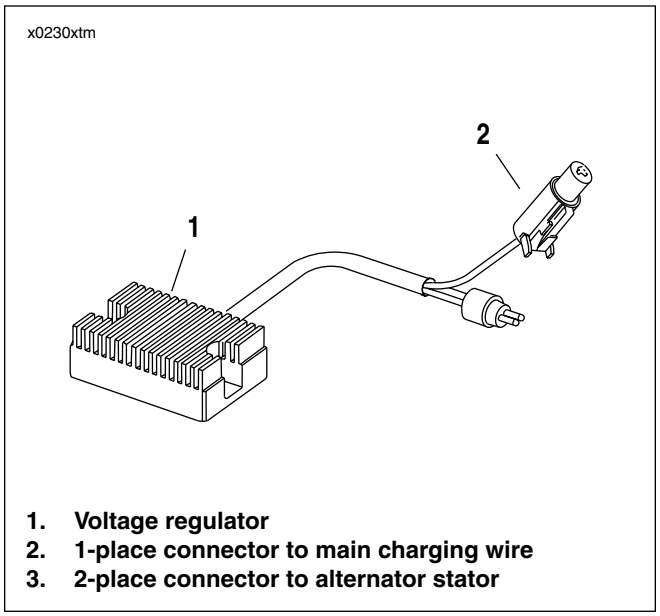
See Figure 1-11. The voltage regulator base must have a clean, tight connection for proper grounding. Check by using an ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator base.

See Figure 1-12. The stator connector plug at engine crankcase must be clean and tight.

Special Tools

Special tools required for troubleshooting include:

- Ammeter
- Load tester
- Ohmmeter
- AC voltmeter



1. Voltage regulator
2. 1-place connector to main charging wire
3. 2-place connector to alternator stator

Figure 1-11. Voltage Regulator

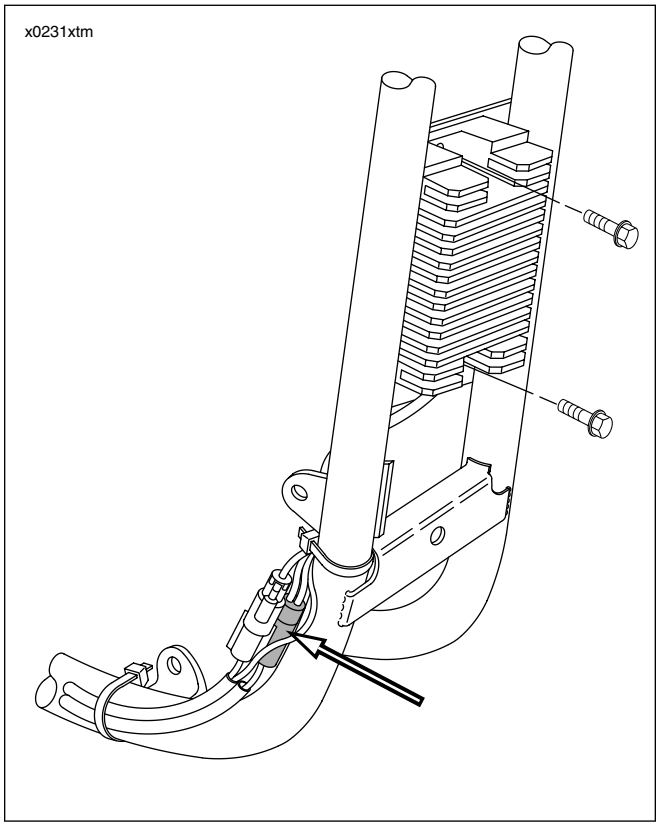
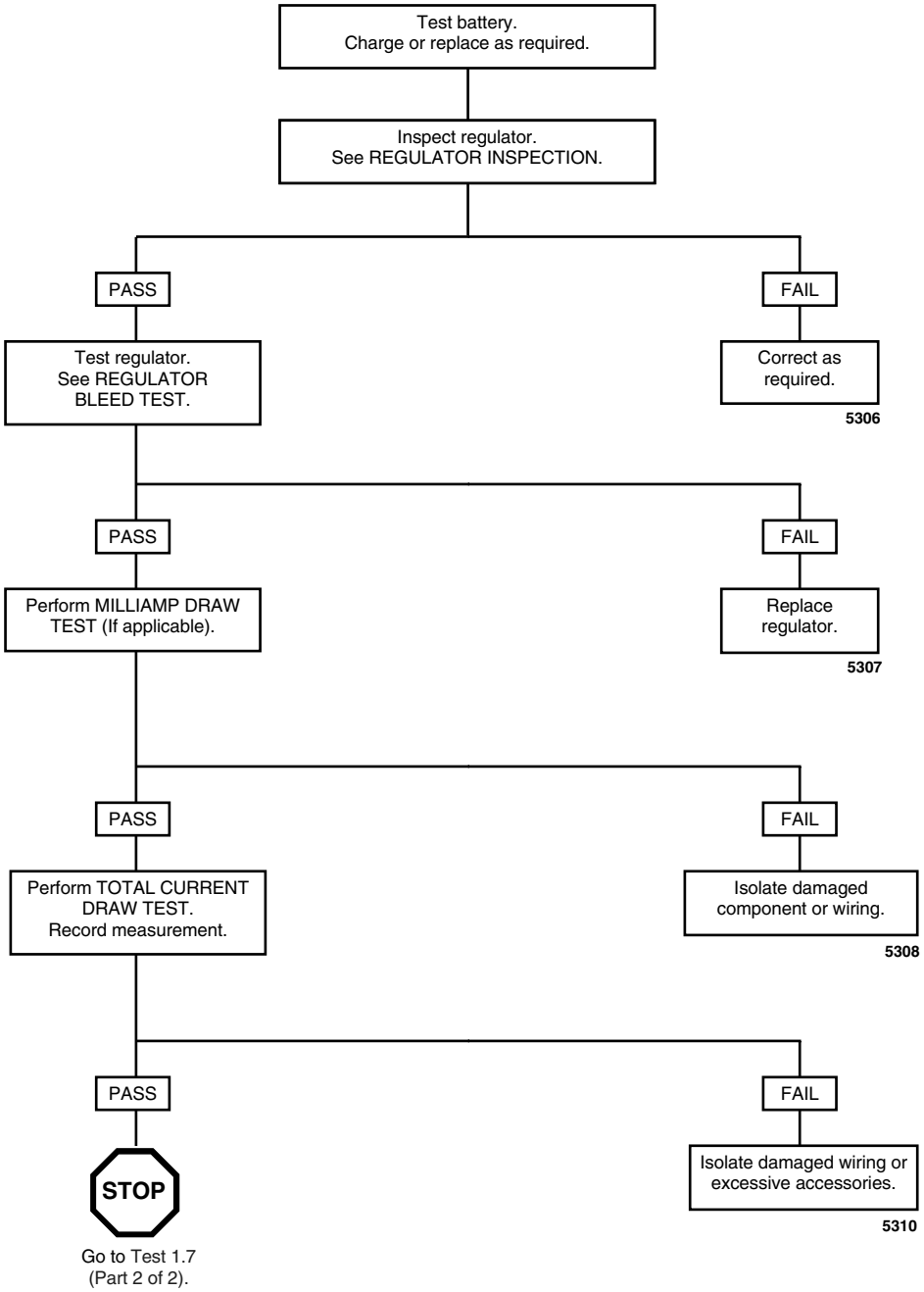


Figure 1-12. Stator Connector Plug

Test 1.7 (Part 1 of 2)

SYMPTOM: BATTERY BECOMES DISCHARGED

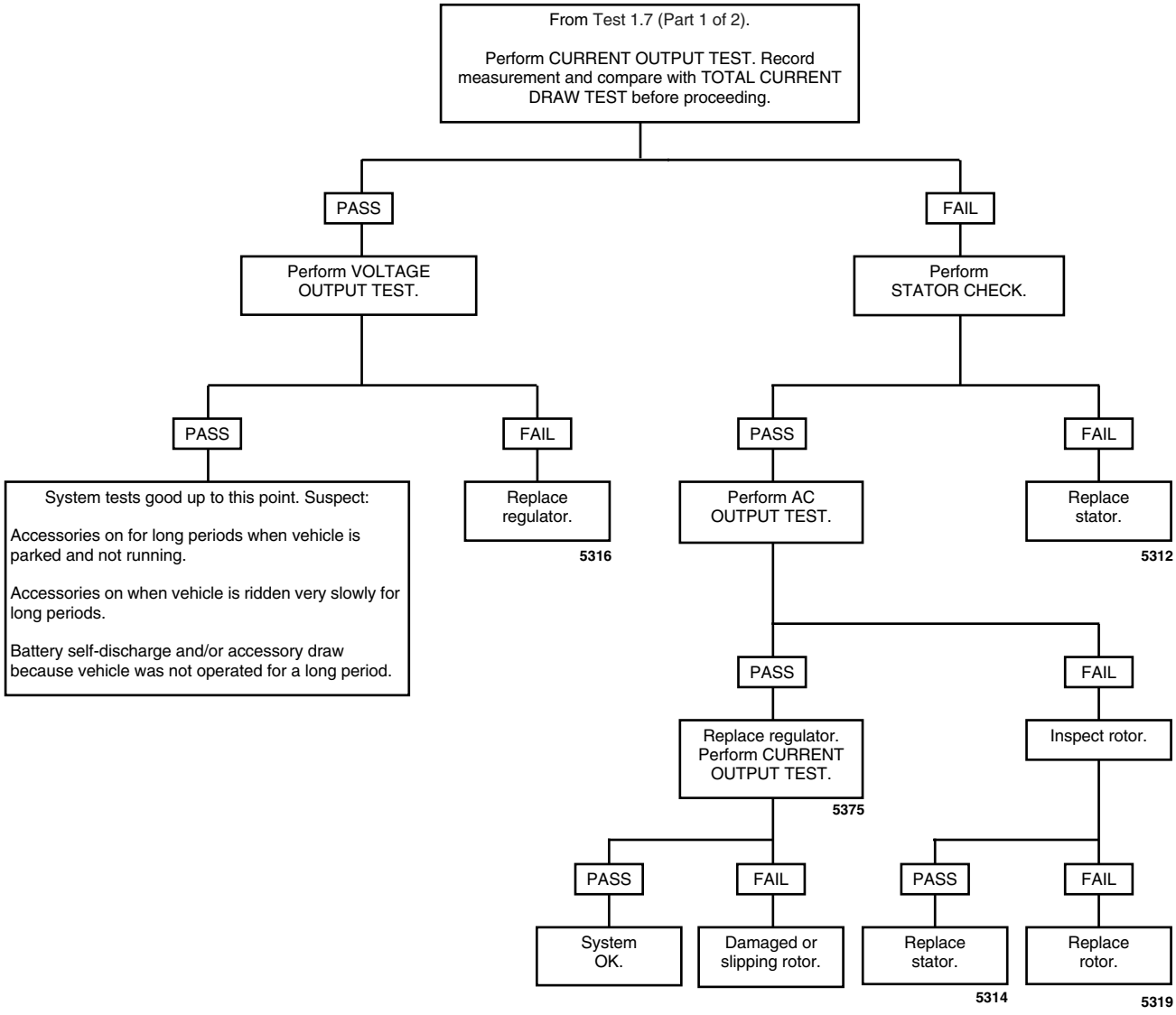


NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

Test 1.7 (Part 2 of 2)

SYMPTOM: BATTERY BECOMES DISCHARGED



NOTE

Whenever a charging system component fails a test and is replaced, re-test the system to be sure the problem has been corrected.

x0220xtm

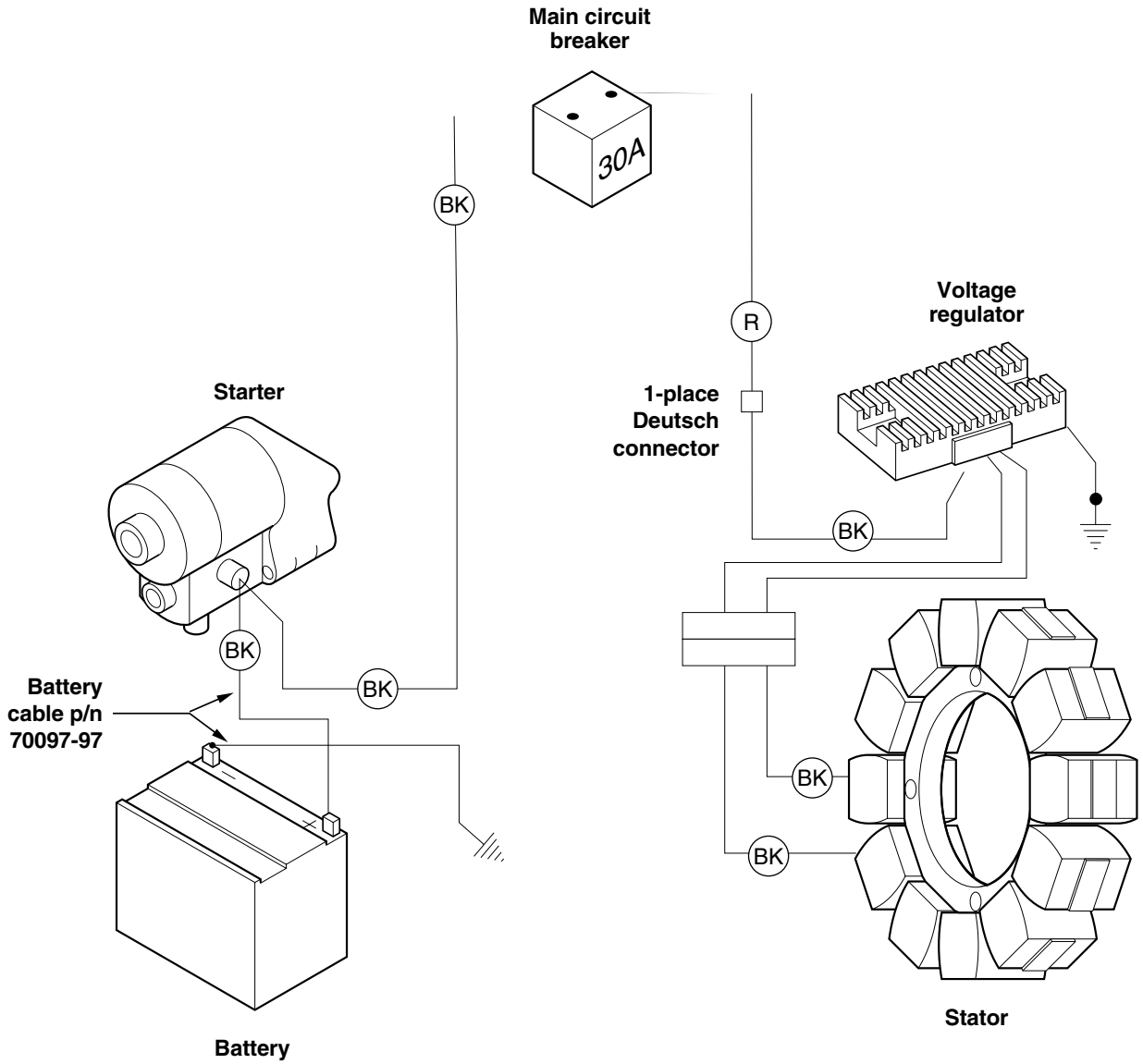


Figure 1-13. Charging System Circuit

TESTING

Voltage Regulator Bleed Test

1. Be sure regulator is connected to battery.
2. Unplug voltage regulator connector at engine crankcase.
3. Check regulator connector using a trouble light.
   a. Touch one probe to a suitable ground.
   b. Touch the other to the regulator pins, one at a time.
   c. If light glows, replace regulator.

Milliampere Draw Test

NOTE

Be sure accessories are not wired so they stay on at all times. This condition could drain battery completely if vehicle is parked for a long time. Check for this by connecting ammeter between negative battery terminal and battery.

1. See Figure 1-14. Connect ammeter between negative battery terminal and battery. With this arrangement, you will also pick up any regulator drain.
2. With ignition key switch turned to OFF and all lights and accessories off, observe amperage reading.
   a. Maximum reading should be 0.5 milliamperes.
   b. A higher reading indicates excessive current draw. Any accessories must be considered and checked for excessive drain.

NOTE

A battery with a surface discharge condition could suffer a static drain. Correct by cleaning battery case.

Total Current Draw Test

If battery runs down during use, the current draw of the motorcycle components and accessories may exceed output of the charging system.

⚠WARNING

Always turn the battery load tester OFF before connecting tester cables to the battery terminals. Connecting tester cables with the load tester ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

1. See Figure 1-15. To check for this condition, place load tester induction pickup or current probe pickup over battery negative cable.
2. Disconnect regulator from stator wiring. Start the motorcycle and run the engine at 2000 RPM.
3. With ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw.

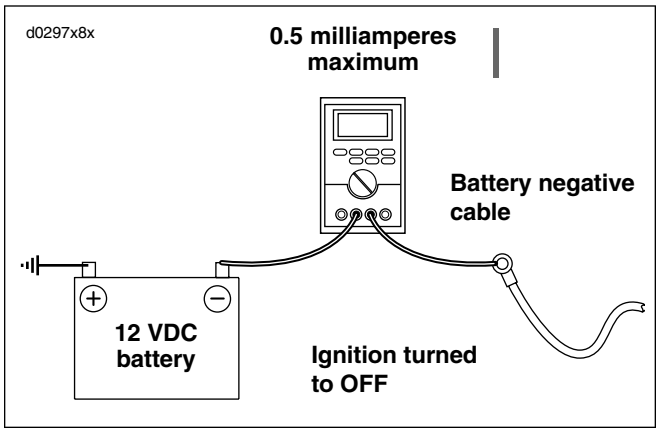


Figure 1-14. Milliampere Draw Test

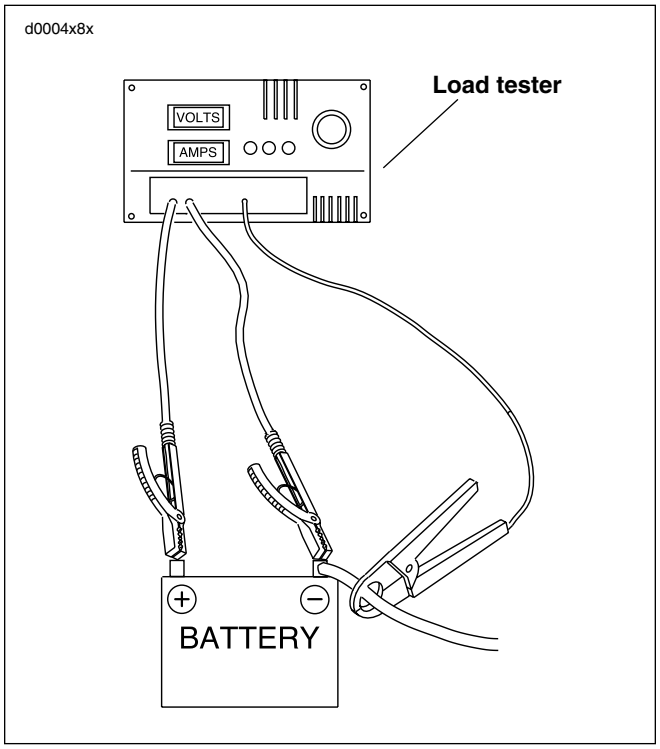


Figure 1-15. Check Current Draw (Ignition Switch On)

4. Compare this reading to the reading obtained after performing the CURRENT AND VOLTAGE OUTPUT TEST.
   a. The current output should exceed current draw by 3.5 amps minimum.
   b. If output does not meet specifications, there may be too many accessories for the charging system to handle.
5. Reconnect regulator after testing.

NOTE

Rider's habits may require test at lower RPM.

Current and Voltage Output Test

1. See Figure 1-16. Connect load tester.
   a. Connect negative and positive leads to battery terminals.
   b. Place load tester induction pickup over positive regulator cable.

CAUTION

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

2. Run the engine at 2000 RPM. Increase the load as required to obtain a constant 13.0 VDC.
3. The current output should be 19-23 amps. Make note of measurement for use in TOTAL CURRENT DRAW TEST.

NOTE

Rider's habits may require test at lower RPM.

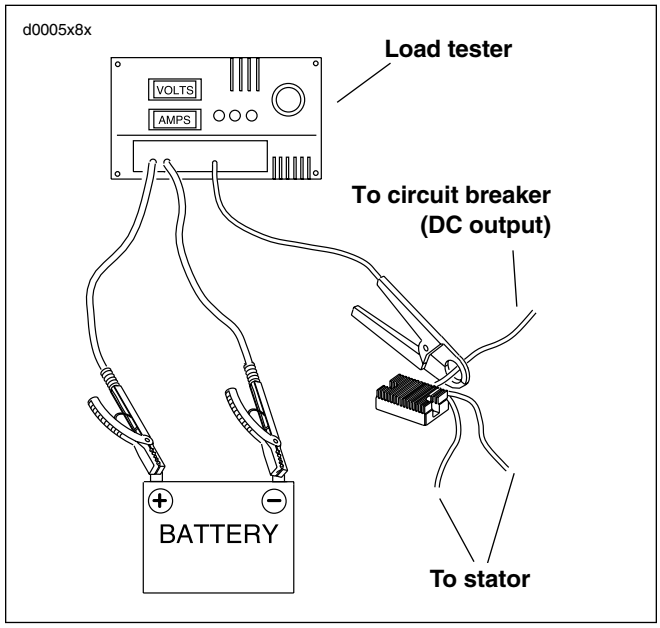


Figure 1-16. Current and Voltage Output Test

Voltage Output Test

1. See Figure 1-16. After removing the load, read the load tester voltage meter.
   a. If voltage to the battery is not more than 15 VDC, voltage output is within specifications. Investigate other possible problems. See Test 1.7 (Part 1 of 2).
   b. If voltage is higher, regulator is not functioning properly or connections are loose or dirty.

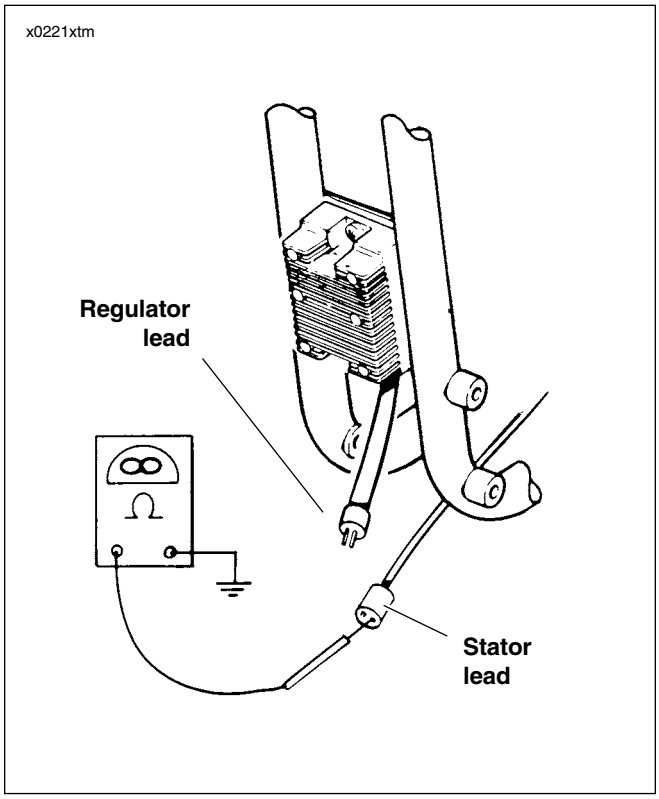


Figure 1-17. Test for Grounded Stator (Typical)

Stator Check

1. Turn ignition key switch OFF.
2. See Figure 1-17. Connect an ohmmeter.
   a. Disconnect voltage regulator connector from alternator stator wiring.
   b. Insert one ohmmeter lead into either stator socket.
   c. Attach the other lead to a suitable ground.
3. Test for continuity with ohmmeter set on the RX1 scale.
   a. A good stator will show no continuity (∞ ohms) across either stator socket.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 1-18. Remove ground lead. Insert lead into the remaining stator socket.
5. Test for resistance with ohmmeter set on the RX1 scale.
   a. Resistance across the stator sockets should be 0.2-0.4 ohms.
   b. If the resistance is lower, a short is indicated. The stator is damaged and must be replaced.
   c. If resistance is higher (OL on meter), an open is indicated. Stator is damaged and must be replaced.

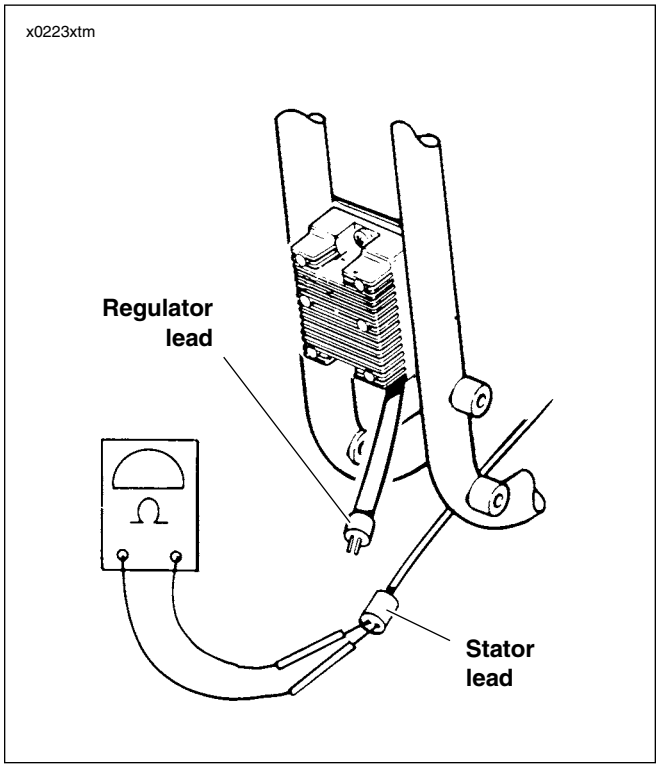


Figure 1-18. Check for Stator Resistance (Typical)

AC Output Check

1. See Figure 1-19. Test AC output.
   a. Disconnect voltage regulator connector from alternator stator wiring.
   b. Connect an AC voltmeter across both stator sockets.
   c. Run the engine at 2000 RPM. The AC output should be 38-52 volts AC.
2. Compare test results to specifications.
   a. If the output is below specifications, charging problem could be a faulty rotor or stator.
   b. If output is good, charging problem might be faulty regulator/rectifier. Replace as required.
3. Check the output again as previously described under CURRENT AND VOLTAGE OUTPUT TEST.

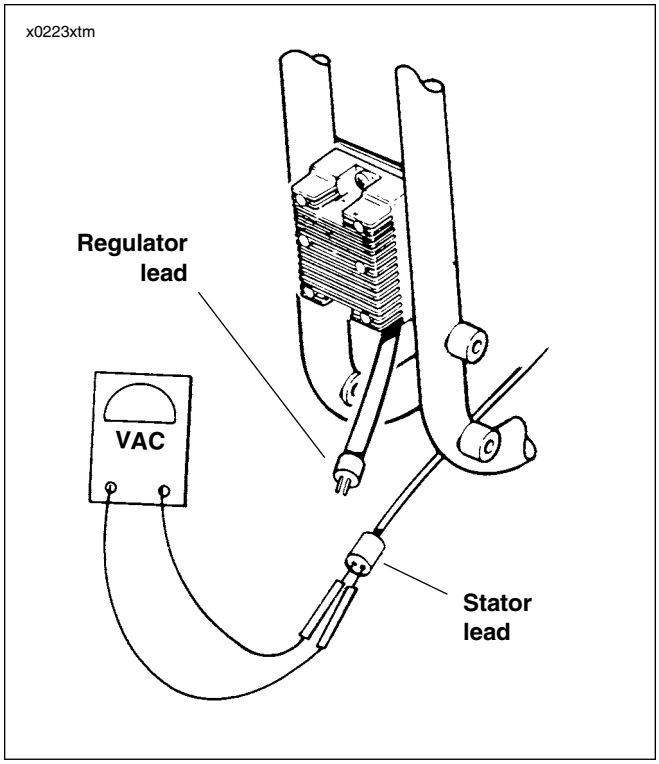


Figure 1-19. Check Stator AC Voltage Output (Typical)

TROUBLESHOOTING

Follow the troubleshooting procedures listed under 4.8 INITIAL DIAGNOSTIC CHECK: 1200S ONLY if the engine will not start, is difficult to start or runs roughly. Also check condition of spark plug cables. Insulation on cables may be cracked or damaged allowing high tension current to short to metal parts. This problem is most noticeable when cables are wet.

If poor starting/running condition persists, check resistance of ignition coil primary and secondary windings using an ohmmeter.

NOTE

The ignition coil cannot be repaired. Replace the unit if it fails.

Ignition Coil Primary Circuit Test

1. Remove ignition coil.
2. Set ohmmeter scale to RX1.
3. See Figure 1-20. Place multimeter wires on primary coil windings.
4. Check for primary coil winding resistance.
   a. For all models except 1200S, see Table 1-4. For 1200S models, see Table 1-5.
   b. See TEST RESULTS which follows if resistance is not within normal operating range.

Ignition Coil Secondary Circuit Test

1. Remove ignition coil.
2. Set ohmmeter scale to RX1K.
3. See Figure 1-20. Place multimeter wires on secondary coil windings.
4. Check for secondary coil winding resistance.
   a. For all models except 1200S, see Table 1-4. For 1200S models, see Table 1-5.
   b. See TEST RESULTS which follows if resistance is not within normal operating range.

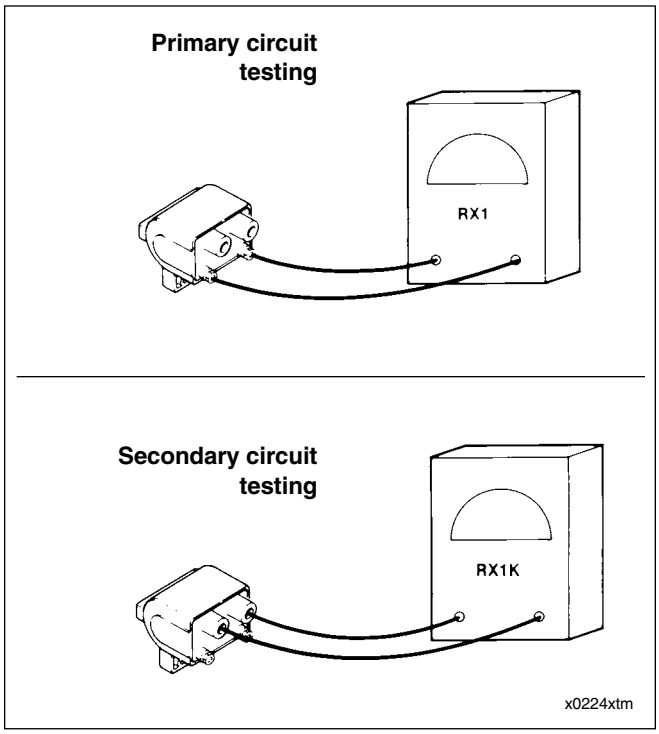


Figure 1-20. Ignition Coil Testing

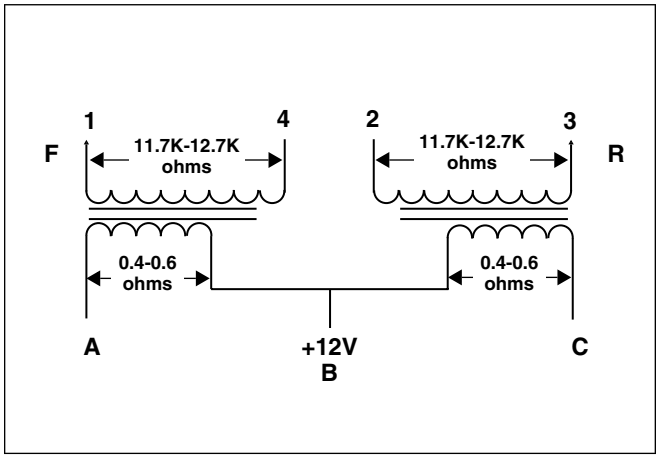


Figure 1-21. 1200S Ignition Coil Winding Resistance

Table 1-4. Ignition Coil Winding Resistance (All But 1200S)

WINDING	OHMMETER SCALE	NORMAL RESISTANCE RANGE (IN OHMS)
Primary	R x 1	2.5-3.1
Secondary	R x 1K	10,000-12,500

Table 1-5. Ignition Coil Winding Resistance (1200S Only)

WINDING	OHMMETER SCALE	NORMAL RESISTANCE RANGE (IN OHMS)
Primary	R x 1	0.4-0.6
Secondary	R x 1K	11,700-12,700

Ignition Coil Substitution

If a coil tester is not available, use the following test.

NOTE

Coil will function without being attached to frame.

1. Substitute a **new** ignition coil by attaching it to any convenient point near the old coil. Transfer terminal wires to **new** coil.
2. Attach **new** spark plug cables to coil and plugs.
3. Test system. If ignition trouble is eliminated by the temporary installation of a **new** coil, carefully inspect old coil and cables for damage. The insulation on the cables may be cracked or otherwise damaged allowing high tension current to short to metal parts. This is most noticeable in wet weather or after the motorcycle has been washed.

Test Results

1. A low resistance value indicates a short in the coil winding. Replace coil.
2. A high resistance value might indicate that there is some corrosion/oxidation of the coil terminals. Clean the terminals and repeat resistance test. If resistance is still high after cleaning terminals, replace coil.
3. An infinite ohms (∞ or OL) resistance value indicates an open circuit (a break in the coil winding). Replace coil.

GENERAL

The load test measures battery performance under full current load and is the best indicator of battery condition. To load test the battery, proceed as follows:

1. Remove battery from motorcycle.

CAUTION

Load testing a discharged battery can result in permanent battery damage.

2. Always fully charge the battery before testing or test readings will be incorrect. Load testing a discharged battery can also result in permanent battery damage.
3. After charging, allow battery to stand for at least one hour before testing.

⚠WARNING

Always turn the battery load tester OFF before connecting the tester cables to the battery terminals. Connecting tester cables with the load tester ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

4. See Figure 1-22. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

CAUTION

To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

5. See Table 1-7. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 70°F. (21°C).

⚠WARNING

Always turn the battery load tester OFF before disconnecting the tester cables from the battery terminals. Disconnecting tester cables with the load tester ON could cause a spark resulting in a battery explosion which could result in death or serious injury.

6. Install the battery on the motorcycle.

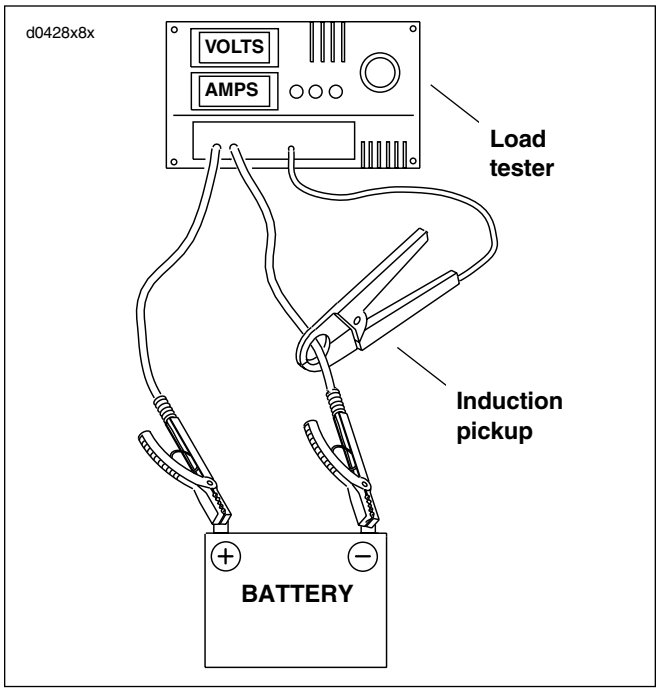


Figure 1-22. Load Test Battery

Table 1-6. Voltmeter Test For Battery Charge Conditions

VOLTAGE (OCV)	STATE OF CHARGE
12.8	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

Table 1-7. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
XLH models	270	135

SUBJECT PAGE NO.

2.1 Electronic Speedometer-How It Works 2-1
2.2 Speedometer and Tachometer 2-2
2.3 Speedometer Performance Check 2-9

INSTRUMENTS

GENERAL

See Figure 2-1. 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 is that of a Hall-Effect sensor that is triggered by the gear teeth of 5th 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 display (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 or "toggling" 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 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 conditions the sensor input to provide an input to the turn signal canceller.

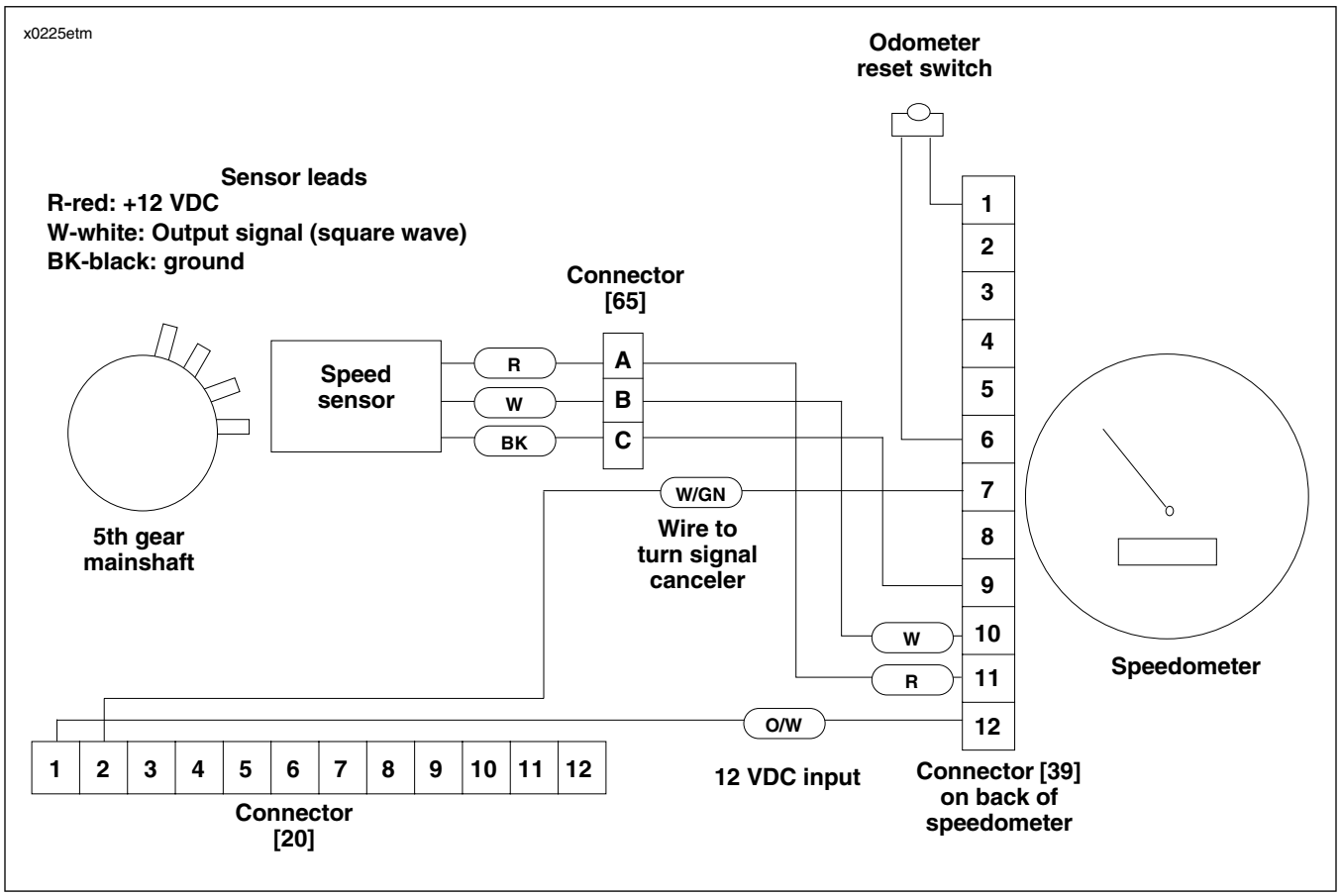


Figure 2-1. Electronic Speedometer Connectors

GENERAL

Reset Switch

See Figure 2-2. Pressing the odometer reset switch provides the following capabilities:

- Change the odometer display between mileage and trip values (press and immediately release).
- Reset the trip odometer (press and hold 2-3 seconds).
- Identify the speedometer calibration (see below).
- Gain access to the diagnostic mode, clear diagnostic codes and exit diagnostic mode (see below).

Diagnostic Mode

The diagnostic mode is entered by turning the ignition from OFF to ON while holding the reset switch in. The normal power-up sequence will occur before entering the diagnostic mode. Diagnostic codes set during this power-up sequence will be stored as well.

IMPORTANT NOTE

Be sure no diagnostic codes are indicated before reset is held in for more than 5 seconds or diagnostic information will be lost.

When in the diagnostic mode the odometer will display the first diagnostic code. When the trip switch is pressed again the next code will be shown. If the trip switch is pressed for more than 5 seconds at any time while in the diagnostic mode, **all of the diagnostic codes will be erased whether they have been displayed or not**.

See Table 2-1. There are 7 different diagnostic codes available. When in the diagnostic mode, all codes are displayed in sequence from d01 to d10.

As a code appears in the display (for instance d02), it will read “d02SEt” if set or “d02CLr” if clear.

The diagnostic mode is exited either by turning ignition from ON to OFF to ON again without depressing the reset switch or if a speed signal greater than 5 MPH is detected.

Diagnostics cannot be performed if system voltage is less than 9 VDC or greater than 16 VDC. The only exception is **d08** which is set when system voltage is greater than 16VDC.

After all the diagnostic codes are displayed, the speedometer’s pulses per unit setting is displayed. This number will vary depending on speedometer part number.

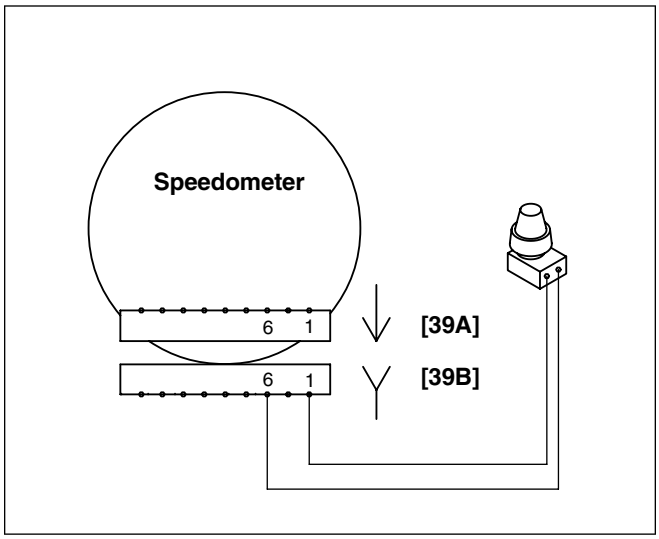


Figure 2-2. Odometer Reset Switch:

Table 2-1. Speedometer Trouble Codes

CODE	TROUBLE	WIRE COLOR
d01	Speed sensor power output shorted low	Red
d02	Speed sensor power output shorted high or open	Red
d03	Not used	
d04	Not used	
d05	Speed sensor return shorted high	White
d06	Speed sensor return shorted low	White
d07	Not used	
d08	Speedometer power overvoltage	Orange/White
d09	Speed output shorted high	White/Green
d10	Speed output shorted low or open	White/Green
5 digit number	Speedometer pulses per unit	

THEORY OF OPERATION

The electronic speedometer consists of a speed sensor, odometer reset switch and the speedometer. The speed sensor is mounted on the right side of transmission case below the starter. The sensor circuitry is that 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 odometer reset 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 six numbers to indicate a maximum of 999999 miles. The trip odometer can display six numbers with a tenth of a mile accuracy for a maximum of 99999.9 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.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with circled numbers on the speedometer diagnostic flow charts.

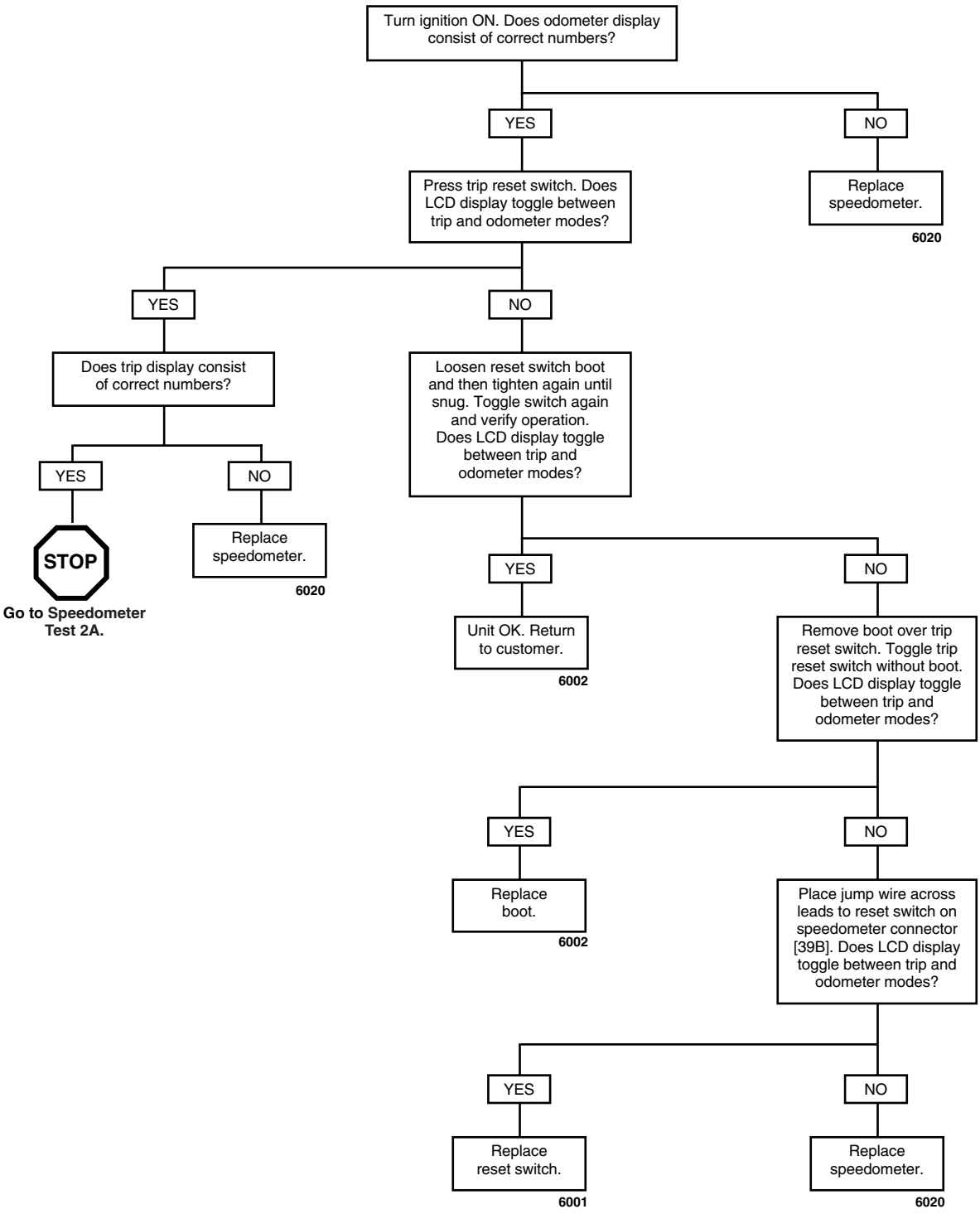
1. To enable diagnostic mode: depress odometer reset switch and turn ignition key switch to ON.
2. To clear codes: depress and hold reset switch for 5 seconds with set code displayed.
3. To return speedometer to normal operating state: cycle ignition/key switch.
4. Remove seat.
5. Test results may be inaccurate if tester battery is low.
6. See 2.3 SPEEDOMETER PERFORMANCE CHECK.
7. Sensor can also be tested with SPEEDOMETER TESTER (Part No. HD-41354) and test harness. See 2.3 SPEEDOMETER PERFORMANCE CHECK.
8. 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. See SPEEDOMETER SPEED SENSOR in the 2002 Sportster Service Manual (Part Number 99484-02).
9. Sweep tool has frequency jumps in full scale sweeps. Perform sweep in 3 stages as described in speedometer tester manual.
10. Disconnecting speed sensor or installing speedometer tester will cause code d02 to set.

Speedometer Trouble Codes

Numbers in bold text beginning with **d0x** refer to the start point for troubleshooting speedometer codes. For codes **d09** to **d10**, see Turn Signal Error 1 under 3.3 TURN SIGNAL TROUBLESHOOTING.

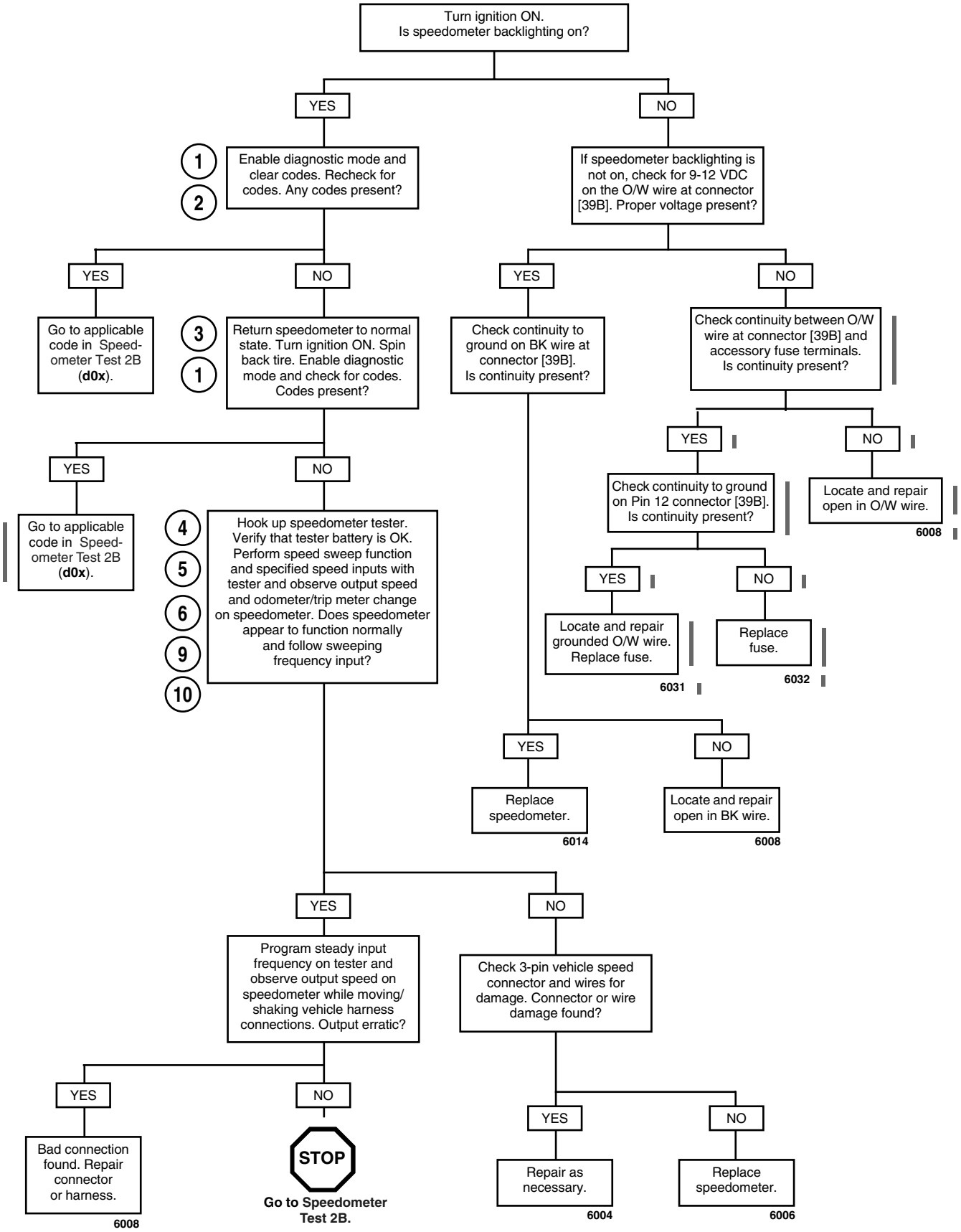
Speedometer Test 1

ODOMETER, TRIP ODOMETER AND RESET SWITCH



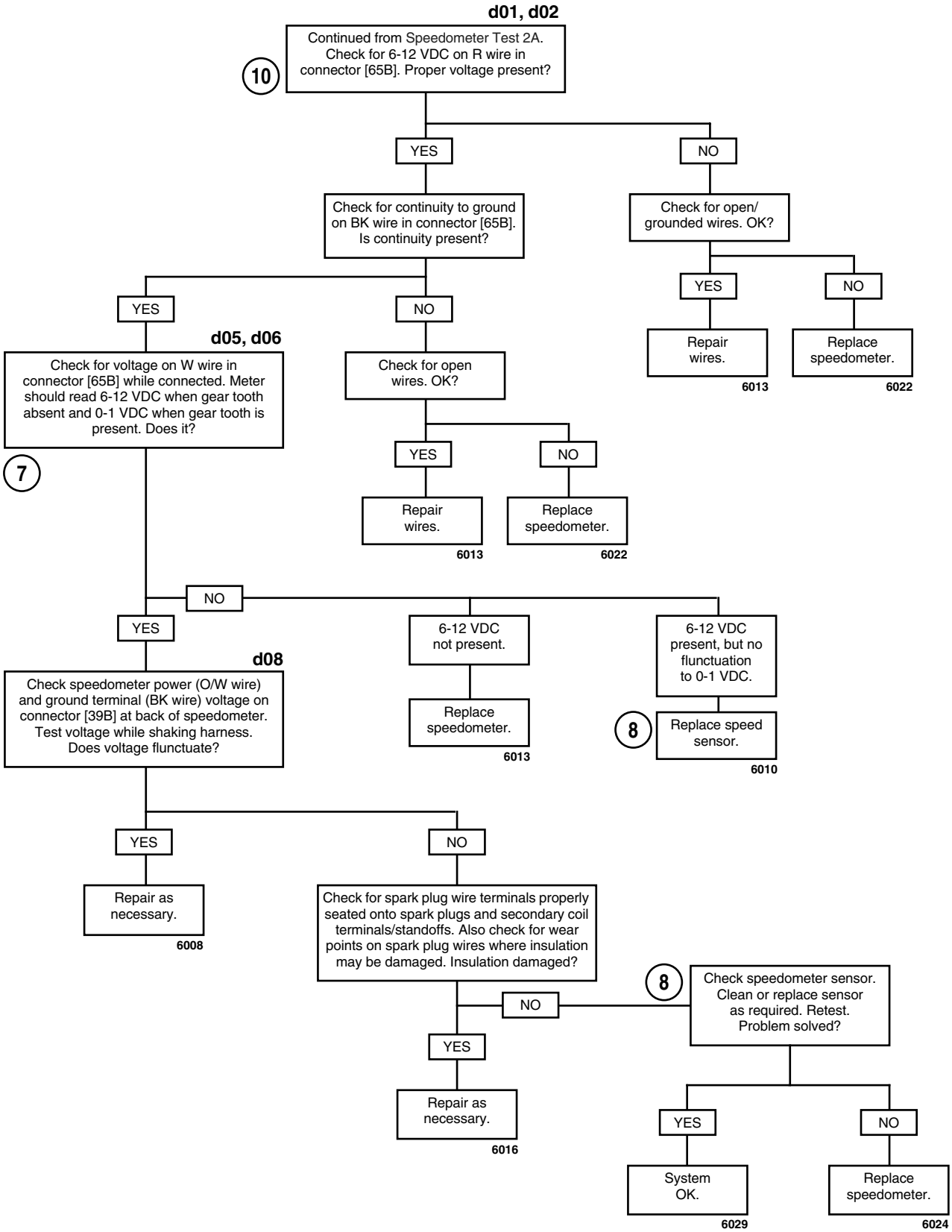
Speedometer Test 2A

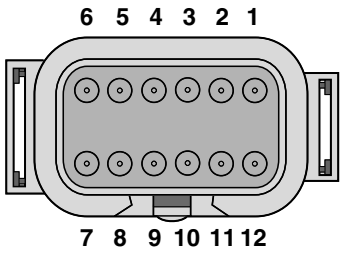
SPEEDOMETER INOPERATIVE, READS HIGH/LOW, NEEDLE STICKS, INTERMITTENT/ERRATIC, OUTPUT SPEED SIGNAL INOPERATIVE



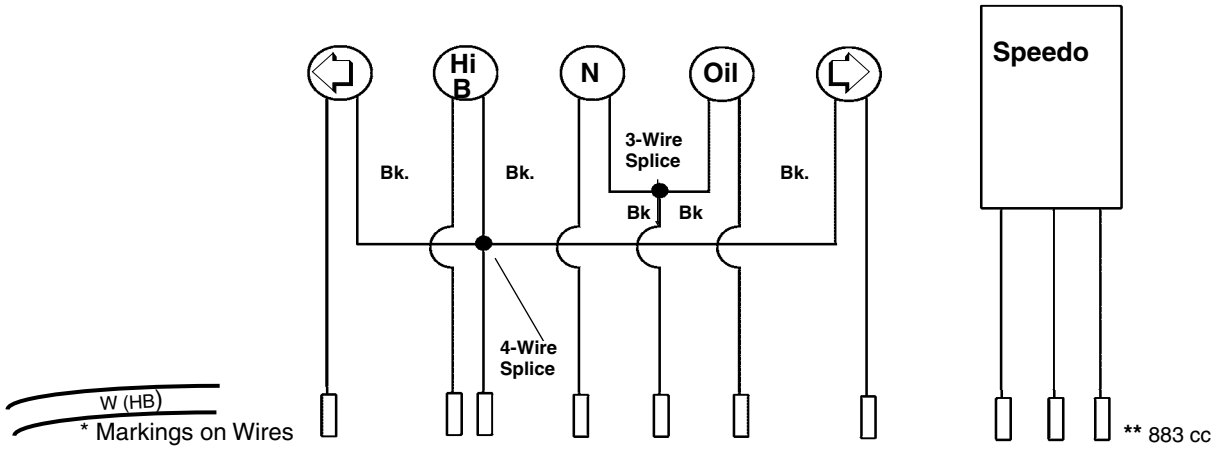
Speedometer Test 2B

SPEEDOMETER INOPERATIVE, READS HIGH/LOW, NEEDLE STICKS, INTERMITTENT/ERRATIC, OUTPUT SPEED SIGNAL INOPERATIVE





12-Pin Grey

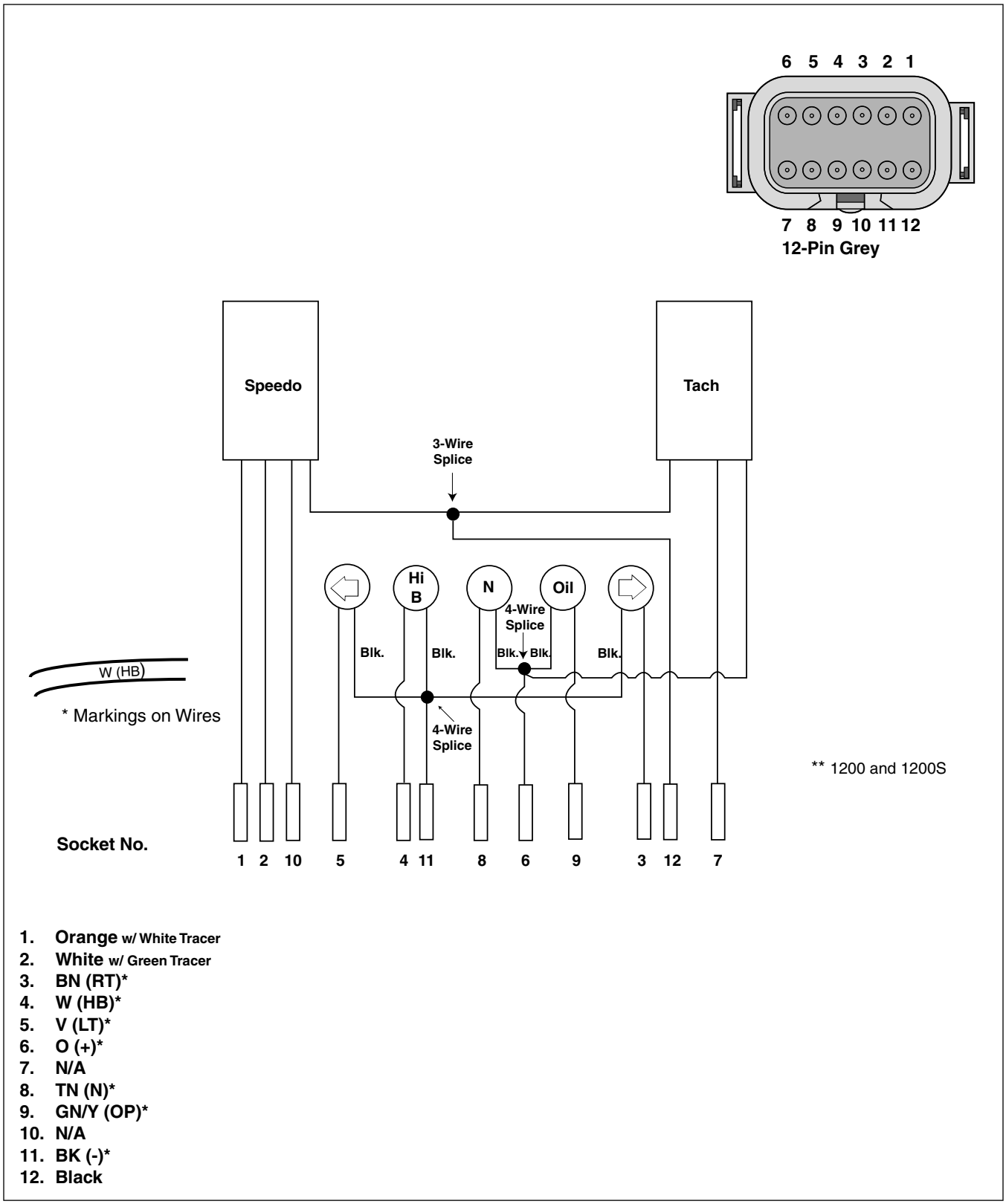


Socket No.	5	4	11	8	6	9	3	2	1	12

Instrument Plug - Speedometer only**

1. **Orange w/ White Tracer**
2. **White w/ Green Tracer**
3. **BN (RT)***
4. **W (HB)***
5. **V (LT)***
6. **O (+)***
7. **N/A**
8. **TN (N)***
9. **GN/Y (OP)***
10. **N/A**
11. **BK (-)***
12. **Black**

Figure 2-3. Single Instrument Plug: Schematic and Wire Colors



1. **Orange w/ White Tracer**
2. **White w/ Green Tracer**
3. **BN (RT)***
4. **W (HB)***
5. **V (LT)***
6. **O (+)***
7. **N/A**
8. **TN (N)***
9. **GN/Y (OP)***
10. **N/A**
11. **BK (-)***
12. **Black**

Figure 2-4. Dual Instrument Plug: Schematic and Wire Colors

GENERAL

See Figure 2-4. Use the SPEEDOMETER TESTER (Part No. HD-41354) for speedometer diagnostics. These diagnostics may include:

- Checking speedometer operation.
- Testing speedometer needle sweeping action.

The tester generates a simulated speedometer sensor signal. This signal aids in determining whether speedometer replacement is necessary.

NOTES

- *Use the following procedures in conjunction with the manual supplied with the speedometer tester.*
- *Test results may be inaccurate if tester battery is low.*

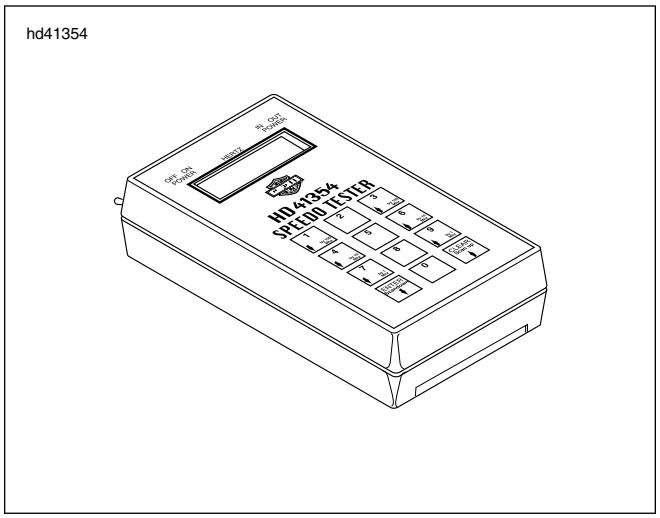


Figure 2-5. Speedometer Tester

TESTING

NOTE

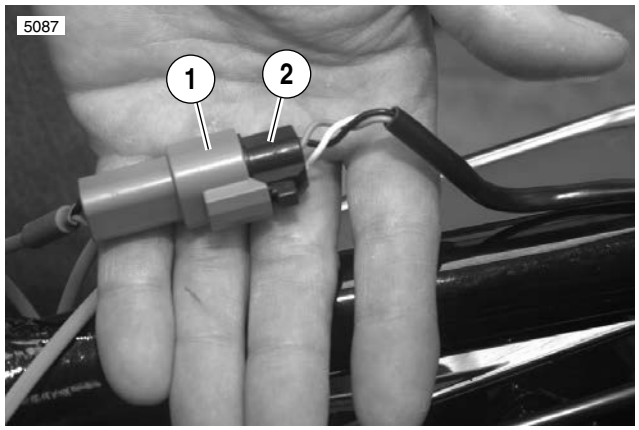
The SPEEDOMETER TESTER (Part No. HD-41354) cannot be used to verify the calibration of a speedometer and it will not verify the speedometer's function to support legal proceedings. It's purpose is to verify speedometer function when performing service diagnosis or repair. It can also assist in determining if speedometer replacement is necessary.

Speedometer Operation Test

1. See Figure 2-5. Locate the 3-place speedometer connector [65] and disconnect. Attach speedometer tester connector.
2. Place speedometer tester power switch in the ON position. Place signal switch in the OUT position.
3. Turn vehicle ignition switch ON.
4. When speedometer tester displays "P_ _ _ _1":
   a. Press 1 and ENTER on the tester keypad.
   b. Enter a frequency from Table 2-2. Note that different markets use different frequencies.
   c. Verify that speedometer display reads the corresponding speed. To change the test frequency, press CLEAR to cancel and enter the new frequency. Press ENTER to begin and reverify.

NOTE

The speedometer should be accurate within -0 to +4 MPH (0 to +6.5 KPH).



1. Tester connector
2. Speedometer sensor connector [65]

Figure 2-6. Speedometer Sensor Connector

Table 2-2. Speedometer Test Frequency in Hertz (Hz)

MARKET	20 MPH (30 KPH)	40 MPH (60 KPH)	60 MPH (100 KPH)	80 MPH (130 KPH)
1200 DOM & GB	408	814	1216	1613
1200 HDI	381	760	1259	1629
883 DOM & GB	439	874	1306	1733
883 HDI	409	816	1353	1750

Speedometer Needle Sweep Test

The tester's sweep function moves the speedometer needle through the full range of movement. This allows for testing the smoothness of operation and checking for hesitancy or a stuck needle.

1. See Figure 2-5. Disconnect speedometer sensor connector. Attach speedometer tester connector to speedometer sensor connector.
2. Place speedometer tester power switch in the ON position. Place signal switch in the OUT position.
3. Turn vehicle ignition switch ON.
4. Begin test by pressing 0 on the tester keypad and then pressing ENTER. The tester will scan for two seconds, then the tester will put out a 1 Hz signal.
5. Select a test range.
   a. Press 2 to select LO range (1-20 Hz).
   b. Press 5 to select CEN range (21-999 Hz).
   c. Press 8 to select HI range (1000-20,000 Hz).
6. After selecting a range, use the corresponding arrow keys to accelerate through the range. As you move through the speed range, check for smooth needle movement.
   a. If testing LO range, press 1 or 3.
   b. If testing CEN range, press 4 or 6.
   c. If testing HI range, press 7 or 9.

Speedometer Sensor Test

If the speedometer is inoperative, but backlighting and odometer work, the speedometer sensor may not be working.

See Figure 2-6. Fabricate a test harness using the following parts. This harness can also be used to test the tachometer on all models except the 1200S.

- Two Deutsch 3-place socket housings (Part No. 72113-94BK) and six socket terminals (Part No. 72191-94).
- Deutsch 3-place pin housing (Part No. 72103-94BK) and three pin terminals (Part No. 72190-94).
- Six lengths of 18 gauge wire, each 6.0 in. (15 cm) long.

1. Deutsch socket housing (2)
2. Deutsch pin housing

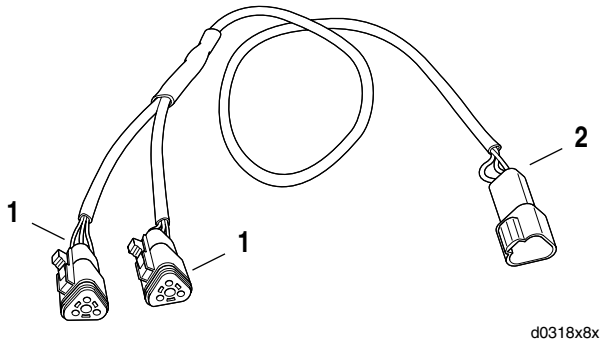


Figure 2-7. Test Harness

Before attempting the actual speedometer sensor check, two system checks must be made. Install the test harness at the speedometer sensor connector.

- 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].

1. Raise rear wheel off floor.
2. Install the test harness between the speedometer sensor connectors.
3. Place speedometer tester power switch in the ON position. Place signal switch in the IN position.
4. Plug the speedometer tester into the test harness. Turn vehicle ignition switch ON.
5. Press ENTER on the tester keypad.
6. Rotate the motorcycle's rear wheel.
   a. If reading on speedometer tester changes as wheel is rotated, speedometer sensor is OK.
   b. If reading does not change, speedometer sensor is suspect. Install a known, good speedometer sensor and test again.

SUBJECT PAGE NO.

3.1 Turn Signal Canceller 3-1
3.2 Distance and Time Testing 3-2
3.3 Turn Signal Troubleshooting 3-3

TURN SIGNALS

GENERAL

See Figure 3-1. Both the directional (turn signals) and 4-way flashers are controlled by an electronic module (self-canceller).

The module is secured to the rear fender, under the seat.

The canceller contains circuitry to generate pulses for “flashing” the appropriate directional lamps, thereby eliminating the previously used directional and hazard flashers. Steps 1 and 2 below explain canceller operation when a rider signals for a left turn; step 3 explains canceller operation when a right turn is signalled.

1. Pressing and releasing the left turn signal switch causes a momentary 12 vdc to be applied to Pin 8. The module sends a series of 12 vdc pulses (Pin 4) to flash the left directional lamps (front and rear).
2. The module monitors the number of vehicle speed sensor pulses from the speedometer at Pin 5. The switch closures indicate vehicle distance traveled. When the number of switch closure pulses equals a quantity preset in the self-cancelling module, the left turn signal is automatically canceled.
3. Pressing and releasing the right turn signal switch causes a momentary 12 vdc to be applied to Pin 7 and an output at Pin 3 identical to that just described for a left turn signal.

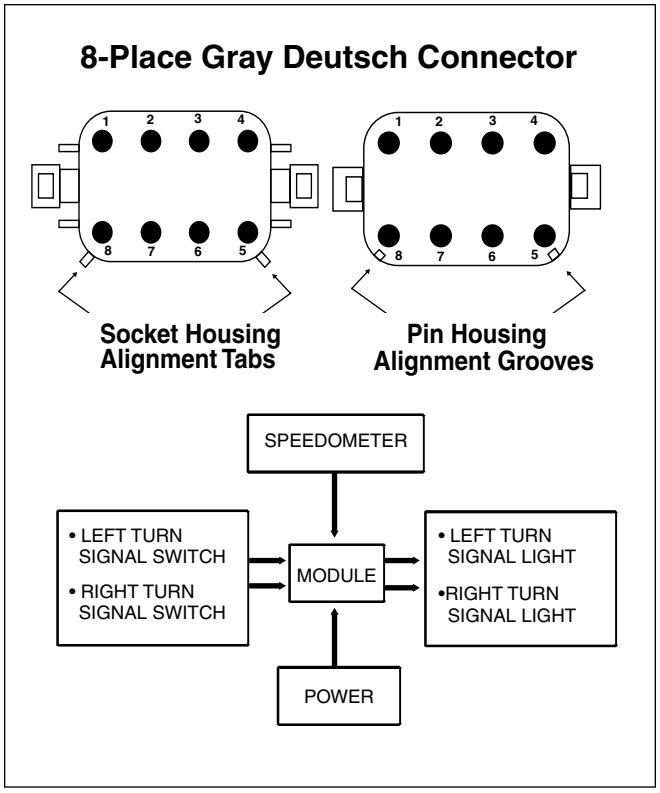


Figure 3-1. Turn Signal Module Pinout

MANUAL OR RIDER CONTROL

Directionals may be cancelled by pressing the turn signal switch a second time. Pressing the left turn signal switch while the right turn signal lamps are flashing will cancel the right turn lamps and activate the left turn lamps (and vice versa).

HAZARD FLASHER (4-WAY)

To activate the hazard flashers, simultaneously press and hold both right and left turn signal switches for 1-1/2 seconds. To cancel hazard flashers, momentarily press and release right and left turn signal switches simultaneously.

Table 3-1. Module Wiring

PIN NO.	WIRE COLOR	DESCRIPTION
1	BK	module ground to motorcycle
2	O/W	12 vdc input from accessory circuit breaker
3	BN	pulsed 12 vdc for flashing right turn signals
4	V	pulsed 12 vdc for flashing left turn signals
5	W/GN	vehicle speed sensor input
6	N/A	not used
7	W/BN	12 vdc from right turn signal switch (when pressed)
8	W/V	12 vdc from left turn signal switch (when pressed)

DISTANCE TEST

Directionals cancel after rear wheel travels a certain distance at a specific speed. Turn signal module begins measuring the distance traveled immediately upon release of the turn signal switch button.

Directionals will remain flashing for the following distances within the speed ranges specified in Table 3-2.

NOTE

Distance test and time test can also be performed using the speedometer tester (HD-41354) as an input device.

To check module operation, proceed as follows:

1. Operate the motorcycle at 15 mph (24 km/h), which is the midpoint of speed range #1.
2. Press and release right turn switch button. Closely monitor vehicle speed and odometer reading. Measure the distance traveled from the time the button is released to the time the directional cancels.
3. Repeat steps 1 and 2 for left turn.
4. Repeat steps 2 and 3 for right and left turns at midpoint of speed ranges 2 through 4.
5. If the distances observed in Steps 1 through 4 are not correct, check the following:
   a. Turn signal module ground and module pin connections.
   b. Vehicle speed sensor operation, connections and grounds.
   c. Replace module with one known to be good and repeat DISTANCE TEST.

NOTE

Turn signal module and turn signal lamps must have the same ground potential; grounds for both module and lamps must have good continuity to one another.

ALTERNATE TIME TEST

Another way of checking the self-cancelling turn signal module is to measure the length of time the directional operates at a constant vehicle speed. From the instant the turn signal switch button is released, measure the number of seconds that elapse before the directional cancels.

The approximate elapsed times at four constant speeds are shown in Table 3-3.

RIDER PREFERENCE AND CONTROL

To extend the distance/time that directionals flash, simply press and hold the turn signal switch button. Since the module does not begin to measure distance traveled and time elapsed until the switch button is released, the flashing sequence is prolonged.

To shorten the distance/time that directionals flash, press the turn signal switch button a second time while the directionals are still flashing. This procedure immediately cancels the turn signal.

Table 3-2. Distance Test

RANGE	SPEED		DISTANCE	
	MPH	KM/H	FEET	METERS
1	10-34	0-48	221 (0.04 mi)	67
2	35-44	56-71	339 (0.06 mi)	103
3	45-60	74-97	680 (0.13 mi)	207
4	61+	98+	1051 (0.20 mi)	320

Table 3-3. Time Test

SPEED		TURN SIGNAL ELASPED TIME IN SECONDS
MPH	KM/H	
25	40	5-7
38	61	5-7
52	84	8-10
65	105	10-12

GENERAL

See the following charts for troubleshooting procedures. Use Turn Signal Error 1 for speedometer trouble codes **d09** (speed output shorted high) and **d10** (speed output shorted low or open).

CAUTION

Do not apply 12 vdc to self-cancelling module without pin 1 connected to ground or module will be damaged.

DIAGNOSTICS

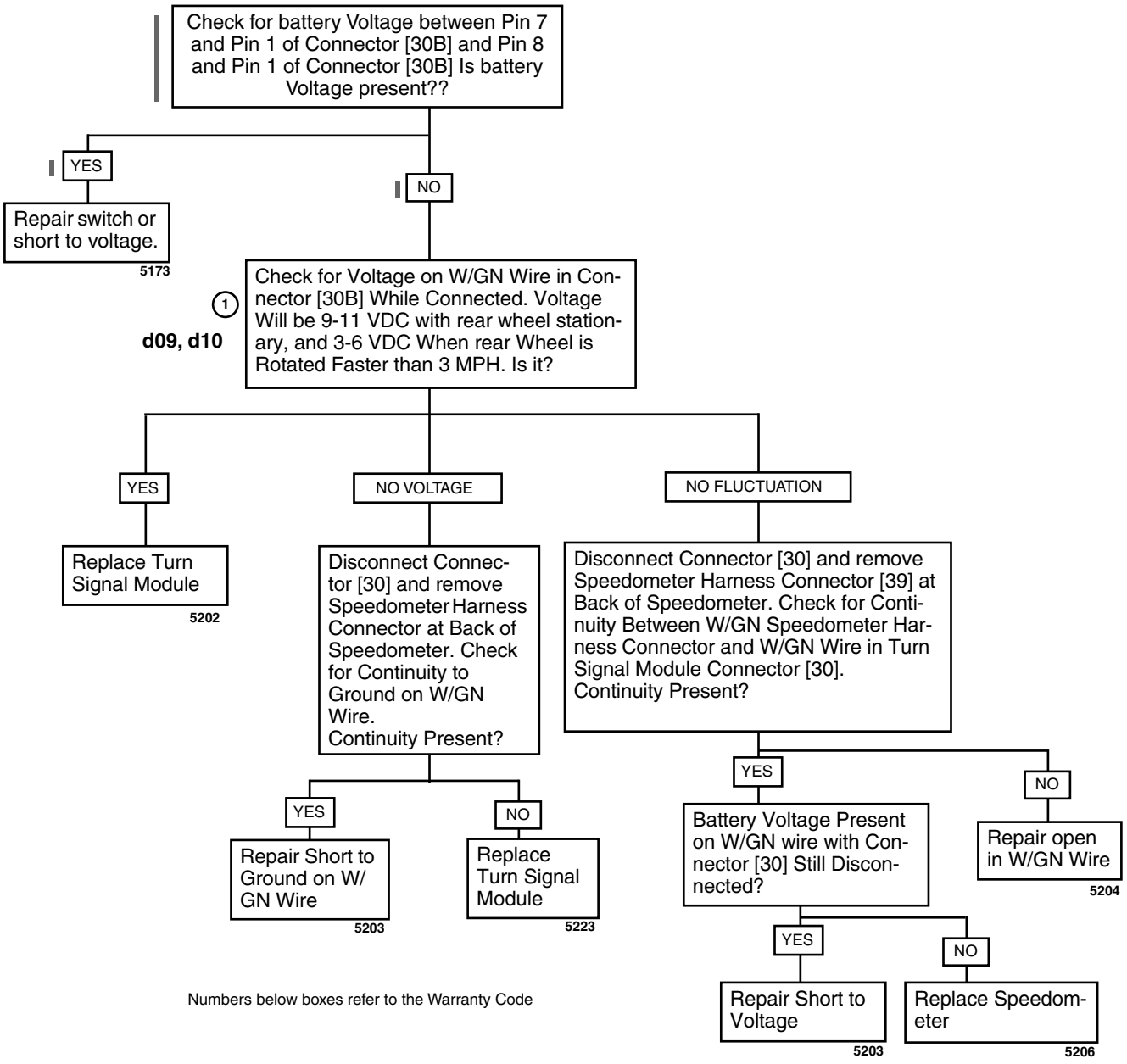
Diagnostic Notes

The reference numbers below correlate with those on the diagnostic flow charts.

1. Use Speedometer tool HD-41354 to input a signal which duplicates 3 MPH. Enter 70 into tester and watch for voltage to drop on W/GN wire. If tester is not available, elevate rear wheel and spin briskly while looking for voltage to drop on W/GN wire.

Turn Signal Error 1

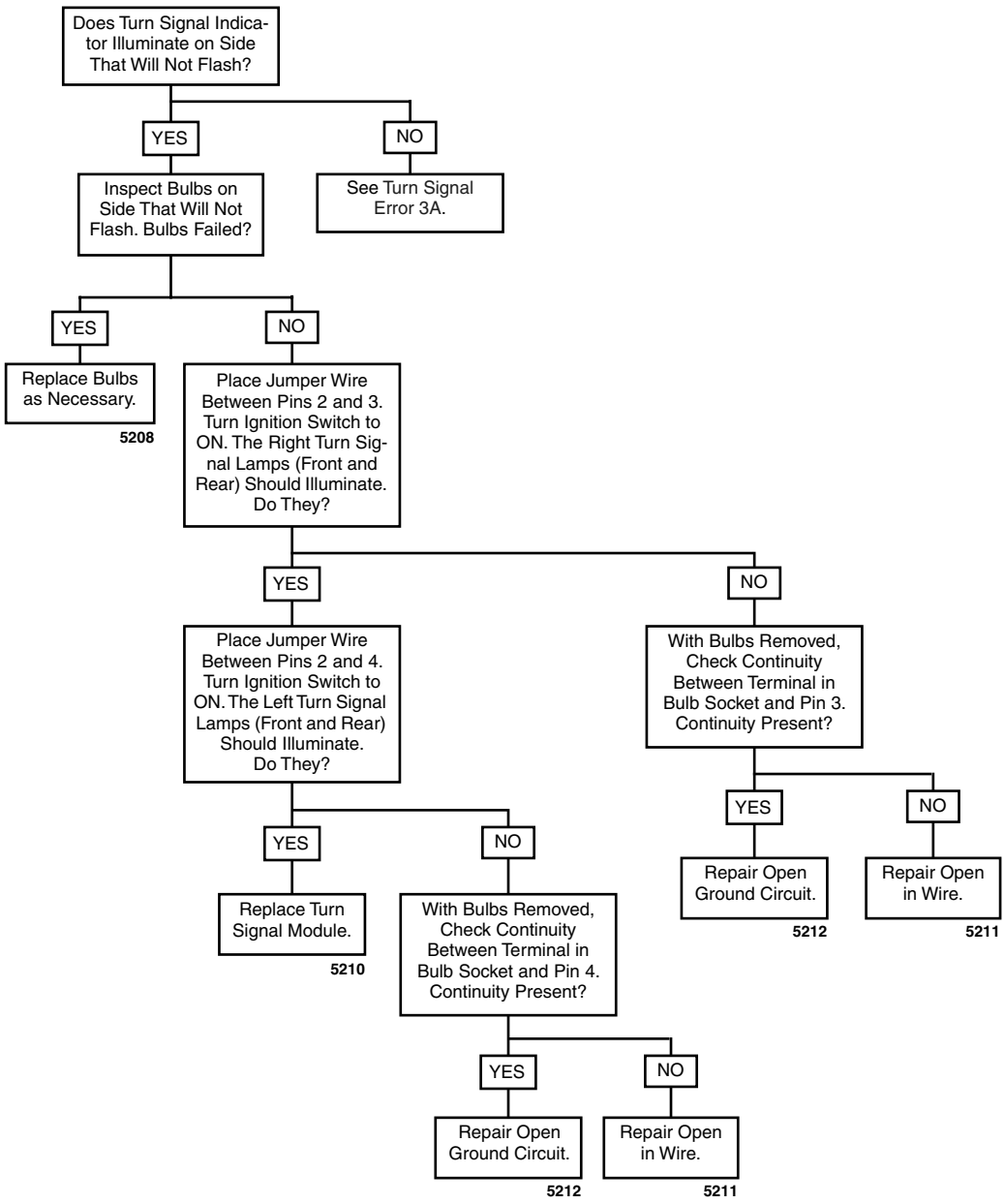
FLASH WILL NOT CANCEL



Numbers below boxes refer to the Warranty Code

Turn Signal Error 2

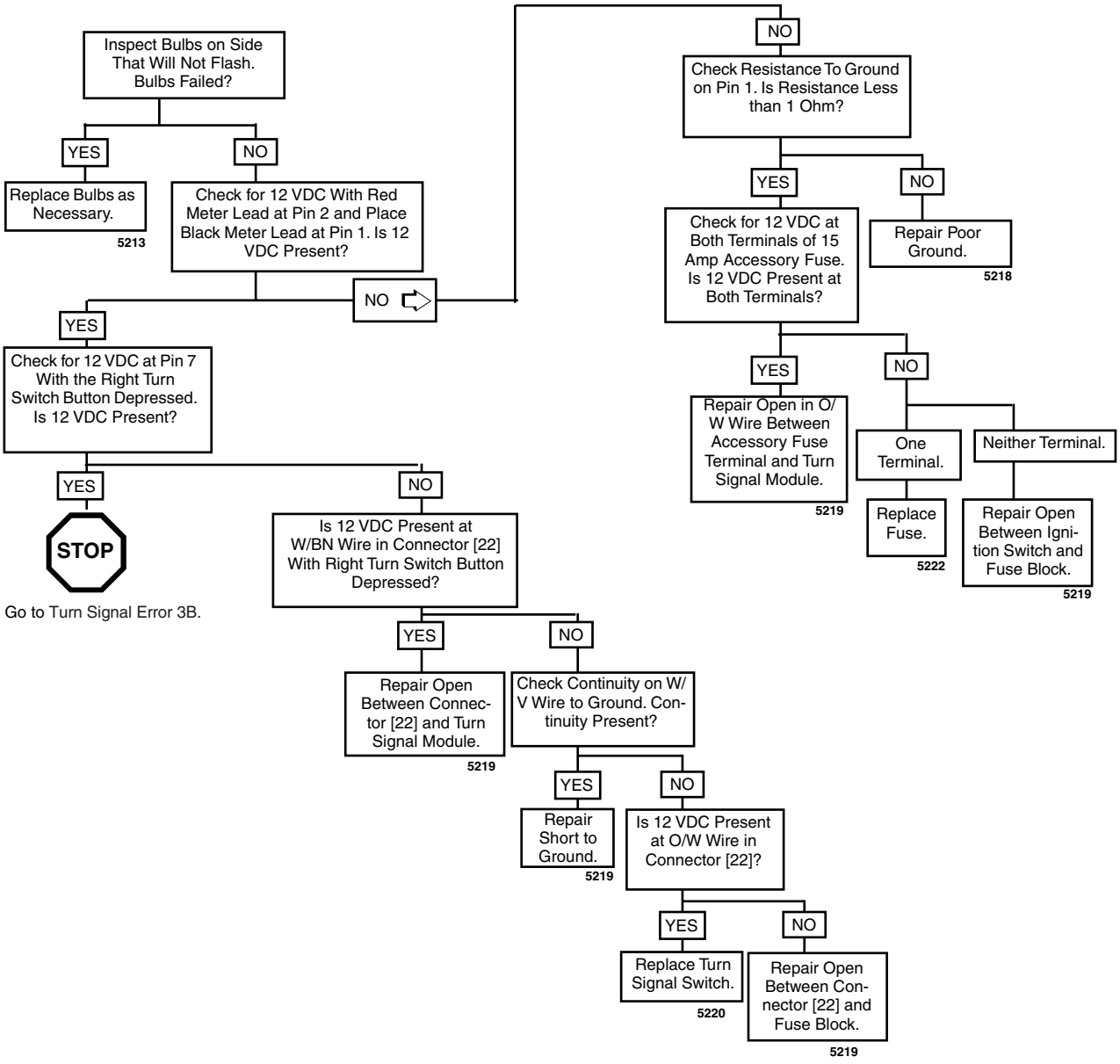
TURN SIGNALS WILL NOT FLASH RIGHT, WILL NOT FLASH LEFT



Numbers below boxes refer to the Warranty Code

Turn Signal Error 3A

TURN SIGNALS WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE

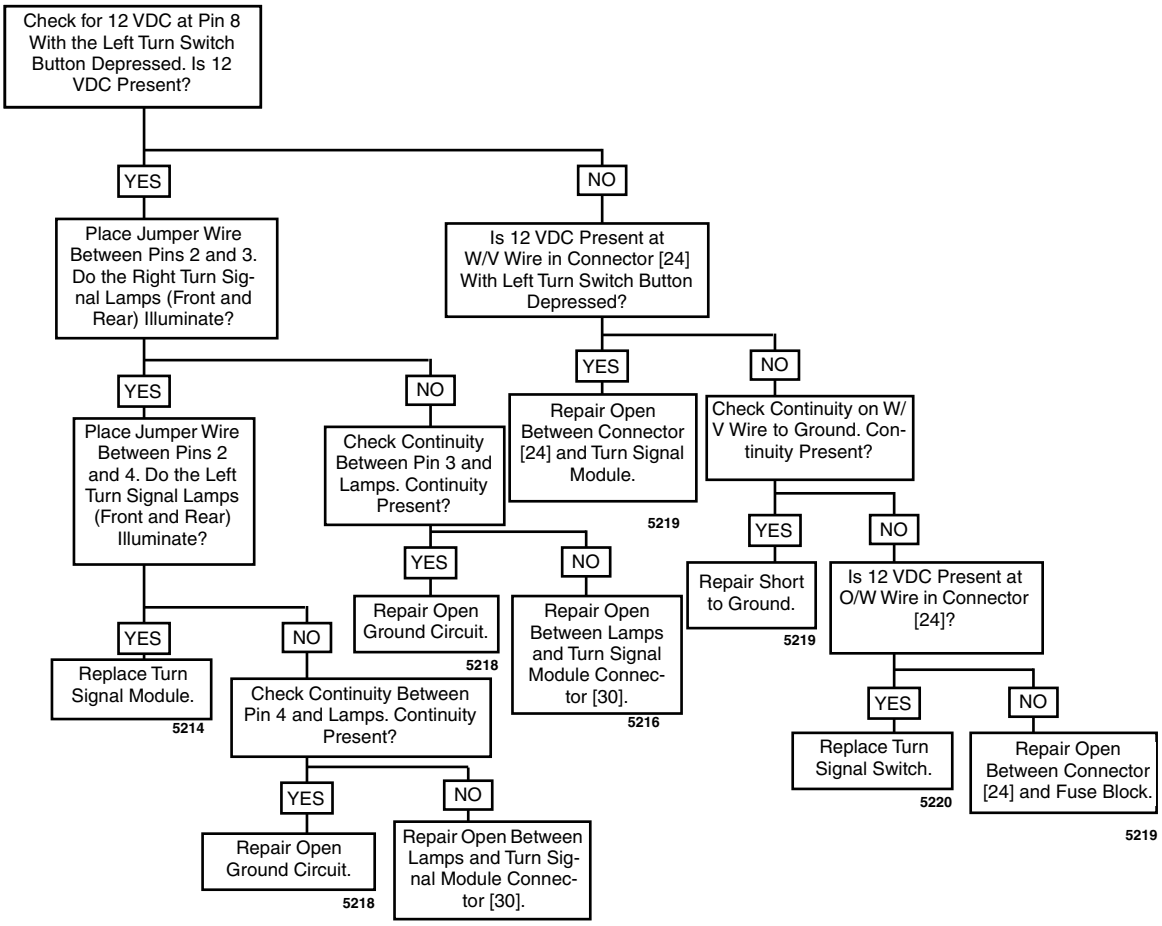


Numbers below boxes refer to the Warranty Code

Turn Signal Error 3B

TURN SIGNALS WILL NOT FLASH, 4-WAY FLASHERS INOPERABLE

From Turn Signal Error 3A.



Numbers below boxes refer to the Warranty Code

ENGINE MANAGEMENT

SUBJECT	PAGE NO.
4.1 Specifications	4-1
4.2 Diagnostic Introduction: 1200S Only	4-2
4.3 Checking For Trouble Codes: 1200S Only	4-4
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4.5 Check Engine Lamp: 1200S Only	4-9
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4.10 Check Engine Lamp on Continuously	4-21
4.11 Engine Cranks, But Will Not Start	4-24
4.12 No Spark/No Check Engine Lamp at Key ON	4-29
4.13 Misfire at Idle or Under Load	4-31
4.14 DTC 12: 1200S Only	4-35
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4.19 DTC 52, 53, 54 and 55: 1200S Only	4-49
4.20 Diagnostics: All Except 1200S	4-50
4.21 Breakout Box: All Except 1200S	4-57

Trouble Codes

IGNITION	DATA
Spark plug size	12 mm
Spark plug gap	0.038-0.043 in.
	0.97-1.09 mm
Spark plug type	HD-6R12

CIRCUIT BREAKER/FUSES	RATING (AMPERES)
Main circuit breaker	30
Ignition fuse	15
Lighting fuse	15
Accessory fuse	15
Instruments fuse	15

CHARGING SYSTEM	DATA
Alternator AC voltage output	19-26 VAC per 1000 RPM
Alternator stator coil resistance	0.2-0.4 ohms
Regulator voltage output @ 75° F	14.3-14.7 VDC
Regulator amperes @ 3600 RPM	22 amps
Battery	12 volt, 19 ampere hours

IGNITION COIL	1200S MODELS	ALL EXCEPT 1200S MODELS
Primary resistance	0.4-0.6 ohms	2.5-3.1 ohms
Secondary resistance	11,500-12,700 ohms	10,000-12,500 ohms

SYSTEM PROBLEMS

IMPORTANT NOTE

If you are not diagnosing a 1200S model, see 4.20 DIAGNOSTICS: ALL EXCEPT 1200S. Differences in engine management systems require different diagnostics.

All system problems fall into at least one of three general categories.

No Start

The engine cranks over freely, but will not start. This does not include situations where the engine will not crank, such as a bad starter, dead battery, etc. This condition assumes that all obvious checks (fuel in tank, etc.) have been made.

Poor Performance

The engine starts but there are performance problems. These problems may include poor fuel economy, rough idle, engine misfire, engine hesitation, severe spark knock, etc.

Check Engine Lamp

See Figure 4-1. The check engine lamp indicates the ignition module has determined a fault condition exists. There may also be starting or performance problems.

RESOLVING PROBLEMS

To resolve system problems, five basic steps are involved. In order of occurrence, they are:

1. Check for trouble codes by observing check engine lamp. See 4.3 CHECKING FOR TROUBLE CODES:1200S ONLY.
2. Retrieve trouble codes using SCANALYZER (Part No. HD-41325) or check engine lamp diagnostics. See 4.4 SCANALYZER: 1200S ONLY, 4.5 CHECK ENGINE LAMP: 1200S ONLY and Figure 4-2.
3. Diagnose system problems. This involves using special tools and the diagnostic flow charts in this section.
4. Correct problems through the replacement and/or repair of the affected components.
5. After repairs are performed, the work must be validated. This involves clearing the trouble codes and confirming proper vehicle operation as indicated by the behavior of the check engine lamp.

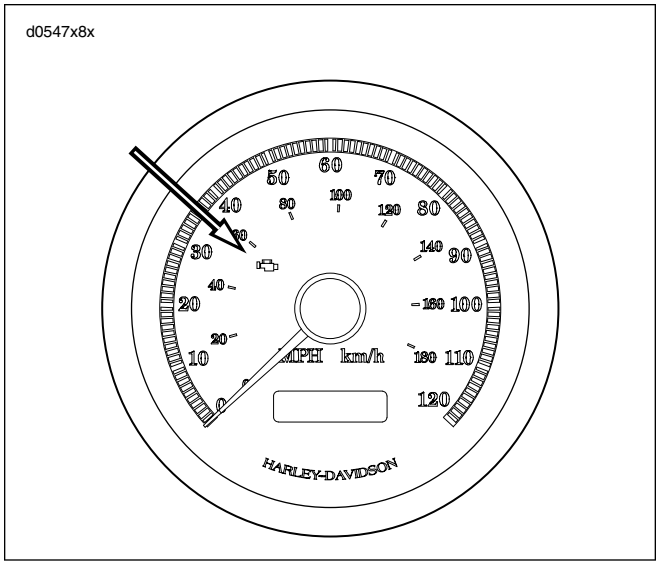


Figure 4-1. Check Engine Lamp

Figure 4-2. Scanalyzer

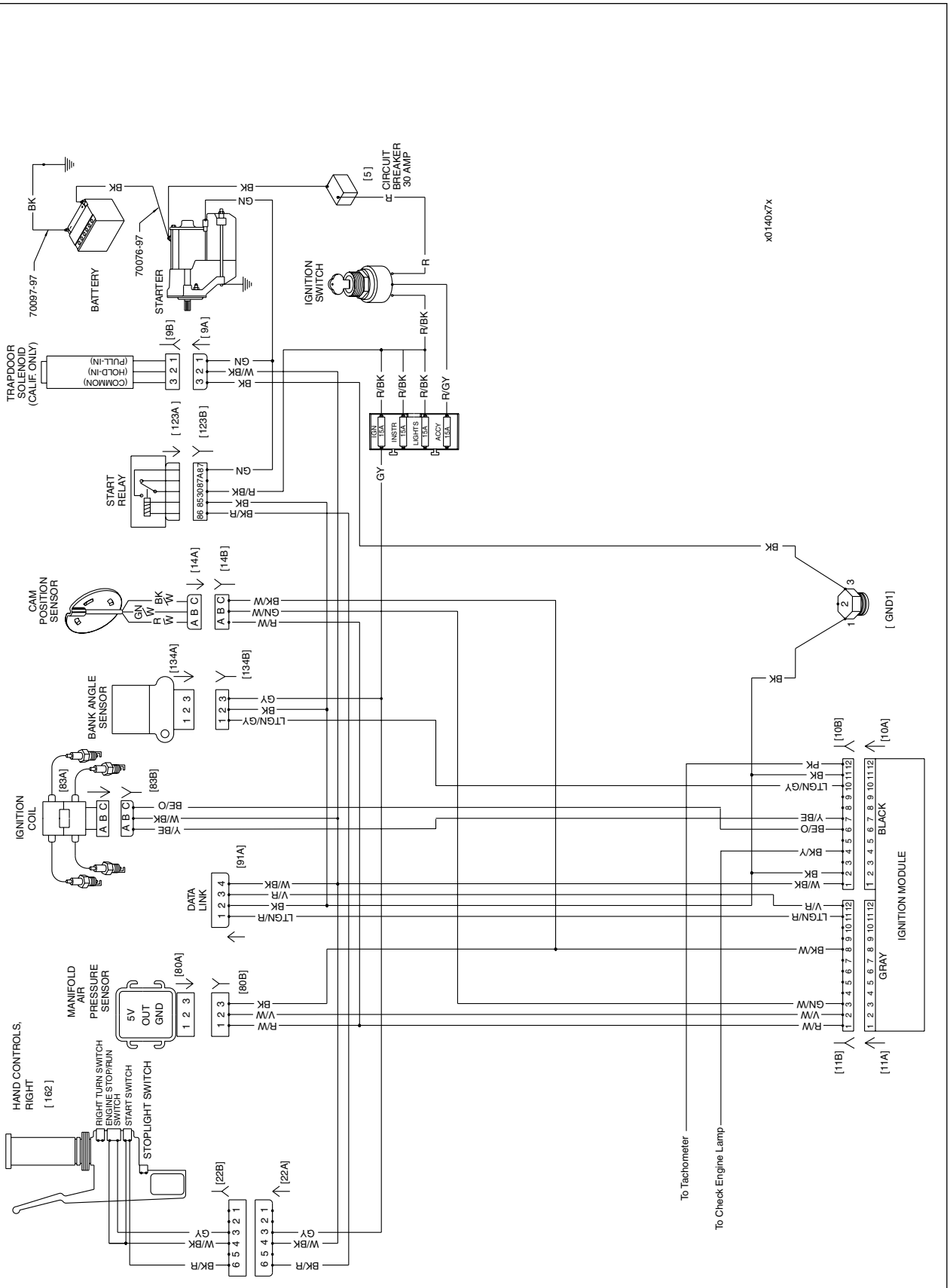


Figure 4-3. 1200S Ignition System

CHECK ENGINE LAMP

To diagnose system problems, start by observing the behavior of the check engine lamp.

NOTE

- *See Figure 4-4. "Key ON" means that the ignition key is turned to ON and the engine stop switch is set to RUN (although the engine is **not** running).*
- *If the check engine lamp is not illuminated at Key ON or if it fails to turn OFF after the initial four second period, then a problem exists in the lamp circuit. See 4.9 NO CHECK ENGINE LAMP AT KEY ON or 4.10 CHECK ENGINE LAMP ON CONTINUOUSLY for more information.*

1. When the ignition switch is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.
2. See Figure 4-5. After lamp turns off after being illuminated for the first four second period, one of three situations may occur.
   a. The lamp remains off. This indicates there are no current fault conditions or stored functional trouble codes currently detected by the ignition module.
   b. The lamp stays off for only four seconds and then comes back on for an eight second period. This indicates a functional error code is stored, but no current trouble code exists.
   c. If the lamp remains on beyond the eight second period, then a current trouble code exists.

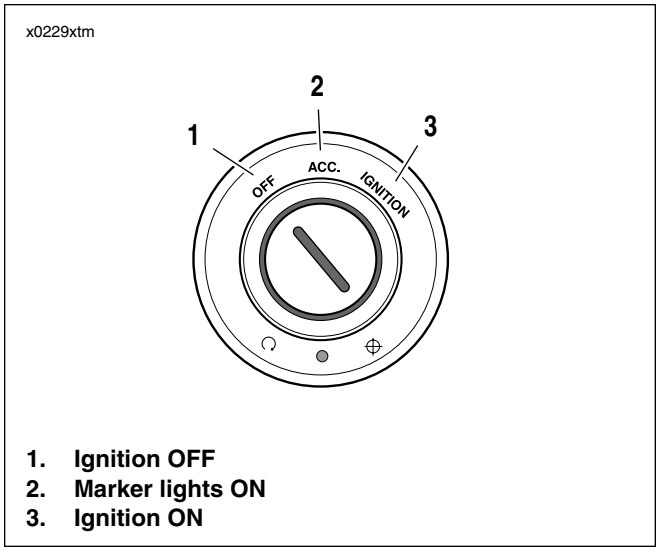


Figure 4-4. Ignition Switch

3. See CODE TYPES which follows for a complete description of trouble code formats.

NOTE

Trouble codes relating to the ignition coil can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since the ignition module will not know of its resolution until after the coil is exercised by vehicle start sequence. In this manner, there may sometimes be a false indication of the current trouble code.

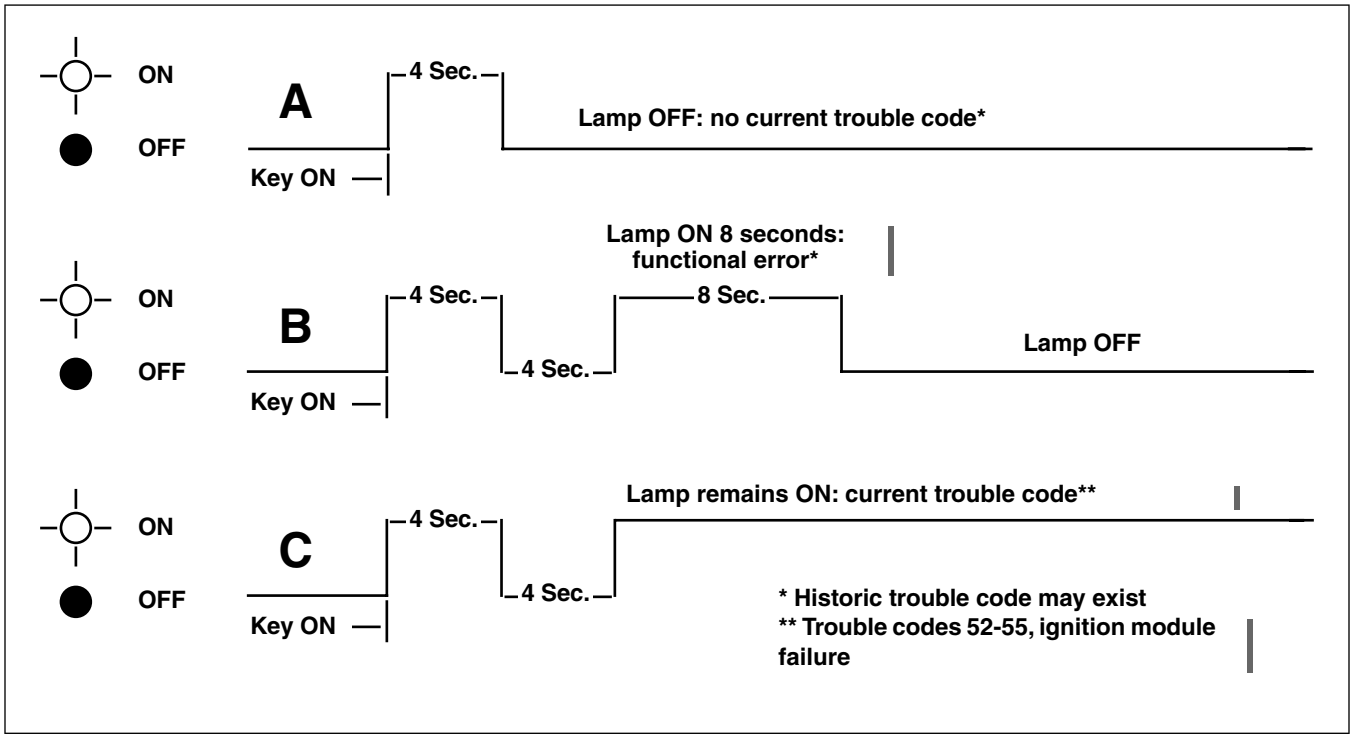


Figure 4-5. Check Engine Lamp Operation

CODE TYPES

There are three types of trouble codes: current, historic or functional. If a trouble code is stored, it can be read using either a Scanalyzer or check engine lamp diagnostics.

All trouble codes reside in the memory of the ignition module until the code is cleared by use of the Scanalyzer or a total of 50 trips has elasped. A trip consists of a start and run cycle, the run cycle lasting at least 30 seconds. After the 50 trip retention period, the trouble code is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.

Current

Current trouble codes are those which presently disrupt motorcycle operation. See the appropriate flow charts for solutions.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic fault rather current fault.

Historic trouble codes are stored for a length of time to assist in the diagnosis of intermittent faults. The check engine lamp will not indicate the existence of only historic trouble codes.

It is important to note that historic trouble codes may also be present whenever the system indicates the existence of a current fault. See MULTIPLE TROUBLE CODES if multiple trouble codes are found.

Diagnostic charts are designed for use with current trouble codes and as a result they frequently suggest part replacement. When diagnosing a historic code the charts can be helpful but should not lead to part replacement without verification the part is faulty.

Functional

A functional trouble code indicates an internal problem with the ignition module (trouble codes 52 through 55).

RETRIEVING TROUBLE CODES

The engine management system provides two levels of diagnostics.

- The most sophisticated mode employs a portable diagnostic tool called a Scanalyzer. This device plugs into the motorcycle wiring harness. It facilitates the diagnosis of system problems through a direct interface with the ignition module. See 4.4 SCANALYZER: 1200S ONLY.
- The second mode requires using the check engine lamp. See 4.5 CHECK ENGINE LAMP: 1200S ONLY for more information.

MULTIPLE TROUBLE CODES

While it is possible for more than one fault to occur and set more than one trouble code, there are several conditions which may result in **one** fault setting **multiple** trouble codes:

If one of the primary side coil lines becomes grounded it will also ground the Bank Angle Sensor resulting in multiple trouble codes being set (DTC 24 and/or 25 and 44).

Always start with the trouble code having the lowest numerical value. In the case of the above multiple trouble codes, the second code should be resolved when the first code is corrected. See list of fault conditions on page 4-14 (Table 4-5.)

SCANALYZER DIAGNOSTICS

Data Link Connector

See Figure 4-6. Using the Scanalyzer requires access to the data link connector (1). See below for instructions on reaching the data link.

Scanalyzer Cartridge

See Figure 4-7. Through a special programmable application cartridge, the Scanalyzer offers data displays and menu selections that allow for quick and easy retrieval of data. The device enables the user to perform a variety of diagnostic tests while monitoring inputs and outputs.

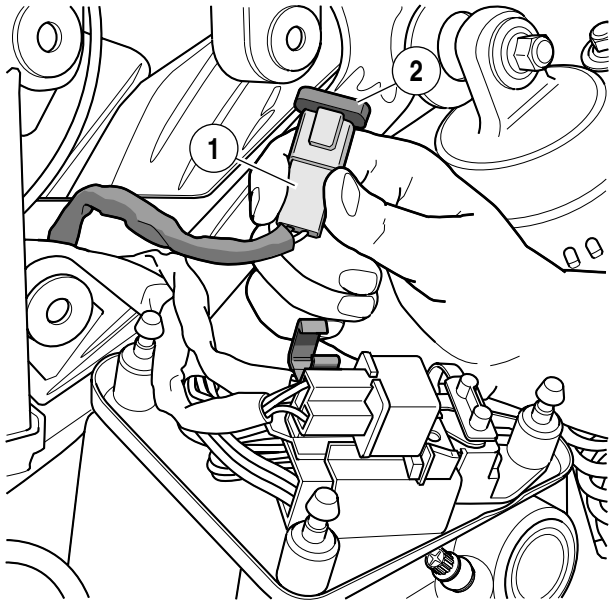
Sample Scanalyzer menu selections are shown in Figure 4-8.

INSTALLATION

PART NO.	SPECIALTY TOOL
HD-41325	Scanalyzer
HD-41325-95B	Scanalyzer cartridge

The behavior of the check engine lamp (as described under 4.3 CHECKING FOR TROUBLE CODES:1200S ONLY) indicates the presence of trouble codes.

1. Turn ignition key switch OFF.
2. Gently pull left side cover from frame downtubes (no tools required).
3. See Figure 4-6. Remove rubber protective plug (2) from data link connector (1). Plug Scanalyzer into connector.
4. Turn ignition key switch ON. Set engine stop switch to RUN, but do not start engine.
5. See Figure 4-7. Insert the diagnostic application cartridge (2) into the Scanalyzer (1). During the next few seconds, the Scanalyzer sequences through a series of screens that reflect a power-on self test, the system copyright, and then an attempt at communications with the ignition module. Once communications is established with the ignition module, the diagnostic menu appears. See Figure 4-8.
6. Continue with the instructions listed under USAGE which follows.

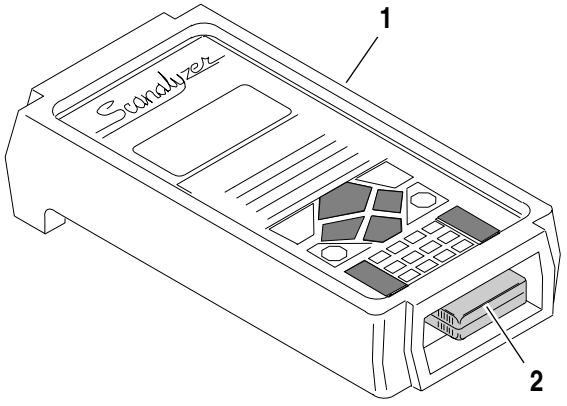


1. Data link connector [91A]
2. Protective rubber plug

x0102x7x

Figure 4-6. Data Link Connector

d0279x8x



1. Scanalyzer (Part No. HD-41325)
2. Cartridge (Part No. HD-41325-95C)

Figure 4-7. Scanalyzer and Cartridge

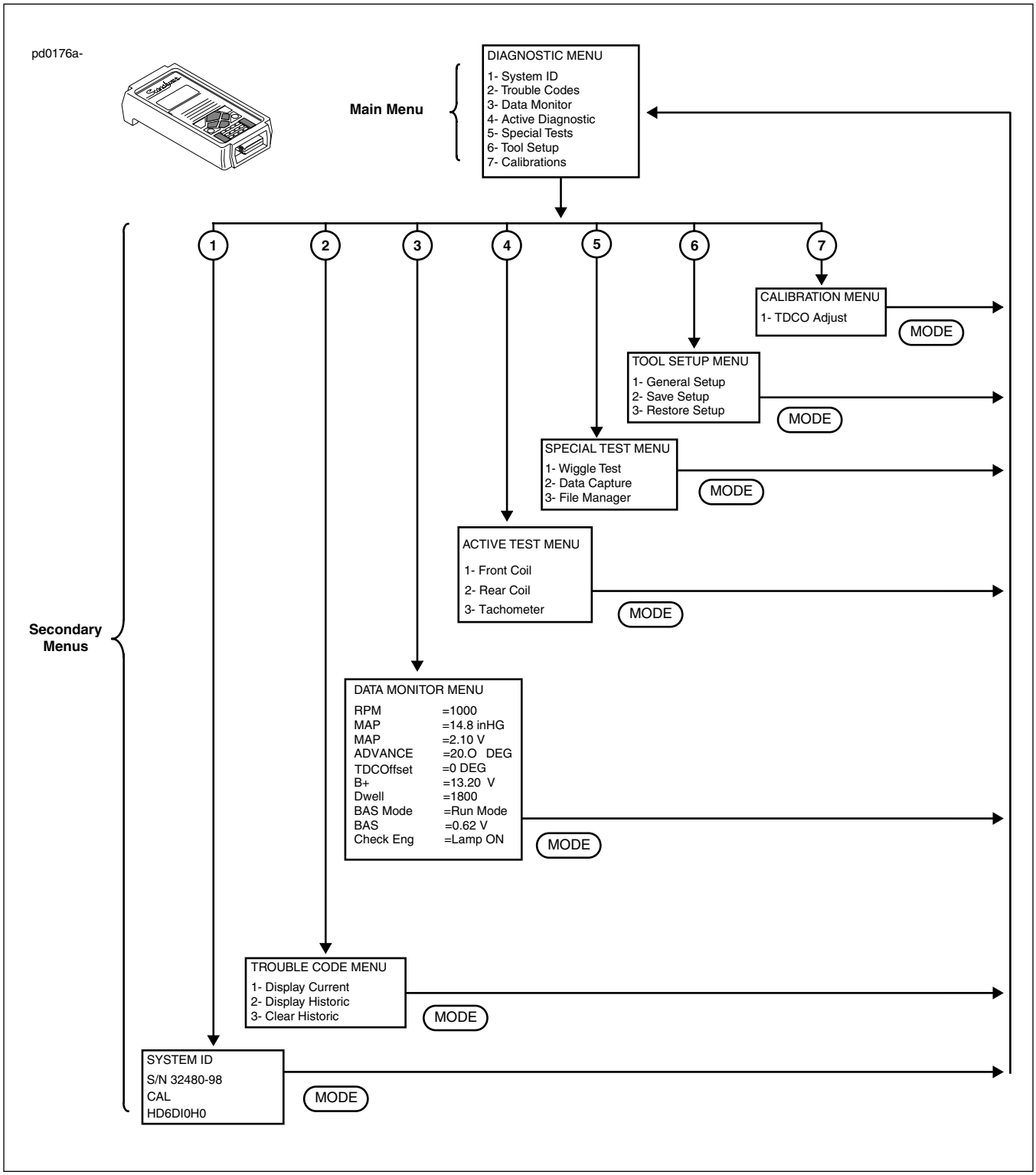


Figure 4-8. Scanalyzer Menus

USAGE

See Figure 4-8. The diagnostic menu is the primary system menu (main menu) through which all other secondary menus and displays are accessed. Since the screen may not be large enough to display all line items at any given time, use the up and down arrow keys to scroll through the list.

Checking Codes

1. See Figure 4-9. From the diagnostic menu, press number “2” to access the trouble codes menu. At this point, the unit allows the operator to:
   a. Press number “1” to display current trouble codes.
   b. Press number “2” to display historic trouble codes.
   c. Press number “3” to clear trouble codes. See Clearing Codes below.
2. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, see Table 4-5. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.8 INITIAL DIAGNOSTIC CHECK: 1200S ONLY.
   c. After reading current/historic trouble codes, simply press the mode key to return to the trouble codes menu.
3. Press the mode key again to return to the diagnostic menu. In this manner, regardless of where the operator is in the program, the mode key need only be pressed once or twice to return to the main menu.
4. After correcting system problems, clear trouble codes using the trouble codes menu of the scanalyzer.

Clearing Codes

Unlike the check engine lamp diagnostics, note that the Scanalyzer **does** allow the operator to clear trouble codes from memory as well as differentiate between current and historic codes.

Trouble codes cannot be cleared while the engine is running. Turn the engine off by setting handlebar stop switch to the OFF position, but leaving the ignition key switch ON. Return the handlebar engine stop switch to the RUN position and restart motorcycle.

NOTE

For more detailed instructions, refer to the literature provided with the Scanalyzer.

Figure 4-9. Scanalyzer Diagnostic Menu

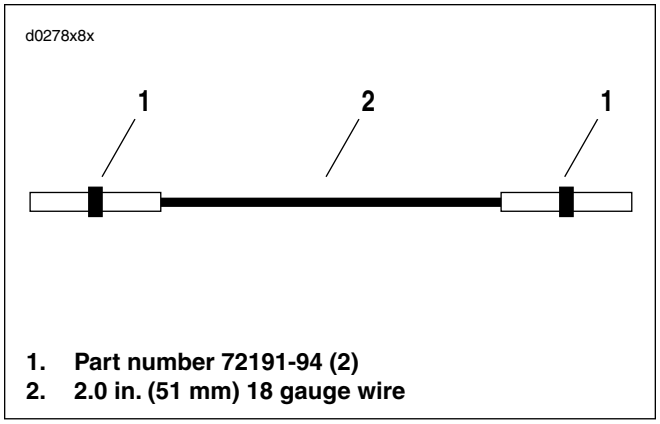
REMOVAL

1. Turn ignition key switch OFF. Set engine stop switch to the OFF position.
2. Unplug Scanalyzer from data link connector. Install protective plug connector.
3. Attach electrical panel cover to frame.
4. Road test vehicle and observe check engine lamp. Confirm proper operation without the reoccurrence of trouble codes. See 4.3 CHECKING FOR TROUBLE CODES:1200S ONLY.

ACTIVATION

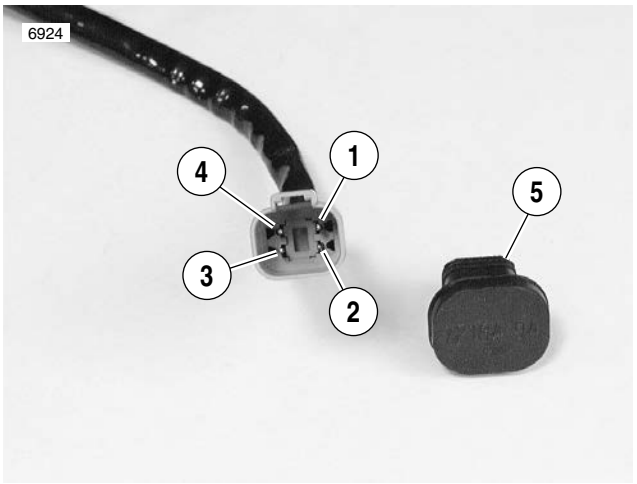
Use of check engine lamp diagnostics assumes that the SCANALYZER (Part No. HD-41325) is not available.

1. Gently pull left side cover from frame downtubes (no tools required). Detach data link connector [91A] from and remove protective cover.
2. To activate the diagnostic feature of the check engine lamp, proceed as follows:
   a. See Figure 4-10. Create diagnostic test wire from parts shown.
   b. See Figure 4-11. Install diagnostic test wire across Terminal 1 and Terminal 2 on the data link connector [91A].
   c. Turn the ignition key switch ON and wait approximately eight seconds for the check engine lamp to start flashing.
3. See Figure 4-12. All trouble codes are sent out as a series of flashes. To retrieve the first digit of the trouble code simply observe the number of times the lamp flashes.
   a. The transmission of a trouble code is always preceded by six rapid flashes (about 3 per second).
   b. This “intermission” is followed by a 2 second pause in which the lamp is off.
   c. The lamp will then flash one or more times to indicate the first digit of the trouble code. **For example, three blinks equals 3.** The length of time the lamp is illuminated and the length of time in which it is off are each about 1 second in duration.
4. The second digit follows:
   a. Following transmission of the first digit, there is another 2 second pause in which the lamp is off.
   b. The lamp will then flash one or more times to indicate the second digit of the trouble code. Count the number of times the lamp flashes to retrieve the second digit. **For example, an additional five blinks would equal 5. If you take the 3 blinks from the first digit and combine it with the second 5 blinks, the numbers represent trouble code 35 (tachometer).**
5. If more than one trouble code is sent:
   a. Following transmission of the second digit of the first code, there is a third 2 second pause in which the lamp is off.
   b. After the pause comes the intermission, which is followed by transmission of the next recorded trouble code.
   c. All subsequent codes are sent in the same manner, each separated from the next by the intermission.



1. Part number 72191-94 (2)
2. 2.0 in. (51 mm) 18 gauge wire

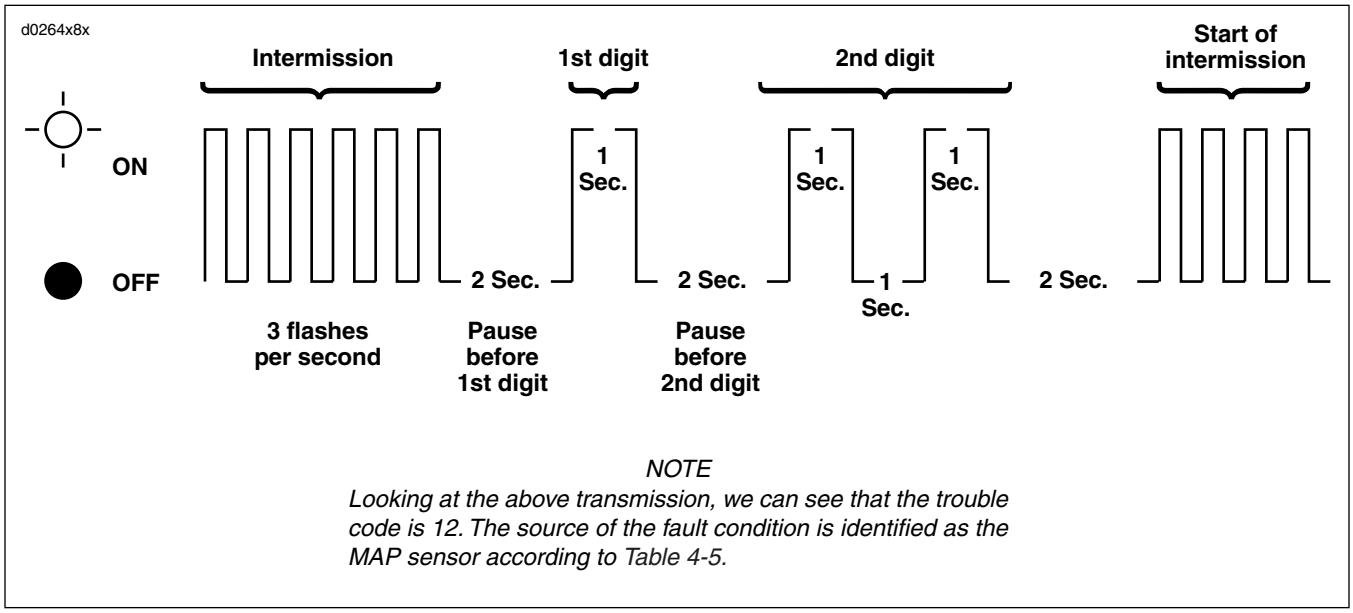
Figure 4-10. Diagnostic Test Wire



1. Terminal 1: receive data line (Lt GN/R)
2. Terminal 2: ground (BK)
3. Terminal 3: transmit data line (V/R)
4. Terminal 4: power (W/BK)
5. Protective cap

Figure 4-11. Installing Diagnostic Test Wire

6. Once all codes have been sent, the data string is repeated. When you have recorded the same trouble code twice, it is an indication that the transmission has been restarted and that all trouble codes have been retrieved.



NOTE

Looking at the above transmission, we can see that the trouble code is 12. The source of the fault condition is identified as the MAP sensor according to Table 4-5.

Figure 4-12. Check Engine Lamp Diagnostics

NOTE

If the lamp flashes at a rate faster than normal, then you are observing the "Intermission" only, which means that no trouble codes are present.

7. When examining trouble codes, write down all codes on a piece of paper. If a current trouble code exists, place it at the top of the list.
   a. If trouble codes are present, see Table 4-5. Follow the applicable flow charts for each code.
   b. If trouble codes are NOT present, but starting or driveability problems are evident, see symptoms charts under 4.8 INITIAL DIAGNOSTIC CHECK: 1200S ONLY.
8. Turn the ignition key switch OFF.
9. Remove diagnostic test wire from connector. Install protective cover over data link connector.
10. Attach electrical panel cover to frame.

IMPORTANT NOTE

If diagnostic test wire is installed across Pins 1 and 2 on connector [91A] in lieu of a Scanalyzer, the ignition module is placed in a diagnostic test mode and the engine will start. The test wire must be removed from the data link connector and the ignition switch turned OFF or the check engine lamp will continue to flash codes.

CLEARING CODES

After correcting system problems, clear trouble codes. If the Scanalyzer is not available, perform 50 start and run cycles. To execute one run cycle:

1. Start the vehicle.
2. Let it run for at least 30 seconds.
3. Turn the engine off.

GENERAL

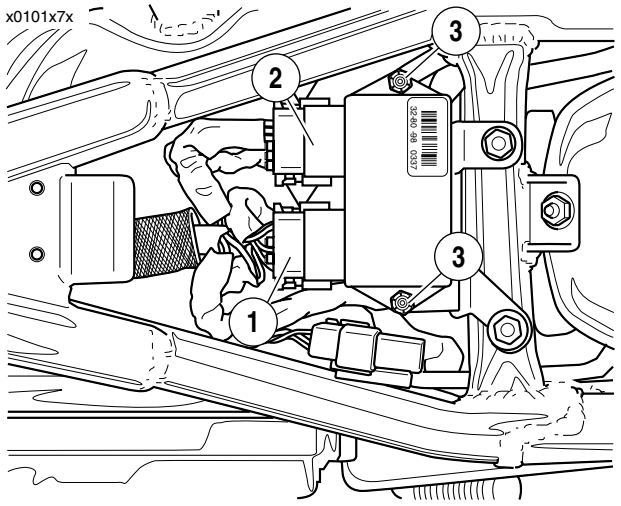
The BREAKOUT BOX (Part No. HD-42682) splices into the main harness. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

INSTALLATION

1. See Figure 4-13. Remove seat to gain access to the ignition module.
2. Depress latches on each side of connectors [10] (black) and [11] (gray).
3. See Figure 4-14. Attach Breakout Box (1) to black connector [10].
   a. Attach black connector from Breakout Box to corresponding black ignition module connector.
   b. Attach black connector from the wiring harness to black connector on Breakout Box.
4. Attach Breakout Box to gray connector [11].
   a. Attach gray connector from Breakout Box to corresponding gray ignition module connector.
   b. Attach gray connector from the wiring harness to gray connector on Breakout Box.

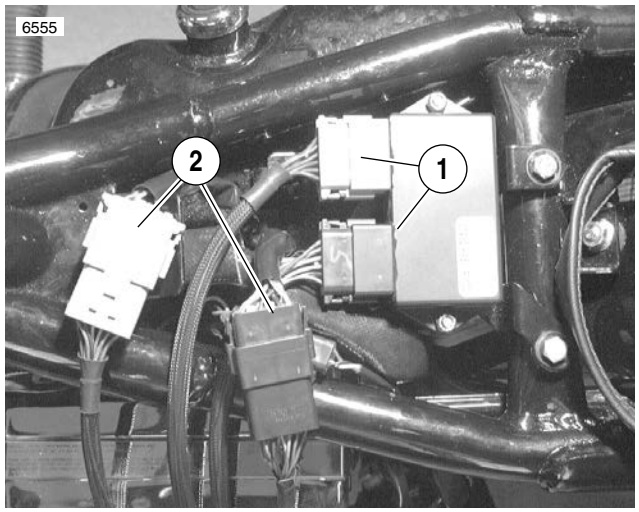
REMOVAL

1. See Figure 4-14. Depress latches on each side of connectors [10] (black) and [11] (gray).
2. Detach Breakout Box connectors from ignition module connectors.
3. Detach Breakout Box connectors from wiring harness.
4. Reattach ignition module connectors to wiring harness.
5. Install seat.



1. Ignition module connector [10] (black)
2. Ignition module connector [11] (gray)
3. Screw (2)

Figure 4-13. Ignition Module Connectors



1. Ignition module connection
2. Wiring harness connection

Figure 4-14. Installed Breakout Box

GENERAL

The wiggle test indicates the presence of intermittents in a wiring harness. Depending upon the availability of diagnostic tools, either version of this test may be used.

PROCEDURE

Using Scanalyzer (Part No. HD-41325)

NOTE

Scanalyzer only works on 1200S models.

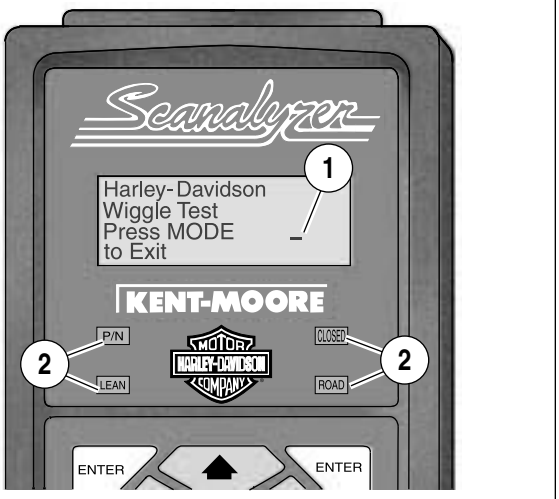
1. Connect Scanalyzer to vehicle. See 4.4 SCANALYZER: 1200S ONLY.
2. Start motorcycle engine and run at idle.
3. Enter wiggle test mode.
   a. Press “5” from the DIAGNOSTIC MENU to enter the SPECIAL TESTS menu.
   b. Press “1” from the SPECIAL TESTS menu to enter the WIGGLE TEST.
4. Shake or wiggle harness to detect intermittents. If intermittents are present the Scanalyzer will beep, light the four corner LEDs and display a minus sign when a current trouble code is detected. See Figure 4-15.

NOTE

If a current trouble code is present when the wiggle test is entered, the Scanalyzer will respond as described immediately upon entering the wiggle test mode. With key ON and engine off, clear trouble codes and then perform wiggle test with vehicle running.

Using DVOM (Part No. HD-39978)

1. See Figure 4-16. Connect DVOM to wiring harness between the suspect connections. When diagnosing ignition module connections, a BREAKOUT BOX (Part No. HD-42682) may be used to simplify the procedure. See 4.6 BREAKOUT BOX: 1200S ONLY.
2. Set DVOM to read voltage changes.
3. Start motorcycle engine and run at idle.
4. Shake or wiggle harness to detect intermittents. If intermittents are present, radical voltage changes will register on the DVOM.



1. Minus sign
2. Corner LED (4)

Figure 4-15. Wiggle Test Indicators

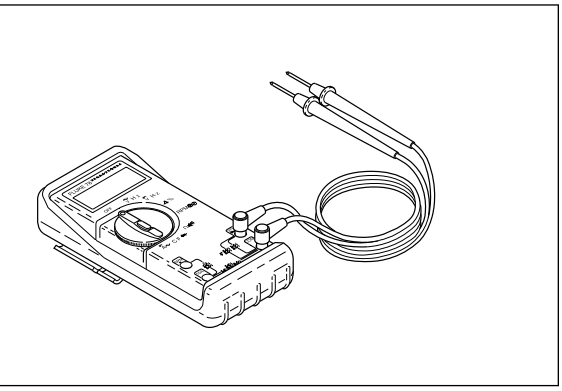


Figure 4-16. Fluke 78 Multimeter (DVOM) (Part No. HD-39978)

GENERAL

To locate faulty circuits or other system problems, follow the diagnostic flow charts in this section. For a systematic approach, always begin with INITIAL DIAGNOSTICS which follows. Read the general information and then work your way through the flow chart box by box.

Diagnostic Notes

If a numbered circle appears adjacent to a flow chart box, then more information is offered in the diagnostic notes. Many diagnostic notes contain supplemental information, descriptions of various diagnostic tools or references to other parts of the manual where information on the location and removal of components may be obtained.

Scanalyzer Icon

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer may be used. If a number is printed next to the icon, then refer to the Scanalyzer notes, which are similar to the diagnostic notes, but are restricted to information on the use of the Scanalyzer. All Scanalyzer notes may be found at the end of the respective flow chart.

Circuit Diagram/Wire Harness Connector Table

When working through a flow chart, refer to the illustrations, the associated circuit diagram and the wire harness connector table as necessary. The wire harness connector table for each circuit diagram identifies the connector number, description, type and general location.

In order to perform most diagnostic routines, a Breakout Box and a DVOM are required. See 4.6 BREAKOUT BOX: 1200S ONLY.

To perform the circuit checks with any degree of efficiency, a familiarity with the various wire connectors is also necessary.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

INITIAL DIAGNOSTICS

General Information

The diagnostic check (see page 4-16) is an organized approach to identifying a problem caused by an electronic control system malfunction. If no problems are found after completion of the diagnostic check, a comparison of Scanalyzer parameters may be used to help locate intermittents and out-of-specification sensors. See Table 4-1.

Diagnostic Tips

- If the Scanalyzer is not working properly, check operation on another vehicle.
- If proper Scanalyzer function is verified, check data link connector [91A] for 12 volts (Terminal 4) and proper ground (Terminal 2). See Figure 4-17.
- See Figure 4-11. If Scanalyzer reads “No Response” with the ignition key switch turned ON (engine stop switch at RUN with the engine off), check serial receive data wire for an open or short to ground between data link Terminal 1 and ignition module.
- Check for an open diagnostic test terminal between data link Terminal 3 and ignition module. With ignition key switch turned ON, transmit data line and receive data line should have 5 volts.

IMPORTANT NOTE

If diagnostic test wire is installed across Pins 1 and 2 on connector [91A] in lieu of a Scanalyzer, the ignition module is placed in a diagnostic test mode and the engine will start. The test wire must be removed from the data link connector and the ignition switch turned OFF or the check engine lamp will continue to flash codes.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the diagnostic check flow charts. See page 4-16.

1. Compare engine behavior to symptoms tables.
   a. Starts hard. See Table 4-2.
   b. Hesitates, stumbles, surges, misfires and/or sluggish performance. See Table 4-3.
   c. Engine exhaust emits black smoke or fouls plugs. See Table 4-4.
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black socket probes and patch cord.
3. Connect BREAKOUT BOX (Part No. HD-42682) to ignition module. See 4.6 BREAKOUT BOX: 1200S ONLY.

All diagnostic codes are listed on page 4-14 in Table 4-5.

Table 4-1. Typical Scan Values

ITEM	MIN. VALUE	MAX. VALUE	HOT IDLE
MAP sensor	0.1 Volt	4.96 Volt	1.5-3.0 Volt
Spark advance while running*	0°	36°	20° @1000 RPM (all but 1200S) 15° @1000 RPM (1200S)
RPM	0	5500	1000
Bank angle sensor	Run mode	Disable	Run mode
Dwell	960 µsec	8100 µsec	1600-2000 µsec

* See IGNITION TIMING in the 2002 Sportster Service Manual (Part No. 99484-02) for more information

Table 4-2. Engine Starts Hard

SYMPTOM	SOLUTION
Battery discharged	See charging system troubleshooting in Section 1.
Spark plugs	4.13 MISFIRE AT IDLE OR UNDER LOAD.
Spark plug wires	4.13 MISFIRE AT IDLE OR UNDER LOAD
Ignition coil	4.13 MISFIRE AT IDLE OR UNDER LOAD.
Valve sticking	See Section 3 in the 2002 Sportster Service Manual (Part No. 99484-02).

Table 4-2. Engine Starts Hard

SYMPTOM	SOLUTION
Water or dirt in fuel system	Drain and refill with fresh fuel.

Table 4-3. Engine Performance Problems

SYMPTOM	SOLUTION
Manifold leak	Spray water around induction module seals with engine idling. If RPM changes, change seals.
MAP sensor plugged or not operating properly	4.14 DTC 12: 1200S ONLY.
Water or dirt in fuel system	Drain and refill with fresh fuel.
Spark plugs	4.13 MISFIRE AT IDLE OR UNDER LOAD.
EVAP hose disconnected from induction module (CA)	Connect.
Throttle plates not opening fully	See throttle cable adjustment in 2002 Sportster Service Manual (Part No. 99484-02).

Table 4-4. Engine Exhaust Emits Black Smoke or Fouls Plugs

SYMPTOM	SOLUTION
Clogged air filter	See 2002 Sportster Service Manual (Part No. 99484-02).
MAP sensor plugged or not operating properly	4.14 DTC 12: 1200S ONLY.

Table 4-5. 1200S Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC NO.	FAULT CONDITION	RELEVANT TOPIC
12	MAP sensor	4.14 DTC 12: 1200S ONLY
16	Battery voltage	4.15 DTC 16: 1200S ONLY
24	Front ignition coil	4.16 DTC 24, 25: 1200S ONLY
25	Rear ignition coil	4.16 DTC 24, 25: 1200S ONLY
35	Tachometer	4.17 DTC 35: 1200S ONLY
44	Bank angle sensor	4.18 DTC 44: 1200S ONLY
52	RAM failure	4.19 DTC 52, 53, 54 AND 55: 1200S ONLY
53	ROM failure	4.19 DTC 52, 53, 54 AND 55: 1200S ONLY
54	EPROM failure	4.19 DTC 52, 53, 54 AND 55: 1200S ONLY
55	Ignition module failure	4.19 DTC 52, 53, 54 AND 55: 1200S ONLY

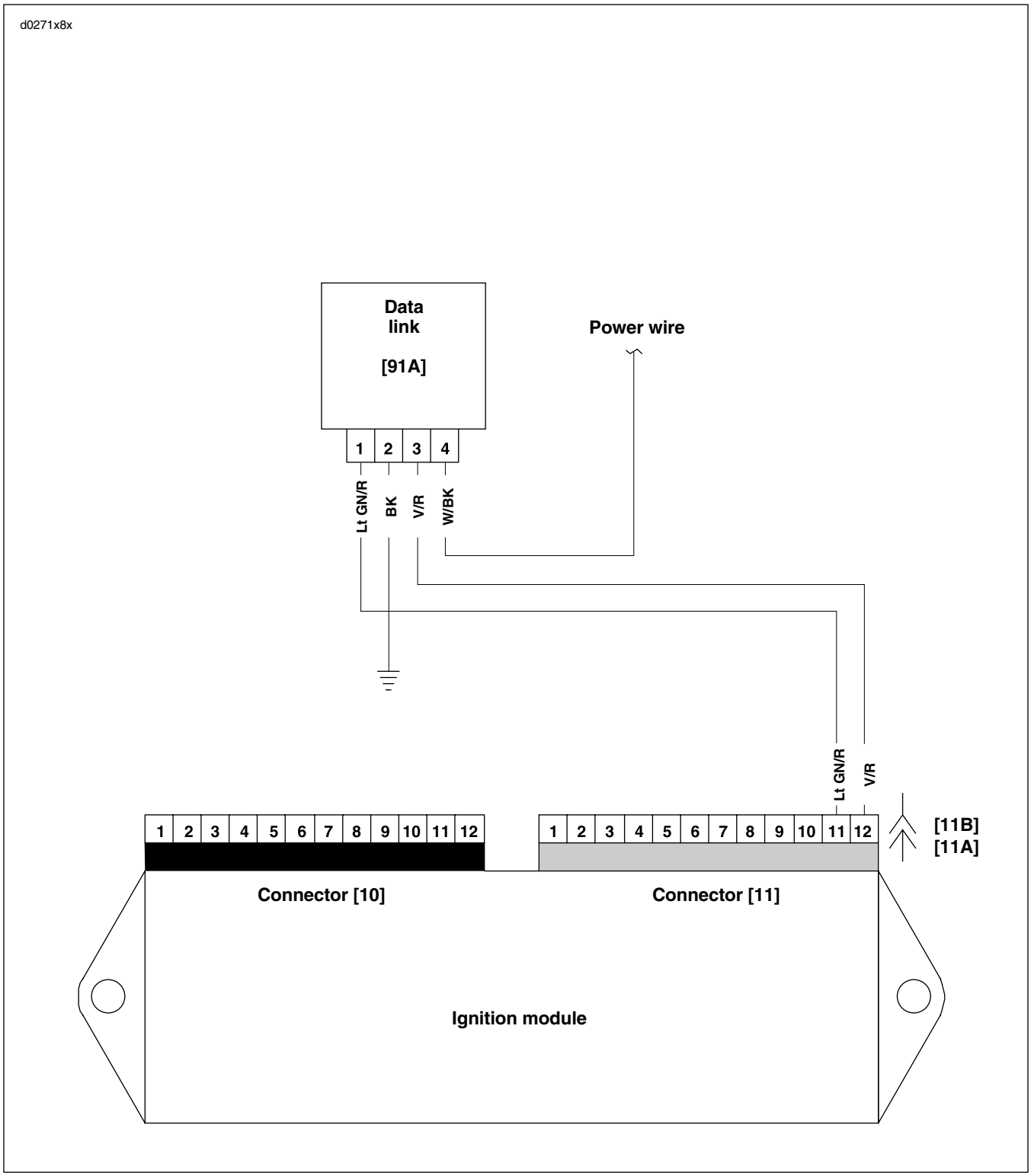
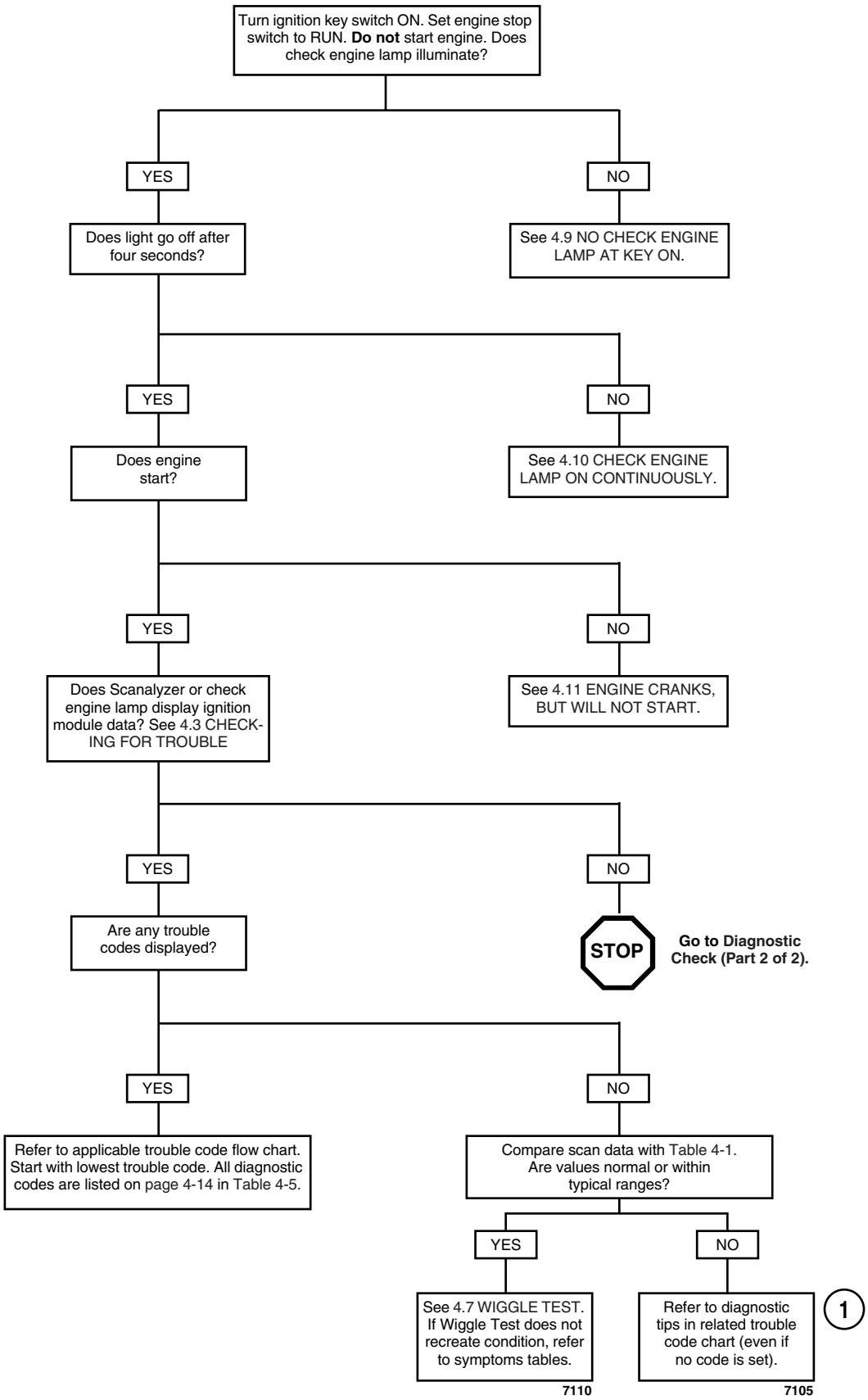


Figure 4-17. Diagnostic Check

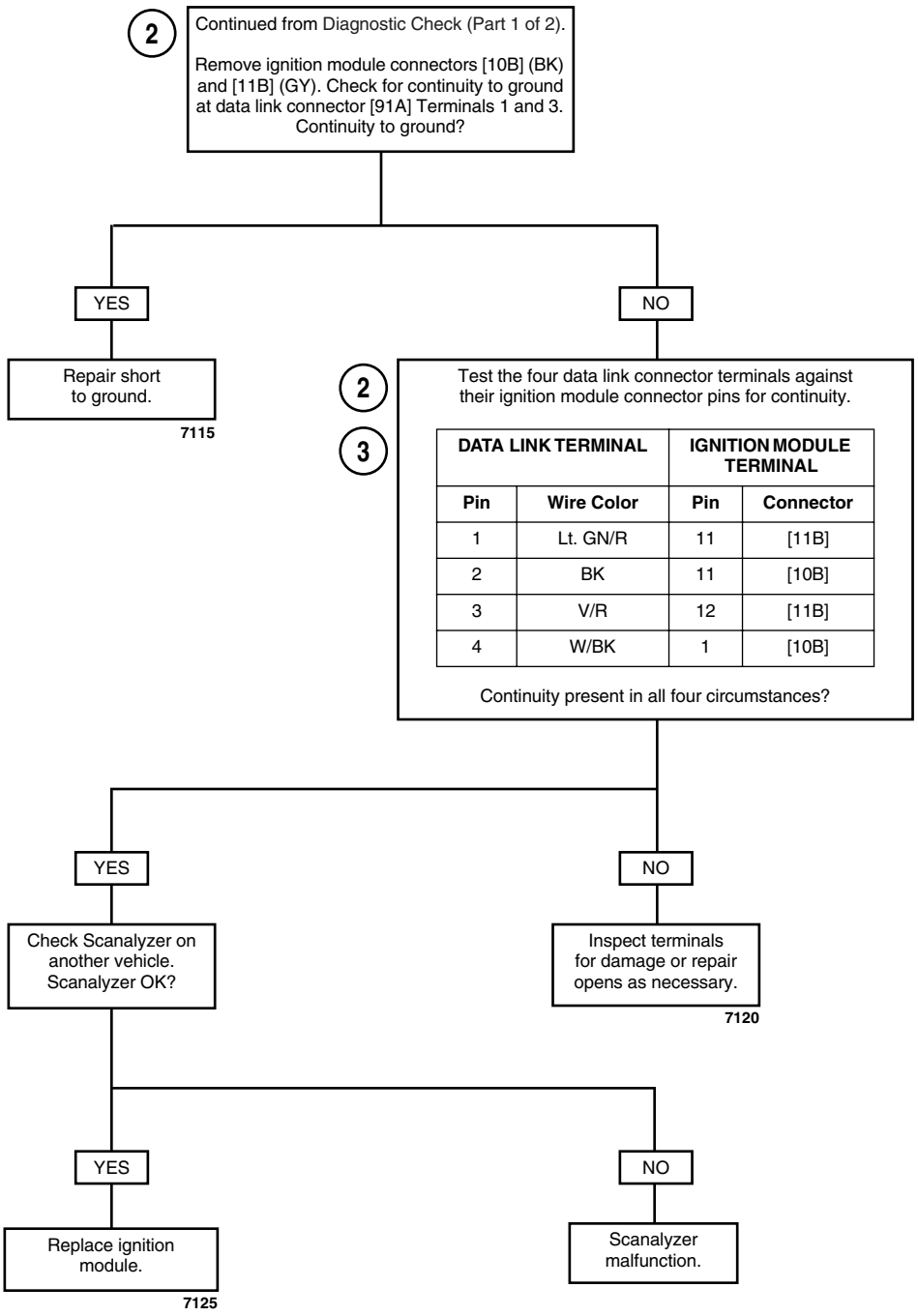
Table 4-6. Wire Harness Connectors in Figure 4-17.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[11]	Ignition module (gray)	12-place Deutsch	under seat
[91A]	Data link	4-place Deutsch	behind electrical panel

Diagnostic Check (Part 1 of 2)



Diagnostic Check (Part 2 of 2)



GENERAL

1200S Only

When the Ignition Switch is turned to ON (Engine Stop Switch at RUN with the engine off), the Check Engine Lamp should illuminate for 4 seconds. Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the Ignition Module through the BK/Y wire. A lack of power to the Ignition Module will cause the Check Engine Lamp to be inoperative and also create a no start situation.

DIAGNOSTICS

Diagnostic Tips

- Check for open in BK/Y wire.
- See Figure 4-19. Check accessories fuse.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.9 flow chart.

1. Use Harness Connector Test Kit (HD-41404), black pin probe and patch cord.
2. Inspect Connector [10] (BK) for contamination or corrosion. If connection is good, Ignition Module requires replacement. See IGNITION MODULE, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).
3. Use special pick (Snap-On Tool TT600-3) as described under 5.2 AMP MULTILOCK ELECTRICAL CONNECTORS in SECTION 5 of this Service Manual.
4. Use Harness Connector Test Kit (HD-41404), gray socket probe and patch cord.
5. Check continuity. If continuity present, then most likely short to voltage; if no continuity, then open.
6. LED failure requires speedometer replacement.

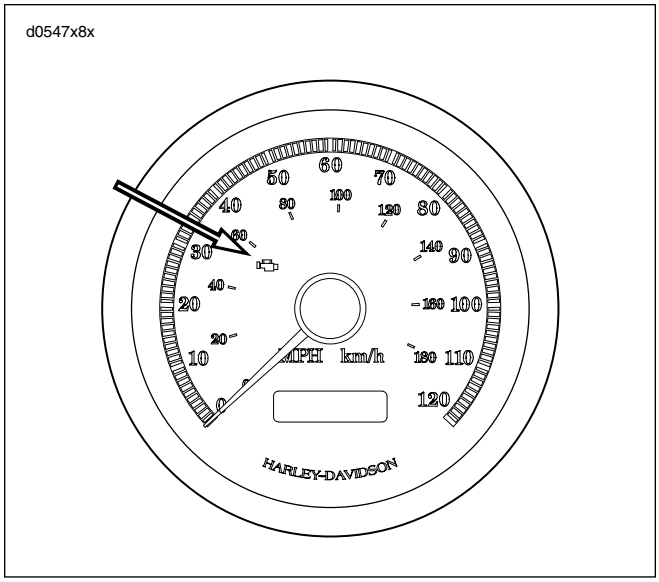


Figure 4-18. Check Engine Lamp

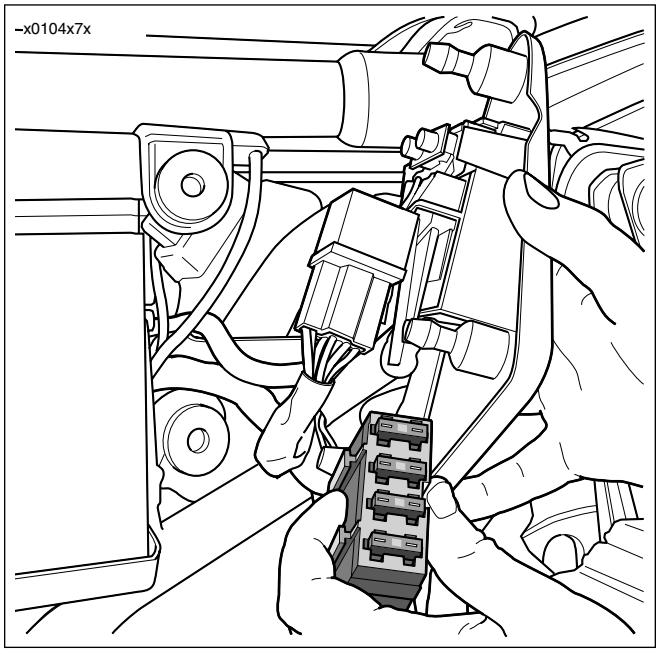


Figure 4-19. Fuse Block

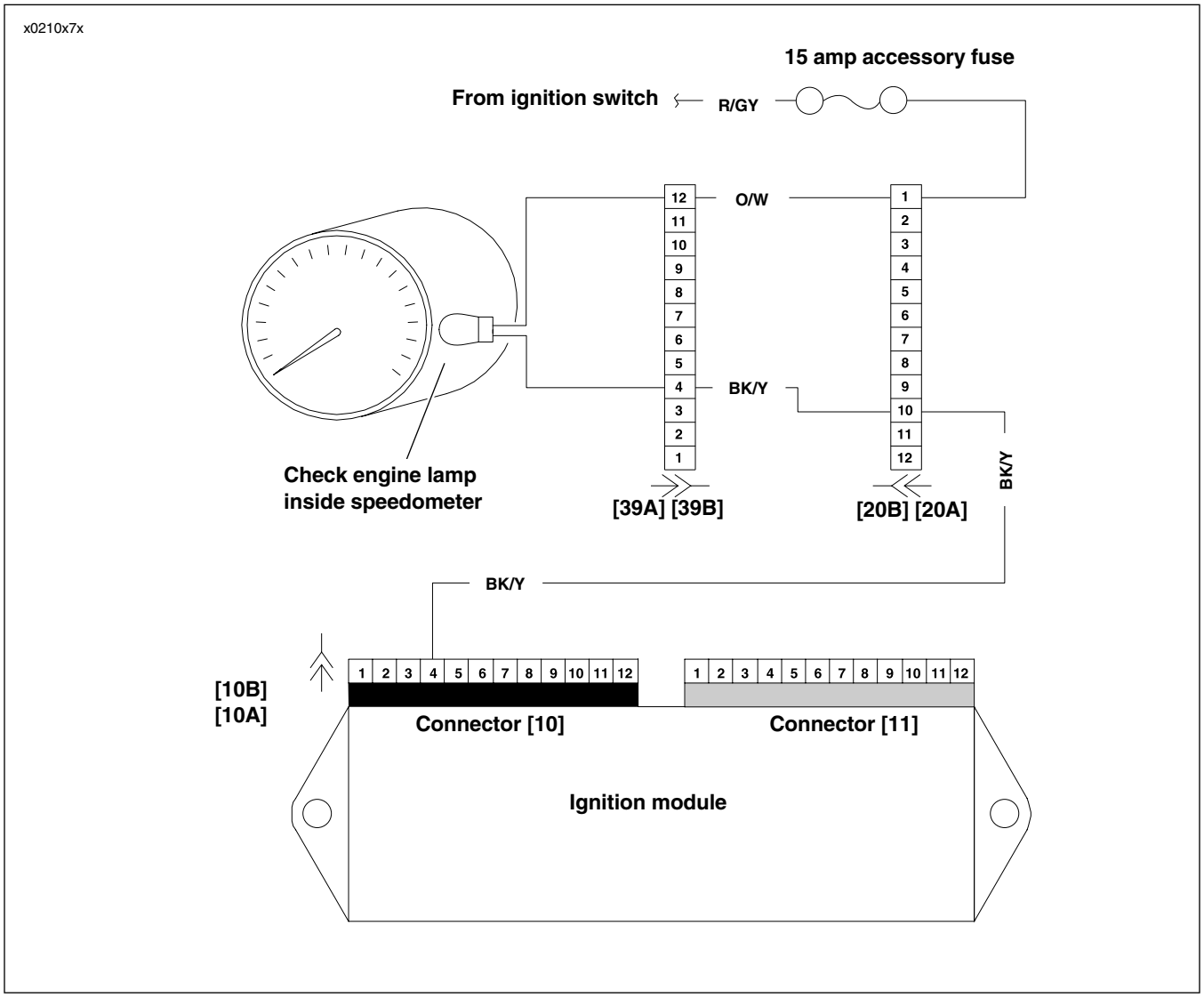


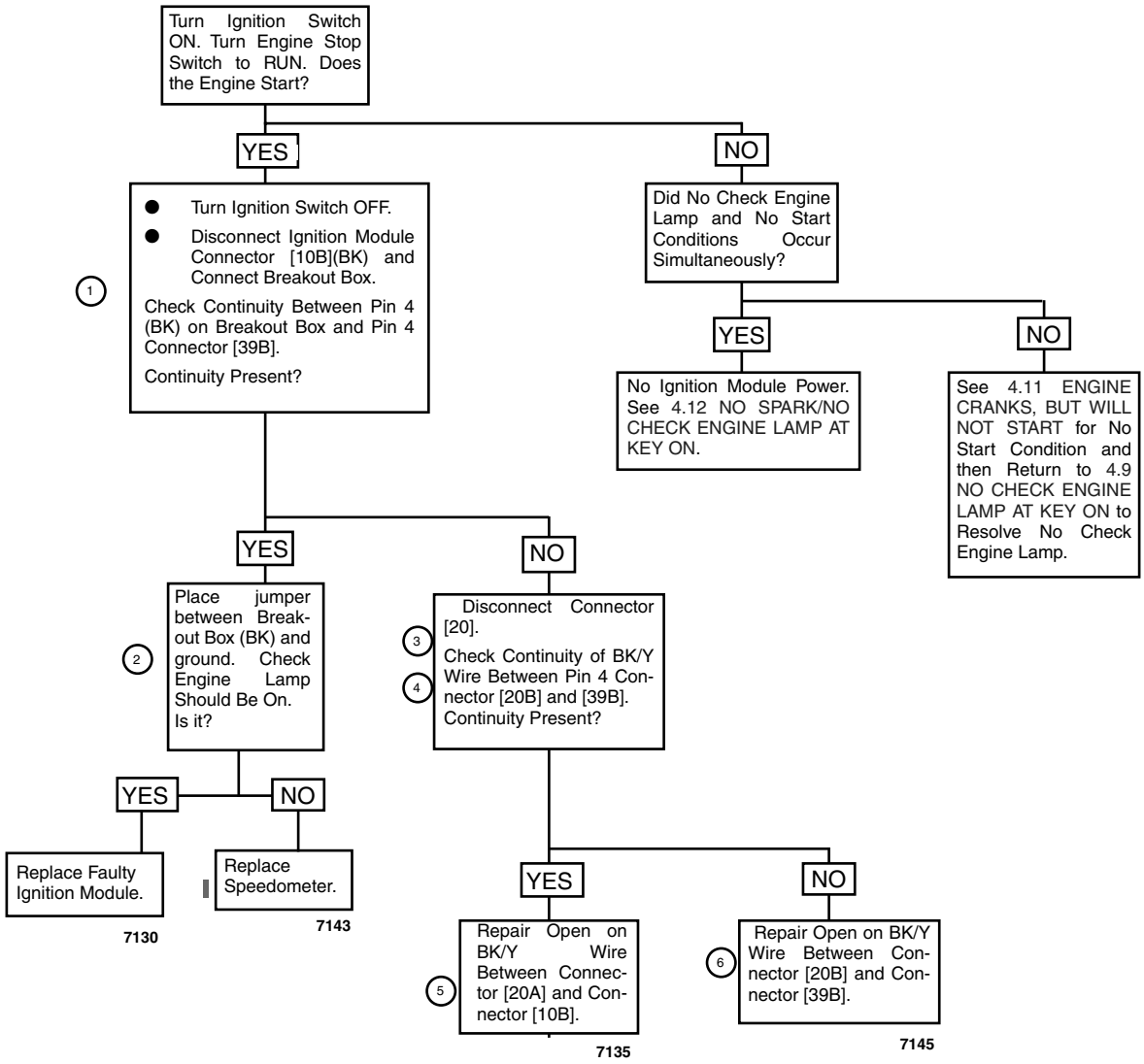
Figure 4-20. Check Engine Lamp Circuit

Table 4-7. Wire Harness Connectors in Figure 4-20.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[20]	Main harness to instruments	12-place Deutsch	under headlamp bracket
[39]	Speedometer	12-place Packard	back of speedometer

Test 4.9

NO CHECK ENGINE LAMP AT KEY ON



GENERAL

1200S Only

See Figure 4-21. The Check Engine Lamp should illuminate for 4 seconds when the Ignition Switch is turned to ON (with the Engine Stop Switch at RUN and the engine off). Following the initial period of illumination, the lamp should go off for 4 seconds. It may then come back on for an 8 second period (for a stored functional error) or remain on continuously (current error).

Battery voltage is supplied to the lamp bulb. The lamp bulb is grounded by the Ignition Module through the BK/Y wire. A steady light may indicate a short to ground on the BK/Y wire.

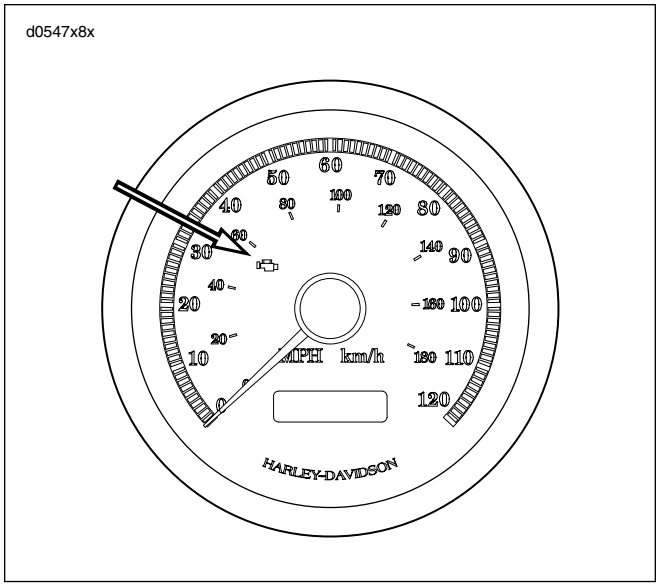


Figure 4-21. Check Engine Lamp

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.10 flow chart.

1. If the lamp goes OFF when ignition module connector is unplugged, BK/Y wire is shorted to ground.
2. Check for trouble codes. See RETRIEVING TROUBLE CODES under 4.3 CHECKING FOR TROUBLE CODES:1200S ONLY.
3. See IGNITION MODULE, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02)
4. Use procedure as described under 5.4 MINI-DEUTSCH CONNECTORS in SECTION 5.

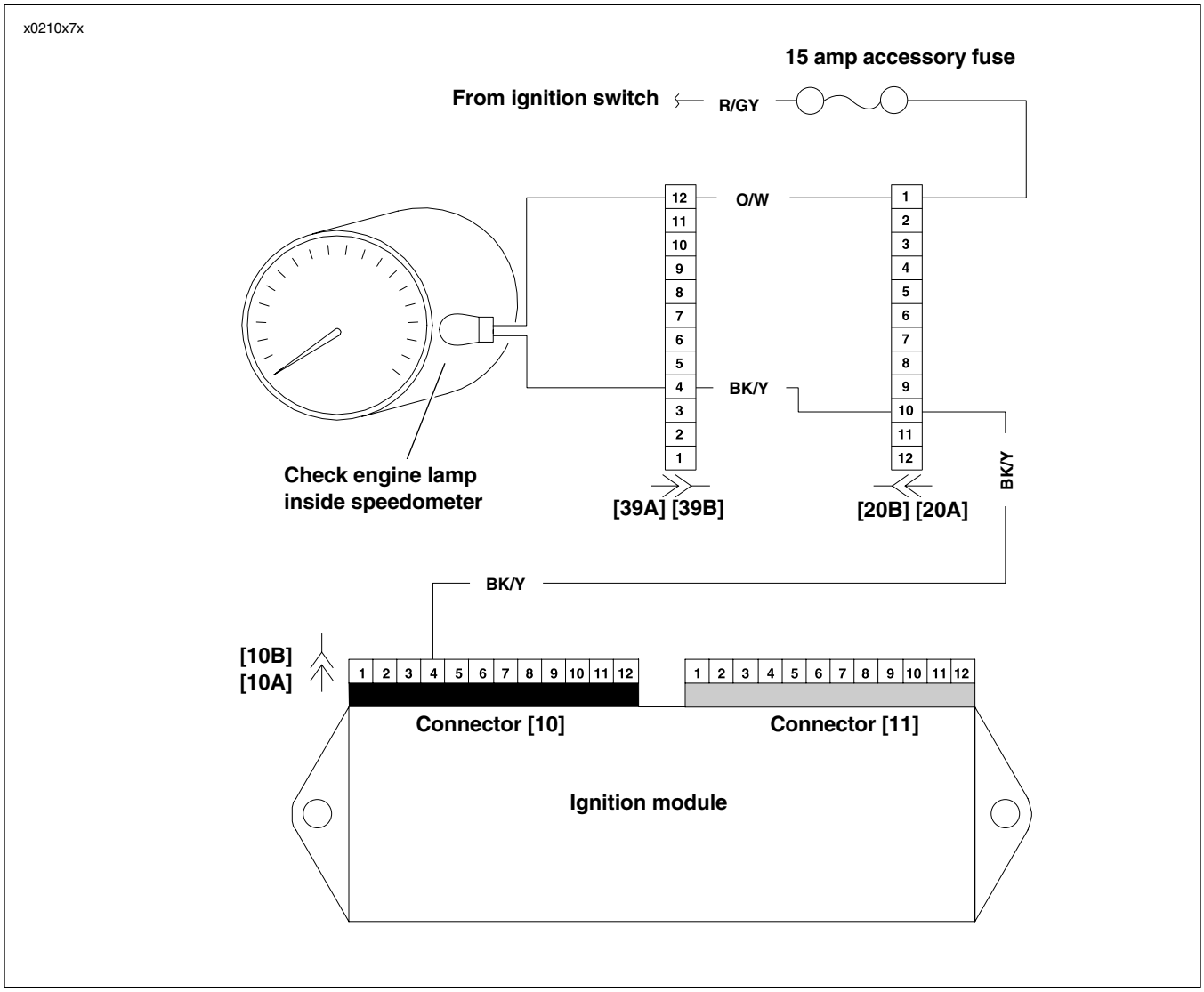


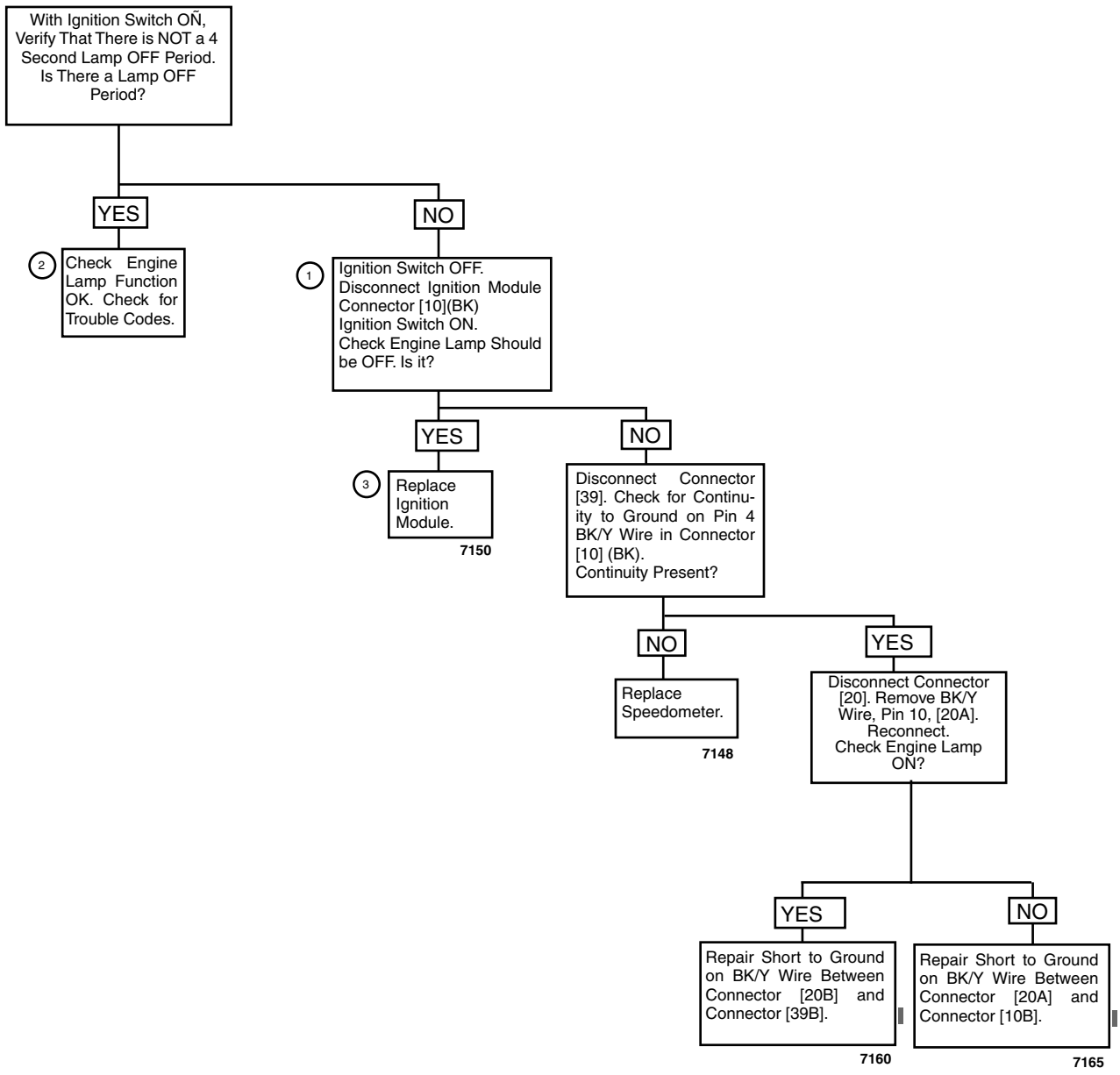
Figure 4-22. Check Engine Lamp Circuit

Table 4-8. Wire Harness Connectors in Figure 4-22.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[20]	Main harness to instruments	12-place Deutsch	under headlamp bracket
[39]	Speedometer	12-place Packard	back of speedometer

Test 4.10

CHECK ENGINE LAMP ON CONTINUOUSLY



GENERAL

1200S Only

If starter will not crank engine, the problem is not ignition related. Refer to SECTION 1-STARTING & CHARGING.

Engine can be started with Diagnostics Test wire installed or if Receive Data Line is grounded. Ignition/Light Key Switch must be turned to OFF after test wire is removed or check engine lamp will continue to flash stored codes.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.11 flow charts.

1. Check for trouble codes. See RETRIEVING TROUBLE CODES under 4.3 CHECKING FOR TROUBLE CODES:1200S ONLY.
2. Check the condition of the battery. Perform a voltage test and recharge if below 12.60V. Check battery connections and perform load test. Replace the battery if necessary.
3. Remove spark plug cable from spark plug.
   a. Visually check condition of plug.
   b. See Figure 4-23. Attach cable to SPARK TESTER (Part No. HD-26792). Clip tester to cylinder head bolt.
   c. While cranking engine, look for spark. Repeat procedure on other spark plug cables.
4. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404) gray pin probes and patch cords.
5. Gently use test lamp as shown in Figure 4-24. Inserting the test lamp forcefully into the connector will damage the terminal and require its replacement.
6. Connect BREAKOUT BOX (Part No. HD-42682) between harness and ignition module. See 4.6 BREAKOUT BOX: 1200S ONLY.
7. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probe and patch cord.
8. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), black pin probe and patch cord.
9. See CAMSHAFT POSITION SENSOR, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).

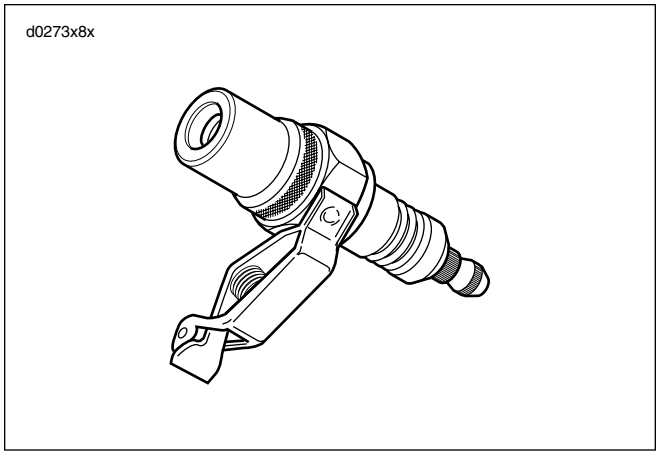


Figure 4-23. Spark Tester

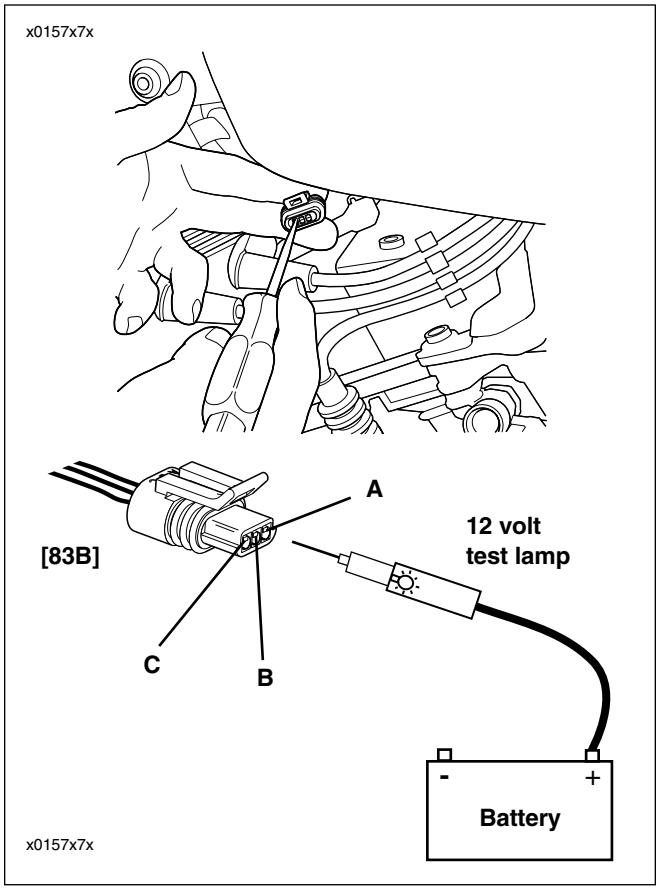


Figure 4-24. Ignition Coil Test

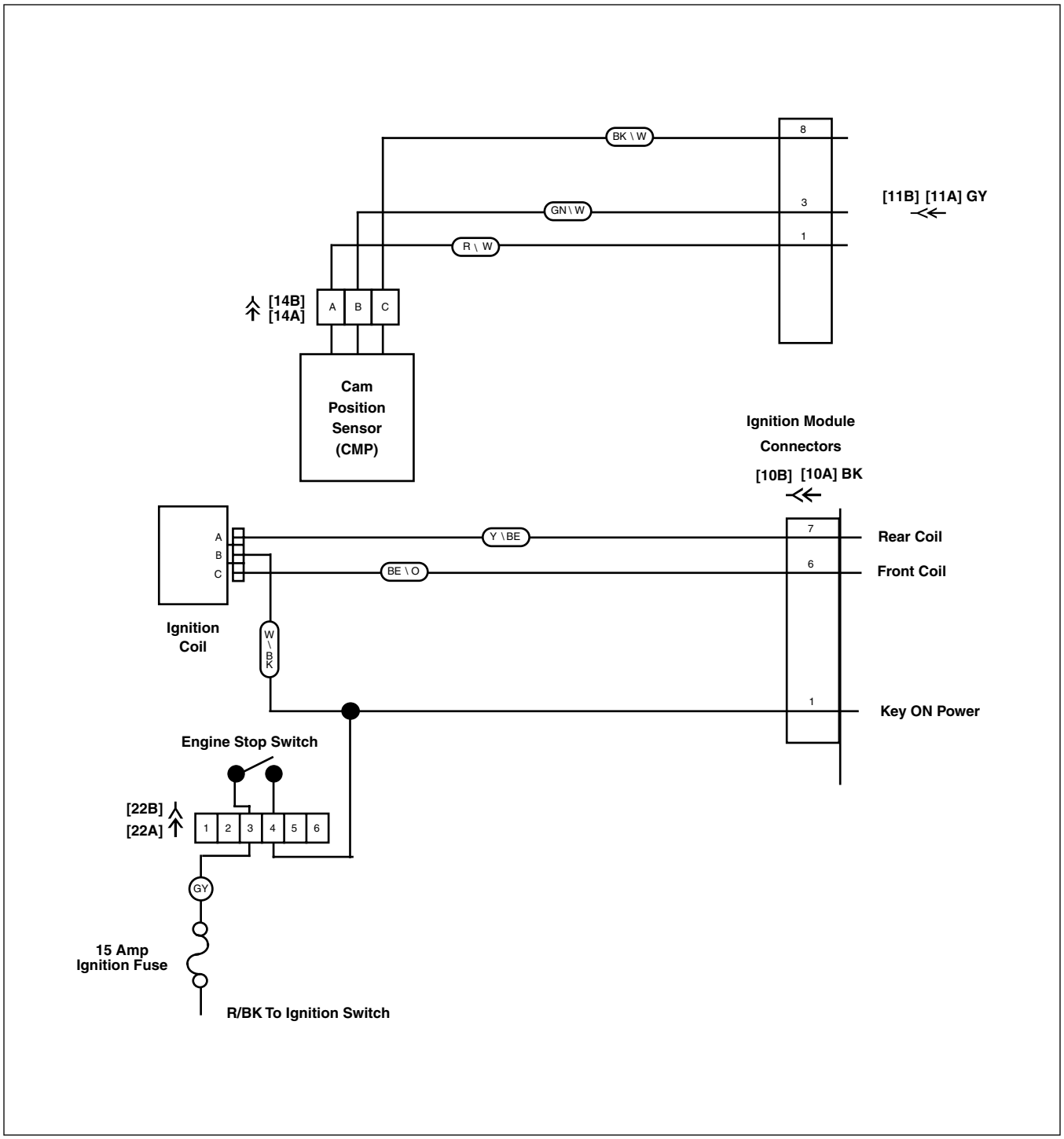


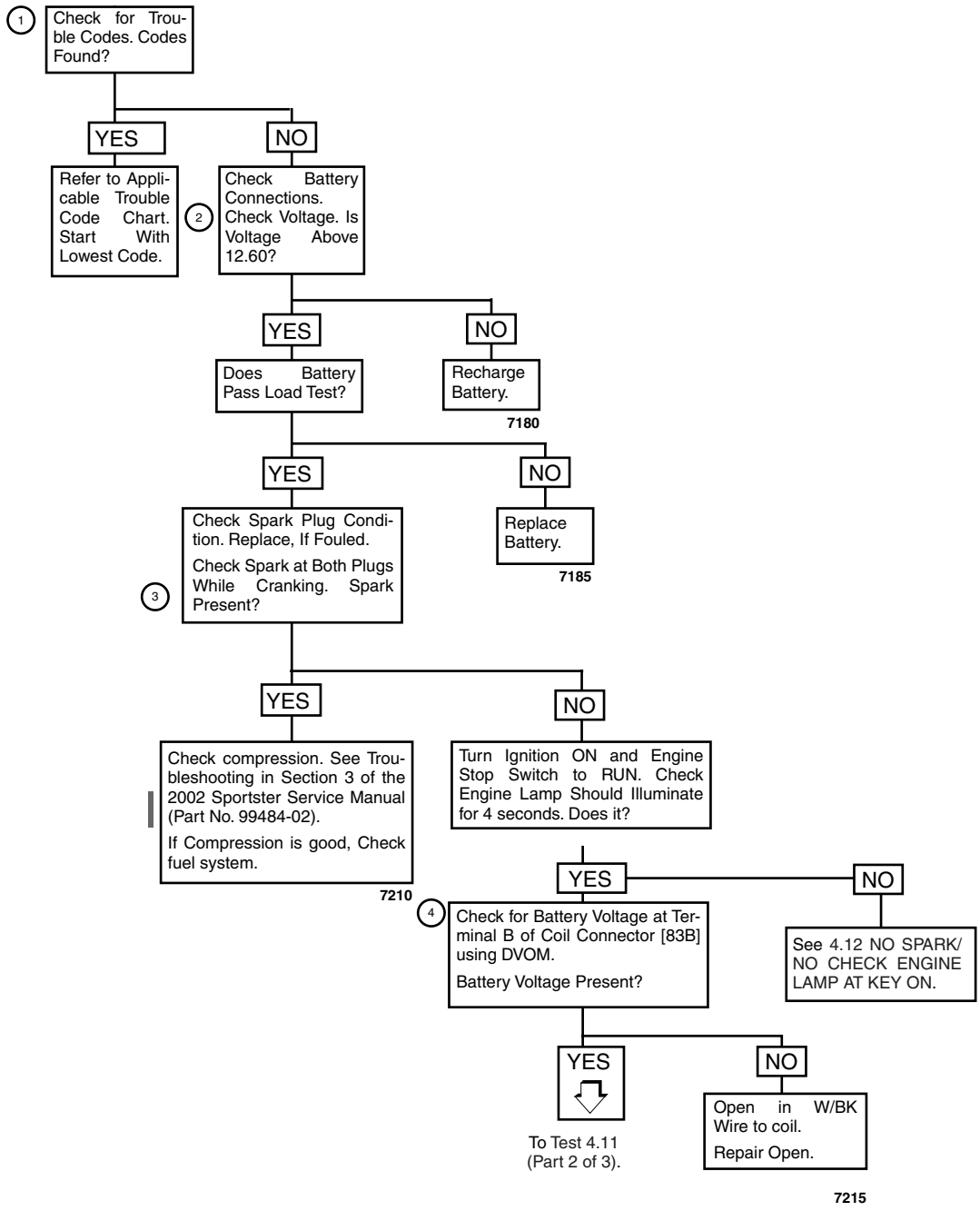
Figure 4-25. Ignition Circuit Diagram

Table 4-9. Wire Harness Connectors in Figure 4-25.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[11]	Ignition module (gray)	12-place Deutsch	under seat
[14]	CMP sensor	3-place Deutsch	bottom frame cross member (right side)
[83]	Ignition coil	3-place Packard	below fuel tank

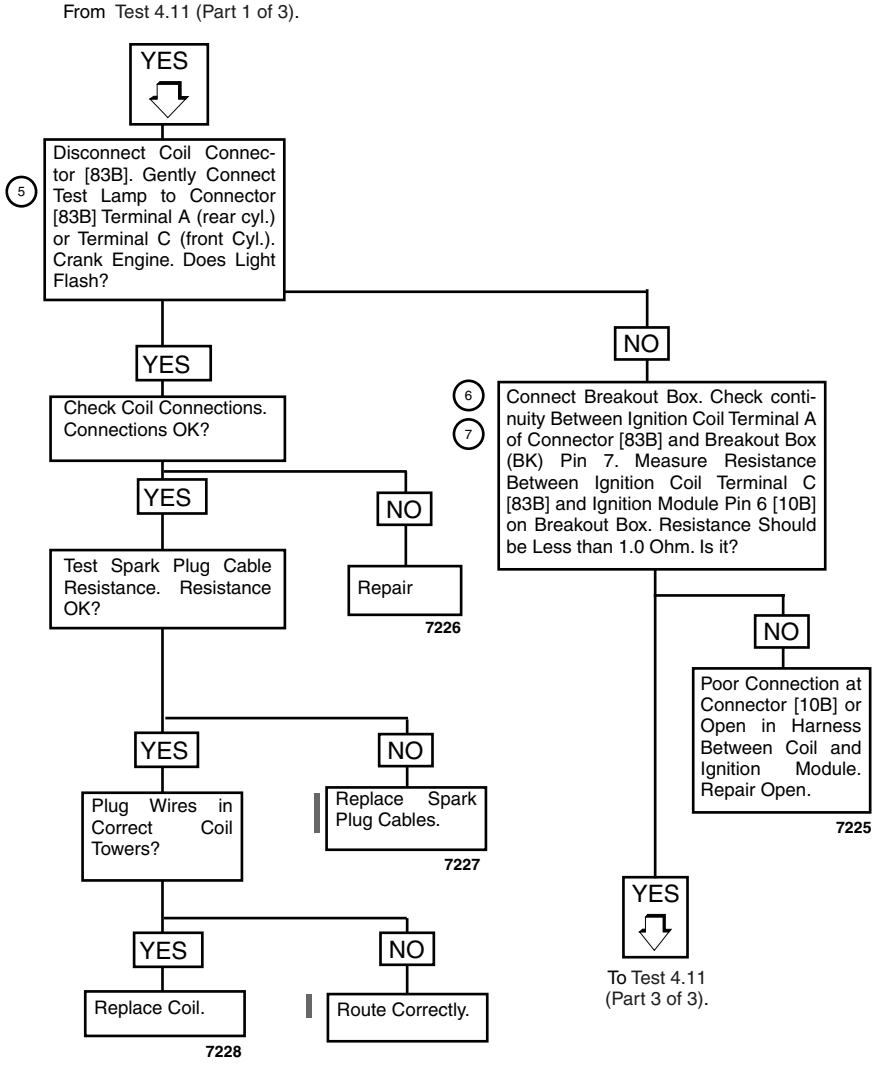
Test 4.11 (Part 1 of 3)

ENGINE CRANKS, BUT WILL NOT START



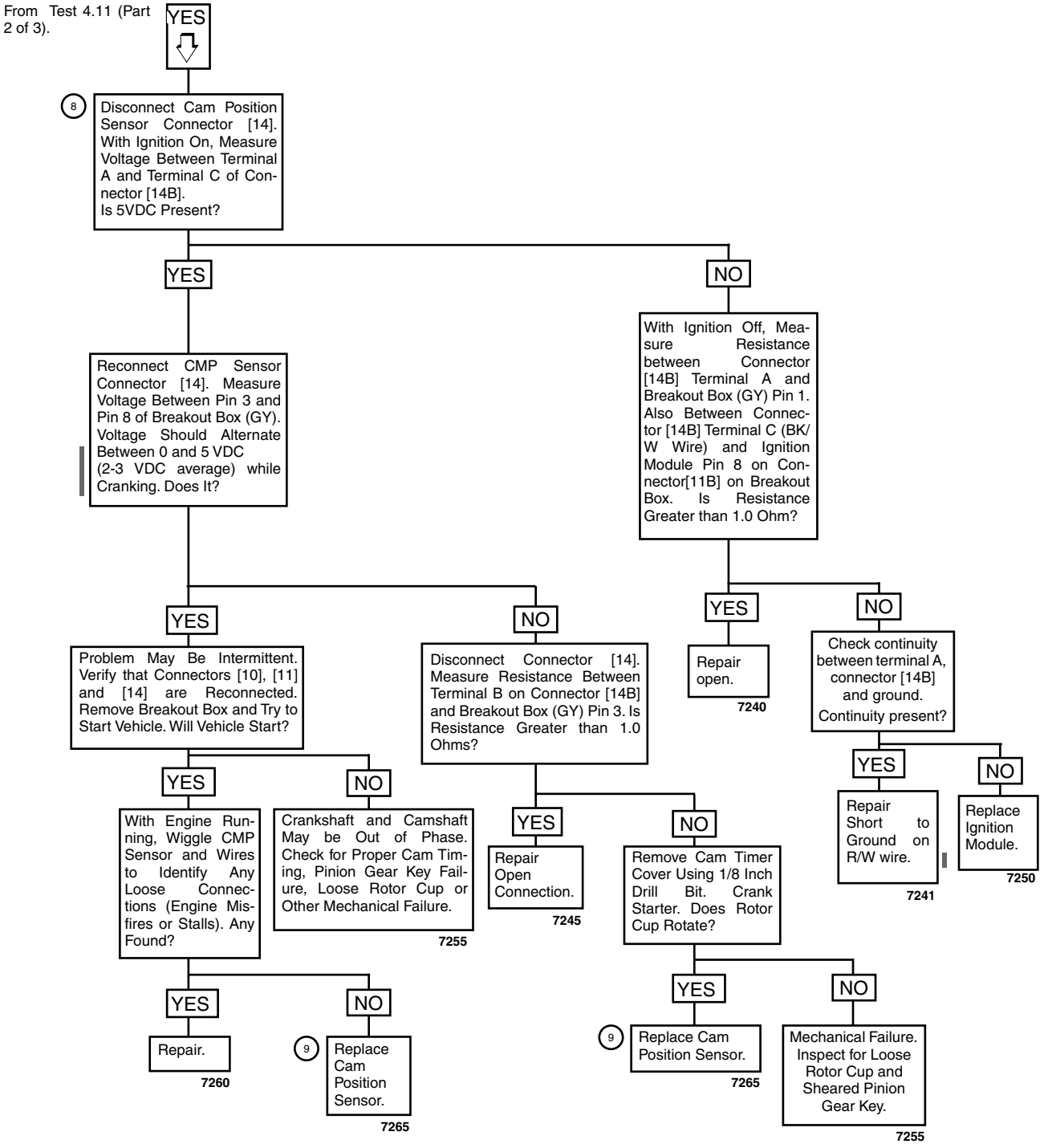
Test 4.11 (Part 2 of 3)

ENGINE CRANKS, BUT WILL NOT START



Test 4.11 (Part 3 of 3)

ENGINE CRANKS, BUT WILL NOT START



GENERAL

1200S Only

The Ignition Module turns on when power is applied to Pin 1 of [10], the black connector. The Ignition Module goes through an initialization sequence every time power is removed and re-applied to Pin 1. The only visible part of this sequence is the Check Engine Lamp. Upon starting, the Check Engine Lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.12 flow chart.

1. See FUSES in the 2002 Sportster Service Manual (Part No. 99484-02).
2. Use HARNESS CONNECTOR TEST KIT (Part No. HD-4104), black pin probe and patch cord.

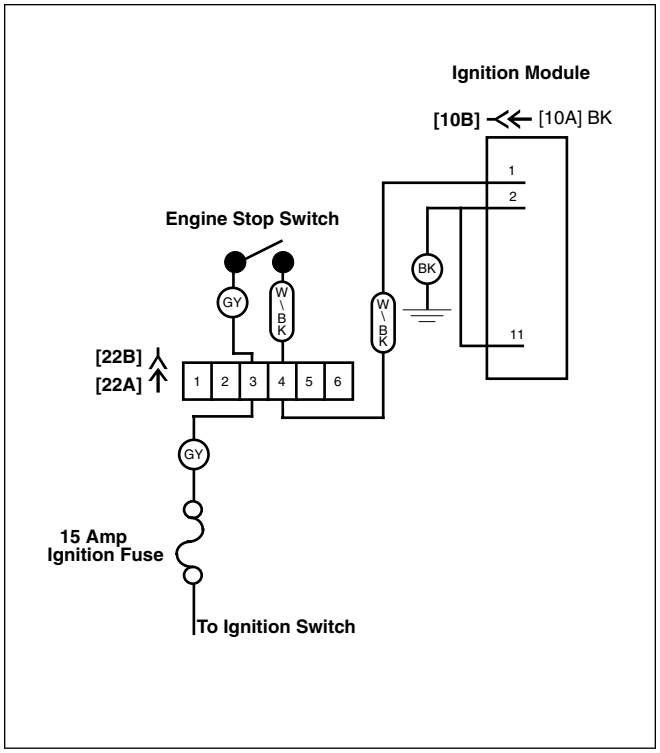


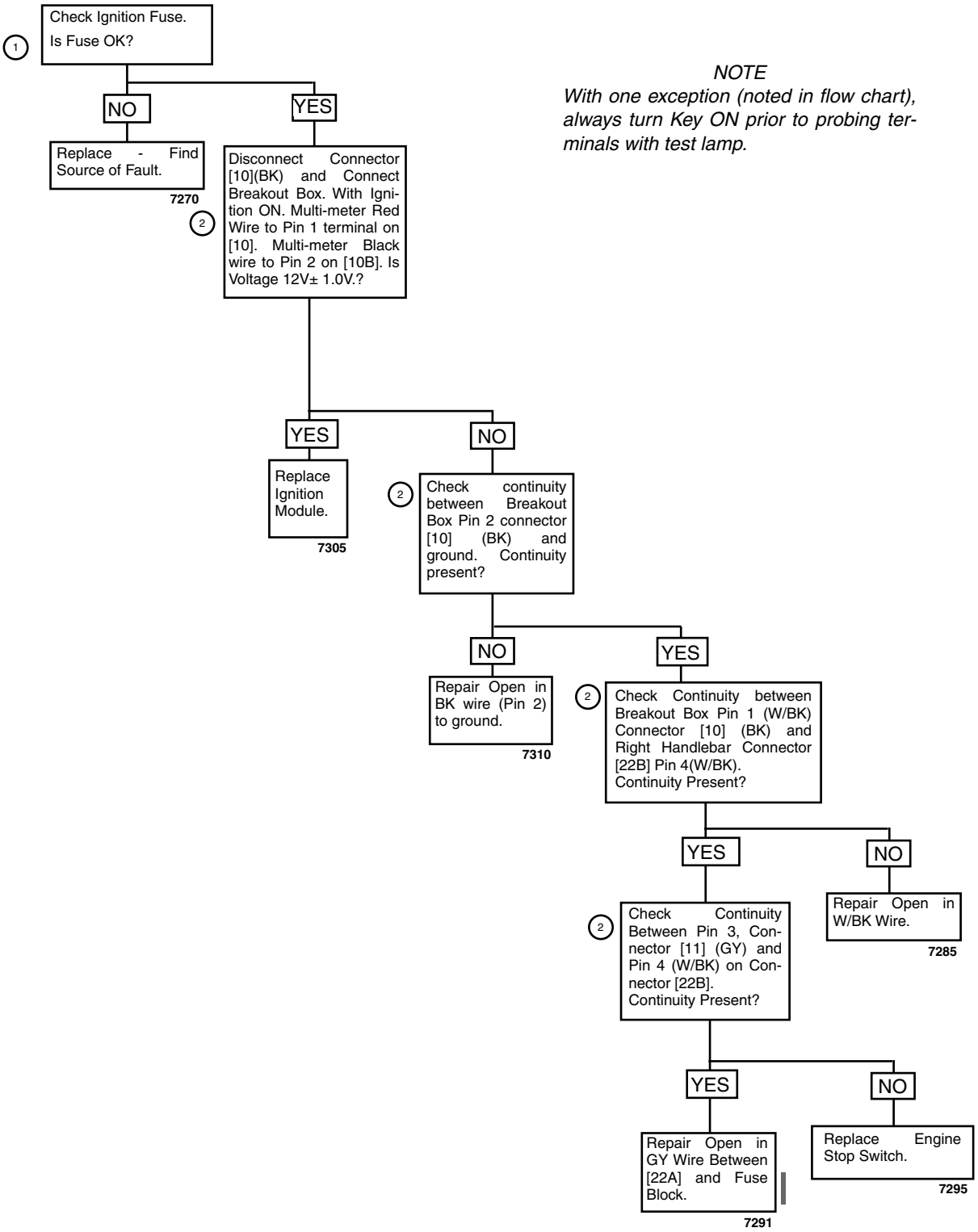
Figure 4-26. Ignition Module Power Circuit Diagram

Table 4-10. Wire Harness Connectors in Figure 4-26.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[22]	Right handlebar switch (black)	6-place Deutsch	in headlight

Test 4.12

NO SPARK/NO CHECK ENGINE LAMP AT KEY ON



NOTE

With one exception (noted in flow chart), always turn Key ON prior to probing terminals with test lamp.

GENERAL

1200S Only

- Battery condition and connections may also cause misfires. See BATTERY in the 2002 Sportster Service Manual (Part No. 99484-02) for more information.
- Fuel system problems may also cause misfires. See Table 4-3.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.13 flow chart.

⚠WARNING

Any open spark around gasoline or other combustibles may result in fire or explosion. Thoroughly wipe up any spilt fuel and dispose of rags in a suitable manner. Inadequate safety precautions could result death or serious injury.

1. See Figure 4-27. A SPARK TESTER (Part No. HD-26792) must be used to verify adequate secondary voltage (25,000 volts) at the spark plug.
   a. Turn ignition switch OFF.
   b. Remove spark plug cable from spark plug. Visually check plug condition.
   c. Attach cable to SPARK TESTER. Clip tester to cylinder head bolt.
   d. While cranking engine, watch for spark to jump tester gap on leads.
   e. Reinstall and repeat procedure on other spark plug cable.
2. Perform spark plug cable resistance test.
   a. Remove spark plug cable from spark plug and ignition coil. For best results, use a needle nose pliers for removal/installation on coil. Gently grasp cable as close to terminals as possible.
   b. Using an ohmmeter, touch probes to terminals on each end plug wire.
   c. Compare resistance values to Table 4-11. Replace cables not meeting specifications. Reinstall and repeat procedure on other spark plug cable.

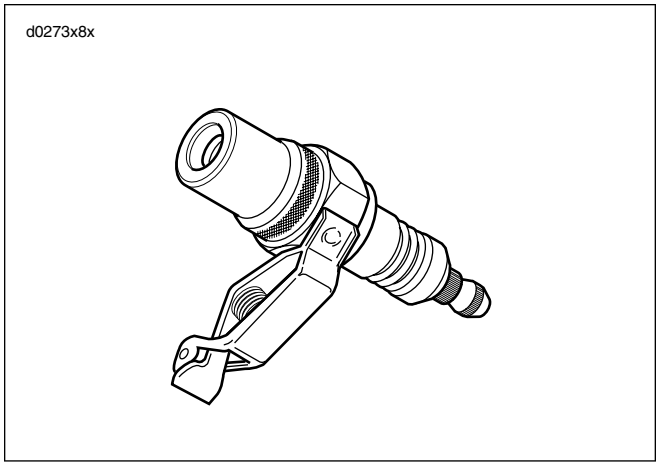


Figure 4-27. Spark Tester

Table 4-11. Spark Plug Cables

SPECIFICATION	REAR	FRONT
Length in.	19.0-19.25	7.25-7.50
Length mm	482.6-489.0	184.2-190.5
Resistance-ohms	4750-11,230	1812-4375

3. If carbon tracking is evident, replace ignition coil and inspect spark plug wires. Wires must be clean and tight. Excessive wire resistance or faulty connections can cause coil damage. See 1.8 IGNITION COIL.
4. This test can also be performed by substituting a known good coil for one causing the no spark condition. The coil does not require full installation to be functional. Verify faulty coil by performing resistance test. See 1.8 IGNITION COIL.
5. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404), gray pin probe and patch cord to the coil connector [83B].
6. Inspect for corrosion at battery terminals, main circuit breakers, ignition fuse terminals (GY and R/BK), right handlebar connector [22] and coil connector.

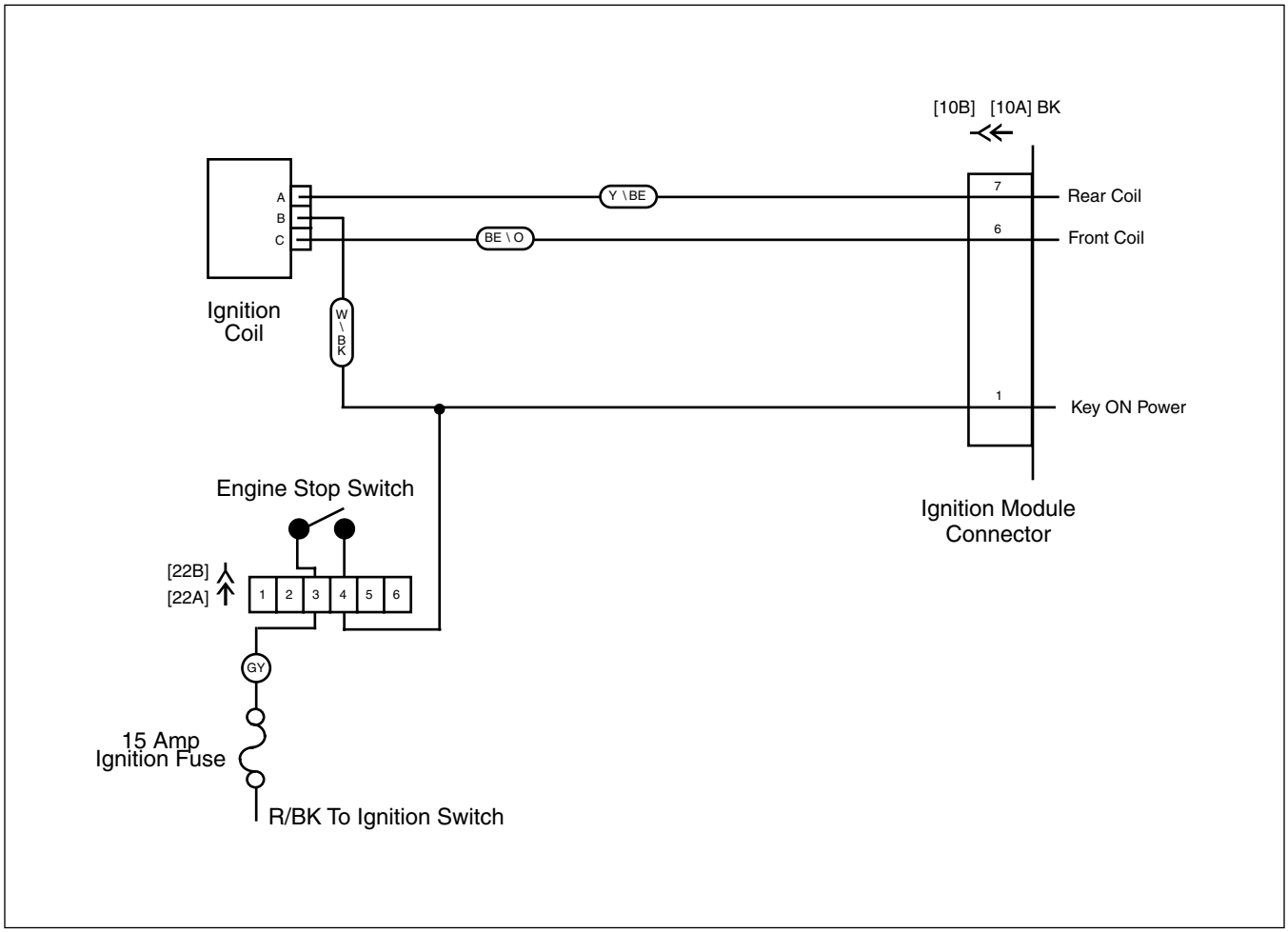


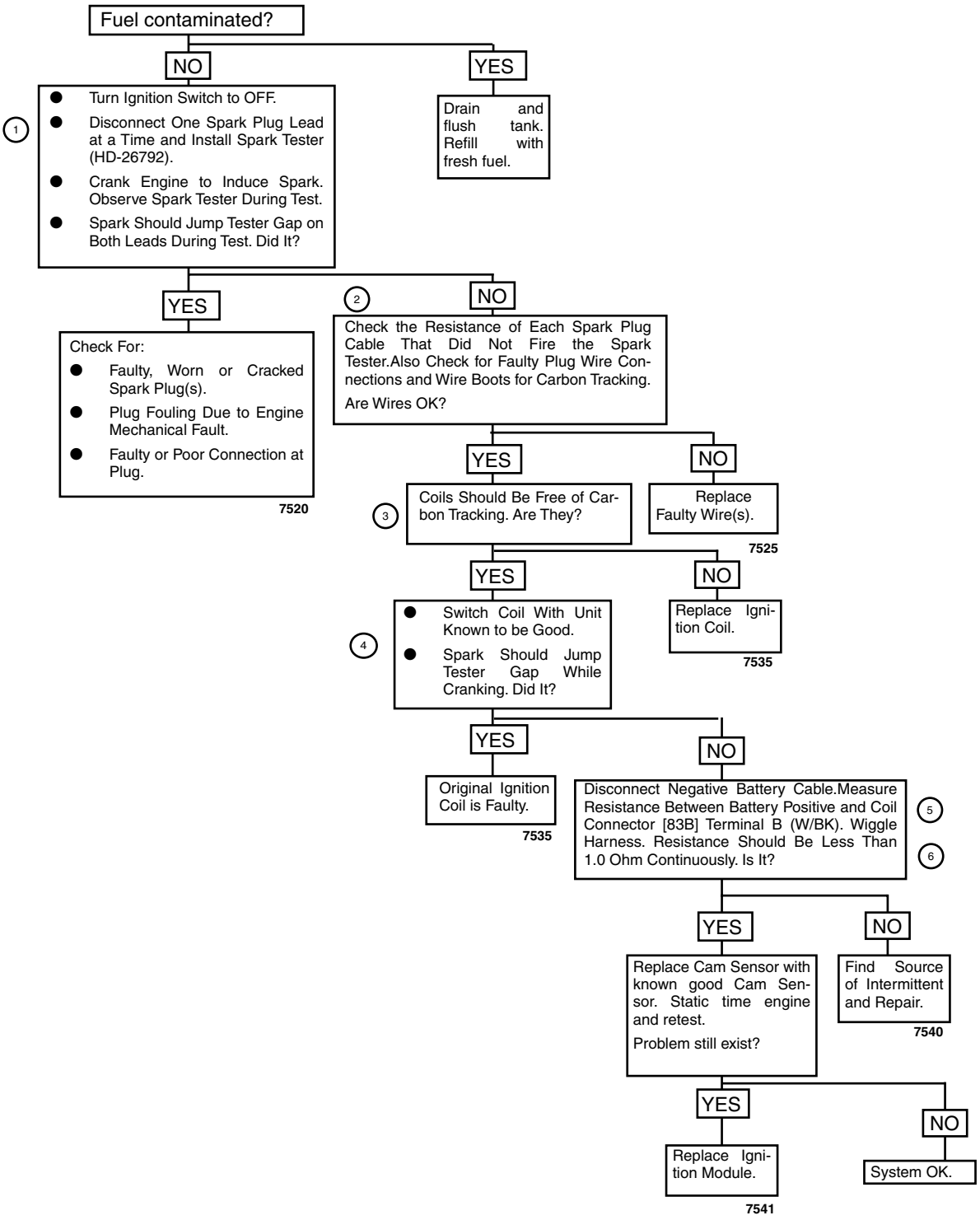
Figure 4-28. Ignition Coil Circuit Diagram

Table 4-12. Wire Harness Connectors in Figure 4-28.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module (black)	12-place Deutsch	under seat
[22]	Right handlebar switch (black)	6-place Deutsch	near headlamp
[83]	Coil	3-place Packard	below fuel tank

Test 4.13

MISFIRE AT IDLE OR UNDER LOAD



NOTES

GENERAL

MAP Sensor

The Manifold Absolute Pressure Sensor (MAP Sensor) is supplied 5 volts from the Ignition Module and sends a signal back to the Ignition Module which varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

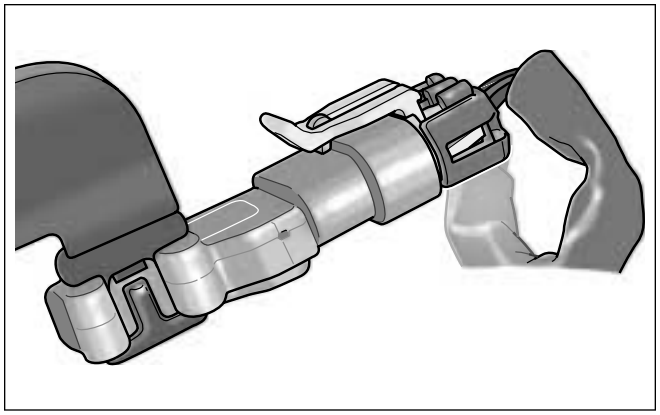


Figure 4-29. MAP Sensor

DIAGNOSTICS

Diagnostic Tips

- DTC 12 will set if the MAP Sensor signal is out of range or fluctuates faster than normal operation.
- With the MAP Sensor disconnected, the Ignition Module and Scanalyzer should recognize a low voltage. If low voltage is observed, the Ignition Module and harness are not at fault.
- Gently place a jumper wire across MAP Sensor connector [80B] terminals 1 and 2 using Harness Connector Test Kit (HD-41404), grey male probes and patch cord. With the MAP Sensor connector jumper in place, the Ignition Module and Scanalyzer should recognize a high voltage. MAP Sensor Output Check. Using the vacuum pump (HD-23738A), apply a vacuum to the pressure port of the MAP Sensor. The signal voltage should lower as the vacuum is applied.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.14 flow charts.

1. Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See 4.6 BREAKOUT BOX: 1200S ONLY.
2. See 4.7 WIGGLE TEST for more information.
3. See MAP SENSOR, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).
4. See IGNITION MODULE REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).
5. Use Harness Connector Test Kit (HD-41404), grey pin probes and patch cords.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

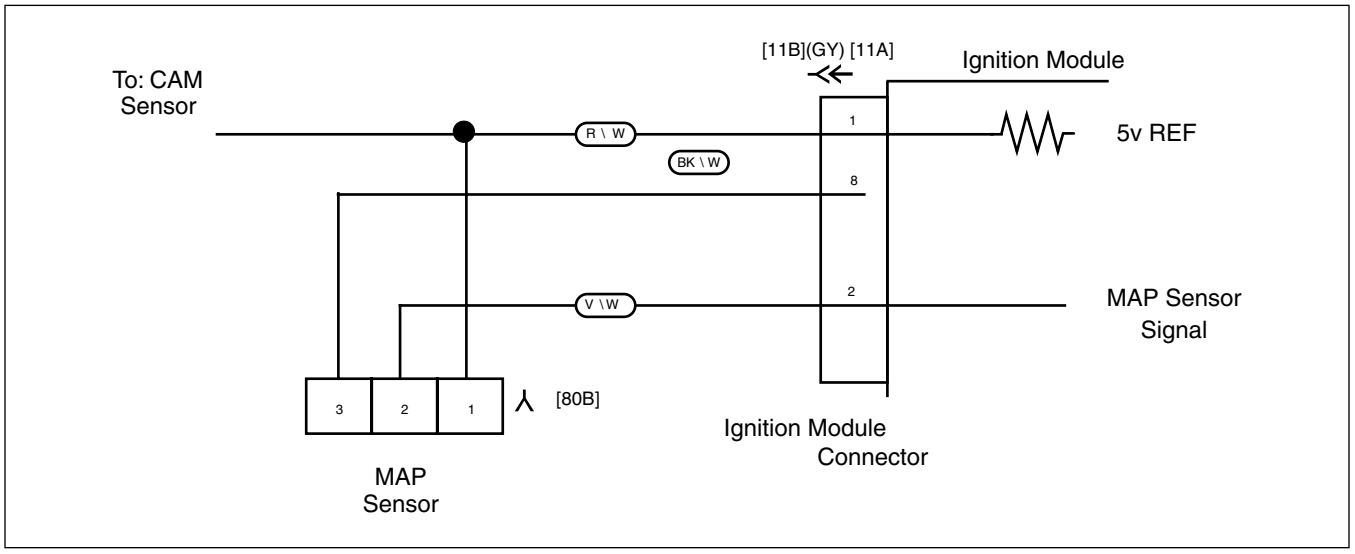
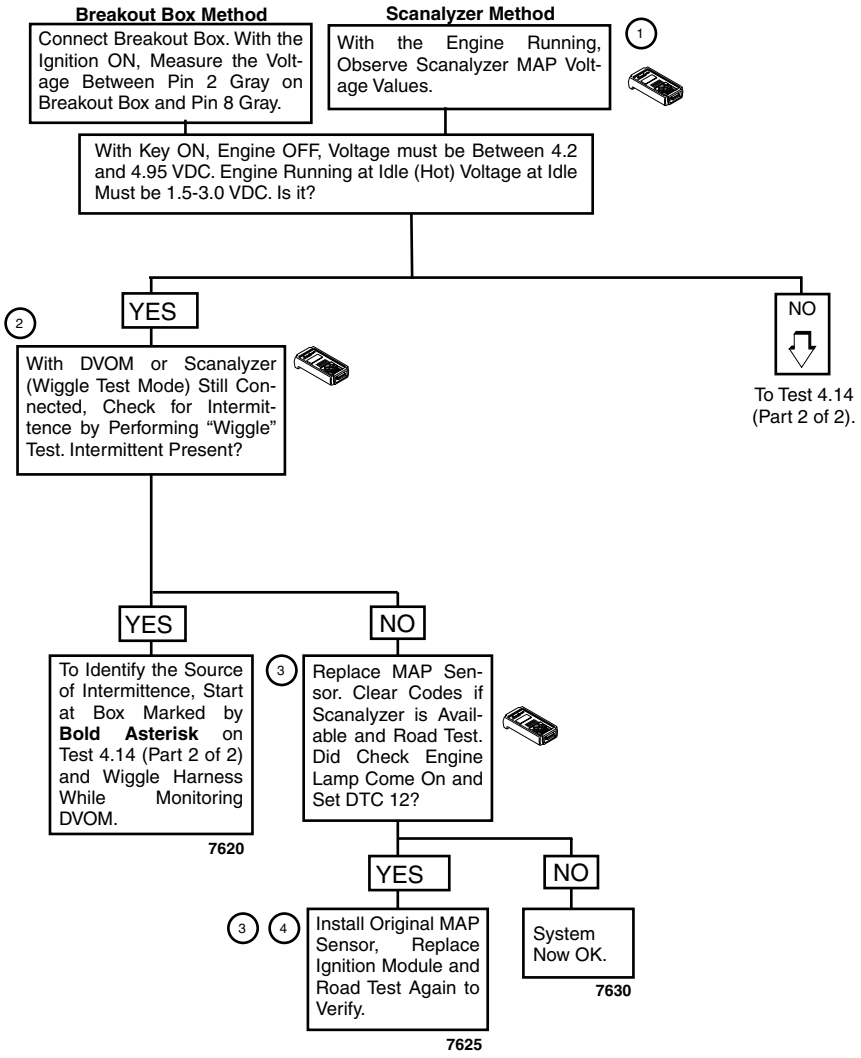


Figure 4-30. MAP Sensor Circuit Diagram

Test 4.14 (Part 1 of 2)

MAP SENSOR: DTC 12



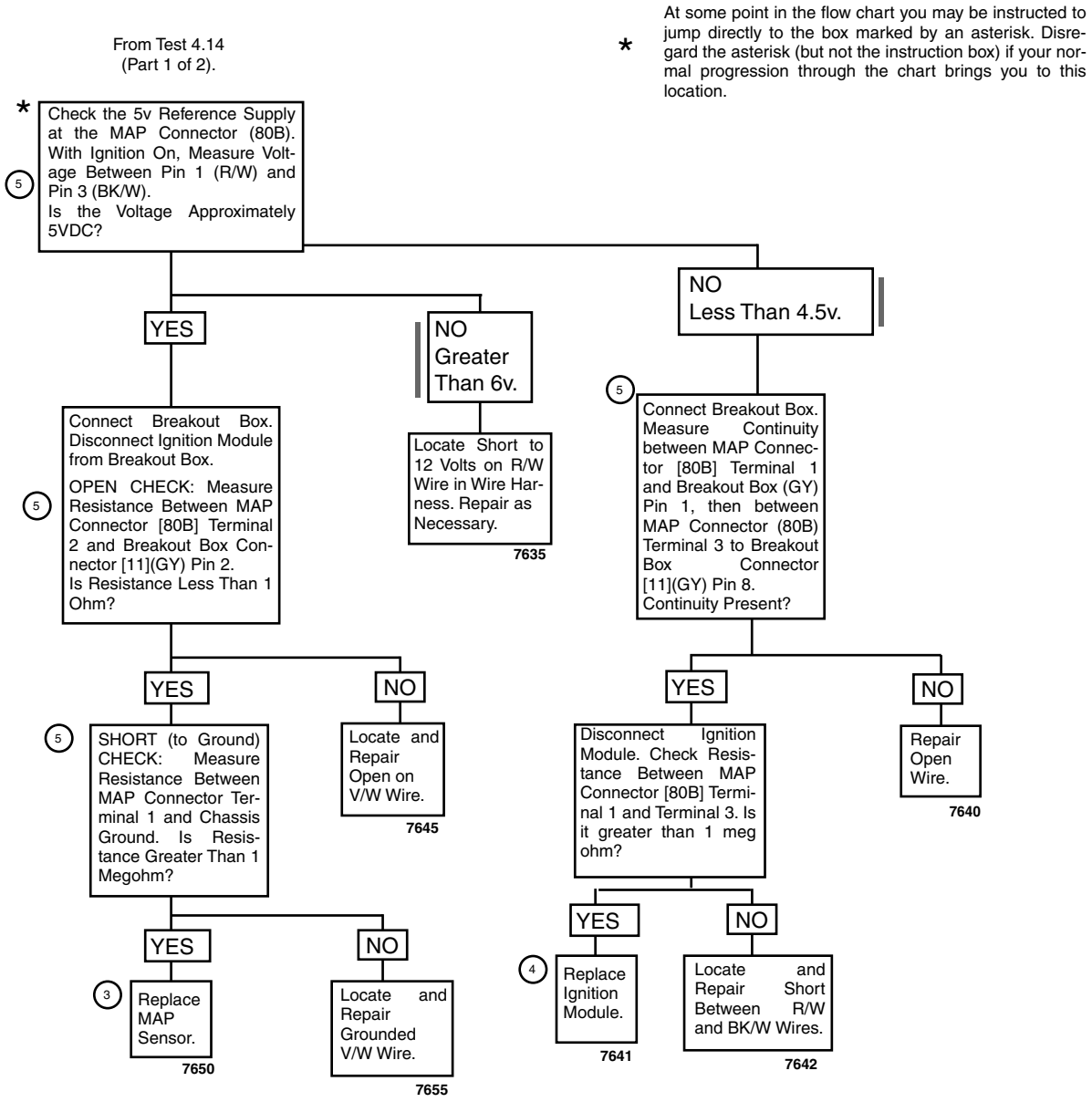
Clear codes and confirm proper operation with no check engine lamp.

Table 4-13. Wire Harness Connectors in Figure 4-30.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module	12-place Deutsch (BK)	under seat
[11]	Ignition module	12-place Deutsch (GY)	under seat
[80]	MAP Sensor	3-place Amp	under fuel tank

Test 4.14 (Part 2 of 2)

MAP SENSOR: DTC 12



Clear codes and confirm proper operation with no check engine lamp.

GENERAL

Positive Battery Voltage

A DTC 16 is set if the Ignition Module sees battery positive voltage less than 8 or greater than 16 volts. Low voltage generally indicates loose wire and/or corroded connections or a charging system problem. A high voltage condition may be caused by a faulty voltage regulator.

DIAGNOSTICS

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used.

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.15 flow charts.

1. Was battery allowed to discharge? Was battery drawn down by starting problem?
   a. Yes, Change battery.
   b. No - See Charging System Troubleshooting in Section 1 of this Service Manual.
2. Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See 4.6 BREAKOUT BOX: 1200S ONLY.
3. The Ignition Module is monitoring voltage at Ignition Module connector [10](BK) Pin 1.
4. This checks for voltage drops in the Ignition Module power circuit.
5. See 4.7 WIGGLE TEST for more information.
6. See FUSES, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).

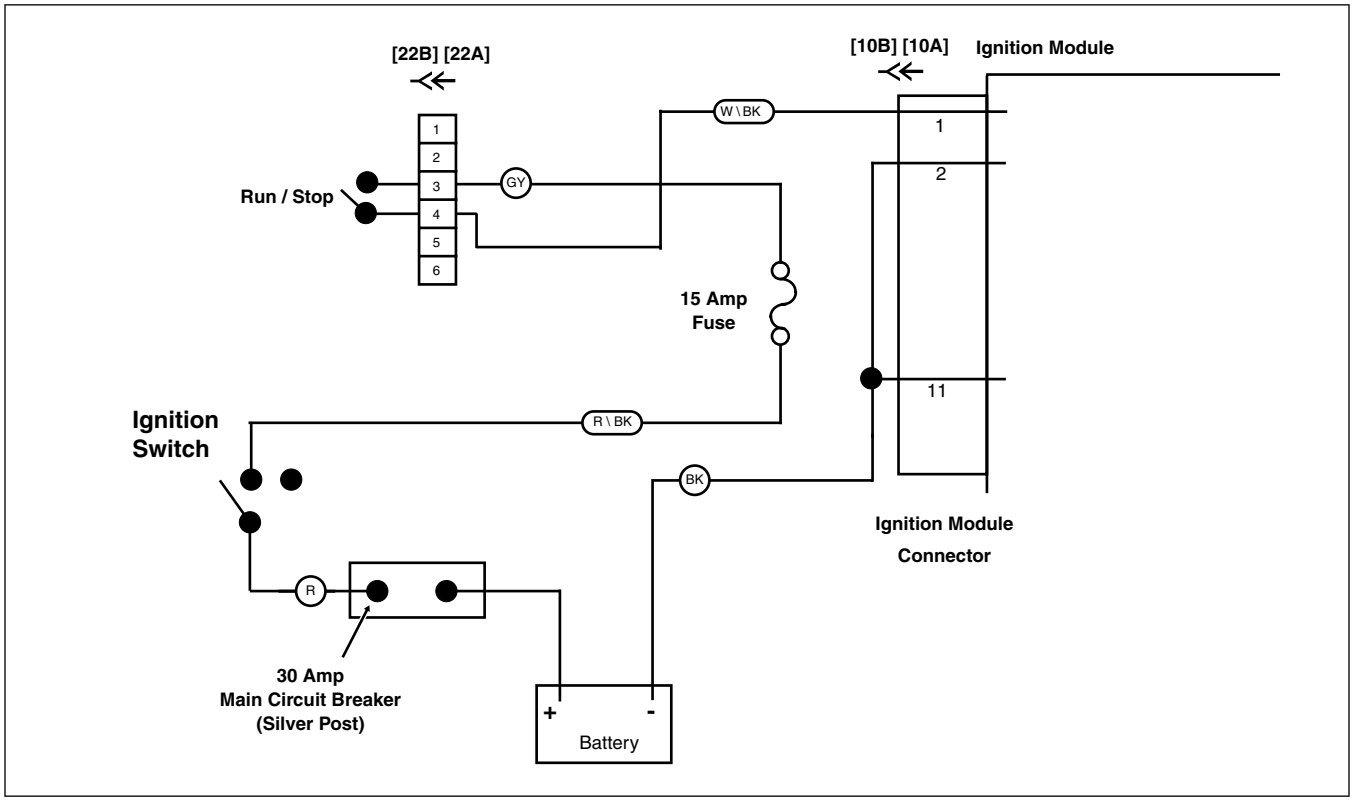


Figure 4-31. Battery Voltage Circuit Diagram

Test 4.15 (Part 1 of 2)

BATTERY POSITIVE VOLTAGE: DTC 16

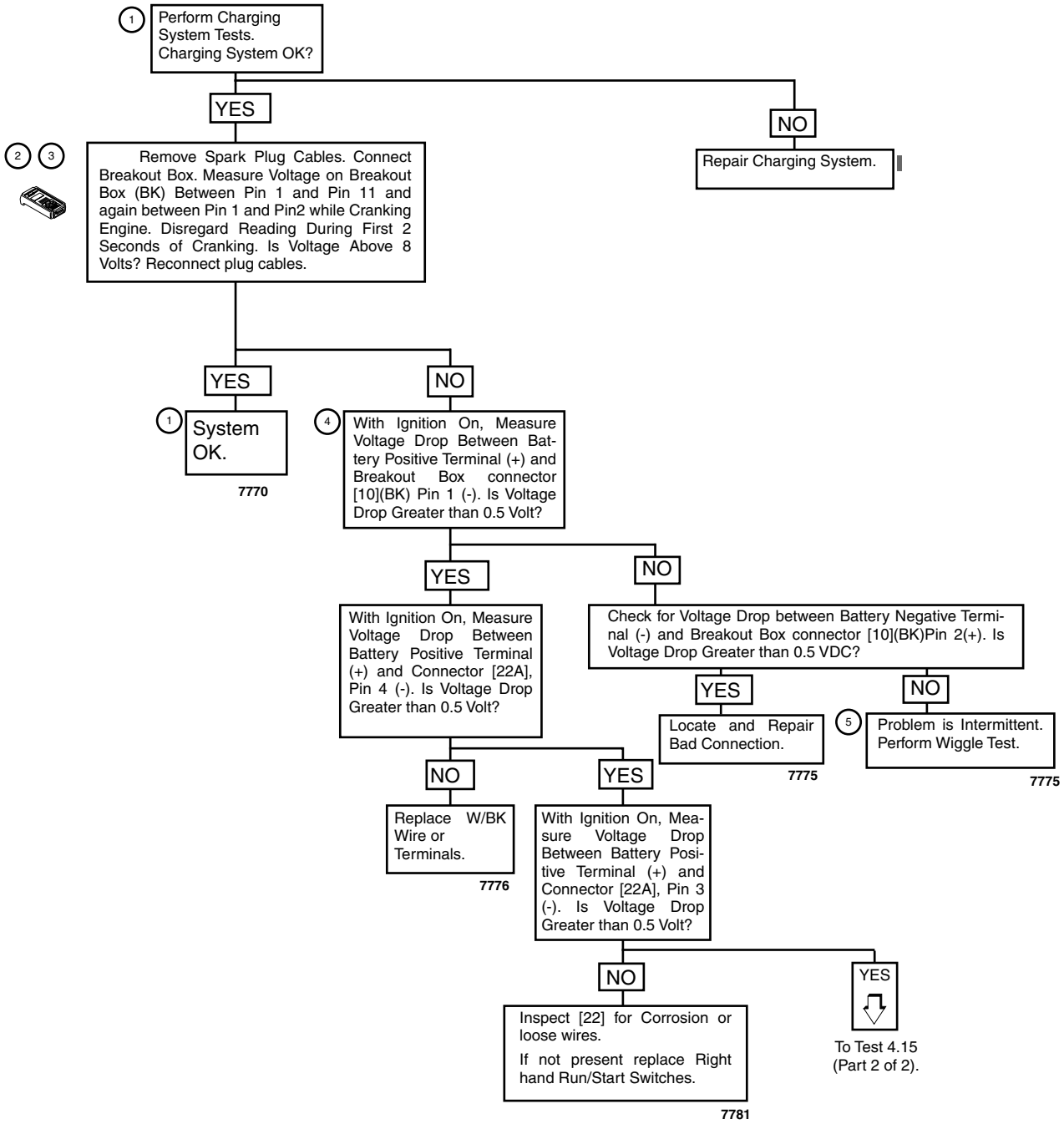
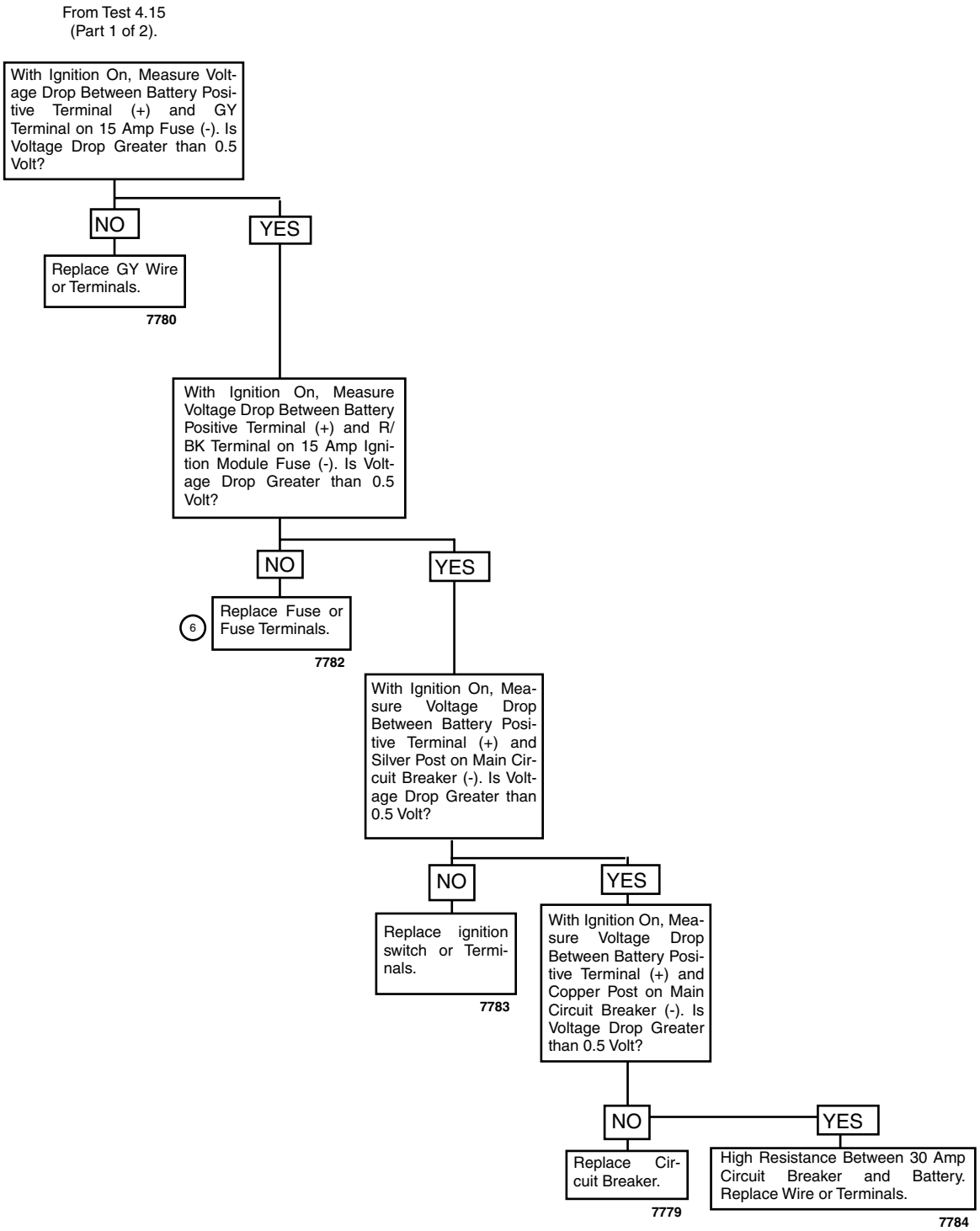


Table 4-14. Wire Harness Connectors in Figure 4-31.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition module	12-place Deutsch (BK)	under seat

Test 4.15 (Part 2 of 2)

BATTERY POSITIVE VOLTAGE: DTC 16



Clear codes and confirm proper operation with no check engine lamp.

GENERAL

Front Coil (DTC 24) and Rear Coil (DTC 25)

A DTC 24 or 25 will set if the ignition coil voltage is out of range. This could occur if there is an open coil or loss of power to the coil. The coil receives power from the Run/Stop Switch.

The Ignition Module is responsible for turning the coils on by providing the ground to activate the coils, which in turn powers the coils. If both codes are set, it is likely a coil power failure or a coil failure.

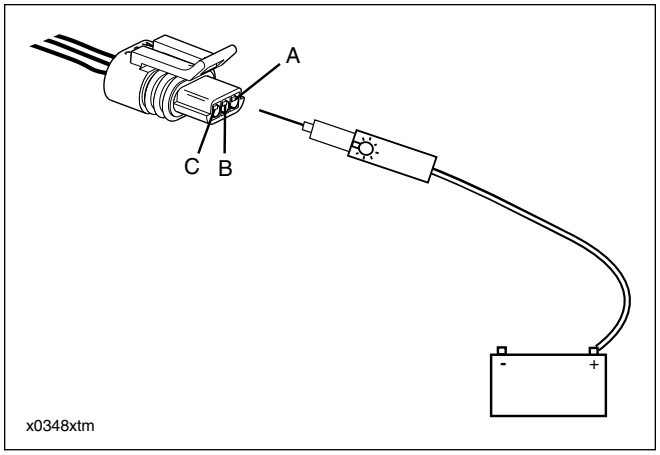


Figure 4-32. Ignition Coil Test Lamp

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.16 flow charts.

1. See Figure 4-32. Use Test Lamp as shown.
2. See IGNITION COIL, REMOVAL/INSTALLATION in the 2002 Sportster Service Manual (Part No. 99484-02).
3. Use Harness Connector Test Kit (HD-41404), gray pin probe and patch cord.
4. Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See 4.6 BREAKOUT BOX: 1200S ONLY.
5. See 4.7 WIGGLE TEST for more information.

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow below.

1. With the engine off, Scanalyzer (Active Diagnostic Test Mode) can be used to energize either the front or rear coil once each second for a total of 5 seconds.

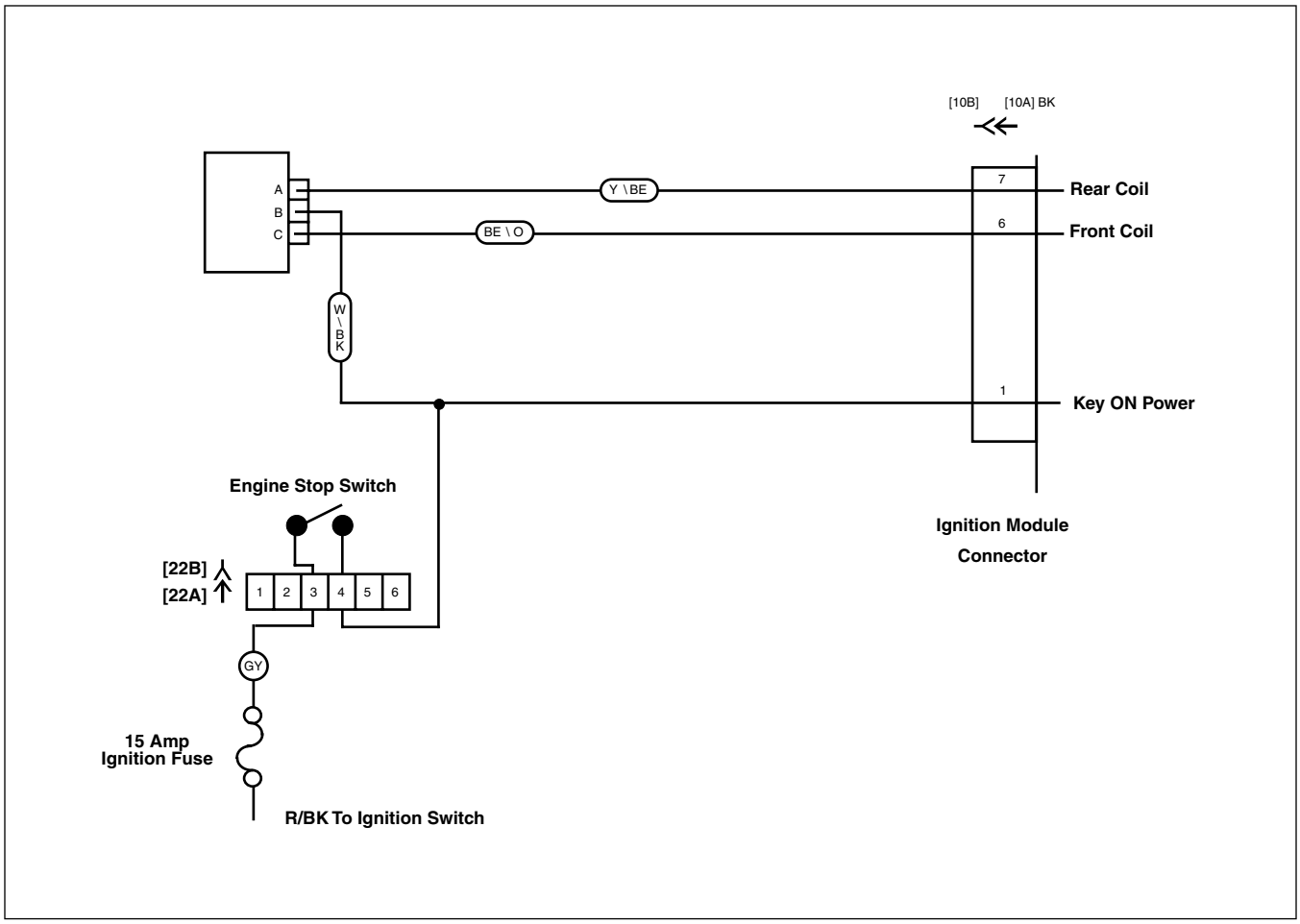


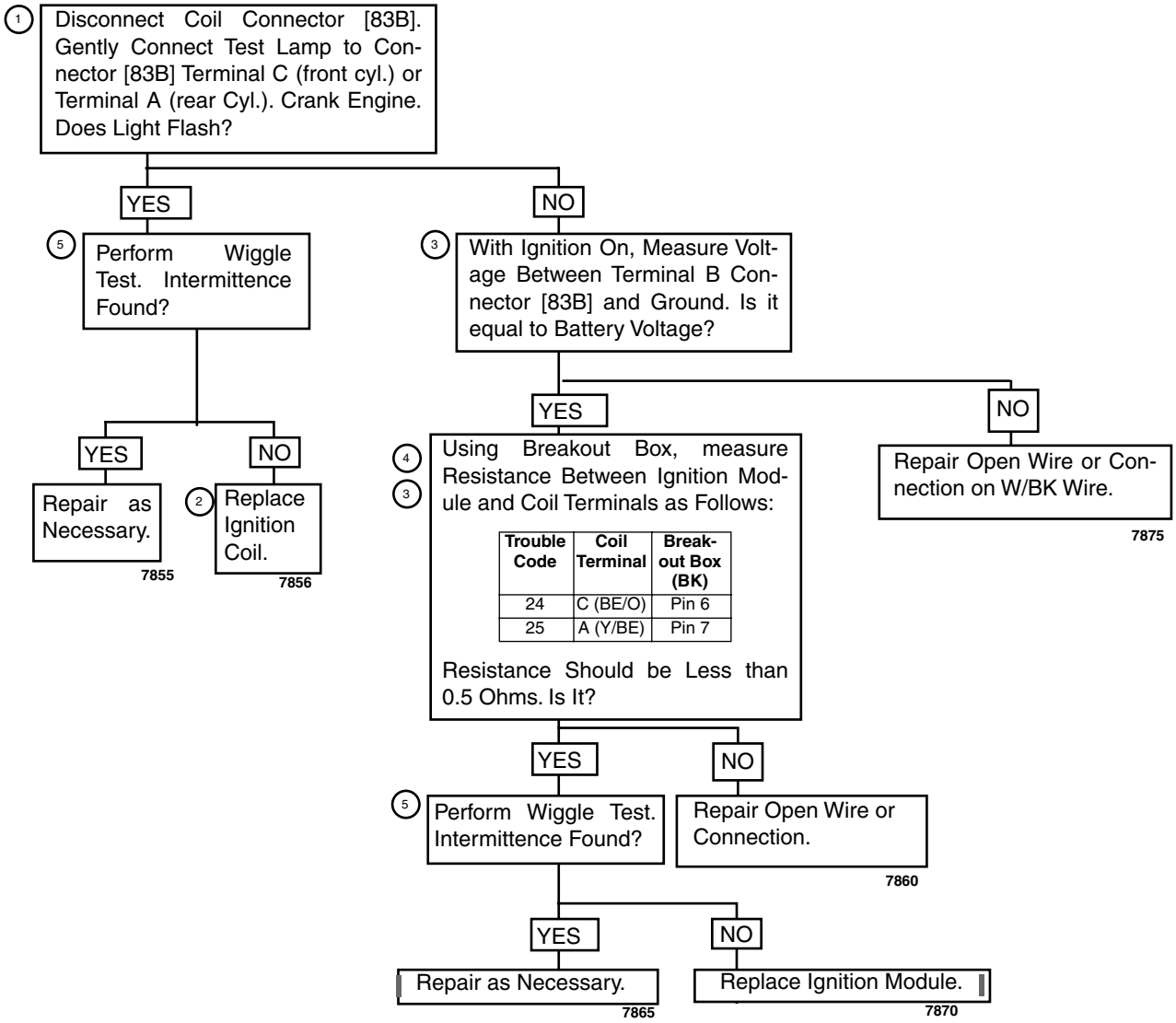
Figure 4-33. Ignition Coil Circuit Diagram

Table 4-15. Wire Harness Connectors in Figure 4-33.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Rt. Handlebar Switch	6-place Deutsch (BK)	inside headlamp housing
[83]	Ignition Coil	3-place Amp	below fuel tank

Test 4.16

IGNITION COIL: DTC 24 (FRONT), DTC 25 (REAR)



GENERAL

Tachometer

DTC 35 will set if the PK wire is shorted to power or ground.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.17 flow charts.

1. Connect Breakout Box (HD-42682) between wire harness and Ignition Module. See 4.6 BREAKOUT BOX: 1200S ONLY.
2. See 4.7 WIGGLE TEST for more information.
3. See TACHOMETER, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).
4. See IGNITION MODULE, REMOVAL/INSTALLATION, in the 2002 Sportster Service Manual (Part No. 99484-02).

Scanalyzer Notes

The Scanalyzer icon appears at those points in the flow chart where the Scanalyzer can be used. If a number is printed next to the icon, then refer to the **Scanalyzer Notes** which follow below.

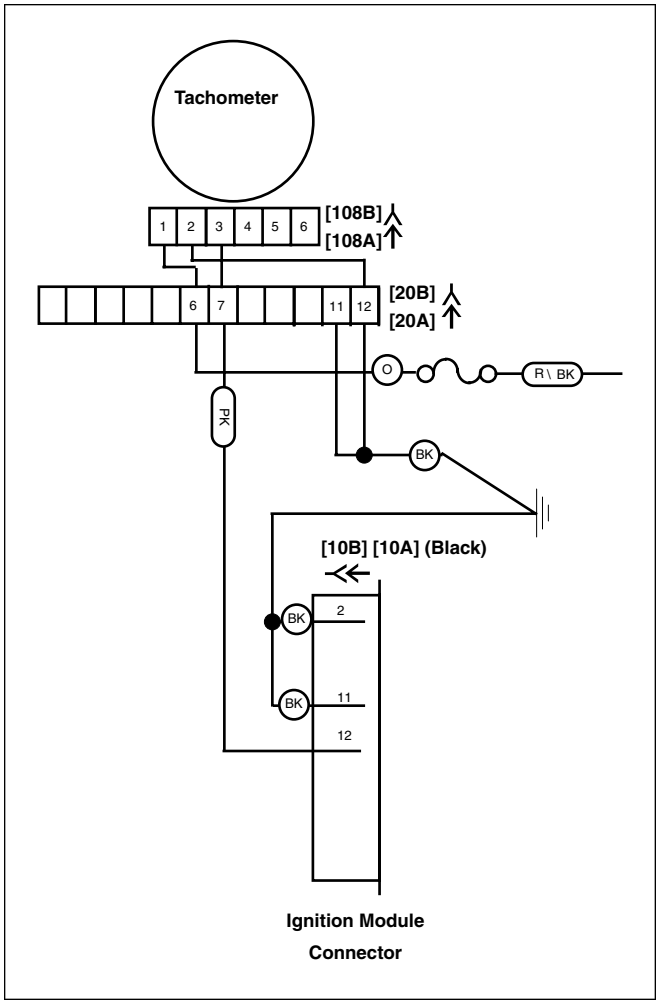


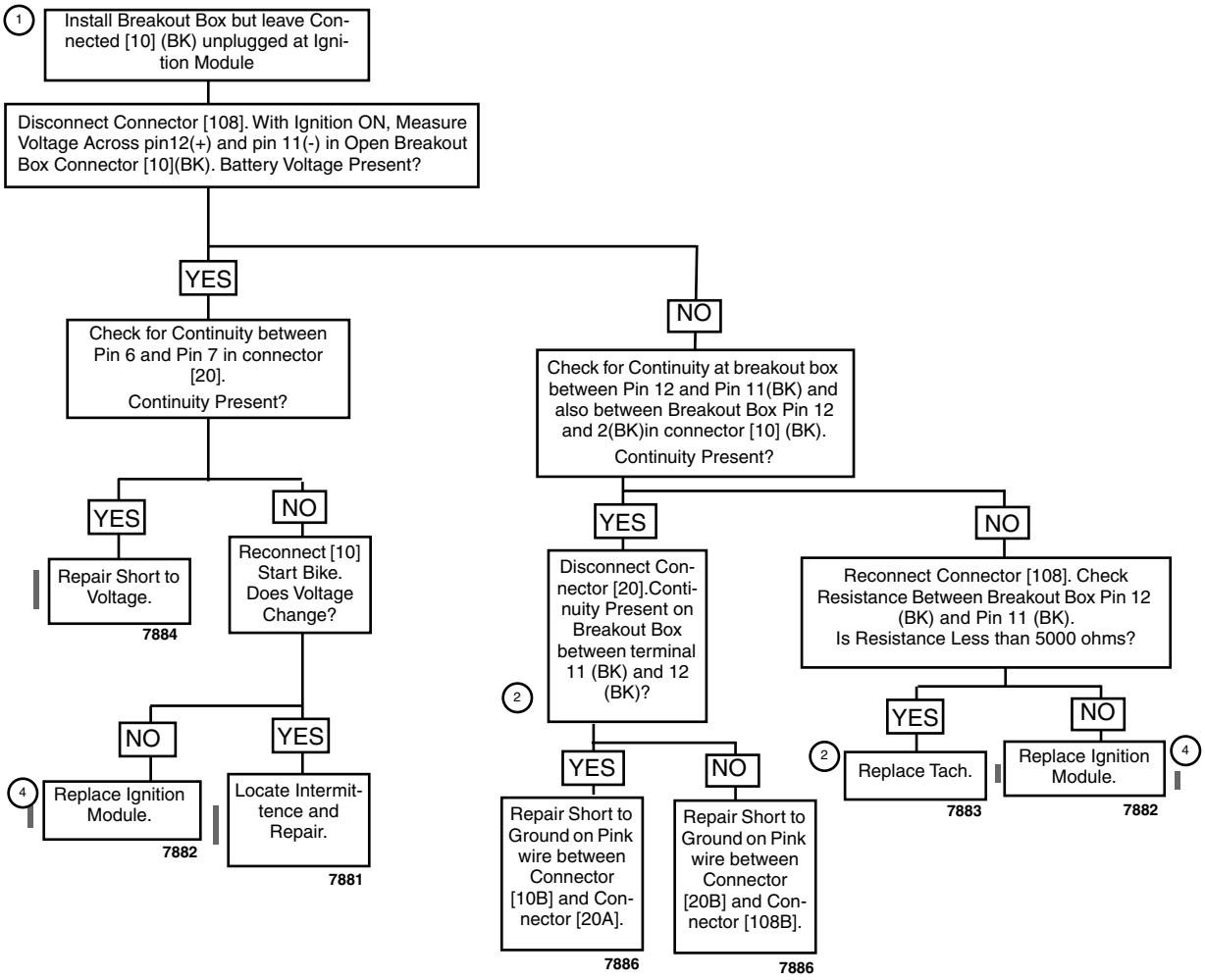
Figure 4-34. Tachometer Circuit Diagram

Table 4-16. Wire Harness Connectors in Figure 4-34.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition Module	12-place Deutsch (BK	below fuel tank
[20]	Instruments	12-place Multi-lock	under headlamp bracket
[108]	Tachometer	6-place Packard	back of tachometer

Test 4.17

TACHOMETER: DTC 35



Clear codes and confirm proper operation with no check engine lamp.

GENERAL

Bank Angle Sensor

This code occurs when the Bank Angle Sensor voltage is outside of the normal operating range. This may be caused by a short to ground, or voltage in the harness between the ignition module and the Bank Angle Sensor, or a failed Bank Angle Sensor.

If this code occurs, the engine may stop running. The engine may still be restarted and ridden to the dealership for repair.

DIAGNOSTICS

Diagnostic Notes

The reference numbers below correlate with the circled numbers on the Test 4.18 flow charts.

1. Use Harness Connector Test Kit (HD-41404), gray pin probe and patch cord.

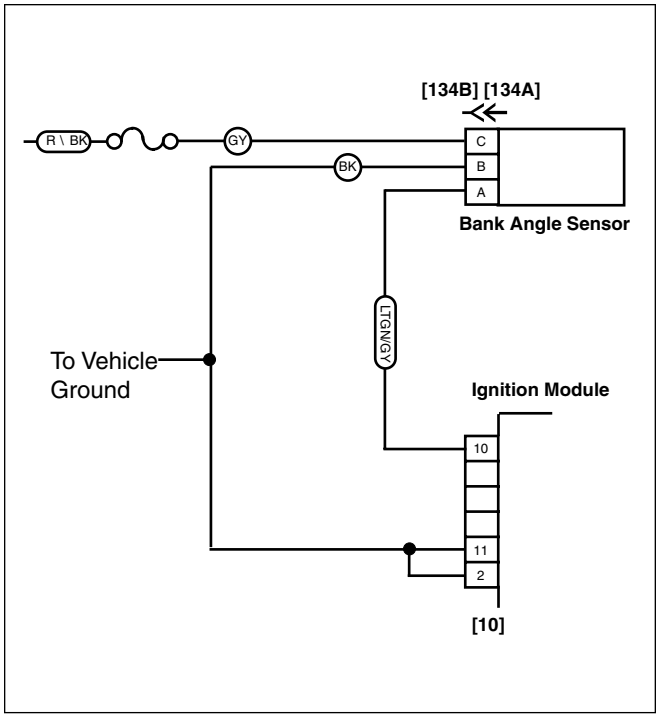


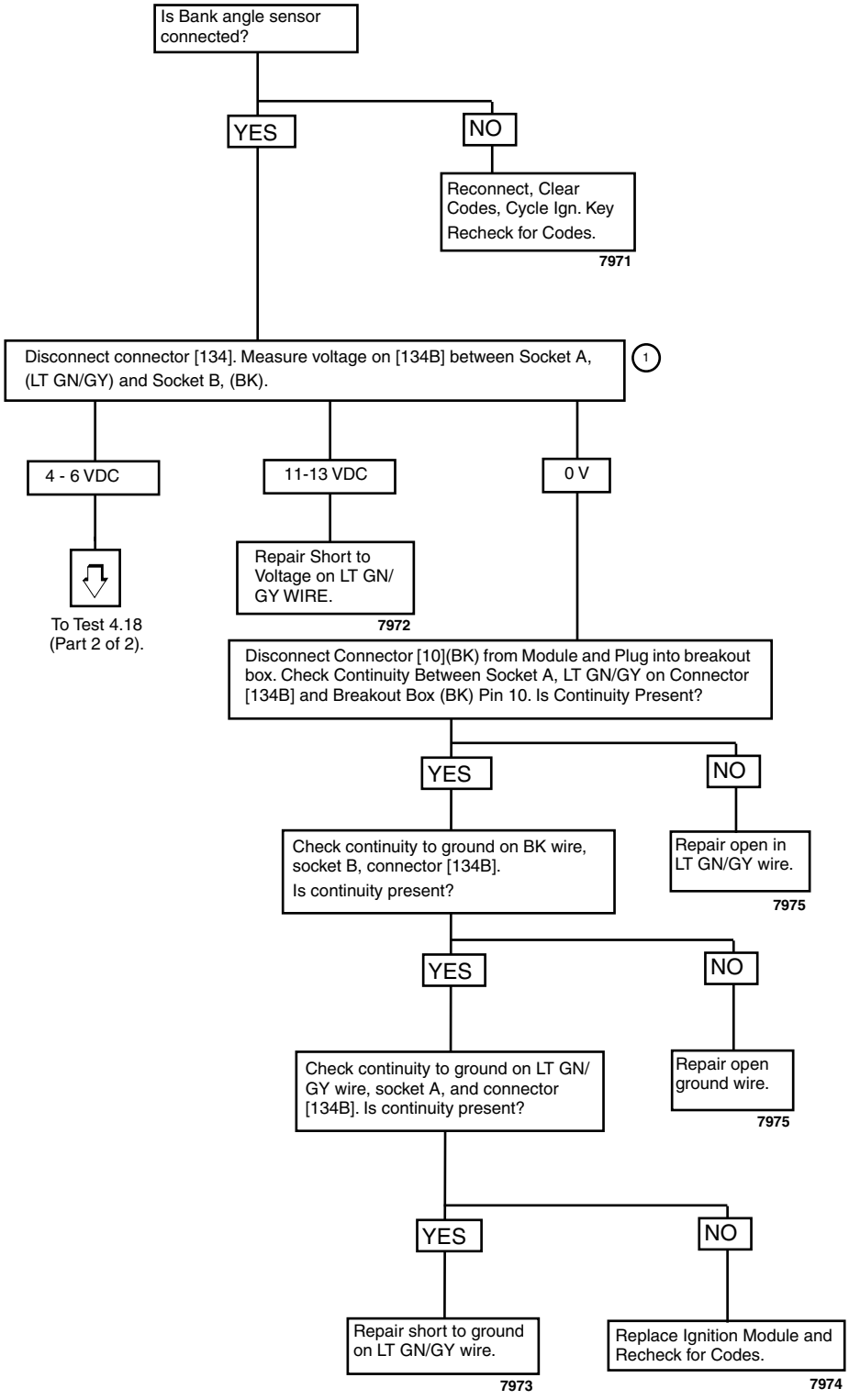
Figure 4-35. Bank Angle Sensor Circuit

Table 4-17. Wire Harness Connectors in Figure 4-35.

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Ignition Module	12-place Deutsch (BK	below fuel tank
[134]	Bank Angle Sensor	3-place Packard	under left side cover

Test 4.18 (Part 1 of 2)

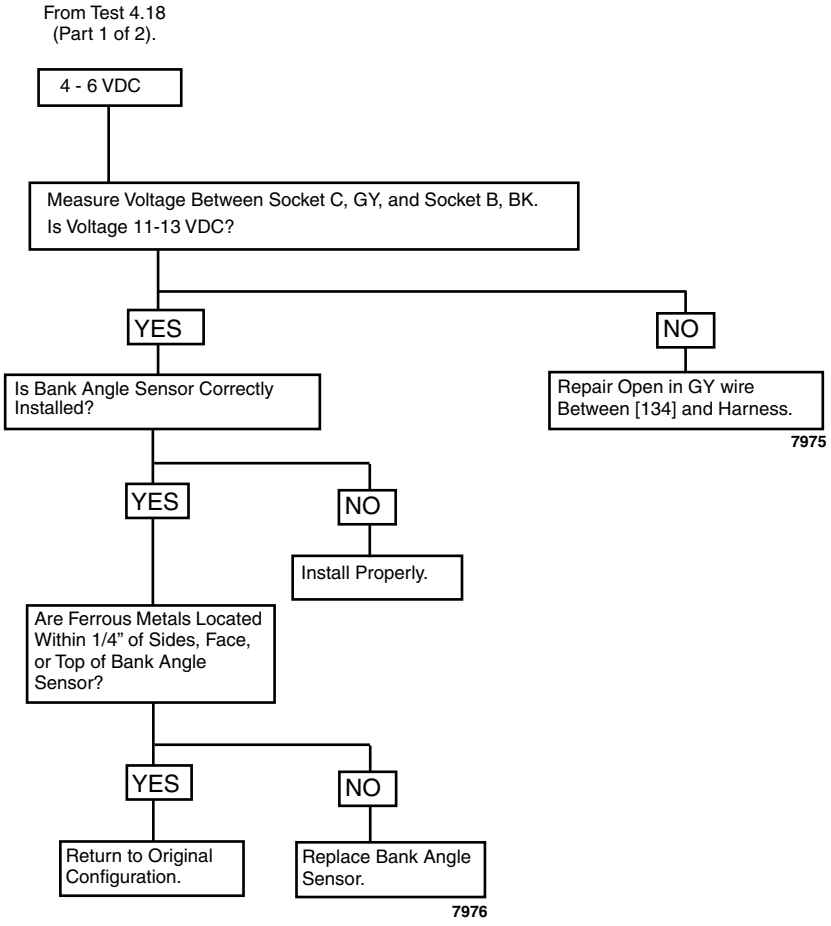
BANK ANGLE SENSOR: DTC 44



Clear codes and confirm proper operation with no check engine lamp.

Test 4.18 (Part 2 of 2)

BANK ANGLE SENSOR: DTC 44



Clear codes and confirm proper operation with no check engine lamp.

GENERAL

Ignition Module

All of the following codes indicate an internal failure which requires replacement of the Ignition Module.

- DTC 52 - RAM Failure
- DTC 53 - ROM Failure
- DTC 54 - EE PROM Failure
- DTC 55 - Module Microprocessor Malfunction

See IGNITION MODULE REMOVAL/INSTALLATION in the 2002 Sportster Service Manual (Part No. 99484-02).

NOTE

*Dealership technicians filing warranty claims should use job/time code **7913** for all Code 52, 53, 54 and 55 ignition module replacements.*

GENERAL

Perform the following tests if the engine will not start, or if hard starting or missing indicates a faulty operating ignition system

DIAGNOSTICS

Check for Ignition 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 end and establish a 3/16 inch (4.8 mm) gap between adapter and cylinder head.
3. Turn ignition ON and engine stop switch to RUN. With transmission in neutral, press engine start button. Check for a spark across plug electrode gap.
   a. If a spark is produced, problem is not in electronic system or coil – check carburetion, enrichener and spark plugs.
   b. If no spark is produced, check battery voltage and battery connection condition. Battery voltage must be 11-13 volts. Charge battery if voltage is low.
4. Verify that the ground wire from battery to frame is in good condition. If there is still no spark, then perform the tests under NO IGNITION SPARK.

No Ignition Spark

See Figure 4-36. To conduct the following tests, it will be necessary to assemble a set of jumper wires. Cut two wires of ample length to reach from a good ground connection to the negative terminal of the coil primary. If a suitable capacitor is not available, use a condenser (such as the type used in earlier breaker point ignition systems).

When conducting the following spark tests, connect a spare spark plug to one of the plug wires and lay the spark plug on the engine cylinder head. During the testing procedures, check for spark across the spark plug electrodes.

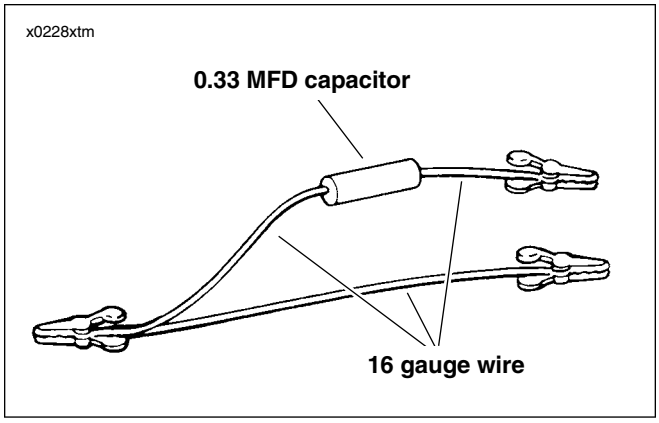


Figure 4-36. Test Jumper

Table 4-18. Wire Harness Connectors in Figure 4-37.

NO.	DESCRIPTION	TYPE	LOCATION
[22]	Right handlebar switch (black)	6-place Deutsch	in headlight (under riser cover on XL1200C and XL 883C)

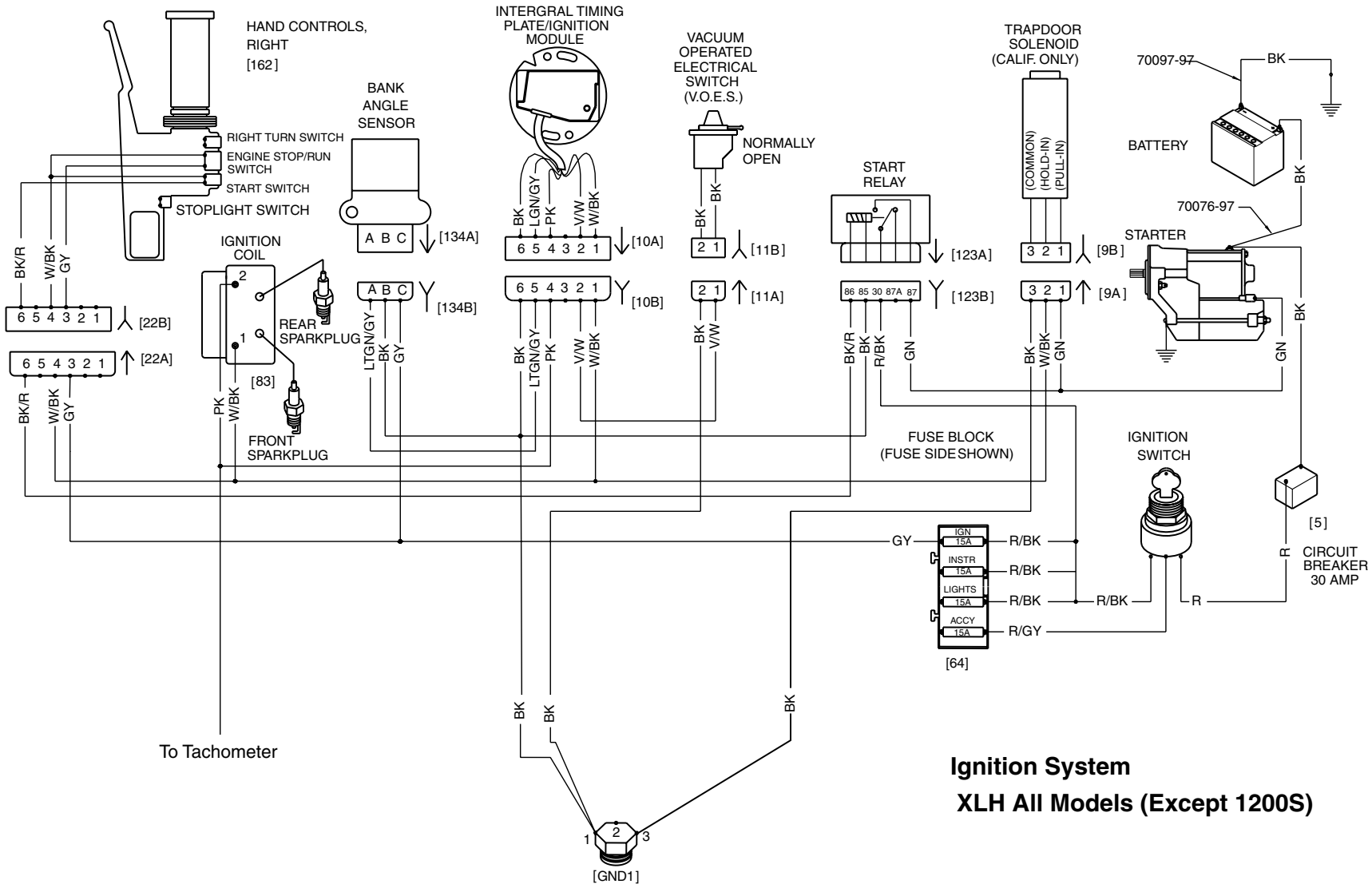
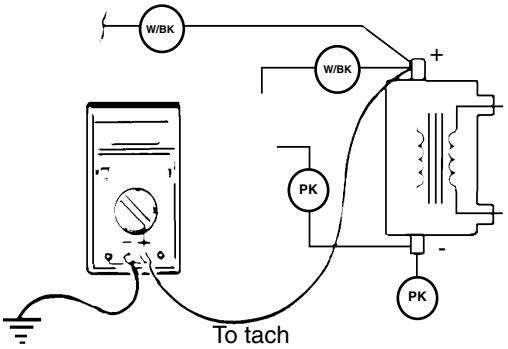


Figure 4-37. Ignition System: All But 1200S

Test 4.20 (Part 1 of 5)

CONTINUOUS OR NO SPARK AT SPARK PLUG: ALL EXCEPT 1200S



•Ignition On.
•Multimeter Red Wire To White/Black Wire On Coil, Black Wire To Ground.
•Meter Should Register 12v ± One Volt.

YES

STOP

Go to Test 4.20 (Part 2 of 5).

NO

Check Ign. Fuse Is Fuse Ok?

YES

Power To Gray Wire In Fuse block?

YES

Measure Voltage At Connector [22A] Pin 3 (GY). Battery Voltage Present?

YES

With Connector [22] Mated And Ignition On, Measure Voltage At Connector [22A], Pin 5 (W/BK). Battery Voltage Present?

YES

Repair Open (W/BK) Wire Between Coil and [22A].

5002

NO

Repair / Replace Engine Stop Switch or Wiring.

5173

NO

Replace - Find Source Of Fault.

5001

NO

Check For 12VDC Between Battery, Main Breaker, Ignition Switch And Fuse Block. Repair As Necessary.

5001

NO

Repair Open (GY) Wire Between [22] and Fuse.

5002

NO

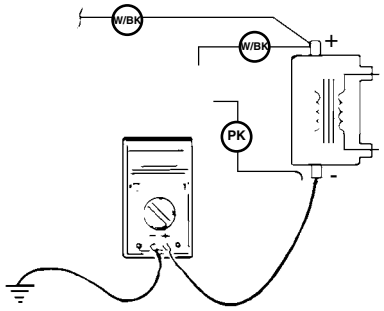
Test 4.20 (Part 2 of 5)

CONTINUOUS OR NO SPARK AT SPARK PLUG: ALL EXCEPT 1200S

From Test 4.20 (Part 1 of 5).

•Remove Pink (Module) Wire From Coil Terminal.
•Ignition Switch On.
•Multimeter Red Lead Alternately To White/Black Wire Terminal And To (PK) Wire Terminal.

12VDC at both terminals?



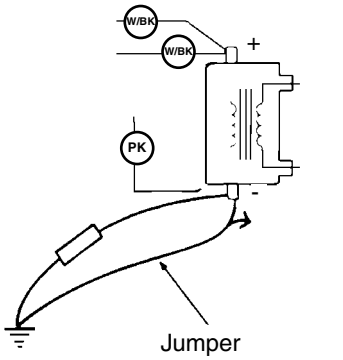
YES

NO

Replace coil.

5010

• Pink (Module) Wire Disconnected.
• Ignition On.
• Jumper Wire – Connect Capacitor Wire To Pink Wire Terminal.*
• Connect Both Wires To Common Ground.
• Momentarily Touch Ground Wire To Pink Wire Terminal.
Is There A Spark At Plug When You Remove The Wire?



*Perform Coil Resistance Check If Capacitor Is Not Available

YES

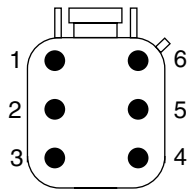
NO

Replace Coil.

5012

• Reconnect (PK) Wire.
• Disconnect 6-pin Connector [10].
• Ignition Switch On.
• Multimeter Red Lead To (W/BK) Wire (Pin 1) Terminal.
• Multimeter Black Lead To BK (Pin 6) On [10B].
• Multimeter Should Register 12VDC ± 1.0 VDC.

[10]



NO

YES

STOP

Check Continuity Between Pin 1 W/BK [10B] And Coil W/BK Wire.
Continuity Present?

YES

NO

Repair Open Between [10B] Pin 6 (BK) And Ground.

5003

Repair Open In W/BK Wire.

5003

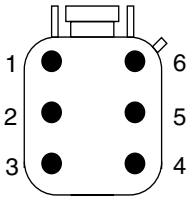
Go to Test 4.20 (Part 3 of 5).

Test 4.20 (Part 3 of 5)

CONTINUOUS OR NO SPARK AT SPARK PLUG: ALL EXCEPT 1200S

From Test 4.20 (Part 2 of 5).

• Ignition On.
• Measure Voltage At Connector [10B] - Multimeter Red Lead To Pin 4 (PK) And Black Lead To Pin 6 (BK).
Is 12VDC ± 1.0 VDC Present?



YES

NO

Check Wire Continuity Between Connector [10B] Pin 4 (PK) And Coil Terminal (PK).
Continuity Present?

YES

NO

Locate And Repair Short To Ground On (PK) Wire.

5003

Repair Open (PK) Wire.

5003

Install 6-pin Harness Adapter (HD-42962) and Breakout Box using Black connectors Between Connectors [10A] And [10B].
Measure Voltage Between LTGN/GY (Pin 5) And BK (Pin 6).
Is Voltage 0.6-1.1 VDC?

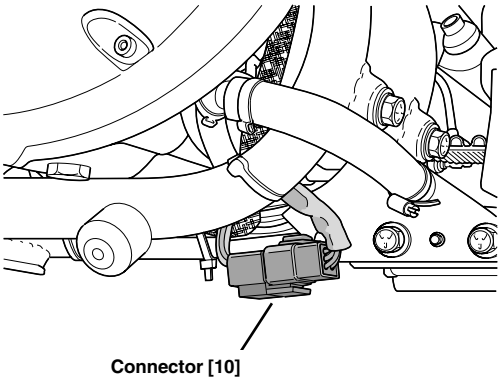
YES

NO

Remove Timer Cover.
Crank Engine.
Is Led Flashing?

STOP

Go to Test 4.20 (Part 4 of 5).



Connector [10]

YES

NO

Replace Ignition Module.

5009

Is Rotor Cup Rotating?

YES

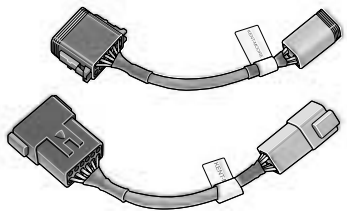
NO

Replace Ignition Module.

5009

Remove Gearcase Cover.
Inspect For Mechanical Failure.
Repair.

5005



Harness Adapters (HD-42962)

Test 4.20 (Part 4 of 5)

CONTINUOUS OR NO SPARK AT SPARK PLUG: ALL EXCEPT 1200S

From Test 4.20 (Part 3 of 5).

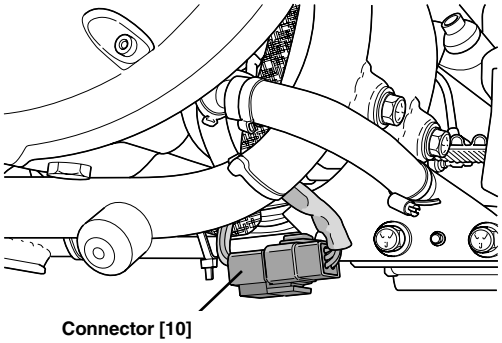
Is Bank Angle Sensor Connected?

- NO → Reconnect. 5004
- YES

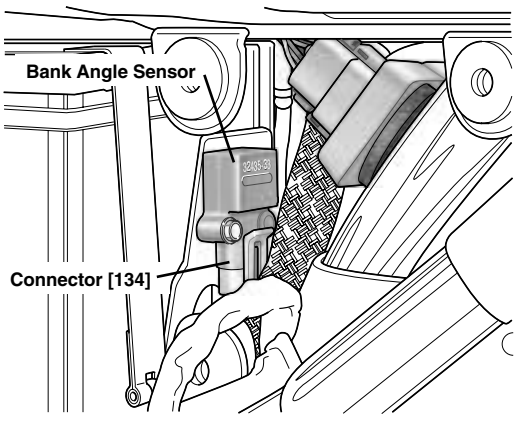
Remove Bank Angle Sensor. Disconnect Connector [134]. Measure Voltage On [134B] Between Socket A, LT GN/GY And Socket B, Bk.

* To avoid damage to terminals, remove Bank Angle Sensor before disconnecting connector [134]. Use Harness Connector Adapter Kit HD-41404,Gray male probe and patch cord

- 3.0-3.5 VDC → STOP
  Go to Test 4.20 (Part 5 of 5).
- 11-13 VDC → Repair Short On LT GN/GY Wire. 5007
- 0 VDC → Disconnect Connector [10]. Check Continuity Between Socket A, LT GN/GY On Connector [134B] And Socket 5, LT GN/GY On Connector [10B]. Continuity Present?
  - NO → Repair Open In LT GN/GY Wire. 5007
  - YES → Check Continuity To Ground On BK Wire, Socket B, Connector [134B]. Is Continuity Present?
    - NO → Repair Open Ground Wire. 5007
    - YES → Check Continuity To Ground On LT GN/GY Wire, Socket A, Connector [134B] Or [10B]. Is Continuity Present?
      - YES → Repair Short To Ground On LT GN/GY Wire. 5007
      - NO → Inspect Module Harness For Damage. Repair If Necessary. If Harness Is Not Damaged, Replace Ignition Module. 5009

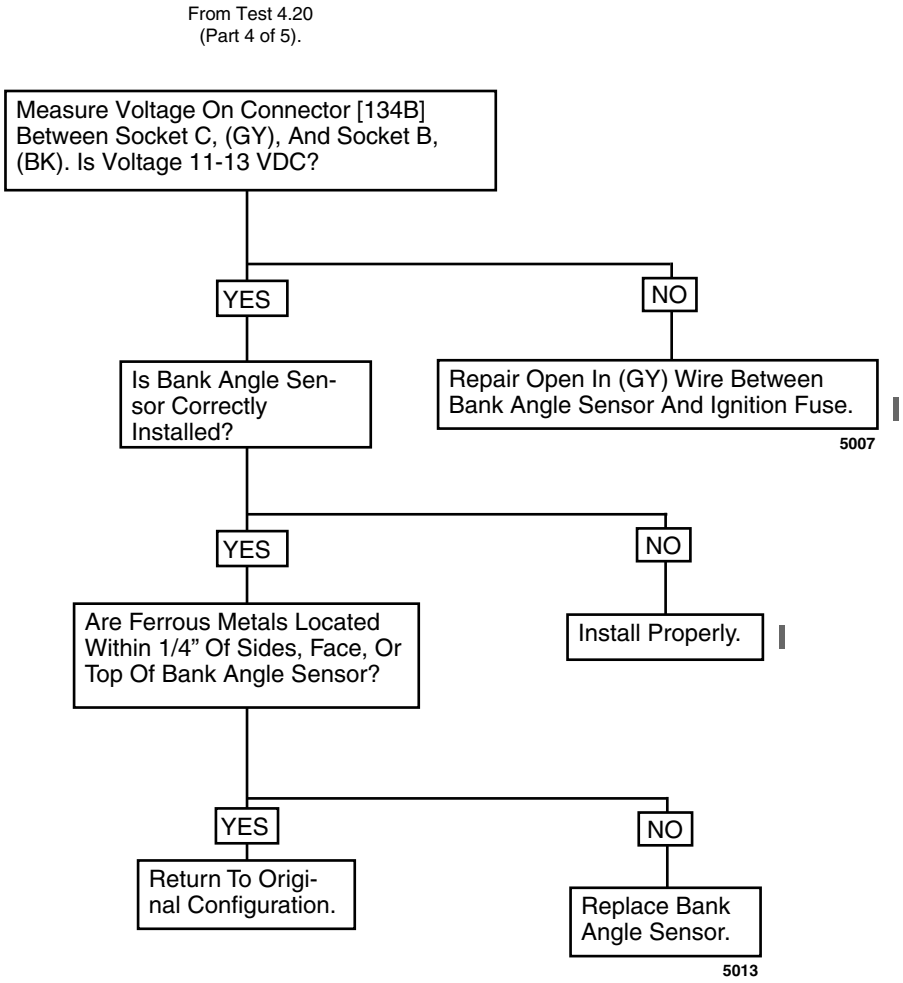


Connector [10]



Test 4.20 (Part 5 of 5)

CONTINUOUS OR NO SPARK AT SPARK PLUG: ALL EXCEPT 1200S



GENERAL

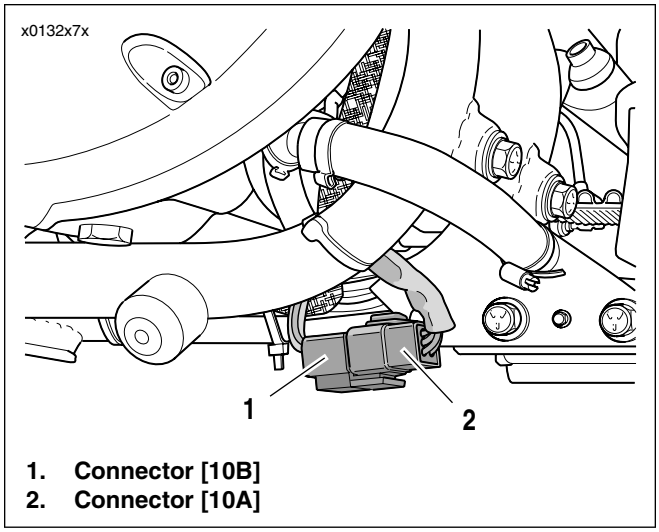
The BREAKOUT BOX (Part No. HD-42682) splices into the main harness. Used in conjunction with a DVOM, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects.

INSTALLATION

1. See Figure 4-38. Separate six pin connector [10] under engine on left frame tube.
2. See Figure 4-39. Connect Harness Adapters (HD-42962) to connectors [10A] and [10B].
3. Connect black connectors from Breakout Box to Harness Adapters.

REMOVAL

1. Detach black connectors from Breakout Box to Harness Adapters.
2. See Figure 4-39. Detach Harness Adapters (HD-42962) from connectors [10A] and [10B].
3. See Figure 4-38. Connect both sides of six pin connector [10].



1. Connector [10B]
2. Connector [10A]

Figure 4-38. Breakout Box Connection

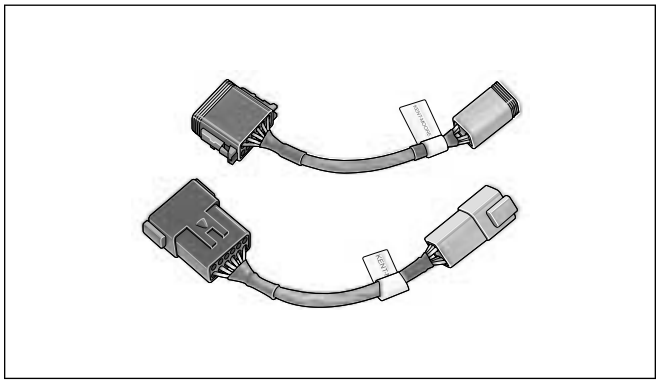


Figure 4-39. Breakout Box Harness Adapters

NOTES

SUBJECT PAGE NO.

5.1 Connector Crimp Tables 5-1
5.2 Amp Multilock Electrical Connectors 5-11
5.3 Deutsch Electrical Connectors 5-15
5.4 Mini-Deutsch Connectors 5-20
5.5 Sealed Butt Splice Connectors 5-22
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5.7 Index To Wiring Diagrams 5-27

WIRING

Table 5-1. 2002 Components

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
IGNITION MODULE [14A] (except 1200S)	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR [14A] (1200S)	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TRAP DOOR SOLENOID [15A]	ALL	72039-71A	PACKARD 270	20	2	4
REAR LIGHTING HARNESS [7B], [94B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
REAR DIRECTIONALS [18B, 19B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
V.O.E.S. [11B]	ALL	72191-94	HD-41609	18	CENTER POSITION	CENTER POSITION
FRONT DIRECTIONALS [31B]	ALL	73191-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP (XL CUSTOM ONLY) [38B]	ALL	74191-96	HD-42879	16	MIDDLE POSITION	MIDDLE POSITION
INSTRUMENT CLUSTER [20B]	ALL	74191-96	DTT-16-00	18	REAR POSITION	N/A
LEFT HANDLEBAR CONTROL [24B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
RIGHT HANDLEBAR CONTROL [22B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
SPEED SENSOR [65A]	ALL	72191-94	DTT-16-00	20 (a)	CENTER POSITION	CENTER POSITION
SPEED SENSOR [65B]	ALL	72191-94	PACKARD 271	20 (a)	CENTER POSITION	CENTER POSITION
POSITION LAMP	ALL	9898	HD-41609	N/A	TIP	N/A
POSITION LAMP	N/A	9898	PACKARD 115	N/A	TIP	N/A
HEADLAMP 68705-93A	N/A	70586-93(j)	PACKARD 115	16	14-16 GA.	N/A
REGULATOR [77B]	ALL	72197-94	HD-42879	12	12	N/A

Table 5-2. Sportster Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842 (a)	PACKARD 270,271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)		9843 (a)	PACKARD 270,271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)		9866 (h)	PACKARD 115	12,14	12-10 GA. (h)	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937 (h)	PACKARD 271	14,16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72219-94(h)	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72217-94	PACKARD 271	18	E	A
FUSE BLOCK (2-BE)	3	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-O/W)	4	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-R/BK)	5	72220-94 (h)	PACKARD 271,115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK)	6	72220-94 (h)	PACKARD 271,115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT	N/A	72241-94 (q) (z)	PACKARD 271	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA.	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115,270	14,16(h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271,115	14	A	G

Table 5-2. Sportster Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HORN	N/A	9898	PACKARD 271	18	TIP	X
HORN	N/A	9898	PACKARD 115	18	TIP	X
COIL	N/A	72241-94 (q)	PACKARD 271	18	C (q)	A
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B,C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	EXCEPT 6	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	ALL	72191-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 3	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS [22A]	3	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1,5,6	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2,3,4	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68705-93A	Y	70586-93 (j)	PACKARD 115	16	14-16 GA.	N/A
HEADLAMP 68705-93A	W,BK	70586-93 (j)	PACKARD 115	16,18	14-16 GA	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (j) (h)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C

Table 5-2. Sportster Main Wiring Harness, Part No. 70135-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Crimp Table Legend

(a) - requires solder after crimping

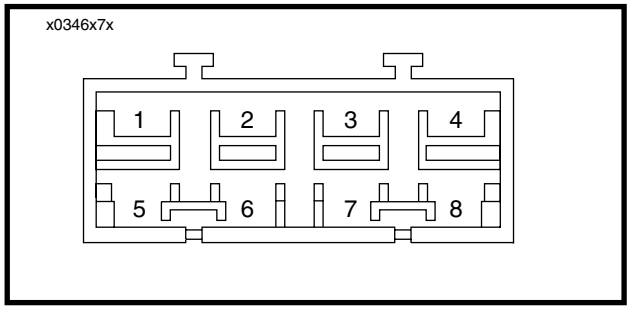
(b) - 9937 terminals require use of 72249-94 heat shrink tubing

(h) - double lug crimp

(j) - heat sealed butt splice connector

(q) - requires use of 72249-94 heat shrink tube

(z) - use with 7629 nut



The cavity numbers or positions in the fuse block are identified in the above illustration.

Table 5-3. Sportster Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL	N/A	9842 (a)	PACKARD 270,271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)	N/A	9843 (a	PACKARD 270,271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)	N/A	9866 (h)	PACKARD 115	12,14	12-10 GA. (h)	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937 (h)	PACKARD 271	14,16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72219-94(h)	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72217-94	PACKARD 271	18	E	A
FUSE BLOCK (2-BE)	3	72220-94 (h)	PACKARD 271	16	A (h	G (h)
FUSE BLOCK (2-O/W)	4	72220-94 (h)	PACKARD 271	16	A (h)	G (h)
FUSE BLOCK (2-R/BK	5	72220-94 (h)	PACKARD 271,115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK	6	72220-94 (h)	PACKARD 271,115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT	N/A	72241-94 (q) (z)	PACKARD 271	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115,270	14,16(h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271,115	14	A	G

Table 5-3. Sportster Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULA-TION CRIMP
HORN	N/A	9898	PACKARD 271	18	TIP	X
HORN	N/A	9898	PACKARD 115	18	TIP	X
COIL (W/BK)	N/A	72241-94 (q)	PACKARD 271	18	C (q)	A
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B,C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO V.O.E.S. [11A]	ALL	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	EXCEPT 6	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [14B]	6	72191-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 3	72190-94	DTT-16-00	16	CENTER POSITION	N/A
TO RIGHT HAND CONTROLS [22A]	3	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1,5,6	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2,3,4	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
HEADLAMP [38A]	1	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP [38A]	2,3,4	73190-96	HD-41609	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION

Table 5-3. Sportster Custom Main Wiring Harness, Part No. 70153-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HEADLAMP 68705-93A	ALL	70586-93 (j)	PACKARD 115	16	14-16 GA.	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (j)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Crimp Table Legend

(a) - requires solder after crimping

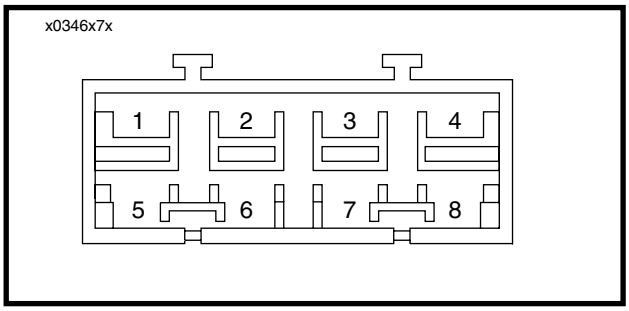
(b) - 9937 terminals require use of 72249-94 heat shrink tubing

(h) - double lug crimp

(j) - heat sealed butt splice connector

(q) - requires use of 72249-94 heat shrink tube

(z) - use with 7629 nu



The cavity numbers or positions in the fuse block are identified in the above illustration.

Table 5-4. Sportster 1200S Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
STARTER TERMINAL		9842 (a)	PACKARD 270,271	12	B	3
CIRCUIT BREAKER TERMINAL (BK)		9843 (a)	PACKARD 270,271	14	B	3
CIRCUIT BREAKER TERMINAL (2-R)		9866 (h)	PACKARD 115	12,14	12-10 GA.	12-10 GA. (h)
STARTER RELAY (BK,BK/R)	85,86	9937	PACKARD 271	18	C	D
STARTER RELAY (R/BK)	30	9937	PACKARD 271	14	C	A
STARTER RELAY (2-GN)	87	9937	PACKARD 271	14,16	C (h)	A (h)
FUSE BLOCK (2-GY)	1	72217-94	PACKARD 271	16, 18	C (h)	B (h)
FUSE BLOCK (O)	2	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-BE)	3	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-O/W)	4	72219-94	PACKARD 271	18	C (h)	B (h)
FUSE BLOCK (2-R/BK)	5	72220-94	PACKARD 271,115	14	A (h)	G (h)
FUSE BLOCK (2-R/BK)	6	72220-94	PACKARD 271, 115	14	A (h)	G (h)
FUSE BLOCK (R/BK)	7	72218-94	PACKARD 271	14	C	A
FUSE BLOCK (R/GY)	8	72218-94	PACKARD 271	14	C	A
OIL PRESSURE SENDING UNIT	N/A	9857 (z)	PACKARD 115	18	C	A
REAR STOP LIGHT SWITCH (O/W)	N/A	9937 (b)	PACKARD 271	18	C	D
REAR STOP LIGHT SWITCH (2-R/Y)	N/A	9937 (b)	PACKARD 271	18	C (h)	D (h)
MAIN GROUND-CHASSIS	N/A	9860	PACKARD 115	14	16-14 GA.	16-14 GA.
MAIN GROUND-CHASSIS (2-BK)	N/A	72242-94 (a)	PACKARD 115,270	14,16(h)	G (h)	3 (h)
SOLENOID	N/A	72291-94	PACKARD 271,115	14	A	G

Table 5-4. Sportster 1200S Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HORN	N/A	9898	PACKARD 271	18	TIP	N/A
HORN	N/A	9898	PACKARD 115	18	TIP	N/A
COIL [130B]	ALL	72033-93	PACKARD 271	18	E	C
REAR LIGHTING HARNESS [7A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	B,C	73190-96	DTT-16-00	18	REAR POSITION	REAR POSITION
EVAP. SOLENOID (CAL.) [9A]	A	73190-96	DTT-16-00	16	CENTER POSITION	CENTER POSITION
CAM POSITION SENSOR [14B]	ALL	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
MAP SENSOR	ALL	72213-94(X)	PACKARD 271,270	18	E	1
TO IGNITION MODULE [10B] (BK)	EXCEPT 2,11	72191-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO IGNITION MODULE [10B] (BK)	2,11	73191-94	DTT-16-00	18	REAR POSITION	REAR POSITION
TO IGNITION MODULE [11B] (GY)	ALL	73191-94	DTT-16-00	18	REAR POSITION	REAR POSITION
INSTRUMENT CLUSTER [20A]	EXCEPT 1	74190-98	HD-42879	18	18	N/A
INSTRUMENT CLUSTER [20A]	1	74190-98	HD-42879	16	16	N/A
TO RIGHT HAND CONTROLS [22A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO RIGHT HAND CONTROLS [22A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	1,5,6	72190-94	DTT-16-00	14	CENTER POSITION	CENTER POSITION
TO LEFT HAND CONTROLS [24A]	2,3,4	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	EXCEPT 2	72190-94	DTT-16-00	18	CENTER POSITION	CENTER POSITION
TO TURN SIGNAL MODULE [30A]	2	72190-94	DTT-16-00	16	CENTER POSITION	CENTER POSITION
FRONT TURN SIGNALS [31A]	ALL	73190-96	HD-41609	18	REAR POSITION	REAR POSITION
HEADLAMP 68705-93A	Y	70586-93 (I)	PACKARD 115	16	14-16 GA.	N/A

Table 5-4. Sportster 1200S Main Wiring Harness, Part No. 70139-99

CONNECTOR	POSITION	TERMINAL PART NUMBER	CRIMPER	WIRE GAUGE	CORE CRIMP	INSULATION CRIMP
HEADLAMP 68705-93A	W,BK	70586-93 (I)	PACKARD 115	16,18	14-16 GA	N/A
IGNITION SWITCH KIT 71441-94	ALL	70586-93 (I)	PACKARD 115	14	14-16 GA.	N/A
BANK ANGLE SENSOR [134B]	ALL	72033-93	PACKARD 271	18	E	C
REGULATOR [77A]	N/A	72196-94	HD-42879	12	12	N/A

Crimp Table Legend

(a) - requires solder after crimping

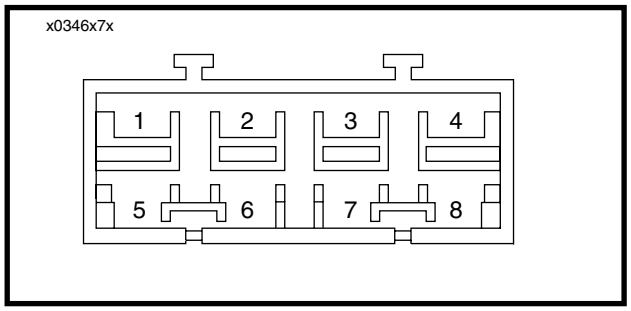
(b) - 9937 terminals require use of 72249-94 heat shrink tubing

(h) - double lug crimp

(j) - heat sealed butt splice connector

(q) - requires use of 72249-94 heat shrink tube

(z) - use with 7629 nut



The cavity numbers or positions in the fuse block are identified in the above illustration.

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 5-1. With the flat edge against the terminal, insert the pick tool (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick away from the terminal (locktab is inside housing) and gently tug on wire to pull terminal from chamber. Do not tug on the wire until the tang is released or the terminal will be difficult to remove. A “click” is heard if the tang is engaged but then inadvertently released. Repeat the step without releasing the tang.

NOTE

- *If pick tool is not available, a push pin/safety pin may be used instead.*
- *An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-41609) is used to install Amp Multi lock pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions on the next page.*

INSTALLING SOCKET/PIN TERMINALS

NOTE

For wire location purposes, numbers are stamped into the secondary locks of both the socket and pin housings. See Figure 5-2.

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.

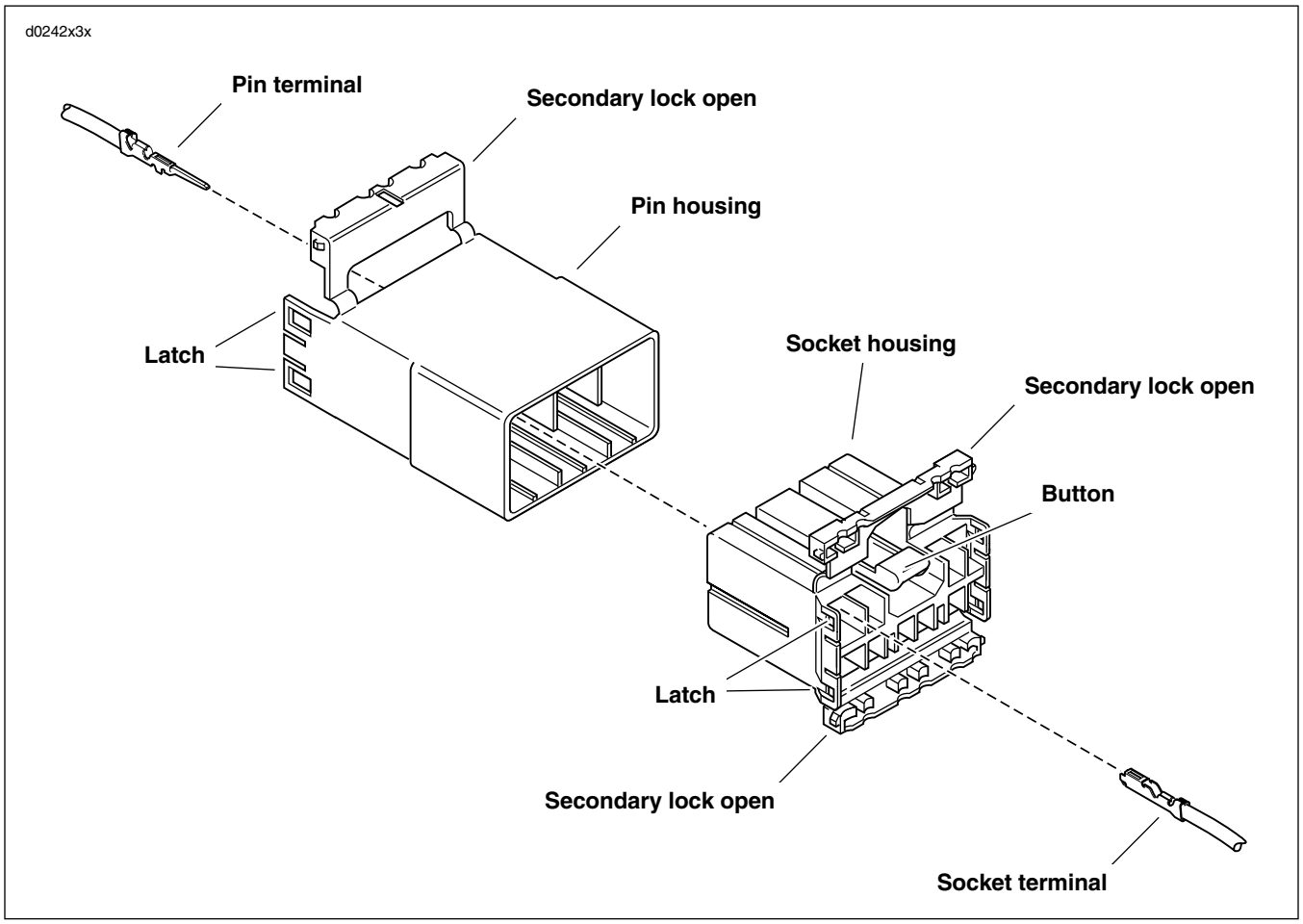


Figure 5-1. 10-Place Amp Multilock Connector

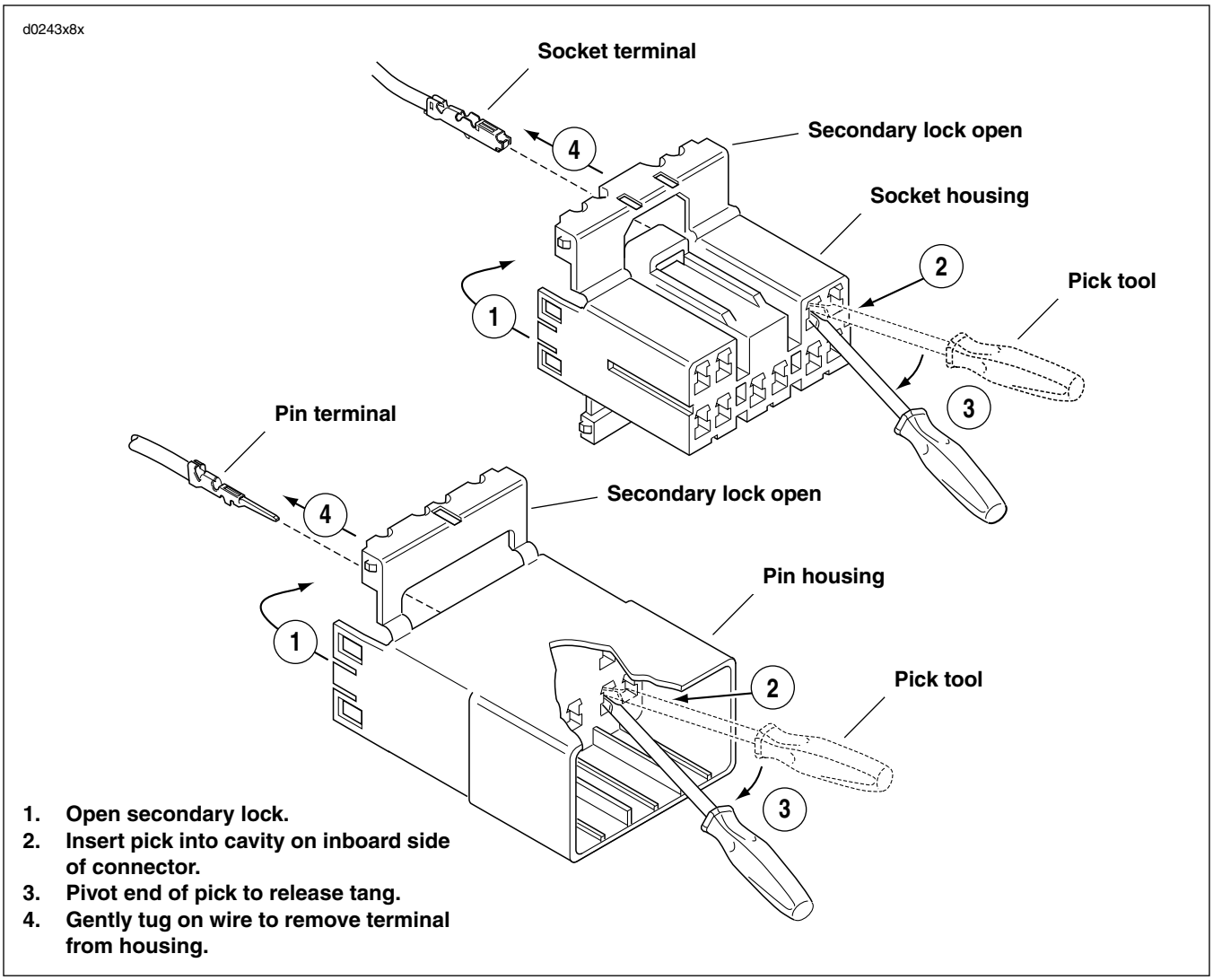


Figure 5-2. Release Tang and Back Out Terminals

NOTES

- *See Figure 5-3. The tang in the chamber engages the slot to lock the terminal in position.*
- *On the pin side of the connector, tangs are positioned at the bottom of each chamber, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each chamber, so the socket terminal slot (on the same side as the crimp tails) must face upward.*
- *Up and down can be determined by the position of the release button (used to separate the pin and socket halves). Consider the button to always be on top of the connector.*

2. Gently tug on wire end to verify that the terminal is locked in place and will not back out of chamber.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.
4. Insert the socket housing (plug) into the pin housing (receptacle) until it snaps in place.
5. Install connector on retaining device, either attachment or rosebud clip.

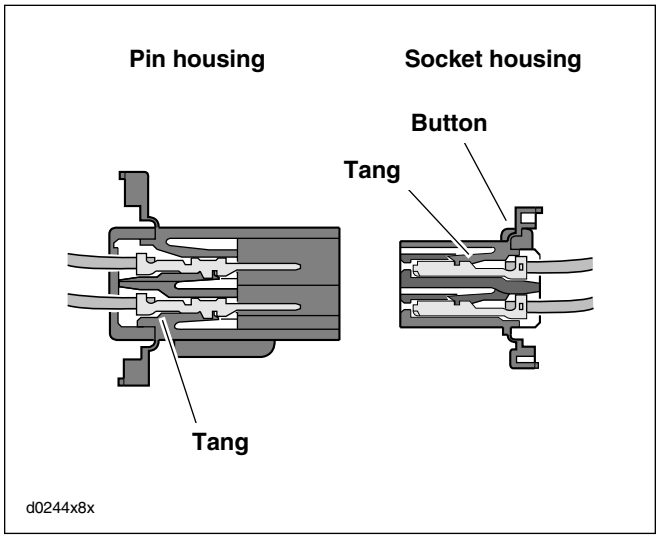


Figure 5-3. Multilock Connector Cutaway View

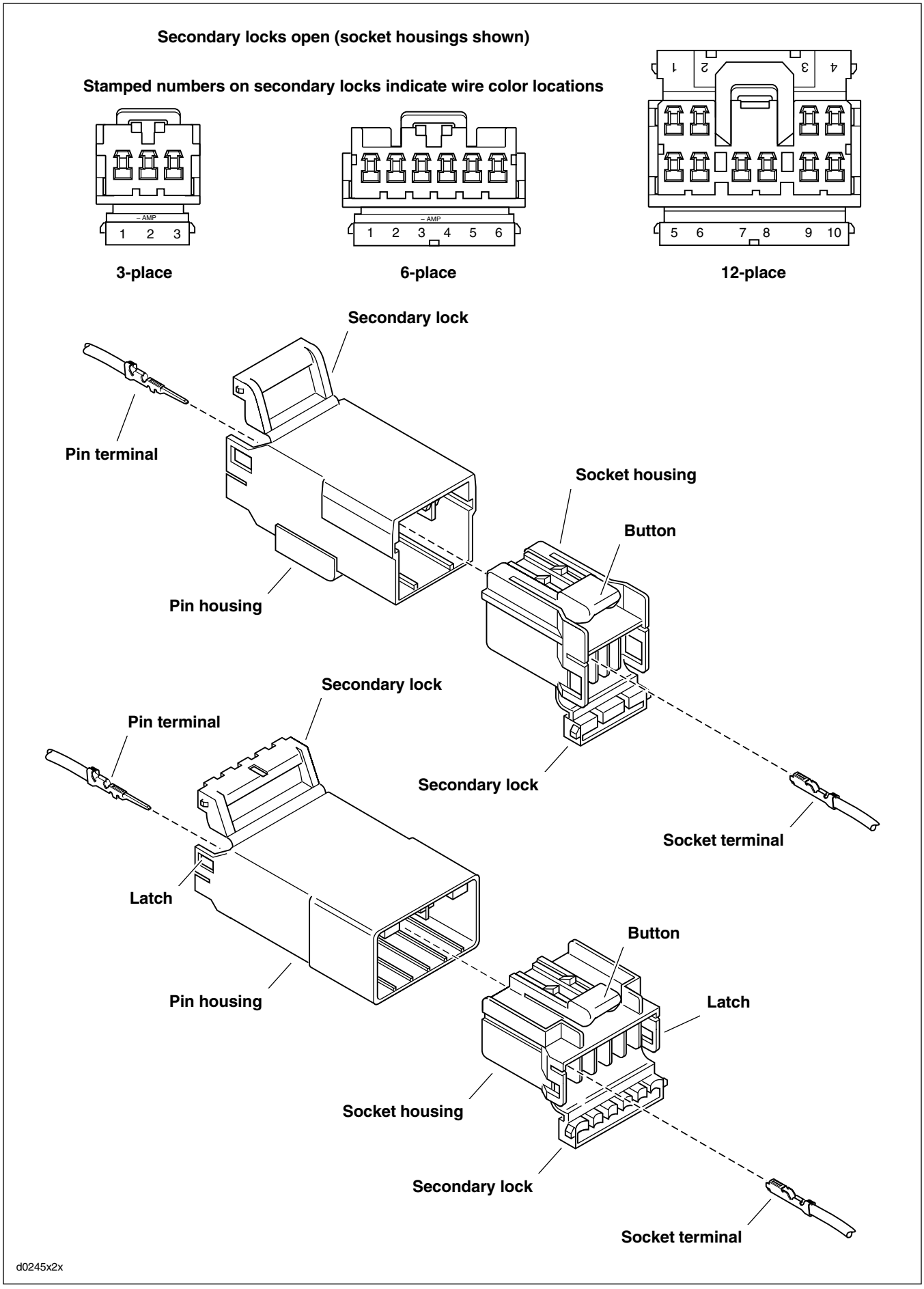


Figure 5-4. 3-Place and 6-Place Amp Multilock Connectors

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 5-3.

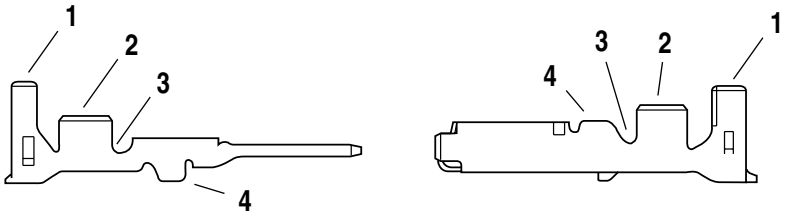
3. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.

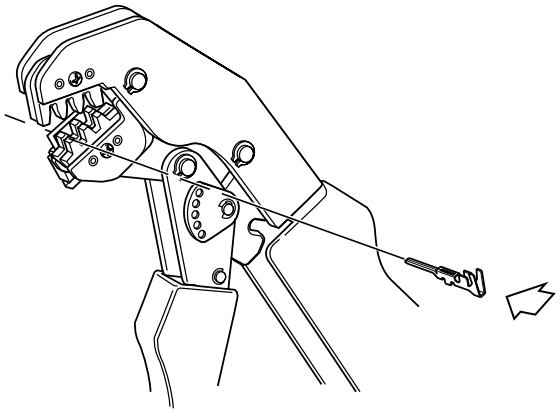
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.

5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.

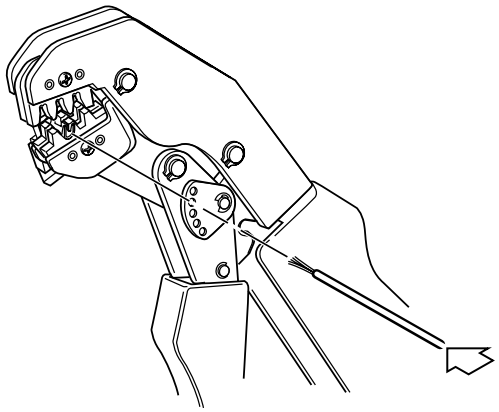
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

1. Insulating crimp tail
2. Core crimp tail
3. Locking bar groove
4. Tang slot

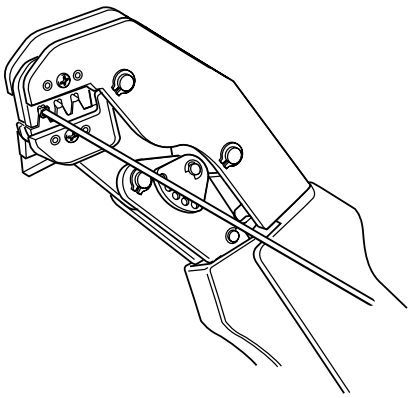




1. Raise locking bar and seat contact on front nest of crimp tool. Release locking bar

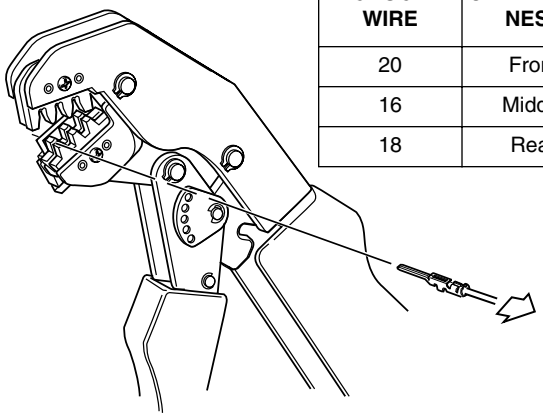


2. Insert stripped lead until it contacts locking bar.



3. Close and squeeze crimp tool.

GAUGE WIRE	CRIMP TOOL NEST
20	Front
16	Middle
18	Rear



4. Raise locking bar and remove contact.

d0246x8x

Figure 5-5. Amp Multilock Crimping Procedure

GENERAL

Deutsch Connectors feature a superior seal to protect electrical contacts from dirt and moisture in harsh environments. The connector also provides superior pin retention.

See Figure 5-8. This 12-pin connector illustrates the various parts of the Deutsch connector. The following instructions may be followed for all 2-pin through 12-pin Deutsch connectors.

Socket housing: alignment tabs and/or external latch, secondary locking wedge, internal seal, wire seal, seal pin.

NOTE

Seal pins or plugs are installed in the wire seals of unused pin and socket locations. If removed, seal pins must be replaced to maintain the integrity of the environmental seal.

Pin housing: alignment grooves and/or external latch cover, attachment clip, secondary locking wedge, wire seal, seal pin.

REMOVING/DISASSEMBLING

Attachment clips are attached to the pin housings of most connectors. The clips are then attached to T-studs on the motorcycle frame. T-studs give positive location to electrical connectors and wire harness. Consistent location reduces electrical problems and improves serviceability.

1. Push the connector to disengage small end of slot on attachment clip from T-stud. Lift connector off T-stud.
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 5-7. Remove the secondary locking wedge. Insert the blade of a small screwdriver between the socket housing and locking wedge inline with the groove (inline with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up.
2. See Figure 5-8. Gently depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

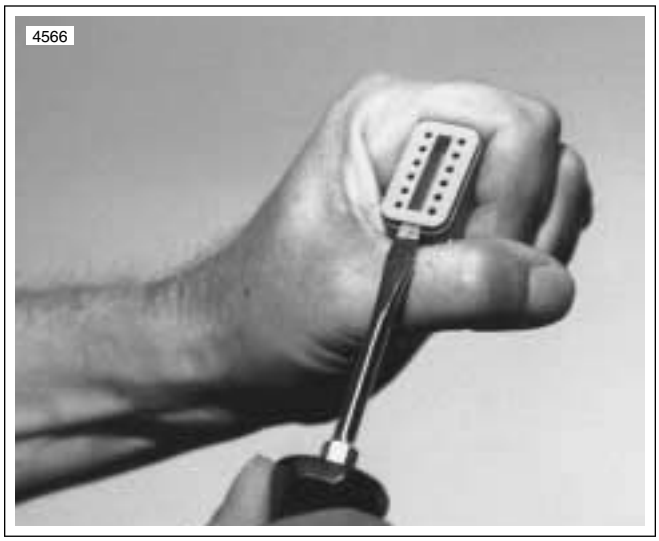


Figure 5-6. Remove Secondary Locking Wedge

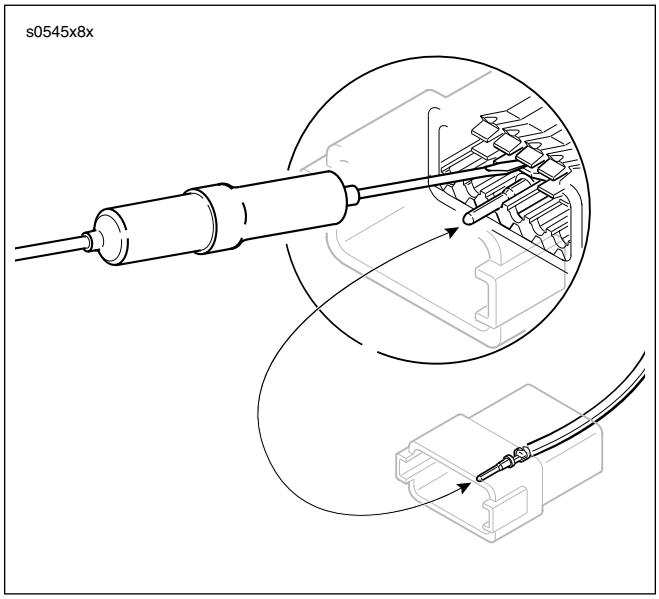


Figure 5-7. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, follow the instructions included with the crimping tool or see Crimping Instructions in this section.*

Fit rear wire seal into back of socket housing, if removed. Grasp socket approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push sockets through holes in wire seal into their respective chambers. Feed socket into chamber until it “clicks” in place. Verify that socket will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.

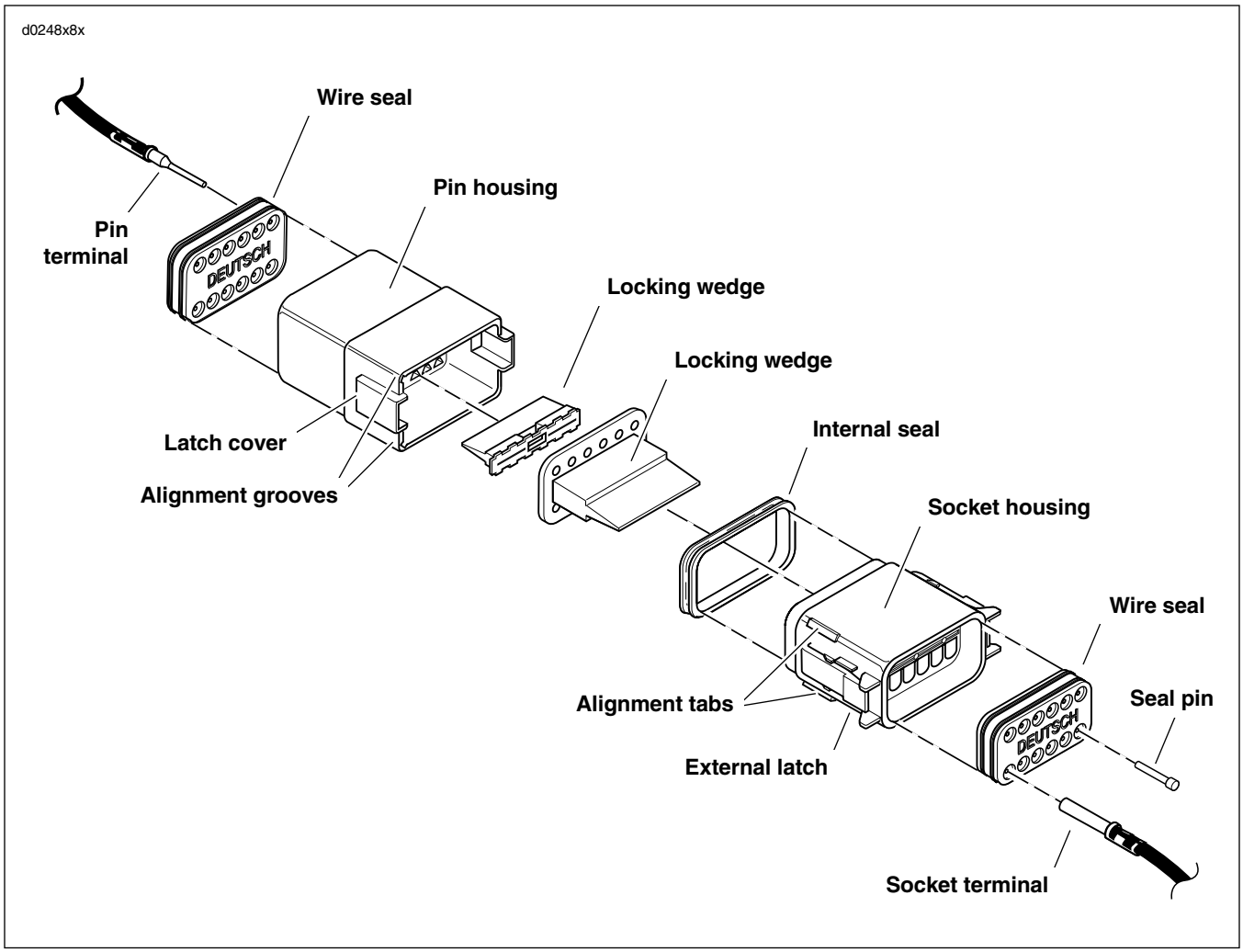


Figure 5-8. 12-pin Deutsch Connector (Exploded View)

3. Install internal seal on lip of socket housing, if removed. Insert tapered end of secondary locking wedge into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure 5-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

REMOVING/INSTALLING PINS

1. Remove the secondary locking wedge. Use the hooked end of a stiff piece of mechanics wire a needle nose pliers, or a suitable pick tool (Part No. HD-41475-100). See Figure 5-10.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

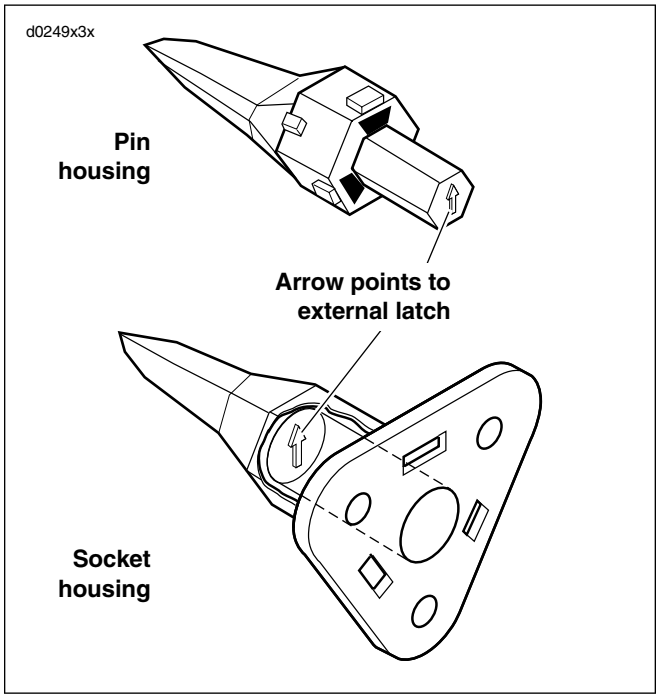


Figure 5-9. Depress Terminal Latches/Back Out Pins

NOTE

*An ELECTRICAL TERMINAL CRIMP TOOL (Part No. HD-39965) is used to install Deutsch pin and socket terminals on wires. If **new** terminals must be installed, see Crimping Instructions in this section.*

3. Fit wire seal into back of pin housing. Grasp crimped pin approximately 1.0 in. (25.4 mm) behind the contact barrel. Gently push pins through holes in wire seal into their respective numbered locations. Feed pin into chamber until it “clicks” in place. Verify that pin will not back out of chamber; a slight tug on the wire will confirm that it is properly locked in place.
4. Insert tapered end of secondary locking wedge into pin housing and press down until it snaps in place. The wedge fits in the center groove within the pin housing and holds the terminal latches tightly closed.

NOTES

- *While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-pin connector must be installed with the arrow pointing toward the external latch. See Figure 5-9.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

ASSEMBLING/INSTALLING

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 color coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are black.*

If it should become necessary to replace a plug or receptacle, please note that the 8-pin and 12-pin gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color. If replacing both the socket and pin halves, then the black may be substituted for the gray, and vice versa. The socket and pin halves of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.

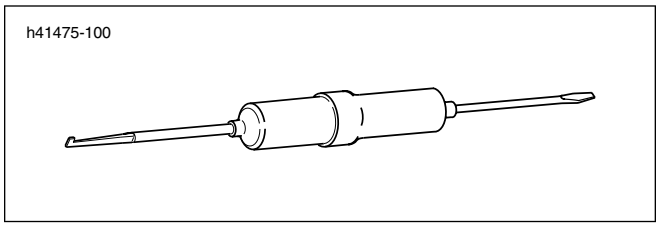


Figure 5-10. Deutsch Connector Pick Tool (Part No. HD-41475-100)

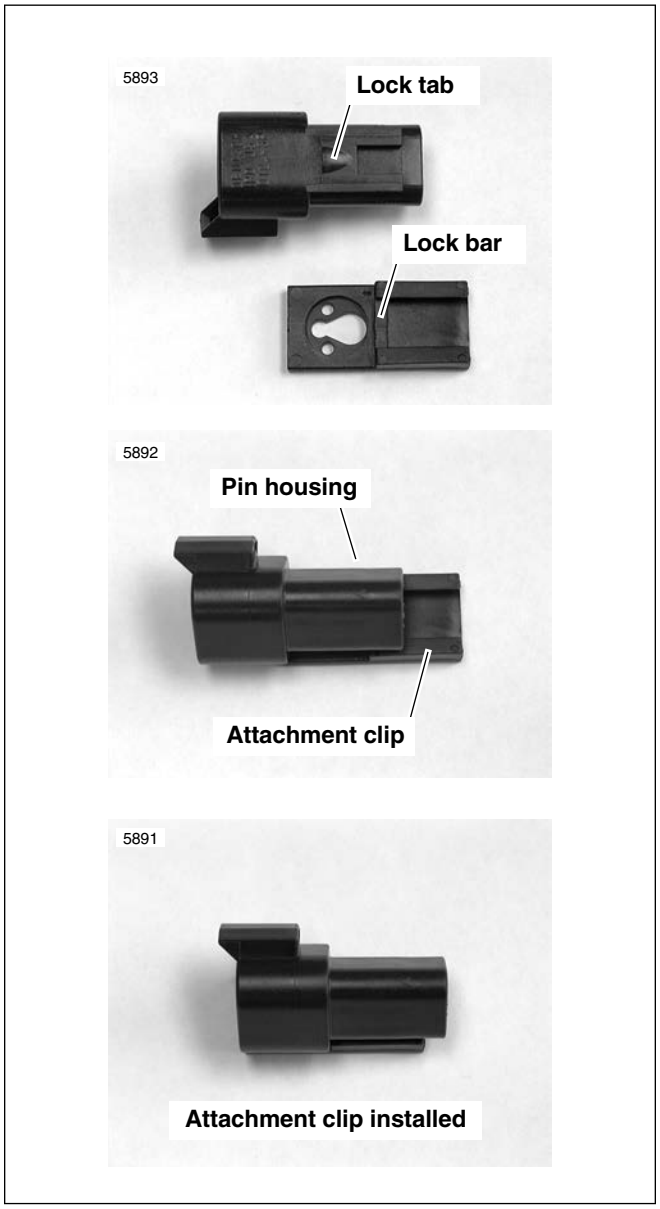


Figure 5-11. Attachment Clip Installation

2. See Figure 5-11. 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.

d0250x8x

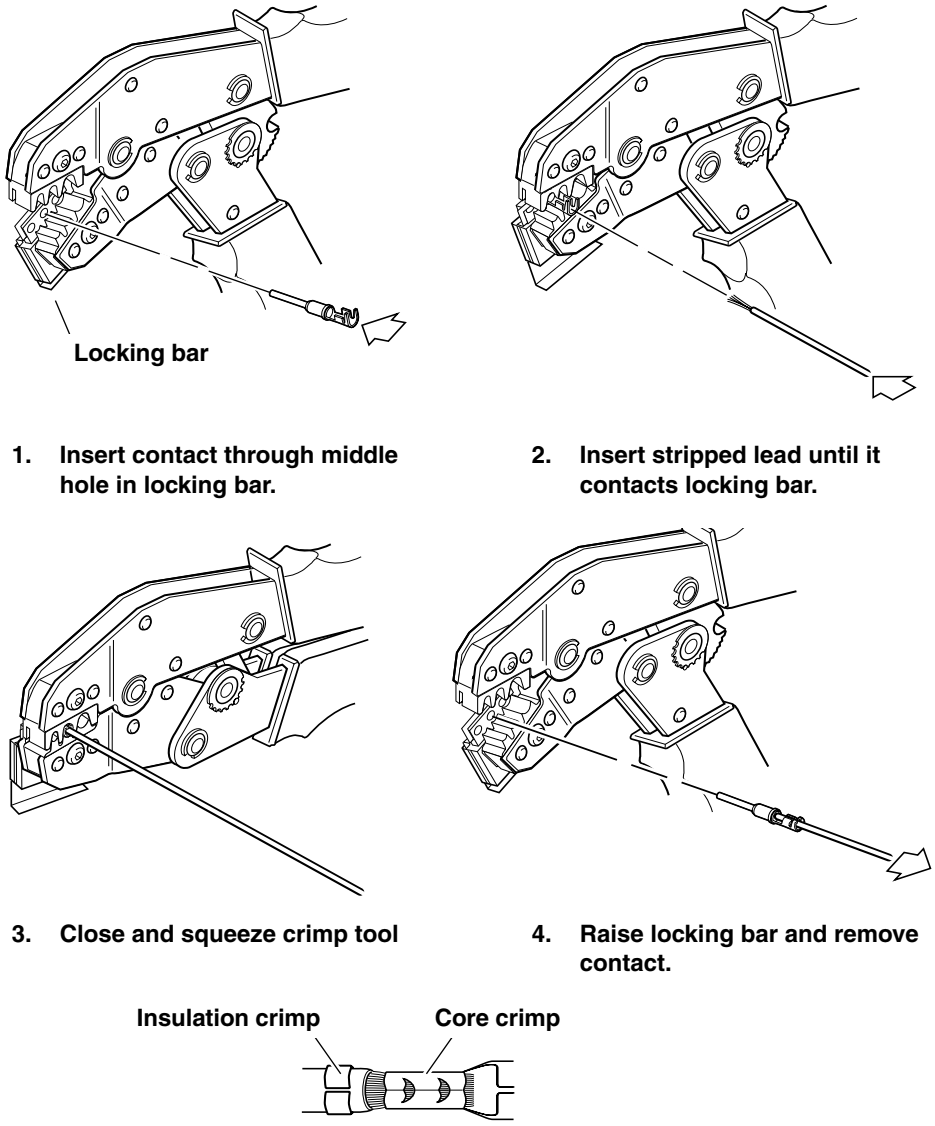


Figure 5-12. Deutsch Crimping Procedure

CRIMPING INSTRUCTIONS

1. See Figure 5-12. Squeeze the handles to cycle the crimp tool to the fully open position.
2. Raise locking bar by pushing up on bottom flange. With the crimp tails facing upward and the rounded side of the contact barrel resting on the concave split level area of the crimp tool, insert contact (socket/pin) through middle hole of locking bar.
3. Release locking bar to lock position of contact. If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the contact so that the tails face straight upward. When correctly positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.
4. Strip lead removing 5/32 in. (4 mm) of insulation. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over insulation material.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete. Raise up locking bar and remove contact.
6. Inspect the quality of the core and insulation crimps. Distortion should be minimal.

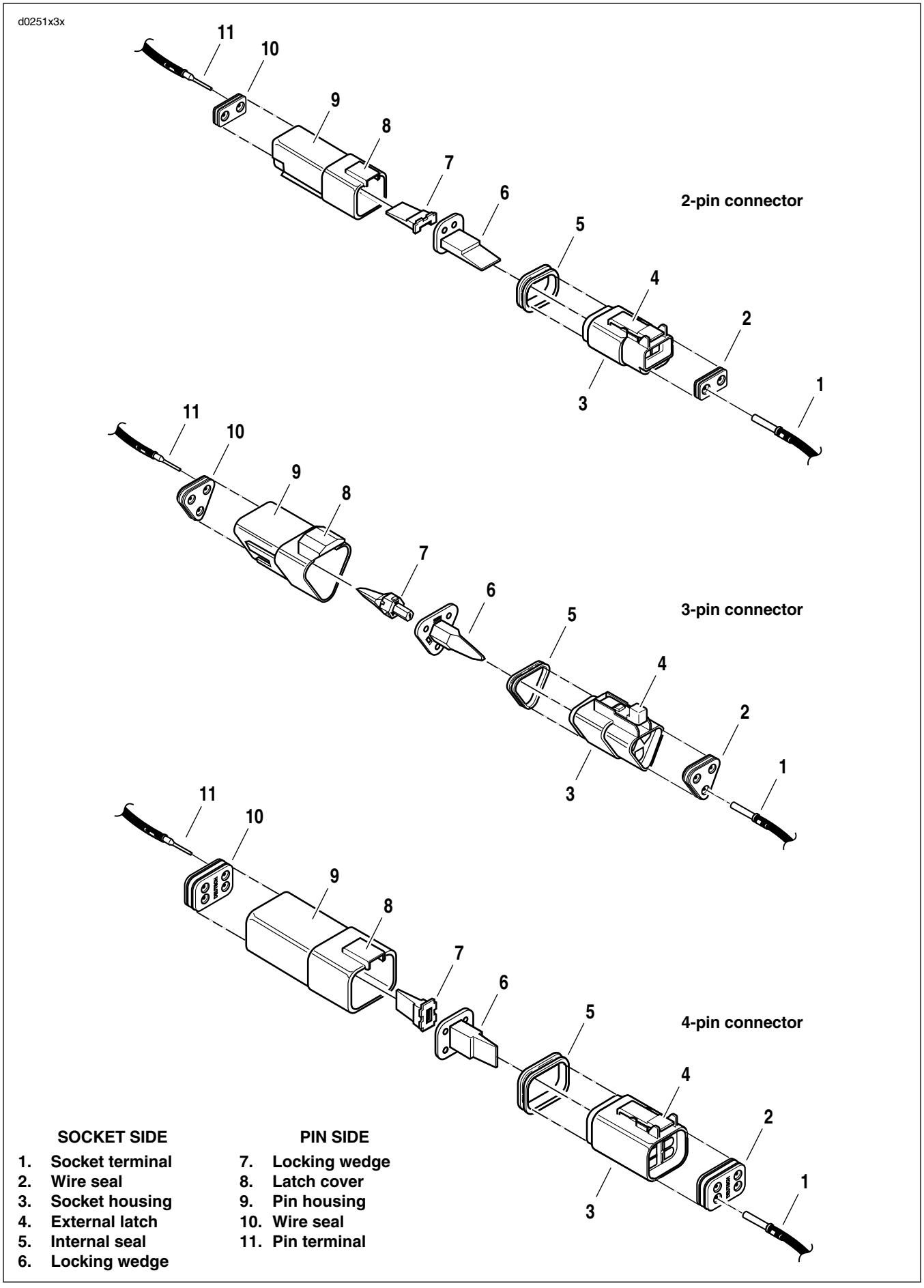
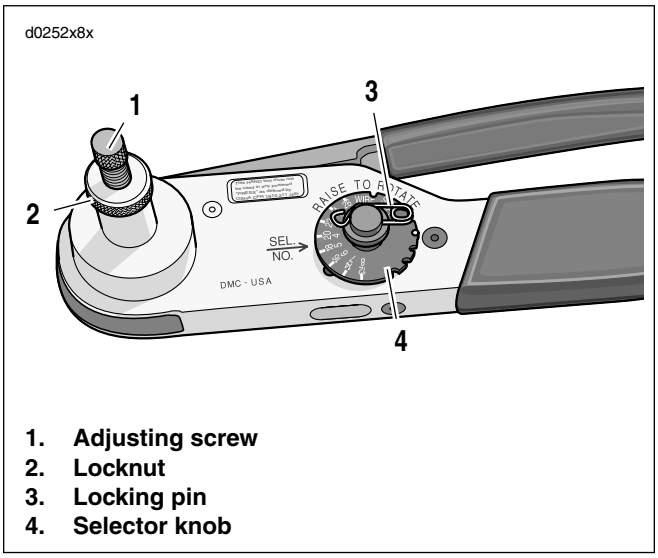


Figure 5-13. 2-Pin, 3-pin and 4-pin Deutsch Connectors

GENERAL

For Size 20, 16 and 12 Contacts Wire Range 26-12 AWG

Mini-Deutsch connectors make use of a solid barrel contact without crimp tails. As a result, a special TERMINAL CRIMP TOOL (Part No. HD-42879) is needed to install pin and socket terminals on wires.



1. **Adjusting screw**
2. **Locknut**
3. **Locking pin**
4. **Selector knob**

Figure 5-14. Deutsch Solid Barrel Contact Crimp Tool (Part No. HD-42879)

CRIMPING INSTRUCTIONS

1. Squeeze the handles to cycle the crimp tool to the fully open position.
2. See Figure 5-14. Remove locking pin (3) from selector knob (4).
3. See Figure 5-15. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with “SEL. NO.” arrow.
4. Loosen knurled locknut and turn adjusting screw clockwise (in) until it stops.
5. Turn tool over and drop contact into indentor cover hole with the wire end out.
6. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
7. See Figure 5-16. Slowly squeeze handles of crimp tool until contact (2) is centered between indentor points (3).

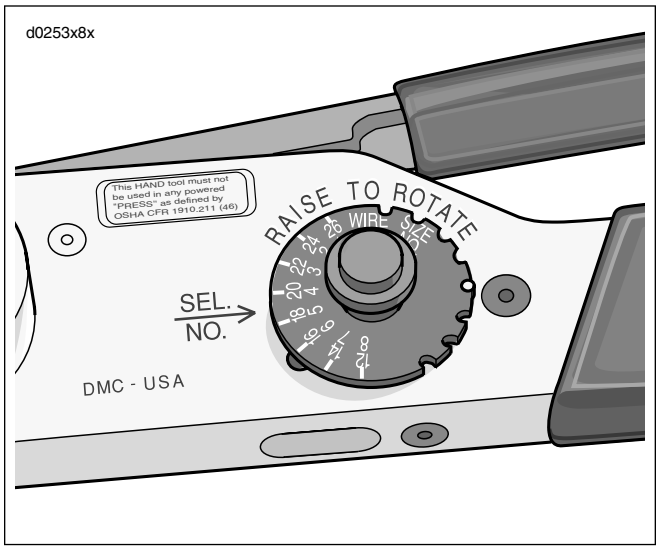


Figure 5-15. Selector Knob

1. **Indentor cover**
2. **Contact**
3. **Indentor points**

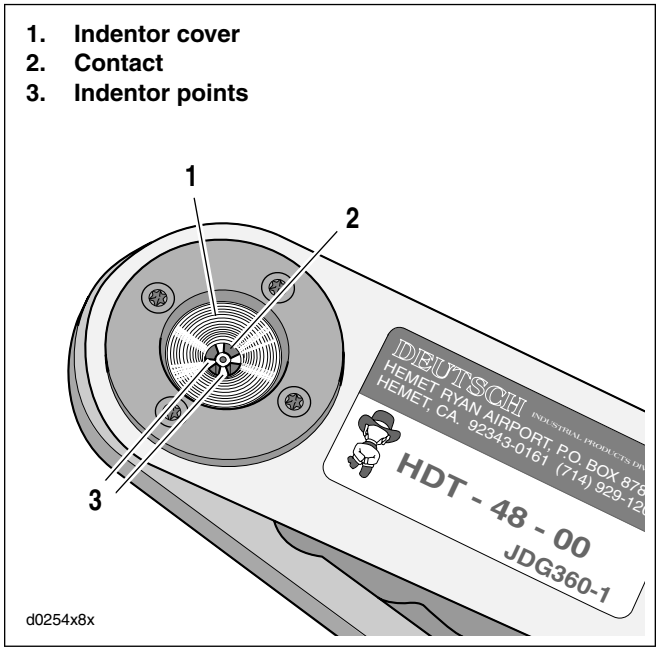


Figure 5-16. Indentor Points

8. Strip wire lead removing 1/4 in. (6.3 mm) of insulation.
9. See Figure 5-17. Insert bare wire strands into contact barrel.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. Remove crimped contact from indentor.
12. Inspect the quality of the crimp. Verify that all wire strands are in crimp barrel.

NOTE

Tool must be readjusted when changing contact size/type.

13. Install pin to lock position of selector knob.

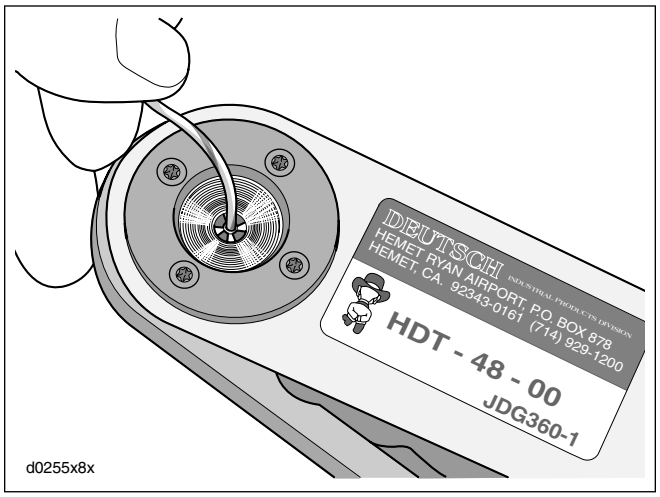


Figure 5-17. Contact Barrel

INSTALLATION

Butt splicing may be a necessary procedure for the replacement of some components.

1. Strip 3/8 in. (9.5 mm) of insulation off the ends of the wires.
2. Compress the handles of the Packard Crimp Tool (HD-38125-8) until the ratchet automatically opens.
3. See Table 5-5. Since the size of the connectors varies with the gauge of the wire, always used the correct components when creating sealed splices.
4. See Figure 5-18. Determine the correct dye or nest for the crimping operation. Match the color or gauge wire marked on the butt splice connector with the corresponding crimp cavity on the crimp tool.
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 5-19. Feed the wire into the butt splice connector until the stripped end contacts the wire stop inside the metal insert.
7. Squeeze the handles of the crimp tool until tightly closed. The tool automatically opens when the crimping sequence is complete.
8. Repeat steps 5, 6, and 7 on the other side of the butt splice connector.

NOTE

If adjacent wires are being spliced, stagger the splices so that the butt splice connectors are spaced at different positions along the length of the wires.

⚠WARNING

Use caution when operating the UltraTorch UT-100 or any other radiant heating device. Read the manufacturers instructions carefully before use. Always keep hands away from tool tip area and heat shrink attachment. Avoid directing the heat toward any fuel system component. Extreme heat can cause fuel ignition or explosion. Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed. Be sure to turn the "ON/OFF" switch to the "OFF" position after use. Improper handling could result in death or serious injury.

9. Using the UltraTorch UT-100 (Part No. HD-39969), Robinair Heat Gun (Part No. HD-25070) with heat shrink attachment (Part No. HD-41183) or other suitable radiant heating device, heat the crimped splice to encapsulate the butt splice connection. Apply heat from the center of the crimp out to each end until the meltable sealant exudes out both ends of the connector.

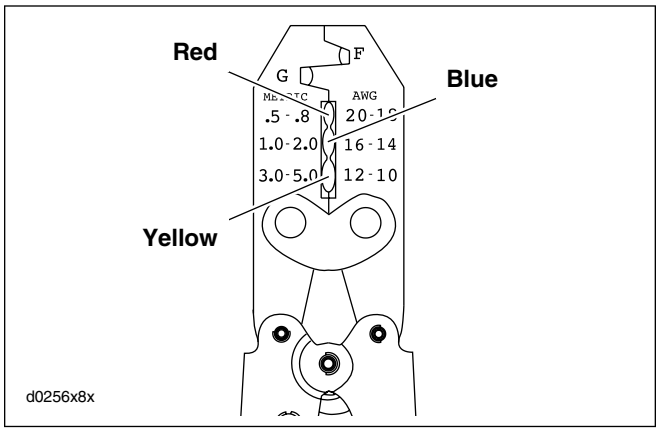


Figure 5-18. Packard Crimp Tool (Part No. HD-38125-8)

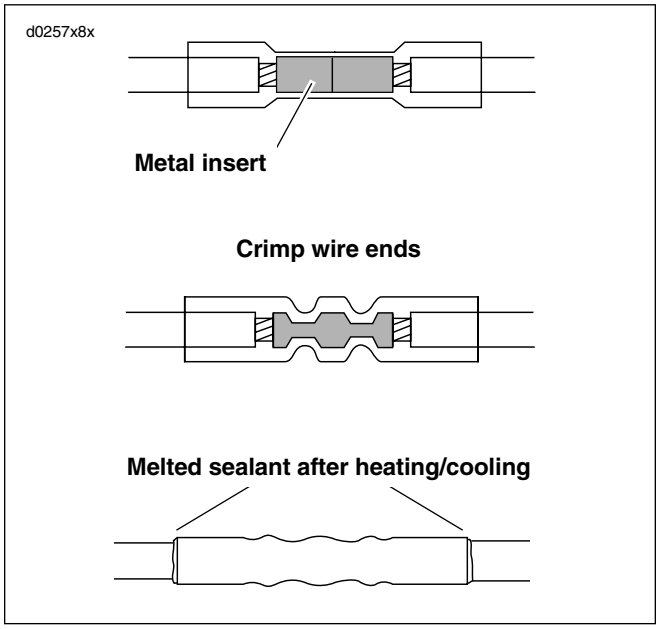


Figure 5-19. Installing Sealed Butt Splice Connectors

Table 5-5. Common Sealed Splices

GAUGE WIRE	CONNECTOR COLOR	PART NO.
18-20	Red	70585-93
14-16	Blue	70586-93
10-12	Yellow	70587-93

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

10. Heat the center of the splice until the crimp indentations disappear and the tubing assumes a smooth cylindrical appearance.

GENERAL

From a servicing standpoint, there are two basic types of Packard electrical connectors, those with pull-to-seat terminals and those with push-to-seat terminals.

Look into the mating end of the connector. If it appears that the terminal can be extracted from this side, then it is probably the pull-to-seat type.

At least one Packard pull-to-seat terminal can be easily recognized by the presence of a locking ear. The ear engages a slot in the connector housing and prevents the terminal from being removed from the wire end side of the connector. The ear also acts as a strain relief in the event that the wires are pulled and further inhibits movement of the terminal inside the chamber.

Unlike most connectors, where the terminals are pulled out the wire end of the connector, to remove the terminals from the pull-to-seat connectors, the terminal is pushed out the mating end of the connector. Once a **new** terminal is crimped onto the end of the wire, the wire is pulled to draw the terminal back inside the chamber of the connector housing.

Two types of Packard pull-to-seat electrical connectors are used. One type has an external latch to lock the pin and socket halves together, while the other makes use of a wireform. See Figure 5-20. The manner in which the terminals are picked differs between these two types of connectors, as further described below.

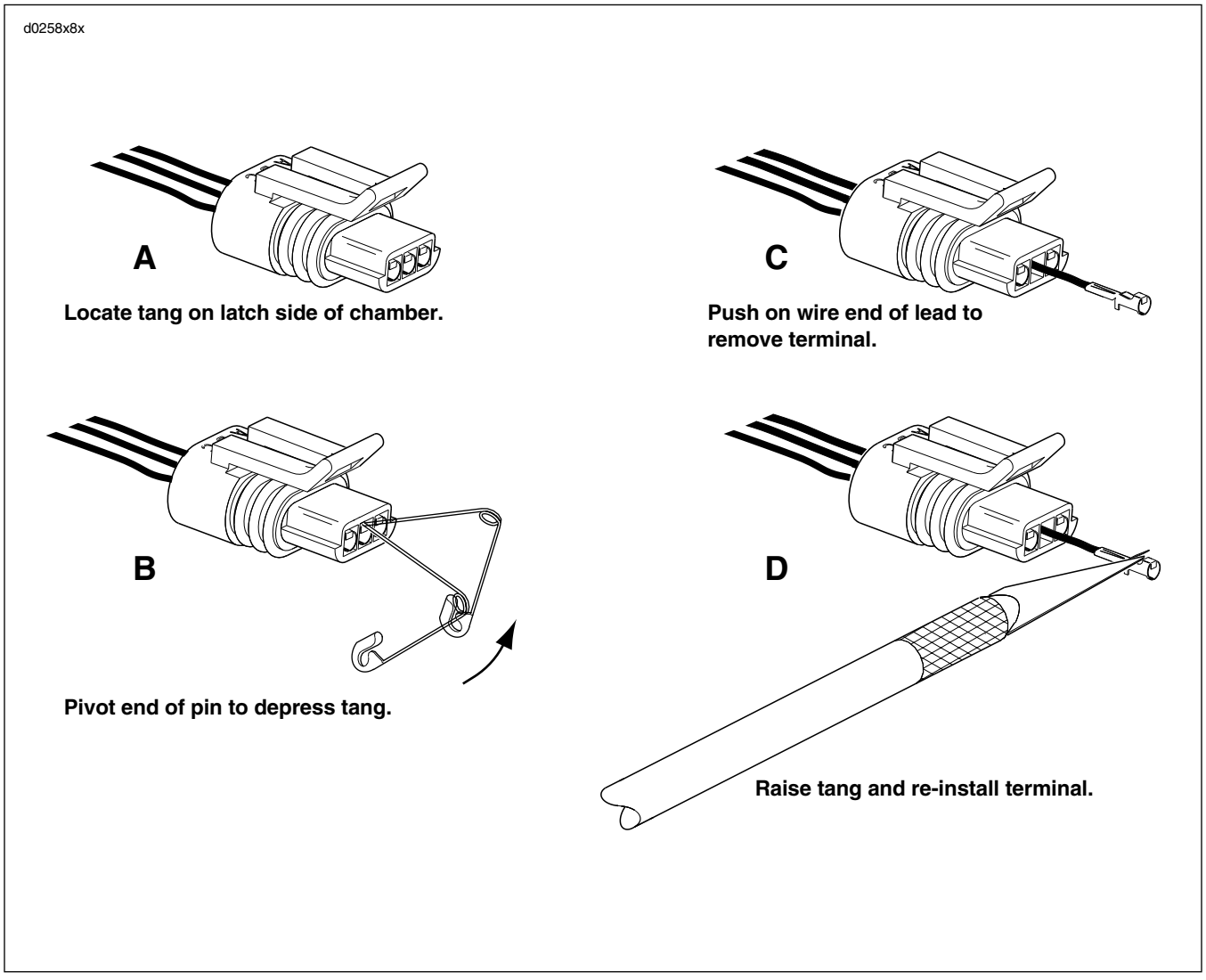


Figure 5-20. Packard Connectors

PULL-TO-SEAT TERMINALS

Removing External Latch Type

To remove a pull-to-seat terminal from connectors with external latches, proceed as follows:

1. Remove the connector from the retaining device, if present.
2. Bend back the external latch(es) slightly and separate the pin and socket halves of the connector.
3. To free a pull-to-seat terminal from the connector housing, first look into the mating end of the connector to find the locking tang. See A in Figure 5-20. The tangs are always positioned in the middle of the chamber and are on the same side as the external latch. On those connectors with locking ears, the tang is on the side opposite the ear.
4. At a slight angle, gently insert the point of a one inch safety pin down the middle of the chamber (about 1/8 inch) and pivot the end of the pin toward the terminal body. When a click is heard, remove the pin and repeat the procedure. See B in Figure 5-20. The click is the sound of the tang returning to the locked position as it slips from the point of the pin. Pick at the tang in this manner until the clicking stops and the pin seems to slide in at a slightly greater depth than it had previously. This is an indication that the tang has been depressed.

NOTES

- *On those terminals that have been extracted on a previous occasion, no clicking sound may be heard when the pin is pivoted to depress the tang, but proceed as if the clicking is audible and then push on the wire end of the lead to check if the terminal is free.*
- *When picking multiple terminals, the end of the pin may become malleable. For best results, continue the procedure with a new safety pin.*

5. Remove the pin and push on the wire end of the lead to extract the terminal from the mating end of the connector. See C in Figure 5-20. If necessary, pull back the conduit and remove the wire seal at the back of the connector to introduce some slack in the wires.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If ***new*** *terminals must be installed, see Crimping Instructions.*

Installing External Latch Type

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body. See D in Figure 5-20.
2. Gently pull on the lead at the wire end of the connector to draw the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Push on the lead to verify that the terminal is locked in place.
4. Push the pin and socket halves of the connector together until the latches “click.”

PUSH-TO-SEAT TERMINALS

Removing Push-to-Seat Terminals

Like most connectors, Packard push-to-seat terminals are pulled out the wire end of the connector. To remove a 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

Both the Ignition Light/Key Switch and the Main Power connectors are provided with secondary locks. The secondary lock, which may be molded onto the connector or exist as a separate piece, aids in terminal retention. Secondary locks must be opened (or removed) before the terminals can be extracted from the connector housing.

3. Open or remove the secondary lock. **Ignition Switch:** Bend back the latch slightly and free one side of the secondary lock, then repeat the step to release the other side. Rotate the secondary lock outward on hinge to access the terminals in the chambers of the connector housing.
4. Looking in the mating end or terminal side of the connector (opposite the secondary lock), take note of the larger cavity next to each terminal.
5. Insert the pick (Snap-On TT600-3) into the cavity until it stops. Pivot the end of the pick toward the terminal to depress the locking tang. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat the step if the terminal is still locked in place.

NOTE

A series of Packard Electrical Terminal Crimp Tools are available to install Packard pin and socket terminals on wires. If new terminals must be installed, see Crimping Instructions.

Installing Push-to-Seat Terminals

NOTE

For wire location purposes, alpha characters are stamped onto the secondary locks or onto the wire end of the connector housing.

1. To install a terminal back into the chamber of the connector housing, use a thin flat blade, like that on an X-Acto knife, and carefully bend the tang outward away from the terminal body.
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. **Ignition Switch:** 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 in. (4 mm) of insulation.
2. Compress handles until ratchet automatically opens.

NOTE

Always perform core crimp before insulation/seal crimp.

3. Determine the correct dye or nest for the core crimp by checking with the appropriate crimp table.

NOTE

When the word “TIP” appears in the Crimp Table, use the tip of the tool specified to perform the core crimp procedure. See Figure 5-21.

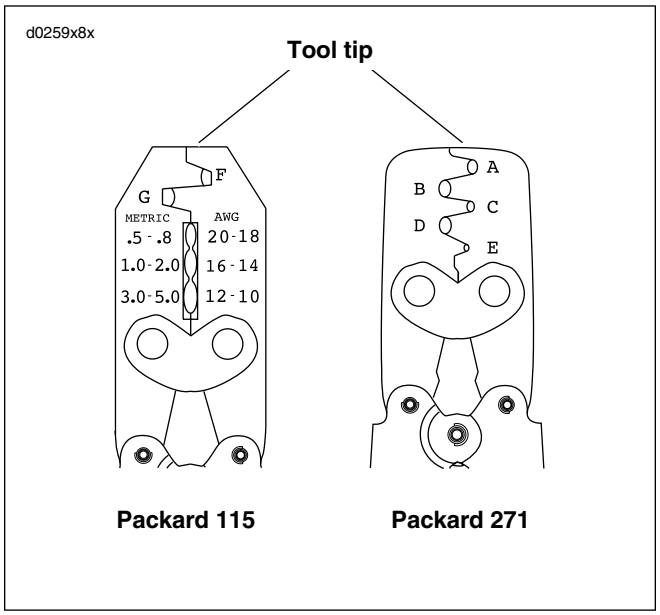
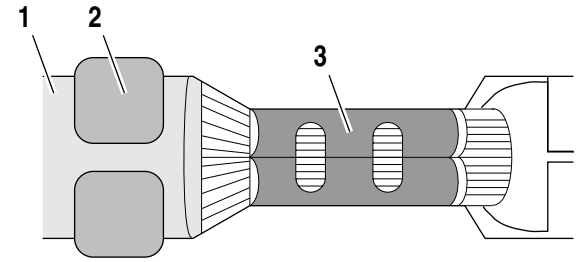


Figure 5-21. Packard Terminal Crimp Tools

Table 5-6. Packard Terminal Crimp Tools

SPECIFICATION	PACKARD 115	PACKARD 271
Part No.	HD-38125-8	HD-38125-7
Type of Crimp	Non-sealed terminals, butt splices	Non-sealed terminals
Dye/nests	F-G	A-E

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. Determine the correct dye or nest for the insulation/seal crimp.
9. Lay the back of the insulation/seal crimp tails on the appropriate nest. Be sure the insulation/seal crimp tails are pointing towards the forming jaws.
10. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
11. See Figure 5-22. Inspect the quality of the core (3) and insulation/seal (2) crimps. Distortion should be minimal.



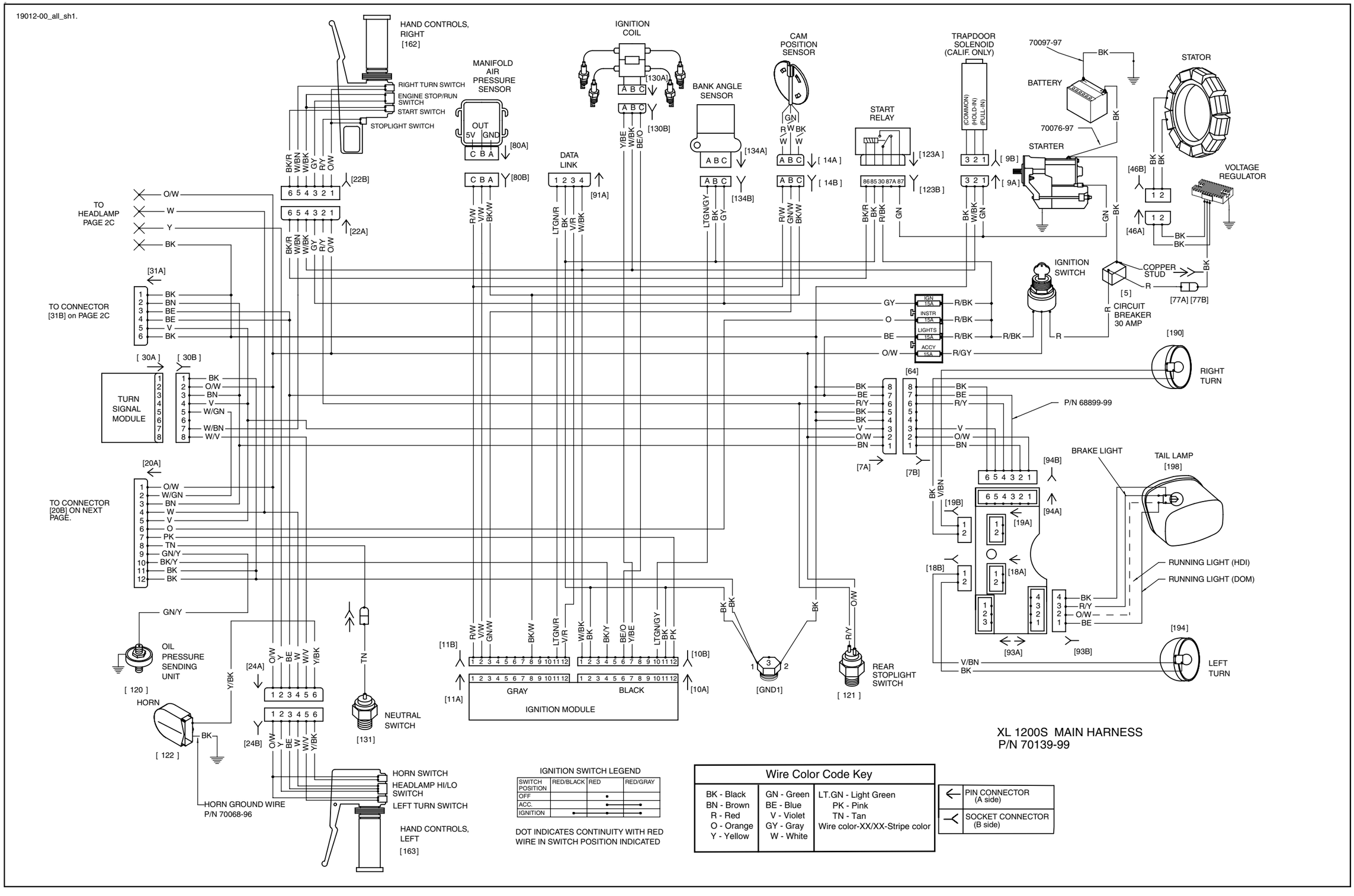
1. Insulation
2. Insulation crimp
3. Core crimp

Figure 5-22. Inspect Core and Insulation/Seal Crimps

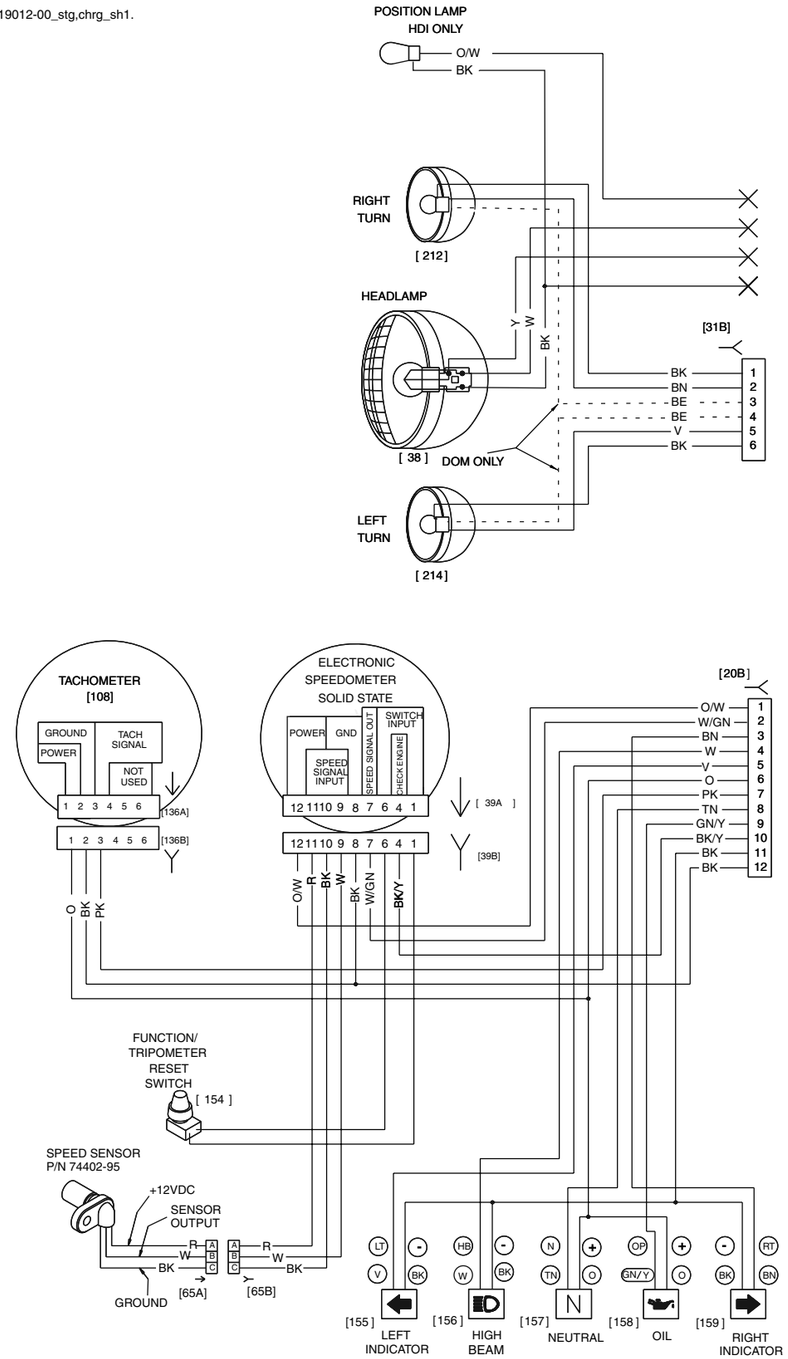
Table 5-7. Wiring Diagrams

DIAGRAM	PAGE
2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, MAIN HARNESS	5-29
2002 ALL SPORTSTER DOM. and INT. MODELS, STARTING & CHARGING	5-30
2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, IGNITION CIRCUIT	5-31
2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, HORN & INSTRUMENTS	5-32
2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, LIGHTS	5-33
2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, MAIN HARNESS	5-34
2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, IGNITION CIRCUIT	5-35
2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, HORN & INSTRUMENTS	5-36
2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, LIGHTS	5-37

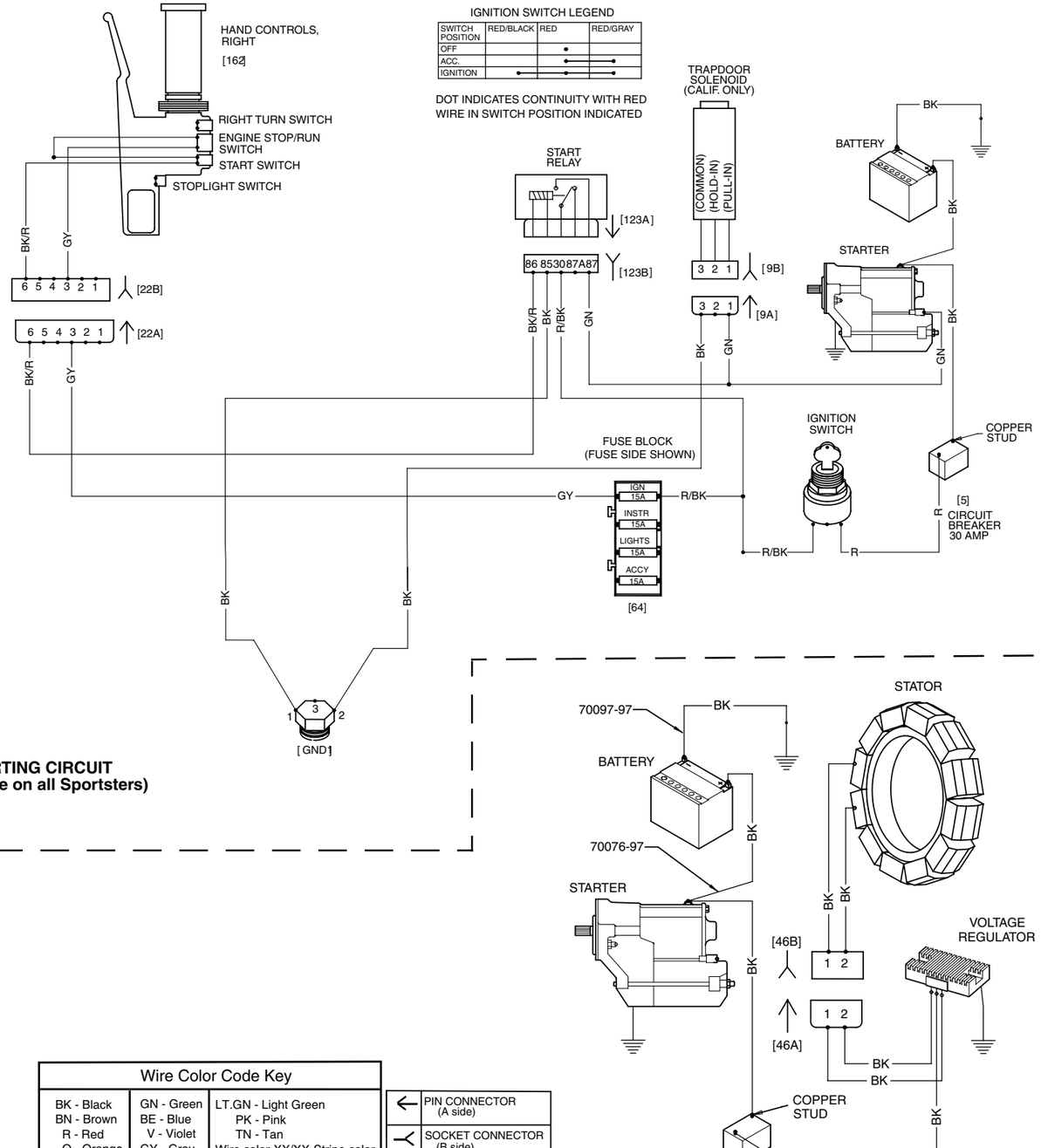
NOTES



2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, MAIN HARNESS



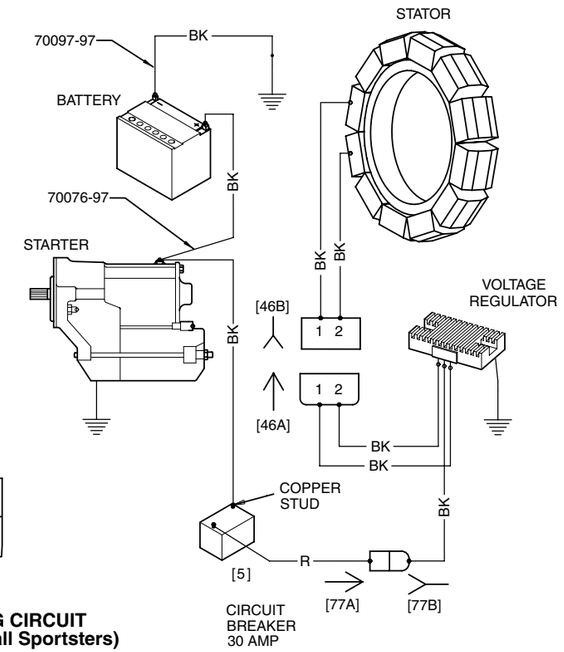
XL 1200S FRONT LAMPS AND INSTRUMENTS FROM SHEET 1



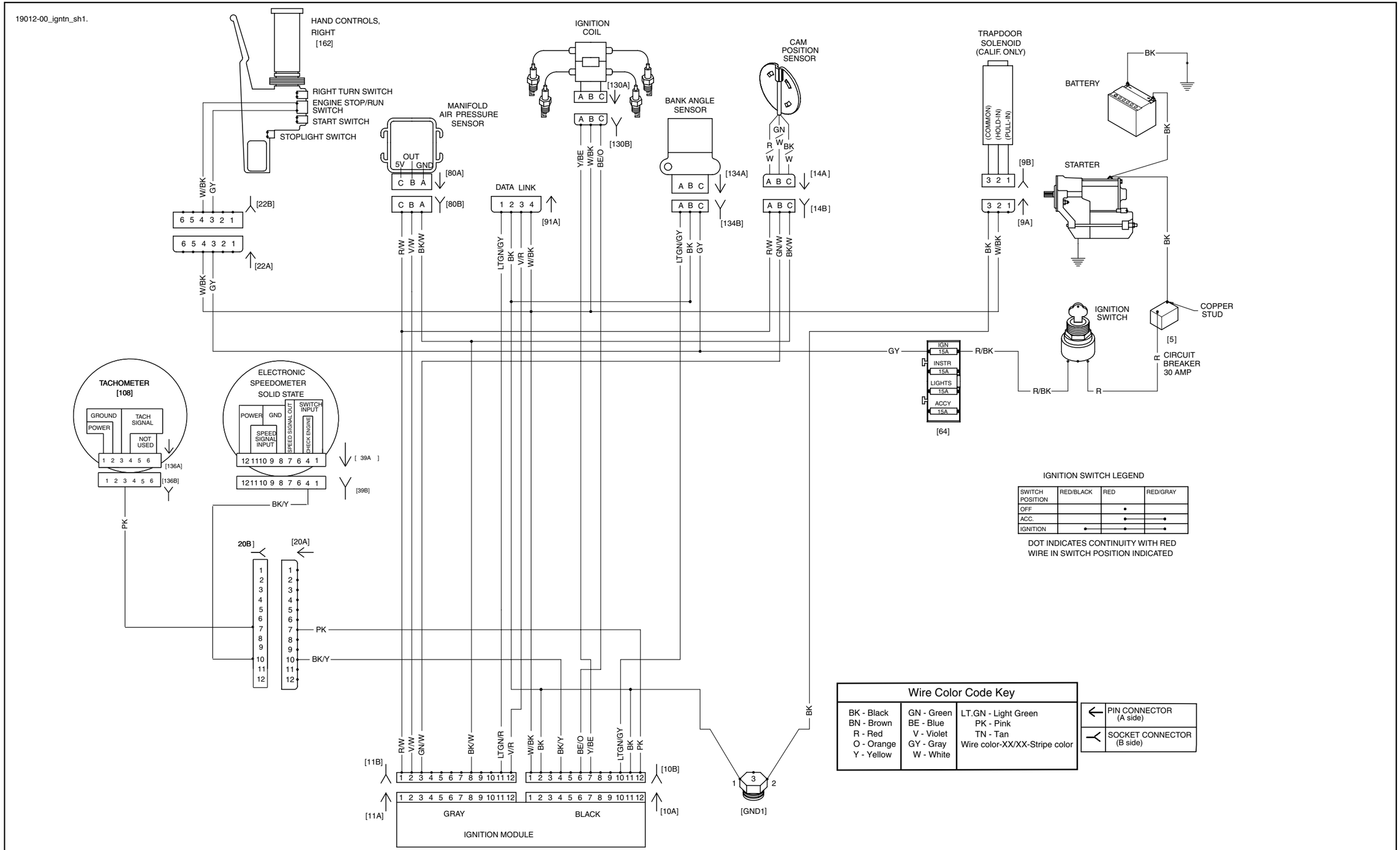
STARTING CIRCUIT
(Same on all Sportsters)

Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

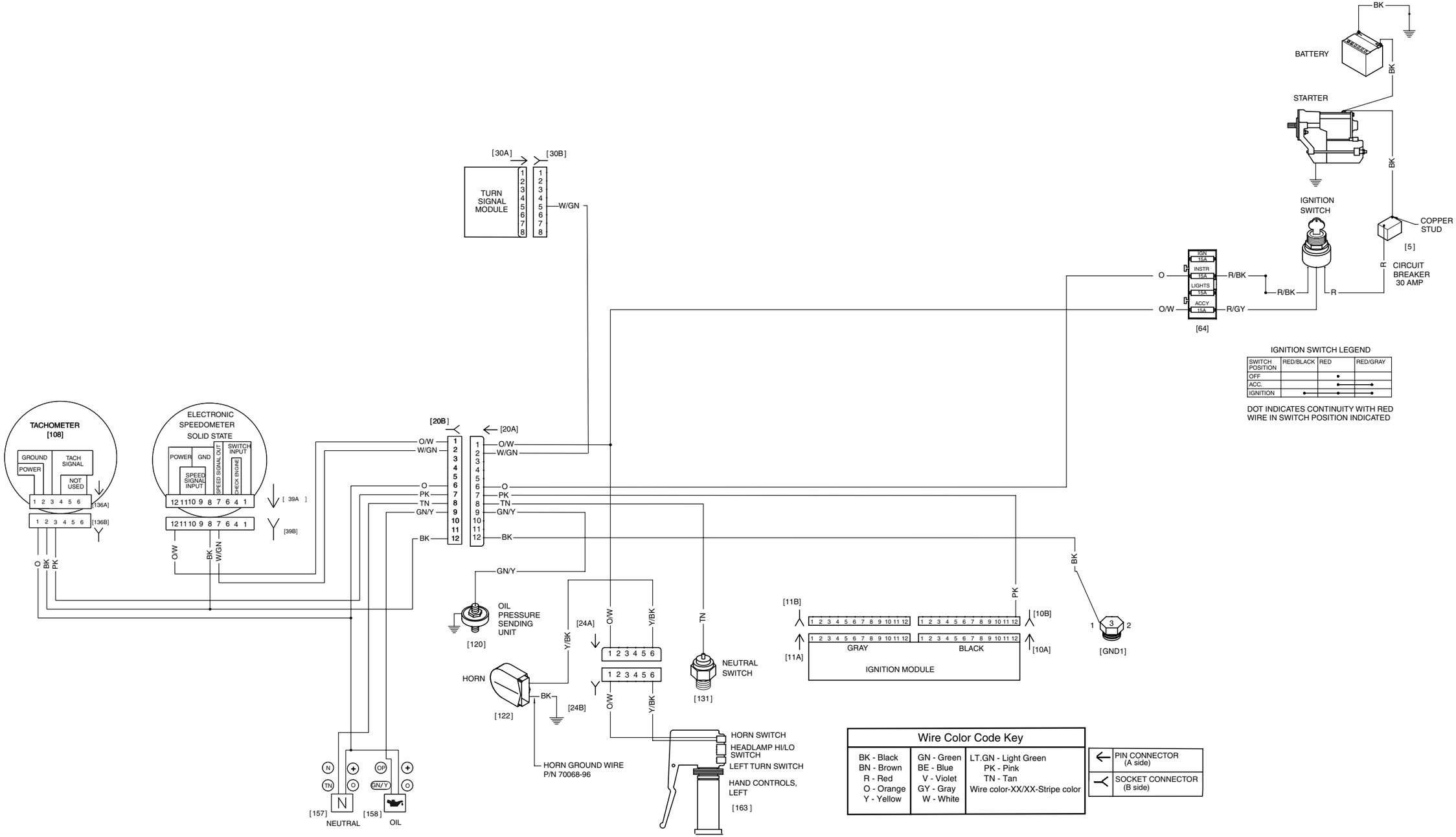
←	PIN CONNECTOR (A side)
⊣	SOCKET CONNECTOR (B side)



CHARGING CIRCUIT
(Same on all Sportsters)



2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, IGNITION CIRCUIT


BK
BATTERY
BK
STARTER
BK
IGNITION SWITCH
COPPER STUD
[5]
CIRCUIT BREAKER 30 AMP
IGN 15A
INSTR 15A
LIGHTS 15A
ACCY 15A
O
R/BK
R/BK
R
O/W
R/GY
[64]
IGNITION SWITCH LEGEND
SWITCH POSITION | RED/BLACK | RED | RED/GRAY
OFF
ACC.
IGNITION
DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED
[30A]
[30B]
TURN SIGNAL MODULE
W/GN
TACHOMETER [108]
GROUND
POWER
TACH SIGNAL
NOT USED
[136A]
[136B]
ELECTRONIC SPEEDOMETER SOLID STATE
POWER
GND
SPEED SIGNAL INPUT
SPEED SIGNAL OUT
SWITCH INPUT
CHECK ENGINE
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BK
PK
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BK
W/GN
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W/GN
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GN/Y
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Y/BK
Y/BK
HORN
[122]
BK
[24B]
HORN GROUND WIRE P/N 70068-96
TN
[131]
NEUTRAL SWITCH
HORN SWITCH
HEADLAMP HI/LO SWITCH
LEFT TURN SWITCH
HAND CONTROLS, LEFT
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NEUTRAL
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OIL
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[10A]
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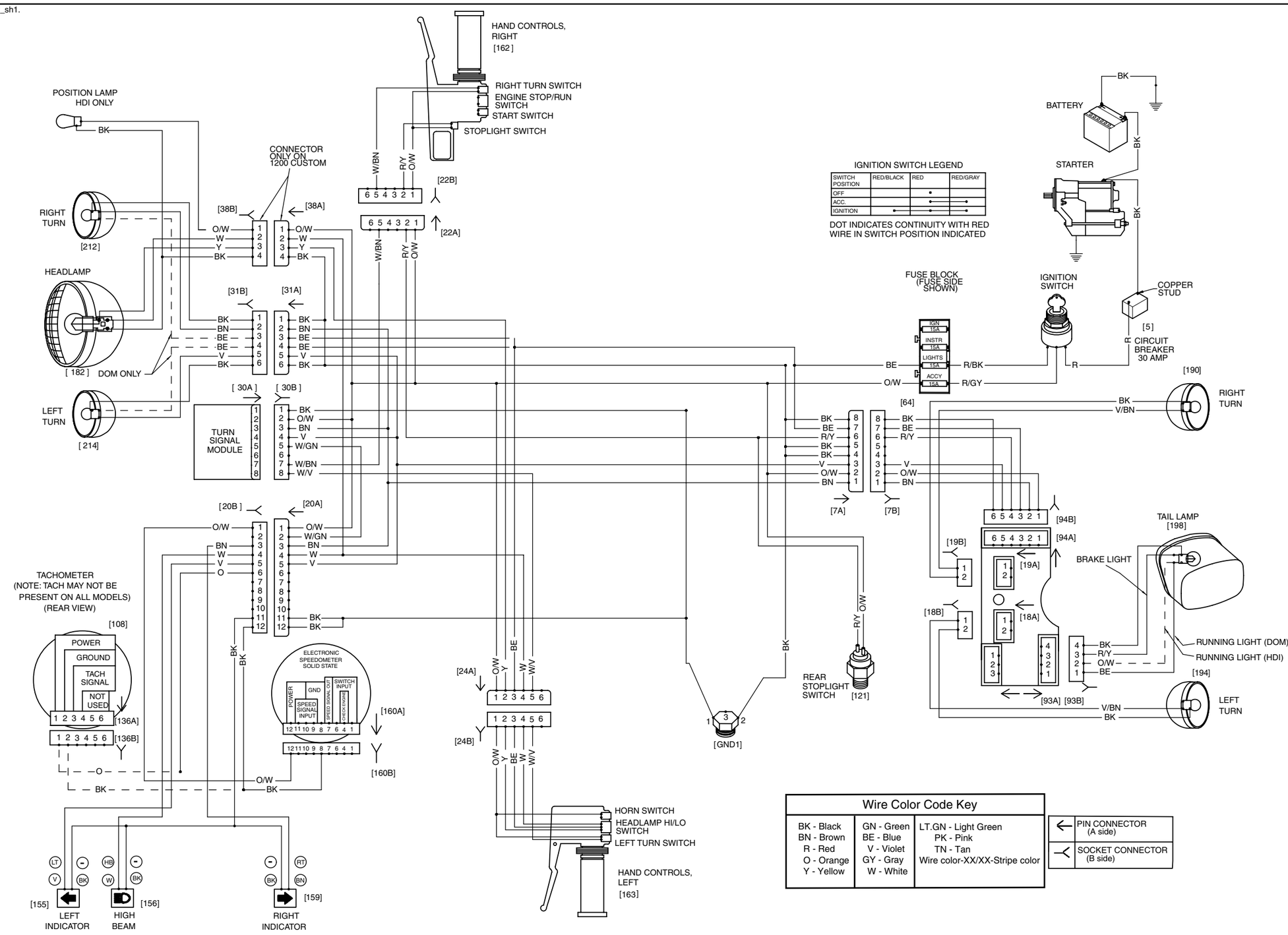
GRAY
BLACK
IGNITION MODULE
BK
[GND1]
Wire Color Code Key
BK - Black
BN - Brown
R - Red
O - Orange
Y - Yellow
GN - Green
BE - Blue
V - Violet
GY - Gray
W - White
LT.GN - Light Green
PK - Pink
TN - Tan
Wire color-XX/XX-Stripe color
PIN CONNECTOR (A side)
SOCKET CONNECTOR (B side)

19012-00_light_sh1.



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
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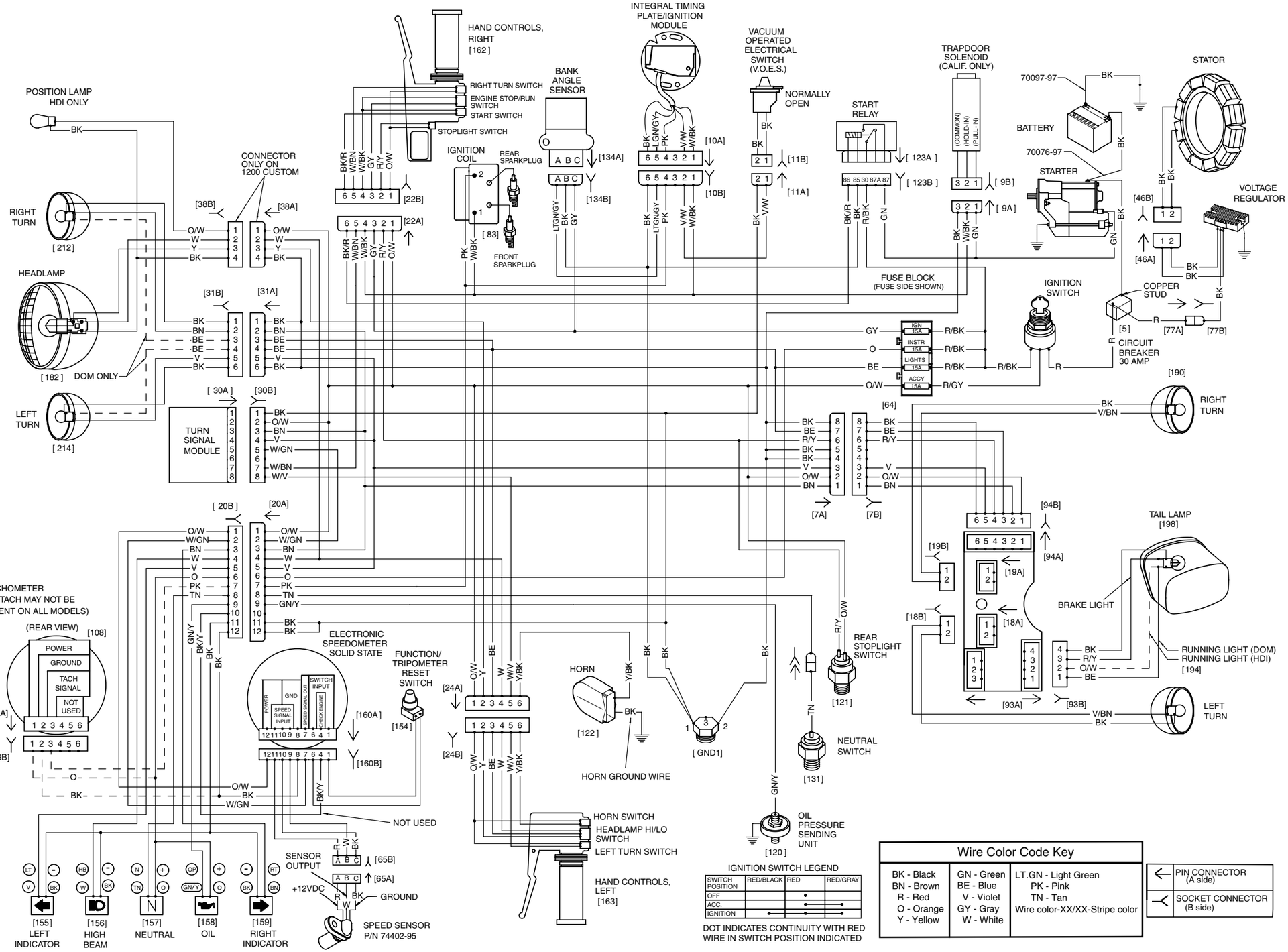
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

← PIN CONNECTOR (A side)

SOCKET CONNECTOR (B side)

19020-00_all_sh1.



2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, MAIN HARNESS

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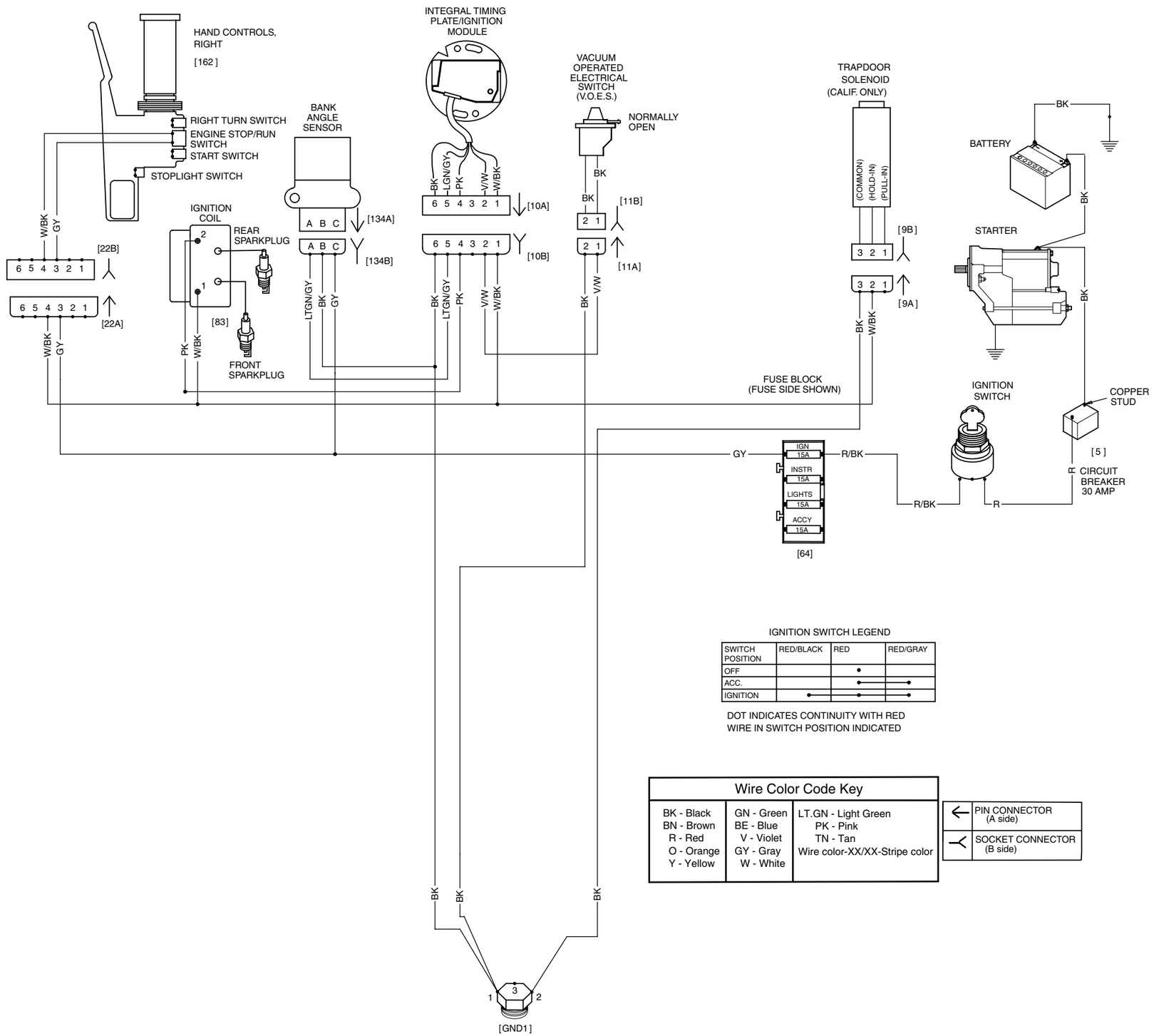
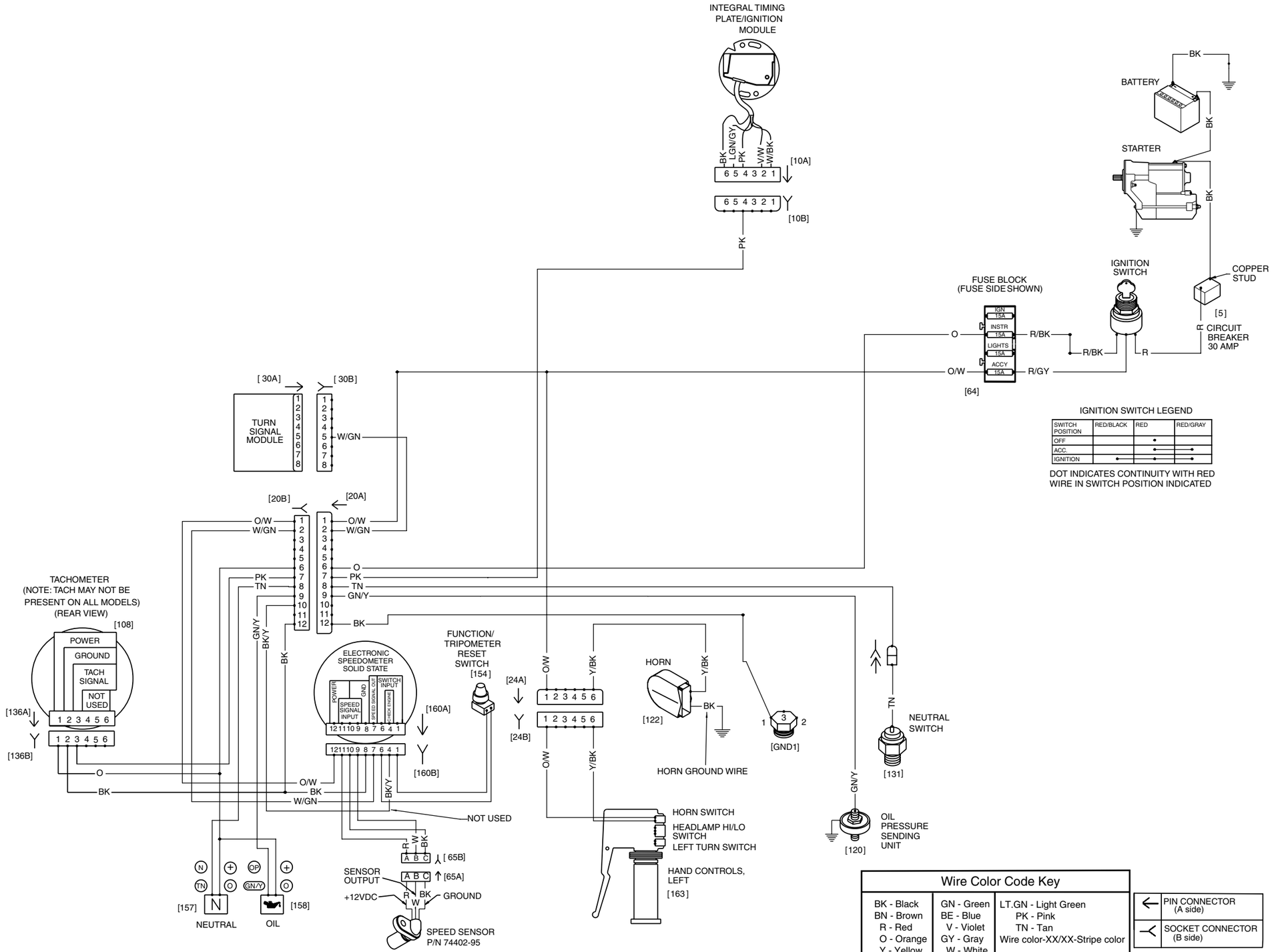
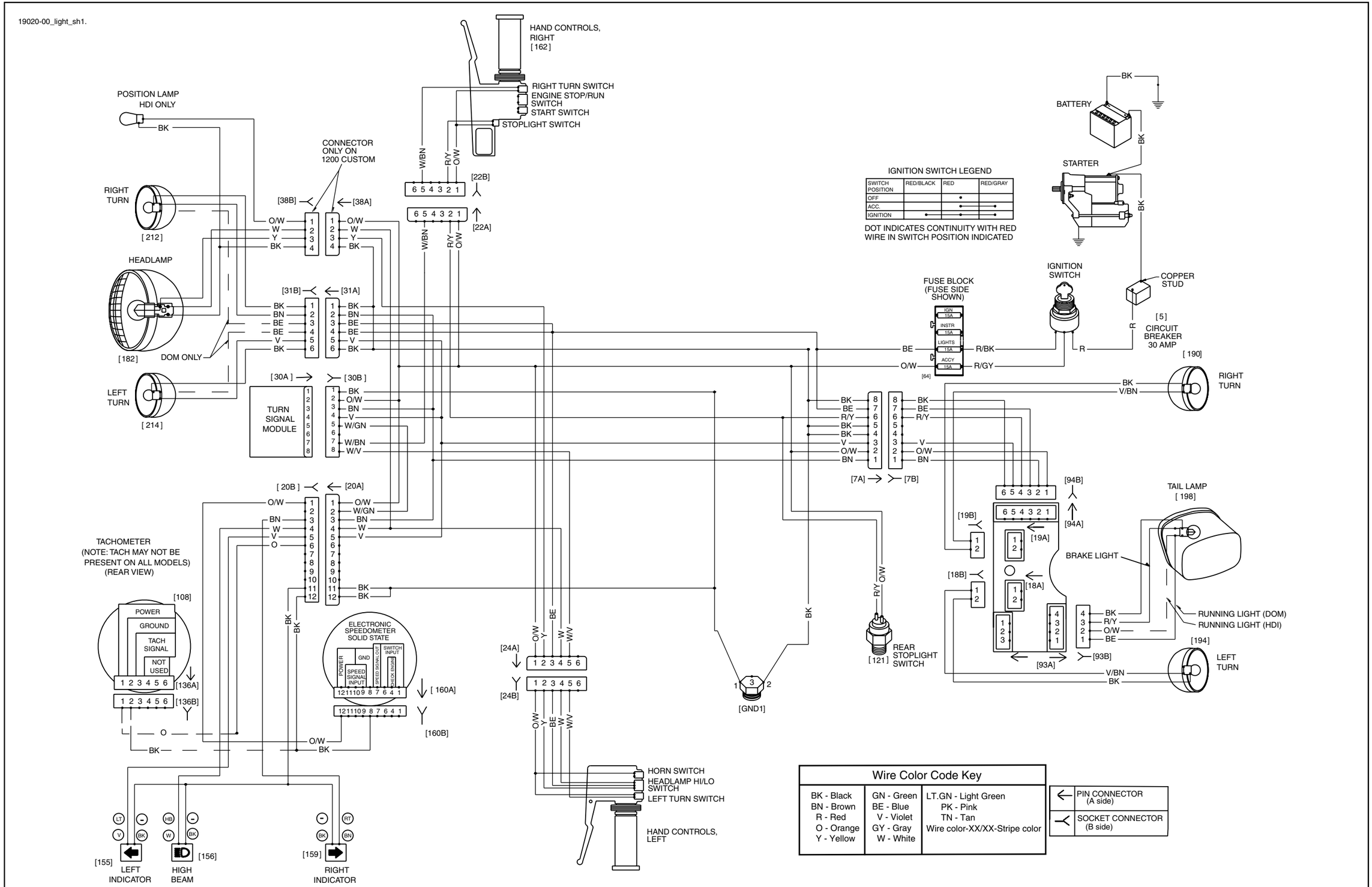


2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, IGNITION CIRCUIT



2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, HORN & INSTRUMENTS

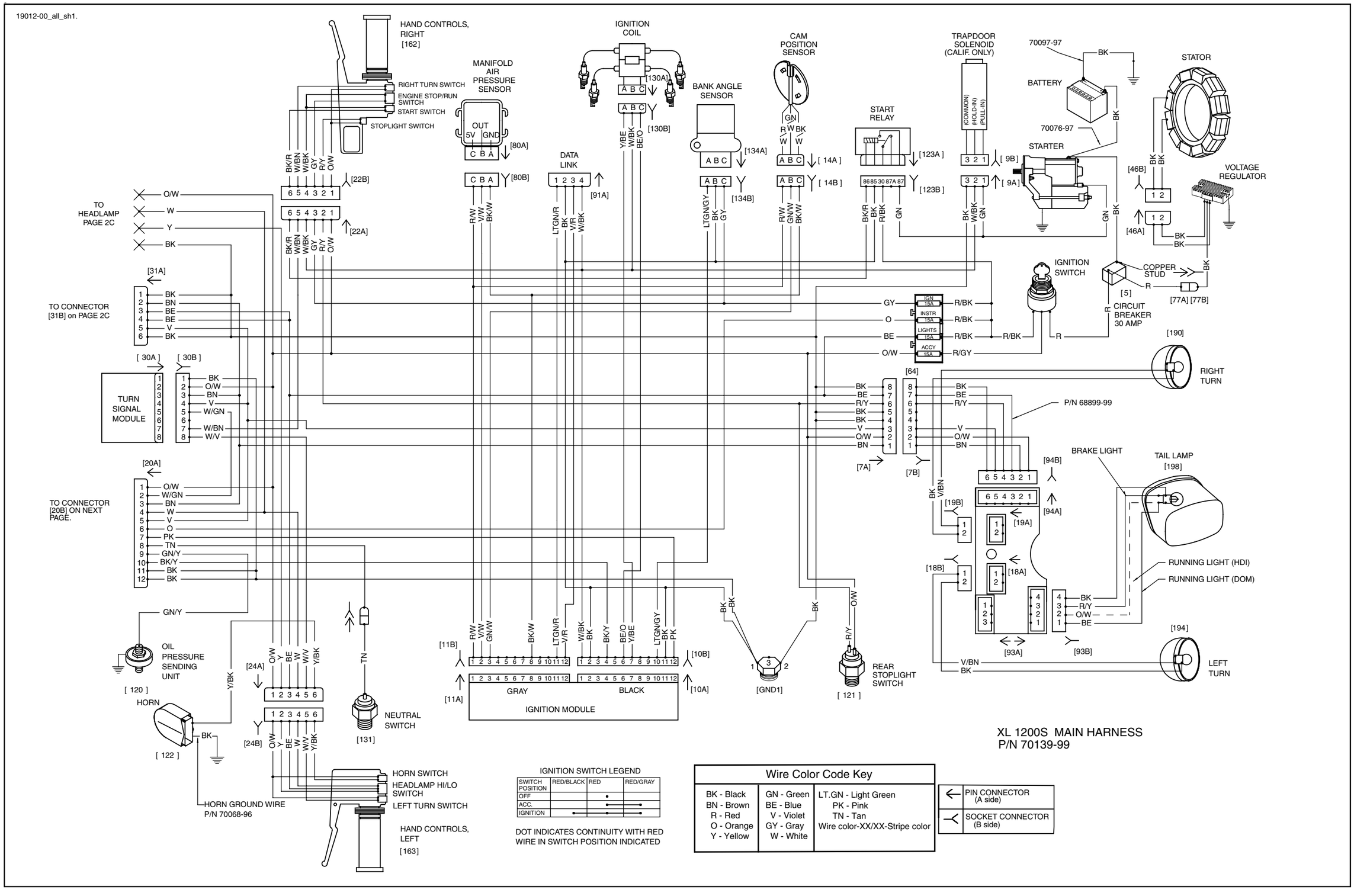
19020-00_light_sh1.



Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

←	PIN CONNECTOR (A side)
≻	SOCKET CONNECTOR (B side)

2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, LIGHTS



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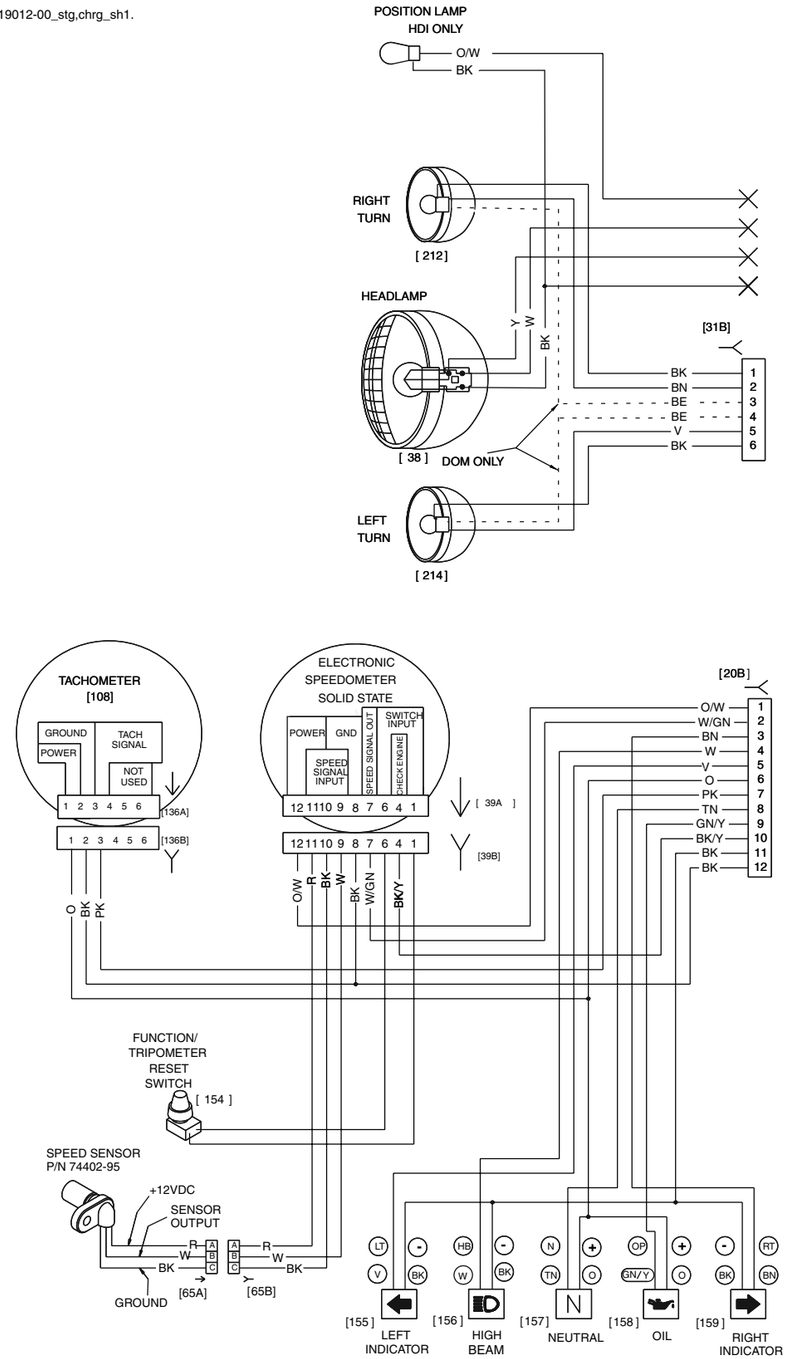
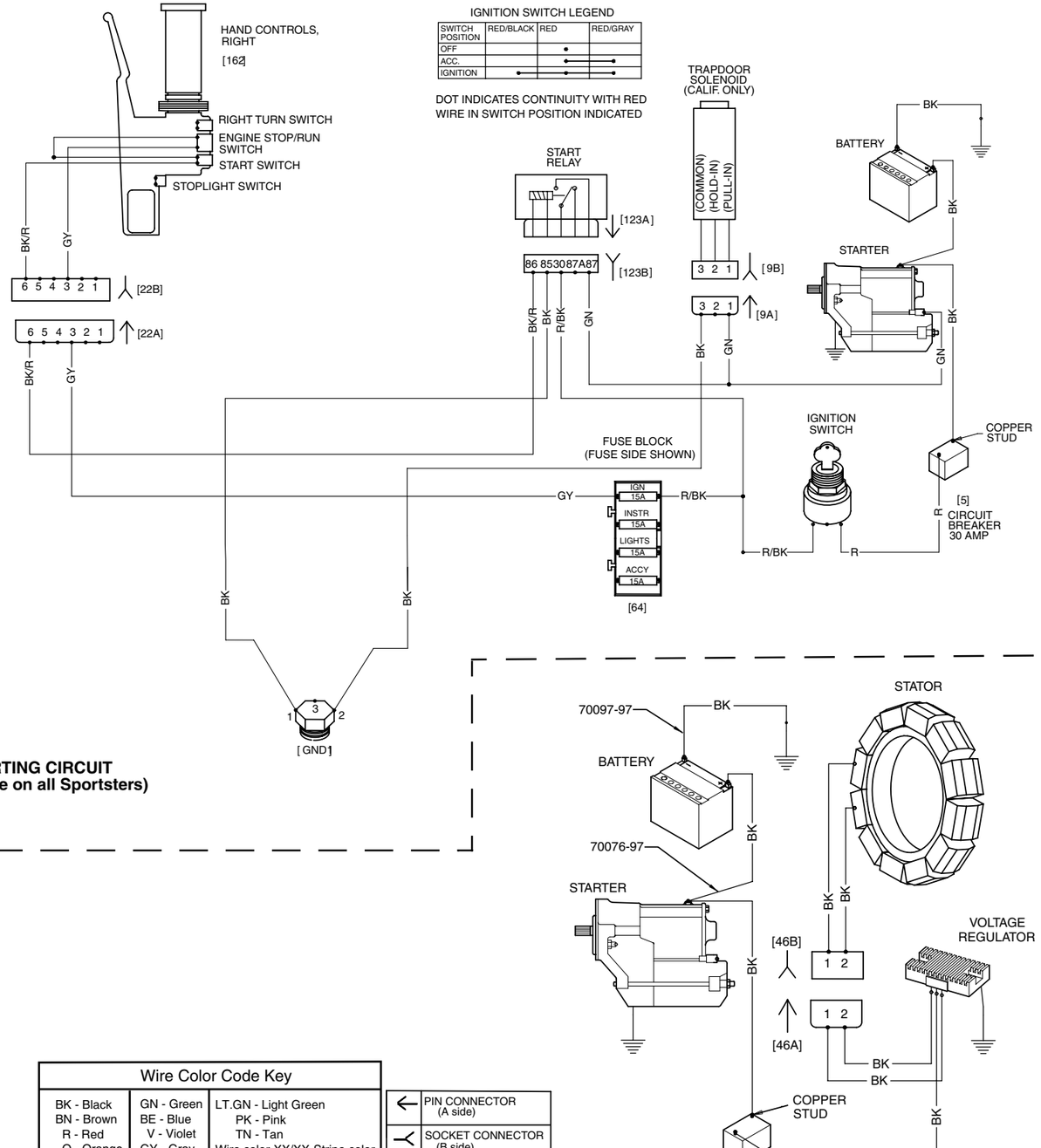


XL 1200S FRONT LAMPS AND INSTRUMENTS FROM SHEET 1



STARTING CIRCUIT
(Same on all Sportsters)

Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
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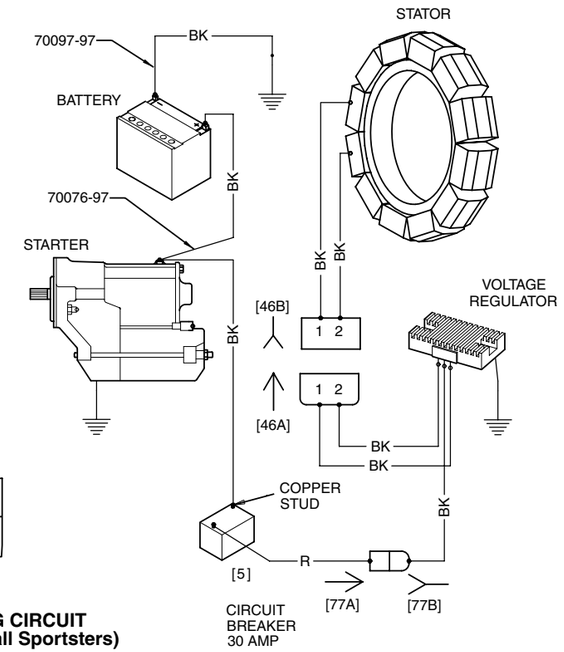
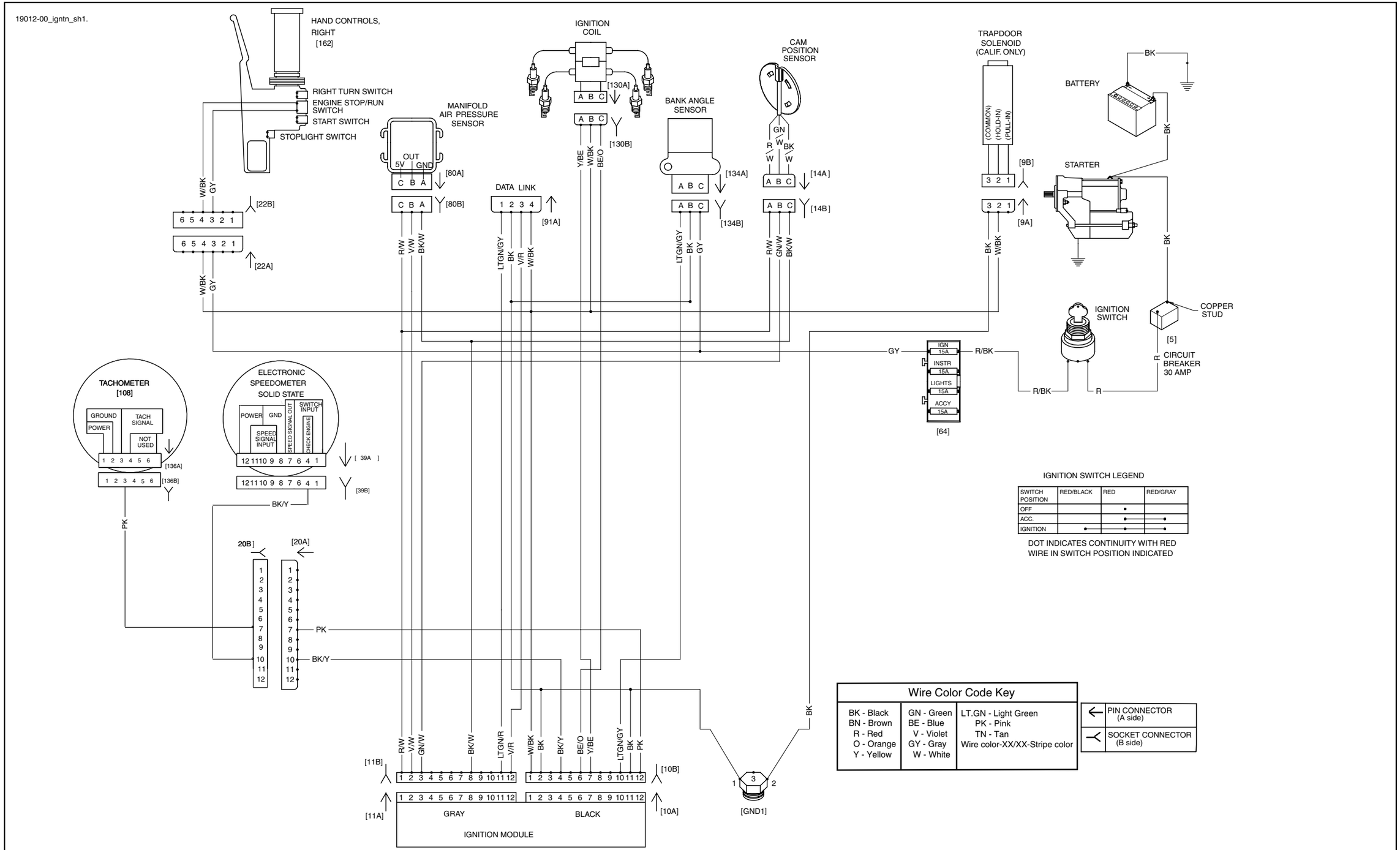
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

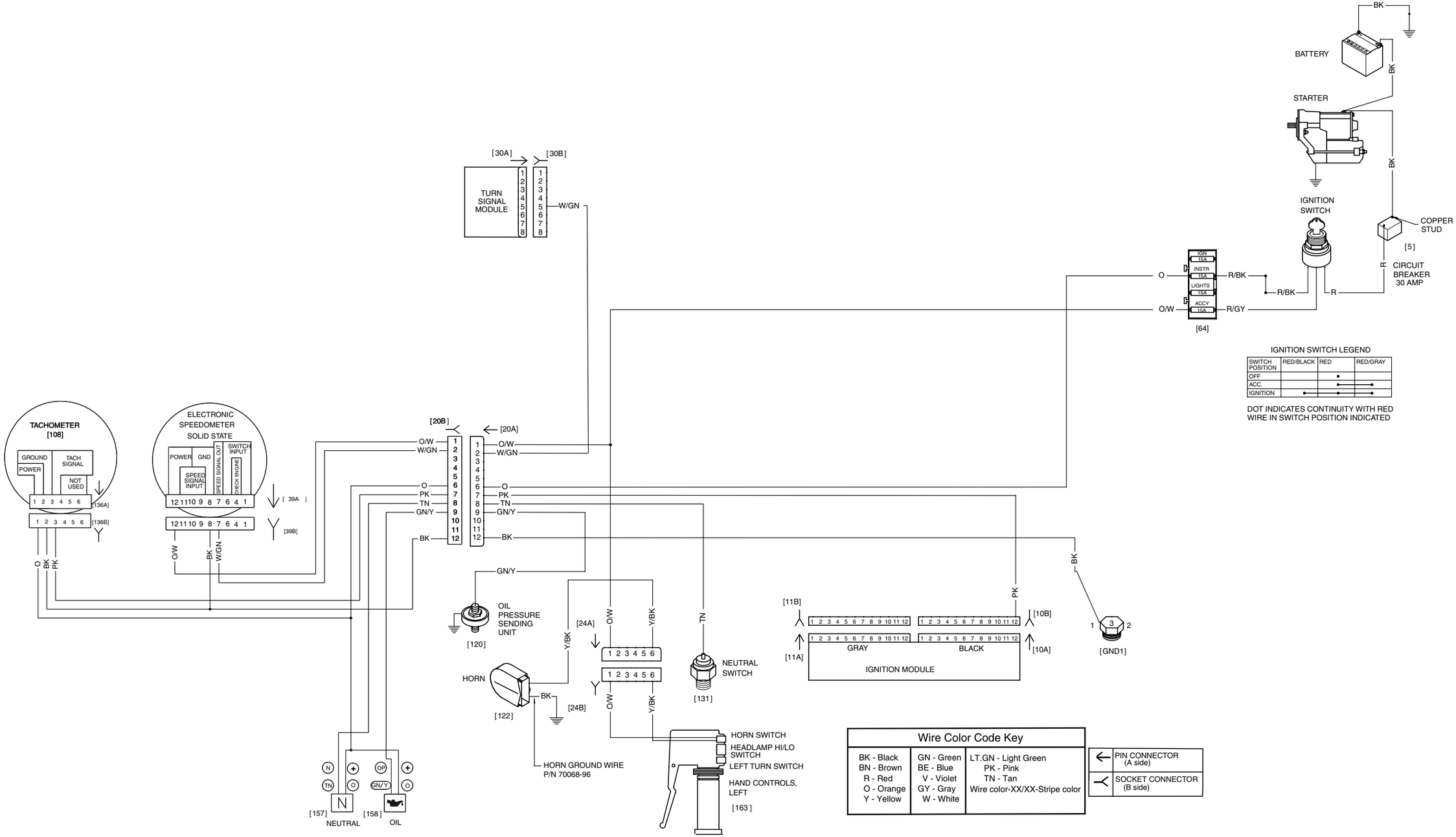
←	PIN CONNECTOR (A side)
⊣	SOCKET CONNECTOR (B side)



CHARGING CIRCUIT
(Same on all Sportsters)



2002 ALL SPORTSTER 1200S DOM. and INT. MODELS, IGNITION CIRCUIT


BK
BATTERY
BK
STARTER
BK
IGNITION SWITCH
COPPER STUD
[5]
CIRCUIT BREAKER 30 AMP
IGN 15A
INSTR 15A
LIGHTS 15A
ACCY 15A
O
R/BK
R/BK
R
O/W
R/GY
[64]
IGNITION SWITCH LEGEND
SWITCH POSITION | RED/BLACK | RED | RED/GRAY
OFF
ACC.
IGNITION
DOT INDICATES CONTINUITY WITH RED WIRE IN SWITCH POSITION INDICATED
[30A]
[30B]
TURN SIGNAL MODULE
W/GN
TACHOMETER [108]
GROUND
POWER
TACH SIGNAL
NOT USED
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ELECTRONIC SPEEDOMETER SOLID STATE
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GND
SPEED SIGNAL INPUT
SPEED SIGNAL OUT
SWITCH INPUT
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HEADLAMP HI/LO SWITCH
LEFT TURN SWITCH
HAND CONTROLS, LEFT
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[GND1]
Wire Color Code Key
BK - Black
BN - Brown
R - Red
O - Orange
Y - Yellow
GN - Green
BE - Blue
V - Violet
GY - Gray
W - White
LT.GN - Light Green
PK - Pink
TN - Tan
Wire color-XX/XX-Stripe color
PIN CONNECTOR (A side)
SOCKET CONNECTOR (B side)

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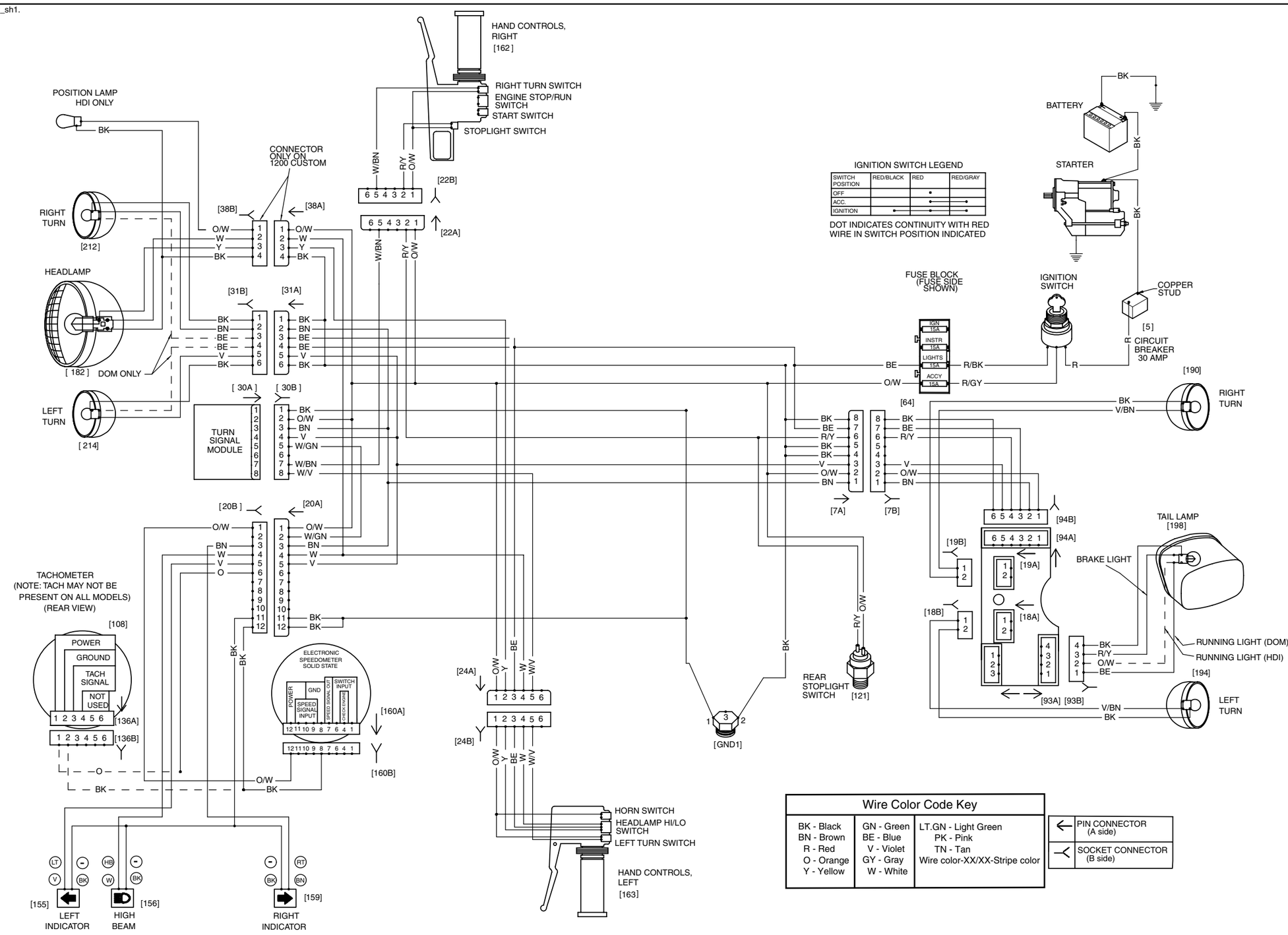

Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

← PIN CONNECTOR (A side)

SOCKET CONNECTOR (B side)

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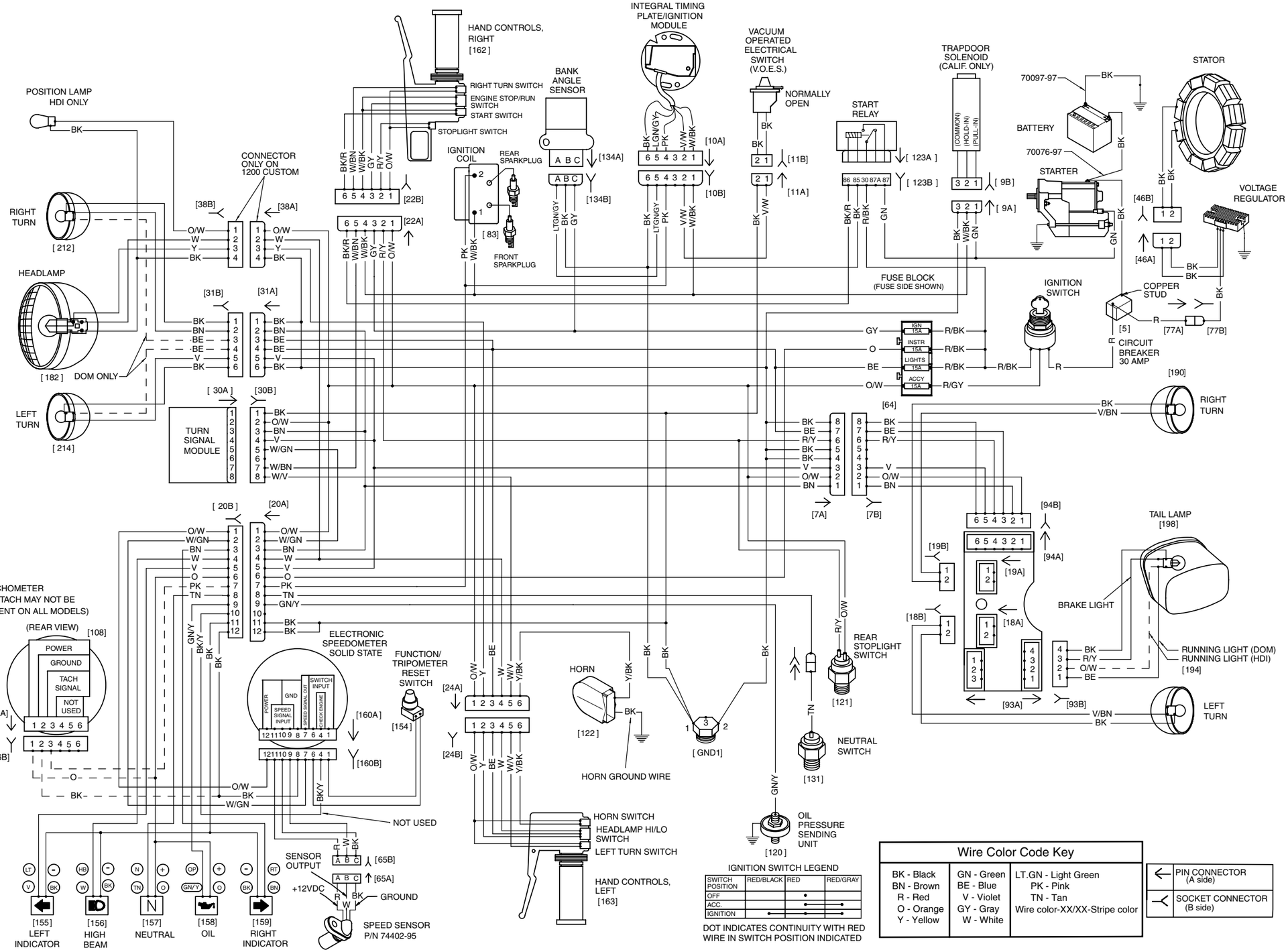

2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, MAIN HARNESS

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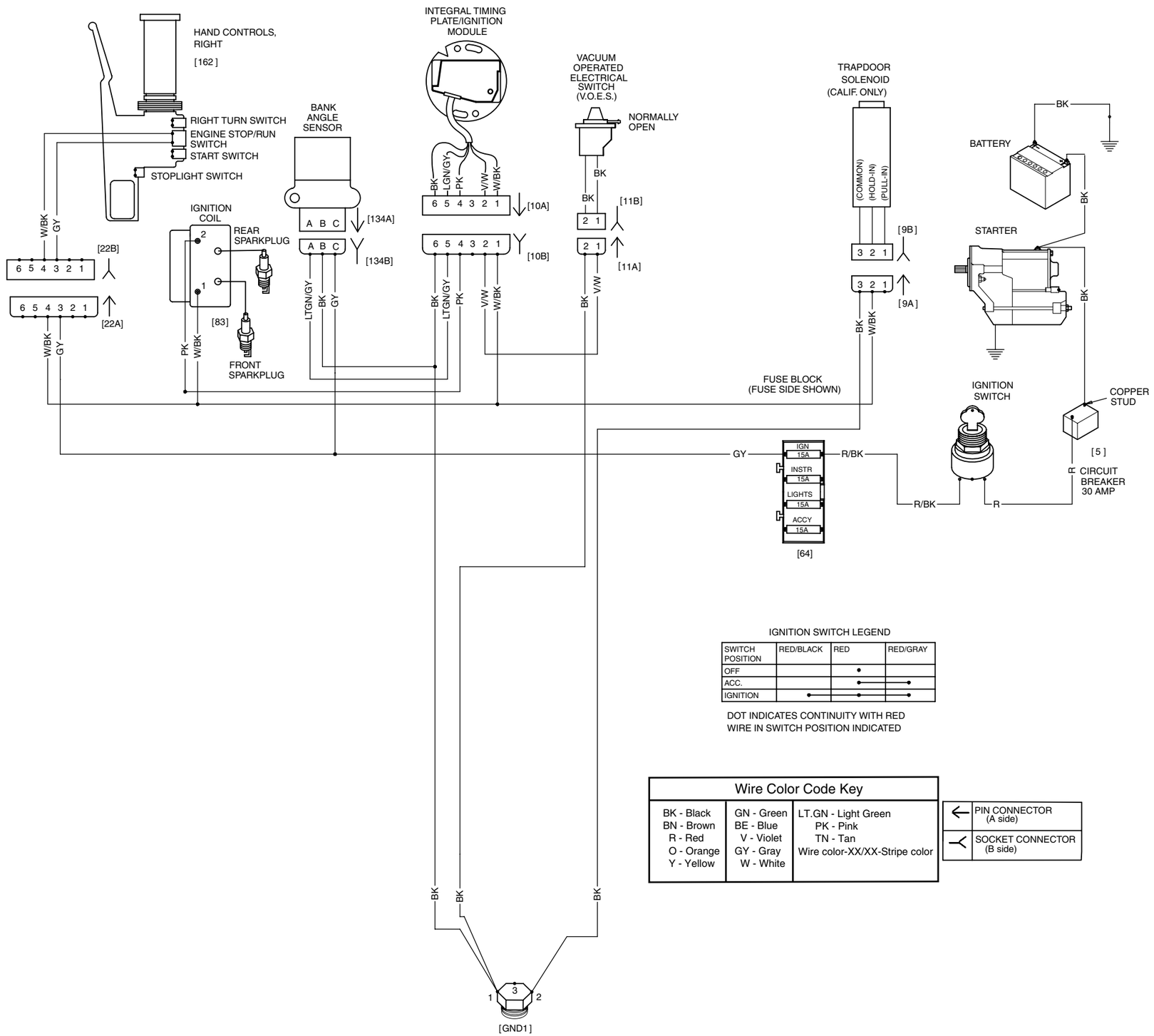
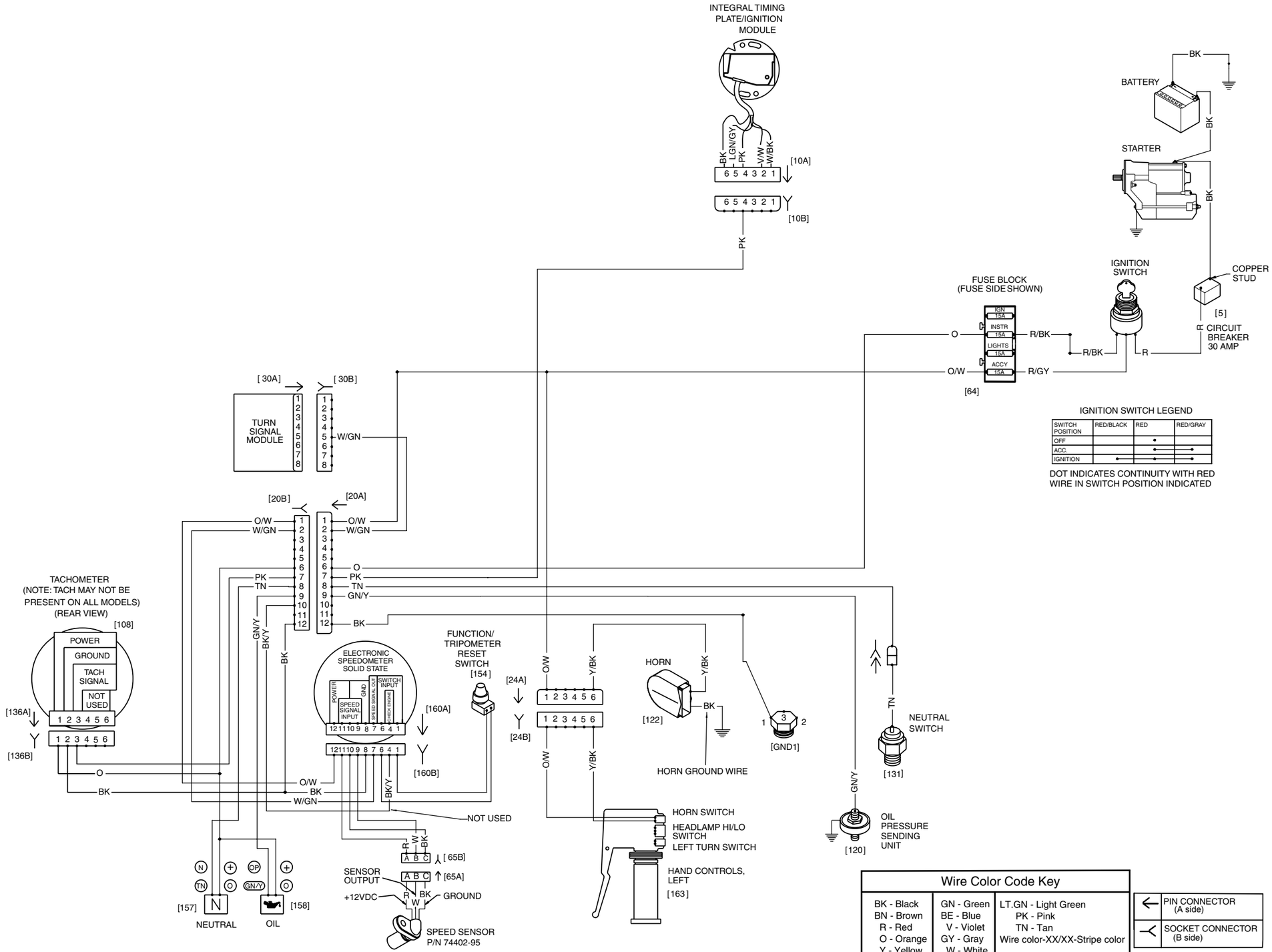


2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, IGNITION CIRCUIT



2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, HORN & INSTRUMENTS

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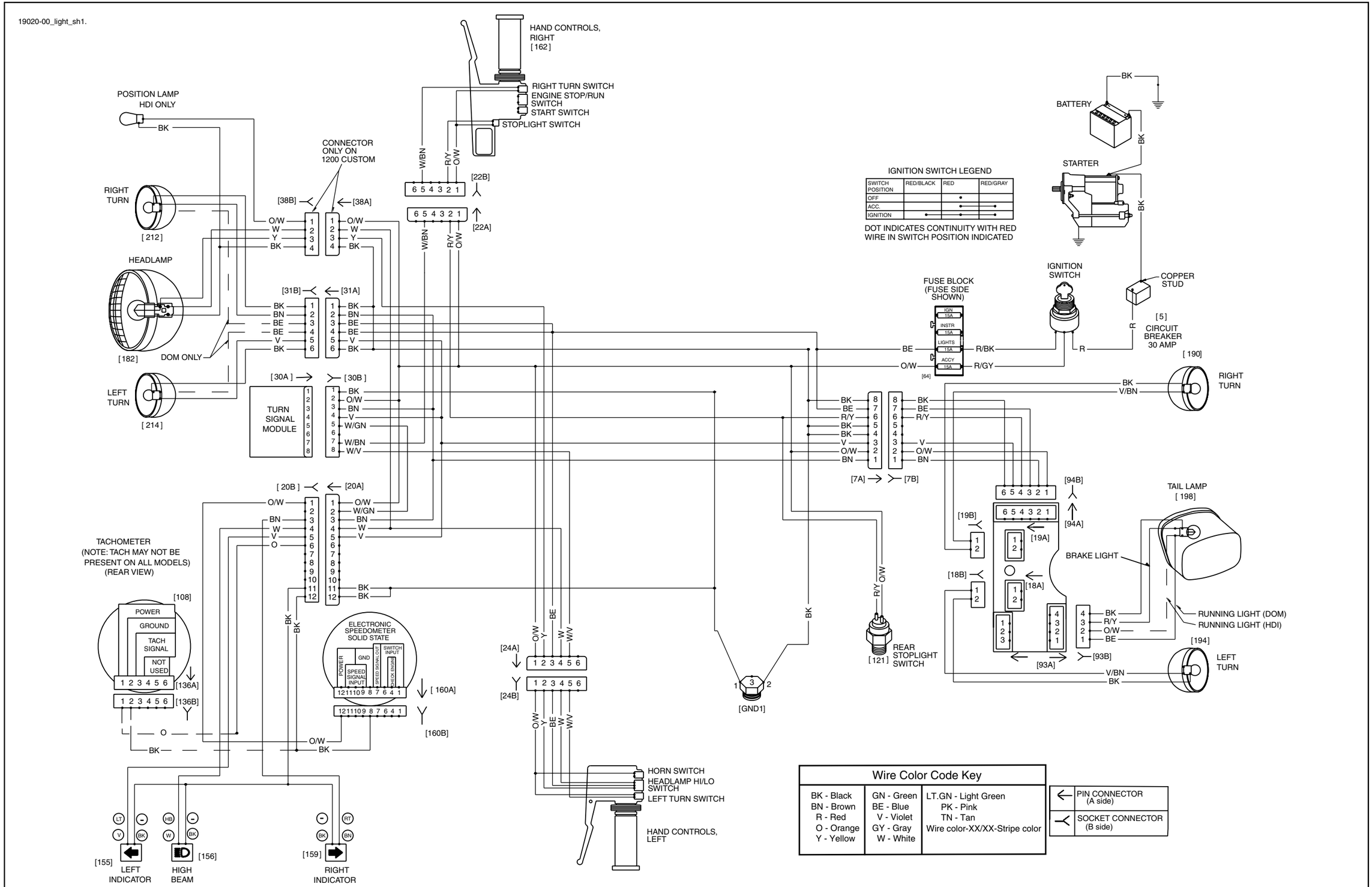

Wire Color Code Key		
BK - Black	GN - Green	LT.GN - Light Green
BN - Brown	BE - Blue	PK - Pink
R - Red	V - Violet	TN - Tan
O - Orange	GY - Gray	Wire color-XX/XX-Stripe color
Y - Yellow	W - White	

←	PIN CONNECTOR (A side)
≻	SOCKET CONNECTOR (B side)

2002 ALL SPORTSTER DOM. and INT. MODELS, EXCEPT XL 1200S, LIGHTS